



ISY5001 COGNITIVE SYSTEMS
Group Project Report

ISS Course Enquiry Chatbot

Chen Liwei (A0101217B)
Raymond Djajalaksana (A0195381X)
Ng Cheong Hong (A0195290Y)
Seah Jun Ru (A0097451Y)
Lee Boon Kien (A0195175W)

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1.0 EXECUTIVE SUMMARY

The evolution of artificial intelligence has become a hot topic in the recent year. While comparing between artificial intelligence and chatbots, chatbots are only a faint splash on a huge wave of progress. In the recent days, the number of users of social media messaging apps like Slack, Whatsapps, Telegrama and Skype are skyrocketing, Facebook Messenger alone has achieved the milestone of 1.2 billion monthly users. With the increasing of popularity of messaging apps, virtual chatbots that imitate human conversations for solving various tasks are becoming a trend and is an inevitable process to move towards an advanced society. Chinese WeChat bots nowadays provide a fancy function to minimize the repetitive process, such as setting medical appointments, calling a taxi, sending money to friends, check in for a flight and so on.

When come to the sector of automating customer support, online chatbots will come in handy to save time and more efficient. Gartner forecasts that by 2020, over 85% of customer interactions will be handled without a human. However, the advantages provided by chatbot systems exceeded the expectation of an ordinary system that give responses to customers' inquiries. They also provide function such as collecting information about users, reducing overhead costs and helping to organize meetings. It is undoubtedly that size of the chatbot market is growing exponentially.

Looking at the current website of ISS, there is still a big improvement that could be made to help our next batch of student in better understanding the ISS programme. Our team has applied the techniques learned in class and scraped the information from the existing website to develop a chatbot. By utilizing the Dialogflow and Slack, it saves us the time to develop the backend and frontend yet achieving the optimized result. It will definitely be a good news for ISS applicants if the chatbot is successfully implemented in the ISS website.

2.0 PROBLEM DESCRIPTION

Potential students who are interested in enrolling in Institute of System Science courses are able to gain more information about them through the online website, hotline or tea sessions currently. However, the hotline is only available during office hours and tea sessions are held only on an adhoc basis. The online website seems like a good platform for them to get the information they need but given that the information presented on the website are in chunks of texts, the information displayed on the website may overwhelm the students and they might need to spend a substantial amount of time to look for the specific answer to their question.

2.1 PROJECT OBJECTIVE

This project aims to create a system that will solve the problem described in above subsection:

1. Implement a chatbot system that will answer any query related to NUS ISS master programme almost instantly. The chatbot should be able to find answers that can be found in NUS ISS website.
2. Develop a chatbot as a ready-to-use system, i.e. Deploy the chatbot so it can be used in real scenario.

3.0 KNOWLEDGE MODELING

In our project, we built a knowledge base via knowledge acquisition techniques and presented an overarching view of the knowledge via knowledge modeling. Thereafter, with our comprehensive knowledge base, the bot was able to identify intents and construct a valid response back to the user.

3.1 KNOWLEDGE BASE

3.1.1 Knowledge acquisition

Using Beautiful Soup Python library, we created a script (as seen in Appendix A) to scrape off raw data from the website of Institute of Systems Science. Thereafter, we formulated a list of questions that potential students of Institute of Systems Science may enquire based on our past experience prior to enrolment into Masters of Intelligent Systems. After which, we segmented the raw data according to our list of questions and created a knowledge base of Q&A for the four different masters courses available in Institute of Systems Science (as seen in Appendix B).

In addition to the documented sources as mentioned above, we also created a knowledge base of information about Institute of System Science lecturers and courses based on our own experience and tacit knowledge as students attending the modules. These additional information complements the information from documented sources to provide a more realistic view of the student life in Institute of System Science, as well as inject some humor into our bot to make the conversations more interesting and engaging.

