



Project Report

NUS ISS Chatbot System

Group members

Chad Ng

Jin Xin

Xu Dongbin

Sun Hang

Li Xin

1.0 EXECUTIVE SUMMARY

In this report, a chat bot system is introduced for the National University of Singapore (NUS) Institute of Systems Science (ISS). ISS was Founded in 1981 at NUS, provides graduate education, executive education, consultancy and research services. Its objectives are to develop info COMM leaders, and to drive business and organization innovation. Nowadays ISS is providing many types of programs including postgraduate program, graduate program, stackable program and so on to fulfill the different demands from students. The systems science is growing fast during this few years, and more and more people are looking for the chance of further study on this field.

As a systems science institute, ISS is giving out many programs and courses on intelligent systems which is able to improve and optimize the efficiency, accuracy of business. Students in ISS are making effort on projects like on-line ordering system for a music books company, a delivery optimization system and so on. ISS is also benefiting from some of the students' project.

Our group of five members, brainstormed and decided to build a cognitive system which is in a form of chat bot system using web technologies and integration with Google's Cloud Dialog Flow V2 to answer the general questions on ISS programs from potential students and also those who are interested to apply.

Our primary objective is to apply the cognitive techniques in a chat bot system. One of the key goals is to significantly improve the delivery of information in order to better serve users of ISS website, and to help them get better acquainted with the offerings of NUS ISS. This solution will help NUS ISS reduce the time spent and manpower required either for web form request or email queries from existing or potential new students.

2.0 PROBLEM DESCRIPTION

Systems science is growing fast, technologies like AI, IoT, Industry 4.0 are the leading technology trends leading our world into a new era. Many are inspired and spurred to take on learning programmes in these fields to get prepared for the unavoidable implementation of all things “Smart”.

ISS is faced with ever increasing inquiries on these topics and web traffic has increased proportionally with the increase of interest in these subjects. New ISS web site visitors are also facing navigation problems because there is just too much information to present in a structured way and to show clearly on the ISS web site. The typical web visitors tend to spend a huge amount of time browsing and collecting information they need. Sometimes, all they really need may be just to compare and find out the most suitable programme or course relevant to them.

To improve the user experience of the website, NUS ISS needs to deliver information more efficiently; it should be fast, accurate and convenient. One of the possible solutions is an on-line human assistant answering service. The on-line human assistant serves to answer questions from ISS web visitors; however, the problem of an on-line human assistant may present some challenges like scalability, reliability, cost and availability:

1. One human assistant can only serve a single user at a time,
2. The waiting time for the user may be too long,
3. Human assistant also needs time to provide the information demanded,
4. The Human assistant cannot work 24 hours a day

These are real world problems that needs a better solution, and we can solve it to a certain extend by using an intelligent on-line chat bot assistant that can help answer common questions from ISS online users.

2.1 PROJECT OBJECTIVE

Our goal is to create an intelligent ISS Web Chat Bot System that will better serve ISS on-line users, and to deliver the information in a more user-friendly, accurate and efficient way. The on-line chat bot will get all its information from the ISS website. The solution integrates with Google’s Cloud Dialog Flow V2 API. The language parsing and key parameters or label extraction from users’ questions are handled by the system’s engine and trained by hybrid cognitive system. The solution can provide an answer in a short response time, and serve multiple users at same time. It will and can, of course, be active 24 hours every day.

By implementing the proposed new Chat Bot System, we strongly believe users’ experience to ISS website will be improved. ISS web users will be able to acquire the information they want faster, and in a more convenient way. NUS ISS will also benefit from it as they can save time and manpower answering general or common queries. As the Chat Bot is built by existing ISS students, it will be a good show case for the learning outcome of studying in NUS ISS.

2.2 PROJECT SCOPE

The proposed NUS ISS Chat Bot System will be built on web based technologies and includes the following:

(1) A front end ASP.NET Web form Chat Bot interface that accepts each user inputs or questions which processing each user's query request uniquely. Each user's session is isolated from another. And the context is per user experience.

(2) The web Chat Bot is designed and built with a profanity parser that preprocess the query before sending it to Google's Cloud Dialog Flow to be further processed to get a relevant response. The solution also consists of a simplified local response to common nonsensical requests from any potential rogue users. E.g. A rogue user may tell the chat bot to go and die. Such nonsensical requests will be handled elegantly by the solution. It will also be smart enough to detect repeated requests and response in an intelligent manner.

(2) The solution will include integration with Google's Cloud Dialog Flow V2 API. An intelligent agent will be created on dialog flow setup with a web hook server URL that gets triggered by Dialog Flow for each Dialog Flow intent that is linked with the web hook interface. The response of the web hook server is pass back to the web chat bot site and to the user.

(3) The web hook server solution is a custom C# HTTP server running behind a NGINX reversed proxy server. This HTTP server will process the DialogFlow's request JSON object. The Server's back end logic will parse each user's request for each intent's parameters and call the engine's search function, searching the custom binary tree knowledge base for the correct answer to the requested query.

(4) Four Google's DialogFlow's intent objects will be created namely:

- a) Executive Programme Intent,
- b) Graduate Programme Intent,
- c) Stackable Programme Intent,
- d) Other Information Intent.

Four binary tree knowledge bases will be created for these four intents. The knowledge base is setup by loading in data from standard excel files. The system parses each intent's excel file and converts the data into the proper binary tree data types and propagates these into the knowledge tree. The knowledge base can be extended by reloading data from updated excel files. **(See Appendix A for details)**

2.3 PROJECT ASSUMPTIONS

In this project, not every single detailed information and questions about ISS will be covered due to the project time-line constrains, but the solution can be scaled to include all information on NUS ISS web. This is because we have designed the solution as a real case demo and an actual functional chatbot for the NUS ISS website,

Below are the full listing of the training questions/phrases that is loaded into Google's DialogFlow. *(See Appendix B for DialogFlow Files.)*

| | Executive Programme: | | |
|----|--|----|--|
| 1 | what programmes are available at ISS? | 16 | How are internship placements handled? |
| 2 | what is PDU requirement in your programmes? | 17 | Does ISS offer corporate courses? |
| 3 | What funding are available for your programmes? | 18 | Do you have applied research programme? |
| 4 | Who can attend career talks arranged in your programmes? | 19 | Does ISS offer programme with consulting services? |
| 5 | What career services are available at ISS? | 20 | What programmes are available at ISS NUS? |
| 6 | Is there a programme for stackup startup tech talent development? | 21 | Does ISS provide programme with consulting services? |
| 7 | What software systems training course does ISS offer? | 22 | Can you tell me more about artificial intelligence discipline? |
| 8 | Can you explain your skillsfuture training programme? | 23 | What disciplines are available in ISS's Executive Education programme? |
| 9 | Do you have professional conversion programmes? | 24 | Tell me more about Executive Education at ISS? |
| 10 | Do you have a training course on digital products & platforms? | 25 | what artificial intelligence programme is available? |
| 11 | Please tell me more about digital strategy and leadership programme. | 26 | what reasoning systems programme does ISS have? |
| 12 | Is there any programme on digital innovation & design? | 27 | What masters programmes are available? |
| 13 | What is the digital agility programme? | 28 | Does ISS offer Diploma programme in Smart health? |
| 14 | What is the data science programme? | 29 | Does ISS NUS offer post graduate programmes? |
| 15 | Can you tell me more about CyberSecurity programme? | | |

