Department of Computer Science

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Content building with ontology assisted domain-specific searching

(Volume 1 of 1)

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Abstract

This system aims to offset the insufficiency of existing search engine that existing searching engine is unfriendly to user who know nothing about a certain topic. It aims to provide a new of searching experience for user which make online self learning more feasible. This project successfully achieve this target in some way. It provide a better searching and learning experience to user by providing domain-specific knowledge search with the help of ontology. Also, providing a text summarization under the search result allow the user have a quick preview of what the website is about. It could also enchance the searching experience of user. Most importantly it allows user to could learn a topic that they have no prior knowledge in more in-depth and concrete when compare to existing search enigne.

The above aims is achieved by applying ontology into the system and allowing user to search for the knowledge they do not have any prior knowledge in. The system built is test and show that it could achieve these aims.

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1. Introduction
1.1 Background

In this Information Age, we could browse anything we want on the Internet: news, academic knowledge, Etc. Data and information are more accessible than in past decades. However, it is found that there would be 463EB data created in every day by 2025 [1]. How could we find the data we want through this large amount of data? It is impossible for us to check through all data one by one and even we do have the time, we are missing a tool or medium to gather the information we need. Therefore, in past decades, “search engines”, like Google and Yahoo, have come into play.

Search Engines allows finding of information or data by typing in keywords in the search bar. They provides a platform or tool which help people to gather scattered information. They become popular when it comes out and become the common tool when everyone wants to find information on the Internet. In 2012, the most popular search engine, Google, already processed 3.3 billion search queries per day [2]. In 2017, there were 6.5 billion searches a day and 4.4 billion searches were using Google [3]. The huge increase in the amount of search queries show that search engine became more widely used and how they are changing everyone life. Also, it was found that 91% of adults online were using the search engine [4]. This shows how search engines change people’s lives and the usage of the Internet.

With the rapid increase in data and information available on the Internet and the appearance of the search engines, searching for academic knowledge and online learning became more feasible. Everyone could learn new things by typing the keyword in the search bar and hundred, thousand or even million results would be found so one of them must satisfy the

user's needs. In research done by Apuke and Iyendo [5], nearly 90% of students interviewed claim that they use the Internet for academic purpose and 84% of the interviewees agree that the use of Internet improved and is improving their academic research and learning [5]. Most interviewees in another piece of research also notice that they use Internet to find information that they want to learn [6]. It proves that the Internet improves or even creates a new way for us to learn. Beside from that, there are some universities and colleges trying to build online repositories and inviting professors to put the copies of their work, such as research paper and data sets, online which agree more academic resource would be available on the Internet [7]. From the above cited data, it seems that learning online using the Internet can be accomplished with the help of search engines.

All in all, search engines provides a different way for us to learn. It makes online learning become more feasible.

1.2 **Existing Problem**

Existing search engine, like Google and Yahoo, they accept user inputted keywords and make the search according to it. It searchs for related results containing that keyword. However, it will produce a problem: What if I know nothing about the thing I want to learn?

For example, if I was a student who wanted to learn something in Computer Science but know nothing about it. By typing "Computer Science" in the search bar of search engine will only return the result containing the keyword "Computer Science" or its definition instead of the thing which is really the target knowledge like Algorithm, Programming Language Etc. Due to that, if I really want to learn new concepts in Computer Science, I need to do in the traditional way:

1. Go through the search results of the keyword "Computer Science" slowly

2. See whether a new concept is mentioned in that result
3. Repeat step 1 and 2 until a new concept is found
4. Type the keyword of new concept into the search engine again
5. Go through the new results and Finally learn a one new concept in Computer Science.

We can see that it would be time-consuming and inefficient to learn a new thing from the above example. It reflects the disadvantage of existing search engines when it come to the situation when we know nothing about a topic, and we want to learn something new in it. We need to find a way to solve this problem so that learning online could be more feasible.

1.3 **Solution to the problem**

To solve the problem mentioned in the above sub section, Ontology is one of the ways which could achieve that. An ontology is a thing that give an explicit specification of a thing and its instance. It lets us know how different terms are related or not related to each other [8]. For example, we could find out that Red Wine and White Wine are an instance of Wine under an ontology.

By applying ontologies, the search result of the instances of the keyword could also be shown. Then, users do not need to know anything about the topic, and they could still find the concept under specific topics.

1.4 **Scope**

This project will mainly focus on English as there is not enough time and manpower to process all languages around the world.

For the building and using of ontology, existing ontology which be found would be used. If building of ontology is needed, the ontology on University subject would be built first (if it does not exist) due to insufficient time and human power to build all ontologies for English phrase.

1.5 **Objective**

This project aims to provide a search assistant which helps to improve existing search engines. It aims to provide a platform which helps user to learn new concepts without any knowledge in it. It tries to make online learning more efficient and feasible.

1.6 **Deliverables**

A website application which provide a search function.

1.7 **Report Organization**

In this project, I will first conduct a literature review on related ideas. Then, it will be the methodology part which will introduce the tools and technologies used. Design of the system will also be discussed in this part. After that, for implementation part, it will introduce how the system is built. Then, it will be the evaluation part which will try to produce the testing result of the system. Finally, it will be the conclusion part which will conclude the whole project and discuss any further improvement which could be carried out.

2. Literature Review

2.1 **Review of Ontology**

[8] claimed that ontology could give an explicit specification of a thing and its instance. It lets us know how different terms are related or not related to each other. [9] made a clearer definition on ontology saying that the relations in ontologies are “inheritance” which could

provide the information about which vocabulary is a “sub-concepts” of a general one. [10] also give the same opinion that ontology could provide a vocabulary that can be used for representing and communicating knowledge about a specific topic and the relationships that share the same concept of that vocabulary. [10] also try to apply ontology into a domain specific semantic web search engine to improve the search results. It tries to make the search engine be “smart” enough to search also for the instance of a single phrase.

However, although the attempt of Mukhopadhyay, Banik, Mukherjee, Bhattacharya and Kim [10] could make the search results become more diverse and not only focus on a specific keyword, it still combines all results in a single column like traditional search engines which is not user-friendly. Users are still required to go through each result which is time wasting and inefficient.

Therefore, this project tries to apply the ontology in a different way which could categorize the search. It tries to optimize the advantage of ontology and reduce the time waste in searching for new knowledge and make online learning become more efficient.

2.1.1 Ontology Learning

“Ontology Learning” refer to the process of ontology construction and building [11].

There would be situation that a keyword does not exist in an ontology tree. Sub-Concept of it could not be found. There is a need for auto/semi-automatic building or extending of ontology tree for this project.

[12] shows the possibility of using statistic way to build a ontology tree for a specific keyword. The method [12] used is gathering a huge number of web document for a specific keyword using existing search engine. Then, the content of the web content is scrapped and statistic calculation is performed on these web documents. Finally, potential concept within a threshold would be chosen as the sub-domain knowledge of the searched keyword. After that, the ontology learning process would keep continue for the sub-concept under the defined depth is reach. The result of the built ontology is feasible and it could reach a considerable accuracy. However, there is still a fatal disadvantage that some unrelated/common word would also be included in the ontology tree.

Therefore, in this project, a similar approach of [12] would be done for ontology learning but it would be semi-automatic instead of fully automatic. The automated built ontology would be tuned by man-power to achieve a higher accuracy.

2.2 **Summarizing Website**

In this project, the search results return by the website will show a brief description of the content of each website. Therefore, the tools and methods used in the summarizing process will be reviewed below.

2.2.1 **Review of NLP Library**

There are many NLP library in the market and performance of them vary. [13] has made a comparison between some NLP library in the market:

1) Google's SyntaxNet
2) Stanford CoreNLP Suite
3) NLTK Python Library
4) spaCy

As shown in [13]'s result, spaCy perform the best among other selected NLP library. spacCy is a NLP written in Python and Cython which become the best suit for this project. Therefore, spaCy would be used in the project.

2.2.2 **Review of Methods of Features Extraction**

2.2.2.1 **title method**

Title method is method that give higher weighting on the word appear in the title. Higher score would be given to sentence in passage which contain those word in title. [14]

This method would not be suitable for this project as there may not be any topic in some of the website.

2.2.2.2 **tf-idf method**

tf-idf is a statistic method of calculating how important a word is. The weighting score of a word will increase if the word appears more in a passage. The increase in score will be proportionally to the frequency of the word appear. The score will be offset with some text corpus to check if it appears more or less than usual in a document. [15]

This method is more suitable for this project as it calculates the score of a keyword by its frequency only which could handle website that contain less word or without title. Also, this method is suitable for this project as this project is working on search engine which aiming to find for "keyword". If the keyword appears frequently in a website, the website is more related to the search. Therefore, tf-idf method is the best suit for this project.

2.2.3 **Review of Text Summarization**

2.2.3.1 **Abstractive Text Summarization**

Abstractive Text Summarization is a text summarization method which will generate a summary of an article provided. The summary generated is not done by only extracting some sentence or word from the passage and form them together. Abstractive Text Summarization will generate the summary by rephrasing the sentence and produce a whole new paragraph base on its understanding of the passage. This method would use some word does not appear in the provided passage. [16]

Although this text summarization method is more accurate than the other one going to be mentioned, it takes time and very difficult to implement. As this project's focus point is not text summarization, a simpler text summarization method would be chosen in this project.

2.2.3.2 **Extractive Text Summarization**

Extractive Text Summarization is a text summarization method which will generate a summary of a passage based of the keyword found. Extractive Text Summarization would try to find the important sentence in the passage and directly form the summary by this sentence without any rephrasing which differ from Abstractive Text Summarization mentioned above. [17]

Although Extractive Text Summarization method is less accurate than Abstractive Text Summarization method, it is easier to implement. As this project is not focusing on text summarization, Extractive Text Summarization method would be used to save time for this project focus point.

3. Methodology & Resources

In this project, a prototype will be done to proof the concept proposed. The following is the design of the project and how the prototype will be test.

3.1 Technology and Design

3.1.1 Software

Library: Owlready2, spaCy, React, BeautifulSoup

3.1.2 Programming Language

For the Backend System, while most of the library used are written in Python, the backend system will be written in Python.

For the Front End, the traditional language will be used: HTML, CSS, Javascript. While there will be many repeated modules when showing the search result. React, which can help to module the result block, will be used.

3.1.3 Query Handling and Constraint on Query

When the user type in a query and press search, the query entered will send to backend and start processing the query. It would extract the keyword from query and get all the sub-concepts of the keyword by ontology. Then, building search queries based on the selected constraint and feed the queries into existing search engine.

3.1.3.1 Query Keyword Extracting

When user input a query, it is not sure that if user will input only a keyword or not. Processing on the search query is need. For example, when a user wants to search knowledge for Computer Science, he/she may not directly input “Computer Science” as a query. He/She may input “What is in Computer Science?”. From this query, we should extract the keyword

“Computer Science”. On the other hand, the system also should not extract the keyword as “Computer” and “Science” which separate the exact keyword.

Therefore, before any processing with any ontologies tree, keyword extracting will be done first. For achieving this, the NLP library, “spaCy”, will be used here. SpaCy contain a linguistic feature called, “Noun Chunks” which would help to find out the key noun phrase. This function helps to find noun plus the words describing the noun. After processing the query input by the user, we may know what keyword to search for and could continue to next stage.

3.1.3.2 Domain Specific Search

When a user is performing a search, sometimes they may want to search a for specific domain of knowledge. For example, user may only want to learn the knowledge of “machine learning” and “artificial intelligence” under “Computer Science” but not all domain knowledge of “Computer Science”

Therefore, in this project, the website would have a column called Advanced search which allow user to specify the exact domain they want to search for. When user search for a keyword, a list of sub-domain specific knowledge would be return. Then, user could choose the specific sub-domain knowledge they want to search for. Finally, only search result for the chosen domain specific knowledge would be return.

