THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

INDUSTRIAL CENTRE
工業中心

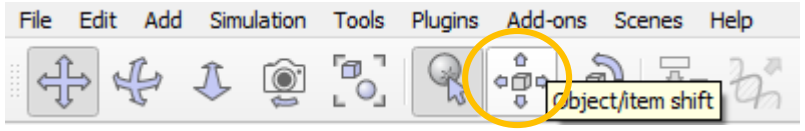
Control and Automation IC2122 Robotics Lab with VREP

Instructor: Louis Wong

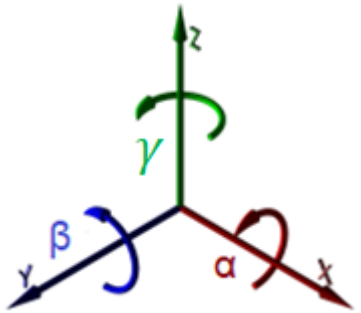
Industrial Centre

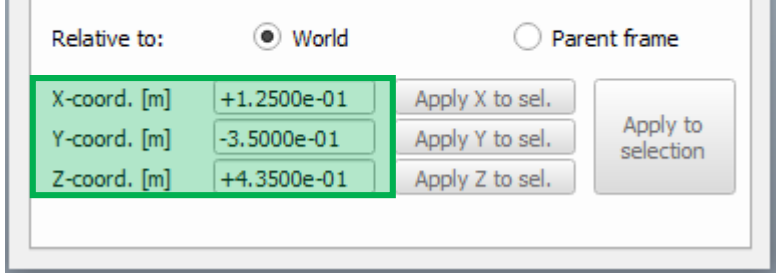
The Hong Kong Polytechnic University

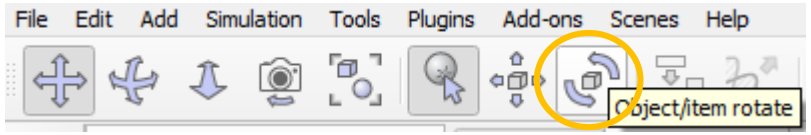
V-REP Tools

- Object Position:
  1. Select the object
  2. Click 

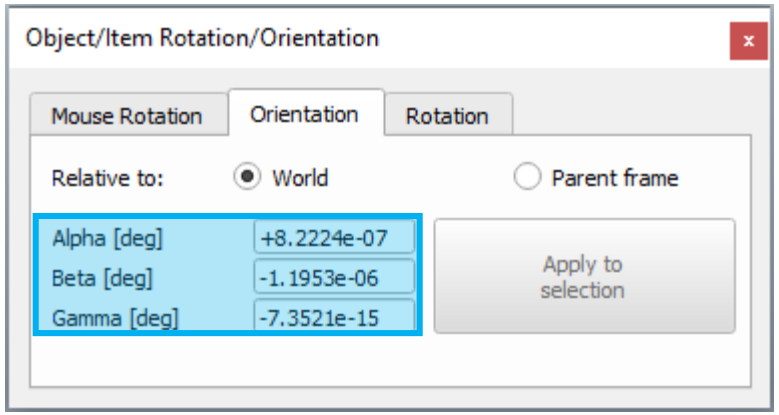
  3. Position: X, Y, Z





- Object Orientation:
  1. Select the object
  2. Click 

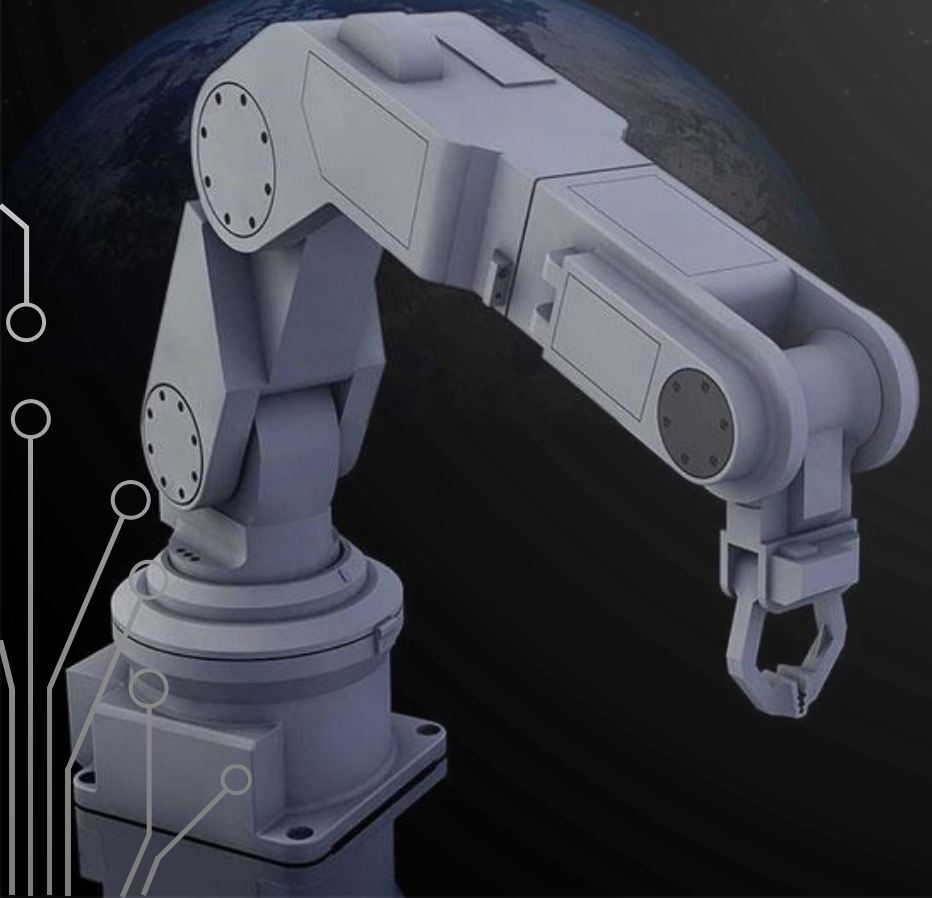
  3. Orientation: Alpha (α), Beta (β), Gamma(γ)

