SGINNOVATE POWERX ROBOTICS

NGEE ANN POLYTECHNIC

PRE-TRAINEESHIP ORIENTATION

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NPROBOTICS RESEARCH & INNOVATION CENTRE

POWER X ROBOTICS ENGINEERING TRAINING

POWER X ROBOTICS

- Nine modules to equip you to be a robotics engineering professional
- From learning robotics languages to construct a prototype for robotics applications
- Acquire IP right knowledge and techniques preparing for a business venture
- Complete this training in 3 months
- Blended learning (mix of F2F & virtual lessons) from 9am to 5pm (5 days per week)
- F2F Venue: Block 7 #01-04, Ngee Ann Polytechnic, 535 Clementi Road S599489
- Two weeks on-the-job training (OJT) in August

OVERVIEW & SCHEDULE OF STRUCTURED TRAINING

POWER X ROBOTICS

STRUCTURED TRAINING SCHEDULE (RUN 2) - FINAL

JULY 2021

SUN	MON	TUE	WED	THU	FRI	SAT
				1 Co. Briefing	2	3
4	5 Orientation	6 Python for Robotics	7	8	9	10
11	12 C++	13	14	15	16	17
18	19 ROS	20 PH	21 ROS	22	23	24
25	26 ROS	27 SLAM: Robot Auto. Nav.	28	29	30	31

AUGUST 2021

SUN	MON	TUE	WED	THU	FRI	SAT
1	2 Machine Learning	3	4	5	6	7
8	9 PH	10 OJT	11	12	13	14
15	16 OJT	17	18	19	20	21
22	23 Computer Vision	24	25	26	27	28
29	30 Embedded Systems	31				

SEPTEMBER 2021

SUN	MON	TUE	WED	THU	FRI	SAT
			1 Embedded Systems	2	3	4
5	6 IP & Biz	7	8 Capstone	9	10	11
12	13 Capstone Project	14	15	16	17	18
19	20 Capstone Project	21	22	23	24	25
26	27 Capstone	28	29 PPT	30		

OCTOBER 2021

SUN	MON	TUE	WED	THU	FRI	SAT
					1 RPT	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

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TRAINING MODULE – ROBOTICS WITH PYTHON FOUR DAYS

POWER X ROBOTICS

- You will learn:
  - Essential of Python Programming
  - Installation and Setting up of Python Environment
  - Manage Source Code with GitHub
  - Modules and Packages
  - Applying Python on Projects
- Assessment:
  - Individual Assignment: 30%
  - Group Assignment: 40%
  - Project Assignment: 30%
- Criteria to Pass:
  - Attendance – 80% and above
  - Passing Mark – 50 & above


```python
# update the estimated position of the robot using it's wheel encoder readings
def _update_odometry( self ):
  R = self.robot_wheel_radius
  N = float( self.wheel_encoder_ticks_per_revolution )

  # read the wheel encoder values
  ticks_left, ticks_right = self.robot.read_wheel_encoders()

  # get the difference in ticks since the last iteration
  d_ticks_left = ticks_left - self.prev_ticks_left
  d_ticks_right = ticks_right - self.prev_ticks_right

  # estimate the wheel movements
  d_left_wheel = 2*pi*R*( d_ticks_left / N )
  d_right_wheel = 2*pi*R*( d_ticks_right / N )
  d_center = 0.5 * ( d_left_wheel + d_right_wheel )

  # calculate the new pose
  prev_x, prev_y, prev_theta = self.estimated_pose.scalar_unpack()
  new_x = prev_x + ( d_center * cos( prev_theta ) )
  new_y = prev_y + ( d_center * sin( prev_theta ) )
  new_theta = prev_theta + ( ( d_right_wheel - d_left_wheel ) /
elf.robot_wheel_base_length )

  # update the pose estimate with the new values
  self.estimated_pose.scalar_update( new_x, new_y, new_theta )

  # save the current tick count for the next iteration
  self.prev_ticks_left = ticks_left
  self.prev_ticks_right = ticks_right
```

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TRAINING MODULE – ROBOTICS WITH C++ FIVE DAYS

POWER X ROBOTICS

- You will Learn:
  - C++ Basics
  - Fundamentals of Object Oriented Programming (OOP)
  - Inheritance, Polymorphism, Exception Handling, I/O and Streams
  - Standard Template Library, Function Template, Class Template
  - Preprocessor, Smart Pointers, Move Semantics, Lambda Functions
  - Application of C++ in Robotic Projects
- Assessment:
  - Individual Assignment: 30%
  - Group Assignment: 40%
  - Project Assignment: 30%
- Criteria to Pass:
  - Attendance: 80% and above
  - Passing Mark: 50% and above

