



ME454

Mobile System Programming



Lecture 05. ROS compile

Class objectives

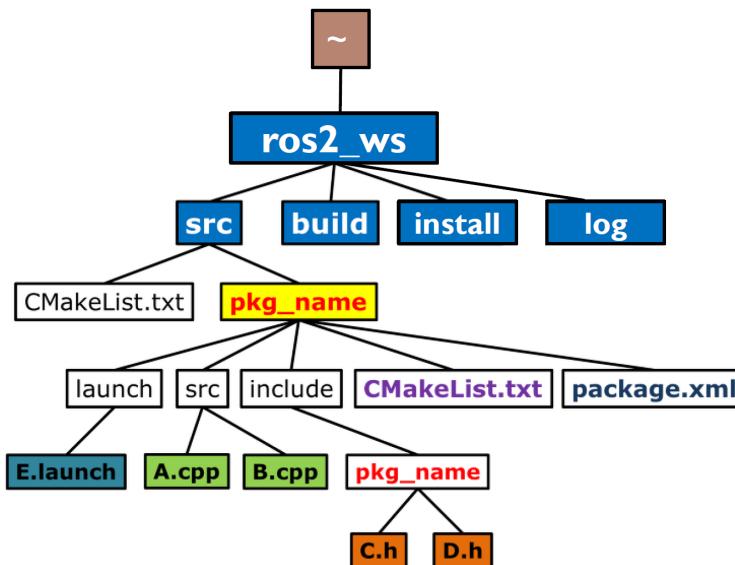
- ▶ ROS 2 package
- ▶ Make a ros2 package
- ▶ Make a publisher node
 - ▶ It publishes string msg
- ▶ Make a subscriber node
 - ▶ It subscribe the publisher node and print the string msg
- ▶ Build and run the two nodes

Colcon build

- ▶ <https://docs.ros.org/en/humble/Tutorials/Beginner-Client-Libraries/Colcon-Tutorial.html>
- ▶ **colcon build --symlink-install**
 - ▶ In the root of the workspace, run `colcon build`. `colcon` supports the option `--symlink-install`. This allows the installed files to be changed by changing the files in the source space (e.g. Python files or other non-compiled resources) for faster iteration.

Workspace naming convention

- ▶ **workspace_folder/ --WORKSPACE**
 - ▶ build – build files for ros2 packages
 - ▶ Install – setup file for this workspace
 - ▶ log – logs during build process
 - ▶ **src – package source code folder**



