

Project Report

Chatbot for ISS Website

Masters of Technology in Intelligent Systems

Module: Cognitive Systems

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Executive Summary

ISS website is informative but is unstructured, like all website experiences. Additionally we see that there is no sitemap to assist user navigation.

Our Chatbot is created to provide a human language conversational interface for contextual, and targeted access.

We started the chatbot design keeping user centricity in mind. Identifying the use categories and their information knowledge expectations from a bot was key.

While the chatbot is designed for english only, we have considered different phrases, utterances and incomplete phrases to train the intents.

For easy information access we have considered slack and Google Assistant.

We have tried to create a dynamic system and hence automated scraping and associated database refresh is ensured.

Intents are central to the user interaction. We designed user journeys based on user interaction, and preserved the user conversation context between dialogue /conversation turns. Similar matching intents were “resolved” through prioritization. Additionally to “course correct” the user, fallback intents were designed with sufficient aids and trials to bring the user back to successful resolution of the queries.

In our opinion, today’s chat bot addresses user category: prospective student well. For the chatbot to truly serve the needs of current students, faculty, and collaborations e.g. research, recruiters, etc. we will need the bot to “crawl” and ingest relevant datasets. Per guidance from course instructors, we restricted ourselves to publicly available information.

The roadmap of our chatbot has to consider following aspects: serving all user categories for ISS, omni-channel (facebook integration, Building BOT into ISS website), authentication (to prevent Denial of Service/DoS), and authentication based personalized interaction.

Introduction

Objective

The objective of our project is to build a chatbot system for ISS website <https://www.iss.nus.edu.sg/>. The chatbot will answer queries regarding various courses, programs offered by ISS and other generic information usually available on website. The team is expected to use and apply various techniques learnt in the Cognitive Systems and earlier modules in MTech course.

Scoping for the project

During the first team meeting session we started with deliberating on the kind of questions the chatbot will expect, and what kind of information / database we would need access to enable chatbot to respond to those queries. We looked through the ISS website to check the kind of information available and it was apparent that lot of questions would need information more than what is publicly available on ISS website. We clarified with our professors and received the guidance that we should limit our chatbot to the information available on website, and or other publicly available information. An immediate need to build a parser for ISS website was felt by team and addressed.

After various discussions and clarifications the scope of project was agreed as below

Inclusions

Scope

1. The queries addressed by chatbot will be limited to information accessible on ISS website and any other publicly available information
2. The chatbot would be integrated to Slack, and would be accessible from our Mtech group slack workspace
3. The chatbot is also integrated to Google Assistant and is accessible from any device with Google Assistant built in

Functionality

1. The chatbot will be contextually aware of the user type. i.e- the first thing chatbot does is to classify user into 4 categories – current student, prospective student, teaching staff, and others. The responses from chatbot are specific to the user type it is interacting with. The conversation state persists across turns of conversation

Technical

1. BeautifulSoup is used for parsing the ISS website

2. The scraped information is used to build databases about teaching staff, courses & programs offered, etc. MS Excel is used as database tool and information is classified and stored in various worksheets
3. Google Dialogflow NLP platform is used for processing user inputs and extracting Intents and parameters.
4. Heroku is used as the backend server to run the Python code interacting with the databases, which in turn fulfils the webhook requests from Dialogflow

Exclusions

1. Voice integration of chatbot to hardware devices such as Google Home. Google Assistant integration is done

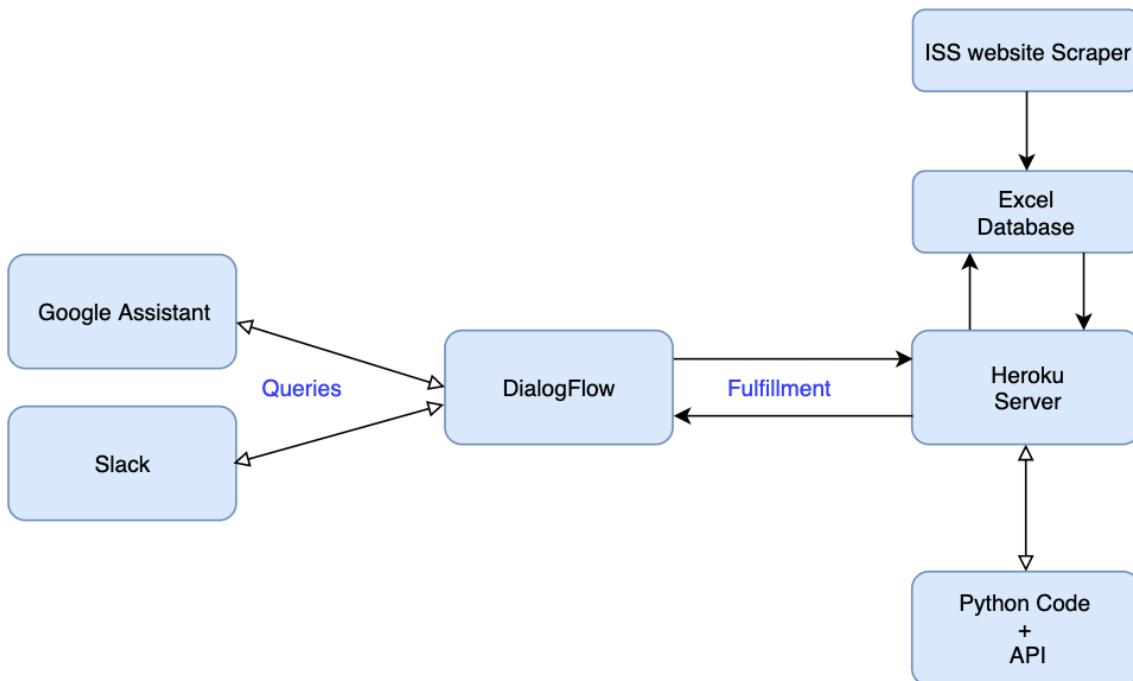
Solution – Using Google DialogueFlow Engine

Overview

The chatbot accepts input from google Assistant accessible from various devices such as smartphones, laptops, and workflow software Slack. For Google Assistant (need to login) via google credentials and slack integration has been done for workspace ‘mtech2019pt’

The user inputs (utterances) are processed by Dialogflow engine and matched against defined Intents. Each Intent has Entities defined which capture the parameters to be processed further. Default Intents of ‘Default Welcome Intent’ and ‘Default Fallback Intent’ are defined to capture the greeting utterances and which do not get matched to any other category, respectively

Picture Flow diagram



User categorization

The first thing the chatbot does after greetings is to ask the user his profile, and categorizes him/her into one out of below four categories –

- Current Student** : If user is currently enrolled into one of ISS programs. This in turn means that he is in general familiar with ISS and its programs and would have more specific queries such as course timetable, teaching staff profiles, classroom locations etc
- Prospective Student** : This is when the user is a prospective student. These users are interested in knowing more about ISS overview, lecturer profiles, catalogue of courses offered, fees, admission requirements, timelines etc
- Teachers**: This category is for teaching staff of ISS, their requirement is quite unique in terms of admin matters, classroom locations, holiday schedules, student profiles, canteen locations
- Others**: Users who do not fit in any of above three categories are classified as others. These could be researchers, collaborators, job aspirants, contractors offering various services, government departments, or general public.

