CRT Display Technology

- **Cathode Ray Tube**
  - Electron gun fires electrons at the screen
  - Electric field steers the electron (X field and Y field)
  - Screen phosphor emits light when electron hits

- **Electron beams scans the screen, left-to-right, top-to-bottom**
  - As the beam moves, we can set the brightness of each color
  - We turn on each pixel for the right about of time

- **We set the horizontal and vertical scan rate using SYNC signals**
  - HSYNC - horizontal scan frequency
  - VSYNC - vertical scan frequency

- **VGA - Video Graphics Adapter**
  - Ancient PC CRT interface standard
  - But still used, just like the 8086 ISA
VGA Timing
One Frame

- Vertical Synch tells the monitor when to go back to the top
- The Blanking Interval turns off the video at the top and bottom of the screen
One Line

- Each frame is divided into many lines
  - Horizontal synch tells the monitor to go back to the start of the next line
- Each line is divided into pixels
  - No timing signal: just change the value from one pixel to the next

![Diagram of VGA Interface 4](image)
VGA Interface

- This is what the image really looks like
  - Horizontal retrace during HSYNC
  - Vertical retrace during VSYNC
  - “Front porch”
  - “Back porch”