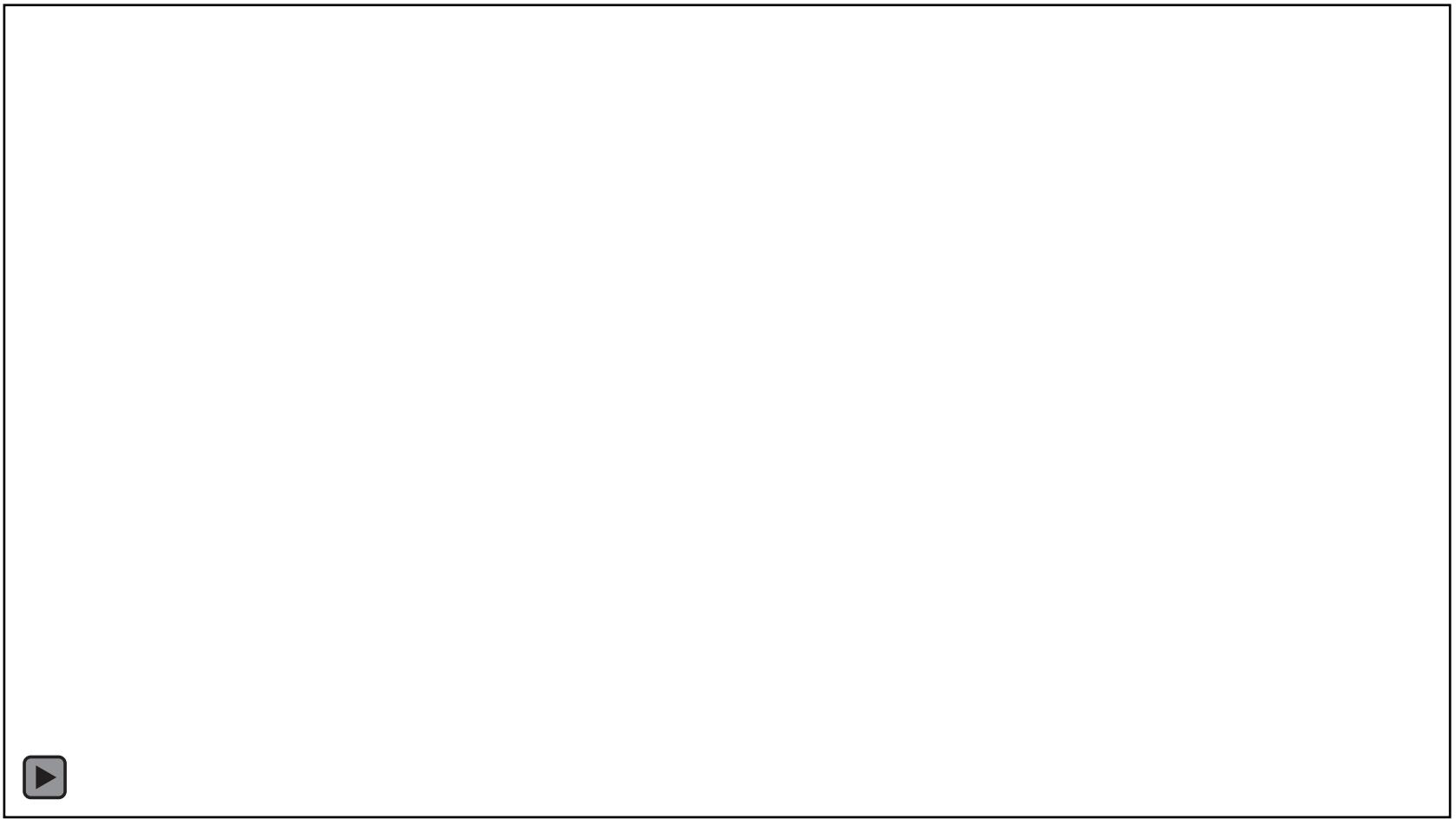
Workspace and package creation

- ▶ <https://docs.ros.org/en/humble/Tutorials/Beginner-Client-Libraries/Creating-A-Workspace/Creating-A-Workspace.html>
- ▶ <https://docs.ros.org/en/humble/Tutorials/Beginner-Client-Libraries/Creating-Your-First-ROS2-Package.html>

Publisher and subscriber

- ▶ <https://docs.ros.org/en/humble/Tutorials/Beginner-Client-Libraries/Writing-A-Simple-Cpp-Publisher-And-Subscriber.html>

