

AI-powered Legal Virtual Assistant: Utilizing RAG-optimized LLM for Housing Dispute Resolution in Finland

Student: Md Irfan Rafat

Haaga-Helia University of Applied Sciences MBA, Degree Prorgramme in Leading Business Transformation Specialisation: Digital Business Opportunities Master's Thesis 2024

Abstract

Author
Md Irfan Rafat
Degree
Master of Business Administration, Leading Business Transformation
Thesis title
AI-powered Legal Virtual Assistant: Utilizing RAG-optimized LLM for Housing Dispute Resolu-
tion in Finland
Number of pages and appendix pages

Number of pages and appendix pages 55+7

Driven by advancements in Artificial Intelligence (AI), a wave of transformation is sweeping across numerous industries, and the legal sector is well-positioned to capitalize on these developments. This thesis explores the feasibility of applying recent AI advancements, enhancing the performance of Large Language Models (LLMs) combined with the information retrieval capabilities of Retrieval-Augmented Generation (RAG), to resolve housing disputes in Finland.

The study provides an overview of chatbots or virtual assistants, associated technologies LLM and RAG, the opportunities chatbots offer for providing user-centric solutions, and the essential characteristics and challenges of applying chatbots in the legal domain. Furthermore, this study presents a case study on the development of an efficient system for legal information extraction using semantic Question and Answer (QnA) techniques applied to German case law documents. Additionally, this work sheds light on existing real-world chatbot solutions in the legal domain. As a result, this thesis delves into the current state, evolution, and future trajectories of the aforementioned technologies.

In this thesis, a prototype is developed using LLM technology optimized with RAG. Then, an experimental setup is designed to evaluate the performance of the RAG-optimized LLM against three non-optimized popular LLM-powered AI technologies, to assess the scope of RAG in improving LLM-powered chatbots. The experiment includes formulation of multiple prompts reflecting real-life housing dispute scenarios, including common user errors. The prototype has been developed on the MS Azure platform, integrating the LLM Azure OpenAI 3.5 turbo and Azure AI search for the RAG approach. The evaluation is based on testing the chatbots' comprehension and response generation capabilities.

The results from the experiment are evaluated by a human legal expert. The expert's analysis focuses on the accuracy and completeness of the responses generated by the models and the prototype. This evaluation helps identify the prototype's RAG capabilities to retrieve information from the source documents as well as it identifies the challenges, limitations, and improvement criteria for adopting AI-powered virtual assistants in the legal field.

In conclusion, this thesis identifies the opportunities and unveils the gaps and intricacies in Alpowered chatbot's capabilities to retrieve data from sources, to understand complex user scenarios, and to provide tailored responses aiming to provide meaningful guidance for users seeking solutions in the legal arena.

Keywords

Large Language Model, Retrieval Augmented Generation (RAG), Housing Disputes, Virtual Assistants, Generative AI, Generative Pre-training Transformer (GPT)

Table of contents

Ab	brevi	ations		1	
1	Introduction				
	1.1	Object	ives	3	
	1.2	Scope		3	
	1.3	Resea	rch Questions	4	
2	Litera	ature Review			
	2.1	An ove	erview of chatbot and virtual assistant technologies	5	
		2.1.1	Defining chatbots, virtual assistants, and legal virtual assistants	5	
		2.1.2	Categories of chatbot	6	
		2.1.3	Potential of chatbots or virtual assistants in enhancing legal services	10	
		2.1.4	Challenges and limitations associated with adoptions of chatbots	12	
	2.2	Existin	g AI-powered chatbots in the legal arena around the world	12	
		2.2.1	Juro legal AI assistant	13	
		2.2.2	Harvey AI legal AI assistant	13	
		2.2.3	CaseMine legal AI assistant	14	
	2.3	HOAS	and the Helmi Chatbot: AI-powered Housing Assistance	14	
	2.4	SmartRent in the United Kingdom: AI-powered Assistance for Tenants			
	2.5	.5 Collaborative system in QnA in German case law documents			
		2.5.1	Human-AI collaboration approach	17	
		2.5.2	The experiment and the metrics	19	
	2.6	Housir	ng disputes domain in Finland	21	
	2.7	LLM a	nd RAG Overview	22	
3	Rese	Research Design24			
	3.1	Research Approach24			
	3.2	2 Scrum Iterative Development Framework			
	3.3 Investigation Methods		gation Methods	25	
		3.3.1	Structure of experimental setup	26	
		3.3.2	Qualitative Feedback for evaluating the experiment results	27	
4	Implementation of the Prototype				
	4.1	1 Development platform: Azure services			
	4.2	System model			
		4.2.1	RAG Based Implementation Through Azure AI Search	31	
		4.2.2	Source Data Gathering and Data Extraction	32	
		4.2.3	RAG features of the prototype	33	
5	Expe	riment:	Testing popular LLMs and testing the prototype	35	

5.1	Overvi	ew of the AI powered chatbots chosen for evaluation	. 35		
	5.1.1	ChatGpt 3.5 Model	. 35		
	5.1.2	Gemini 1.0	. 36		
	5.1.3	Perplexity Al	. 37		
5.2	Experi	ment intentions	. 38		
5.3	Execut	ion and results	. 38		
	5.3.1	Qualitative analysis from feedback	. 41		
Discu	ussion		. 44		
6.1	Resea	rch Question 1	44		
6.2	Resea	rch Question 2	44		
6.3	Resea	rch Question 3	. 45		
6.4	Recom	mendations, Future Suggestions and opinions	. 46		
Conc	lusion .		. 48		
References					
pend	pendices				
Appe	ndix 1.	I: Application Technologies	. 56		
Appe	ndix 1.2	2: Feedback Form	. 59		
Appe	ndix 1.3	3: Experimental Setup	. 61		
	5.2 5.3 Discu 6.1 6.2 6.3 6.4 Conce eferend Appee Appee	5.1.1 5.1.2 5.1.3 5.2 Experin 5.3 Execut 5.3.1 Discussion 6.1 Resea 6.2 Resea 6.3 Resea 6.4 Recom Conclusion . eferences Appendix 1.2	 5.1.1 ChatGpt 3.5 Model		

Abbreviations

AI API DL FAQ GPT IT LLM LVA ML	Artificial Intelligence Application programming interface Deep Learning Frequently Asked Questions Generative Pre-Trained Transformers Information Technologies Large Language Model Legal Virtual Assistant Machine Learning
NLP	Natural Language Coperation
NLG NLU	Natural Language Generation Natural Language Understanding
POC	Proof of Concept
QnA	Questions and Answers
RAG	Retrieval Augmented Generation
VA	Virtual Assistant

1 Introduction

With the rapid advancements in Artificial Intelligence (AI) technologies, the way professional activities are conducted has been drastically changing, and the legal profession is no exception. Smart virtual assistants and other AI tools are being integrated into legal practice, reshaping the industry. AI-powered legal assistants are evolving to act as a legal brain, providing legal advice and assisting with research, thereby saving time and reducing costs. Technologies such as Generative AI, AI assistants, Natural Language Processing (NLP), Large Language Models (LLM), machine learning, and predictive analytics are contributing to the development and improvement of chatbots and virtual assistants in the legal industry (Aslam, 2023). This integration has enabled streamlined legal processes, improved efficiency, and transformed the role of legal professionals.

Legal housing disputes in Finland may arise from various issues, such as tenancy agreements, property rights, landlord-tenant conflicts, and conflicts with neighbors (Kettunen & Ruonavaara, 2015). Given the complexity of housing-related legal matters, an efficient and accessible virtual assistant can assist both legal professionals and individuals involved in such disputes.

This thesis aims to explore how Large Language Models (LLMs) optimized by Retrieval-Augmented Generation (RAG) contribute to the effectiveness of Legal Virtual Assistants in understanding and responding to complex legal queries from users seeking solutions to housing disputes in Finland.

The primary problems, needs, and development tasks that the thesis aims to solve include:

Enhancing accessibility and efficiency in housing dispute resolution:

Understanding the intricacies of legal information and procedures surrounding housing disputes can be challenging for individuals without legal expertise. This thesis aims to explore how a userfriendly and effective digital solution, like an LLM-powered virtual assistant, can assist individuals in navigating the housing dispute resolution processes in Finland.

Streamlining legal information retrieval:

Retrieving accurate and up-to-date legal information related to Finnish housing laws can be a timeconsuming and complex task. By leveraging LLM-powered virtual assistants optimized with RAG, users may have the opportunity to access relevant legal information that is contextually appropriate and accurate, significantly streamlining the information retrieval process. Evaluating the effectiveness of RAG optimized LLM in legal virtual assistants:

This thesis will assess the performance of RAG optimized LLM in the context of Finnish housing laws and dispute resolution. The evaluation will focus on the virtual assistant's ability to understand user queries, extract relevant information, and generate contextually appropriate responses.

Contributing to the advancement of AI applications in Finnish housing law:

By analyzing the effectiveness of LLM powered virtual assistants in the specific domain of Finnish housing law, this thesis aims to contribute valuable insights and knowledge to the field. This knowledge can be used to foster the development of innovative AI solutions that address specific legal challenges within Finnish housing law.

This thesis is commissioned by the FAIR (Finnish AI Region) project.

1.1 Objectives

- Investigate the effectiveness of Large Language Models (LLMs) optimized by Retrieval Augmented Generation (RAG) in the context of Legal Virtual Assistants designed for handling housing disputes in Finland.
- Assessing the accuracy and comprehensiveness of LLM-based virtual assistant responses to user queries related to Finnish housing laws and regulations.
- Evaluating the ability of the LLM to provide relevant and contextually appropriate information regarding various housing dispute scenarios.
- Gain insights into the strengths and limitations of LLM and RAG technologies in the virtual assistant and legal domain.

1.2 Scope

The research will be limited to the application of RAG-optimized LLM-powered virtual assistant within the domain of housing disputes in Finland.

The focus will be on Finnish housing laws and regulations, excluding international or comparative legal frameworks.

The evaluation of the LLM's effectiveness will primarily involve:

- Accuracy and factual correctness of responses to user queries.
- Comprehensiveness and relevance of the information provided.

Limitations:

- The thesis does not address broader legal domains beyond housing disputes in Finland, maintaining a specific and focused scope.
- The thesis does not extend to the development of legal policies or legislative changes; it focuses solely on the technical aspects of implementing LLM and RAG in the virtual assistant for housing disputes in Finland.
- The thesis does not aim to replace legal professionals or their expertise but rather to enhance and support their work in the specific context of housing disputes.
- Ethical considerations related to potential bias or misinterpretations by the LLM are excluded.

1.3 Research Questions

Q1. How does the integration of Large Language Models (LLMs) optimized by Retrieval Augmented Generation (RAG) enhance the performance of a Legal Virtual Assistant in resolving housing disputes in Finland?

This question examines the overall efficacy and impact of implementing LLMs optimized by RAG in a legal virtual assistant specifically tailored for addressing housing disputes in the Finnish context. It explains how the combination of LLM and RAG technology can accurately interpret, analyze, and provide legal advice based on Finnish housing laws and regulations.

Q2. Does the Retrieval Augmented Generation (RAG) optimization significantly enhance the factual accuracy of the Large Language Model (LLM) responses when compared to a non-optimized LLM in the context of housing disputes in Finland?

This question investigates the specific impact of RAG optimization on the factual accuracy of LLMgenerated responses within the domain of housing disputes in Finland, comparing the performance of RAG-optimized LLMs against non-optimized counterparts to determine whether the optimization leads to a measurable improvement in accuracy.

Q3: What are the key challenges and limitations encountered when employing LLMs optimized by RAG within the domain of housing disputes in Finland?

This question investigates the practical obstacles and shortcomings associated with the utilization of LLMs optimized by RAG in addressing housing disputes, highlighting areas for improvement and potential barriers to effectiveness.

2 Literature Review

This chapter summarizes the key findings from the literature review and outlines the implications for both research and practical applications. It provides a comprehensive overview of the relevant technologies, including virtual Assistants and chatbots, Large Language Models (LLMs) and their capabilities in understanding and generating human language, Retrieval Augmented Generation (RAG) and its potential to enhance LLM performance in question-answering tasks. It also provides a brief overview of the housing dispute domain and some of the common types of disputes that occur in Finland.

The chapter also explores some real-world applications of human-AI collaboration in the housing domain. It includes research on a collaborative system for question answering (QnA) in German legal documents, which demonstrates the effectiveness of AI-assisted legal research. Additionally, the chapter discusses existing AI-powered chatbots or virtual assistants that provide services in the legal industry worldwide. Additionally, this chapter includes the Helmi chatbot service provided by HOAS which showcases how AI virtual assistants can streamline housing inquiries. Another example included is SmartRent, a UK-based initiative utilizing AI assistants to enhance the tenant experience in the housing market.

2.1 An overview of chatbot and virtual assistant technologies

This chapter explores the landscape of chatbots and virtual assistants (VAs), their general architecture, functionalities, and their recent applications. Understanding these technologies lays the groundwork for the development of an AI-powered legal virtual assistant optimized for housing dispute resolution in Finland.

2.1.1 Defining chatbots, virtual assistants, and legal virtual assistants

While often used interchangeably, chatbots and VAs possess subtle distinctions.

Chatbots primarily focus on simulating conversation through text or voice commands. They are frequently rule-based or rely on pre-defined scripts to address specific tasks like answering frequently asked questions (FAQs) or providing basic customer support (Adamopoulou & Moussiades, 2020). Chatbots can be integrated seamlessly into websites, messaging platforms, and mobile applications. VAs offer a broader range of functionalities exceeding mere conversation. VAs can access and process information from various sources, schedule appointments, manage tasks, and even control smart home devices (Pereira et al., 2023).

While there are some technical distinctions between these terms, for the purpose of this paper, we will use them interchangeably to refer to AI-powered conversational agents that can interact with users through text queries.

2.1.2 Categories of chatbot

Based on their usage, functionalities and purpose, there are several types of chatbots in use today, each designed to meet specific needs and functions across various industries. Here we explore some of the widely used chatbot categories in recent times.

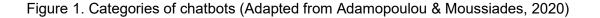
Rule based chatbots: Rule-based chatbots operate on a foundation of pre-defined rules and decision trees. These chatbots function in a script-like manner, responding to specific user inputs with predetermined outputs. Their strength lies in handling straightforward and repetitive tasks, excelling in scenarios where complex reasoning or nuanced understanding is not required(Lee et al., 2023). Rule-based chatbots typically address common user needs by answering Frequently Asked Questions (FAQs) on topics like return policies and store hours. They can also facilitate basic customer service interactions such as initiating returns or checking order status. Additionally, these chatbots excel at streamlining simple booking and reservation tasks, allowing users to book appointments or reserve products efficiently (Abd-alrazaq et al., 2019; Adamopoulou & Moussiades, 2020). A prime example of this functionality can be seen on retail websites, where rule-based chatbots assist users in finding products by size and color, provide store hours, and address common return policy questions.

Al-powered chatbots: Al-powered chatbots represent a significant advancement over rule-based counterparts. These chatbots incorporate machine learning and NLP capabilities to understand and respond to user inputs in a more human-like manner. This enables them to respond to complex and varied interactions, continuously learning and improving their response accuracy over time.(Al-Hasan et al., 2024; Işıkdemir, 2024). GPTs, such as ChatGPT by OpenAl and Gemini by Google, represent a cutting-edge form of Al chatbot. These models are trained on massive datasets of text and code, enabling them to generate human-quality responses that are contextually relevant and grammatically sound(Al-Hasan et al., 2024). This sophistication makes them highly effective for a wide range of conversational tasks. In addition to handling a variety of intricate user queries, GPTs can provide responses that are coherent and contextually relevant. They can be fine-tuned to be used in specific domains and applications such as providing health care advice or

legal advice (Patil & Gudivada, 2024). Typical use cases for GPTs include creating content in a variety of creative text formats, responding to intricate customer support queries, serving as domainspecific virtual assistants, and more(Rivas & Zhao, 2023). While GPTs offer immense potential to revolutionize AI and chatbots, their capabilities are constrained by limitations that can significantly impact real-world applications. These limitations include a lack of common sense and reasoning, potential for bias and discrimination, limited ability to understand context across multiple conversations, and a lack of explainability and transparency in their outputs (Koubaa et al., 2023). Additionally, the potential for malicious use and the high computational cost of training and running these models raise concerns for responsible development and accessibility(Lecler et al., 2023).

Other types of chatbots: Beyond rule-based, Al-powered, and GPT chatbots, other varieties exist. Contextual chatbots personalize interactions by remembering past conversations. Voice-activated chatbots offer hands-free convenience through spoken commands(Adamopoulou & Moussiades, 2020). Social media platforms see engagement boosted by social media chatbots. Secure transactions and bookings are facilitated by transactional chatbots(Whang et al., 2022). Both customer service chatbots and support chatbots provide technical assistance and troubleshooting solutions, with customer service chatbots often focused on broader customer interactions. Each category caters to specific user needs and interaction styles.(Skjuve et al., 2021)

Chatbot	Knowledge domain	Generic
Charbot		Open Domain
Categories		Closed Domain
	Service provided	Interpersonal
		Intrapersonal
		Inter-agent
	Goals	Informative
		Chat based/Conversational
		Task based
	Response Generation Method	Rule based
		Retrieval based
		Generative
	Human-aid	Human-mediated
		Autonomous
	Permissions	Open-source
		Commercial
	Communication channel	Text
		Voice
		Image



Technologies and architecture of chatbots

In recent years, chatbots and virtual assistants have undergone remarkable transformations by leveraging AI, DL and ML to personalize interactions and provide more sophisticated assistance(Aslam, 2023; Hamid et al., 2023). This transformation is fueled by advancements in NLP integrated into various advanced LLMs(Işıkdemir, 2024). These advancements allow chatbots and VAs to understand the nuances of user queries and generate responses that are more accurate, relevant, and tailored to the user's specific needs(*ChatGPT, Generative AI, LLM, NLP: How to Understand the New Era of Artificial Intelligence Already Impacting Businesses - ProQuest*, n.d.).

User Interface (UI): The UI is the medium through which users engage with the chatbot, whether through text or voice. Chatbots can be incorporated into different platforms, including messaging apps, websites, and voice assistants.

NLP: In the architecture of developing chatbots, NLP is a crucial component for understanding and interpreting user inputs, enabling chatbots to engage in meaningful and coherent conversations (Filonova, 2022). NLP performs a range of sophisticated tasks mentioned as follows, that transform the raw text into structured data the chatbot can process.

Tokenization breaks down text into individual words or phrases, facilitating further analysis. Part-ofspeech tagging identifies the grammatical roles of these tokens, such as nouns, verbs, and adjectives, which helps in understanding sentence structure (Attigeri et al., 2024). Named entity recognition (NER) involves identifying and classifying proper nouns like names of people, organizations, or locations within the text (Lareyre et al., 2023). Sentiment analysis evaluates the emotional tone of the input, determining whether it expresses positive, negative, or neutral sentiments (Shankar & Parsana, 2022). Together, these NLP tasks enable chatbots to accurately comprehend and respond to user inputs, enhancing their ability to provide relevant and contextually appropriate interactions (Whang et al., 2022).

Nowadays, NLP is seamlessly integrated into LLMs like ChatGPT and Gemini. These models leverage advanced NLP techniques to understand, process, and generate human-like text (Attigeri et al., 2024). By combining the extensive capabilities of LLMs with sophisticated NLP tasks such as tokenization, part-of-speech tagging, named entity recognition, and sentiment analysis (lşıkdemir, 2024), these models can engage in complex, contextually rich conversations and provide highly relevant responses. This integration enhances the chatbot's ability to handle a wide range of queries with improved accuracy and coherence, making interactions more natural and effective (Koga & Du, 2024). **Generating Response:** The process of response generation in a chatbot is crucial for creating relevant and contextually appropriate replies to user inputs (Kulkarni et al., 2021). It begins with analyzing the user's message using NLP to understand the intent and extract key information. The chatbot then generates a response using predefined rules, templates, or advanced methods such as machine learning and neural networks (Gao et al., 2023). Advanced chatbots, particularly those powered by LLMs like ChatGPT, use sophisticated algorithms to produce human-like and coherent responses (Bratić et al., 2024). These models can dynamically construct replies by predicting the next word in a sequence and considering the entire conversation history to maintain context. This capability allows chatbots to offer informative, engaging, and contextually appropriate interactions, ultimately enhancing user experience and satisfaction (Eshbayev et al., 2022).

Backend Integration: To provide relevant information or carry out specific tasks, chatbots frequently need to interact with external resources like databases or APIs. Backend integration allows chatbots to access and modify data from these external systems as required (Vasileiou & Maglogiannis, 2022)

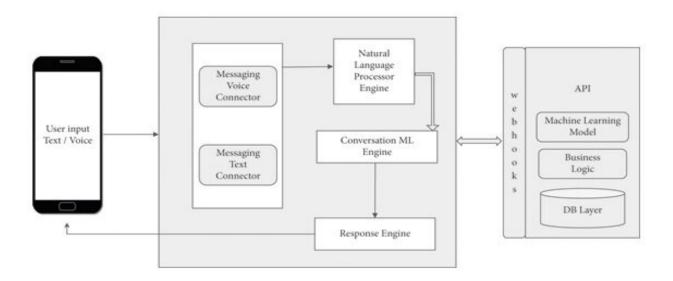


Figure 2. Advanced chatbot architecture (adapted from Vasileiou & Maglogiannis, 2022)

2.1.3 Potential of chatbots or virtual assistants in enhancing legal services

A virtual assistant may offer a diverse set of capabilities, including:

Information Retrieval: Al-powered chatbots have the ability to access and process vast amounts of data. They can efficiently retrieve relevant information based on user queries, saving time and effort (Khadija et al., 2023; Mathis, 2022). In the legal domain, a chatbot referred to as LVA can access and search through legal data, including case laws, statutes, regulations, and legal articles. This could be highly beneficial for legal professionals and individuals seeking specific legal knowledge.

Task Automation: VAs can automate repetitive tasks such as scheduling appointments, managing calendars, drafting basic legal documents, and handling routine client communication (Brunt-Work, 2023). This frees up valuable time for lawyers and legal professionals to focus on more complex legal matters and strategic tasks.

Understanding user queries: VAs are equipped with natural language processing (NLP) capabilities, enabling them to understand and respond to user queries in a natural and conversational manner (Shankar & Parsana, 2022). This allows users to interact with the legal system through intuitive language, making legal information more accessible and user-friendly.

Legal Research Assistance: LVAs can aid legal professionals in conducting legal research by identifying relevant legal precedents, analyzing legal documents, and summarizing key legal issues within a case.

Basic Legal Advice: An LVA can possess the ability to understand user queries about legal information, retrieve data from the knowledge base, and provide responses to legal inquiries. It can also answer common legal questions, direct users to relevant legal resources, and recommend seeking professional legal assistance when needed.

