

CS 200: Computer Systems Programming I (Fall 2006)

Midterm Exam

Name: _____

1. (10 pts) (K&R Ch. 1-2)

Assuming 32-bit integers, write a C expression that returns an integer that is the result of swapping the high and low words of integer x.

```
int x;
```

2. (5 pts) (B&O Ch. 1)

List the 4 steps that convert a source file into a machine executable

3. (15 pts) (B&O Ch. 1)

a. What is the main motivation for the memory hierarchy?

b. What is the main motivation for virtual memory?

4. (15 pts) (B&O Ch. 2.1, Problems 2.3-2.4)

- a. Assuming the use of unsigned numbers, fill in the following table. Use 8 bits for representing binary numbers and 2 digits for hexadecimal numbers

Decimal	Binary	Hexadecimal
55		
	10101100	
		A7

- b. Assuming the use of unsigned values, perform the following hex arithmetic.

$$0x502c + 0x08 =$$

$$0x502c - 0x30 =$$

5. (10 pts) (B&O Ch. 2.1)

Consider the following declaration:

```
char c;  
int i;  
unsigned int ui;  
float f;  
double d;  
double* dp;
```

List the number of bits used to represent the following terms assuming C on IA32.

a. c

b. &c

c. ui

d. i

e. f

f. d

g. dp

h. &d

6. (10 pts) (B&O Ch. 2.1-2.2)

- a. Given the code below, what are the outputs of the two `printf` statements.

```
char c=0xff;
unsigned char uc=0xff;
printf("%d %d\n", (int) c, (unsigned int) uc);
c = c >> 1;
uc = uc >> 1;
printf("%d %d\n", (int) c, (unsigned int) uc);
```

- b. Give the 8-bit, two's complement representation of the following decimal numbers.

-32

-7

7. (5 pts) (B&O Ch. 2.3)

- a. Assuming unsigned arithmetic using 4-bit integers, what are the results (after truncation) of the following operations?

$1001 + 1001 =$

$1001 * 1001 =$

8. (10 pts) (B&O Ch. 2.4, Problem 2.31)

a. What is the binary representation of $\frac{3}{8}$?

b. What is the binary representation of $\frac{23}{16}$?

c. What fraction does the binary number 10.1101 represent?

d. What fraction does the binary number 1.011 represent?

9. (15 pts) (B&O Ch. 2.4, Figure 2.23, Problem 2.33)

Consider a 7-bit IEEE floating point format with a sign bit, a 3-bit exponent field ($k=3$) and a 3-bit fraction field ($n=3$). The bias of the exponent field is 3.

- a. What is the bit representation of the smallest, strictly positive, floating point number in this format?

- b. Is the number in a) in normalized or denormalized form?

- c. What is the value of the number in a) given as a fraction?

- d. What is the bit representation of the largest, non-infinite, floating point number in this format?

- e. Is the number in d) in normalized or denormalized form?

- f. What is the value of the number in d) in decimal?

10. (5 pts) (B&O Ch. 2.4, Problem 2.37)

Assume variables `x`, `f`, and `d`, are of type `int`, `float`, and `double`, respectively. Their values are arbitrary, except that neither `f` nor `d` is infinite or NaN. For each of the following C expressions, argue whether it will always be true or explain when it will not be true.

a. `x == (int)(float) x;`

b. `x == (int)(double) x;`