



NATIONAL UNIVERSITY OF SINGAPORE

COGNITIVE SYSTEMS PROJECT

**IChat  
ISS Chatbot System**

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# **Executive Summary**

Working in this ever-change world, No one can continue to grow only through past learning experiences. It is relieved that more and more people in Singapore are pursuing post-graduate studies [1]. Most of us decided on our Bachelor's when we were young. Not all the people know what they want when taking a major. After gaining some experience during working, people have a clearer path and idea what they want.

National University of Singapore - Institute of Systems Science (NUS-ISS) upskills people through skills-based, industry-relevant courses so that they stay competitive in the digital age. The courses it provides is more practical and industry-based skills compared with traditional Postgraduate education [2].

Although NUS-ISS has a user-friendly website, it may still be a challenge for a learner to find information fast and accurate. A research [3] showed over 75% users rank ease of finding the information as the most important factor in a website.

For NUS-ISS website to successful, our team targets to create a chat bot. It can interact with user directly to answer relevant questions. The technology we utilised included Dialogflow [4] and Slack [5].

# **Chapter 1**

## **Business Problem Background**

NUS-ISS provides 3 categories of programmes. In each category, there are 4 to 12 different programmes. Over 130 courses are provided in these programmes.

With over 130 courses available in NUS-ISS website, how to efficiently answer the questions in the user's mind would be a challenge. For people who are not familiar with NUS-ISS website structure, it is difficult to get the information without trying clicking a lot of links.

# **Chapter 2**

## **Objectives & Success Measurements**

### **2.1 Objectives**

The objective of this project is to create a chatbot system that will answer inquiries related to ISS programmes, courses and related information.

The primary target audience of our system are people who are seeking advance knowledge and additional exposure to an area of interest from NUS-ISS. Our system will answer inquiries in an efficient way

### **2.2 Success Measurements**

There are three key measures of our chatbot [6]:

1. Whether the chatbot was able to understand the user
2. Whether the chatbot was able to respond to the specific question being asked
3. Whether the chatbot was able to present the related information

# Chapter 3

## Solution

### 3.1 Assumptions

#### 3.1.1 Target Audience

The major target audience would be the people pursuing post-graduate studies or professionals interested in practical and applicable skills in the industry.

Current NUS-ISS students can also enjoy the benefit if they want to get the quick enquiry reply.

#### 3.1.2 Data Quality

All information used to build IChat is from NUS-ISS website [2]. It is assumed the data provided by NUS-ISS website are correct.

### 3.2 Project Scope

In this project, a chatbot system (IChat) based on NUS-ISS website data is performed via Dialogflow [4]. IChat focuses on two parts: **(i) intent-based system** [7]; **(ii) knowledge-based system** [8]. The inquiries related to Graduate Programmes are replied by the former system while the inquiries related to the courses of Executive Education Programmes and Stackable Certificate Programmes are answered by the knowledge-based system.

The intent-based system can answer question with context [9] via **rich messages response** [10] option or manual input. It includes questions related to Admission & Application, Career Path, Fee & Loans, Modules, Overview and Project & Internship for each Graduate Programme.

The knowledge-based system can only answer questions for over 130 courses listed in Executive Education Flyer [11]. It covers Course Overview, Key Takeaway, Target Audience, Prerequisites, Course Details, Fees & Loans and Certification.

### 3.3 Knowledge Model

Knowledge modeling can be classified into three parts [12]:

- (i) Knowledge identification
- (ii) Knowledge specification
- (iii) Knowledge refinement

#### 3.3.1 Knowledge Identification

Knowledge identification sets the groundwork for the next stage encompassing knowledge specification. Information sources that are deemed to be useful are identified in preparation of knowledge acquisitions. In the context of building a chatbot, two main sources have been identified and are documented in Table 3.1.

S/N	Source of Information	Insights from information sources	Knowledge acquisition technique
1	NUS ISS website	It provides basic information on different postgraduate programs	Data gathering from publicly available/documentated information
2	Generic Population	To validate and support the assumptions	Elicitation of tacit knowledge through analysis result of feedback from general population

Table 3.1: Knowledge Source and Acquisition Technique

#### 3.3.2 Knowledge Acquisition

Following from the identification of knowledge sources, knowledge acquisition is conducted to capture the problem-solving domain knowledge. The techniques adopted to acquire the

knowledge have been described in Table 3.1 and the corresponding results are presented using a dependency diagram as shown in Figure 3.1.

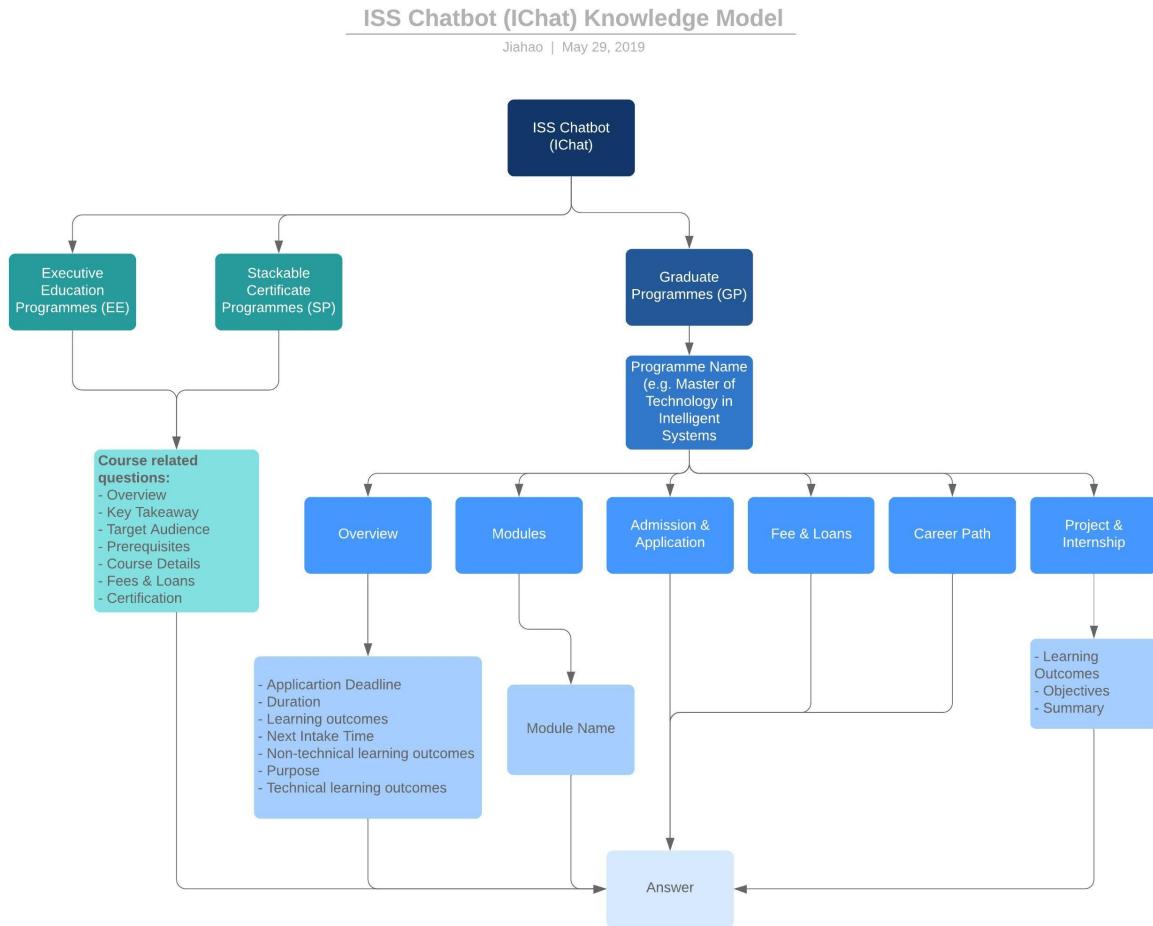


Figure 3.1: Domain Model of IChat

The domain diagram arranges the factors affecting user's question flow in a hierarchical tree structure. The top most level node represents the description of the proposed chatbot, which in this case, called iChat chatbot for NUS ISS website pages. This chatbot can be broken down into multiple layers of different components before arriving at the answers. These question flows are gathered from users of proposed question flow and represent their inherent preference. Table 3.2 illustrates an example using the composition tree diagram in 3.1.

