COMPUTERS

Worksheet 14

A worksheet produced by the Native Access to Engineering Programme
Concordia University, Montreal

Teacher's Guide

Here are some suggestions for how you can work with Worksheet 14, Computers.

1. Vocabulary
   The following terms may be new to your students.

abacus
AND gate
base
binary code
bit
byte
capacitor
collector
computer
computer aided drafting and design (CADD)
digital
emitter
flip-flop
hardware
input
integrated circuits
logic gates
NOT gate
operating system
OR gate
output
resistor
silicon
silicon chips
software
superimpose
transistor
ultraviolet light

2. Definition. Do your students understand the definition? Can they demonstrate their understanding?

3. The answer to this question depends on the community in which you live but may make a good research project for your class. The first computers may have been in the school or community centre, or perhaps a private business. Computers may have been used in the community for longer than the students realize,if your community has a satellite receiver for television, it may have been controlled by a computer.

4. Here are some of the key dates in computer development.

3000 BCE
Abacus invented

12th Century
ibn Musa Al'Khowarizmi develops concept of algorithms

1500
da Vinci sketches mechanical calculator

1612
J. Napier uses decimal point in print for 1st time

1621
Slide rule invented

1642
Blaise Pascal creates adding machine

1801
Punch cards invented

1822
Charles Babbage develops Difference Engine

1833
Charles Babbage develops Analytical Engine

1842
Ada King becomes world's first programmer

1854
Boolean logic described

1926
1st patent for semiconductur transistor

1935
K.Zuse builds Z-1, 1st first computer. Not widely known until after WWII.

1943
1st general purpose computer, ENIAC

1945
Grace Murray Hopper coins phrase "computer bug"

1947
Point contact transistor developed at Bell Laboratories

1951
1st real-time processing computer

1952
Grace Hopper introduces idea of reusable software

1954
FORTRAN proposed

1957
IBM develops 1st disk memory system

1960
Vacuum tube computers give way to transistor computers

1963
ASCII developed

1964
Mouse patented

1965
Moore's law formulated

1967
Integrated circuit computers become the norm

1969
Work on what will become the Internet begins

1972
Term "microcomputer"1st appears in print

1975
IBM introduces 1st personal computer

1976
Apple founded

1979
Atari develops Asteroids computer game

1981
IBM introduces its 1st desktop PC

1982
Computer named *Time*'s "Man of the Year"

1983
Sony announces 3.5" disk which holds up to 1MB data

1984
Hewlett-Packard introduces the laser printer

1985
Nintendo introduces NES system to North America

1987
9600 bps modems standard

1989
Number of network hosts passes 100,000

1991
World Wide Web structure developed by Tim Berners-Lee

1992
1st 2X speed CD-ROM

1992
Number of network hosts passes 1,000,000

1993
Intel introduces the Pentium processor

1994
Iomega introduces Zip disks which hold up to 100MB of data

1995
Microsoft releases Windows '95

1996
Nintendo announces Nintendo 64

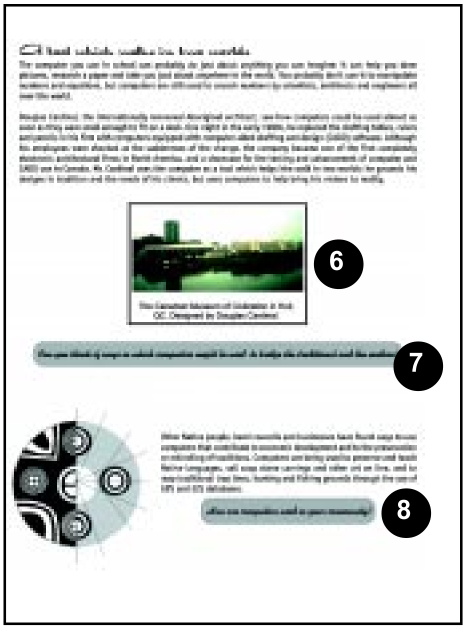
1997
CA*net II launched in Canada

1998
Apple releases iMac

1999
MP3 encoding takes off

2000
World Wide Web exceeds 1 billion indexable pages

5. The answer to this question is contained in the paragraph below. No matter how slow a computer is, it still performs calculations much faster than any human can. Before ENIAC , ballistic trajectory calculations (it was a rather tense time in history) were done by teams of people. It could take a team up to 3 months to calculate a trajectory which ENAIC could do in 30 seconds.



