

Lab3

Process Scheduling

Objective

In this experiment, students will be exposed to:

- Different scheduling algorithms
- Problems that can arise from different scheduling algorithms
- Learn about process/task starvation, priority inversion, etc

Prelab

In the prelab, you should include the definitions for the following terms from your embedded systems book:

- First come first served, Round robin, Polled scheduling, Priority based scheduling, Priority inversion, Starvation

Read and write about the wiringPi's following functions:

- wiringPiSetupGpio, pinMode, pullUpDnControl, digitalWrite, digitalRead

Read about the following functions to initialize and signal semaphores:

- sem_init, sem_wait, sem_post.

Lab Procedure

The overall purpose of this lab is to implement a traffic light program in user-space using **WiringPi** library.

You will use three of the lights, which represent the signals for one direction, the other direction, and pedestrians (figure-1). When a light is turned on it represents a “green light” or “WALK sign” and when turned off, it represents a “red light”. The far left button on the auxiliary board will represent the push button for the pedestrians to use when they wish to cross the street. The lights on the auxiliary board are connected to GPIO ports 2, 3, 4 and 5 on the RPi. Be sure to configure those ports as outputs. As you know from *Lab-1-Part-2*, the left push button is connected to GPIO port 16. This port should be configured as input. You will need to enable the **pull down** resistor for this port.

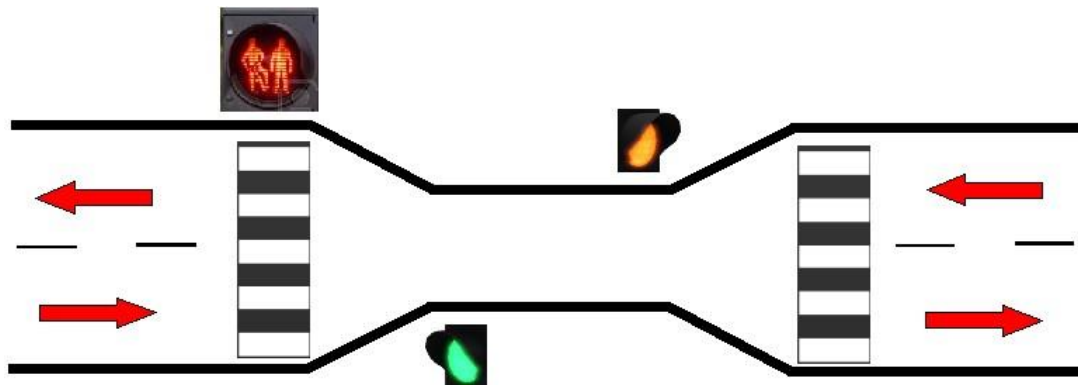


Figure 1: Traffic Lights

Part 1: Polled Scheduling

For this part of the lab, you are to set up a task that acts as a scheduler. It should turn on the light corresponding to one direction, then the light for the other direction, and then check if the pedestrian light needs to be turned on by checking the status of the button.

Questions:

1. What are the limitations of this approach?
2. How can you improve the scheduling so that the implementation acts more like a real traffic light system?

Part 2: Priority Scheduling

For Part 2 you are to create three threads. Each one is responsible for turning ON and OFF one of the lights. Because the lights are a shared resource for all tasks, you need to implement some sort of protection to ensure that no more than one light can be on at any given time. That will be done through **semaphores**.

In your code, you will need to change some parameters of the **pthread**s that you will create. Those are the priority and the scheduling policy.

For this section, you should experiment with the following combination (table-1 of priority levels for each task and report the corresponding observations.

Case No.	Priority Combinations	Observations
1	PTL1=PTL2=PPL	
2	PTL1=PTL2 > PPL	
3	PTL1=PTL2 < PPL	
4	PTL1 > PTL2 > PPL	
5	PTL2 < PTL1 < PPL	
6	PTL1 < PTL2=PPL	
7	PTL1 > PTL2 = PPL	

Table 1: Note: PTL1, PTL2 and PPL are the priorities of traffic light-1, traffic light-2 and the pedestrian light, respectively.

Which configuration(s) of priorities will lead to a round robin scheduling scheme? Which configuration(s) will cause a task to starve? What other configurations can you find?

Make sure you report your findings and thoroughly explain/discuss the results.

Questions:

1. What are some problems that you ran into with this implementation?
2. How did you fix your code to overcome these problems?
3. What happens if the pedestrian button is pressed frequently/rapidly?

Post Lab:

Be sure your lab report contains answers to all of the questions asked in this lab plus the description of your tasks/threads/functions, goals, comments, results, conclusions, etc.