MyRobot.cs MyProject

FNL.MyRobot Run()

```
// Access to standard .NET System
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;

// Access to the public Robocode API
using Robocode;

// The namespace with your initials, in this case FNL is the initials
namespace FNL
{
    // The name of your robot is MyRobot, and the robot type is Robot
    class MyRobot : Robot
    {
        // The main method of your robot containing robot logic
        public override void Run()
        {
            // -- Initialization of the robot --

            // Here we turn the robot to point upwards, and move the gun 90 degrees
            TurnLeft(Heading - 90);
            TurnGunRight(90);

            // Infinite loop making sure this robot runs till the end of the battle round
            while (true)
            {
                // -- Commands that are repeated forever --

                // Move our robot 5000 pixels ahead
                Ahead(5000);

                // Turn the robot 90 degrees
                TurnRight(90);

                // Our robot will move along the borders of the battle field
                // by repeating the above two statements.
```

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TRAINING MODULE – ROS FOR ROBOTICS
FIVE DAYS

POWER X ROBOTICS

- You will Learn:
  - Overview of ROS ecosystem
  - ROS Installation and Setup, Catkin Workspace
  - ROS Master, Packages & Nodes
  - ROS Topics, Messages, Publishers, Subscribers
  - ROS Services & Actions
  - Debugging and Visualization Tools in ROS
  - ROS Parameters
  - Custom Messages and Services

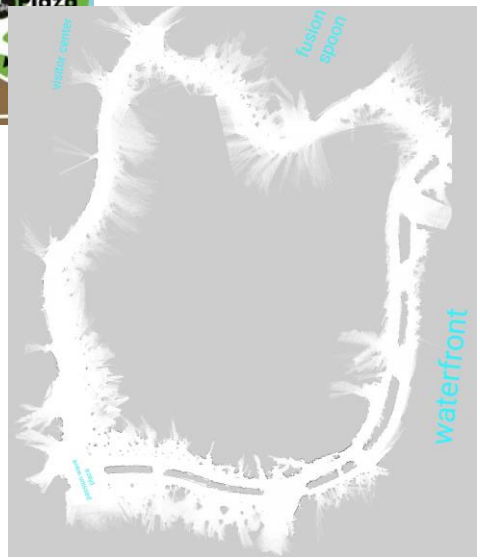
- You will Learn:
  - OOP with ROS in Python and C++
  - ROS Launch files, Bags
  - Introduction to ROS2
- Assessment:
  - Assignment: 50%
  - Quiz: 25%
  - Practical Test: 25%
- Criteria to Pass:
  - Attendance: 80% and above
  - Passing Mark: 50% and above

ROS

TRAINING MODULE – FOUR DAYS AUTONOMOUS ROBOT NAVIGATION

POWERX ROBOTICS

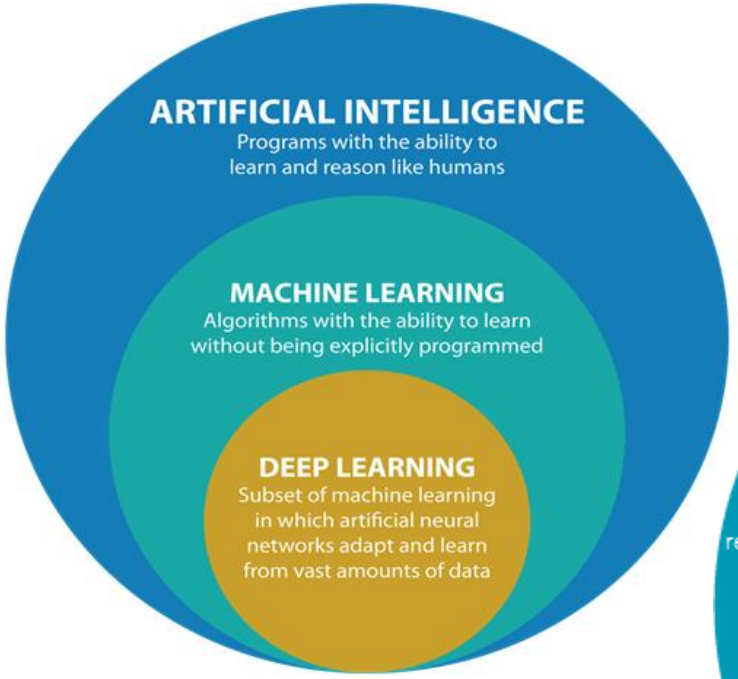
- You will Learn:
  - Overview of Robot Autonomous Navigation
  - Hardware for Robot Navigation System
  - ROS Navigation Stack
  - Odometry Kinematics
  - Mapping
  - TF and URDF
  - Localization
- You will Learn:
  - Path Planning
  - Obstacle Avoidance
  - Waypoint Management
- Assessment:
  - Assignment: 50%
  - Quiz: 25%
  - Practical Test: 25%
- Criteria to Pass:
  - Attendance: 80% and above
  - Passing Mark: 50 and above