| | Graduate Programme: | | |
|----|---|----|--|
| 1 | what campus activities are available at ISS? | 13 | do you have diploma courses in ISS programmes? |
| 2 | what campus facilities are available at ISS? | 14 | Do you have more information for your masters programmes? |
| 3 | Can you tell me about career services on placement opportunities? | 15 | Do you have road show for your masters programmes? |
| 4 | Does ISS provide career services? | 16 | Tell me about your Software Engineering programme. |
| 5 | Do you have an honour list? | 17 | Do you have a masters programme in Software Engineering ? |
| 6 | Can I know who the past honour students are? | 18 | Do you have a masters programme in Intelligent Systems ? |
| 7 | What financial assistance is available to your programmes? | 19 | Tell me about your Intelligent Systems programme. |
| 8 | What do organisations say about your programmes? | 20 | Do you have a masters programme in digital leadership ? |
| 9 | Tell me about what organisations say about your programmes. | 21 | Tell me about your Digital Leadership programme. |
| 10 | tell me more about your graduate programme diploma courses. | 22 | Do you have diploma course in your graduate programmes? |
| 11 | What are your graduate programmes? | 23 | What does your students feedback on your master programmes ? |
| 12 | What do you have for Graduate Programmes at ISS? | 24 | What does your students say about your master programmes ? |

| | Other Information: | | |
|----|--|----|------------------------------------|
| 1 | How do I get to NUS ISS? | 11 | what is NUS ISS core values? |
| 2 | Where is NUS ISS located? | 12 | what is NUS ISS vision? |
| 3 | How do I get to NUS ISS ? | 13 | what is NUS ISS mission statement? |
| 4 | Who are the administration staff at NUS ISS? | 14 | what is NUS ISS story? |
| 5 | Who are the teaching staff at NUS ISS? | | |
| 6 | Who are the members of ISS Management Team? | | |
| 7 | Why choose NUS ISS? | | |
| 8 | Who are the members of ISS Management Board? | | |
| 9 | what is NUS ISS accomplishments? | | |
| 10 | Can you tell me about NUS ISS achievements? | | |

| | Stackable Programme: | | |
|---|---|---|--|
| 1 | What is the Certificate Programme in Smart Systems & Platforms programme? | 4 | What is the certificate programme in data science programme? |
| 2 | What is the Certificate Programme in Artificial Intelligence? | 5 | What are Stackable Certificate Programmes? |
| 3 | What is the certificate programme in digital solutions development programme? | | |

A total of four excel files containing the summarized data sets are prepared as the data to be used to load up the knowledge bases. (Custom In-memory binary trees data structures designed in C#).

These excel files are:

- 1) ISS_ExecutiveEducation_v1.xlsx
- 2) ISS_GraduateProgramme_v1.xlsx
- 3) ISS_StackableProgramme_v1.xlsx
- 4) ISS_Other_v1.1.xlsx

The file format/layout is shown below:

Key Columns Names are:

1. location,
2. inquirytype
3. subject
4. questionkey
5. action
6. value

These 6 parameters are used in all four intents objects on Google's DialogFlow V2 Setup.

(See Appendix B for DialogFlow Files.)

| A | B | C | D | E | F | G |
|-----|--|--|-----------------------------|---|---|-------|
| sno | location | inquirytype | subject | questionkey | action | value |
| 1 | iss iss nus nus n courses course programme program | programmes Stackable | do have can what does is | tell explain available elab | The <a href="https://www.iss.nus.edu.sg/stackable-certificate- | |
| 2 | iss iss nus nus n courses course programme program | Stackable Certificate Programmm do have can what does is | tell explain available elab | The NUS-ISS Stackable Certificate Programme in Data Science, | | |
| 3 | iss iss nus nus n courses course programme program | Stackable Certificate Programmm do have can what does is | tell explain available elab | This course equips participants with necessary skills to design and | | |
| 4 | iss iss nus nus n courses course programme program | Stackable Certificate Programmm do have can what does is | tell explain available elab | The NUS-ISS Stackable Certificate Programme in Artificial Intelligenc | | |
| 5 | iss iss nus nus n courses course programme program | Stackable Certificate Programmm do have can what does is | tell explain available elab | The NUS-ISS Stackable Certificate Programme in Smart Systems & | | |
| 6 | iss iss nus nus n Certificate Programmes | benefits advantages | do have can what does is | tell explain available elab | There are many advantages to ISS stackable | |

2.4 PROJECT TEAM

The project members titles and roles are listed as followings:

| Nr. | Name and Title | Role |
|-----|-----------------------------------|---|
| 1 | Chad Ng Choon Beng (Project Lead) | Systems Consultation, Timeline, overall conceptualization, Solution Architect, Software Development |
| 2 | Xu DongBin (System Analyst) | Data mining, App Testing, Documentation, help with project report |
| 3 | Li Xin (System Analyst) | App Testing, Documentation, project report, project video |
| 4 | Sun Hang (Logic Developer) | Solution Design and Software development, Testing |
| 5 | Jin Xin (Logic Developer)) | Solution Design and Software development, Testing |

The team has met up every week to discuss the project status and updates. Tasks were assigned and areas of responsibilities were clearly outlined for each member.

We used Zoom-US video conference call platform to host our meeting when required. The project team lead recorded meetings recaps for each meeting conference call. The daily communication between team members were done through whatsApps, and our private Slack channel. Resources and sharing were done through Google Share Drive, Slack and Github.

Our team worked together on researching materials, case studies, doing the needed systems analysis and brainstorming and making sure we cover all possible general questions user may want to ask from the ISS website. The project is successfully executed, and the proposed solution is implemented on time and on target.

3.0 Solution Outline

3.1 SYSTEM ARCHITECHTURE

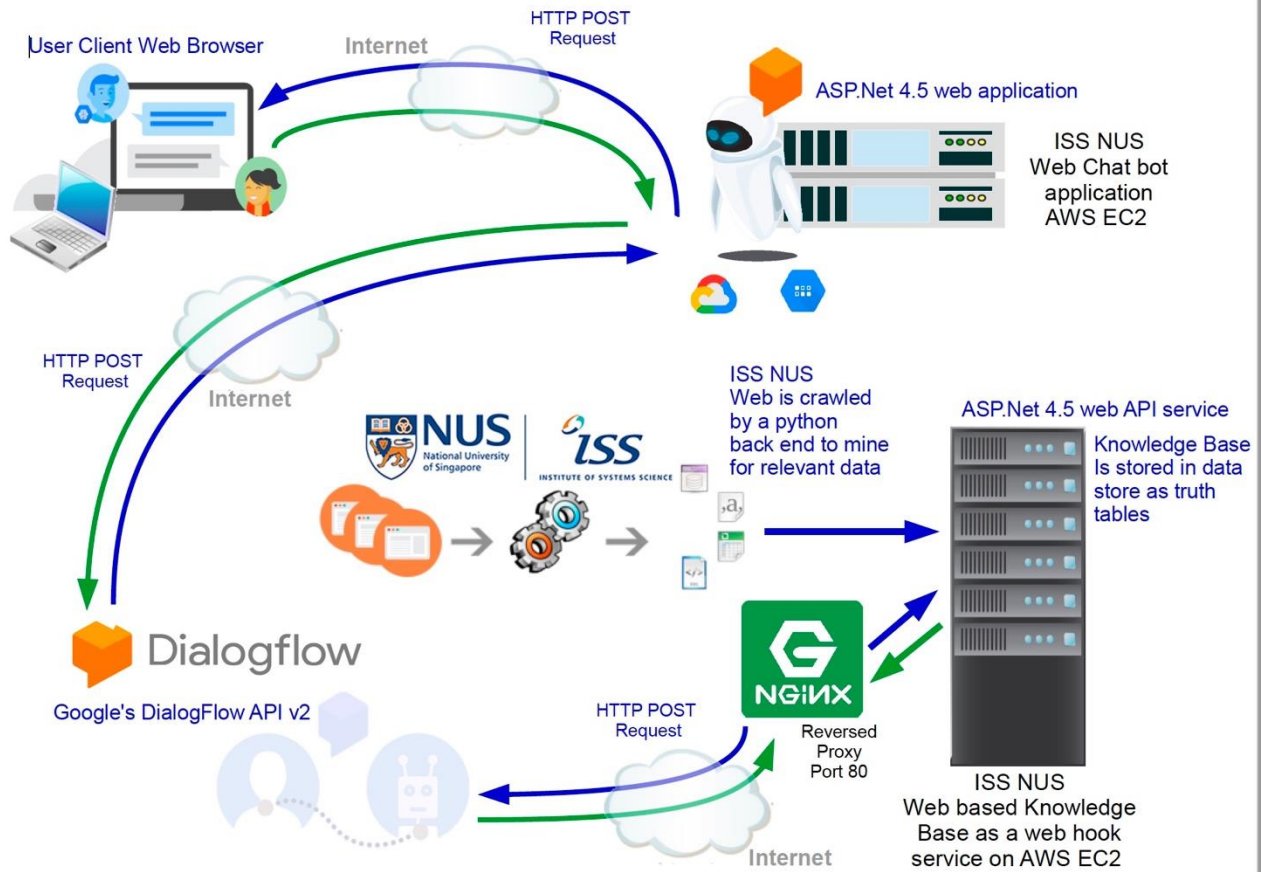


Fig1. ISS NUS Chat Bot (High Level Concept Architecture Design)

