

NUS SOC Summer Workshop 2022

Artificial Intelligence of Things

Analytics & IoT / AI & FinTech

Course Information

Pre-requisites:

🐱 Which year of study is appropriate for your topic?

Year 2 and above

🐱 What background and programming languages are required for your topic?

Python and JavaScript

🐱 What do you think is attractive/unique about your topic?

This topic provides students with a unique opportunity to learn and integrate three important skills of the future economy, namely software engineering, IoT development and machine learning.

Learning content and Teaching

🐱 What will be covered during “trial” lectures?

Topic 1 – Overview of Artificial Intelligence of Things

- Pervasive computing paradigm.
- Introduction to Internet of Things (IoT).
- Overview of IoT architecture and IoT system design.
- Introduction to Artificial Intelligence (AI).
- Overview of implementing AI with machine learning.
- Artificial Intelligence of Things (AIoT) – The whole is greater than the sum of the parts.

Topic 2 – Single-board Microcontroller (I)

- Overview of single-board microcontrollers.
- Overview of the micro:bit.
- Technical characteristics and features of micro:bit.
- Programming micro:bit with JavaScript.
- Working with micro:bit onboard sensors.

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 What will be covered during the “advanced” seminars?

Topic 3 – Single-board Microcontroller (II)

- Working with micro:bit computational and communication capabilities.
- Basic electronic component concepts.
- How to work with external peripherals via the micro:bit’s edge connector.
- What is an Analogue to Digital Converter.
- How to write and read analogue and digital values to/from the micro:bit.
- Programming peripherals directly with micro:bit’s pins, and indirectly with edge connector breakout board.

Topic 4 – Single-board Computer (I)

- Overview of the Raspberry Pi single-board computer.
- General purpose programming with Python on Raspberry Pi.
- Basic Raspberry Pi GPIO programming using digital signal (I).

Topic 5 – Single-board Computer (II)

- Basic Raspberry Pi GPIO programming using digital signal (II).
- Basic Raspberry Pi GPIO programming using analogue signal.
- Working with other external devices.
- UART communication with Raspberry Pi over GPIO pins.
- BLE communication with Raspberry Pi.
- Using Raspberry Pi to control micro:bit devices with BLE and radio.
- Working with Raspberry Pi’s advanced interfaces.

Topic 6 – Server-side Backend Integration

- What is Service-Oriented Architecture.
- What is RESTful web service.
- How to create RESTful web service in Python with Flask-RESTful.
- How to test RESTful web service in Postman.

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- How to consume RESTful web service in Python.
- Persisting the data to a relational database.
- What is Publish-Subscribe messaging architecture.
- What is Message Queuing Telemetry Transport (MQTT).
- What is MQTT broker.
- How to create MQTT publisher and subscriber clients in Python with Eclipse Paho.

Topic 7 – Data Preparation for Machine Learning

- Basic data structures in Python and their limitations.
- How to use Python SciPy data science libraries to perform common data analytics tasks easily.
- Basic numerical processing using NumPy.
- Data preparation and exploration using Pandas.
- Data visualisation using Matplotlib.

Topic 8 – Machine Learning (I) – Supervised Learning (I)

- Regression analysis – Simple linear regression, multiple linear regression
- Classification (I) – Decision tree
- How to apply supervised learning to IoT sensor data.

Topic 9 – Machine Learning (II) – Supervised Learning (II) and Unsupervised Learning

- Classification (II) – Logistic regression
- Clustering – Partitioning methods
- How to apply unsupervised learning to IoT sensor data.

What will be the nature of the project work?

The project involves the conceptualization, design and implementation of a smart AIoT system. The deliverable must demonstrate both elements of IoT and AI.

The group size of the project is 4 students. The project involves IoT hardware development and thus students working on the hardware development might need to meet-up physically.

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The recommended group configuration is 2 students on hardware development, and 2 students on software development and AI.

Students would typically be grouped based on the university and actual location during the summer vacation period. For example, if a student is travelling home for the summer vacation, s/he might be grouped with students from another university that is located closer to his/her hometown.

🐱 Do you have any recommendations for references (books) where students can study to prepare for this topic beforehand?

Students are encouraged to self-learn the Python programming language if they are not familiar with it. Please refer to the official Python tutorial on this website –

<https://docs.python.org/3/tutorial/>

🐱 Apart from a laptop/computer, is there any other equipment/software required for this topic?

The course requires a set of IoT equipment based on micro:bit and Raspberry Pi. This would be issued to each group of students via courier. As this course focuses on IoT, it is important for students to hands-on with the IoT hardware. The hardware is also required for the group project.