The second level nodes represent the program we focused for the chatbot system and as well as the following detailed level nodes for more specific areas that may be asked within the chatbot system.

S/N	Category	Information
1	Observable	A user who is keen to explore postgraduate program in NUS-ISS
2	Inferable sub-goals	The user in “1” might be interested in a master program. He/she might also be only eligible for a given subset of master program
3	Top-level inference	The sub-goal in “2” is also one of the main factors that affects a user’s choice of a suitable master program

Table 3.2: Example to Show A Part of the Dependency Diagram

### 3.3.3 Knowledge Refinement

The knowledge refinement is an iterative process and it include model validation and model refinement. For model validation, different sets of test data will be used to run the simulation, and the result will be compared with sample data.

For model refinement, after getting different actual results from expected results, we adjust the training phrases into different formats and retest it with the confidence score again to modify the model.

## 3.4 System Architecture

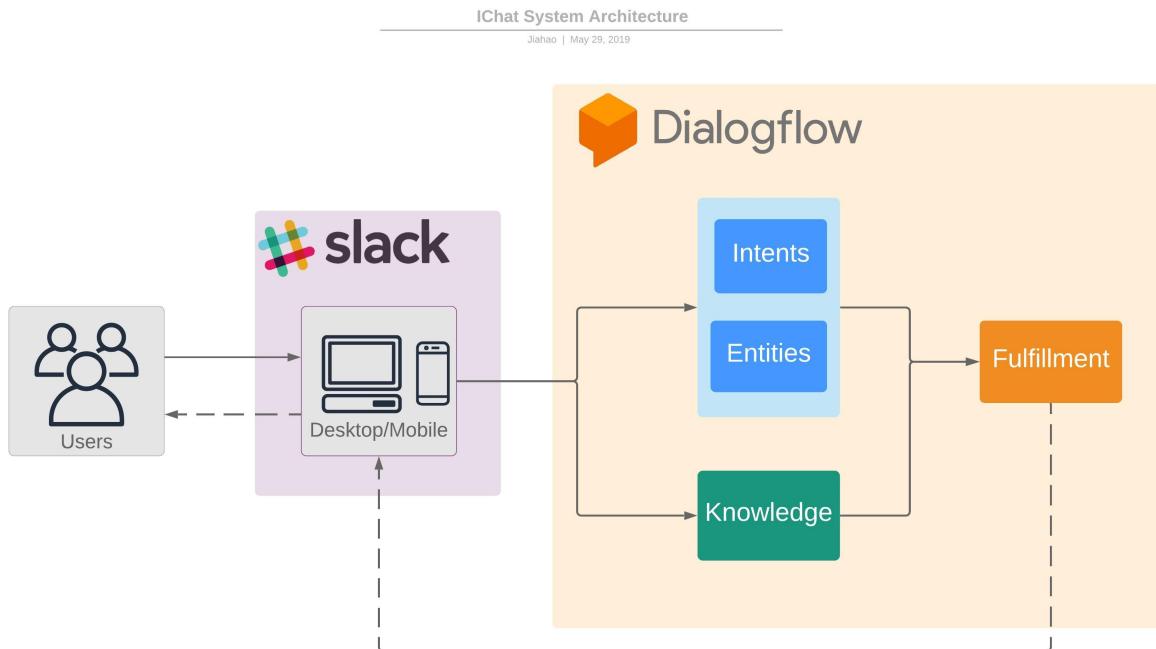


Figure 3.2: System Architecture Diagram

Figure 3.2 shows the system architecture diagram of IChat. It illustrates how the different components interact with each other through Dialogflow. After the user keys in the inputs in the Slack by either mobile phone or computer, Slack will be passed the input through the Dialogflow to process. Based on the enquiries from the user, Dialogflow will choose either intent-based system or knowledge-based system to answer. Then the data will be passed to fulfillment and return the results to Slack so the user can read the answer.

# **Chapter 4**

## **Implementation**

### **4.1 Dialogflow Set-up**

In IChat, the beta feature “Knowledge Bases” is used. So we need to enable it before building the knowledge.

To simplify the deployment, we use Inline Editor [13] (Powered by Cloud Functions for Firebase). It would match a user’s query to make suggestions or reply an answer.

The details would be illustrate in Appendix A (User’s Manual).

### **4.2 FAQ Knowledge Test**

For Executive Education programs and Stackable Certificate Programs under NUS-ISS website, our team crawled the content from the web page as the knowledge document to build a FAQ document in Dialogflow. However, one question can be phrased into many different ways. If the certain key word are replaced or missing from the question, IChat won’t be able to provide a correct answer. For example, ‘cost’ are trained as the key word for question related to school fees or loans inside the knowledge document. But when user enter word like ‘how much’ or ‘price’, IChat cannot provide the answer related to school fees. Therefore, our team decides to do a knowledge document validation.

Knowledge document validation is an iterative process and our team focuses on question refinement. For question refinement, different sets of test data is used to run the simulation, and result will be compared with previous iteration to get the highest accuracy rate. Full knowledge document validation question, together with the result are listed in Table B.1 of Appendix B.

## 4.3 Intent Test

For Graduate Programs under NUS-ISS website, our team decide to use intent and fulfillment to represent knowledge to related questions.

Intent validation is conducted based on the intent we created and training sets we provided in the fulfillment. Different sets of test data is used to run the simulation. Intent details, together with the testing result are appended in Table B.2 of Appendix B.

## 4.4 UI Test

To get a good user experience, we tested different integration tools [14] provided in Dialogflow. The test includes **Web Demo**, **Facebook Messenger** and **Slack**.

### 4.4.1 Web Demo

In the beginning, we wanted to add Web Demo into NUS-ISS website. It successfully replied the user when we said “hi” (Figure 4.1). However, after we had more tests, we realized Web Demo can not reply more than one message and cannot correctly pop up the suggestions we set up in the fulfillment. It only gave the last message showed in Figure 4.2.

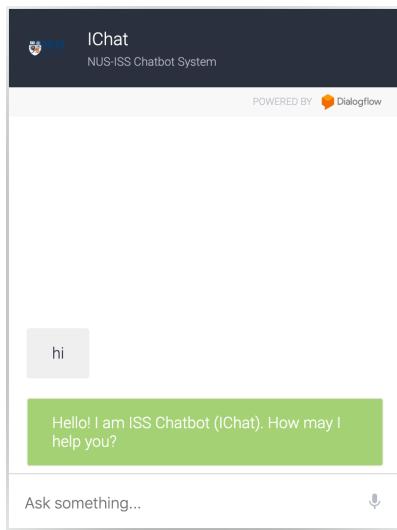


Figure 4.1: Web Demo Reply 1

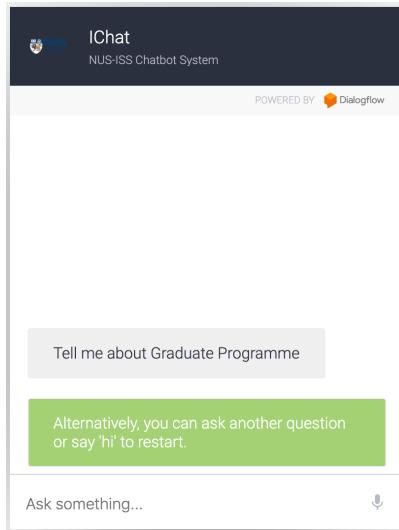


Figure 4.2: Web Demo Reply 2

#### 4.4.2 Facebook Messenger

The Facebook Messenger successfully gave suggestions (Figure 4.3) but with one line suggestion which was not very friendly to click if several suggestions were provided. Furthermore, when we clicked the follow-up suggestions, it would cancel the suggestion buttons if the suggestion was not the last message (Figure 4.4).