Database of possible questions

We deliberated on the possible questions that our chatbot will be required to answer and came up with a list. Next we evaluated the questions on perceived importance and complexity in addressing them. We looked through ISS website to understand what kind of data is available and noted for each question if data is publicly available or no. http links were noted down for directly addressable queries. Also we defined sample intents to address the questions and assigned team members to work on them. Some of the sample questions needed more info than readily available on ISS website and thus we reached out to our professors who guided us to limit ourselves to publicly available information on ISS website.

Profile	Possible Questions	Intent Description	Response	Availability of Data	Relevant pages	Complexity of question	Ability to Address	Importance of Question	Data Filled in By	Assigned to	Status	M	N	
Prospective Students	What is the ranking of NUS?		Link to external	TBC	not available on the NUS or ISS pages	Easy	Easy	Medium	Ajay					
	What is ISS?			Yes	Welcome">https://www.iss.nus.edu.sg/about-us/director-ceo's>Welcome	We	Easy	High	David	Ajay				
	How is ISS different from rest of NUS - NUS			Yes	https://www.iss.nus.edu.sg/about-us/why-NUS-ISS	Hard	Hard	High	Li Duo					
	What master degree(s) does NUS ISS			Yes	https://www.iss.nus.edu.sg/graduate-degree/	Medium	Medium	High	Rahul	David	-Data	GetGraduateProg		
	What are the requirements for Intelligent Systems?			Yes	https://www.iss.nus.edu.sg/graduate-degree/	Medium	Medium	High	Ajay	Li Duo	Scrapped	GetGraduateProg		
	What programs does NUS ISS offer?			Yes	(1 for each program)	Medium	Medium	High	David	Rahul			GetProgramInfo	
	What courses are taught by NUS ISS?			Yes	https://www.iss.nus.edu.sg/executive-education/course-exams/	Medium	Medium	High	Li Duo	Ajay			GetProgramInfo	
	What are the courses related to?			Yes	https://www.iss.nus.edu.sg/executive-education/course-exams/	Hard	Hard	Medium	Rahul	requires			GetModuleIntent	
	What are the modules under Software Engineering?			Yes	https://www.iss.nus.edu.sg/graduate-degree/	Medium	Medium	High	Ajay	David	Scrapped	GetGraduateProg		
	How much is the programme fee?			Yes	(1 for each program)	Easy	Easy	High	David	Li Duo	Scrapped		GetGraduateProg	
	Do banks provide loans?		Link to external	TBC	https://www.iss.nus.edu.sg/graduate-programmes/financial-aid/	Easy	Medium	Medium	Li Duo					
	What are the criteria for bank loans?		Link to external	TBC	https://www.iss.nus.edu.sg/graduate-programmes/financial-aid/	Easy	Medium	Medium	Rahul					
	How much is the programme fee?			Yes	(1 for each program)	Easy	Medium	Medium	Li Duo					
	Are there any grants?		Asks questions	Yes	not available on the ISS pages. Some related funding	Medium	Medium	High	Ajay	Rahul	Scrapped		GetModuleIntent	
	What is the application deadline?		Asks questions	Yes	(1 for each program)	Easy	Easy	High	David	Ajay	Scrapped		GetGraduateProg	
	What is the enrollment time?			Yes	https://www.iss.nus.edu.sg/graduate-degree/	Easy	Easy	High	Li Duo	David	Scrapped	GetGraduateProg		
	How to apply to Intelligent Systems?		Link to application	Yes	partial name of companies here under each of the individual	Easy	Easy	High	Rahul	Li Duo	Scrapped		ApplyGraduateF	
	Where are the alumnis now?			TBC	Not specifically alumni guidance, but there is a website for	Easy	Medium	Medium	David					
	Does the school provide alumnis?			TBC	https://www.iss.nus.edu.sg/community/our-alumni	Easy	Medium	Medium	Li Duo					
	Details of tapping alumnus mentoring for			TBC		Easy	Easy	High	Rahul	Li Duo	Scrapped			
	Where can I get more info?		Link to preview	Yes	No direct information found on comparison found to answer the	Hard	Hard	Low	Ajay		Scrapped		GetMoreInfoInt	
	Why should I take a masters at NUS ISS?			TBC		Hard	Hard	Low	Ajay					
	Why ISS is right for my profile.			TBC	Nil	Hard	Hard	Low	David					
	Based on my history, what is the most			TBC	https://www.iss.nus.edu.sg/graduate-degree/	Very Hard	Hard	Low	Li Duo					
	What is a stackable program?			Yes		Easy	Easy	High	Rahul	Li Duo	Scrapped			
	Are ISS students eligible for campus			TBC	no information available on ISS	Medium	Medium	Low	Ajay					
	What are the campus accomodation			TBC	Not under NUS ISS, but Office of Student Admission:	Medium	Medium	Low	David					
	What are the job prospects after NUS			TBC	https://www.iss.nus.edu.sg/community/events/industry-events	Medium	Medium	Low	Li Duo					

	A	B	C	D	E
1	COUNTA of Importance of Ques		Availability of Data		
2	Importance of Question	Complexity of question	TBC	Yes	Grand Total
3	Medium	Easy	19	1	20
4		Hard	4	1	5
5		Medium	6	1	7
6	Medium Total		29	3	32
7	Low	Easy	2	2	4
8		Hard	2		2
9		Medium	8	1	9
10		Very Hard	1		1
11	Low Total		13	3	16
12	High	Easy	2	10	12
13		Hard		2	2
14		Medium	1	6	7
15	High Total		3	18	21
16	Grand Total		45	24	69
17					

Total 69 sample questions were coded after our first go at list of probable queries.