3.1.4 Ontology

Using of the ontology will happen after the keyword extracting step. After all the sub-concepts of the keyword are got, the system will feed all the found sub-concepts into the process of building query for domain specific search.

3.1.4.1 Finding Ontology

While this project is based on ontology, finding of ontologies are needed. Some website providing the searching for ontology, like “Ontobee” (link: http://www.ontobee.org/), would be used.

3.1.4.2 Ontology Learning

There would be situation that a keyword is not exist in the ontology tree, and no sub-domain knowledge of that keyword could not be found. There is a need for the system to have a auto/semi-auto way of building/extending the ontology tree.

3.1.4.3 Handling Ontology

While the Ontology file are usually huge and in different data format, such as OWL and RDFS, a tool is needed to handle these ontologies file.

Therefore, in this project, the Python library, “Owlready2”, would be used in the help of handling the ontologies. Owlready2 allow importing of ontologies in NTriples, RDF/XML and OWL/XML format. Also, Owlready2 could help with looking through all relation in the complex ontologies. More than that, Owlready2 provide a searching function which could help with quickly locate an entity inside an ontologies tree. Beside the mentioned function, Owlready2 still have more functions which help with the handling of the ontologies. Therefore, the Python library “Owlready2” is the best suit for this project.

3.1.5 Text Summarization

Text Summarization would be done after getting the search result from the system. It would first use a scrapper to get the content of the website. Then, it would perform the summarization process and finally return back to front end (website) to show the result to user.

3.1.5.1 Web Scrapper

While we need to get the content of a website in order to do the text summarization, a scrapper is needed to check the html tag of a website and get the main content of the website.

Therefore, the Python Library, “Beautiful Soup” would be used to help get the job done. Beautiful Soup is a html parser which can help in getting a website’s content including the html tag. By using it, we could know the title of the website and get the content of it which will be used for summarization.

3.1.5.2 Summarization

Before summarization of the content, there would be some process of the content first. SpaCy would first be used in tokenizing the content of the website. Then, TF-IDF would be used to weight the importance of the words. After that, an Extractive Summarization would be done based on the weighting of the word.

3.1.6 System Flow Chart

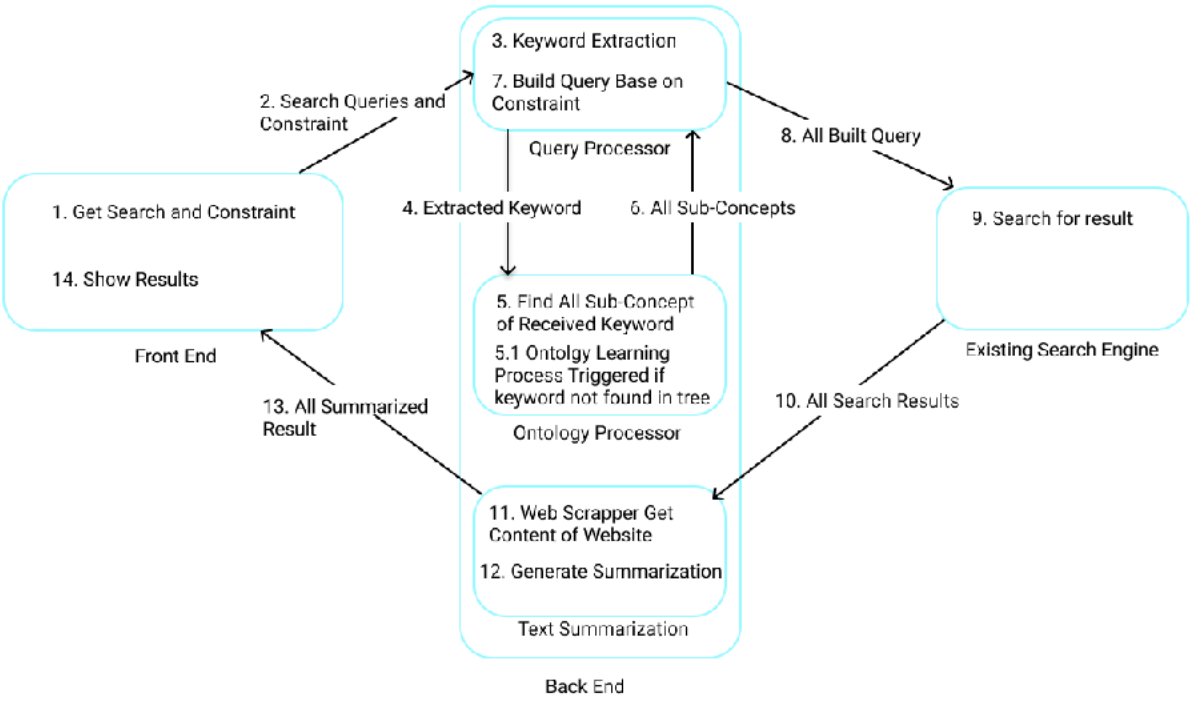

Figure 3.1 A system flow chart

1. The user type in the thing they want to search for (i.e. Query) and choose the domain specific constraint

2. When the user press search, the query and constraint got will be pass to the query process stage in the backend system.

3. In the Query Processor, it extracts the keyword from the query got.

4. After the keyword extraction is done, the keyword got will be passed to the Ontology processing stage.

5. In the Ontology processing stage, the system will find all the hyponyms and sub-concepts of the keyword got.

    5.1. Ontology Learning Process would be trigged if the keyword is not found in the ontology tree

6. After all the hyponyms are found, the sub-concept keywords will be passed back to the query processor

7. When the query processor receives all the hyponyms, it will build all the real query based on the constraint got in step 2.

8. After the query building is done, it will pass all the search queries to existing search engine.

9. The search will be done by the existing search engine

10. The search result will be passed to the text summarization stage in the backend system

11. When the text summarization processor receives the search result, it will loop through the search results and use web scrapper to get the main content of the website.

12. Summary of each website will be generated based on the main content got in step 11.

13. All search results with their summary will be passed to the frontend

14. The frontend will show all the search result and summary got.

3.1.7 Use Case

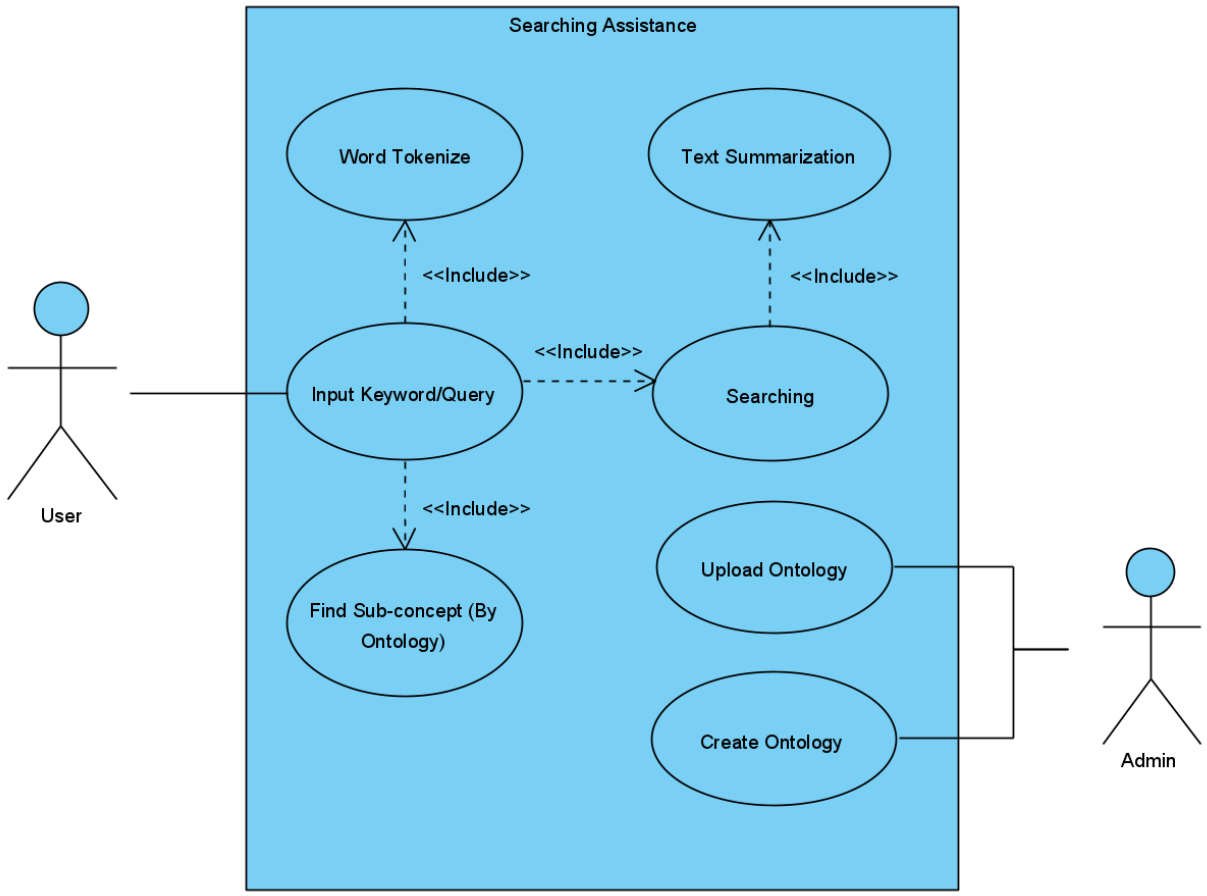

Figure 3.2 A use case diagam of the system

3.1.8 Block Diagram

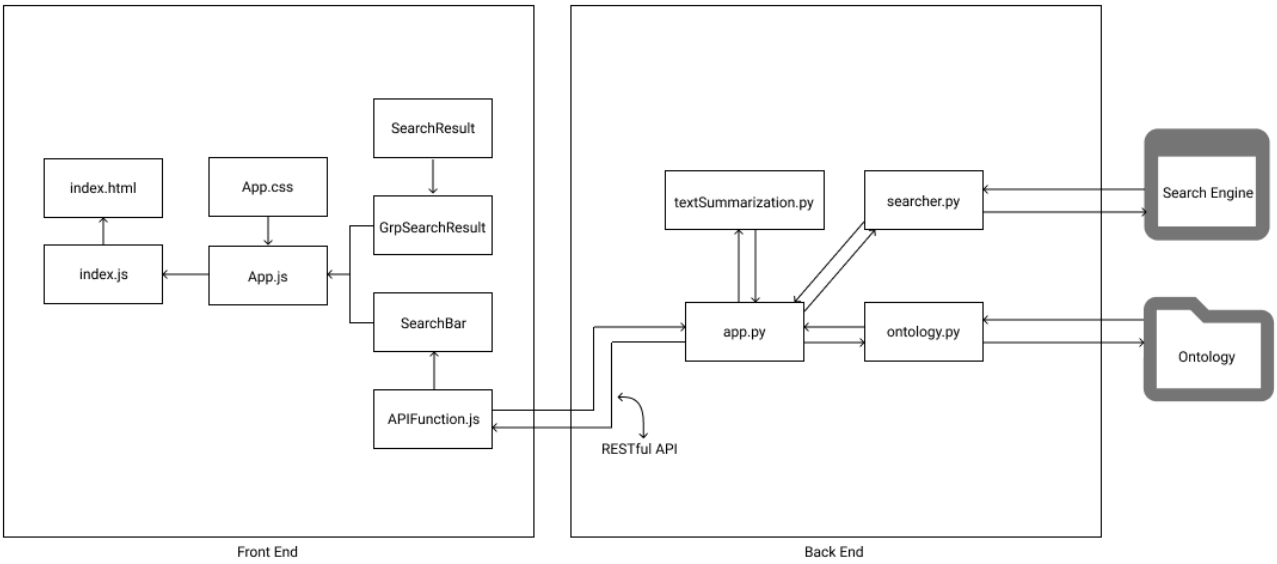

Figure 3.3 A block diagram of the system

The above block diagram shows the structure of the system.