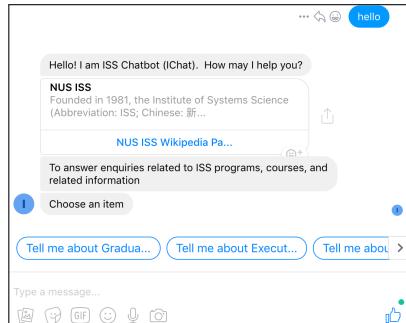


Figure 4.3: Facebook Messenger Reply 1

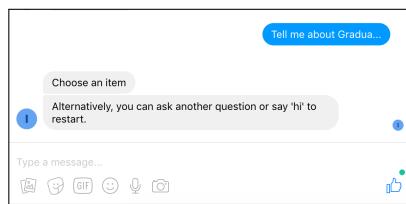


Figure 4.4: Facebook Messenger Reply 2

#### 4.4.3 Slack

At last, we chose Slack which can give a relatively good result (Figure 4.5) compared with Web Demo and Facebook Messenger. It gave suggestions and still kept them in the history (Figure 4.6) so the user are more flexible to go back choosing other questions. Since Slack can be accessed from different devices, it means the user can enquiry via mobile or desktop.

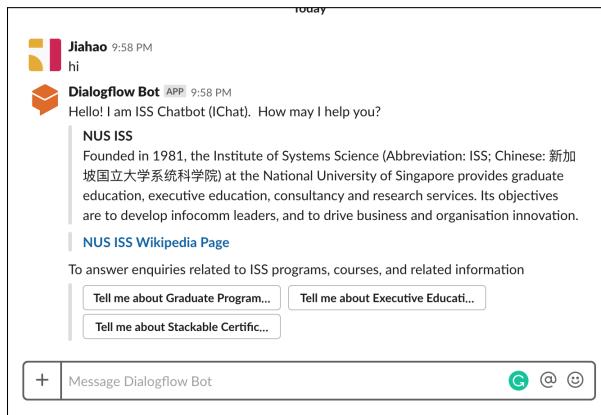


Figure 4.5: Slack Reply 1

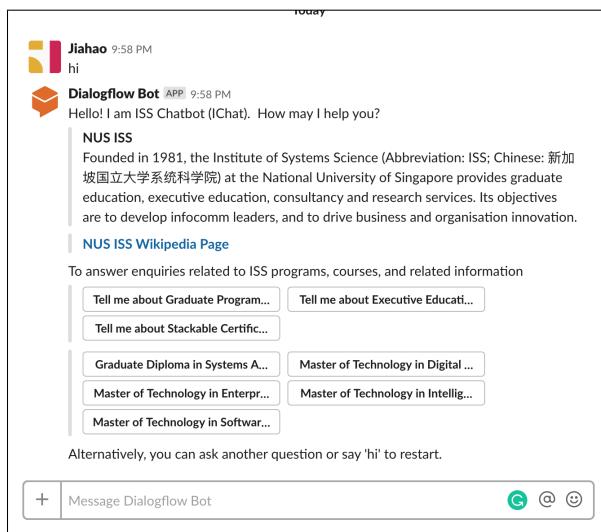


Figure 4.6: Slack Reply 2

# Chapter 5

## Performance & Validation

We perform validation on 2 different scenarios (shown in Appendix C) to ensure that IChat provides the correct expected output.

Scenario 1 is a future student wants to check some information about **Master of Technology in Intelligent Systems**, which is under **Graduate Programme**. This student wants to know when the next intake time and how long will the programme last. In this scenario, the user only need to click suggestion button to get answers.

Scenario 2 is an employee wants to learn more about **Machine Reasoning** course in **Executive Education Programmes**. The user needs to input questions related to the course in this scenario.

Based on Success Measurements mentioned in Section 2.2, IChat proved its performance in these scenarios.

# Chapter 6

## Conclusions

Our project, IChat, is a chatbot cognitive system that will generate related answer for user requests about NUS-ISS programmes, courses and related information. By using IChat, user can easily get useful and related information from different programmes provided by NUS-ISS.

### 6.1 Improvements

With the limited time, our project scope was diminished to a minimum viable product (MVP) level, which is version 1.0. Here is the full scope for the commercial version:

#### **version 1.1** Include More Data

To get better result, an advanced method should be used to scrape the data. Add more data fields like lecturers and their detail information for a specific course should be included for a better reply.

#### **version 1.2** Add API

An API should be created to fetch dynamic data instead of coding in "Inline Editor" of Dialogflow.

#### **version 1.3** User Interface

Although Slack can provide an acceptable user interface, there are still some limit like button length and numbers. Message Menus [15] could be an option. Even so, for the moment a user needs to use Slack to inquire. Integrating a chatbot like kommunicate [16]with the NUS-ISS website would help user get a much smoother experience.

# Chapter 7

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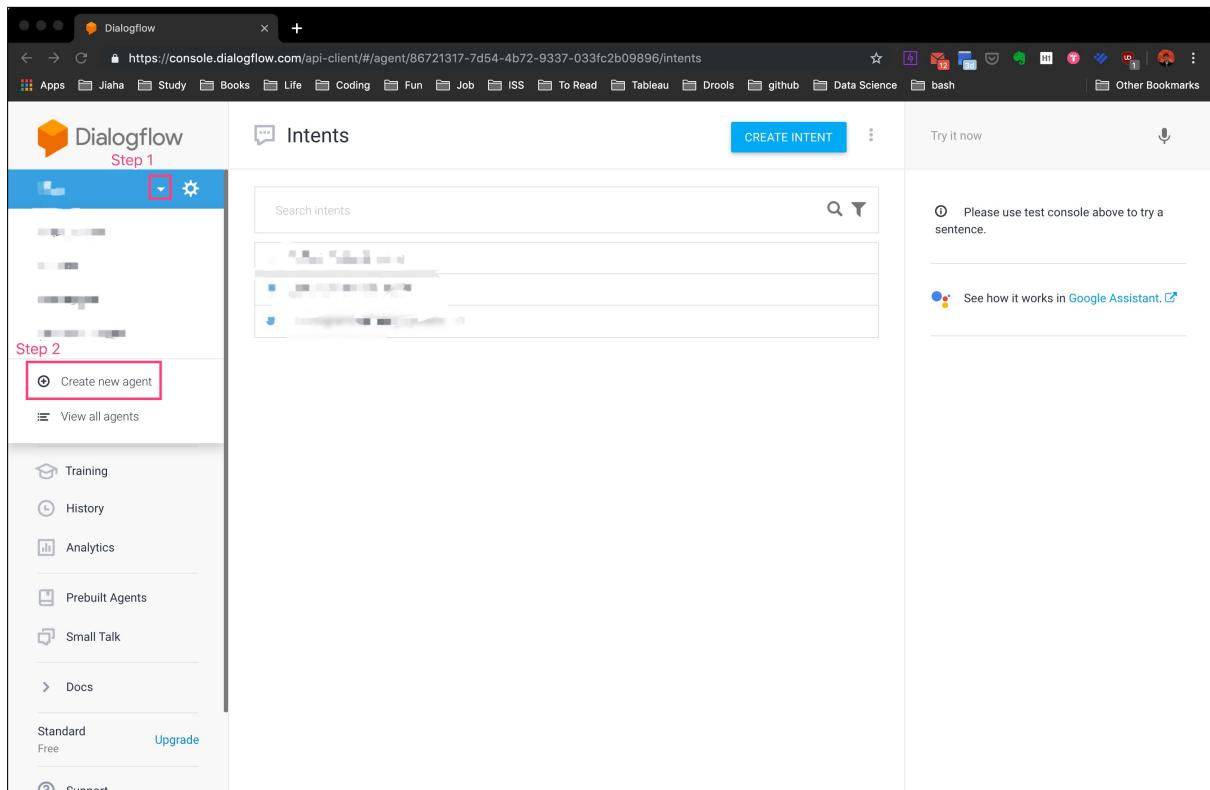
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# Appendix A

