MTRN 3060

PRACTICAL WEEK 2

ABB IRB120 and IRC5

Learning outcome:

In the first week of this course, you were introduced to the simulation environment and its functions in ABB robotic studio, a software tool for designing and testing robotic applications. In the second week, you will explore the following topics:

- Students can use RobotStudio or similar software to design, simulate and program various industrial robots for different applications and scenarios.
- Students will be able to understand and interpret the datasheet and technical drawing of a robot. Evaluate the advantages and disadvantages of different robots.

TASKS:

Understanding the robot datasheet and running simulations are important.

Reading the robot datasheet helps you understand the robot's specifications, features, and capabilities, such as its size, weight, payload, speed, accuracy, and range of motion. This can help you select the best robot for your task and avoid errors or failures, especially avoiding singularity.

Running simulation helps you to design, test, and optimize the robot system in a virtual environment before deploying it in the real world. This can help you to save time, money, and resources by avoiding costly physical experiments and debugging. Simulation can also help you improve the robot system's performance, safety, and reliability by enabling you to try different scenarios, parameters, and algorithms.

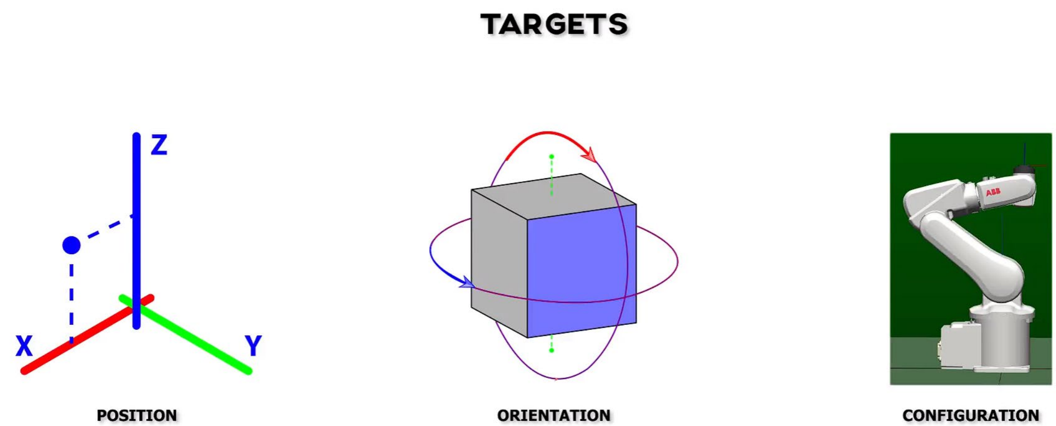
In this lab, you will:

- Identify an Articulated robot's main components and features, such as the base, arm, wrist, and end effector.
- Read and use the Cartesian coordinate with the Euler angles coordinate system to specify the position and orientation of the robot.
- Compare and contrast different types of Articulated robots based on their specifications, such as reach, speed and accuracy.
- Building an environment for the simulation and validating the result.

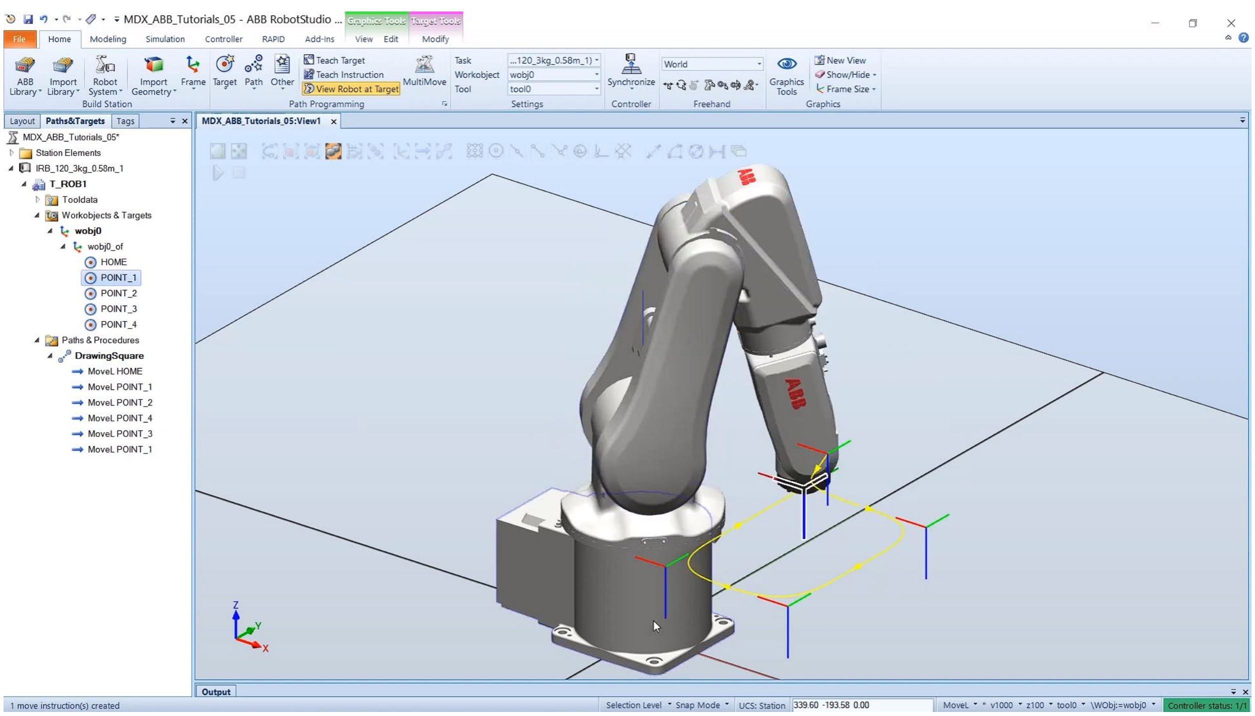
Prepare:

