16.070 Exam #2
4/13/01

1) (3 points) **Fill in the blank:**
A C program always contains a function called ____________________.

2) (6 points) **Fill in the blanks:**
The three major hardware components of a computer are the ____________ and .

3) (4 points) **Fill in the blanks:**
Arithmetic operations are performed in the ____________ and the results are stored in the ____________.

4) (3 points) **Answer the question:**
A microcomputer system with a 16-bit address bus could potentially access how many memory locations? ________________

5) (3 points) **Fill in the blank:**
When the CPU is required to write data to memory, the ____________ control bus signal will be activated.

6) (3 points) **Fill in the blank:**
Of the three system buses, only the ____________ bus is bi-directional.

7) (4 points) **Circle one:**
An interpreted language generally runs ________________ a compiled language.
   a) faster than
   b) slower than
   c) at about the same speed as
8) (12 points) Number conversions: Fill in the following table by converting the numbers below into the other bases. Assume signed magnitude representation for binary numbers. Each number is one byte long.

<table>
<thead>
<tr>
<th>Binary</th>
<th>Hexadecimal</th>
<th>Decimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>01001100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1E</td>
<td></td>
<td>-1</td>
</tr>
</tbody>
</table>

-1
9) (15 points) Boolean Algebra, gates: Write a short function that would implement an XOR logical operator. For example, if \( a = 1 \) and \( b = 0 \), \( \text{XOR}(a, b) \) would return 1. Note that this is a logical operator, not a bitwise operator.

HINT: Use existing logical operators (such as \&\&, ||, !).

The prototype is:

```c
int XOR(int a, int b);
```
10) (12 points) Complete the lines below to show the output for the following program.

```c
int main(void)
{
    int a = 1, b = 2, c = 3 ;
    int *ptr1, *ptr2 ;

    ptr1 = &a ;
    ptr2 = &b ;
    a = *ptr1 + *ptr2 ;
    printf("Line 1: ");
    printf("a = %d, b = %d, c = %d\n\n", a, b, c) ;

    *ptr2 = *ptr1 + c ;
    printf("Line 2: ");
    printf("a = %d, b = %d, c = %d\n\n", a, b, c) ;

    ptr2 = ptr1 ;
    printf("Line 3: ");
    printf("a = %d, b = %d, c = %d\n\n", a, b, c) ;

    *ptr2 = *ptr1 + c ;
    printf("Line 4: ");
    printf("a = %d, b = %d, c = %d\n\n", a, b, c) ;

    return 0;
}
```

**Output:**

Line 1:

Line 2:

Line 3:

Line 4:
11) (15 points) The function below is meant to fill a two dimensional array of characters with the following pattern:

```
A B C D E F
B A B C D E
C B A B C D
D C B A B C L
E D C B A B
F E D C B A
```

You may assume that the array being modified is square (same number of columns and rows) and has 26 or less rows. The argument `ar` will be passed the address of the [0][0] element of the array to be modified. The argument `size` will be passed the number of rows/columns in the array to be modified. (HINT: The pattern is symmetric.)

Fill in the blanks to achieve the desired function:

```c
void alphabet_soup(char *ar, const int size) {
    int i, j;
    for (i=0; i<size; i++)
        for (j=i; j<size; j++)
        {
            *(ar + ______________) = ______________;
            *(ar + ______________) = ______________;
        }
    return;
}
```
(10 points) Below you will find a 1hz and a 3hz sine wave, and the graph produced by sampling of each wave at 12hz. Complete the graphs for sampling at 6, 3, and 1 hz.

a) What is the lowest frequency you can sample the signal on the right in order to determine the period of the signal?

b) What do we call the phenomenon you witnessed when sampling the signals at 1 Hz?
13) (10 points) Identify the five computer components highlighted on the schematic below.

Figure B.9: 6811, Memory, Address Decoding and Miscellaneous Circuitry