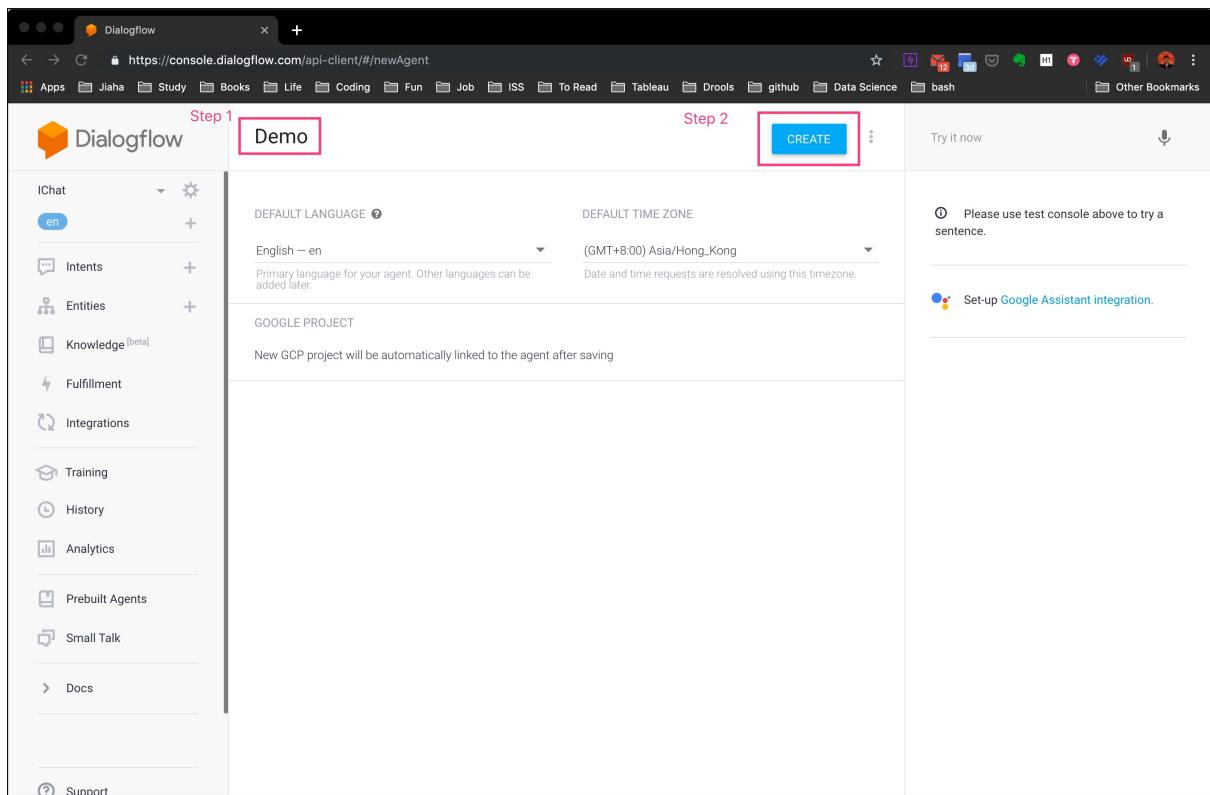
## User's Manual

### A.1 Import Agent

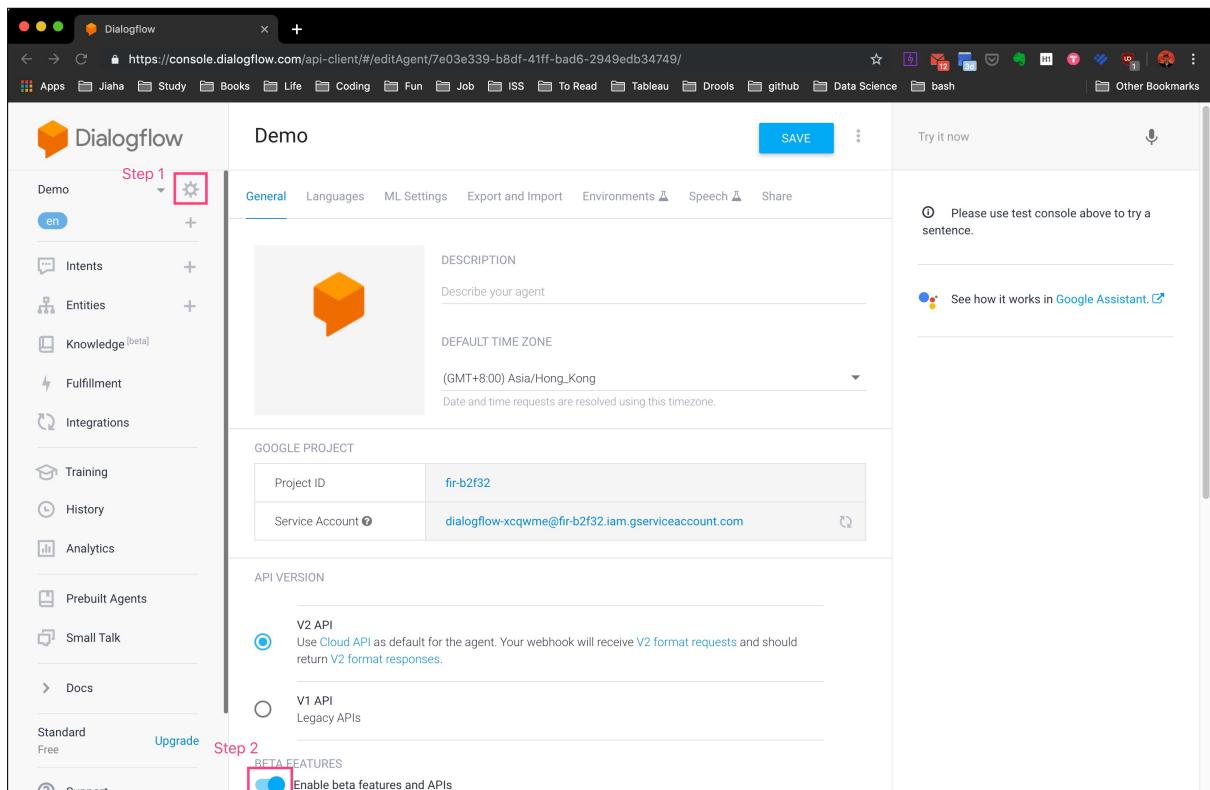
1. Go to Dialogflow Console (<https://console.dialogflow.com>), then click “Create new agent”



