Homework 3

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1. It is safe if the processes continue in the order P2, P3, P4, P1.
2. Fragmentation:
   (a) No. On average 1/2 a page is wasted for every process, causing internal fragmentation.
   (b) Yes. Pages are of finite predetermined size so programs are allocated consistent amounts of space, eliminating external fragmentation.
3. To allow translation from program internal addresses (i.e. text line 26) to physical memory addresses (page number + offset)
4. TLB (translation lookaside buffer). The TLB contains the page to frame mapping of the most frequently accessed pages to improve performance when reaccessing those pages.
5. (a) 4 for page and 2 for offset
   (b) $31 \rightarrow p = 0, d = 32 \rightarrow p1 = f3 \rightarrow (3*32) - 1 + 32 = (4*32) - 1 = 127$
6. Segmented Paging:
   (a) Virtual addresses are split into variably sized segments which are then mapped to locations in constant size pages throughout system memory.
   (b) Two levels of code sharing: at the page and segment level. Easy to allocate memory of various sizes.
   (c) More resource consuming to map a virtual address to a physical one through multiple tables.
7. Spatial and Temporal Locality
   (a) Temporal locality of reference is the idea that recently accessed information will likely be accessed in the future.
   (b) Spatial locality of reference is the idea that information near recently accessed information is likely to be accessed in the future.

(c) Locality of reference helps guide what information is most crucial to store in memory and cache space based on reasonable predictions of how likely it is to be accessed in the near future based on whether it was recently accessed and whether currently processed information is close to it spatially in the process's virtual memory.