Finally we selected the sample questions with high importance and for which data was readily available on ISS website. These probable questions were then used to design utterances to train the bot

Website scrapping

BeautifulSoup and other popular python libraries available such as Scrappy and Selenium were explored as the scrapping mechanism for this project. Selenium is more able to do user interactions (button clicks/ filling in of forms/ etc) than BeautifulSoup, however the interface for BeautifulSoup seemed easier at the time and there was more familiarity from the class workshop, hence it was selected as the scrapper of choice. Jupyter Notebook was utilized as it provided a simple interface to check the temporary output.

The scrapper searched by looking through the main page "<https://www.iss.nus.edu.sg>" and identifying embedded hyperlinks within. The sections selected to be scraped were: course-finder, discipline, graduate_programmes, stackable_certificate_programmes, iss_team.

```
In [16]: cert_urls_dict = {}
for category in stackable_certificate_programmes_category_list:
    website = iss_subcategory_url + category
    data = get(website.strip())

    #Access all the relevant urls and store them in a list
    soup = BeautifulSoup(data,"html.parser")
    alltags = soup.findAll("a")

    cert_urls_list = []
    for a_tag in alltags:
        href = a_tag.get("href")
        if href and href != "" and "/course/detail" in href:
            print(href)
            if iss_subcategory_url in href or "https://www.iss.nus.edu.sg" in href:
                cert_urls_list.append(href)
            else:
                cert_urls_list.append(iss_subcategory_url+href)
    cert_urls_dict[category] = cert_urls_list

https://www.iss.nus.edu.sg/executive-education/course/detail/nus-lss-certificate-in-digital-solutions-development
https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-data-analytics-process-and-best-practice-(sf)
https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-data-storytelling-(sf)
https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-data-governance-protection-(sf)
https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-managing-business-analytics-projects-(sf)
https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-statistics-bootcamp-(sf)
https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-data-analytics-process-and-best-practice-(sf)
https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-predictive-analytics--insights-of-trends-and-irregularities-(sf)
https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-text-analytics-(sf)

In [28]: staff_urls_dict

Out[28]: {'management': ['https://www.iss.nus.edu.sg/about-us/staff/detail/561/KHOONG Chan Meng',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/5/YUM Hui Yuen',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/281/LEONG Mun Kew'],
 'centres-of-excellence': ['https://www.iss.nus.edu.sg/about-us/staff/detail/521/Ashok Kumar SEETHARAMAN',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/584/Tamsin Emma Maria GREULICH-SMITH',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/330/Brian NG',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/339/Debashis TARAFDAR',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/623/HOE Siu Loon',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/209/KOH Wai Kin',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/654/Matthew CHUA',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/208/Sean HOANG'],
 'practice-chiefs': ['https://www.iss.nus.edu.sg/about-us/staff/detail/225/Daniel BOEY',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/377/GOH Boon Nam',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/668/LIM Wee Khee',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/632/TAN Peng Wei'],
 'graduate-programme-chiefs': ['https://www.iss.nus.edu.sg/about-us/staff/detail/24/Barry Adrian SHEPHERD',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/173/charles PANG',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/53/Esther TAN',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/532/LEE Chuk Munn',
 'https://www.iss.nus.edu.sg/about-us/staff/detail/77/Megan WANG']}
```

Subsequently, each section was selected and the scrapping code was developed separately. Most of the information could be scrapped via the text naming such as “Application Deadline/Next Intake”:

```

for table_tag in alltags:
    content = table_tag.get_text()
    if "Next Intake" in content or "Application Deadline" in content:
        content_list = table_tag.get_text().split("\n")
        for i in range(len(content_list)-1):
            if content_list[i] == "Next Intake":
                intake.append(specific_clean(content_list[i+1], clean_list))
            elif content_list[i] == "Application Deadline":
                deadline.append(specific_clean(content_list[i+1], clean_list))
    if len(intake) >= 1 and len(deadline) >= 1:
        break

apply = [] #TOD0
alltags = soup.findAll("div", class_=lambda x: x != "accordion_block-inner", id="tab6-container")
for div_tag in alltags:
    if "How to Apply" in div_tag.get_text():
        apply.append(div_tag.get_text())

gradProg.append([name, prettify_nouns(name), "\n".join(modules), "\n".join(cost), "\n".join(financing), "\n".join(requirement)
]

```

Certain components were slightly more difficult as the content was not present in the html text that BeautifulSoup extracted such as the POST request required to load instructors of a given module. Instead, the CourseId, CourseUrlName, ControllerName, ViewName was scrapped from each link and a POST request was submitted, then the name of the lecturers were extracted from the response.text.

```

requestData = {
    "CourseId": CourseId,
    "CourseUrlName": CourseUrlName,
    "ControllerName": ControllerName,
    "ViewName": ViewName
}

# url = "https://www.iss.nus.edu.sg/api/Course/LoadInstructors"
# requestData = {
#     "CourseId": "63b4bade-4213-6fdb-9c52-ff000079db5a",
#     "CourseUrlName": "ISS_CourseDetailTabModel_",
#     "ControllerName": "coursedetailsTabsMVCWidget",
#     "ViewName": "ViewInstructors"
# }

full_url = "https://www.iss.nus.edu.sg" + url
response = requests.post(url=full_url, data=requestData)
if response.status_code == 200:
    soup2 = BeautifulSoup(response.text,"lxml")

alltags = soup2.findAll("div", class_="col-xs-9")
for div_tag in alltags:
    lecturers.append(div_tag.find("h3").get_text().strip())
module.append([name, prettify_nouns(name), "\n".join(discipline), "\n".join(cost), "\n".join(financing), "\n".join(requiremen

```

In [19]: ## Desired Data ##
 module
 'Dr. ZHU Fang Ming\nDr. TAN Jen Hong']

Knowledge database

Beautifulsoup was used to scrap the ISS website and output was classified into various categories as Gradprog, stackableprog, executiveProg, modules, lecturer info.