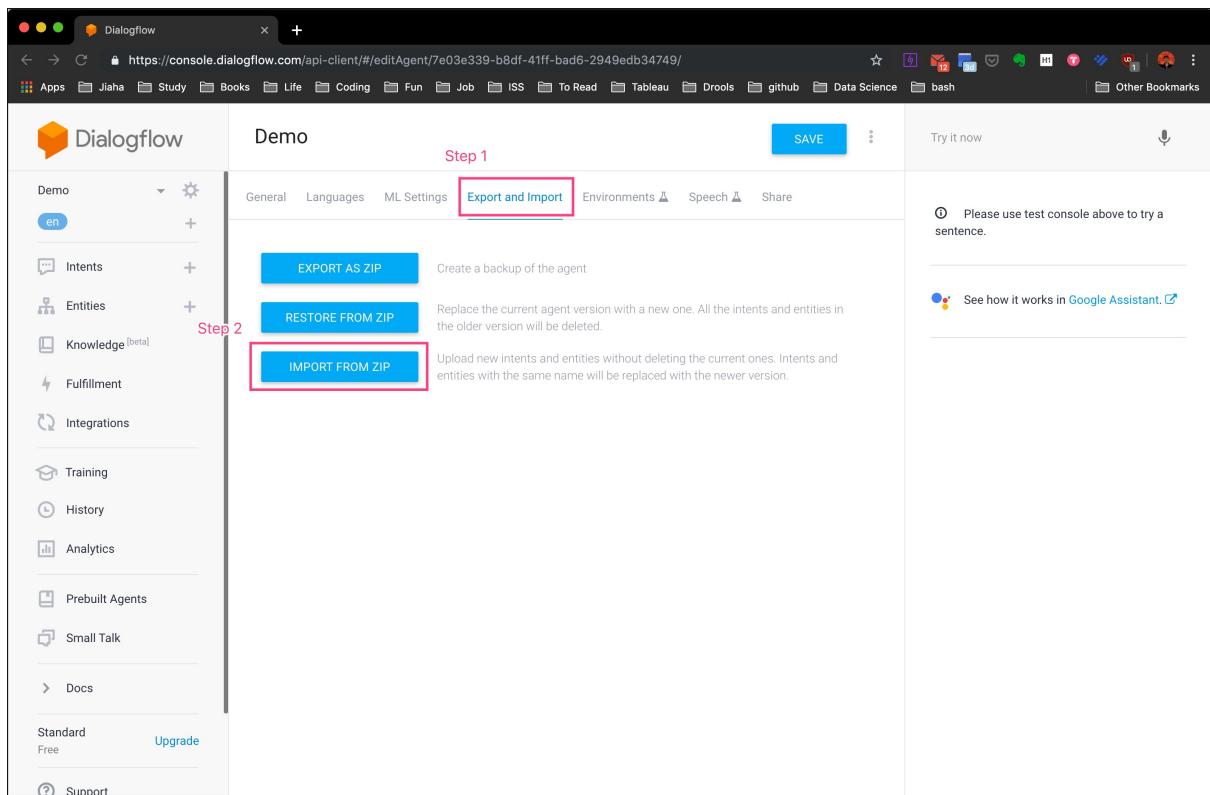
2. Put Agent name as you wish, then click “CREATE” button



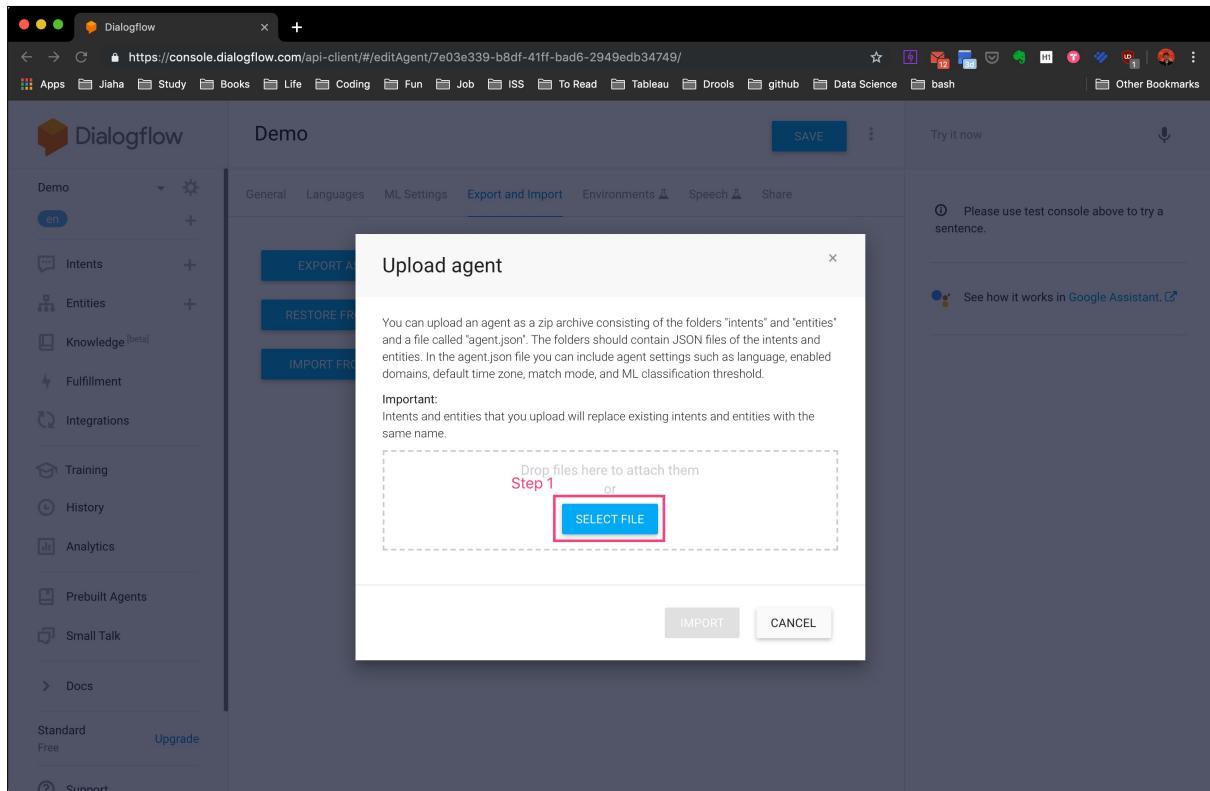
### 3. Go to Settings and enable beta features and APIs



