

## Examples: Version 9.1.3

This is a collection of diagrams the author has had occasion to produce using m4 circuit macros and others, and gpic or dpic. In some cases there are other or better m4 or pic constructs for producing the same drawings, but the source-file names are shown for reference. Most of the examples can be processed using either dpic -p or gpic -t, but the possibility of other postprocessing has meant that sometimes the source is slightly more complicated than it would be if only one workflow had been assumed. The most simplicity and elegance is achieved by sticking to one pic interpreter and one postprocessor.

A few of the examples following the circuits test some of the boundaries of what macros and the pic language can do.

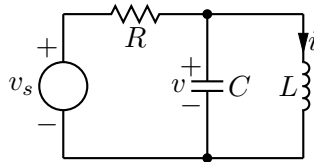


Figure 1: The quick-start example from the manual [quick.m4].

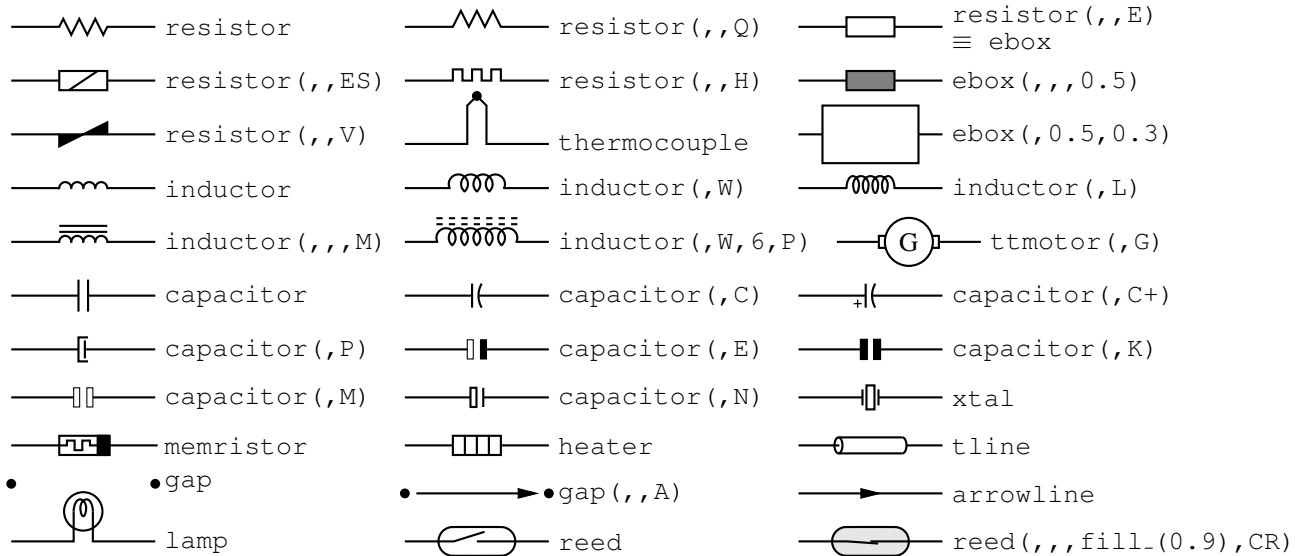


Figure 2: Two-terminal elements, showing some variations [CctTable.m4].

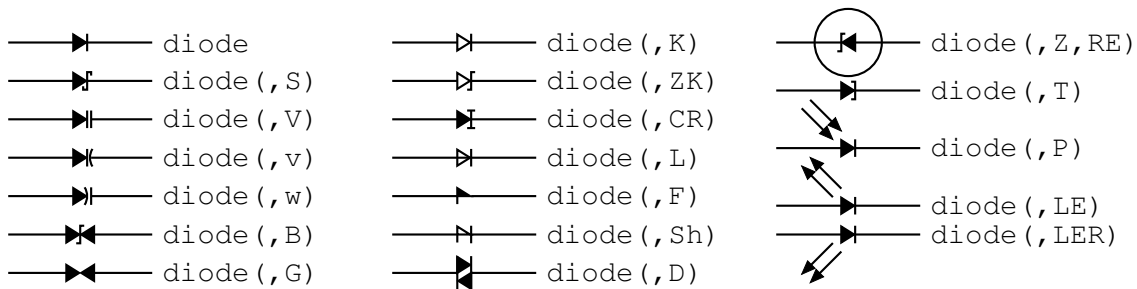


Figure 3: Diodes: a K in the second argument draws an open arrowhead [Diodes.m4].

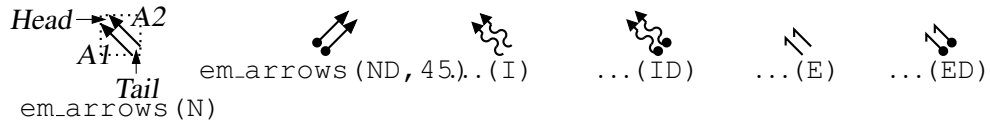


Figure 4: Radiation arrows [Emarrows.m4].

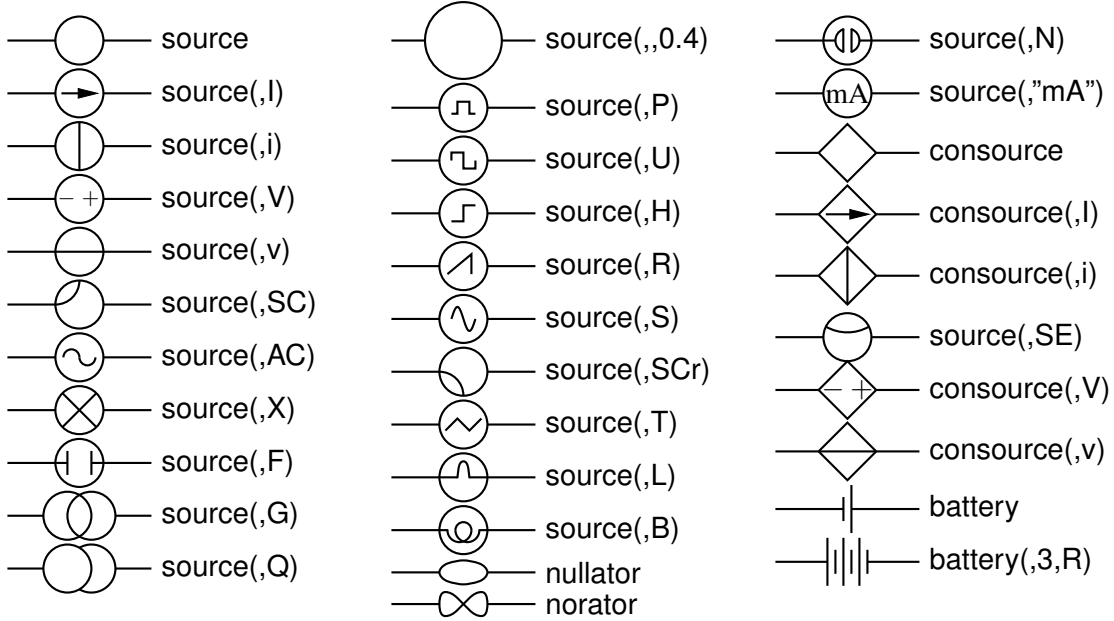


Figure 5: Sources and source-like elements [Sources.m4].

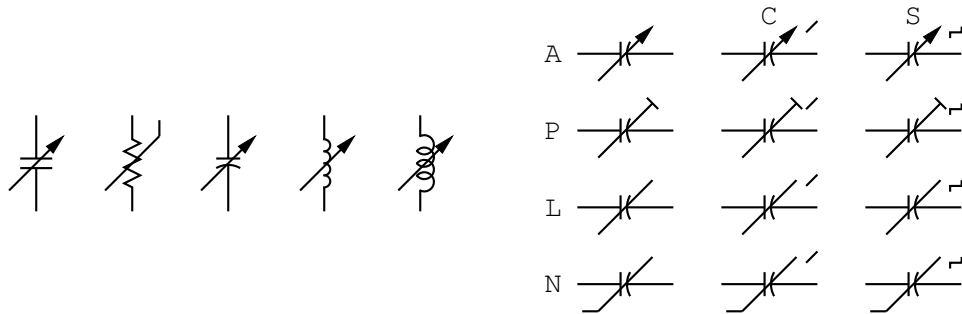


Figure 6: Arrows and marks indicating variability [Variable.m4].

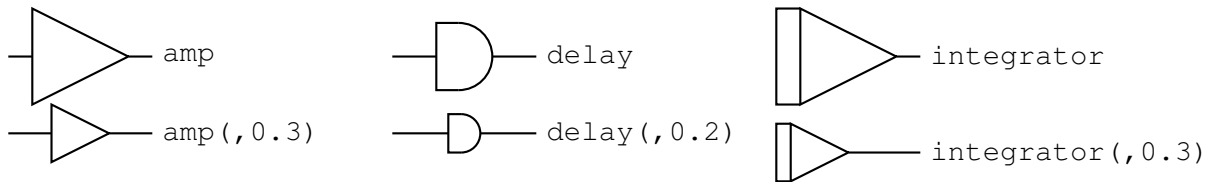


Figure 7: Macros amp, delay, and integrator [AmpTable.m4].

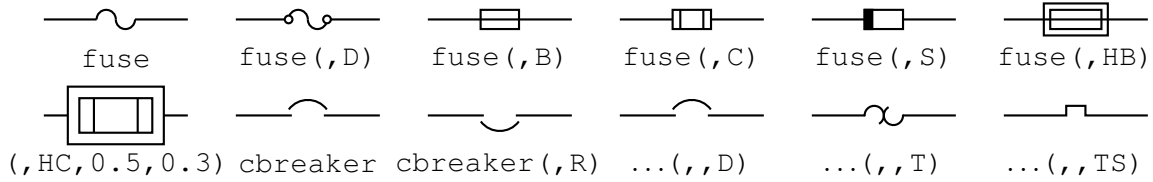


Figure 8: Macros fuse and cbreaker [Fuses.m4].

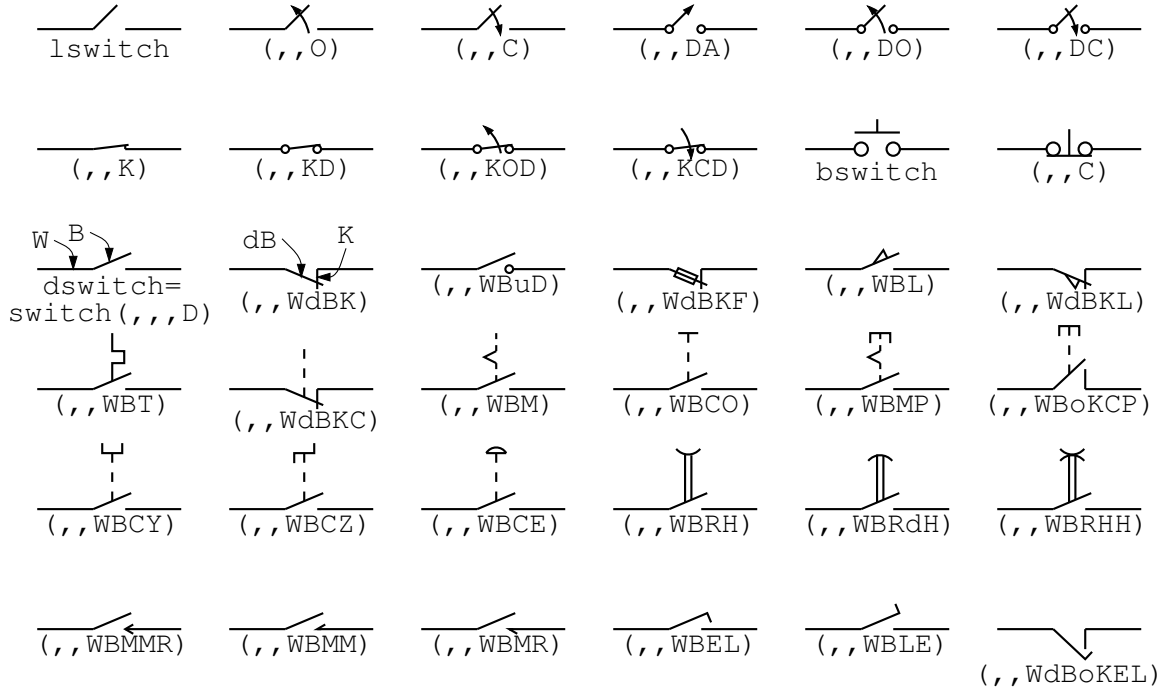


Figure 9: The switch macros; switch(...,L|B|D) is a wrapper for lswitch, bswitch, and dswitch [Switches.m4].

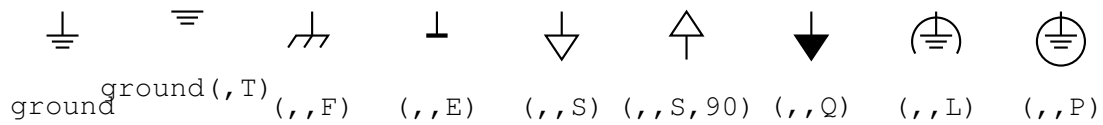


Figure 10: Ground symbols [Grounds.m4].

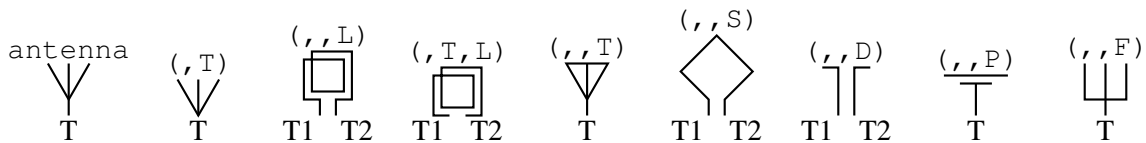


Figure 11: Antenna symbols [Antennas.m4].

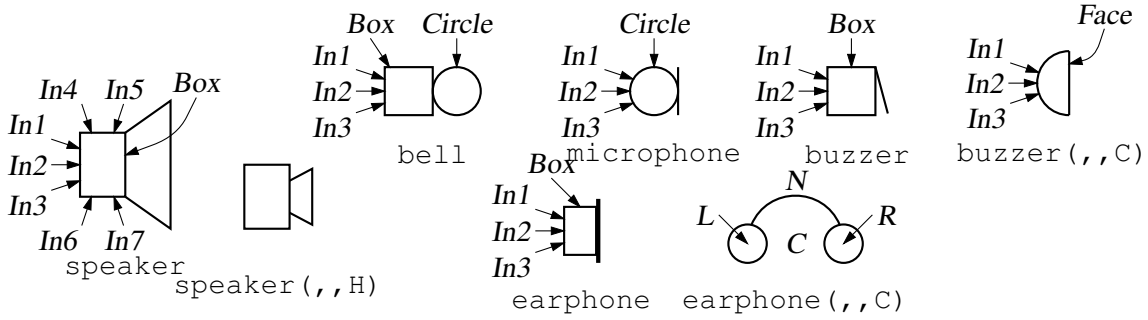


Figure 12: Audio elements [Audio.m4].

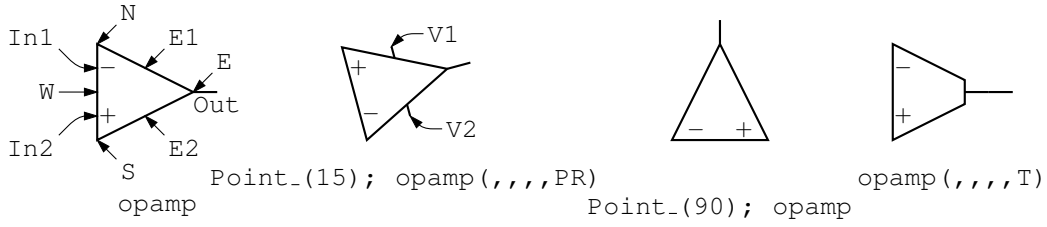


Figure 13: The opamp [Opamp.m4].

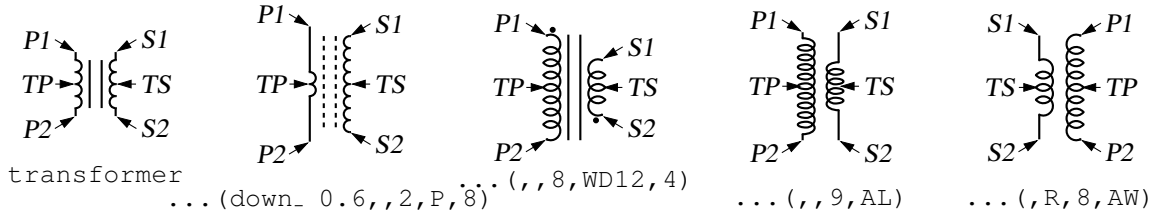


Figure 14: The transformer element, drawing direction down [Xform.m4].

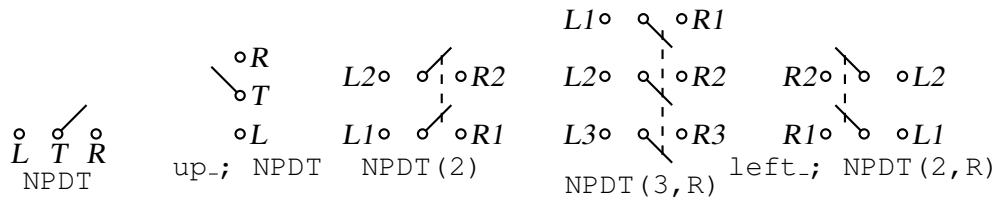


Figure 15: Double throw with the NPDT macro [NPDT.m4].

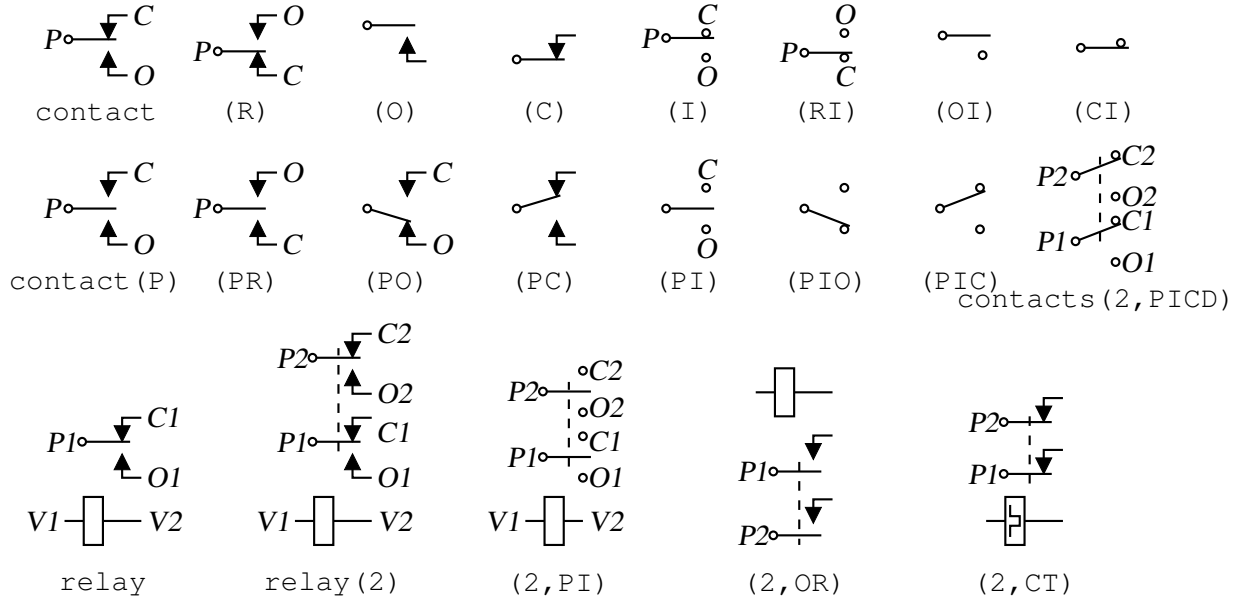


Figure 16: The contact and relay macros [Relay.m4].

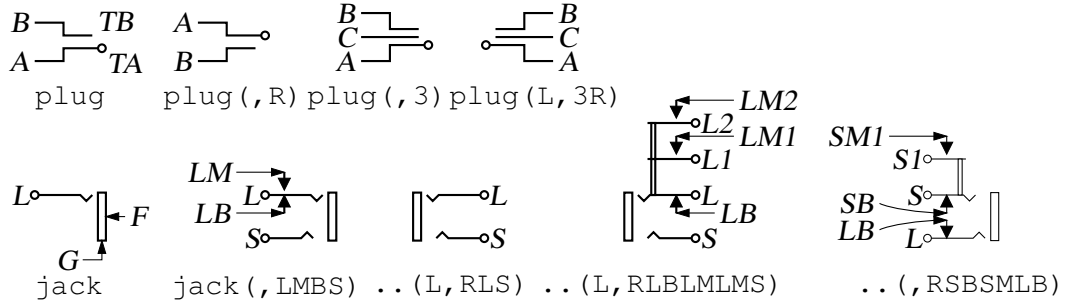


Figure 17: The jack and plug macros [Jack.m4].