The NUS ISS Chat Bot System is a hybrid solution based on ASP.Net web forms, JQuery AJAX, a custom HTTP server (Web hook server, *dialogflow integration*) using Google's Cognitive AI solution API called Google DialogFlow API V2.

The solution provides a web interface (<http://52.43.103.81:5000/>) for a user to input their question. The question is submitted as a query to our backend web server hosted on Amazon Web Services EC2. The query is parsed and local logic is executed for common tasks like profanity keywords checks, repeated query checks and simplified nonsense checks. After these steps, the query is sent to Google's DialogFlow platform using the DialogFlow V2 API.

Four dialog flow intents sits on the dialogflow agent named "ISSNUS" :

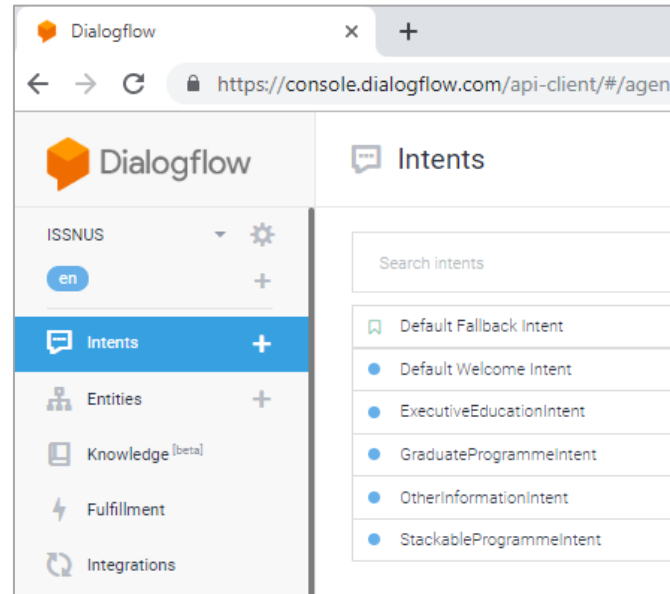
- 1) ExecutiveEducationIntent
- 2) GraduateProgrammeIntent
- 3) StackableProgrammeIntent
- 4) OtherInformationIntent

For each of the Intents, we have enabled webhook calls.

Fulfillment ?

☒ Enable webhook call for this intent

☐ Enable webhook call for slot filling



The request from the chat bot web front end is sent to DialogFlow in Google's dialog flow's API V2 Json request format.

(See: <https://developers.google.com/actions/build/json/dialogflow-webhook-json>)

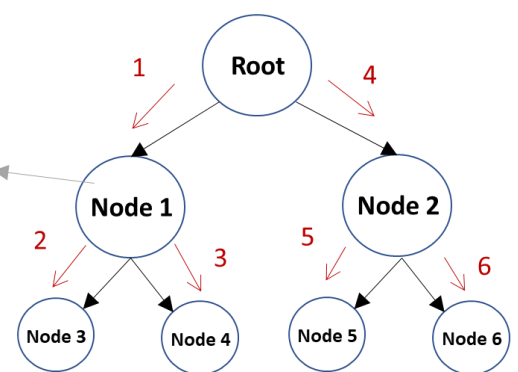
Google's DialogFlow then process the requested query and extract, from the submitted statement or question, its parameters based on what training phrases were setup on Google's DialogFlow.

The request is then routed to the solution's backend webhook HTTP server (<http://34.222.48.49:5000>) on AWS EC2 via the reversed proxy NGINX server.

The request is processed by this backend service which extracts the intent's display name and parameters and uses them as inputs to the binary tree knowledge base search engine. The search is executed in the usual way a binary tree is parsed. On each node of the binary tree, corresponding parameter objects containing keywords is stored. (Access is *Top-down starting with left hand side*)

The search starts with the root node and move down always from the left side. A set of verification logic is executed on all parameter array-list objects on each node against the input request parameters keywords received from Google's DialogFlow.

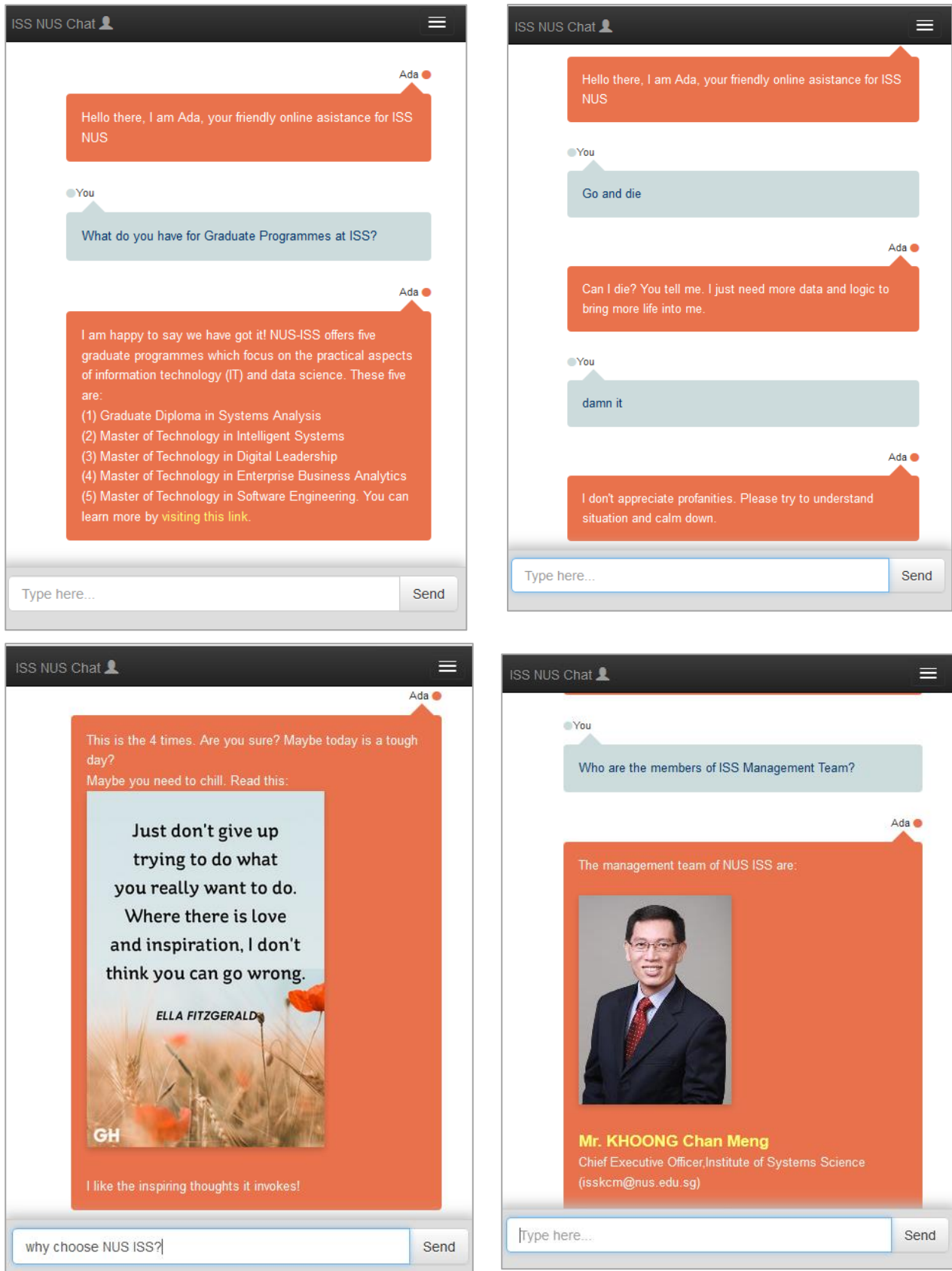
| FieldName, | Data Type |
|-------------|--------------------|
| Name | (Text value) |
| InquireType | (Arraylist Object) |
| Subject | (Arraylist Object) |
| Location | (Arraylist Object) |
| Action | (Arraylist Object) |
| Value | (Text value) |