- Read Chapter 1&2 of the robot datasheet: "RB 120-en.pdf" (Safety guide requirement).
- Read Chapter 3 of the RobotStudio manual.
- Watch the tutorial videos below:

- Paths and target part 1: https://youtu.be/7shSlqdwl5o



- Paths and target part 2: https://youtu.be/adqSN_IEK-w



- Download the "Table.sat" file on ilearn

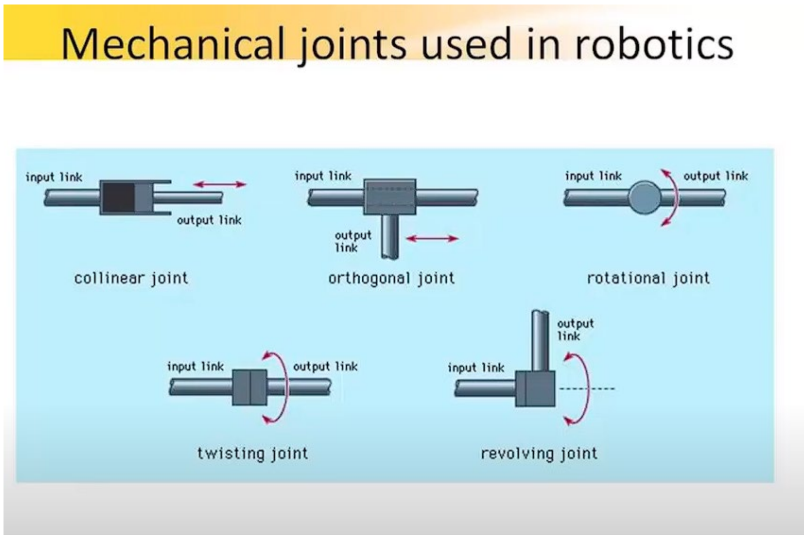
TASK 1. PHYSIC CONFIGURATION

The physics configuration of a robot is a way of describing the position and orientation of all the parts of the robot. It depends on the type and number of joints that connect the robot's links. The set of all possible physics configurations of a robot is called the configuration space or C-space.

There are five basic configurations for robots: Cartesian configuration, cylindrical configuration, polar and spherical configuration, articulated configuration, and SCARA configuration.

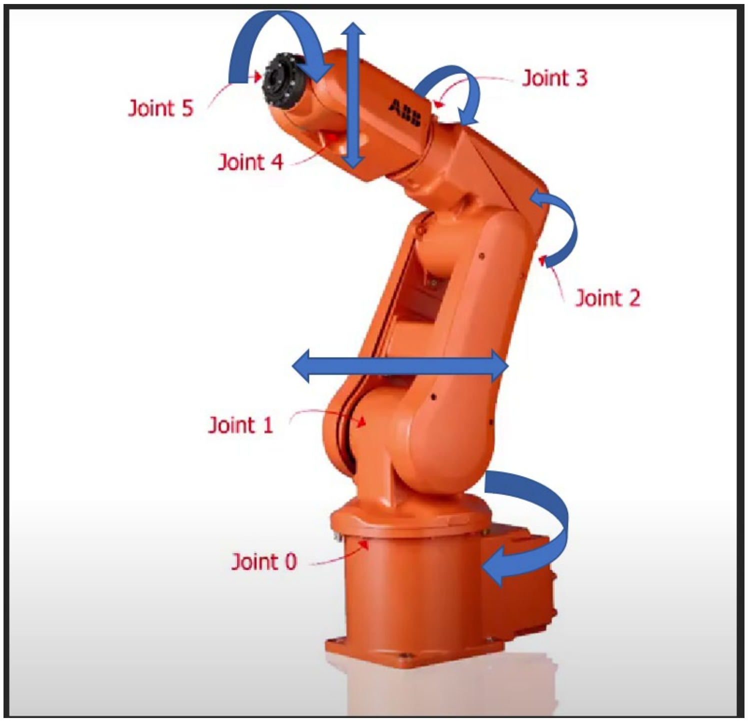
Before going through robot configuration, we must understand the different types of joints used in robotics.

1.1: Go through this video: [Robot Mechanical Joints - YouTube.]