3.1.2 Knowledge model and refinement

After acquiring the knowledge base as mentioned previously, we developed the following inference diagram to illustrate our knowledge base in a structured representation:

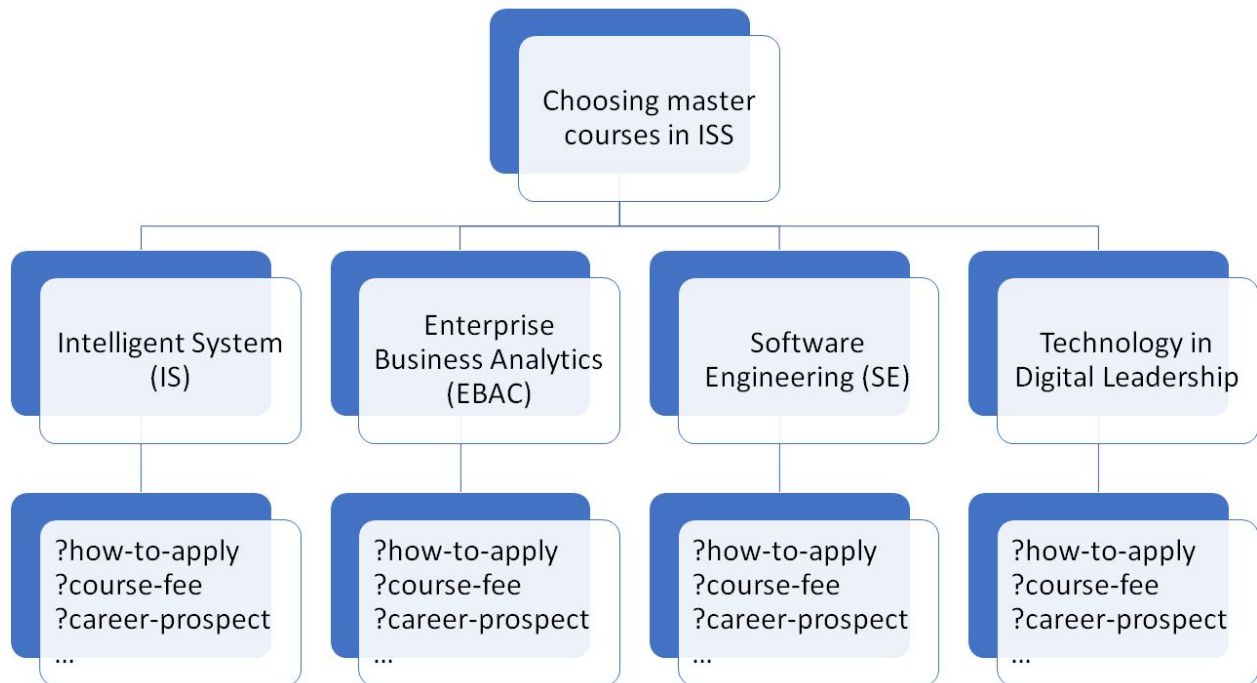


Figure 3.1.2.1 Course information inference diagram

The inference diagram arranges the courses information based on the four master ISS courses. The decision of the proposed system is illustrated by the top most level node, which in this case, the master courses in ISS. This decision is broken down into layers of inferable sub-goals or sub-factors before arriving at a list of “observables”. These “observables” are derived from standard queries being asked during course application and they represent the main factors that influence the decision of users when selecting the preferred course.

3.2 INTENT MATCHING

To analyze user conversation, we are using intent detection method to deduce user intent and context. We leverage this function using dialogflow intent matching features. We build our intent models using the knowledge base that we have acquired.

For each intent we have trained them by giving various utterances sample so our chatbot can cover wide range of possible conversations. Furthermore along with intent parsing, our chatbot will also try to guess the context of the conversation. This means that the system is able to link the context or reference from past conversations. For example: *"I want to know about IS programme. What is the course fee of this program ?"* (*this refers to IS programme*). With this chatting with our bot will feel more natural since the user does not have to repeat the same object again and again.

As a bonus we also train our system with funny intent so that the chatbot is able to detect any weird queries coming from the user. This way we can gracefully handle such edge cases.

