MASTER OF TECHNOLOGY MR-RS PROJECT

ISS RECOMMENDATION SYSTEM

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1.EXECUTIVE SUMMARY

Singapore, as a nation, has been emerging as one of the smartest on Earth. The rapid advancements in digital technologies and the unfolding digital revolution has changed the way its inmates live work and play. The economy of Singapore is looking forward for more digital innovation techniques which can be incorporated in all the sectors in order to enhance itself. As mentioned in smartnation.sg few of the notable projects undertaken are as follows: Personal alert button trials, SGQR payment standards, use of bank cards for public transport, payment services bill, etc.,

As reported by Straitstimes[2], there were three major issues prevailing in this country as addressed by the Prime minister. One amongst them being handling big data to provide better public services. He also added that the aim of this nation is to have a digitally literate society for competing with the emerging cashless countries. Therefore, it is important to enhance the skills of people who are employed in the digital and the IT sector in order to achieve this goal.

"By using IT for practical applications, big and small, we can improve our lives, and make this a fun and happening place."

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-as stated by PM Lee Hseing Loong. Source: channelnewsasia.[3]

The Institute of System Sciences at the National University of Singapore targets in developing Information technology and Communication leaders that drive business and organisation innovation. It offers a wide variety of programmes suitable for employed people who wish to sharpen their skills in data science, artificial intelligence, cybersecurity etc., Working people can gain knowledge and at the same time earn Professional Development Units (PDU) and showcase their skills in the digital industry.

The "ISS-Course Recommender" project intends to cater the appropriate course for its user based on the details specified in their resume and the proficiency which they wish to inculcate in themselves. The system consists of a user interface in the form of a web page which encourages users to enter their resumes. Additionally, it also provides them with an application form wherein they can mention their details and their known and interested skills. The page then takes them through the main list of programmes available at ISS [5] and asks the user to choose from. Once the user has made the selection, it puts forward a list of sub programmes and its description. Once the necessary choices are picked up, the user is acknowledged with the schedule of the selected course.

2.PROBLEM STATEMENT:

The executive education programs offered by NUS-ISS consists of twelve major disciplines and each of them contains about ten to fifteen sub courses. Therefore, it becomes difficult for the higher education aspirants to read through every course and select. He/she might feel bombarded with the large list of courses after a busy working day. They also consider the learning outcomes which can increase their potential in their workplace. Hence the need to devise a course recommender system arose. This system can make the life of candidates easy by handing them over the befitting courses.

"ISS -Course recommender "is designed in such a way that it put forward an interactive web application for its users to hand in their resumes and leave it to the system to select an appropriate program based on their skills. Alternatively, it also furnishes a form where in the users can manually enter their details and their capabilities and get information about the relevant course. After specifying all the choices, the user gets facts about the befitting higher education course and its schedule.

2.1PROBLEM OBJECTIVE:

The project "ISS -course recommender" proposes a user -friendly web application for its customer to specify their competences and expertise and visualize the relevant courses that they can study and hone their abilities in their respective industry. The schedule and fee structure are also mentioned for the end user to decide upon the exact selection they wish to exercise.

The system makes use of the data provided under the executive education program list provided by the NUS-ISS. It is then stored in a data base which consists of attributes such as course names, its prerequisites, learning outcomes, the designation ideal for, its schedule and fee structure. The database is then used to assign rules for each course based on the prerequisites using drools which is tool present in java business process management. The similarity in the prerequisites and the course names are identified using the association rules algorithm. The web application is created using tools such as HTML, CSS and java script which triggers the end users to enter their resume or fill in a form. The data is then parsed from the specifications and used for identifying the prerequisites and match the necessary courses. Optaplanner is used to check the overlapping of two or more courses selected by the user and solved.

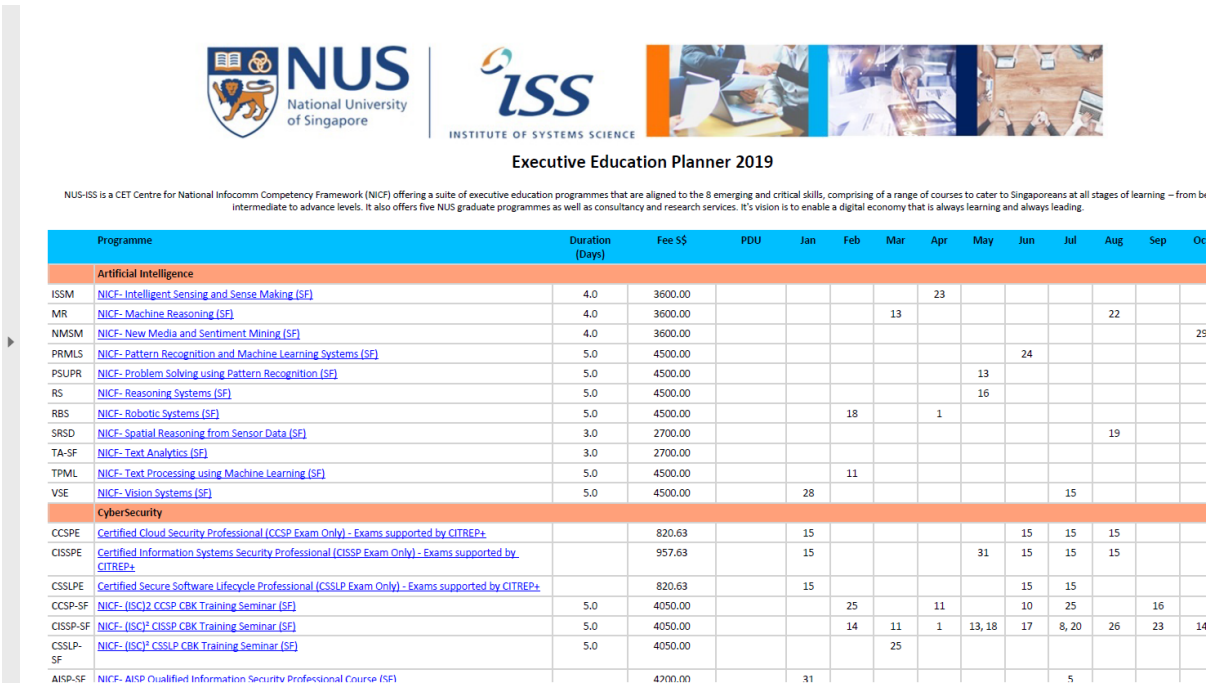
3.KNOWLEDGE MODELLING:

Knowledge modelling can be put down into three major phases:

a) Knowledge identification
b) Knowledge specification
c) Knowledge refinement

3.1. KNOWLEDGE IDENTIFICATION:

The knowledge base for this project is obtained from the webpage of NUS-ISS under the "executive education" tab. This carries the major disciplines available and the sub courses accommodated in it. The data available is downloaded in the form of a pdf file. The file contains links to all the courses provided by ISS. The file is parsed to obtain the necessary details in the form of a data frame using Python. The facts obtained are then stored in an excel file. Libraries such as pyPDF2 for reading the pdf file, beautiful soup and selenium for scraping data from the file and pandas to collect the data frame are being used for this purpose. The data frame consists of details such as "Parent course", "Course name", "Part of"(main category),"course duration", "time", "introduction", "classes", "dates", "take away", "prerequisite/requirement", "topics covered", "self-funded international participants"(fee structure),"self-funded PR/Singaporean", "self-funded with skillsfuture mid-career enhanced subsidy", "self-funded workfare training support", "self-funded International participants", self-funded PR/Singaporean", "company sponsored International participants", "company sponsored PR/Singaporean", "Company sponsored with skillsfuture mid-career enhanced subsidy", "Company Sponsored workfare training support" etc.,. These data frames become the attributes of the excel file.

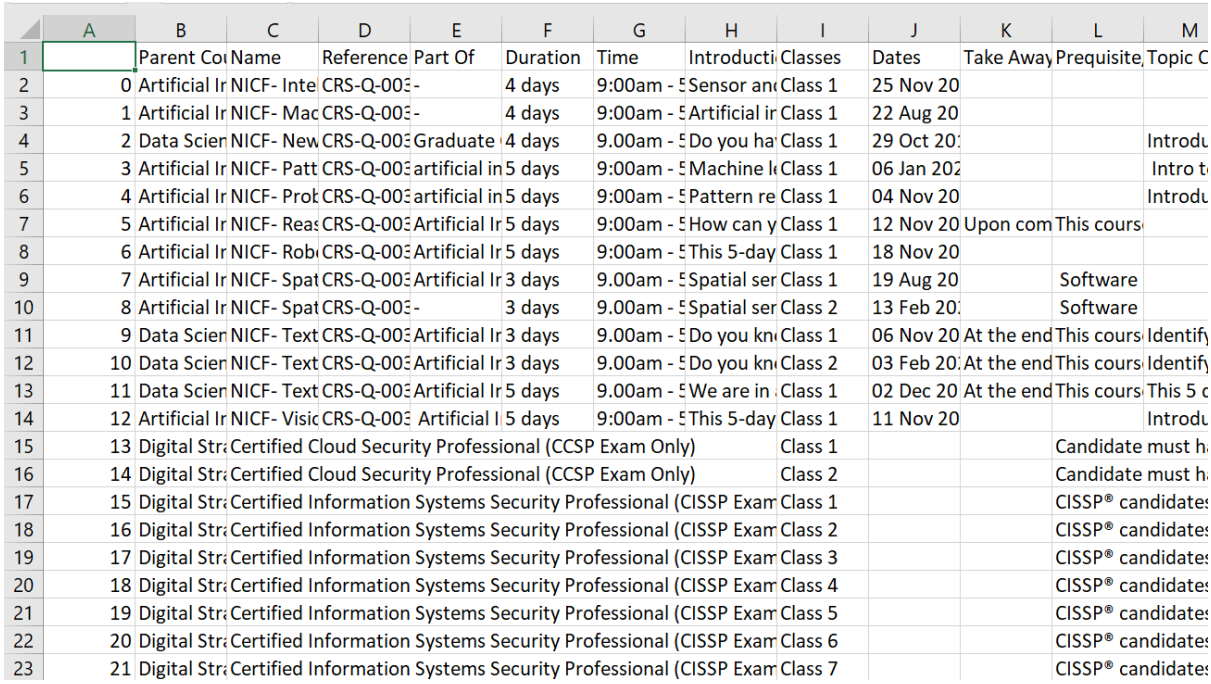


Executive Education Planner 2019

NUS-ISS is a CET Centre for National Infocomm Competency Framework (NICF) offering a suite of executive education programmes that are aligned to the 8 emerging and critical skills, comprising of a range of courses to cater to Singaporeans at all stages of learning – from be intermediate to advance levels. It also offers five NUS graduate programmes as well as consultancy and research services. It's vision is to enable a digital economy that is always learning and always leading.