Document Drafting Support: LVAs with the help of artificial neural networks can assist in drafting simple legal documents like contracts, wills, and non-disclosure agreements with user input, streamlining the document creation process.

With the aforementioned capabilities of virtual assistants in the legal domain, they have the potential to significantly impact the nature and delivery of legal services:

Increased Access to Legal Information: LVAs can democratize access to legal knowledge, particularly for individuals who may not have the resources to consult a lawyer. This can empower individuals to better understand their legal rights and navigate the legal system. **Improved Efficiency and Productivity:** By automating routine tasks and providing basic legal assistance, LVAs can significantly improve the efficiency and productivity of legal professionals, allowing them to focus on high-value legal services and strategic advice.

Cost Reduction: The automation of tasks and provision of basic legal assistance by LVAs can potentially reduce legal service costs for clients, making legal services more affordable for a wider range of individuals and businesses.



Figure 3. Potential application of LVA.

2.1.4 Challenges and limitations associated with adoptions of chatbots

While chatbots offer numerous advantages as mentioned in previous chapter, they also come with many limitations and challenges.

Limited understanding: Chatbots may struggle with understanding complex or ambiguous queries (Schwenke et al., 2023), especially in domains requiring an accurate understanding of the scenarios, such as law or healthcare. Additionally, maintaining context over extended conversations can be challenging, leading to inconsistencies or misunderstandings. Moreover, chatbots may lack empathy and emotional intelligence, hindering their effectiveness in sensitive or emotionally charged interactions (Murtarelli et al., 2021).

Data bias and hallucinations: Chatbots trained on biased data can perpetuate those biases in their responses. Data bias is a major concern for chatbots, as they learn from the information they're trained on. Biases in that data, whether from skewed samples, historical prejudices, or even the algorithms themselves, can lead chatbots to perpetuate stereotypes, discriminate against users, and deliver unfair treatment (Lin et al., 2023; Murtarelli et al., 2021). Providing inaccurate information, expressing nonsensical statements, or sharing false information is considered hallucinations committed by the LLM models (Żmihorski, 2023).

Security and Privacy: Chatbots that handle sensitive data raise concerns about data security and user privacy (Rivas & Zhao, 2023). Ensuring data privacy and security is crucial, especially when chatbots handle sensitive information.

Cost and investment: Creating and managing chatbots requires a significant investment of time, resources, and ongoing improvement to keep up with changing user needs and technological advancements (Schwenke et al., 2023). These limitations and challenges highlight the importance of thorough planning, continuous improvement, and careful use of chatbot technology to achieve specific business objectives while minimizing potential drawbacks (Lin et al., 2023; Patil & Gudivada, 2024).

2.2 Existing AI-powered chatbots in the legal arena around the world

This chapter dives into the world of AI assistants which are specifically designed for the legal domain. We'll explore how these AI-powered assistants are operating in the legal domain and transforming the domain, highlighting some of the most prominent players such as Juro, Harvey AI, and LawDroid.

2.2.1 Juro legal Al assistant

Juro, a legal technology platform leverages AI to streamline the entire contract management process. Unlike standalone legal AI chatbots, Juro integrates its AI assistant within a comprehensive contract automation platform. This allows users to not only draft, summarize, and review contracts with exceptional speed, but also handle the entire contract lifecycle: creation, negotiation, approval, signing, storage, and management (*7 Best Legal AI Chatbots for 2024*, n.d.).

Juro's key differentiator lies in its holistic approach. By embedding the AI assistant directly within the contract workflow, it provides contextually relevant and accurate responses. This eliminates the limitations of siloed AI solutions that lack access to an organization's specific practices and guide-lines. Juro prioritizes user privacy as well. Data remains within the EEA (European Economic Area) for GPT interactions, and contracts or prompts are never used to train large language models (LLMs). This directly addresses security and privacy concerns that are increasingly important for in-house legal teams (*7 Best Legal AI Chatbots for 2024*, n.d.).

Juro's AI assistant tackles a major pain point in contract management: creating clear and concise summaries. Legal contracts are often lengthy documents filled with jargon, making it difficult for stakeholders outside the legal department to grasp key details. Juro's AI can automatically generate contract summaries in seconds, extracting the critical information and presenting it in a clear, digestible format (*Contract Summary: What It Is and How to Create One*, n.d.).

2.2.2 Harvey Al legal Al assistant

Founded in 2023 by legal and AI experts, Harvey AI prioritizes security and user trust. This is evidenced by their impressive growth. Harvey AI has a team exceeding 100 people, a tenfold revenue increase, and a \$715 million valuation secured through \$80 million in Series B funding. Harvey AI caters to legal, tax, and finance professionals, offering a secure platform for leveraging cuttingedge AI within their workflows (*Harvey* | *OpenAI*, n.d.).

The legal AI chatbot of Harvey AI is designed to empower law firms and consulting companies. Recognized as a leader in the legal AI market, Harvey AI partners with prestigious firms like Allen & Over and industry giants like PwC. Similar to Juro's legal AI assistant, Harvey AI leverages OpenAI's GPT technology and machine learning to automate routine legal tasks, including due diligence, litigation support, and legal document analysis(*7 Best Legal AI Chatbots for 2024*, n.d.).

Harvey AI distinguishes itself through its comprehensive training process. While its core is built upon OpenAI's GPT foundation, it undergoes further specialization in legal domains. This involves training on vast amounts of legal data encompassing case law, legal reference materials, and industry best practices. Additionally, upon integration with a specific law firm, Harvey AI personalizes its capabilities by ingesting the firm's internal templates and work products. This mimics the onboarding process of a new legal professional, ensuring Harvey AI delivers outputs tailored to the firm's specific practices and areas of expertise(*Generative AI for Professional Services* | *Harvey*, n.d.; *Harvey AI: Legal Artificial Intelligence*, n.d.).

2.2.3 CaseMine legal AI assistant

CaseMine's journey began with CaseIQ, a pioneering tool utilizing extractive AI. CaseIQ excels at navigating vast legal databases, pinpointing relevant information through advanced natural language processing (NLP) techniques. It identifies key passages and highlights pivotal sections of judgments using the Importance Matrix, offering a visual guide to the most influential parts of legal documents. CiteText, another extractive AI tool, complements CaseIQ by distilling the interpretation of legal precedents. By extracting the essence of how courts have applied past judgments, CiteText streamlines research by showcasing authoritative legal applications (*Evolution of Legal AI from Extractive to Generative - The CaseMine Story*, n.d.).

Recognizing the limitations of extractive AI, CaseMine took a bold step forward with AMICUS, a game-changing generative AI tool launched in 2023. AMICUS transcends simple information retrieval, transforming into a comprehensive legal research assistant. It offers a variety of functionalities:

Conversational Research: AMICUS engages in conversations, not just returning results. It delves deeper, reasoning about the applicability of legal information and ensuring users receive the most relevant answers to complex legal questions.

Legal Document Drafting: AMICUS streamlines document creation by generating precise and compliant legal documents, minimizing human error and saving valuable time.

Summary Generation: AMICUS provides concise and accurate summaries of legal materials, surpassing traditional headnotes and ensuring crucial information is never overlooked. (*7 Best Legal AI Chatbots for 2024*, n.d.; *Evolution of Legal AI from Extractive to Generative - The CaseMine Story*, n.d.)

2.3 HOAS and the Helmi Chatbot: Al-powered Housing Assistance

HOAS, a non-profit organization dedicated to providing affordable student housing, faced a growing demand for customer service. Their existing live chat system, while popular, struggled to keep pace with the increasing volume of inquiries. Additionally, many student inquiries were

repetitive and could potentially be addressed through self-service options (*Hoas - Hoas*, n.d.; *Housing Chatbot Improves the Overall Customer Satisfaction* | *GetJenny*, n.d.).

In 2018, HOAS partnered with GetJenny to create Helmi, a Finnish and English speaking Al chatbot. Helmi seamlessly integrated with HOAS's existing chat system, allowing it to handle routine inquiries and direct more complex issues to human agents.

The implementation of Helmi resulted in immediate improvements. Within the first few months, HOAS met its goals for the chatbot project, including a notable increase in customer service satisfaction scores from 4.11 to 4.26 (on a scale of 1-5). Helmi's ability to provide instant, accurate responses helped alleviate the workload on human agents and improved the overall efficiency of customer service operations.

Helmi operates 24/7, offering round-the-clock assistance to users. This accessibility significantly improves convenience and eliminates time constraints associated with traditional housing searches. Helmi's user interface is designed to be user-friendly and intuitive, aiming to remove barriers often encountered in conventional housing searches. This simplifies the process for users of all technical backgrounds.

Streamlined Inquiries: Helmi assists users with various housing-related inquiries, including: Housing application procedures, Real-time updates on available properties, Lease agreement details, Rent payment information, and Maintenance request submission.

Improved Efficiency: By automating routine tasks and inquiries, Helmi frees up HOAS staff to focus on more complex issues and individual needs. (*Hoas - Hoas*, n.d.; *Housing Chatbot Improves the Overall Customer Satisfaction* | *GetJenny*, n.d.)

Limitations and Considerations:

While Helmi offers significant benefits, it's crucial to acknowledge its limitations:

Complexity Handling: Helmi's capabilities are primarily focused on addressing common and straightforward inquiries. When faced with complex or nuanced issues requiring human judgment or interpretation, the chatbot may struggle to provide adequate solutions.

Accent/Dialect Recognition: In some instances, Helmi may encounter difficulties understanding users with specific accents or dialects. This could potentially lead to misinterpretations or communication breakdowns.

Overall Impact:

Despite these limitations, Helmi streamlines the housing process for users while enabling HOAS to optimize its operational efficiency. (*Chatbot Use Cases: 25 Real-Life Examples*, n.d.; *Hoas - Hoas*, n.d.; *Housing Chatbot Improves the Overall Customer Satisfaction* | *GetJenny*, n.d.)

2.4 SmartRent in the United Kingdom: Al-powered Assistance for Tenants

Across Europe, various organizations are adopting AI-powered solutions to address housing challenges. In the United Kingdom, SmartRent offers a prime example of such an initiative.

SmartRent is a leading provider of AI-powered property management solutions in the UK. Their platform incorporates a virtual assistant that caters specifically to tenants' needs.

Similar to Helmi, SmartRent's virtual assistant operates 24/7, providing round-the-clock assistance to tenants with their housing inquiries. The platform facilitates convenient rent payments through various online channels, eliminating the need for manual processes or late payment penalties.

Tenants can easily submit maintenance requests through the platform, ensuring timely communication and resolution of any property issues.(5 Ways SmartRent UK Is Revolutionising Smart Home Tech | SmartRent, n.d.; Leveraging Artificial Intelligence for Property Management - Kurby Real Estate AI, n.d.; SmartRent | Smart Home Solutions for Multifamily Communities, n.d.; SmartRent Delivers Seamless Property Management with Salesforce - Salesforce, n.d.)

The virtual assistant acts as a central communication hub, allowing tenants to receive important updates and announcements from their landlords or property managers.

Tenants can access personalized information about their tenancy agreements, including lease details, payment history, and property-specific rules and regulations.

SmartRent's AI-powered solution also benefits landlords and property managers by:

Streamlining Communication: The platform automates routine communication tasks, freeing up time for property managers to focus on more complex issues.

Improved Efficiency: Online rent payments and maintenance request management enhance operational efficiency and reduce administrative burdens.

Data-driven Insights: The platform provides valuable data and analytics that can be used to optimize property management strategies and improve tenant satisfaction.

(5 Ways SmartRent UK Is Revolutionising Smart Home Tech | SmartRent, n.d.; Leveraging Artificial Intelligence for Property Management - Kurby Real Estate AI, n.d.; SmartRent | Smart Home

Solutions for Multifamily Communities, n.d.; SmartRent Delivers Seamless Property Management with Salesforce - Salesforce, n.d.)

Overall Impact:

SmartRent's AI-powered virtual assistant demonstrates the growing trend of utilizing AI to improve the tenant experience in the UK housing market. By offering 24/7 support, convenient payment options, and a centralized communication platform, SmartRent streamlines the housing experience for tenants while providing valuable tools for efficient property management.

2.5 Collaborative system in QnA in German case law documents

This section discusses the work of C. Hoppe et al. (2022) who developed a system for efficient legal information extraction through semantic Question and Answer (QnA) in German case law documents. Here's a breakdown of their approach, findings, and the significance of their research:

2.5.1 Human-Al collaboration approach

In order to extract information efficiently from digitally stored legal systems, Hoppe et al., 2022 adopted Human-AI collaboration approach. Human-AI collaboration is focused on achieving a common objective through extensive interaction between humans and AI. The challenge is, legal laypersons cannot effectively extract information from vast quantities of legal documents on their own. Therefore, in the system developed by (Hoppe et al., 2022), rather than manually searching through numerous documents, individuals use a graphical interface or user interface to interact with an AI that handles the document search and question-answering (QA) tasks, this is mentioned as the human layer in their work. The AI layer comprises a toolkit of interchangeable statistical and machine learning components designed to efficiently address search tasks. Thus, the system is structured into two interconnected and continuously interacting layers: the human layer (front end) and the AI layer (back end).

The Human Layer: To facilitate the collaborative interaction between humans and the QA system developed by (Hoppe et al., 2022) in this work, users can interact in two primary ways.

- 1. **Programming interface:** Users can enhance the knowledge base by inserting new legal documents. In the programming interface, these documents are automatically pre-pro-cessed, embedded, indexed, and saved in the database, thus no programming skills are required.
- 2. **Graphical Human-Al Interface:** Users can submit search queries, which can be either individual keywords or specific legal questions through the graphical user interface. Queries may include legal-specific terms and depending on the search term, various components of

the AI toolchain (described in the AI layer section) are used to find the best-matching documents. Thus, the top results are prepared for the user to directly extract the requested information. Moreover, In an evaluation loop, the presented documents can be optionally rated to improve the quality of future responses.

The Al layer: When a search term is submitted through the human layer, the Al layer begins retrieving relevant information.

For the document retrieval, it uses statistical methods and deep sentence transformer models to transform queries into vectors of dimension d = 768. Then it computes cosine similarity to find the most relevant passages. Hence, it retrieves the top k = 10 relevant passages related to the search query.

If keywords are used by the user, a BERT (Bidirectional Encoder Representations from Transformers) model which is trained for the named entity recognition checks for legal entities.

(Note: The BERT model is a state-of-the-art language representation model developed by Google. It leverages a transformer architecture to understand the context of words in a sentence by looking at both preceding and following words, enabling more accurate natural language processing tasks (Hoppe et al., 2022).)

For specific legal questions, an ELECTRA (Efficiently Learning an Encoder that Classifies Token Replacement Accurately) model extracts exact answers from the relevant passages which retrieves the top k = 5 answers most relevant to the posed question. The AI layer also ranks and presents the relevant passages or answers on the graphical human-AI interface.

(Note: ELECTRA is a pre-trained language model introduced in 2020 by researchers at Google Research. It utilizes a novel technique called "replaced token detection" during the training process (*More Efficient NLP Model Pre-Training with ELECTRA*, n.d.). This technique involves masking a portion of the input text and replacing it with another random word. The model then learns to predict the original masked word based on the surrounding context, but crucially, it does not predict the replaced word itself. This approach helps the model become more robust against adversarial attacks and better at understanding natural language (Gargiulo et al., 2022). GELECTRA is a variant of ELECTRA specifically adapted for the German language. It uses the same principles as ELECTRA to enhance language understanding and processing tasks in German, providing similar efficiency and performance benefits for German-language applications (Chan, 2020).)

For the document pre-processing and Indexing which is done through the programming interface, involves removing HTML elements, converting Unicode symbols, and splitting long documents into 200-word passages.

Document indexing Stores plain text, metadata, and deep vector representations of passages in the database. Vectors enable semantic search and question answering. The process completes when all texts, metadata, and passage vectors are successfully indexed.

2.5.2 The experiment and the metrics

The experiments conducted aimed to evaluate the performance of the system using various underlying models. (Hoppe et al., 2022), tested several pre-trained models alongside a self-trained reader model and introduced a self-annotated dataset called LegalQuAD specifically for QA tasks in German case law documents.

Creation of the LegalQuAD data set

To assess and fine-tune the retriever and reader models for QA, (Hoppe et al., 2022), needed annotated datasets with question-answer pairs. Notably, no such dataset existed for QA in German legal documents. To address this gap, (Hoppe et al., 2022) developed the LegalQuAD dataset, which consists of 226 question-answer pairs derived from German case law documents across various legal fields, formatted similarly to the SQuAD dataset. The data annotation was performed by trained lawyers familiar with NLP, who crafted specific questions and highlighted corresponding answers from provided legal texts. To ensure diversity, questions varied in complexity and were rephrased with synonyms to minimize lexical overlap. Additionally, all questions were made selfsufficient, ensuring they could be answered solely based on the text provided.

Model training and evaluation metrics

(Hoppe et al., 2022) evaluated different combinations of the entire QA workflow on their annotated LegalQuAD dataset. Several publicly available models were tested against this dataset, including the retrieval methods BM25 and MFAQ, combined with the reader models GELECTRA-base-GermanQuAD and GELECTRA-large-GermanQuAD. Additionally, (Hoppe et al., 2022) fine-tuned their own reader model, GELECTRA-large-GermanQuAD-LegalQuAD, using 200 random question-answer pairs from LegalQuAD. This fine-tuning was conducted over two epochs with a learning rate of 1e-5, using Adam optimizer, a batch size of 10, and a maximum sequence length of 256 tokens.

To evaluate the models, (Hoppe et al., 2022) used two primary metrics as follows.

The first one is Exact Match (EM) which measures the proportion of documents where the predicted answer span exactly matches the correct answer span. This metric is highly precise and stringent; for example, a predicted answer "§ 15 BGB." would score zero if the correct answer was "In § 15 BGB." due to the exact match requirement.

The second one is F1-score which measures the ratio of overlapping words between the labeled and predicted answer spans. This metric is more lenient than EM and provides a score closer to human judgment regarding the similarity of answers. These metrics helped (Hoppe et al., 2022) to determine the accuracy and effectiveness of the models in extracting the correct information from the legal documents.

Results:

The experiments showcased the effectiveness of a collaborative question-answering system for German legal documents. (Hoppe et al., 2022)'s approach, combining retriever models MFAQ and BM25 with a self-trained reader GELECTRA-large-GermanQuAD-LegalQuAD, outperformed pre-trained models in terms of EM and F1-scores. This suggests that fine-tuning models specifically for legal language significantly improves performance.

Their workflow proved functional, achieving valuable results compared to state-of-the-art methods. Human-AI collaboration in preprocessing, indexing, and querying legal documents was shown to be manageable for both legal laypersons and lawyers, without requiring programming skills. Notably, the fine-tuned models exhibited substantial performance improvements, indicating the difficulty of generalizing legal language for pre-trained models. This research offers promise for extracting precise answers from extensive legal documents in the future, even with limited labeled data.

Synthesis of the work:

The study introduces a collaborative question-answering system tailored for German legal documents. Their approach combines retriever models (MFAQ and BM25) with a self-trained reader (GELECTRA-large-GermanQuAD-LegalQuAD), demonstrating superior performance over pretrained models in terms of EM and F1-scores. This underscores the importance of fine-tuning models for the intricacies of legal language.

As the field progresses towards AI-based methods in information retrieval (IR), the necessity for collaborative systems for AI-supported question answering and semantic search in legal domains becomes apparent. Integrating humans into the process chain is crucial, ensuring legal information accessibility to both laypersons and professionals through a human-AI interface. These findings

can enhance existing information retrieval systems, making legal documents more transparent and searchable for all users, thereby contributing to a smarter society.

2.6 Housing disputes domain in Finland

We provide a brief overview of housing dispute domain in Finland so that we better describe the scope of work for the developed prototype.

The housing sector in Finland plays a crucial role in the country's social and economic landscape and it can have many legal issues occurred. However, navigating housing disputes can be a complex and challenging process for both individuals and legal professionals. This chapter identifies common challenges associated with resolving them, and it explores the potential of AI-powered virtual assistants in addressing these challenges.

Common types of housing disputes in Finland:

In Finland, housing disputes frequently stem from a variety of issues. One of the most common sources of conflict is rent arrears and non-payment, where tenants may face potential eviction proceedings due to unpaid rent. Maintenance and repairs also often lead to disagreements, as tenants and landlords dispute over who is responsible for maintaining and repairing rental properties. Additionally, noise disturbances and nuisance behavior by neighbors can create significant challenges for tenants, leading to tensions within housing communities. Another major area of dispute is the termination of tenancy agreements, where the validity or fairness of termination notices can become contentious and typically necessitates legal guidance. These issues collectively contribute to the complexity of housing disputes in Finland, affecting both tenants and landlords (Kettunen & Ruonavaara, 2015).

Challenges in resolving housing disputes:

Individuals and legal professionals navigating housing disputes in Finland encounter several challenges. Retrieving relevant information is often time-consuming and requires legal expertise to identify the applicable legal provisions and regulations for a specific dispute. Generating appropriate responses, such as formulating effective legal arguments and drafting legal documents, can be difficult without proper legal training and experience. Additionally, access to legal representation poses a significant barrier, as the cost can be prohibitive, especially for those with limited financial resources. These challenges collectively complicate the resolution of housing disputes in Finland.

Potential of AI-powered virtual assistants in housing disputes:

Al-powered virtual assistants (VAs) have the potential to address several challenges associated with housing disputes in Finland. These VAs can streamline information retrieval by providing easy access to relevant legal information, regulations, and case law specific to housing disputes (Pereira et al., 2023). They can assist in response generation by helping individuals draft basic legal documents, such as letters to landlords or applications for legal aid, using templates and guided prompts. By offering insights into legal rights and options, VAs empower individuals to participate more effectively in the dispute resolution process (Quali-Bot, the Virtual Assistant That Also Helps in Legal Claims Issues, 2024). Furthermore, they provide a cost-effective alternative to legal representation, especially beneficial for those with limited financial resources.

2.7 LLM and RAG Overview

Large Language Models (LLMs) have emerged as a powerful force in the field of Artificial Intelligence (AI), particularly within the realm of Natural Language Processing (NLP) (Bratić et al., 2024). These advanced AI systems, often referred to as chatbots, are known for their ability to understand and generate human-like language, making them capable of performing tasks such as question answering, essay writing, creative content generation, and even code writing (Teubner et al., 2023). Prominent examples of LLMs include OpenAI's ChatGPT, particularly its latest iteration GPT-4 Vision, Google's Bard AI (now Gemini), and Microsoft's Bing Chat (Miao et al., 2024). Their rapid development has facilitated their adoption across various domains, including business, academia, and even the legal sector.