1.2: Research and fill the table below with your understanding:

Feature	Revolute joint	Linear joint	Twisting joint	Orthogonal joint	Revolving joint
Structure	Pin or knuckle joint through a rotary bearing				
Mobility	One degree of freedom (rotation)				
Examples	Elbow, knee, interphalangeal joints				



1.3: Using the robot datasheet and the image above, fill in the table below with your understanding:

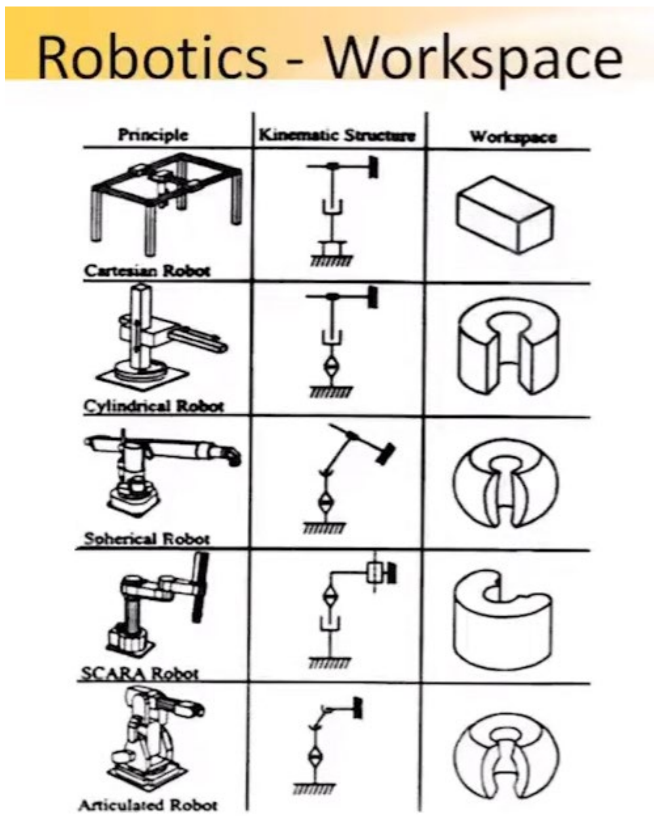
No.	Type of joint	Mobility
Joint 1	Revolute	One degree of freedom (rotation around 1 axis)

TASK 2. WORKING ENVELOPE AND WORKING SPACE

Working space and working envelope are important concepts in robotics because they describe the range of movement and the shape of space a robot can reach and operate in. Different types of robots have different shapes of work envelopes, such as cubic, rectangular, and cylindrical…. The robot's physic configuration determines the work envelope, while the workspace depends on the type and size of the tools and the work envelope.

The workspace and work envelope are useful for safety and layout considerations, as they help to avoid collisions and interference with other objects or robots in the environment. They also help to determine the feasibility of a desired task or configuration, as some positions and orientations may not be reachable or stable for a given robot. Therefore, knowing a robot's workspace and work envelope can help optimize its performance and efficiency.

2.1: Watch this video: Robot Principal Types and their Work Space - YouTube.



2.1: Using the working envelope in the robot datasheet, describe its shape in a few sentences:

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2.2: Does IRB 120 use a Polar configuration? If not, explain the correct configuration of it.

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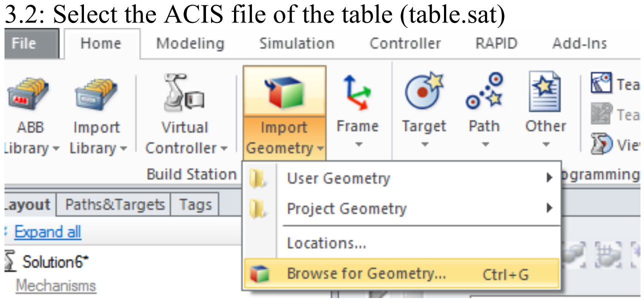
2.3: The tool (in the image below) is mounted to the robot's flange, and the length of the tool is 20cm. Using the simulation to describe the difference in a few sentences (you need to complete task 3&4 first):