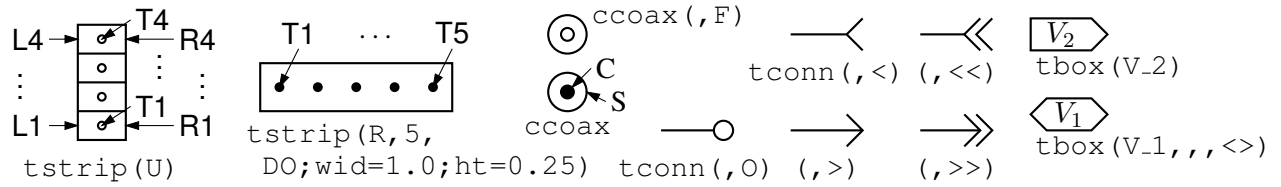


Figure 18: The tstrip, ccoax, tconn, and tbox macros [Conn.m4].

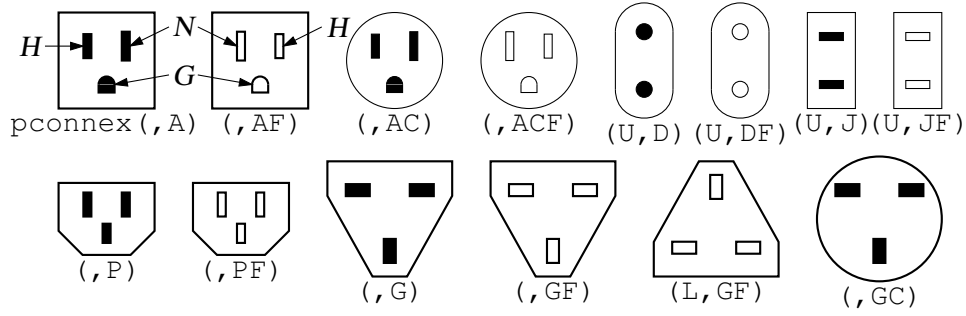


Figure 19: The pconnex macro [Pconn.m4].

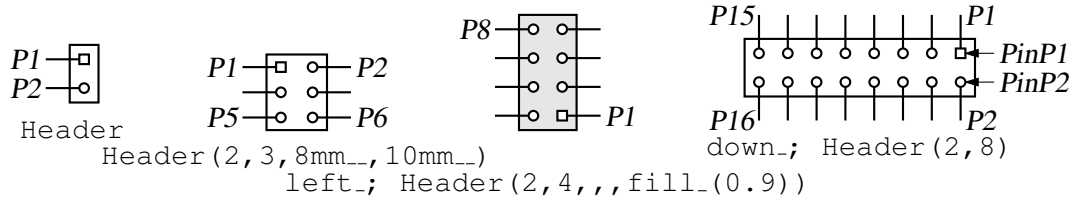


Figure 20: The Header macro [Headers.m4].

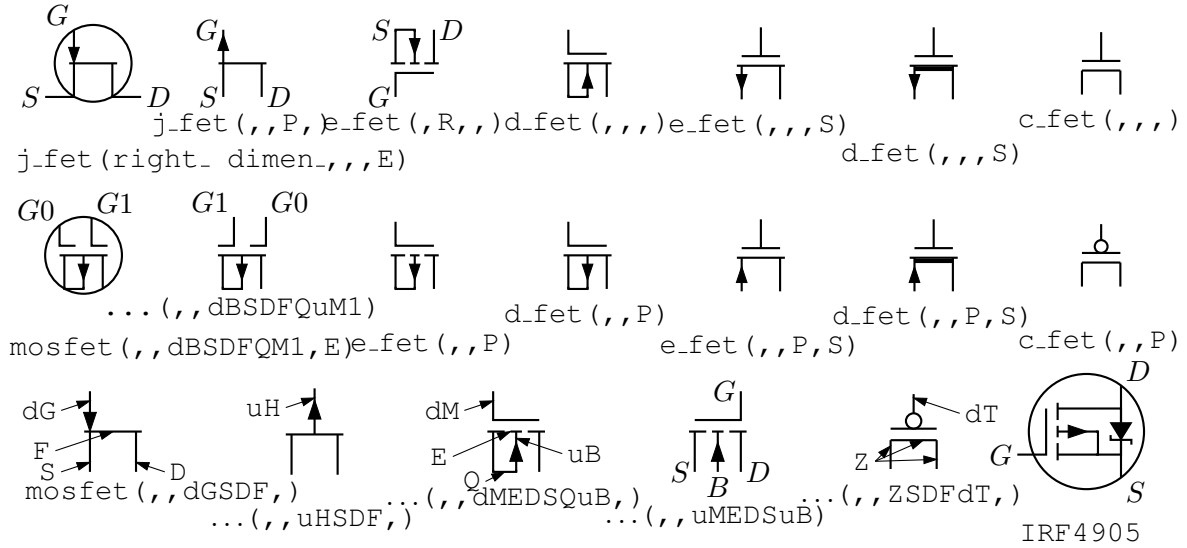


Figure 21: FETs, showing programmable components and example customizations [fet.m4].

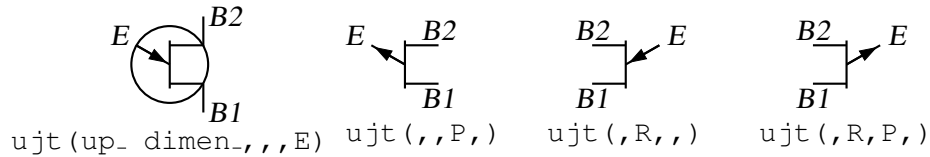


Figure 22: UJT examples [ujt.m4].

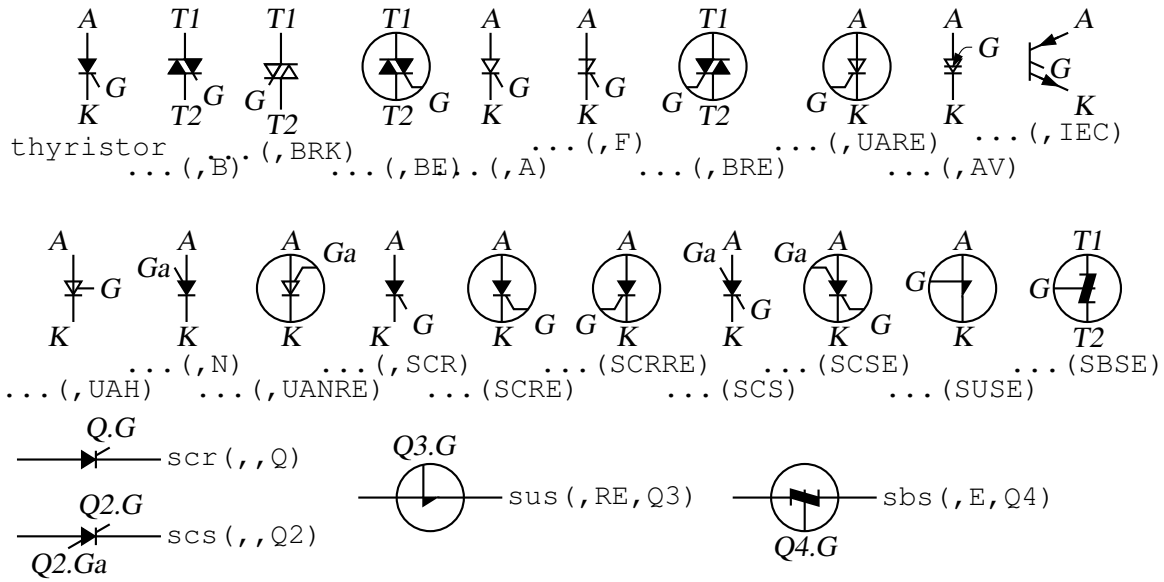


Figure 23: Thyristor examples [thyristor.m4].

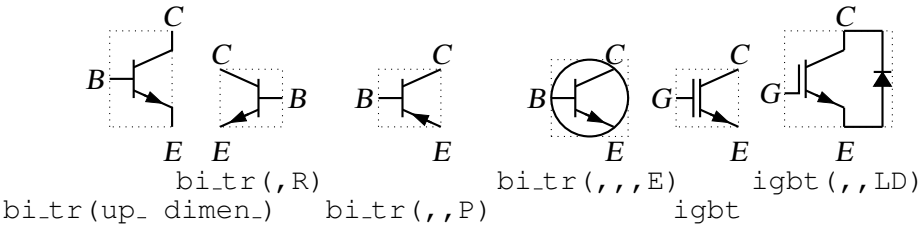


Figure 24: Bipolar transistors (drawing direction: up) [Bip.m4].

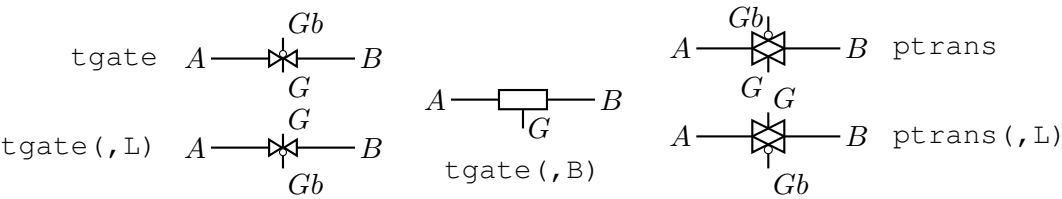


Figure 25: The tgate and ptrans elements [Tgate.m4].

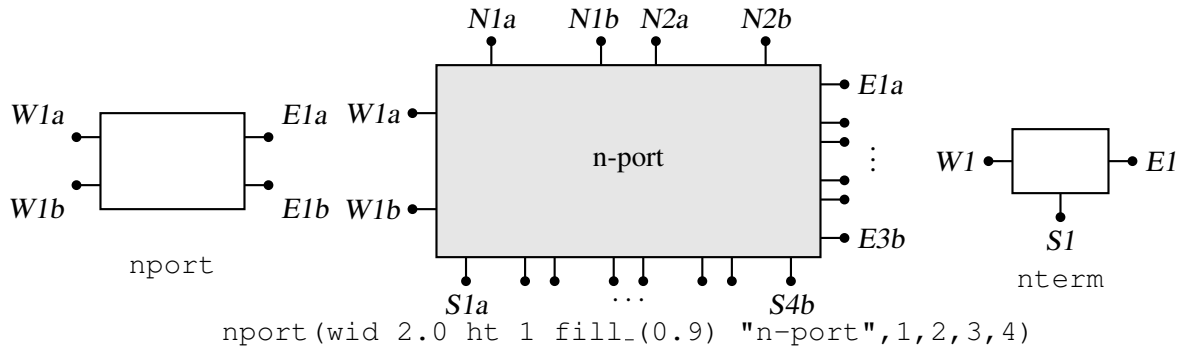


Figure 26: The nport and nterm macros [Nport.m4].

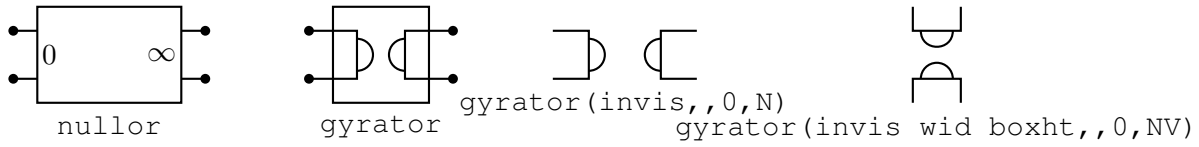


Figure 27: Some customizations of nport [NLG.m4].

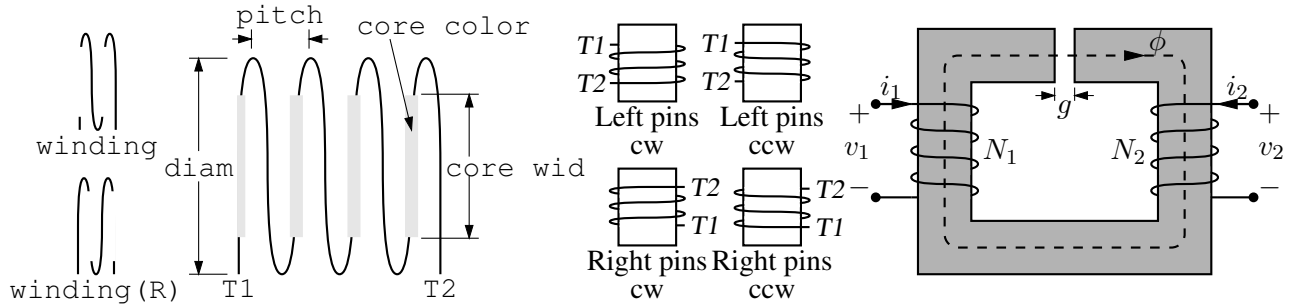


Figure 28: The macro winding (L|R,diam,pitch,turns,core wid,core color) [Windings.m4].

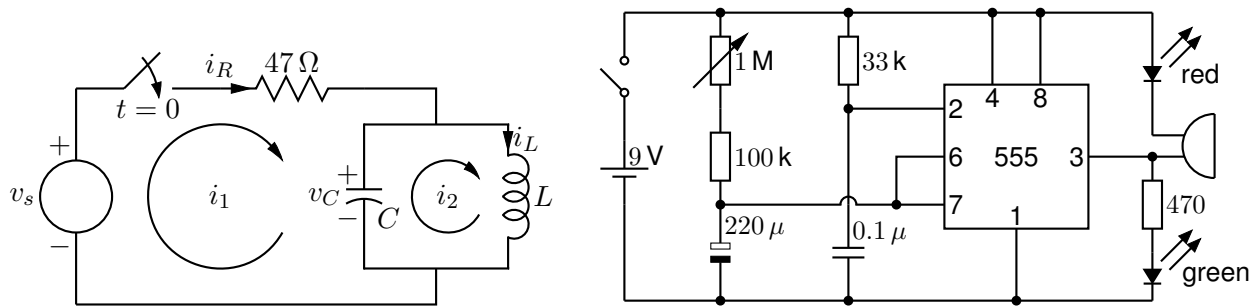


Figure 29: Two simple labeled circuits [ex01.m4] [Timer.m4].



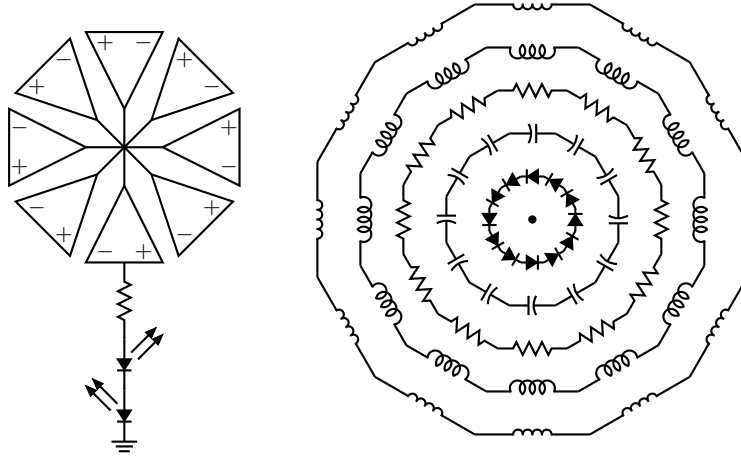


Figure 30: Elements at obtuse angles [ex02.m4].

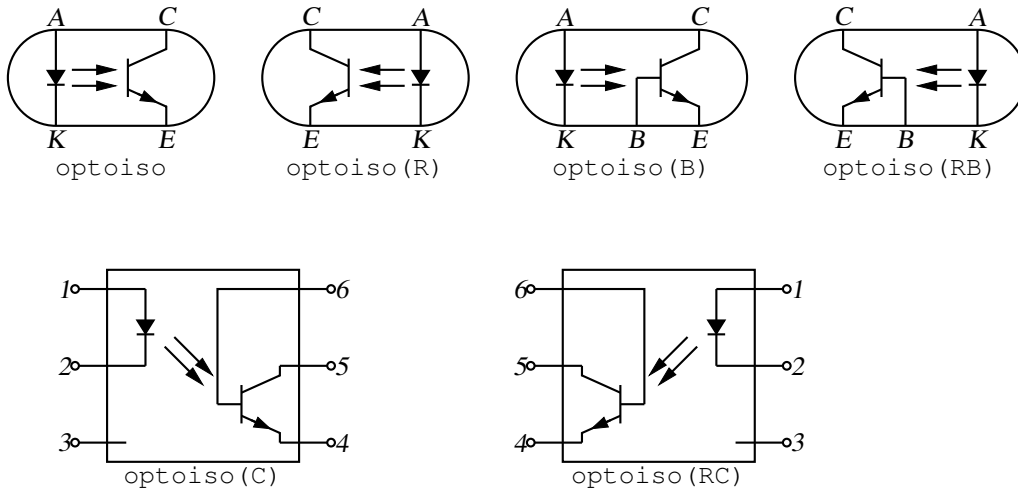


Figure 31: Optical isolator: a circuit with right or left orientation [Optoiso.m4].

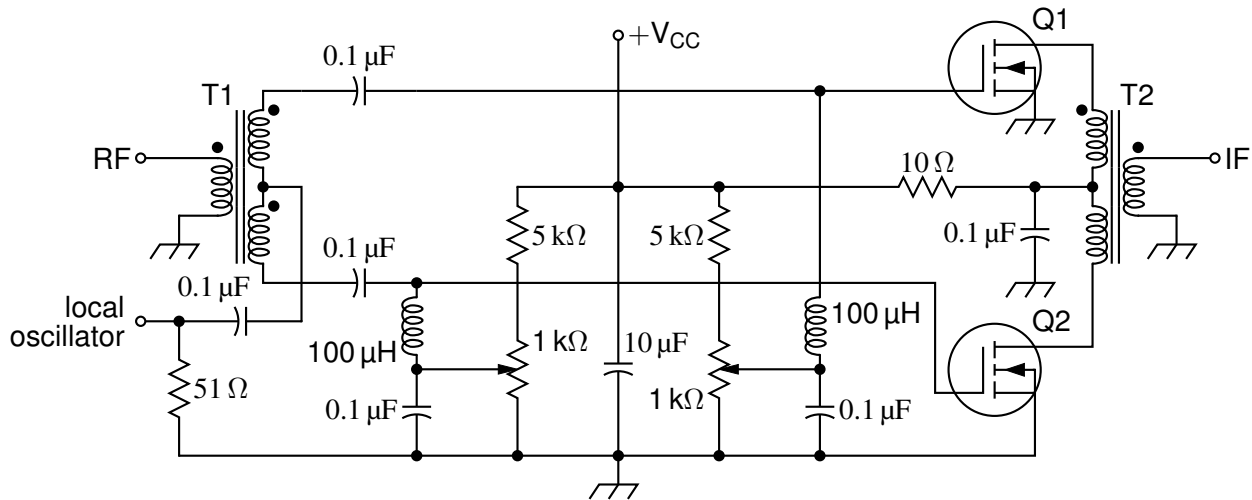


Figure 32: A balanced mixer, using mosfet and a custom transformer [Mixer.m4].

