PRACTICE MODULE BRIEFING for Certificate in Intelligent Reasoning Systems (IRS)

Machine Reasoning (MR)
Reasoning Systems (RS)
Cognitive Systems (CGS)

by Dr. Gary Leung (cc.leung@nus.edu.sg)

Practice Module : Learning Outcomes

Certificate in Intelligent Reasoning Systems (IRS)

Goal: Teach participants the knowledge, skills and industry best practices to design and build Intelligent Systems that solve problems by computational reasoning using captured domain knowledge as well as knowledge discovered/learnt from both small and big data.

Key Takeaways:

- Expose participants in a supervised manner to real world problems so that they may practice the use of the skills they have learned during the individual course modules in a real-world setting and obtain expert advice and guidance when needed.
- Enable participants to demonstrate their proficiency across all of the skills that they have learned in the course modules and hence be certified as competent at the Certificate level.
- Provide a formal grading mechanism so that the certificate may be used as one component in the NUS-ISS Stackable Master of Technology (MTech) in Intelligent Systems.

Agendas

Machine Reasoning

Day 1

1.1 Machine Reasoning Overview
1.2 Searching for Problem Solving
1.3 Search in Solving Constraint Satisfaction Problems (**Workshop**)
1.4 Class Discussion

Day 2

2.1 Reasoning for Problem Solving
2.2 Knowledge Representation
2.3 Reasoning using Different Techniques (**Workshop**)
2.4 Representation of Models from Machine Learning

Day 3

3.1 Machine Reasoning over Knowledge Graph
3.2 Knowledge Graph Embeddings
3.3 Generative AI Project Lifecycle
3.4 Knowledge Graphs (**Workshop**)
3.5 Reflection and Takeaways

Day 4

4.1 Inductive Reasoning and Learning
4.2 Neural Networks and Transformers
4.3 Machine Learning Tasks & Models (**Workshop**)
4.4 Discussion and Summary

Reasoning Systems

Day 1

- Reasoning for Problem Solving
- Knowledge Representation
- Workshop: Reasoning using different techniques
- Representation of Models from Machine Learning

Day 2

- Graph Neural Networks

Day 3

- Reasoning using Optimization Techniques
- Optimization Based Intelligent Systems (GA)
- Optimization Reasoning Workshop

Day 4

- Reasoning and Knowledge Discovery from Large Datasets
- Market Based Analysis and Recommender Systems & Workshop
- Similarity-based Recommender Systems & Workshop

Day 5

- Model-based Recommender Systems & Workshop
- Hybrid and Advanced Recommender Systems
- Hybrid Recommender Systems Workshop

Cognitive Systems

Dr. FAN Zhenzhen

Dr. TIAN Jing

Dr. Gary LEUNG

Dr. WANG Aobo

- **Day 1 (AM)**
  - Introduction of Cognitive Systems
  - Natural language cognition
- **Day 1 (PM)**
  - Vision Cognition
- **Day 2**
  - Audio cognition and LLM reasoning
- **Day 3**
  - Knowledge representation and reasoning
  - Case studies and workshops

Graduate Cert: Assessment Components

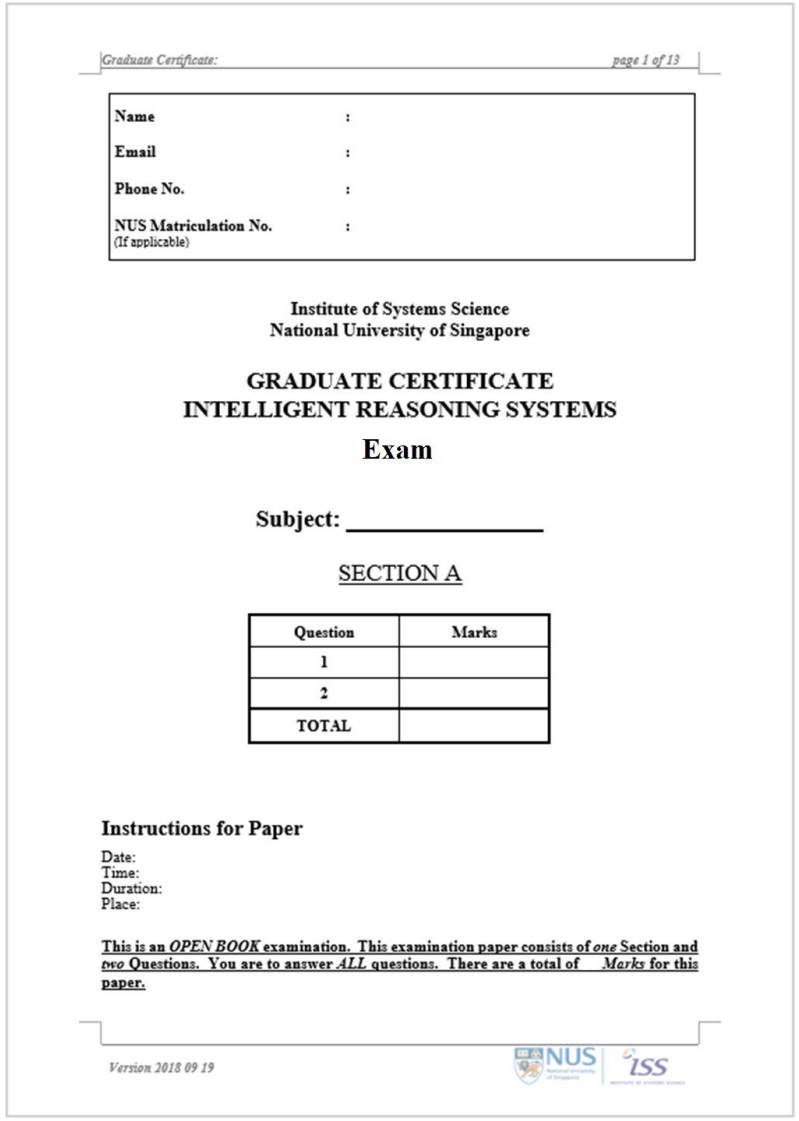
- The graduate cert assessment comprises the assessment components below:

Assessment Component	Weight
Examination	50%
Practice Module Project Work	50%

Standard Grading Scheme		CAP
A+	85 - 100	5.0
A	80 - 84	5.0
A-	75 - 79	4.5
B+	70 - 74	4.0
B	65 - 69	3.5
B-	60 - 64	3.0
C+	55 - 59	2.5
C	50 - 54	2.0
D+	45 - 49	1.5
D	40 - 44	1.0
F (Fail)	0 - 39	0.0

- A participant must attain a minimum overall score of **50%** to pass the practice module and hence be awarded the Certificate in Intelligent Reasoning Systems.
- **Note:** The participant must pass ***both written examination*** and ***Practice Module.***

Examination



Graduate Certificate: *page 1 of 13*

Name	:	
Email	:	
Phone No.	:	
NUS Matriculation No. (If applicable)	:	

Institute of Systems Science
National University of Singapore

GRADUATE CERTIFICATE
INTELLIGENT REASONING SYSTEMS
Exam

Subject: _____

SECTION A

Question	Marks
1	
2	
TOTAL	

Instructions for Paper

Date:
Time:
Duration:
Place:

This is an *OPEN BOOK* examination. This examination paper consists of *one* Section and *two* Questions. You are to answer *ALL* questions. There are a total of *Marks* for this paper.

Version 2018 09 19

- 3-hour open-book individual exam during the week of 3-7 Nov 2025 (tentative).
- Pencil can be used for drawing.
- Internet (re)search is NOT allowed.
- Bring your NUS matriculation ID card and Identification Card.

