Examples: Version 8.0

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, which has meant that sometimes the source is slightly more complicated than it would be if only one processor had been assumed. The possibility of multiple postprocessors also complicates a few of the source files. The most simplicity and elegance is achieved by sticking to one pic interpreter and one postprocessor.

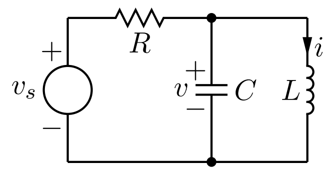


Figure 1: The quick-start example from the manual `[quick.m4]`.

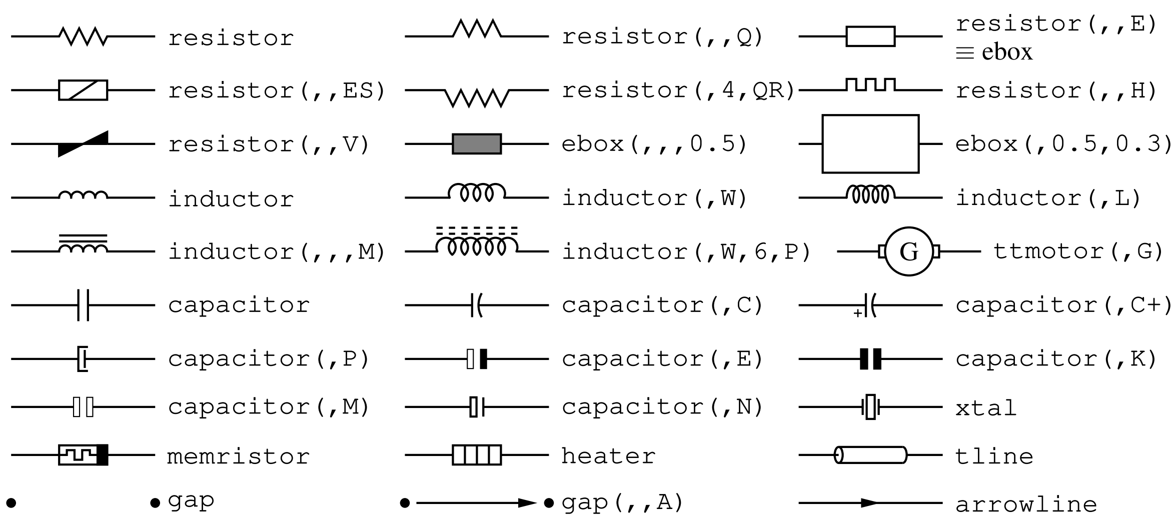


Figure 2: Two-terminal elements, showing some variations `[CctTable.m4]`.

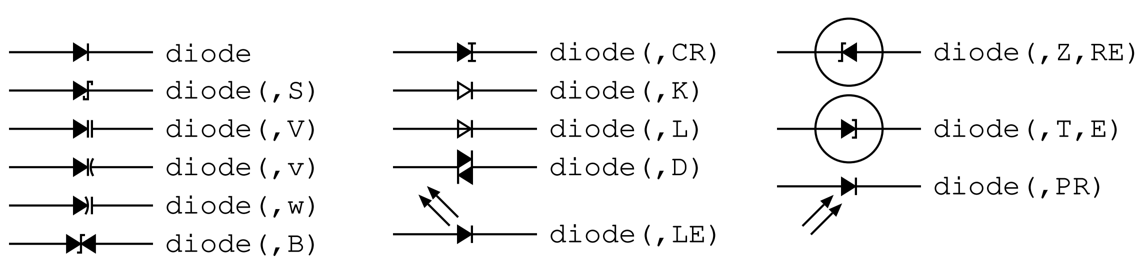


Figure 3: Diodes `[Diodes.m4]`.

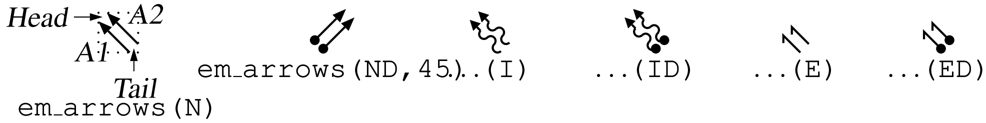


Figure 4: Radiation arrows [Emarrows.m4].

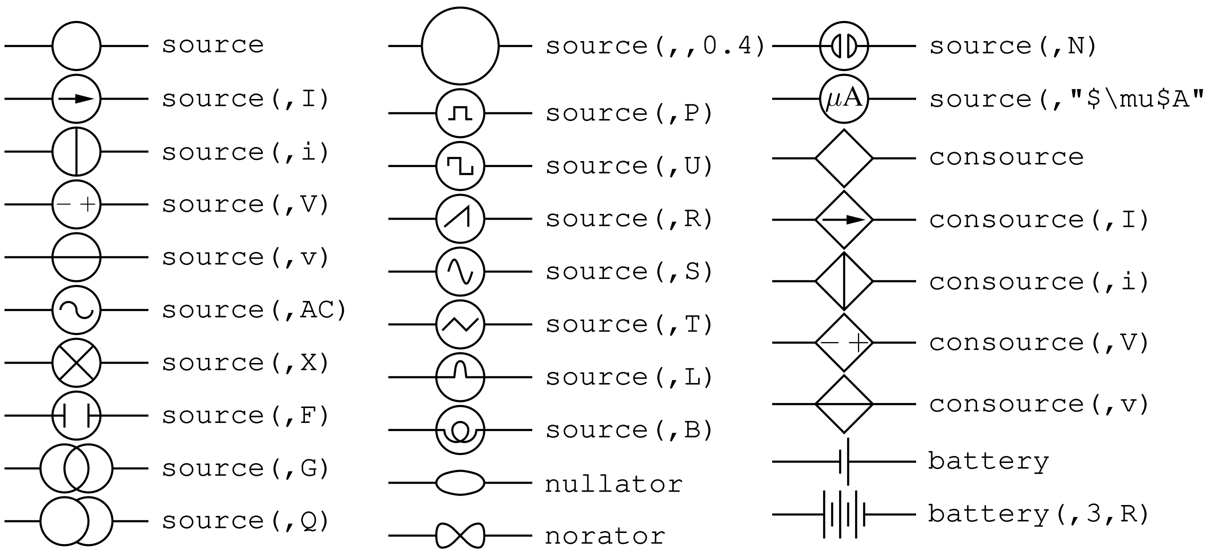


Figure 5: Sources and source-like elements [Sources.m4].

