Addition is done in columns

* Half adder has inputs of x and y bits and the outputs are the sum bits and the carry out (carry like in normal addition in base 10)
* Use one adder circuit for each column of addition
* Issue: no place for carry out of last adder circuit
* Solution: design the adder circuit in a manner that includes an input for the carry
* If it has an input for the carry, the circuit is now a full adder
* Full adder for each column of addition has inputs of x, y and the carry from the previous lower digit, and the outputs of the sum for that digit place, and the carry out for the next digit place
* Subtraction using 2’s complement

Timing

* A chain of full adders has an interesting timing analysis
* Each full adder needs the carry out bit from the previous full adder to compute its own sum and carry out
* Works in parallel so the full adders down the chain may momentarily produce the wrong outputs because the carry didn’t have enough time to propagate to them

Remember, that the critical path is the path with the longest delay possible

Constant multiplication with adders

* Designing a circuit to calculate y = 10x where x is a 4 bit unsigned integer (10base10 is a constant)
  + Break down into powers of 2 ie 8x and 2x

General Multiplication

* To multiply 2 variable numbers, we need circuitry to generate the partial products and adders to sum the general products
* Partial product Generation