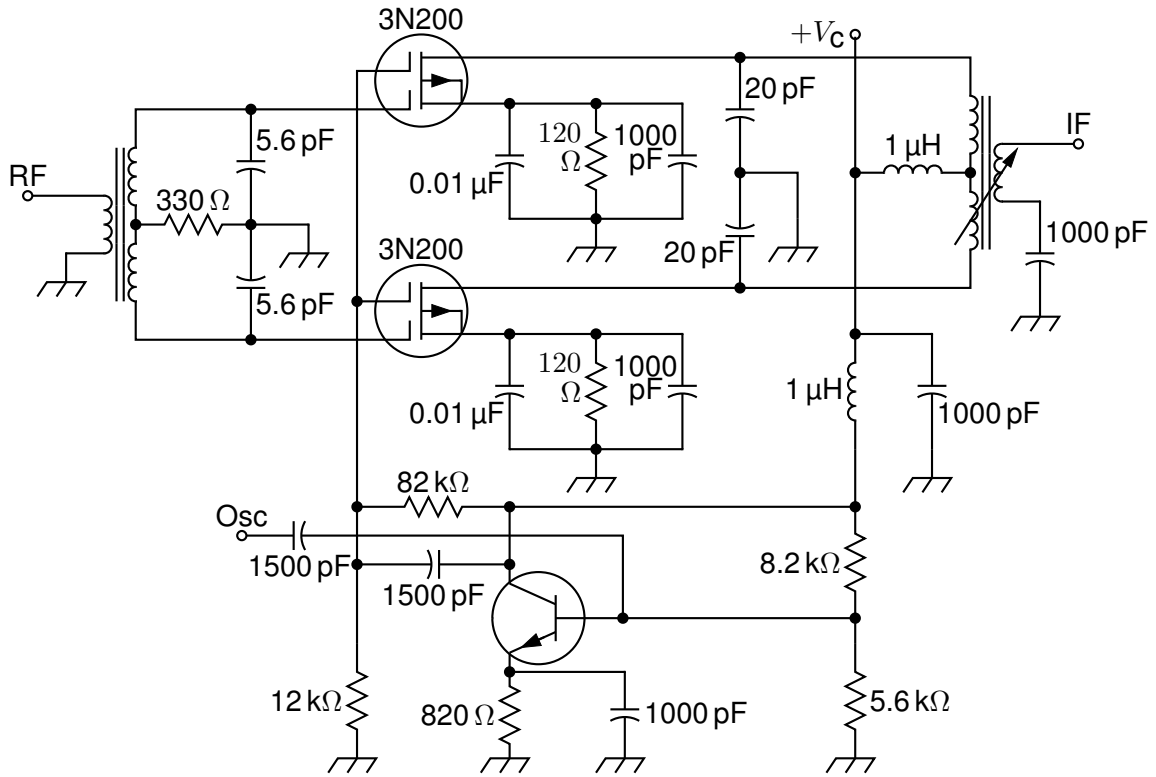


Figure 33: A push-pull mixer, showing FETs with multiple gates [PushPull.m4].

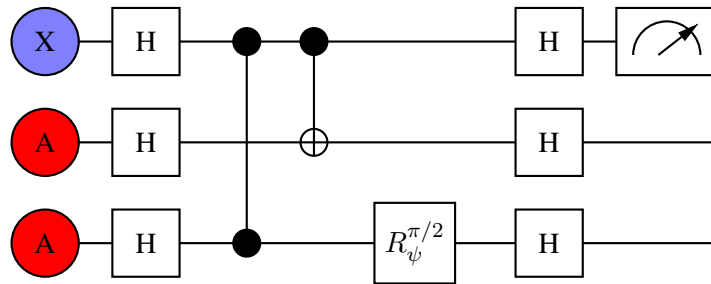


Figure 34: A quantum circuit [Quantum.m4].

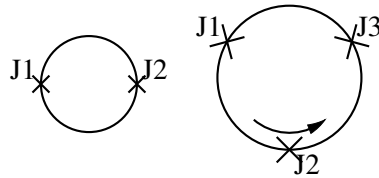


Figure 35: Superconducting quantum interface device (drawing direction down) [SQUID.m4].

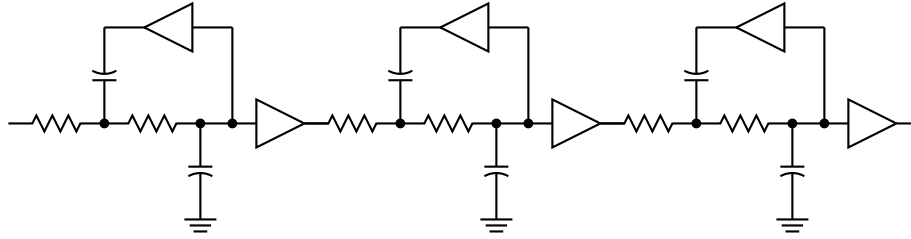


Figure 36: A six-pole filter [Sixpole.m4].

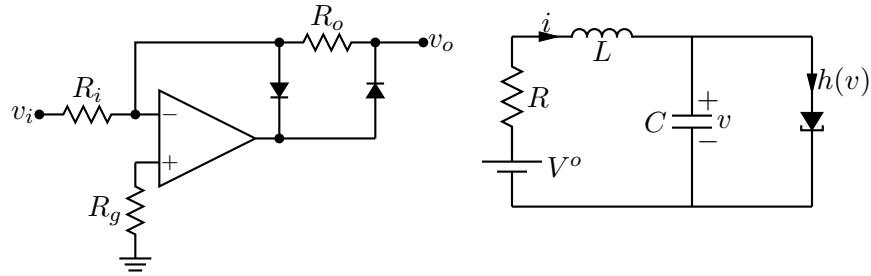


Figure 37: Precision half-wave rectifier and a tunnel diode circuit (illustrating opamp, diode, resistor, ground, and labels) [ex18.m4].

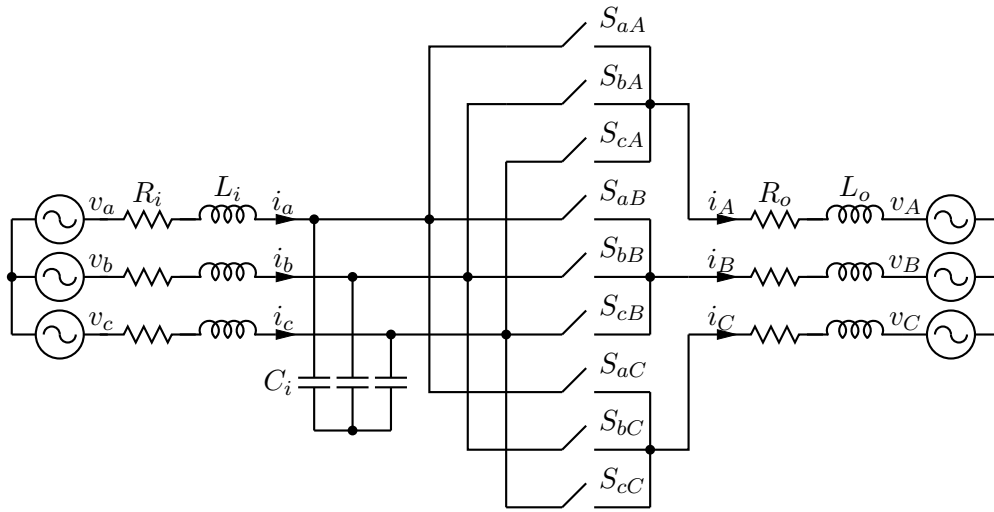


Figure 38: A three-phase switched AC-AC converter [MC.m4].

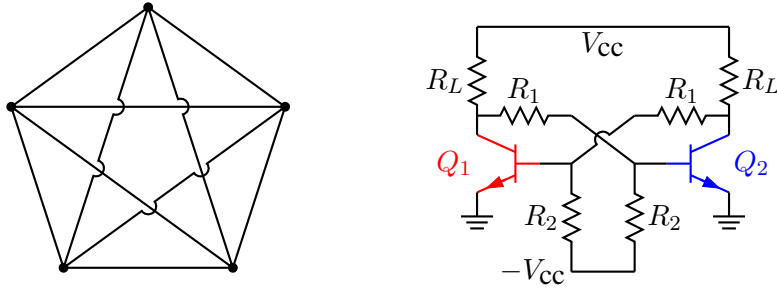


Figure 39: Non-planar graph and bistable circuit (illustrating the crossover macro and colored elements) [ex10.m4].

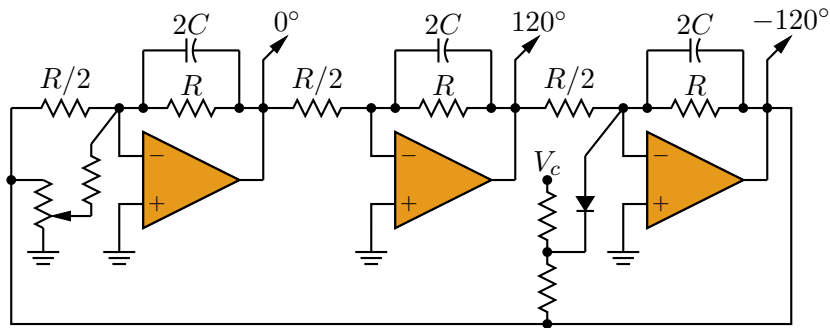


Figure 40: Three-phase oscillator [Three.m4].

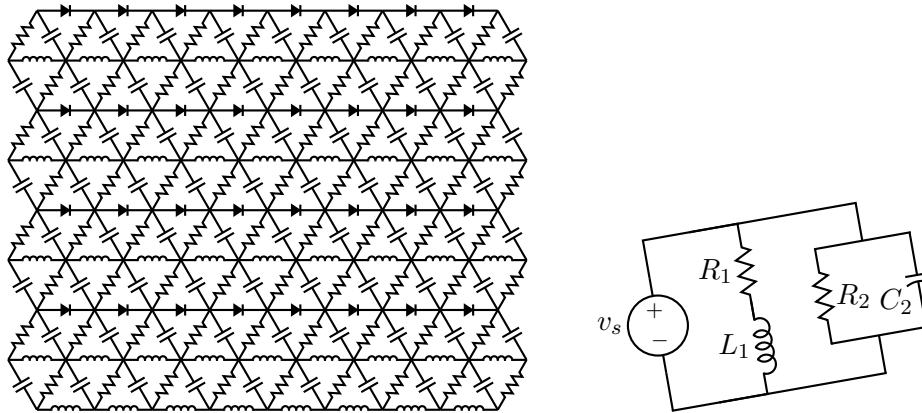


Figure 41: A repetitive network created by Pic looping and a skewed circuit used to test the macro parallel\_ [ex17.m4].

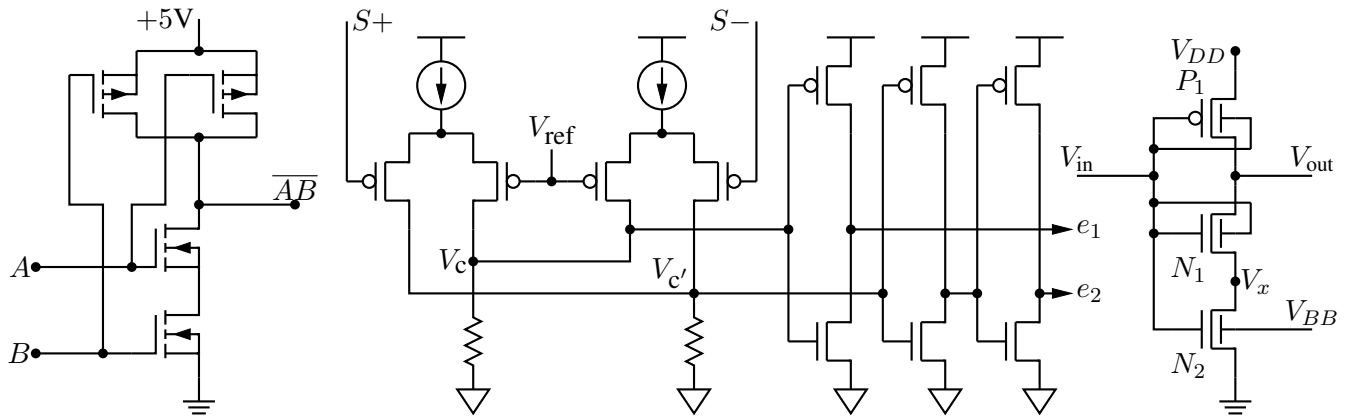


Figure 42: A CMOS NAND gate, a test circuit, and an X MOSFET example [ex12.m4].

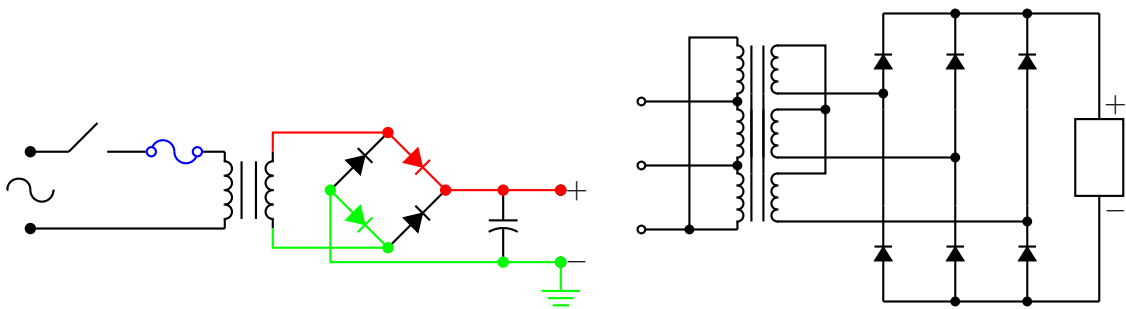


Figure 43: An elementary power supply circuit with colored elements, and a multiple-winding transformer with 3-phase rectifier [pwrsupply.m4].

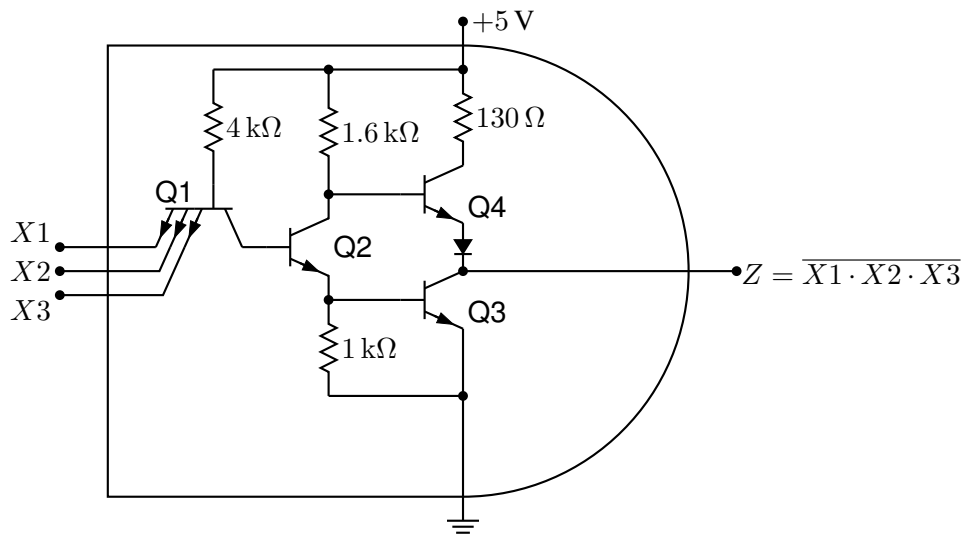


Figure 44: TTL NAND gate illustrating a transistor with multiple emitters [TTLnand.m4].

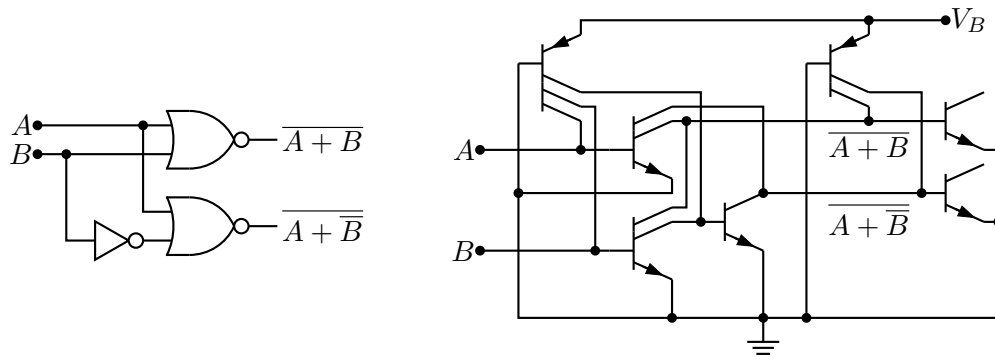


Figure 45: Gate circuit and equivalent embedded  $I^2L$  components illustrating multiple collectors [I2L.m4].

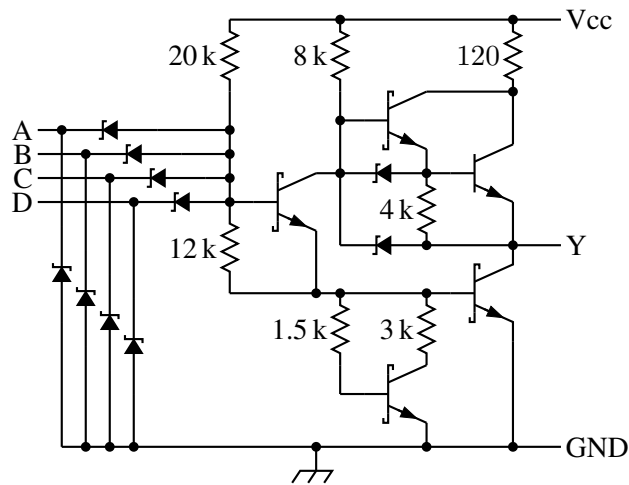


Figure 46: A 4-input NAND circuit illustrating the S (Schottky) option of bi\_trans [Schottky.m4].

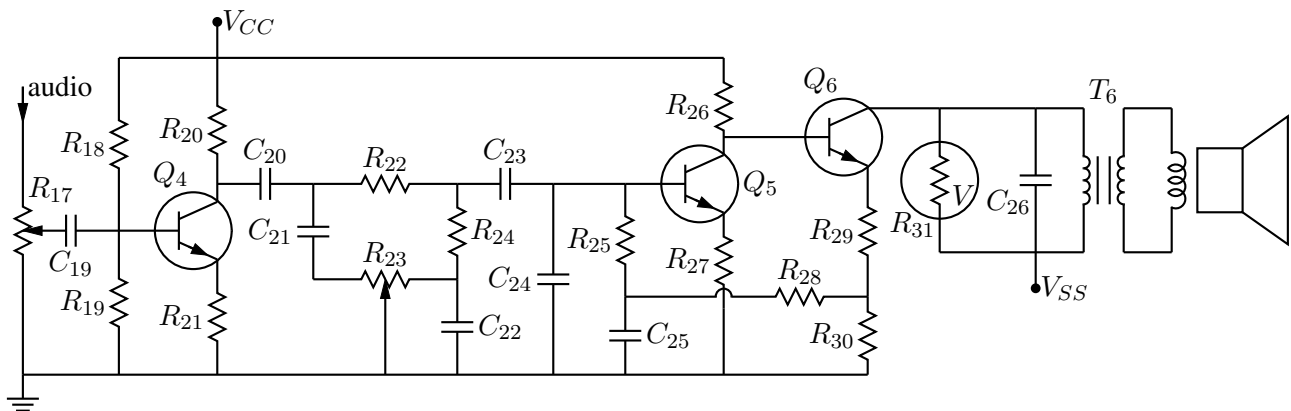


Figure 47: Transistor radio audio chain [ex11.m4].

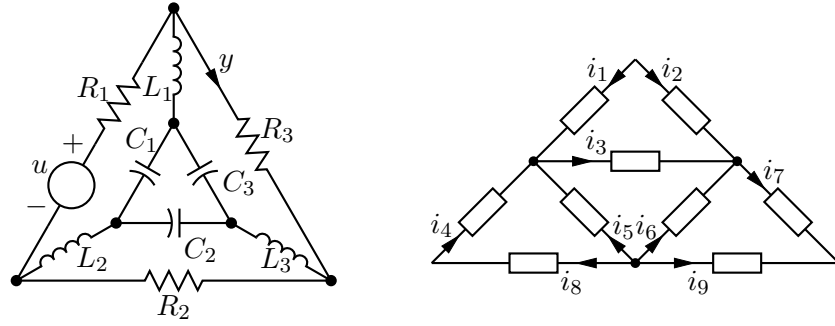


Figure 48: Labels on non-manhattan elements [ex04.m4].

