About Us

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Agenda

1. State of ROS 2 in Undergraduate Classrooms
2. Making ROS 2 Classroom-Friendly Using Create® 3 Robot
3. What We’ve Learned
State of ROS 2 in Undergraduate Classrooms
Why should ROS 2 be introduced in the classroom?

- Not widely integrated into undergraduate curricula
- Important to prepare students for industry positions
What's keeping ROS 2 out of the undergraduate classroom?

- Requires some knowledge of intermediate computer science concepts
- Limited availability of educational resources for teaching ROS 2
- Configuration challenges within university infrastructure
Making ROS 2 Accessible: Classroom-Friendly Configurations
Using the Create® 3 Robot to Teach ROS 2

- Opportunity to start in Python and advance to ROS 2
- Learn and apply ROS 2 concepts using various functionalities of the robot
- Hands-on activities allow for integration of multiple engineering disciplines
Classroom-friendly Configurations

Virtual Machine

JupyterLab Server

Raspberry Pi
Classroom-friendly Configurations

Virtual Machine

JupyterLab Server

Raspberry Pi
JupyterLab Server

**Pros**
- Works on any computer
- No Linux knowledge required
- Simplified interface

**Cons**
- Server build out with IT support
- Instructor material prep time
JupyterLab Server

Pros

• Works on any computer
• No Linux knowledge required
• Simplified interface

Cons

• Server build out with IT support
• Instructor material prep time

Recommended for First Year Undergraduates
Raspberry Pi

Pros
- Reduce network traffic
- More flexibility
- Full access via SSH/VNC
- Add & control additional sensors & actuators

Cons
- Uncontrolled environment
- Instructor prep of image required
Raspberry Pi

Pros
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Cons
• Uncontrolled environment
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Recommended for Upper Level Undergraduates

Student’s Computer
Wi-Fi
Raspberry Pi
Eth over USB
Create® 3 Robot
<table>
<thead>
<tr>
<th>Week</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
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</thead>
<tbody>
<tr>
<td><strong>Topic</strong></td>
<td>Basics of Python &amp; using Python with the Create® 3 robot</td>
<td>Intro to Linux &amp; Raspberry Pi</td>
<td>Intro to ROS 2</td>
<td>Intro to rclpy</td>
<td>Cloud-based teleoperation</td>
<td>Invisible Springs - proportional control</td>
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<td>Gears, linkages &amp; actuators</td>
<td>ROS 2 via terminal</td>
<td>Sensors and actuators on Create® 3 robot</td>
<td>obstacle course</td>
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<td><strong>ROS 2 Concept</strong></td>
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<td>Nodes &amp; Topics</td>
<td>Subscribers &amp; Publishers</td>
<td>Subscribers &amp; Publishers</td>
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<th>Week</th>
<th>Week 7</th>
<th>Week 8</th>
<th>Week 9</th>
<th>Week 10</th>
<th>Week 11</th>
<th>Week 12</th>
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<tr>
<td><strong>Topic</strong></td>
<td>Color sensor line follower - PID control &amp; sensor integration</td>
<td>E-stop and reset position</td>
<td>Square drive</td>
<td>Navigation Using Object Recognition</td>
<td>Mapping &amp; Nav2</td>
<td>Custom interfaces &amp; packages</td>
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<td><strong>ROS 2 Concept</strong></td>
<td>Subscribers &amp; Publishers</td>
<td>Services</td>
<td>Actions</td>
<td>Subscribers, Publishers &amp; Actions</td>
<td>Parameters &amp; Launch Files</td>
<td>Messages, Services &amp; Actions</td>
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</tbody>
</table>
What We've Learned
Challenges

- Network connectivity & interfacing with campus IT
- Fostering an environment where “experienced coders” and “non-experienced coders” feel equal
- Facilitating students in understanding complex concepts
Successes

- Project-based learning through hands-on activities
- Opportunity to combine multiple engineering disciplines in projects
- Collaborative environment
Key Takeaways
Acknowledgments
THANK YOU

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Kathryn Wujciak
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20% off the iRobot® Create® 3 robot and its accessories

code: TUFTS-ROSCON-23

Offer code valid through November 3, 2023 on edu.irobot.com/shop and code must be entered at checkout. Cannot be applied to previous purchases or combined with any other offer. Not redeemable for cash or credit.