	Programme	Duration (Days)	Fee S$	PDU	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oc
	Artificial Intelligence													
ISSM	NICF- Intelligent Sensing and Sense Making (SF)	4.0	3600.00					23						
MR	NICF- Machine Reasoning (SF)	4.0	3600.00				13					22		
NMSM	NICF- New Media and Sentiment Mining (SF)	4.0	3600.00											25
PRMLS	NICF- Pattern Recognition and Machine Learning Systems (SF)	5.0	4500.00							24				
PSUPR	NICF- Problem Solving using Pattern Recognition (SF)	5.0	4500.00						13					
RS	NICF- Reasoning Systems (SF)	5.0	4500.00						16					
RBS	NICF- Robotic Systems (SF)	5.0	4500.00			18		1						
SRSD	NICF- Spatial Reasoning from Sensor Data (SF)	3.0	2700.00									19		
TA-SF	NICF- Text Analytics (SF)	3.0	2700.00											
TPML	NICF- Text Processing using Machine Learning (SF)	5.0	4500.00			11								
VSE	NICF- Vision Systems (SF)	5.0	4500.00		28						15			
	CyberSecurity													
CCSPE	Certified Cloud Security Professional (CCSP Exam Only) - Exams supported by CITREP+		820.63		15					15	15	15		
CISSPE	Certified Information Systems Security Professional (CISSP Exam Only) - Exams supported by CITREP+		957.63		15				31	15	15	15		
CSSLPE	Certified Secure Software Lifecycle Professional (CSSLP Exam Only) - Exams supported by CITREP+		820.63		15					15	15			
CCSP-SF	NICF- (ISC)2 CCSP CBK Training Seminar (SF)	5.0	4050.00			25		11		10	25		16	
CISSP-SF	NICF- (ISC)² CISSP CBK Training Seminar (SF)	5.0	4050.00			14	11	1	13, 18	17	8, 20	26	23	14
CSSLP-SF	NICF- (ISC)² CSSLP CBK Training Seminar (SF)	5.0	4050.00				25							
AISP-SF	NICF- AISP Qualified Information Security Professional Course (SF)		4200.00		31						5			

FIGURE 1: File that contains the list of courses

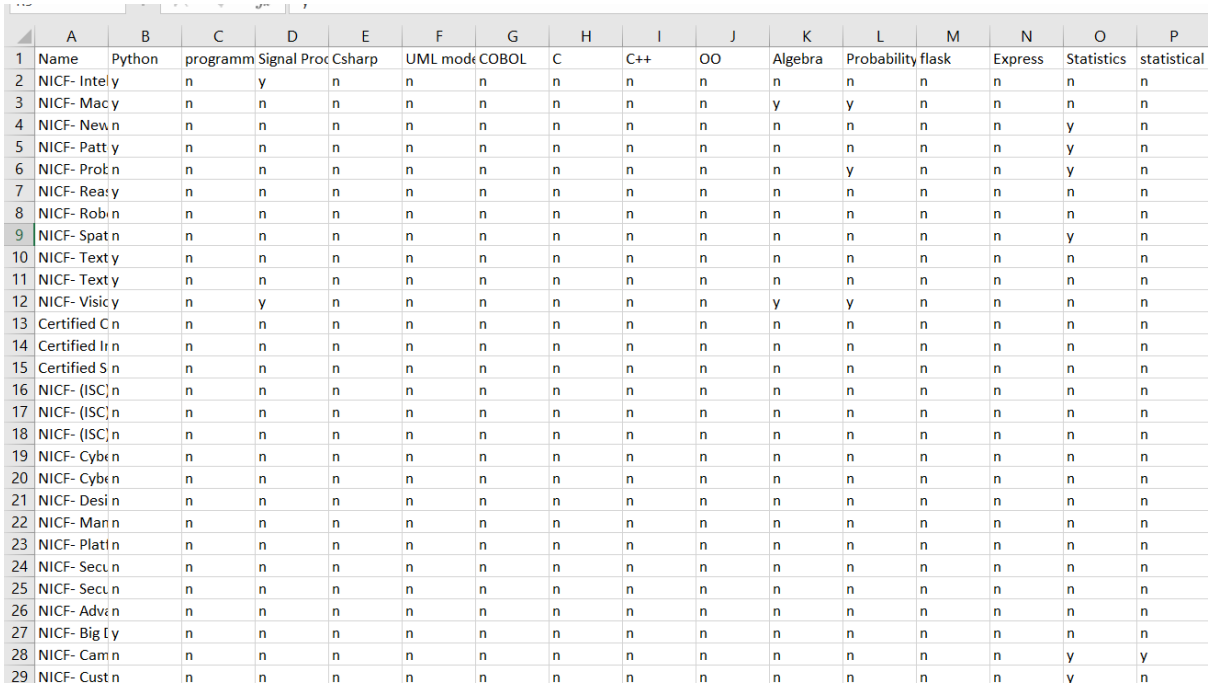


	A	B	C	D	E	F	G	H	I	J	K	L	M
1		Parent Cou	Name	Reference	Part Of	Duration	Time	Introducti	Classes	Dates	Take Away	Prequisite	Topic C
2	0	Artificial Ir	NICF- Inte	CRS-Q-003	-	4 days	9:00am - 5	Sensor an	Class 1	25 Nov 20			
3	1	Artificial Ir	NICF- Mac	CRS-Q-003	-	4 days	9:00am - 5	Artificial ir	Class 1	22 Aug 20			
4	2	Data Scien	NICF- New	CRS-Q-003	Graduate	4 days	9.00am - 5	Do you ha	Class 1	29 Oct 20			Introdu
5	3	Artificial Ir	NICF- Patt	CRS-Q-003	artificial in	5 days	9:00am - 5	Machine l	Class 1	06 Jan 202			Intro t
6	4	Artificial Ir	NICF- Prob	CRS-Q-003	artificial in	5 days	9:00am - 5	Pattern re	Class 1	04 Nov 20			Introdu
7	5	Artificial Ir	NICF- Rea	CRS-Q-003	Artificial Ir	5 days	9:00am - 5	How can y	Class 1	12 Nov 20	Upon com	This cours	
8	6	Artificial Ir	NICF- Rob	CRS-Q-003	Artificial Ir	5 days	9:00am - 5	This 5-day	Class 1	18 Nov 20			
9	7	Artificial Ir	NICF- Spat	CRS-Q-003	Artificial Ir	3 days	9.00am - 5	Spatial ser	Class 1	19 Aug 20		Software	
10	8	Artificial Ir	NICF- Spat	CRS-Q-003	-	3 days	9.00am - 5	Spatial ser	Class 2	13 Feb 20		Software	
11	9	Data Scien	NICF- Text	CRS-Q-003	Artificial Ir	3 days	9.00am - 5	Do you kn	Class 1	06 Nov 20	At the end	This cours	Identify
12	10	Data Scien	NICF- Text	CRS-Q-003	Artificial Ir	3 days	9.00am - 5	Do you kn	Class 2	03 Feb 20	At the end	This cours	Identify
13	11	Data Scien	NICF- Text	CRS-Q-003	Artificial Ir	5 days	9.00am - 5	We are in	Class 1	02 Dec 20	At the end	This cours	This 5 c
14	12	Artificial Ir	NICF- Visic	CRS-Q-003	Artificial I	5 days	9:00am - 5	This 5-day	Class 1	11 Nov 20			Introdu
15	13	Digital Stra	Certified Cloud Security Professional (CCSP Exam Only)						Class 1			Candidate must h	
16	14	Digital Stra	Certified Cloud Security Professional (CCSP Exam Only)						Class 2			Candidate must h	
17	15	Digital Stra	Certified Information Systems Security Professional (CISSP Exam						Class 1			CISSP® candidates	
18	16	Digital Stra	Certified Information Systems Security Professional (CISSP Exam						Class 2			CISSP® candidates	
19	17	Digital Stra	Certified Information Systems Security Professional (CISSP Exam						Class 3			CISSP® candidates	
20	18	Digital Stra	Certified Information Systems Security Professional (CISSP Exam						Class 4			CISSP® candidates	
21	19	Digital Stra	Certified Information Systems Security Professional (CISSP Exam						Class 5			CISSP® candidates	
22	20	Digital Stra	Certified Information Systems Security Professional (CISSP Exam						Class 6			CISSP® candidates	
23	21	Digital Stra	Certified Information Systems Security Professional (CISSP Exam						Class 7			CISSP® candidates	

FIGURE 2: The data frame being stored in an excel file

3.2.KNOWLEDGE SPECIFICATION:

The approach used in this project is to extract the skills specified by the user, match them with the pre-requisites for all the courses and arrive at the exact program that they can learn. The pre-requisite from the previous excel file is saved manually in to a separate excel file and a decision tree is obtained from it which symbolises the rules to be applied for all the subjects. This process is carried out using Orange, an IDE available in python.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Name	Python	programm	Signal Proc	Csharp	UML mode	COBOL	C	C++	OO	Algebra	Probability	flask	Express	Statistics	statistical
2	NICF- Intel	y	n	y	n	n	n	n	n	n	n	n	n	n	n	n
3	NICF- Mac	y	n	n	n	n	n	n	n	n	y	y	n	n	n	n
4	NICF- New	n	n	n	n	n	n	n	n	n	n	n	n	n	y	n
5	NICF- Patt	y	n	n	n	n	n	n	n	n	n	n	n	n	y	n
6	NICF- Prob	n	n	n	n	n	n	n	n	n	n	y	n	n	y	n
7	NICF- Rea	y	n	n	n	n	n	n	n	n	n	n	n	n	n	n
8	NICF- Rob	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
9	NICF- Spat	n	n	n	n	n	n	n	n	n	n	n	n	n	y	n
10	NICF- Text	y	n	n	n	n	n	n	n	n	n	n	n	n	n	n
11	NICF- Text	y	n	n	n	n	n	n	n	n	n	n	n	n	n	n
12	NICF- Visic	y	n	y	n	n	n	n	n	n	y	y	n	n	n	n
13	Certified C	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
14	Certified Ir	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
15	Certified S	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
16	NICF- (ISC)	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
17	NICF- (ISC)	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
18	NICF- (ISC)	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
19	NICF- Cybe	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
20	NICF- Cybe	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
21	NICF- Desi	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
22	NICF- Man	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
23	NICF- Platf	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
24	NICF- Secu	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
25	NICF- Secu	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
26	NICF- Adva	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
27	NICF- Big D	y	n	n	n	n	n	n	n	n	n	n	n	n	n	n
28	NICF- Cam	n	n	n	n	n	n	n	n	n	n	n	n	n	y	y
29	NICF- Cust	n	n	n	n	n	n	n	n	n	n	n	n	n	y	n