Publisher and subscriber-result



Publisher and subscriber-result

```
junyo94@DESKTOP-28A37S8: ~$ cd ros2_ws
junyo94@DESKTOP-28A37S8: ~/ros2_ws$ ./install/local_setup.bash
junyo94@DESKTOP-28A37S8: ~/ros2_ws$ ros2 run cpp_pubsub talker
[INFO] [1679906033.114251937] [minimal_publisher]: Publishing: 'Hello, world! 0'
[INFO] [1679906033.614176862] [minimal_publisher]: Publishing: 'Hello, world! 1'
[INFO] [1679906034.114186486] [minimal_publisher]: Publishing: 'Hello, world! 2'
[INFO] [1679906034.614181999] [minimal_publisher]: Publishing: 'Hello, world! 3'
[INFO] [1679906035.114166299] [minimal_publisher]: Publishing: 'Hello, world! 4'
[INFO] [1679906035.614179399] [minimal_publisher]: Publishing: 'Hello, world! 5'
[INFO] [1679906036.114292898] [minimal_publisher]: Publishing: 'Hello, world! 6'
[INFO] [1679906036.614181298] [minimal_publisher]: Publishing: 'Hello, world! 7'
[INFO] [1679906037.114184898] [minimal_publisher]: Publishing: 'Hello, world! 8'
[INFO] [1679906037.614186098] [minimal_publisher]: Publishing: 'Hello, world! 9'
[INFO] [1679906038.114186098] [minimal_publisher]: Publishing: 'Hello, world! 10'
[INFO] [1679906038.614335498] [minimal_publisher]: Publishing: 'Hello, world! 11'
[INFO] [1679906039.114164698] [minimal_publisher]: Publishing: 'Hello, world! 12'
[INFO] [1679906039.614272598] [minimal_publisher]: Publishing: 'Hello, world! 13'
[INFO] [1679906040.114249498] [minimal_publisher]: Publishing: 'Hello, world! 14'
[INFO] [1679906040.614186598] [minimal_publisher]: Publishing: 'Hello, world! 15'
[INFO] [1679906041.114183898] [minimal_publisher]: Publishing: 'Hello, world! 16'
[INFO] [1679906041.614258498] [minimal_publisher]: Publishing: 'Hello, world! 17'
[INFO] [1679906042.114223998] [minimal_publisher]: Publishing: 'Hello, world! 18'
[INFO] [1679906042.614196000] [minimal_publisher]: Publishing: 'Hello, world! 19'
[INFO] [1679906043.114219806] [minimal_publisher]: Publishing: 'Hello, world! 20'
[INFO] [1679906043.614211411] [minimal_publisher]: Publishing: 'Hello, world! 21'
[INFO] [1679906044.114189917] [minimal_publisher]: Publishing: 'Hello, world! 22'

junyo94@DESKTOP-28A37S8: ~$ cd ros2_ws
junyo94@DESKTOP-28A37S8: ~/ros2_ws$ ./install/local_setup.bash
junyo94@DESKTOP-28A37S8: ~/ros2_ws$ ros2 run cpp_pubsub listener
[INFO] [1679906033.114718037] [minimal_subscriber]: I heard: 'Hello, world! 0'
[INFO] [1679906033.614481562] [minimal_subscriber]: I heard: 'Hello, world! 1'
[INFO] [1679906034.114578486] [minimal_subscriber]: I heard: 'Hello, world! 2'
[INFO] [1679906034.614511999] [minimal_subscriber]: I heard: 'Hello, world! 3'
[INFO] [1679906035.114505999] [minimal_subscriber]: I heard: 'Hello, world! 4'
[INFO] [1679906035.614501899] [minimal_subscriber]: I heard: 'Hello, world! 5'
[INFO] [1679906036.114583698] [minimal_subscriber]: I heard: 'Hello, world! 6'
[INFO] [1679906036.614440398] [minimal_subscriber]: I heard: 'Hello, world! 7'
[INFO] [1679906037.114514598] [minimal_subscriber]: I heard: 'Hello, world! 8'
[INFO] [1679906037.614586098] [minimal_subscriber]: I heard: 'Hello, world! 9'
[INFO] [1679906038.114536098] [minimal_subscriber]: I heard: 'Hello, world! 10'
[INFO] [1679906038.614638098] [minimal_subscriber]: I heard: 'Hello, world! 11'
[INFO] [1679906039.114554098] [minimal_subscriber]: I heard: 'Hello, world! 12'
[INFO] [1679906039.614614198] [minimal_subscriber]: I heard: 'Hello, world! 13'
[INFO] [1679906040.114564098] [minimal_subscriber]: I heard: 'Hello, world! 14'
[INFO] [1679906040.614492698] [minimal_subscriber]: I heard: 'Hello, world! 15'
[INFO] [1679906041.114647498] [minimal_subscriber]: I heard: 'Hello, world! 16'
[INFO] [1679906041.614622798] [minimal_subscriber]: I heard: 'Hello, world! 17'
[INFO] [1679906042.114522498] [minimal_subscriber]: I heard: 'Hello, world! 18'
[INFO] [1679906042.614501100] [minimal_subscriber]: I heard: 'Hello, world! 19'
[INFO] [1679906043.114505506] [minimal_subscriber]: I heard: 'Hello, world! 20'
[INFO] [1679906043.614509811] [minimal_subscriber]: I heard: 'Hello, world! 21'
[INFO] [1679906044.114433317] [minimal_subscriber]: I heard: 'Hello, world! 22'
```