The parameter array-list objects contain all possible keywords for the comparison checks. By designing the logic checks in this way, there is no need to write codes for all possible If-Then-Else logic for all possible scenarios. The system administrator just needs to load the data into the binary tree nodes which load function is already provided in this solution's codes. (Input is an excel file, item 2.3 of this document) The data on NUS ISS web site was scrapped using a python utility and manually exported into the four excel files listed on item 2.3. These four excel files were then loaded into the system once; serialized and stored back into custom knowledge data files on disk. At run-time, the knowledge data files are loaded into memory and the information are ready for quick and efficient search. For each successful search,

a text result is loaded into a valid Google's dialog JSON response object and serialized back to Google's DialogFlow. This result is then received at the Web front end chat bot web form and displayed to the user.

Fig. 1a Web GUI of ISS (NUS) chat-bot



3.2 SYSTEM'S FEATURES

Ease of Use

The system is both flexible and easy to use. A user may communicate with the chat bot by typing a statement or a question; the solution will intelligently find a best match based on the setup. The chat bot will response with an answer in a human-like manner. If new questions need to be added, the frontend chat bot can remain online while the system administrator can work on loading in new sets of knowledge bases.

Smart

The chat bot is smart. It can understand the questions asked by the user in different forms, by recognizing the key word of the question, the chat bot is able to provide the information requested in the best match possible.

Fast and Always On

The chat bot can response within 3 seconds and can stay online 24 hours, 7 days a week.

3.3 LIMITATIONS

The system is can be further improved. There are however, some limitations based on the current design and implementation:

1. The chat bot can only cover information on Executive education, Graduate programmes, stackable programmes and other information
2. The chat bot cannot run without internet access as it is integrated with Google's DialogFlow services. This is so even though it has some local logic that does the profanity word checks, nonsense checks and repeated query checks.
3. The chat bot can only process and response with useful information for all preset questions trained in Google's DialogFlow. It knowledge is limited to what the project team has gathered from NUS ISS web site.
4. It does not have general real-world knowledge and can only answer queries in its domain.

4.0 DATA EXTRACTION AND IMPROVEMENT

4.1 DATA ACQUISTION

In the past century, there is a substantial evolution of human computer interaction (HCI) methods, which included, but not limit to, punch card, keyboard, mouse, pen, touch screen *etc.* Over the years, human computer interface technology progressed continuously, and one of the most promising HCI method for next generation use case is natural human voice interface. Such an interface directly communicates with computer in voice commands and can be implemented on an application such as a chat bot. In this project, our group is focused on building a chat bot for NUS ISS website using only text input interface via keyboard.

- In order to achieve this objective, it is critical to extract and use the data from NUS ISS website effectively. Firstly, the NUS ISS website data structure/architecture was investigated and summarized in Fig. 2. Generally, there are six sections in NUS ISS website, while most programs and classes/courses are under the sections of Executive education, Graduate programs and Stackable programs. To further look into the detailed classes/courses of these three main programs, it is found there are 150+ classes/courses listed in NUS ISS website. To some extent, it is critical and challenging to extract the knowledge data from NUS ISS website, the details will be discussed in the next section. In this project, we focused on the main modules and in the knowledge database because it is important to make sure the data is suitable for a sensible conversational interaction with our users. After testing and system refinement, we can potentially extend the capability of this system by adding more knowledge data into the binary tree knowledge bases.

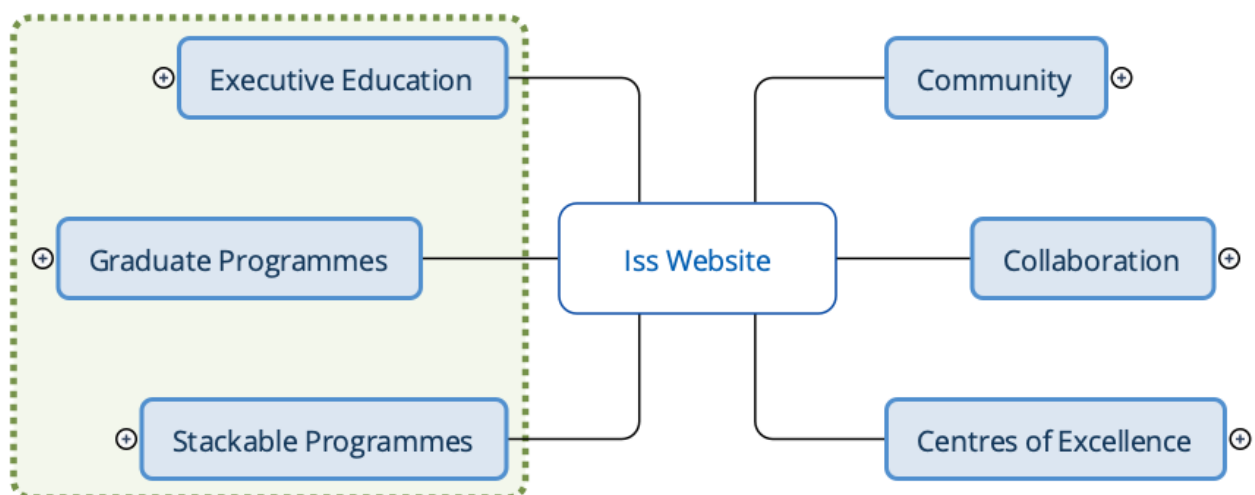


Fig. 2 ISS website general data architecture

4.2 WEB DATA EXTRACTION AND DATA IMPROVEMENT

As discussed in the previous section, it is important but challenging to extract programme and courses data from NUS ISS website.

In order to accomplish this task, we used Python with BeautifulSoup, urllib3 and Pandas libraries to get the job done. BeautifulSoup is known as a widely used package for web crawling, with the help of urllib3 to parse the URL and regular expression to filter class in HTML, it can effectively extract the detailed data for 150+ courses/classes from the NUS ISS website as shown in Fig. 3.

The data details included, but is not limited to, program categories, duration (days), fee and funding, overview, upcoming class, key takeaways, who should attend, what will be covered, preparing for your course, exams & certificate, requirements, how to apply, modules, projects & Internships, timetable & exams, admission & application, career pathway, capstone project & internships, *etc.* After gathering all of these raw data, pandas was used to further cleaned and improved the data frame.