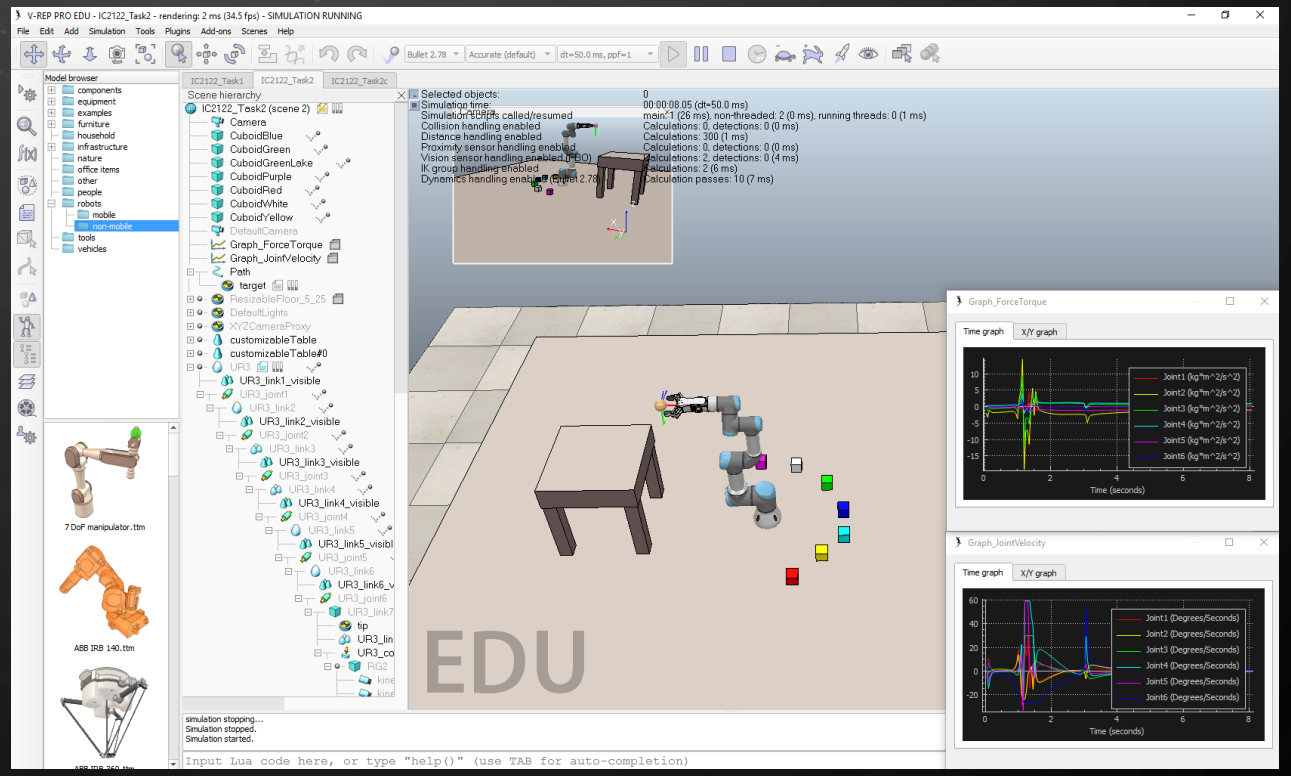


THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

INDUSTRIAL CENTRE
工業中心

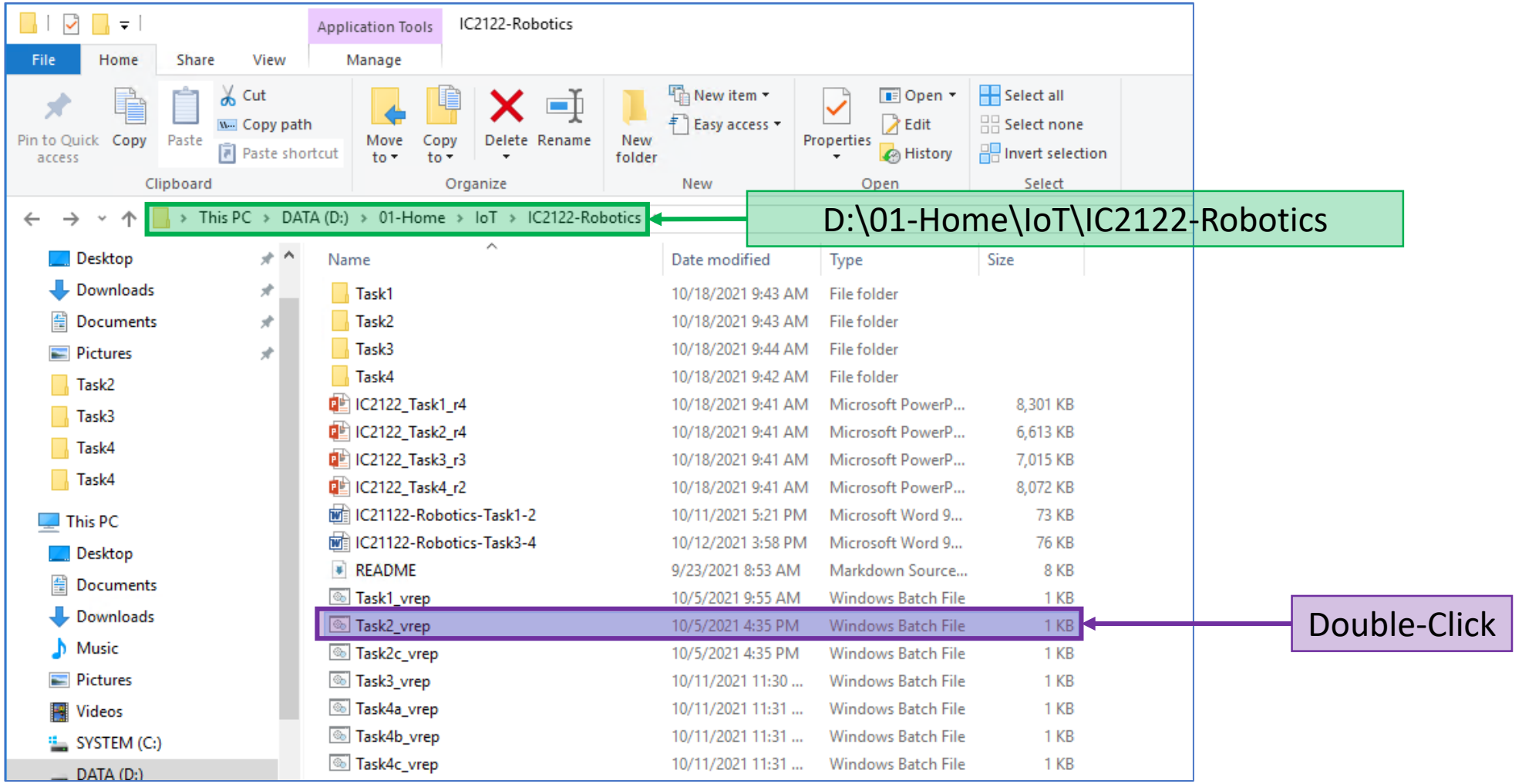