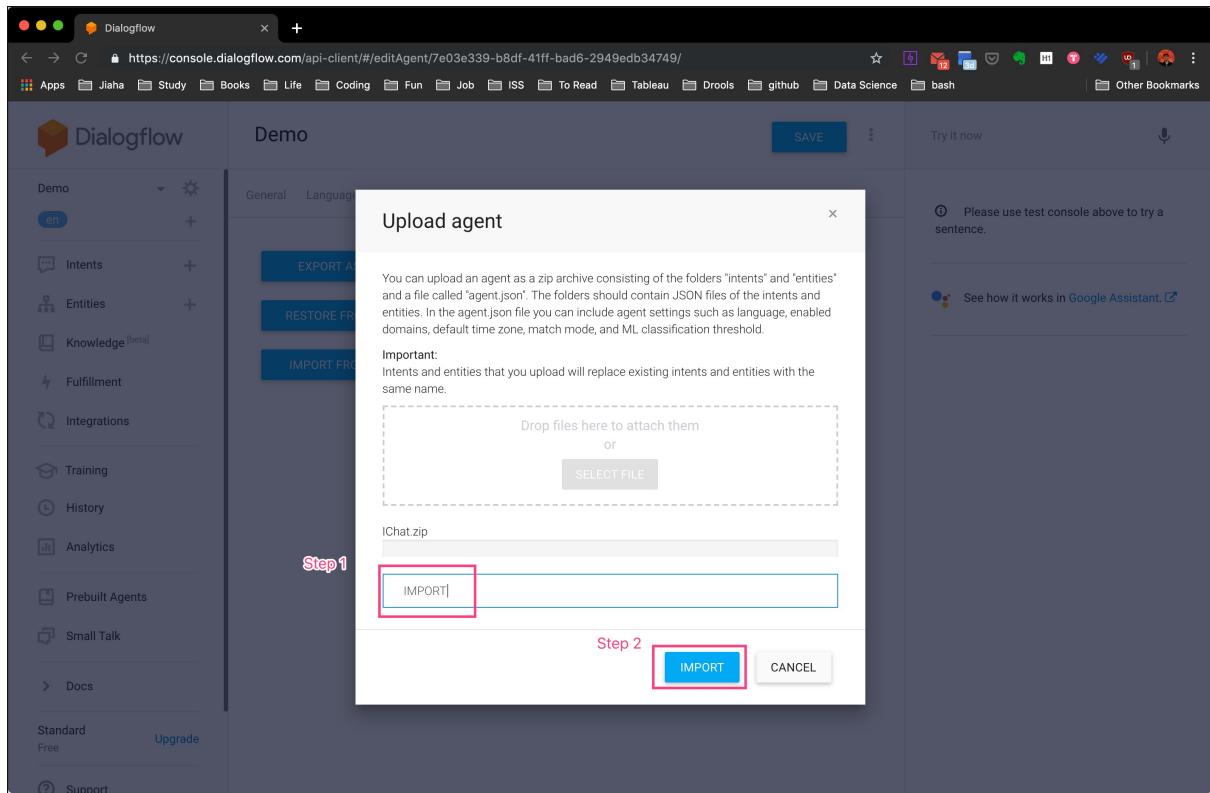
### 4. Go to “Export and Import” and click “IMPORT FROM ZIP”



## 5. Click “SELECT FILE”



## 6. Choose “IChat.zip”, type IMPORT and click “IMPORT” button. Click “Done” button once imported.



So far the “Intent” and “Entities” should be all imported into this agent. Let’s continue to import “knowledge”.

## A.2 Create Knowledge

1. Click “Knowledge” and then “Create the first one”

The screenshot shows the Dialogflow console interface. On the left, a sidebar lists various agent components: Demo, en, Intents, Step 1 Entities, Knowledge [beta] (highlighted with a red box), Fulfillment, Integrations, Training, History, Analytics, Prebuilt Agents, Small Talk, Docs, Standard Free, Upgrade, and Support. The main area is titled "Knowledge Bases". It displays a message: "No knowledge base has been created yet." with a "Create the first one." button highlighted with a red box. Below this, a paragraph explains the Knowledge Connector feature, followed by a "more here" link. A "ADJUST KNOWLEDGE RESULTS PREFERENCE" section contains a slider from "Weaker" to "Stronger". A "Try it now" button and a "See how it works in Google Assistant" link are also present.

2. Put Agent name as you wish, then click “SAVE” button

The screenshot shows the "Courses" knowledge base creation process. The "Step 1" field contains "Courses" and the "Step 2" field contains a "SAVE" button highlighted with a red box. The main area displays a message: "After you name and save this knowledge base, you can add knowledge documents such as websites, FAQs or knowledge base articles." A "Try it now" button and a "See how it works in Google Assistant" link are also present.

3. Click “Create the first one”

The screenshot shows the Dialogflow console interface. On the left, there's a sidebar with various navigation options like Demo, Intents, Entities, Knowledge (which is selected and highlighted in blue), Fulfillment, Integrations, Training, History, Analytics, Prebuilt Agents, Small Talk, and Docs. The main area is titled 'Courses' and contains sections for 'Responses' and 'Fulfillment'. In the 'Responses' section, there's a placeholder for a user icon and the text 'Execute and respond to the user'. Below it, there's a button labeled 'ADD RESPONSE'. In the 'Fulfillment' section, there's a small icon of a person with a speech bubble. At the top right, there's a 'SAVE' button and a 'Try it now' button. A red box highlights the text 'Create the first one.' in the 'Responses' section. A green box at the bottom right says 'Agent training completed' with an 'OK' button.

4. Input the fields as follows and upload “part1.csv”, then click “CREATE” button

This screenshot shows the 'Create New Document' dialog box. It has fields for 'Document Name\*' (with 'Part 1' entered), 'Knowledge Type\*' (set to 'FAQ'), 'MimeType\*' (set to 'text/csv'), and a 'DATA SOURCE' section with three options: 'File on Cloud Storage' (with a URL 'gs://bucket-name/object-name'), 'URL' (with a URL 'http://www.example.com/faq'), and 'Upload file from your computer' (with a file selected 'part1.csv'). A red box highlights the 'CREATE' button at the bottom right of the dialog.

5. Click “+ New Document”

The screenshot shows the Dialogflow console interface. On the left, there's a sidebar with various navigation options like Demo, Intents, Entities, Knowledge (selected), Fulfillment, Integrations, Training, History, Analytics, Prebuilt Agents, Small Talk, Docs, Standard (Free), Upgrade, and Support. The main area is titled 'Courses' and shows a table with one row: 'Part 1 (View Detail)' under 'Document Name', 'FAQ' under 'Knowledge Type', 'text/csv' under 'Mime Type', and 'File uploaded' under 'Source/Path'. Below this is a section titled 'Step 1' with a button '+ New Document' highlighted with a red box. Further down are sections for 'Responses' (with a sub-section 'Execute and respond to the user') and 'Fulfillment'.

6. Input the fields as follows and upload “part2.csv”, then click “CREATE” button

This screenshot shows the 'Create New Document' dialog box. It has fields for 'Document Name\*' (containing 'Part 2'), 'Knowledge Type\*' (set to 'FAQ'), 'Mime Type\*' (set to 'text/csv'), and a 'DATA SOURCE' section. Under 'DATA SOURCE', the 'Upload file from your computer' option is selected, and a file named 'part2.csv' is chosen via a 'SELECT FILE' button. A red arrow points to this file selection. In the bottom right corner of the dialog box, there is a 'CREATE' button highlighted with a red box.

7. Click “ADD RESPONSE”

The screenshot shows the Dialogflow console interface. On the left, a sidebar menu includes options like Demo, en, Intents, Entities, Knowledge [beta] (which is selected and highlighted in blue), Fulfillment, Integrations, Training, History, Analytics, Prebuilt Agents, Small Talk, Docs, Standard Free, Upgrade, and Support. The main content area is titled 'Courses' and displays a table of documents:

Document Name	Knowledge Type	Mime Type	Source/Path
Part 1 (View Detail)	FAQ	text/csv	File uploaded
Part 2 (View Detail)	FAQ	text/csv	File uploaded

Below the table are buttons for '+ New Document' and 'Responses'. The 'Responses' section contains a sub-section titled 'Execute and respond to the user' with an icon of a person speaking. It includes a callout 'Step 1' and a button labeled 'ADD RESPONSE'. The 'Fulfillment' section is also visible.