In frontend, it provides a user interface for user to input their search query and view the search result return by the backend. All API function call would be put in “APIFunction.js”. All search would generate as “SearchResult.jsx” and grouped by “GrpSearchResult.jsx”. Finally, all component would be put in “App.js” and generate into a virtual DOM which show to user.

In backend, it is acting as a RESTful API server which would response to http request from the frontend, which is the search query. Classes are divided into different py file relate to their functionalities. “textSummarization.py” would provide the function of finding the keyword from the query and summarizing the content of each search result. “searcher.py” would provide the function of accessing existing search engine and get the search result of every keyword fed. “ontology.py” would provide the function of finding all sub-keywords of the keyword provided from the ontology trees. “Ontology.py” would perform the ontology learning process if the keyword search is not in the onotolgy tree.

The communication method between frontend and backend is RESTful API.

3.2 Testing Method (Test Case in Appendix)

3.2.1 Searching

3.2.1.1 Query Keyword Extracting

By Entering Some Long Query, like “I want to learn Computer Science”, testing if the system can extract the keyword, “Computer Science”. In the testing procedure, a set of long queries with expected output will be provided to test the accuracy of the system.

3.2.1.2 Domain Specific Search

Before clicking the search button, some domain specific requirement will be chosen. In the testing procedure, checking if the system can return the required result base on the domain specific requirement.

3.2.2 Text Summarization

A long passage will be fed into the text summarization system and the returned summary will be tested. A set of passages with expected keyword in summary will be provided to test if the system be able to generate a summary with correct key point.

3.2.3 Ontology Learning

There dose not have any standard way of testing an ontology tree. Therefore, in this project, the ontology tree built would test against existing ontology tree or published book in the market.

3.2.4 Overall Testing

1. A group of interviewees would be asked to learn the new concept “Artificial Intelligence”. The group of interviewees would be divided into two. Half of them would be using existing search engine and half of them would directly use the system built. After that, all interviewee

would be asked the question 1 [Appendix 2.4]. It is used to check if the knowledge learnt by user is different between existing search engine and the tool built.

2. The remaing interviewees who have not tried the system would be asked to use the system built. Then, all interviewees would be interviewed about their using experience of the system built by asking the question 2-6 [Appendix 2.4]. This part try to examine if the system could enhance the online-learning experience of user when compare to existing search engine.

While trying to prove the feasibility of the system, a pre-built ontology about “Computer Science” [18] is used in these two stage. The automated built ontology process is examine separately and would be interviewed in following step

3. The interviewee would be asked to use the system again. This time user need to search for domain knowledge that they know well and does not exist in the ontology tree. Then, question 6-7 [Appendix 2.4] would be asked. This part tries to examine how well the automate generate ontology process perform.

4. Implementation

4.1 The Prototype

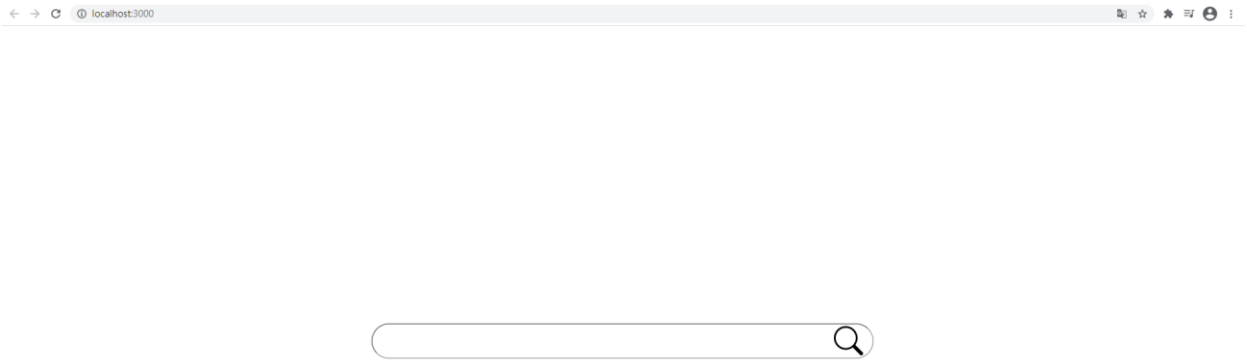

Figure 4.1 The initial web page of the system

In initial page, user need to input the concept they want to search in the search bar. For example, concrete search query as “Computer Science” or long query as “What is Computer Science”. After the search query is sent to the server, keyword from search query would be extracted. Then, a list of sub-domain knowledge under the keyword is return and show on page.

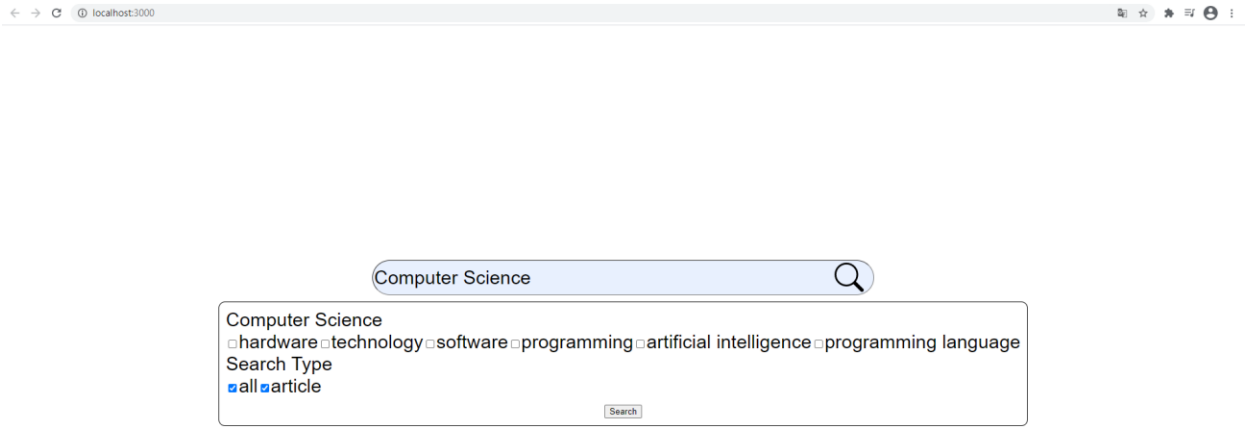

Figure 4.2 The web page after user search for a keyword

The list of sub-domain knowledge is generated from ontology tree. If the keyword or its sub-domain knowledge do not exist in the ontology tree, an ontology learning procedure would occur.

User could choose the specific domain of knowledge they want to searh for on the sub-domain knowledge filter list. When the user press the “search” button in the filter list, the server would start garthering the search result of the keyword and the chosen specific domain of knowledge. Also, a text summarization would be generated for each search result.

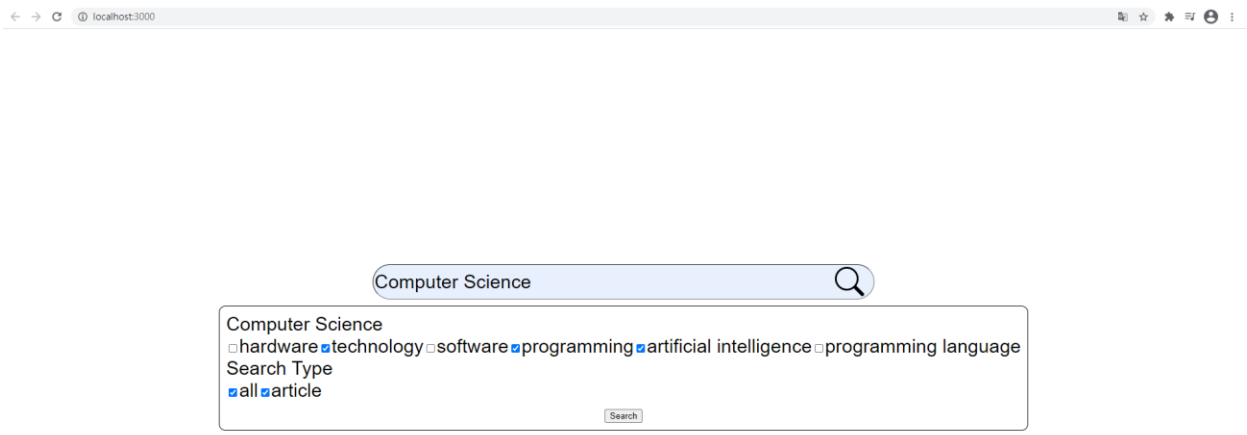

Figure 4.3 The web page when user choose specific domain knowledge

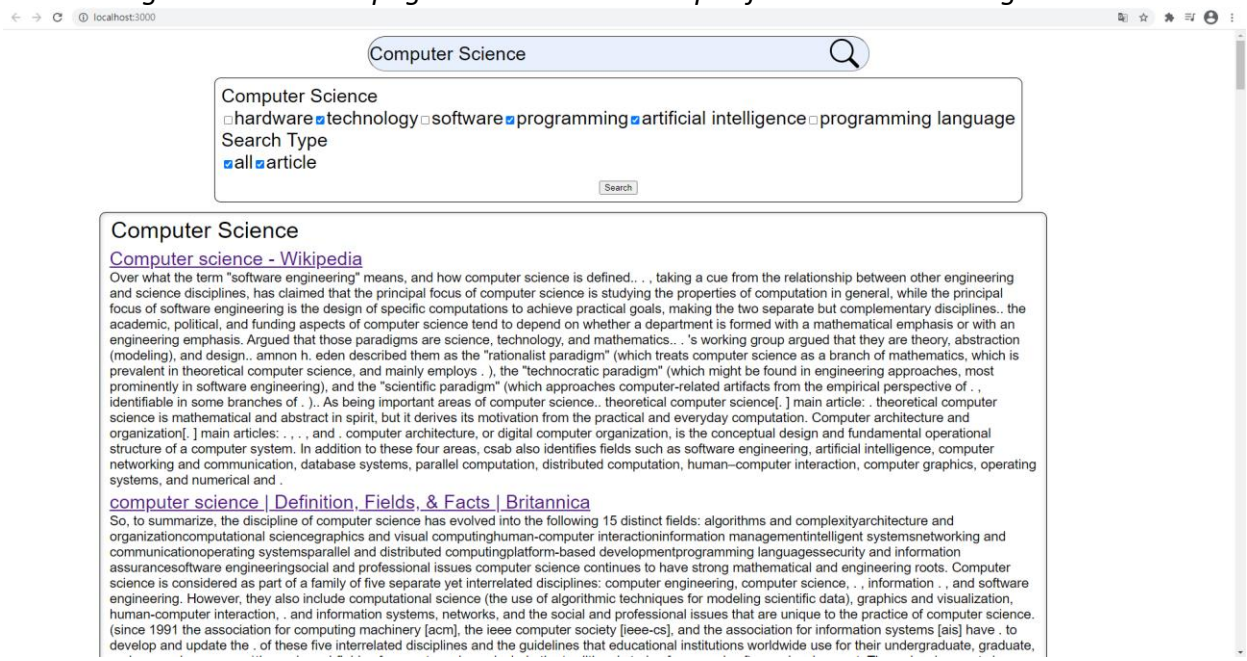

Figure 4.4 The result web page after user choose all the domain specific knowledge they want to search and pressed search (1)