FIGURE 3: Copy of the prerequisites file

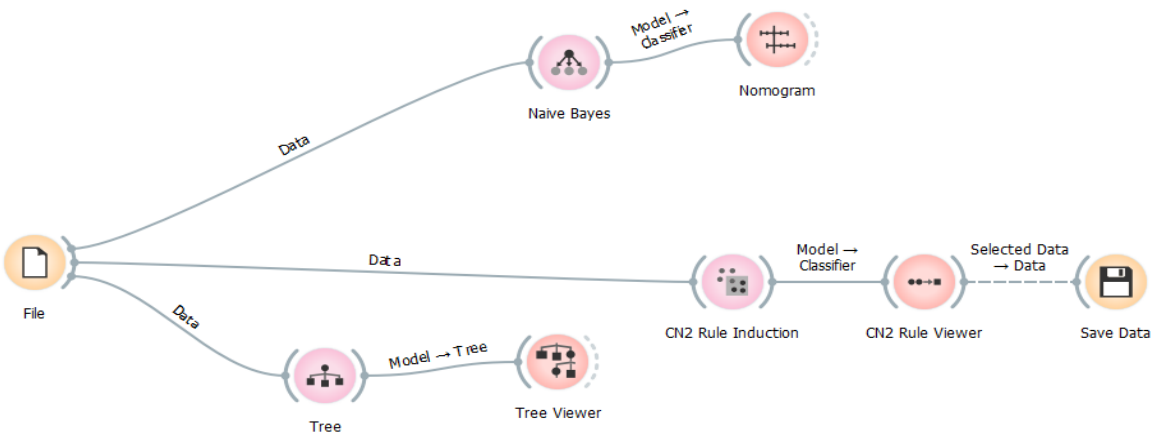


FIGURE 4: Widgets to obtain decision tree

+

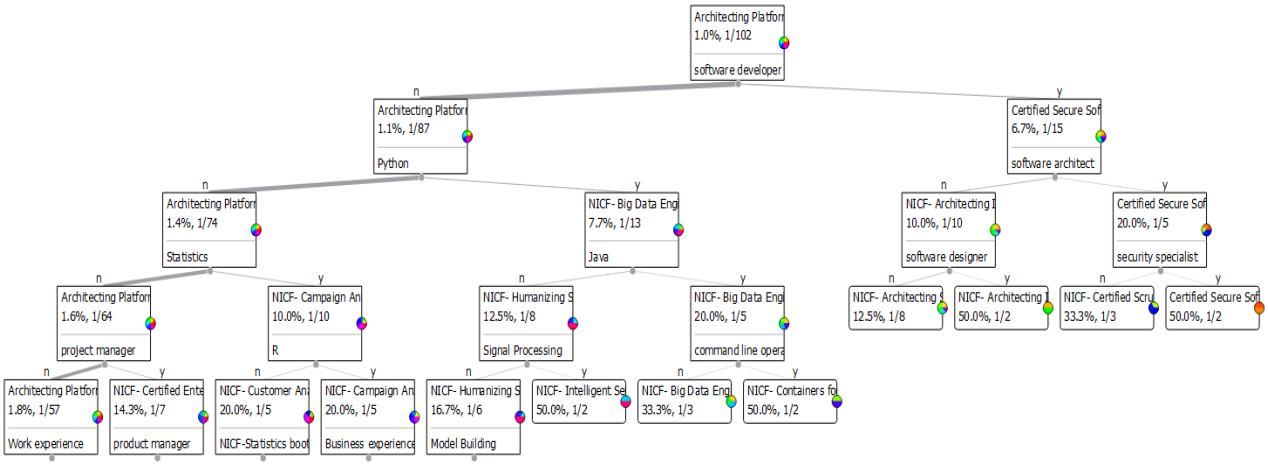


FIGURE 5: Decision tree model obtained from Orange

The excel file as shown in figure 3, contains the pre-requisites as the attributes and the course names as the row variables. The instances are indicated as “yes” or “no” based on the course name and its specific requirements. The “y” instance notifies that a particular skill is essential to participate in the program and the “n” notifies that the skill is not required for this program. This file is used to obtain the decision tree from Orange. Orange is an open source machine learning tool and is also used for data visualisation. This project employs the widget programming method (graphical programming) to arrive at the decision. Firstly, the excel file is bought into picture using the file widget. It is then fed into the tree data modeller and visualised using the decision tree viewer.

In application the knowledge is represented in the form of a relational database structure with below knowledge representation:

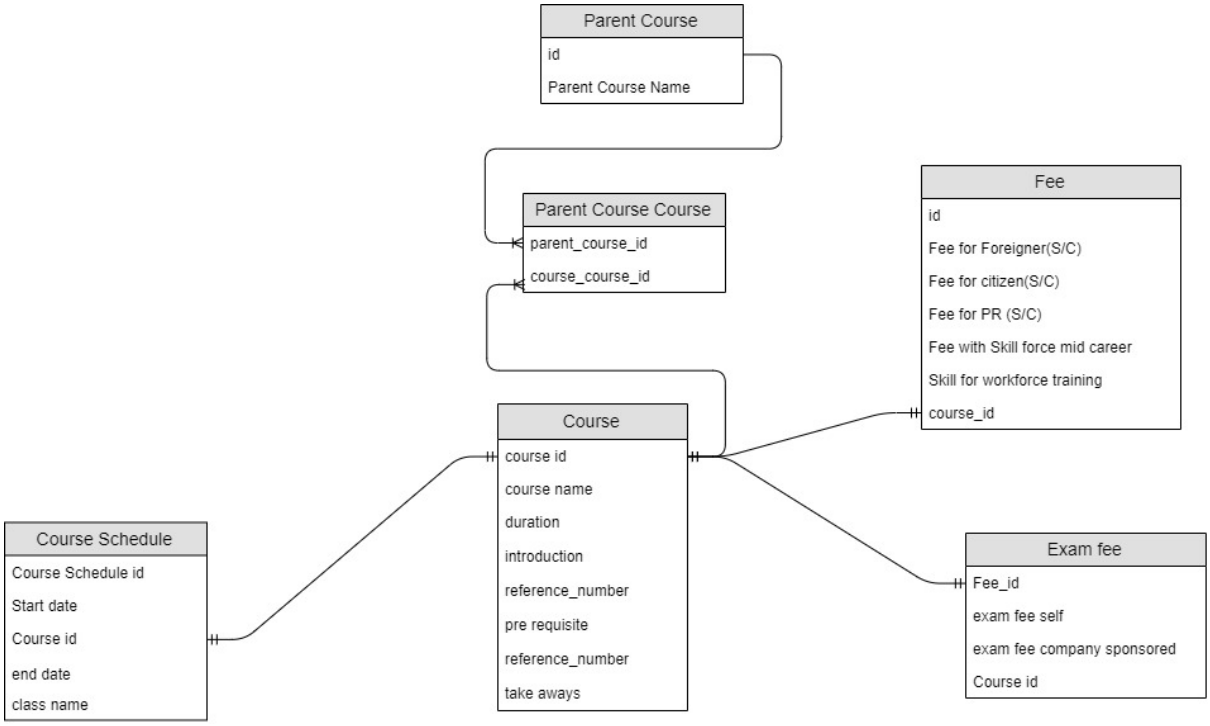


FIGURE 6: Database entity relationship

3.3. KNOWLEDGE REFINEMENT:

This stage involves deriving synonyms for each of the specified prerequisites. This is done to arrive at the exact match of the skills put forth by the end user and the requirements of each program. In this way, the user can be recommended with the best choice. This process is carried out by manually entering the synonyms for all the requirements in an excel file. The associations for the same is derived using apriori. The resumes given by the applicant is converted to a text file using java libraries and is then tokenised using. These tokenised words are then compared to the synonyms which are saved in the form of an array. When match occurs, the skills vector defined is incremented by 1. Based on the skills vector the appropriate skill sets are further derived.

SOLUTIONS:

The solution procedure followed in "ISS COURSE RECOMMENDER" can be put down as follows:

1. The data collected is stored in the form of databases to provide the user with the description of each course, its timing and the fee structure.
2. Building a web application that asks for the candidate's resume or asks them to fill an application form with their details.
3. The skillsets of the applicants are compared to the prerequisites mentioned in each program and they are assigned to the relevant program. This is carried out by defining rules for each of the courses and the similarity is derived using association algorithm.

The tools and programming languages used for this project are HTML, CSS, JavaScript, Java, Spring boot, Orange, python, Eclipse, maven repository, Drools, Optaplanner which are part of the Java business process system (JBPM).

The high-level architecture of the application can be described as below:

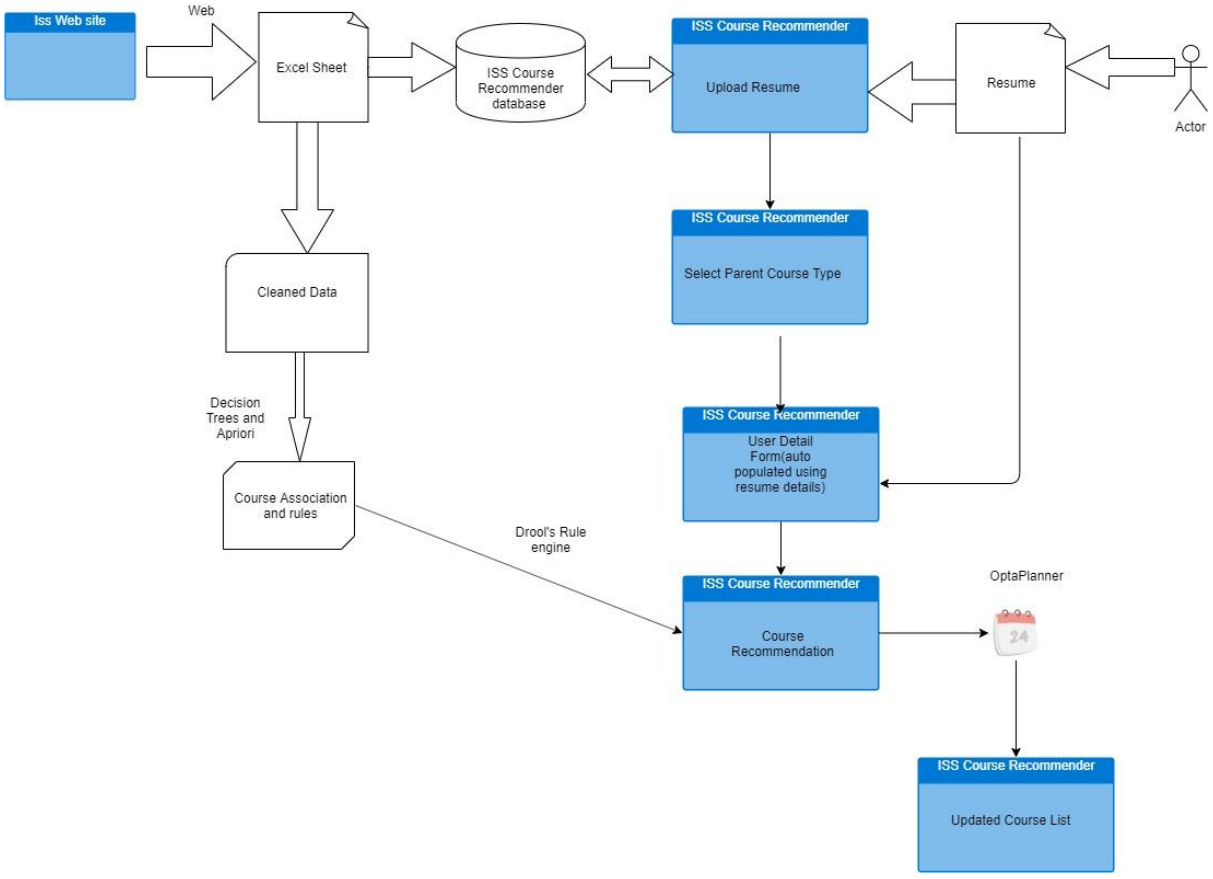


FIGURE 7: Architecture of the system

As mentioned earlier, all the data required for this project are saved in the form of an excel file. This file is used read the facts about the course, course schedule, fess, exam fees and the major study disciplines offered by ISS. This is done to give a brief explanation about each of the educational program to the applicant as and when they make their choice. The