Other than user defined intents, Google Dialogflow also allows creation of knowledge base and no intent definition is required. Dialogflow will analyse the conversation and try to match the intent to the knowledge base. However, we find it rather challenging to balance the intent matching with both user-defined intents and knowledge base despite having a control slider to indicate the strength. There are some other limitations of knowledge base like unable to add more training phrases to cover different utterances and knowledge documents need to be well structured in order to return answer accurately. Switching from user-defined intent to knowledge base in a conversation also seem to reset the original context.

3.3. Chatbot Response

After doing all the analysis on user conversation, we are able to understand what user wants. Naturally the next step is how to response and answer to this query in human-like manner. Firstly we need to form the informations that will give the correct answer to the user queries. Since we have breakdown the query in systematic way, we can look up the answer from our knowledge regarding ISS courses.

Thereafter we will need to wrap this answer in the form of conversation. This is simply done by providing several templates for the system to randomly pick one of them. Injecting the core information to the template, the chatbot will then be able to converse back with user.

4.0 SOLUTION

4.1 SYSTEM ARCHITECTURE

The system can be divided into 2 parts, frontend and backend.

For our frontend, we chose not to reinvent the wheel by using existing established messenger services such as Slack to provide the user interface for interaction with user. In addition, because these established messenger services already have a wide user base, it is highly likely the potential student is already an existing user of the messenger service, and is able to use the existing app that they are familiar with to interact with our chatbot to get the information they need. With a familiar and user friendly interface, these potential students will be more inclined to use the chatbot service, hence being more effective in attracting potential students to enquire about courses at Institute of Systems Science as compared to building a bespoke chat user interface.

For our backend, we used one of the most established Natural Language Processing engine available - Dialogflow by Google. With clear and precise documentation available online, integrating Dialogflow with Slack was a breeze. Upon submission of utterance via the Slack app, the utterance is sent to the Dialogflow engine, which then identify and matches the intents in the utterance with those we have in our database. The following actions for each intent is defined in our fulfillment (Webhook). In addition, fulfillment also tracks the context of the conversation, such as which ISS masters course the user is referring to. This allows co-referencing to take place, providing a continuous and engaging experience to the user. Based on the matching intent and context of the conversation, the response replying to the intent is constructed with the data from our database defined in fulfillment, and sent back to the Slack app. The system flow is depicted in Fig 4.1.

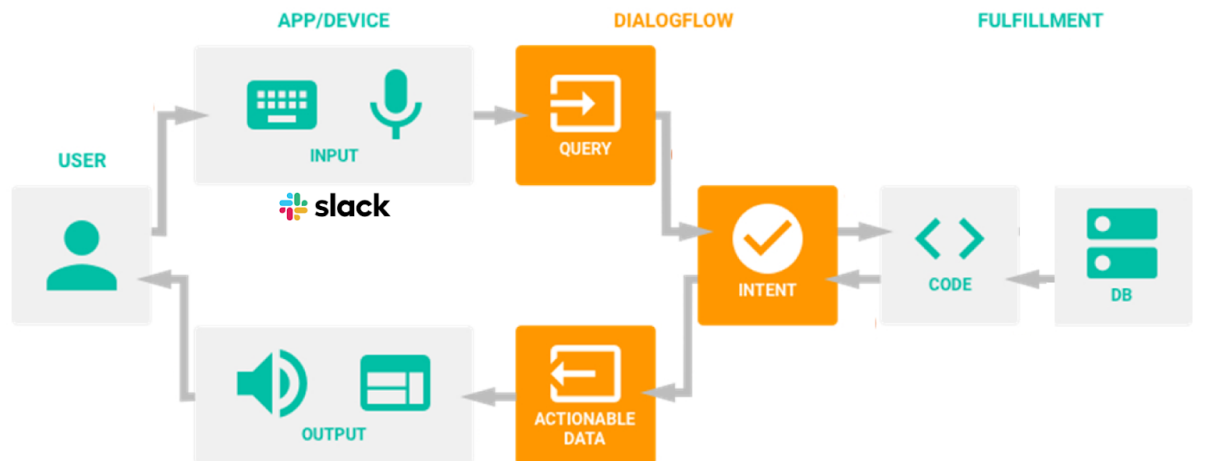


Figure 4.1 [Overall System Design Diagram]. Referenced

<https://www.margo-group.com/en/news/a-brief-introduction-to-chatbots-with-dialogflow/>

