Building Computer Circuits

1-bit comparator

\[ a \rightarrow b \quad a = b \quad (a \cdot \overline{b}) + (a \cdot b) \]

For truth table:

<table>
<thead>
<tr>
<th>a</th>
<th>b</th>
<th>a \cdot b</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Full ADDER CIRCUIT

\[ \begin{array}{c|cccc}
    & \overline{a} & a \cdot b & a \cdot \overline{b} & \overline{a} \cdot \overline{b} \\
\hline
a & 1 & 0 & 1 & 0 \\
b & 0 & 1 & 1 & 0 \\
c_{in} & 1 & 0 & 0 & 1 \\
\hline
\end{array} \]

You can chain many of these together to add large numbers.

This circuit describes something that can add two bits \( A \) and \( B \) and a Carry bit \( C_{in} \) and output a sum and a Carry out bit \( C_{out} \).

This is generally called a ripple-carry adder.
This adder is very simple. Chains them together into a ripple adder however is (An) which is not the best solution.

Better solution: See the carry look-ahead adder.

Control circuit:
- Multiplexer (MUX)
  - 2^n input
  - 1 output
- Decoder
  - n input
  - 2^n output

A, B are selectors.