Practice Module : MVP Project

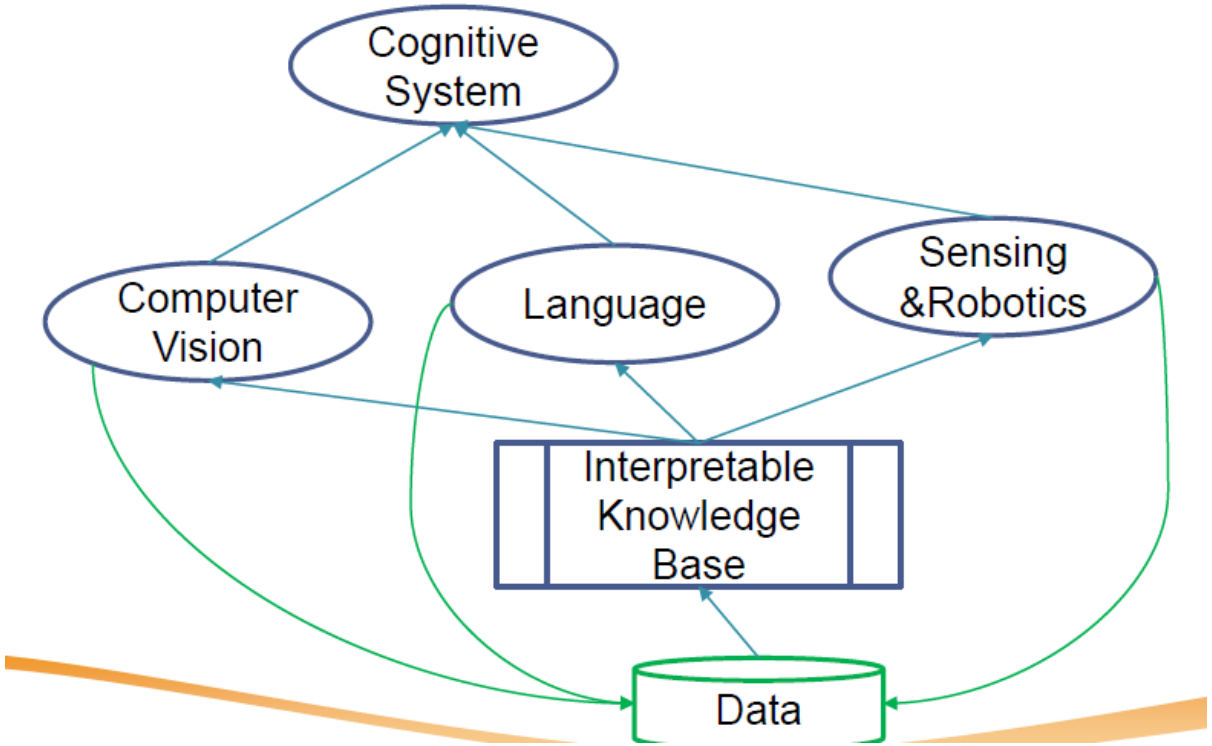
[Group Project] What are the requirements?

- Form a project team of max **5** members, appoint a team leader.
- Identify a relevant business/research problem in the domain of **knowledge discovery, hybrid machine reasoning, recommendation or optimization**. Propose, design and create an **intelligent reasoning** system for the business need/problem.
- Projects may be selected from within their own organizations or from other approved sources. These projects will be assessed by ISS lecturers.
- Practice module takes an estimated **10 man-days** of effort by each participant.
- The proposed project must develop, integrate, and demonstrate any **three** or more aspects out of following **four** technique groups:
  - Decision automation: Business rules & process **OR** Knowledge based reasoning techniques
  - Business resource optimization: Informed search **OR** Evolutionary computing techniques
  - Knowledge discovery & (big) data mining techniques, e.g. recommendation; diagnosis; etc.
  - System designed with cognitive techniques or tools, e.g. components of knowledge base: knowledge graph, frame systems, user-interface supporting human mode of communication like natural language, chat-bot, etc.

Resulting software/hardware system should have **user interfaces**, results interpretation and visualization where deemed necessary. To minimize "reinventing the wheels", the delivered system is encouraged to adopt existing **open source sub-modules and/or application programming interfaces APIs**. Teams can explore other relevant technologies to extend the system/solution for more effective business problem solving, which can be considered for **value-added** marks. Teams must demonstrate (**write in report**) their ability to apply and practice the knowledge, techniques and skills they have learnt from the courses.

What are Cognitive Systems?

- Systems that exhibit **human-like** intelligence through processes like **perception, learning**, **reasoning**, and **memory.**



Cognitive Systems Application Areas

- **Product** applications embed cognitive technologies in a product or service providing customer benefits like ease of use, simplicity, or automation.
- **Process** applications embed the technology in an organization's workflow, automating tasks to get things done faster, better, cheaper, or a combination.
- **Insight** applications use analytic capabilities and machine learning to uncover insights to make better operational and strategic decisions based on large amounts of data.

Practice Module : MVP Project

[Group Project] What to develop?

- A 5-minute video clip to **promote/sell** your system/solution, covering:
  - Business Pain & Value; Use Case Demo; Pricing;
- A 5-minute video clip to **describe high level system design** your system/solution, covering:
  - System Design; Technical explanation of use cases;
- A **runnable** intelligent reasoning system;
- A **group project report** (.doc or .pdf) with relevant attachments, including:
  - Business Case / Market Research
  - System Design / Model
  - System Development & Implementation
  - Findings and discussion
- Appendix of **report**: Project Proposal
- Appendix of **report**: Mapped System Functionalities against knowledge, techniques and skills of modular courses: MR, RS, CGS
- Appendix of **report**: Installation and User Guide
- 1 or 2 pages of **individual project report** per **project member**, including:
  - Individual reflection
  - Peer review form

Practice Module : MVP Project

[Group Project] What to submit?

Create Github repository using template:

https://github.com/IRS-PM/Workshop-Project-Submission-Template

As a project group: Prepare below ***four*** files with naming convention:

1. A ***member-github.txt***, containing:
   - Group name, e.g. AwsomeSG
   - All member's full name (as shown on your student ID/NRIC/FIN/Passport)
   - All member's student IDs, e.g. A1234567B; or masked NRIC, e.g. S****123T
   - Weblink to your online github project repository, e.g. https://github.com/...
2. Two separate video files, e.g. ***IRS-PM-2021-01-16-IS03PT-GRP-AwsomeSG-ReleaseOptimizer-promotion/system.mp4/wmv/mov/avi/etc***
3. A downloaded github repo zip, e.g. ***IRS-PM-2021-01-16-IS03PT-GRP-AwsomeSG-ReleaseOptimizer.zip***
4. A group project report, e.g. ***IRS-PM-2021-01-16-IS03PT-GRP-AwsomeSG-ReleaseOptimizer-Group-Report.pdf***

Finally, compress all above files into one single .zip file, naming convention, e.g. ***IRS-PM-2021-01-16-IS03PT-GRP-AwsomeSG-ReleaseOptimizer.zip***, then upload to **Canvas Assignments**: ***[Group Leader] Project Deliverables (zip)*** folder.

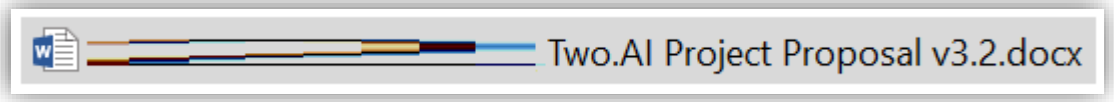
As an individual: Prepare and submit confidential **Individual reflection** *and* ***peer review form*** to **Canvas Assignments**: ***[Individual] Project Peer Evaluation (doc, docx, pdf)*** folder.

Practice Module : MVP Project

[Group Project]
What to submit?