6. For more information about Douglas Cardinal and his work, check out the following web sites:

   http://www.djcarchitect.com/
   http://www.ouje.ca/comunity/comunity.htm
   http://www.ainc-inac.gc.ca/ks/english/6013_e.html

7. Some of the ways that computers have been and are being used to bridge the modern and traditional are listed in the paragraph which follows. Your students may know of other ways of bridging in the community. If they want to see examples of computers being used to bridge the traditional and the modern let them explore:

   First Nations SchoolNet
   http://www.schoolnet.ca/aboriginal/menu-e.html
   Aboriginal Digital Collections
   http://aboriginalcollections.ic.gc.ca/e/index.html

8. Again, the answers to this question will depend on the community and may involve some research by the students. How many different uses can they identify?

9. All of the physical components found inside a computer's casing are its hardware: the motherboard, central processing unit, hard drive, graphics card etc.

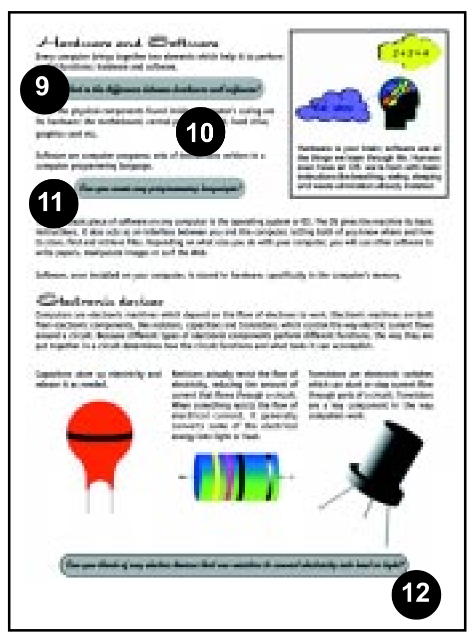
   Software are computer programs; sets of instructions written in a computer programming language.

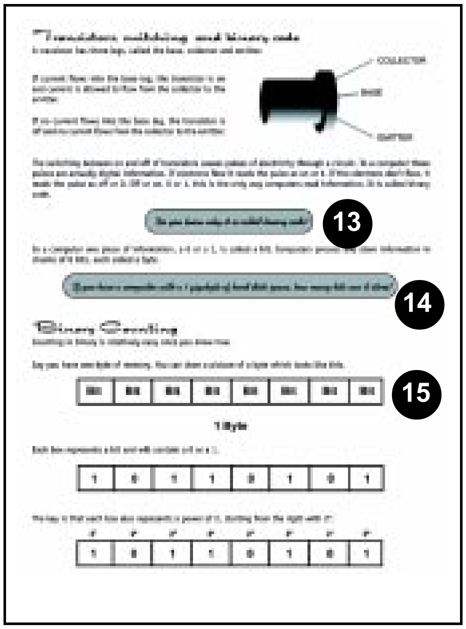
10. If there is someone in the school or community who is comfortable and familiar with computers, it might be interesting for the class to be walked through all the components inside a computer.

11. There are many computer programming languages. They include:

BASIC	Pascal
FORTRAN	COBOL
C	APL

12. Incandescent light bulbs use a resistor to turn electricity into visible light. Electric heaters use resistors to turn electricity into heat.





13. Binary means something made of or based on two things or parts, because the code in computers uses two numbers, 0 an 1, it is called binary code.

14. The prefix "Giga" represents 10^9 or 1 billion. So a Gigabyte has 1 billion bytes. Since a byte has 8 bits, a gigabyte holds 8 billion bits.

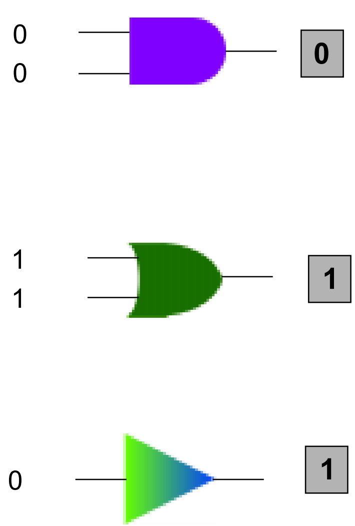
15. You may want to try converting binary numbers with your class.