recommendation process begins by invoking the candidates to hand in their resume in the form of a word file or pdf file. If the user enters a file that is neither a word document nor a pdf file, the application directs them enter a file in any one of these two formats. If the applicant is not interested in providing a resume, then he/she can fill in an application form where they can mention their educational qualifications.

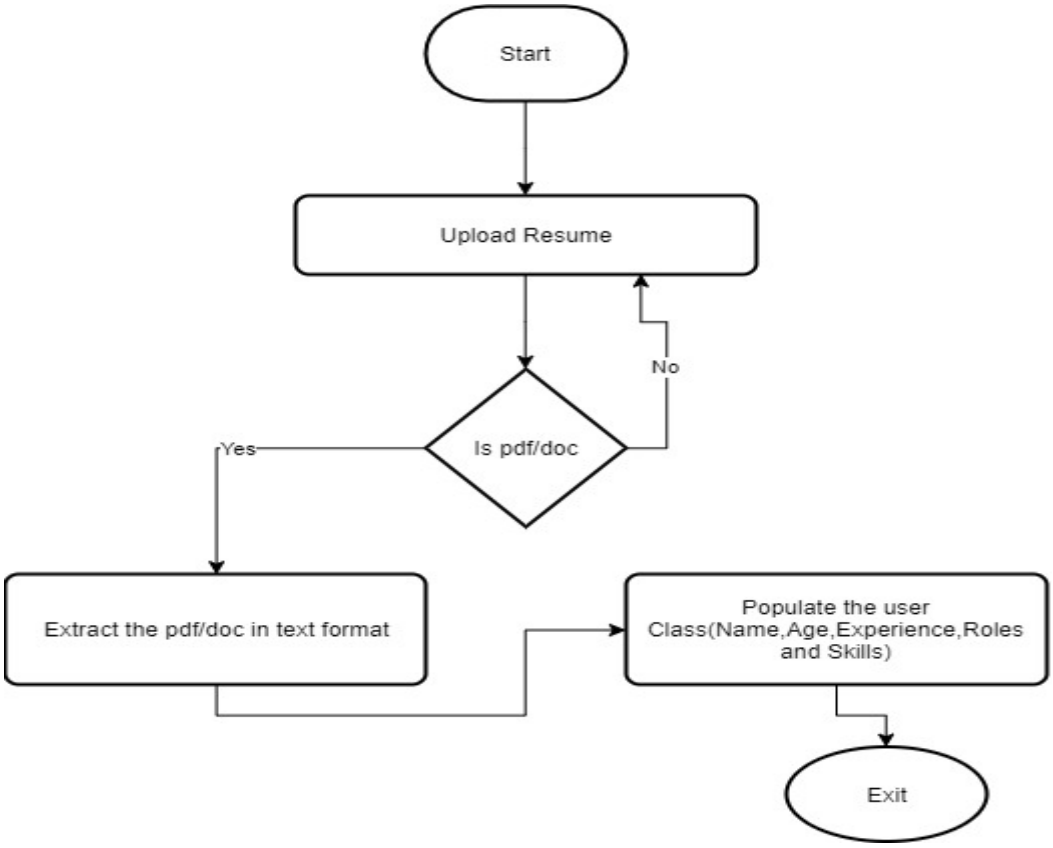


FIGURE 8 : Flow of resume upload

Once the resume is successfully uploaded the data from the resume is extracted. Regular expression and the rules derived from apriori algorithm stated in section 3 is used to extract the rules for the same. The resume parser has following steps:

1. Extract the name of the user: This step assumes that the first text used in any resume is the user's name. This is being derived by going through a larger set of resumes
2. Extract user's email address: The text parser looks for '@' symbol and copies the word associated with the same
3. Extract the user's work experience: This assumes that the work experiences are stated in after 'Experience' letter. The parser checks for the four digit year and extracts 4 years from the same. The difference between the minimum and maximum years as stored as the years of experience.
4. Extract Technical skill: Based on the skill set mentioned and the skills derived from the decision tree and apriori associations the technical skills are matched against the resume and populated against user's technical skills.
5. Extract user's Professional Experience: Based on the skills and description stated in the experience field of the resume the parser tries to approximate the position the user might have been.

Web application is build using tools such as Spring boot, java Script and CSS. It helps in increasing productivity and reduces the development time.

After the resume is uploaded or the personal details are entered by the applicant, the web application takes them through main course page which gives a drop-down menu of all the available major disciplines. Clicking on them exhibits a short description about the study program. In the next step, the application exposes the list of sub courses under the major discipline. The displayed courses are recommended courses based on the user's skillset. The details for the same is explained in user guide.

The scenes behind the recommendation part is carried out using drools and optaplanner." As described by drools.org[18], "Drools is a Business Rules Management System (BRMS). It provides a core Business Rules Engine (BRE), a web authoring and rules management application (Drools Workbench), full runtime support for decision model and notation (DMN) models at conformance level 3 and an eclipse IDE PLUGIN for core development". The drools compiler used in this project is drawn from the maven repository. As specified in maven.apache.org, "Maven's primary goal is to allow a developer to comprehend the complete state of a development effort in the shortest period time. In order to attain this goal, there are several areas of concern that maven attempts to deal with:

1. Making the build process easy.
2. Providing a uniform build system.
3. Providing quality project information.
4. Providing guidelines for best practices development.
5. Allowing transparent migration to new features."

Defining rules in the drools is like prescribing a condition using if and else statements. The advantage of drools is that it can be updated dynamically, and it can also be implemented by any programmer. In this project, the rules are derived from Orange as reported in "knowledge modelling" section. They are written in the format required in drools as "when, then". The java class enforced consists of two variables: one is for the course variable and the other is for the pre-requisites. The rules are materialised in the following form:

courseRecommender.drl | PdfReaderExampleApplication.java

```
1 package com.example.recommender;
2
3 import com.example.demo.parser.userinfo;
4 dialect "java"
5
6 rule "NICF-Vision systems"
7       when
8           u:userinfo(TechnicalSkills.indexOf("vision system")!=-1 && (CareerPath==1 || CareerPath=
9       then
10        u.addCourse(11);
11    end
12
13 rule "NICF- Intelligent Sensing && Sense Making "
14    when
15        u:userinfo(TechnicalSkills.indexOf("signal processing")!=-1 && (CareerPath==1 || CareerPa
16    then
17        u.addCourse(1);
18        end
19
20 rule "NICF-Machine reasoning"
21    when
22        u:userinfo(TechnicalSkills.indexOf("algebra")!=-1 && (CareerPath==1 || CareerPath==10))
23    then
24        u.addCourse(2);
25        end
```

FIGURE 9: Sample drool file

ISS has 103 courses, from the rules derived from steps mentioned in section 3, about 103 rules were derived

As explained in docs.jboss.org[4], Optaplanner is a “light weight, embeddable constraint satisfaction engine which optimises planning problems.” As per the facts provided in optaplanner documentation, the use of cases of it are as follows:”

1. Employee shift rostering
2. Agenda scheduling
3. Educational timetabling
4. Vehicle routing
5. Bin packing
6. Job shop scheduling
7. Cutting stock
8. Sport scheduling
9. Financial optimisation.”

This project involves both soft and hard constraints to be solved. Following hard constraints were derived

1. No two courses start time and end time should collide
2. A course with multiple schedule should only have one class selected while recommendation

The Soft constraints derived were as follows:

1. The course should be arranged in increasing order of the dates.
2. The course recommended should have classes greater than the current date.

For example: If the user chooses to study "NICF-Object Oriented Analysis & Design" and “NICF- Reasoning systems” and both are scheduled on 6th of October 2019, then solver assigns

him/her with the most suited one. The soft constraint is the order in which the courses are to be taken. For instance, the candidate cannot study “"NICF- Feature Extraction and Supervised Modeling with Deep Learning" first and then choose to study “NICF-Python, Data and Ops” because python is an important requirement for the former program.

5.LIMITATIONS:

Although the system can deliver the essential output, it does suffer from few limitations. Firstly, the recommender system is all about courses offered by the institute of system sciences. So, it might or might not satisfy the user's expectation. The database created is based on the prerequisites available in the ISS webpage. Therefore, if the skill specified by an applicant does not match the values provided in the database, it cannot provide the appropriate recommendation. Synonyms derived for the association algorithm could have been extended to few real-life scenarios. The data parsed from the resumes could have been more intuitive. More interactive user interface could have been made.

6.FURTHER ENHANCEMENTS:

Due to the limited amount of time, few ideas could not be incorporated into this project. These opinions are explained in brief in this section. This project can be extended to recommending courses from other popular companies like course-era, edX, Udemy, Udacity etc., Additionally, a link between the user's calendar and the web application can established in order to exactly schedule their study.

7.CONCLUSION:

Overall the team had a wonderful time spent for this project starting from gathering ideas, data collection, data cleaning, building rules, solver and the user interface. Additionally, the scope of learning new techniques was also wide. Firstly, the problem statement of building a course recommender system arose after analyzing the major issues prevailing in Singapore. Next, data collection and cleaning were undertaken. All the data were stored in the form of an excel file and were refined to have the requirements and the synonyms for it in a separate file. Rules were defined using drools for each of the courses and their similarities were derived using association algorithms. The hard constraint of schedule collision was solved using opta planner. The user interface is in the form of a web application that interacts with the applicants to get their resume and skill set. The data from the resume was parsed and matched with the available database. When there is an equivalent found for the user, it displays the recommended study program based on their preferences and skills acquired. Finally, the user gets to know the appropriate higher education program for him/her in order to excel in this digital era .