Tasks

- ▶ Make a package named “gauss_summation”, which depends on `rclcpp` and `std_msgs` on `ros2_ws` workspace
- ▶ Make a publisher node named “gauss_publisher”, topic name “gauss”, and message type `std_msgs::msg::Int32`
- ▶ Publish a increasing integer for every 100 milliseconds (0, 1, 2, 3, ...)
- ▶ Display the published integer in the terminal using `rclcpp_info` format:
- ▶ I shouted {number}.

Tasks

- ▶ Make a subscriber node named “gauss_subscriber”, topic name “gauss”, and message type std_msgs::msg::Int32.
- ▶ Make subscriber node to print out the summation of all published integer from the gauss_publisher.
- ▶ Display the added integer in the terminal using rclcpp_info format :
I have summed all the number I heard and the answer is {number}.

Task result



Std_msgs type

2. ROS Message Types

- ▶ http://wiki.ros.org/std_msgs
- ▶ Should import headers to use specific msg type
- ▶ In this tasks, you should use `std_msgs::msg::Int32`
- ▶ `#include "std_msgs/msg/int32.hpp"`

ROS Message Types

Bool
Byte
ByteMultiArray
Char
ColorRGBA
Duration
Empty
Float32
Float32MultiArray
Float64
Float64MultiArray
Header
Int16
Int16MultiArray
Int32
Int32MultiArray
Int64
Int64MultiArray
Int8
Int8MultiArray
MultiArrayDimension
MultiArrayLayout
String
Time
UInt16
UInt16MultiArray
UInt32
UInt32MultiArray
UInt64
UInt64MultiArray
UInt8
UInt8MultiArray

Std_msgs type

▶ For std_msgs::msg::String

File: std_msgs/String.msg

Raw Message Definition

```
string data
```



```
auto message = std_msgs::msg::String();
message.data = "Hello, world! " + std::to_string(count_++)
```

Compact Message Definition

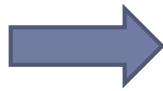
```
string data
```

▶ For std_msgs::msg::Int32

File: std_msgs/Int32.msg

Raw Message Definition

```
int32 data
```



```
auto message = std_msgs::msg::Int32();
message.data = count_;
```

Compact Message Definition

```
int32 data
```

Removing red line on the VS Code

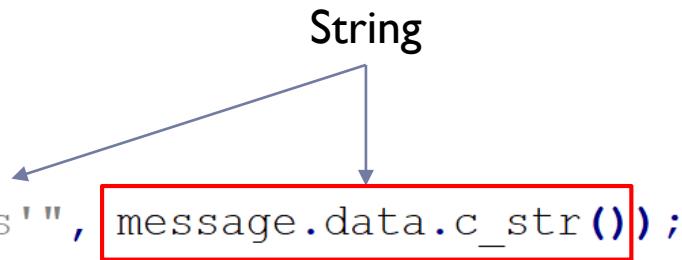
- ▶ Install C/C++ Extension pack on Extensions
- ▶ Press F1 button on the VS Code
- ▶ Search : C/C++ Edit configuration (UI)
- ▶ Find “Include path”

- ▶ Copy lines below
 - ▶ /opt/ros/humble/include
 - ▶ /usr/include/**

F&Q

▶ C++ conversion specifier

- ▶ %s : for string
- ▶ %d : for int



▶ You should remove 'const' in the subscriber node for summation, topic_callback

```
private:  
    void topic_callback(const std_msgs::msg::String & msg) const  
{  
    RCLCPP_INFO(this->get_logger(), "I heard: '%s'", msg.data.c_str());  
}  
rclcpp::Subscription<std_msgs::msg::String>::SharedPtr subscription_;
```

