**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 year that the Intel 8085 microprocessor was introduced was in 1977.

* 1. Size of data bus (in bits)

The size of the data bus in this microprocessor is 8-bit

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

The largest 8 bit number is will be 255 and in binary numbers it will be 11111111.

* 1. Size of address bus (in bits)

The size of the address bus in bits will be 16-bit within the microprocessor.

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

The largest memory in binary will be 1111111111111111 and the decimal number 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

The Intel 8086 microprocessor was introduced by Intel in 1978.

* 1. Size of data bus (in bits)

The size of the data bus is 16-bit with the Intel 8086 microprocessor.

* 1. Largest data number (in decimal)

The largest data number is a 16 bit number which decimal is 65535.

* 1. Size of address bus (in bits)

The size of the address bus in bits is 20-bits

* 1. Largest memory address (in decimal)

The largest memory address in decimal will be 1048575 with 20 bits.

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

The Intel 80286 microprocessor is a microprocessor which was introduced in 1982. It is 5th of a i86 microprocessor family. This microprocessor consist of a faster clock speed than the previous microprocessor Intel 8086 and Intel 8085. Furthermore, is a 16-bit microprocessor as its predecessor.

* 1. Size of data bus (in bits)

The size of the data bus is 16 bits just like the 8086 microprocessor.

* 1. Largest data number (in decimal)

The highest data number with the Intel 80286 microprocessor is 16 bit with the decimal number of 65535.

* 1. Size of address bus (in bits)

The size of the address bus is 24 bits with the microprocessor.

* 1. Largest memory address (in decimal)

The highest 24 bit value within the memory address of the microprocessor 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)

A 64-bit processor within the windows operating system has much more capacity and is more capable than a 32-bit processor as it can handle more data at once.

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

These bit processors are significantly different in terms of memory capacity. 32 bit processors only have around 4GB or less of RAM while 64 bit processors are capable of utilizing way more. 4GB of ram is around 32 trillion bits. This means that the 64 bit processor is more capable which will be over 32 trillion bits.

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

In terms of hardware, is that the processors have different GB of ram. This means that the 64 bit will have much higher amount of ram and will perform significantly better in all situations. Furthermore, the 64 bit operating system can increase the capabilities of a processor drastically in which it leads to a real jump in power in terms of software.

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

Negative numbers are represented using bits by the Two’s complements in which it’s a mathematical operation which is used on binary numbers. The two’s complement is calculated by inverting the digits and adding one. Two complement is the most common method of representing signed integers on computers and more generally, fixed point binary values.

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

The term floating point is derived from the fact that there is no fixed number of digits before and after the decimal point; that is, the decimal point can float. There are also representations in which the number of digits before and after the decimalpoint is set, called fixed-point representations. Floating point representations are slower and less accurate than fixed point representations but can handle a larger range of numbers. These are stored in the computer memory by using four bytes which is 32 bits.

**How do floating point numbers work?**

A significand that contains the numbers 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.

**Level 3: Sample Program**

1. Explain the result of the following Python operations:
   1. bin(11) This function prints the number 11 in binary. The result is 0b1011
   2. oct(11) This function prints the number 11 in octal. The result is 0o13
   3. hex(11) This function prints the number in hexadecimal. The result is 0xb.
2. Explain the following Python operations:
   1. bin(‘11’) - Why does this operation give an error? You cannot turn a string into a binary number, only integers can be turned into binary numbers.
   2. int(‘11’) - Why does this work? This works because the function is turning the string which is called 11 into a integer with a value of 11.
   3. bin(int(‘11’)) - Why does this fix the problem? This fixes the problem because it turns the string into an integer and then it changes to a binary number.
3. 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)