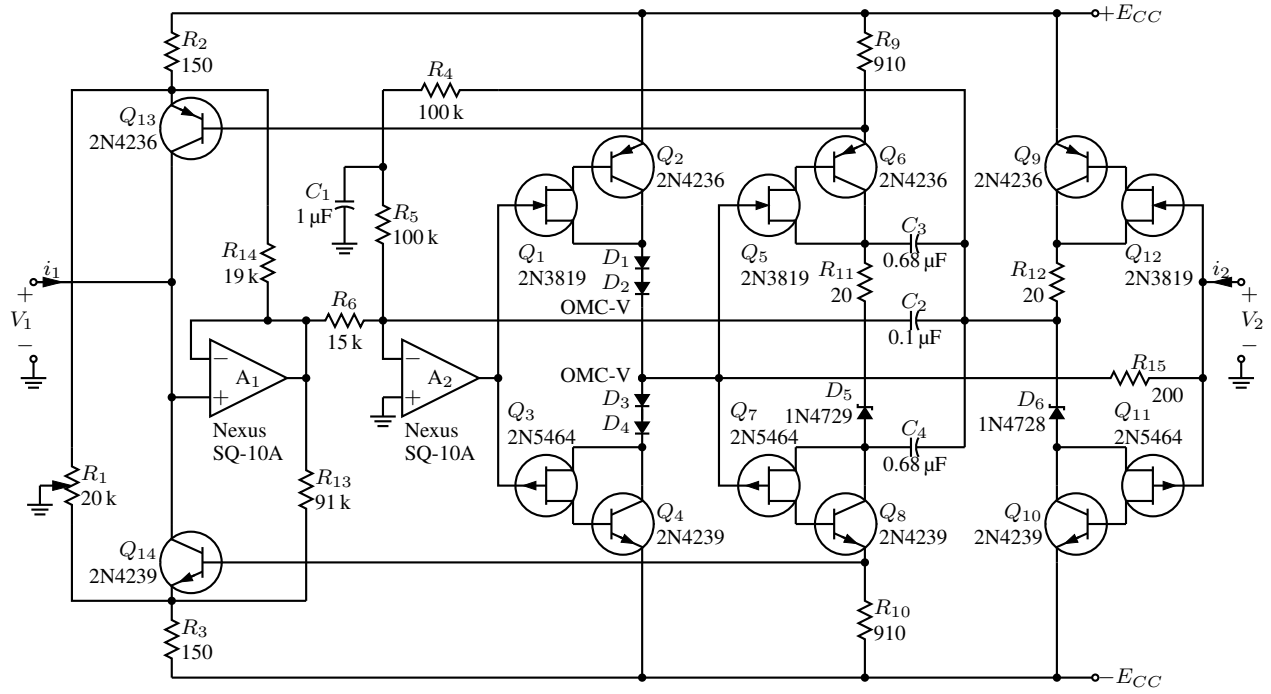


Figure 49: Realization of a controlled source (illustrating stacked element labels) [Csource.m4].

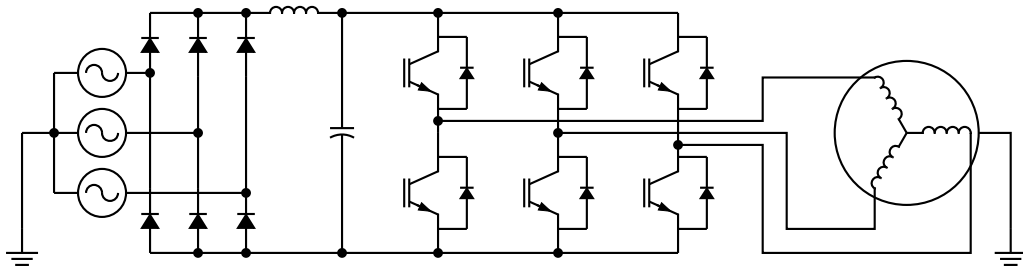


Figure 50: Synchronous machine driven by variable-speed drive and rectifier [Drive.m4].

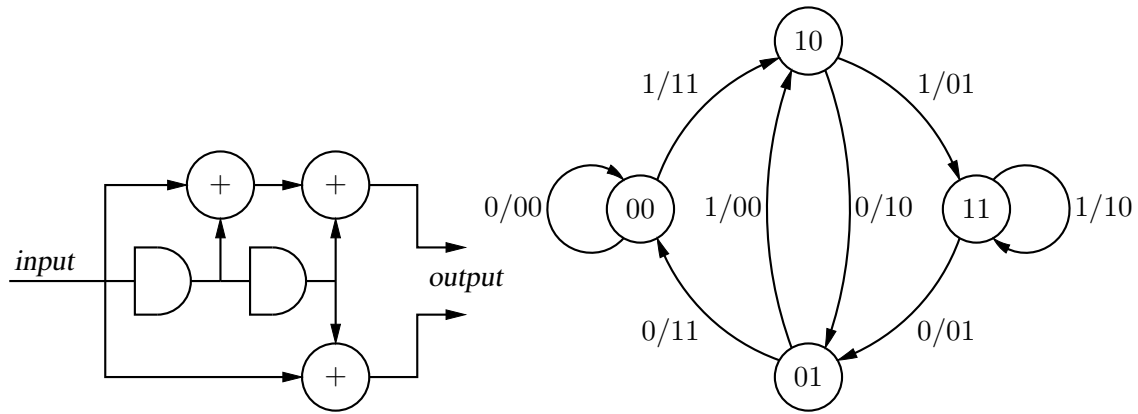


Figure 51: A rate 1/2 binary convolutional coder and its state diagram [ex16.m4].

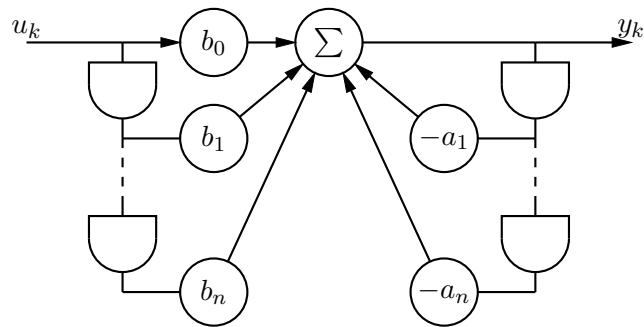


Figure 52: Digital filter [ex03.m4].

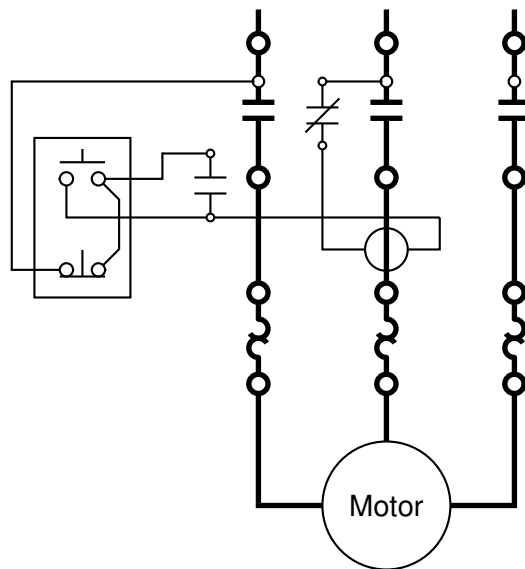


Figure 53: Motor control connections [MotorControl.m4].



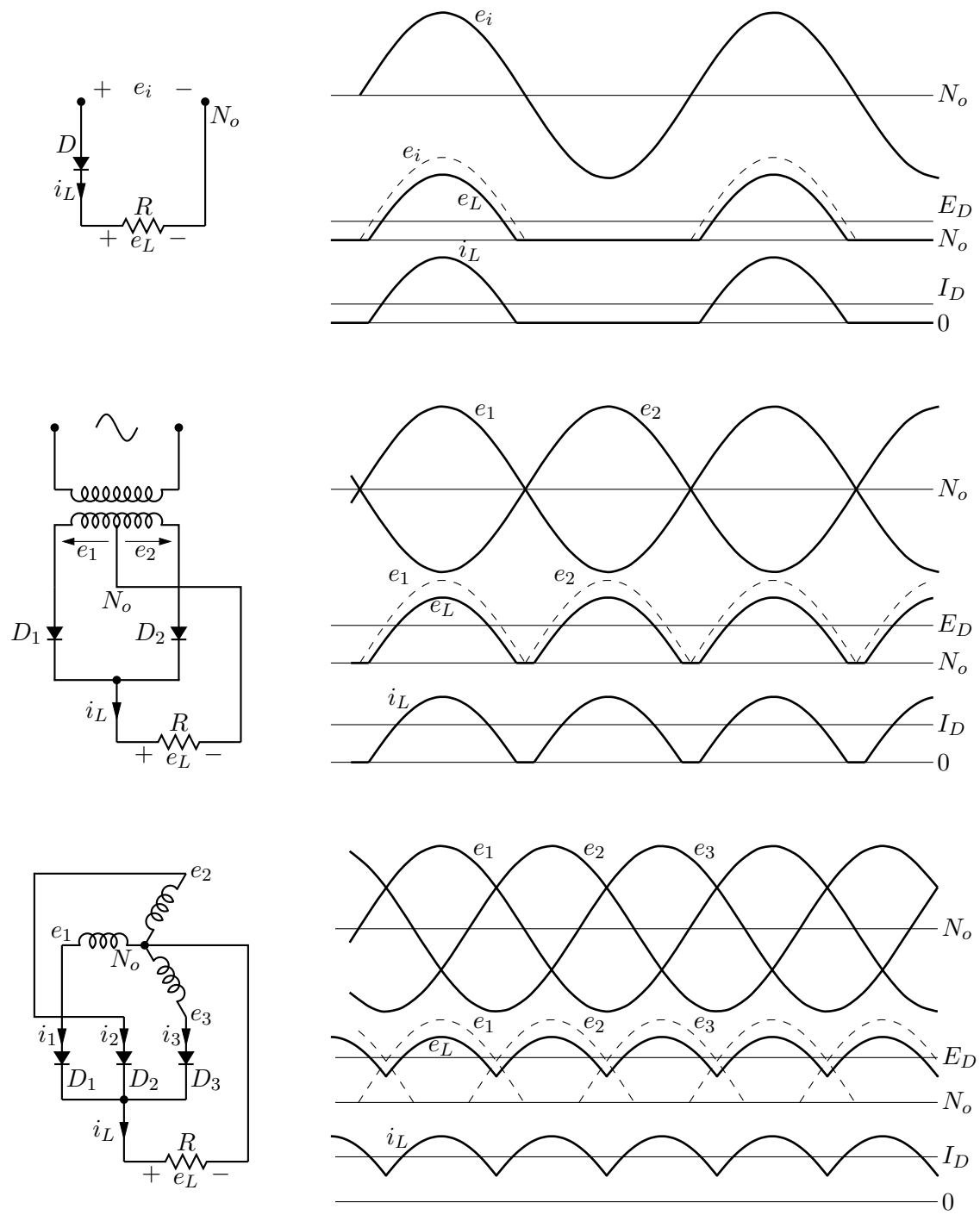


Figure 54: Rectifier circuits and waveforms [Rectifiers.m4].

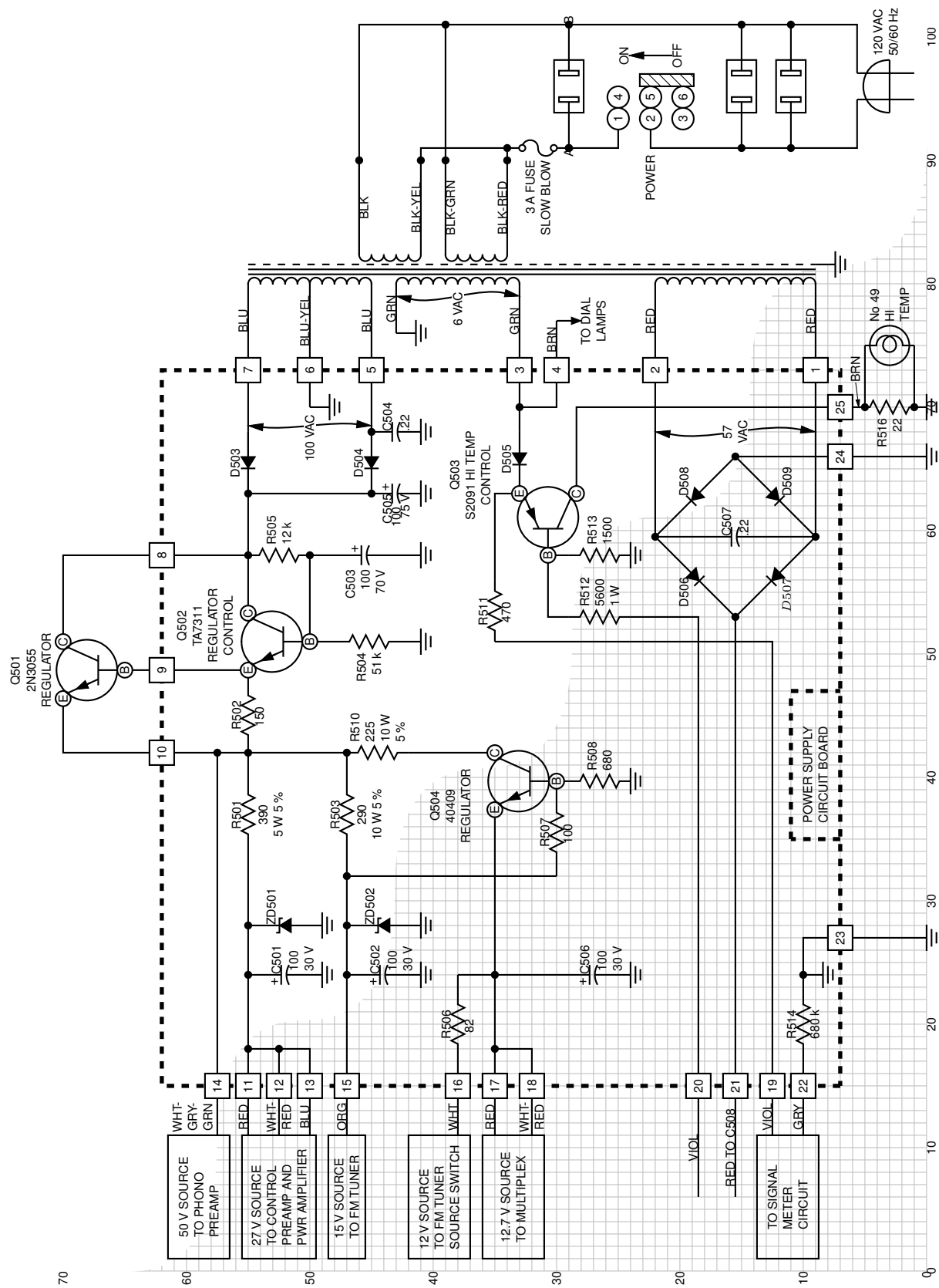


Figure 55: The power supply of a Heathkit AR-15 (Now, *that* was a receiver!) with custom transformer and other elements, drawn on a grid (partially shown) to aid in placement [Heathkit.m4].



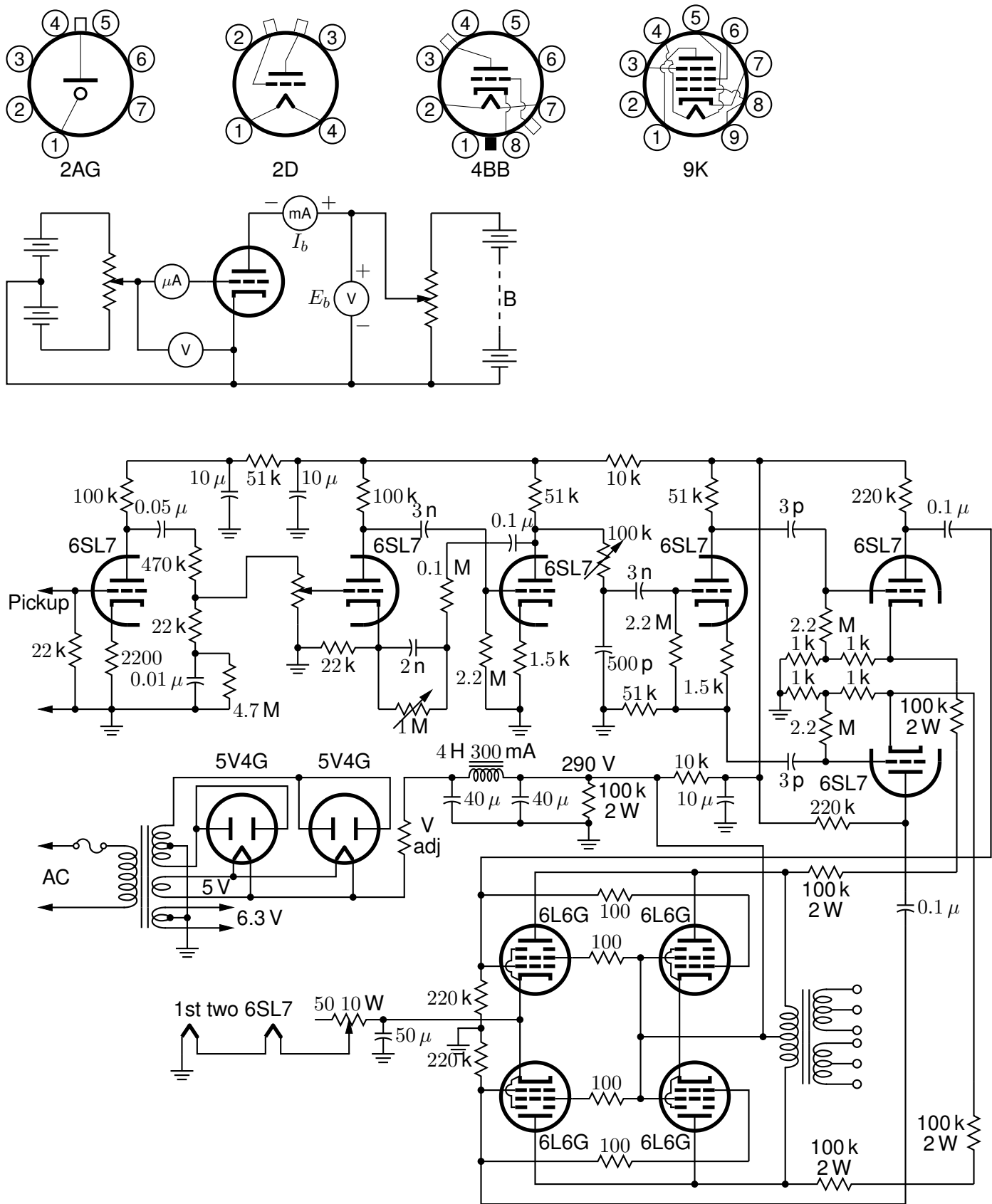


Figure 57: Electron-tube diagrams: a few bottom-view base diagrams, a generic triode test circuit, and a 25-watt audio amplifier adapted from F. Langford-Smith, *Radiotron Designer's Handbook*, fourth edition, Harrison, NJ: Radio Corporation of America, 1952 [Tubediags.m4].

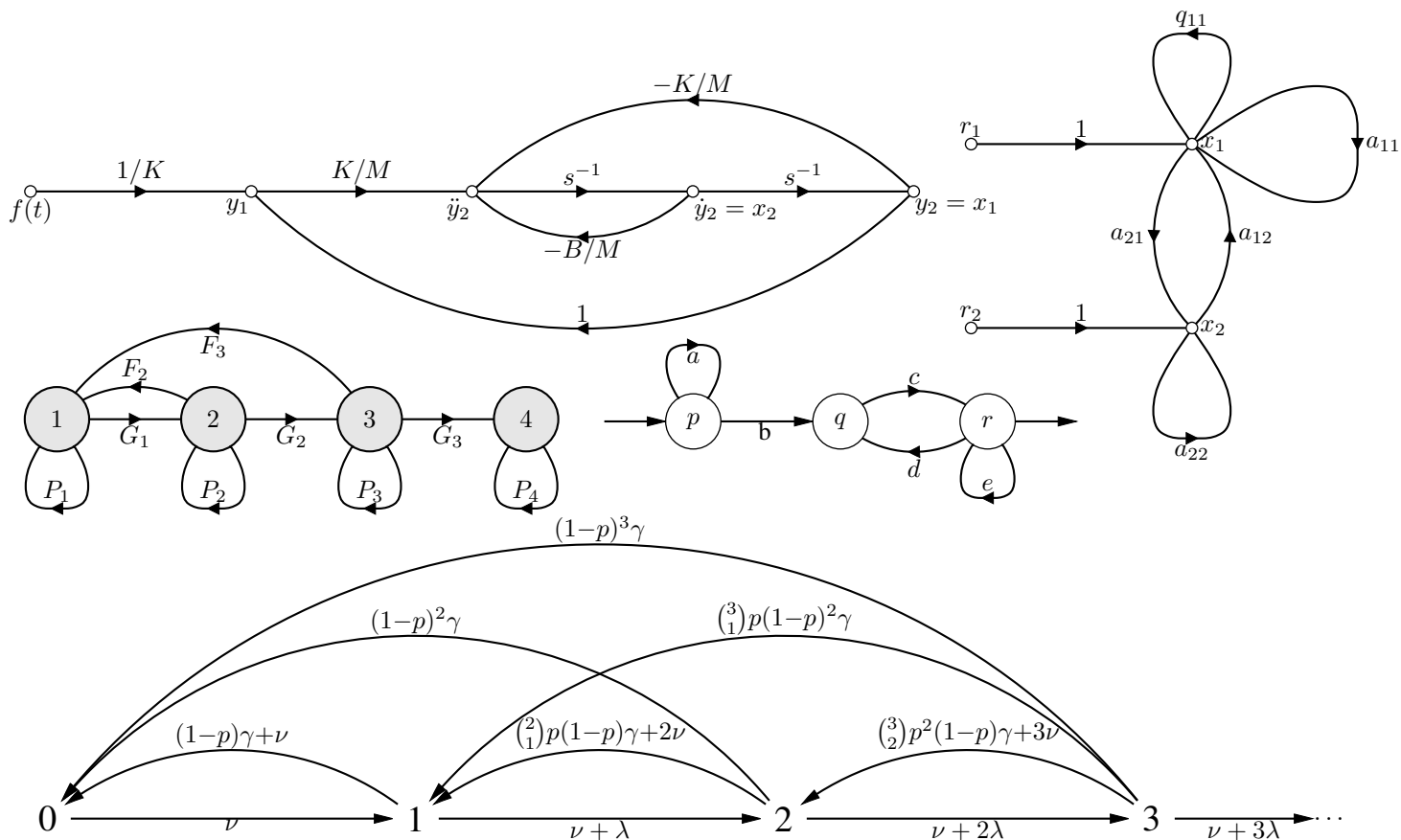


Figure 58: Signal-flow graphs [sfg.m4].

