

CAPSTONE PROJECT: AI AGENT CREATION

SELECTED OPTION: RESEARCH ASSISTANT AGENT

RESEA

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Course: ITAI2376 Deep Learning AI

Deliverable: Final Report

INTRODUCTION

In today's information-rich world, the sheer volume of available data can be overwhelming for researchers, students, and professionals alike. **Resea**, a Virtual Research Assistant, was developed as an innovative tool to automate and streamline the research process. Its goal is to help users quickly gather relevant information on a given topic, generate summaries from credible sources, and produce structured research reports. By leveraging advanced technologies such as Natural Language Processing (NLP), machine learning, web scraping, and summarization techniques, Resea aims to make research more accessible and efficient.

This report outlines the journey of developing Resea, from the initial challenges faced, the solutions implemented, and the final working product. It also reflects on the technical insights gained during the process, the difficulties in working with Azure due to limited coding experience, and future improvements.

PROJECT OPTION

Research Assistant Agent - "Resea":

Justification: This option was selected due to its broad applicability and potential to transform how individuals conduct research. Unlike narrower tools (e.g., citation generators), this agent offers an end-to-end solution—retrieval, summarization, evaluation, and reporting—making it a versatile assistant. It aligns with the mission to accelerate human scientific discovery by automating foundational research tasks.

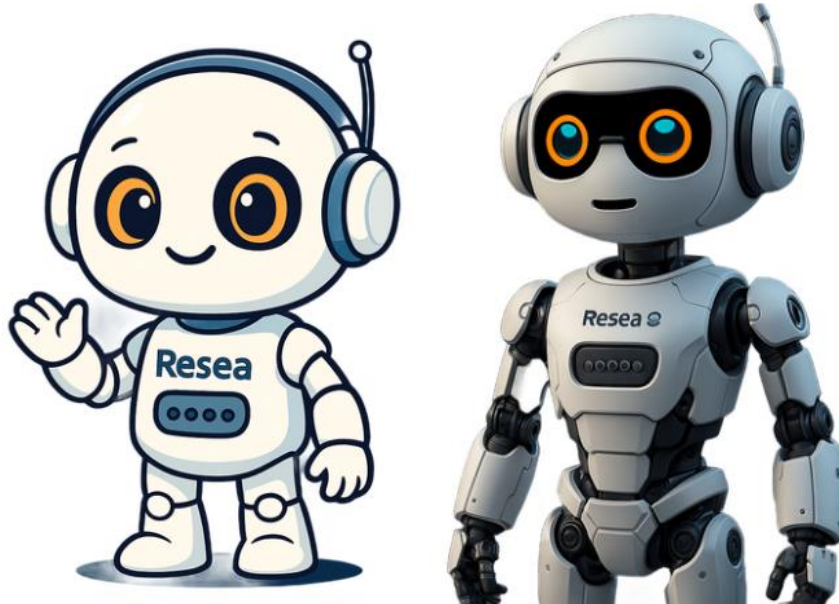
Focus Areas: The project will emphasize (1) topic-based information retrieval from diverse sources, (2) accurate summarization using NLP, (3) credibility assessment of sources, and (4) structured report generation with citation support. These aspects ensure the agent meets academic and professional standards while remaining user-friendly.

BRANDING

Name: Resea (pronounced "Re-see")

- *Short-form of Research and Re-see illustrates the meaning.*

Brand Persona: *Have created one **animated** and one real-life **Robo** mascot to relate to the right target audience*

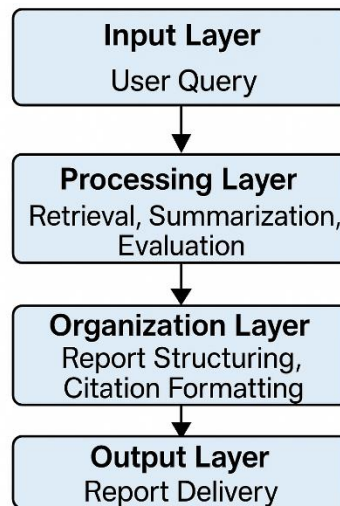


AGENT DESIGN

Main Components:

- Input Layer: Accepts a topic via text input (user query)
- Processing Layer:
 - Retrieval Module: Gathers data from web APIs and user uploads.
 - Summarization Module: Condenses content using NLP models.
 - Evaluation Module: Scores source credibility and relevance.
- Reasoning Component:
 - Report Generation through the structures findings and citations.
- User Interface / Output Layer: Accepts inputs and delivers outputs.

Architecture Diagram:



Resea Pattern: It follows ReAct (Reasoning + Acting) pattern with memory, responding to user queries while storing past interactions to refine future outputs (e.g., learning preferred citation styles). It will reason source quality and acts by generating a report.

Processing: Inputs (e.g., topic, preferences) are processed by fetching data, summarizing it, evaluating sources, and organizing results into a report. Outputs are delivered as text or interactive displays, with citations formatted per user specification.

TECHNOLOGIES USED

1. Hugging Face's Transformers: Utilized for NLP tasks like text summarization using models such as BART and T5.
2. SerpAPI: Allows performing Google searches and retrieving information from trusted sources.
3. Newspaper3k: Extracts article content from URLs for summarization.
4. Gradio: Used to build an interactive web interface for the research assistant.
5. Python-docx & ReportLab: Libraries used to generate reports in DOCX and PDF formats.
6. LXML: Used for web scraping and parsing HTML content from web pages.