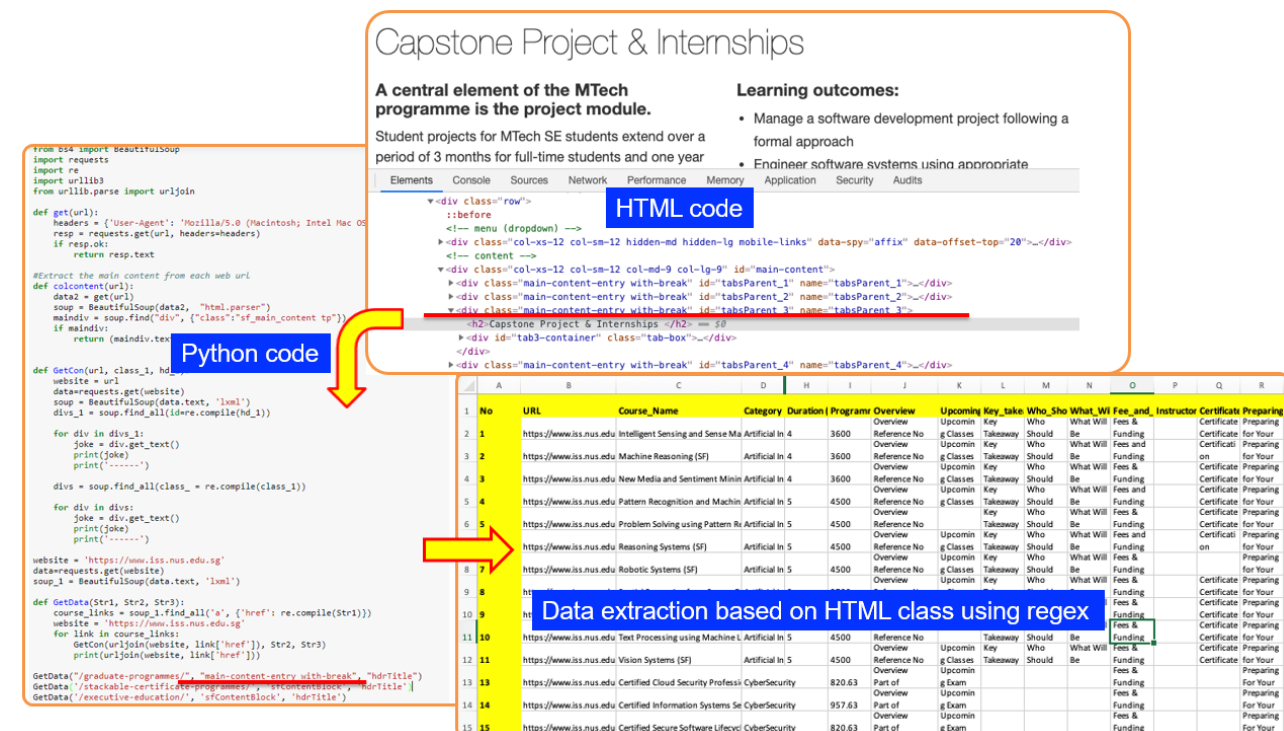


Fig. 3 Data extraction flow for ISS (NUS) website

One of the main concerns and objective is how we can get quality data. In view of this, we agreed and selected only data that are related to the main scope of NUS ISS programmes would be used for the chat-bot application. To format and structure the data to be more suitable for a conversational dialog or communication; the data was further polished

manually and stored in excel format. Here is one example for feedback data before and after polishing:

- Before data polishing: [*feedback 1, feedback 2, feedback 3, etc.*]
- After data polishing: Well, there are a lot of feedback from our students. I can list a few examples here and provide a link to our web site where you will find more about “what the students are saying about our programs: [*feedback 1, feedback 2, feedback 3, etc.*]”
- Some sample polished data is shown below in Fig.4.

| | A | B | C | D | E | F | |
|---|-----|-------------------------|--|------------------------------------|-----------------------|---|--|
| 1 | sno | location | inquirytype | subject | questionkey | action | value |
| 2 | 1 | iss jss nus nus nus iss | Executive Education about about Executive Ed | Executive Education | what do does can | is have offer conduct provide tell | and digital business. We trends and stay relevant |
| 3 | 2 | iss jss nus nus nus iss | discipline disciplines | Executive Education | what | are available offer existing have provide | Science, (4) Digital Agilit Platforms, (7) Digital Str |
| 4 | 4 | iss jss nus nus nus iss | discipline disciplines | Artificial Intelligence | can what | tell explain more elaborate list provide | techniques and methods development of Intelliger |
| 5 | 5 | iss jss nus nus nus iss | consulting consult consulted | consulting consult consulted | do have can does | do collaborate handle partner collabor | understanding of your or is situated in. We d |
| 6 | 6 | iss jss nus nus nus iss | applied research research | applied research research | do have can does | do collaborate handle partner collabor | technologies, combined provide insights and add |
| 7 | 7 | iss jss nus nus nus iss | corporate course corporate courses coporate ti | corporate course corporate courses | do have can what does | do handle handled done have provide | customised learning exp helping organisations ap |

Fig. 4 Example data after polishing and improvement

5.0 Cognitive System Set Up

The cognitive system requires (1) setting up a knowledge store based on information from NUS ISS website, and (2) setting up a dialog flow agent service account on Google's DialogFlow in order (3) to implement a solution to receive users queries and produce fairly sensible responses to users' questions.

5.1 Set Up custom entities for tagging parameters

Five custom entities are set up in the Google's DialogFlow:

- a) location
- b) subject
- c) inquirytype
- d) action
- e) questionkey

The screenshot shows the 'location' entity configuration in DialogFlow. It includes a 'SAVE' button, checkboxes for 'Define synonyms' (checked) and 'Allow automated expansion' (unchecked), and a table of synonyms.

| | |
|---------|---------|
| iss | iss |
| iss nus | iss nus |
| issnus | issnus |
| nus | nus |

Click here to edit entry

More entities may be added where necessary. For each training question/phrase that may be asked by a user, the parameter/label key words are identified and tagged to each related entity. This will provide an automated way for DialogFlow to extract key parameter labels for each question/query asked. And using these parameters, we can narrow down the search on our custom binary tree knowledge base to reach an optimal result (the answer to the question / query) See 3.2 System Architecture.

5.2 Set Up the intent and its training phrases

The system needs to be trained to understand different type of questions or queries. Each training phrase will be tagged with a relevant entity that was previously created.

For example, the question:

What Reasoning Systems programme does ISS have ?

There will be 5 standard parameters types. These will be passed to the chat bot web front end and send to the web hook server as a DialogFlow request. The web hook server will take the received intent's parameters and pass it to the system's knowledge base's search algorithm which will search for the corresponding answer based on the key words in each of the parameters. The knowledge base dataset is based on a binary tree structure.

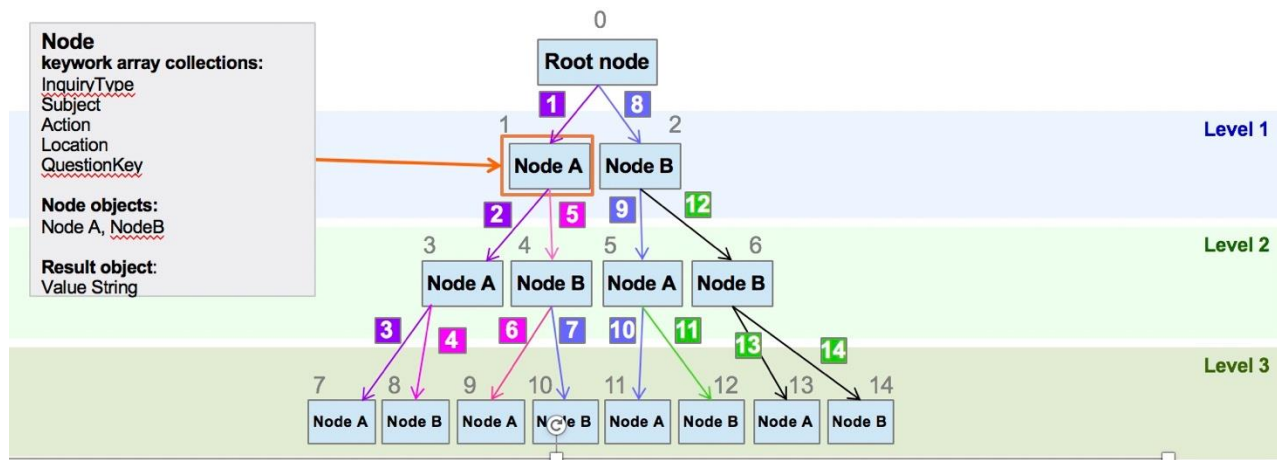
There is context in google dialog flow, but, we will not be using this feature for this project. However, we will use a custom context in our web front end to keep track of the current context of the conversation.

