Homework #2
Due Th. 9/14

Note: Do note use a calculator or computer to complete the following exercises. You must show all your work and put a box around your final answer to receive credit.

Total Points: 99

1. (0 points) How long did it take you to complete the homework? This will not affect your grade (unless omitted) but it helps gauge the workload for this and future semesters. If you do not answer this question you will get -5 points. Do not include time to download the software.

2. (4 points) Convert the following 8-bit unsigned binary numbers to 8-bit one's complement representation. Provide your answer first in binary then in hexadecimal.

   Note1: One's complement is the same as two's complement without the +1 step. It just requires you to invert the bits.

   Note2: Hexadecimal (binary) can represent a value (i.e., an unsigned number) but it is also a shorthand for representing a collection of bits. As a collection of bits, the value is not explicit without knowing the representation (e.g. unsigned or two's complement). As an example bits 101**1010** can be written in hexadecimal as 0x5**A**. Remember to start with the right-most group of 4-bits (least significant byte), then move left in groups of four bits.

   (a) (1 point) 00011001

   (b) (1 point) 11001101

   (c) (1 point) 00100011

   (d) (1 point) 01100110

3. (9 points) Consider a 10-bit binary number. Determine how many values (1 point) can be represented and what is the range of values (2 points) for the following representations:

   (a) (3 points) Unsigned binary number.

   (b) (3 points) Two's complement number.

   (c) (3 points) Sign/magnitude number.

4. (2 points) Suppose you are offered 2^{31} Bytes of memory with your new cell phone. How much memory is this in gigabytes (GB)?

5. (4 points) Is it possible for a result to overflow when adding a positive and negative number? Explain briefly.

6. (9 points) Add the following 12-bit two's complement numbers and write the result in hexadecimal. Does the result overflow the 12-bit result.

   (a) (3 points) 0x03A + 0xCDE

   (b) (3 points) 0xF03 + 0x805

   (c) (3 points) 0xFFF + 0xFF0

7. (9 points) Add the following 12-bit unsigned binary numbers and write the result in hexadecimal. Does the result overflow the 12-bit result.

   (a) (3 points) 0x03A + 0xCDE

   (b) (3 points) 0xF03 + 0x805

(c) (3 points) 0xFFF + 0xFF0

8. (8 points) Extend the following 4-bit values to 7-bits using sign-extension. Write the final result in hexadecimal.
   (a) (2 points) 0xA
   (b) (2 points) 0x7
   (c) (2 points) 0x3
   (d) (2 points) 0xF
9. (4 points) Consider the previous Problem.
   (a) (2 points) Are the 4-bit values equal to the corresponding sign-extended 7-bit values when interpreted as two's complement numbers? Explain briefly.
   (b) (2 points) Are the 4-bit values equal to the corresponding sign-extended 7-bit values when interpreted as unsigned numbers? Explain briefly.
10. (8 points) Extend the following 4-bit values to 7-bits using zero-extension. Write the final result in hexadecimal.
    (a) (2 points) 0xA
    (b) (2 points) 0x7
    (c) (2 points) 0x3
    (d) (2 points) 0xF
11. (4 points) Consider the previous Problem.
    (a) (2 points) Are the 4-bit values equal to the corresponding zero-extended 7-bit values when interpreted as two's complement numbers? Explain briefly.
    (b) (2 points) Are the 4-bit values equal to the corresponding zero-extended 7-bit values when interpreted as unsigned numbers? Explain briefly.
12. (8 points) Represent the following numbers in two's complement using a minimum number of bits. Write your final result in binary and hexadecimal.
    (a) (2 points) 22
    (b) (2 points) -17
    (c) (2 points) -5
    (d) (2 points) -54
13. (12 points) Draw the symbol, boolean equation, and truth table for the following: (You may draw a single truth table with columns for (a)-(d)).
    (a) (3 points) 4-input OR gate
    (b) (3 points) 4-input NOR gate
    (c) (3 points) 4-input XOR gate
    (d) (3 points) 4-input XNOR gate
14. (4 points) Can a CMOS gate drive a LVCMOS gate reliably? If so, state the low and high noise margins. If not, explain why concisely.
15. (4 points) Can a TTL gate drive a CMOS gate reliably? If so, state the low and high noise margins. If not, explain why concisely.