Task 2: Inverse Kinematics





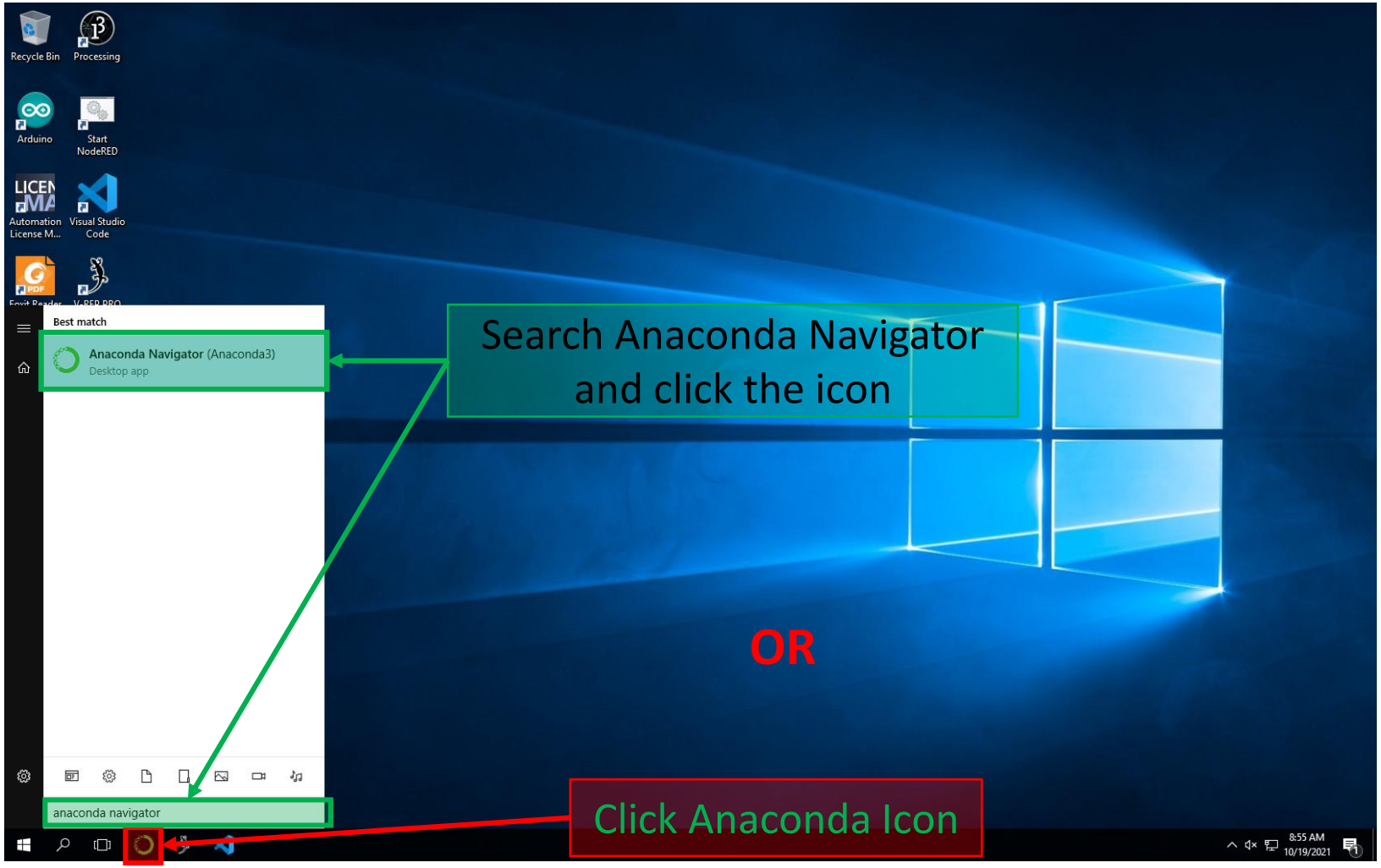
Start-up – V-REP

- Start the V-REP (Task2_vrep.bat)