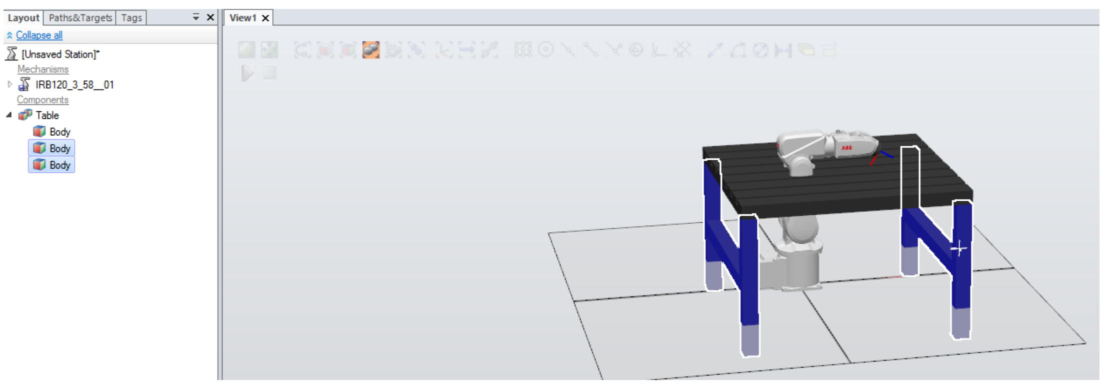
TASK 3. CREATE SIMULATION ENVIRONMENT

3.1: Follow the step below to create Workobject using the world base frame

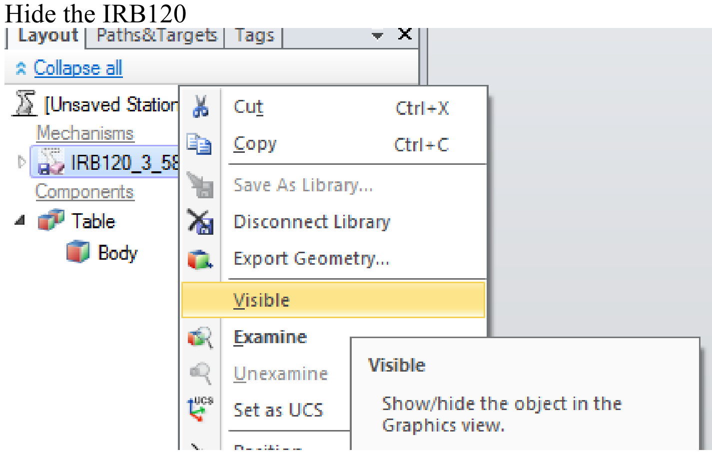
3.2: Select the ACIS file of the table (table.sat)



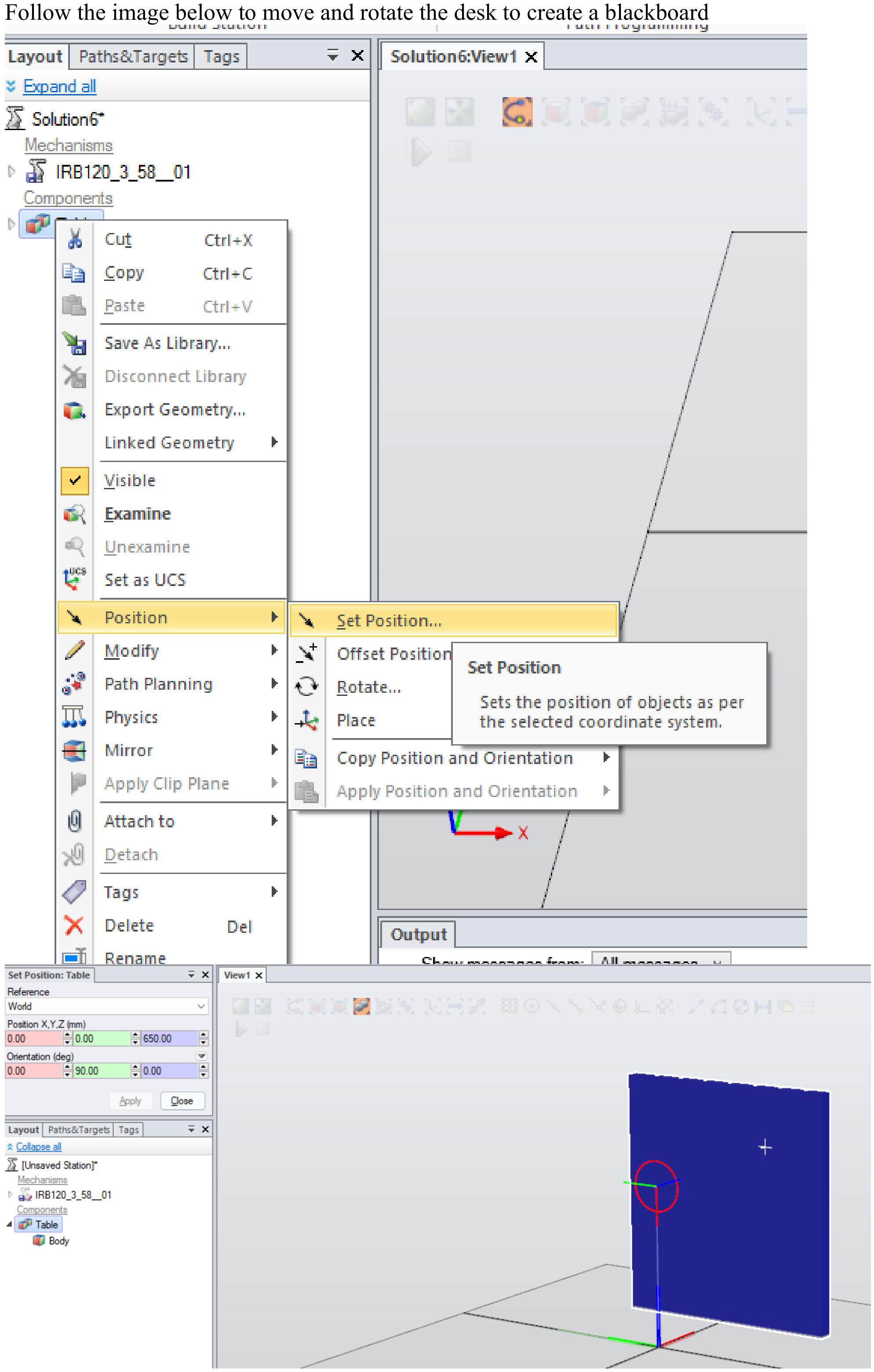
3.3: Select the stands of the table → Delete it