16. (10 points) **Hands-On Exercise**

This weeks hands-on exercise will help you get ready to use the Quartus II Web Edition v13.1 software, a powerful commercial suite that will enable you to design, simulate, and test digital circuits. To use this software, you can either:

1. Install the software on your own laptop or computer, and/or
2. Use the software located on the PCs located in the Electrical and Computer Engineering Laboratories, located in TBE B-350 or TBE B-311.

You will be using the Quartus II software in this and future hands-on exercises. **Unless you are confident in installing software and drivers on your own, it is recommended that you use the software in the ECE labs**. If you are using the ECE lab computers, you will need an ACE account (see: `https://ace.unlv.edu/`).

For the hands-on portion of the assignment, either install the Quartus II software (optional) and/or make sure you have an ACE account and confirm that you can log into the computers in TBE B-350 or TBE B-311. Instructions on how to install the software on your own computer are below.

After you have completed this hands-on portion, **write a single statement at the bottom of your homework** that says one of the following:

1. I successfully installed Quartus II v13.1 on my own computer.
2. I successfully logged into a computer in one of the ECE labs using my ACE account.
3. I both installed Quartus II v13.1 on my own computer and logged into a computer in one of the ECE labs using my ACE account.

(Optional) Quartus II Software Installation

If you would like to install the Quartus II v13.1 software on your own laptop or computer, follow these instructions. Note that a newer version of the software exists, however, you will install version 13.1 to be consistent with the version in the ECE labs.

Browse to: `https://dl.altera.com/13.1/?edition=web`. Select release 13.1, the operating system of choice (Windows or Linux), (recommended) use the Akamai download method and leave the **Select All** box selected, as shown in Figure 1. Then click on **Download Selected Files**.

You will now be directed to the myAltera login page. Select **Create Your myAltera Account** enter your email address and click on **Create Account**. Follow the steps to create a free account.

After you have successfully created an account and logged in, the download will begin, as shown in Figure 2. If for some reason the download does not begin, you can click on **Show direct links** to download the individual files manually. Depending on your internet connection speed, downloading the files can take a while – so if you decide to install the software on your own computer, **do not attempt at the last minute**.

