Computer Science Explorations

Manipulating Bits

Algorithm:

Read the information below, doing what you are asked. If you are unsure what to do, ask your teacher.

Learning Targets:

"I can add bits like a computer does."
*"I can **show my work** when adding like a person does."*
"I can find correct answers when performing binary addition."

A Central-Processing Unit (CPU) is the "brain" of the computer—it is a chip that is filled with microscopic circuits that can be either "on" or "off"; the main purpose of a CPU is to manipulate bits, converting data into information.

The CPU can manipulate bits in only three ways:

- It can remember and recall bits—much like memory in our brains.
- It can add bits.
- It can compare bits—1 is larger than 0.

In this assignment, we focus our attention on adding bits.

There are the five rules of adding bits:

- When you add bits, the answer must always be a bit.
- 0 + 0 = 0 (as usual)
- 0 + 1 = 1 (as usual)
- 1 + 0 = 1 (as usual)
- 1 + 1 = 10 (unusual! More about this later…)

Here is an example:

```
  10
+ 01
----
  11
```

since 1 + 0 = 1 ↗ ↖ since 0 + 1 = 1

Here is another example:

```
  1 1
    1 1
+     1
------
  1 0 0
```

since 1 + 1 = 10, "carry" the 1

Perform the three following binary number additions as the CPU would. **Show your work**, as in the examples.

```
    1 0 1 0
+     1 0 1
-----------
```

```
    1 0 1 0 1 1
+   1 1 0 1 0 0
---------------
```

```
    1 0 0 1
+     1 1 1
-----------
```

- Write your work/results in your textbook.
- In an acceptable way, submit your work to your teacher.