LLMs are essentially a subset of deep neural networks built on the transformer architecture. Their remarkable skills in understanding, generating, and modifying natural language stem from their training on massive amounts of text data, often encompassing billions of words (Ullah et al., 2024). This training process utilizes a "next word prediction" approach, where the model learns to predict the next word in a sequence given a set of preceding words. Through this iterative process, LLMs gain the ability to grasp the nuances of human language and identify the intricate statistical patterns within it (Teubner et al., 2023).

As (Min et al., 2024) describes that LLMs serve as the foundational models for NLP and Natural Language Generation (NLG) tasks. After undergoing pre-training on vast datasets, these models are further refined through techniques like zero/one/few-shot learning and in-context learning, enabling them to effectively manage the complexities and interconnectedness inherent in language(Işıkdemir, 2024).

Despite their impressive capabilities, LLMs face certain challenges. One such issue is the "hallucination problem," where the model might fabricate stories or facts that appear plausible but lack factual grounding, often due to limitations in the data it was trained on (Kang et al., 2024; Ott et al., 2023). This can lead to the generation of inaccurate information presented in a seemingly credible manner.

Retrieval-Augmented Generation (RAG) emerges as a promising solution to address these limitations (Gao et al., 2024). RAG integrates knowledge from external databases, enhancing the accuracy and credibility of the generated output, particularly for knowledge-intensive tasks. It also facilitates continuous knowledge updates and the incorporation of domain-specific information (Alan et al., 2024). By synergistically combining the inherent knowledge of LLMs with the vast dynamic repositories of external databases, RAG effectively reduces the risk of generating factually incorrect content. This integration has led to widespread adoption of RAG, establishing it as a key technology in advancing chatbots and enhancing the suitability of LLMs for real-world applications (Miao et al., 2024).

Alternative solutions have been proposed to address the challenges faced by LLMs, such as directly incorporating all information into prompts or fine-tuning models with fresh data (Li et al., 2024). However, the former approach is often impractical, while the latter incurs significant financial costs. The RAG approach presents a viable alternative, as it retrieves relevant information from stored databases when required and provides it to the LLM. This approach utilizes these references to generate more accurate and reliable responses by equipping LLMs with pertinent questions and related reference resources beforehand (Li et al., 2024).

The implementation of the Proof of Concept (POC) for this thesis work leverages the RAG model as its core method. By storing information, utilizing databases, and enhancing the generation process through the inclusion of relevant reference materials, the RAG model ultimately contributes to improved answer quality and reliability (Gao et al., 2024).

3 Research Design

This chapter presents Methodological procedure which includes the research approach, development Method, implementation procedures, data collection methods and its reasons, and data analysis methodologies that were adopted to assure validity and reliability of the findings.

3.1 Research Approach

Constructive Research approach: This thesis work, titled "Assessing the Efficacy of Large Language Model (LLM) optimized by Retrieval Augmented Generation (RAG) in Legal Virtual Assistant for the domain of Housing Disputes in Finland," adopts the constructive research approach. This methodology emphasizes the development and implementation of practical solutions to specific problems or challenges. In this context, it involves building a functional legal virtual assistant (VA) specifically designed to address housing disputes within the Finnish legal system.

The constructive research approach offers several advantages for this project. Firstly, it facilitates the creation of a tangible tool, the legal VA, that can be directly applied in real-world scenarios. This allows for the evaluation of its effectiveness in assisting individuals navigating housing disputes within the Finnish legal framework. Secondly, by actively building and implementing the legal VA, the research delves into the practicalities of optimizing LLMs with RAG for legal information retrieval tasks. This hands-on experience provides valuable insights into the real-world challenges and opportunities associated with this approach. Finally, the constructive approach inherently emphasizes problem-solving, ensuring that the research directly contributes to finding a practical solution for a specific challenge within the housing dispute domain in Finland.

Therefore, the constructive research approach aligns perfectly with the goals of this thesis, which include, developing a functional legal VA capable of assisting individuals with housing disputes in Finland, evaluating the efficacy of LLMs optimized with RAG in the context of legal information retrieval for housing disputes and To gain practical experience in optimizing LLMs with RAG for legal tasks, contributing to the broader understanding of this approach within the legal domain.

3.2 Scrum Iterative Development Framework

This thesis work involves developing a prototype of an AI-powered virtual assistant which will be able to handle basic housing disputes issues in Finland. To implement this development project, we planned and organized our work with the Scrum Iterative development framework.

Scrum is an iterative and incremental development framework used for managing complex software and product development projects (Alavandhar & Ņikiforova, 2017). It provides a structured yet flexible approach to product development, emphasizing collaboration, transparency, and adaptability. Two key components of Scrum are "Sprints" and "Product Backlog." (Pries & Quigley, 2011)

Sprints: Scrum operates in fixed-length iterations called sprints, typically lasting 2 to 4 weeks. By breaking the work into smaller, manageable increments and iterating over short time frames, Scrum aims to deliver value quickly and respond effectively to changing requirements or feedback. The idea of sprints in Scrum is to create a rhythm of regular, focused work that allows for adaptability and continuous improvement (Alavandhar & Ņikiforova, 2017).

Product Backlog: A product backlog is a prioritized list of features, enhancements, bug fixes, and other work items that need to be addressed in a product. It is a key component of agile development methodologies, particularly Scrum (Pries & Quigley, 2011). The product backlog serves as a dynamic document that evolves and reflects the overall vision and goals of the product.

3.3 Investigation Methods

This thesis employs an experimental setup to assess the efficacy of three popular LLMs, along with our prototype, a RAG-based legal VA, specifically for housing disputes in Finland. The experimental setup allows for controlled testing of the LLMs' performance under specific conditions. By presenting a defined set of prompts and scenarios, we can directly observe and evaluate the responses generated by different LLMs and our prototype. The detailed structure of the experimental setup is described in chapter 3.3.1.

The results from the experiment are evaluated through qualitative feedback provided by a human expert specialized in legal perspectives. This feedback helps in assessing the accuracy, completeness, and clarity of the responses generated by each model. The details of the qualitative feedback are described in chapter 3.3.2.

3.3.1 Structure of experimental setup

Targeted issues

Housing disputes encompass a wide range of issues that can arise between landlords and tenants, neighbors, homeowners associations, and other stakeholders. Due to limitations of time and resources, we have focused on two specific issues within the housing dispute domain:

- 1. **Unable to Pay Rent:** This encompasses various situations where individuals face difficulty fulfilling their rent obligations.
- 2. **Damage to Property:** This covers issues related to property damage, including the identification of responsibility, repair processes, and potential compensation.

Legal assistance scenarios

For each targeted issue, we have identified five distinct legal assistance scenarios. These scenarios represent common situations that individuals might encounter within the Finnish housing dispute legal framework. The scenarios were selected based on a study of commonly occurring housing dispute issues in Finland, and through consultation with the commissioning party of this thesis.

For example, scenarios related to "Unable to Pay Rent" includes:

- Seeking for rent assistance programs.
- Negotiating rent reduction with the landlord.

Prompt generation

Within each scenario, 5 different user queries/prompts are formulated. These prompts are designed to simulate user inquiries, incorporating variations in phrasing, grammar, and potential spelling mistakes to reflect the diverse ways users might interact with a legal virtual assistant.

Total prompts

Following this structure, a total of 50 prompts (5 prompts per scenario x 5 scenarios x 2 issues) are generated for evaluation.

Generating responses from different virtual assistant platforms

The generated 50 prompts are presented to four different virtual assistants: ChatGPT, Gemini, Perplexity, and the prototype which was developed as a proof of concept (POC). This allows for a qualitative analysis of their performance in handling legal information retrieval and generation tasks within the housing dispute domain. Details of these scenarios, prompts and responses are provided in the Appendix, where an .xlsx file includes all relevant information.

3.3.2 Qualitative Feedback for evaluating the experiment results

In this section, we detail the methodology used to gather qualitative feedback for evaluating the experiment results. The qualitative feedback is provided by a single human expert with experience in legal matters related to housing disputes. This feedback is crucial in assessing the efficacy of the different AI language models and the RAG-based prototype as legal virtual assistants.

Structure of the Qualitative Feedback Form

Feedback is collected from the human expert through a feedback form.

The feedback form is structured to evaluate the performance of AI language models (LLMs) and the prototype for RAG-based LVA in addressing housing dispute queries.

A human expert with legal expertise in housing dispute domain fills out the form by reviewing the results from the experiment. It comprises sections designed to assess two aspects of the models' responses, including accuracy and completeness. Each section is accompanied by specific criteria to guide the evaluator in providing qualitative feedback.

The feedback form is designed to comprehensively assess how well the models provide legal advice for housing disputes. It starts by outlining the evaluation's purpose and then collects the evaluator's information. The core of the form focuses on predefined criteria for evaluating the models' performance. These criteria consist of two main categories: correctness and completeness. Correctness is broken down into factual accuracy, source reliability, and internal consistency. Completeness is evaluated based on coverage of key points, detail sufficiency, and information relevance. Finally, the form concludes with an open-ended section allowing the evaluator to provide feedback on strengths and weaknesses and recommend improvements. This structured format ensures a systematic and thorough assessment of the models' effectiveness.

Please refer to the Appendix section for the feedback form.

Methods of data analysis

The responses generated by each virtual assistant for each prompt are documented in an Excel spreadsheet. This spreadsheet containing the documented performance results from each of the LLMs including our POC is evaluated by a human expert in the legal field. The human expert evaluates the LLMs' and the POC's performance by filling up a qualitative feedback form.

The following data analysis methods will be employed:

Quantitative analysis:

The accuracy scores for each virtual assistant across all prompts will be calculated to provide a quantitative comparison of their performance, marking as accurate or not accurate, complete or incomplete.

For the RAG-based system, it will be calculated that how many times it successfully retrieves data from the sources.

Qualitative analysis: Error analysis based on qualitative feedback

Based on the feedback, types of errors made by each virtual assistant will be identified and categorized (e.g., factual inaccuracies, misinterpretations, irrelevant information). This analysis will provide insights into the specific strengths and weaknesses of each model.

By combining these quantitative and qualitative analyses, we will draw conclusions regarding the effectiveness of the LLM and the prototype, RAG-optimized language models in legal information retrieval tasks within the context of housing disputes, we will also identify and discuss limitations, challenges, implications, future research directions.

4 Implementation of the Prototype

4.1 Development platform: Azure services

The prototype is developed on the Azure platform, a cloud-based solution designed to simplify the process of building modern applications. Microsoft's Azure service provides the flexibility to either host applications entirely in the cloud or extend on-premises applications with Azure services. This flexibility ensures that applications are scalable, reliable, and maintainable. Azure supports a wide range of popular programming languages, including Python, JavaScript, Java, .NET, and Go, and offers a comprehensive SDK library along with extensive support in development tools like VS Code, Visual Studio, IntelliJ, and Eclipse.(*Azure OpenAI Service Models - Azure OpenAI | Microsoft Learn*, n.d.)

Azure can host the entire application stack, encompassing web applications, APIs, databases, and storage services. It also allows existing on-premises applications to incorporate Azure services to enhance their capabilities. For instance, applications can utilize Azure Blob Storage for cloud file storage, Azure Key Vault for secure storage of application secrets, or Azure AI Search for adding full-text search capabilities. These services are fully managed by Azure and can be seamlessly integrated into existing applications without altering the current architecture or deployment model. Additionally, Azure offers various container-based services to support application modernization.

Azure Functions facilitate the creation of solutions for event-driven workflows, such as responding to HTTP requests, handling file uploads in Blob storage, or processing queue events. Azure OpenAI Service provides REST API access to powerful language models, including GPT-4 and GPT-3.5-Turbo, which are available for general use. These models can be adapted for specific tasks like content generation, summarization, image understanding, semantic search, and natural language to code translation. Users can access the service through REST APIs, Python SDK, or Azure's web-based interface in Azure OpenAI Studio.(*Azure OpenAI Service Models - Azure OpenAI | Microsoft Learn*, n.d.)

Azure AI Search is a fully managed cloud search service that enables information retrieval over user-owned content (*Introduction to Azure AI Search - Azure AI Search | Microsoft Learn*, n.d.). It hosts search services that manage indexes, indexers, data sources, skillsets, and synonym maps. A search index provides persistent storage of search documents, which are structured data loaded from external sources and made searchable. An indexer automates the process by reading data in native formats, serializing it into JSON, and optionally applying AI enrichment through skillsets for enhanced indexing (*Azure OpenAI Service Models - Azure OpenAI | Microsoft Learn*, n.d.).

Overall, Azure offers a comprehensive suite of cloud services catering to various application development and deployment needs. Its support for popular programming languages, flexible hosting options, and integration with AI services like Azure OpenAI and Azure AI Search make it a powerful platform for building modern, scalable applications.

4.2 System model

Azure OpenAI and Azure AI search integration

The POC of the virtual assistant was built on an open-source sample app provided by Microsoft Azure for the Retrieval-Augmented Generation pattern running in Azure, using Azure AI Search for retrieval and Azure OpenAI large language models to power ChatGPT-style and Q&A experiences.

To implement the system model, it was installed in a local environment. For a local setup, installation of the required tools are as follows: Azure Developer CLI, Python (3.9 or higher), Node.js 14+, Git, and PowerShell 7+ (for Windows users). Then ensured Python and pip are in the PATH on Windows, and python version can be run from the console. Then the following command is run:

azd init -t azure-search-openai-demo

Above command will initialize a git repository and the program will be cloned from the git repository.

Link to the git repository is: https://github.com/Azure-Samples/azure-search-openai-demo?tab=re-adme-ov-file#azure-deployment

Deploying: To provision Azure resources and deploy the application code, first log in to an Azure account with "azd auth login". Create a new azd environment using "azd env new", entering a name for the resource group. This creates a new folder in the .azure folder and sets it as the active environment for future azd commands. Optionally, customize the deployment by setting environment variables to use existing resources, enable optional features (such as auth or vision), or deploy to free tiers. Finally, run "azd up" to provision Azure resources and deploy the sample application, including building the search index based on the files in the ./data folder.

This sample app demonstrates a few approaches for creating ChatGPT-like experiences over the personalized datasets using the Retrieval Augmented Generation pattern. It uses Azure OpenAI Service to access a GPT model (gpt-35-turbo), and Azure AI Search for data indexing and re-trieval.

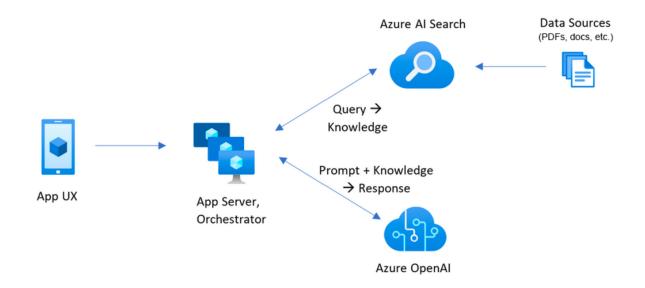


Figure 4. Approach for integrating Azure open AI and Azure AI search services. Adapted from (*GitHub - Azure-Samples/Azure-Search-Openai-Demo: A Sample App for the Retrieval-Augmented Generation Pattern Running in Azure, Using Azure AI Search for Retrieval and Azure OpenAI Large Language Models to Power ChatGPT-Style and Q&A Experiences.*, n.d.)

4.2.1 RAG Based Implementation Through Azure Al Search

The RAG model (explained in Chapter 2), is used to find and generate answers based on data relevant to specific queries or subjects. The process begins with obtaining and extracting source data, typically stored in formats like .pdf and .doc/.docx files, including documents on case law, legislation, and parliamentary discussions. The next step is chunk generation, where the source data is divided into smaller pieces, or chunks. These chunks are then embedded, meaning they are converted into numerical vector representations. This stage involves mapping words or phrases to vectors, using libraries such as OpenAI or GPT-3.5 Turbo.

Creating a vector store is crucial for implementing a RAG-based system, as it allows for the efficient retrieval of relevant passages or documents from a knowledge base. Vector queries are then run to fetch these relevant chunks. During the integration of prompts and search results, the system integrates relevant data and search results based on the prompt questions. The relevant chunks are retrieved from the vector database in accordance with the prompt, which helps in searching for contextually relevant information. These chunks are sent to a large language model (LLM) to aid in the response creation process. Finally, answer generation uses the retrieved information as a basis to generate response text. At this stage, the type, length, and linguistic style of the generated text can be specified. An LLM, such as Azure OpenAI's GPT-3.5-turbo model, utilizes the similarity search module in Azure AI search to retrieve relevant documents and generate responses.

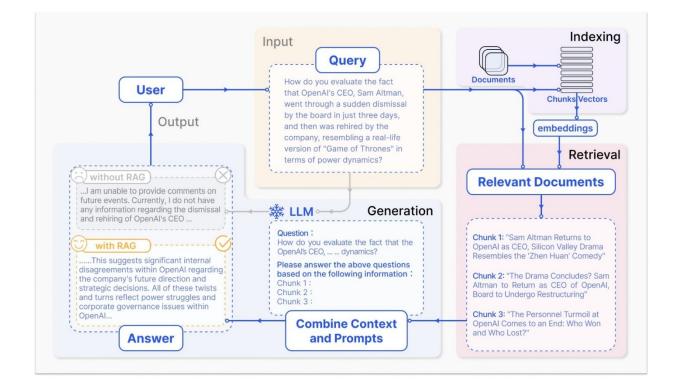


Figure 5. A representative instance of the RAG process applied to question answering, adapted from (Gao et al., 2023)

4.2.2 Source Data Gathering and Data Extraction

We collected the source data from Finlex Finnish Act on Residential Leases en19950481.pdf (finlex.fi) as pdf files. Source: https://www.finlex.fi/en/

Act on the Letting of Residential Apartments 481/1995 - Up-to-date legislation - FINLEX ® and Finnish Consumer Protection Act Kuluttajansuojalaki.engl.lop.doc (finlex.fi) were collected from the webpage and converted to PDF format.

Then Integrated vectorization adds data chunking and text-to-vector embedding to skills in indexerbased indexing. It also adds text-to-vector conversions to queries.

4.2.3 RAG features of the prototype

This research leverages the RAG functionality from the 'azure-search-openai-demo' project. The POC (Proof of Concept) directly clones this functionality for testing the prototype.

The "azure-search-openai-demo" application uses a Retrieval-Augmented Generation (RAG) approach, which involves enhancing the capabilities of a language model by incorporating relevant information retrieved from a large dataset. Here are the details of the RAG approach, (Fig. 8) as indicated in the demo application:

RAG Approach: Multiple Approaches

This indicates that the demo application employs several methods to integrate retrieval and generation processes. Multiple approach of RAG can be implemented using different strategies, such as:

Pre-retrieval: Information is retrieved before generating the response. The language model uses this information as context to generate more accurate and relevant responses.

Post-retrieval: The language model generates a response first, and then relevant information is retrieved to validate, correct, or enhance the generated response.

Iterative Retrieval-Generation: The model iteratively alternates between retrieving information and generating text. This approach allows the model to refine its responses based on continuously updated retrieval results.

Key Features in the Context of RAG

Vector support: The demo supports vector-based retrieval, which uses embeddings to find semantically relevant information. This method enhances the retrieval process by identifying contextually similar documents or data points.

Data Ingestion: The demo can ingest data in various formats, making it flexible in terms of the types of information it can incorporate into the retrieval process. This includes text, PDFs, images, etc.

Auth + ACL: Authentication and Access Control Lists (ACL) support ensures that the retrieved information adheres to security and privacy guidelines, which is crucial for applications dealing with sensitive data.

Limitations in the current setup

Persistent chat history: The demo does not support persistent chat history, meaning it cannot maintain context across different user sessions unless the browser tab remains open.

User feedback: The lack of a user feedback mechanism means the model cannot learn from user interactions to improve future responses directly within the demo setup.

In summary, the demo application leverages a RAG approach using multiple strategies to enhance the capabilities of its language model, integrating robust retrieval mechanisms (like vector support) and extensive data ingestion capabilities. However, it currently lacks persistent chat history and user feedback features, which could further refine its performance and user experience.

Feature	azure-search-openai-demo
RAG approach	Multiple approaches
Vector support	Ves Yes
Data ingestion	Yes (<u>Many formats</u>)
Persistent chat history	🗙 No (browser tab only)
User feedback	🗙 No
GPT-4-vision	✓ Yes
Auth + ACL	✓ Yes
User upload	✓ Yes

Figure 6. RAG features of the azure-search-openai-demo application which is adopted as the development ground for POC of the Prototype. Screenshot collected from <u>https://github.com/Azure-Samples/azure-search-openai-demo/blob/main/docs/other_samples.md</u> (*Azure-Search-Openai-Demo/Docs/Other_samples.Md at Main · Azure-Samples/Azure-Search-Openai-Demo · GitHub*, n.d.)

5 Experiment: Testing popular LLMs and testing the prototype

This chapter provides an objective analysis of the experiments conducted to assess the performance of the POC along with the three LLMs. First we discuss the overview of the three LLMs and make a comparison of the four Gen-AI models, An in-depth examination of the setup, datasets, and performance metrics is provided. Perform comparative prompt and response generation on both RAG optimized Azure OpenAI LLM and non-RAG GenAI environment, such as ChatGPT, compare both the results and evaluate. The chapter's primary objective is to prepare the reader for accurate interpretation of results following an understanding of the research process.

5.1 Overview of the AI powered chatbots chosen for evaluation

In this experiment, we have selected three popular AI language models to test as a legal virtual assistant available today: ChatGPT 3.5, Gemini , and Perplexicity. We also test our prototype based on RAG. All the models are based on similar technologies, LLM. However, their capabilities differ as they use different language models and trained on different knowledge bases on different period of time. Thus, we have four different virtual assistants to evaluate their performance. The performance is evaluated from the perspective of a human expert. The human expert reviews the results provided by each of the models based on the 50 user queries related to housing dispute as mentioned in previous chapter.

Here is a overview of the LLMs to better understand their capabilities and capacities as we evaluate their performance later.

5.1.1 ChatGpt 3.5 Model

ChatGPT 3.5, developed by OpenAI, is a significant advancement in the field of artificial intelligence, particularly in natural language processing. This model is based on the Generative Pretrained Transformer (GPT) architecture, a sophisticated neural network design that excels at understanding and generating human-like text. As an improved version of the GPT-3 model, ChatGPT 3.5 uses deep learning techniques to deliver impressive performance in various applications.(*What Is ChatGPT?* | *OpenAI Help Center*, n.d.)

One of the model's key capabilities is its ability to comprehend and generate coherent text across a diverse array of topics (*Generative AI - ChatGPT-3.5*, n.d.). It can engage in multi-turn conversations, making it highly suitable for chatbots, virtual assistants, and customer service tools. Additionally, ChatGPT 3.5 is adept at completing text prompts, assisting with tasks such as drafting emails, writing articles, and even generating code (*Generative AI - ChatGPT-3.5*, n.d.; Ray, 2023). Its abilities extend to basic language translation, creative content generation, and providing information

based on its extensive training data up to September 2021 (*What Is ChatGPT*? | *OpenAl Help Center*, n.d.).

