Chapter 1 Questions - Assignment Questions for Week 1

1.4

1.4 [2] ¡§1.4¿ Assume a color display using 8 bits for each of the primary colors (red, green, blue) per pixel and a frame size of 1280 × 1024.

a. What is the minimum size in bytes of the frame buffer to store a frame?

b. How long would it take, at a minimum, for the frame to be sent over a 100Mbit/s network?

1.6

1.6 [3] ¡§1.7¿ A given program runs on two different computer systems. The first computer system completes the execution of the program in 10 seconds, while the second computer system completes the execution of the program in 15 seconds.

a. Calculate the speedup ratio of the first computer system compared to the second computer system.

b. Calculate the performance ratio of the first computer system compared to the second computer system.

c. If the execution time of the program on the first computer system is reduced by 20% while keeping the execution time on the second computer system the same, calculate the new speedup ratio and performance ratio.

1.7

1.7 [4] ¡§1.8¿ Consider a system with a clock frequency of 2.5GHz and an average CPI of 1.5. When running a program, 35% of the instructions are arithmetic, 20% are load/store, 25% are branch, and 20% are other instructions. The CPI for each instruction category is as follows: 1.0 for arithmetic, 1.5 for load/store, 2.0 for branch, and 3.0 for other instructions.

a. Calculate the effective CPI for the program.

b. If the program executes 1 billion instructions, calculate the total execution time.

1.8

1.8 [3] ¡§1.9¿ A computer system has a 32-bit virtual address and a 4 KB page size. It uses a two-level page table where the first-level page table contains 1024 entries, and each entry is of size 4 bytes. The second-level page table

contains 512 entries, and each entry is of size 4 bytes. Each page table entry also has a valid bit. Calculate the total memory overhead required for the page table of a process.

1.10

1.10 [4] ¡§1.11¿ A computer system has a level-1 data cache with a hit time of 1 ns, a miss time of 10 ns, and a hit rate of 90%. It also has a level-2 data cache with a hit time of 10 ns, a miss time of 100 ns, and a hit rate of 80%. Calculate the average memory access time (AMAT) for the system.

1.11

1.11 [4] ¡§1.12¿ A computer system uses a 32-bit virtual address and a 4 KB page size. The system has a translation lookaside buffer (TLB) with a hit rate of 95% and a hit time of 1 ns. The TLB is small enough to hold 32 entries. The system also has a page table stored in memory with an access time of 100 ns. Calculate the average memory access time (AMAT) for the system.

1.12

1.12 [4] ¡§1.13¿ A computer system has a cache with a hit time of 1 ns, a miss time of 10 ns, and a hit rate of 90%. The system also has a main memory with an access time of 100 ns. The hit rate of the cache can be improved to 95% by adding a small buffer between the cache and the main memory. This buffer introduces a delay of 5 ns on a cache miss, but it allows the cache to access the main memory in parallel with the buffer. Calculate the average memory access time (AMAT) for the system with the buffer.

1.13

1.13 [3] ¡§1.14¿ A computer system has a cache with a miss penalty of 20 ns and a miss rate of 5%. The cache is connected to a main memory with an access time of 100 ns. A processor running a program generates 100 memory references, out of which 40% are loads and 60% are stores. Calculate the average memory access time (AMAT) for the system.