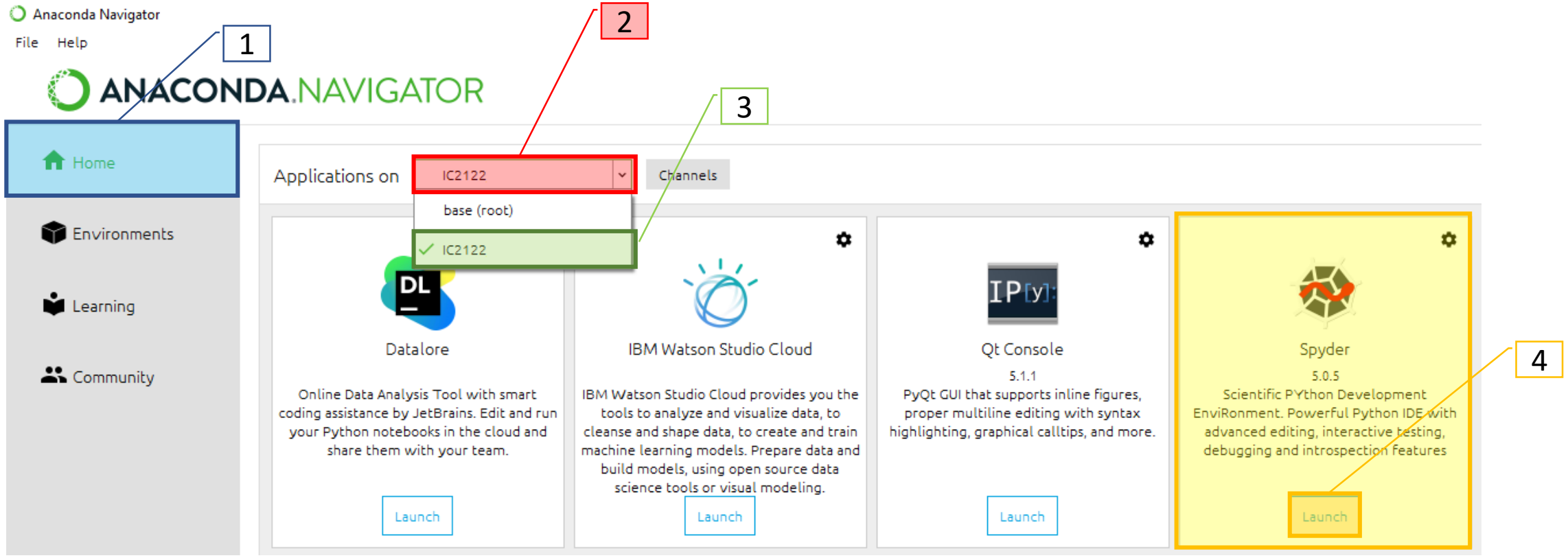
Start-up – Anaconda Navigator

- Start the Anaconda Navigator on Taskbar or search Windows

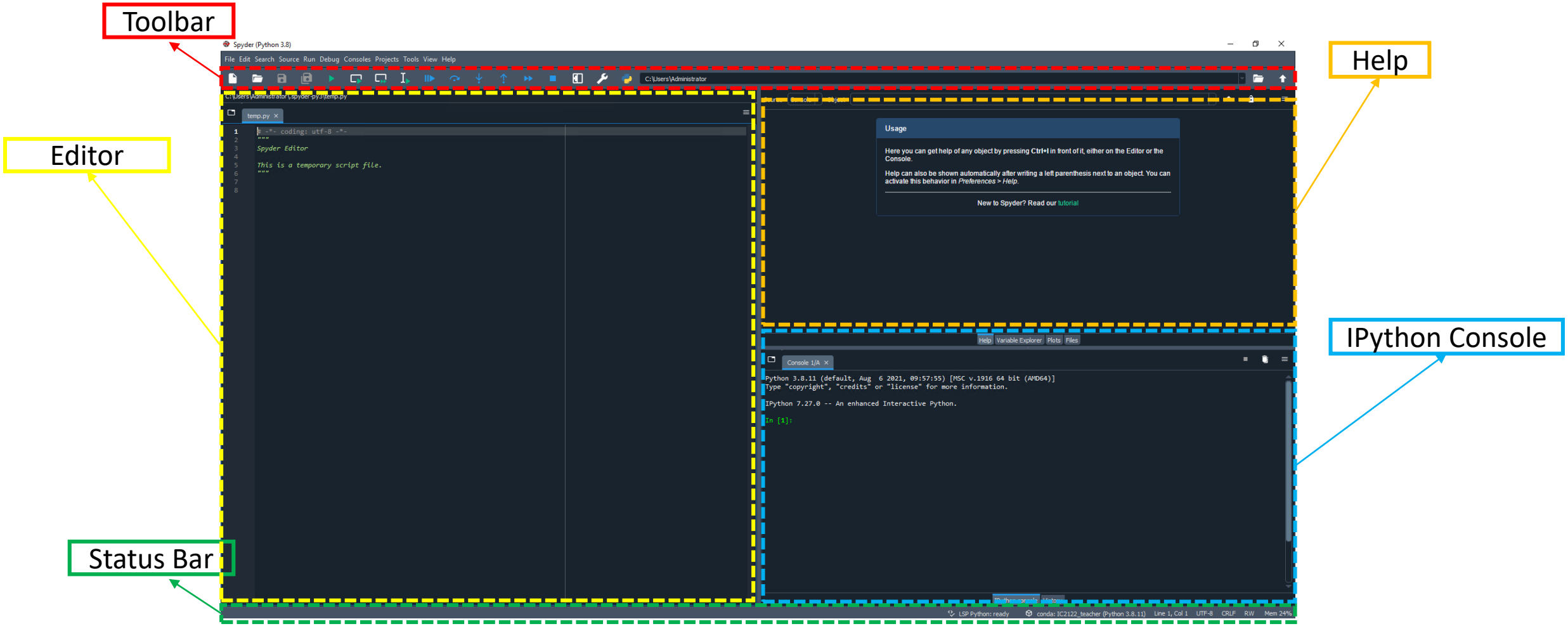


Start-up – Spyder

- Launch Spyder

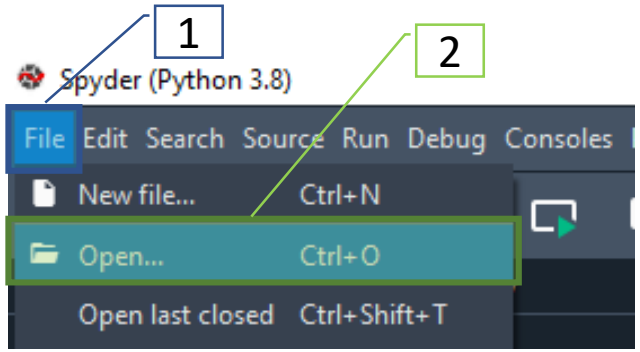


Start-up – Spyder



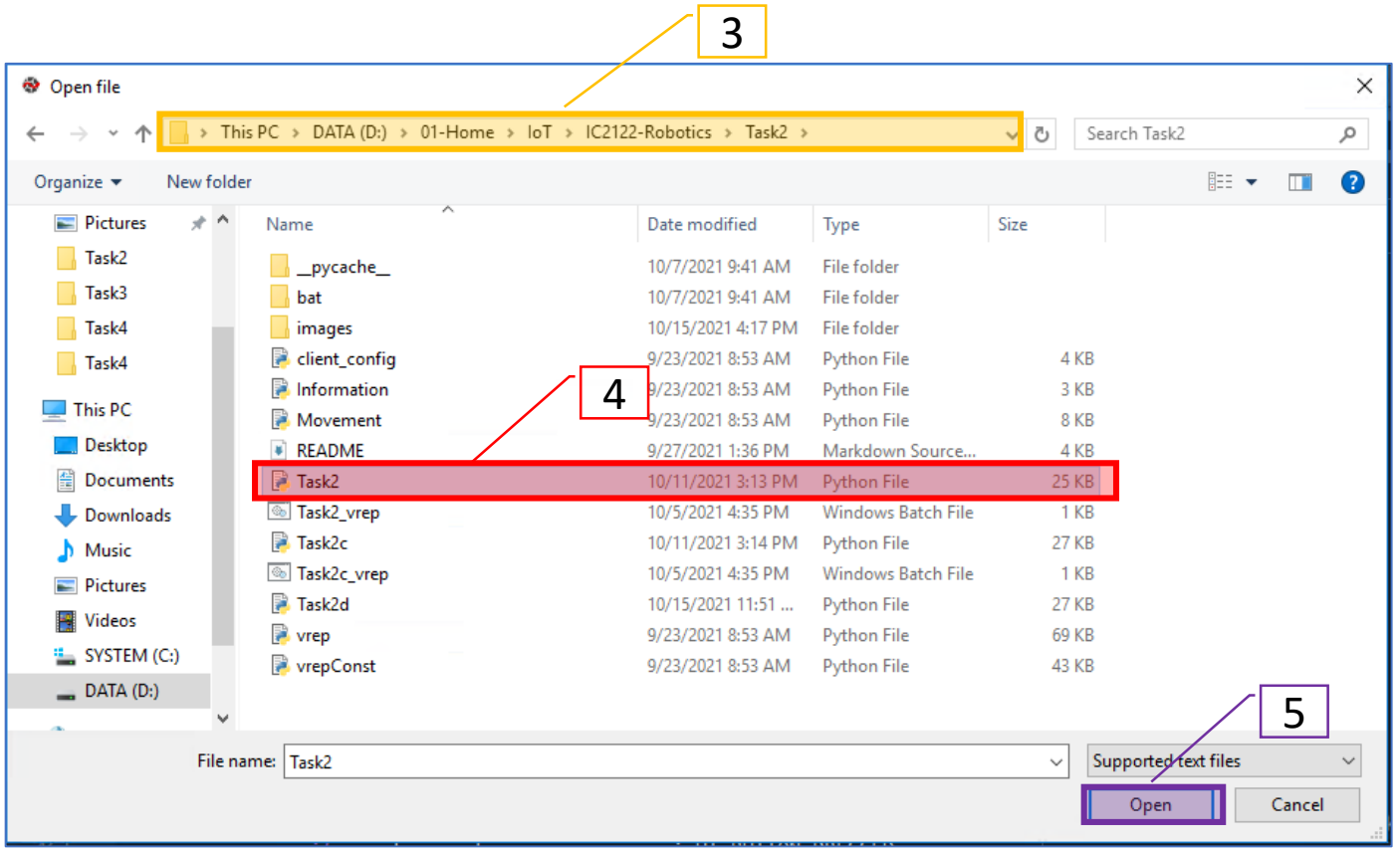
Start-up – Spyder

- Open Python file at editor



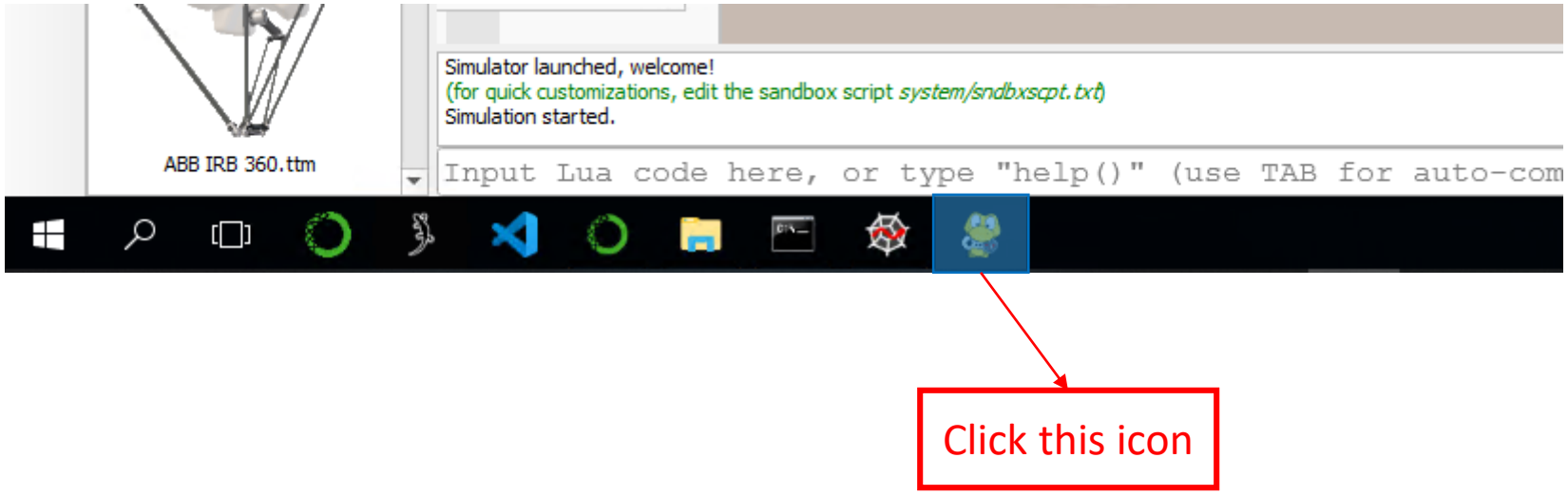
- Run the program at Spyder

D:\01-Home\IoT\IC2122-Robotics\Task2



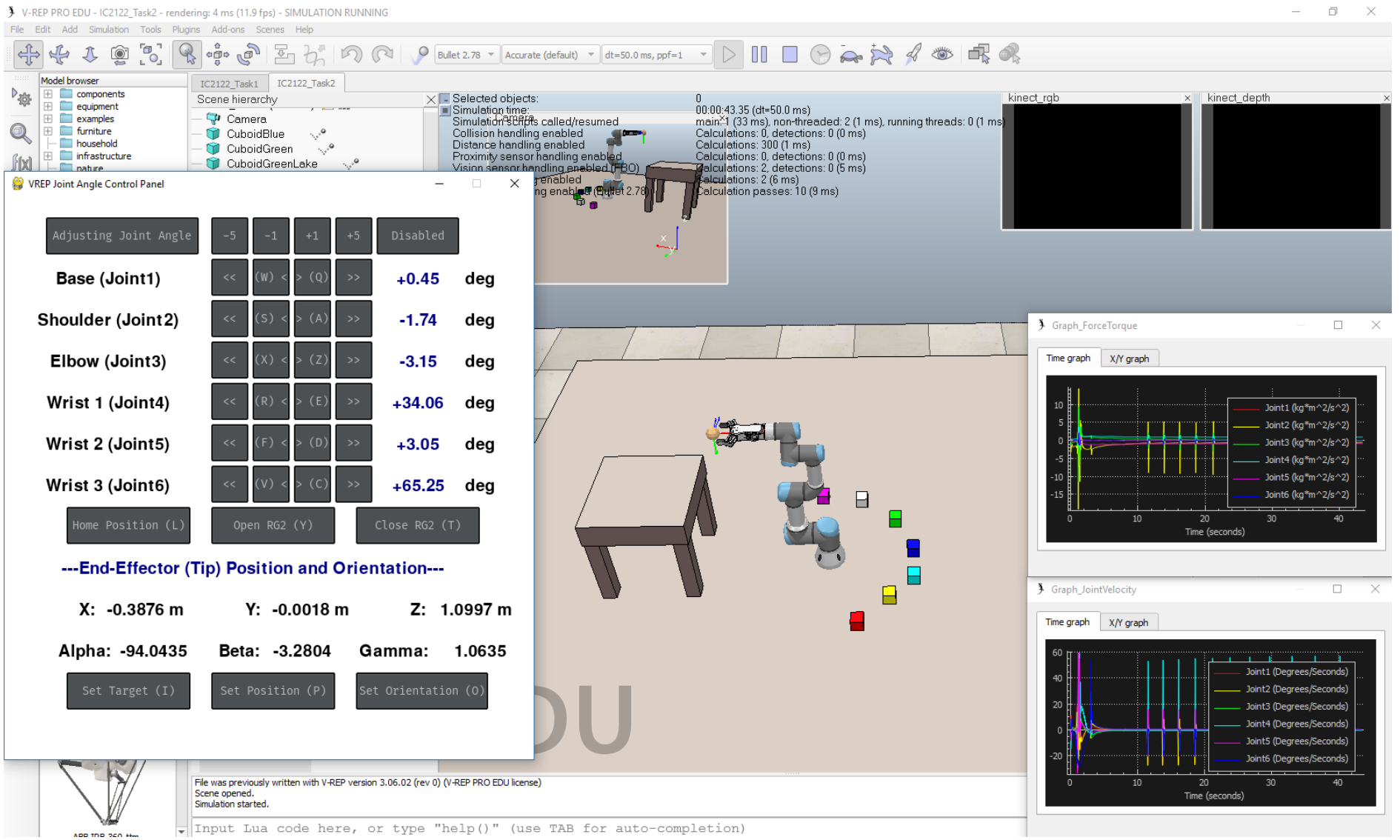
Start-up – Control panel window

- Control panel window will be appeared after running the program
- After switching to the V-REP, the control panel window will be hidden
- Click the Control panel window icon to open it.



Start-up

- V-REP interface:



V-REP Joint Angle - Control Panel