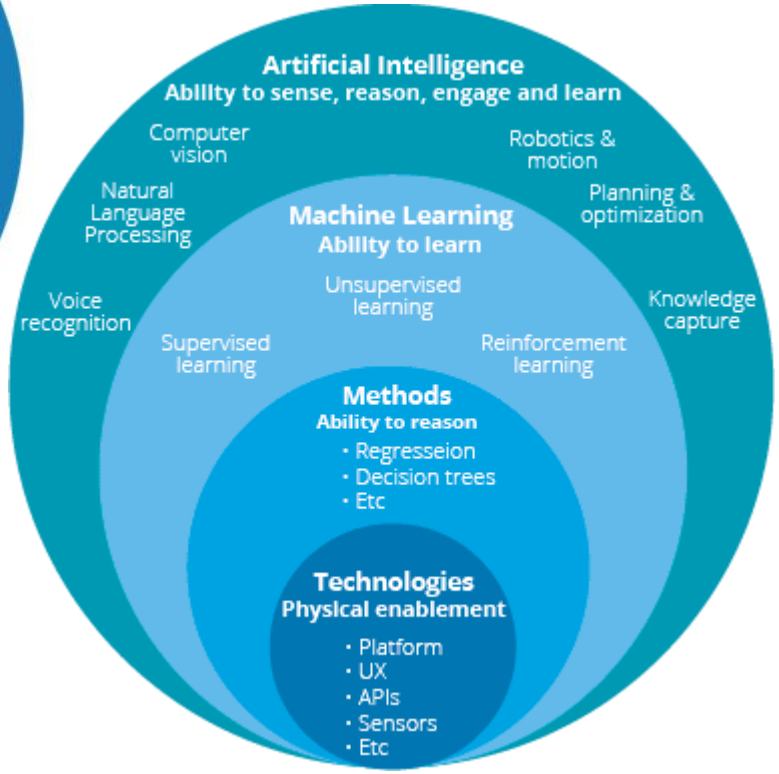


TRAINING MODULE – MACHINE LEARNING FOR FIVE DAYS ROBOTICS

POWER X ROBOTICS

- You will Learn:
  - Machine learning and its applications
  - Different machine learning models
  - Deep Learning with Tensorflow and Python
  - Machine learning using cloud service
- Assessment:
  - Assignment: 50%
  - Quiz: 25%
  - Practical Test: 25%
- Criteria to Pass
  - Attendance: 80% and above
  - Passing Mark: 50 and above





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TRAINING MODULE – COMPUTER VISION AND DEEP LEARNING FOR ROBOTICS

FIVE DAYS

POWER X ROBOTICS

- You will Learn:
  - Overview of Computer Vision
  - OpenCV functions for image processing and object detection
  - Convolutional Neural Networks (CNN)
  - Image Classification using Deep Learning
  - Building CNN Models with Tensorflow 2
  - Classifying images using Keras available models
  - Transfer Learning

- You will Learn:
  - Object Detection using Deep Learning
  - Object Detection Algorithms: SSD, YOLO, Faster R-CNN
  - Real-Time Object Detection Application with Tensorflow 2
  - Case Study: Person Re-Identification
- Assessment:
  - Assignment: 50%
  - Quiz: 25%
  - Practical Test: 25%
- Criteria to Pass
  - Attendance: 80% and above
  - Passing Mark: 50 and above

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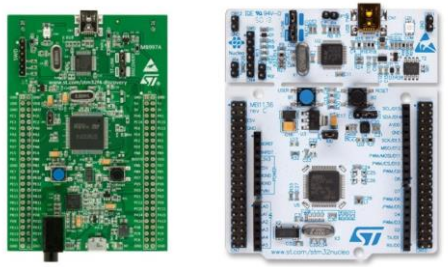
TRAINING MODULE – EMBEDDED SYSTEMS FOR ROBOTICS FIVE DAYS