	A	B	C	D	E	F	G	H	I
1	Name	Module	Cost	Financing	Requirements	Deadline	Intake	Apply	
2	Artificial Intelliger Robotic Systems	Please refer to ir	Please refer to ir	Please refer to ir	Please refer to ir	Please refer to ir	Please refer to ir	Please refer to individual module	
3	Cybersecurity	NICF- AISP Qua	Please refer to ir	Please refer to individual module					
4	Data Science	New Media And	Please refer to ir	Please refer to individual module					
5	Digital Agility	Certified Scrum	I	Please refer to ir	Please refer to individual module				
6	Digital Innovator Nicf	Web Analyt	Please refer to ir	Please refer to individual module					
7	Digital Strategy	€ Certified Informa	Please refer to ir	Please refer to individual module					
8	Digital Product	8 Project Manager	Please refer to ir	Please refer to individual module					
9	Professional Cor	NICF - Statistics	Please refer to ir	Please refer to individual module					
10	Smart Health Le	NICF - Systems	Please refer to ir	Please refer to individual module					
11	Software System Nus	Iss Certifica	Please refer to ir	Please refer to individual module					
12	StackUp - Staru	NICF- Python fo	Please refer to ir	Please refer to individual module					
13									
14									
15									

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	H1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
		Name	ime_Clean	Discipline	Cost	Financing	Requirements	Lecturers	Link											
1	robotic-sy	Robotic Sy	Artificial In Fees & FundingSelf-sp	This is an ir Dr. Matthe	https://www.iss.nus.edu.sg/executive-education/course/detail/robotic-systems/artificial-intelligence															
2	vision-syst	Vision Syst	Artificial In Fees & FundingSelf-sp	This is an ir Dr. TIAN Jir	https://www.iss.nus.edu.sg/executive-education/course/detail/vision-systems/artificial-intelligence															
3	new-medie	New Medi	Data Scien Fees & Funding Self-sp	This is an ir Mr. Eric TH	https://www.iss.nus.edu.sg/executive-education/course/detail/new-media-and-sentiment-mining-new/artificial-intelligence															
4	text-proce	Text Proce	Data Scien Fees & FundingSelf-sp	The course Dr. FAN Zh	https://www.iss.nus.edu.sg/executive-education/course/detail/text-processing-using-machine-learning/artificial-intelligence															
5	machine-r	Machine R	Artificial Intelligence	This is an ir Mr. GU Zh	https://www.iss.nus.edu.sg/executive-education/course/detail/machine-reasoning/artificial-intelligence															
6	intelligent-	Intelligent	Artificial In Fees & FundingSelf-sponsored	Dr. TAN Jer	https://www.iss.nus.edu.sg/executive-education/course/detail/intelligent-sensing-and-sense-making/artificial-intelligence															
7	problem-s	Problem	S Artificial In Fees & FundingSelf-sponsored	Dr. ZHU Fa	https://www.iss.nus.edu.sg/executive-education/course/detail/problem-solving-using-pattern-recognition/artificial-intelligence															
8	pattern-re	Pattern Re	Artificial Intelligence	Dr. ZHU Fa	https://www.iss.nus.edu.sg/executive-education/course/detail/pattern-recognition-and-machine-learning-systems/artificial-intell															
9	nicf-text-a	Nicf Text	A Data Scien Fees & FundingSelf-sp	The course Dr. FAN Zh	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-text-analytics-(sf)/artificial-intelligence															
10	nicf-reasoning	Reasoning	Artificial Intelligence	This is an a Mr. GU Zhi	https://www.iss.nus.edu.sg/executive-education/course/detail/reasoning-systems/artificial-intelligence															
11	nicf-secur	Nicf Secur	Software S Fees & Funding Self-sp	As a prere	Mr. NG Kol	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-secur-iot-(sf)/cybersecurity														
12	nicf-design	Nicf Desig	Software S Fees & FundingSelf-sp	Participant	Mr. HENG	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-design-secure-mobile-architecture-(sf)/cybersecurity														
13	nicf-asp	Nicf Aisp	Digital Stra Fees & FundingExam	FeeInternat	Ms. Angel	https://www.iss.nus.edu.sg/executive-education/course/detail/certified-information-systems-security-professional-(ccisp-exam-														
14	nicf-cs	Nicf C	Digital Stra Fees & FundingExam	FeeInternat	Ms. Angel	(sf)/cybersecurity														
15	nicf-cl	Nicf C	Digital Stra Fees & FundingExam	FeeInternat	Ms. Angel	(sf)/cybersecurity														
16	nicf-secu	Nicf Secur	Software S Fees & Funding Self-sp	As a prere	Mr. NG Kol	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-securing-iot-(sf)/cybersecurity														
17	nicf-design	Nicf Desig	Software S Fees & FundingSelf-sp	Some expe	Mr. CHIA Y	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-design-secure-mobile-architecture-ssla-sf/cybersecurity														
18	nicf-asp	Nicf Aisp	Digital Stra Fees & FundingSelf-sp	Some expe	Mr. CHIA Y	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-asp-qualified-information-security-professional-course-(sf)/cybersecurity														
19	nicf-cs	Nicf C	Digital Stra Fees & FundingSelf-sp	One of the Ms.	Angela	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-(isc)-ccsp-cbk-training-seminar-(sf)/cybersecurity														
20	nicf-(isc)	Nicf C	Digital Stra Fees & FundingSelf-sp	a) CISSP C	Ms. Angel	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-(isc)-ccsp-cbk-training-seminar-(sf)/cybersecurity														
21	nicf-(isc)-c	Nicf C	Digital Stra Fees & FundingSelf-sp	a) CISSP C	Ms. Angel	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-(isc)-ccsp-cbk-training-seminar-(sf)/cybersecurity														
22	nicf-cyber	Nicf Cyber	Digital Stra Fees & FundingSelf-sp	sponsore	Dr. TAN L	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-cybersecurity-risk-awareness-(sf)/cybersecurity														
23	nicf-mana	Nicf Mana	Digital Stra Fees & FundingSelf-sp	sponsore	Dr. Richard	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-managing-cybersecurity-risk-(sf)/cybersecurity														
24	nicf-cyber	Nicf Cyber	Digital Stra Fees & FundingSelf-sp	sponsore	Dr. Richard	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-cyber-security-for-ict-professionals-(sf)/cybersecurity														
25	nicf-asp	Nicf Aisp	CyberSecu Fees & FundingSelf-sp	a) CSSLP C	Ms. Angel	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-(isc)-csslp-cbk-training-seminar-(sf)/cybersecurity														
26	nicf-data	Nicf Data	Data Scien Fees & FundingSelf-sp	sponsore	Dr. Nirmal	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-data-analytics-process-and-best-practice-(sf)/data-science														
27	nicf-recon	Nicf Recor	Data Scien Fees & Funding Self-sp	This is an ir Dr.	Barry A	https://www.iss.nus.edu.sg/executive-education/course/detail/nicf-recommender-systems-(sf)/data-science														
28	new-medie	New Medi	Data Scien Fees & Funding Self-sp	This is an ir Mr. Eric TH	https://www.iss.nus.edu.sg/executive-education/course/detail/new-media-and-sentiment-mining-new/data-science															
29	text-proce	Text Proce	Data Scien Fees & FundingSelf-sp	The course Dr. FAN Zh	https://www.iss.nus.edu.sg/executive-education/course/detail/text-processing-using-machine-learning/data-science															