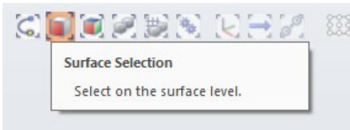
3.4: Hide the IRB120

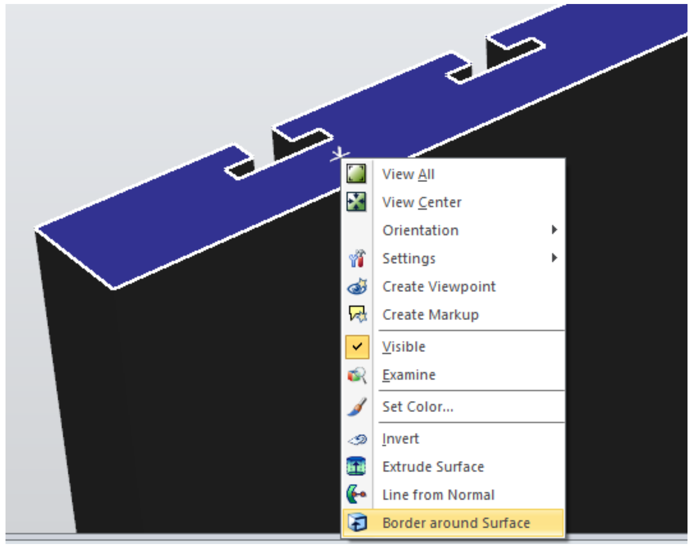


3.5: Follow the image below to move and rotate the desk to create a blackboard



3.6: To create a selectable surface, switch to surface selection and right-click on the top surface of the board → Border around Surface → Create

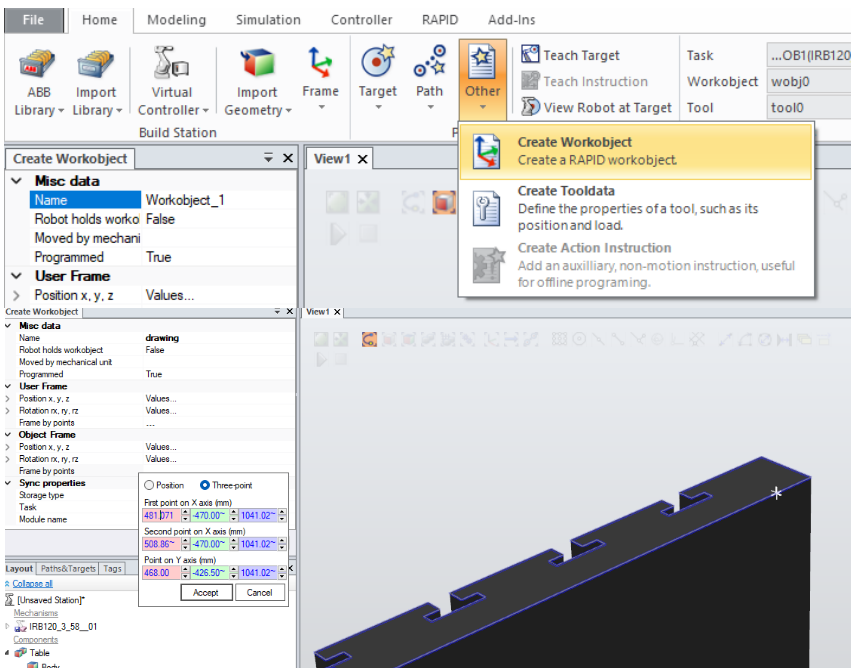




3.7: Rename the new surface to "table_top."