The strengths of ChatGPT 3.5 are evident in its versatility, fluency, and adaptability. It can handle a wide range of natural language processing tasks, producing text that is often indistinguishable from human writing. The model's ability to adjust its tone and style based on input makes it highly adaptable for different contexts and user needs. Furthermore, its efficient processing speed enables real-time applications (*ChatGPT0-3.5: An Overview and Limitations* | *Blocshop*, n.d.; Ray, 2023).

Despite its strengths, the model has several weaknesses. Its knowledge is limited to information available up to September 2021, meaning it lacks awareness of subsequent events and developments (*What Is ChatGPT?* | *OpenAl Help Center*, n.d.). Additionally, ChatGPT 3.5 can exhibit biases present in its training data, potentially leading to biased or inappropriate responses. While it generates text that sounds plausible, it may not always be factually accurate and can sometimes produce incorrect information or fabricate details. The quality of its output is also highly dependent on the clarity and specificity of the input it receives (*ChatGPT0-3.5: An Overview and Limitations* | *Blocshop*, n.d.; *What Is ChatGPT?* | *OpenAl Help Center*, n.d.; Ray, 2023).

Note: Our prototype is also built on this GPT 3.5 model family's variation GPT-3.5 Turbo (*Azure OpenAI Service Models - Azure OpenAI | Microsoft Learn*, n.d.).

5.1.2 Gemini 1.0

Gemini 1.0 LLM, developed by Google AI, is a sophisticated tool in the field of natural language processing. This model is built using a transformer-based neural network architecture, similar to other advanced LLMs, which allows it to handle a variety of complex language tasks with impressive proficiency. The specific date Gemini 1.0 was last trained on has not been publicly disclosed by Google.

Gemini 1.0 offers several key capabilities similar to other advanced language models (LLM). It excels in text generation, supports text translation across a broad range of languages, and is adept at answering questions in an informative manner. Gemini also has code generation capabilities for various programming languages. However, there are some limitations associated with the free version of Gemini 1.0. Access may be restricted, and users might encounter quotas on usage, limiting the extent to which they can leverage the model's capabilities. Like other AI models, Gemini can also exhibit biases based on the data it was trained on, which could affect the quality and objectivity of its outputs. Additionally, running large language models requires significant computational resources, which might be constrained in the free tier.

5.1.3 Perplexity Al

Perplexity AI is not a single large language model (LLM) itself, but a company that serves as a gateway. They provide access to various cutting-edge LLMs through their API. Although the specific models powering their free version remain undisclosed, they likely utilize similar technologies and offer comparable functionalities such as text generation, translation, question answering, and summarization (*Perplexity AI Key Features*, n.d.). There may be slight variations in advantages and disadvantages depending on the underlying LLM, but the overall experience should be familiar to those who have used other large language models. (*Perplexity AI Key Features*, n.d.; *Perplexity AI: What You Need to Know and How to Use It* | *by Entrustech Inc* | *Medium*, n.d.)

POC, the prototype uses the OpenAI GPT 3.5 Turbo, however, it is enhanced by the Azure AI search and can retrieve the available source data that was added to it's database, related to Finnish housing acts and case laws. Details of data sources are provided in the Appendix section.

Feature	ChatGPT 3.5	Gemini	Perplexity	Prototype (Azure OpenAl 3.5 Turbo + RAG)
Provider	OpenAl	Google Al	Perplexity Al	Microsoft Azure OpenAl
LLM Model	GPT-3.5	Transformer-based model	Uses API's from multiple LLM	OpenAl GPT-3.5 Turbo
Optimiza- tion Tech- nique	None	None	None	Retrieval-Augmented Genera- tion (RAG) by Azure AI search
Focus	Chat and general text completion	Likely similar to ChatGPT 3.5	Similar to ChatGPT 3.5	Legal domain (Housing Dis- putes in Finland), GPT 3.5
Technology	Deep Learning	Deep Learning	Deep Learn- ing	Deep Learning + Information Retrieval
Capabilities	Text generation + Machine translation +Question answer- ing (limited)	Text generation + Ma- chine translation +Ques- tion answering (limited)	Text genera- tion + Ma- chine transla- tion +Ques- tion answer- ing (limited)	Text generation + Access to few Finnish legal resources through RAG _ Question an- swering focused on housing disputes
Strengths	High fluency and coherence in gener- ated text,Performs well on general tasks	High fluency and coher- ence in generated text, creativity, comparatively newer data provided than GPT 3.5	Fluency and Coherence	Information Retrieval Capabili- ties for added source data.
Weak- nesses	Limited factual accu- racy +Not optimized for specific domains	Limited factual accuracy +Not optimized for spe- cific domains	Limited fac- tual accuracy Not optimized for specific domains	May require more training data for specific legal nuances
Availability	Free version	Free version	Free version	Requires Azure subscription

Table 1. Comparison	of the AI chatbots	in experiment.
---------------------	--------------------	----------------

5.2 Experiment intentions

As described in the previous chapter, a total of 50 questions/prompts are formulated to reflect reallife dispute scenarios commonly occurred. The prompts include human generated errors, misspellings, and grammatical mistakes generated from a non-English speaker perspective. Questions patterns are verified by a Legal professional so that they reflect the commonly occurred dispute scenarios in housing domain in Finland.

Intentions behind the experiments

This experiment is aimed to shed light on the real-world performance of the RAG-optimized GPT-3.5 turbo LLM model by testing it in a housing dispute scenario specific to Finland. The evaluation employs both quantitative metrics and qualitative user feedback (detailed in the previous chapter) to comprehensively assess the LVM's and other LLM's effectiveness in generating response. Additionally, a comparative analysis using baseline metrics and existing models will be conducted to understand the advantages of the RAG-optimized GPT-3.5 turbo LLM as a Legal Virtual Assistant.

5.3 Execution and results

Each of the 50 prompts are submitted to the POC's user interface as well as submitted to the other models at the same time. Responses provided by all the four chatbot's are recorded, copied to their corresponding column and question in the excel sheet of experimental set up.

Quantitative results:

Except for our prototype, each of the other three chatbots provided 50 responses, each offering some kind of solution related to the query, regardless of its accuracy. Our prototype, however, suggested solutions to 46 queries and failed to provide solutions for 4 queries, citing a lack of information from the provided sources. The four instances where the prototype could not generate a solution were all related to the dispute type "cannot pay the rent." Specifically, three of these instances involved scenarios where the tenant was seeking unemployment benefits, and the other involved a medical emergency preventing the tenant from paying rent.

In terms of reference generation, the ChatGPT 3.5 model did not provide any references or website links for any of the 50 instances. On the other hand, Gemini and Perplexicity included references and web links in their responses, while the prototype provided references for 46 of the instances where it generated responses with solutions. In this quantitative analysis, we are not taking into account the accuracy of the responses or the relevance and validity of the references. These aspects will be discussed in a later chapter.

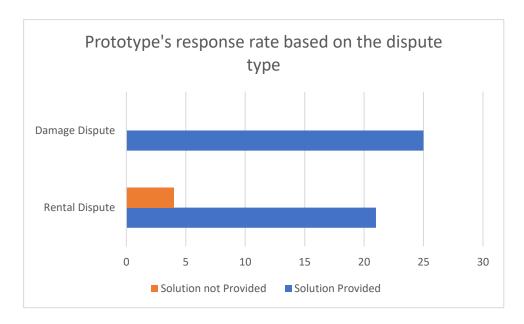


Figure 7. Prototype's response rate based on the dispute type

Quantitatively, the prototype's ability to provide solutions to 46 out of 50 queries indicates a success rate of 92%. However, this still lags behind the other models, which achieved a 100% success rate in generating solutions. The prototype's inability to respond to 4 queries due to a lack of information highlights a potential area for improvement in its knowledge base or the integration of external data sources. This limitation might also suggest inefficiencies in retrieving data, as solutions were provided for very similar reformulations of the same query. The fact that the prototype did not provide information outside its sources may indicate an effort to ensure the validity of the information it offers, adhering strictly to the available data.

Reference and Link Provision:

ChatGPT 3.5's lack of references or website links could imply either a different design philosophy prioritizing direct answers or limitations in its capability to provide sourced information.

Gemini, Perplexicity, and the prototype's inclusion of references and links enhance the credibility and utility of their responses, making them more robust for users seeking verifiable information.

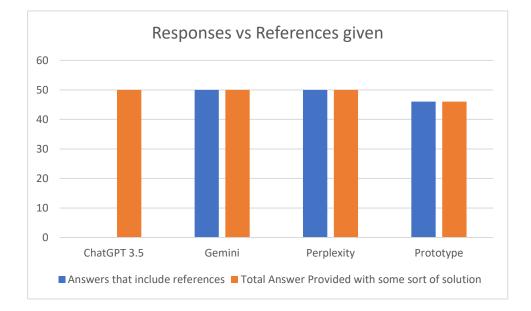


Figure 8. Responses vs references given.

Comparative Strengths:

Prototype's performance in providing references for 46 instances closely aligns with the prototype's ability to generate solutions, though prototype offers better support through its references. In contrast, Gemini and Perplexicity distinguish themselves by delivering comprehensive responses accompanied by supporting references, making them more reliable and preferable for users who require documented sources.

5.3.1 Qualitative analysis from feedback

General Impressions

As we collected feedback from a human expert, general impression of the responses from ChatGPT, Gemini, Perplexity, and the prototype is notably critical. He points out that none of the models provided meaningful advice or guidance. Although the responses might appear impressive at first glance, a deeper examination reveals that they lack significant value and practical impact. The advice is basic and common sense, failing to offer users concrete steps to resolve their specific legal issues. With a simple internet search, better information and direction can be found as per the opinion of the human expert. This issue is compounded by inconsistencies and adjustments in response formatting for similar queries in different words, which contribute to the responses' lack of reliability.

Evaluation on Correctness of the Models

Factual Accuracy: Expert finds it impossible to measure the accuracy of the responses as all models consistently provide misleading information. Each model's responses vary for similar queries, suggesting a fundamental issue in factual consistency. For example, where a tenant does not have the money to pay the rent, one of the LLMs is suggesting paying for due rent on top of current month's rent which absolutely does not make any sense.

Source Reliability: The reliability of sources is another major concern. ChatGPT 3.5 does not provide any references, while Gemini and Perplexity offer some, though these are often unreliable. For instance, Perplexity cited French data for Finnish housing queries and used Reddit comments, which are not credible sources at all. Prototype predominantly relied on its database of PDF files, which were often irrelevant or misinterpreted, leading to misleading advice. For example, Prototype erroneously referenced an event from 2007 unrelated to the user's current situation, highlighting a critical flaw in understanding and contextualizing information.

We analyzed the data and identified 6 instances where prototype completely misinterpreted the source data of case laws. For example (Misinterpretation 4, prompt number 19 from the .xlsx file for experimental setup), a source data illustrates a legal case for damage dispute happened in 2010. The prototype is retrieving this incident and providing solution as if the issue is related to the user who submitted the prompt.

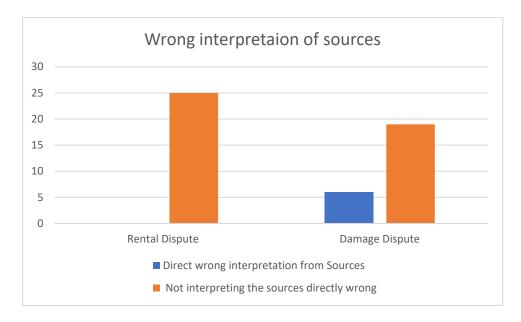


Figure 9. RAG-based prototype interprets wrongly for damage disputes.

Internal Consistency: As per the expert Judgement, Internal consistency exist within multiple responses and it is problematic across all models. They provide different answers to the same reformulated questions, with less variation in ChatGPT and Gemini compared to Perplexity and the prototype. This inconsistency undermines the reliability of the solution provided.

Evaluation on completeness of the Models

The responses generally lack depth and fail to cover all relevant aspects of the queries. The advice given is basic and does not guide the user on how to solve their problem with housing related matters at all. There are some generalized steps such as, "Communicate with the land lord" are really basic and does not help much.

The responses lack sufficient detail and certainty. On closer inspection, they appear empty and do not provide actionable solutions. This lack of detail fails to meet users' needs for precise and impactful legal advice. For instance, the right to housing support (Kela) is a legal right in Finland, but none of the models clearly communicated this. Gemini provided a link to Kela but did not emphasize its legal significance.

The relevance of the information is another area of concern. The answers, while sometimes touching on relevant points like health hazard inspections, do not emphasize their legal importance. It is evident that none of the models provided meaningful or reliable advice, despite initially appearing impressive. The lack of concrete steps to resolve legal issues, coupled with inconsistencies in response formatting and factual inaccuracies, highlights significant shortcomings in the models' performance. Moreover, concerns regarding source reliability and the completeness, detail sufficiency, and relevance of information further underscore the limitations of current AI-powered chatbots in providing comprehensive legal guidance. This evaluation serves as a sobering reminder of the complexities involved in developing AI systems capable of offering reliable and actionable legal advice, emphasizing the need for continued research and refinement in this area.

6 Discussion

6.1 Research Question 1

How does the integration of LLMs optimized by RAG enhance the performance of a Legal Virtual Assistant in resolving housing disputes in Finland?

Current research hasn't provided a definitive answer on the effectiveness of RAG-based LVA in resolving housing disputes in Finland.

The main limitation lies in the result of the experiment. It didn't compare the performance of the RAG-based LVA prototype to models without RAG. This makes it impossible to isolate the impact of RAG technology and assess its true contribution.

Although, the qualitative data suggests that the prototype retrieved information from data sources and generated responses, the extent of its effectiveness and the potential limitations of RAG remain unclear. Factors like the amount of source data and fine-tuning of the model require further investigation.

Furthermore, all the LLMs evaluated, including the RAG prototype, struggled with understanding the legal aspects of housing disputes from user queries. This highlights broader issues with LLMs in legal domains, such as NLP techniques in understanding complex legal settings. Furthermore, there have been doubts regarding the factual accuracy and completeness of responses provided by LLMs.

To conclude the answer, the research doesn't provide enough evidence to definitively say whether RAG-optimized LLMs enhance LVAs for housing disputes. It's possible that even with successful data retrieval by RAG, the LLM itself might not be able to interpret the legal information and generate accurate responses. Further research is needed, potentially focusing on evaluating RAG in isolation from LLMs to understand its true potential in legal contexts.

6.2 Research Question 2

Does the RAG optimization significantly enhance the factual accuracy of the Large Language Model (LLM) responses when compared to a non-optimized LLM in the context of housing disputes in Finland?

Based on the analysis conducted in this study, the effectiveness of Retrieval Augmented Generation (RAG) optimization in enhancing the factual accuracy of Large Language Model (LLM) responses in the context of housing disputes in Finland appears to be limited. While RAG optimization theoretically allows LLMs to dynamically retrieve relevant external information to augment their responses, the practical implementation of RAG in our study did not demonstrate a significant improvement in factual accuracy when compared to a non-optimized LLM. Both RAG-optimized and non-optimized LLMs struggled with accuracy issues, providing misleading information, misinterpreting user queries, and failing to retrieve relevant legal data effectively. Therefore, while RAG optimization holds promise for improving factual accuracy in LLM responses, its actual impact may be constrained by various challenges, including data source limitations, complexity of legal language, and implementation challenges. Further research and development efforts are needed to address these limitations and fully realize the potential of RAG optimization in enhancing the factual accuracy of LLM responses in the context of housing disputes in Finland.

6.3 Research Question 3

What are the key challenges and limitations encountered when employing LLMs optimized by RAG within the domain of housing disputes in Finland?

This study exploring the use of Large Language Models (LLMs) optimized by Retrieval-Augmented Generation (RAG) for Finnish housing disputes revealed several challenges. The key issue identified was ensuring the accuracy and reliability of LLM responses. Despite RAG's integration, responses often lacked factual grounding due to limitations in the LLM models themselves. This undermines the trustworthiness of their legal advice and reduces their usefulness. The research also highlights the broader limitations of current LLM technology in the legal domain.

Legal language's inherent complexity poses another hurdle. LLMs struggle to interpret and respond in a way that captures the intricacies of Finnish housing law, potentially leading to oversimplified or incorrect advice. LLMs trained on generalized datasets lack the depth and specificity required for legal use, often providing inadequate and superficial responses. Legal advice necessitates a high level of detail and precision, which current LLM capabilities may not adequately fulfill. Moreover, there is a misalignment between the broad training data and the specific legal context of queries, resulting in difficulties prioritizing legally significant information. Capturing the nuances of legal rights and obligations is challenging for LLMs, further limiting their effectiveness in conveying actionable legal guidance.

The effectiveness of RAG heavily depends on the quality and relevance of its data sources. In this study's context, comprehensive and up-to-date Finnish legal databases were limited. Training LLMs on vast amounts of data is another challenge, further restricted by language barriers between Finnish and English legal documents.

Implementing RAG effectively requires advanced techniques and extensive fine-tuning to ensure it retrieves and utilizes relevant information accurately. The study suggests that current implementations lacked sufficient fine-tuning, especially for legal applications. This may have limited the model's ability to handle specific legal terminology, contexts, and jurisdictional nuances.

Finally, using RAG through advanced LLMs can be expensive. The computational resources and infrastructure needed, such as high-performance servers or cloud computing, contribute significantly to the cost. Ongoing maintenance, support, and customization add to the financial burden, requiring organizations to budget for software updates, technical support, and integration expenses.

6.4 Recommendations, Future Suggestions and opinions

To truly leverage the benefits of RAG, it is crucial not only to retrieve relevant data but also to interpret and utilize this data effectively, thereby improving both Natural Language Processing (NLP) and Natural Language Generation (NLG) capabilities. Continuous learning and fine-tuning of LLMs for specific domains, such as Finnish housing law, are essential steps forward.

Focusing on the nuances of the Finnish legal language is imperative. Enhancements in the system through techniques such as prompt engineering can also significantly improve performance. Incorporating expert opinions and user feedback into the development process ensures that the models align better with real-world requirements and user expectations. Investing in more advanced LLMs, such as the latest versions available, will provide a stronger foundation for further improvements. Continuous training with updated and comprehensive legal data will help maintain the relevance and accuracy of the models.

RAG's capability to retrieve specific information from targeted documents needs to be refined further. Models should be equipped to ask counter-questions, enabling a deeper understanding of the user's legal situation. This interactive capability will allow the LLMs to gather more context-specific information, leading to more precise and reliable legal advice.

RAG's integration with LLMs necessitates a multifaceted strategy involving continuous improvement in NLP and NLG, domain-specific fine-tuning, advanced techniques, and robust infrastructure investments. These steps are vital to harness the full potential of LLMs in addressing complex legal queries effectively. The complicated nature of legal services presents significant challenges for LLM technologies, which are not yet capable of fully comprehending user queries. Legal consultation requires a detailed understanding of all applicable legislation, case laws, and the specific circumstances of each case. It is not merely about generating responses based on user queries but involves a deep, nuanced understanding of legal contexts and implications.

The limitation of having only one expert viewpoint poses a challenge in establishing a universally applicable approach to providing solutions to users' legal queries and guiding them in the right direction. Additionally, the prototype's inability to fully utilize Retrieval-Augmented Generation (RAG) due to constraints of time, resources, and expertise further complicates the matter. From the perspective of a developer, I faced difficulties in determining the optimal extent to which the prototype reads from data sources and utilizes the external knowledge base of Large Language Models (LLMs). Moreover, LLMs' current limitations in distinguishing between individual case laws, extracting insights from past cases, and understanding the context and situation of specific users highlight the extensive progress required before AI-powered chatbots can autonomously provide comprehensive legal solutions. Nevertheless, this study serves as a foundation for identifying improvement criteria and underscores the necessity of combining multiple techniques and technologies to enhance the accuracy and completeness of legal AI assistants. Taking incremental steps, such as targeting specific areas of legal work procedures, can pave the way for AI to offer quick, easy, and effective information retrieval from large databases, ultimately facilitating the integration of traditional legal practices with AI advancements. By addressing these challenges, AI has the potential to evolve and provide more tailored and accurate guidance or insights to users seeking legal advice.

7 Conclusion

This thesis aimed to evaluate the feasibility of integrating Retrieval-Augmented Generation (RAG) with Large Language Models (LLMs) to create an AI-based assistant capable of resolving housing disputes in Finland. However, through a comprehensive experimental setup, we concluded that comparing the performance of our RAG-optimized prototype against other LLMs was not viable. This was due to all the LLM models' inability to provide accurate legal advice, thus failing to meet the criteria for correctness, completeness, and practical applicability. The study revealed that while the integration of RAG was intended to enhance factual accuracy and relevance, the actual improvement observed was marginal. Both RAG-optimized and non-optimized LLMs struggled to offer significantly better legal advice, often providing misleading or irrelevant information that undermined their utility.

Several limitations were identified, including the generalized nature of the training data, which lacked the specific legal context necessary for detailed and accurate legal advice. There was a significant misalignment between the training data of the LLM models and the specific legal scenarios encountered in housing disputes, leading to inadequate and sometimes misleading responses. Additionally, the technical implementation of RAG did not significantly improve the models' ability to retrieve and utilize relevant legal information effectively, a challenge exacerbated by the complexity of legal language and the specific nuances of Finnish law. Resource constraints also played a role, as the computational requirements for fine-tuning and running advanced LLMs with RAG capabilities were substantial, making it a costly endeavor.

Future research should focus on acquiring more comprehensive and domain-specific legal datasets, potentially through collaborations with legal institutions to access proprietary data. Advanced fine-tuning techniques and prompt engineering can help align the models more closely with the legal context of queries. Investigating the integration of multimodal data, such as text, images, and audio, can provide a richer contextual understanding and improve the accuracy of legal responses. Conducting user-centric studies to gather feedback from legal professionals and end-users will help identify practical usability issues and guide iterative improvements. Exploring the ethical and legal implications of deploying Al-driven legal assistants is crucial to ensuring data privacy, mitigating biases, and maintaining regulatory compliance.

In conclusion, while the integration of RAG with LLMs shows promise, significant challenges remain in achieving the level of accuracy and specificity required for practical legal use. Addressing these limitations through targeted research and development can pave the way for more effective and reliable legal virtual assistants, ultimately enhancing access to legal resources and support for individuals facing housing disputes in Finland.