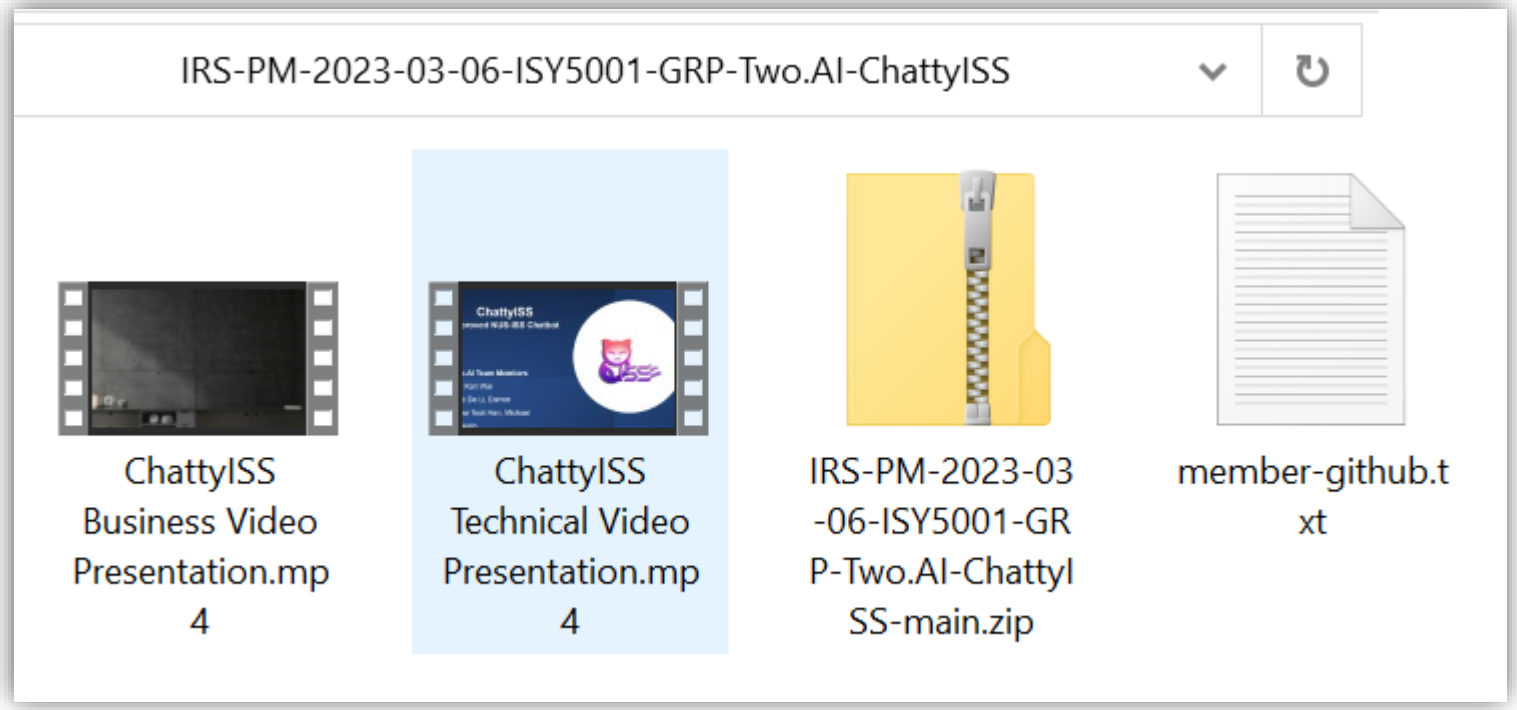
Canvas Assignments:

[Group Leader] Project Proposal (doc, docx, pdf) folder.



Canvas Assignments:

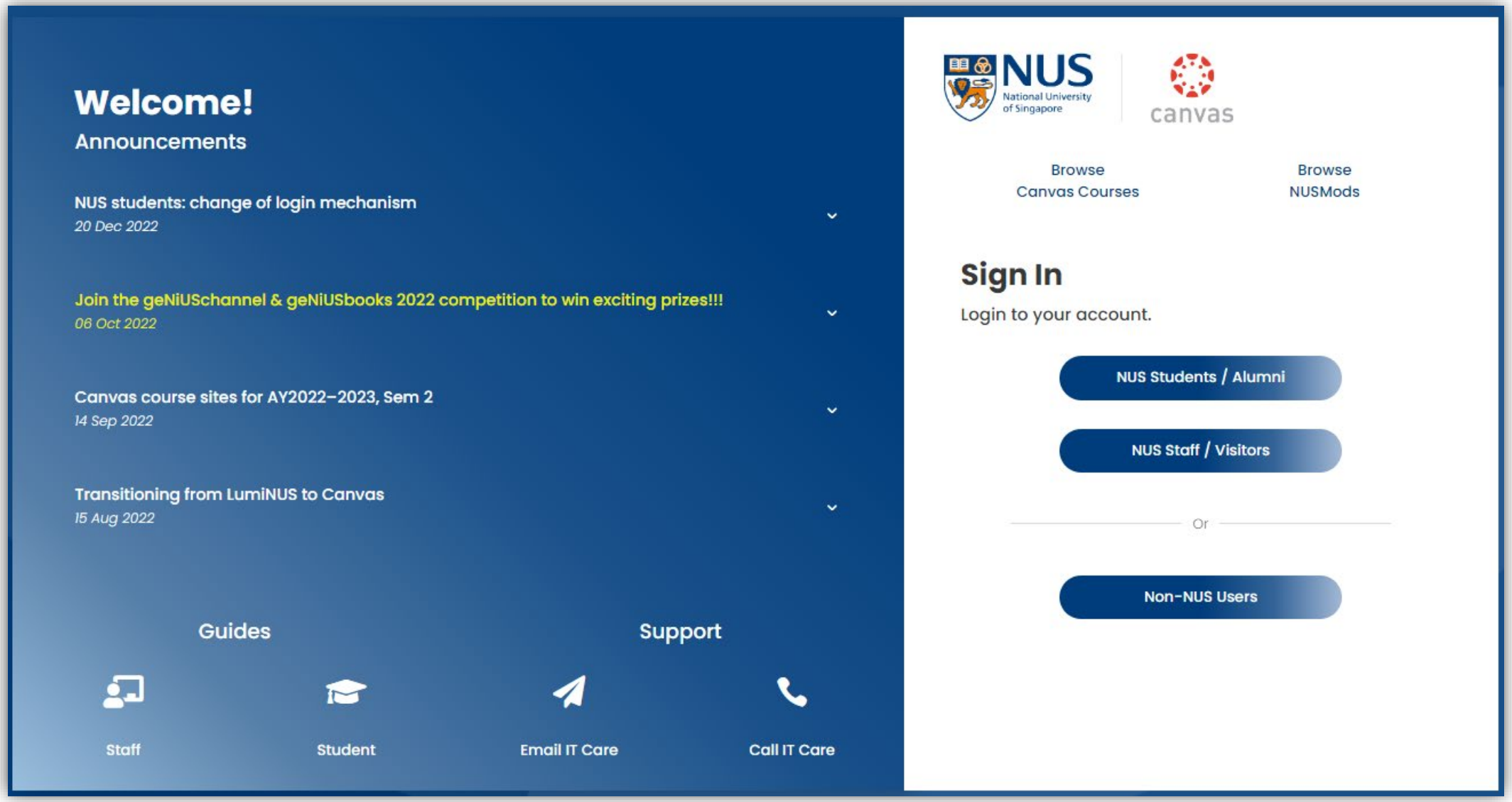
[Group Leader] Project Deliverables (zip) folder.



Canvas Assignments:

[Individual] Project Peer Evaluation (doc, docx, pdf) folder.

[Group Project] Where to submit?



Practice Module : MVP Project

[Group Project] How to evaluate?

The deliverables will be assessed in a scheme including aspects of:

1. Business Value (shown in report/ market research)
2. System Design, e.g. Smart functions; Technological advancement (shown in report/ documentation)
3. System Implementation (run and use your system/ user-guide)
4. Presentation Videos
5. Project Contribution: peer-review; team-size
6. Value Adds, e.g. relevant techniques via self research; intuitive user interface

with focus on **System Design** & **System Implementation** & **Individual project contribution**

Practice Module : MVP Project

[Submission deadline]

- Project proposal due by 23:59 on 14th Sept 2025 (Sun.)
- Proposal presentation on the following week (TBA)
- Submission of final project deliverables and individual peer review due by 23:59 on 26th Oct 2025 (Sun.)

Practice Module : MVP Project

[Group Project] What are some project ideas?