4.2 PROJECT SCOPE

The scope of our system is limited to enquiring information related to the full-time or part-time masters courses provided by Institute of Systems Science. Information related to stackable courses or enrolment of single module is not included in our project scope.

4.3 ASSUMPTIONS

Assumptions that we made when we building our system include:

1. The potential student is only interested in getting information related to 4 full-time or part-time graduate programmes comprising of: Masters of Technology in Digital Leadership, Masters of Technology in Intelligent Systems, Masters of Technology in Enterprise Business Analytics and Masters of Technology in Software Engineering.
2. User will select the course name context first before asking for specific information about the course.
3. Information provided by chatbot is based on information provided by Institute of Systems Science on 18th May 2019, hence some of details might be inaccurate or outdated at the point of usage of the system.

4.4 SYSTEM'S FEATURES

Despite of the limitations mentioned in the previous sections, we were able to implement some key features as illustrated in this section.

4.4.1 Dialogflow engine

We use Dialogflow as our main engine for cognition system. We have customized all the intent matching and knowledge bases to align with our goal to serve as NUS ISS curriculum chatbot. Furthermore we have done some training on the chatbot itself to increase the accuracy of its recognition system.

4.4.2 Ease of usage and integration

As we use Dialogflow engine for our main chatbot system, we can leverage the full integration by using the built-in api that is available with other app. We can easily deploy our chatbot to many popular apps such as facebook messenger, slack app, telegram and many more. For our demonstration purpose we have embedded our chatbot system with slack app.

4.5 LIMITATIONS

The knowledge model that are used to build the system has been simplified. This is mainly happen because of the complexity of the problem that we would like to tackle. The result of knowledge acquisition is insufficient to give all the insights needed to solve the problem. Hence the system tend to focus to solve on one small part of the area. However going forward we can expand our system to cover more cases from different perspectives.

5.0 CONCLUSION & REFERENCES

The group discussion session was fruitful and rewarding as we have learnt much from each other. Even though every one of us has personal commitment on our work, we still committed a substantial portion of our rest time and weekend to deliver the project. The time spent on this group project was not wasted, the joy of witnessing the completion of final product was unforgettable and we are glad that we have successfully achieved our objective of providing timely information to the potential ISS students.

5.1 IMPROVEMENTS

If we were given a longer duration to work on this project, we would have worked upon the following points of improvement:

5.1.1 Including course enquiries related to individual modules

The data we acquired from ISS website does not provide the description of each individual modules. For example, there are four specialist modules under Intelligent System, such as Intelligent Robotic Systems, Intelligent Sensing System, Intelligent Software Agents and Practical Language Processing. Providing insights on each individual modules within the specialist module could have swayed the potential candidate's interest to register for the particular course. We could have worked with ISS lecturer to collect all the module information and build it into our chatbot.

5.1.2 Differentiate part-time and full-time courses

Based on the current data structure, part-time and full-time courses are being lumped together in one answer. The chatbot would not be able to give a precise answer pertaining to a standalone question regarding part-time or full-time course. A lot of works have to be carried out in order to segregate the part-time and full-time courses. This could be achieved if we were more focused on establishing the FAQ, instead of building the chatbot.

5.1.3 Use fulfillment to capture latest update of course context

We did consider to adopt fulfillment under Dialogflow, which allows code to be deployed through a web service to capture the latest update in ISS website. However, considering the robustness of API and potential redesign of website in the future, the failure of calling API is expected to be quite high. In order to achieve a more stable bot environment, standalone system was adopted in this project. We can look into the feature of fulfillment in future when the course context is more or less stabilized.

