APSC 380 : INTRODUCTION TO MICROCOMPUTERS
1997/98 WINTER SESSION TERM 2

Assignment 1

due February 4 1998 (9:30 AM)

Question 1

What are the values of the following C expressions?

1. `2 * ' '`
2. `31 / 6 + 8`
3. `y = ( 1 + 2 ) == ( 4 - 1 )`
4. `x = 1 == -2 + 3`
5. `6 <= 4 + 9 / 2`
6. `( 0xab & 0x0f )`
7. `( 0x2d & 0xf0 ) | ( 0x2d \& 0x0f )`
8. `3 * ( 0x0d && 0xd0 )`
9. `( 0x2d ^ 0xff ) + ( 1 << 1 )`
10. `~ ( 256 | ' ' )`
11. `128 || ( ' ' == 0x21 )`

Question 2

What will be printed when the following program is run?

```
#include <stdio.h>
main()
{
   int i ;
   i = 0 ;
   while ( i < 7 ) {
      i = i + ( i < 3 || i >= 6 ) + 1 ;
      printf ( "%d\n", i ) ;
   }
}
```

Question 3

Write a (complete) C program that prints the numbers between 6 and 66 inclusive that are multiples of 3 except for those numbers that are between 30 and 45 inclusive. Use one (and only one) `for` loop in your program.

Question 4

Write a function with the name `len` that takes an array of characters as an argument and returns an integer value which is the number of characters in the array. The last character in the array has a value zero. This character should not be included in the count. For example, given the following sequence of statements, the value of the last expression would be 2:

```
char s[3] ;

s[0]='H' ;
s[1]='i' ;
s[2]=0 ;

len(s) ;
```

Question 5

Convert the following decimal numbers to binary and hexadecimal. Express the hexadecimal numbers as C constants (use a `'0x'` prefix). Look for similarities between the numbers – it may save you time.

1. 8
2. 7
3. 16

4. `15`
5. `256`
6. `255`
7. `237`

Question 6

Convert the following binary numbers to hexadecimal and decimal. The spaces are for ease of reading.

1. `1011`
2. `1011 1011`
3. `1000 0000`
4. `11 1100`
5. `0011 1100`

Question 7

Convert the following hexadecimal numbers to binary and decimal.

1. `0x0e`
2. `0xe`
3. `0xAA`
4. `0xFA`
5. `0x40`
6. `0x18`

Question 8

Write a function called `printbin` that prints the binary value of an integer whose value can be assumed to be less than 32768. This function should take one integer argument and not return a value. *Hint: use a loop which computes the values of powers of 2 starting at 16384 and going down to 1. Use the conversion algorithm described in the class notes.*

Question 9

Design the state machine for a motor controller with a special over-temperature protection feature as described below. The controller's two inputs are labelled `on-off` and `temp` and the two outputs are labelled `slow` and `fast`. The motor runs slowly when only the `slow` output is on. The motor runs fast when only the `fast` output is on. The motor is off when both outputs are off.

The `on-off` input is a push-button switch. Pushing the `on-off` button when the motor is running turns it off. Pushing the `on-off` button when the motor is on turns it off. The `temp` input comes from a temperature sensor. If the `temp` signal is off then the motor should be run at high speed. If it is on, then the motor should be run at low speed.

Design a state machine controller for the motor controller. List the inputs and outputs. Choose a sufficient number of states and give a name to each state. Write a table giving the output conditions for each state. Draw a state transition diagram showing the states and the logical conditions that cause transitions between them. Write out a tabular description of the state machine with the following columns: starting state, input, next state.

You may assume the controller only sees the button as "pushed" for the duration of one state transition. Briefly explain how you would have to modify your design if this were not the case.