Gazebo tutorials

▶ Gazebo classic

Gazebo classic install

```
sudo apt remove gz-harmonic && sudo apt autoremove  
curl -sSL http://get.gazebosim.org | sh  
sudo apt install ros-humble-gazebo-ros-pkgs
```

Github Download

```
cd ~/repos/ME454_2024  
git pull  
cd ~/ros2_ws/src  
cp -r ~/repos/ME454_2024/bowling ~/ros2_ws/src
```

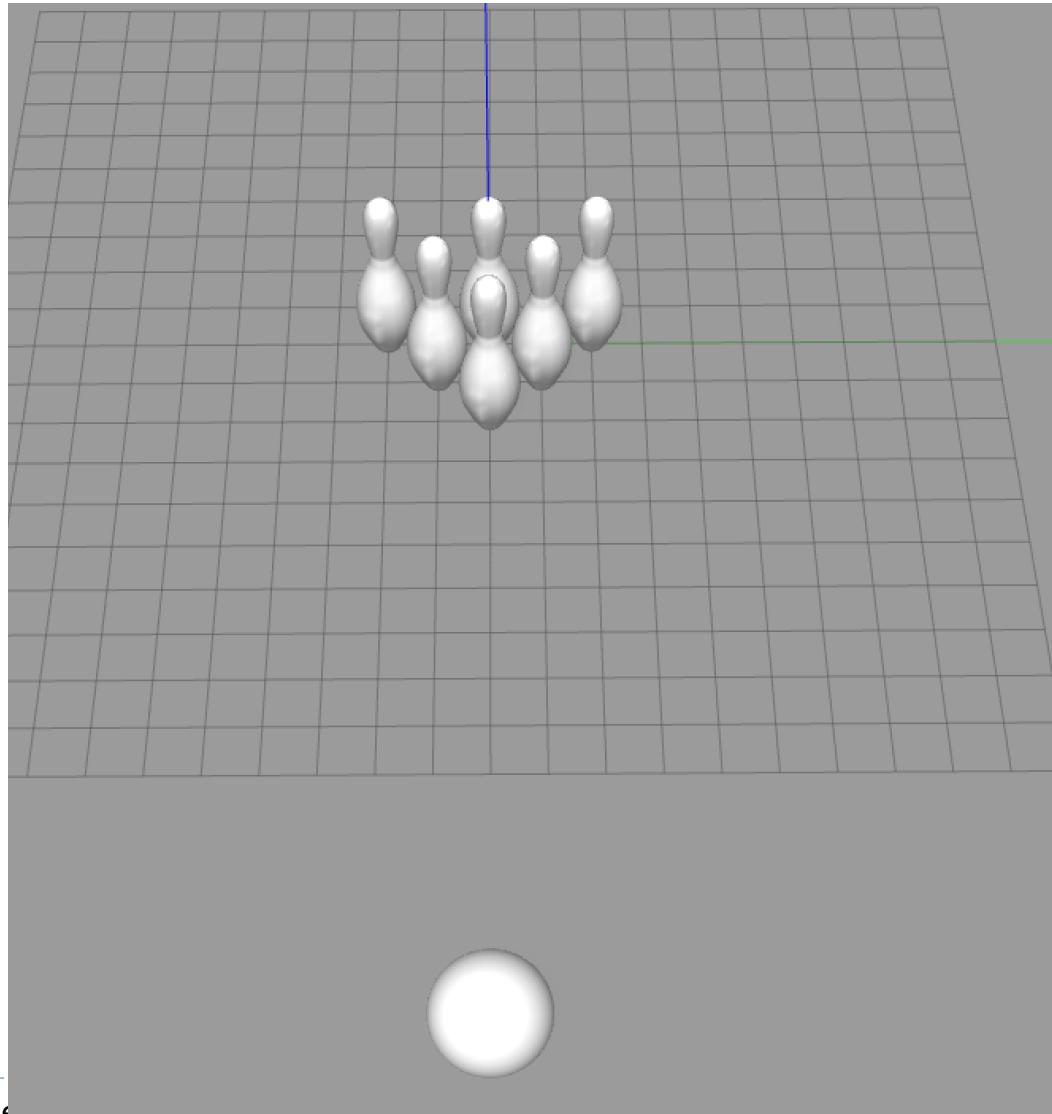
Running Gazebo

```
cd ~/ros2_ws  
colcon build  
.install/local_setup.bash  
ros2 launch bowling launch.py
```