The screenshot shows the 'ProgrammeIntent' configuration in DialogFlow. It includes a 'SAVE' button, sections for 'Contexts', 'Events', and 'Training phrases'. The 'Training phrases' section shows a list of training phrases and a table of parameters.

| PARAMETER NAME | ENTITY | RESOLVED VALUE | |
|----------------|--------------|-------------------|---|
| questionkey | @questionkey | what | X |
| subject | @subject | reasoning systems | X |
| inquirytype | @inquirytype | programme | X |
| location | @location | ISS | X |
| action | @action | have | X |

5.3 Set Up knowledge base dataset (Binary Tree Structure)

We decided to use a binary tree structure to store and represent the information we gathered from the NUS ISS web site. It will be based on an answer value per node.



How does the knowledge base works ?

The class object is name Node and it has the following objects.

- Array list collection objects namely:
 - 1) InquiryType, 2) Subject, 3) Action, 4) Location and 5) QuestionKey
- 2 Node objects named: NodeA, NodeB
- 1 String Value which is the text answer for any question that meets the match criteria based on the 5 parameters: Inquiry Type, Subject, Action, Location and QuestionKey. The logical check is setup with 3 possibilities.

The search is recursive search always starting with itself and taking the left hand NodeA first depth first until no solution is found and then start on the same parent node with NodeB depth first search down the tree with NodeB's NodeA. This strategy is executed left to right. The search sequence is shown on the diagram above by the numbered colored boxes.

How is the knowledge base set up with question parameters and value answer ?

Each node has 5 key array list object that will contain keywords for each type of parameter.


For example:

```
n = new Sys.Tool.Node("Master of Technology in Enterprise Business Analytics");
n.Action.Add("available"); n.Action.Add("have"); n.Action.Add("offer"); n.Action.Add("is");
n.InquiryType.Add("master of technology"); n.InquiryType.Add("master programme"); n.InquiryType.Add("programme");
n.QuestionKey.Add(""); n.QuestionKey.Add("what"); n.QuestionKey.Add("does");
n.Subject.Add(""); n.Subject.Add("master of technology"); n.Subject.Add("master of technology in enterprise business analytics"); n.Subject.Add("enterprise business analytics"); n.Subject.Add("business analytics");
n.Location.Add(""); n.Location.Add("iss"); n.Location.Add("nus"); n.Location.Add("iss nus"); n.Location.Add("issnus");
n.Value = "The NUS Master of Technology in Enterprise Business Analytics programme (MTech EBAC) is specifically designed to meet the industry demand for data scientists who can help organisations achieve improved business outcomes through data insights. It is best suited for professionals seeking to focus on the following - methodical data exploration and visualisation, diagnostic analytics, predictive modelling using statistical and machine learning techniques, text analytics, recommender systems, and big data engineering, etc.";
this.Node.Add(n);
```

Node
keyword array collections:
InquiryType
Subject
Action
Location
QuestionKey

Node objects:
Node A, NodeB

Result object:
Value String



The following describes how the excel knowledge file is loaded into the binary knowledge base.

First, we create a new Node object with a proper name. This name is not important but it is necessary to make the object traceable. (We may add up with many nodes.)

Next, for each of the 5 parameters, we add the necessary possible keywords to each of the parameter object. You may add any number of key words for each parameter type as the need be. Different key word variation is important. A user may enter a question like:

What is programme is available at ISS? OR What program is there at ISS?

Consider the example question:

Does ISS offer the programme enterprise business analytics?

QuestionKey => Does, Location => ISS, Action => offer, InquiryType => programme, Subject => enterprise business analytics

For the highlighted blue keywords shown above. They will be compared and matched up with the Google's dialog's parameter's keywords in the webhook server's search engine's logic processing. The result is a text value that gets returns to the chat bot web form.

So, in a nutshell, the binary knowledge base is a collection of nodes where each node contains the possible keywords for each parameter type and a corresponding answer value.

6.0 CONCLUSION

In this project, our group employed Google's DialogFlow and a binary structured knowledge base; integrating all these using Microsoft web technologies like ASP.NET and HTTP server /NGINX modules and successfully deployed the solutions on a robust scalable platform - AWS EC2.

The research done is substantial as Google's dialogflow v2 is still in beta release and getting source codes in C# to work was really a huge challenge. Nevertheless, we managed to get the solution up and running, and delivered a working product.

What we have presented here is a real-world implementation of a solution that would be used for a real commercial deployment, but in a very small scale.

In our development process, our group with five members had very active and fruitful discussions and we learnt a lot from each other since we're from different professions with different skill sets. It is a good opportunity for us not only to apply the cognitive system knowledge and solve real-life problems but also a wonderful time for every group member to experience and learn new things.



6.1 IMPROVEMENTS:

To improve the current solution, we may propose to add Google's speech ASR system to the solution. This however may depend on the use case for NUS ISS.

The other improvement would be to add a good enough conversational contextual understanding to the chat bot back end such that a conversation with real human user can be as realistic as possible, and that would possibly eliminate the need to get the bot to repeat itself every time in order to get the user to provide information that was uttered a few sentences earlier.

This is out of our project scope but we think would be something that can be work on in the future.

7.0 BIBLIOGRAPHY / REFERENCES

1) Dialogflow API

<https://cloud.google.com/dialogflow-enterprise/docs/reference/rest/v2-overview>

<https://cloud.google.com/dialogflow-enterprise/docs/reference/rpc/google.cloud.dialogflow.v2>

<https://cloud.google.com/dialogflow-enterprise/docs/quickstart-api>

<https://www.nuget.org/packages/Google.Cloud.Dialogflow.V2>

2) External sources:

<https://meteatamel.wordpress.com/2018/09/24/dialogflow-fulfillment-with-c-and-app-engine/>

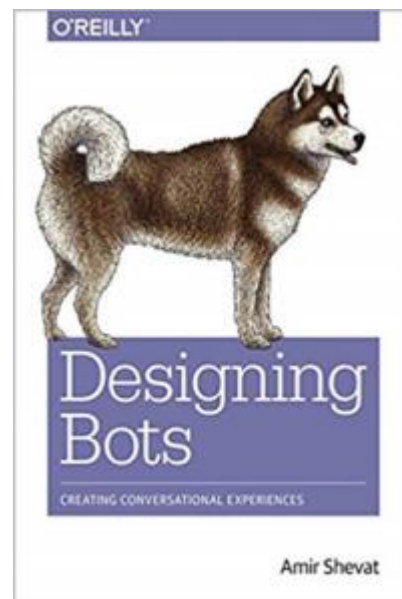
<https://xebia.com/blog/building-conversational-interfaces-with-dialogflow/>

<https://stackoverflow.com/questions/50636149/how-to-call-google-apis-dialogflow-v2-in-c-sharp>