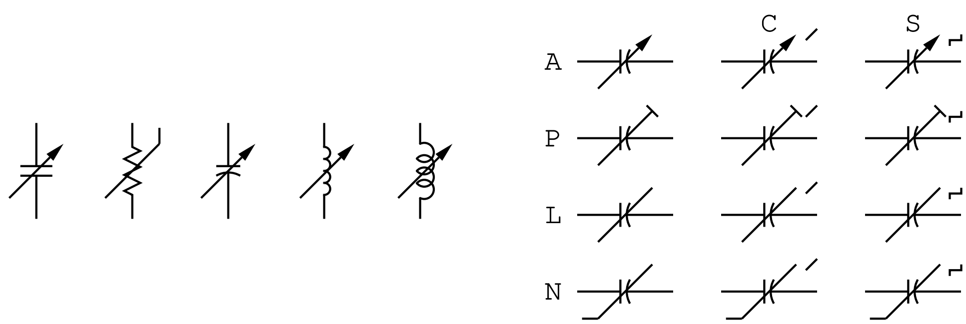


Figure 6: Arrows and marks indicating variability [Variable.m4].

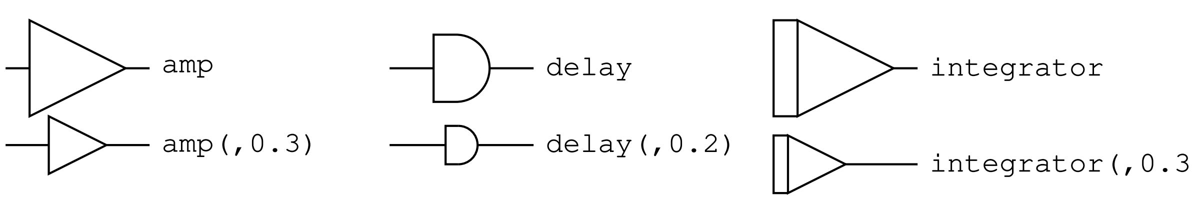


Figure 7: Macros amp, delay, and integrator [AmpTable.m4].

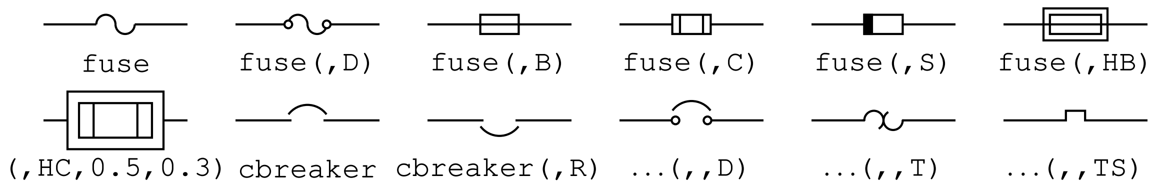


Figure 8: Macros `fuse` and `cbreaker` `[Fuses.m4]`.

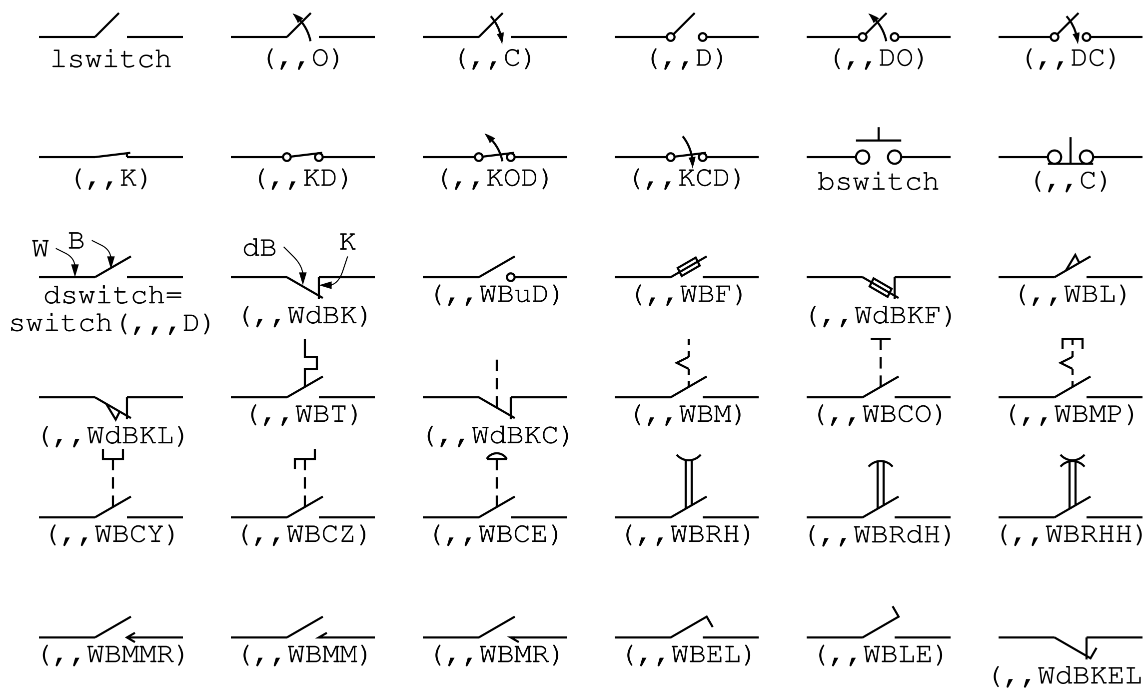


Figure 9: The switch macros; `switch(,,,L|B|D)` is a wrapper for `lswitch`, `bswitch`, and `dswitch` `[Switches.m4]`.