Gazebo tutorials

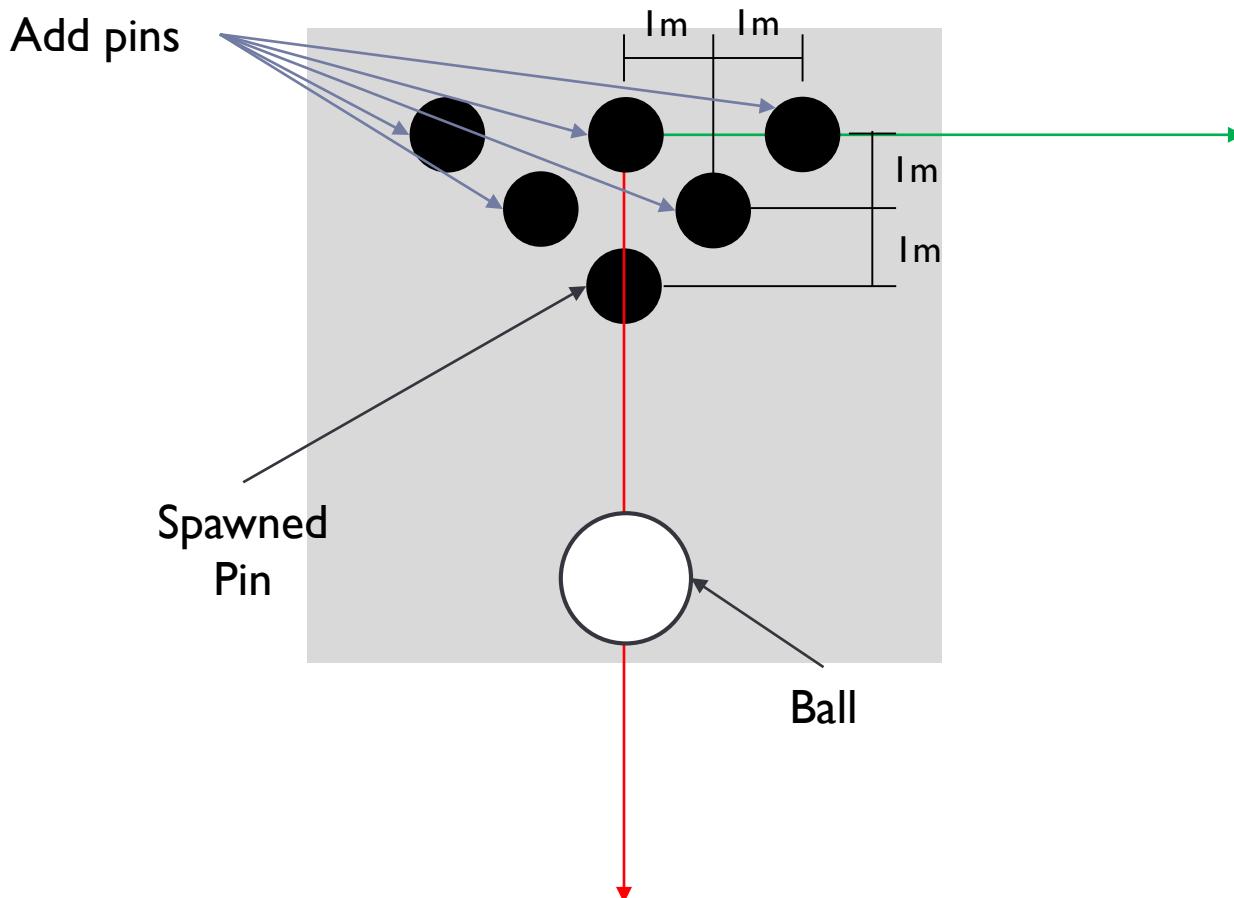
- ▶ **Check for the folder structure**
- ▶ Workspace (ros2_ws)
 - ▶ src
 - ▶ Bowling (ros2 package folder)

