Exam Review

The midterm exam will cover chapters 1 through 3 in Patterson and Hennessy, as well as the C programming language. Here are some sample questions to help you review.

1. Which of the following statements correctly describes how to negate a twos-complement integer \( i \)?
   
   (a) flip all the bits in \( i \) and subtract 1
   (b) flip all the bits in \( i \)
   (c) flip all the bits lying strictly to the left of the rightmost “1”
   (d) flip all the bits lying to the left of the leftmost “0”

2. Write a swap method that exchanges the values of two int variables. Use pointers. Show how the method is used to swap the contents of \( a \) and \( b \) in the following program:

   ```c
   #include <stdio.h>
   ...
   int main() {
     int a, b;
     /* Input values of a, b: */
     scanf("%d%d", &a, &b);
     swap( ....);
     printf("Swapped values: a=%d, b=%d\n", a, b);
     return 0;
   }
   ```

3. Show the representation of the decimal number “\(-\frac{1}{5}\)” using IEEE standard 32-bit floating point representation (You don’t have to write every single bit if there is a long string of 1’s or 0’s — just indicate this with “…” or something.) Indicate which groups of bits represent the sign, the exponent, and the fraction.

4. In MIPS assembly language, fill in the instructions needed to find the sum of the ten values stored beginning at location list. The sum should be stored in register $t0$ when the program reaches location “done”. You may need to use more registers than the ones shown in the code.
.data
list: .word 10,17,23,36,44,59,61,77,83,92

.text
li $t0,0       # t0 holds the sum so far; initially zero
la $t1,list   # t1 holds the address of the next number
li $t2,0       # t2 counts from 0 through 9
loop: bge $t2,10,done   # quit if t2 >= 10

# MISSING STATEMENTS GO HERE
addi $t2,$t2,1    # increment the loop counter
b loop   # return to top of loop
done:

5. In the following C program, main calls a function named f with three int parameters. Function f then calls function g with two int parameters. Finally, main calls g with two parameters. Assuming that the stack grows towards decreasing memory addresses, show the allocation of memory in the stack and the location of the stack pointer at the indicated check points during program execution. Label the locations of all variables.

```
#include <stdio.h>

void g(int c, int d) {
    /* THIRD AND FIFTH CHECK POINTS */
}

void f(int a, int b, int c) {
    /* SECOND CHECK POINT */
    g(a+1, b+1);
}

int main() {
    int i = 10, j = 20, k = 30;
    /* FIRST CHECK POINT */
    f(i,j,k);
    /* FOURTH CHECK POINT */
    g(i,j);
}
```

6. What are the five parts of a computer as described in your textbook?
Which of these parts is responsible for decoding instructions?
Which of these parts is responsible for carrying out arithmetic and logical instructions?
7. In MIPS assembly language, write the statements needed to create space on the stack for two integers, then store the values “37” and “-12” on the stack in the space you just reserved. If you need to reserve any additional memory, do it in the “.data” section.

8. What does the following program print?

```c
#include <stdio.h>

int main() {
    int i = 17;
    int j = 22;

    printf("%d %d %d %d\n", i&j, i|j, i>>2, j<<2);
    printf("%x %x %x %x\n", i&j, i|j, i>>2, j<<2);
    return 0;
}
```

9. How many bytes of memory are reserved by the following MIPS directives?

```assembly
.data
.word 10
.word 20
.space 16
.ascii "a string"
```

10. What is wrong with the following C function? (Explain the concept, don’t just tell me what the error message says.)

```c
/**
 * Returns an uninitialized array of ten integers
 */
int * createArrayOfSize10()
{
    int temp[10];
    return &temp;
}
```

11. Repair the function in the previous problem so that it correctly does what the comment says.

12. Assuming 8-bit twos-complement integer representation,
   (a) What is the largest value, in decimal, that can be stored?
   (b) What is the smallest value, in decimal, that can be stored?
   (c) What is the hexadecimal representation of the integer 90?
(d) what is the hexadecimal representation of the integer -90?

13. Who is generally credited with coming up with the notion of the stored program computer?

14. Your book uses a great many acronyms. What do the following mean?

   (a) DRAM
   (b) CPU

15. What command would you use to produce an assembly language version of the C program exam.c?