	A3	B	C	D	E	F	G	H	I
	Name	Module	Cost	Financing	Requirements	Deadline	Intake	Apply	
2	Stackable Certifi	NICF - Data Ana	Please refer to ir Please refer to individual module						
3	Stackable Certifi	NICF-NUS-ISS	(Please refer to e Various Funding Please refer to ir Please refer to ir Please refer to ir Please refer to individual module						
4	Stackable Certifi	NICF - Machine	Please refer to ir Please refer to ir Please refer to ir Please refer to ir Please refer to individual module						
5	Stackable Certifi	NICF-Cloud Nati	Please refer to ir Please refer to ir Please refer to ir Please refer to ir Please refer to individual module						
6									
7									
8									
9									

Intents

Apart from default welcome and fallback intents, below Intents were programmed in Dialogflow

The screenshot shows the Dialogflow web interface. On the left is a sidebar with the following navigation items:

- ISS-CS-DaLiRaAj (owned...) (dropdown)
- en (language selector)
- Intents** (selected, highlighted in blue)
- Entities
- Knowledge [beta]
- Fulfillment
- Integrations
- Training
- History
- Analytics
- Prebuilt Agents
- Small Talk
- Docs
- Standard
- Free

The main area is titled "Intents" and lists several intents:

- app-enroll-programmoduledegree
- Default Fallback Intent
- Default Welcome Intent
- execprogmodulelisting
- ExecProgramlisting
- fallbackusertypeintent Contexts: awaiting_usertype
- feesprogrammoduledegree
- GetUserTypeIntent
- grants-financing-programmoduledegree
- lecturerinfo
- MastersProgramModuleListing
- MastersProgramsListing
- ModuleDetailing
- ProgramsatISS
- SkillbasedCourseListing
- StackablePgm
- StackableProgramModuleListing
- StaffListingbyCategory
- WhatisISS?
- WhatisISS

We look into details of a sample intent - execprogmodulelisting

The screenshot shows the Dialogflow web interface. On the left, a sidebar lists various sections: ISS-CS-DaLiRaAj (owned...), en, Intents (selected), Entities, Knowledge [beta], Fulfillment, Integrations, Training, History, Analytics, Prebuilt Agents, Small Talk, Docs, Standard Free. The main area displays an intent named "execprogmodulelisting".

- Contexts: defined_usertype (input context, count 5)
- Events: None
- Training phrases:
 - "what are the modules in artificial intelligence?"
 - "what are the modules offered in DS?"
 - "tell me about DS?"
 - "Tell me about data science?"
 - "tell me about Artificial intelligence?"
 - "tell me about AI?"

This intent answers the queries when a user is interested in knowing more details of Executive program courses offered by ISS. Various training phrases were defined.

tell me about Artificial intelligence?			
PARAMETER NAME	ENTITY	RESOLVED VALUE	
ExecProgramModulelisting	@ExecProgramModulelisting	Artificial intelligence	<input type="button" value="X"/>
tell me about AI?			
tell me about IP security?			
tell me about IPSec?			
tell me about DA?			
tell me about digital agility?			

Action and parameters

Enter action name				
REQUIRED ?	PARAMETER NAME ?	ENTITY ?	VALUE	IS LIST ?
<input type="checkbox"/>	ExecProgramModulelisting	@ExecProgramModulelisting	\$ExecProgramModulelisting	<input type="checkbox"/>
<input type="checkbox"/>	Enter name	Enter entity	Enter value	<input type="checkbox"/>

Entities

For each training phrases ‘entities’ were defined which pick up the parameters and are passed on to the Heroku server for fulfillment via webhook functionality

Responses 



DEFAULT GOOGLE ASSISTANT FACEBOOK MESSENGER HANGOUTS +

Text response

- 1 hello #defined_usertype. you want to know \$ExecProgramModulelisting.original
- 2 Enter a text response variant



[ADD RESPONSES](#)

Set this intent as end of conversation 



Fulfillment 

Enable webhook call for this intent

Enable webhook call for slot filling

Fulfillment

For fulfillment we used Heroku as we needed an endpoint that is permanent. Paid version has a functionality of hosting multiple servers which was not needed. We didn't use 'ngrok' as the server it provides is only valid for 8 hours, whereas Heroku provides one permanent server

Integration with Slack

For integration with slack we go to the workspace and go to 'Apps' section, then click on '+' button

Slack - mtech2019pt

mtech2019pt Ctrl+1

Rahul Ctrl+2

Jump to... Ctrl+Shift+P

Threads

Channels Ctrl+Shift+N

general Ctrl+Shift+G

random Ctrl+Shift+R

+ Add a channel

Direct Messages Ctrl+Shift+M

Slackbot

Rahul (you)

DongBin

Gary

issgz nus gmail

Jaykay

Jiahao

Shawn Chia

William

Yoke

+ Invite people

Apps

#general

☆ | 65 | 0 | This MTech group is NOT wishing you Friday, May 24th day exam. And have an (unlikely) good weekend. I am going offline in 10 minutes (no Q&A in weekend), see you at exam.

Chad Ng 10:43 PM

Thank you Sam.

Saturday, May 25th

GU Zhan (Sam) 12:40 PM

@everyone Generally exam won't test your coding ability, e.g. what's the correct spelling of agendaregroup keywords in Drools. It is not cost effective to spend the last two precious days to read bulky programming documentations, e.g. KIE, R, Python, Orange and alike. (Programming is a language, you won't master French or Italian with in few days). (edited)

6

Monday, May 27th

GU Zhan (Sam) 1:26 PM

@everyone the exam venue might be very cold, bring a jacket if possible.

1

+ Message #general @ 😊

It takes us to a window where Apps could be searched

The screenshot shows the Slack interface with the title bar "Slack - mtech2019pt". On the left, there's a sidebar with icons for "n" (Ctrl+1), "m" (Ctrl+2), and a plus sign. The main area has a dark header with the text "Manage apps...". Below it, the title "Browse Apps" is displayed in large bold letters, with a "View App Directory" button to its right. A search bar contains the placeholder "Search by name or category (e.g. productivity, sales)". A callout box in the center says "Upgrade for unlimited apps" and notes that the team is using 6 apps. It includes a "Learn more" link and a visual representation of 6 apps (Google Sheets, Google Drive, Google Sheets, Google Sheets, Google Sheets, Google Sheets) followed by a series of dashed boxes. At the bottom, a section titled "In your workspace (6)" is shown.

We input ‘Stanley’ in the search area, ‘stanleyisschatbot2’ appears as a result.