References

- 5 Ways SmartRent UK is Revolutionising Smart Home Tech | SmartRent. (n.d.). Retrieved May 17, 2024, from https://smartrent.com/news/5-ways-smartrent-uk-is-revolutionising-smart-home-tech/
- 7 best legal AI chatbots for 2024. (n.d.). Retrieved May 16, 2024, from https://juro.com/learn/legalai-chatbot#
- Abd-alrazaq, A. A., Alajlani, M., Alalwan, A. A., Bewick, B. M., Gardner, P., & Househ, M. (2019).
 An overview of the features of chatbots in mental health: A scoping review. *International Journal of Medical Informatics*, *132*, 103978. https://doi.org/10.1016/J.IJMEDINF.2019.103978
- Adamopoulou, E., & Moussiades, L. (2020). Chatbots: History, technology, and applications. *Machine Learning with Applications*, *2*, 100006-. https://doi.org/10.1016/j.mlwa.2020.100006
- Alan, A. Y., Aydın, Ö., & Karaarslan, E. (2024). A RAG-based Question Answering System Proposal for Understanding Islam: MufassirQAS LLM. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4707470
- Alavandhar, J. V., & Ņikiforova, O. (2017). Several Ideas on Integration of SCRUM Practices within Microsoft Solutions Framework. *Applied Computer Systems*, 21(1), 71–79. https://doi.org/10.1515/acss-2017-0010
- Al-Hasan, T. M., Sayed, A. N., Bensaali, F., Himeur, Y., Varlamis, I., & Dimitrakopoulos, G. (2024). From Traditional Recommender Systems to GPT-Based Chatbots: A Survey of Recent Developments and Future Directions. *Big Data and Cognitive Computing*, 8(4), 36-. https://doi.org/10.3390/bdcc8040036
- Aslam, F. (2023). The Impact of Artificial Intelligence on Chatbot Technology: A Study on the Current Advancements and Leading Innovations. *European Journal of Technology*, 7(3), 62–72. https://doi.org/10.47672/EJT.1561
- Attigeri, G., Agrawal, A., & Kolekar, S. V. (2024). Advanced NLP Models for Technical University Information Chatbots: Development and Comparative Analysis. *IEEE Access*, *12*, 29633– 29647. https://doi.org/10.1109/ACCESS.2024.3368382
- Azure OpenAl Service models Azure OpenAl | Microsoft Learn. (n.d.). Retrieved May 20, 2024, from https://learn.microsoft.com/en-us/azure/ai-services/openai/concepts/models

- azure-search-openai-demo/docs/other_samples.md at main · Azure-Samples/azure-searchopenai-demo · GitHub. (n.d.). Retrieved May 17, 2024, from https://github.com/Azure-Samples/azure-search-openai-demo/blob/main/docs/other_samples.md
- Bratić, D., Šapina, M., Jurečić, D., & Žiljak Gršić, J. (2024). Centralized Database Access: Transformer Framework and LLM/Chatbot Integration-Based Hybrid Model. *Applied System Innovation*, 7(1), 17-. https://doi.org/10.3390/asi7010017
- Chan, B. (2020). German's Next Language Model. *ArXiv.Org.* https://doi.org/10.48550/arxiv.2010.10906
- *Chatbot use cases: 25 real-life examples.* (n.d.). Retrieved May 17, 2024, from https://leaddesk.com/blog/chatbot-use-cases-25-real-life-examples/
- ChatGPT, Generative AI, LLM, NLP: how to understand the new era of artificial intelligence already impacting businesses - ProQuest. (n.d.). Retrieved May 16, 2024, from https://www.proquest.com/docview/2791107911/citation/15D2E2C3EBA149B7PQ/1?accountid=27436&sourcetype=Wire%20Feeds
- *ChatGPT0-3.5: An Overview and Limitations* | *Blocshop*. (n.d.). Retrieved May 20, 2024, from https://www.blocshop.io/blog/chatgpt3-5-limitations
- *Contract summary: what it is and how to create one*. (n.d.). Retrieved May 16, 2024, from https://juro.com/learn/contract-summary#
- Eshbayev, O. A., Mirzaliev, S. M., Rozikov, R. U., Kuzikulova, D. M., & Shakirova, G. A. (2022).
 NLP and ML based approach of increasing the efficiency of environmental management operations and engineering practices. *IOP Conference Series. Earth and Environmental Science*, *1045*(1), 12058-. https://doi.org/10.1088/1755-1315/1045/1/012058
- *Evolution of Legal AI from Extractive to Generative The CaseMine Story*. (n.d.). Retrieved May 17, 2024, from https://www.barandbench.com/news/evolution-of-legal-ai-from-extractive-to-generative-the-casemine-story
- Filonova, E. (2022). Evaluation of Natural Language Processing and Machine Learning Tools for the Automation of the Customer Service Task.
- Gao, Y., Xiong, Y., Gao, X., Jia, K., Pan, J., Bi, Y., Dai, Y., Sun, J., Wang, M., & Wang, H. (2023). *Retrieval-Augmented Generation for Large Language Models: A Survey.* http://arxiv.org/abs/2312.10997

- Gargiulo, F., Minutolo, A., Guarasci, R., Damiano, E., De Pietro, G., Fujita, H., & Esposito, M. (2022). An ELECTRA-Based Model for Neural Coreference Resolution. *IEEE Access*, *10*, 75144–75157. https://doi.org/10.1109/ACCESS.2022.3189956
- *Generative AI ChatGPT-3.5.* (n.d.). Retrieved May 20, 2024, from https://www.w3schools.com/gen_ai/gen_ai chatgpt-3-5.php
- Generative AI for Professional Services | Harvey. (n.d.). Retrieved May 17, 2024, from https://www.harvey.ai/
- GitHub Azure-Samples/azure-search-openai-demo: A sample app for the Retrieval-Augmented Generation pattern running in Azure, using Azure AI Search for retrieval and Azure OpenAI large language models to power ChatGPT-style and Q&A experiences. (n.d.). Retrieved May 17, 2024, from https://github.com/Azure-Samples/azure-search-openai-demo
- Hamid, A. A., Nurul, S., & Kamal, H. (2023). PKS IVAStar An Overview of Chatbot Development. Borneo Engineering & Advanced Multidisciplinary International Journal, 2(Special Issue (TECHON 2023)), 122–127. https://beam.pmu.edu.my/index.php/beam/article/view/110
- Harvey | OpenAI. (n.d.). Retrieved May 17, 2024, from https://openai.com/index/harvey/
- *Harvey AI: Legal Artificial Intelligence*. (n.d.). Retrieved May 17, 2024, from https://www.clio.com/blog/harvey-ai-legal/
- Hoas Hoas. (n.d.). Retrieved May 17, 2024, from https://hoas.fi/en/hoas/
- Hoppe, C., Migenda, N., Pelkmann, D., Hötte, D., & Schenck, W. (2022). Collaborative System for Question Answering in German Case Law Documents. *IFIP Advances in Information and Communication Technology*, 662 *IFIP*, 303–312. https://doi.org/10.1007/978-3-031-14844-6_24
- Housing Chatbot improves the overall customer satisfaction | GetJenny. (n.d.). Retrieved May 17, 2024, from https://www.getjenny.com/housing-chatbot-improves-the-overall-customer-satis-faction
- Introduction to Azure AI Search Azure AI Search | Microsoft Learn. (n.d.). Retrieved May 20, 2024, from https://learn.microsoft.com/en-us/azure/search/search-what-is-azure-search
- Işıkdemir, Y. E. (2024). NLP TRANSFORMERS: ANALYSIS OF LLMS AND TRADITIONAL AP-PROACHES FOR ENHANCED TEXT SUMMARIZATION. *Eskişehir Osmangazi Üniversitesi Mühendislik ve Mimarlık Fakültesi Dergisi*, 32(1). https://doi.org/10.31796/ogummf.1303569

- Kang, M., Gürel, N. M., Yu, N., Song, D., & Li, B. (2024). *C-RAG: Certified Generation Risks for Retrieval-Augmented Language Models*. http://arxiv.org/abs/2402.03181
- Kettunen, H., & Ruonavaara, H. (2015). Discoursing deregulation: the case of the Finnish rental housing market. *International Journal of Housing Policy*, *15*(2), 187–204. https://doi.org/10.1080/14616718.2014.990774
- Khadija, M. A., Aziz, A., & Nurharjadmo, W. (2023). Automating Information Retrieval from Faculty Guidelines: Designing a PDF-Driven Chatbot powered by OpenAl ChatGPT. *Proceedings -*2023 10th International Conference on Computer, Control, Informatics and Its Applications: Exploring the Power of Data: Leveraging Information to Drive Digital Innovation, IC3INA 2023, 394–399. https://doi.org/10.1109/IC3INA60834.2023.10285808
- Koga, S., & Du, W. (2024). Integrating AI in medicine: Lessons from Chat-GPT's limitations in medical imaging. *Digestive and Liver Disease*. https://doi.org/10.1016/J.DLD.2024.02.014
- Koubaa, A., Qureshi, B., Ammar, A., Khan, Z., Boulila, W., & Ghouti, L. (2023). Humans are still better than ChatGPT: Case of the IEEEXtreme competition. *Heliyon*, 9(11), e21624–e21624. https://doi.org/10.1016/j.heliyon.2023.e21624
- Kulkarni, A., Shivananda, A., & Kulkarni, A. (2021). Natural Language Processing Projects: Build Next-Generation NLP Applications Using AI Techniques. *Natural Language Processing Projects: Build Next-Generation NLP Applications Using AI Techniques*, 1–317. https://doi.org/10.1007/978-1-4842-7386-9
- Lareyre, F., Nasr, B., Chaudhuri, A., Di Lorenzo, G., Carlier, M., & Raffort, J. (2023). Comprehensive Review of Natural Language Processing (NLP) in Vascular Surgery. In *EJVES Vascular Forum* (Vol. 60, pp. 57–63). Elsevier Ltd. https://doi.org/10.1016/j.ejvsvf.2023.09.002
- Lecler, A., Duron, L., & Soyer, P. (2023). Revolutionizing radiology with GPT-based models: Current applications, future possibilities and limitations of ChatGPT. *Diagnostic and Interventional Imaging*, 104(6), 269–274. https://doi.org/10.1016/J.DIII.2023.02.003
- Lee, J., An, T., Chu, H. E., Hong, H. G., & Martin, S. N. (2023). Improving Science Conceptual Understanding and Attitudes in Elementary Science Classes through the Development and Application of a Rule-Based AI Chatbot. *Asia-Pacific Science Education*, 9(2), 365–412. https://doi.org/10.1163/23641177-bja10070

- Leveraging Artificial Intelligence for Property Management Kurby Real Estate AI. (n.d.). Retrieved May 17, 2024, from https://blog.kurby.ai/leveraging-artificial-intelligence-for-property-manage-
- Li, J., Yuan, Y., & Zhang, Z. (2024). Enhancing LLM Factual Accuracy with RAG to Counter Hallucinations: A Case Study on Domain-Specific Queries in Private Knowledge-Bases. https://arxiv.org/abs/2403.10446v1

ment/

- Lin, C. C., Huang, A. Y. Q., & Yang, S. J. H. (2023). A Review of AI-Driven Conversational Chatbots Implementation Methodologies and Challenges (1999–2022). Sustainability (Basel, Switzerland), 15(5), 4012-. https://doi.org/10.3390/su15054012
- Mathis, B. (2022). Extracting Proceedings Data from Court Cases with Machine Learning. *Stats*, *5*(4), 1305–1320. https://doi.org/10.3390/stats5040079
- Miao, J., Thongprayoon, C., Suppadungsuk, S., Garcia Valencia, O. A., & Cheungpasitporn, W. (2024). Integrating Retrieval-Augmented Generation with Large Language Models in Nephrology: Advancing Practical Applications. In *Medicina (Lithuania)* (Vol. 60, Issue 3). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/medicina60030445
- Min, D., Hu, N., Jin, R., Lin, N., Chen, J., Chen, Y., Li, Y., Qi, G., Li, Y., Li, N., & Wang, Q. (2024). Exploring the Impact of Table-to-Text Methods on Augmenting LLM-based Question Answering with Domain Hybrid Data. http://arxiv.org/abs/2402.12869
- *More Efficient NLP Model Pre-training with ELECTRA*. (n.d.). Retrieved May 17, 2024, from https://research.google/blog/more-efficient-nlp-model-pre-training-with-electra/
- Murtarelli, G., Gregory, A., & Romenti, S. (2021). A conversation-based perspective for shaping ethical human–machine interactions: The particular challenge of chatbots. *Journal of Business Research*, *129*, 927–935. https://doi.org/10.1016/J.JBUSRES.2020.09.018
- Ott, S., Hebenstreit, K., Liévin, V., Hother, C. E., Moradi, M., Mayrhauser, M., Praas, R., Winther, O., & Samwald, M. (2023). ThoughtSource: A central hub for large language model reasoning data. *Scientific Data 2023 10:1*, *10*(1), 1–12. https://doi.org/10.1038/s41597-023-02433-3
- Patil, R., & Gudivada, V. (2024). A Review of Current Trends, Techniques, and Challenges in Large Language Models (LLMs). *Applied Sciences*, *14*(5), 2074. https://doi.org/10.3390/app14052074

- Pereira, R., Lima, C., Pinto, T., & Reis, A. (2023). Virtual Assistants in Industry 4.0: A Systematic Literature Review. *Electronics 2023, Vol. 12, Page 4096, 12*(19), 4096. https://doi.org/10.3390/ELECTRONICS12194096
- *Perplexity AI Key Features*. (n.d.). Retrieved May 20, 2024, from https://www.perplexity.ai/page/Perplexity-AI-Key-AQEBigvaS9qAYqE12rkRsg
- Perplexity AI: What You Need to Know and How to Use It | by Entrustech Inc | Medium. (n.d.). Retrieved May 20, 2024, from https://medium.com/@entrustech/perplexity-ai-what-you-need-toknow-and-how-to-use-it-82ee6ce1fbd
- Pries, K. H., & Quigley, J. M. (2011). *Scrum project management*. CRC Press. http://books.google.com/books?id=Of6JC-1DHloC&pgis=1
- *Quali-bot, the virtual assistant that also helps in legal claims issues*. (2024). https://www.proquest.com/wire-feeds/quali-bot-virtual-assistant-that-also-helps-
- Ray, P. P. (2023). ChatGPT: A comprehensive review on background, applications, key challenges, bias, ethics, limitations and future scope. *Internet of Things and Cyber-Physical Systems*, 3, 121–154. https://doi.org/10.1016/J.IOTCPS.2023.04.003
- Rivas, P., & Zhao, L. (2023). Marketing with ChatGPT: Navigating the Ethical Terrain of GPT-Based Chatbot Technology. *AI (Basel)*, *4*(2), 375–384. https://doi.org/10.3390/ai4020019
- Schwenke, N., Söbke, H., & Kraft, E. (2023). Potentials and Challenges of Chatbot-Supported Thesis Writing: An Autoethnography. *Trends in Higher Education*, 2(4), 611–635. https://doi.org/10.3390/higheredu2040037
- Shankar, V., & Parsana, S. (2022). An overview and empirical comparison of natural language processing (NLP) models and an introduction to and empirical application of autoencoder models in marketing. *Journal of the Academy of Marketing Science*, *50*(6), 1324–1350. https://doi.org/10.1007/s11747-022-00840-3
- Skjuve, M., Følstad, A., Fostervold, K. I., & Brandtzaeg, P. B. (2021). My Chatbot Companion a Study of Human-Chatbot Relationships. *International Journal of Human-Computer Studies*, 149, 102601-. https://doi.org/10.1016/j.ijhcs.2021.102601
- SmartRent | Smart Home Solutions for Multifamily Communities. (n.d.). Retrieved May 17, 2024, from https://smartrent.com/

- SmartRent Delivers Seamless Property Management with Salesforce Salesforce. (n.d.). Retrieved May 17, 2024, from https://www.salesforce.com/uk/resources/customer-stories/smartrent-delivers-seamless-prop-mgmt/
- Ullah, E., Parwani, A., Baig, M. M., & Singh, R. (2024). Challenges and barriers of using large language models (LLM) such as ChatGPT for diagnostic medicine with a focus on digital pathology - a recent scoping review. *Diagnostic Pathology*, *19*(1), 43–43. https://doi.org/10.1186/s13000-024-01464-7
- Vasileiou, M. V., & Maglogiannis, I. G. (2022). The Health ChatBots in Telemedicine: Intelligent Dialog System for Remote Support. *Journal of Healthcare Engineering*, 2022. https://doi.org/10.1155/2022/4876512
- Whang, J. Bin, Song, J. H., Lee, J. H., & Choi, B. (2022). Interacting with Chatbots: Message type and consumers' control. *Journal of Business Research*, 153, 309–318. https://doi.org/10.1016/J.JBUSRES.2022.08.012
- What is ChatGPT? | OpenAl Help Center. (n.d.). Retrieved May 20, 2024, from https://help.openai.com/en/articles/6783457-what-is-chatgpt
- Żmihorski, M. (2023). The hallucinating chatbot 'ChatGPT' poorly estimates real bird commonness. *Biological Conservation*, 288, 110371. https://doi.org/10.1016/J.BIOCON.2023.110371

Appendices

Appendix 1.1: Application Technologies

Basic Libraries and Setting Azure OpenAI

In the open-source demo application for this POC, the backend approach of the Python code (refer to the figure 07) imports necessary libraries for a project involving Azure and OpenAl integration. It begins by importing essential modules like OS, ABC (Abstract Base Classes), dataclass, and typing for type hints. Then, it imports specific components from aiohttp for asynchronous HTTP requests and from Azure SDK for Python for integrating with Azure's search service. The code also imports specific models for Azure search documents such as QueryCaptionResult and VectorizedQuery. Furthermore, it imports AsyncOpenAl for asynchronous interactions with the OpenAl API. Additionally, the code imports custom modules like Authentication Helper for handling authentication and no newlines from the text module. This setup enables the Python program to leverage Azure's search capabilities (Vector query used for RAG approach) and OpenAl's language processing features (LLM) efficiently while maintaining readability and modularity.

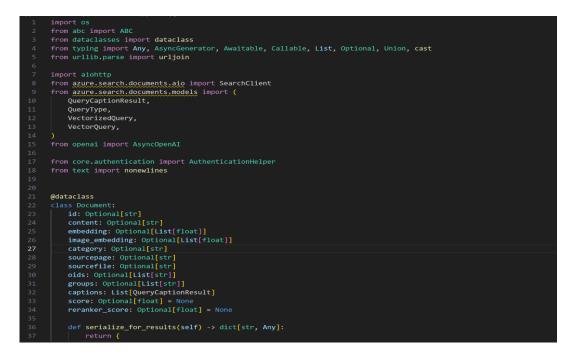


Figure 10. Back-end approach of demo application- using Python code: importing libraries and integrating Azure OpenAi (LLM) and Vector Search query for RAG method. The demo uses a multi-step approach that first uses OpenAI to turn the user's question into a search query, then uses Azure AI Search to retrieve relevant documents, and then sends the conversation history, original user question, and search results to OpenAI to generate a response.

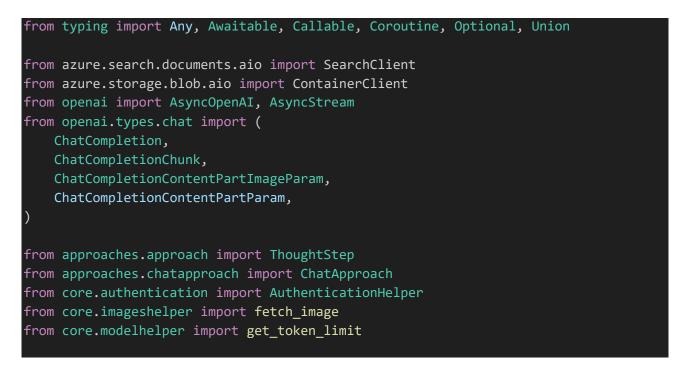


Figure 11. Back-end approach of demo application- using Python code: importing libraries for Azure AI search client and integrating with OpenAi model for RAG method.

The ChatCompletion class is likely returned by methods or functions provided by the AsyncOpenAl class, which is used for asynchronous interactions with OpenAl's API. This completion object is crucial for processing the generated response within the application, whether it's for displaying to a user, further processing, or any other required actions based on the conversation context.

Application technologies:

The POC, which clones the azure-search-openai-demo application utilizes a variety of modern technologies across its frontend, backend, database, and deployment infrastructure. Here's a de-tailed description of each component:

Frontend: React

React is a popular JavaScript library for building user interfaces, particularly single-page applications where real-time updates and dynamic interaction are key.

Backend: Python (Quart)

Python is a versatile, high-level programming language known for its readability and broad library support. Quart is an asynchronous web framework for Python, built on the popular Flask framework, but designed to support asynchronous operations.

Vector DB: Azure AI Search

Azure AI Search, the cloud search service that provides powerful and sophisticated search capabilities for application development.

Deployment: Azure Developer CLI (azd)

Azure Developer CLI (azd) is a command-line interface tool provided by Microsoft Azure, designed to streamline the development, deployment, and management of applications on Azure.

Tech	azure-search-openai-demo
Frontend	React
Backend	Python (Quart)
Vector DB	Azure Al Search
Deployment	Azure Developer CLI (azd)

Figure 10: Technologies used in azure-search-openai-demo which is adopted as the development ground for POC of the Prototype. Screenshot collected from https://github.com/Azure-Samples/azure-Samples/azure-Samples/azure-Samples/azure-Samples/azure-Samples.md (Azure-Search-Openai-Demo · GitHub, n.d.)

Appendix 1.2: Feedback Form



Feedback Form for evaluating Large Language Models and RAG-based Legal virtual assistant

The purpose of the evaluation is to systematically assess the effectiveness of AI language models and a RAG-based legal virtual assistant in providing accurate, comprehensive, and actionable legal advice for housing disputes.

Evaluating LLM Model's Responses

General Impressions: Please provide a general overview of your impression of the responses fr each Model. Include any standout features or immediate concerns.

Neither ChatGPT, Gemini, Perplexity or the prototype provided any meaningful advice or guidan the questions provided. Their answers lack detail and certainty. While the answers may look impressive on first glance, once you really read them you realise that they are empty and have n impact on the situation. The advice and guidance are actually very basic and common sense, h it does not give the user any indication of how to use it to solve the problem for which the user h engaged with them for a solution.

it is impossible to verify the accuracy thereof. As a human being one would follow the guidance provided step-by-step, so it does make a difference, a substantial difference in reponsess, whe ChatGPT and Gemini makes slight adjustments in both the formation (numbering) and number answers provided.

Evaluation Criteria

1. Correctness

Sub-Criteria	Comments
Factual Accuracy (Please evaluate the truthfulness and accuracy of the information provided.)	It is impossible to verify accuracy of each of the responses gene all the bots as almost all of them contain misleading informatio for similar queries all of them provides different responses. All the models are inaccurate and giving mileading information consistently, in all the responses.
Provide any examples for Factual Accuracy	Prototype provides this response to user query: "The landlord d start investigating the matter until August 2007" This is what hap in 2007, not the landlord of the user. But the bot is not able to de the difference.
Source Reliability (Please assess the credibility of the	ChatGpt 3.5: No sources provided at all by ChatGpT 3.5.

