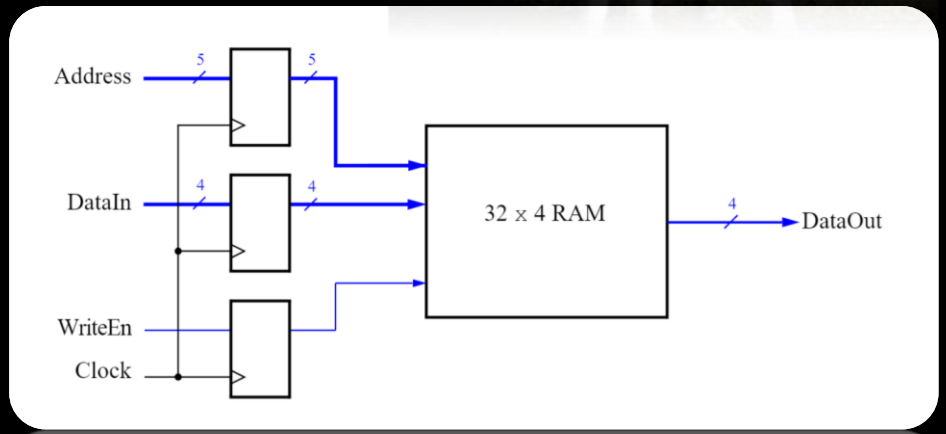
Lab 6 Tutorial

Lab 6 Components

- Part I: Create a memory unit
- Part II: Interface with the VGA display
- Part III: VGA animation (optional)

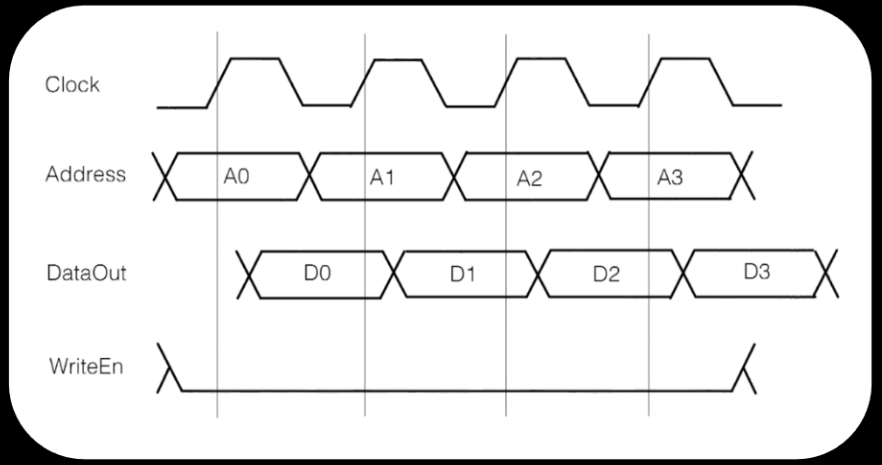
Part I: Memory Unit

- Creating a mini-RAM unit.
- Make use of the IP Catalog built into Quartus.
  - Follow lab instructions to create a 4-bit RAM unit with 32 words.
- Once created, connect this RAM to the switches, keys and HEX.

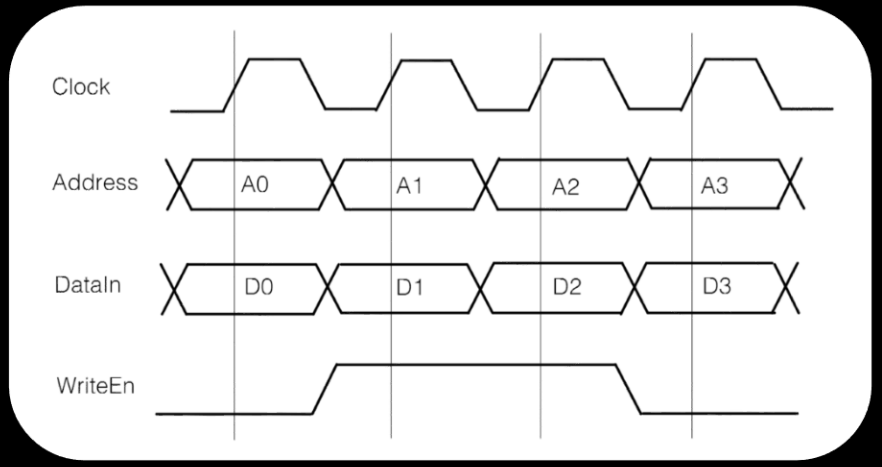


Part 1: Read & Write Timing

- Read:
  - Note slight delay after clock signal, before data appears.



- Write:
  - Note that only `D1` and `D2` are written (because of the `WriteEn` signal).