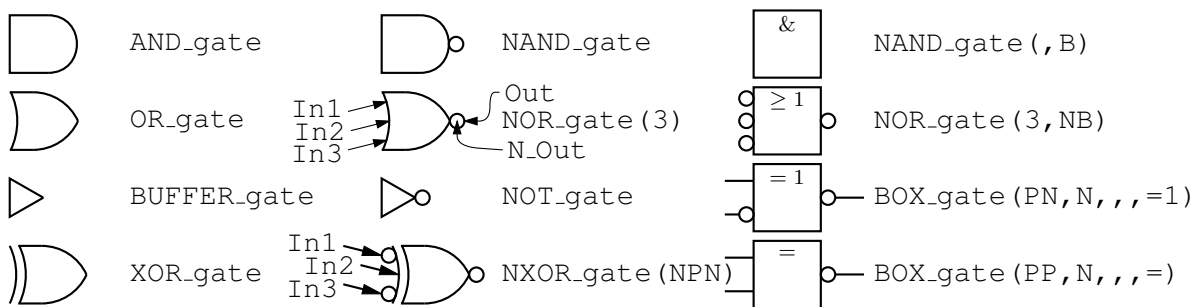


Figure 59: Basic logic gates [Logic.m4].

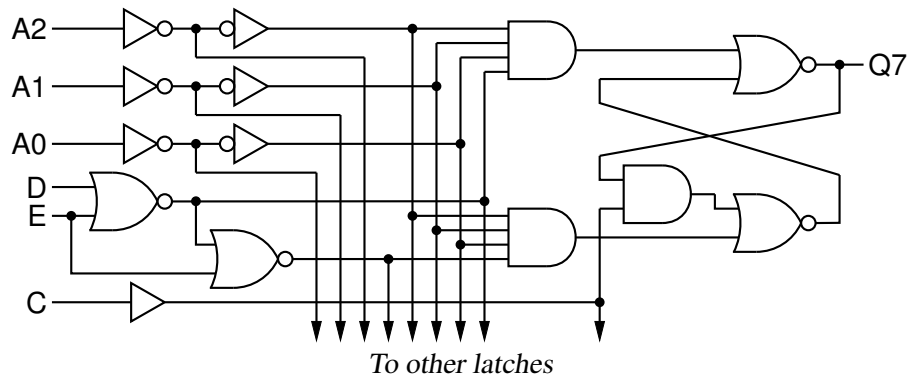


Figure 60: General-purpose latch: a small logic circuit [ex08.m4].

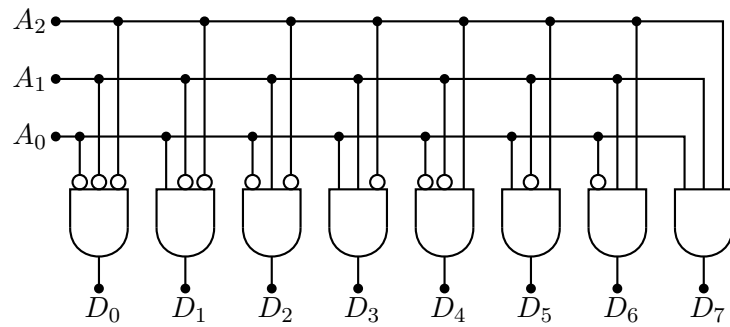


Figure 61: Decoder logic, constructed using the `for_macro` [Decoder.m4].

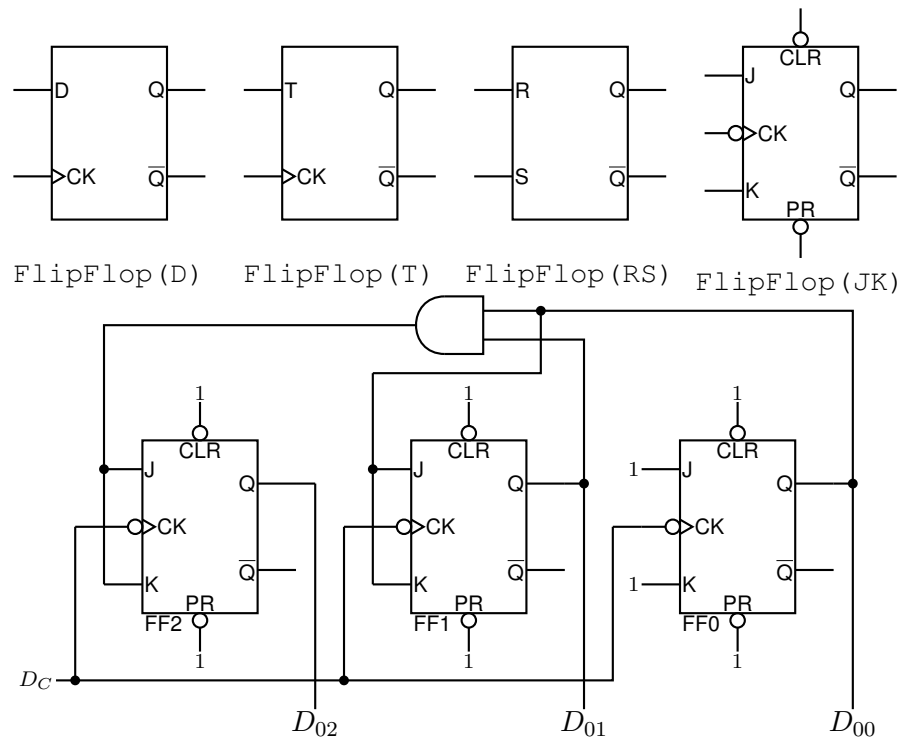


Figure 62: Some flip-flops [ex21.m4].

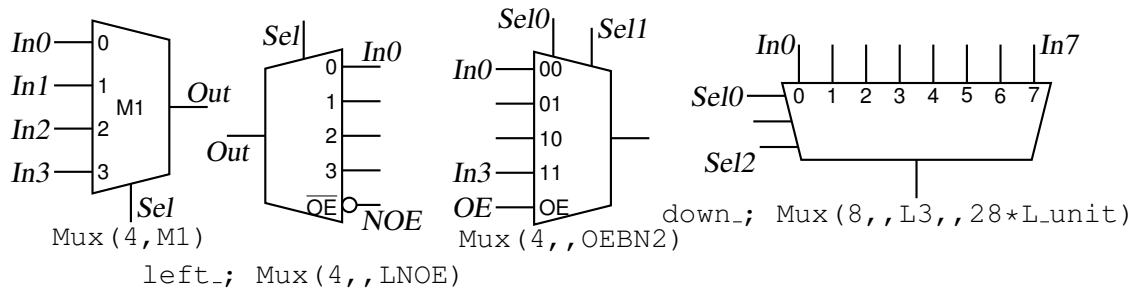


Figure 63: Multiplexer [Multiplexer.m4].

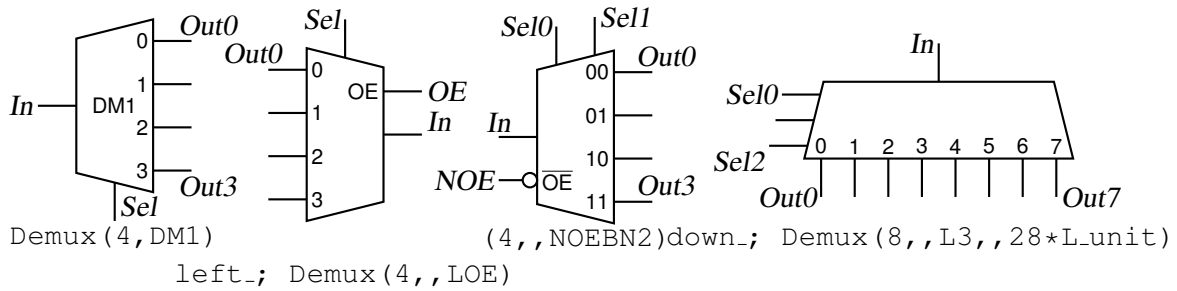


Figure 64: Demultiplexer [Demultiplexer.m4].

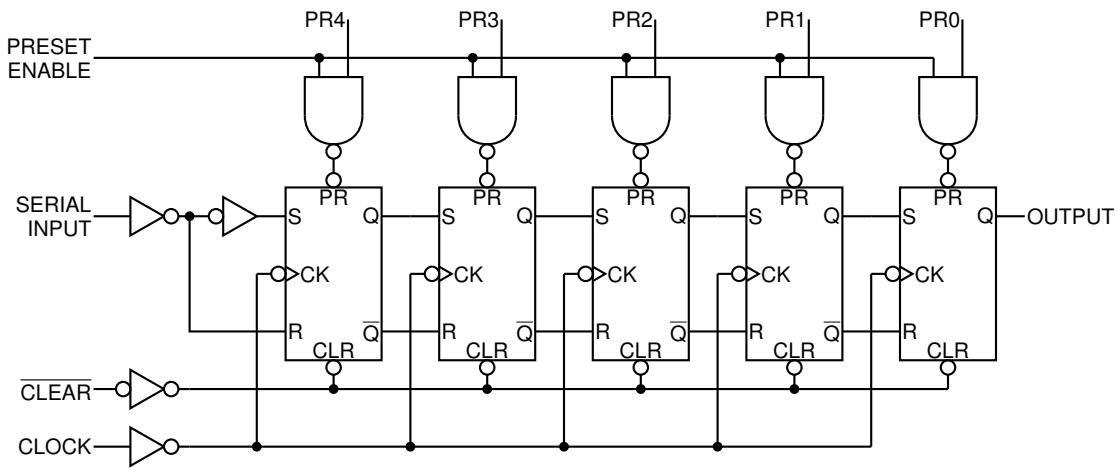


Figure 65: A 5-bit shift register drawn using a custom flip-flop [ShiftR.m4].

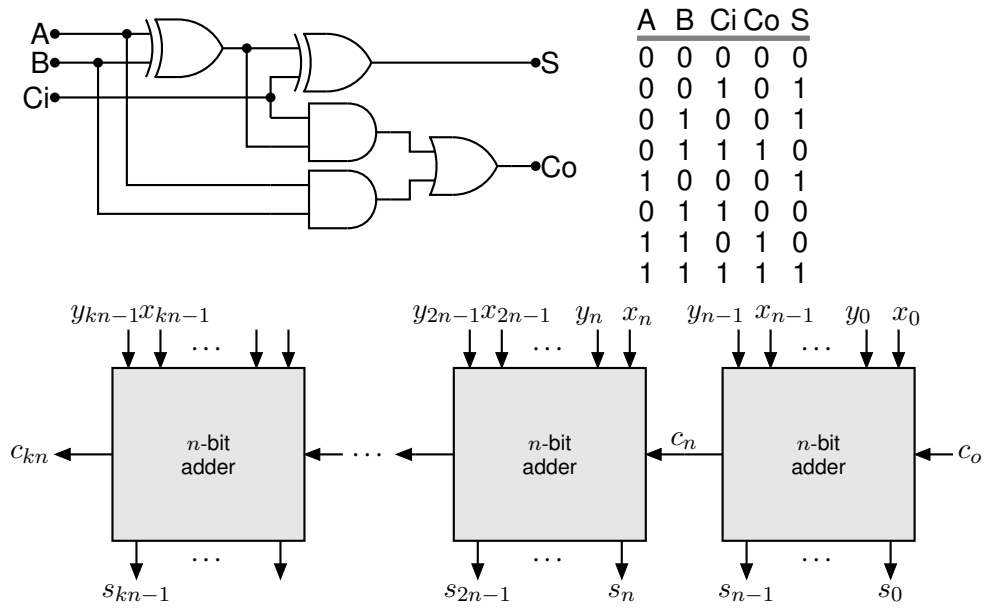


Figure 66: A full adder and a cascade of  $n$ -bit adders [Adder.m4].

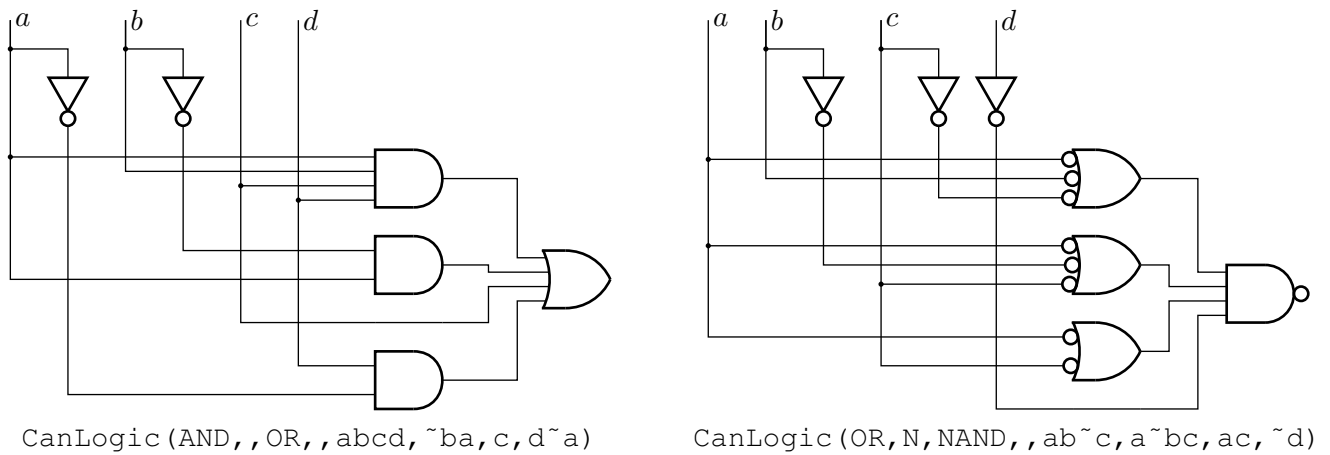


Figure 67: A way of automatically drawing two-layer logic diagrams [CanLogic.m4].



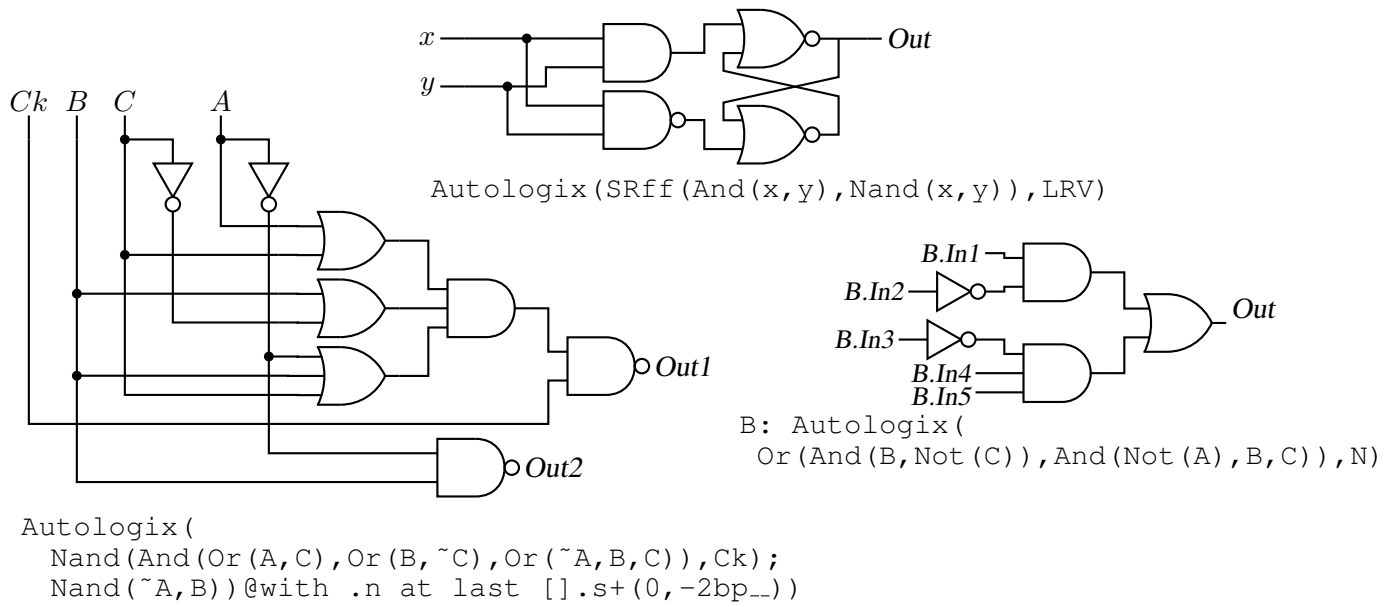


Figure 68: The `Autologix (Boolean expression; Boolean expression... , options)` macro automatically draws Boolean expressions in function notation. The function tree is drawn, then a row or column of inputs, then the connections. The default result is on the left, a custom element at the top, and a tree of gates only is shown on the right. [Alogix.m4].

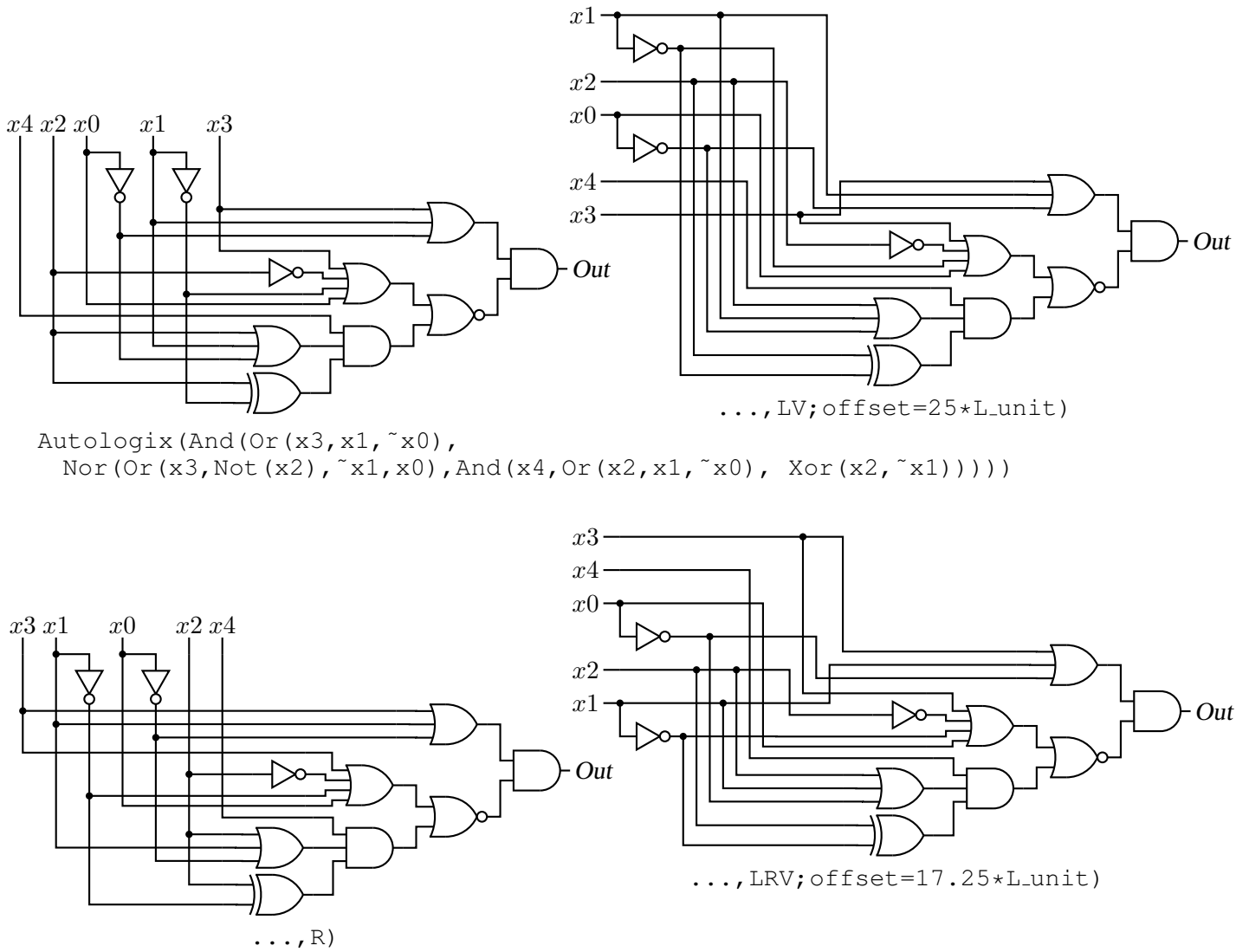


Figure 69: The Autologix macro can draw inputs on the left but the added drawing complexity may require hand tuning with second-argument options: L puts the inputs on the left, R reverses their order, V scans the input arguments in reverse order, and offset=value displaces the array of inputs [ABlogix.m4].