POWER X ROBOTICS

- You will Learn:
  - Overview of Embedded Systems
  - Introduction to ATmega32 Microcontroller
  - Installation of IDE and Libraries
  - Essential C and Debugging
  - Microcontroller Input Interfacing
  - Sensors and Programming
- Assessment:
  - Quiz: 10%
  - Assignment: 45%
  - Project Assignment: 45%
- Criteria to Pass:
  - Attendance: 80% and above
  - Passing Mark: 50 and above

- You will Learn:
  - Microcontroller Output Interfacing
  - Output Devices and Programming
  - Microcontroller and ROS Communication
  - Microcontroller for Robotics Autonomous Navigation



STM32F4-DISCOVERY STM32 NUCLEO

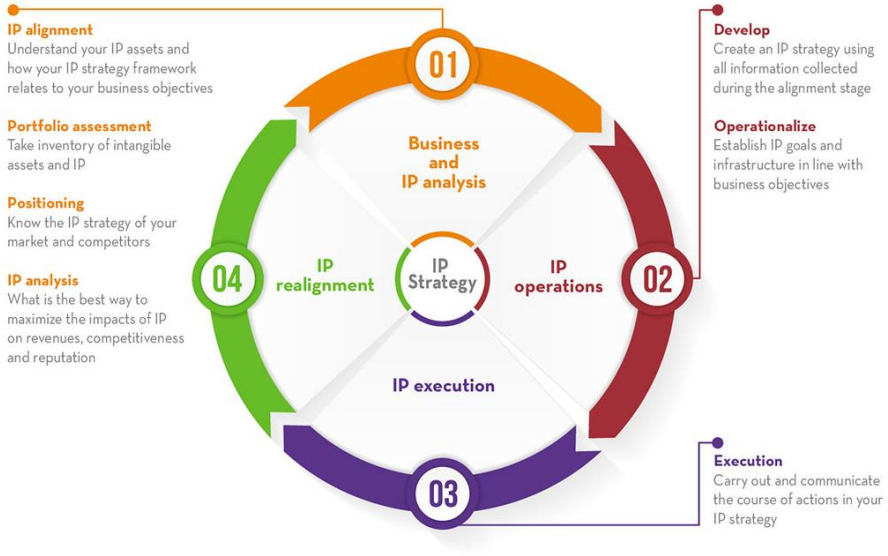
MOTORS

SENSORS

TRAINING MODULE – INTELLECTUAL PROPERTY AND BUSINESS MODEL PLANNING
TWO DAYS

POWER X ROBOTICS

- You will Learn:
  - Acquire the fundamental understanding of business planning, concepts and processes toward building effective business models
  - Apply the use of business techniques such as Business Model Canvas to design value propositions for a business venture
  - Analyse and integrate the various business functional areas involved in developing and managing a business venture
  - Acquire the fundamentals of understanding the IP rights may be created, protected and the role of IP rights in the robotics innovation process
- Assessment:
  - Quiz: 40%
  - Project Assignment: 60%
- Criteria to Pass:
  - Attendance: 80% and above
  - Passing Mark: 50 and above



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CAPSTONE ROBOTICS REAL WORLD PROJECT THREE & HALF WEEKS

POWER X ROBOTICS

- You will Learn:
  - To develop key systems on a robotics real-world project which comprises of
    - Robot Navigation System
    - Robot Guide Tour
    - Robot Usher or Follow-me
    - Vision Object Detection and Identification
- Assessment:
  - Report: 35%
  - Presentation: 35%
  - Demonstration: 30%
- Criteria to Pass
  - Passing Mark: 50 and above

- You will Work in a Team of 2 or 3 Members

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CERTIFICATION OF TRAINING MODULES

POWER X ROBOTICS

- **Post Diploma Certificate in Robotics Programming Fundamentals**
  - Python for Robotics
  - C++ for Robotics
  - Robot Operating System (ROS)
- **Post Diploma Certificate in Intelligent Autonomous Robotics**
  - Autonomous Robot Navigation
  - Machine Learning for Robotics
  - Computer Vision and Deep Learning for Robotics
  - Capstone Robotics Real World Project
- Passed both Post Diploma Certificates will be awarded:

  Specialist Diploma in Robotics Engineering

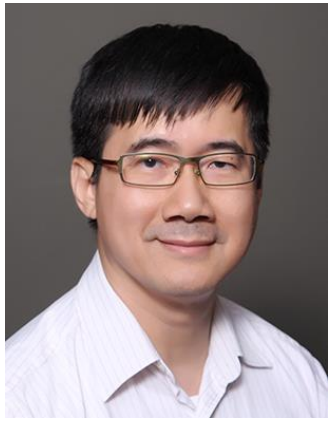
INTRODUCTION OF KEY PERSONNEL

POWER X ROBOTICS

- Ngee Ann Polytechnic Point of Contact (POC) for Administrative Matters:
  - Mr. TNG Chee Chin
  - Assistant Director/School of Engineering
  - Email: TNG_Chee_Chin@np.edu.sg

TNG Chee Chin

- Ngee Ann Polytechnic POC for Course Matters:
  - Mr. HUI Tin Fat
  - Assistant Director/Robotics Research & Innovation Centre (RRIC)
  - Email: HUI_Tin_Fat@np.edu.sg



HUI Tin Fat

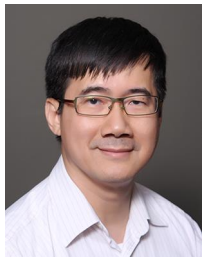
MODULE LEADERS

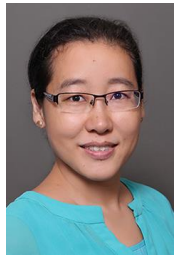
POWER X ROBOTICS


M1


M2


M3

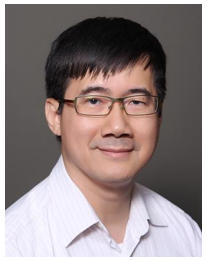

M4


M5


M6


M7


M8


M9

M1: Robotics with Python,	MR. LOW Chee Kin	Email: LOW_Chee_Kin@np.edu.g
M2: Robotics with C++,	MR. Kenneth KWEK	Email: Kenneth_KWEK@np.edu.sg
M3: ROS for Robotics,	MR. Edwin HO	Email: Edwin_HO@np.edu.sg
M4: Autonomous Robot Navigation,	MR. HUI Tin Fat	Email: HUI_Tin_Fat@np.edu.sg
M5: Machine Learning for Robotics,	DR. QU Weijuan	Email: QU_Weijuan@np.edu.sg
M6: Computer Vision & Deep Learning,	MS. CUI-LI Yan	Email: CUI-LI_Yan@np.edu.sg
M7: Embedded Systems for Robotics,	MR. Billy TEY	Email: Billy_TEY@np.edu.sg
M8: IP and Business Model Planning,	MR. Jayaprakash JAYADEVAN	Email: Jayaprakash_JAYADEVAN@np.edu.sg
M9: Capstone Real World Project	MR. HUI Tin Fat	Email: HUI_Tin_Fat@np.edu.sg

