

## 4 Bit Multiplication Example

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      0010
    x 0011
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      0010
     0010
    0000
   0000
  -----
  0000110
  
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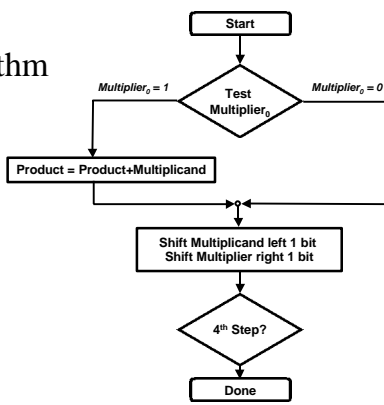
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## The Algorithm




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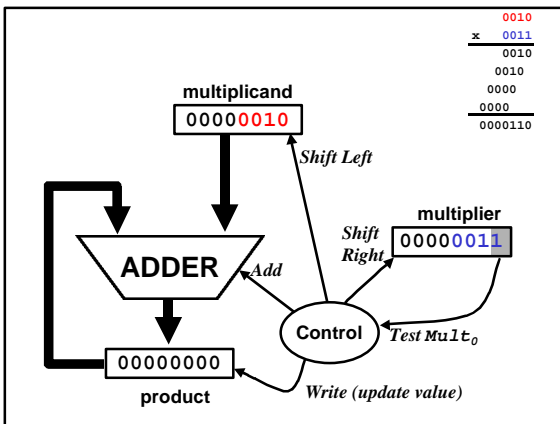
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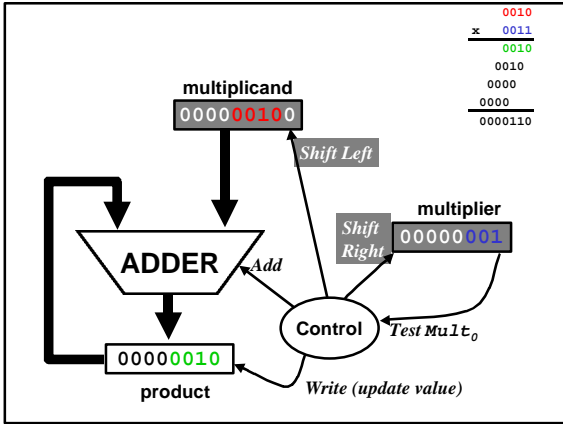
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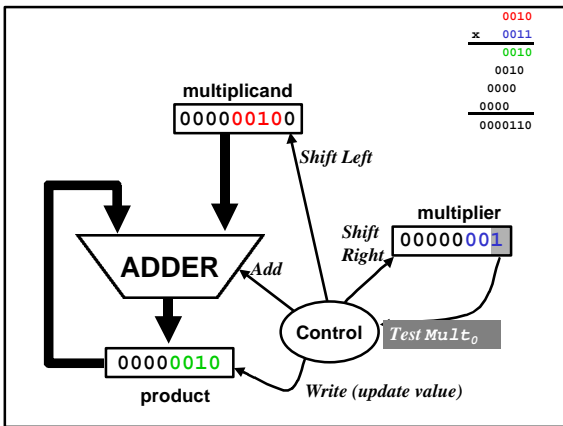
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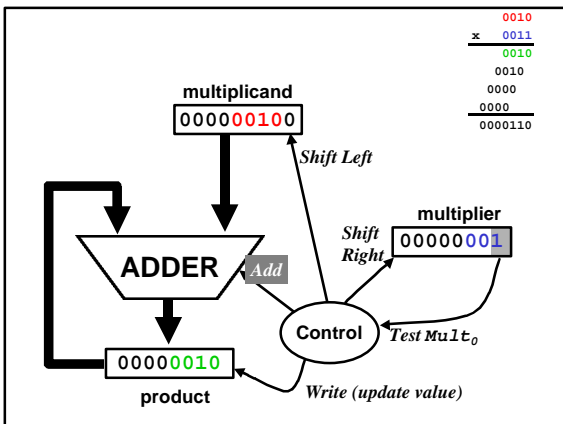
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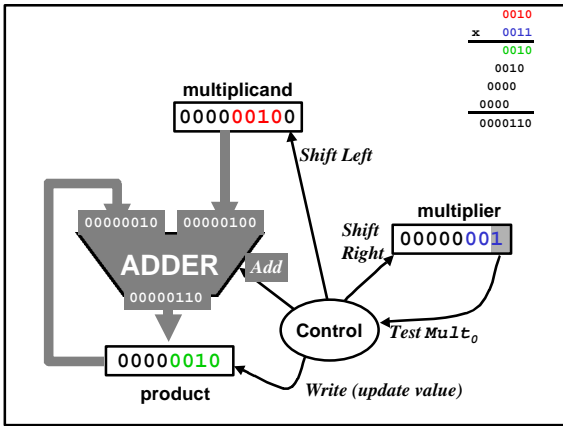
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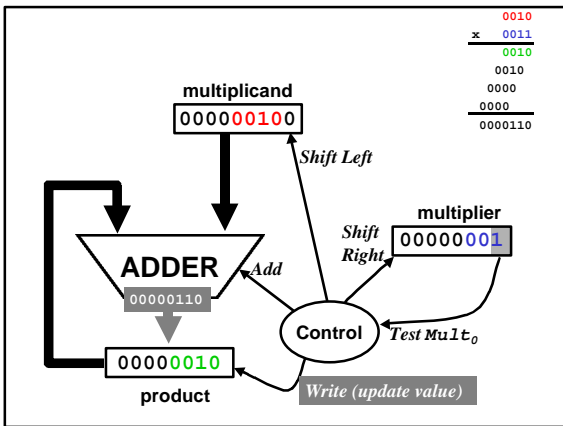
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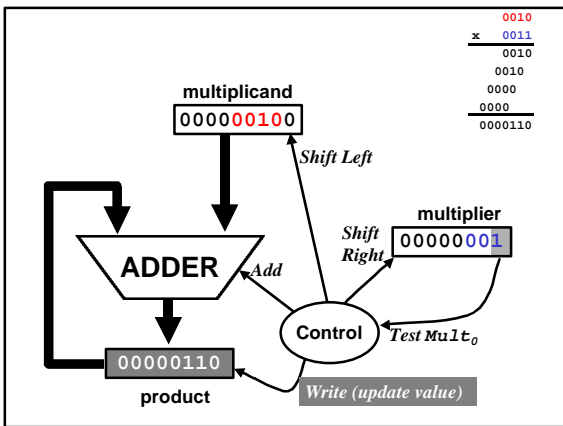
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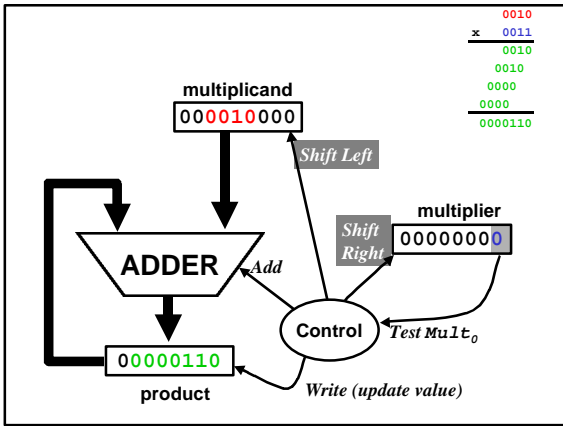
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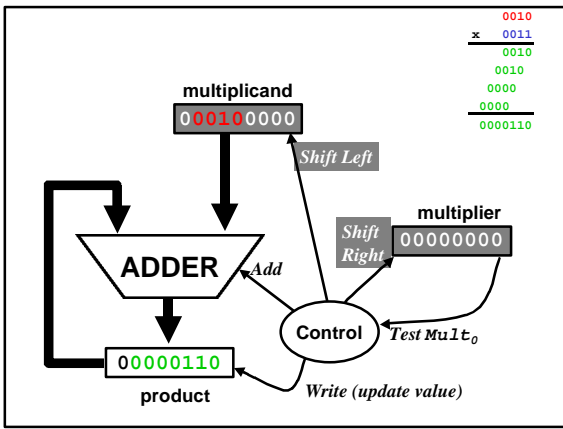
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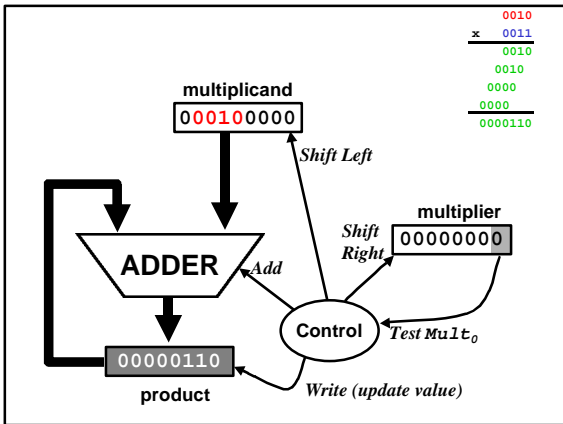
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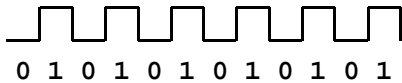
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## Multiplication Control