- Target Configuration

1. Set Target (T)

(Input your value at Console)

- Set target Position (X, Y, Z)
- Set target Orientation (Alpha, Beta, Gamma)

```
Input Position X: 0.4
Input Position Y: 0
Input Position Z: 0.435
Input Orientation Alpha (in degree): 0
Input Orientation Beta (in degree): 90
Input Orientation Gamma (in degree): 180
```

2. Set Position (P)

(Input your value at Console)

- Set target Position (X, Y, Z)

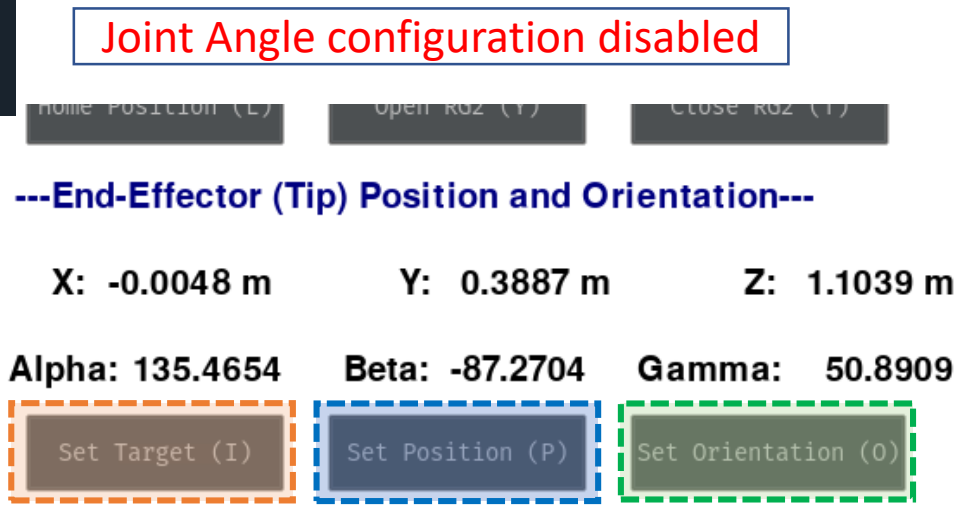
```
Input Position X: 0.4
Input Position Y: 0
Input Position Z: 0.435
```

3. Set Orientation (O)

(Input your value at Console)

- Set target Orientation (Alpha, Beta, Gamma)

```
Input Orientation Alpha (in degree): 0
Input Orientation Beta (in degree): 90
Input Orientation Gamma (in degree): 180
```



V-REP Joint Angle – How to use "Set Target" button?

- How to use the "Set Target" button?
  1. Click "Set Target" button
  2. Switch to the Spyder IPython Console
  3. Input Position or Orientation value
  4. Press "Enter" to confirm the inputted value
  5. Repeat above two steps
  (X, Y, Z, Alpha, Beta, Gamma)
  6. The UR3 will be moved
  based on the setting

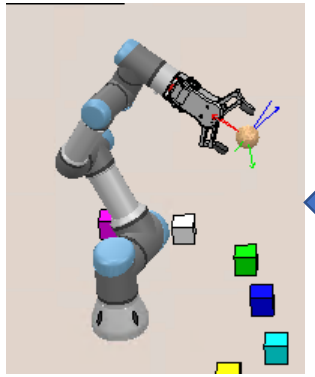
Step 1

Step 2

```
pygame 2.0.1 (SDL 2.0.14, Python 3.8.11)
Hello from the pygame community. https://www.pygame.org/contribute.html
Simulation started
connect successfully
Simulation start

Input Position X: 0.3

Input Position Y: 0

Input Position Z: 0.9

Input Orientation Alpha (in degree): 0

Input Orientation Beta (in degree): 43

Input Orientation Gamma (in degree): -169
```