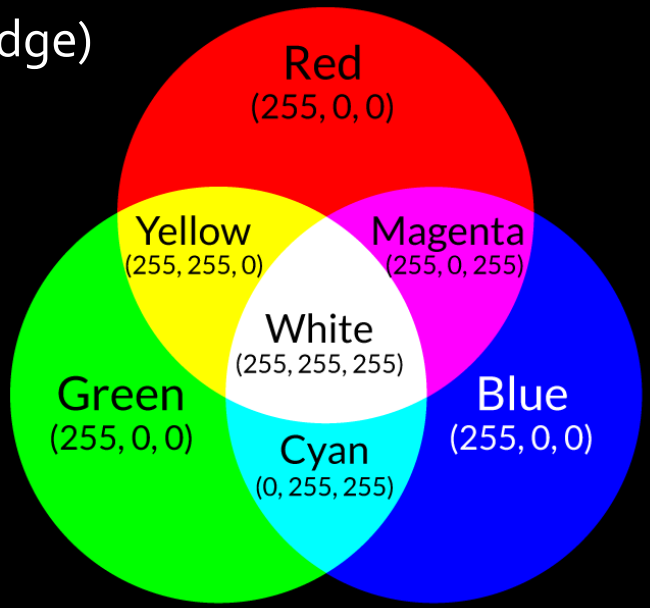


Part II: VGA Display

- Draw pixels on the screen, given a VGA adaptor that takes in the following values:
  - `X` (horizontal position of pixel)
  - `Y` (vertical position of pixel)

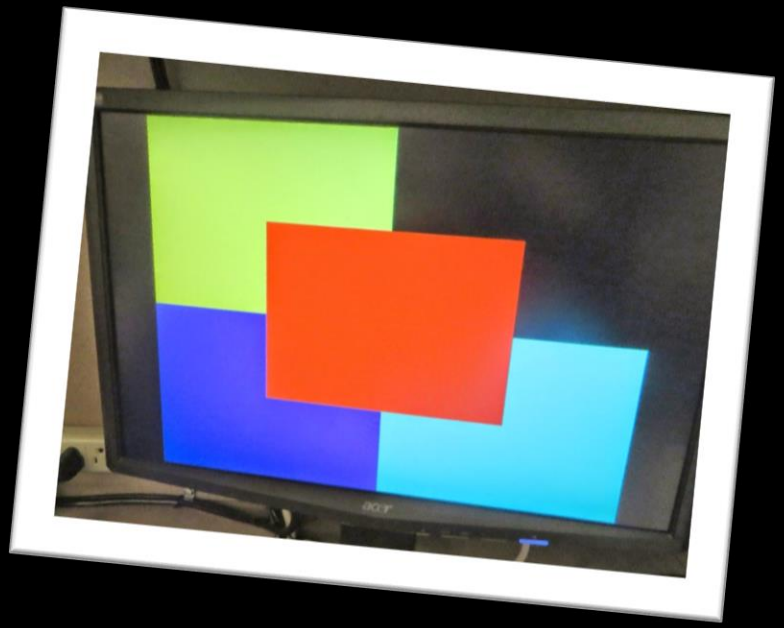
  } Where `(0, 0)` is top left corner of screen

  - `colour` (three values: **R**, **G**, **B**)
  - `plot` (signals to write at next clock edge)
  - `clock`, `resetn`
- Colours are additive!



Part II: VGA Display

- Specifying the inputs to the VGA adaptor will set a single pixel to a single colour.
  - How would you make a box on the screen?
- Given input coordinates `X` and `Y`, make a `4x4` box of coloured pixels, using `X` and `Y` as the top left corner of the box.



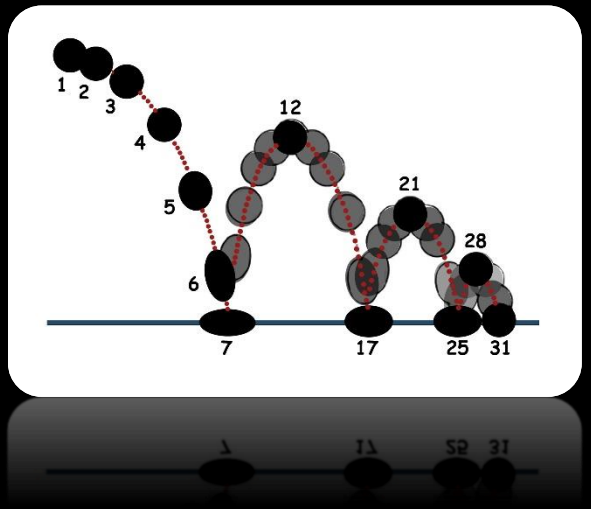
Part II: VGA Display

- Components needed:
  - VGA adaptor (provided by us)
  - Datapath that takes in:
    - X and Y (through switches)
    - control signals (from KEYs, clock and FSM)
  - FSM:
    - Controls datapath to load X and Y values, and iterate through the pixel locations that need to be updated (relative to X and Y).

Part II: VGA Display

- Hints:
  - Have tests to verify that each component works on its own.
    - Try using the VGA adaptor to draw a single pixel, make sure the datapath works on its own, verify that the FSM is moving from state to state as expected.
  - Consider using counters to store the offsets from `X` and `Y` that need to be displayed.
  - Background is black by default, so test with pixel colour values other than (`0`,`0`,`0`)

Part III: Animation (optional)



- Note: This part is optional, but doing it may come in hdany in the project.
- Animate a box by drawing it, then waiting, then drawing another at a different location, then waiting…
- Many projects will use animation in some form, so you should try this part out!