\* What are the three primary methods of organizing memory using "no memory abstraction"?

\* How did the early IBM 360 do it, and what was its drawback, and how did IBM solve it?

\* What's the purpose of having an address space in a process?

\* What is the relocation problem? Describe how base/limit registers are used to handle this.

\* Swapping - what is this in its most simple form? Why is it not used in its most simple form?

\* (Note - this does not include the various init and destroy routines related to management of threads, mutexes, condition variables - I'm mainly interested in the behavior of threads, mutexes, and condition variables)

\* Thus:

+ Behavior of mutex, condition variable

+ What detached vs. joinable means

+ How to implement a barrier

\* Virtual memory:

+ what IS virtual memory?

+ paging

+ difference between virtual and physical address

+ definitions of: virtual pages, page frames, MMU

+ Page tables and various components thereof.

+ what is a page fault?

+ Understand the various components of page table entries: referenced bit,

modified (dirty) bit, protection bits, present/absent bit.

+ TLB

Ex: page size is 512 bytes. This means 9 bits are page offset. This means that 7 bits are used to index the page table - 128 entries per table.

\* Page replacement algorithms:

+ optimal

+ not recently used

+ FIFO

+ second chance

+ clock

+ LRU; what special hardware used for it?

What about the 2-d matrix method?

+ NFU (used to simulate LRU)

+ Working set

+ WSClock

- understand how they work. You may be asked to do problems involving reference strings.

Implementation issues

+ What happens when a page fault occurs?

+ What is instruction backup? Why is it necessary?

+ What are the two general strategies to implementing a backing store (swap area)? What are the relative merits?

turn-around time

TAT = (n-1)Tq and Tq = p x q  
Throughput = (sum of) time for jobs to complete / Number of completed jobs

Q ) Five batch jobs A through E, arrive at a computer center at almost at the same time They have estimated running times of 10, 6, 2 ,4 8 minutes. Their ( externally determined ) priorities are 3, 5, 2, 1 and 4 respectively, with 5 being the highest priority. For each of the following scheduling algorithms, determine the mean process turnaround time. Ignore process switching overhead.  
( a ) Round Robin.   
Quantum ( Q ) be 50 sec.AS  
A = 10 mins = 600 sec and uses 12 Quanta  
B = 6 mins = 360 sec and 8 Quanta while using only 2 sec on the last one  
C = 2 mins = 120 sec 3 Quanta and 2 sec only on the last one  
D = 4 mins = 240 sec 5 Quanta with 4 mins on the last Quanta  
E = 8 mins = 480 sec 10 Quanta with 3 mins in the last Quanta  
If A to E are in sequence then   
Turnaround A = 3000  
Turnaround B = 1751  
Turnaround C = 502  
Turnaround D = 1004  
Turnaround E = 2253  
and mean Turnaround time would then be 1702.  
**(a) Round Robin**:  
Round Robin doesn't take into account priorities. Considering that, let's enumerate the run with a quantum of 2 min:  
A B C D E | A B D E | A B E | A E | A  
So, the average turnaround time is (all 5 process started at time 0):  
((30-0) + (22-0) + (6-0) + (16-0) + (14-0))/5 = **17.6**  
However, for a quantum of 1 min, the sequence would be:  
  
A B C D E | A B C D E | A B D E | A B D E | A B E | A B E | A E | A E | A | A  
Turnaroud for quantun of 1 min is:  
((30-0) + (24-0) + (8-0) + (17-0) + (28-0))/5 = **21.4**  
So, clearly, the mean turnaround time depends on the quantum. I don't know if we can derive a formula out of it based on the quantum. Anyone?  
**(b) Priority Scheduling**:  
The order of the process run is determined by the priority set:  
B E A C D = ((6-0) + (14-0) + (24-0) + (26-0) + (30-0))/5 = **20**  
**(c) First -come, first served (run in order 10, 6, 2, 4, 8)**:  
A B C D E = ((10-0) + (16-0) + (18-0) + (22-0) + (30-0))/5 = **19.2**  
**(d) Shortest job first**:  
C D B E A = ((2-0) + (6-0) + (12-0) + (20-0) + (30-0))/5 = **14**  
**Bottom line:**  
In this particular case, Shortest job first is better. However, round robin should be calculated for bigger quantums such as 3 or 4 and see if that makes a significant difference or not.