OzoBlockly Editor Challenge

ORA AI & Robotics Density Challenge

Student Guide

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Introduction

Welcome to this Ozobot ORA challenge! You will integrate advanced robotics, computer vision, and Large Language Models (LLMs) to solve a sorting problem based on the physical property of density. Using the ORA cobot, you are tasked with identifying and categorizing five 3D-printed cubes. While these cubes appear identical, their internal infill settings vary, resulting in different masses and densities.

In this lab, ORA will pick up a cube and place it on a digital balance. A camera will capture the balance display, and an LLM will process the image to determine the mass in grams. Since each cube is one cubic inch or alternatively 2.54 cm on a side, you must determine if its density is greater or less than that of water, approximately 1 gram per cubic cm. Based on this data, ORA will sort the cubes into one of two bowls--one for cubes that float and one for those that sink.

This setup mirrors real-world industrial automation. In modern manufacturing, cobots are frequently used for *quench tank* operations, where metal parts are submerged in water or oil for rapid cooling after heat treatment. They are also utilized in waterproof testing for consumer electronics and chemical cleaning stations. The goal of this lab is to establish a seamless interface where the ORA cobot serves as the vital connection between LLM-processed data and real-world task performance.

Lab Setup

Figure 1 shows a typical digital balance. The green one-inch 3D-printed cube currently on the balance shows a mass of 18 grams. The camera just above the digital display is used in conjunction with an LLM whose prompt requests the mass of the cube in grams. The LLM then returns the mass value to the Ozobot Editor program. The program then determines if the block would float or sink if dropped into a bowl of water. ORA then picks up the cube and moves it to the appropriate bowl. The cube responds by floating or sinking depending on its density.

Figure 1

Figure 2 shows the complete lab setup. ORA's job is to sort five cubes based upon their density. The snapshot shows the situation after ORA has processed the first two cubes. You can see that ORA has placed one "floater" and one "sinker".

Figure 2

To get a better understanding of how the challenge works, you should view two accompanying videos now. One of the videos is time-lapse and shows ORA sorting all five cubes. The other video is a standard video and shows ORA sorting just the first two cubes.

Two <u>VERY IMPORTANT</u> Notes Regarding Safety

1. You should include the Ozobot Editor block shown in Figure 3 at the beginning of your program, perhaps right after the *Program start* block or in a function where you initialize a number of things required by your solution to the challenge. Why? When ORA is moving at a slower speed, say 20% or less, you have more time to prevent an impending collision. Of course, this also allows a person more time to move out of the way of ORA's moving arm! This is particularly important throughout the development process while creating your program, when you are more apt to make errors in coordinate values in *move to coordinates* blocks.

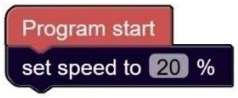

Figure 3

2. Make sure that the **Emergency Stop Button**, also shown in the upper-right side of Figure 1, is within easy reach. It might even be a good idea to have one student with his or her hand above the button when the program is started, in the event that it becomes necessary to instantly terminate all motion of ORA's arm and cancel any commands.

Step into the future of industrial automation with the ORA AI & Robotics Density Challenge! This hands-on lab pushes you to integrate advanced robotics, computer vision, and Large Language Models to solve real-world problems. You will program the ORA cobot to analyze material properties and make intelligent sorting decisions based on density. It is a unique opportunity to master cutting-edge tech while gaining practical experience in high-tech manufacturing and automated quality control.