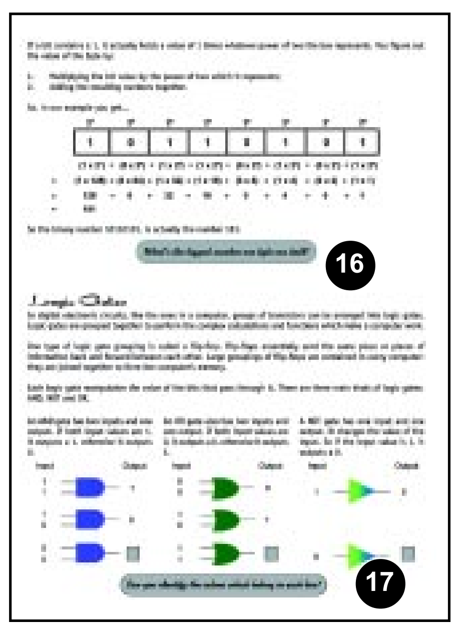
11001100 = 204
10101010 = 170
10000001 = 129
110011 = 51
100111101 = 573

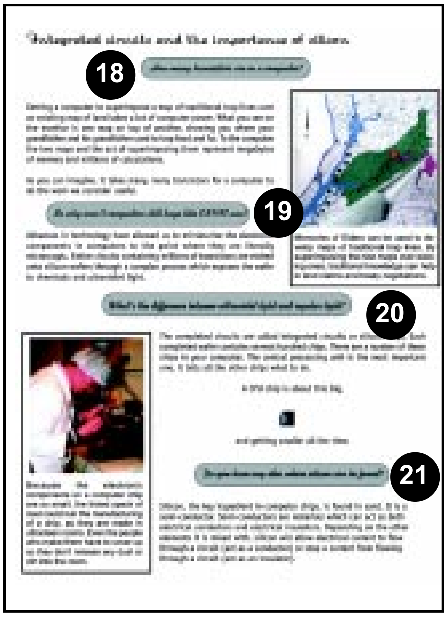
Computers store data in 8-bit groups, but binary numbers can be longer or shorter than 8 digits.

16. The biggest number one byte can hold is 11111111 or 255. A byte can hold any of the 256 numbers between 0 and 255. When a computer deals with numbers larger than 255 it needs to use more than one byte.

17. Outputs are as shown







18. There are millions of transistors in a computer.

19. Computers today are much smaller than ENIAC, despite being more powerful, because of advances in technology which have allowed us to miniaturize electronic components to the microscopic level.

20. Ultraviolet, infrared and visible light, as well as radio waves and x-rays and gamma rays, are all part of what scientists refer to as the electromagnetic spectrum. Each part of the spectrum exists within specific wavelengths. These wavelengths are very small and are measured in a unit called the angstrom. An angstrom is 1 hundred-millionth of a centimeter, which makes this sheet of paper about 1,000,000 angstroms thick.

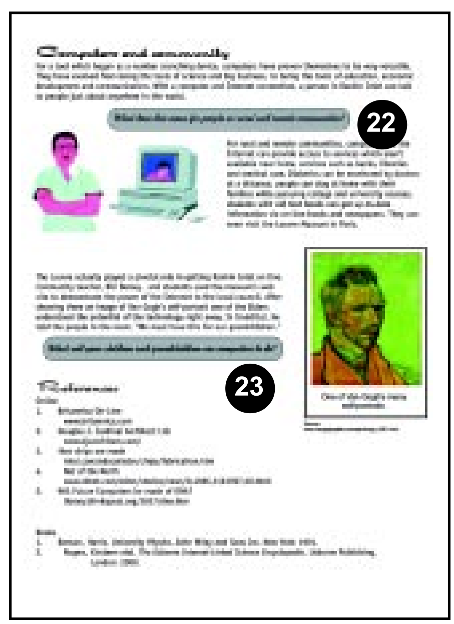
    The only part of the electromagnetic spectrum which humans can see is visible light, wavelengths of about 4,000 to 8,000 angstroms. Ultraviolet light isn't visible to humans. It has a wavelength of about 100-3000 angstroms.

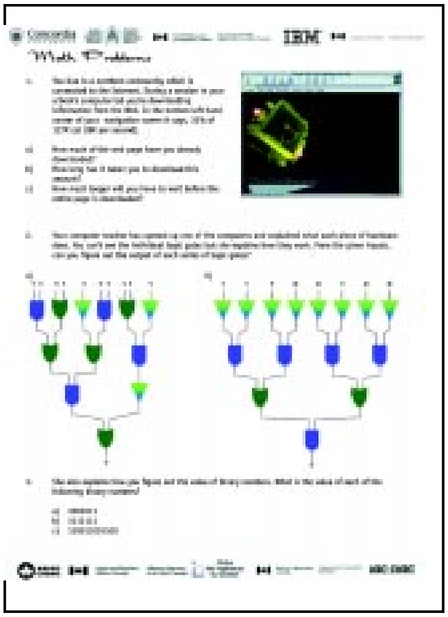
21. Silicon is found in beach sand.

