**Level 1: 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

**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.
   1. Year Introduced

The microprocessor was introduced in 1976

* 1. Size of data bus (in bits)

It is 8 bits large

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

The largest 8 bit number is 255 and in binary it is 11111111

* 1. Size of address bus (in bits)

The address bus is 16 bits large

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

The largest memory address in binary will be 1111111111111111 and decimal will be 1048575

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

It was introduced in 1978 by intel

* 1. Size of data bus (in bits)

The size of the data bus Is 16 bits

* 1. Largest data number (in decimal)

The largest data number is a 16 bit number which in decimal will be 65535

* 1. Size of address bus (in bits)

The address bus is 20 bits large

* 1. Largest memory address (in decimal)

The largest memory address is a 20 bit number which in decimal will be 1048575

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

It was introduced in 1982

* 1. Size of data bus (in bits)

The data bus is 16 bits large

* 1. Largest data number (in decimal)

The largest data number is 16 bit, a decimal number of 65535

* 1. Size of address bus (in bits)

The address bus is 24 bits

* 1. Largest memory address (in decimal)

The largest memory address which is a 24 bit value in decimal is 16777215

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)

The more bits a processor is the more data it can handle at once. A computer that has a 64 bit processor is much more efficient and more capable than a 32 bit processor

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

32-bit processors can only use 4gb or less of RAM, while 64-bit processors can use much more. A 32-bit processor can use about 32 trillion bits (4gb of ram) meaning that a 64 bit processor can use more than 32 trillion bits.

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

64-bit will have much higher amount of ram and will perform much better in all situations. While 32-bit will have much less ram and will perform much worse. The processors have different amount of RAM they can use, the more they can use the better and more efficient the pc will be.

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

The computer uses the two complement system.

“ For example, using 1 byte (=8 bits), the decimal number 5 is represented by

0000 01012

The most significant bit is 0, so the pattern represents a non-negative value. To convert to −5 in two's-complement notation, first, the bits are inverted, that is: 0 becomes 1 and 1 becomes 0:

1111 10102

At this point, the representation is the ones' complement of the decimal value −5. To obtain the two's complement, 1 is added to the result, giving:

1111 10112

The result is a signed binary number representing the decimal value −5 in two's-complement form. The most significant bit is 1, so the value represented is negative.

The two's complement of a negative number is the corresponding positive value. For example, inverting the bits of −5 (above) gives:

0000 01002

And adding one gives the final value:

0000 01012”

And it stores information also use the two complement system.

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

Floating point decimal is called there is no fixed number of digits before and after the decimal point.

A significand that contains the number’s digits. Negative significands represent negative numbers.

An exponent that says where the decimal (or binary) point is placed relative to the beginning of the significand. Negative exponents represent numbers that are very small (i.e. close to zero)

**Level 3: Sample Program**

1. Explain the result of the following Ptyhon operations:
   1. bin(11)

it returns '0b1011'. “Convert an integer number to a binary string prefixed with ‘0b’”

* 1. oct(11)

it returns '0o13'. It converts an integer number to a octal string with the prefix “0o”

* 1. hex(11)

it returns '0xb'. It is used to convert an integer into a hexadecimal form.

1. Explain the following Ptyhon operations:
   1. bin(‘11’) - Why does this operation give an error?

This gives an error because you cannot convert a string into a binary string. It has to be an integer.

* 1. int(‘11’) - Why does this work?

This works because it converts the string into a integer.

* 1. bin(int(‘11’)) - Why does this fix the problem?

This fixes the problem because it turns the string into a integer so that the bin() function can than convert it into a binary string.

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)

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

index = 0

for char in number :

print("Binary:")

print(bin(int(char)))

print("Octal:")

print(oct(int(char)))

print("Hexadecimal:")

print(hex(int(char)))

index += 1

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