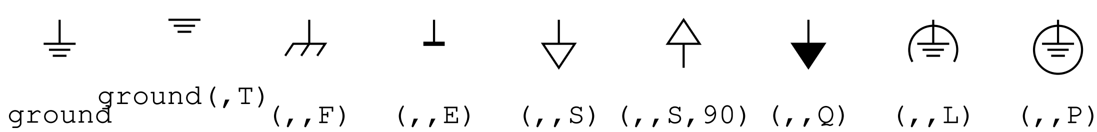


Figure 10: Ground symbols `[Grounds.m4]`.

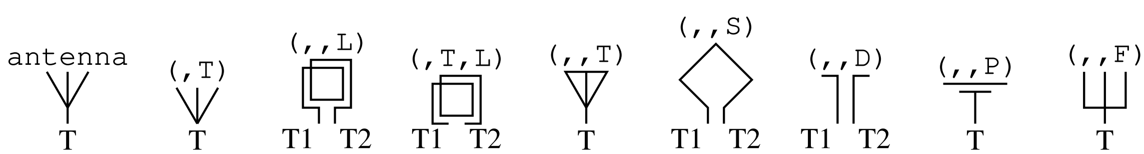


Figure 11: Antenna symbols `[Antennas.m4]`.

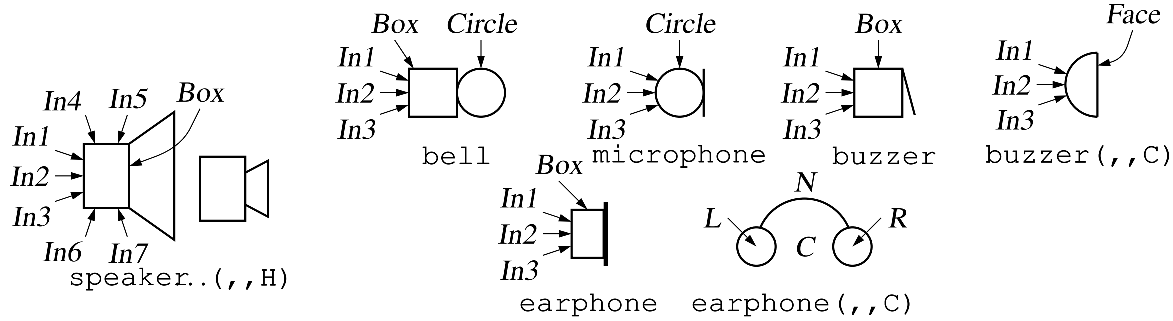


Figure 12: Audio elements [Audio.m4].

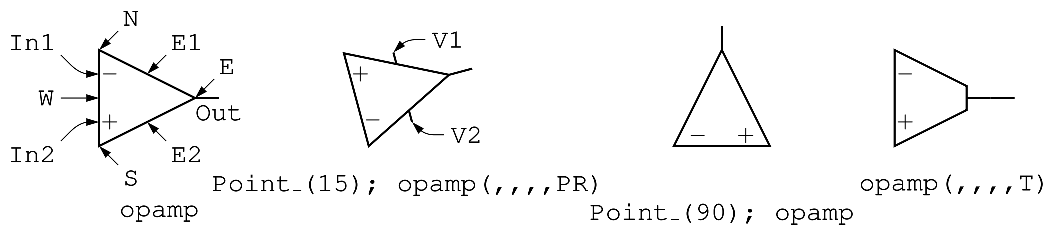


Figure 13: The opamp [Opamp.m4].

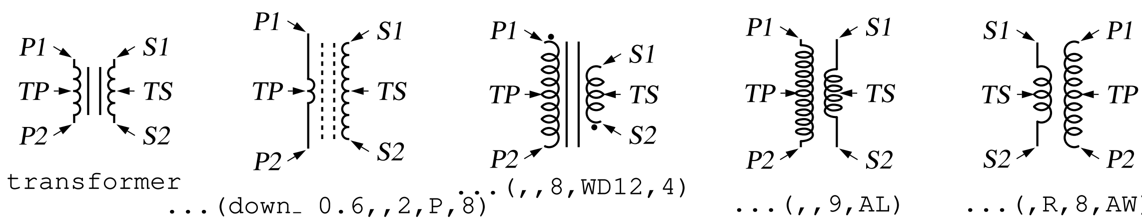


Figure 14: The transformer element, drawing direction down [Xform.m4].