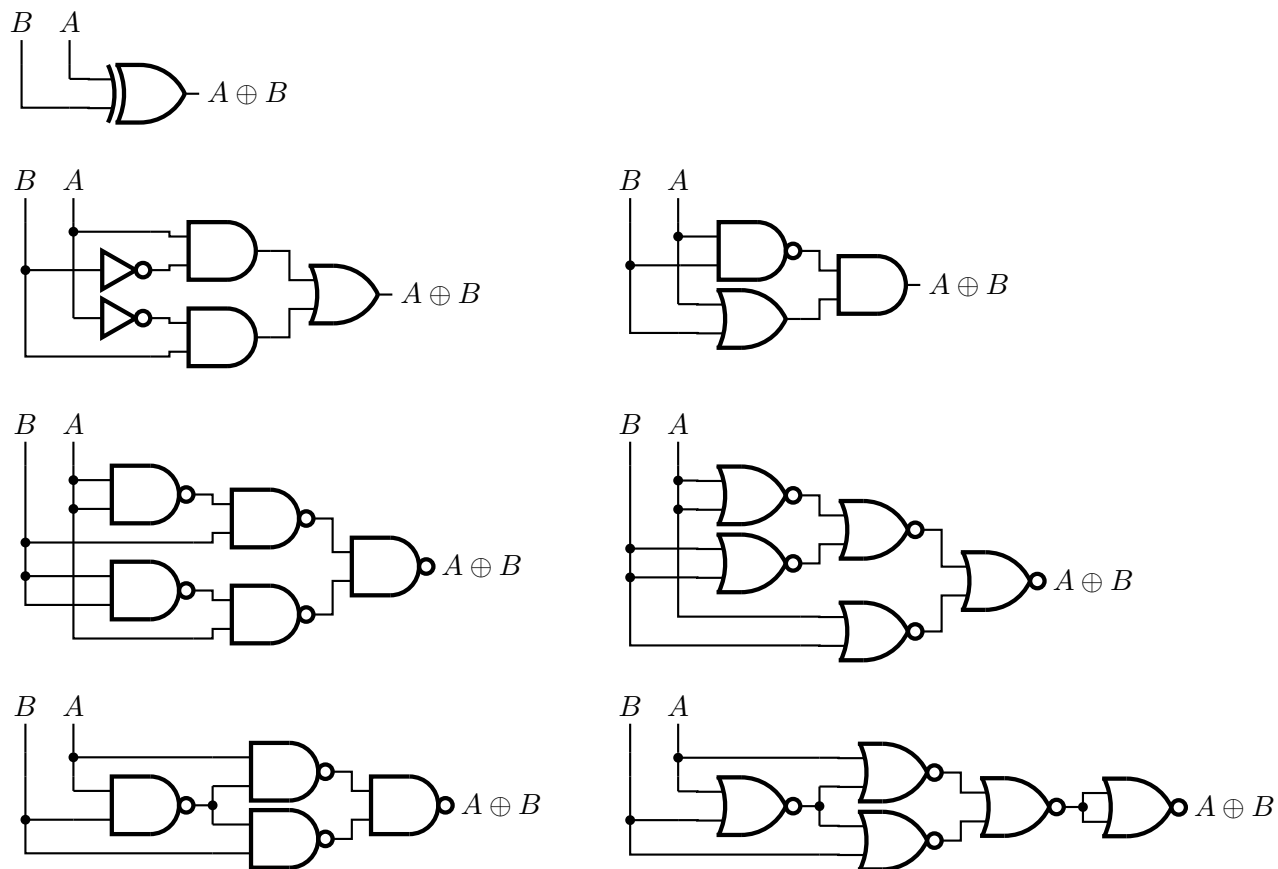


Figure 70: Realizations of the XOR function using Autologix [XOR.m4].

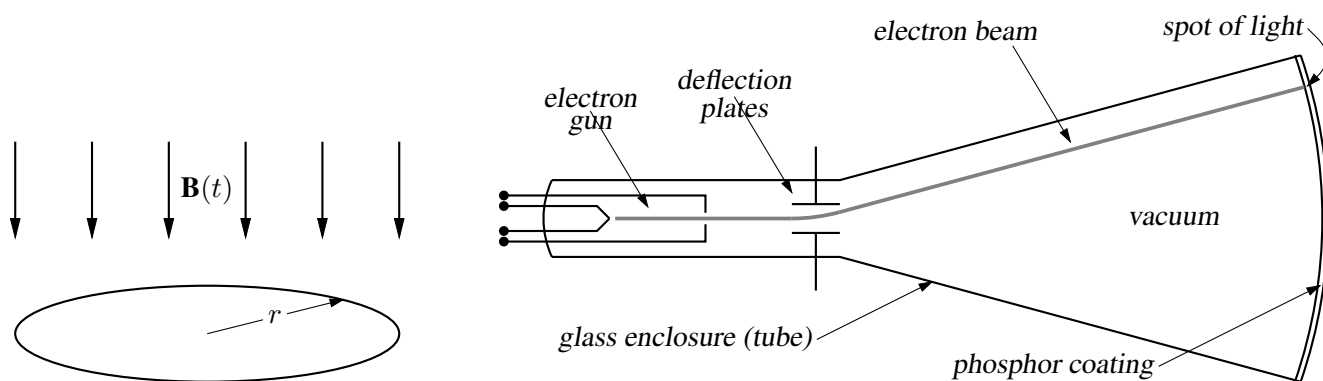


Figure 71: Line diagrams [ex00.m4].



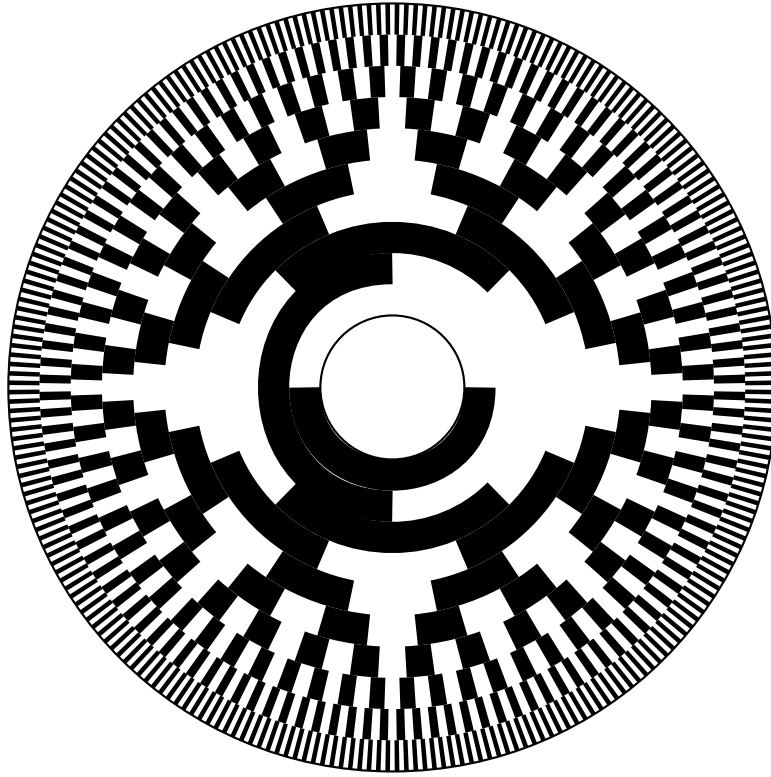


Figure 73: Gray code 10-bit encoder disk pattern [GrayCode.m4].

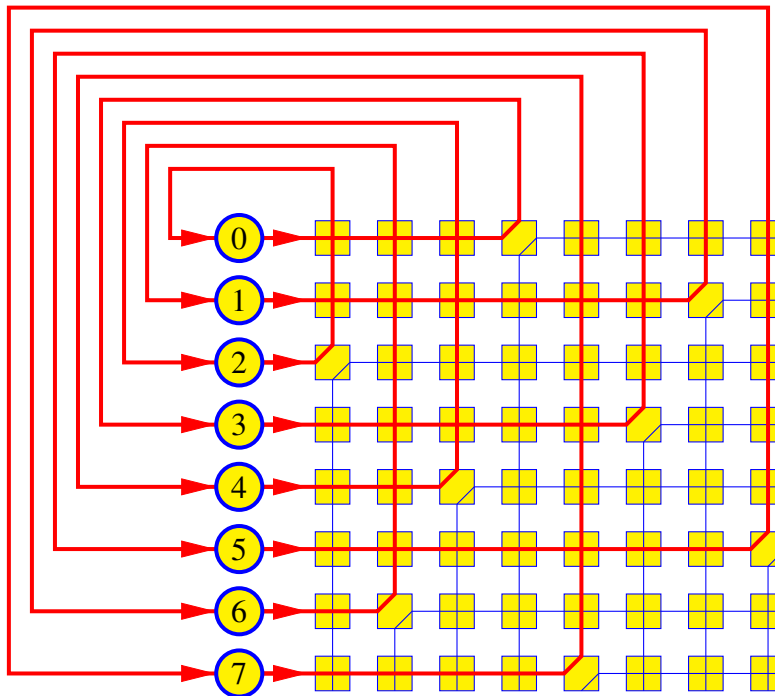


Figure 74: A crossbar switch [Crossbar.m4].

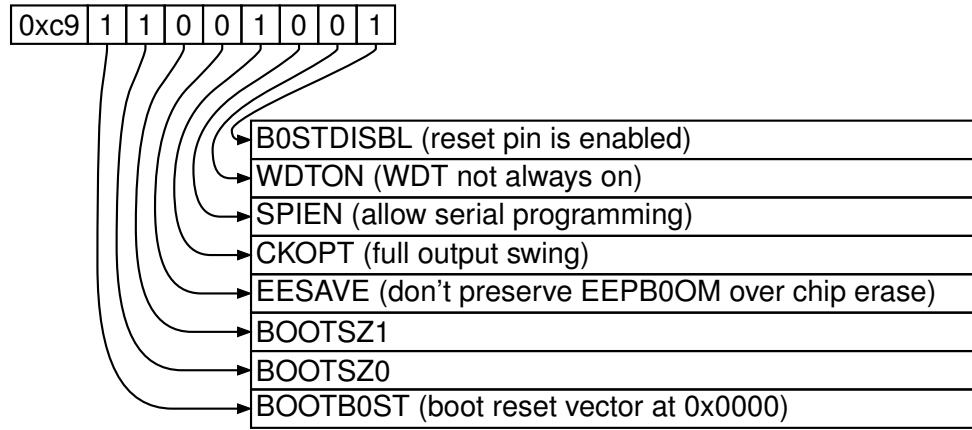


Figure 75: Elementary splines [Byte.m4].

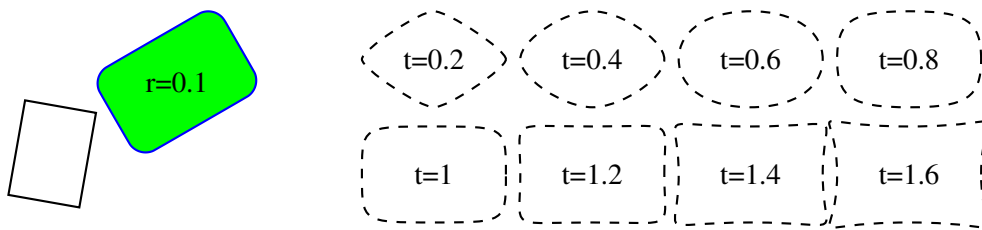


Figure 76: The macro `rotbox (wid,ht,type,[r|t=val])` draws a box in the current direction [Rotbox.m4].

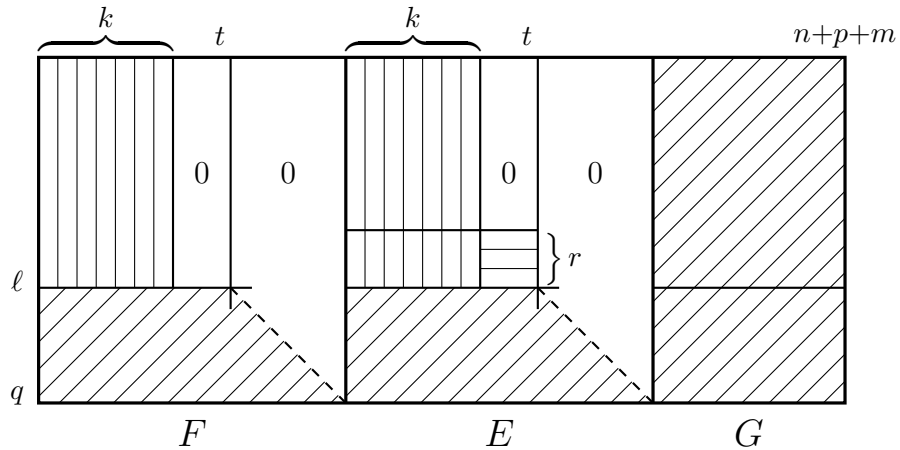
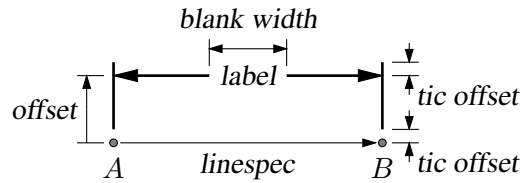
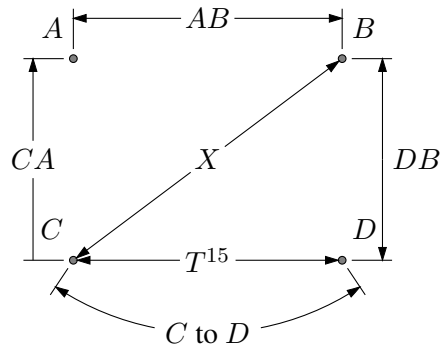
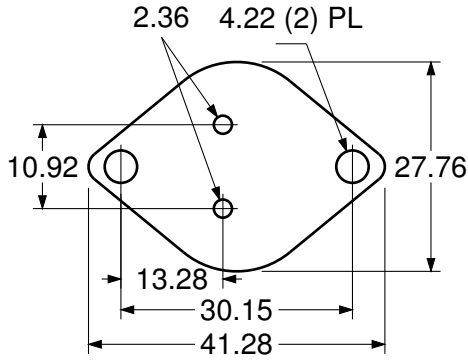


Figure 77: Crosshatching by `for` loops [ex06.m4].



```
dimension_(from A to B,0.3,$AB$,20bp_)
dimension_(from C to B,, $X$,16bp_)
dimension_(from C to A,0.3,$CA$,14bp_,->)
dimension_(from D to B,-0.3,"$DB$" ljust)
dimension_(from C to D,,s_box($T^{%g}$,15),W)
arcdimension_(from C to D with .c at \
0.5 between A and B,12bp_,s_box($C$ to $D$),W)
```

```
dimension_(from A to B,0.5,\sl label,29bp_,0.1)
```

Figure 78: Illustrating the macro `dimension_(linespec, offset, label, D|H|W|blank width, tic offset,<-|->)`. A negative second argument implies an offset to the right of the `linespec` direction. A `label` starting with `"` or `sprintf` is copied literally. If `label` is an `s_box(...)` then setting argument 4 to H, W, or D tailors the blank width to the `s_box` height, width, or diagonal respectively; i.e., W is equivalent to `s_wd+textoffset*2`. The macro `arcdimension_` is similar but the first argument specifies the arc to be dimensioned and the second argument is the outward radial offset of the dimension arrow arc. [ex09.m4].

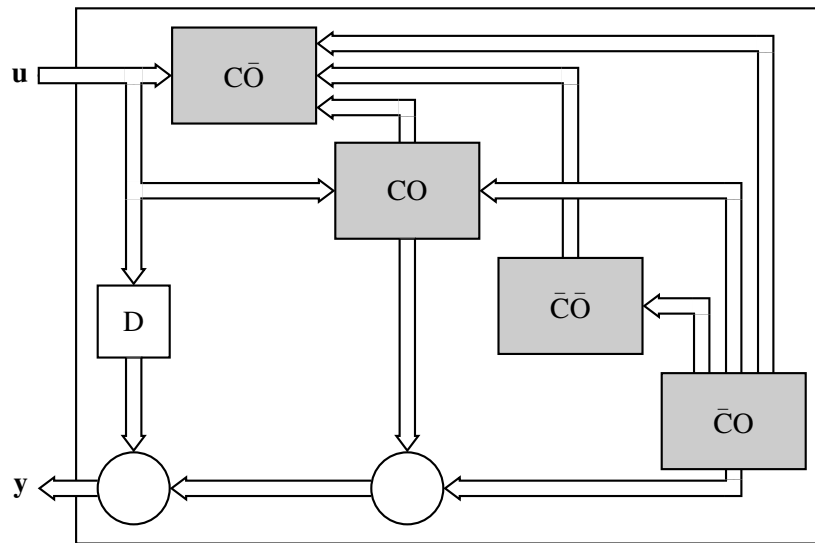


Figure 79: Use of `darrow` [ex05.m4].

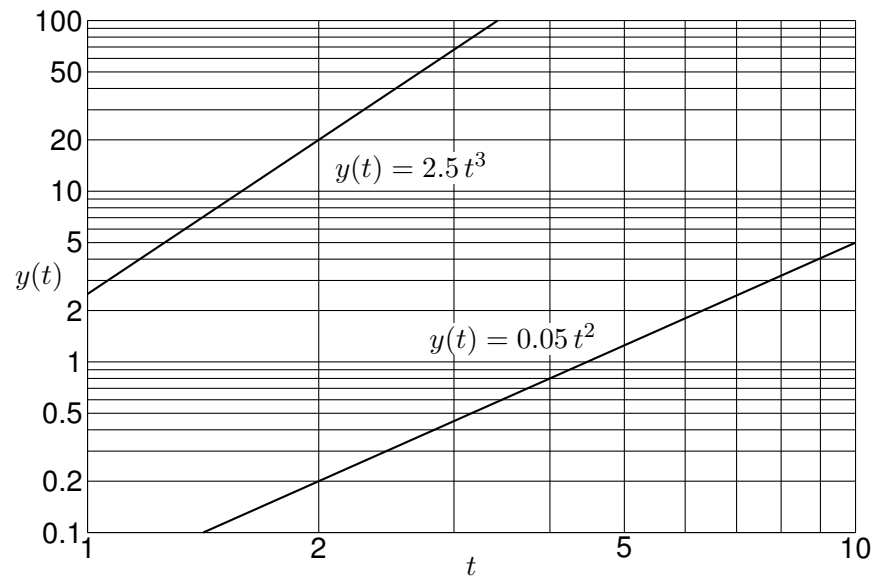


Figure 80: A graph drawn using the pic language [Loglog.m4].