6.0 BIBLIOGRAPHY

Hao Chen. (2018, May 07). A brief introduction to Chatbots with Dialogflow. Retrieved May 28, 2019, from <https://www.margo-group.com/en/news/a-brief-introduction-to-chatbots-with-dialogflow/>
(for system architecture diagram)

Slack | Dialogflow Documentation | Google Cloud. (2019, January 16). Retrieved May 28, 2019, from <https://cloud.google.com/dialogflow-enterprise/docs/integrations/slack>

Internship and Placements. (n.d.). Retrieved May 28, 2019, from <https://www.iss.nus.edu.sg/collaboration/internship-and-placements>

Appendix

APPENDIX A: PYTHON SCRIPT FOR KNOWLEDGE ACQUISITION

```
# -*- coding: utf-8 -*-
#pip install BeautifulSoup4 if needed

from bs4 import BeautifulSoup
import requests

def get(url):
    headers={}
    resp = requests.get(url, headers=headers)
    if resp.ok:
        return resp.text

#Extract the main content from each web url
def colcontent(url):
    data2 = get(url)
    soup = BeautifulSoup(data2, "html.parser")
    maindiv = soup.find("div", {"class":"main-content-entry with-break"})
    if maindiv:
        return (maindiv.text)

urls =
['https://www.iss.nus.edu.sg/graduate-programmes/programme/detail/master-of-technology-in-intelligent-systems','https://www.iss.nus.edu.sg/graduate-programmes/programme/detail/master-of-technology-in-enterprise-business-analytics','https://www.iss.nus.edu.sg/graduate-programmes/programme/detail/master-of-technology-in-software-engineering','https://www.iss.nus.edu.sg/graduate-programmes/programme/detail/master-of-technology-in-digital-leadership']
names = ['IS','EBC','SE','DL']

totalCount = 5
file = open("ISS Data.txt","w")

for item in urls[:totalCount]:
    contents=colcontent(item)
    print(contents)
    file.write(names[urls.index(item)])
    file.write(contents)
    print (names[urls.index(item)]+" downloaded.")

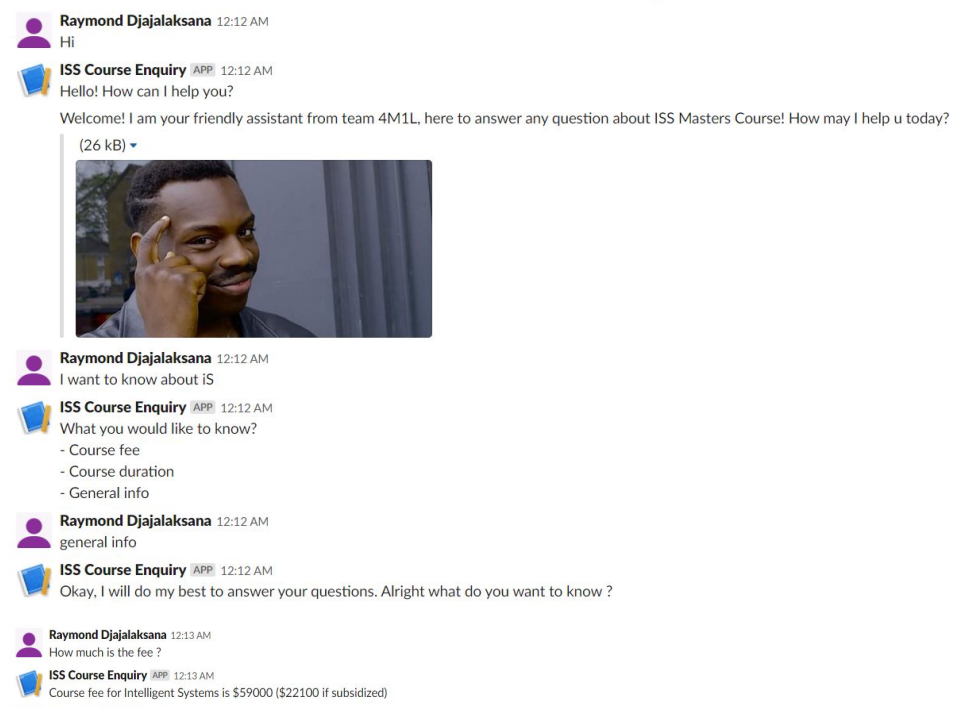
file.close()
```