3.8: Switch back to "curve selection" 

3.9: Create a workobject to create a new reference frame at another point

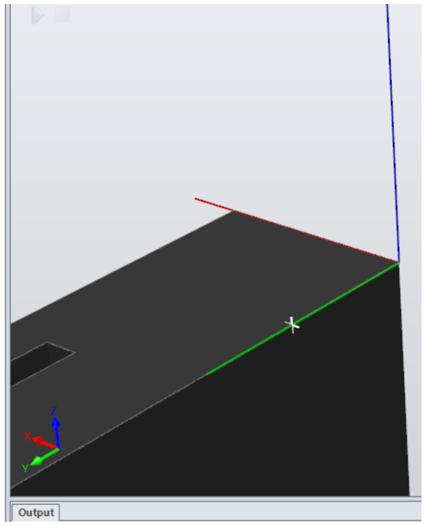


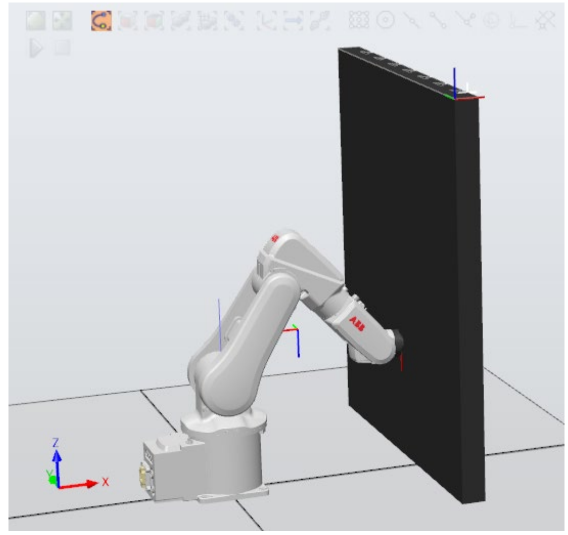
3.10: Change the Name to "drawing."

3.11: Select Three-point in Frame by points → using the previous "table-top" surface to create a new Frame.

3.12: Accept → Create

3.13: The new Frame should be in the same orientation as the world frame (on left bottom corner)

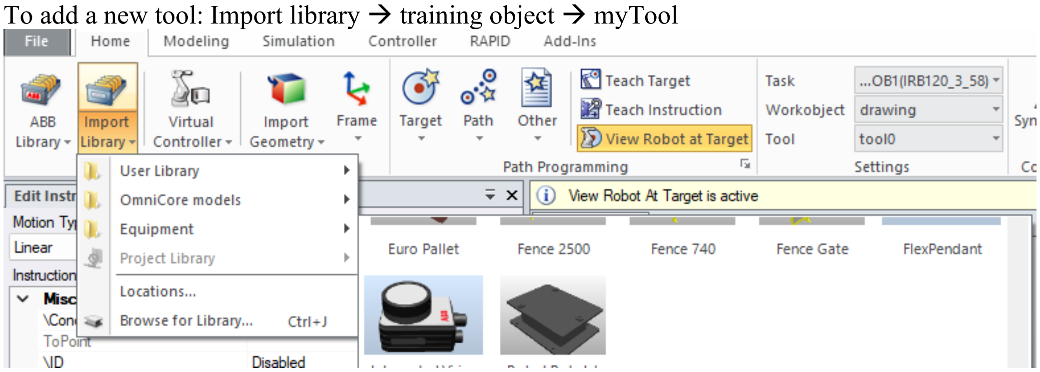




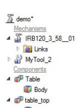
3.14: Follow the video at the beginning of this practical to create a target that allows the robot to touch the wall, like the image above.

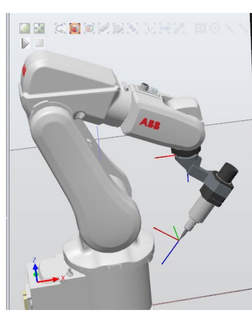
TASK 4. ADD AND MANIPULATE TOOL

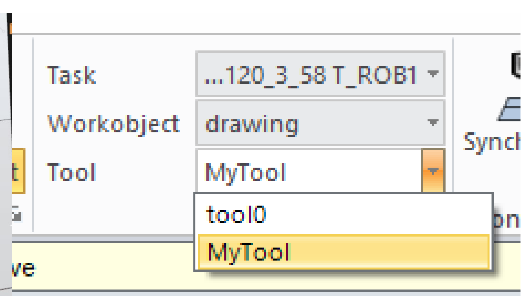
4.1: To add a new tool: Import library → training object → myTool



4.2: Drag "MyTool" to the top of IRB120 mechanisms to attach the tool to the robot.