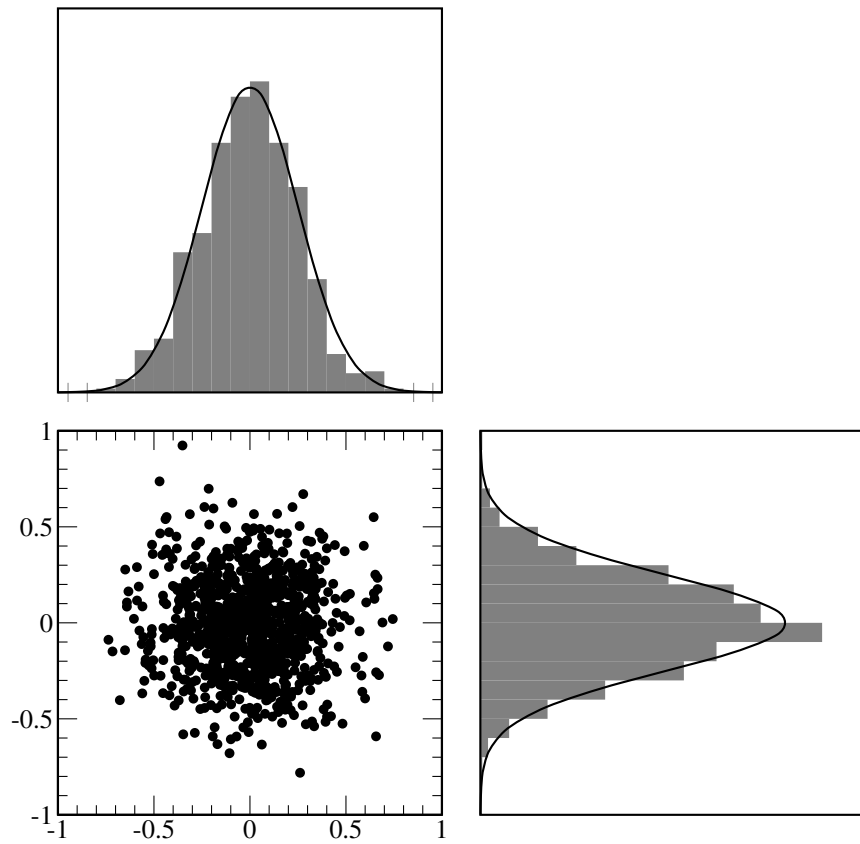


Figure 81: Testing random numbers [random.m4].



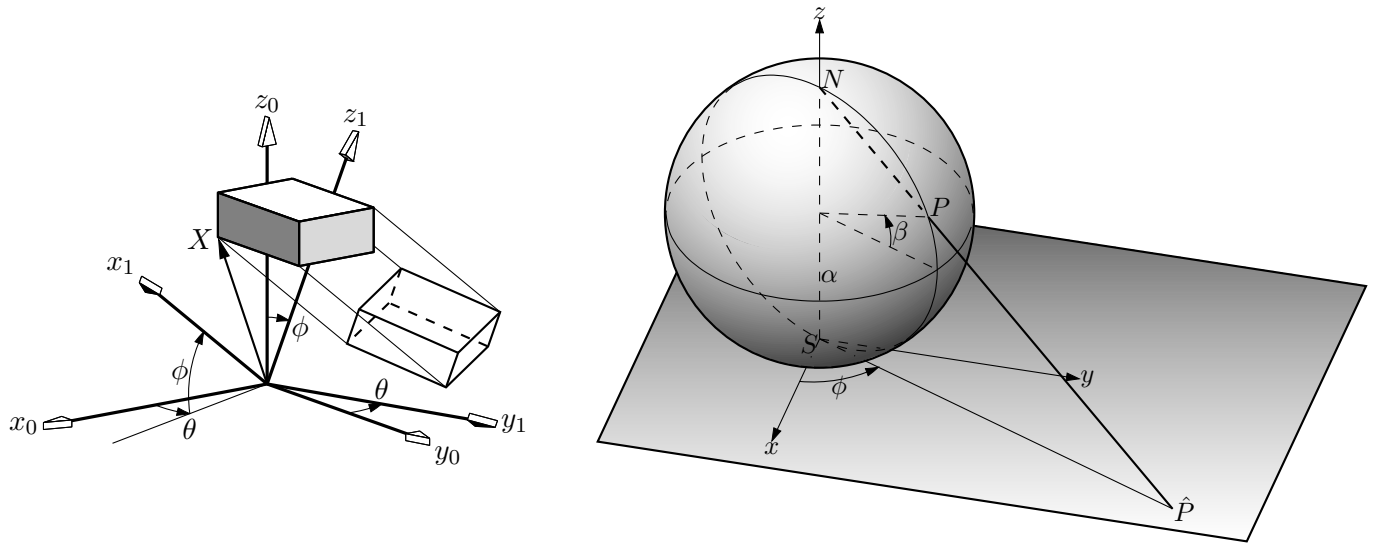


Figure 82: Test of `project` and other `lib3D` macros, showing the projection of a solid onto the  $y_1, z_1$  plane by sighting along the  $x_1$  axis. [`exp.m4`].

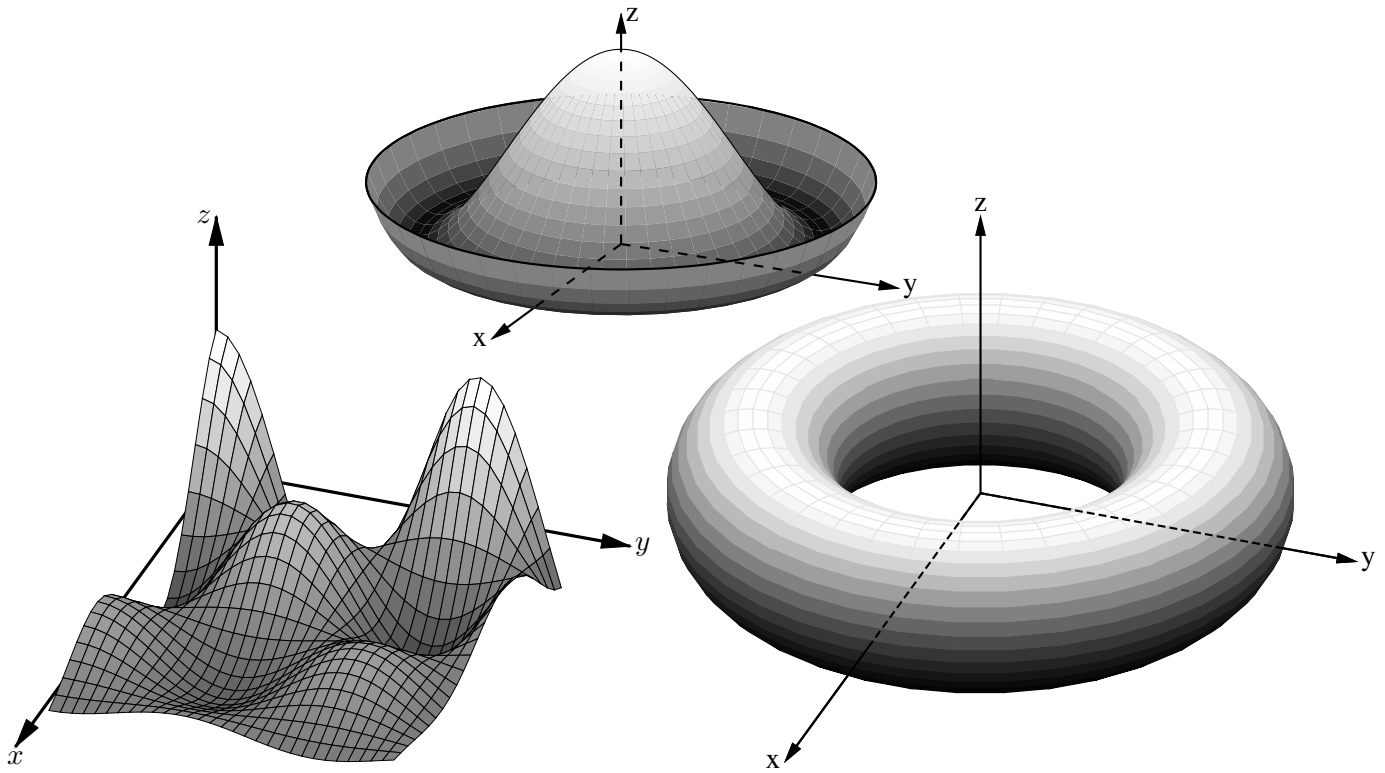


Figure 83: Plotting surfaces using gray scales. A sort algorithm determines plotting order [`graysurf.m4`].

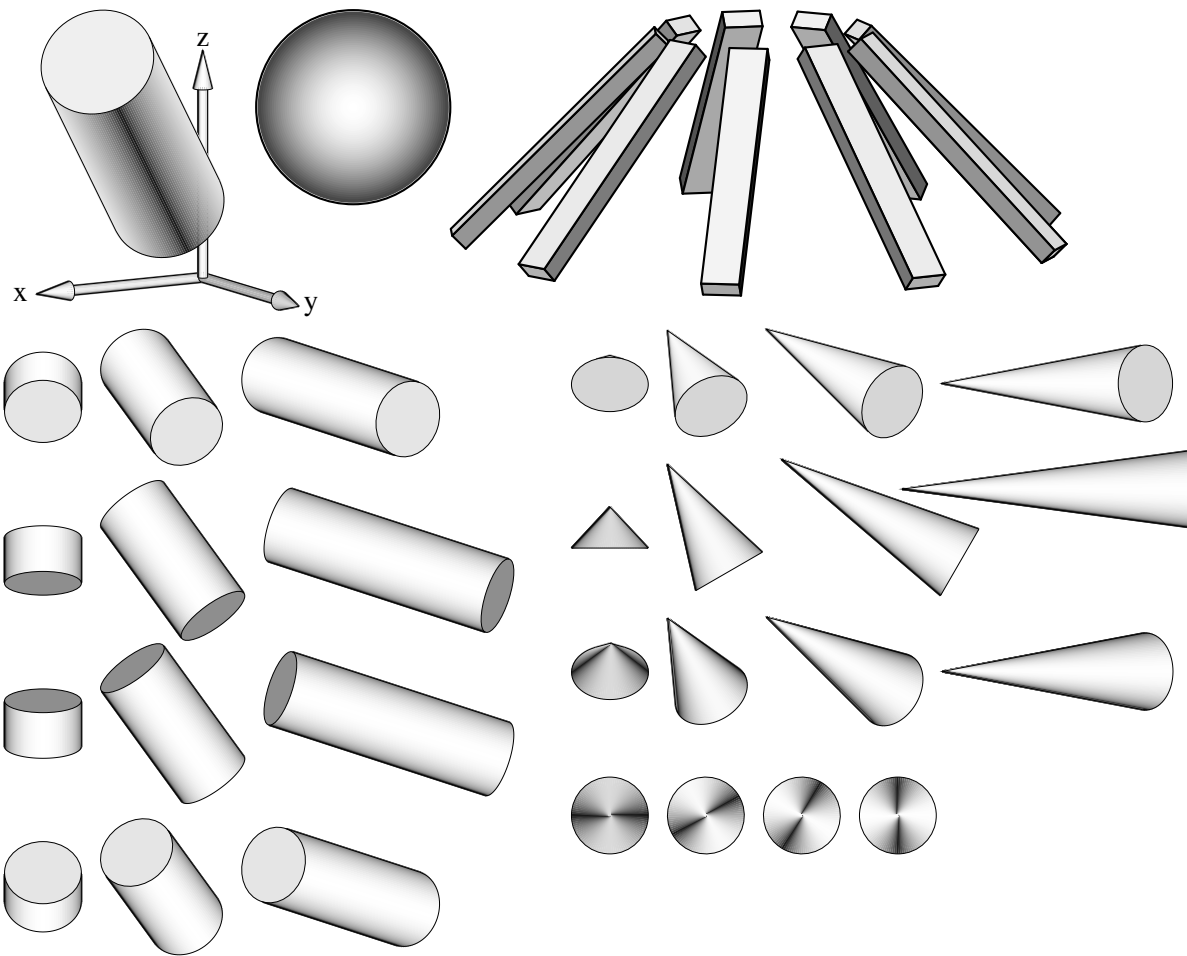


Figure 84: Basic shapes [shapes.m4].

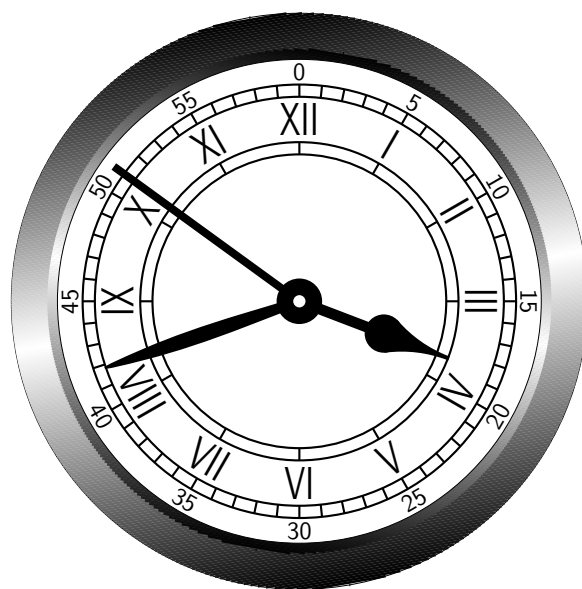


Figure 85: An antique clock face [AntiqueClock.m4].



Figure 86: Conestoga Sailing Club (illustrating the filling of arbitrary shapes) [csc.m4].

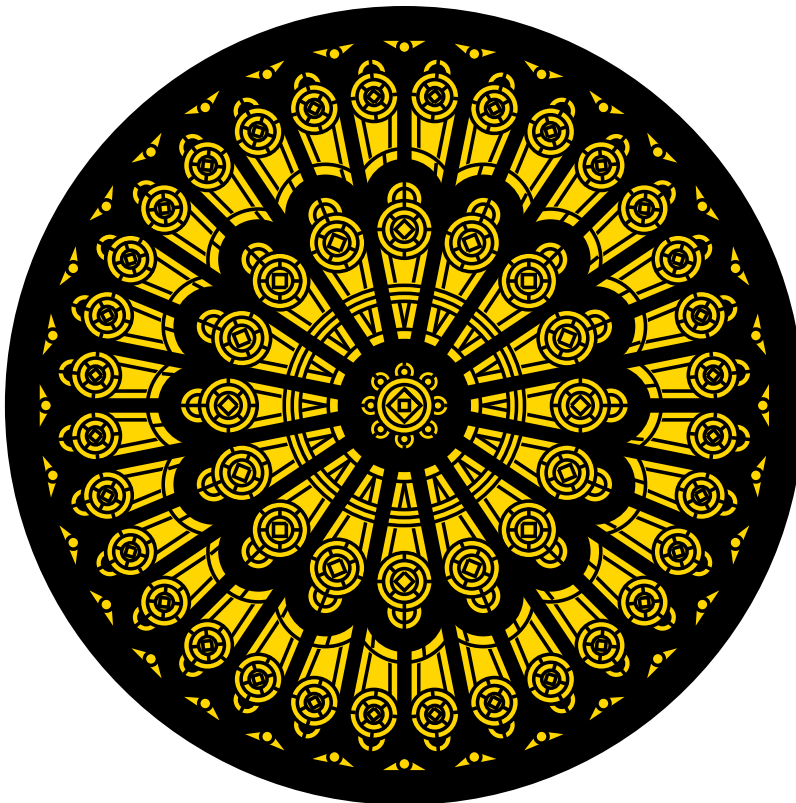


Figure 87: Redrawn from a detail of the set design for the musical *Dracula*, used for testing `dpic`. This diagram consumes much  $\text{\LaTeX}$  main memory but can be produced directly as pdf using `dpic -d`, as svg using `dpic -g`, or as postscript using `dpic -r` since no text formatting is required [rose.m4].

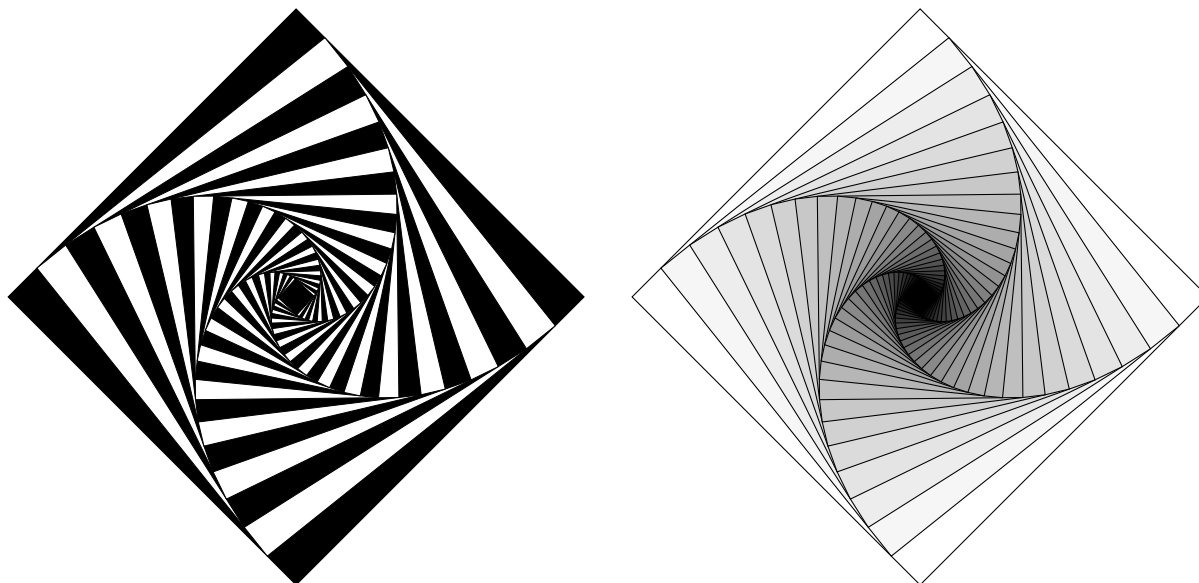


Figure 88: Variations on M. Goossens, S. Rahtz, and F. Mittelbach, *The L<sup>A</sup>T<sub>E</sub>X Graphics Companion*, Addison-Wesley 1997, pp. 57-58 [diamond.m4].

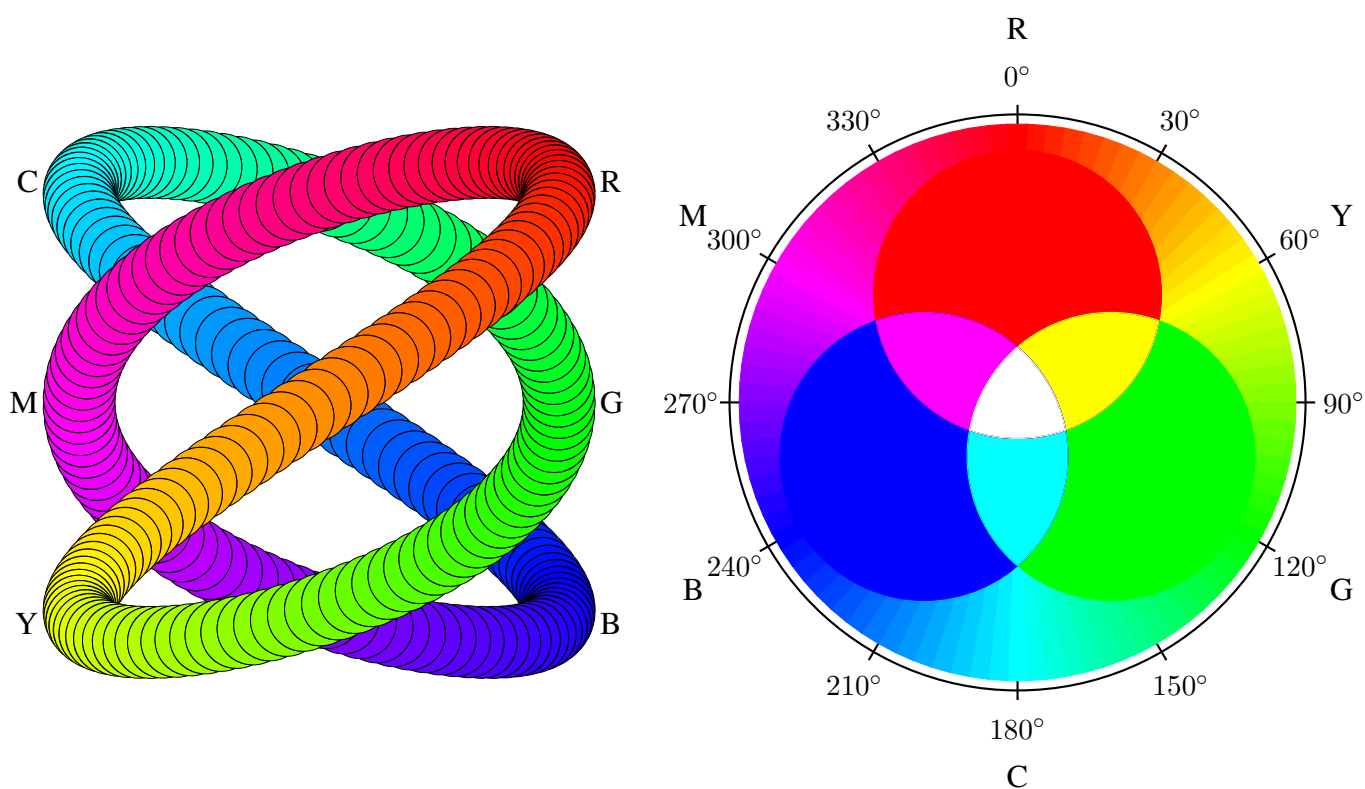


Figure 89: An exercise in calculating RGB colours [worm.m4].

