**Level 1 was completed during class**

**Level 1: Presentation Notes**

1. Number systems used in Computer Science

a. List the main features of the Decimal System

b. List the main features of the Binary System

c. List the main features of the Octal System

d. List the main features of the Hexadecimal System

2. Compare and contrast the Decimal and Binary systems

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

3. Convert the following binary numbers to decimal:

a.

b.

c.

4. Convert the following decimal numbers to binary:

a.

b.

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

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

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

a. Bit

b. Byte

c. Word

d. Integer Data Type

e. 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

The Intel 8085 microprocessor was introduced in the year 1977.

b. Size of data bus (in bits)

In this microprocessor, the size of the data bus is 8-bits.

c. Largest data number (in binary and decimal)

For this 8-bit, the largest data number for binary is 11111111 and the largest data number for decimal is 255.

d. Size of address bus (in bits)

Within the microprocessor, the size of the address bus in bits is 16-bit.

e. Largest memory address (in binary and decimal)

The largest memory address in binary is 1111111111111111 and the largest memory address is 1048575.

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

In 1978, the Intel 8086 microprocessor was introduced by Intel.

b. Size of data bus (in bits)

In the Intel 8086 microprocessor, the size of the data bus is 16-bit.

c. Largest data number (in decimal)

The largest data number in decimal is 65535 and this is a 16-bit number.

d. Size of address bus (in bits)

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

e. Largest memory address (in decimal)

In decimal, the largest memory address with 20 bits is 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

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

b. Size of data bus (in bits)

The size of the data bus is 16-bits which is like the 8086 processor.

c. Largest data number (in decimal)

With the Intel 80286 microprocessor, the largest data number in decimal with 16-bits will be 65535.

d. Size of address bus (in bits)

With this microprocessor, the size of the address bus is 24-bits.

e. Largest memory address (in decimal)

For this microprocessor, the largest memory address with 24-bits in decimal is 16777215.

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)

A compared to a 32-bit processor, a 64-bit processor within the Windows operating system has much more capacity and it is much more capable than the 32-bit processor. This is because it can handle much more data at once.

b. 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.

c. 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 a 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 hardware.

5. 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 complements” is calculated by inverting the digits and adding one. “Two’s complements” are the most common method of representing signed integers on computers and more generally, fixed-point binary values. Negative numbers are stored in the computer memory by

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

There are representations in which the number of digits before and after the decimal point 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.

**Level 3: Sample Program**

1. Explain the result of the following Python operations:

a. bin(11)

This function prints the number 11 in binary and the result is 0b1011.

b. oct(11)

This function prints the number 11 in octal and the result is 0o13.

c. hex(11)

This function prints the number in hexadecimal and the result is 0xb.

2. Explain the following Python operations:

a. bin(‘11’) - Why does this operation give an error?

An error occurs because you cannot turn a string into a binary number since only integers can be turned into binary numbers.

b. int(‘11’) - Why does this work?

This works because the function is turning the string which is called 11 into an integer with a value of 11.

c. 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:

a. Binary

b. Octal

c. Hexadecimal

Here is my new code and it works for any digit decimal number:

1. number = input("Enter any digit decimal number: ")
2. index = 0
3. for char in number :
4. index += 1
5. print("DIGIT #", index, " is : ", char)
6. print(bin(int(char))," is in BINARY")
7. print(oct(int(char))," is in OCTAL")
8. print(hex(int(char))," is in HEXADECIMAL")