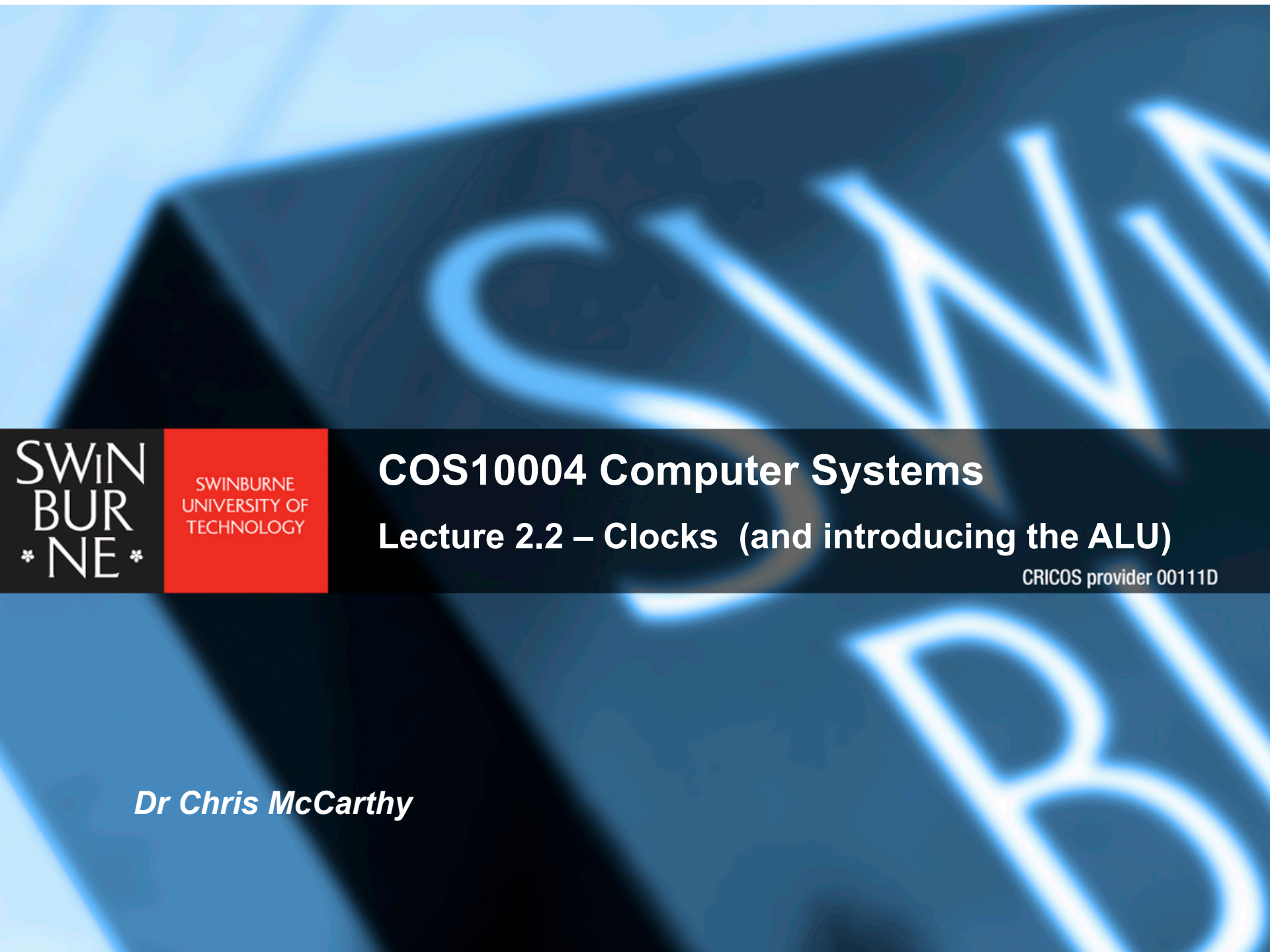


COS10004 Computer Systems

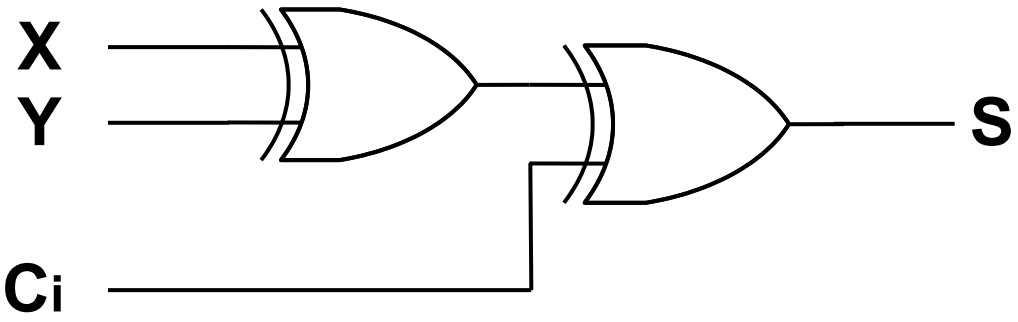
Lecture 2.2 – Clocks (and introducing the ALU)

CRICOS provider 00111D

Dr Chris McCarthy

GATES ARE NOT INSTANTANEOUS

Changing the state of a gate takes some finite time.



What's the issue here ?