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9. https://www.iss.nus.edu.sg/executive-education/discipline/detail/data-science

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12. https://www.iss.nus.edu.sg/executive-education/discipline/detail/digital-strategy-leadership
13. https://www.iss.nus.edu.sg/executive-education/discipline/detail/digital-products-platforms
14. https://www.iss.nus.edu.sg/executive-education/discipline/detail/software-systems
15. https://www.iss.nus.edu.sg/executive-education/discipline/detail/stackup---startup-tech-talent-development
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19. https://www.optaplanner.org/
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21. *https://www.w3schools.com/*

9. APPENDIX:

As a part of this project a survey was conducted to analyze people's preferences, their skillsets and their residential status in Singapore. There were about 58 responses recorded from candidates with different educational qualifications, skillsets, higher level courses they wish to study and their residentiary stature. The form was created using Google forms as shown in figure and the details incorporated in the form are as follows:

1. Name
2. Age
3. Residential status in Singapore
4. Domain of work experience
5. Work experience(years)
6. Role in the organization
7. Programming knowledge
8. Skills
9. Domain of interest for further studies
10. Interested courses in Artificial intelligence
11. Interested courses in Cyber security
12. Interested courses in Data science
13. Interested courses in Digital agility
14. Interested courses in digital innovation and design
15. Interested courses in Digital products and platforms
16. Interested courses in digital strategy and leadership
17. Interested courses in Software systems
18. Interested courses in Stack up-Startup Tech talent Development

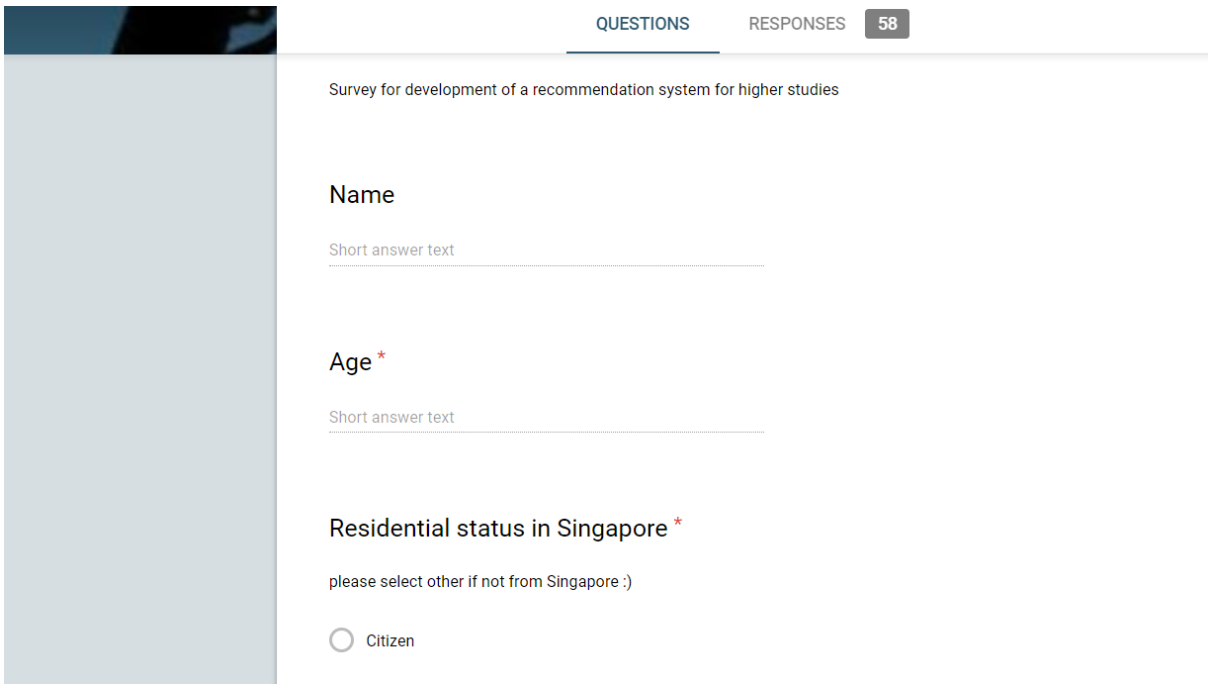

FIGURE 10 : The form

From the kickback earned, the following conclusions were inferred:

AGE:

Most participants belonged to the age group between 23 and 30. Meagre number of partakers were found to be between the age group of above 30. Less than 2 percent of participants were observed to be of age above 50. The following figure shows a histogram distribution of the age of all applicants.

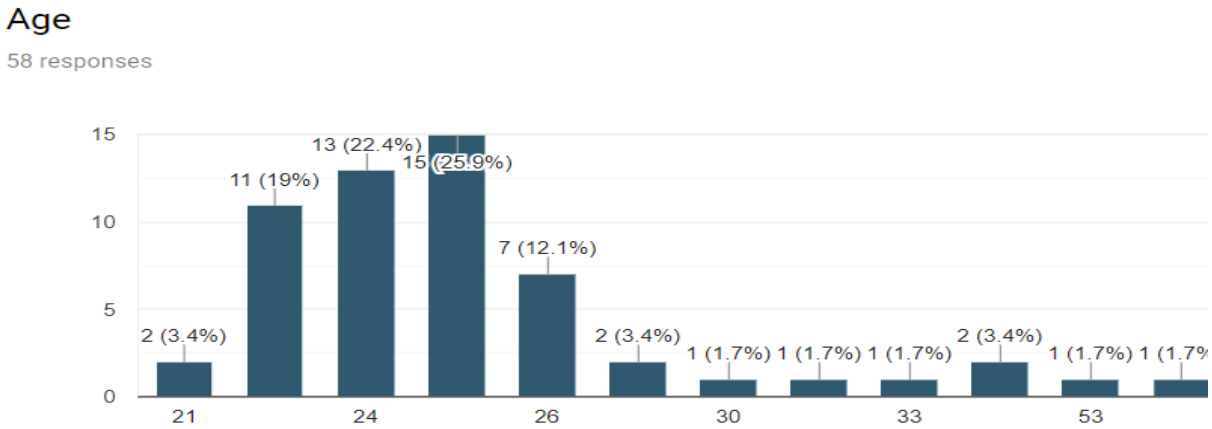

FIGURE 11 : Histogram distribution of age

RESIDENTIAL STATUS IN SINGAPORE:

From the observations captured, majority of the participants constituted to be foreigners residing in Singapore. Amongst all the participants their count accounts to about 98.3 percent.

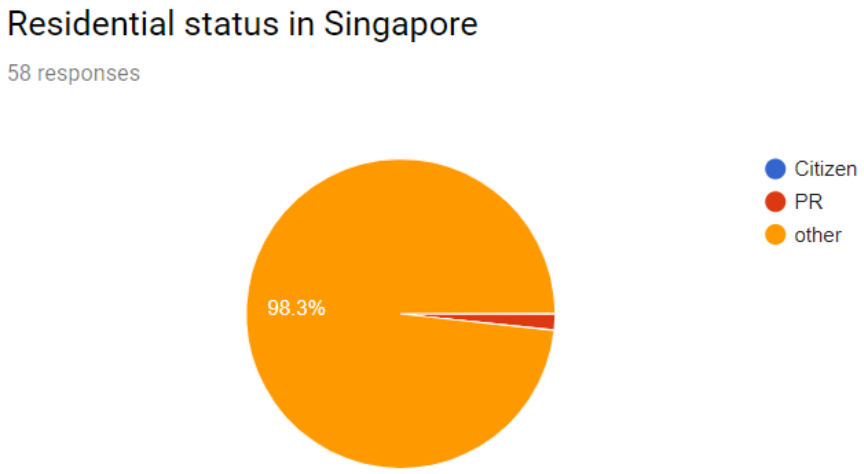

FIGURE 12 : Pie chart of residential status

DOMAIN OF WORK EXPERIENCE:

People working /have worked previously in the following domains have participated:

1. Airfield
2. Data Analytics
3. Automotive industry

4. Banking
5. Business intelligence
6. Computer vision
7. Robotics
8. Industrial automation
9. Embedded systems engineer
10. Finance and commercial
11. Firmware
12. Functional testing
13. Information technology
14. Media and entertainment
15. Network management
16. SAP Basis
17. Sales and marketing
18. Software engineer
19. Strategy Consultation

A greater number of participants have worked in the information technology department. The histogram distribution of the same is exhibited below:

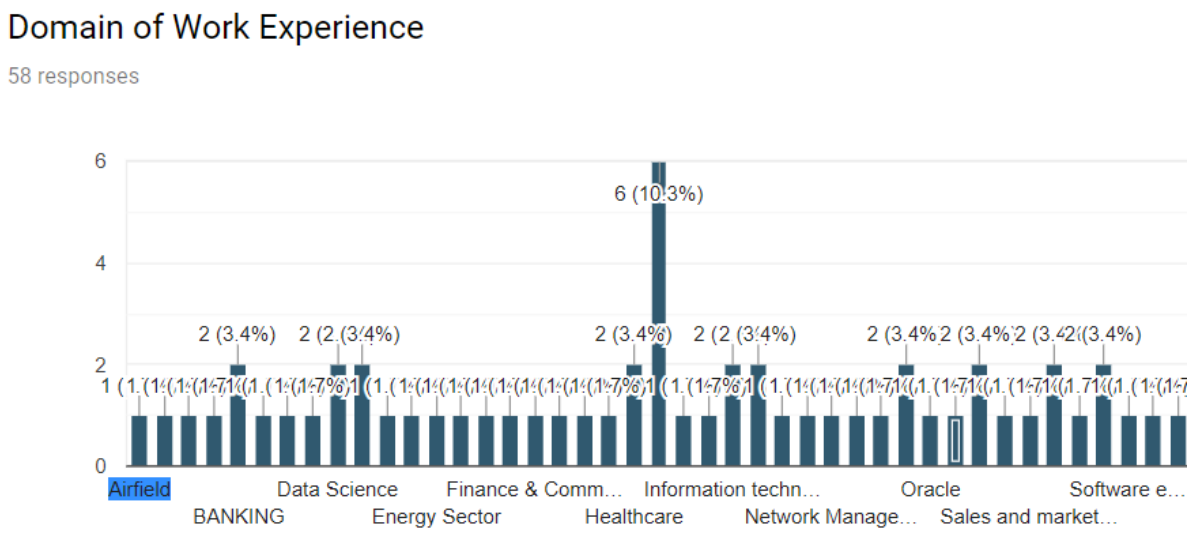

FIGURE 13 : Histogram distribution of work experience domain

WORK EXPERIENCE (NUMBER OF YEARS):