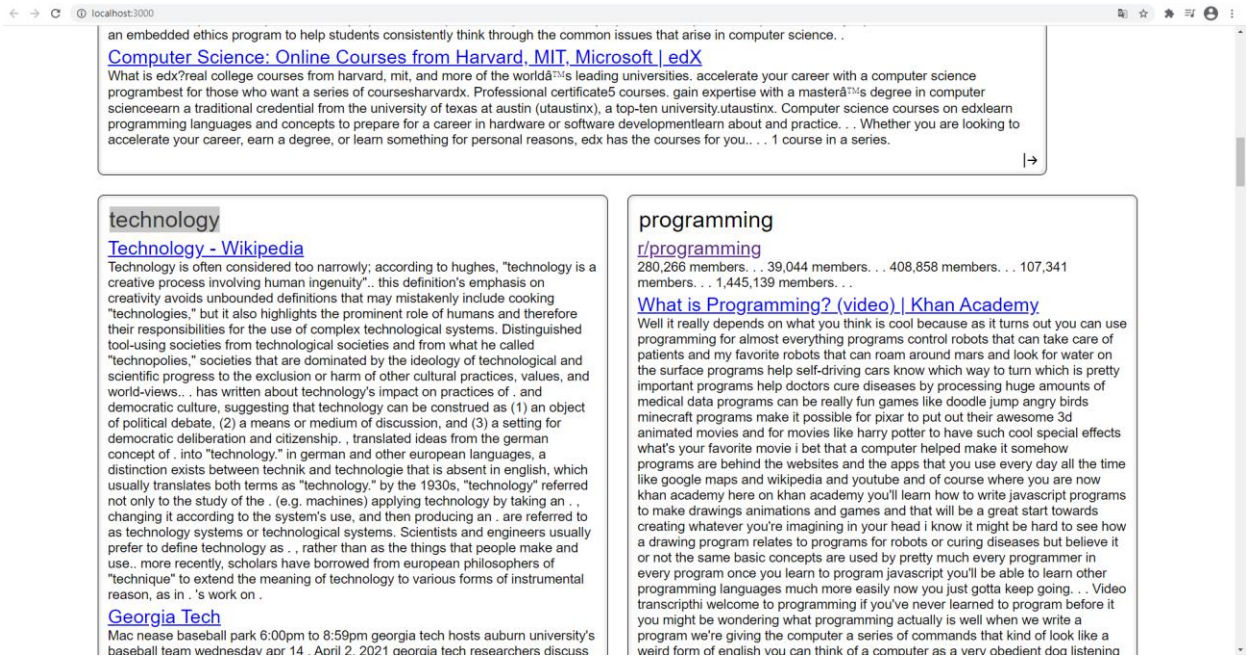

Figure 4.5 The result web page after user choose all the domain specific knowledge they want to search and pressed search (2)

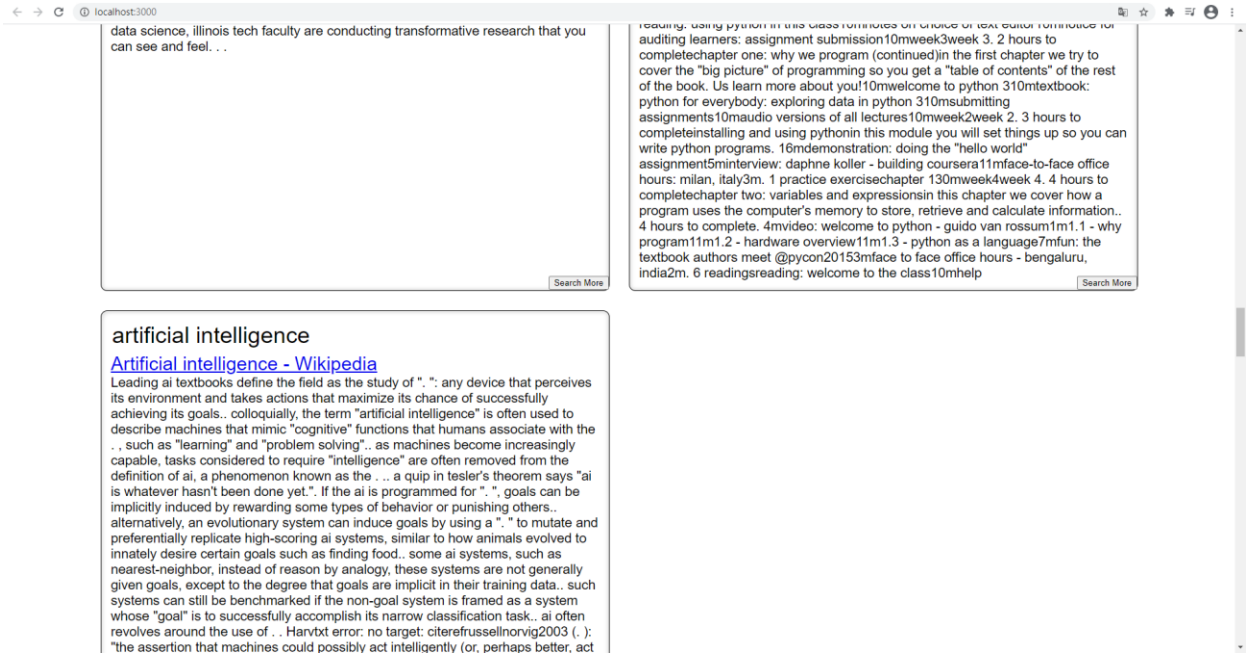

Figure 4.6 The result web page after user choose all the domain specific knowledge they want to search and pressed search (3)

There would be a “Search More” Button on each sub-domain specific knowledge. When the user press “Search More”, it would refresh the page and search for that keyword. Then, it would repeat the beginning step, i.e. return sub-domain knowledge list to user.

4.2 Ontology Learning

The keyword, which need for ontology learning, would be fed to existing search engine and get a bunch number of search result. After that, the occurrence of potential keyword in all document and each document would be counted. Then, the potential keyword with higher occurrence would be chosen as sub-concept of the searched keyword. The occurrence count of every potential keyword would be saved as json file for later reference for human tuning of the ontology tree. Moreover, to enhance the efficiency of the system, the ontology learning process will only build 1 depth for each time only. For example, only sub-concept of “computer science”, like “artificial intelligence”, “machinec learning”,etc would be added to the ontology tree. Ontology learning process would not be triggered at this stage for the sub-concept, like “artificial intelligence”, “machinec learning”,etc. The building process would only be triggered when user search for that specific keyword and it does not have any child under the ontology tree. This could effectively reduce the time and resource needed to build/extend a ontology tree for each time.

5. Evaluation

5.1 Searching

5.1.1 Query Keyword Extracting

The system could clearly extract the keyword from a chain of query.

Accuracy: 100%

[Refer to Appendix 2.1]

5.1.2 Domain Specific Search

The system could accurate follow the constrait on the sub-concept selected. Only result for the chosen domain-specific knowledge is searched.

Accuracy: 100%

[Refer to Appendix 2.2]

5.2 Text Summarization

The system could nearly generate a text summarization including all the expected keyword. There is few keyword missing from the text summarization.

Test Case 1: 7/7 = 100%

Test Case 2: 5/6 = 83.3%

Test Case 3: 5/5 = 100%

Test Case 4: 5/7 = 71.4%

Test Case 5: 6/8 = 75%

Overall: 85.94%

5.3 Ontology Learning

“Computer Science” is chosen as a evaluation target. The automatic generated ontology tree is compared with [18]. Only the first few depth of the tree is compared while it is impossible to compare all depth.

Before human-modification: Precision = 36%, Recall = 17%

After human-modification: Precision = 100%, Recall = 82%

It reflects that human interate with the ontology learning process is still needed to produce higher performance.

5.4 Overall Testing

10 interviewees are being interviewed.

1. All interviewees could answer some concept related to “Artificial Intelligence”. However, there is a different in the quality of the answer. Most of the interviewee using existing search engine only answer the definition and a brief description of “Artificial Intelligence”. On the other hand, interviewees using the system built could answer more sepific knowledge under “Artificial Intelligence” like, “NLP”, “Machine Learning”, etc. Some of the interviewees could mentioned some algorithm/concept related to AI/Machine Learning, like, “K-mean clustering”, “Neural network”, etc. It shows that the system built perform better in online-learning when compare to existing search engine in some way. It allows user the have more in-depth learning and have a more concrete picture about the new concept learnt.

2. Most of interviewees (8 out of 10, 80%) agree that the system have offset the insufficiency of existing search engine if the user do not have prior knowledge on a certain topic. Over half of them (8 out 10, 80%) agree that this system shorter the effort on learning new concept. However, most of the interviewee (9 out of 10, 90%) agree that the time need for this system to gather website is too long when compare to existing search engine. They agree that it would be better if the searching time could be shorter. Most of the interviewee (8 out of 10, 80%) agree that they would use this system to learn new concept.

3. Nearly all interviewees (9 out of 10, 90%) disagree that the domain specific knowledge suggested by the automate generate ontology tree is concrete and accurate enough. They agree that there are many concepts is missing in the list and many relentant concept are include in the list. After a human tuning of the ontology tree referring to json generated, mentioned in part 4.2, the interviewees tried the system again and still most of the interviewees (8 out of 10) think like before. However, they agree that they result have improved.

To conclude, the system could provide a better and in-depth learning experience to user. However, the time needed for the system to gather result is a little bit too long. Also, the automate generated ontology process is not efficient enough.

6. Conclusion

6.1 Achievements

A system is developed in this project. This system aims to offset the insufficiency of existing search engine that existing searching engine is unfriendly to user who know nothing about a certain topic. It aims to provide a new of searching experience for user which make online self learning more feasible. This project successfully achieve this target in some way. It provide a better searching and learning experience to user by providing domain-specific knowledge search with the help of ontology. Also, providing a text summarization under the search result allow the user have a quick preview of what the website is about. It could also enchance the searching experience of user. Most importantly it allows user to could learn a topic that they have no prior knowledge in more in-depth and concrete when compare to existing search enigne.

To conclude, the system built in this project could achieve the target of making online self learning more feasible.

6.2 Future Improvements

As shown in the evaluation, there are two main improvements is needed. Also, there is another 2 improvement which could enhance the functionality of the system.

The first improvement needed is the gathering time of the website. While the user reflects that the searching time of the system is too long, it would affect the user experience of the system. It would results in drop of the feasibility of online self learning using this system. User may rather to use existing search engine if the searching time of this system is too long. Then, the aims and target of this project would fail. Therefore, a way need to be proposed to solve the situation. One way could be setting up a database which act as a cache. This cache would save the most recent and popular searched keywords' search results. Then, when these keyword is searched, it could quickly retrieve the search results to user and no need wait for the response of existing search engine.

The second improvement is the automatic ontology learning system. As mention in part 2, an atutomatic ontology learning system is a must as there may be a situation that a keyword does not exist in an ontology tree. A automatic ontology learning system could help to make sure the system could return find sub-domain knowledge to user. This project have tried to use statistic way to achieve this target. However, as shown in evaluation, the accuracy is not satisfaction and man-power is still needed to tune the ontology tree to achieve a higher accuracy. Therefore, a better way is needed to be found and applied in this system to make the ontology tree generated be more accurate. In [19], it shows there are many other ontology learning method that could produce higher accuracy of the ontology tree like, machine learning, etc. By applying these kind of method may help improve the functionality of the this project system.

Besides, the first two improvement, there is another possible way to improve the system. The way is let user choose the document type they want to search and set up a web crawler which help user to scrap for the knowledge they needed. At this stage, the system only return a general search result to user for different domain-specific knowledger. However, it may not be accurate enough and fulfill the user needs. Adding the function of choosing desire document type and building a vertical web crawler could help to improve the search quality of the system

Moreover, the text summarization could be change from using extractive text summariziton to abstractive text summarization. At this stage, using extractive text summarization, there would be some time the sentence is not make sense at all as it is combine keyword using statistic calculation only. If abstractive text summarization is used, every sentence built for summary is based on machine learning method and the sentence is repharse. It could make the text summary more readable and understandable. It may help to enhance the using experience of this system.