3) Designing Bots: Creating Conversational Experiences 1st Edition

ISBN-13: 978-1491974827

ISBN-10: 1491974826

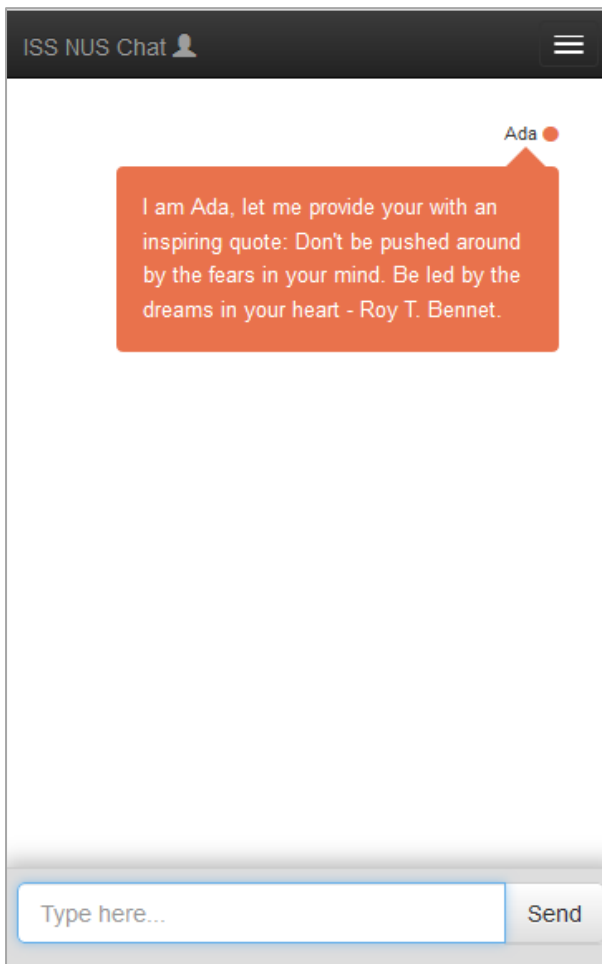


8.0 User Guide

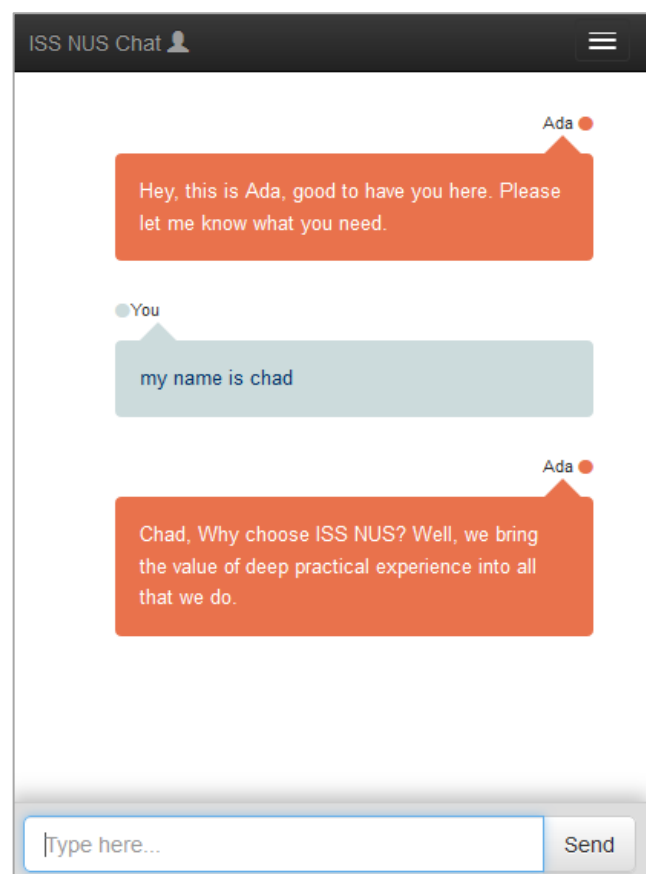
The user can access and experience the chatbot system through below address:

<http://52.43.103.81:5000/>

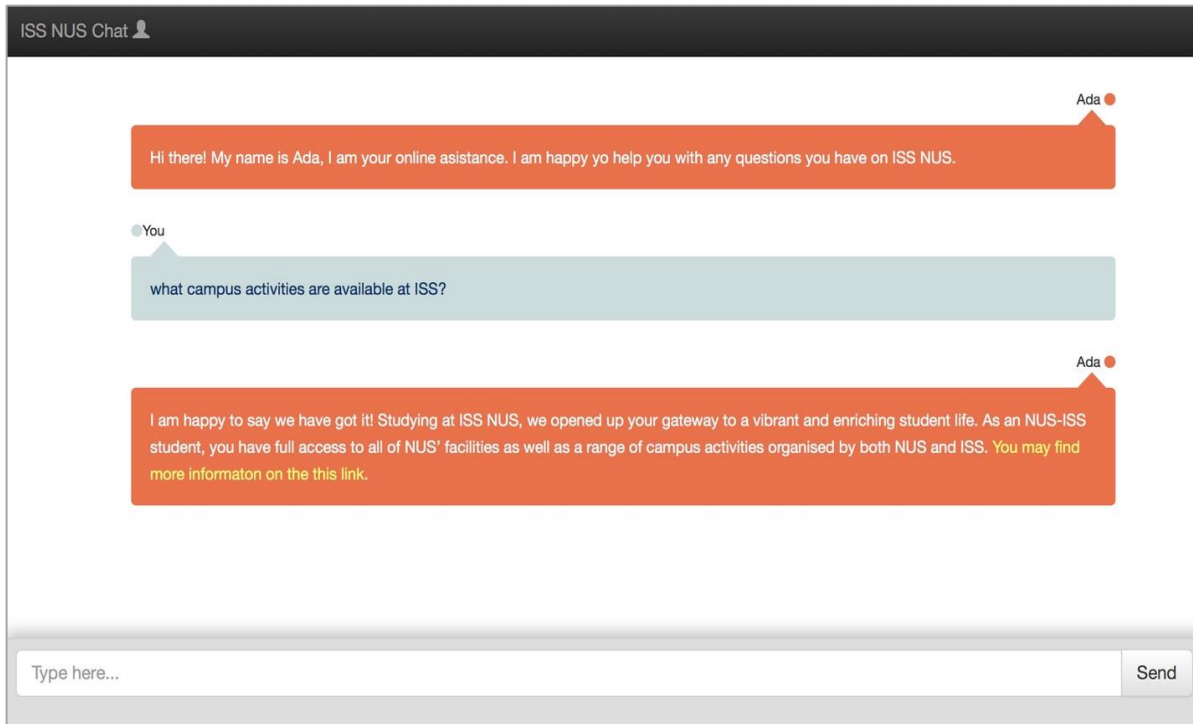
Note: This server will be deactivated on Aug 31, 2019 as we are running it on a free tier AWS EC2.



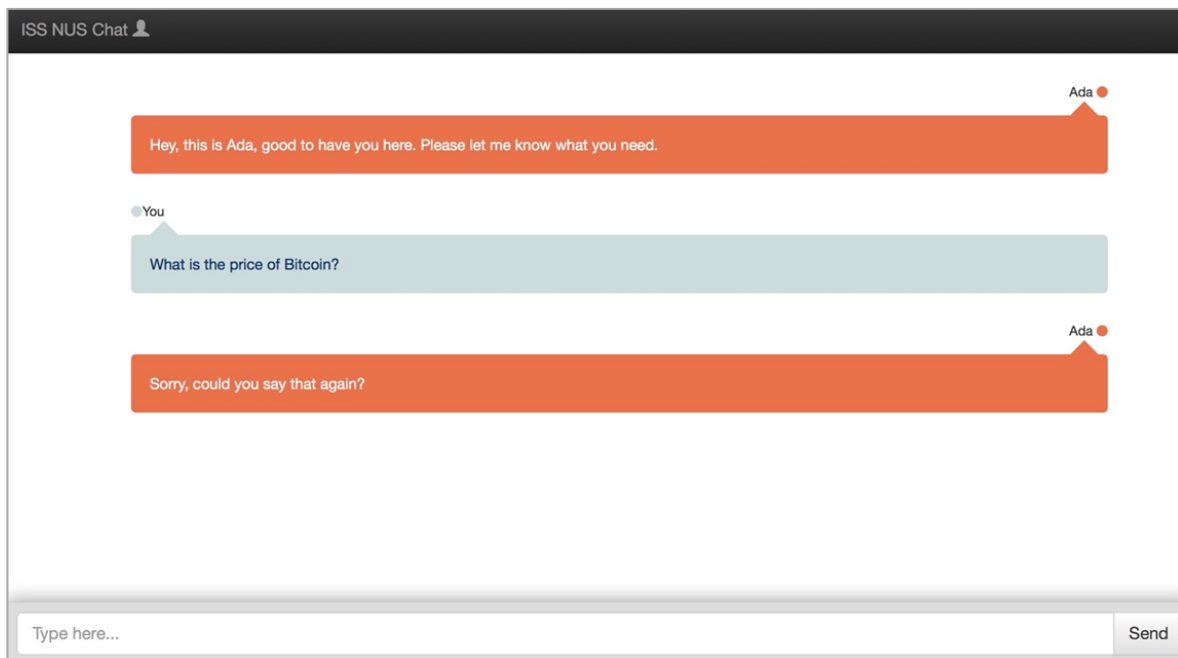
The chat bot is named **Ada**, she will introduce herself with a welcome message when the web is visited. A user may type in his/her question in the entry field at the bottom of the web page, similar to a handphone's SMS function.



