Homework #1

1. No because higher-level programming languages basically translate into lower-level programming languages through a compiler.

2. It is more difficult to increase the accuracy of analog computers in comparison to digital designs. An example of this is that a digital clock can tell time more accurately through measuring hundredths, i.e. 10:25.16 rather than just 10:25, where in order to increase the accuracy of analog clocks you must utilize a very long second hand.

3. The three characteristics of algorithms are definiteness, effective computability, and finiteness. For an algorithm to have definiteness, each step of the algorithm must be precisely stated. Effective computability means that the algorithm must be possible for the computer to perform. Finiteness in an algorithm means that the procedure eventually ends.

4. Higher-level programming languages are easier to learn and can be designed for particular purposes. A disadvantage is that they do not run on the computer directly unless through the use of a compiler.

5. The ISA specifies the set of operations the computer can perform and the operands, or data, needed by the operation. The ISA also specifies data types, which are the legitimate representations for operands such that the computer can perform operations on these representations. Finally, the ISA specifies addressing modes that are used to figure out where operands are located.

6. An ISA is all the basic functions a program should have. The implementation of the ISA or microarchitecture can be all the different ways the program is designed to achieve those basic functions.

7.

a. $26_{10} = ?_2$

$$\begin{array}{r} 26 \\ -16 \\ \hline 10 \\ -8 \\ \hline 2 \\ -2 \\ \hline 0 \end{array}$$

$\boxed{0110010_2}$

b. $49_{10} = ?_2$

$$\begin{array}{r} 49 \\ -32 \\ \hline 17 \\ -16 \\ \hline 1 \\ -1 \\ \hline 0 \end{array}$$

$\boxed{0110001_2}$

n	2^n
0	1
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256

c. $255_{10} = ?_2$

$$\begin{array}{r} 255 \\ -128 \\ \hline 127 \\ -64 \\ \hline 63 \\ -32 \\ \hline 15 \\ -8 \\ \hline 7 \\ -4 \\ \hline 3 \\ -2 \\ \hline 1 \\ -1 \\ \hline 0 \end{array}$$

$$\boxed{01111111_2}$$

d. $129_{10} = ?_2$

$$\begin{array}{r} 129 \\ -128 \\ \hline 1 \\ -1 \\ \hline 0 \end{array}$$

$$\boxed{010000001_2}$$

8.

a. $00101010_2 = ?_{10} = ?_{16}$

$= 1 \cdot 2^5 + 0 + 1 \cdot 2^3 + 0 + 1 \cdot 2^1 + 0$

$= 32 + 8 + 2$

$= \boxed{42_{10}}$

$$\underbrace{0010}_{2} \quad \underbrace{1010}_{10}$$

$$\boxed{2A_{16}}$$

b. $00111111_2 = ?_{10} = ?_{16}$

$2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0$

$= \boxed{63_{10}}$

0011 1111

3   15

$\boxed{3F_{16}}$

c. $10000000_2 = ?_{10} = ?_{16}$

$1 \cdot 2^7 + 0 + 0 + 0 + 0 + 0 + 0 + 0$

$= \boxed{128_{10}}$

1000 0000

8   0

$\boxed{80_{16}}$

d. $11101001 = ?_{10} = ?_{16}$

$2^7 + 2^6 + 2^5 + 0 + 2^3 + 0 + 0 + 2^0$

$= \boxed{233_{10}}$

1110 1001

14   9

$\boxed{E9_{16}}$

e. $00001001 = ?_{10} = ?_{16}$

$2^3 + 0 + 0 + 2^0$

$= \boxed{9_{10}}$

0000 1001

0   9

$\boxed{09_{16}}$

9.

a. $100_{10} = ?_3$

$\boxed{10201_3}$

$3 \overline{)100} \quad \dfrac{33}{} R1$

$\quad -9\downarrow$
$\quad 10$
$\quad \underline{-9}$
$\quad 1$

$3 \overline{)33} \quad 11 \; R0$
$\quad \underline{-3}\downarrow$
$\quad 03$
$\quad \underline{-3}$
$\quad 0$

$3 \overline{)11} \quad 3 \; R2$
$\quad \underline{-9}$
$\quad 2$

$3 \overline{)3} \quad 1 \; R0$

$3 \overline{)1} \quad 0 \; R1$

b. $100_{10} = ?_4$

$4\overline{)100}$ $\overset{25}{}$ R0 $4\overline{)25}$ $\overset{6}{}$ R1 $4\overline{)6}$ $\overset{1}{}$ R2 $4\overline{)1}$ $\overset{0}{}$ R1

$\underline{-8}$
20
$\underline{-20}$
0

$\underline{-24}$
1

$\underline{-4}$
2

$\boxed{1210_4}$

c. $100_{10} = ?_5$

$5\overline{)100}$ $\overset{20}{}$ R0 $5\overline{)20}$ $\overset{4}{}$ R0 $5\overline{)4}$ $\overset{0}{}$ R4

$\underline{-10}$
00

$\underline{-20}$
0

$\underline{-0}$

$\boxed{400_5}$

d. $100_{10} = ?_6$

$6\overline{)100}$ $\overset{16}{}$ R4 $6\overline{)16}$ $\overset{2}{}$ R4 $6\overline{)2}$ $\overset{0}{}$ R2

$\underline{-6}$
40
$\underline{-36}$
4

$\underline{-12}$
4

$\boxed{244_6}$

10 a. $210_3 = ?_{10}$

$2 \cdot 3^2 + 1 \cdot 3^1 + 0 \cdot 3^0$

$2 \cdot 9 + 3$

$18 + 3 = \boxed{21_{10}}$

b. $321_4 = ?_{10}$

$3 \cdot 4^2 + 2 \cdot 4^1 + 1 \cdot 4^0$

$3 \cdot 16 + 2 \cdot 4 + 1$

$48 + 8 + 1 = \boxed{57_{10}}$

c. $432_5 = ?_{10}$

$4 \cdot 5^2 + 3 \cdot 5^1 + 2 \cdot 5^0$

$4 \cdot 25 + 3 \cdot 5 + 2$

$100 + 15 + 2 = \boxed{117_{10}}$

11. a. $-6 + 20$

```
00000110 (6)
11111001
+        1
_____
11111010 (-6)
```

```
 00010100 (20)
+11111010 (-6)
_____
✗ 00001110
```

b. $67 + 30$

```
01000011 (67)
+00011110 (30)
_____
01100001
```

c. $42 - 20$

```
00010100 (20)
11101011
+       1
_____
11101100 (-20)
```

```
 00101010   (42)
+11101100   (-20)
_____
✗ 00010110
```

d. $-44 - 23$

```
00101100 (44)
11010011
+       1
_____
11010100 (-44)
```

```
00010111 (23)
11101000
+       1
_____
11101001 (-23)
+11010100 (-44)
_____
✗ 10111101
```

e. 26 - 26

0011010 (26)   0011010   (26)
1100101   + 1100110   (-26)
  ⊥   ⊥   * ┌─────────────┐
─────────   │ 0000000   │
1100110 (-26)   └─────────────┘