To conclude, the above mentioned improvement could be perform in the future which may help to make online self learning more feasible and enhance the searching experience of users.

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8. Appendix

1. Montly Log:

October:
This month is all about designing the structure of the system ,finding tool/methods/algorithm/etc. that could help in building the system which could solve the defined problem. Also, finishing the Interim Report I. The brief abstract about what had done is shown below: Designing - Designing how system should be built --> how the module interact? - Thinking how the system could be tested Discover Thing and Knowledge about the System - Finding how ontology could be applied into the coming system --> The file type: owl? rdf-xml? --> Python library to use owl: Owlready2? - Finding tool that can help in building ontology --> tool: Protégé? - Finding existing ontologies - Finding literature relate to the topic Learning - Learning React [help in building website in later stage->modulability; building speed] - Revision in JS - Learning how to host website
November:
This month is focusing on finding/testing the ontology from the internet. Also, this month is used to evaluating different kind of way to build ontology if it is not exist for certain keyword.
December:

This month is focusing on studying how to build the web interface for FYP and studying how web hosting is done for the FYP. Also, this month is continuing to estimating the different way of building the ontology tree for the system. For web hosting and building: -Docker -HTML/CSS/JS
January:
This month is start learning how to build the backend of the system and start working on it. For example: building the API server which listen to API call, building the function which will go through the ontology tree and return the sub-concept of the keyword inputted. Some adjustment has been made in this month also. Also, this month is working on interim report II which thinking about how the test case should be.
February:
- Study what is a domain-specific search engine and how to build it - Studying past ontology learning method and see whether it is possible to apply in this project
March:
- Finishing up the remaining part - Testing the system - Writing the Final Report

2. Test Case (In progress)

2.1 Query Keyword Extracting

1.	Input:	What is Computer Science
	Expected Keyword Extracted:	Computer Science
	Actual Keyword Extracted:	Computer Science
2.	Input:	I want to learn Biology
	Expected Keyword Extracted:	Biology

	Actual Keyword Extracted:	Biology
3.	Input:	What knowledge is under Chemistry and Physic
	Expected Keyword Extracted:	Chemistry, Physic
	Actual Keyword Extracted:	Chemistry, Physic

2.2 Domain Specific Search

Input	Computer Science [technology|programming|artificial intelligence]
Expect Result:	[Search Result of] Computer Science, technology, programming, artificial intelligence
Actual Result:	[Search Result of] Computer Science, technology, programming, artificial intelligence

2.3 Text Summarization

1.	Input:	Computer Science is the study of computers and computational systems. Unlike electrical and computer engineers, computer scientists deal mostly with software and software systems; this includes their theory, design, development, and application. Principal areas of study within Computer Science include artificial intelligence, computer systems and networks, security, database systems, human computer interaction, vision and graphics, numerical analysis, programming languages, software engineering, bioinformatics and theory of computing. Although knowing how to program is essential to the study of computer science, it is only one element of the field. Computer scientists design and analyze algorithms to solve programs and study the performance of computer hardware and software. The problems that computer scientists encounter range from the abstract--determining what problems can be solved with computers and the complexity of the algorithms that solve them – to the tangible – designing applications that perform well on handheld devices, that are easy to use, and that uphold security measures. Graduates of University of Maryland's Computer Science Department are lifetime learners; they are able to adapt quickly with this challenging field. (Extracted from: https://undergrad.cs.umd.edu/what-computer-science)

	Expected Keyword Include In Summary:	Software|Computer|Algorithm|Program|Solve|Design| Systems
	Actual Output:	principal areas of study within computer science include artificial intelligence, computer systems and networks, security, database systems, human computer interaction, vision and graphics, numerical analysis, programming languages, software engineering, bioinformatics and theory of computing. Unlike electrical and computer engineers, computer scientists deal mostly with software and software systems; this includes their theory, design, development, and application. Computer scientists design and analyze algorithms to solve programs and study the performance of computer hardware and software. The problems that computer scientists encounter range from the abstract-- determining what problems can be solved with computers and the complexity of the algorithms that solve them – to the tangible – designing applications that perform well on handheld devices, that are easy to use, and that uphold security measures. Computer science is the study of computers and computational systems.
2.	Input:	Biology is the study of life. The word "biology" is derived from the Greek words "bios" (meaning life) and "logos" (meaning "study"). In general, biologists study the structure, function, growth, origin, evolution and distribution of living organisms. Biology is important because it helps us understand how living things work and how they function and interact on multiple levels, according to the Encyclopedia Britannica. Advances in biology have helped scientists do things such as develop better medicines and treatments for diseases, understand how a changing environment might affect plants and animals, produce enough food for a growing human population and predict how eating new food or sticking to an exercise regimen might affect our bodies. The basic principles of modern biology Four principles unify modern biology, according to the book "Managing Science" (Springer New York, 2010): Cell theory is the principle that all living things are made of fundamental units called cells, and all cells come from preexisting cells. Gene theory is the principle that all living things have DNA, molecules that code the structures and functions of cells and get passed to offspring. Homeostasis is the principle that all living things maintain a state of balance that enables organisms to survive in their environment.

		Evolution is the principle that describes how all living things can change to have traits that enable them to survive better in their environments. These traits result from random mutations in the organism's genes that are "selected" via a process called natural selection. During natural selection, organisms that have traits better-suited for their environment have higher rates of survival, and then pass those traits to their offspring. The many branches of biology Although there are only four unifying principles, biology covers a broad range of topics that are broken into many disciplines and subdisciplines. On a high level, the different fields of biology can each be thought of as the study of one type of organism, according to "Blackie's Dictionary of Biology" (S Chand, 2014). For example, zoology is the study of animals, botany is the study of plants and microbiology is the study of microorganisms. Related: Plant photos: Amazing botanical shots by Karl Blossfeldt Within those broader fields, many biologists specialize in researching a specific topic or problem. For example, a scientist may study behavior of a certain fish species, while another scientist may research the neurological and chemical mechanisms behind the behavior. There are numerous branches and subdisciplines of biology, but here is a short list of some of the more broad fields that fall under the umbrella of biology: Biochemistry: The study of the chemical processes that take place in or are related to living things, according to the Biochemical Society. For example, pharmacology is a type of biochemistry research that focuses on studying how drugs interact with chemicals in the body, as described in a 2010 review in the journal Biochemistry. Ecology: The study of how organisms interact with their environment. For example, an ecologist may study how honeybee behavior is affected by humans living nearby. Genetics: The study of heredity. Geneticists study how genes are passed down by parents to their offspring, and how they vary from person to person. For example, scientists have identified several genes and genetic mutations that influence human lifespan, as reported in a 2019 review published in the journal Nature Reviews Genetics. Physiology: The study of how living things work. Physiology, which is applicable to any living organism, "deals with the life-

		supporting functions and processes of living organisms or their parts," according to Nature. Physiologists seek to understand biological processes, such as how a particular organ works, what its function is and how it's affected by outside stimuli. For example, physiologists have studied how listening to music can cause physical changes in the human body, such as a slower or faster heart rate. A botanist, which is a type of biologist, examining plants growing in a greenhouse. A botanist is a biologist who studies plants. (Image credit: Shutterstock) The multidisciplinary nature of biology Biology is often researched in conjunction with other fields of study, including mathematics, engineering and the social sciences. Here are a few examples: Astrobiology is the study of the evolution of life in the universe, including the search for extraterrestrial life, according to NASA. This field incorporates principles of biology with astronomy. Bioarchaeologists are biologists who incorporate archaeological techniques to study skeletal remains and derive insights about how people lived in the past, according to George Mason University. Bioengineering is the application of engineering principles to biology and vice versa, according to the University of California Berkeley. For example, a bioengineer might develop a new medical technology that better images the inside of the body, like an improved MRI that scans the human body at a faster rate and higher resolution, or apply biological knowledge to create artificial organs. Biotechnology involves using biological systems to develop products, according to the Norwegian University of Science and Technology. For example, biotechnologists in Russia genetically engineered a better-tasting and more disease-resistant strawberry, which the researchers described in their 2007 study published in the journal Biotechnology and Sustainable Agriculture 2006 and Beyond. Biophysics employs the principles of physics to understand how biological systems work, according to the Biophysical Society. For example, biophysicists may study how genetic mutations leading to changes in protein structure impacts protein evolution. What do biologists do? Biologists can work in many different fields, including research, healthcare, environmental conservation and art, according to the American Institute of Biological Sciences. Here are a few examples:

		Research: Biologists can perform research in many types of settings. Microbiologists, for instance, may study bacterial cultures in a laboratory setting. Other biologists may perform field research, where they observe animals or plants in their native habitat. Many biologists may work in the lab and in the field — for example, scientists may collect soil or water samples from the field and analyze them further in the lab, like at North Carolina University's Soil and Water Lab. Healthcare: People who study biology can go on to work in healthcare, whether they work as doctors or nurses, join a pharmaceutical company to develop new drugs and vaccines, research the efficacy of medical treatments or become veterinarians to help treat sick animals, according to the American Institute of Biological Sciences. Conservation: Biologists can help with efforts in environmental conservation by studying and determining how to protect and conserve the natural world for the future. For example, biologists may help educate the public on the importance of preserving an animal's natural habitat and participate in endangered species recovery programs to stop the decline of an endangered species, according to the U.S. Fish & Wildlife Service. Art: Biologists who also have a background in art have both the technical knowledge and artistic skill to create visuals that will communicate complex biological information to a wide variety of audiences. One example of this is in medical illustration, in which an illustrator may perform background research, collaborate with experts, and observe a medical procedure to create an accurate visual of a body part, according to the Association of Medical Illustrators. (Extracted from: https://www.livescience.com/44549-what-is-biology.html)
	Expected Keyword Include In Summary:	Biology|Living|Biologists|Research|Living Things| Study How
	Actual Output:	healthcare: people who study biology can go on to work in healthcare, whether they work as doctors or nurses, join a pharmaceutical company to develop new drugs and vaccines, research the efficacy of medical treatments or become veterinarians to help treat sick animals, according to the american institute of biological sciences. the basic principles of modern biology four principles unify modern biology, according to the book "managing science" (springer new york, 2010):

		cell theory is the principle that all living things are made of fundamental units called cells, and all cells come from preexisting cells. there are numerous branches and subdisciplines of biology, but here is a short list of some of the more broad fields that fall under the umbrella of biology: biochemistry: the study of the chemical processes that take place in or are related to living things, according to the biochemical society. biologists can work in many different fields, including research, healthcare, environmental conservation and art, according to the american institute of biological sciences. here are a few examples: research: biologists can perform research in many types of settings. on a high level, the different fields of biology can each be thought of as the study of one type of organism, according to "blackie's dictionary of biology" (s chand, 2014).
3.	Input:	What is Management? Management is essential for an organized life and necessary to run all types of management. Good management is the backbone of successful organizations. Managing life means getting things done to achieve life's objectives and managing an organization means getting things done with and through other people to achieve its objectives. Whether management is an art or science, will continue to be a subject of debate. However, most management thinkers agree that some form of formal academic management background helps in managing successfully. Practically, all CEO's are university graduates. Hence, the reason for including business degree programs in all academic institutions. management Management is a set of principles relating to the functions of planning, organizing, directing and controlling, and the application of these principles in harnessing physical, financial, human, and informational resources efficiently and effectively to achieve organizational goals. Contents [show]