22. For rural and remote communities, computers and the Internet can provide access to services which aren't available near home, services such as banks, libraries and medical care.

23. This questions asks the students to speculate into the future. It may be fairly easy for them to think about what there own children will use computers for, especially if they already have kids, but can they project changes which might not occur for 10, 20, 30 years?

    It isn't an easy exercise. Perhaps they could begin by talking to their parents or grandparents and see what – if any – memories they have about electric technology from their childhoods or teenage years. It might be easier for them to grasp change by hearing concrete examples of change that has taken place in or close to their lifetimes, for instance their parents listened to music on vinyl LPs where they now listen to CDs and MP3s. Or, depending on where you live, looking at the change in telephones and long-distance communication might underline how fast or slow technological changes can take place. Once they have some grasp of how technology changes, evolves, and is adopted by the community, it may be easier for them to speculate about the future.





Solutions

Question 1a. Percentage.

I. What do we know?

- You've already downloaded 31% of the web page.
- The web page size is 127kBytes.
- You're download speed is 28 kBytes/s

II. Determine how much of the site you have downloaded.

Amount dowloaded = Percentage downloaded x Total size of site
= 0.31 x 127kBytes
= 39.4 kBytes

Answer
You've downloaded 39.4 kBytes.

Question 1b. Velocity-distance-time

I. What do we know?

- You've already downloaded 31% of the web page.
- The web page size is 127kBytes.
- Your download speed is 28 kBytes/s
- You've downloaded 39.4 kBytes.

II. Does the problem remind you of anything?

It isn't called the information superhighway for nothing. This problem is analogous to a velocity-distance-time problem, where

the number of bytes = distance
and download speed = velocity.

If velocity = distance/time, then

Download speed = number of bytes/time.

III. Calculate the time it took to download 31% of the site.

$$\text{Download speed} = \frac{\text{number of bytes}}{\text{time}}$$

$$\text{Time} = \frac{\text{number of bytes}}{\text{download speed}} = \frac{39.4\text{kBytes}}{28\text{ Kbytes/s}} = 1.41\text{ s}$$

Answer
It took you 1.41 seconds to download 39.4 kBytes.

Question 1c. Arithematic/Velocity-distance-time

I. What do we know?

- You've already downloaded 31% of the web page.
- The web page size is 127kBytes.
- Your download speed is 28 kBytes/s
- You've downloaded 39.4 kBytes.

II. Calculate how much of the page is left to download.

Amount remaining = Total size of web page – amount downloaded
= 127 kBytes – 39.4 kBytes
= 87.6 kBytes

III. Calculate the time to download the rest of the site.

$$\text{Download speed} = \frac{\text{number of bytes}}{\text{time}}$$

$$\text{Time} = \frac{\text{number of bytes}}{\text{download speed}} = \frac{87.6 \text{ kBytes}}{28 \text{ Kbytes/s}} = 3.13 \text{ s}$$

Answer
It will take 3.13s to download the rest of the site.

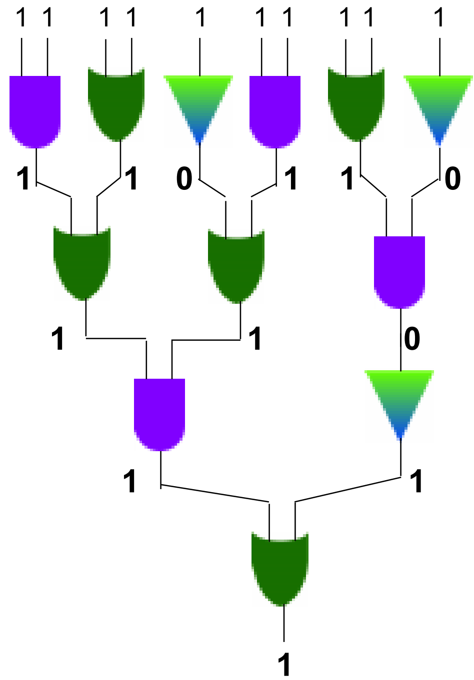
Question 2a and b. Logic.

