**Presentation Notes**

1. Number systems used in Computer Science
   1. List the main features of the Decimal System

* 1. List the main features of the Binary System

* 1. List the main features of the Octal System

* 1. List the main features of the Hexadecimal System

1. Compare and contrast the Decimal and Binary systems

|  |  |  |
| --- | --- | --- |
| **Criteria** | **Decimal System** | **Binary System** |
| Digits  Used |  |  |
| Addition Example |  |  |
| Powers of  Base |  |  |
| Value of 111 |  |  |

1. Convert the following binary numbers to decimal:
2. Convert the following decimal numbers to binary:
3. Add the following binary numbers. (verify your answers using decimal)

|  |  |
| --- | --- |
| a) | b) |
| c) | d) |

1. List the main features of the following Computer Memory Structures:
   1. Bit
   2. Byte
   3. Word
   4. Integer Data Type
   5. Double Word

**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.
   1. Year Introduced

Designed by Intel in 1977

* 1. Size of data bus (in bits)

Has an 8-bit data bus

* 1. Largest data number (in binary and decimal)

Binary = (0 – 1111 1111)

Decimal = 255

* 1. Size of address bus (in bits)

Has a 16 bit address bus

* 1. Largest memory address (in binary and decimal)

Binary = (0 – 1111 1111 1111 1111)

Decimal = 0 – 65, 535

1. 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.
   1. Year Introduced

Designed by Intel in 1976

* 1. Size of data bus (in bits)

Has a 16-bit data bus

* 1. Largest data number (in decimal)

Binary = (0 – 1111 1111 1111 1111)

Decimal = 0 – 65, 535

* 1. Size of address bus (in bits)

Has a 20 bit address bus

* 1. Largest memory address (in decimal)

Binary = (0 – 1111 1111 1111 1111 1111)

Decimal = (0 – 1, 048, 575)

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

Introduced by Intel in 1982

* 1. Size of data bus (in bits)

Has a 16-bit data bus

* 1. Largest data number (in decimal)

Binary = (0 – 1111 1111 1111 1111)

Decimal = 0 – 65, 535

* 1. Size of address bus (in bits)

Has a 24-bit data bus

* 1. Largest memory address (in decimal)

Binary = (0 – 1111 1111 1111 1111 1111 1111)

Decimal = 0 – 16, 777, 215

1. The modern PCs run either a 32 bit or 64 bit Windows operating system. Google “32 vs 64 bit” to answer these questions.
   1. How do these systems differ in data capacity? (explain using bits)

A 32 bit-processor has a 32-bit processor, which can store 232 or 4,294,967,296 values. A 64-bit processor includes a 64-bit register, which can store 264 or 18,446,744,073,709,551,616 values.

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

A 32-bit system can reference a maximum of 4 gigabytes, while a 64-bit register can reference a maximum of 17,179,869,184 gigabytes.

* 1. How do these systems differ in hardware requirements?

The **only** real requirement needed to run a 64-bit operating system is that the CPU needs to be able to store 64bit extensions. A 32-bit operating system needs a CPU that can store 32bit extensions.

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

Negative numbers are represented using two’s complement. Two's complement is the way most computers represent positive or negative integers. To get the two's complement negative notation of an integer, you write out the number in binary. You then invert the digits, and add one to the result.

Whenever a number with minus sign is encountered, the number (ignoring minus sign) is converted to its binary equivalent. Then the two’s complement of the number is calculated. That two’s complement is kept at place allocated in memory and the sign bit will be set to 1 because the binary being kept is of a negative number.

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

The floating point numbers are broken down into sign, mantissa, and exponent bits when representing it in the binary format.

Converting a floating point number to decimal involves the following steps:

~Separately process the decimal and binary parts of the number and convert them into binary format

~Normalize the binary number by moving the decimal point to the leftmost position

~Convert the exponent part into binary

**Level 3: Sample Program**

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

* 1. Binary
  2. Octal
  3. Hexadecimal

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

index = 0

for char in number :

index += 1

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

**Binary:**

|  |  |
| --- | --- |
| *White Area* | *Black Area* |
| *number = input("Enter a 4 digit decimal number:")*  *index = 0*  *for char in number :*  *index += 1*  *print("Digit ", index, " is : ", bin(int(char)))* | *Enter a 4 digit decimal number: 1133*  *Digit 1 is : 0b1*  *Digit 2 is : 0b1*  *Digit 3 is : 0b11*  *Digit 4 is : 0b11* |

**Octal:**

|  |  |
| --- | --- |
| *White Area* | *Black Area* |
| *number = input("Enter a 4 digit decimal number:")*  *index = 0*  *for char in number :*  *index += 1*  *print("Digit ", index, " is : ", oct(int(char)))* | *Enter a 4 digit decimal number: 1133*  *Digit 1 is : 0o1*  *Digit 2 is : 0o1*  *Digit 3 is : 0o3*  *Digit 4 is : 0o3* |

**Hexadecimal:**

|  |  |
| --- | --- |
| *White Area* | *Black Area* |
| *number = input("Enter a 4 digit decimal number:")*  *index = 0*  *for char in number :*  *index += 1*  *print("Digit ", index, " is : ", hex(int(char)))* | *Enter a 4 digit decimal number:1133*  *Digit 1 is : 0x1*  *Digit 2 is : 0x1*  *Digit 3 is : 0x3*  *Digit 4 is : 0x3* |