- Children Development Monitor / Milestone Tracker https://www.cdc.gov/ncbddd/actearly/index.html
- Augmented Reality: Evidence-based tools to help you teach social-emotional skills to students with autism or ADHD http://www.brain-power.com/
- Dynamic Book Order Handling System https://github.com/IRS-MR/IRS-MR-2019-01-19-IS1PT-GRP-X-Men-Online_Order_Management_System
- Query Answering Information Retrieval Chat-Bot https://github.com/IRS-CGS/IRS-CS-2019-04-27-IS1PT-GRP-ISSChatBot
- Algorithmic Trading System (ATS) for Crude Palm Oil Futures https://github.com/IRS-PM/Workshop-Project-Submission-Template-Trading
- IT Project Release Optimizer https://github.com/IRS-PM/Workshop-Project-Submission-Template-GA-Optimizer
- IBM Watson® Discovery service https://www.ibm.com/cloud/garage/architectures/cognitiveDiscoveryDomain/overview
- IBM Watson® Assistant https://www.ibm.com/cloud/watson-assistant/
- Google Dialogflow https://dialogflow.com/
- MyCroft https://mycroft.ai/

Past student project references: https://github.com/IRS-PM

Practice Module : MVP Project

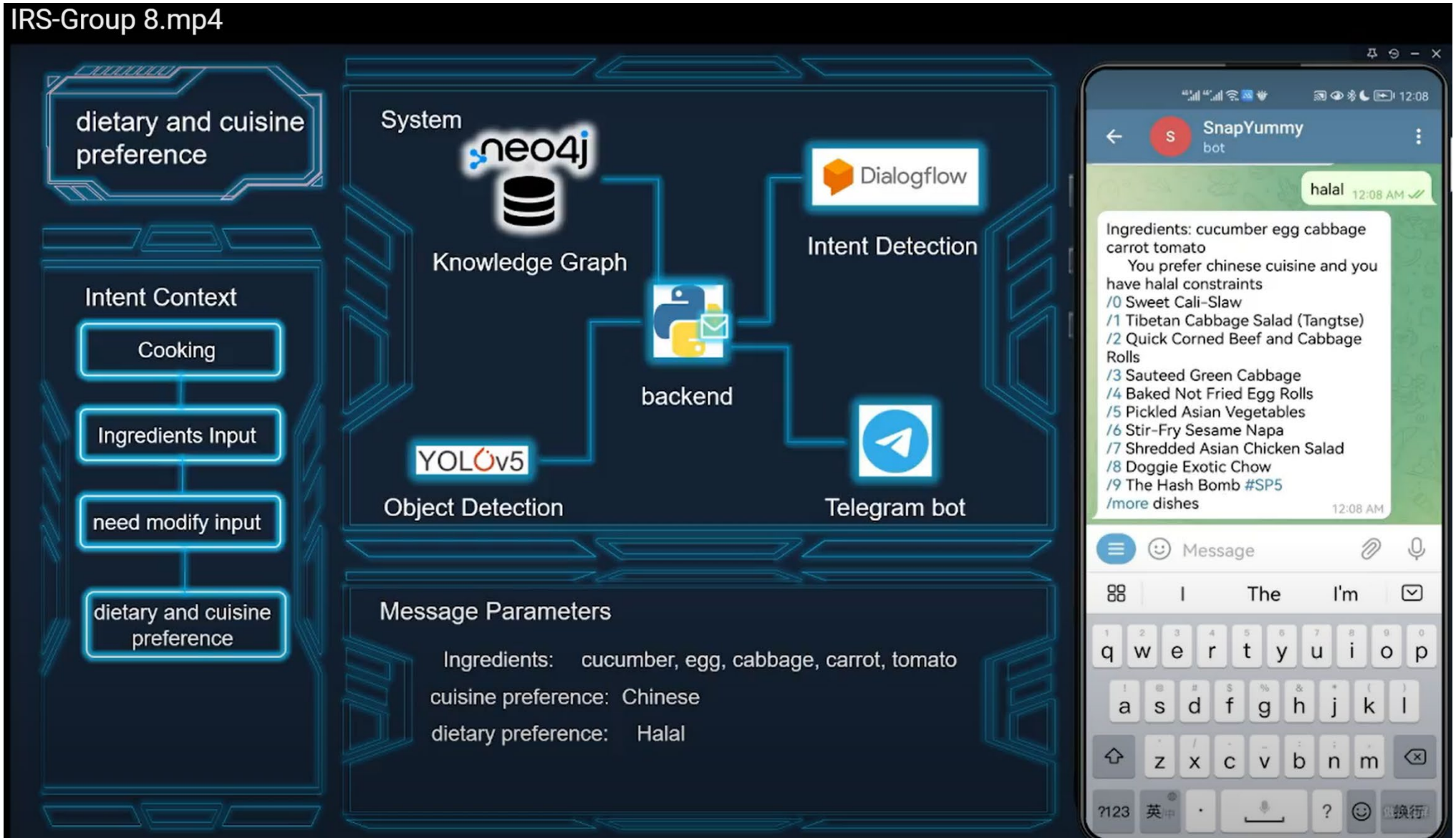
[Example Past Project]

https://github.com/IRS-PM

[Home Improvement] Cooking Assistant

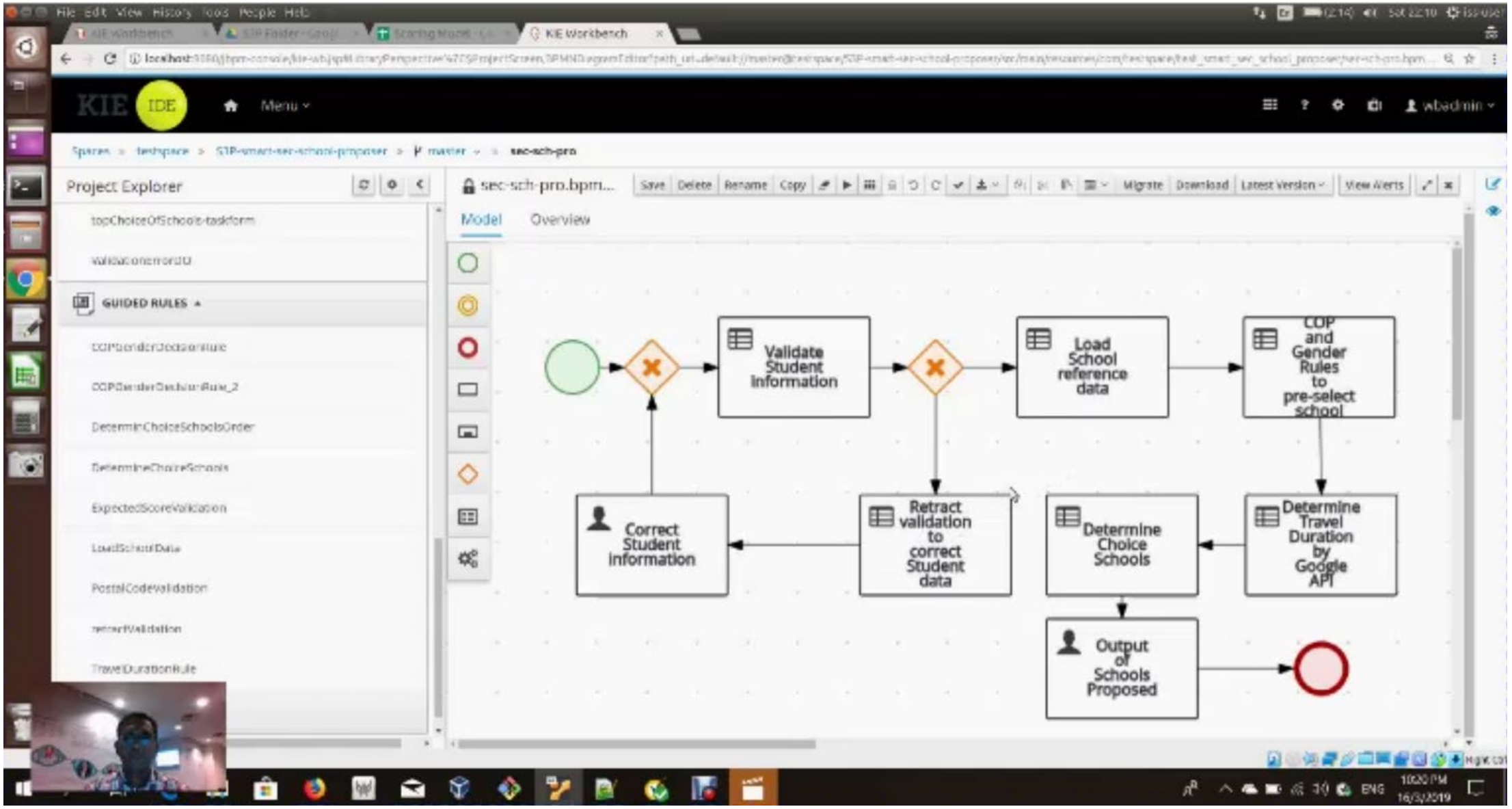
Source https://github.com/IRS-PM/IRS-PM-2021-07-05-IS03FT-Group-8-SnapYummy-Cooking-Assistant