This screenshot shows the same Slack interface as above, but with the search bar containing the text "stanley". The search results section at the bottom now displays one result: "stanleyisschatbot2" with a small blue and green icon. To the right of the result is a yellow "View" button.

We click on ‘view’, and the ‘stanleychatbot2’ is added in the ‘Apps’ section of the workspace

The screenshot shows a Slack interface. On the left is a sidebar with the user's name 'mtech2019pt' and a dropdown arrow. Below it are sections for 'Threads', 'Channels' (including '# general' and '# random'), '+ Add a channel', 'Direct Messages' (listing users like Slackbot, Rahul, DongBin, Gary, etc.), '+ Invite people', and 'Apps' (with 'stanleyisschatbot2' listed). The main area shows a conversation with 'stanleyisschatbot2'. The bot has a blue icon and the name 'stanleyisschatbot2' with a star. It says 'Sorry, I didn't get that. Can you rephrase?'. A user 'Rahul' replies 'hello'. The bot responds with a long message introducing itself as the NUS Institute of System Science Bot, capable of helping prospective students, current students, faculty, and collaborators. It asks which user type Rahul is. Rahul replies 'prospective'. The bot welcomes him as a prospective student and asks how it can help. Rahul then says 'machine learning'. The bot replies that it doesn't understand this user type and lists its serving user types: Prospect, Student, Teachers, others (recruiters, collaborators). At the bottom, there's a message input field with '+', 'Message stanleyisschatbot2', '@', and a smiley face icon.

After this the user is free to start interacting with the chatbot via slack interface

Chatbot performance

The chatbot is always live and responds immediately to the queries. Below are two sample sessions with the chatbot from Dialogflow interface, similar results are obtained on conversing with bot via Slack or Google assistant

Scenario 1

The first utterance from user is ‘Hi’

The screenshot shows the Dialogflow interface with a conversation log. At the top, there is a text input field with a microphone icon and a blue 'Try it now' button. Below this, the word 'Agent' is displayed in blue. The conversation log is divided into two sections: 'USER SAYS' and 'Agent' (the bot's response). In the 'USER SAYS' section, the user has typed 'Hi'. In the 'Agent' section, the bot has responded with a welcome message: 'Hi There! welcome to the National University of Singapore (NUS) Institute of System Science (ISS) Bot. I can help you with information about NUS-ISS. I can converse in English only-thanks for your understanding. At present, I serve following user types - Prospective student, current student, Faculty, collaborators (industry, research, contractor). Which of the above user type you are?'. Below the conversation log, there are sections for 'CONTEXTS' (containing 'gotousercontext') and 'RESET CONTEXTS'. Further down, there are sections for 'INTENT' (labeled 'Default Welcome Intent') and 'ACTION' (labeled 'input.welcome').

Lets take example where user is a ‘prospective student’ and states so

USER SAYS [COPY CURL](#)
prospective student

 DEFAULT RESPONSE ▾

Welcome prospective student . Your assigned user type is "Prospective Student". How can I help you today?

CONTEXTS [RESET CONTEXTS](#)
awaiting_usertype defined_usertype
gotousercontext

INTENT
 [GetUserTypeIntent](#)

The bot responds with welcoming the prospective student, and assigns him usertype as “Prospective Student”

next question from user is about AI course as below, the bot responds with a list of courses related to AI as below

USER SAYS [COPY CURL](#)
tell me a about AI?

 DEFAULT RESPONSE ▾

Prospective Student the related courses for Artificial Intelligence are the following: Robotic Systems Vision Systems Machine Reasoning Intelligent Sensing And Sense Making Problem Solving Using Pattern Recognition Pattern Recognition And Machine Learning Systems Reasoning Systems Spatial Reasoning From Sensor Data

Scenario 2

Now we look at another scenario where the user belong to user profile 'Faculty'

USER SAYS

lecturer

COPY CURL



DEFAULT RESPONSE ▾
Welcome lecturer . Your assigned user type is
"Faculty". How can I help you today?

CONTEXTS

RESET CONTEXTS

awaiting_usertype

defined_usertype

gotousercontext

INTENT

[GetUserTypeIntent](#)

ACTION

Not available

PARAMETER

VALUE

UserType

Faculty

The user asks about ISS

Agent

USER SAYS

COPY CURL

tell me about ISS?

DEFAULT RESPONSE ▾

hi Faculty. ISS stands for Institute of System Studies. More information can be had at <https://www.iss.nus.edu.sg/about-us/director-ceo's-welcome>

CONTEXTS

RESET CONTEXTS

defined_usertype

gotousercontext

awaiting_usertype

INTENT

WhatisISS?

The user enquires “Why iSS”

Agent

USER SAYS

Why should i do ISS?

COPY CURL

DEFAULT RESPONSE ▾

Hi Faculty. Please find information at
<https://www.iss.nus.edu.sg/about-us/why-NUS-ISS>

CONTEXTS

RESET CONTEXTS

defined_usertype

gotousercontext

awaiting_usertype

INTENT

WhyNUSISS

The user enquires further about degree programs at ISS, bot responds with relevant information

Agent

USER SAYS

COPY CURL

tell me about degree program at ISS?



DEFAULT RESPONSE



ISS offers 6. The name of the Masters Programs are Graduate Diploma In Systems Analysis, Master Of Technology In Enterprise Business Analytics, Master Of Technology In Digital Leadership, Master Of Technology In Knowledge Engineering, Master Of Technology In Intelligent Systems, Master Of Technology In Software Engineering. Which Masters Programs would you want to know about?

CONTEXTS

RESET CONTEXTS

defined_usertype

define_masterspgm

define_programs_iss

gotousercontext

INTENT

MastersProgramsListing

Next user enquires about stackable programs at ISS, the intent ‘StackablePgm’ kicks in

Agent

USER SAYS

[COPY CURL](#)

tell me about stackable program at ISS?



DEFAULT RESPONSE



ISS offers 4. The name of the Stackable Programs are Stackable Certificate Programme in Data Science, Stackable Certificate Programmes in Digital Solutions Development, Stackable Certificate Programme in Artificial Intelligence, Stackable Certificate Programme in Smart Systems & Platforms. Which Stackable Programs would you want to know about?