## 8. Click "SAVE" button

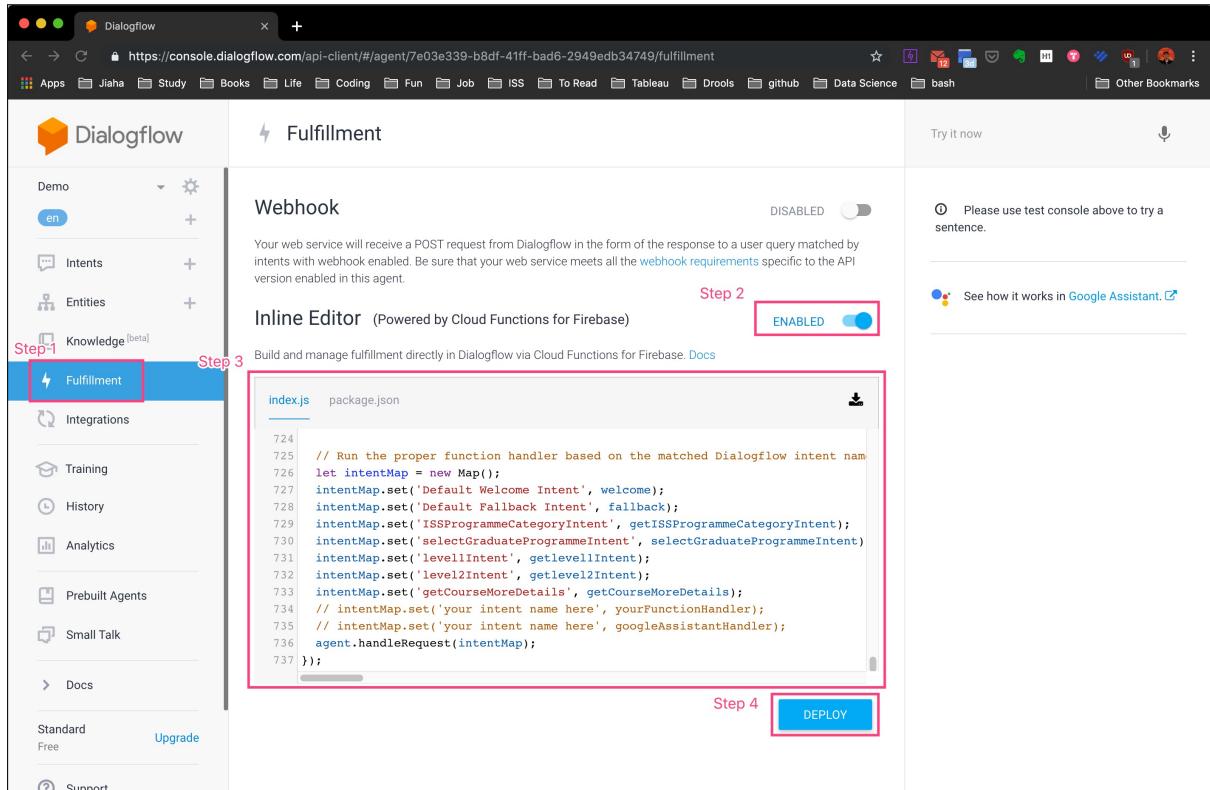
This screenshot shows the same Dialogflow interface after the 'SAVE' button has been clicked. The 'Responses' section now shows a 'Text response' card with two variants:

1	\$Knowledge Answer[1]
2	Enter a text response variant

Below the card are buttons for 'ADD RESPONSES' and 'Set this intent as end of conversation'. The 'Step 1' label is present above the 'SAVE' button, which is now highlighted with a red box.

## A.3 Create Fulfilment

Click “Fulfillment” and enable “Inline Editor”, copy “IChat.js” and replace the content in “Index.js”. Then click “DEPLOY” button



## A.4 Integration

1. Click “Integrations” and then enable “Slack”

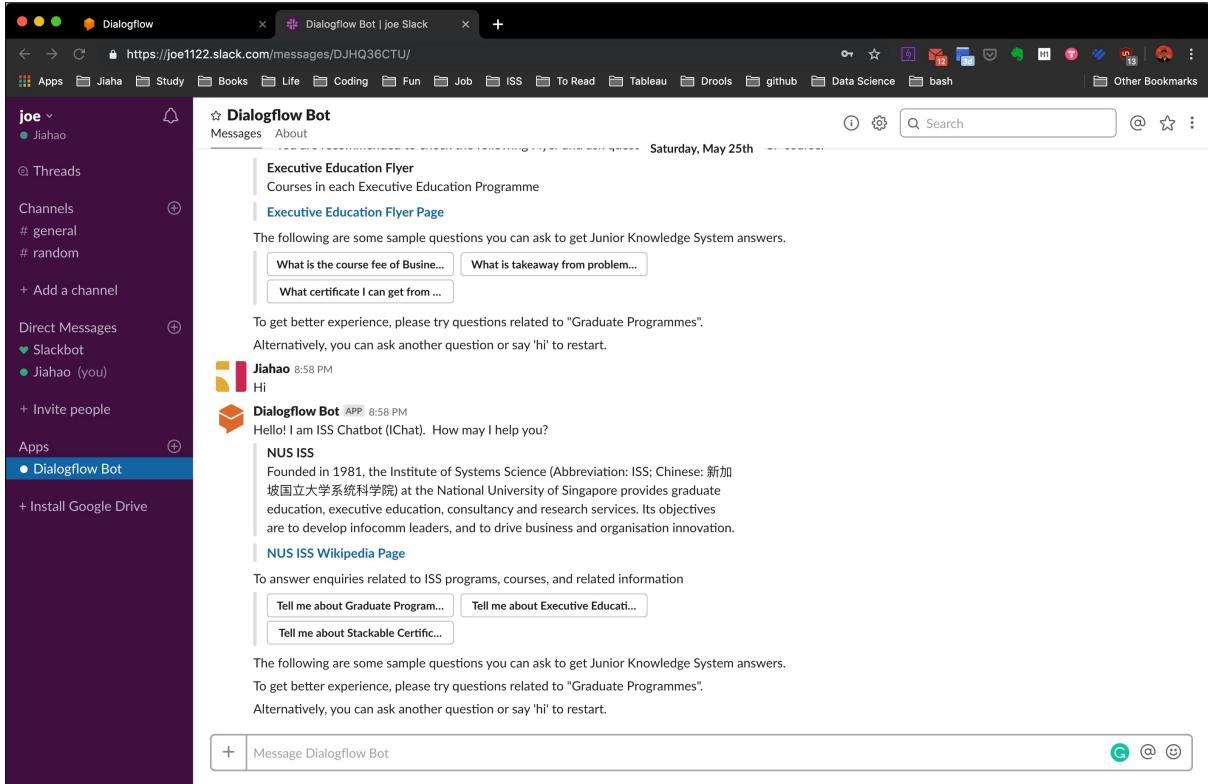
The screenshot shows the Dialogflow interface with the 'Integrations' tab selected. On the right, there's a section for Google Assistant integrations, followed by a grid of other platforms. The 'Slack' icon is highlighted with a red box and labeled 'Step 2'. The 'INTEGRATION SETTINGS' section at the top right of the grid also has a red box around it.

- Follow the “Launch” to use, or click “TEST IN SLACK” with proper Slack set-up for testing

This screenshot shows the 'Slack' configuration page within the Dialogflow interface. It includes sections for 'Test' (with a 'TEST IN SLACK' button highlighted with a red box) and 'Launch' (with detailed instructions for setting up the Slack app). The 'INTEGRATION SETTINGS' section from the previous screenshot is also visible at the top right.

## A.5 Test Demo

If Dialogflow is successfully integrated with Slack, you can say “hi” or other welcome words, and IChat will answer you enquiries.



To easier test, the invite link is created for one of my demo.

Here is the [link](#).