- We need to build the *Control*.
- The control determines what happens and when.
- We need a clock!
  - alternating 1s and 0s - regular intervals.



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## Control Inputs

- We need a clock as input.
  - used for sequencing
- Multiplier<sub>0</sub> is used to decide whether or not to add.

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## Control Outputs

- **Add:** 1 tells the ADDER to add it's inputs.
- **Write:** 1 tells the product register to replace it's value with the value coming from the adder.
- **Shift Left, Shift Right:** 1 means "shift"
  - multiplicand *knows* to shift left a bit.
  - multiplier *knows* to shift right 1 bit.

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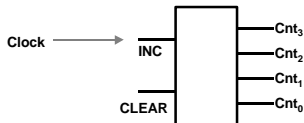
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## Sequencing

- One simple way to provide sequencing is to use the clock to update a counter.
  - and we all know how to build a counter!




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## Truth Table (abbreviated)

Cnt	Add	Write	Shift
0000	Mult <sub>0</sub>	0	0
0001	Mult <sub>0</sub>	Mult <sub>0</sub>	0
0010	0	0	1
0011	Mult <sub>0</sub>	0	0
0100	Mult <sub>0</sub>	Mult <sub>0</sub>	0
0101	0	0	1
0110	Mult <sub>0</sub>	0	0
0111	Mult <sub>0</sub>	Mult <sub>0</sub>	0
1000	0	0	1
1001	Mult <sub>0</sub>	0	0
1010	Mult <sub>0</sub>	Mult <sub>0</sub>	0
1011	0	0	1

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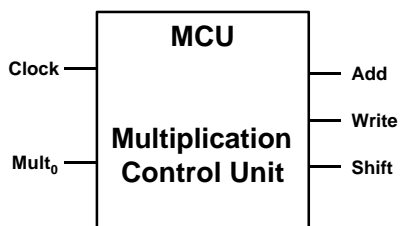
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SOP, minimize, put it in a box  
and give it a name.




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