CONTEXTS

[RESET CONTEXTS](#)

defined_usertype

define_programs_iss

define_masterspgm

INTENT

StackablePgm

The user requests more information on ‘Software Engineering’ degree program

USER SAYS

COPY CURL

tell me about Software engineering



DEFAULT RESPONSE



Faculty the related courses for Master Of Technology In Software Engineering are the following: Cloud Native Solution Design Architecting Software Solutions DevOps Engineering and Automation Platform Engineering Architecting IoT Solutions Designing Intelligent Edge Computing Humanizing Smart Systems Strategic Product Manager Service Design Digital Product Strategy Architecting Platforms as a Business Information Architecture for Data-driven Insights Big Data Engineering for Analytics Architecting Systems for Real-Time data processing (ISC)2 CISSP CBK Training Seminar Design Secure Mobile Architecture Platform Security Secure Software Development Lifecycle for Agile

Text Response

CONTEXTS

RESET CONTEXTS

defined_usertype

define_programs_iss

define_masterspgm

INTENT

MastersProgramModuleListing

Next the user requests more information on Data Science related courses

Agent

USER SAYS

COPY CURL

tell me about DS?



DEFAULT RESPONSE ▾

Faculty the related courses for Data Science are the following:
New Media And Sentiment Mining
New Text Processing Using Machine Learning
Nicf Text Analytics (sf) Nicf Data Analytics
Process And Best Practice (sf) Nicf
Recommender Systems (sf) New Media And
Sentiment Mining New Text Processing Using
Machine Learning Nicf Health Analytics (sf) Nicf
Advanced Customer Analytics (sf) Nicf Big Data
Engineering For Analytics (sf) Nicf Customer
Analytics (sf) Nicf Web Analytics Seo (sf) Nicf
Data Storytelling (sf) Nicf Managing Business
Analytics Projects (sf) Nicf Predictive Analytics
Insights Of Trends And Irregularities (sf) Nicf
Statistics Bootcamp (sf) Nicf Statistics For
Business (sf) Nicf Social Media Analytics (sf)
Nicf Service Analytics (sf) Nicf Text Analytics (sf)
Nicf Data Driven Decision Making (sf) Nicf Data
Governance Protection (sf) Nicf Feature
Engineering And Analytics Using Iot Data (sf)
Nicf Campaign Analytics (sf) Nicf Web Analytics
Seo (sf) Nicf Social Media Analytics (sf) Nicf
Managing Business Analytics Projects (sf) Nicf
Data Driven Decision Making (sf) Nicf Data
Governance Protection (sf) Nicf Big Data
Engineering For Analytics (sf)

User asks about AI courses

Agent

USER SAYS

tell me about AI?

COPY CURL

 DEFAULT RESPONSE ▾

Faculty the related courses for Artificial Intelligence are the following: Robotic Systems Vision Systems Machine Reasoning Intelligent Sensing And Sense Making Problem Solving Using Pattern Recognition Pattern Recognition And Machine Learning Systems Reasoning Systems Spatial Reasoning From Sensor Data

CONTEXTS

RESET CONTEXTS

defined_usertype

define_programs_iss

define_masterspgm

INTENT

execprogmodulelisting

The user asks about Practice Chiefs

Agent

USER SAYS

tell me practice chiefs

COPY CURL

DEFAULT RESPONSE

For Practice Chiefs. The staff names are Daniel BOEY , GOH Boon Nam, LIM Wee Khee, TAN Peng Wei. Which staff would you want to know about?

CONTEXTS

RESET CONTEXTS

defined_usertype

define_masterspgm

define_programs_iss

INTENT

StaffListingbyCategory

The user enquires about COE members

Agent

USER SAYS

tell me CoE members

COPY CURL

 DEFAULT RESPONSE ▾

For Centres Of Excellence. The staff names are
Ashok Kumar SEETHARAMAN, Tamsin Emma
Maria GREULICH-SMITH, Brian NG, Debashis
TARAFDAR , HOE Siu Loon, KOH Wai Kin,
Matthew CHUA , Sean HOANG. Which staff
would you want to know about?

CONTEXTS

RESET CONTEXTS

defined_usertype

define_programs_iss

define_masterspgm

INTENT

StaffListingbyCategory

ACTION

The user asks about particular lecturer, the bot responds with correct profile from its database

USER SAYS

COPY CURL

tell me about gu zhan?



DEFAULT RESPONSE ▾

gu zhan's profile is this: GU Zhan (Sam) lectures Master of Technology programme in the areas of data science, machine intelligence, soft computing, and applied deep learning. Prior to joining ISS, he was in New Zealand running Kudos Data start-up, which focussed on training programs to democratize artificial intelligence and machine learning. Before that, he was a data scientist in Yokogawa Engineering, leading industrial innovation initiatives. Sam had also spent many years in financial sector wearing versatile hats: project manager, consultant, and business analyst in Barclays bank, system manager and senior software engineer at Citibank, leading to experience in actualizing information technology values in complex business environment. He devotes himself into pedagogy, and is very passionate in inspiring next generation of artificial intelligence lovers and leaders.

CONTEXTS

RESET CONTEXTS

defined_usertype

INTENT

lecturerinfo

The user enquires about another lecturer, the bot responds correctly

USER SAYS

COPY CURL

tell me about chan meng?

 DEFAULT RESPONSE ▾

chan meng's profile is this: Mr Khoong Chan Meng brings 30 years of international experience in the information and communication technology industry. Chan Meng is driving NUS-ISS to develop and inspire the next generation of digital talent through education, applied research and consulting services. He has transformed NUS-ISS with a vision and strategy focused on delivering impact to the industry and aligned to the national agendas of SkillsFuture, the Smart Nation and the Future Economy. Under Chan Meng's leadership, NUS-ISS has implemented a unique portfolio of multiple learning pathways, with a wide spectrum of programmes in critical industry disciplines such as software development, data science, artificial intelligence, cyber security, smart health, digital government and digital innovation. He recently led the development of the ISS2025 blueprint, which will propel the institute to new heights as the beacon of an industry that is always learning and always leading. Prior to joining ISS, Chan Meng was the Group Chief Information Officer (CIO) of RGE, a multi-national group of companies in the natural resources based manufacturing industry. He oversaw investments on IT and IT-enabled shared services across the RGE group, which has a combined workforce of 50,000 employees worldwide. He drove IT planning and governance,

The user finishes the chat, and gives indication of exit. The bot picks that up correctly

Agent

USER SAYS

bye

COPY CURL

DEFAULT RESPONSE ▾

thanks for using Stanley chatbot. Hope you got
the information you were looking. Have a good
day!