# Appendix B

## Test Result

Can you give me an overview of Machine Reasoning?	Knowledge	0.871	Pass
About Machine Reasoning	Knowledge	0.671	Pass
What are the Machine Reasoning course pre-requisites?	Knowledge	0.974	Pass
What are the Machine Reasoning course pre-requested knowledge?	Knowledge	0.974	Pass
What are the Machine Reasoning course learning points?	Knowledge	0.974	Pass
Learning result of Machine Reasoning	Knowledge	0.587	Pass
What is the Machine Reasoning course key takeaway?	Knowledge	0.974	Pass
Target Audience	Intent: Default Fallback Intent		Fail
Who should attend Machine Reasoning course?	Knowledge	0.973	Pass
What will be covered in this Machine Reasoning course?	Knowledge	0.976	Pass
What are the certs obtained from Machine Reasoning course?	Knowledge	0.974	Pass
How much is Machine Reasoning?	Knowledge	0.961	Pass
What are price for the Machine Reasoning?	Knowledge	0.968	Pass
What are the Machine Reasoning course fees?	Knowledge	0.974	Pass

Table B.1: FAQ Test

<b>Test Question</b>	<b>Intent Returned</b>	<b>Final Test Case Result</b>
Hi, tell me more about NUS ISS	Default Welcome Intent	Pass
Graduate Programmes	ISSProgramCategoryIntent	Pass
Overview of Master of Intelligence Systems	level1Intent	Pass
Purpose	level2Intent	Pass
Modules	level2Intent	Pass
Price	level2Intent	Pass
Application	level2Intent	Pass
Career	level2Intent	Pass
About Master of Intelligence Systems	level1Intent	Pass
Learning Point	level2Intent	Pass
Course	level2Intent	Pass
Fees	level2Intent	Pass
Application	level2Intent	Pass
Future Job	level2Intent	Pass
Overview of Master of Intelligence Systems	level1Intent	Pass
Purpose	level2Intent	Pass
Courses	level2Intent	Pass
School fee	level2Intent	Pass
Admission	level2Intent	Pass

Table B.2: Intent Test

# Appendix C

## Demo

### C.1 Scenario 1

A future student wants to check some information about **Master of Technology in Intelligent Systems**, which is under **Graduate Programme**. This student wants to know when the next intake time and how long will the programme last. In this scenario, the user only need to click suggestion button to get answers.

Jiahao 11:43 PM  
hi

Dialogflow Bot APP 11:43 PM  
Hello! I am ISS Chatbot (IChat). How may I help you?

NUS ISS  
Founded in 1981, the Institute of Systems Science (Abbreviation: ISS; Chinese: 新加坡国立大学系统科学院) at the National University of Singapore provides graduate education, executive education, consultancy and research services. Its objectives are to develop infocomm leaders, and to drive business and organisation innovation.

[NUS ISS Wikipedia Page](#)

To answer enquiries related to ISS programs, courses, and related information

Tell me about Graduate Program...   Tell me about Executive Educati...  
Tell me about Stackable Certific...

+ Message Dialogflow Bot   G @ 😊

[Graduate Diploma in Systems A...](#) [Master of Technology in Digital ...](#)  
[Master of Technology in Enterpr...](#) [Master of Technology in Intellig...](#)  
[Master of Technology in Softwar...](#)

Alternatively, you can ask another question or say 'hi' to restart.



Message Dialogflow Bot



You have selected, Master of Technology in Intelligent Systems. Click below to know more.

[Overview](#) [Modules](#) [Project & Internship](#) [Fee & Loans](#)  
[Admission & Application](#)



Message Dialogflow Bot



You have selected, Master of Technology in Intelligent Systems : Overview.

[Purpose](#) [Next Intake Time](#) [Duration](#) [Application Deadline](#)  
[Learning outcomes](#)

You may ask another question or say 'hi' to restart.



Message Dialogflow Bot



You have selected, Master of Technology in Intelligent Systems : Overview : Next Intake Time.

Jan 2020 (Part-time)

You may ask another question or say 'hi' to restart.



Message Dialogflow Bot



You have selected, Master of Technology in Intelligent Systems : Overview : Duration.

Full-time 1 year (2 semesters)

Part-time 2 years (4 semesters)

You may ask another question or say 'hi' to restart.



Message Dialogflow Bot



## C.2 Scenario 2

An employee wants to learn more about **Machine Reasoning** course in **Executive Education Programmes**. The user needs to input questions related to the course in this scenario.

Jiahao 11:58 PM  
Hello

Dialogflow Bot APP 11:58 PM  
Hello! I am ISS Chatbot (IChat). How may I help you?

**NUS ISS**  
Founded in 1981, the Institute of Systems Science (Abbreviation: ISS; Chinese: 新加坡国立大学系统科学院) at the National University of Singapore provides graduate education, executive education, consultancy and research services. Its objectives are to develop infocomm leaders, and to drive business and organisation innovation.

**NUS ISS Wikipedia Page**  
To answer enquiries related to ISS programs, courses, and related information

Tell me about Graduate Program...   Tell me about Executive Educati...  
Tell me about Stackable Certific...

+ Message Dialogflow Bot   G @ 😊

There are many courses in Executive Education Programmes. Questions related to Executive Education Programmes would be answered based on our Junior Knowledge System. It covers Course Overview, Key Takeaway, Target Audience, Prerequisites, Course Details, Fees & Loans and Certification. You are recommended to check the following Flyer and ask questions related to each NICF course.

#### **Executive Education Flyer**

Courses in each Executive Education Programme

#### **Executive Education Flyer Page**

The following are some sample questions you can ask to get Junior Knowledge System answers.

What are price for the Machine ...

Can you give me an overview of ...

What is the Machine Reasoning ...

Who should attend Machine Re...

What are the Machine Reasonin...

To get better experience, please try questions related to "Graduate Programmes".

Alternatively, you can ask another question or say 'hi' to restart.



Message Dialogflow Bot



Jiahao 12:02 AM

Who should attend machine reasoning



Dialogflow Bot APP 12:02 AM

This course is suitable for information technology professionals who are interested in creating intelligent computer software system able to make use of knowledge (digitised data useful to business), reason and take actions automatically, in various business contexts and industry domains.

This course will be useful for:

- \* Artificial Intelligence Engineer who need develop competency in knowledge modelling, representation, discovery, knowledge graph, knowledge/rule base, and machine inference.
- \* Software Developer/Engineer who need develop competency in business rule management system (BRMS) and business process management system (BPMS)
- \* Application Solution Architect who need design intelligent system solutions and integrate them into enterprise system architecture
- \* Data Scientist/Engineer who need obtain domain knowledge in artificial intelligence to assist data analytics.
- \* Working professionals who need to upgrade existing machine reasoning knowledge and skills by practicing contemporary system building tool sets.



Message Dialogflow Bot





**Jiahao** 12:06 AM

What are the Machine Reasoning course pre-requisites?



**Dialogflow Bot** APP 12:06 AM

This is an intensive, intermediate course.

- \* Participants should have intermediate mathematics and statistics knowledge, e.g. calculating boolean algebra (logic), and probability.
- \* Participants should have intermediate computer literacy and software engineering fundamentals, e.g. using Windows or Linux or MacOS, Microsoft Office or LibreOffice, VMware or VirtualBox, and aware of web application, and client-server software architecture.
- \* Participants should have current or prior hands-on coding experience in one or more high-level computer programming languages, preferable in Java. Experiences with Python, R, or structured query language (SQL) would have added advantages.
- \* Participants are required to bring their own internet enabled computing device & power charger to access and download e-courseware in PDF e-copies. This course issues only PDF e-courseware without paper-courseware (Go Green).
- \* Participants, who prefer using their own laptop/computer during course workshops, should preinstall iss-vm virtual machine (about 30 GB in size) into own device before course start date. Participants without programming experience should self-study basic Java or Python.

\* \* \*



Message Dialogflow Bot



## Appendix D

# Project Related Files

**Presentation Video:** test

**Attribute Table:** [https://github.com/davidygp/IRS-MR-2019-01-19-IS1PT-GRP-MRCard/  
blob/master/Miscellaneous/Data%20Fields%20-%20Sheet1.csv](https://github.com/davidygp/IRS-MR-2019-01-19-IS1PT-GRP-MRCard/blob/master/Miscellaneous/Data%20Fields%20-%20Sheet1.csv)