Benefits

- A good schematic will save way more time than it takes to produce.
- Even the eventual CAD drawing will go much faster.
- Errors, forgotten pins, omissions jump out at you.
- Avoid the rush to implementation before things are thought out.
- A schematic is code and comments for the HW designer when coupled with a written description.
- Drawing the schematic is part of the act of design, not an afterthought.

Schematic Diagram Must Include:

- All electrical connectivity including decoupling caps
- On parts: pins, pin numbers, pin function, part number
- On nets: annotate (name) where helpful
- On nets: Use off-page connection symbols
Schematic Diagrams: Art and Rules

- **Fine points**
  - No ”horseshoe” jumpers
  - Keep all lines straight, use a straight edge
  - Don’t ”drag” Vdd and Vss all over
  - Grouping decoupling caps on one page is nice
  - Let designer intent be clear
  - Schematic should aid in visualizing functionality
  - Signal/control flow usually left to right, rarely top to bottom
  - Limit excessive hierarchical blocks, use only when necessary for clarity
  - Hierarchy clearly shown with multiple pages
  - Write on the schematic: comments, measurements, questions, etc.
Fine points cont.

- If you scan/copy your schematic and turn in the copy, make sure it's readable.
- Don’t just print the schematics provided on the course webpage and turn them in. This shows no effort and undermines the benefits for drawing a schematic.
- You are drawing schematics, not a block diagram. You should not (for example) replace an entire board with an empty block and label.
- When appropriate to combine multiple wires into a bus, you may do that.
Tools for making schematics

- Make the medium easily extensible, small is not necessarily good
- Green engineering paper, scotch tape, pencil, no colors, KISS
- Beyond two/three taped pages, split design into separate pages
- Prototypes change a lot, make schematic changes easy as well
- Expect many changes, sometimes large; use a big eraser
- Bottom line: Can an engineer familiar with your design, replicate it without any further explanation? If not, your schematic and documentation is incomplete.

- CAD drawing is a necessary last step. During development however, messing with another tool hinders thinking and progress.
- Some best schematics are started on napkins!
Schematic Diagrams: Art and Rules

9. This part of the vertical amplifier schematic from a Tektronix 454 oscilloscope shows