CSED211 Homework #3, Due Nov 11, 2019

1. Exercise 6.24 on page 685

   First we need to determine a few basic properties of the file and the disk. The file consists of 4,000 512-byte logical blocks. For the disk,

   $T_{\text{avg seek}} = 4$ ms, $T_{\text{max rotation}} = 4$ ms, and $T_{\text{avg rotation}} = 2$ ms.

   A. Best case: In the optimal case, the blocks are mapped to contiguous sectors, on the same cylinder, that can be read one after the other without moving the head. Once the head is positioned over the first sector it takes 4 full rotations (1,000 sectors per rotation) of the disk to read all 4,000 blocks. So the total time to read the file is

   $T_{\text{avg seek}} + T_{\text{avg rotation}} + 4 * T_{\text{max rotation}} = 4 + 2 + 16 = 22$ ms.

   B. Random case: In this case, where blocks are mapped randomly to sectors, reading each of the 4,000 blocks requires $T_{\text{avg seek}} + T_{\text{avg rotation}}$ ms, so the total time to read the file is

   $(T_{\text{avg seek}} + T_{\text{avg rotation}}) * 4{,}000 = 24{,}000$ ms (24 seconds).

2. Exercise 6.29 on page 687

   A. CT: [11–4], CI: [3–2], CO: [1–0]

   B.

Operation	Address	Hit?	Read Value (or Unknown)
Read	0x834	No	Unknown
Write	0x836	Yes	(not applicable)
Read	0xFFD	Yes	C0

3. Exercise 6.30 on page 688

   A. Cache size: C = 128 bytes.

   B. Address fields: CT: [12-5] CI: [4-2] CO: [1-0]

4. Exercise 6.36 on page 690

   A. Case 1: Assume the cache is 512-bytes, direct-mapped, with 16-byte cache blocks. What is the miss rate? In this case, each access to x[1][i] conflicts with previous access to x[0][i], so the miss rate is 100%.

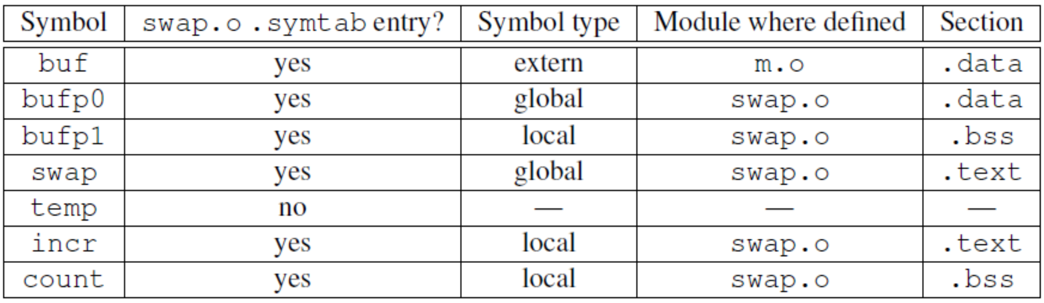
   B. Case 2: What is the miss rate if we double the cache size to 1024 bytes? If we double the cache size, then the entire array fits in the cache, so the only misses are the cold (compulsory) misses for each new block. Since each block holds four array items, the miss rate is 25%.

   C. Case 3: Now assume the cache is 512 bytes, 2-way set associative using an LRU replacement policy, with 16-byte cache blocks. What is the cache miss rate? Increasing the associativity removes the conflict misses that occurred in the direct mapped cache of Case 1. The only misses are the cold misses when each block is loaded, so the miss rate is 25%.

D. For Case 3, will a larger cache size help to reduce the miss rate? No. Even if the cache were infinitely large, we would still have the compulsory misses required to load each new cache block.

E. For Case 3, will a larger block size help to reduce the miss rate? Yes. A larger block size would reduce the number of compulsory misses by an amount inversely proportional to the increase. For example, if we doubled the block size, we decrease the miss rate by half.

5. Exercise 7.6 on page 750



Symbol	`swap.o .symtab` entry?	Symbol type	Module where defined	Section
`buf`	yes	extern	`m.o`	`.data`
`bufp0`	yes	global	`swap.o`	`.data`
`bufp1`	yes	local	`swap.o`	`.bss`
`swap`	yes	global	`swap.o`	`.text`
`temp`	no	—	—	—
`incr`	yes	local	`swap.o`	`.text`
`count`	yes	local	`swap.o`	`.bss`

6. Exercise 7.8 on page 751

A. Because Module 2 defines main with the static attribute, it is a local symbol, and thus there are no multiply-defined global symbols. Each module refers to its own definition of main. This is an important idea; make sure students understand the impact of the static attribute and how it limits the scope of function and variable symbols.

(a) REF(main.1) → DEF(main.1)
(b) REF(main.2) → DEF(main.2)

B. Here we have two weak definitions of x, so the symbol resolution in this case is UNKNOWN (Rule 3).

C. This is an ERROR, since there are two strong definitions of x (Rule 1).

7. Exercise 7.12 on page 753 solution

A. 0x4004f8 -- 4 -- 0x4004ea = 0xa

B. 0x400500 -- 4 -- 0x4004da = 0x22

8. Exercise 8.13 on page 825.

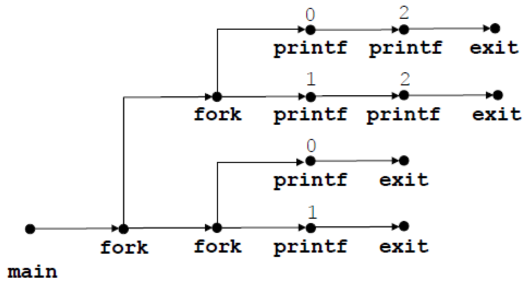
The parent process prints x=4 <nl> x=3 and the child process prints x=2. (<nl> means a new line.) Thus, any of the following sequences represents a possible outcome (each column is a possible outcome):

x=4 <nl> x=3 <nl> x=2 or

x=4 <nl> x=2 <nl> x=3 or

x=2 <nl> x=4 <nl> x=3

9. Exercise 8.18 on page 827



A. 112002 (possible)
B. 211020 (not possible)
C. 102120 (possible)
D. 122001 (not possible)
E. 100212 (possible)

10. Exercise 8.21 on page 828

This program has only two possible output sequences: “abc” or “bac”.