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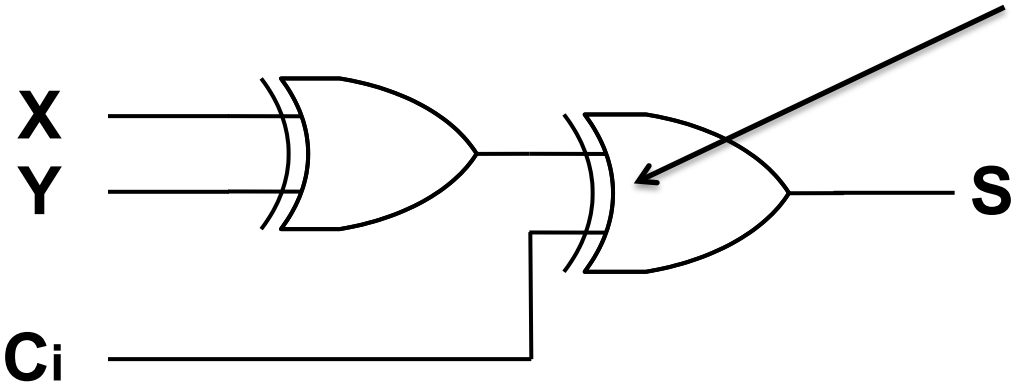


Ci and the output of X XOR Y will arrive at different times!!!

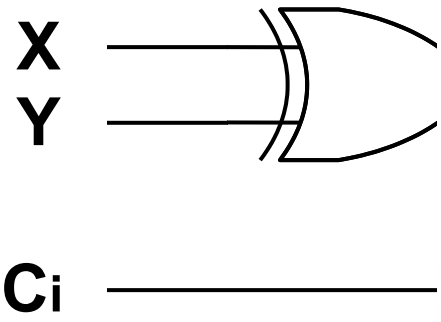
The circuit is **unstable**.

If only we could synchronise things !!

What's the issue here ?

GATES ARE NOT INSTANTANEOUS

Changing the state of a gate takes some finite time.