CONTEXTS

RESET CONTEXTS

gotousercontext

awaiting_usertype

INTENT

byebye

Project Critical Analysis

Functionality and system short comings, pending issues

- The bot only looks at partial names and returns the first match. it is currently unable to match full names
- Who, what , when, where adverbs are not interpreted and bot only looks at the adverbs. Probably Google Dialog flow limitation
- On providing non trained input the bot picks only first word of the phrase. e.g. Singapore armed forces.. picks only singapore, but it encounters trained phrases it picks up complete trained phrase. e.g - data storytelling

Future Project Enhancements

Scope & Functional Enhancements

- One enhancement would be to connect it to the ISS Webpage via an application window. This would allow users of the ISS Webpage to interact with the Chatbot.
- More questions and intents could be added to make the bot cover more scenarios.

Technical Enhancements

- Understanding how to provide API calls to DialogFlow for the purposes of connecting the ChatBot to the ISS Webpage.
- Increase training corpus for intent detection and providing test cases to ensure quality of ChatBot.
- Consider other methods instead of merely returning the default fallback intent when an intent is not recognised by DialogFlow. An example method would be using cosine similarity to return text in the database which is similar to the requested text.

References

[Ref 1]: Dialogflow | Heroku | BeautifulSoup - Documentation and References

<https://dialogflow.com/docs>

<https://devcenter.heroku.com/categories/reference>

<https://www.crummy.com/software/BeautifulSoup/bs4/doc/>

[Ref 2]: How to build a Google Home App with Dialogflow | Overview

<https://medium.com/swlh/chapter-6-how-to-build-a-google-home-app-with-dialogflow-overview-4549d92d8d6a>

[Ref 3]: How does scrapy compare to beautifulsoup

<http://doc.scrapy.org/en/latest/faq.html#how-does-scrapy-compare-to-beautifulsoup-or-lxml>

Appendices

Appendix A - Details of all defined Intents

Below is the list of Intents

1. Default Welcome Intent
 - a. O/P context: gotousercontext
2. GetUserTypeIntent
 - b. i/p context: gotousercontext
 - c. o/p context: awaiting usertype, defined usertype, gotousercontext
 - d. Entity : UserType (student, teacher etc. **actionableentity**)
3. WhatisISS
 - e. i/p context: defined usertype,
 - f. o/p context: defined usertype,
 - g. Entity: none
4. WhyNUSISS
 - h. i/p context: defined usertype,
 - i. o/p context: defined usertype,
 - j. Entity: none
5. ProgramsatISS
 - k. i/p context: defined usertype,
 - l. o/p context: defined usertype, define program iss
 - m. Entity: ProgISS - different ways of asking programs at ISS. **Non- actionable (capture only variations)**
6. MastersProgramsListing
 - n. i/p context: defined usertype,
 - o. o/p context: defined usertype, define master program
 - p. Entity: mastersdegree program - different ways of asking. **Non-actionable (capture only variations)**
7. ExecProgramlisting
 - q. i/p context: define program iss, define user type
 - r. o/p context: define program iss, defined usertype

- s. Entity: exec pgm - different ways of asking. Non-actionable (capture only variations)

8. SkillbasedCourseListing

- t. i/p context: defined usertype, define program iss
- u. o/p context: defined usertype, define program iss
- v. Entity : skill course listing. IOT, security etc. actionableentity

9. StackablePgm

- w. i/p context: defined usertype, define program iss
- x. o/p context: defined usertype, define program iss
- y. Entity: stackable - different ways of asking. Non-actionable (capture only variations)

10. MastersProgramModuleListing

- z. i/p context: defined usertype, define program iss, define master program
- aa. o/p context: defined usertype, define program iss, define master program
- bb. Entity: MastersProgramModulelisting: Entity : e.g. SE/EBA/IS etc. actionable

11. ExecProgramModuleListing (working)

- cc. i/p context: defined usertype, define program iss, define master program
- dd. o/p context: defined usertype, define program iss, define master program
- ee. Entity: execprogmodulelisting: Entity : e.g. DS/AI etc. actionable

12. StackableProgramModuleListing

- ff. i/p context: defined usertype, define program iss, define master program
- gg. o/p context: defined usertype, define program iss, define master program
- hh. Entity:stackableprogrammodulelisting: Entity : e.g. Stackable Certificate Programme in Smart Systems & Platforms etc. actionable

13. Feesprogrammoduledegree

- ii. i/p context: define user type
- jj. o/p context: defined usertype, fees program module followup, grants financing
- kk. Entity:
 - i. fees - different ways of asking. Non-actionable (capture only variations),
 - ii. proctype (masters, exec etc actionable),
 - iii. MastersProgramModulelisting: Entity : e.g. SE/EBA/IS etc. actionable
 - iv. ExecProgmodulelisting: Entity : e.g. DS/AI etc. actionable
 - v. StackableProgrammodulelisting: Entity : e.g. Stackable Certificate Programme in Smart Systems & Platforms etc. actionable

grants-financing-programmoduledegree

- ll. i/p context:
- mm. o/p context: grants financing
- nn. Entity:
 - i. grantsandfinancing- grants or financing - different ways of asking. -
actionable (capture action for grant/financing),
 - ii. progtpe (masters, exec etc **actionable**),
 - iii. MastersProgramModulelisting: Entity : e.g. SE/EBA/IS etc. **actionable**
 - iv. ExecProgmodulelisting: Entity : e.g. DS/AI etc. **actionable**
 - v. StackableProgrammodulelisting: Entity : e.g. Stackable Certificate Programme in Smart Systems & Platforms etc. **actionable**

14. app-enroll-programmoduledegree

- oo. i/p context:
- pp. o/p context:
- qq. Entity:
 - i. appenroltime (different ways of phrasing, app and enrol **actionable**)
 - ii. progtpe (masters, exec etc **actionable**),
 - iii. MastersProgramModulelisting: Entity : e.g. SE/EBA/IS etc. **actionable**
 - iv. ExecProgmodulelisting: Entity : e.g. DS/AI etc. **actionable**
 - v. StackableProgrammodulelisting: Entity : e.g. Stackable Certificate Programme in Smart Systems & Platforms etc. **actionable**

15. StaffListingbyCategory: List of lecturer by category (category cleaned used)

- a. i/p context: defined user type
- b. o/p context:
- c. Entity: StaffCategory e.g. teachers, adjunct staff etc **actionable**

16. Lecturerinfo:

- i/p context:
- a. o/p context:
 - b. Entity:
 - i. StaffCategory: **actionable**
 - ii. @sys.given-name: : **actionable**
 - iii. @sys.last-name: **actionable**

17. ModuleDetailing

- a. i/p context: defined user type
- b. o/p context:
- c. Entity:
 - i. module: non-actionable... but is the identifier for intent selection between competing intents, e.g. lecturer info!
 - ii. @sys.any: : **actionable** .. captures the phrase for parsing and matching in backend