APPENDIX B: Q&A KNOWLEDGE BASE

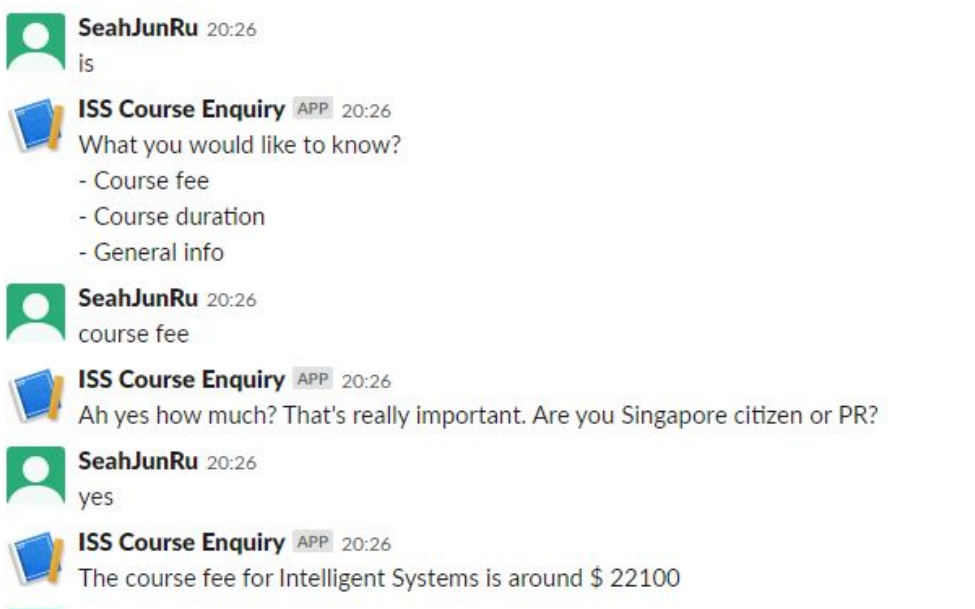
Please refer to attached separate Appendix B document.

APPENDIX C: SAMPLE INPUT & SYSTEM OUTPUT

A.1 Scenario 1: Basic Course Fee Intent (Context Usage)




Screenshots	 <p>Raymond Djajalaksana 12:12 AM Hi</p> <p>ISS Course Enquiry APP 12:12 AM Hello! How can I help you? Welcome! I am your friendly assistant from team 4M1L, here to answer any question about ISS Masters Course! How may I help u today? (26 kB) ▾</p> <p>Raymond Djajalaksana 12:12 AM I want to know about IS</p> <p>ISS Course Enquiry APP 12:12 AM What you would like to know? - Course fee - Course duration - General info</p> <p>Raymond Djajalaksana 12:12 AM general info</p> <p>ISS Course Enquiry APP 12:12 AM Okay, I will do my best to answer your questions. Alright what do you want to know ?</p> <p>Raymond Djajalaksana 12:13 AM How much is the fee ?</p> <p>ISS Course Enquiry APP 12:13 AM Course fee for Intelligent Systems is \$59000 (\$22100 if subsidized)</p>
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A.2 Scenario 2: Switching between courses