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INSTRUCTORS OF THE COURSE

S1

S2

S3

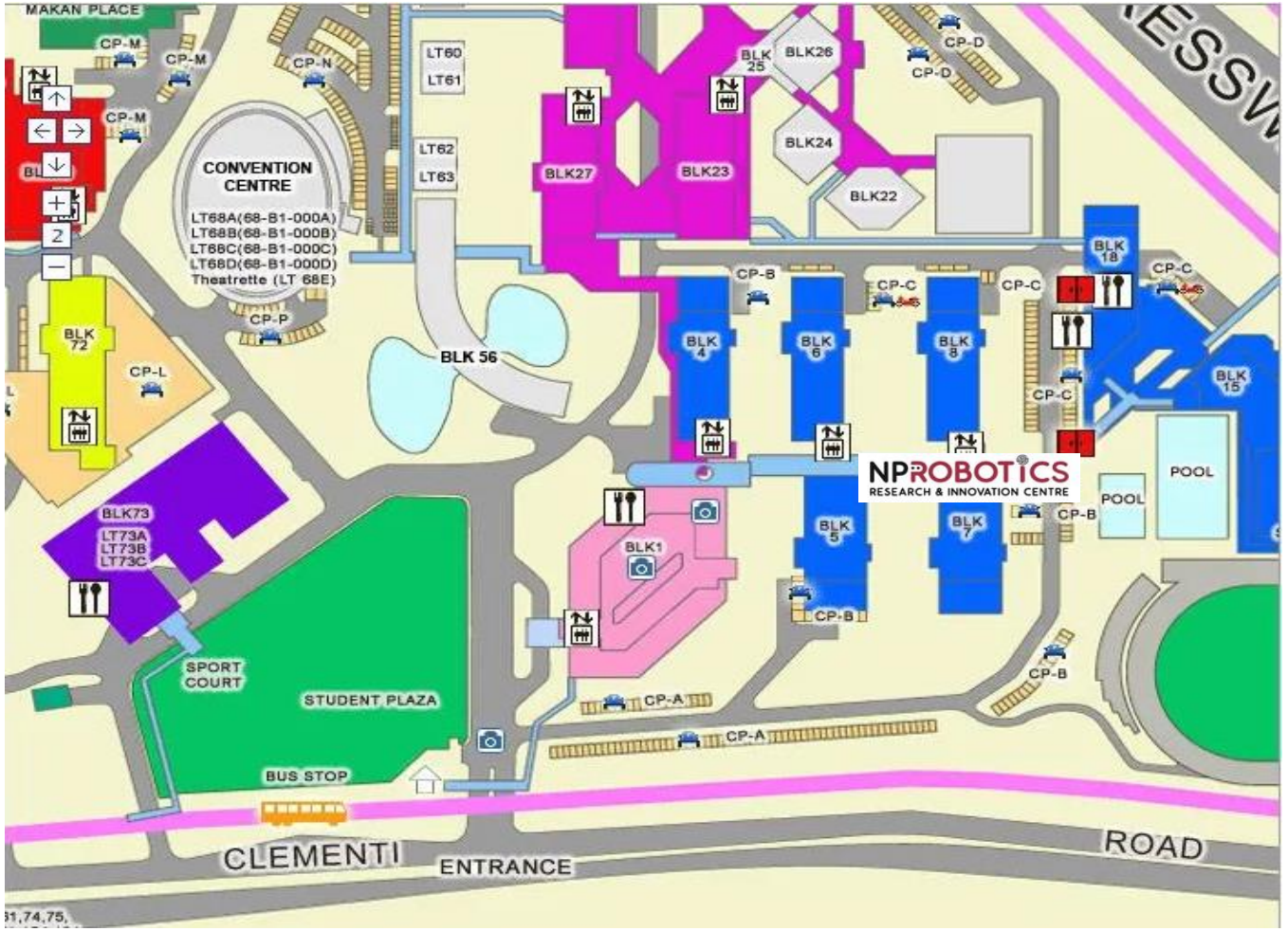
S4

S1: Embedded System for Robotics,	MR. TAI Jiun Pink	Email: TAI_Jiun_Pink@np.edu.sg
S2: Capstone Project and Practice,	MR. NG Kwek Khen	Email: NG_Kwek_Khen@np.edu.sg
S3: Capstone Project and Practice,	MR. ONG Wei Kok	Email: ONG_Wei_Kok@np.edu.sg
S4: ROS for Robotics	MR. CHAN Foo Chon	Email: Foo_Chon_CHAN@np.edu.sg

CAMPUS MAP AND MODE OF DELIVERY

POWER X ROBOTICS

- Face to Face Classes
- Follow MOE Safe Management Measures (SMM)
  - Wearing Mask in the Class
  - Keep 1 Meter Safe Distance in the Class
- Support Virtual Lesson but NOT Practical
- Venue: Block 7 Level 1 Room 4
  Ngee Ann Polytechnic
  535 Clementi Road
  Singapore 599489



SOFTWARE & HARDWARE REQUIREMENTS

Laptop PC Requirements

Minimum Specifications

Processor	Intel Core i5 4xxx or equivalent (Intel i7 recommended)
RAM	8 GB (16 GB recommended)
Storage Device	256 GB
Optical Device	DVD-ROM Drive (Optional)
Display	1024 x 900 display (1280 x 1024 recommended) with 16-bit colour and 512 MB Video RAM OpenGL 2.0 capable HDMI to VGA Adaptor or Display Port to VGA Adaptor for non VGA notebook Microsoft® Direct3D® DirectX9 with WDDM 1.0 or higher driver
Communication	Integrated or external IEEE 802.11b or equivalent
Operating System	Windows 10

Software Installation

- A NP PolyMall platform will be setup to provide all the teaching material and software installation guide of each module for the trainees
- For Python, teaching materials will be shared via email by 29 June.
- NP will run through PolyMall platform with trainees on 6 July.

THANK YOU!

POWER X ROBOTICS