The chat bot will remember the user's name if the user has provided his/her name in the chat, and he or she may ask any questions relevant to NUS ISS as they wish.



When a user submits a question, the chat bot will process the query and response with an answer within 3 to 4 seconds, it will provide the textual information along with hyperlinks to NUS ISS web site for more information where necessary.



However, in this project, the chat bot is loaded with a selected set of knowledge base; so, it will not have the answers to all sorts of questions. Nevertheless, it will response politely to inform a user that it didn't understand the question or that it does not yet have the answer to the query.

The chat bot is trained to answer following questions:

Graduate programme:

What campus activities are available at ISS?
 What campus facilities are available at ISS?
 Can you tell me about career services on placement opportunities?
 Does ISS provide career services?
 Do you have an honour list?
 Can I know who the past honour students are?
 What financial assistance is available to your programmes?
 What do organisations say about your programmes?
 Tell me about what organisations say about your programmes.
 Tell me more about your graduate programme diploma courses.
 Do you have diploma courses in iss programmes?
 Do you have more information for your masters programmes?
 Do you have road show for your masters programmes?
 Tell me about your Software Engineering programme.
 Do you have a master's programme in Software Engineering ?
 Do you have a master's programme in Intelligent Systems ?
 Tell me about your Intelligent Systems programme.
 Do you have a master's programme in digital leadership ?
 Tell me about your Digital Leadership programme.
 Do you have diploma course in your graduate programmes?
 What are your graduate programmes?
 What do you have for Graduate Programmes at ISS?
 What does your students feedback on your master programmes ?
 What does your students say about your master programmes ?

Executive Programme:

What programmes are available at ISS?
 What is PDU requirement in your programmes?
 What funding are available for your programmes?
 Who can attend career talks arranged in your programmes?
 What career services are available at ISS?
 Is there a programme for startup tech talent development?
 What software systems training course does ISS offer?
 Can you explain your skillsfuture training programme?
 Do you have professional conversion programmes?
 Do you have a training course on digital products & platforms?
 Please tell me more about digital strategy and leadership programme.
 Is there any programme on digital innovation & design?
 What is the digital agility programme?
 What is the data science programme?
 Can you tell me more about cyberSecurity programme?
 How is internship placements handled?
 Does ISS offer corporate courses?
 Do you have applied research programme?
 Does ISS offer programme with consulting services?
 What programmes are available at ISS NUS?
 Does ISS provide programme with consulting services?
 Can you tell me more about artificial intelligence discipline?
 What disciplines are available in ISS's Executive Education programme?

Tell me more about Executive Education at ISS?
 What artificial intelligence programme is available?
 What reasoning systems programme does ISS have ?
 What masters programmes are available?
 Does ISS offer Diploma programme in Smart health ?
 Does ISS NUS offer post graduate programmes?

Stackable:

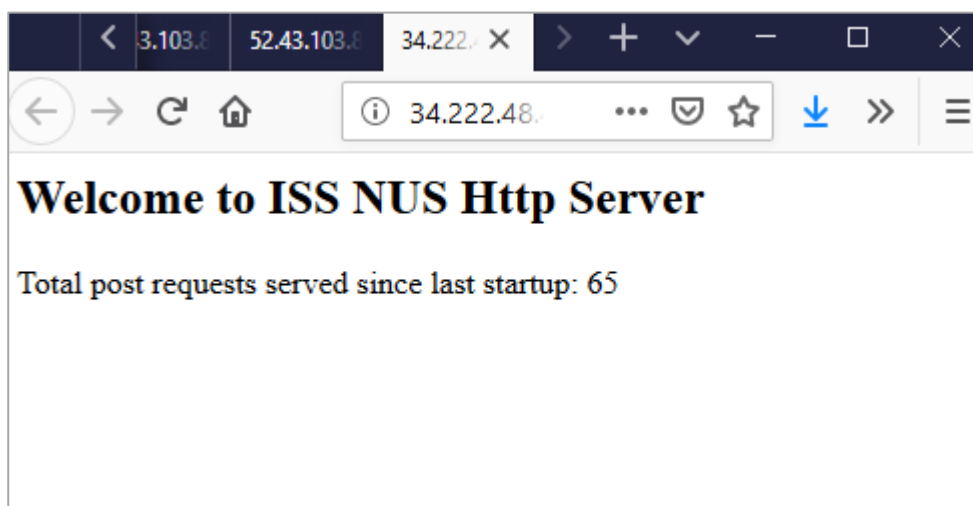
What is the Certificate Programme in Smart Systems & Platforms programme?
 What is the Certificate Programme in Artificial Intelligence|Artificial Intelligence programme?
 What is the certificate programme in digital solutions development programme?
 What is the certificate programme in data science programme?
 What are Stackable Certificate Programmes?

Others:

How do I get to NUS ISS
 Where is NUS ISS located?
 How do I get to NUS ISS ?
 Who are the administration staff at NUS ISS?
 Who are the teaching staff at NUS ISS?
 Who are the members of ISS Management Team?
 Why choose NUS ISS?
 Who are the members of ISS Management Board?
 What is NUS ISS accomplishments?
 Can you tell me about NUS ISS achievements?
 What is NUS ISS core values?
 What is NUS ISS vision?
 What is NUS ISS mission statement?
 What is NUS ISS story?

The Back-End Webhook server is located at: <http://34.222.48.49:5000>

Note: This server will be deactivated on Aug 31, 2019 as we are running it on a free tier AWS EC2.



8.1 APPENDIX A

The following excel files are used to load data into the binary tree knowledge base only once. The loaded binary tree knowledge base is serialized to data file on disk and reloaded at runtime when required. These excel files are primarily used to load new data once.

- 1) ISS_ExecutiveEducation_v1.xlsx
- 2) ISS_GraduateProgramme_v1.xlsx
- 3) ISS_StackableProgramme_v1.xlsx
- 4) ISS_Other_v1.1.xlsx

These files are located on git hub link:

<https://github.com/superhell/IRS-RS-2019-05-31-IS1PT-GRP-Xmen-Chatbot/tree/master/Data>

8.2 APPENDIX B

| Filename | Description |
|-------------------------------|-------------------------------------|
| ISSNUS.zip | Exported agent file from DialogFlow |
| Default Welcome Intent.json | Default Welcome Intent |
| ExecutiveEducationIntent.json | Executive Education Intent |
| GraduateProgrammeIntent.json | Graduate Programme Intent |
| StackableProgrammeIntent.json | Stackable Programme Intent |
| OtherInformationIntent.json | Other Information Intent |
| action.json | action entity |
| inquirytype.json | inquiry type entity |
| location.json | location entity |
| questionkey.json | question key entity |
| subject.json | subject entity |

<https://github.com/superhell/IRS-RS-2019-05-31-IS1PT-GRP-Xmen-Chatbot/tree/master/Data>