Robot Simulation Assignment 1

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Due: February 17th 2022 (5pm)

- Launch Files
- World Files
- http://gazebosim.org/tutorials?tut=ros_roslaunch

Generating Launch Files

A launch file is used to configure and execute one or more ROS node(s). These nodes can be of mix types; example cpp node and python node. Use the following steps to create a launch files for this assignment

Terminal 1

In [ ]:
```
mkdir -p ~/ros1_ws/src/robotics_module1/launch
```

In [ ]:
```
touch module1.launch
```

Edit module1.launch

This script launch gazebo with an world defined in assignment1.world

Generating Custom World

We will now generate a world file for this assigment using the following commands.

Terminal 1

In [ ]:
```
mkdir -p ~/ros1_ws/src/robotics_module1/worlds
```

In [ ]:
```
touch assignment1.world
```

Edit assignment1.world

In [ ]:

```
<?xml version="1.0" ?>
<sdf version="1.4">
  <world name="default">
    <include>
      <uri>model://ground_plane</uri>
    </include>
    <include>
      <uri>model://sun</uri>
    </include>
    <include>
      <uri>model://table</uri>
      <name>table</name>
      <pose>1 0 0 0 0 1.57</pose>
    </include>
    <include>
      <uri>model://coke_can</uri>
      <name>coke_can1</name>
      <pose>2 0 1 0.24 0 1.57</pose>
    </include>
    <include>
      <uri>model://coke_can</uri>
      <name>coke_can2</name>
      <pose>1 2 0 0 0.35 1.57</pose>
    </include>
    <include>
      <uri>model://coke_can</uri>
      <name>coke_can3</name>
      <pose>0 0 5 1.57 0 1.57</pose>
    </include>
    <include>
      <uri>model://coke_can</uri>
      <name>coke_can4</name>
      <pose>2 4 0 1.57 0 1.57</pose>
    </include>
    <include>
      <uri>model://coke_can</uri>
      <name>coke_can5</name>
      <pose>3 0 6 0 1.57 1.57</pose>
    </include>
    <include>
      <uri>model://coke_can</uri>
      <name>coke_can6</name>
      <pose>6 4.6 0 0 0 1.57</pose>
    </include>
    <include>
      <uri>model://coke_can</uri>
      <name>coke_can7</name>
      <pose>1 0 7 .45 0 1.57</pose>
    </include>
    <include>
      <uri>model://coke_can</uri>
      <name>coke_can8</name>
      <pose>6 2 1 0 0.27 1.57</pose>
    </include>
    <include>
      <uri>model://coke_can</uri>
      <name>coke_can9</name>
      <pose>-1 -3 0 0 0 1.57</pose>
    </include>
    <include>
      <uri>model://coke_can</uri>
      <name>coke_can10</name>
      <pose>-3 -4 0 1.57 0 1.57</pose>
    </include>
    <include>
      <uri>model://coke_can</uri>
      <name>coke_can11</name>
      <pose>-1 -1 0 0 0 1.57</pose>
    </include>
    <include>
      <uri>model://coke_can</uri>
      <name>coke_can12</name>
      <pose>0 -4 0 0 1.57 1.57</pose>
    </include>
  </world>
</sdf>
```

- Module 1 Assignment -

Estimated time to completion: ~ **2 hours**

In this Module, you will learn the basic concepts for representing the position and orientation of rigid bodies in 3D:

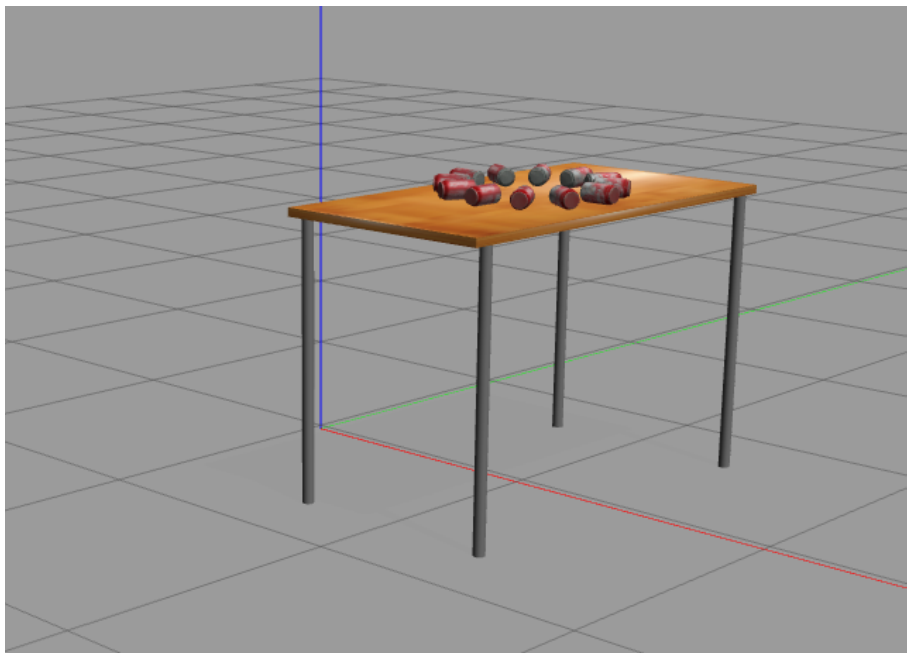
- Frames of reference
- Representing positions
- Representing rotations
- Rotational transformations
- Composition of rotations