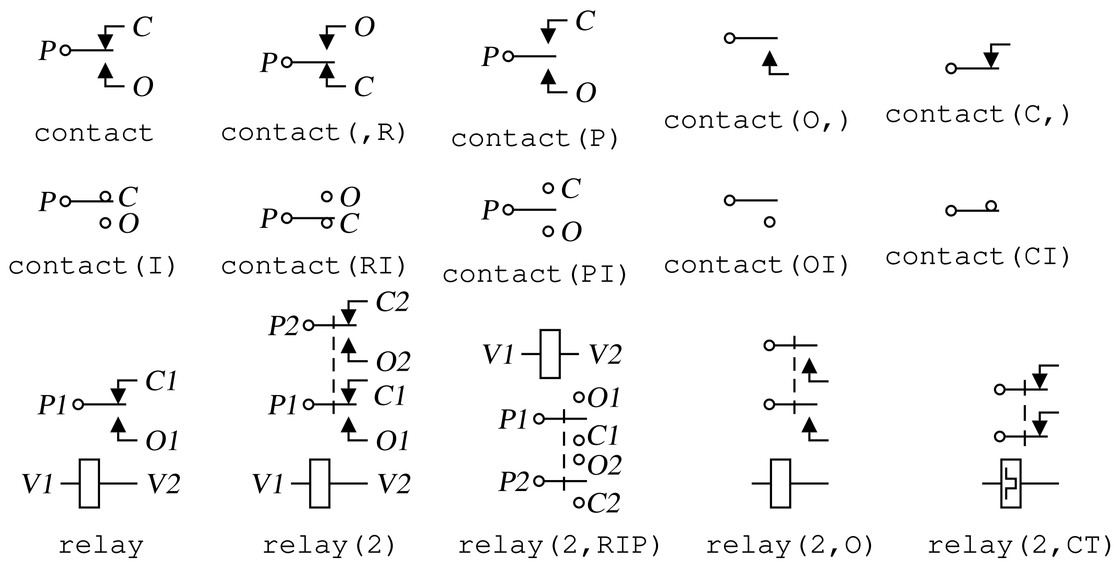


Figure 15: The contact and relay macros [Relay.m4].

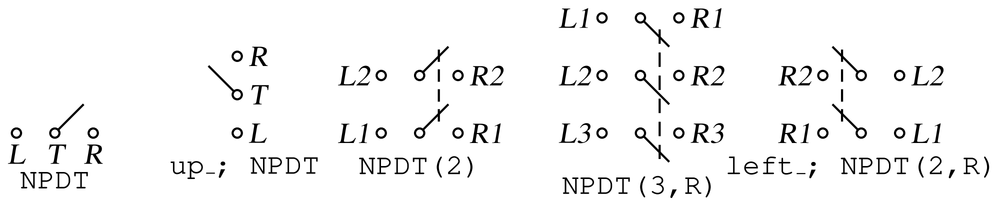


Figure 16: Double throw with the `NPDT` macro `[NPDT.m4]`.

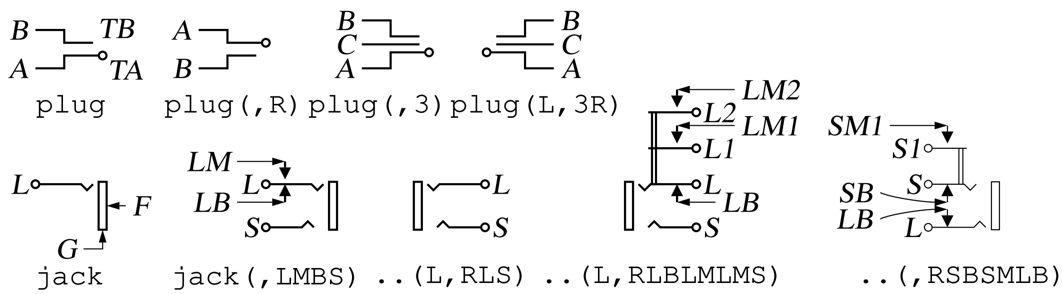


Figure 17: The `jack` and `plug` macros `[Jack.m4]`.

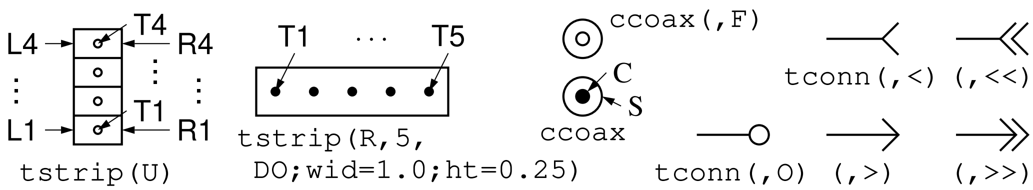


Figure 18: The `tstrip` and `ccoax` macros `[Conn.m4]`.

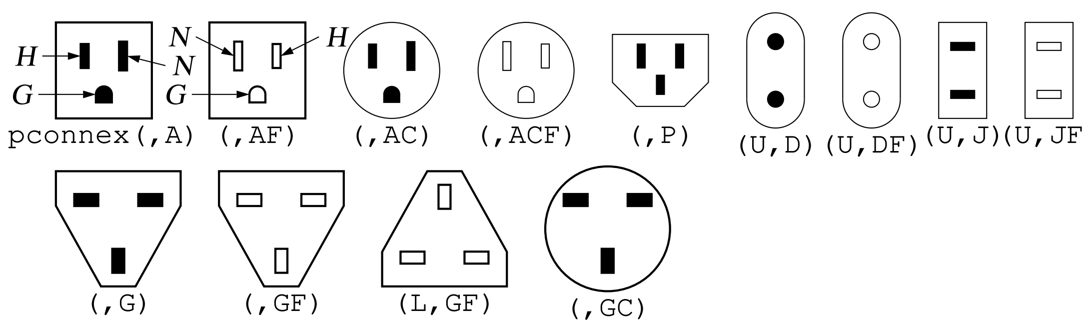


Figure 19: The `pconnex` macro `[Pconn.m4]`.

