Embedded Real-Time Systems (AME 3623)
Homework 1 Solutions

February 21, 2011

Question 1

1. (5pts) Given the binary number: 10110101. What is the decimal equivalent? Assume that this is an unsigned number. Show your work.

   $1 + 4 + 16 + 32 + 128 = 181$

2. (5pts) What is the hexadecimal equivalent of the above binary number?

   $0xB5$

3. (5pts) Assume that we interpret the above number is a signed 8-bit number (two's complement). Is it positive or negative? What is the decimal equivalent? Show your work.

   It is negative.

   Flip and add one yields: 01001011

   This is decimal 75.

   So, the original number has a value of -75

4. (5pts) Given the binary number: 1001011011111. What is the decimal equivalent? Assume an unsigned integer of 16 bits. Show your work.

   $1 + 2 + 4 + 8 + 16 + 64 + 128 + 512 + 4096 = 4831$

5. (5pts) What is the hexadecimal equivalent of the above binary number?

   $0x12DF$

6. (5pts) Assume that we interpret the above number is a signed 16-bit number. Is it positive or negative? What is the decimal equivalent? Show your work.

   It is positive (bit 15 is zero).

   The value is still 4831

7. (5pts) Given the decimal number: 98. What is the binary equivalent? Show your work (all of the steps of the algorithm that we discussed in class).

value	**binary**
98	x
49	0
24	10
12	010
6	0010
3	00010
1	100010
0	1100010

8. (5pts) Given the decimal number: 867. What is the binary equivalent? Show your work.

value	**binary**
867	x
433	1
216	11
108	011
54	0011
27	00011
13	100011
6	1100011
3	01100011
1	101100011
0	1101100011

Question 2

1. (10pts) Given the following code, what are the final values of variables b and c. Give your answers in hexadecimal.

```
uint8_t a = 0xA5;
uint8_t b = a | 0x10;
uint8_t c = a || 0x10;
```

b = 0xB5
c = 1

2. (10pts) Given the following code, what are the final values of variables b and c. Give your answers in hexadecimal.

```
uint8_t a = 0xA5;
uint8_t b = a | 0x33;
uint8_t c = a + 0x33;
```

b = 0xB7
c = 0xD8

3. (10pts) Given the following code, what are the final values of variables b and c. Give your answers in hexadecimal.

```
uint8_t a = 0x3C;
uint8_t b = a & 0x11;
uint8_t c = a && 0x11;
```

b = 0x10
c = 0x1

4. (10pts) Given the following code, what are the final values of variables b and c. Give your answers in hexadecimal.

```
uint8_t a = 0xF0;
uint8_t b = a & 0x42;
uint8_t c = a - 0x42;
```

b = 0x40
c = 0xAE

5. (10pts) Given the following code, what are the final values of variables b and c. Give your answers in hexadecimal.

```
uint8_t a = 0x5A;
uint8_t b = a ^ 0xF0;
uint8_t c = a ^ 0x0F;
```

b = 0xAA
c = 0x55

Question 3

1. (10pts) Briefly explain the distinction between the *value* and the *address* of a memory element.

   A memory contains many memory elements, each of which stores a value. The address allows a microprocessor to specifically request or change the value of a specific memory element.

2. (10pts) Briefly describe the conditions under which you would store program variables in EEPROM.

   We would do this if we wanted the values of the variables to be persistent (i.e., continue to exist after power is turned off).

3. (10pts) What device inside the microprocessor is responsible for handling the multiplication of two integers?

   The Arithmetic Logical Unit (ALU).