

Apply the Finger Gripper:

Lesson 8

Name: _____

Date: _____

Pitch - a movement that moves the end tool around the Y-axis.

Yaw - a movement that moves the end tool around the Z-axis.

Roll - a movement that moves the end tool around the X-axis.

Singularity - a particular point in a robot's workspace that causes the robot to lose one or more degrees of freedom

Engage

Your instructor will have the ORA running. Watch the ORA carefully as it moves through the new motions. How can you describe these new movements? Try to describe each new movement relative to the X, Y, and Z axes.

Answers may vary. The sequence is repeated as it moves through the Pitch, Yaw, and Roll commands.

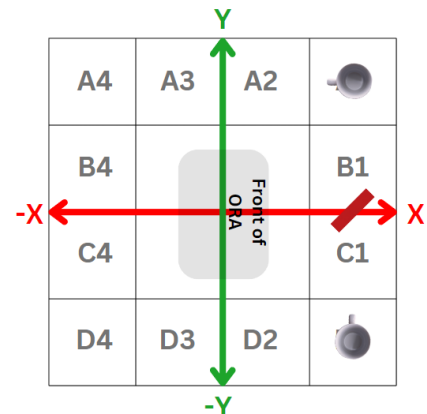
Students may describe the Pitch as keeping the tool at a given point and then moving the ORA forward and back in a +/- X direction.

Students may describe the Yaw as keeping the tool at a given point and then rotating the last joint in the ORA similar to how a wrist moves.

Students may describe the Roll as keeping the tool at a given point and then moving the ORA side to side in a +/- Y direction.

Explore

Your instructor will set up objects on the quadrant map similar to the image (right). You need to reorient the ORA to pick up the objects in a particular way. Use your knowledge of Pitch, Yaw, and Roll and angles to orient the finger grippers to pick up these items!



	Motion needed (Yaw, Pitch, or Roll)	How many degrees from the Initial Position needed?
Coffee Cup in A1	Pitch	-90 degrees
Wood Cylinder in B1/C1	Yaw	45 degrees
Coffee Cup in D1	Roll (with yaw)	-90 degrees

Note: the cup in D1 also requires yaw motion as well to line up the finger gripper with the mug handle, if a student figures that out on their own, give them a bonus point!

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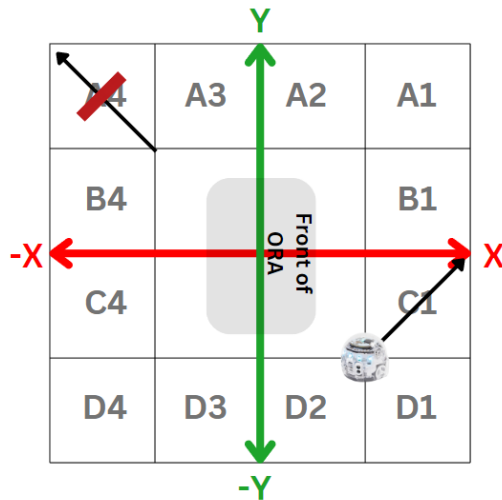
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Elaborate

In this challenge, you will use ORA to assist Evo in patrolling a specific path around the quadrant map.



Task Requirements:

1. ORA must start in the Initial Position.
2. ORA must move concurrently with Evo to remove the obstruction before Evo reaches the corner where B1/C1 meets.
3. ORA must pick up the obstructing wooden block and place it, on end, in the middle of A1.
4. After the obstruction is cleared, ORA will pick up Evo and place it at the corner of A3/A4/B4 turned so that it will follow the line.
5. ORA and Evo will again run concurrently as Evo finishes the patrol and ORA returns to the Initial Position.
6. Evo will light up to signal completion of the patrol at the outside corner of A4.

Pseudocode	Code Blocks
ORA moves to initial position ORA sets tool to finger gripper Run Concurrently Evo Follows Line AND ORA moves to Block in A4 and uses the Yaw motion to line up with block, ORA closes finger grippers ORA moves to A1 and pitch to rotate cylinder and place it on end ORA opens finger grippers ORA Moves to outside corner of C1/ ORA closes finger grippers on Evo ORA moves to A4 and Yaws 90 degrees Run Concurrently Evo Follows Line AND ORA returns to Initial Position Evo lights up	Example of Student work

After testing your code, was it successful? If not, what changes do you need to make to accomplish the task at hand? **Student Answers May Vary**

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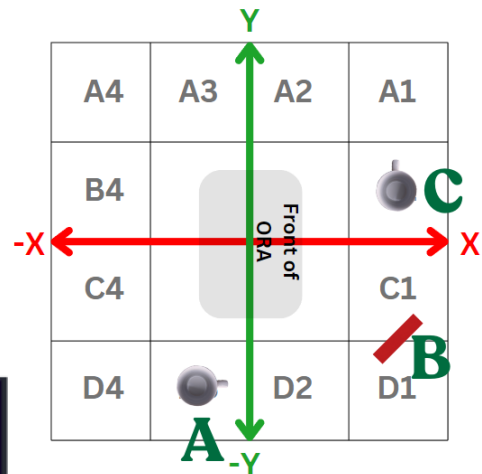
Evaluate

Please answer the following prompts.

Do not forget to include your **name** and **date** on this paper!

- Looking at the diagram on the right, use your understanding of the XYZ coordinate system and yaw, pitch, and roll to provide coordinate and tool angle position to pick up the two coffee cups and the wooden cylinder.

Note: Approximations can be used for X, Y, Z coordinates on cups if exact dimensions are not available



safely move to coordinate (x = , y = , z =) [mm]
with tool angle (roll = , pitch = , yaw =) [°]

	X Coord.	Y Coord.	Z Coord.	Roll	Pitch	Yaw
Object A	-75	-225	50	0	90	0
Object B	225	-150	30	0	0	45
Object C	225	75	50	90	0	90

- Using the example situation above, add in an Evo that will follow a line from C1 to D1. The path has an obstruction (wooden cylinder B). Draw the code blocks and write the pseudocode for a series of commands that clears the path and allows Evo to move from C1 to D1. Use at least one example of concurrency.

Pseudocode	Code Blocks
ORA moves to initial position ORA sets tool to finger gripper Run Concurrently Evo Follows Line AND ORA moves to B using XYZ and Yaw ORA Closes Finger Grippers ORA Raises block to Z=100mm to clear path for Evo	Example of Student Work