Bowling setup



Add pins by modifying launch file

- ▶ Modify the `bowling.launch.py` to spawn five more pins



Play bowling

- ▶ To give speed to the ball (10m/s)

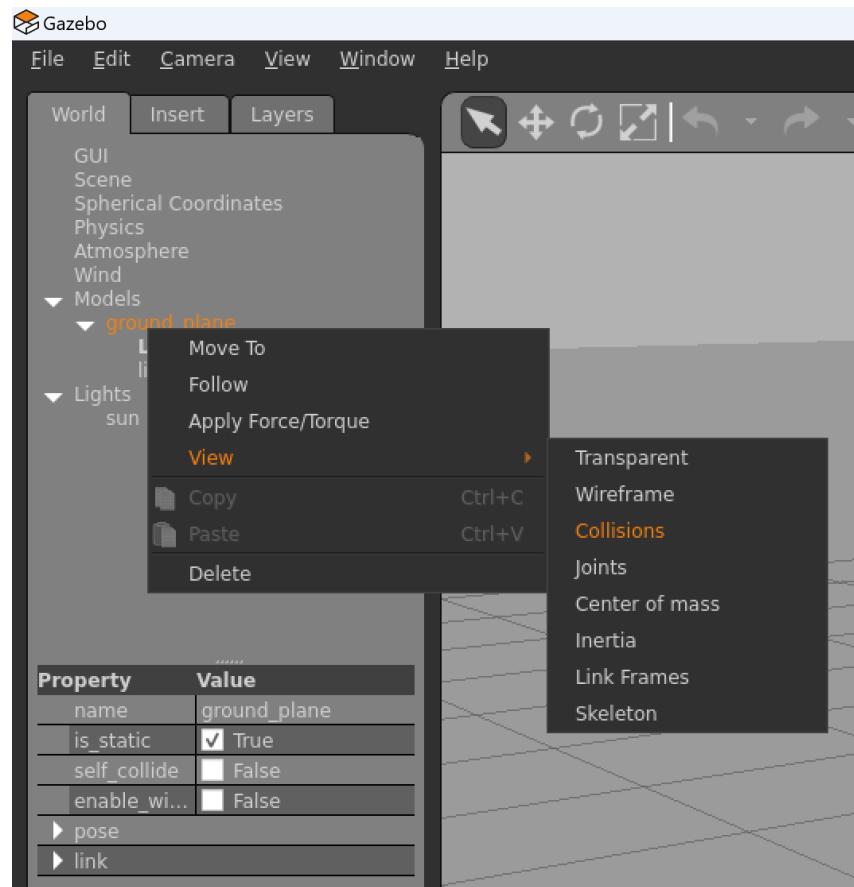
```
ros2 service call /demo/set_entity_state  
'gazebo_msgs/SetEntityState' '{state: {name: "bowl", pose:  
{position: {x: 15.0, y: 0.0, z: 1.001}}, twist: {linear: {x: -10.0, y: 0.0, z:  
0.0}}}}'
```

Bowling!



