Systems Programming and Operating Systems	**Solutions to Assignment 4**
CS414, Summer 1996	**August 12, 1996**

Problem 1 (25 points)

The head is currently on track 143 moving right (towards the higher numbers).

1. FCFS – – 143 – 86 – 147 – 91 – 177 – 94 – 150 – 102 – 175 – 130.
   Total number of tracks moved = 565.
2. SSTF – – 143 – 147 – 150 – 130 – 102 – 94 – 91 – 86 – 175 – 177.
   Total number of tracks = 162.
3. SCAN – – 143 – 147 – 150 – 175 – 177 – 199 – 130 – 102 – 94 – 91 – 86
   Total number of tracks moved = 169
4. CSCAN – – 143 – 147 – 150 – 175 – 177 – 199 – 0 – 86 – 91 – 94 – 102 – 130
   Total number of tracks moved = 385.
5. LOOK – – 143 – 147 – 150 – 175 – 177 – 130 – 102 – 94– 91 – 86

   Total number of tracks moved = 125

Problem 2 (20 points)

1. Since p bits are used for the segment number, the offset is $32 - p$ bits long. This can be used to address 2^{32-p} bytes and hence 2^{32-p} is the maximum size of a segment.

   If atleast 50% of the physical memory is being used then the segments in memory are occupying $0.5 \times 2^{20} = 2^{19}$ bytes. Since the maximum size of a segment is 2^{32-p} there must be atleast $2^{19}/2^{32-p} = 2^{p-13}$ segments. There is one entry per segment in the segment table and hence the segment table must have atleast $\lceil 2^{p-13} \rceil$ entries.
2. Since the page size is $1024 = 2^{10}$ bytes, we need 10 bits as offset into the page table. The number of physical pages in memory is $2^{20}/1024 = 2^{10}$ So in each entry of the page table we need to store atleast 10 bits (some additional bits will be required to store the disk information, protection flags etc.). The number of virtual pages we have is $2^{32}/1024 = 2^{22}$. Hence the amount of storage required for the page table is $2^{22} \times 2bytes = 8MBytes$ (we round 10 bits to 2 bytes).

Problem 3 (15 points)

The requests not mentioned below are unsatisfied.

1. Best Fit – $212K \rightarrow 300K, 417K \rightarrow 600K$ (creates a 183K hole), $112K \rightarrow 183K$.
   Utilisation percentage $= (212 + 417 + 112)/(100 + 200 + 300 + 600) = 61.75$.
2. First Fit – $212K \rightarrow 300K, 417K \rightarrow 600K, 112K \rightarrow 200K$
   Utilisation percentage $= (212 + 417 + 112)/(100 + 200 + 300 + 600) = 61.75$
3. Worst Fit – $212K \rightarrow 600K$ (creates a 388K hole), $112K \rightarrow 388K$
   Utilisation percentage $= (212 + 112)/(100 + 200 + 300 + 600) = 27$.