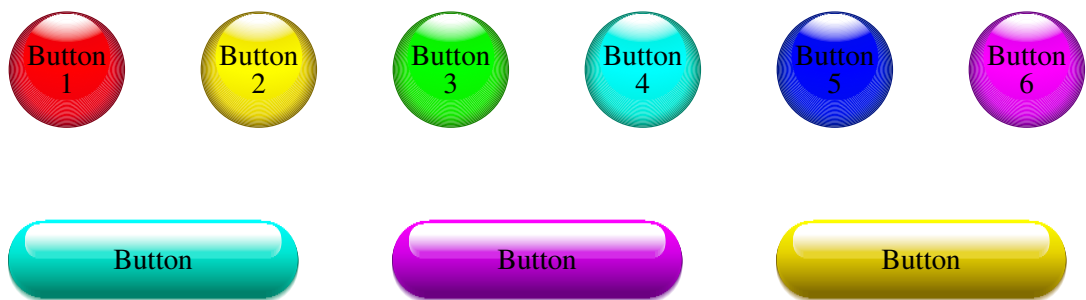


Figure 90: Shading in color [Buttons.m4].

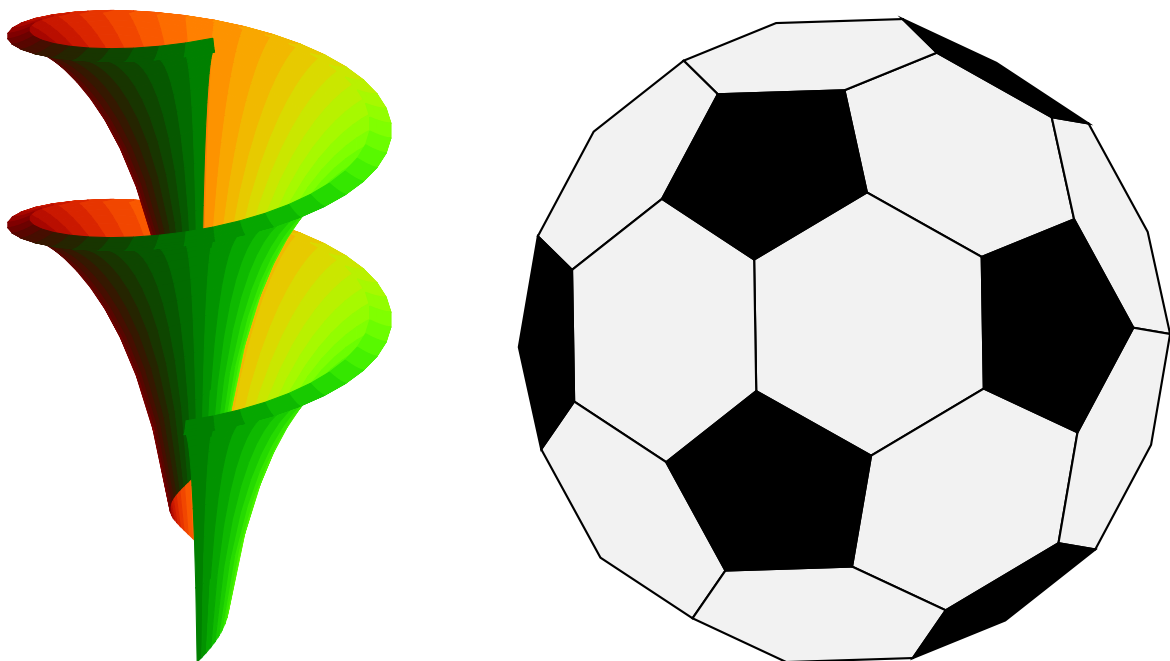


Figure 91: Dini surface and an icosahedron [Dini.m4].

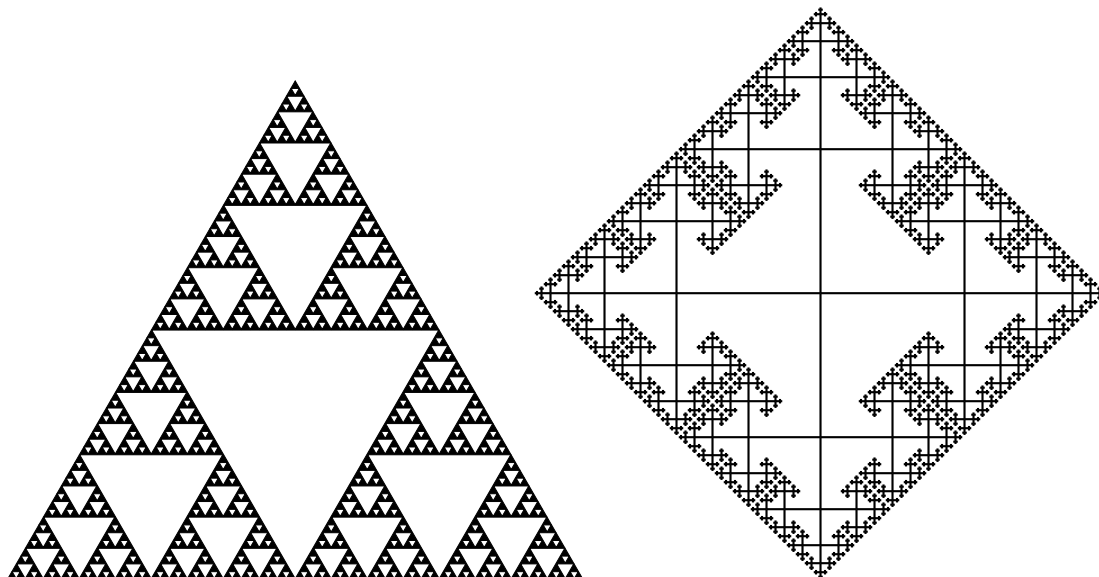


Figure 92: The Sierpinski triangle and a Cayley graph: tests of pic macro recursion [Sierpinski.m4].

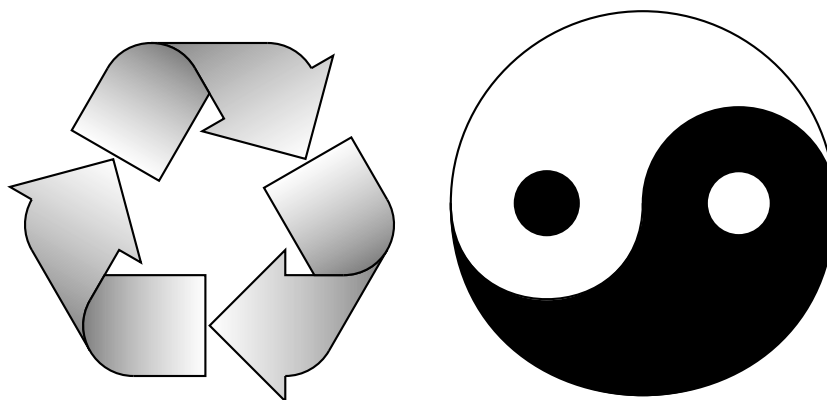


Figure 93: Modest repetition and partial fill [recycle.m4].

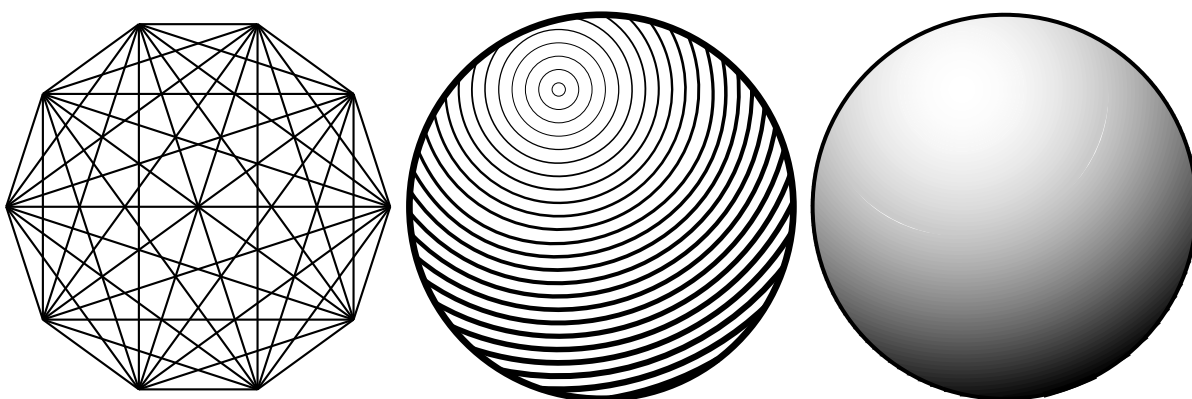


Figure 94: Simple diagrams that are easily drawn by looping [ex15.m4].

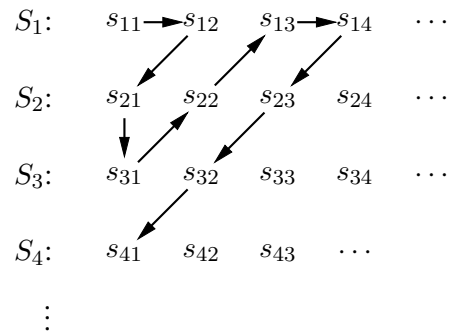


Figure 95: An example of enumeration [Counting.m4].

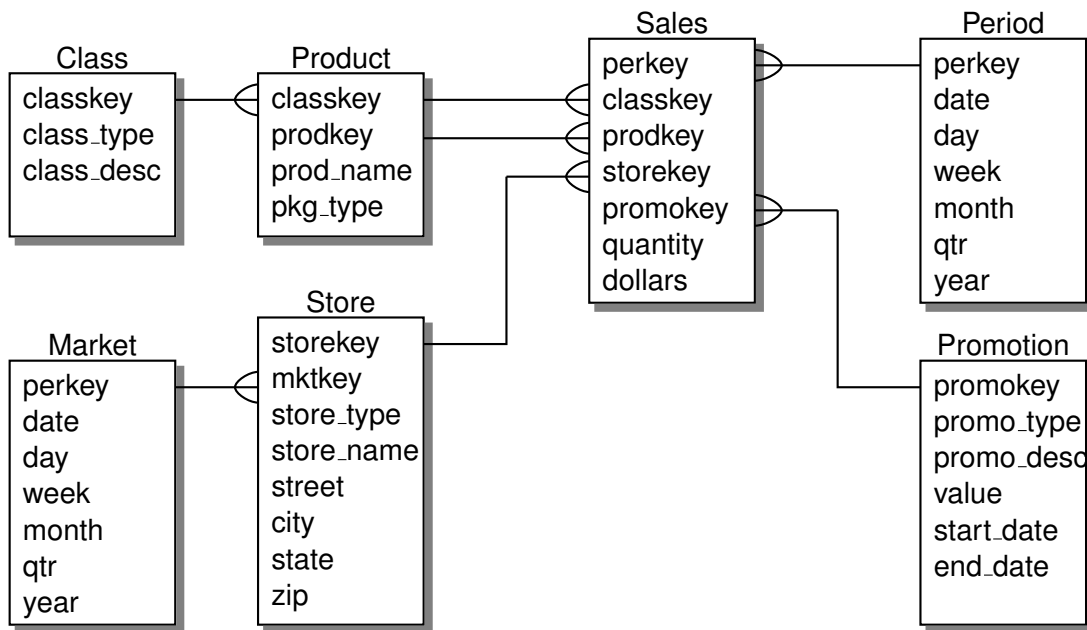


Figure 96: Illustrating shadebox and a custom crowfoot line termination [Crow.m4].

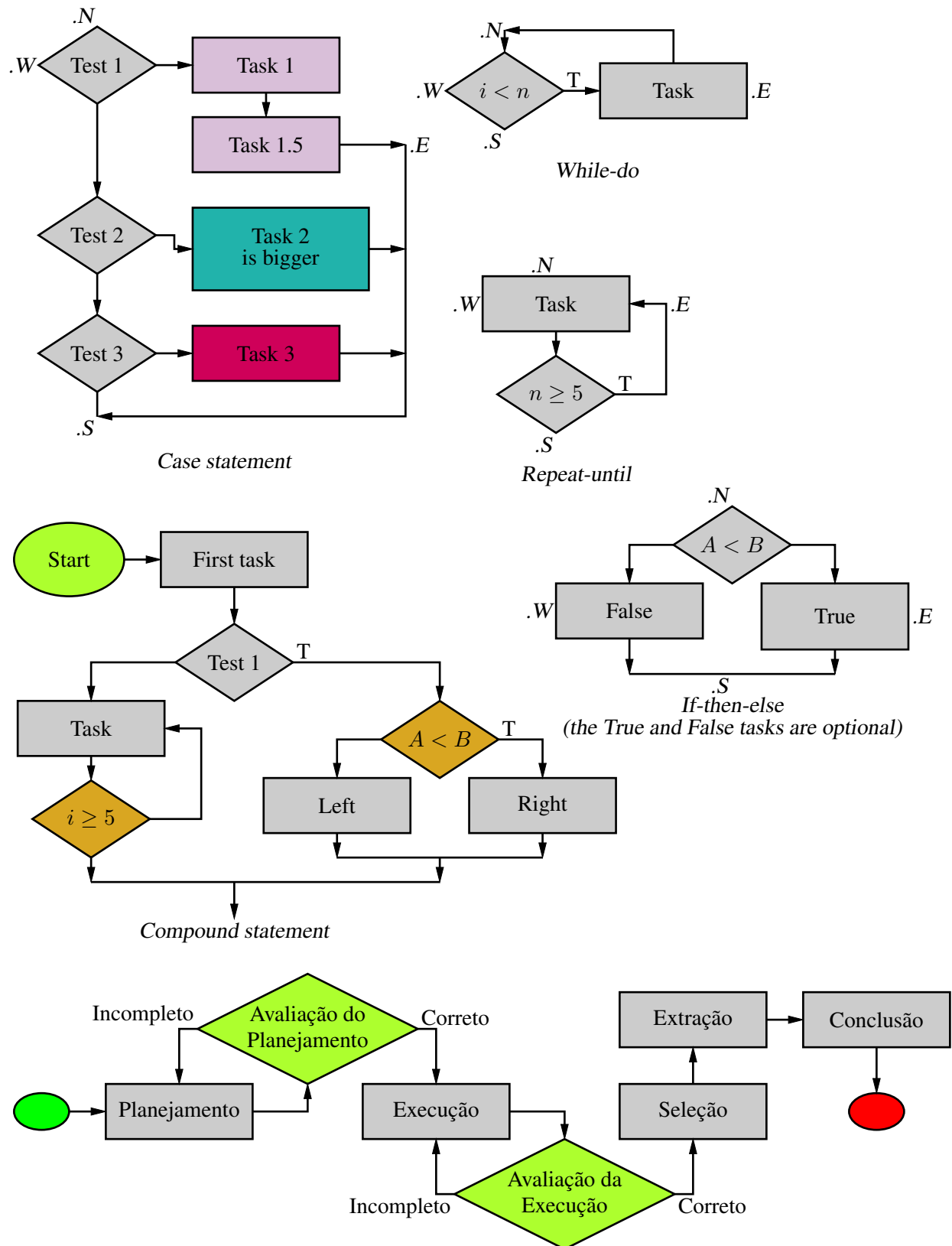


Figure 97: A flowchart sampler [Flow.m4].



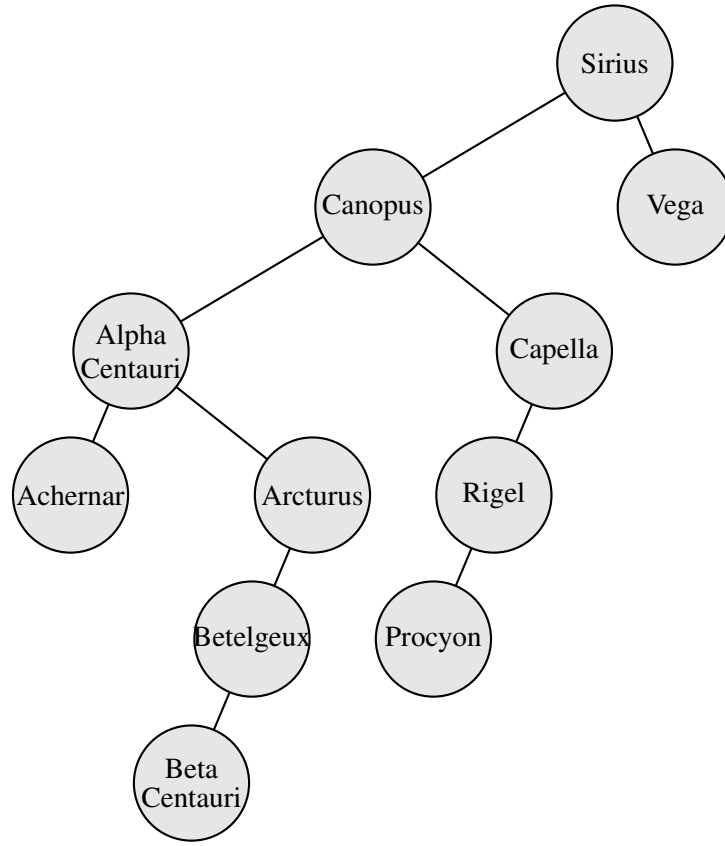


Figure 98: A binary tree [Btree.m4].

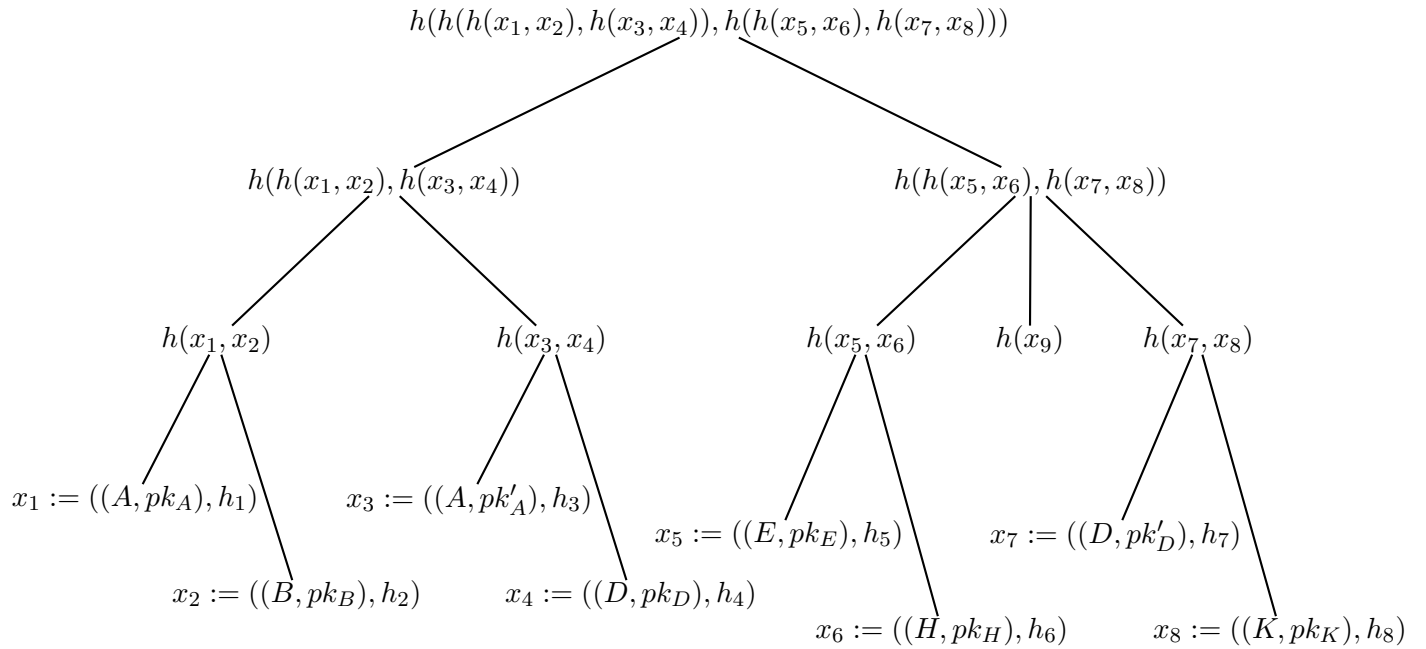


Figure 99: Another tree [Ttree.m4].



Figure 100: Overlaying a figure with line graphics [Incleps.m4].