CHALLENGES FACED

1. **Lack of Coding Experience:** One of the main challenges during the development process was the lack of extensive coding experience, especially when integrating various technologies and building a seamless workflow. As someone who wasn't highly familiar with coding and programming practices, I faced hurdles in understanding the nuances of libraries, APIs, and the overall development process.

Solution: To overcome this, I spent considerable time learning Python libraries, reading documentation, and participating in online forums to resolve errors. The knowledge gained from the Deep Learning AI course helped improve my understanding of the technologies used in the project, but more time was needed to feel comfortable working with the code. By dedicating additional hours to practice coding and debugging, I was able to get Resea to a functional state.

2. **Initial Attempt at Using Azure:** In the beginning, I tried to deploy Resea on Microsoft Azure, hoping to utilize its powerful cloud infrastructure to manage the application's backend. However, due to my limited experience with cloud computing and deployment, I quickly ran into issues with understanding the environment, configuring services, and managing resources. Azure's complex setup, combined with a limited time frame and credits, resulted in wasted time and resources.

Solution: After several unsuccessful attempts to deploy Resea on Azure and facing significant difficulties with services such as Azure Bot Services, I decided to resort back to Google Colab. The familiarity of Colab and its simplicity allowed me to continue development without the added complexity of cloud infrastructure. Additionally, Colab provided a free environment for testing the core functionalities of Resea, allowing me to focus on building the research assistant without worrying about deployment costs.

3. **GitHub Upload Issues:** Once I had a working version of Resea, I attempted to upload it to GitHub. However, I encountered an error when trying to upload the Jupyter notebook: "The notebook is invalid and is missing an expected key: cells." This error occurred due to the absence of certain metadata in the notebook, which GitHub required for rendering.

Solution: The issue was resolved by installing the required Python packages (nbformat==4.2.0 and ipywidgets) to handle the notebook's metadata correctly. After installing the necessary packages, I was able to upload the notebook successfully and continue with version control and collaboration. The solution to this issue allowed the project to be shared with others for feedback and improvement.

```
bash  
  
pip install nbformat==4.2.0 ipywidgets
```

4. **Working Solo on the Project:** As a solo project, developing Resea was particularly challenging. Managing the research, development, and deployment on my own meant that I had to juggle different tasks and frequently switch between learning new technologies, debugging, and testing features. This led to moments of frustration, especially when dealing with integration issues or understanding concepts I had never worked with before.

Solution: Despite the challenges, this solo project also provided valuable learning experiences. I gained a deeper understanding of the technologies involved and became more confident in my ability to work independently. By taking one step at a time and breaking down the development process into smaller milestones, I was able to complete the project successfully.

5. **Library and Dependency Issues:** Throughout the development, I encountered several issues related to dependencies and conflicting versions of libraries, such as lxml and

serpapi, which caused import errors and prevented certain functionalities from working as expected.

Solution: These issues were resolved by carefully reading the error messages, researching solutions online, and installing the required libraries with specific versions. Ensuring the correct dependencies were installed allowed Resea to function without errors related to missing modules or incompatible library versions.

```
pip install lxml[html_clean] google-search-results
```

CORE FEATURES OF RESEA

1. **Web Search and Summarization:** Resea automatically searches the web for relevant articles on a given topic. It retrieves information using SerpAPI for Google searches and Newspaper3k for extracting text from the URLs. After extracting the content, it summarizes the text using the BART model from Hugging Face's transformers.
2. **Report Generation:** Resea generates formatted research reports based on the gathered information. The reports are structured into the following sections:
 - **Topic Overview:** A brief introduction to the topic.
 - **Summarized Web Articles:** Summaries of the top articles retrieved from the search results.
 - **Citations and References:** Credible references from trusted sources.
 - **Reports are created in DOCX and PDF formats for ease of use.**
3. **User Interface:** The user interface of Resea is built with Gradio, offering a simple, intuitive design. Users can input their research topic, and Resea will provide a downloadable research report in seconds. The interface is easy to use, even for those with no technical background.

DEPLOYMENT

After several attempts to deploy Resea on Azure, I decided to move the deployment process to Google Colab. Colab provided an excellent environment for testing the functionality of Resea without the overhead of managing cloud infrastructure. The application is now available as a web app, where users can interact with Resea and generate reports.

GITHUB WORKSPACE

<https://github.com/AbdullahFaiza/Deep-Learning-Spring-2025/tree/main/CapstoneProject/Colab>

FUTURE IMPROVEMENTS

Despite successfully deploying the project, I aim to improve **Resea** further:

- Reattempting Deployment on Azure: I plan to revisit deploying Resea on Microsoft Azure and create a Bot that will allow users to interact with Resea directly through messaging platforms.
- Improved Summarization: Integrating more advanced NLP models for better text summarization and paraphrasing.
- Multi-User Support: Adding collaborative features that allow multiple users to work on the same research project simultaneously.

CONCLUSION

Building **Resea** has been a rewarding experience, despite the challenges faced along the way. The journey from struggling with Azure deployment to learning Python libraries, resolving GitHub upload issues, and finally achieving a working solution was both challenging and insightful. The project helped me grow both as a developer and a researcher. Resea is now a functional tool that automates the research process, and I look forward to further improving and deploying it at scale.