A larger number of responses were recorded from people with two years of work experience. A scanty percentage was evidenced for people with 12 or more years of experience. A pie chart for the same is demonstrated as follows:

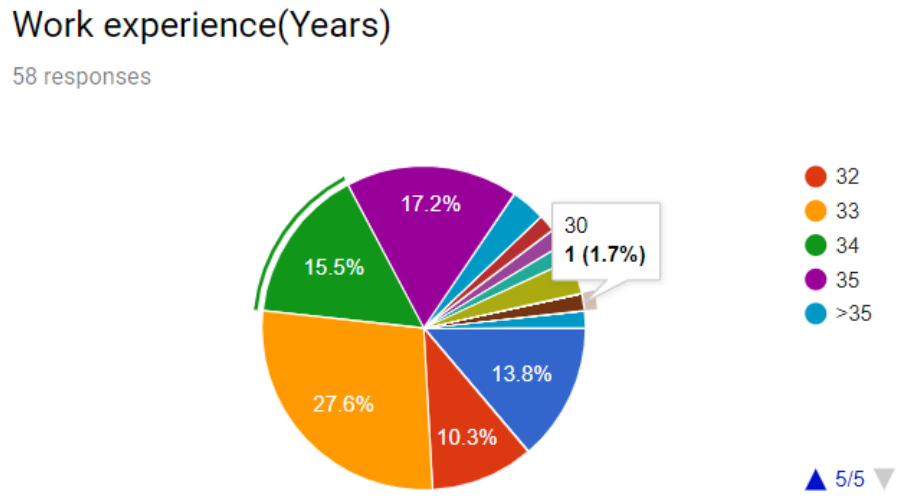

FIGURE 14 : Pie chart of work experience (years)

ROLE IN THE ORGANISATION:

Candidates with the following designations have shown interest in the taking up the higher education:

1. Engineer
2. Administration
3. Assistant managers
4. Associate
5. Associate software engineer
6. Business analyst
7. CTO
8. Consultant
9. Data scientist
10. Design engineer
11. Developer
12. Director
13. Division head
14. Firmware engineer
15. HSE Engineer
16. IT analyst
17. IT Engineer
18. Project Engineer
19. Project manager
20. QA analyst
21. Robotics engineer
22. Software developer and consultant
23. Team lead
24. Validation engineer

The following histogram distribution shows the details about this:

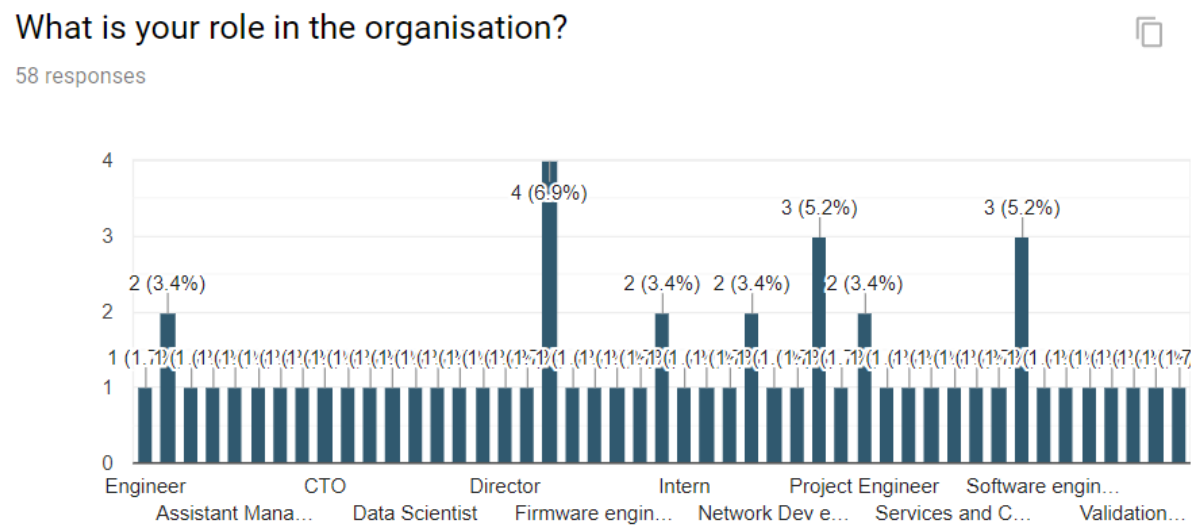

FIGURE 15 : Histogram distribution of role in the organisation

PROGRAMMING KNOWLEDGE:

Majority of the participants have claimed themselves to have knowledge in programming. Only a limited number have reported about not having programming knowledge.

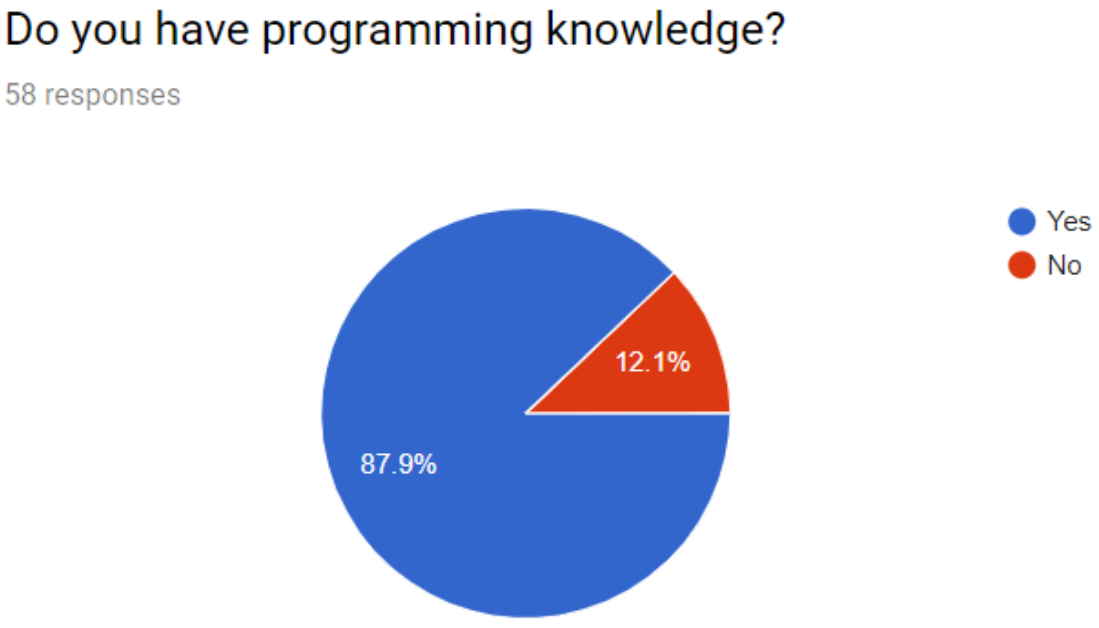

FIGURE 16 : Pie chart of Programming knowledge

SKILLSETS:

The various skillset options provided were:

1. Java

2. C
3. C++
4. C#
5. Python
6. R
7. Statistics
8. Web development
9. SQL
10. Other. Here the user can mention the other skills bestowed on him/her which are not available in the list.

Larger number of people have picked up C++ and python and a fewer number in SQL, Qlik, informatica, Ruby etc.,

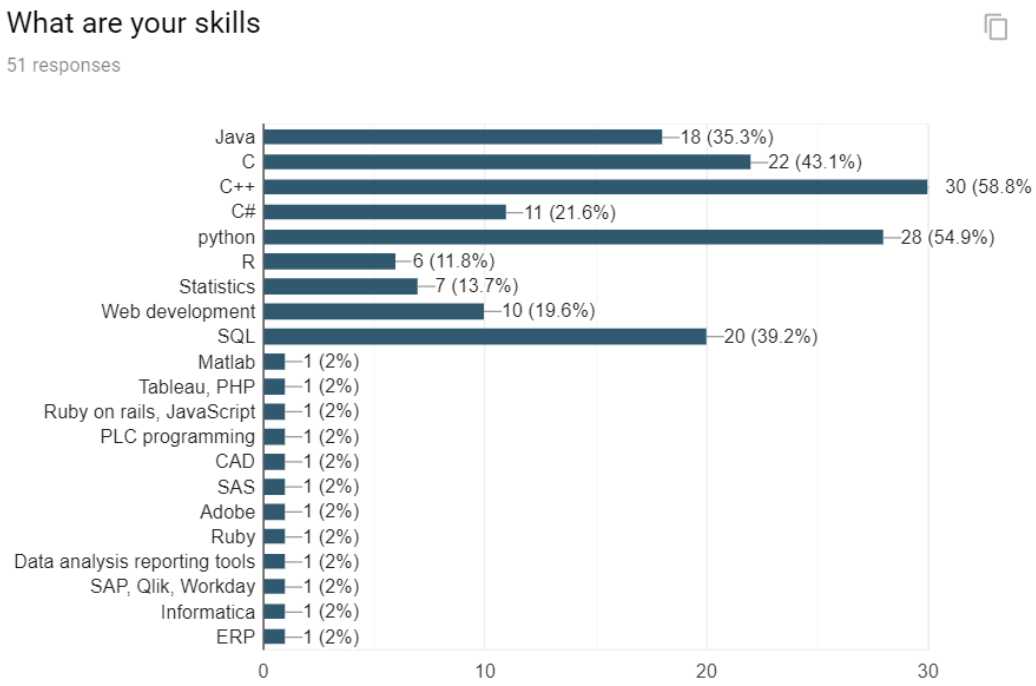

FIGURE 17: Bar graph of skillset

INTERESTED DOMAIN FOR FURTHER STUDIES:

About 48.3% of the survey participants have shown their interest in studying artificial intelligence. A moderate number of people wants to gain knowledge in the field of data science, digital innovation and design. A fewer number of people have chosen digital products and platforms, stack up start up tech development. The pie chart visualisation for this is as follows:

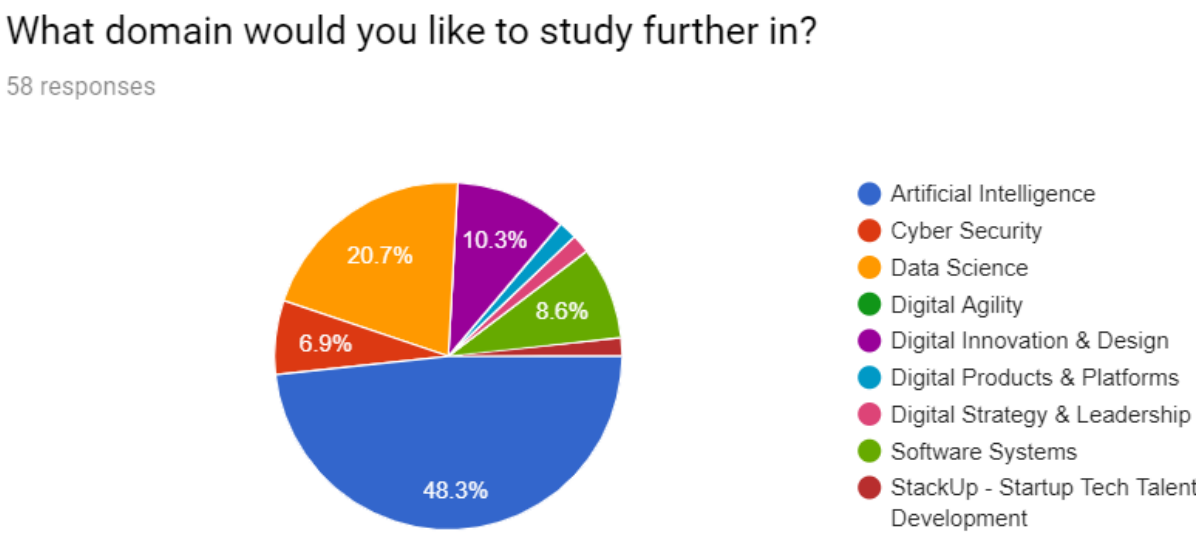

FIGURE 18 : Pie chart of further study domain

INTERESTED COURSES IN ARTIFICIAL INTELLIGENCE:

Amongst the list of sub courses available under artificial intelligence, robotics systems were chosen by many people. The course that falls in the next place is problem solving using pattern recognition. Deep learning has the least number of choices.

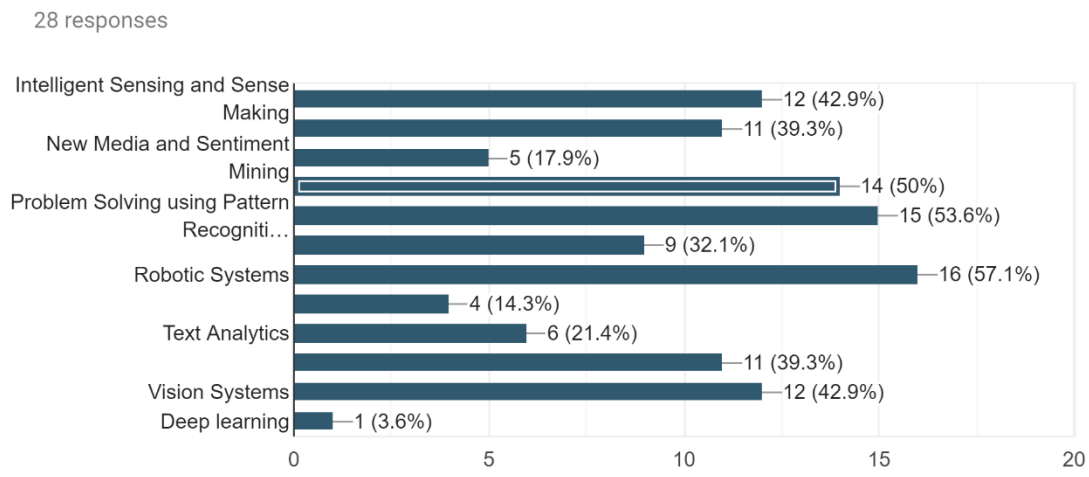

FIGURE 19 : Bar graph of artificial intelligence courses

INTERESTED COURSES IN CYBER SECURITY:

Lot of people have shown their interest in studying managing Cybersecurity risk and cybersecurity risk awareness. Unfortunately, none of them have registered their significance towards the certifications offered by various providers.

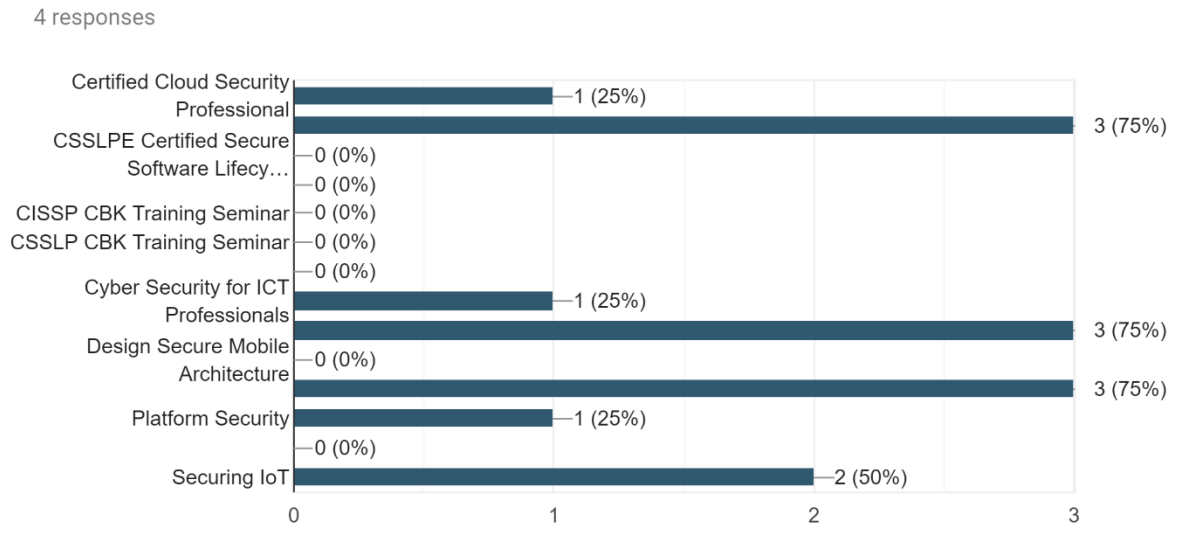

FIGURE 20 : Bar graph of cyber security

INTERESTED COURSES IN DATA SCIENCE:

Advanced customer analytics and big data engineering for analytics are topmost choices made by people. This is followed by data driven decision process and data analytics process and best practices. The least choices are text analytics, web analytics and service analytics.

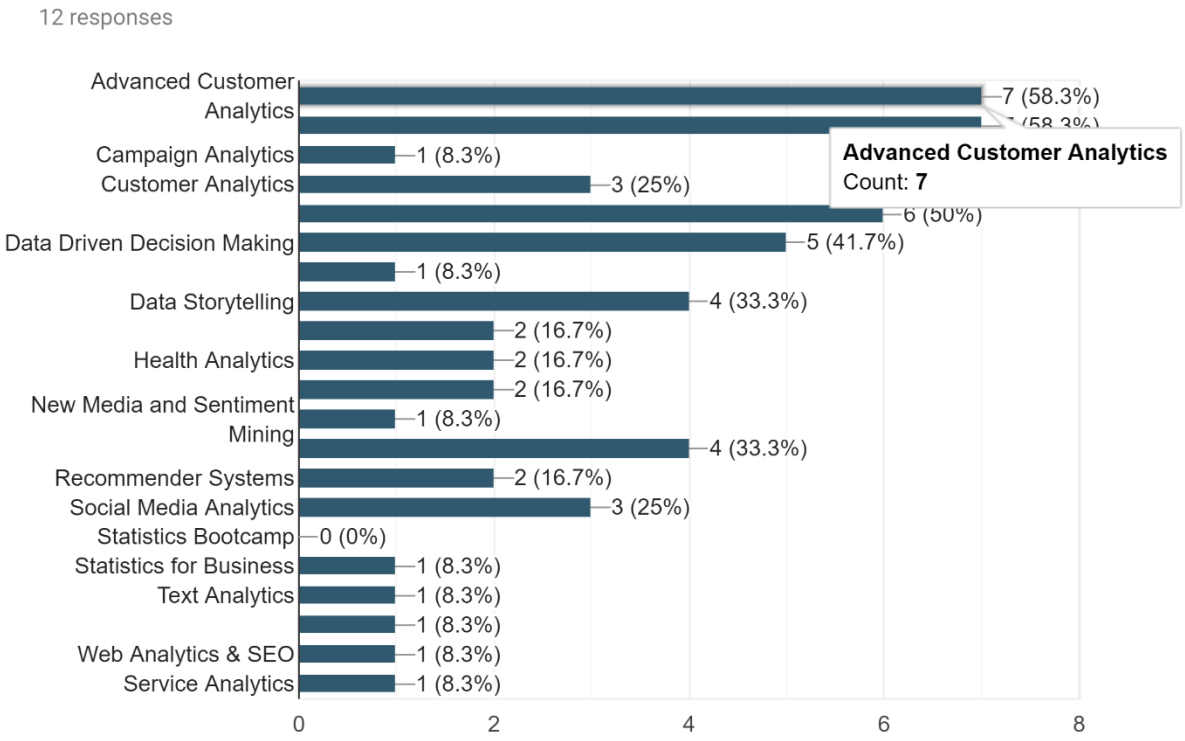

FIGURE 21 : Bar graph of data science

INTERESTED COURSE IN DIGITAL AGILITY:

Unfortunately, nobody has registered their interest in taking any of the courses under digital agility.

INTERESTED COURSE IN DIGITAL INNOVATION AND DESIGN:

Most candidates showed their interest in taking up digital and social engagement strategy, digital user experience design and strategic design and innovation. Web analytics has the least pick from all the candidates.

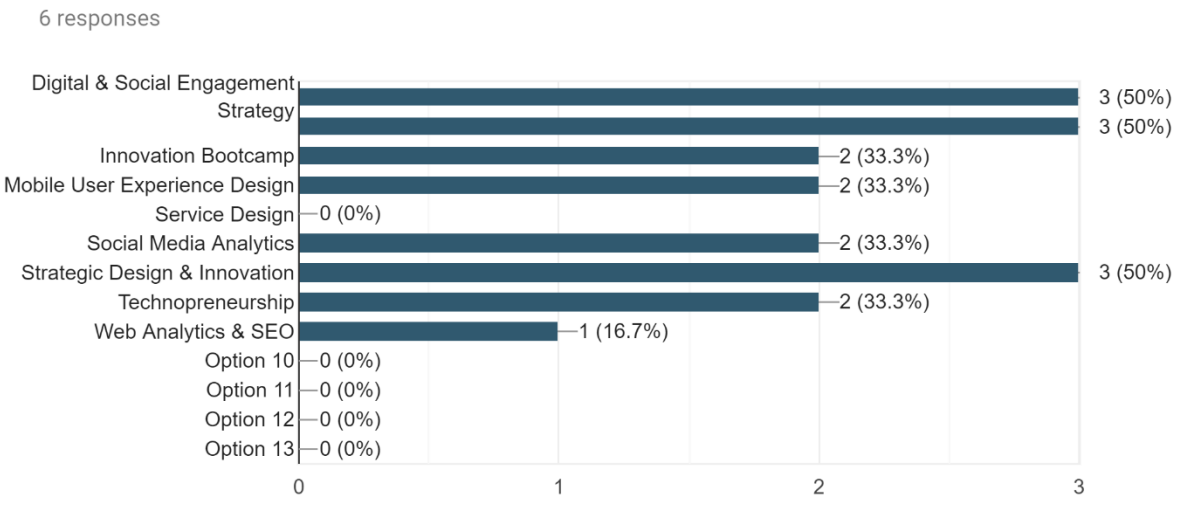

FIGURE 22 : Bar graph of Digital innovation and design

INTERESTED COURSE IN DIGITAL PRODUCTS AND PLATFORMS:

Only one responder has made the selection for Product thinking for organisations, strategic product manager and product management professional.