[Home Improvement] Cooking Assistant



Source https://github.com/IRS-PM/IRS-PM-2021-07-05-IS03FT-Group-8-SnapYummy-Cooking-Assistant

[Education] Secondary School Proposer



Source https://github.com/IRS-MR/IRS-MR-2019-01-19-IS1PT-GRP-aiVoyagers-S3P-smart-sec-school-proposer

[Education] School Shuttle Scheduler

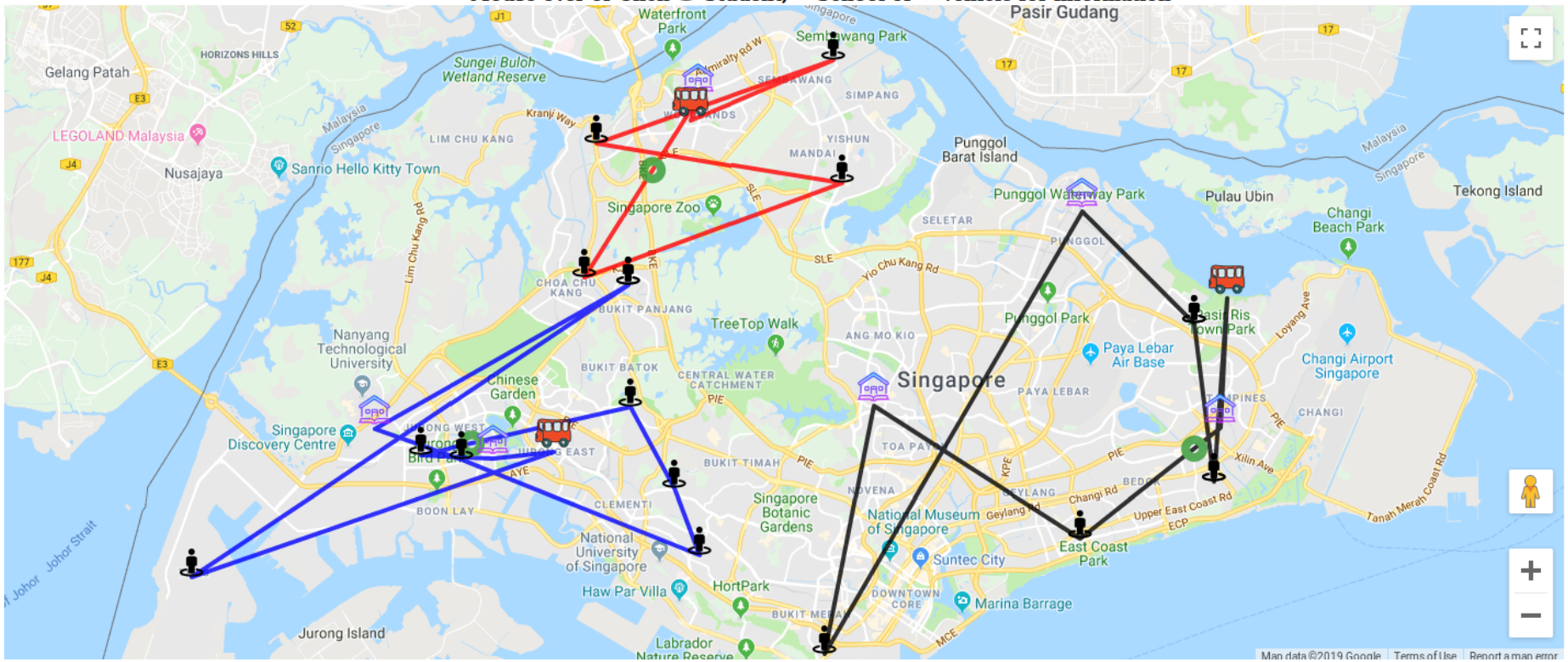
Intelligent Rapid Shuttle

AI powered Shuttle Service -The fastest way to reach School at an affordable price

DataSet 1(8 Students, 3 Schools, 2 Vehicles)
DataSet 2(18 Students, 5 Schools, 3 Vehicles)
DataSet 3(23 Students, 8 Schools, 3 Vehicles)
DataSet 4(Same as Dataset3 + 1 Vehicle)
Show on Map

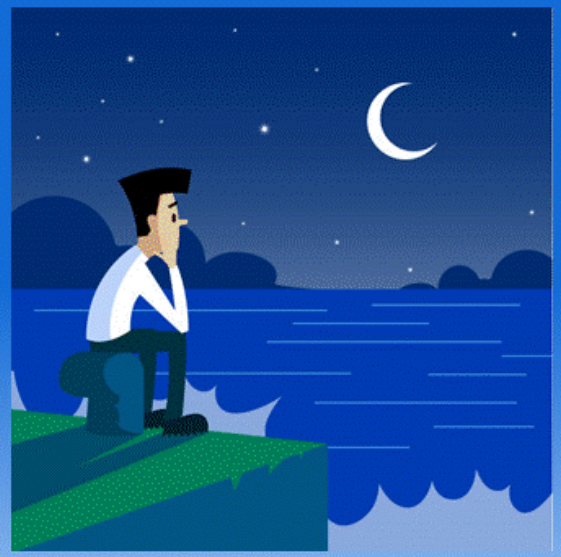
Find Best Route for the Students | Score : 0hard/-3381soft

Mouse over or Click Student, School or Vehicle for information



Source https://github.com/IRS-RS/IRS-RS-2019-03-09-IS1PT-GRP-aiVoyagers-irs-Intelligent-Rapid-Shuttle

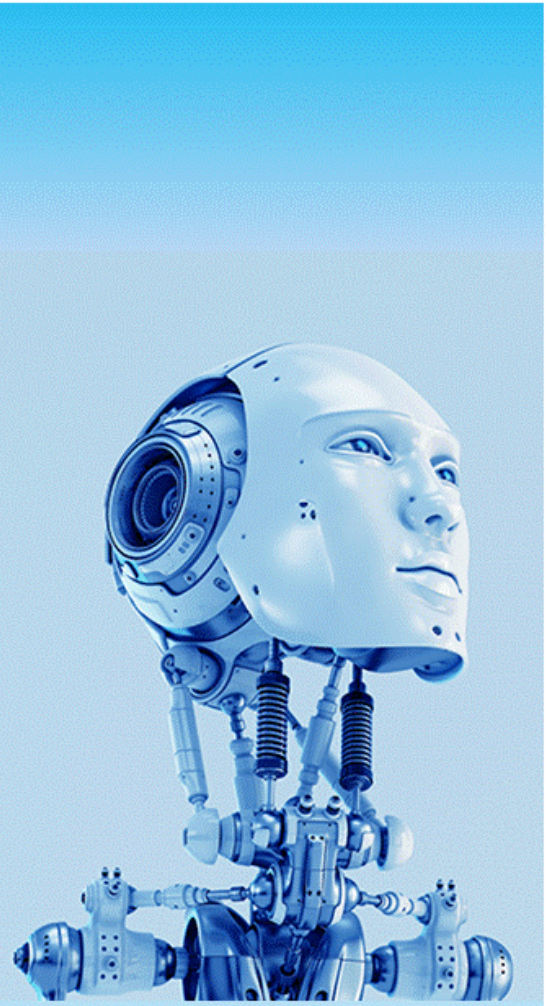
[Health] Depression Screener



Pepper Project Group

CAO LIANG	A0012884E
GENG LIANGYU	A0195278M
HAN DONGCHOU FRANCIS	A0195414A
ONG BOON PING	A0195172B
TAN CHIN GEE	A0195296M

Depression Screening System



Source https://github.com/IRS-MR/IRS-MR-2019-01-19-IS1PT-GRP-Pepper-DepressionScreeningSystem