Screenshots	 <p>SeahJunRu 20:26 is</p> <p>ISS Course Enquiry APP 20:26 What you would like to know? - Course fee - Course duration - General info</p> <p>SeahJunRu 20:26 course fee</p> <p>ISS Course Enquiry APP 20:26 Ah yes how much? That's really important. Are you Singapore citizen or PR?</p> <p>SeahJunRu 20:26 yes</p> <p>ISS Course Enquiry APP 20:26 The course fee for Intelligent Systems is around \$ 22100</p>
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	<div>  SeahJunRu 20:27 what about se </div> <div>  ISS Course Enquiry APP 20:27 What you would like to know? <ul style="list-style-type: none"> - Course fee - Course duration - General info </div> <div>  SeahJunRu 20:27 course fee </div> <div>  ISS Course Enquiry APP 20:27 Ah yes how much? That's really important. Are you Singapore citizen or PR? </div> <div>  SeahJunRu 20:27 yes </div> <div>  ISS Course Enquiry APP 20:27 The course fee for Software Engineering is around \$ 18220 </div>
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A.3 Scenario 3: Funny Intent

Screenshots	<div>  liwei123 1:42 AM Is studying at ISS fun? </div> <div>  ISS Course Enquiry APP 1:42 AM (26 kB) <div>  </div> </div> <div> ISS has awesome campus, intelligent students, genius lecturers, ...and of course, the smartest bot that is answering your question now! How can you ever doubt it?! </div>
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APPENDIX D: USERS MANUAL

SYSTEM OVERVIEW

We have deployed our chatbot system to slack workspace. The chatbot will try to answer questions related to ISS course. To be able to start conversation with the chatbot you simply just need to login to the slack.

USER INTERFACE

As we integrate our application with slack, hence the user interface is also relying on slack UI.

REQUIREMENTS

You just need to create account to our chatbot workspace. To create new account simply use this invitation link:

https://join.slack.com/t/iss4m1l/shared_invite/enQtNjM5MzgZMTQ4NDM3LTcxZjM1ZGZIM2VkYzVjZGY4OTU4NDcxYTkyMDViNTFhYjVmMDRmZWZhYjFIMjNIZDM5NGFhODEyN2E0MDNkOTE

If you already have the account you can try login from here :


<https://iss4m1l.slack.com/>

Join public channel #iss-course-enquiry or simply browse ISS Course Enquiry app.

LET'S TALK

That's all it takes. Now you can ask the bot some questions regarding NUS ISS course informations. Here is some question samples you can try:

 **Raymond Djajalaksana** 12:12 AM
Hi


 **ISS Course Enquiry** APP 12:12 AM
Hello! How can I help you?

Welcome! I am your friendly assistant from team 4M1L, here to answer any question about ISS Masters Course! How may I help u today?


(26 kB) ▾





 **Raymond Djajalaksana** 12:12 AM
I want to know about iS

 **ISS Course Enquiry** APP 12:12 AM
What you would like to know?


- Course fee
- Course duration
- General info

 **Raymond Djajalaksana** 12:12 AM
general info


 **ISS Course Enquiry** APP 12:12 AM
Okay, I will do my best to answer your questions. Alright what do you want to know ?

 **ISS Course Enquiry** APP 12:12 AM
Okay, I will do my best to answer your questions. Alright what do you want to know ?


 **Raymond Djajalaksana** 12:13 AM
How much is the fee ?

 **ISS Course Enquiry** APP 12:13 AM
Course fee for Intelligent Systems is \$59000 (\$22100 if subsidized)

 **Raymond Djajalaksana** 12:13 AM
What is the objective learning of IS ?

 **ISS Course Enquiry** APP 12:13 AM
Acquire hands-on experience in defining and analysing the knowledge and data requirements of real-world business problems. Plan and strategise high-value intelligent systems projects to provide identifiable benefits to the internship company. Design, develop and implement Intelligent Systems through the effective use of Artificial Intelligence and Knowledge Engineering tools and techniques

 **Raymond Djajalaksana** 12:13 AM
Who teach the program ?

 **ISS Course Enquiry** APP 12:13 AM
Dr. Barry Adrian SHEPHERD, Dr. FAN Zhen Zhen, Mr. GU Zhan, Dr. TAN Jen Hong, Dr. TIAN Jin, Dr. WANG Aobo, Dr. ZHU Fang Ming