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

Used for communicating with human users

Digits: 0,1,2,3,4,5,6,7,8,9,

* 1. List the main features of the Binary System (BASE 2)

Used by internal CPU and Memory Circuits

Digits: 0,1 (On or Off)

Binary 10 == Decimal 2

* 1. List the main features of the Octal System (BASE 8)

Used by computer scientists for grouping of 3 Binary digits

Octal 10 == Decimal 8

Digits: 0,1,2,3,4,5,6,7

(No Digits 8 & 9)

* 1. List the main features of the Hexadecimal System (BASE 16)

Used by computer scientists for groupings of 4 Binary digits

Hex F == Decimal 15

(Uses Extra Letters)

Hex 10 == Decimal 16

Digits: 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F

1. Compare and contrast the Decimal and Binary systems

|  |  |  |
| --- | --- | --- |
| **Criteria** | **Decimal System** | **Binary System** |
| Digits  Used | 0,1,2,3,4,5,6,7,8,9 | 0,1 (True, False) (+,-) |
| Addition Example | 0 + 1 = 1  1 + 1 = 2  9 + 1 = 10 | 0 + 1 = 1  1 + 1 = 10  11 + 1 = 100 |
| Powers of  Base | Etc. | Etc. |
| Value of 111 | 111 =  (100 + 10 + 1) | 111 =  (Decimal: 4 + 2 + 1 = 7) |

1. Convert the following binary numbers to decimal:  
   1. 11 Binary = 3
   2. 101 Binary = 5
   3. 1010 Binary = 10
2. Convert the following decimal numbers to binary:  
   1. 6 Decimal = 0110
   2. 13 Decimal = 1101
3. Add the following binary numbers. (verify your answers using decimal)

|  |  |
| --- | --- |
| a)  0101 (Decimal 5)  +  0010 (Decimal 2) 0111 | b)  0101 (Decimal 5)  +  1010 (Decimal 10)  1111 |
| c)  0011 (Decimal 3)  +  0010 (Decimal 2)  0101 | d)  0110 (Decimal 6)  +  0011 (Decimal 3)  1001 |

1. List the main features of the following Computer Memory Structures:
   1. Bit

1 Binary digit

Used for Boolean type data

Building block for all computer data and memory

* 1. Byte

8 Binary digits

Largest value: 1111 1111

Used for Char (Character) data type

26 lower case letters + 26 uppercase letters + 10 number symbols + punctuation marks + other stuff equal about 130 distinct characters

* 1. Word

16 Binary digits

Largest value: 1111 1111 1111 1111

(

* 1. Integer Data Type (Short)

Is 1 word (16 bits)

But must represent both positive (+) and negative (-)

Range: +32767 to -32768

Larger or smaller numbers require a different type of data

* 1. Double Word

32 Binary digits (4 bytes or 2 words)

Largest value:

* 1. Integer Type Data (Long)
* Provides much larger range than integer for positive (+) and negative (-) numbers
  1. Double Word Memory Addressing
* Provides access to about 4GB of memory max

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

1976

* 1. Size of data bus (in bits)

8-bits

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

65,535 Decimal and 16 Binary

* 1. Size of address bus (in bits)

8-bits

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

65,535 Decimal and 16 Binary

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

1979

* 1. Size of data bus (in bits)

16-bits

* 1. Largest data number (in decimal)

1,048,576

* 1. Size of address bus (in bits)

20-bit

* 1. Largest memory address (in decimal)

e.1,048,576

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

1982

* 1. Size of data bus (in bits)

16-bits

* 1. Largest data number (in decimal)

65,535

* 1. Size of address bus (in bits)

24-bits

* 1. Largest memory address (in decimal)

65,535

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)

64-bit processors are more capable than a 32-bit processor because it can handle more data at once.

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

A 64-bit processor of storing more computational values, including memory addresses, which means it is able to access over four billion times the physical memory of a 32-bit processor.

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

32-bit processors are perfectly capable of handling a limited amount of RAM (in Windows, 4GB or less) and a 64-bit processor is capable of utilizing much more. In the case of Microsoft Windows, the basic versions of the operating systems put software limitations on the amount of RAM that can be used by applications, but even in the ultimate and professional version of the OS, 4GB is the maximum usable memory the 32-bit version can handle. The latest versions of a 64-bit operating system can increase the capabilities of a processor drastically.

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

Negative numbers in any base are represented by prefixing them with a minus (-) sign. In computer hardware, numbers are represented only as sequences as bits, without extra symbols. Computers can only store information in bits, which can only have the values of zero or one.

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