C6

1. How many bits do you need to represent a number in excess-16 format? What is the excess-16 representation of 12?

$16 = 2^4 = 2^{N-1} \Rightarrow N = 5.$

Five bits are needed to represent the number in excess-16 format.

Step 1. Add 16 to the number
16+12=28

Step 2. Convert to binary
12 in excess-16 = 11100

2. Convert 29/8 into binary 8-bit floating-point representation.

Step1. Set the sign bit to zero since number is positive

Step2. Convert the number into binary representation
29/8 $= 3 + 5/8$
$= 011.101$

Step 3. Normalize the binary representation

$0.11101 * 2^2$

Step 4.Convert the exponent into excess-4

$2 = 110$

Step 5. Fill in the mantissa

Therefore 29/8 $= 01101110$

3. Sketch the basic von Neumann architecture and describe each component in a few lines.

The von Neumann architecture describes a computer with four main sections:
the Arithmetic and Logic Unit (ALU)
the control unit (CU)
the memory
the input and output devices (collectively termed I/O)
These parts are interconnected by a bundle of wires, a Bus.

The central processing unit (or CPU) is the part of a computer hat interprets and carries out the instructions contained in the software. In most CPUs, this task is divided between a CU that directs program flow and one or more execution units that perform operations on data. Almost always, a collection of Registers is included to hold operands and intermediate results.

The ALU is one of the core components of all CPUs. It is capable of calculating the results of a wide variety of common computations. The most common available operations are the integer arithmetic operations of addition, subtraction, and multiplication, the bitwise logic operations of **and**, **not, or** and **xor**, and various shift operations. The ALU takes as inputs the data to be operated on and a code from the CU indicating which operation to perform, and for output provides the result of the computation. In some designs it may also take as input and output a set of condition codes, which can be used to indicate cases such as carry-in or carry-out, overflow, or other statuses.
The CU the part of a CPU or other device that directs its operation. The outputs of the unit control the activity of the rest of the device.

The memory is a sequence of numbered "cells", each containing a small piece of information. The information may be an **instruction** to tell the computer what to do. The cell may contain **data** that the computer needs to perform the instruction. Any slot **may contain either**, and indeed what is at one time data might be instructions later. In general, memory can be rewritten over millions of times - it is a scratchpad rather than a stone tablet.
The size of each cell, and the number of cells, varies greatly from computer to computer, and the technologies used to implement memory have varied greatly - from electromechanical relays, to mercury-filled tubes in which acoustic pulses were formed, to matrices of permanent magnets, to individual transistors, to integrated circuits with millions of capacitors on a single chip.

The bus is a bundle of wires that interconnect all the different parts of the computer.

4. Write an assembly language program (using the language described in the machine language handout) to add two positive numbers. Assume that the numbers are present in memory locations FEh and FFh. Turn in both a hard copy and an electronic copy of your code.

    ```
    ; Program to Add two positive numbers stored in FEh and FFh
    ; Programmer : Joe B
    ; Date Last Modified: September 15th 2003

    load r1, [FEh] ; load number in FEh
    load r2, [FFh] ;load the number in FFh
    addi r3, r1,r2;perform the addition operation
    store r3,[F0h]; store the result in F0h
    halt; stop the program
    ```