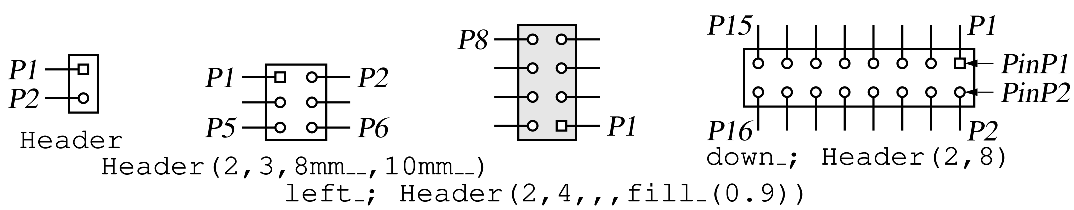


Figure 20: The `Header` macro `[Headers.m4]`.

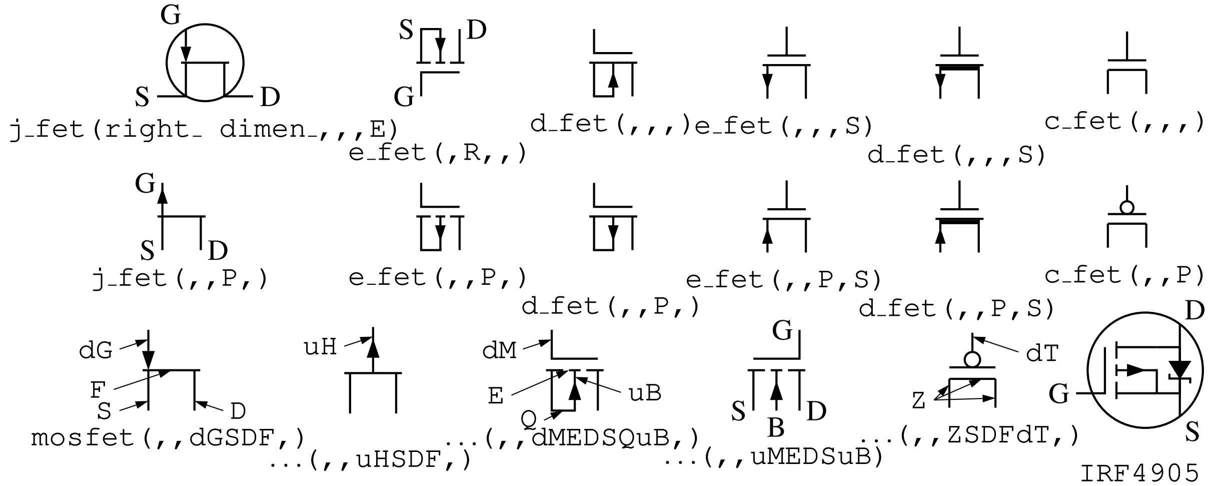


Figure 21: FETs, showing programmable components and example customizations [fet.m4].

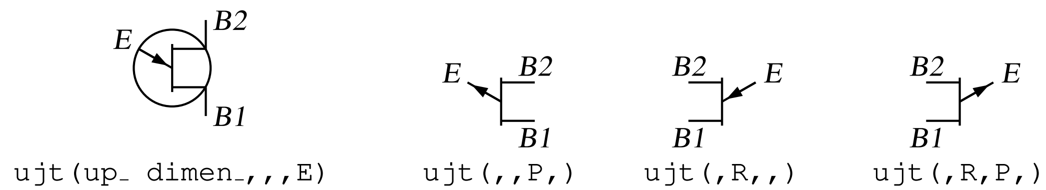


Figure 22: UJT examples [ujt.m4].

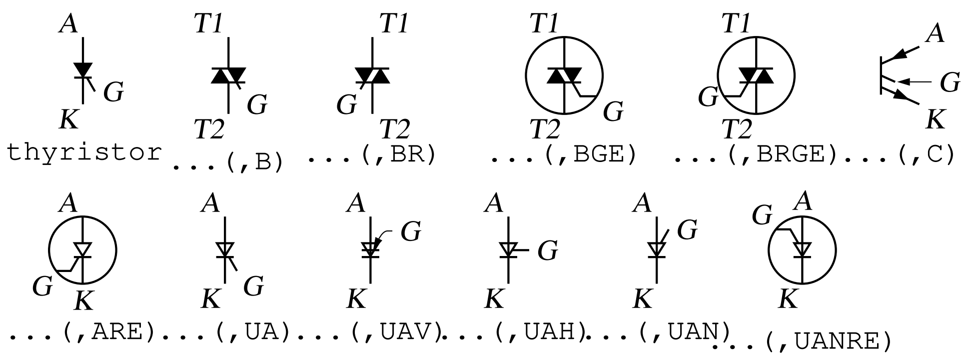


Figure 23: Thyristor examples [thyristor.m4].

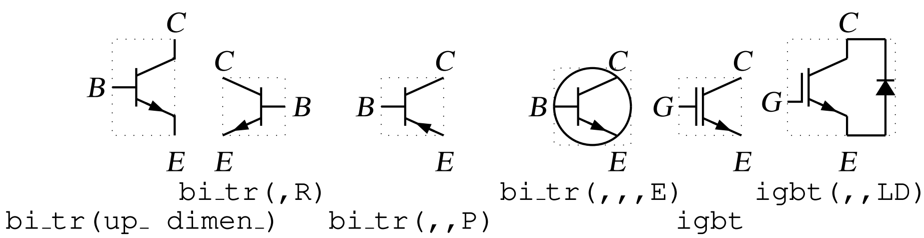


Figure 24: Bipolar transistors (drawing direction: up) [Bip.m4].