		Definition of Management Many management thinkers have defined management in their own ways. For example, Van Fleet and Peterson define management, 'as a set of activities directed at the efficient and effective utilization of resources in the pursuit of one or more goals.' Megginson, Mosley, and Pietri define management as 'working with human, financial and physical resources to achieve organizational objectives by performing the planning, organizing, leading and controlling functions'. Kreitner's definition of management: 'Management is a problem-solving process of effectively achieving organizational objectives through the efficient use of scarce resources in a changing environment.' According to F.W. Taylor, ' Management is an art of knowing what to do when to do and see that it is done in the best and cheapest way '. According to Harold Koontz, 'Management is an art of getting things done through and with the people in formally organized groups. It is an art of creating an environment in which people can perform and individuals and can co-operate towards attainment of group goals.' A leader has certain inherent qualities and traits which assist him in playing a directing role and wielding commanding influence which others. Leadership is an integral part of management and plays a vital role in managerial operations, while management is an integral component of technical as well as social processes. The practice of management is as old as human civilization. However, the study of management in a systematic and scientific way as a distinct body of knowledge is only of recent origin. Management in some form or another is an integral part of living and is essential wherever human efforts are to be undertaken to achieve desired objectives. The basic ingredients of management are always at play, whether we manage our lives or our business. For example, let us look at the managerial role of a simple housewife and how she uses the managerial ingredients in managing the home. First, she appraises her household and its needs. She forecasts the needs of the household for a period of

		a week or a month or longer. She takes stock of her resources and any constraints on these resources. She plans and organizes her resources to obtain the maximum benefits out of these resources. She monitors and controls the household budget and expenses and other activities. In a large household, she divides the work among other members and coordinates their activities. She encourages and motivates them to do their best in completing their activities. She is always in search of improvement, mentions goals, resources, and means to attain these goals. These ingredients, generally, are the basic functions of management. READ Importance and Features of Activity Management Management Can Be Defined In Detail In The Following Categories : Management as a Process Management as an Activity Management as a Discipline Management as a Group Management as a Science Management as an Art Management as a Profession The concept of management is as old as the human race itself. The concept of 'family' itself required that life be organized and resources of food are apportioned in a manner so as to maximize the utility of such resources. Taking proper steps to safeguard the family from attacks by wild animals, planning on where to go fishing and hunting and whom to go with, organizing these groups into chiefs and hunting and fishing bands where chiefs gave directions, and so on, are all subtle ingredients of management and organization. A study of various people around the world shows good examples of organizational structures and organizational evolution over the years. A village open market in a tribe and a large department store in a modern city serves the same needs in a similar fashion, which is putting things together that people need. While the tribal organization was simple in nature, the modern organization is much more sophisticated and complex with many technological innovations. However, the basic form of management and organizational structure seems to have existed since the beginning of organized human activity. Even the recorded history shows the application of some current management techniques as far back as 5000 BC. when the ancient Sumerians used written records in assisting

		governmental operations. The Egyptian pyramids, built as early as 3000 BC., required the organized efforts of over 1,00,000 workers. It would be natural to assume that all functions of modern management, namely, planning, organizing, directing, and controlling played a significant role in the construction of these monuments. Similarly, the early civilization of India bears witness to organized living. Management, as a system, is not only an essential element of an organized society but also an integral part of life when we talk about managing our lives. Managing life is not much different from managing an organization and this 'art' of management has been with us from time immemorial. Just as a well-managed life is much better organized, goal-oriented, and successful, 'good' management of an organization makes the difference between the success and the failure of the organization. Perhaps, the importance of management was highlighted by the late President of the United States, John F. Kennedy when he said that, the role of management in our society is critical in human progress. It serves to identify a great need of our time: to improve standards of living for all people through the effective utilization of human and material sources. Similarly, Peter F. Drucker, a noted management authority has emphasized the importance of management to social living. He proclaimed nearly 25 years ago that, 'effective management was becoming the main resource of developed nations and that it was the most needed resource for developing nations.' A manager's job is highly crucial to the success of any organization. The more complex the organization, the more crucial is to the manager's role in it. A good manager makes things happen. The importance of management in any organization was emphasized by Professor Leonard R. Sayles in his address to a group of management development specialists, as follows: READ Nature and Scope of Management 'We must find ways of convincing society as a whole, and those who train managers in particular, that the real leadership problems of our institutions-the getting things done, the implementation, the evolving of a consensus, the making of the right decisions at the right time with the right people is where the action is. Although we as a society haven't learned to give much credit to managers, I hope we can move toward recognizing that managerial and leadership jobs are among the most critical tasks of our society. As such, they deserve the

		professional status that we give to more traditional fields of knowledge.' There Are Basically Five Primary Functions of Management. These Are: 1. Planning 2. Organizing 3. Staffing 4. Directing 5. Controlling The controlling function comprises coordination, reporting, and budgeting, and hence the controlling function can be broken into these three separate functions. Based upon these seven functions, Luther Gulick coined the word POSDCORB, which generally represents the initials of these seven functions i.e. P stands for Planning, O for Organizing, S for Staffing, D for Directing, Co for Co-ordination, R for reporting & B for Budgeting. But, Planning, Organizing, Staffing, Directing, and Controlling are widely recognized functions of management. management_functions (1) Planning Planning is future-oriented and determines an organization's direction. It is a rational and systematic way of making decisions today that will affect the future of the company. It is a kind of organized foresight as well as corrective hindsight. It involves predicting of the future as well as attempting to control the events. It involves the ability to foresee the effects of current actions in the long run in the future. Planning Peter Drucker has defined planning as follows: "Planning is the continuous process of making present entrepreneurial decisions systematically and with best possible knowledge of their futurity, organizing systematically the efforts needed to carry out these decisions and measuring the results of these decisions against the expectations through organized and systematic feedback". An effective planning program incorporates the effect of both external as well as internal factors. The external factors are shortages of resources; both capital and material, general

		economic trend as far as interest rates and inflation are concerned, dynamic technological advancements, increased governmental regulation regarding community interests, unstable international political environments, etc. The internal factors that affect planning are limited growth opportunities due to saturation requiring diversification, changing patterns of the workforce, more complex organizational structures, decentralization, etc (2) Organizing Organizing requires a formal structure of authority and the direction and flow of such authority through which work subdivisions are defined, arranged, and coordinated so that each part relates to the other part in a united and coherent manner so as to attain the prescribed objectives. Organizing According to Henry Fayol, “To organize a business is to provide it with everything useful or its functioning i.e. raw material, tools, capital and personnel’s”. Thus the function of organizing involves the determination of activities that need to be done in order to reach the company goals, assigning these activities to the proper personnel, and delegating the necessary authority to carry out these activities in a coordinated and cohesive manner. It follows, therefore, that the function of organizing is concerned with: Identifying the tasks that must be performed and grouping them whenever necessary Assigning these tasks to the personnel while defining their authority and responsibility. Delegating this authority to these employees Establishing a relationship between authority and responsibility Coordinating these activities READ Management as an Art (3) Staffing Staffing is the function of hiring and retaining a suitable work-force for the enterprise both at managerial as well as non-managerial levels. It involves the process of recruiting, training, developing, compensating, and evaluating employees and maintaining this workforce with proper incentives and motivations. Since the human element is the most vital factor

		in the process of management, it is important to recruit the right personnel. According to Kootz & O'Donnell, "Managerial function of staffing involves manning the organization structure through the proper and effective selection, appraisal & development of personnel to fill the roles designed in the structure". This function is even more critically important since people differ in their intelligence, knowledge, skills, experience, physical condition, age, and attitudes, and this complicates the function. Hence, management must understand, in addition to the technical and operational competence, the sociological and psychological structure of the workforce. (4) Directing The directing function is concerned with leadership, communication, motivation, and supervision so that the employees perform their activities in the most efficient manner possible, in order to achieve the desired goals. The leadership element involves issuing instructions and guiding the subordinates about procedures and methods. The communication must be open both ways so that the information can be passed on to the subordinates and the feedback received from them. Motivation is very important since highly motivated people show excellent performance with less direction from superiors. Supervising subordinates would lead to continuous progress reports as well as assure the superiors that the directions are being properly carried out. (5) Controlling The function of control consists of those activities that are undertaken to ensure that the events do not deviate from the pre-arranged plans. The activities consist of establishing standards for work performance, measuring performance and comparing it to these set standards, and taking corrective actions as and when needed, to correct any deviations. According to Koontz & O'Donnell, "Controlling is the measurement & correction of performance activities of subordinates in order to make sure that the enterprise objectives and plans desired to obtain them as being accomplished".

		The controlling function involves: a. Establishment of standard performance. b. Measurement of actual performance. c. Measuring actual performance with the pre-determined standard and finding out the deviations. d. Taking corrective action. All these five functions of management are closely interrelated. However, these functions are highly indistinguishable and virtually unrecognizable on the job. It is necessary, though, to put each function separately into focus and deal with it.
	Expected Keyword Include In Summary:	Management|Planning|Organizing|Resources|Controlling
	Actual Output:	read importance and features of activity management management can be defined in detail in the following categories : management as a process management as an activity management as a discipline management as a group management as a science management as an art management as a profession the concept of management is as old as the human race itself. The importance of management in any organization was emphasized by professor leonard r. sayles in his address to a group of management development specialists, as follows: read nature and scope of management 'we must find ways of convincing society as a whole, and those who train managers in particular, that the real leadership problems of our institutions-the getting things done, the implementation, the evolving of a consensus, the making of the right decisions at the right time with the right people is where the action is. management management is a set of principles relating to the functions of planning, organizing, directing and controlling, and the application of these principles in harnessing physical, financial, human, and informational resources efficiently and effectively to achieve organizational goals. The concept of 'family' itself required that

		life be organized and resources of food are apportioned in a manner so as to maximize the utility of such resources. taking proper steps to safeguard the family from attacks by wild animals, planning on where to go fishing and hunting and whom to go with, organizing these groups into chiefs and hunting and fishing bands where chiefs gave directions, and so on, are all subtle ingredients of management and organization. contents [show] definition of management many management thinkers have defined management in their own ways.
4.	Input:	You might think of chemistry only in the context of lab tests, food additives or dangerous substances, but the field of chemistry involves everything around us. "Everything you hear, see, smell, taste, and touch involves chemistry and chemicals (matter)," according to the American Chemical Society (ACS), a non-profit science organization for the advancement of chemistry, chartered by the U.S. Congress. "And hearing, seeing, tasting, and touching all involve intricate series of chemical reactions and interactions in your body." So, even if you don't work as a chemist, you're doing chemistry, or something that involves chemistry, with pretty much everything you do. In everyday life, you do chemistry when you cook, when you use cleaning detergents to wipe off your counter, when you take medicine or when you dilute concentrated juice so that the taste isn't as intense. Related: Whoa! Enormous 'cotton candy' explosion in kids' chemistry lab According to the ACS, chemistry is the study of matter, defined as anything that has mass and takes up space, and the changes that matter can undergo when it is subject to different environments and conditions. Chemistry seeks to understand not only the properties of matter, like the mass or composition of a chemical element, but also how and why matter undergoes certain changes — whether something transformed because it combined with another substance, froze because it was left for two weeks in a freezer, or changed colors because it was exposed to too much sunlight. Chemistry basics

		The reason why chemistry touches everything we do is because almost everything in existence can be broken down into chemical building blocks. The main building blocks in chemistry are chemical elements, which are substances made of a single atom. Each chemical is unique, composed of a set number of protons, neutrons and electrons, and is identified by a name and a chemical symbol, such as "C" for carbon. The elements that scientists have discovered so far are listed in the periodic table of elements, and include both elements that are found in nature like carbon, hydrogen and oxygen, as well as those that are manmade, like Lawrencium. Related: How are elements grouped in the periodic table? Chemical elements can bond together to form chemical compounds, which are substances made up of multiple elements, like carbon dioxide (which is made of one carbon atom connected to two oxygen atoms), or multiple atoms of a single element, like oxygen gas (which is made of two oxygen atoms connected together). These chemical compounds can then bond with other compounds or elements to form countless other substances and materials. Chemistry is a physical science Chemistry is typically considered a physical science, as defined by the Encyclopedia Britannica, because the study of chemistry does not involve living things. Most of the chemistry involved in research and development, such as making new products and materials for customers, falls within this purview. But the distinction as a physical science becomes a bit blurry in the case of biochemistry, which explores the chemistry of living things, according to the Biochemical Society. The chemicals and chemical processes studied by biochemists are not technically considered "living," but understanding them is important to understanding how life works. A young girl mixing food ingredients in a bowl, next to a mini-oven. Chemistry is a physical science, which means it doesn't involve "living" things. One way a lot of people practice chemistry regularly, perhaps without realizing it, is in cooking and baking. (Image credit: Shutterstock) The five main branches of chemistry

