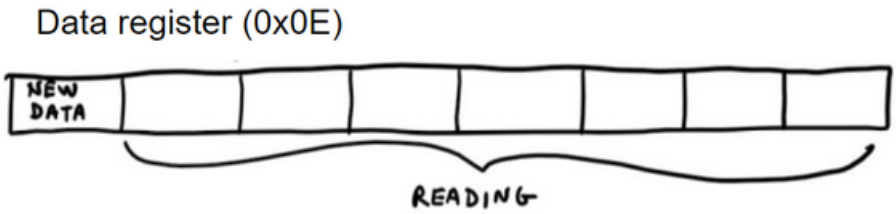
# RBE2002 Review Session

December 13th 2023

1. You are using a pressure sensor with I2C address 0xF3 to calculate the altitude of your airplane. It can measure pressures between 28.00 and 30.00 inches of mercury. The value of the reading is directly proportional to the pressure over the full range.

Every time that it takes a reading, it stores the value in an 8-bit data register with address 0x2E. The most significant bit is reserved for a flag showing new data. Whenever the sensor takes a new reading, it raises that most significant bit to 1.




You have your microcontroller ask the sensor for its data. Assume that the sensor has just taken a new reading with pressure value 29.92 inHg. Calculate each byte in the I2C transaction for the microcontroller to request the new data.

| Master | ST | SAD + W | | SUB | | SR | SAD + R | | | NMAK | SP |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Slave | | | SAK | | SAK | | | SAK | DATA | | |

2. For your final project, you have decided to use an Arducam 16MP IMX519 camera (https://www.arducam.com/product/imx519-autofocus-camera-module-for-raspberry-pi-arducam-b0371/), which has a sensor resolution of 4656x3496 pixels.

You place a small object 3m away from the camera, 0.5m to the left and 0.4m above the optical axis.

The focal length and pixels are

$$f = 4.288mm$$

$$p = 1.22\mu msquare$$

respectively.

What are the pixel coordinates (u,v)?

3. Let's assume f and p are different. You place a 3m square object 8m away from the camera. The top corners of the object are located at (2360, 2014), and (2518, 2014). Where is the center, and the bottom two corners pixels located at. And, what are the (X, Y, Z) values of the center pixel.

4. You are making a robot to explore the safari.

- When it is turned on, the robot will spin.
- If it detects an elephant using its camera (don't worry about how it detects, just know that it can), it drives forwards until it stops detecting the elephant, and then starts spinning again.
- If it detects a lion, it reverses until it stops detecting the lion, and then starts spinning again.
- If it ever hears a lion roar, then it freezes in place (your robot definitely cannot outrun a lion).
- Between transitions, the robot stops its motors.

You have to come reset the robot if it ever does hear a lion roar as it can't start moving again. Draw out the state machine diagram for this robot.