Step 3&4

Step 5



Step 6

IC2122 – Task 2a

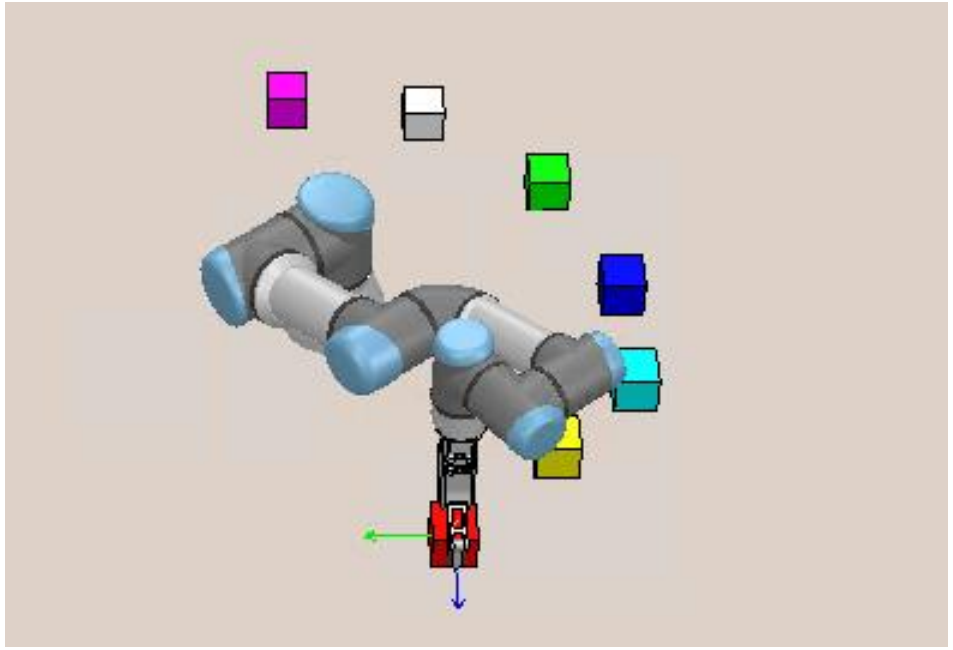
- Task 2a: Move the end-effector to the RED block using Inverse Kinematics and write down the procedure.
- (Remark: Adjust the end-effector vertically to the ground)

Red Block Position:	Position X	Position Y	Position Z
	0.125 m	-0.35 m	0.435 m

Joint Angle

Base (Joint1)	<< (W) < > (Q) >>	+37.65	deg
Shoulder (Joint2)	<< (S) < > (A) >>	-70.57	deg
Elbow (Joint3)	<< (X) < > (Z) >>	-0.33	deg
Wrist 1 (Joint4)	<< (R) < > (E) >>	+162.7	deg
Wrist 2 (Joint5)	<< (F) < > (D) >>	-89.42	deg
Wrist 3 (Joint6)	<< (V) < > (C) >>	-142.32	deg

Final Goal



IC2122 – Task 2b

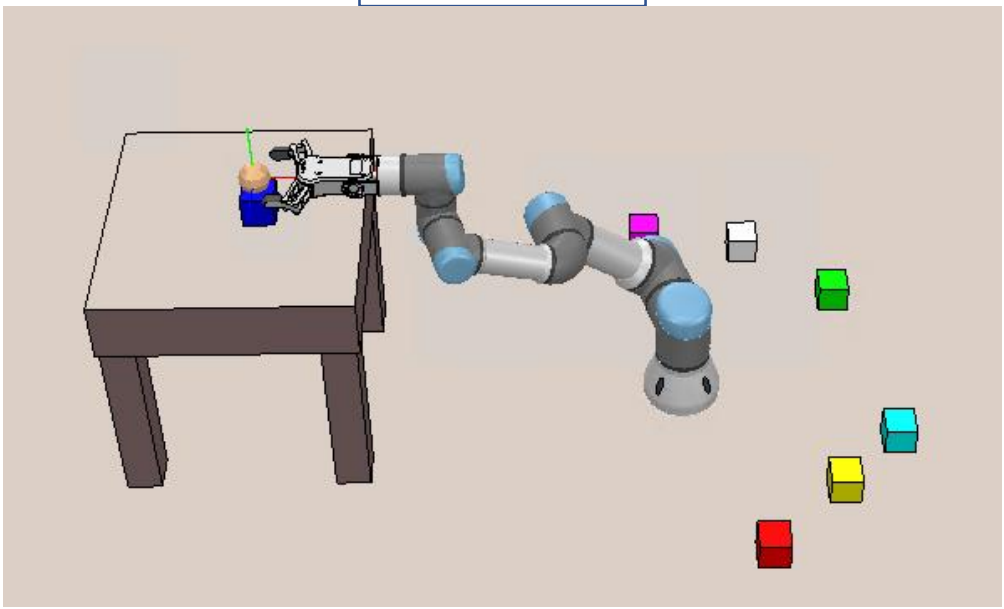
- Task 2b: Pick the BLUE block and place it on the table using Inverse Kinematics and write down the procedure.

(Remark: Make the end-effector vertically to the ground for picking and horizontally to the table for placing)

BLUE Block original Position:	**Position X**	**Position Y**	**Position Z**
	0.35 m	0.0225 m	0.435 m

BLUE Block final Position:	**Position X**	**Position Y**	**Position Z**
	≈ -0.667 m	≈ 0 m	0.846 m