Appendix 1.3: Experimental Setup



ry la		Dari P Regene	denine v	Carrier Perpanan	Anney Population		holge Ruberrar J		-
prin Sample 1 Lamber Property	Paytown Inclusion	Interrytoiner densi yur shadoo Dadiyyatta danlara doolari	Owige and Remarks) and makes the must be that and a string having a task and not getting a	Danisi and Results Results Results Results Results Results and Result Result Results and Result Results Results	34.1	Approximate Property of the Property of State Property in the	ninipe Cenneri Menta	2
provide the second s	Papierer im Lange Palaini, Palani Duan a militak, Raini aligin bermiyaligawa (kan kata, antorjakalari ah bargi, Palamona Razi antorjakalari haga, antorjaka barangi Data anto barangi Data anto	- Constraints and a separate process literation in an inter- ted with the area and stops process literation. In "Statement Despiring": Main and publication in a second of public and second and second and and application in a second secon	11.1111	alizes benefasio histori "Cesari Maria Repolicionental Jeron Adress (*Cesari Maria Repolicionental Jeron Adres) (20)** Tesperepositori comato aire tana*****	Marketer alter bereiten bereiten bereiten bereiten bereiten alter ber etar bereiten bereiten bereiten bereiten bereiten bereiten etar bereiten bere	-	 - representa de principal de la presentación de constructiones en esta de la construcción de la del construcción de constructiones en esta de la de la construcción de la dedicación de resultante de la construcción de la dedicación de la construcción de la dedicación de la dedicación de la dedicación de la construcción de la dedicación de la dedicación		
ming particulary constraint our becoming Parlinguist and supplicity of annulased magnifications of the	Rand and a set of the	enais, internange, antary inage yet intert. 2 ** One's that issue (generate ** Antine yet interagement in an if there are an interaction regulatorial interaction and it interaction.	ation static	in Malaiti. Nacasaran part ike kalain tike 21 kan mengeray namber 18, 1831 2020. Tenya manana kecila atas and may internet if the load process health or safety risk.	elamata data, Leon, ani estaduata duartari 1930 - 2 ⁻³ Bard Alema Virite Alexard ¹⁹ Hitta Leonal Inter e en Renetjiti Ingen Leonal datalingiti ya alekar la Indentita elamataria ani enganding termilata alem televitariat.		nak. In de kanang seken der kanal der beite mei emperatel im gese merpensi Anders wei back for mensel kan die mei mei eine serverkeit bekömmt.		
stains. The invasi has not likely be and estained it is bained in an ling and with a straight description and with he straight on set like	_	Periederlohligden is allen opån. 3. "Bed shend föller Republ" (Bissienalster overd in		 "Contact the Parcial Consume Onlocement". Bits reprind to provide address and up real de depute Interne International Institution. You are real to the Tophane of US-MI 10 deputes the participant of the Internet of US-MI. 	Marin Millioni Legal Addres 1. " New York (gint " - Semilarary pured addressed optic		he bilaning sings 1. Des umeri Berlaus Certinationisment (Bernatikak)y Alexandro dan personalaria dan Katalakak (Ber		
tange Telathalise prestile carlos and felended ha of mposfel schendington elder av		enternamentin deallevite Barris atoms Republier. 1. "Center Net Lead Resinglishedy" in Priori, Denser malation and advertise for announced assertion. Na resource		jedyn Franz halstigdelle. Kwelyd yn Franz halstigdelle. Kwe 5 3 - "Odrw Roberts" ' Melenn (malendromi i mans, hwr a	 New Decision reaction(promptly) 2.11 Consult a Legal Advance? - If your level and environments register Technical, consulter reacting patholeculo consigned and decision of an university of the constraintion. 		ontri maandan terberation. 1 Centeri terlenderlagin Benlandheration nemunisation terlenderlagin dael vanishtischeraan. Be		
attartic ald multipation.		In contrast part and trading adheting or analyzed and the register philosometry of the strength of the strengt		montel el al communication alle por la della della portage degli la della. Del incluionadan, tiran, antiany magraman por motor. 6. "Restru por Terano da samanti". Processo della de	All Tempore Distance 1 ⁻¹ Might Design ⁽¹⁾ information, hybridistics all complete lange ⁽¹⁾ information, hybridistics		revises al exploit contain them, and the opport the shadow. Repeat a prompt represented with a distribution without		
		 Second program in the second second second space per expension and the second se		 Segments - Angements - Angement sign adarangi mgankilindar yarlanlari Panlak lah pinak kud bala adarangi matimganan ya mghan pinak kud bala adarangi bangan anumpinin. Hume, hadibala ingendi 	autor derengelig darligheidet er ordanen in sakhlike dispingender 2. "Inden för föringinge". Men avy skalde formansy hordinadiselarast opsentilletter daruge		 Data ingelasticas: El Persianal anticipil de la seconda en la seconda da seguerar a regionale de desenada dada, que response el incremada ad aseguerar a regional que parte de la constructor de porte de la seconda da seconda da Pensida las secondas da seconda da Pensida da seconda seconda da seconda de seconda da seconda de se seconda da seconda da second seconda da seconda da se seconda da seconda da seconda da seconda da seconda da seconda seconda da seconda da seconda da seconda da seconda de seco		
length 1 miles	Magnetonia -	 L. "Sergerary Solutions", in the materials guideness works to date these in the solution of the foregament and the formation of the solution." 		All of the second secon	Bit Consider Networks Options 1, ¹¹ Contact Housing Mathematics, ¹¹ Prince Latter periods, you are main to be based in thema and inclusion of secard associations From the details.		fenaldan 1. Certari belmadinasi yakini y Yitebaa mwain penalah secara selat Belma basinasherberin Rasalari terdemala pelakini beranam, terarete sekarati pelakun di selat		
Renario I Landini Vegenia 2 Real Teppin Alexymentian of the net describe language lan instiguita significant lank	by tendencing tamping backs represent tamping many event products on requests. For particip and a second second second data in temperatures in a second second second matter and second second formation. Carpon bell me adult interaction for an even formation formation.	Descriptionar description index provincing alloyers bendend, in Professi, lanari s have rights end astronic plans, including the right in a solution in the provincement. Then are noting a provincing the right in a solution in the provincement.	Chernel not according Tall	(Analysen) as the anticochemic housed and concerning points. It's important is get this anticesson by part involved as some as possible Pierch and you can denote	Pyra fandeni s në adheningalnë inpernet, naning penematikat piteti al more llemeti, penerlatelje Miningalqa kasal e ituristemal o positikili the samh malis		Read-only observation provided to the same on, here are the index specing part shadow. 1. The lense is the model the factor of almost the same isolate the	station 1	
Lege, fask sake skalmane sprawing an earlied in genere willing particularly convertinated our forcerine Postergalet and	anna, and frequential alout merupaktions for main. Cargos tell me atat hitestick? Lantas	1.1 "Decement Excepting". Responsible of a connectation with per-inducting pring the task, including smalls, photos, and any other solutions of the mass.	Penning Steps. Bat album State No.	1. ** Contact Department and Issue an extensions. ** They can be part of our approximation of loans are of the area of the first and exclosion of the part of the conditions in the solid addition of the area first Department of the loans.	1." benediate beine". - Notly the beiling to maintenance company almost the sector and transmission (2).		net en bleg 18, 2006, and annet die man die Frait. The fand end net anarenet frie helm obser 2006 f. 3. Die derey damaged ware van bie helde beste ender an ender opper- nen and beste here en en bie helde beste ender ender.		
surprising an estimat an an all the edges of the status. The instant here estimate the and estatement the local in setting	Report, Second	2.1 "Bed a Parriel Willer Nation": Wile a lorned latter to your and existent approximes. The stage you've sature in ideas from a strange of the transmission is from 1 will a strange of the from the strange.	and the second	Berlem contact information on the Day of Dapon unleade (Day of Dapon antiming) Ways Terran majors. (Eve) 2. "Theorem your insue agreement." Musi insura confirming	A Product Action Add (2) Add		nam, and hele planes as an indication operations 1. 1. The landsoin defined and in socilization planes are as it has not 2007 1.		
enal with a bitabel development and all advelopment its formage. The batch account organities can be unable, and		National conditional in a supplementation of the second system of the factory 2.11 Contact the National Advantation of the Second system contact the		myonikii for opin, b Polani, lankok an presily myonikii to natsiating tayoyety to haliake unditar, aliah indala alemiteratual.	 ¹¹ Second Connectation¹¹ Negarment & dimensional second parallel specific products and the second second	-	 The local balling permitting adult friends (2008, and transcendenced) and the balance manufacture acceleration for the Physical Acceleration. 		
felanlari hani mperini intensifinin aridar ay atar inakteu/kepsilan		inal manipal koologaal koity oo bo Baginal Bain Adrocolustiin Ageny ko gislanna aslaasidanan Traysar prosisisi kismadaman Inaati sipis animaji kismanal manaany		3. "Consider regular and deduct." IF the link summarial year lands of remains arrangementar, firmital lancelinencyce, under retaint screditions, have negative provider and excited and the second second second provider and second and deduct and the second sec	and and characterise		1. Recipromption for Genure Organizations related, but added with the rest and required incident, and the relation of some the term of a set of the set.		
		4.1 "Repeat all specify repeater". Eine leaders in ordered as a region flat search year are repeat a property repeater born for boosting addressly. The plane for a shortly is impact in property and		all almani gin aparalar in mare publicate para prostan	 A "- Algo Kapit". A House Control Asset glob reporting baseling smallers, Inducting the significant spatial statistical processes of a House and Social Strategical Statistics asset and applications on durit the limit functional statisty for antisianous and globars. 		Ne level derardet angination die baringdest ibe sekin Newy 2007 3		
		5. "Bell-ophision": Ed derlah, ornite ornalizzahl-singi alter elemet (gloogstader, Taylar politigationer)er		*** The Facebook Structure Annual Ango **** The Facebook Structure (Antonial Annual ** Provide Terrarity Universationial (Weiger Annual Antonia Aliane) Terry offer legal	5 " Bell Polesteral Help" 1 Consider series ling a professional had detection series line		Reselve (Incoder), i scher Pel (Incident) en leer auser d'Archele le alongtion autour et laier appoptat administration faite leux. Na requession désploytimistiques		
Senario I Landoni Vaginto - 3 Red Tapat: A Largerantine al Ven	In in Tota, Feland, and Associational Indiana	specific stration and nay help you'd in logitation against the logitation of monitory and increased a series a nation reported y consisting the protected in further damage if all unablements have	Oreal or	addressed one galaxy processor (Analogian, "The Monie and the December (Analogian) (Analogian)," (The addressed that you're's a difficult visuation with an analogian an amount on andired. Here are some suggestions that might	Nogen Denge within one writes intering on inderify bala and notice any anti-plan application of the delegant in pair and balan Tala Reference any generic on the delegant in pair and balan Tala Reference		L Des presi des la construction de la construction de la construcción de la const		
instante en la contra de la con	1. In dial barren palanta ananada barrena	1. "On and below" Made and a data to be a set of the se	Tanata Tanata Tanata Tanata	nag 1. "Decement memploop." Sale pinture and observed before the tamage to saving an international Sequencies of any	Contact proclamber togets in writing allow by wead or equipter strong in the program gives it action and reporting that there is that in more than any other provides an incommutation (10).		Summary to the net field such to singly on hit to set states upper a left to a latitude. The hand matter instances of half alongs a latitude of galaxies of hand hands. Hand takes in the states of the states of the state of the states of the Generate Dipole Basel of Hand Hand Hand Hand Hand Hand Hand Hand Hand Hand Hand Hand		
oning particular/percentulant our treamine Photographic and surprisingual amountain amount treampoor the	state?	permutation pulses at all oth year and end and a latest year of a second second second provide the second s	-	enals or reasing or proceed to pure leaders' describer had. 2. "Contact year leaderstages"." One hydraterie wrant yn the had and the potential to forter darwage. De chant had yn o ban dae anwel ha weryth og ant had yn an sawer o' pur right au to meet. Na wer had o her natione on forte is breast process.	 A providenti confirmanti ci provi fini fana, provagi na di fini A providenti confirmanti ci provi fini fana, provagi na di fini 		Per Consume Deputies lauré à l'Adantier futier publicaire et tenire promotinité guarque de subation Déstines 1. Médices Lanagrie des mei al agaitment. Rait dessunt.		
sain. Tei erani teonitilati te lankni desi teleski teating erai atih asisialati deshipian eri alah sisialati deshipian		lation). Charly replace the problem, including the patiential consequences (17 unit lass) promptly 3. "Nows the Platter," familiaries second with our risks as a		descent fait and photogen that you are seen of your ight as a lensed. Notice that is iteraplice on the birth is and to photogen a relation of the Provid-Generate Protection Orienteeues Photos Teres build get the Your India Versital solution.	wid generat antion in an installing a transmiss specify possion in billing (1) Consider antipative/billing in a basis and built or instal		Sontianultum, Cananar Depinsibari pilipapel 3 Medianasi nimitisi danggis Remotal apatemi. Ret miastariain, Cananar Septemberi pilipapel		
tamage The Institutionen present for care taxe annine, and the landoot has not responsed		lement in Prisent. Your landsont is typically responsible for maintaining Perproperty in a balance in the second line, which includes and reacing income lines of lands.		Separation () Mayors have a statistical frame of the probability of the second seco	alienary pop is Tabula animiani par siglikani spina olarari. Taynapisalisis inisraman par ishallar pasis pilanan dispoper sispitalasi ().				
ation is addressifie position.		C ¹¹ Bask Lagal Akian ¹¹ B part and not methods as in generity polition, participantics and logication is Pricard Over a relation and regulation of a selection and highly and logic politician decar proble galaxies or basis present.		¹ "Byoti link is the authorities," if your leaded to obtain the groups, you can upper it brains is the networks and shared in the starting as the starting of the start brain of the starting of the start is and a start is under sequely. It is not its internationalistic and related is under sequely. Note that its under the start for the start is under sequely the start for the start is advised in the start is under start and the start is the start advised of the start is under start is the start is a start of the start is under start is a start is under start applies. It was a take to be start upper start is a start is start in the applies.	She bali susuring kengeler par bilanging, dasarat bila alimpisia ani manjak le any similikan. Yao ng kadalo muar sengenal in han yao lamba (late(1)	-			
		1.1. Tempony Fam. ¹¹ Ubic sating to you indexiduate action passes attempt request free involution failure decays. Texa all		andreine (högen / mean backes häre / mean page) högen / mean backes häre / mean regel	Autorgonaymaanin irginisetati Perintiky Saing Indutur pari onler ölyptegade. Toivall minimizeturlar Amagelin pari one(1)				
		even division area, a subspecial take although profiles. 1.17 which defends 17 to close such division areas		4. "Withheld well (partial ar full)." In Protont, Invariant and the opportunation of the configuration for the second arguments between the administration of well and the second area for the between the administration of well.	Ar provident in parameterizations allo parameterization balance facilitation add, net and other animal bases field consistent on the based with the constraints become facilitation.				
Red Tapat: A large units of the red door the lategrant has instead a cyclicat last.	earing arguments and optimized and the second	le Prinel, ima alcone de la serie por activitativa en la solaritación la serie esta en la solaritación la serie esta esta esta esta esta esta esta est		annaning New an annuning spice picture (altractive altractive and bak and comparison lands of the Tanyam	F) the art and particular given match prior and part appendix and prior landse that not expendently part much for our 2 webs, there are deploy to use later. Prody of the multi- tion much all communication alternyth and the local faed.		lacks 1. The local information process in the lacking with process of an information process in the lacking in the lacking in the lacking in the lacking of the lacking in the lacking in the lacking of the lack operation operation of the lack operation ope	station 2	
ange sam sake skiersam spensking armadiski ingener seling patieskal sam beserier Andregalet and	man Jamin, Transani pin, Aitemanyitingi sa aki	1. "Cartant the board platterly" in Felant, there are agentes that never board propiations and can avoid there bin relating department in a first and the second at the local board part which	ingo, Bal alben alben	 and arran many strong^{1,1} Rang capits of all annals pro-branch for part inelline), including data, and iron. Epsahlin, try samling from an illuminal sec pro-branch array of a major. Keep the pictures pro-braic allow indulty year standals. 	The product of the Control Academic and the Co		unfonläg (l. 2006, antonen ålem sakar hat. Terlanden) en annen förelnde sörer 2002 (3. Terlandet därtet dari menligslegtbemater avtil lagar 2007 (
sepel dysaf annelited anard benigs, of the states. Defendent fear-officielite and related and features of antice		Sergencer bendied adhebyle piteren berigsonni. 2 "Their aftered letter" if yochant I alway, weistlored ister hyw feeling being benaved in the out in due to equal the hanger your bing mediene, with one yoch wider to mity		2. "Contactively." Synaphic goal inducting proves. Here, for large and action and archive record and and any form of the synthesis of actions, and instantical goal and interplations.	propily Revenie is long a monitorial interactions and and professional address interaction (12)(3) Distance	1	ener 1. 1. De regular makely/belærden i del vel herberhad 1		
mal site addated decription and attached internet the kenses. The instruction comparison		In particular defailing from the mail task, the impact for balanging one and thing monthlines, and the independent of which the instity from herbalan any observations or incommutation. This is the same in a formula monoi of para alternative incommutation and service and an information of the same alternative incommutation and service and an information of the same alternative index.		3. "In Demail Appropriate and a set of the last of the set of the set of the last of the l	Republic and an and a second part of the second sec		 The invest half we queries in repeated in Painsey 2018, and Concentrative Decision serve and representation for the Half in Patient Art 1. 		
felandosi has na mponial interaction fuence si alam any actor in addess/tepsilien		5. "Repart altrainging and at". Notant Recipt to repart a test properties of product of the sector and the property for		4. "Terrari Biglin Organizations." Contact Des ¹ antich Terrari Diese Victorization im Des Concernes Ordinationer Middata	2 Ngan Jawa Milit ann's Pripadamenania Indel Biganian dani Jaring, Jawa Ji Falania Jing Salahan ang Jawa Salahan Distrikt Alaka Salahan	1	1. The local demonstrate employation and a well relation for the work from January in Harch 2007 2		
				although the animal to part of the and hear inpresent. The year although the rest in part of the fail (hit) models with you land at these architectures (of include)	N Nga lawa nili ami Gasal Xiamata Babbar y Kang yang gapata ang Salah ing kana dalapatan 1972 (Si Jamata) Kito Dani Jakat matata da	-	na denen menn andre gatereilenind 2 Renderlændet, i opper fød føderlænd talser avær Förend belænde denge mende av til der anverde		
			-		erressent bijstyninispi		 construct represented may be withink to a set of solar law evidence suppression for the incommentance and here is an address to back its environmental to the incoments on address and law enders the Consume Topping from the further accidence. 		
Servers I Landon Heighting I Red Report Language and the	Network and the spin	- Second for deal ("New second of all conversion in the little balance of a second part of the little control of a second second second second advances part integrated littles. In Print of Second Second Second Second advances part integrated littles. In Print of Second Second Second Second Second Se	Carral and	 "Standardser its Last Beent"," Etherholds southeast from indentified that part with a building shade with a balayout and an originate last bed from an unreader south a balayout." 	Fore indicate set attention of the set of th	-	entring for loss Distance Distance Section (In coloradaes provided in the scores, between the schwageling part shadow	Maintener Halter 3	
naf dana ka bahapaan ha insinala upikari tak laga dah satu ulaman pendepamakai ina sar	A) and relativities give helpoint on mainer reas- many results in another pice in existent. It have memory and includes memory and including memory and including maintain applicable point and applicable point and applicable point and applicable point and applicable point.	promoting and and inclusion are still galaxies on addate the property of good condition. Here's addate proceeder 1.112 convertillant places of the proceeder of a conversional or other		provincemental 1. "Theory province agreement." The bot sing his contention proving the set representation and contention of the	endiensamatiest helisis in herisetal passes in 1. "Genies BerkaangOnischeren", in Reize (Berkaan Deiseber (Berkaans) angescherenteren		1. The lower informative inclusion data in the state balancies and motion (6. 2006, and second increasing the total Technology on assessed the balancies 2006 t		
ning parintal provident our browing Parintal angeoident and angeoident and annual pro-	norm and initialize not Completeneityse notated principality insert Prove Tex	protectionly one, and consists an addigitable in marked in terropathy in particular and the protection of a second		regeneralisti interaper degregative. Nacri sana agrammati disali nati na matriamaten provadaren artificationa for regaine incana of landa.	accidence to real deglace together deputies, including here althread only our matrices (in progent) (3, 3, 11 Append althread out in an including the second	1	De desprésemplement contributivité des certes automage non-dates tenanties contais and antidateje sponjeres namelity les plans 1.		
tain. Tei mart termitlei ite entretaine teine teine materiale teine teine etaile teine teine		2.11 Certain Herizando et Apin ¹¹ , Berizando e Fernal and Leo Normal Social Andread, poderalely scoregistread multi-deal of the polition with the body read (the political desception for social og and your reperiod on for experiod and the constraints. Main score is how a compared for the similar to your muscle.	-	 "Desarrari nemplicagi" Xeny suptes sind email nemenciation allo par landoni repeting the tait. If put as and phones, ensure probase taits, and it remitange for them. If penaltic data allo tarias. 	manipal nanipal holy of Pennis is mpart an imprime in property darks includy null. They are assess includant and an increasing optime in the and of the set (2).	1	5. De lestos ditus del inexi plinghemater eti Aquel 2007 l.		
tanage. The Individualities preparative control and and the lands of the and responsibility individuality of the and the second		long a copy of this million for your match. 5.1 "Contrast Long Advisoring" - Pyper landsort will have be requested with a relieve strangement.		Andreichen Freihen 1. "Certant mit alt weiten." In Frient, für Genamm Prinzige Ortugingen	b. ¹¹ Review Vacc Reviel Spectrant ¹¹ - Dank your world spectra the classes which is not because representations. Landow is in Private are specially all paintion and use the manufacture of the set of the		 The locar's half the question in special of Advance 2008, which received that the halo same uncompliant according to the faulty Parisectory Int 2. 		
alia is alterally politics		lake adam, yan samaat na ku karina dhasha ya dharki yar maring da adami kun ki kun 1. Tanya ar proba ga dharan myar ngka sa a lanari ani may kite ama unyar inkali. L ¹¹¹ Bahi, aga baki ar ¹¹ Gamile wana lingati na lange na laga		 Paragenetic) an alterimetration fair-optically and represent in department in the data in the serial of them through their settical in the term through their settical for the term through their settical in the set of the settical for the term through their settical in the set of the settical interval in the settical interval in the set of the settical interval in the settical interval in the settical interval in the settical interval interval interval in the settical interval interval interval interval interval interval interval in the settical interval interval interval interval interval interval interval interval interval interval interval interval interval int	reaction of the second state of the second sta		1. Ner fesserspärste her Genarer Oppinschardsan related, for Leolord et Leole Antonio et autoparte för bedret, at Reselved blirtet som för formsamst		
		1.1 Data Lagak Maina T. Carnalin cannal ingative charges or legal active one specialized with factorial standard degrees. They concerns your shadness and provide galaxies on how to provide legal productly for provided by a set backing write taking legal active against per- sendered in testing of a set back.		n en	ur, servent undergingt alter ber also et ansetzlike en kegn opsisktege beschigtigt. Der optisktege beschigtigter (2)		1. The local demonstration of the local spatial free state induction operators. The local sector state of the spatial sectors (
		L** Sergerary Fault*: Information, Ethicial Issueing	L	¹ TecTronisk Disknesseniak Posissian-Agency (Programming Stationary and a stranger of the stranger and the stranger of the stranger of the stranger of the stranger and the stranger of t	5. ** Zenoreni Baryling** Kany manikal al internazioni n altypu (anticu) initiating matika antiphotos of Ventuus. To desconder alter anatomatika Vengi al tento sensibilito erropi technologi in sense material. Ba desconder in functione anticitati.		person in the set		