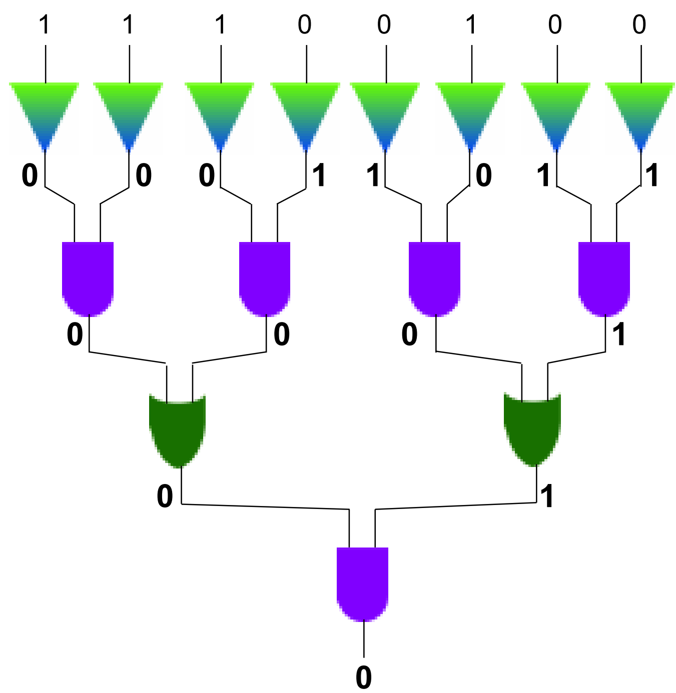
I. What do we know?

- An AND gate has two inputs and one output. If both input values are 1, it outputs a 1, otherwise it outputs 0.
- An OR gate also has two inputs and one output. If both input values are 0, it outputs a 0, otherwise it outputs 1.
- A NOT gate has one input and one output. It changes the value of the input. So if the input value is 1, it outputs a 0.

II. The easiest way to solve the series is to analyze one logic gate at a time. Starting at the top and working from left to right, determine what each gate outputs and write the appropriate numbers on the corresponding output wires, as shown. The wires indicate that the output from the gates above become the inputs for the gates below.

Answers are on the following page.





Answer
Logic gate a outputs a 1.
Logic gate b outputs a 0.

Question 3a. Binary conversion.

I. What do we know?

- Each digit in a binary number is actually a place holder for a power of 2, beginning at the right with 2^0.
- You convert the binary number to decimal by multiplying each digit in the binary by its corresponding power of two and then adding the resulting numbers.

II. Set up the binary as shown on page 4 of the worksheet.

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	**0**	**0**	**1**	**0**	**1**	**1**	**0**

III. Multiply each digit in the binary by its corresponding power of two, and add the resulting numbers together.

$$(1 \times 2^7) + (0 \times 2^6) + (0 \times 2^5) + (1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (1 \times 2^0) =$$
$$128 + 0 + 0 + 16 + 0 + 4 + 2 + 0 = 150$$

IV. Alternatively, solve using a table, as shown below.

2n	2^7 128	2^6 64	2^5 32	2^4 16	2^3 8	2^2 4	2^1 2	2^0 1
Binary	1	0	0	1	0	1	1	0
Value	**128**	**0**	**0**	**16**	**0**	**4**	**2**	**0**

For each column, students should multiply row 1 by row 2 and insert the result in row 3. The answer can be determined by adding the values in row 3.

Answer
The binary number 10010110 is equivalent to the decimal number 250.

Question 3b. Binary conversion.

Solve using the tabular method shown in 3a.

2n	2^5 32	2^4 16	2^3 8	2^2 4	2^1 2	2^0 1
Binary	1	1	1	1	1	1
Value	**32**	**16**	**8**	**4**	**2**	**1**

Answer
The binary number 111111 is equivalent to the decimal number 63.

Question 3c. Binary conversion.

Solve using the tabular method shown in 3a.

2n	2^{11} 2048	2^{10} 1024	2^{9} 512	2^{8} 256	2^{7} 128	2^{6} 64	2^{5} 32	2^{4} 16	2^{3} 8	2^{2} 4	2^{1} 2	2^{0} 1
Binary	1	1	0	0	1	1	0	0	1	1	0	0
Value	2048	1024	0	0	128	64	0	0	8	4	0	0

Answer
The binary number 110011001100 is equivalent to the decimal number 3276.

Notes

Notes