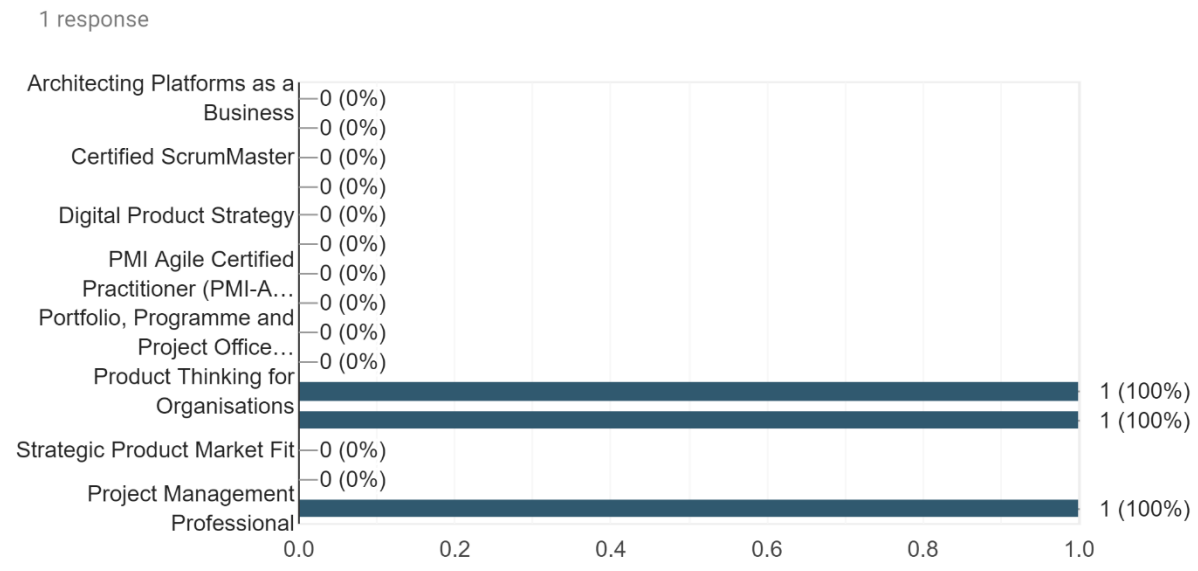

FIGURE 23: Bar graph of Digital products and Platforms

INTERESTED COURSE IN DIGITAL STRATEGY AND LEADERSHIP:

Only one response has been received for each of these courses: business analysis for agile practitioners, business process reengineering,communicating and managing change, digital transformation planning, innovation bootcamp, strategic business analysis and strategic futures and foresight.

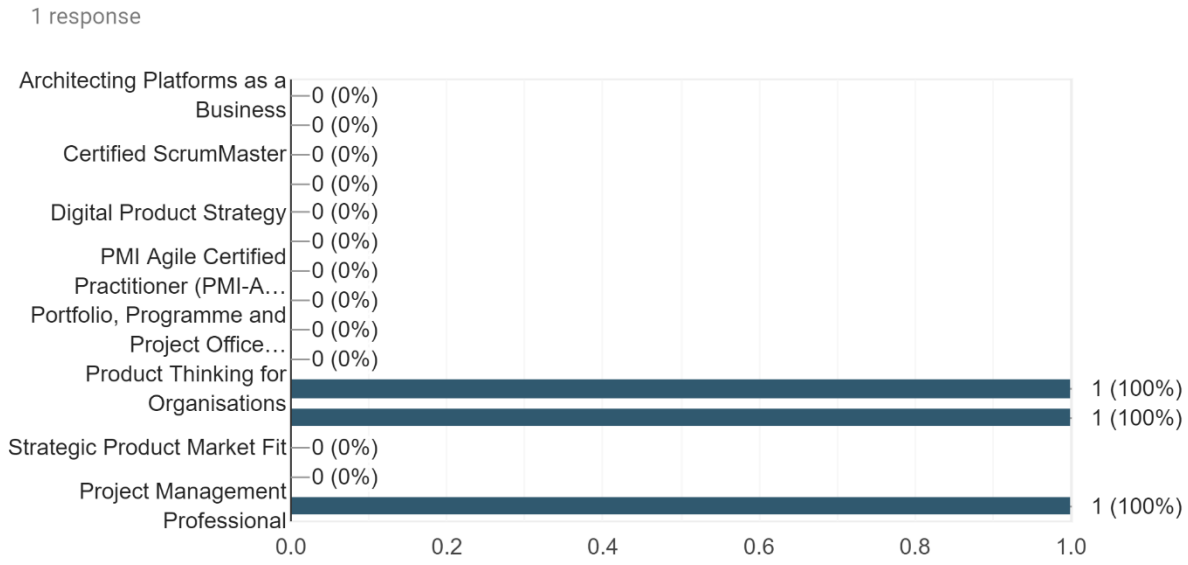

FIGURE 24 : Bar graph for Digital strategy and leadership

INTERESTED COURSES IN SOFTWARE SYSTEMS:

Big data engineering and service design were the choice of the majority. Few other prominent selections were cloud native design solution, design secure mobile architecture, object oriented analysis and design , object oriented design patterns ,platform security etc.,.

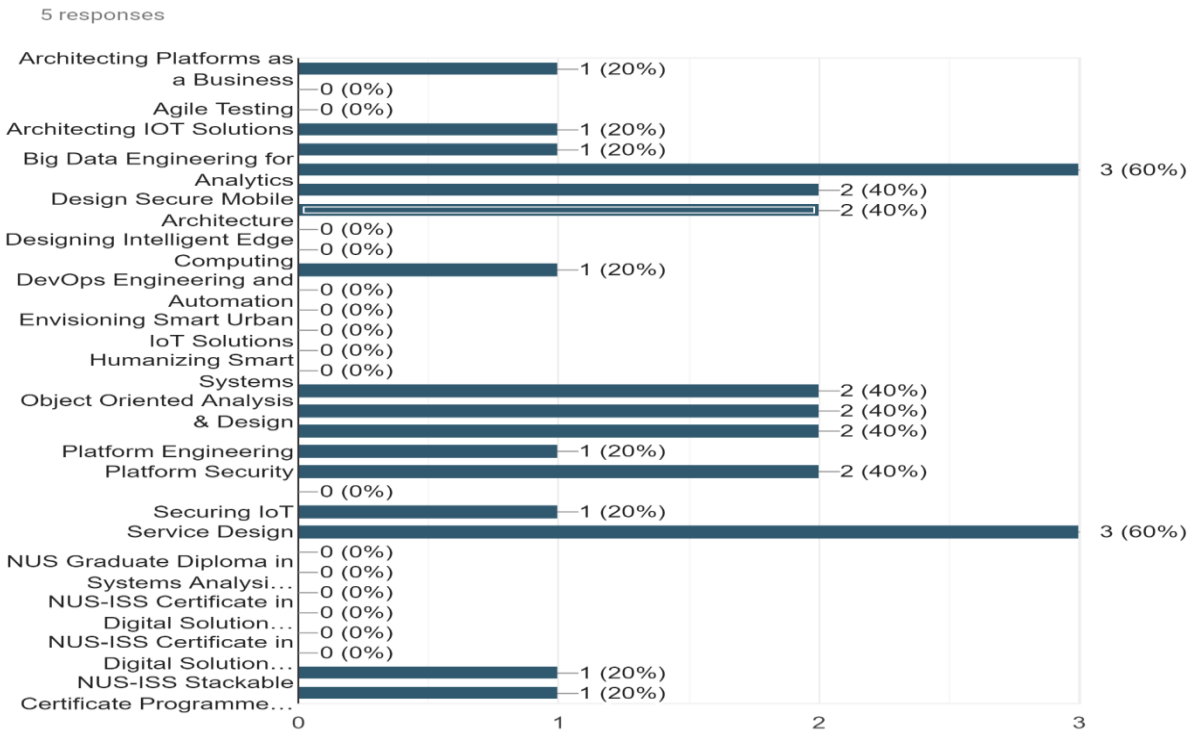

FIGURE 25 : Bar graph for software systems

INTERESTED COURSES IN STACK UP -STARTUP TECH TALENT DEVELOPMENT:

Only one responsed was received for the following sub modules: Client side foundation, feature extraction and supervised modelling, persistence and analytics modelling.

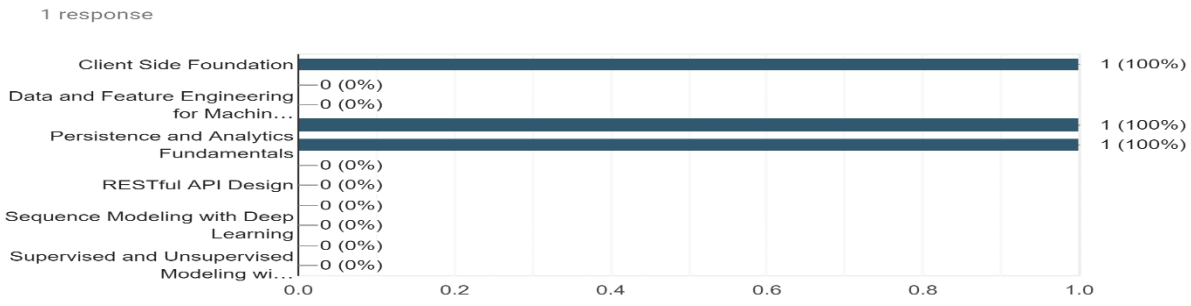

FIGURE 26 : Bar graph of Stack up- Start up tech talent development

About 6 responses were witnessed for the resumes part.The link to the form is as follows:

https://docs.google.com/forms/d/1Pe5Oi9FR-Nk6JKUmBqoGLRh7iSjN8B8QPj8mow0wFZc/edit?ts=5d32d910