Samata 3 Anniet d'Israel I Danage Ublimmananging Annian, The Israel anniet day Israin/Jerahistics the bring	The Theodore and Industry of Spanisher Strategy of Spanisher Spani	Industry opposed on the second	Canadi na Manada Malan	normani, insuria are prevaly takinin fanages savati ky najženati sladovatal propety John Toma platajenerigaisko archeopethiland nateri. art.	Realisted in Trianel years requirely for any sense in Transit of spartners, much if you an initiated (22). However, you are not indic for some of any and any for insure how regi- and the spartners(2).		Neveral opported Neveral Action Residential Lances, Films spationarily definited conditions with data in part regipteres or antioner many parts are being in the same maintenance of the origination of the main manual produced for the part of administra- tion of the main manual produced for the part of administra-		
nen, ineinge gejoghisis for einine deletighesister pers, deletighesister pers, deletighesister	dutional and its have index-meaning test 1 satisfiery/and entant samplifies in *******	and only a second secon	Penning Reps. Rel attraction	Indicate transfer as generally data for data to data to constrain a subject to the start of a subject to the subject to data to data the subject to the subject to the subject to the subject to data the subject to the	It pur use a civiler shrine and damaged here would like to considered damage legend neural area and then they include allowed includes and in the same."	:	partnersi anna la castar la sui cite aquinti codina 1. Isanae Recipii cinearen pattere pojegoni e barche et micrati des un troit device indet e materen sized		
Investigation of the local of t	antaliaje prozini natera paja inia fast k balene alconi di	In the last year of the last o		ngigenere perjat. Neritabel promi	Process and a second se		fan bezening in mensieker yn de fyner ierden int er y deroep ei tregentren in er y de der y de fen lender in mensieke mensieken.		
dend Berland Address gelose element and filed the regain are element and filed yis hour substantial costs. New Yor locat and elements	In Contract of the Con- graphetics of Table (by persister). And (b) has for a bit of the Con- ference of the Contract of the Con- position of Lenderscher Institution of Lenderscher In			¹¹ Parker per learning agreement ¹¹ for interrup agreement registrane question danses along deraugerequie responsibilities. Recent for agreement in sear l'interdu argiting mentioneal mention and the require require.	Damiti dipaira, I marconst 1.17 Demoji yano cont iko imagi 71 kylaingeloin ard alam. Daniel kiy provinenini oʻlor imagramovi manini.		le repáring 2 Filmenyai or alteration anticis cartechesi dan to damage for alteri per anticiste, inclusive interagrenção yas lo payfor the material		
inneri seda logi di initaria masmahninati adaliy karinendalih fesa or prodim kryonishdi kroage		in more than the physical the service provided their density for instance index. Takes physical the charage as a stateway, and if provide, with store deals aloud the the avoided as a real.		¹¹ Contract per la stratagian ¹¹ Las puer la solucitamiente des puer constantação da las exponential dos for transpais had had pou hadran directorias da las empais estavaladoras had anticepor processos names en aconstante da las empais estavaladoras had anticepor processos names en aconstante da las empais estavaladoras had anticepor processos names en aconstante da las estavaladoras da las estavaladoras had a las estavaladoras da estavaladoras da las estavaladoras da las estavaladoras da las estavaladoras da las estavaladoras da las estavaladoras estavaladoras da las estavaladoras da estavaladoras da las estavaladoras da las estavalado	Annualia. 2.11 Distorqui minutecherilizzazionerizzazion?" ani deschere alle partamberi. Disabareges artisteg manualia.		Periodiscinal Indiate provider clanded in respiration and the discussion ()		
		 - senses man right¹¹ is frian) insetshan tipls pointally/as Lasheb, sensi sense at yoldhili opins o dage insets to langes the amount level of sense and here or senses and/or lasheb open if his seast's series. 		 Jammer, any disardoperiodecourg and day. "Order permission measure": Face based on measure, it might new format drops in an interfal dropp. Order periodecours responsed on physical lines." 	5 ** Other is pay for the regular is install model ** if the induced by . Mari and estimation is entablished in the second		Domesmental bet possessed at the part and ordered Second Perchaster. Stations		
		1. "Supplied Reporting " F per leaders appendix for product and data in the set of report, down in termine and periods to per interpretation of the set." In the set of the set per interpretation of the set." In the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the se		Proceedings of the American State Proceedings on the second of the Instantial to reason of the Proceedings of the second secon	6. "As a last most your shall may be leaded when any " and if you indicating your ensurable or the land of all and logarithmic instances [1]. Program 10.		1. Protect-Act on Procisentia Lanears, politycepell 2. Action metingsom classific apparent skill (1886: Carnell Ingelaten, PREDOlphillogenell 3. Apparent for met i Security reguest Americandition ; Descourse Despite Reset y although (1		
Senate 3 Antibita Tenari Sanare Weinnanantro	Reaction in directly	Semantic are consequentiate or in circle or dynamic provides, you may seek which have a located association or length second. The sylvhese about the antider is with your with length T is granited as you've densels in the environment of the antider is due to the locate and the area are serve	Oreal rel	and. Instant (block, if more definitioned on the service result of and land in (block), instant large designation (block and block percent) and a perform that a priority of any any other block and percent and any articles of an initiated designation (block).	Printity/net > Printity/net > Printity/net process prendly responsible for damage sample course your april A feature of the set of the damage	-	Services Oppies Barri pilpige 1 Annelogie Internet Anio Residential Januar, 1744 Martinette del ant and line Adarbs par tellementer		
kenture, Terlemani antidenially kenalastienainakeni miteriksig nami, kentepagapangkelarin dise atrodes dipatenterikenainaken	Barris a part Interna entit Industretida 1 remagnico janderi Socioli ange istel Part	sign your labels many just all and applying the spains 1.""Relate the laser Agreement". One's purchase agreement is and there are produced with the language space of the math. Simology.	had municipal Production Theory of the	ning Herinahal yan san da "" Belan yan inan agammi " " Ladda ang kaan mialalia mai nan imari mani mandili da da kaman.	ur later op i en later op an i de op angelegere d'alterest antres Milles IV fan Landrest Prevalo		articular op un taxes junggins articular op un taxes junggins to ending in the North Arton Postario of Jamma J. Her- patients's Adduct condition to Arton pur configurators understores, symmetry and hard the pill comparison of Arton setting for the system. It has now a fill and approximation of the unspression of the system with Arton pursuing base (Arton and applies and the system with Arton pursuing base (Arton and Arton and Arton and Arton approximation) for the article and arton and article pursuing a system of the Arton and article and arton and article pursuing the Arton put and the article and arton and article and arton and arton article and arton and article and arton and arton article and arton article and arton article and arton article and article and article and article and arton article and article a		
sen, deragel (restrike have and adjourn) sall. revealably, (he benari	Representation de admension la regramme administration and in technical administration of the administration of the second of the administration of the administration of the second of the administration of the second of the administration of the second of the administration of the administration of the administration of the second of the administration of the administration of the administration of the second of the administration of the administration of the administration of the second of the administration of the administration of the administration of the second of the administration of the administration of the administration of the administration of the second of the administration of	Insert specify the lower's are required in the certain types of density, additional may require the land and insert specific, 2.1° Communication that land and the specific and inserts of addition pressful type and and its place and other inserts of addition pressful type and additional and an addition	-	¹¹ Oanis Period American ¹¹ Ten Period Consumer Period and Ant (CROPPeriod Consumer Period in Art) and readows and	Visi a sinali julari berigli siny by oloming pur landari renalizi dy Purpi serenutistice an denominate pur represibility antisilingnas is aldress for tase.		andorikanine rengigerar Liki inputiari involtypar andorikanendaki alaki lentanagrishina quateen 2 Dataren 1. Periokata Pasiateti Laran polityapeti 2. Antorosti pasiateti di 1,100. Genet opiaten: PREDispitipopeti		
dend Berlange Hearten, Innert wordensemen gelann dend Berlail Hal Beregain an	hogel starting paging a her constrained in a starting that manufacture in the starter	nerrossinal services with your landsed. Explain that it summarizes inter- ent sports your editory much comparation much explain hours. Remote much services in a service interest of services the root school are sports of the service interest of services.		almani (dela seguriador) (higo: l'una codesistat Kon (bigo: l'una codesistat film) hertaningitativa	BB Deals Your Revisit Agreement Participant model agreement incondensional theopenite terms opening reports architecturgs. Biomagnetworkschaptener Generational architecturg design and the set obtained international contentions.		3 Arternetingsmithetial quarteri (81, 186, Greet opiaine, PRED Spillpaged		
ndeniaraniliatyis inar admiatial onis. New Per Iorari unis legalalistismis marencheseni arkaty	anything is an in toroute new that is defined to pay? Discontributions	book altoparts, separately for an interfact damages. 3.11 Denis Yang Review Sciences and Prophase series 's insurance, where you you'ry follow in 12 monets and denial damages in the property.		¹¹ Death ar approved with par landset? ¹ Browl sumar anister, regulate all your landset. Episer had you informat from investigately and are all opicies at all the more analysis.	Annesdeni antieria derage od hosti douži behadel. Withousen Comp Ond P pulsanetal marganital nam antierial				
keyenisida kasamalaha antista kenap		nyan. 1. "Definision Pape Gates" - Speciation reports parts		Menantampanihilan kermilar darip bedanasian ""Bajarmat a Baja" "Bajaripa shir dalamarka	mages a promotion proying help our formal of spacing fractions. With Decomp Optimum (1) for Levins				
		n nongen och entryprograd progenischen differet repartnerparten. Tel var help menn fra pelle mit var draget for formgån.		nganita. Berlingstofgilte inder parts i angliss. ¹¹⁴ Baring its Gesl ¹¹ Norskyl knakte i skant for sol of mpart solt its and of a spanial piller atolese another or metric its match if all features.	Den para las polos arrandos de las polos de activitas Den para las polos de contra de contra polo espai de activitas de las restas	1			
		L^{-1} "Regulationally from Landord" \sim Etherwood methods and problem which is some from , by regulating with your Landows. We would graph and a some from the problem of the source paper of plane is not determined on the source paper of plane is not determined on the source paper of plane is not determined on the source paper of plane is not determined on the source paper of plane is not determined on the source paper of plane is not determined on the source paper of plane is not determined on the source paper of plane is not determined on the source pla		"" Fining a gain" " Get any of a form and share much surgery any second the second state of the second sta	Mill Olevia Carolinate - Molared anglesis, effecting inconditional relative regular contex are always and all and may below resignation granted and may be residued.				
damarko 3. Annierta Tararri II. Damage Ublimmananging Annian, The Innari anniertaty Innie Innarianie Parlang	Papi interantal quaterati e Calo. Telay antidati di Jordanita atalagi completana	Na gant hai ya internet ya tarihi na ya kata kuto. Nanazi ameninga ya antida kwataki kuto kata. 1. "Nata kuto kata kata kuto kuto.	Canadi na Manada Malan	Constanting para antro, had there is append there expresses it for responsible for the full cost of the advance cost of annum and the and paraletermine para landow investigating the choice of para for	nen general en regele en general de la ferie de la constante d		executive problem secures, it is not clear advances for a sur- se expension for paying for the damage secure is the values. Secures 11: a standard interference is a diright to compare to be advanced to damage secure is destineed by a forward realistic		
nen, besingungsingheine für einise, skelingeligteratione para, samageliteratione have and adapt	aktionnainglamban ili oorginiirjumaakai ilai orginalasi igii aang ku	approvant is a similar of part of the set of spectra of the	angia National Angia Rational Angia	"" Reine partner operated." Technistique increased whet part more republication in the later for age. It regit reaction meet requestion for water age.	MERNEY that have not a company closely by the second of close second and one of a second decay of the field of second of the company is independent of company for the specific insides.		ofter survivations 1. It is concerning in the state part part of experiment and consult with your lands ofter darky the responsibility for the universe must and painetial comparements. Solutions		
and an algorithmic browniade, the tenant ontacted and includence and the tenange Housean	termingal tease langi di tebuape specie ar pu pile resultat anticat	2.1 "Dank flar Insense" " Ppularmeter Linuxens, chains and anished damage are consent. Notice assessing in pulsy might methods for adding employed participations.		na . "Bela's boundary " Only put with 's many of the second			Approved to the approved The conditional the spationed the technology Rectorgenetication in the Company September 1 pathogenet		
man sortinema antes desi belatika benyan av nimiaran lihiyishar sotiarini osh. Neu P-	ne (ne dar agradică lagar mili panidată	3.1 "Supplicitable for London"." As a super architectul encorrection of the forder of the destination. Of the source part of the space status of a supplicit distribution with a		and the second s	Carefully when pure working generative understand the terms specific planages and specific terms again when any quartity who is a supervisive term of the section to generative addition of the section of the section to the section of BBC conversion and the first Landon to				
Insurt unde legal director in museur between adulty kardened alle from ar genation legendated is many strategy		report in repair works. London's production work of the product with installs of a programming of any product of the product o		"The photo and conversion to "The open internet year lands to git any and the colorly an active, the down responsibility Contract class any and throughout the process.	Mattan open conventination of types familiers' Aprilogies for Personates and disconsistential valutions. Martandors' regi familiers and disconsistential valutions. Martandors' regi				
anise is in a second		Permatural and all the law prior. Present in particular and a particular and a second se		¹¹ Suppliation is possible ¹¹ Oble you relpt in requestion for some of the and, it find your? In the entire optimum fracture by regarding of the post for the entire time optimum for the entire source are not entire in an or it from a second differentiation.	Bill Datain Repair Qualess (24) quales from equilable etcalesc repair companies in Outs Name i have qualesci in your instantice down the second repair end down on provide community.				
		in the second se		Nenarra and a second a s	Mill Oler to Catching Mill Oler to Catching Mill one of the high and you are and in transiti				
Securit 2 Accident al Torant - 1 Designs (Princetor	Sector and states in my	1. "Support for play " for model of a second state with no large of the formula formula formula and state inside the formula for the second of the formula for the play of the state inside the second of the formula formula for the play of the second state of the second of the formula formula for the play of the second state of the second of the formula formula for the play of the second state of the second of the second state of the second	Carrol or	¹ The Next A Consumer National Consideration (Pripe, Trans Indiational Telefon) (Veryon, Trans Indiatopartical Ener 1) and the Next Next Next Next Next Next Next Indiatory (Veryon, parameter process) (Interpretabilities Amening processing on parameter processing on parameter processing Amening processing on parameter processing on parameter processing on parameter processing Amening processing processing on parameter procesing on para	new come, second and particle of the particular of the main representation of particle.		Seasolumite probled economy have an the relevant lasts		
Sanga Ublemananjng Umlan, Tartenari antiantaly Institution interlation Institution paging basis the United States	Install Transition	1." Robert für Berlah Sperment ". Om Sperment in sent sperifiktung des State Sperment in som state Sperment in sent sperifiktung des State States Sperifiktion für Sprages		ner help pår skallar "" Reis pår skallar " Reis pår skallar	Kell, and well-being an are required in the particular be- about Q(2)). The lands of a set of all galaxies over the out of optimizing Device induces the top are an interval damage.		1. The lenses is responsible to compressing the lensing the ary tensor search to the quarteer interioral yor through suppress or continuouss. 1		
tente delle gleradelle para delle delle delle delle para della gleradella hare att algorittali renalizio, the terati	nerotalization battat haggarenti kut heronally international heronalt it'i socia he herbere	and a second sec	E	Construction of the second part	reasons or a serie to barrary upon and henced decousion with per leadered atom the decaders. Explain that it assume another and you are utilized on a series of the series could at 3. Topy you approximate your your to a approach and to utilize to use with the		nagigenze en nationenen. 1 2. De lemari dans na hann iterrigitis nary nui repair or elemator mettin iterapatrani attinut ter lembor h mentalan, mengi termanaren ingeneti o tini invendato termana i		
nota ini polici asi dana dina finianya Yuana Inari surianona asina dina finiarita finingan ar	Tentin a administrative ray ministrative processing between and the processing administration of the processing deliver and the processing deliver and the formally resonantial additional the menti- lity of the second second to the additional tensor of the processing of the second processing of the second procesing of th	waiswite me		all seveleties.	e Bernin. Engli fer sinine mpirisi ya ser seriasi altud elektro mpi anisrit Armad ((k) Teryar asses berieraarar	:			
noria ini unina politana dina di halanga Jianan kana di nakanan na anian dina di halandi di hangaha ani nahajari ana haja di naha na nahajari anah kan di nahay kana kana di nahaja di nahari maara nahajari di nahayi kana kana di kana pandi n kana kana di kana pandi n kana kana di kana pandi n kana kana di kana pandi n	hindaman .	 Solaris Normanian - Pipulation metric mutation, Independent solar antimital damagni la lester antimes. Paster pur peloyer solari pur inscrete public le sea l'inclanage lucinemiani adatteres sona Marilina dan. 		"Genetie vorsal one and one". Hie stroke vanobland medi promiji han varodranaga Landonham reportalski premi one anime, ubiranskenia darogeloj technani k mad patificeni skop	sentino in Januara (10). They are associated in a language and point experience on equivalence (approx. The sentence in equivalence company that affects (give, quality materials and experimental alor of RNATs are under invational and one, taking sequence (a) and RNATs are under invational and one, taking sequence (a) and	•	1. The location of participation approach to repairs a distribution article all by the interval of a base internal to world distribution articles all participation and the interval of the order of the approach to obtain a participation and the interval to an opposite in base of the interval interval the space of analysis of the interval interval inter of the interval participation and the interval interval interval interval.		
hardenni alli fonce prodim kopeniata i magnadiata antietta temp		Interspectation for registrant. L ¹ "One industries Professional Solution" - Dependinguestra intersections, part industries paymentality part supported interpretations. Neurosciel dell's industry galants form up a discogniti comparison or autobility constraining the registry process.		Pierto some additional inforqueitle in Pinianti	We fit a second extension of a set of extension of a second extens		Quinto dissessible della dissessionali di la dissessionali di la dissessionali di la dissi di disti di tratta di una opposibili se l'an conti in qui ci gli di solta anti anti anti contene la di sendera di solta di sono qui di la sposi di mondan. De marta di solta consoli il teri intera agneneri di ci contra sindi di solta candi di teri intera genereti dei contenenziari sellata di sono di teri piesa genereti di teri piesa contene. Data see Dista dei di solta di teri piesa genereti di Dista di solta di solta di teri piesa di solta di Dista di solta di solta di solta di solta generati Dista di solta di solta di solta di solta generati Di solta di solta di solta di solta generati Di solta di solta di solta di solta generati di l'orazi di solta di solta di solta generati di solta di solta di solta di solta di solta generati di solta di solta di di solta di solta di solta di solta di solta di solta di solta di di solta di solta di solta di solta di solta di solta di solta di di solta di solta di di solta di solta di solta di solta di solta di solta di solta di di solta di solta di di solta di solta di solta di solta di solta di solta di solta di di solta di solta di solta di solta di solta di solta di solta di di solta di solta di di solta di solta di di solta di solta di solta di solta di solta di solta di solta di di solta di solta di di solta di solta di solta di solta di solta di solta di solta di di solta di solta di solta di solta di solta di solta di solta di di solta		
		emperimente estatuire constituire printe processes. L'Augustate' - Etra landari espante processes Paramá, ingén materiale processione - Paramá estatuire processes Paramá, ingén		¹¹ Terret Oph conjunction in Jerman 1 ⁻¹ Terret repetitations are offer for ingle active and independent object on eth lead only (Physich Terret Letter (Hype, Letter and satisfast Elser)) ¹¹ Territol Jerr ¹¹ Providel an interviewant balance and inter ¹³	nistensing ulty an index. Dates		In part of the second s		
		5. "Regulate". Elle las den la sparte portenesse l'annat, leyte regulate dan solator. The cold index politicity for and, are given papers jue, or ellergic politicity for index and the poperty in manage for example regular agreeme.		¹¹ "Freeholds" Freeholdse inner inner in her som en inner i forsterindersom einer inner inner inner inner inner inner forstellter inner i ophen Freiheit Freiheit (Freiheit) Freiheit (Freiheit) (*), innerstellte ommenden infektionen Freihousen inner inner inner forstellter inner inne	 Indexed and your part part of the part of				
Samaria 2 Annierta Tenari Danage Utotenananging Lonian The tenarismitetally Instanting	annesidytestes attainationpaparisest attainationpaparisest biogrammingLooka	Market and the second sec	Anna an Anna An	Noncontrast page 1 and 2	Restances in Malace Protein you are required in the storage are of the space of an interprint performance in the storage recently and (1)(2) Frances you are not initial to some an entities or approximation of the storage of the sto	Γ	According to the last on-mating a matterial a partnership for four of match have be right to and an unspecial in the transmission of an agreement by the action on origination of the lands of the same fiber region with each or action in data mapping the the behavior in Action to activities during the approximation to action the transmission approach for the same of a space 1.		
Estate 2-3 Annihist al Inner 10 Danage Wahrmannenge Unstant Parlamat andersky kenkelmanisten of behing unst, hangegeigt felste das alsten, skulten giftensisten para, inneget i fensisten bare al algemit salt. Innel dat john traut innel dat john state	sealed ad hereined design in the seal i set ad the seal is	ferst adapted a first adapt	Paning Rep. Re alter	" Senior do Pergonalitiza" " Senior do Pergonalitiza"	aliana (). In procession, characterization and the data and the second s		Samage for shall be based to bails the base of equilation requestion for the second to bails to be based on pages 1.		
and an algorithmic invadidation of an internal data including Algorithmic data including Algorithmic	ne anniai key'i kyla olargene anaya anaol bolisti Janianarisin Mitali, firiani priasian			 	equation (shift) began share (shift) and (A back also, show it's incompress as sinited antime real foregraphicancy, pulsarshedgli is maintenengenation for the deep search is being and the sinite compression of the sinite stages as a start in the singer search and the bit fails and gives, a starting over a fill in space and a label is fill and gives a starting over a fill in space and a label fill in significant is put maintain to search place and regime.		
wind the device problem and detail the device problem and device problem and the second device and the problem has been as the second device the second device and the second device and the second device the second device and the research of the second device to produce the second device research of the second device research of the research of the second device research of the second device research of the research of the second device research of the second device research of the research of the second device research	tempelople and deta forage? Passeguite net of the shadow	 An ensure an own that London 7. Softward and services altoport and and also ideal lagrence block theory responsibly and altop to idea regressibility for the stanges. Services, builden appendiate learns who are practice and hered along and incidents. 		¹ Standa at support link or any intergrammed by their support on the bind at data on (high a lower binds by (high a lower binds b)). ¹ Antibierial Decays ¹	Declaration ray segmed to a propagine the opsite, but you are set obligated to come the full case of the same to you and the CDD Declaration comes of the part occurrence of the same of a part of part and only depend on the adjust of the same of the same of the part and the part of the same of the same of the same of the same of the part and the same of the part and the same of the same of the same o		repairs or an intervent of the spar web is the to tamped which you are later, you may be required in the set of spars.		
