Binary Arithmetic

Binary Addition

```
  1
 0 1
+ 0 1
--------
 1 0     (1+1 = 0 carry 1 to the next column, so 1+1=10)

 1 0
+ 0 1
--------
 1 1      (no carry)
```

But,

```
  1
 1 1
+ 0 1
--------
1 0 0     (1 + 1 = 0 carry 1 to next column, then again 1 + 1 is 0
              carry 1 to next column)
```

There are only two ***carry*** combinations
1 + 1 = 10
1 + 1 + 1 = 11

```
    1
 1 0 1
+ 0 0 1
----------
 1 1 0    (1 + 1 = 0 carry 1 to next column
```

Now try this:

```
 1   1
 1 0 1
+ 0 1 1
----------
1 0 0 0    (all columns involve carry)
```

And this,

```
     1 1
    1 1 1
 +  0 1 1
-------------
  1 0 1 0   (all columns involve carry, remember 1+1+1 = 1 carry 1 to next column)
```

Try these examples:

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

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

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

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Binary Arithmetic

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

It doesn't matter how many digits (bits) there are in the binary number the rules are the same.
Remember:

1 + 0 = 1
1 + 1 = 10
1 + 1 + 1 = 11

Another, longer example:

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

Now try these examples: (results on the next page)

a)
```
  1011 0001
+  111 1100
-----------------
```

b)
```
  1010 1100 1111
+      1 0000 0101
----------------------
```

c)
```
  1100 1100 1100
+    11 1010  0100
----------------------
```

d)
```
  1111 0000 1111
+    10 1010  0101
----------------------
```

Binary Arithmetic

a) 1011 0001 + 111 1100 = 1 0010 1101

b) 1010 1100 1111 + 1 0000 0101 = 1011 1101 0100

c) 1100 1100 1100 + 11 1010 0100 = 1 0000 0111 0000

d) 1111 0000 1111 + 10 1010 0101 = 1 0001 1011 0100