Storing Data

Objectives	
2.1.9	Define the terms: bit, byte, binary, denary/decimal, hexadecimal.

Before You Begin

The following images show two methods that have been developed for communicating over large distances.

Flag Semaphore

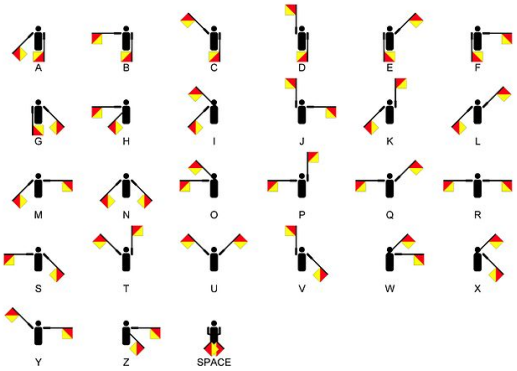

Image courtesy Western University Canada.

Morse Code

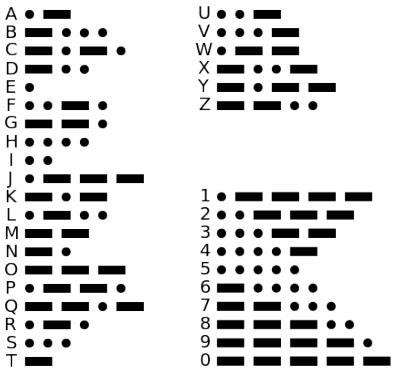

Image courtesy codebug.org.uk.

Answer each of the following questions about what you observe in the above communication methods.

Question #1 *The telegraph and its associated code were developed in the early 19th century by Samuel Morse, revolutionizing communications over exceedingly long distances through the use of undersea cables. What makes this code more suitable for communication over electrical circuits than, for instance, the flat semaphore system?*

Question #2 *One criticism of Morse Code is its lack of consistency in the number of symbols required to represent each character. Why might this cause significant challenges when attempting to adopt its use to computer systems?*

Important Terms

Term	Definition
Bit	
Byte	
Binary	
Denary / Decimal	
Hexadecimal	
Number Base	
Octal	
Word	

Technical Background

Encoding Information in Bits

The following image shows light switches in both an “ON” and “OFF” position.

Consider how these switches, and others like it, can be used to convey information in a way similar to the Morse Code example given in the Opening Exercises.

Notes

Question #3 *Describe a method you could use to encode a negative value using only bits.*

Bits & Bytes

Due to the increasingly large amount of data being processed and stored by modern computer systems, prefixes similar to those used by the metric system have been developed for expressing large volumes of data.

Units of Information Prefixes		
Prefix	**Binary Size**	**Metric Size**
kilo-		
mega-		
giga-		
tera-		
peta-		
exa-		
zetta-		
yotta-		

Notes

Question #4 *Computer systems store and process information in a series of electronic switches called* transistors. *Over time, these devices have become significantly smaller and fasater, resulting in modern processors containing billions of them. In contrast, a processor from the 1970s would have contained transistors numbering in the thousands. What problems exist due to the sheer quantity of these switches in modern computers?*

Different Number Bases

The following table represents the same values in binary, octal, decimal, and hexadecimal.

Binary	1100100	111101000010010000	11110100001001000000	10011000100101101000000
Octal	0144	0750220	03641100	046113200
Decimal	100	250000	1000000	10000000
Hexadecimal	0x64	0x3D090	0xF4240	0x98680

Note the convention of prepending octal values with a '0' and hexadecimal values with '0x'.

Notes

Binary ⟶ Decimal	**Decimal ⟶ Binary**
Octal ⟶ Decimal	**Decimal ⟶ Octal**
Hexadecimal ⟶ Decimal	**Decimal ⟶ Hexadecimal**
Binary ⟶ Octal	**Octal ⟶ Binary**
Binary ⟶ Hexadecimal	**Hexadecimal ⟶ Binary**

Question #5 *As discussed, hexadecimal allows for the expression of larger numbers with fewer written digits required. Do you think storage capacities will ever force computer scientists to consider and adopt an even larger base? Why or why not?*

Developing Technical Skills

The ASCII Table

The American Standard Code for Information Interchange (ASCII) represents one of the first widely adopted standards for encoding text characters for digital communications. Originally, it used 7-bits to encode 128 characters before being extended into 8-bits, allowing for 256 unique characters. In fact, the first 256 characters of the now common Unicode Standard are exactly the same as in the Extended ASCII table.

Below is the ASCII table for the capital letters in the standard Latin alphabet. Use it to complete the activity below.

#	Letter	#	Letter	#	Letter	#	Letter
65	A	72	H	79	O	86	V
66	B	73	I	80	P	87	W
67	C	74	J	81	Q	88	X
68	D	75	K	82	R	89	Y
69	E	76	L	83	S	90	Z
70	F	77	M	84	T		
71	G	78	N	85	U	32	Space

Conver the following binary values to text using the ASCII encoding standard above to read the message. For clarity, each byte is separated by a space.

Binary

01000011 01001111 01001101 01010000 01010101 01010100 01000101 01010010
00100000 01010011 01000011 01001001 01000101 01001110 01000011 01000101
00100000 01001001 01010011 00100000 01000111 01010010 01000101 01000001
01010100

Message

Question #6 *The first 32 characters (0 to 32) in the ASCII standard are reserved for non-printable, command-type characters. For instance, character 2 represents the command "Start of Test" and 28 represents "File Separataor". Why do you think these characters are necessary for digital communications?*

Reflections

Question #7 *A* binary coded decimal *value is one which uses binary to express the individual digits in a decimal number. For example, the value* 37 *in decimal could be written as* $0011\ 0111$ *under this scheme. Why do you think this method for encoding numeric values is* not *the standard in computer science?*

Question #8 *Why is the ASCII encoding standard insufficient for modern communications? Consider the global nature of the Internet and related data transmission networks.*

Question #9 *Describe at least one new thing you have learned from this lesson. How might you apply this knowledge in the future?*

Question #10 *Select the option which best reflects how confident you are in applying what you have learend in this lesson.*



Question #11 *What further questions do you still have about this lesson's content?*