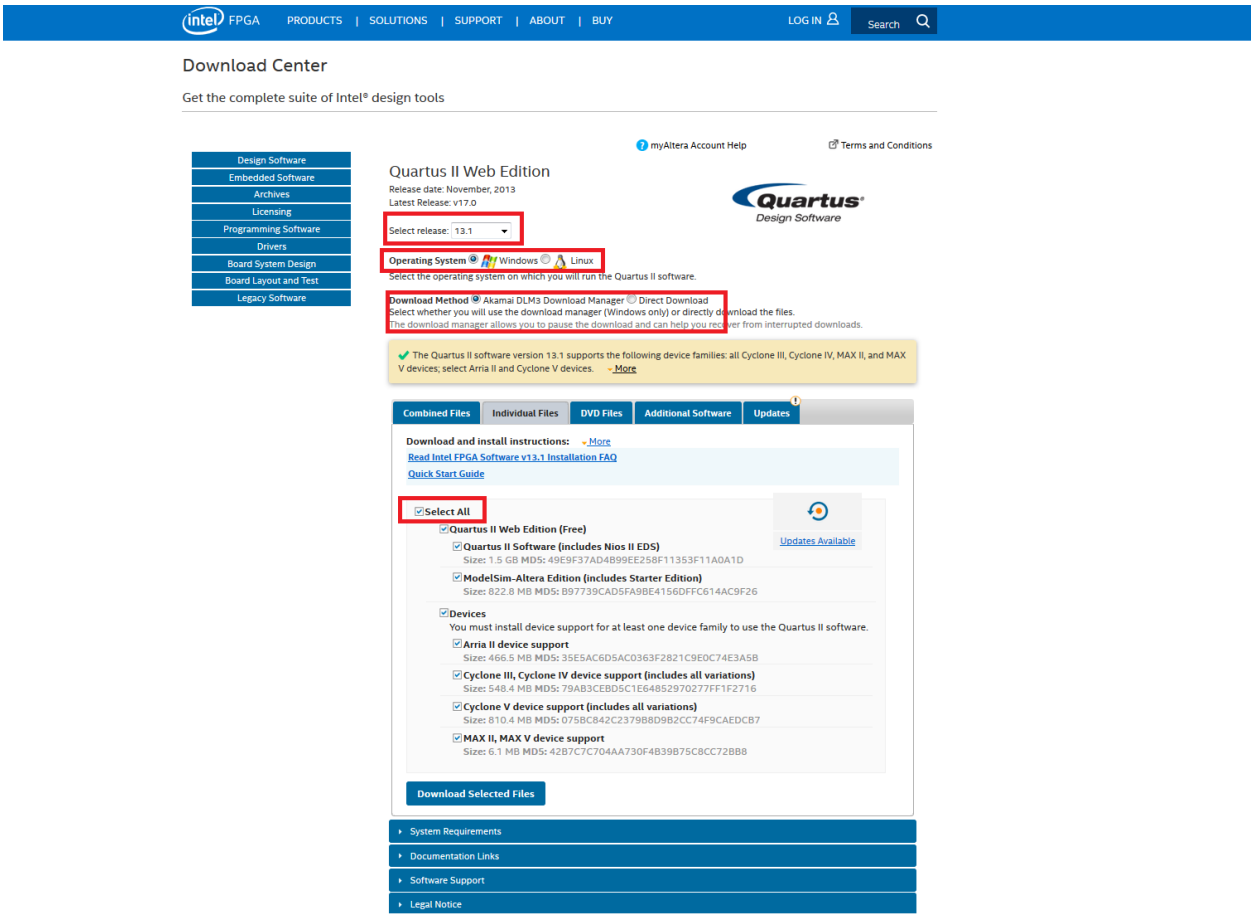

Figure 1: Quartus II Download Page

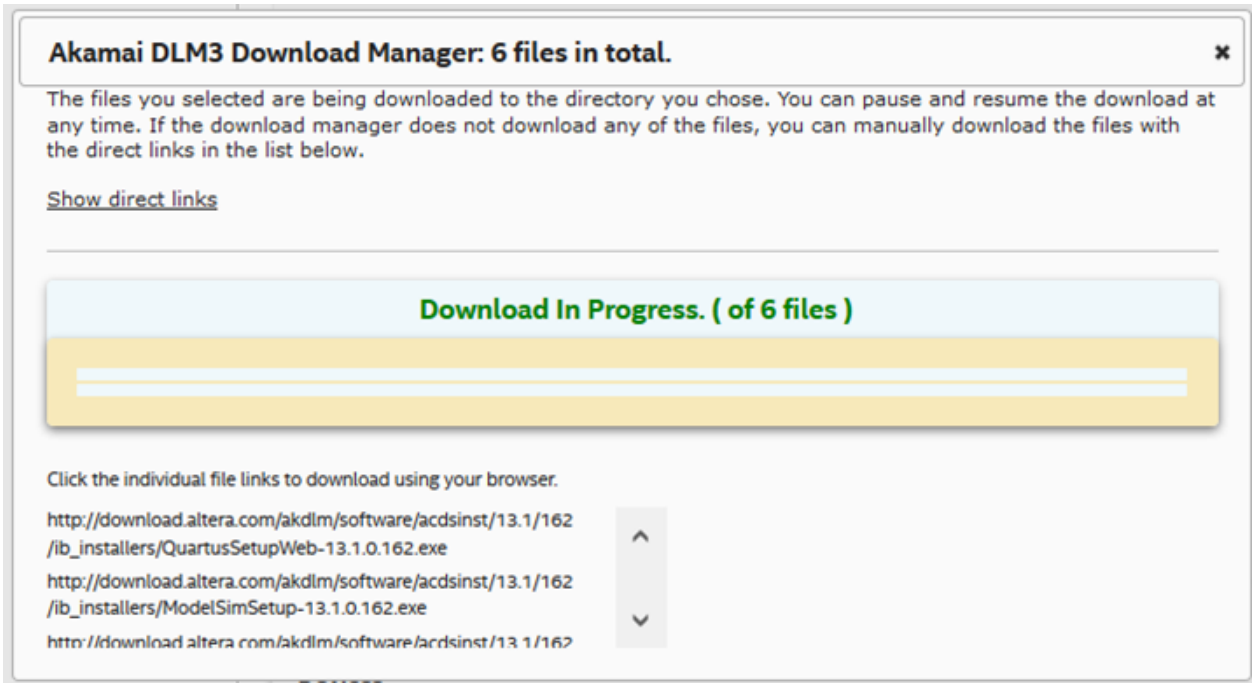

Figure 2: Akamai Download Manager