		Traditionally, chemistry is broken into five main branches, according to the online chemistry textbook published by LibreText. There are also more specialized fields, such as food chemistry, environmental chemistry and nuclear chemistry, but this section focuses on chemistry's five major subdisciplines. Analytical chemistry involves the analysis of chemicals, and includes qualitative methods like looking at color changes, as well as quantitative methods like examining the exact wavelength(s) of light that a chemical absorbed to result in that color change. These methods enable scientists to characterize many different properties of chemicals, and can benefit society in a number of ways. For example, analytical chemistry helps food companies make tastier frozen dinners by detecting how chemicals in food change when they are frozen over time. Analytical chemistry is also used to monitor the health of the environment by measuring chemicals in water or soil, for example. Biochemistry, as mentioned above, uses chemistry techniques to understand how biological systems work at a chemical level. Thanks to biochemistry, researchers have been able to map out the human genome, understand what different proteins do in the body and develop cures for many diseases. Related: Unraveling the human genome: 6 molecular milestones Inorganic chemistry studies the chemical compounds in inorganic, or non-living things such as minerals and metals. Traditionally, inorganic chemistry considers compounds that do not contain carbon (which are covered by organic chemistry), but this definition is not completely accurate, according to the ACS. Advertisement Some compounds studied in inorganic chemistry, like "organometallic compounds," contain metals, which are metals that are attached to carbon — the main element that's studied in organic chemistry. As such, compounds such as these are considered part of both fields. Inorganic chemistry is used to create a variety of products, including paints, fertilizers and sunscreens. Organic chemistry deals with chemical compounds that contain carbon, an element considered essential to life. Organic

		chemists study the composition, structure, properties and reactions of such compounds, which along with carbon, contain other non-carbon elements such as hydrogen, sulfur and silicon. Organic chemistry is used in many applications, as described by the ACS, such as biotechnology, the petroleum industry, pharmaceuticals and plastics. Physical chemistry uses concepts from physics to understand how chemistry works. For example, figuring out how atoms move and interact with each other, or why some liquids, including water, turn into vapor at high temperatures. Physical chemists try to understand these phenomena at a very small scale — on the level of atoms and molecules — to derive conclusions about how chemical reactions work and what gives specific materials their own unique properties. This type of research helps inform other branches of chemistry and is important for product development, according to the ACS. For example, physical chemists may study how certain materials, such as plastic, may react with chemicals the material is designed to come in contact with. What do chemists do? Chemists work in a variety of fields, including research and development, quality control, manufacturing, environmental protection, consulting and law. They can work at universities, for the government or in private industry, according to the ACS. Here are some examples of what chemists do: Research and development In academia, chemists performing research aim to further knowledge about a particular topic, and may not necessarily have a specific application in mind. Their results, however, can still be applied to relevant products and applications. Advertisement In industry, chemists in research and development use scientific knowledge to develop or improve a specific product or process. For example, food chemists improve the quality, safety, storage and taste of food; pharmaceutical chemists develop and analyze the quality of drugs and other medical formulations; and agricultural chemists develop fertilizers, insecticides and herbicides necessary for large-scale crop production.

		Sometimes, research and development may not involve bettering the product itself, but rather the manufacturing process involved in making that product. Chemical engineers and process engineers devise new ways to make the manufacturing of their products easier and more cost effective, such as increasing the speed and/or yield of a product for a given budget. Environmental protection Environmental chemists study how chemicals interact with the natural environment, characterizing the chemicals and chemical reactions present in natural processes in the soil, water and air. For example, scientists can collect soil, water or air from a place of interest and analyze it in a laboratory to determine if human activities have contaminated, or will contaminate, the environment or affect it in other ways. Some environmental chemists can also help remediate, or remove contaminants, from the soil, according to the U.S. Bureau of Labor Statistics. Related: Why fertilizer is dangerous (infographic) Scientists with a background in environmental chemistry can also work as consultants for various organizations, such as chemical companies or consulting firms, providing guidance on how practices and procedures can be completed in accordance with environmental regulations. Law Chemists can use their academic background to provide advice on or advocate for scientific issues. For instance, chemists may work in intellectual property, where they might apply their scientific background to copyright issues in the sciences, or in environmental law, where they may represent special interest groups and file for approval from regulating agencies before certain activities occur. Chemists can also perform analyses that help law enforcement. Forensic chemists capture and analyze the physical evidence left behind at a crime scene to help determine the identities of the people involved, as well as to answer other vital questions regarding how and why the crime was carried out. Forensic chemists use a wide variety of analysis methods, such as chromatography and spectrometry, which help identify and quantify chemicals.

		(Extracted from: https://www.livescience.com/45986-what-is-chemistry.html)
	Expected Keyword Include In Summary:	Chemistry|Chemical|Chemists|Compounds|Elements| Chemical Compounds|Chemical Reactions
	Actual Output:	"everything you hear, see, smell, taste, and touch involves chemistry and chemicals (matter)," according to the american chemical society (acs), a non-profit science organization for the advancement of chemistry, chartered by the u.s. congress. "and hearing, seeing, tasting, and touching all involve intricate series of chemical reactions and interactions in your body." There are also more specialized fields, such as food chemistry, environmental chemistry and nuclear chemistry, but this section focuses on chemistry's five major subdisciplines. chemistry is a physical science chemistry is typically considered a physical science, as defined by the encyclopedia britannica, because the study of chemistry does not involve living things. (image credit: shutterstock) the five main branches of chemistry traditionally, chemistry is broken into five main branches, according to the online chemistry textbook published by libretext. advertisement some compounds studied in inorganic chemistry, like "organometallic compounds," contain metals, which are metals that are attached to carbon — the main element that's studied in organic chemistry.
5.	Input:	What Is Economics? Economics is a social science concerned with the production, distribution, and consumption of goods and services. It studies how individuals, businesses, governments, and nations make choices about how to allocate resources. Economics focuses on the actions of human beings, based on assumptions that humans act with rational behavior, seeking the most optimal level of benefit or utility. The building blocks of economics are the studies of labor and trade. Since there are many possible applications of human labor and many different ways to acquire resources, it is the task of economics to determine which methods yield the best results. Economics can generally be broken down into macroeconomics, which concentrates on the behavior of the economy as a whole, and microeconomics, which focuses on individual people and businesses.

KEY TAKEAWAYS
Economics is the study of how people allocate scarce resources for production, distribution, and consumption, both individually and collectively.
Two major types of economics are microeconomics, which focuses on the behavior of individual consumers and producers, and macroeconomics, which examine overall economies on a regional, national, or international scale.
Economics is especially concerned with efficiency in production and exchange and uses models and assumptions to understand how to create incentives and policies that will maximize efficiency.
Economists formulate and publish numerous economic indicators, such as gross domestic product (GDP) and the Consumer Price Index (CPI).
Capitalism, socialism, and communism are types of economic systems.
Understanding Economics
One of the earliest recorded economic thinkers was the 8th-century B.C. Greek farmer/poet Hesiod, who wrote that labor, materials, and time needed to be allocated efficiently to overcome scarcity. But the founding of modern Western economics occurred much later, generally credited to the publication of Scottish philosopher Adam Smith's 1776 book, An Inquiry Into the Nature and Causes of the Wealth of Nations.1

The principle (and problem) of economics is that human beings have unlimited wants and occupy a world of limited means. For this reason, the concepts of efficiency and productivity are held paramount by economists. Increased productivity and a more efficient use of resources, they argue, could lead to a higher standard of living.

Despite this view, economics has been pejoratively known as the "dismal science," a term coined by Scottish historian Thomas Carlyle in 1849.2 He used it to criticize the liberal views on race and social equality of contemporary economists like John Stuart Mill, though some commentators suggest Carlyle was actually describing the gloomy predictions by Thomas Robert Malthus that population growth would always outstrip the food supply.

Types of Economics
The study of economics is generally broken down into two disciplines.

Microeconomics focuses on how individual consumers and firms make decisions; these individual decision making units

		can be a single person, a household, a business/organization, or a government agency. Analyzing certain aspects of human behavior, microeconomics tries to explain how they respond to changes in price and why they demand what they do at particular price levels. Microeconomics tries to explain how and why different goods are valued differently, how individuals make financial decisions, and how individuals best trade, coordinate, and cooperate with one another. Microeconomics' topics range from the dynamics of supply and demand to the efficiency and costs associated with producing goods and services; they also include how labor is divided and allocated; how business firms are organized and function; and how people approach uncertainty, risk, and strategic game theory. Macroeconomics studies an overall economy on both a national and international level, using highly aggregated economic data and variables to model the economy. Its focus can include a distinct geographical region, a country, a continent, or even the whole world. Its primary areas of study are recurrent economic cycles and broad economic growth and development. Topics studied include foreign trade, government fiscal and monetary policy, unemployment rates, the level of inflation and interest rates, the growth of total production output as reflected by changes in the Gross Domestic Product (GDP), and business cycles that result in expansions, booms, recessions, and depressions. Micro- and macroeconomics are intertwined. Aggregate macroeconomic phenomena are obviously and literally just the sum total of microeconomic phenomena. However these two branches of economics use very different theories, models, and research methods, which sometimes appear to conflict with each other. Integrating the microeconomics foundations into macroeconomic theory and research is a major area of study in itself for many economists. Schools of Economic Theory There are many competing, conflicting, or sometimes complementary theories and schools of thought within economics. Economists employ many different methods of research from logical deduction to pure data mining. Economic theory often progresses through deductive processes, including mathematical logic, where the implications of specific human activities are considered in a "means-ends" framework. This type of economics deduces, for example, that it is more efficient for individuals or companies to specialize in specific types of labor and then trade for their other needs or wants,

		rather than trying to produce everything they need or want on their own. It also demonstrates trade is most efficient when coordinated through a medium of exchange, or money. Economic laws deduced in this way tend to be very general and not give specific results: they can say profits incentivize new competitors to enter a market, but not necessarily how many will do so. Still, they do provide key insights for understanding the behavior of financial markets, governments, economies—and human decisions behind these entities. Other branches of economic thought emphasize empiricism, rather than formal logic—specifically, logical positivist methods, which attempt to use the procedural observations and falsifiable tests associated with the natural sciences. Some economists even use direct experimental methods in their research, with subjects asked to make simulated economic decisions in a controlled environment. Since true experiments may be difficult, impossible, or unethical to use in economics, empirical economists mostly rely on simplifying assumptions and retroactive data analysis. However, some economists argue economics is not well suited to empirical testing, and that such methods often generate incorrect or inconsistent answers. Two of the most common in macroeconomics are monetarist and Keynesian. Monetarists are a branch of Keynesian economics that argue that stable monetary policy is the best course for managing the economy, and otherwise often have generally favorable views on free markets as the best way to allocate resources. In contrast, other Keynesian approaches favor fiscal policy by an activist government in order to manage irrational market swings and recessions and believe that markets often don't work well at allocating resources on their own. Economic Indicators Economic indicators are reports that detail a country's economic performance in a specific area. These reports are usually published periodically by governmental agencies or private organizations, and they often have a considerable effect on stocks, fixed income, and forex markets when they are released. They can also be very useful for investors to judge how economic conditions will move markets and to guide investment decisions. Below are some of the major U.S. economic reports and indicators used for fundamental analysis. Gross Domestic Product (GDP)