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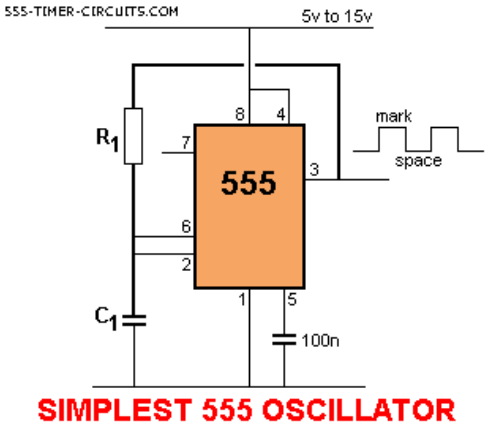
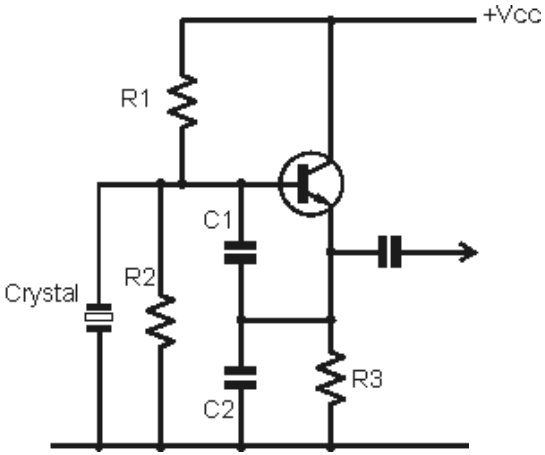
What's the issue he

Clock

Could be something simple like a 555 timer (astable multivibrator using an RC timing element), a crystal oscillator, a phase-locked loop or an atomic clock. Probably just a chip.





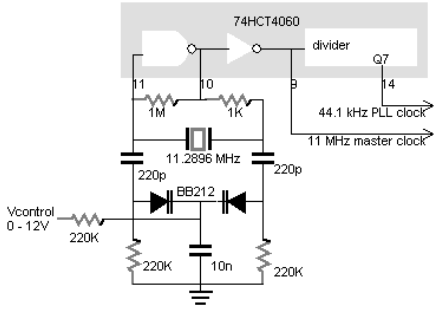
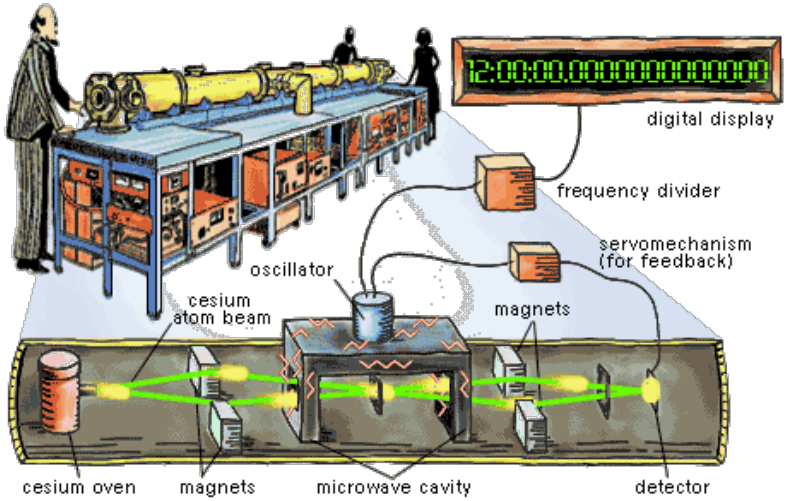
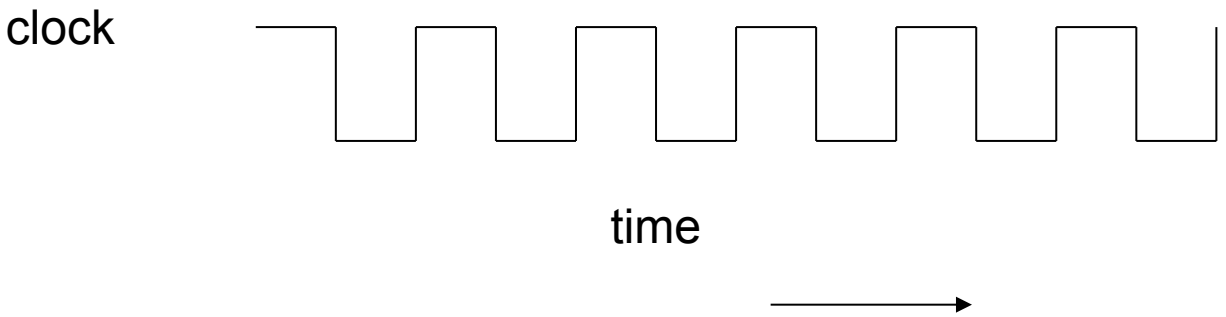