[Health] Patient-Doctor Matcher

Pepper Project Group

CAO LIANG	A0012884E
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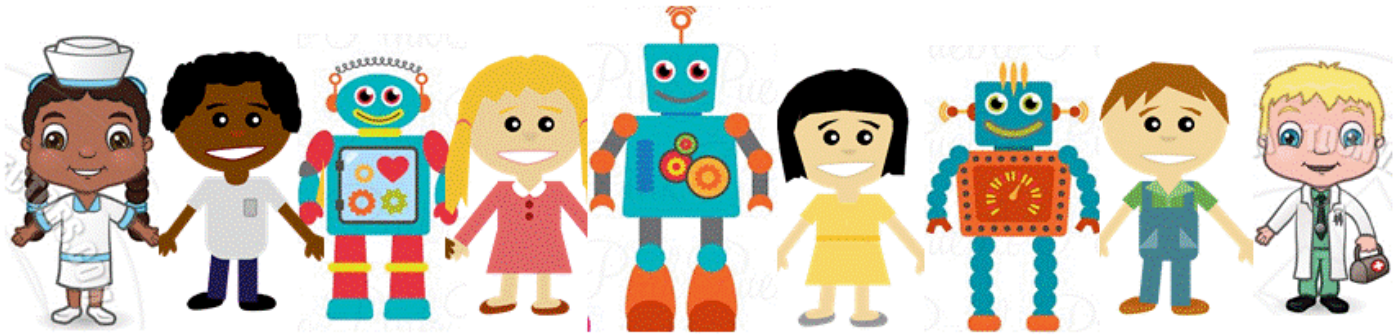
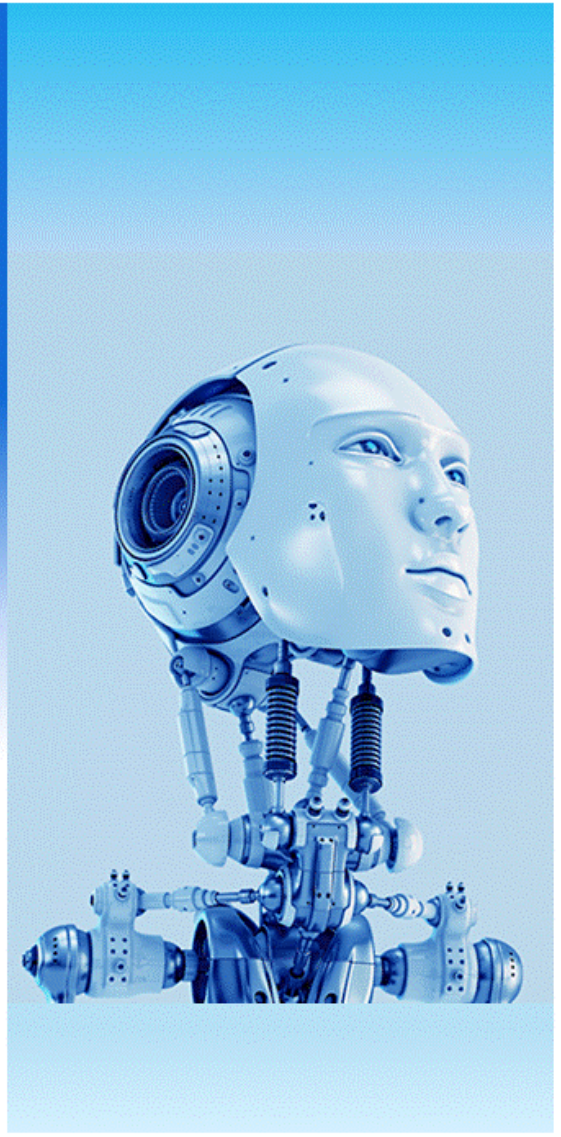
HAN DONGCHOU FRANCIS	A0195414A
ONG BOON PING	A0195172B
TAN CHIN GEE	A0195296M

Patient Matching System



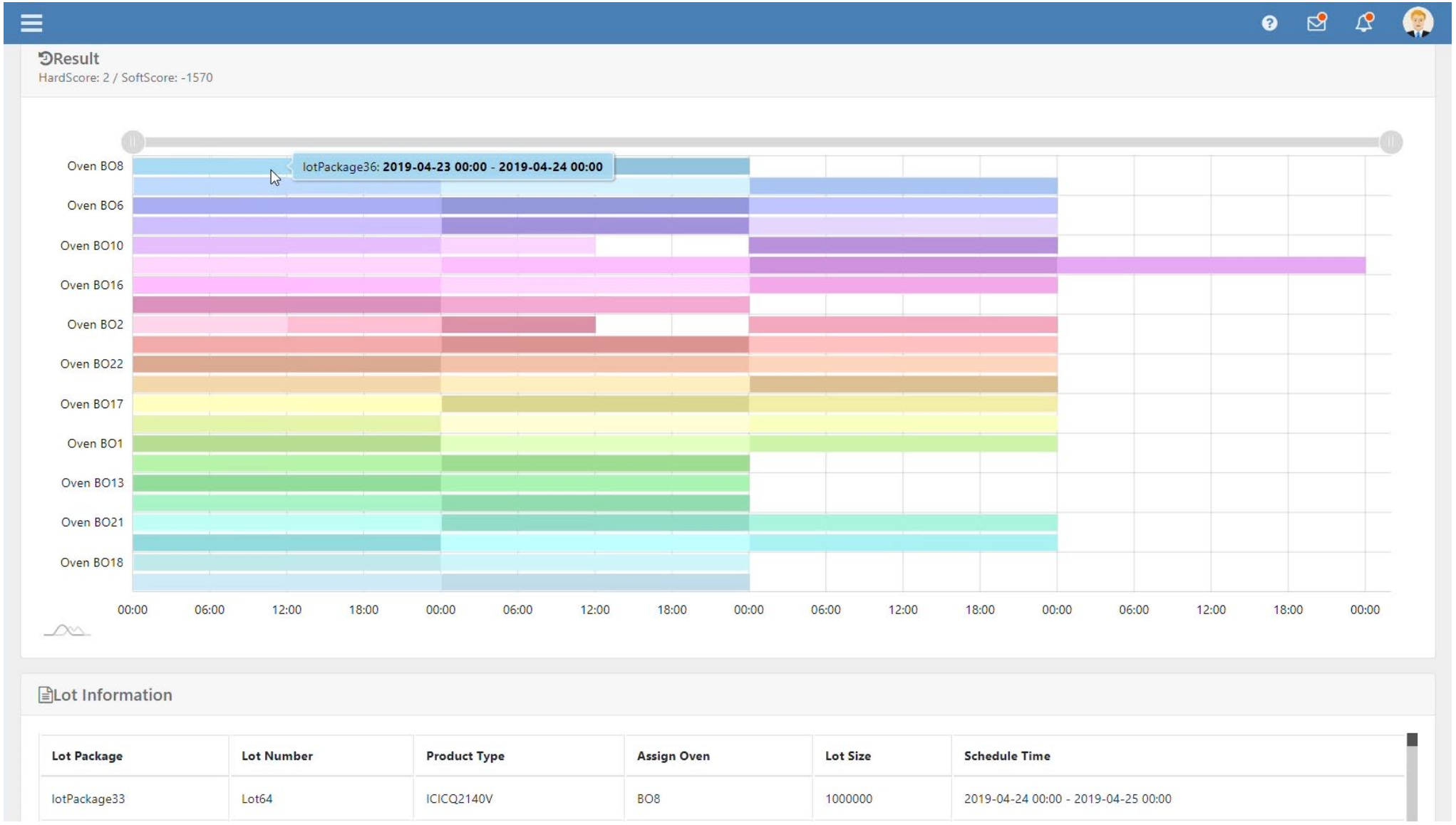


Source https://github.com/IRS-RS/IRS-RS-2019-03-09-IS1PT-GRP-Pepper-PatientMatchingSystem