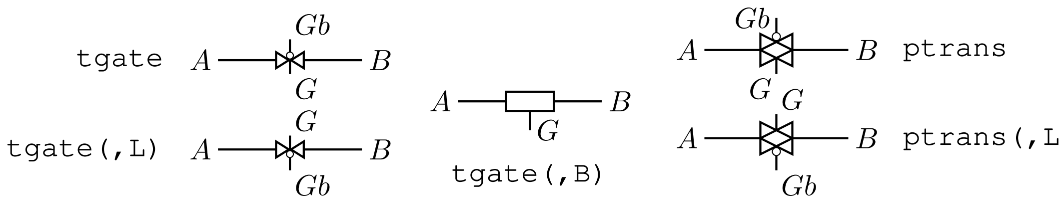


Figure 25: The `tgate` and `ptrans` elements [`Tgate.m4`].

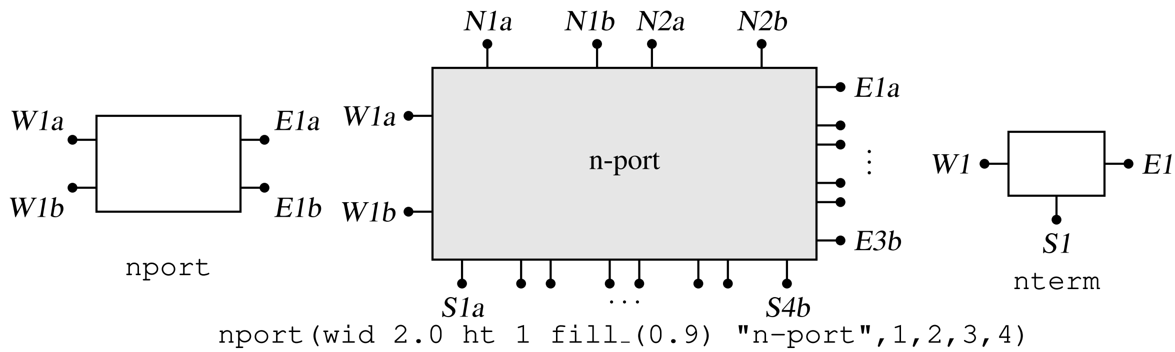


Figure 26: The `nport` and `nterm` macros [`Nport.m4`].

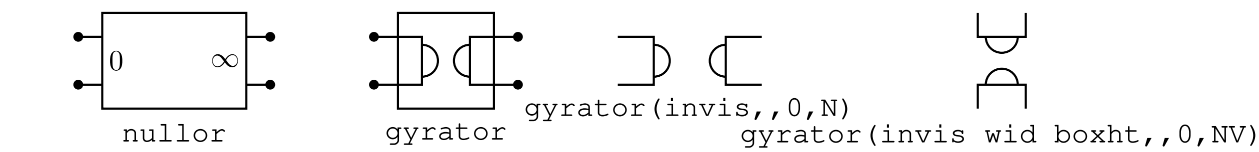


Figure 27: Some customizations of `nport` [`NLG.m4`].

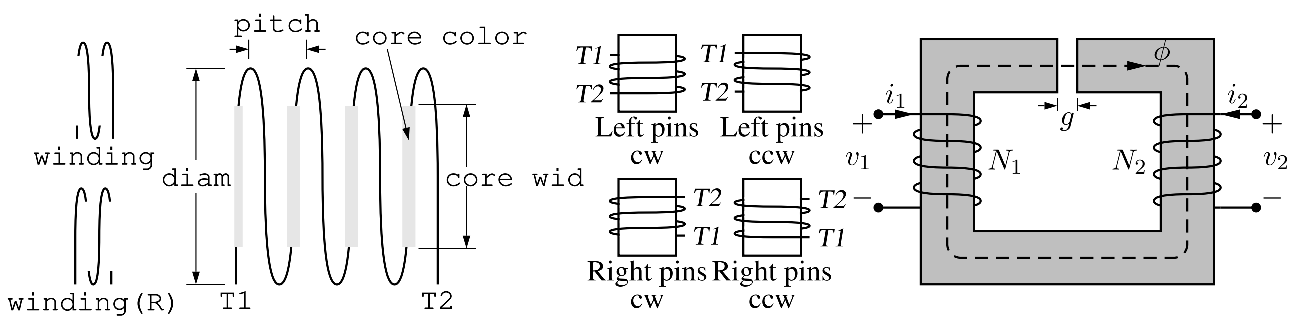


Figure 28: The macro `winding(L|R,diam,pitch,turns,core wid,core color)` [`Windings.m4`].

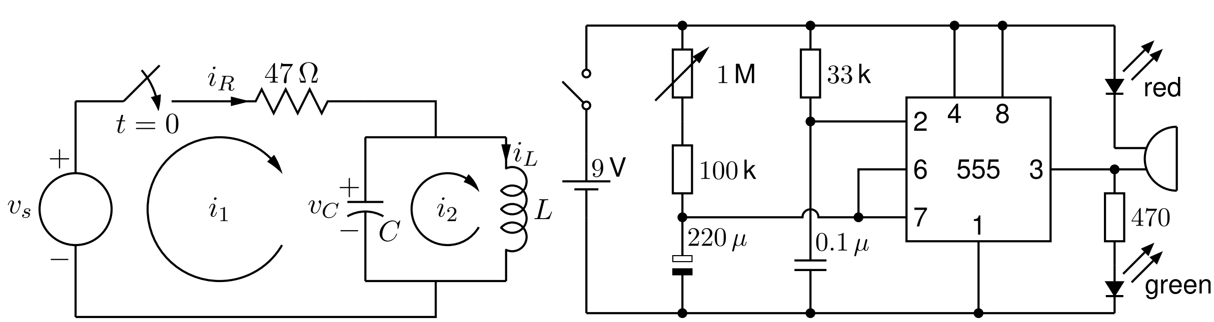


Figure 29: Two simple labeled circuits [`ex01.m4`] [`Timer.m4`].