figure 7 Voltage Controlled Crystal Oscillator



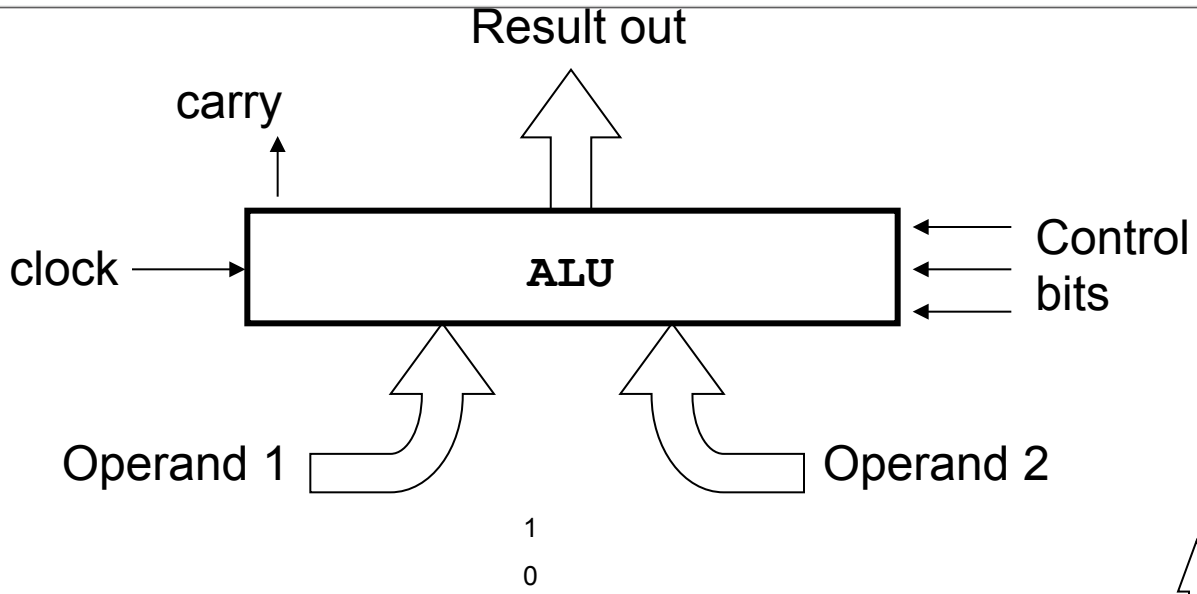
Clock feeds into the ALU



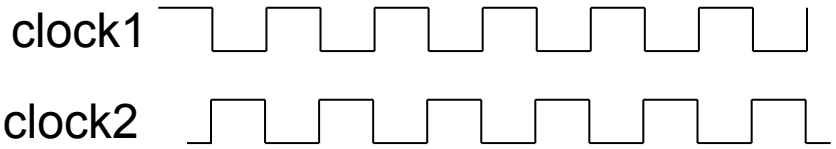
The *clock* is needed because bits need to "settle" before you can use them.

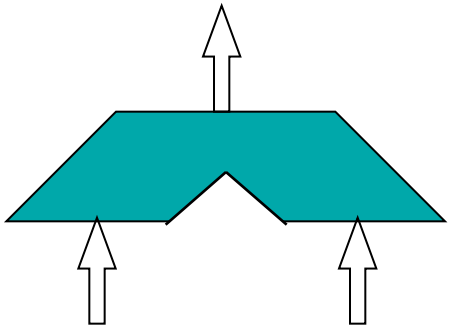
Computers often have different clocks controlling different parts.

Clock feeds into the ALU



Often an ALU needs 2 clock bits *out of phase*:





Common symbol for ALU

Summary

- Clocks ensure data flow is synchronised in a circuit:
  - Ensures predictability
  - Avoid illegal/ill-defined states
- Arithmetic Logic Unit:
  - Where integer calculations and bit shifting operations are performed
- We'll come back to both these topics!
- Next Lecture: Storing bits