

Addition - the ripple adder

slide 26 arithmetic2.pptx

can handle signed (2's complement) or unsigned values
cascading full adders.

size $\propto n$ (as good as it gets)

delay is also $\propto n$ which is a potentially serious time lag.

Carry-lookahead

size is proportional $\propto n^2$ (not good)

delay though is a constant (good)

carry lookahead logic is huge (not good)

$$C_{out} = P C_{in} \rightarrow \text{see slide!}$$

on ripple adder there is increasing delay

but on carry lookahead logic (2)

The delay is constant at 2d

Addition - Multicycling

diagram has multiplexer in and de-multiplexer out.

Floating point addition (subtraction)

- Handle NaN propagation (not numbers)
- checking for zero operands is usually best at the start.

example of aligning fractions; adding and normalising

$$\begin{array}{r} 1.68 \quad 10^1 \\ 2.34 \quad 10^2 \\ \hline 16.8 \\ 234 \\ \hline 1.68 \times 10^1 \\ + 23.40 \times 10^1 \\ \hline 25.08 \times 10^1 \\ \hline 2.508 \times 10^2 \end{array}$$

Binary Multiplication

see slide. binary very similar to base 10.

Unsigned integer multiplication:

combinatorial, huge area of n^2 , small cycle.

Multicycle unsigned integer multiplier

Booth multiplier is a difficult ('horrible') thing to explain, advised to read ^{about} it and think about it!

Microcoded operations

if no hardware, can use software - see slides for examples of 32 bit unsigned integer division + square root.

Arithmetic Logic unit

see slide for 74181 ALU manufacture data sheet