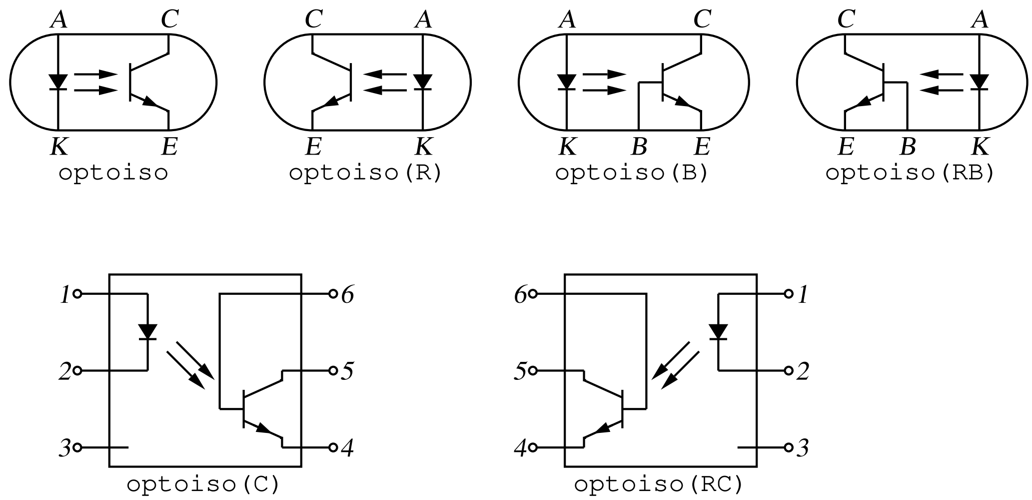


Figure 30: Optical isolator: a circuit with right or left orientation `[Optoiso.m4]`.

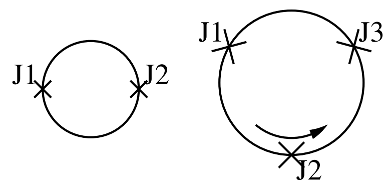


Figure 31: Superconducting quantum interface device (drawing direction down) `[SQUID.m4]`.

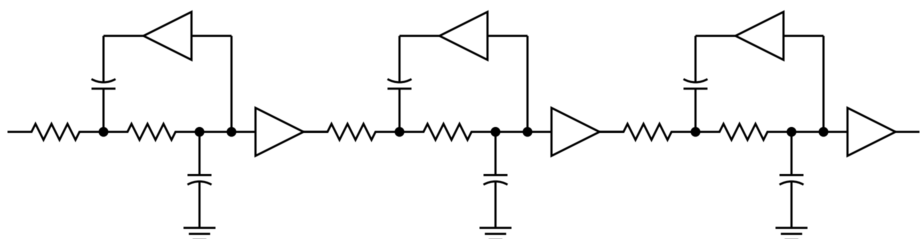


Figure 32: A six-pole filter `[Sixpole.m4]`.

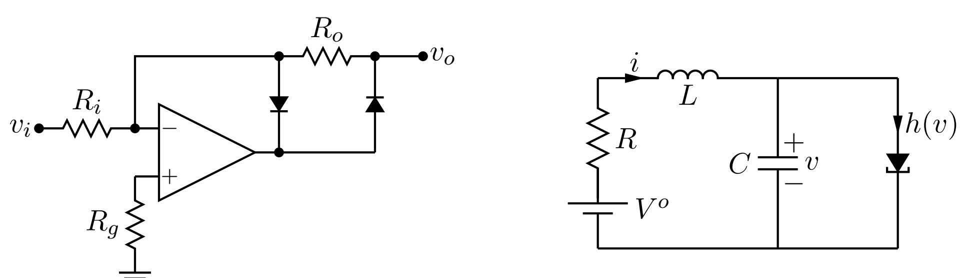


Figure 33: Precision half-wave rectifier and a tunnel diode circuit (illustrating `opamp`, `diode`, `resistor`, `ground`, and labels) `[ex18.m4][ex19.m4]`.

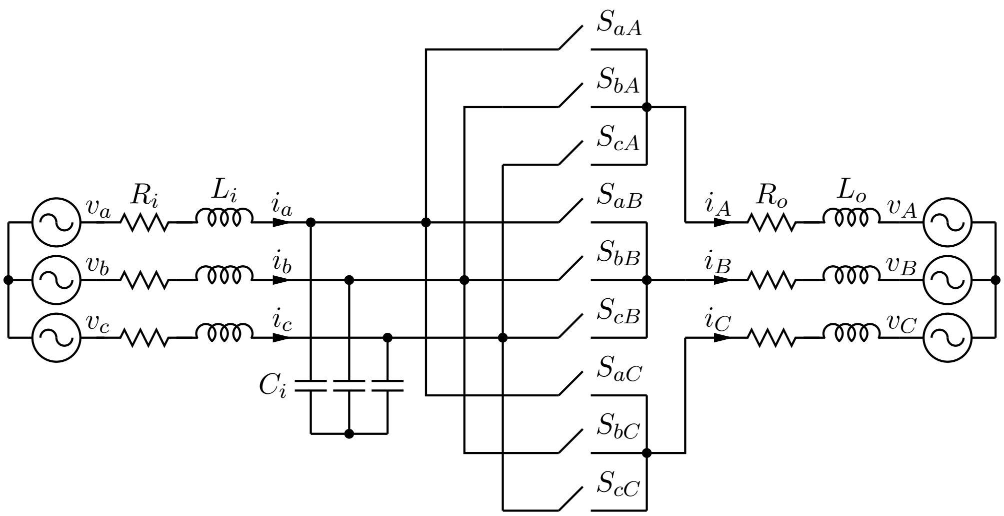


Figure 34: A three-phase switched AC-AC converter `[MC.m4]`.