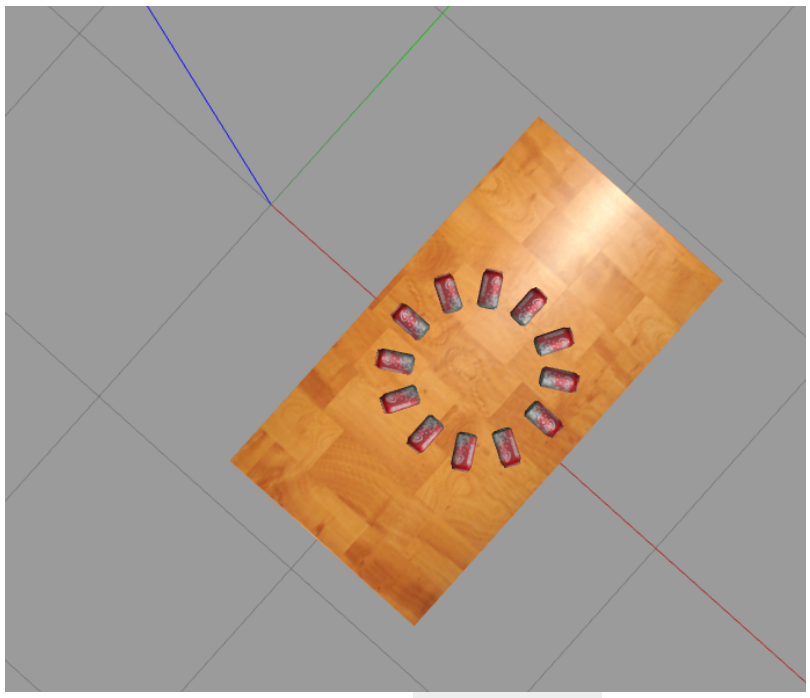
- Parameterization of rotations
- Homogeneous transformation matrices

Bibliography:

[1] Spong, M. W., Vidyasagar, M. (2008). *Robot dynamics and control*, chapter 2. John Wiley & Sons.

In the final exercise of this unit, you have to properly position and orient the elements of the scene below:





The below code spawns the table and Coke cans. Each can must have a different model name: we use the names `coke_can_n` with n between 0 and 11.

Before spawning the objects, let's restart the physics of the simulator for to have more fun!

Create a file in the **ros1_ws/src/robotics_module1** directory, named **setup_table.cpp**, and add the below code:

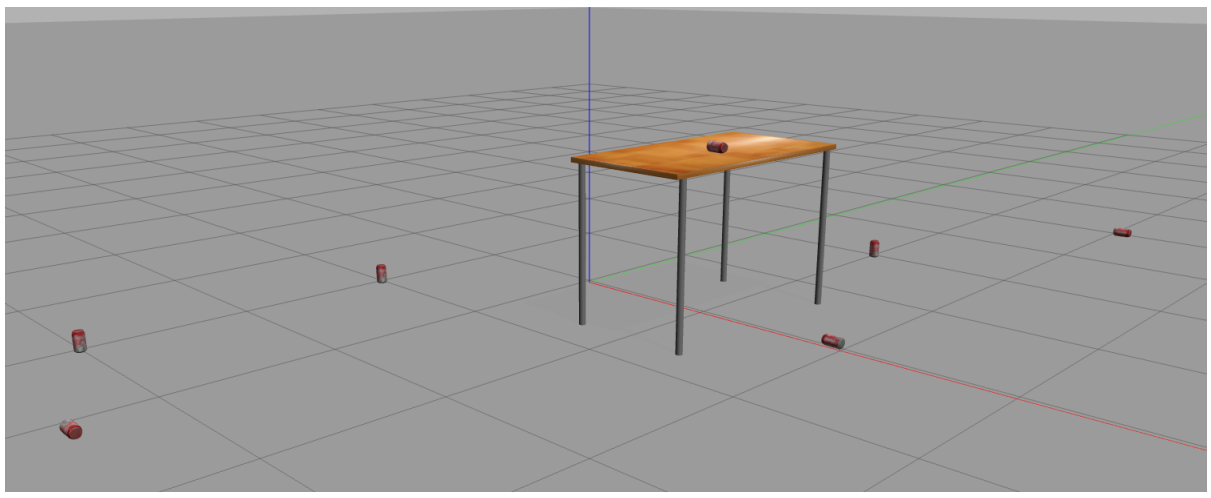
Add this code to *setup_table.cpp*

And execute the script:

Execute *terminal 1

In [ ]:
```
$ roslaunch robotics_module1 module1.launch
```

After running the code, you will have something like this:



Add the necessary code for properly positioning and orienting the requested elements.

The table is moved from the orgin to an initial position of $(x = 1, y = 0, z = 0)$ and rotated 90º about the z-axis.

The cans are positioned in a circle with a radius 0.2 centered in $(x = 1, y = 0, z = 1.05)$ (in the middle of the table, a bit on top of it). Each can is rotated twice: first, a rotation about the z-axis, proportional to its angle in the circle; second, 90º about each can's y-axis, so they lay on the table, in a star-shaped pattern.

Execute *terminal 2

In [ ]:
```
rosrun robotics_module1 setup_table
```