

1. True/False
  - a. The lottery scheduler prevents CPU starvation by assigning at least one ticket to each scheduled thread.
    - i. TRUE
  - b. Round robin scheduling provides a latency improvement over FCFS scheduling for interactive jobs.
    - i. TRUE
  - c. One major difference between paging and segmentation is that memory is allocated in finer grained units with segmentation.
    - i. FALSE
2. Short answer
  - a. If a computer has 32 bit address space, and 1K (i.e.  $2^{10}$  bytes) pages, how many page table entries does it have? (fine to express answer base-2).
    - i.  $2^{22}$  or 4.1 Million
  - b. If you have a very large virtual address space, what would be the benefit of using an inverted page table? Would there be any drawbacks?
    - i. The benefit is that it would take up less space to store the page table. The drawback is that you have more memory references during a page table lookup.
  - c. Give two ways in which to predict runtime in order to approximate SRTF:
    - i. SRTF needs to know the future so it can choose the thread with the shortest processing time as the next thread to run. This can be approximated by having processes state what their approximate running times are when created. Past behavior can also be used to approximate the future – CPU bursts, average running time for a process, etc. Multi-level feedback queues can also be used to approximate the behavior of SRTF by penalizing threads that run a long time and rewarding threads that finish quickly.

3. Scheduling example

- a. Consider the following processes, arrival times, and CPU processing requirements:

Process Name	Arrival Time	Processing Time
1	0	3
2	1	5
3	3	2
4	9	2

For each scheduling algorithm, fill in the table with the process that is running on the CPU (for timeslice-based algorithms, assume a 1 unit timeslice). For RR and SRTF, assume that an arriving thread is run at the beginning of its arrival time, if the scheduling policy allows it. The turnaround time is defined as the time a process takes to complete after it arrives.

Time	FIFO	RR	SRTF
0	1	1	1
1	1	2	1
2	1	1	1
3	2	3	3
4	2	2	3
5	2	1	2
6	2	3	2
7	2	2	2
8	3	2	2
9	3	4	2
10	4	2	4
11	4	4	4
avg. turnaround time	5	5.75	4.25