Name:_____

Problem 1: (5 points) Short Answers (5 minutes)

a) Moore's Law states that the number of _____ will double every

_____.

b) Name the 5 classic components of a computer

c) What evaluates to TRUE in C? What evaluates to FALSE?

d) Name the 4 regions of a program's memory space

e) What do the acronyms CISC and RISC stand for? What is the difference between the two?

Name:_____

Problem 2: (5 points) C Syntax and Semantics (5 minutes)
Given the following declarations:

```
char a[14] = "pointers in c";
char c = 'b';
char *p1 = &c, **p2 = &p1;
```

State whether out any of the following 5 statements that are not correct C. If they are not correct, give the reason why.

1. `p1 = a + 5;`

2. `&p1 = &a[0];`

3. `p2 = a;`

4. `*(a + 10) = 't';`

5. `*p2 = %c;`

Name:_____

Problem 3: (15 points) Pointers and Arrays (10 minutes)
Below is a segment of C code:

```
char *p, *q, y=0; x[8]={0,1,2,3,4,5,6,7};
int i=0;
p = x;
q = &y;
*q = 'a';
for(i = 0; i < 6; i++){
*p++ = *q;
}
q = p;
```

Assume the address of x is 0x4000 and the address of y is 0x4008.
(3 points) What is the value of `x[1]` at the end of the code?

(3 points) What is the value of `(x+1)` at the end of the code?

(3 points) What is the value of `*q` at the end of the code?

Consider the following code and assume the address of variable array is 0x10000000.

```
int array[5]={-1,0,1,2,3};
int main(){
unsigned char *ptr1 = (((unsigned char *) array) + 3);
unsigned char val;
int *ptr2 = array + 3;
val = *ptr1;
return 0;
}
```

(3 points) What address (in hex) does `ptr2` point to at the end of the program?

(3 points) What value does `val` contain at the end of the program?

Name:_____

Problem 4: (20 points) Strings (15 minutes)
Write a C function named *substring* that, given a string *s*, and two positions *start* and *finish,* where $1 \leq start < finish \leq strlen(s)$, inclusive, returns the substring corresponding to positions start through finish. For example, *substring("abcd", 2 , 4)* should return the string *"bcd"* . The insertion should not change the argument string. You must return a pointer to a new string. You don't need to do any error checking.

```
char * substring (char *s, int start, int finish){
```

Name:_____

Problem 5: (30 points) Data Structures (20 minutes)
A list is a series of elements that are sequentially connected to each other. A list node is a structure that represents a single element of a list. A list node is formally defined as follows:

```
struct ListNode {
      int         data;  // this is the data contained in this element
      ListNode*   next;  // this is a pointer to the next element in the list
      ListNode*   prev;  // this is a pointer to the previous element in the list
};
```

a) **(5 points)** On a MIPS machine with 32 bit addressing, and every word in memory must be aligned to 4 byte addressing, how many bytes does the compiler allocate for one variable ListNode?

b) **(20 points)** A list is simply a series of these nodes connected using pointers.

Write a C function that completely reverses the ordering of the elements in the list. Extra credit will be given if you do it using recursion.

The function should be named `reverse` and should take one argument: a pointer to the first `ListNode` object of the list. It should return a pointer to the new first element of the list (which was previously the last element)

```
ListNode * reverse(ListNode *aNode) {
```

Name:_____

Problem 6: (25 points) Assembly (20 minutes)

```
Morbo:
bge $a1, $a2, Zoidberg
mul $t1, $a1, 4
add $t1, $a0, $t1
mul $t2, $a2, 4
add $t2, $a0, $t2
lw $t3, 0($t1)
lw $t4, 0($t2)
sw $t3, 0($t2)
sw $t4, 0($t1)
addi $a1, $a1, 1
sub $a2, $a2, 1
j Morbo
Zoidberg:
jr $ra
```

a) (20 points) Translate *Morbo* into a high-level language like C or Java. Be sure to describe the number and types of any arguments and return values. We will not deduct points for syntax errors *unless* they are significant enough to alter the meaning of your code. You are not allowed to use goto statements (gotos are bad).

b) (5 points) Describe briefly, in English, what this function does.

Name:_____

Extra Credit: History of Computing

a) (1 point) What is the significance of the Jacquard Loom?

b) (1 point) Jeopardy: She helped Charles Babbage program his computing engines and was called the first woman programmer

Who is _____?

A theoretical machine proposed in 1937 in an attempt to define the meaning of computation.

What is _____?

They independently invented the integrated circuit in 1959.

Who are _____?

c) (1 point) Name and describe the significance of the major concept introduced by the Von Neumann machine.