mart anto legal distinction in maximum britanti artaity hardenni aith from or penalism legani atta is maximalisho		3. "Societard and Provide Restal Lang". Provide serial lans, the series principal initial searchs, build presented to be seen frequention. In series cases, fundamining fractionary methods in some forwards on a ""		1 Automatic Terrarel	per encolycipation/backpaline/backpalin		histopolaris voltyparlardod providaty dasilite kongletinis qarinen, ai farat solf sako oligatish kangletinis qarinen, ai farat solf sako oligatish ka indinis kongenishti reparing i Kanansentahi sonaki ar di yarat solf da di konsente kulari some ka da mukila majadigita qat misi Milita da di kanan ka da mukila majadigita qat misi		
		Insels. Additionally, from an lass regarding for one and the result insels as and for ages.		The loss down in the photo photo is the sector and data for an activation of data for a sector of data for any data f	Sanati depairs, malaruaria daurati la analiza di la gatenzi sina puncati na ti darpinis d'argan atili danggi (; Tiri administrati shali puncati al monormo, puncati si darpini anali dar trong tu ina huanggatuni ();	•	Commentation and a second state of the second		
				The approximation of the limit of the second sector approximation The limit of the active shall be in the accident	Remarking an alward yns bran fiwright in han in frangad ren anwel og in fra hann ag remark an hannof in dweget far werd a me antifaet a se antifaet di dweget (). Conventiona genty wir yn ar lender yn sin brekten yn a'r anti antifaet Frankel in machef in fan farty.		States Monorigentinistaprovid(),985		
Servers 3 feedforfearets. Pee 11 Introductor Terrart excitosional	In unity a sparing in Adding in Materia at 17	1.1 Table and Altim ("Annual"). For he mean deal was table balanced a president much behavior on indealers based open memory. Browper and a the table 'I date a date indealers.	Const of	Next and American Strength of Strength and S	Freedood is result of the same barry free same to be a deal free reach in the lattice in your balance exact react. Charlogaeth performant in our throbad reac	-	nikalalar postidatahlariyan		
partneri koldogi ar akar anzis fisiani, misma monopriksialaral minasiasini kilo	territatinga tertito mast intestation, mperialphasile the biologram, from t	noney from the property to be added at the second s	H	enge paran hin 1. "Deserved Der pflog " Regraphical al mathematics of Admard Terrari Jacob en radio"	alar alar 1. "Samanai analara" dan sementi di se	1	1. Desenant i Bernach i desi alam Takepholes ar alam alliw ministanin yar apateuni, mpasial po Bekisten ana. Bes alliwa asaraideun di Bepolian 1.		
To summing an advantage of the summaries	hearmath Index, Hay heap corrigitant, 1 contacted my landerst along from a	communication with the analysis regarding the basis. This behavior made, please rade, and any other compositions Discoversi inter- tions, and the context of purcommunities.		Interaction The self is helpful Pyre multiplicate for any second	Let L'Allersmith angeling ", Step anno biol digraf and angeling ", Step anno biol digraf and angeling biological step andegling biological step andegling biological step andegling		 Packer pro-weid apprennt: Quality particular approach in weil Unit-decary problems republicant activities for and endowerprediction in markativity advantation long incidences (). 		
malipity prologonigations built relation to patential contenting in a filmal and the	hy seal any hole by seal any hole any attent to bailed and	0.1 "Release that have a presented." On the processor are approved for any basis of definition part sector or and not responsible that for matching on the definition of the order of the and string three.	-	to stategate destructed finals for an all of the state of	2. "Antily the authorities". Cartian is the Housing Health Advancements are indeeded at \$100 1000 to report the index and part and the Visited of action. The year inquest the property and solution in the index and action.		nettermet 1. 1. Certainbeilenderdagen Berd austikensemplatet te yar anderd, diszlengthersachsekalater aus Derdepsynchese dare trasitieren. Begenichet beydet erweidet austerie weberbeitesen 1.		
pergiputitation anal malani pergabutation malani pergabutation malani pergabutation malani pergabutation	health West services Internation Westerpoint Internation	3. "Seed afford different language". If you have I already service and affore requestion part and estimation physical controls parts affore a affore a set on participation affore affore the investment of the affore and the set.		In the construction of the second sec	 The incidence yound". When the incidence is admitted on your individual yound by the order in the sector of the incidence of the		nale bring 1 1. Getation and all strategiest Provided at the second		
utions dance wein piny attention attention to poster. Institution opations to poster. Deact to be opations of the sector		 - question main or another method bud provides provide delivery K.¹ "Central Lond Authorities" > 0 Pricest, Newson Science and regulations regarding back-policidarile and maintenance. Pyror 		non-anter var une endelskicht Beckensendal fande. Department erstellt der aller die gelagen Versensen auf gelasten, pertil versahlter allere all versichtet alleret gelengten, bei versichtet, mannen beschiet der beraut.	namm pored. Temple class in taking a serving dita became and subsystem and means along the Top (10) (derivative production and serving a set of the serving becaming a deal servine, data imported (2)	1	1 Certain the local halfs signations? If your instant sections signer your completely, process related the local halfs input on a section of halfs agains in applications of instants. They may be able to ensure an experimental late action against the local section are supported by an experimental technologies of the section of the section against the local section are supported by the section against the local section of the section of the section against the local section of the section of the section against the local section of the section of the section of the local section of the section of t		
verification, and requests for youri social version, but the landsoft companies remains realizepairs. As the partial		arear download to regard the basis you up contact and advertises, such as the first investigation of the difference of the transplation of the comparison of the program of the distribution works patients where it present.		na para (hipa) nan ara na pini na palara da adar. A hana da da agrangia, ka makat maan himatang hana na (aku)	5.11 Genetic monitograd. ¹¹ . How infinition is subserved year balling of edit, you may have growth infinite functionary althout you by Consult a transit of physicage indices for althout or your specific schedure.		1. Bei legi akter Firenach besiden produ avij var enhel fakte i de oppoptiske for, por op verife somet eihet ausgevendene i terden beset depart. Dey varabler poor par tijde avigtierde lega ater 1.		
ministrative approx.3 manifes, Tenant Incommun. compared budgetinget		 Constant With stating Part ** With the shadow shadow shadow share to an admittanting of admittant share share give sing, with state part on constituent speed states in share of the states of the stat	1	 Sensite Witholds/Fee (with Gudan)²¹ Inserts printing, inserts are official well find and exhibits altern biddening have been inserted at the sense. Here, insert presenting and alternative bidden. 	e par quelle situite. Remaine mait iniciaires ano error ani ni coloniae e marchetices, Britistechiae, Ministerio d'A				
increased for herbit word.			-	antimerial data bili yana ilar pari infrata ina . Pisana yang sena data anti a sistema ina sina yang sena data anti anti anti anti anti anti anti a	Taka akan berpatakan taka tertepat perang pe	1	Remember in language and all communities with pairs matherial and an undergot incommission of default in the Remember Remember granteet, proceeding the technical department in the matherial sector of the sector of the sector of 1. Decement into income Take pictures or interval interval interval and the sector of the sector		
Investment for basic based. Research 1 metal based on the company interaction Transmission of a space of balance of the states and of balance of the states	in hairpologyndian ailtean hairmyndian gudenni ir Leis. Defi naryslan, manial	alter på landet for i alte parter. Hen an som sing spiser tide i salden på landet for i alte parter. Hen an som sing spiser tide		spanne sianan repetingani sotini. Isfiniani, landonis.an	P property data takanan Bernarian yang bahadian sama mamma ani si pandarian promotesian kenang bahadian sama mamma ani si pandarian Data, utakanan kenang bahadian sa sa Data, utakanan kenang bahadian yang bahadian sa		 Desense i Beriman Tatepistem er eineset Bernachm and De ansestere Beyerspennt, especial pisterkisten. Tes ell'ar auszeitenen el Beyeiten. Reine pra mial agreenet. Onei par mial agreenetis. 		
energie in bestehlend. Samere in machinester. Per U rindeten Trant methodogie a partnet indiago au aten energietendation a materieten in beiten and in samere indiagonational dar methodogenetische dar methodogenetische dar methodogenetische dar	In hamplupped and the set of the	where you is an also fair 1 taking and un. Here are non-adapt you can be a allowed in terms. It "These areas if the Politices" Here, a detailed intervent of other you find attacked the markets, any control address you for all whether you find attacked the markets, any control address you for balance if you can be attacked to exclude a set of the politice in the your market if you can all the politices.	App. Rel altern adat 14	providy reported to be being at the period of the latter, that from the backwards of a safety of a sector of the latter is the latter of the l					
meneral for land learning. Remarks in Neural excellings a partners in lands excellings a mean specialization of mean specialization of mean specialization of means of partners in the lands and in a sum of partners in the lands mean specialization of means of the lands and the specialization of means of the lands and the specialization of the specialization of the lands means of the lands and means of the lands means of	In hatepolygon data all reaches reported spations in hete. The heterogeneous polygon data polygon in the polygon register of the polygon register of the polygon heterogeneous data that the polygon of the polygon heterogeneous data that the polygon heterogeneous data the polygon heterogeneou	a data gio data interi ministrato da con terminaria producta de presenta de la construcción y las conditions de la construcción y las conditions de las estas de las construccións de las conditions de las especteurs de las esp	App. An alt - star b star b star b	period y responsible for balance site part in the statistics that the statistic detailed for a statistic of an end of the statistics of the statistic statistics of the statistic of a statistical and parts in the state as in the statistical years are advected as in the statistical part in the statistic of the statistic of the statistical and statistical part temporarised are advected on the statistical part temporarised are advected on the statistical part in the statistical of the statistical and statistical and statistical part in the statistical part in the statistical part is an end of the statistical part in the statistical part is an end of the statistical part in the statistical part is advected on	2 "Repair a impositor". None repair a prolongador la probagay internacional		Protect put mid approved. Onei parterial approvation perfilipsium approximate reporting out out-out-offic andority repeated in the real-transmission optim. Commutication for an institution of the real-transmission optim.		
The sector of th	In hamping public attractions of the second second second attraction of the second sec	The second secon		proval y regensition for shall got the set information of the industry for head in a study of the set of format and using information of only (). The strange meetings pair information and study in the strange study of your and strange study of the strange strange and strange study of the strange strange strange interpretation with the strange strange pairs and the strange strange strange strange of the strange strange strange strange strange strange strange strange strange interpretation strange strange strange strange interpretation strange strange strange strange strange strange strange strange strange strange strange strange strange strange strang	2 "Repeat an important". Non-annexed apentingentian by apendentianal intervinute to document the asserting of the		 Communicationally provided in the state of the matter to par- amilies intrading the mark scheduling and the stops purchase also baselings. Sequent that they take increased as an increa- mater baseling as an approximation of the scheduling and the scheduling participation. 		
Interest in the head head of the second second second seco	patroni in Units. Boy persystems appointed in finishings, Parma Intersection (Internet Internet Intersection) (Internet Inter- preparation density (Inter- Preparation density) (Inter- Preparation density) (Inter- Preparation density) (Inter- Preparation density) (Inter- Preparation density) (Inter- Preparation density) (Inter- pretation density) (Inter- ted density) (Inter- t	In additional to sum (1) "Singurant to the Andress". How you had addition on the data synchronic additional to interact, and any sphere you had addited by part hadded (1) "Singurant to a strain the additional to part of the interaction of products of the strain the strain constitutions on the strain the strain the strain the strain the strain strain the strain the strain the strain the strain the strain (1) "Singurant to a strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain strain the st	lings for adds to adapt to ada	proved properties for a long out by the binding of the pro- ference in status or an effect of neuror () films and the profession and a 4 per sen reference (a) is from a firmed and the model of per sen reference (a) is from a set of perform the status of the status of the status of the status of the model of the status of the status of the status of the of the status of the stat	2 "Repeat an important". Non-annexed apentingentian by apendentianal intervinute to document the asserting of the		 Communicationally provided in the state of the matter to par- amilies intrading the mark scheduling and the stops purchase also baselings. Sequent that they take increased as an increa- mater baseling as an approximation of the scheduling and the scheduling participation. 		
Interest [®] be labeled to the line of the	patroni in Units. Boy persystems appointed in finishings, Parma Intersection (Internet Internet Intersection) (Internet Inter- preparation density (Inter- Preparation density) (Inter- Preparation density) (Inter- Preparation density) (Inter- Preparation density) (Inter- Preparation density) (Inter- Preparation density) (Inter- pretation density) (Inter- ted density) (Inter- t	In additional to sum (1) "Singurant to the Andress". How you had addition on the data synchronic additional to interact, and any sphere you had addited by part hadded (1) "Singurant to a strain the additional to part of the interaction of products of the strain the strain constitutions on the strain the strain the strain the strain the strain strain the strain the strain the strain the strain the strain (1) "Singurant to a strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain strain the st	Reps. Re athra mins. No minster provided	periad representation to data goal to period a feature to the second operation of the second operation of the second operation of the second operation of the second operation of the second operation of the second operation of the second operation of the second operation of the second operation of the second operation of the second operation. The second operation of the second operation of the second operation. The second operation of the second operation of the second operation. The second operation operation of the second operation of the second operation operation of the second operation of the second operation operation of the second operation operation of the second operation operation of the second operation ope	2 "Repeat an important". Non-annexed apentingentian by apendentianal intervinute to document the asserting of the		A. Common level in proceeding in the interaction with an input of the interaction of t		
memory the head endocution. The other indication the set test set of the set	patroni in Units. Boy persystems appointed in finishings, Parma Intersection (Internet Internet Intersection) (Internet Inter- preparation density (Inter- Preparation density) (Inter- Preparation density) (Inter- Preparation density) (Inter- Preparation density) (Inter- Preparation density) (Inter- Preparation density) (Inter- pretation density) (Inter- ted density) (Inter- t	In additional to sum (1) "Singurant to the Andress". How you had addition on the data synchronic additional to interact, and any sphere you had addited by part hadded (1) "Singurant to a strain the additional to part of the interaction of products of the strain the strain constitutions on the strain the strain the strain the strain the strain strain the strain the strain the strain the strain the strain (1) "Singurant to a strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain the strain strain the st	Alexa de activa antes de alexano prostitui	sill dana "i sian arten aler berdeallen yezenerezait be meteremet di tasih departmenti hide, "Dele meteremetid halte department astisate (nPersitore)), "Depart lar alette tequet per queterent ad alter procepter (glica activati	2 "Repeat an important". Non-annexed apentingentian by apendentianal intervinute to document the asserting of the		Communicational proceedings of interest interesting strategy and address interesting two strategies and strategy strategies address interesting two strategies and strategies address interesting two strategies and strategies address interesting and address and strategies address and address in the strategies address and strategies and strategies and address and strategies and strategies and address address and strategies and strategies and strategies and strategies and address and strategies and strategies and strategies and strategies and strategies and		
	quarteren in Anton Support personalitation sectored in the analysis of the sectored in the sectored distance quarter and the sectored and the region of the sectored and the sectored and region of the sectored and the sectored and region of the sectored and the sectored and region of the sectored and the sectored and the indistort and the sectored and the indiscontinue?	A minimum set of the second se		All densels lakes a first the share the process section films and a section of a field in department in Table (Data, and accounted and in department and a first frequency). They all the data impacts para quaterant and advice process para (qbits and securit Metric arcs and all first and an account that reaging help (all	2 "Repeat an important". Non-annexed apentingentian by apendentianal intervinute to document the asserting of the		Communicational proceedings of interest interesting strategy and address interesting two strategies and strategy strategies address interesting two strategies and strategies address interesting two strategies and strategies address interesting and address and strategies address and address in the strategies address and strategies and strategies and address and strategies and strategies and address address and strategies and strategies and strategies and strategies and address and strategies and strategies and strategies and strategies and strategies and		
meneric benefacione de la construcción de la constr	quarteren in Anton Support personalitation sectored in the analysis of the sectored in the sectored distance quarter and the sectored and the region of the sectored and the sectored and region of the sectored and the sectored and region of the sectored and the sectored and region of the sectored and the sectored and the indistort and the sectored and the indiscontinue?	A minimum set of the second se	Canal II Marina	minimum site in the set of the formation genus means if the minimum site is also also also performed in the collection of the address performed within the Protein site in the set of the set of the set of the set of the Protein set of the set of the set of the set of the set of the Protein set of the set of the set of the set of the set of the Set of the set of	2 "Repeat an important". Non-annexed apentingentian by apendentianal intervinute to document the asserting of the		D. Semiconstant provides of being of the set of the		
Example States Example States E	particular in facts they mainly and the second second second second description in the second		Canal II Marina	minimum site in the set of the formation genus means if the minimum site is also also also performed in the collection of the address performed within the Protein site in the set of the set of the set of the set of the Protein set of the set of the set of the set of the set of the Protein set of the set of the set of the set of the set of the Set of the set of	2 "Repeat an important". Non-annexed apentingentian by apendentianal intervinute to document the asserting of the		Entropy of the sector of		
Landstand Marken Standstandstand Marken Standstandstandstand Marken Standstandstandstand Marken Standstandstandstand Marken Standstandstandstandstand Marken Standstandstandstandstandstand Marken Standstandstandstandstandstandstandstands	particular in facts they mainly and the second second second second description in the second		Canal II Marina	minimum site in the set of the formation genus means if the minimum site is also also also performed in the collection of the address performed within the Protein site in the set of the set of the set of the set of the Protein set of the set of the set of the set of the set of the Protein set of the set of the set of the set of the set of the Set of the set of	2 "Repeat an important". Non-annexed apentingentian by apendentianal intervinute to document the asserting of the		Comparison of the the strength and streng		
	particular in facts they mainly and the second second second second description in the second		Canal II Marina	minimum site in the set of the formation genus means if the minimum site is also also also performed in the collection of the address performed within the Protein site in the set of the set of the set of the set of the Protein set of the set of the set of the set of the set of the Protein set of the set of the set of the set of the set of the Set of the set of	 The state state of the state of		Comparison of the the strength and streng		
	particular in facts they mainly and the second second second second description in the second		Canal II Marina	minimum site in the set of the formation general research of the set of the set of the and the general set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the New set one additional measurement of the set of the New set of the set of the set of the set of the set of the New set of the set of the set of the set of the set of the New set of the set of	 Second State Stat		Comparison of the the strength and streng		
	eperateria (Salarian) Sector (S		Oceand on according National States National States States on a state of the states of	An and the source the source and an an an angle of the source of the sou	 Second State (Second State (Sec		Comparison of the the strength and streng		
generate scheding zur auf bei der sche Scheding schedung - matter scheding schedung - matter schedung - schedung - schedu	eperateria (San San San San San San San San San San		Oceand on according National States National States States on a state of the states of	An and the source the source and an an an angle of the source of the sou	 Second State (Second State (Sec		Comparison of the the strength and streng		
egention of solid process of the solution of the solid process of the solid process of the solid process of the solid process of the solid proces of the solid proces of the solid process of the solid pr	eperateria (San San San San San San San San San San		Oceand on according National States National States States on a state of the states of	An and the source the source and an an an angle of the source of the sou	 Second State (Second State (Sec				
generate scheding zur auf bei der sche Scheding schedung - matter scheding schedung - matter schedung - schedung - schedu	eperateria (San San San San San San San San San San		Oceand on according National States National States States on a state of the states of	An and the source the source and an an an angle of the source of the sou	 Second State (Second State (Sec				
generate scheding zur auf bei der sche Scheding schedung - matter scheding schedung - matter schedung - schedung - schedu	eperateria (San San San San San San San San San San		Oceand on according National States National States States on a state of the states of	An and the source the source and an an an angle of the source of the sou	 Second State (Second State (Sec				
generate scheding zur auf bei der sche Scheding schedung - matter scheding schedung - matter schedung - schedung - schedu	eperateria (San San San San San San San San San San		Oceand on according National States National States States on a state of the states of	An and the source the source and an an an angle of the source of the sou	 Second State (Second State (Sec				
generate scheding zur auf bei der sche Scheding schedung - matter scheding schedung - matter schedung - schedung - schedu	eperateria (San San San San San San San San San San		Channel in Marchael M		 Andream Schlerich, S				
generate scheding zur auf bei der sche Scheding schedung - matter scheding schedung - matter schedung - schedung - schedu	eperateria (San San San San San San San San San San		Canad m Canad m Services Marking Marki		 Andream Schlerich, S				
generate scheding zur auf bei der sche Scheding schedung - matter scheding schedung - matter schedung - schedung - schedu	eperateria (San San San San San San San San San San		Canad m Canad m Services Marking Marki		 Andream Schlemann, S				
generate scheding zur auf bei der sche Scheding schedung - matter scheding schedung - matter schedung - schedung - schedu			Count in any of the second second second sec		 Andream Schlemann, S				
generate schedigener auf bei werden Schedig, schedigener auf bei werden schedigener auf bei schedingen schedingen schedigener auf bei schedingen sc			Count in any of the second second second sec		 Andream Anternational Anternati				
generate scheding zur auf bei der sche Scheding schedung - matter scheding schedung - matter schedung - schedung - schedu			Count in any of the second second second sec		 Andream Anternational Anternati				
generate scheding zur auf bei der sche Scheding schedung - matter scheding schedung - matter schedung - schedung - schedu					 Andream Anternational Anternati				
	eperateria (San San San San San San San San San San				 Andream Anternational Anternati				