Final Goal

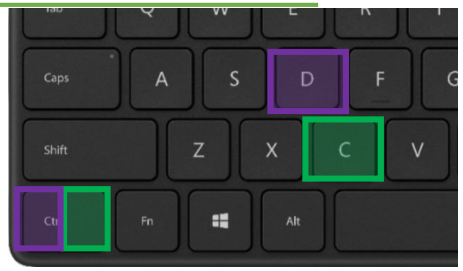


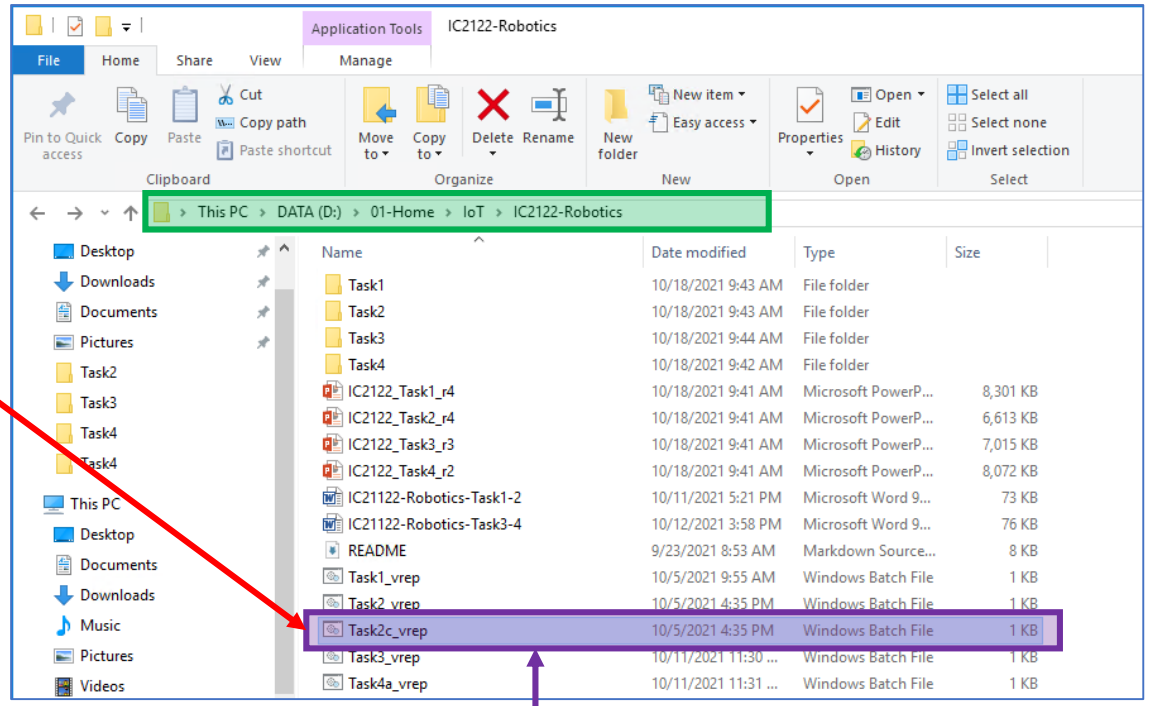
IC2122 – Task 2c

- Stop the program by holding “Ctrl” and clicking “C” (IPython console)
- Open a new console by holding “Ctrl” and clicking “D” (IPython console)
- Close the previous V-REP
- Start a new V-REP (Task2c_vrep.bat)
- Switch to Spyder and open Tack2c.py

(D:\01-Home\IoT\IC2122-Robotics\Task2)

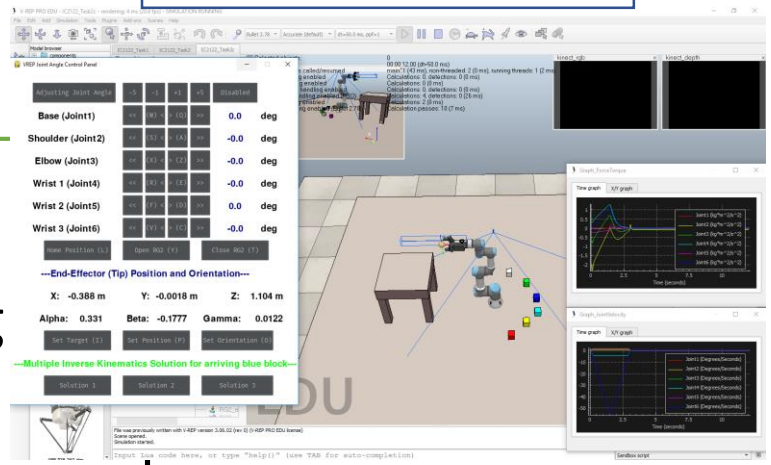
- Run the program (Spyder)





IC2122 – Task 2c

Task 2c interface



- Task 2c: Moving the end-effector to the BLUE block using

Inverse Kinematics often provides different solutions or approaches.

a) Observe and discuss the below 3 solutions.

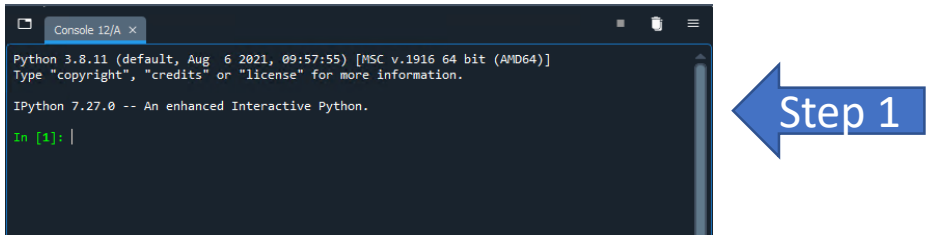
---Multiple Inverse Kinematics Solution for arriving blue block---

Solution 1 | Solution 2 | Solution 3

b) Suggest the method to create the unique solution (e.g. guide)

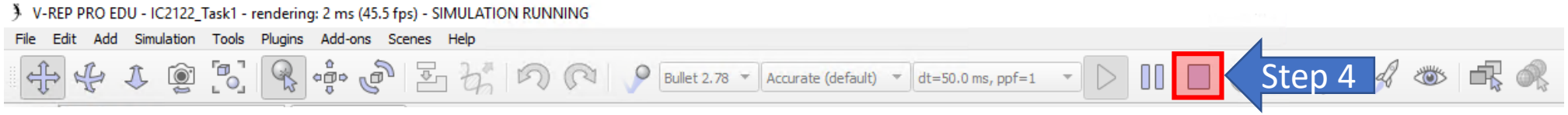
Task2 – Troubleshoot

- Step 1: Switch to the Spyder IPython Console

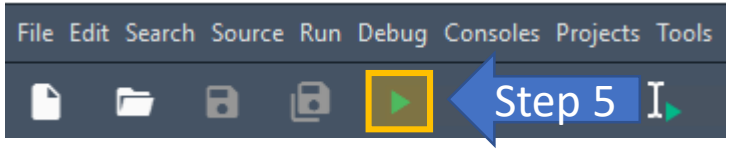


- Step 2: Stop the program by holding “Ctrl” and clicking “C”
- Step 3: Open a new console by holding “Ctrl” and clicking “D”

- Step 4: Stop the V-REP simulation



- Step 5: Run the program at Spyder



THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

INDUSTRIAL CENTRE
工業中心

Q&A