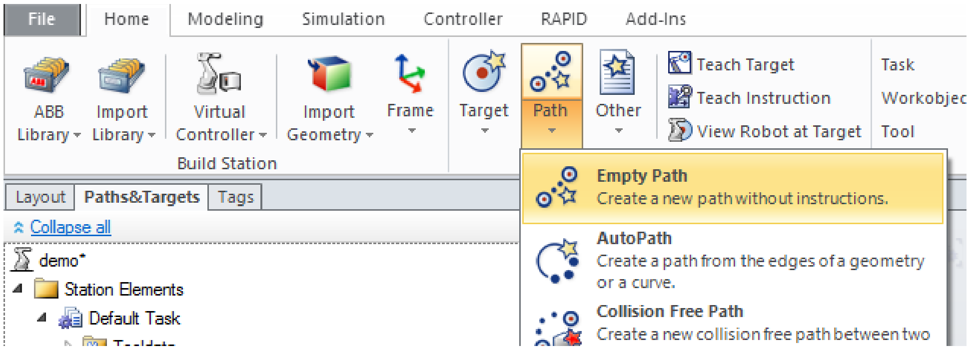




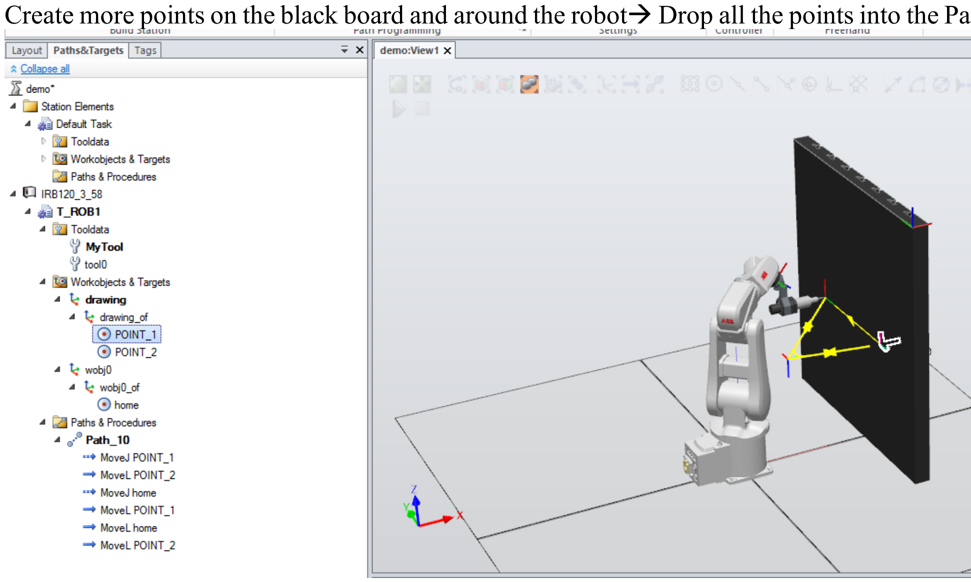


4.3: Using "Target" to move the tool to the position in Task 1.

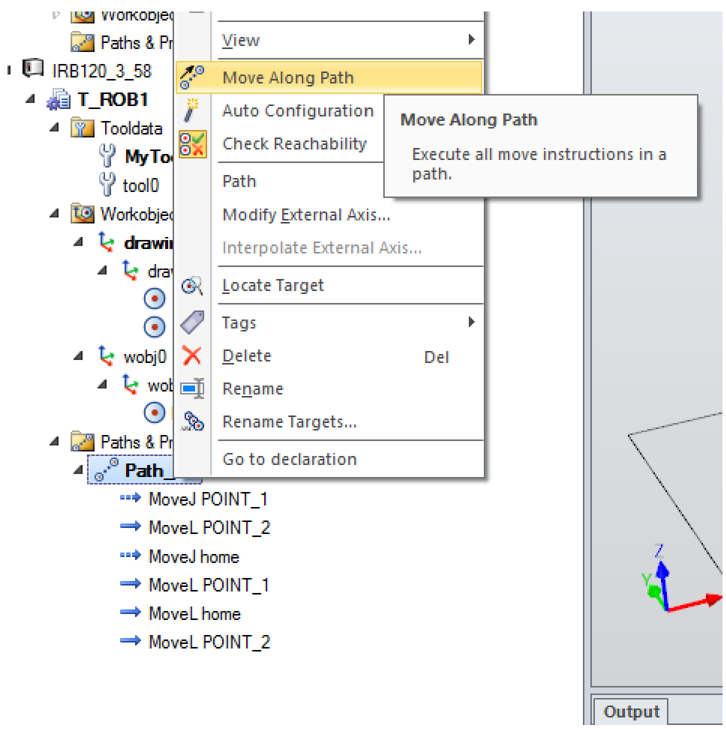
4.4: Create an empty path.



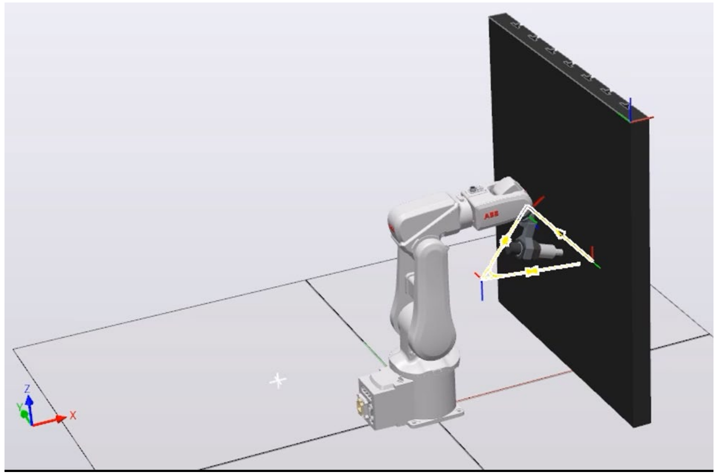
4.5: Create more points on the black board and around the robot→ Drop all the points into the Path folder



