Chapter 8 Solutions: For More Practice

8.25 No solution provided.

8.35 We can't saturate the memory. At most five disks can transfer at a time because we have two I/O buses and the I/O bus is at 100 MB/sec and the disks at 40 MB/sec. Another limitation is the seek and rotational latency. For this size transfer, the overhead time is 8.1 ms (0.1 + 8), and the transfer time is 4 kB/40 MB = 0.1 ms. Thus the disk is only transferring 0.1/8.1 = 1.2% of the time. Every I/O bus is serving four disks but is not saturated, because the four disks act like 0.05 (less than one disk) constantly transferring. A disk constantly transferring can perform 40 MB/4 KB = 10,000 transfers each second. Thus the maximum I/O rate is 2 (controllers) * 0.05 disks * 10,000 = 1000 I/Os per second. This is an I/O bandwidth of 1000 * 4 KB = 4 MB/sec.

8.36 To saturate an I/O bus we need to have 2 simultaneous transfers from $2\,^1/_2$ disks (theoretically). This means that $2 = 2.5 \times (T/(8.1 + T))$, where T is the transfer time. So, $T = 32.4$ ms. This corresponds to 1296 KB reads, so the blocks must be 2 MB. A disk constantly transferring can perform 40 MB/2 MB = 20 transfers each second. With this block size we can perform $2^1/_2$ transfers per I/O bus for a total of 50 transfers per bus per second. We have 2 buses, so we can perform 100 transfers per second. This is a bandwidth of 2 MB × 100 = 200 MB/sec.

8.37 How many cycles to read or write 8 words? Using the current example (64-bit bus with 128-bit memory bus, $1 + 40 + 2 \times (2+2) = 49$ cycles. The average miss penalty is $.4 \times 49 + 49 = 68.6$ cycles. Miss cycles per instruction = $68.6 \times .05 = 3.43$. If we up the block size to 16, we get 57 cycles for 16 words, which makes $79.8 \times .03 = 2.39$ miss cycles per instruction.

8.41 No solution provided.

8.42 No solution provided.

8.43 No solution provided.