**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 Intel 8085 was introduced in 1977 by Intel.

* 1. Size of data bus (in bits)

The size of 8085’s data bus was 8-bits.

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

Binary: llll llll

Decimal: 2n-1 (2 to the power of 8 – 1) = 255

* 1. Size of address bus (in bits)

The size of the 8085 address bus is 16-bits.

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

Binary: llll llll llll llll

Decimal: 65535

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 8086 was introduced in 1976 by Intel.

* 1. Size of data bus (in bits)

The data bus size of 8086 is 16-bits.

* 1. Largest data number (in decimal)

Decimal: 65535

* 1. Size of address bus (in bits)

The size of 8086 address bus is 20-bits.

* 1. Largest memory address (in decimal)

Decimal: 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

The Intel 80286 was introduced in 1982.

* 1. Size of data bus (in bits)

The data bus size of 80286 is 16-bits.

* 1. Largest data number (in decimal)

Decimal: 65535

* 1. Size of address bus (in bits)

The address bus size of 80286 is 24-bits.

* 1. Largest memory address (in decimal)
  2. Decimal: 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)

The 32 bit has a data capacity of 232 – 1 + 42949673 x 109, but the 64 bit has a capacity of 264 – 1 + 1.844667441x1019.

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

The 32 bit has 4GB of maximum usable memory and 64 bit memory can access about 512GB depending on the operation system you are running.

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

64 bit runs much more efficiently than 32 bit, mostly because of its much much larger memory. This lets the 64 bit access more data at once than 32 bit can.

1. Research and explain how negative (-) numbers are represented using bits and how they are stored in computer memory.  
    Sign magnitude is used to designate one of the bits (usually the far left) to indicate whether a number is positive or negative. Usually a 0 is positive and a 1 is negative.

They are stored based on signed magnitude, one’s magnitude, or twos magnitude. Whichever section the negative number comes under, it will be stored under it. They are stored in a integer field

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

**Floating**-**point** numbers are encoded by **storing** the significant and the exponent (along with a sign bit). Like signed integer types, the high-order bit indicates sign; 0 indicates a positive value, 1 indicates negative. The next 8 bits are used for the exponent.

Floating point numbers are represented by non-computers (humans) in scientific notation (\*\* represents raising to power)

A floating number is represented using

2 numbers-the exponent and the mantissa

2 signs-one for the exponent and one for the mantissa

The computer represents each of these signed numbers differently in a floating point number

exponent and sign - [excess 7FH notation](https://users.cs.fiu.edu/~downeyt/cop2400/signed.htm)

mantissa and sign - [signed magnitude](https://users.cs.fiu.edu/~downeyt/cop2400/signed.htm)

Eight digits are used to represent a floating number : two for the exponent and six for the mantissa. The sign of the mantissa will  be represented as + or -, but in the computer it is represented by a bit: 1 means negative, 0 means positive.

**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 : ", bin(int(char)))

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

index = 0

for char in number :

index += 1

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

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

index = 0

for char in number :

index += 1

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