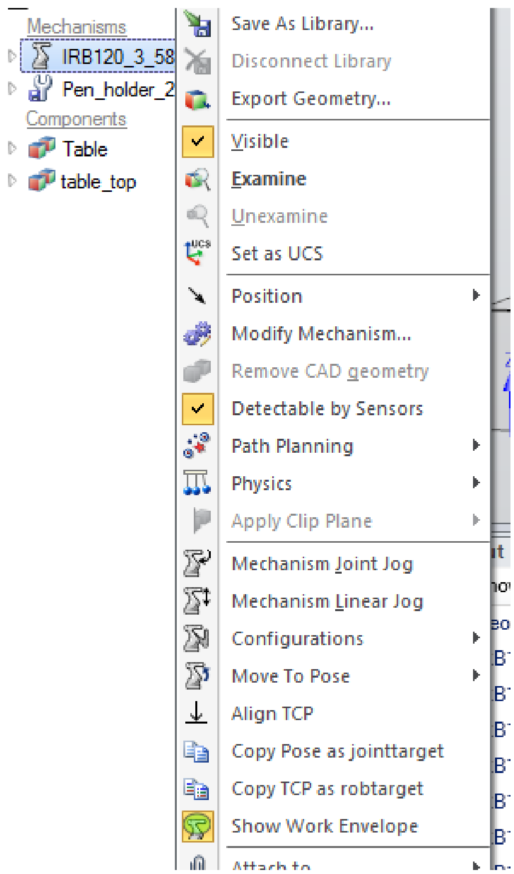
4.6: Right-click on the Path → move along the path to run the simulation



4.8: Watch the video on ilearn and replicate it without any errors.



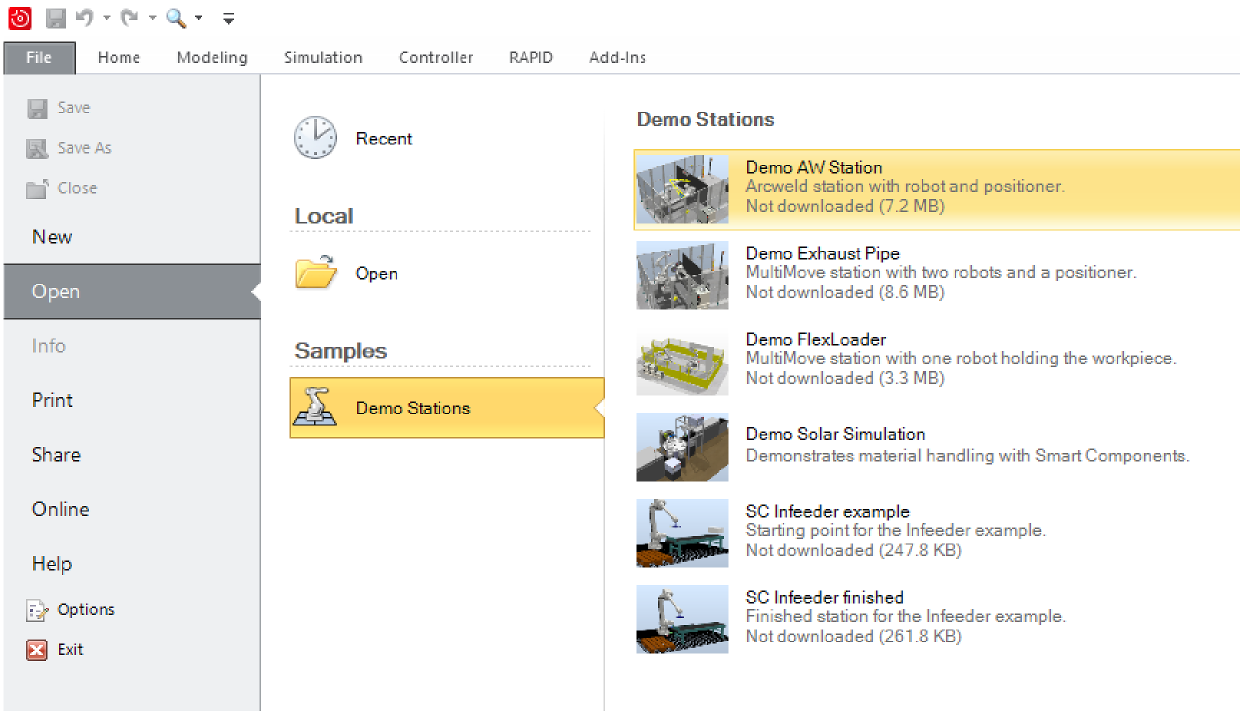
4.9: Hint: Right-click on the robot → Show work envelope. This might help you better understand why the robot is stuck at some points.



4.10: Open the simulation tab: Run the simulation (press the move along path button, not the play button) and record it. The play button runs the RAPID program in the main not the path.

CHALLENGE: MODIFY THE SOLAR SIMULATION

1. Follow the image to open the "Demo Solar Simulation" and watch how all mechanisms interact with others.



2. Describe the working principle of the simulation
3. Draw a state machine to visually the principle