[Manufacturing] Integrated Circuits Lot Disposition Recommender

Source https://github.com/IRS-MR/IRS-MR-2019-01-19-IS1PT-GRP-HEX-LOH_Disposition_Decision-Making_Process_System

[Manufacturing] Integrated Circuits Lot-Oven Scheduling and Dispatch Optimizer

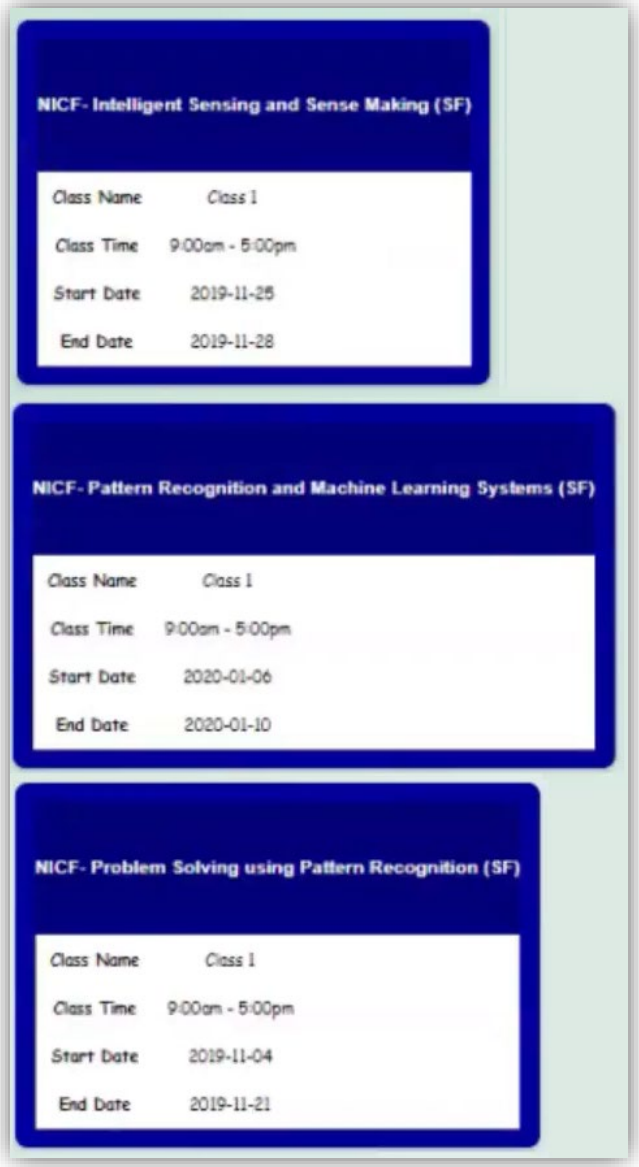


Source https://github.com/IRS-RS/IRS-RS-2019-03-09-IS01PT-GRP-Hex-Sdot_Scheduling_and_Dispatch_Optimization_Tool

[Health] Meal Planner for Diabetics

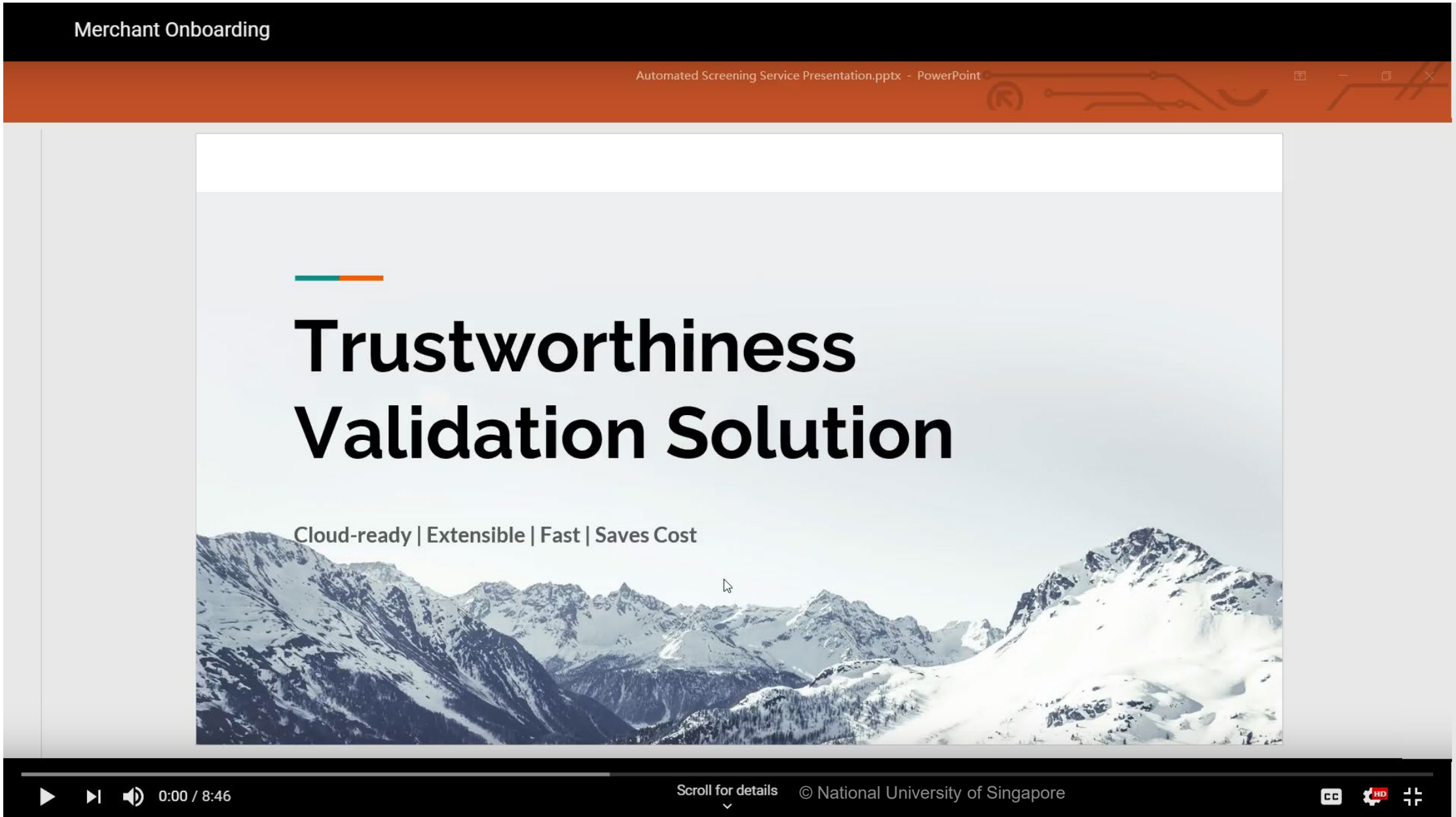
Source https://github.com/IRS-RS/IRS-MRS-2019-07-01-IS01FT-GRP9-Meal-Planner-for-Diabetics