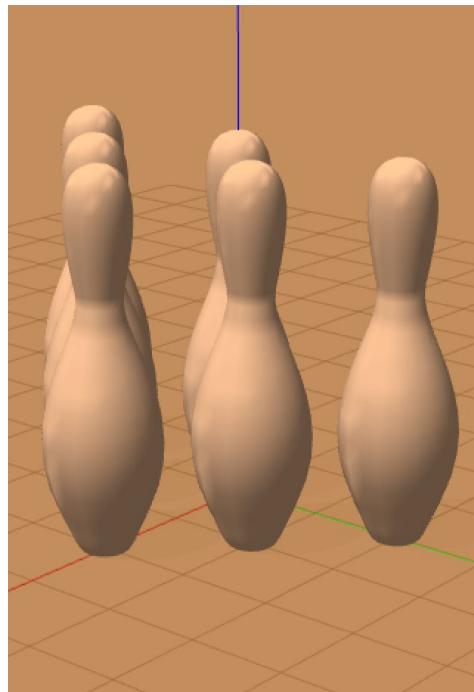
Able to spawn multiple bodies using the launch file
Can simulate the collision and dynamics of multiple bodies

Collision body view

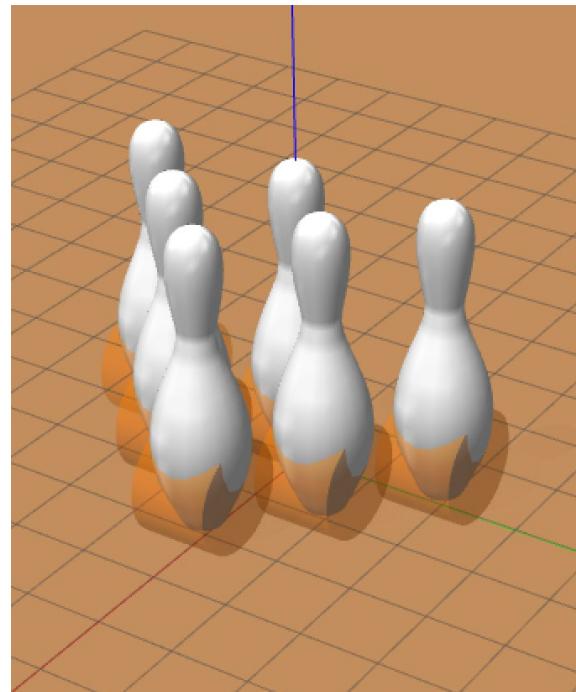


Right mouse button click on the model
Select View -> Collisions

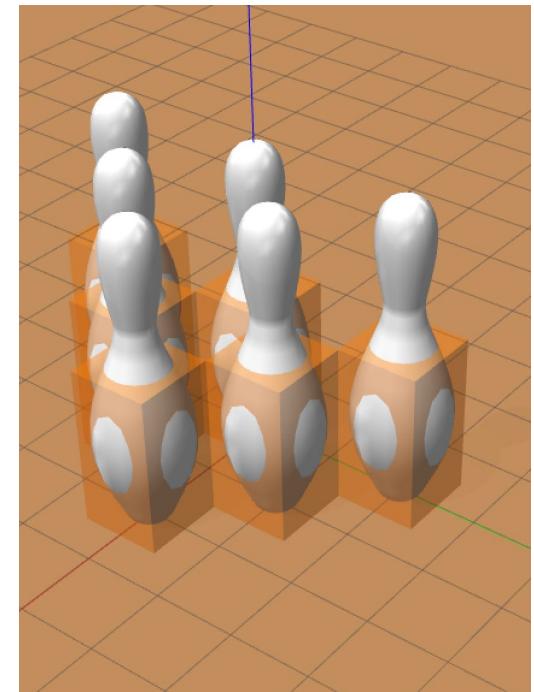
Visual body & Collision body



Collision body :
Pin



Collision body :
cylinder



Collision body :
Box

Visual Body \neq Collision Body

Task

- ▶ Edit launch/launch.py file to load different pin urdf file having different collision body
- ▶ Launch the launch file, and set velocity to a bowl
- ▶ See how collision bodies react
- ▶ Hint: pin_model_file_name

F&Q

- ▶ If you launch gazebo first time, it might take some time to download resources. If you see error messages including spawn failure, please
 - ▶ Do not turn off the terminal until gazebo execution
 - ▶ After gazebo has turned on, turn off the gazebo
 - ▶ Relaunch the launch.py

End of TA Session 5