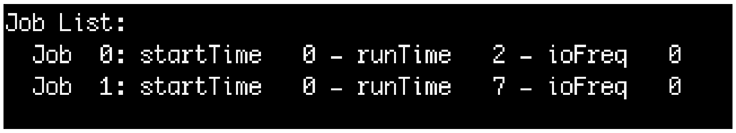
CSC 369 Worksheet 5 Solution

August 18, 2020

1. I need to run randomly-generated problems with two jobs and two queues using file `mlfq.py` with I/O turned off, and compute the MLFQ execution trace for each.

   Using the command `./mlfq.py -s 1 -m 10 -n 2 -j 2 -M 0`, we have



```
Job List:
  Job  0: startTime   0 - runTime   2 - ioFreq   0
  Job  1: startTime   0 - runTime   7 - ioFreq   0
```

   with

   - allotments for queue 1 is 1
   - quantum length for queue 1 is 10
   - allotments for queue 0 is 1
   - quantum length for queue 0 is 10
   - no priority boost

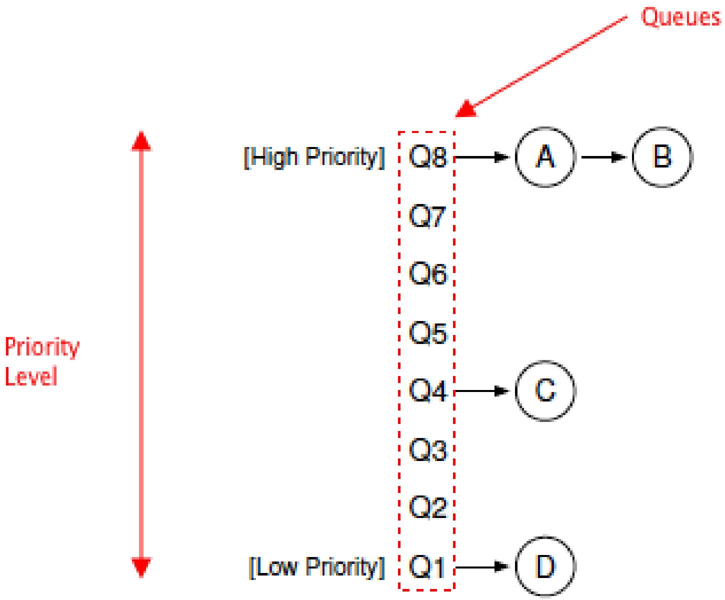
   ,
   the exeuction trace is:

```
    [time 0] Job begins by job 0
    [time 0] Job begins by job 1
    [time 0] Run job 0 at priority 1 [Ticks 9, Allotment 1, Time 1 (of 2)]
    [time 1] Run job 0 at priority 1 [Ticks 8, Allotment 1, Time 0 (of 2)]
    [time 2] Finished JOB 0
    [time 2] Run job 1 at priority 1 [Ticks 9, Allotment 1, Time 6 (of 7)]
```

```
  [time 3] Run job 1 at priority 1 [Ticks 8, Allotment 1, Time 5 (of 7)]
  [time 4] Run job 1 at priority 1 [Ticks 7, Allotment 1, Time 4 (of 7)]
  [time 5] Run job 1 at priority 1 [Ticks 6, Allotment 1, Time 3 (of 7)]
  [time 6] Run job 1 at priority 1 [Ticks 5, Allotment 1, Time 2 (of 7)]
  [time 7] Run job 1 at priority 1 [Ticks 4, Allotment 1, Time 1 (of 7)]
  [time 8] Run job 1 at priority 1 [Ticks 3, Allotment 1, Time 0 (of 7)]
  [time 9] Finished JOB 1
```

Notes

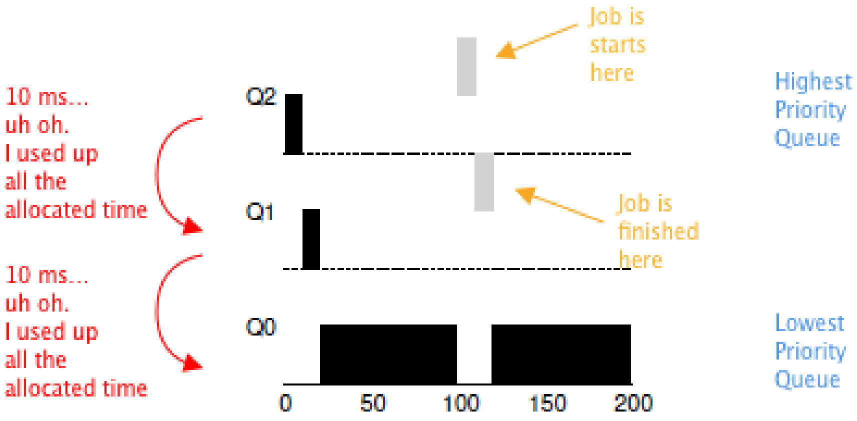
- Learned that notification and subsequent job execution happen at the same time.
- The reason why round robin doesn't occur despite Priority(A) = Priority(B) is because allotment of queue is 1 (i.e. only one job can be in a queue)
- **allotment** means the amount of something allocated to a person/object (i.e. the size of queue)
- `-m 10` sets the maximum runtime of a job to 10
- `-M 0` turns off I/O in `mlfq.py`
- `-n 2` sets number of queues to 2
- `-j 2` sets number of jobs to 2
- **Multi-level Feeback Queue (MLFQ):**
  - Is one of the most well-known approaches to scheduling
  - Does two things:
    a) Optimizes turnaround time
    b) Minimizes response time
  - Uses **priority level** and **Queues** to achieve it's goal
- **MLFQ Basic Rules:**
  - Jobs on same queue → Same priority
  - **Rule 1:** If Priority(A) > Priority(B), A runs (B doesn't)
  - **Rule 2:** If Priority(A) = Priority(B), A & B run in RR



- **Attemp #1: How to Change Priority**
  - **Rule 3:** When a job enters the system, it is placed at the highest priority (the topmost queue)
  - **Rule 4a:** If a job uses up an entire time slice while running , its' priority is reduced (i.e. it moves down on queue).
  - **Rule 4b:** If a job gives up the CPU before the time slice is up, it stays at the same priority level (e.g I/O Operation)
    - ∗ Means that the shifting down of priority level only depends on CPU time

  Example (Along Came a Short Job):

  1) A job A enters system
  2) Job is placed on highest Queue Q_2
  3) After time-slice (e.g. 10 ms) in Q_2, A is placed on lower queue Q_1
  4) After time-slice in Q_1, A is placed in lowest priority queue Q_0



- **Attemp #2: The Priority Boost**
  - **Rule 5:** After some time period S, move all the jobs in the system to the topmost queue.
    - This is to prevent starvation (i.e. a job never being run)
- **Attempt #3: Better Accounting (Fix of Attempt # 1)**
  - Is to prevent programmers from gaming (i.e tricking) the CPU so all programs get a fair share of allotment time
  - **Rule 4:** Once a job uses up its time allotment at a given level (regardless of how many times it has given up the CPU), its priority is reduced (it moves down one queue).