Module A.4

**Level 1: Presentation Notes**

1. Number systems used in Computer Science

a. List the main features of the Decimal System

Digits: 0,1,2,3,4,5,6,7,8,9

Used for communicating with human users

b. List the main features of the Binary System

Digits: 0,1 (On or Off)

Binary 10 == Decimal 2

Used by internal CPU and Memory circuits

c. List the main features of the Octal System

Digits: 0,1,2,3,4,5,6,7 (No digits 8 & 9)

Octal 10 == Decimal 8

Used by Computer Scientists for groupings of 3 binary digits

d. List the main features of the Hexadecimal System

Digits: 0,1,2,3,4,5,6,7,8,9, A, B, C, D, E, F (Uses extra letters)

Hex F == Decimal 15

Hex 10 == Decimal 16

Used by Computer Scientists for groupings of 4 binary digits

2. Compare and contrast the Decimal and Binary systems

|  |  |  |
| --- | --- | --- |
| **Criteria** | **Decimal System** | **Binary System** |
| Digits  Used | • Uses Digits:  • 0, 1, 2, 3, 4, 5, 6, 7 , 8, 9 | Uses Digits:  0, 1 (True, False) (+, -)  Evaluate 111 |
| Addition Example | • Addition  • 0 + 1 = 1  • 1 + 1 = 2  • 99 + 1 = 100 | Addition  0 + 1 = 1  1 + 1 = 10  11 + 1 = 100 |
| Powers of  Base | • Powers of 10  • 100 = 1  • 101 = 10  • 102 = 100  • Etc. | Powers of 2  20 = 1  21 = 10 (or 2 decimal)  22 = 100 (or 4 decimal)  Etc. |
| Value of  111 | • 111 = 102 + 101 + 100  • (100 + 10 + 1) | 111 = 22 + 21 + 20  (Decimal : 4 + 2 + 1 = 7) |

3. Convert the following binary numbers to decimal:

a. 11 binary = 3 decimal

b. 101 binary = 5 decimal

c. 1010 binary = 10 decimal

4. Convert the following decimal numbers to binary:

a. 11 binary = 3 decimal

b. 101 binary = 5 decimal

c. 1010 binary = 10 decimal

5. Add the following binary numbers. (verify your answers using decimal)

|  |  |
| --- | --- |
| a) 0101 + 0010 = 0111 | b) 0101+1010 = 1111 |
| c) 0011 + 0010 = 0101 | d) 0110 + 0011 = 1001 |

6. List the main features of the following Computer Memory Structures:

a. Bit

1 binary digit

Used for Boolean data type

Building Block for All computer data and memory

b. Byte

8 binary digits

Largest value: 1111 1111 (28 – 1 = 255 Decimal)

Used for Char (character) data type

c. Word

8 binary digits

Largest value: 1111 1111 (28 – 1 = 255 Decimal)

Used for Char (character) data type

d. Integer Data Type

Is 1 Word (16 bits)

But must represent both Positive (+) and Negative (-)

Range: +32767 to -32768

Larger or smaller numbers require a different data type

Double Word

**Level 2: Research Questions**

1. The Intel 8085 microprocessor was a first generation processor that was used in many early game systems and personal computers. Google “8085 microprocessor architecture” to answer these questions.

a. Year Introduced

1976

b. Size of data bus (in bits)

8-bits

c. Largest data number (in binary and decimal)

Binary 0-1111 1111

Decimal 0-255

d. Size of address bus (in bits)

16-bits

e. Largest memory address (in binary and decimal)

Binary 0-1111 1111 1111 1111

Decimal 0-524287

2. The Intel 8086 microprocessor was the processor used in the first IBM PCs running the DOS operating system. Google “8086 microprocessor architecture” to answer these questions.

a. Year Introduced

1976

b. Size of data bus (in bits)

16-bit

c. Largest data number (in decimal)

Decimal 0-524287

d. Size of address bus (in bits)

20-bit

e. Largest memory address (in decimal)

Decimal 0-1048575

3. The Intel 80286 microprocessor a common processor used in IBM PCs running the Windows operating system. Google “80286 microprocessor architecture” to answer these questions.

a. Year Introduced

1982

b. Size of data bus (in bits)

16-bits

c. Largest data number (in decimal)

Decimal 65535

d. Size of address bus (in bits)

24 bits

e. Largest memory address (in decimal)

Decimal 1048575

4. The modern PCs run either a 32 bit or 64 bit Windows operating system. Google “32 vs 64 bit” to answer these questions.

a. How do these systems differ in data capacity? (explain using bits)

232-1= 4 294 967 295

264-1= 18 446 744 073 709 551 616

b. How do these systems differ in memory capacity? (explain using bits)

62 is a larger number in memory capacity that’s why 64 bit is designed to support more ram than 32-bit.

c. How do these systems differ in hardware requirements?

A 64-bit processor does not need to increase the size of hardware to enable more processing power.

5. Research and explain how negative (-) numbers are represented using bits and how they are stored in computer memory.

When it is 0 it is positive, when it is 1 it is negative.

6. Research and explain how floating point (decimal) numbers are represented using bits and how they are stored in computer memory.

Floating point numbers are representing a larger range in numeric values.

**Level 3: Sample Program**

1. Modify the following sample Python program to print out the digits in:

a. Binary

number = input("Enter a 4 digit decimal number:")

index = 0

for char in number :

index += 1

print("Digit ", index, " is : ", bin(int(char)))

b. Octal

number = input("Enter a 4 digit decimal number:")

index = 0

for char in number :

index += 1

print("Digit ", index, " is : ", oct(int(char)))

c. Hexadecimal

number = input("Enter a 4 digit decimal number:")

index = 0

for char in number :

index += 1

print("Digit ", index, " is : ", hex(int(char)))

number = input("Enter a 4 digit decimal number:")

index = 0

for char in number :

index += 1

print("Digit ", index, " is : ", char)