		The Gross Domestic Product (GDP) is considered by many to be the broadest measure of a country's economic performance. It represents the total market value of all finished goods and services produced in a country in a given year or another period (the Bureau of Economic Analysis issues a regular report during the latter part of each month).3 Many investors, analysts, and traders don't actually focus on the final annual GDP report, but rather on the two reports issued a few months before: the advance GDP report and the preliminary report. This is because the final GDP figure is frequently considered a lagging indicator, meaning it can confirm a trend but it can't predict a trend. In comparison to the stock market, the GDP report is somewhat similar to the income statement a public company reports at year-end. Retail Sales Reported by the Department of Commerce during the middle of each month, the retail sales report is very closely watched and measures the total receipts, or dollar value, of all merchandise sold in stores.4 The report estimates the total merchandise sold by taking sample data from retailers across the country—a figure that serves as a proxy of consumer spending levels. Because consumer spending represents more than two-thirds of GDP, this report is very useful to gauge the economy's general direction. Also, because the report's data is based on the previous month sales, it is a timely indicator. The content in the retail sales report can cause above normal volatility in the market, and information in the report can also be used to gauge inflationary pressures that affect Fed rates. Industrial Production The industrial production report, released monthly by the Federal Reserve, reports on the changes in the production of factories, mines, and utilities in the U.S. One of the closely watched measures included in this report is the capacity utilization ratio, which estimates the portion of productive capacity that is being used rather than standing idle in the economy.5 It is preferable for a country to see increasing values of production and capacity utilization at high levels. Typically, capacity utilization in the range of 82–85% is considered "tight" and can increase the likelihood of price increases or supply shortages in the near term. Levels below 80% are usually interpreted as showing "slack" in the economy, which might increase the likelihood of a recession. Employment Data The Bureau of Labor Statistics (BLS) releases employment data in a report called the non-farm payrolls, on the first Friday of each month.6 Generally, sharp increases in employment

		indicate prosperous economic growth. Likewise, potential contractions may be imminent if significant decreases occur. While these are general trends, it is important to consider the current position of the economy. For example, strong employment data could cause a currency to appreciate if the country has recently been through economic troubles because the growth could be a sign of economic health and recovery. Conversely, in an overheated economy, high employment can also lead to inflation, which in this situation could move the currency downward. Consumer Price Index (CPI) The Consumer Price Index (CPI), also issued by the BLS, measures the level of retail price changes (the costs that consumers pay) and is the benchmark for measuring inflation. Using a basket that is representative of the goods and services in the economy, the CPI compares the price changes month after month and year after year.7 This report is one of the more important economic indicators available, and its release can increase volatility in equity, fixed income, and forex markets. Greater-than-expected price increases are considered a sign of inflation, which will likely cause the underlying currency to depreciate. Types of Economic Systems Societies have organized their resources in many different ways through history, deciding how to use available means to achieve individual and common ends. Primitivism In primitive agrarian societies, people tend to self-produce all of their needs and wants at the level of the household or tribe. Families and tribes would build their own dwellings, grow their own crops, hunt their own game, fashion their own clothes, bake their own bread, etc. This economic system is defined by very little division of labor and resulting low productivity, a high degree of vertical integration of production processes within the household or village for what goods are produced, and relationship based reciprocal exchange within and between families or tribes rather than market transactions. In such a primitive society, the concepts of private property and decision-making over resources often apply at a more collective level of familial or tribal ownership of productive resources and wealth in common. Feudalism Later, as civilizations developed, economies based on production by social class emerged, such as feudalism and slavery. Slavery involved production by enslaved individuals

		who lacked personal freedom or rights and were treated as the property of their owner. Feudalism was a system where a class of nobility, known as lords, owned all of the lands and leased out small parcels to peasants to farm, with peasants handing over much of their production to the lord. In return, the lord offered the peasants relative safety and security, including a place to live and food to eat. Capitalism Capitalism emerged with the advent of industrialization. Capitalism is defined as a system of production whereby business owners (entrepreneurs or capitalists) organize productive resources including tools, workers, and raw materials to produce goods for sale in order to make a profit and not for personal consumption. In capitalism, workers are hired in return for wages, owners of land and natural resources are paid rents or royalties for the use of the resources, and the owners of previously created wealth are paid interest to forgo the use of some of their wealth so that the entrepreneurs can borrow it to pay wages and rents and purchase tools for hired workers to use. Entrepreneurs apply their best judgement of future economic conditions to decide what goods to produce, and are earn a profit if they decide well or suffer losses if they judge poorly. This system of market prices, profit, and loss as the selection mechanism as to who will decide how resources are allocated for production is what defines a capitalist economy These roles (workers, resource owners, capitalists, and entrepreneurs) represent functions in the capitalist economy and not separate or mutually exclusive classes of people. Individuals typically fulfill different roles with respect to different economic transactions, relationships, organizations, and contracts which they are a party to. This may even occur within a single context, such as a employee-owned co-op where the workers are also the entrepreneurs or a small business owner-operator who self-finances his firm out of personal savings and operates out of a home office, and thus acts as simultaneously as entrepreneur, capitalist, land owner, and worker. The United States and much of the developed world today can be described as broadly capitalist market economies. Socialism Socialism is a form of cooperative production economy. Economic socialism is a system of production where there is limited or hybrid private ownership of the means of production (or other types of productive property) and a system of prices,

		profits, and losses is not the sole determinant used to establish who engages in production, what to produce and how to produce it. Segments of society band together to share these functions Production decisions are made through a collective decision making process, and within the economy some but not all economic functions are shared by all. These might include any strategic economic functions that effect all citizens. These would include Public Safety (police, fire, EMS), National Defense, resource allocation (utilities. like water, and electric), education, and more. These are often paid for through income or use taxes levied on the remaining tactically independent economic functions (individual citizens, independent businesses, foreign trade partners, etc). Modern socialism contains certain elements of capitalism, such as a market mechanism, and also some centralized control over some resources. If more of the economic control is centralized in ever increasing ways, it may eventually become more akin to communism. Note that socialism as an economic system can and does occur under various forms of government, from the Democratic Socialism of the Nordic countries to more authoritarian strands found elsewhere. Communism Communism is a form of command economy, whereby nearly all economic activity is centralized, and through the coordination of state-sponsored central planners. A society's theoretical economic strength can be marshaled to the benefit of the society at large. Executing this in reality is far more difficult than in theory, in that it requires no conflicting or competing entities within the society to challenge the allocation of resources. Note that instances of economic communism in the modern era have also been coupled with an authoritarian form of government, although this need not be the case in theory. (Extracted from: https://www.investopedia.com/terms/e/economics.asp)
	Expected Keyword Include In Summary:	Economic|Economist|Resources|Goods|Indicators|Consumer| GDP|Price
	Actual Output:	It represents the total market value of all finished goods and services produced in a country in a given year or another period (the bureau of economic analysis issues a regular report during the latter part of each month).3 many investors, analysts, and traders don't actually focus on the final annual gdp report, but rather on the two reports issued a few months

		before: the advance gdp report and the preliminary report. Economic socialism is a system of production where there is limited or hybrid private ownership of the means of production (or other types of productive property) and a system of prices, profits, and losses is not the sole determinant used to establish who engages in production, what to produce and how to produce it. Using a basket that is representative of the goods and services in the economy, the cpi compares the price changes month after month and year after year.7 this report is one of the more important economic indicators available, and its release can increase volatility in equity, fixed income, and forex markets. economic indicators economic indicators are reports that detail a country's economic performance in a specific area. This system of market prices, profit, and loss as the selection mechanism as to who will decide how resources are allocated for production is what defines a capitalist economy these roles (workers, resource owners, capitalists, and entrepreneurs) represent functions in the capitalist economy and not separate or mutually exclusive classes of people.

2.4 Overall Testing

Question:

- Q1: Can you describle anything about “Artificial Intelligence”?
- Q2: Do you think that the system you used just now could offset the insufficiency of existing searh engine, for example, the unfriendliness to user that have no prior knowledge in specific domain of knowledge, no summarization/abstract of a searched website…etc?
- Q3: Could this system successfully reduce the effort need for you to learn a new concept?
- Q4: What do you think this system is lacking of? For example, time needed, concise suggestion of searching domain knowledge return by system?
- Q5: If this system really published, would you use this system to learn new concept?
- Q6: Do you have any suggestion to improve this system?
- Q7: Do you think the domain specific knowledge suggested is concrete enough?

3. Timeline table: (1 = 1 day in Plan Duration)

Project Planner

Select a period to highlight at right. A legend describing the charting follows.

ACTIVITY	PLAN START	PLAN DURATION
Doing Interim Report I	1	4
Finding Existing Ontologies	1	8
Finding Any Past Work about Document Classification for Ontology Building	5	7
Start to build the Backend	10	7
Testing: Try to use Found Ontologies	17	2
Testing: Try to feed some keyword into the system and test if it can generate sub-concept base on the Ontologies (Debug if cant Use)	19	3
Build Text Summarization part (+Debug)	21	7
Testing: Try to feed passage with expected output into the Text Summarization part (+Debug)	28	3
Build Query Processing Part (Keyword Extraction+Query Building)	31	3
Testing: Try to feed long query with expected output into the Query Processing Part (+Debug)	34	1
Testing: Try to build Query base on the contrainst provided (+Debug)	35	1
Build Part passing query to existing search and get search result (+Debug)	36	3
Build the whole backend: make built part can communicate with other (+Debug)	39	3
Testing: Try the feed query into the system and get result (+Debug)	42	3
Build FrontEnd to accept query and show search Result	45	10
Testing: Try to feed dummy fixed search result to website and see if it can show result (+Debug)	55	3
Testing: Try to choose domain specific constraint and see if the frontend can correctly pass all constraint (+Debug)	58	2
Build The whole system: allow frontend and backend communicate (+Debug)	60	7
Testing: Feeding Query with Expected Output (Debug)	67	7
Evalution	74	7
Final Report	81	7

Project Planner

Select a period to highlight at right. A legend describing the charting follows.

Period Highlight: 87

Plan Duration | Actual Start | % Complete | Actual (beyond plan) | % Complete (beyond plan)

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Doing Interim Report I	1	4	1	4	100%
Finding Existing Ontologies	1	8	3	8	100%
Finding Any Past Work about Document Classification for Ontology Building	5	7	5	7	100%
Start to build the Backend	10	7	39	41	100%
Testing: Try to use Found Ontologies	17	2	11	10	100%
Testing: Try to feed some keyword into the system and test if it can generate sub-concept base on the Ontologies (Debug if cant Use)	19	3	11	10	100%
Build Text Summarization part (+Debug)	21	7	39	7	100%
Testing: Try to feed passage with expected output into the Text Summarization part (+Debug)	28	3	45	2	100%
Build Query Processing Part (Keyword Extraction+Query Building)	31	3	47	3	100%
Testing: Try to feed long query with expected output into the Query Processing Part (+Debug)	34	1	50	1	100%
Testing: Try to build Query base on the contrainst provided (+Debug)	35	1	50	1	100%
Build Part passing query to existing search and get search result (+Debug)	36	3	51	7	100%
Build the whole backend: make built part can communicate with other (+Debug)	39	3	58	7	100%
Testing: Try the feed query into the system and get result (+Debug)	42	3	65	7	100%
Build FrontEnd to accept query and show search Result	45	10	15	28	100%
Testing: Try to feed dummy fixed search result to website and see if it can show result (+Debug)	55	3	20	23	100%
Testing: Try to choose domain specific constraint and see if the frontend can correctly pass all constraint (+Debug)	58	2	72	2	100%
Build The whole system: allow frontend and backend communicate (+Debug)	60	7	74	7	100%
Testing: Feeding Query with Expected Output (Debug)	67	7	79	2	100%
Evalution	74	7	81	2	100%
Final Report	81	7	81	7	100%
					0%