[Education] ISS Course Recommender

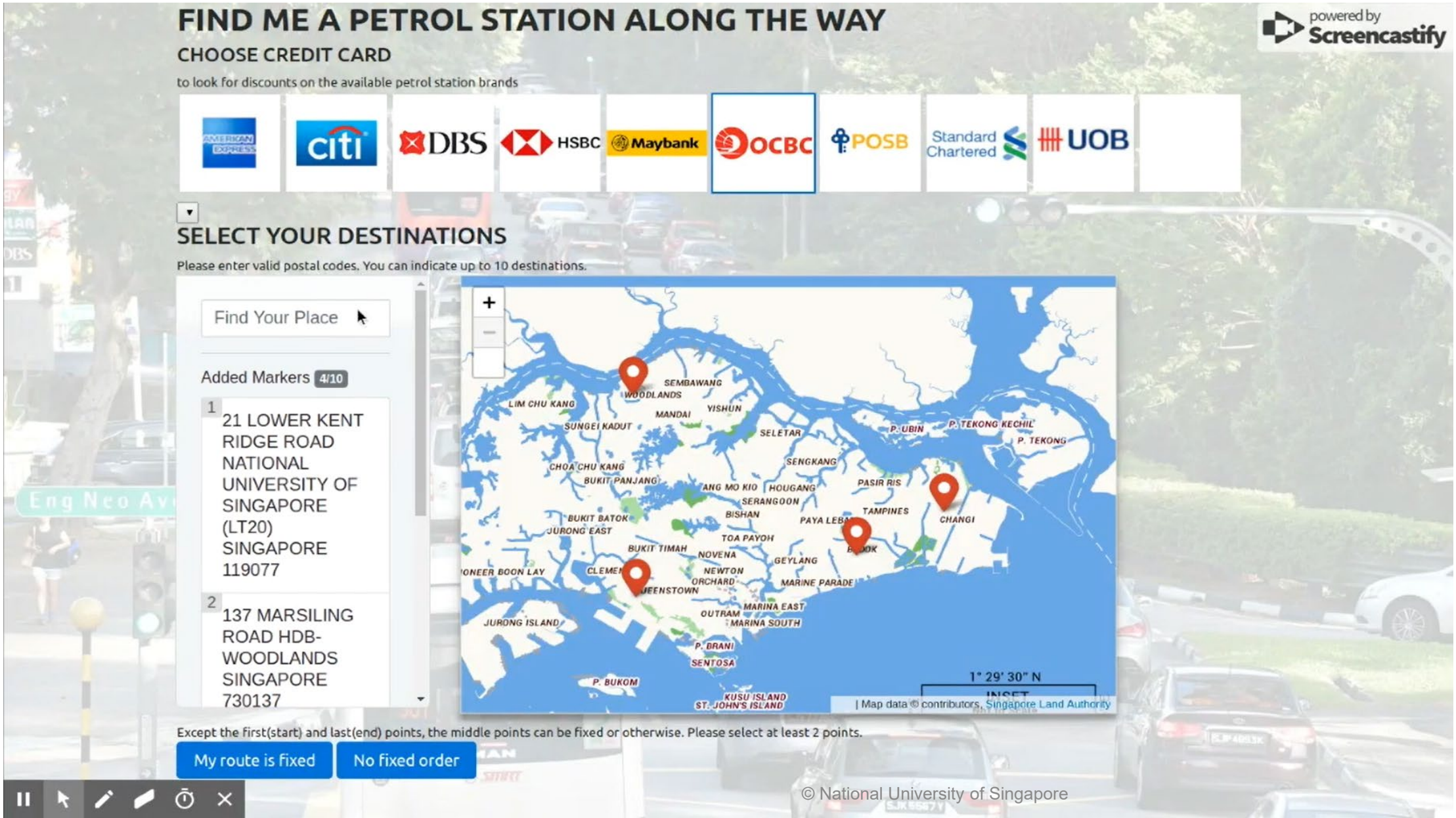


Source https://github.com/IRS-RS/IRS-MRS-2019-07-01-IS01FT-GRP1-ISS-COURSE-RECOMMENDER-SYSTEM

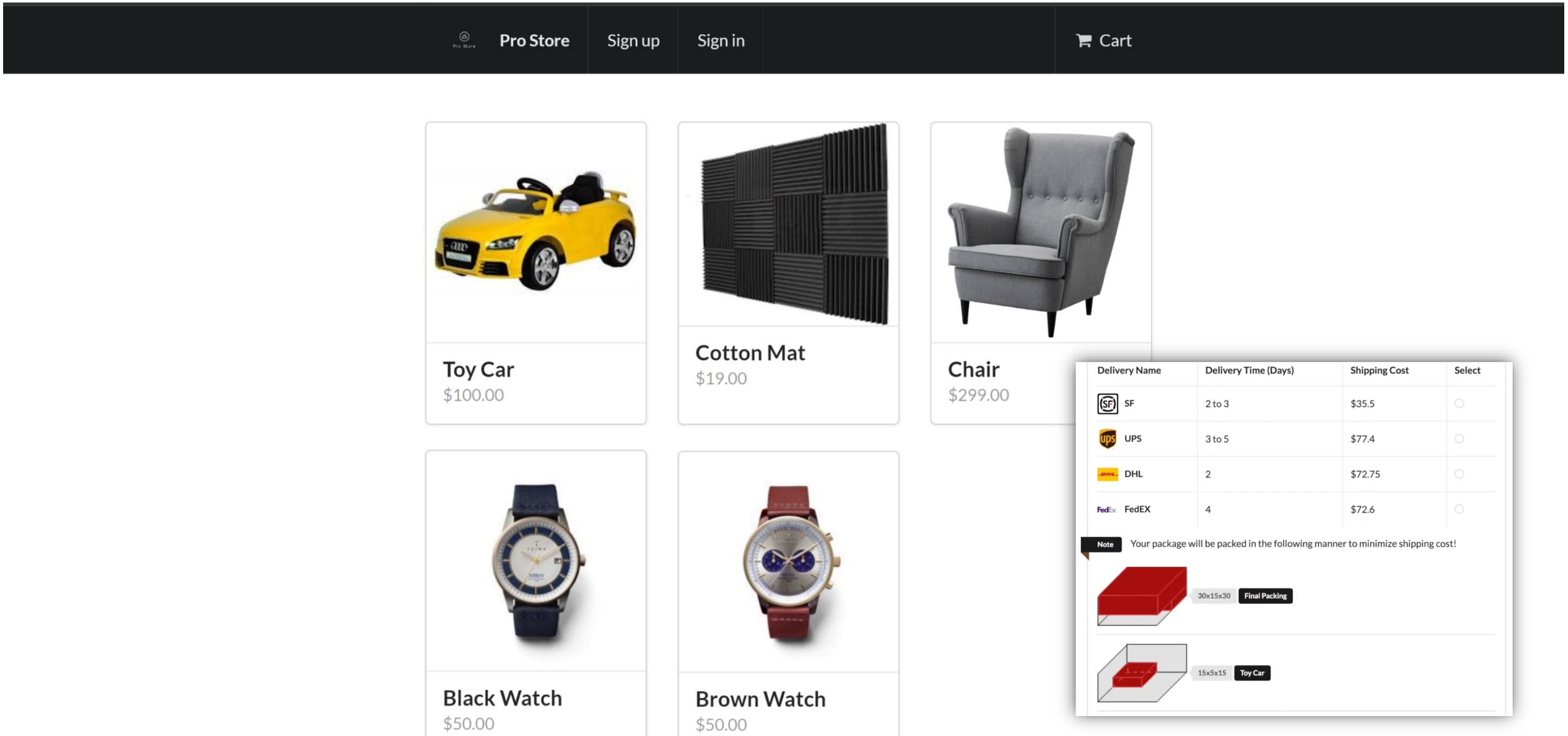
[FinTech] Merchant On-boarding



[FinTech] Co-branded Petrol Credit Card



[E-Commerce] Shipping and Packing Optimizer



Source https://github.com/IRS-RS/IRS-MRS-2019-07-01-IS01FT-GRP5-Intelliship

THE END