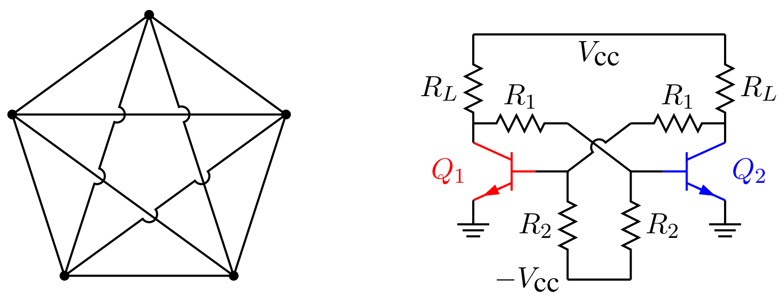


Figure 35: Non-planar graph and bistable circuit (illustrating the `crossover` macro and colored elements) `[ex10.m4][bistable.m4]`.

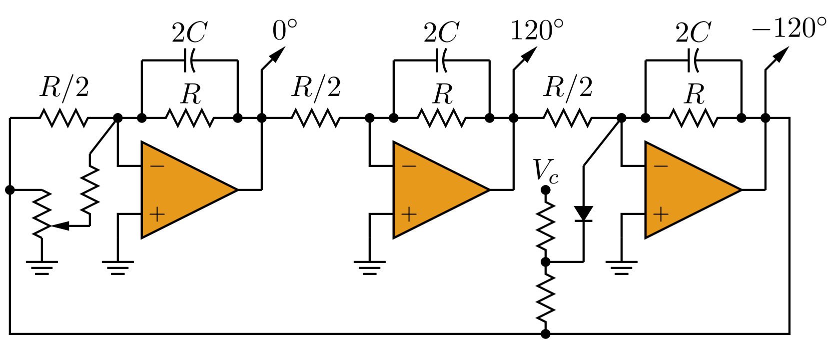


Figure 36: Three-phase oscillator `[Three.m4]`.

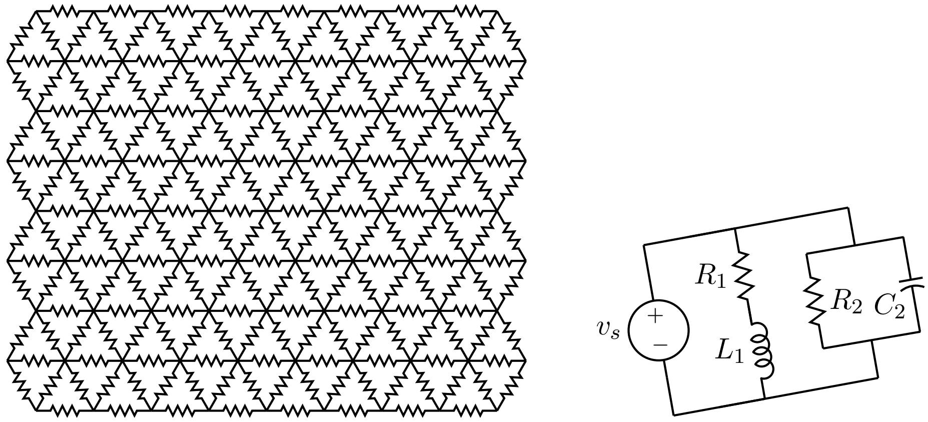


Figure 37: A repetitive network created by Pic looping and a skewed circuit used to test the macro `gpar_(`*element*, *element*, *separation*`)` `[ex17.m4]`.

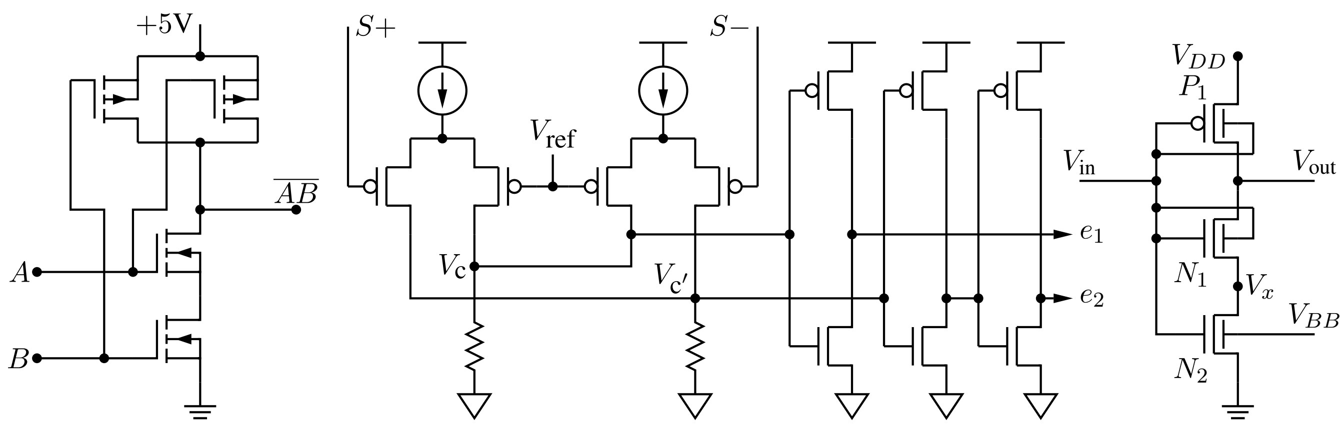


Figure 38: A CMOS NAND gate, a test circuit, and an XMOSFET example `[ex12.m4]`.

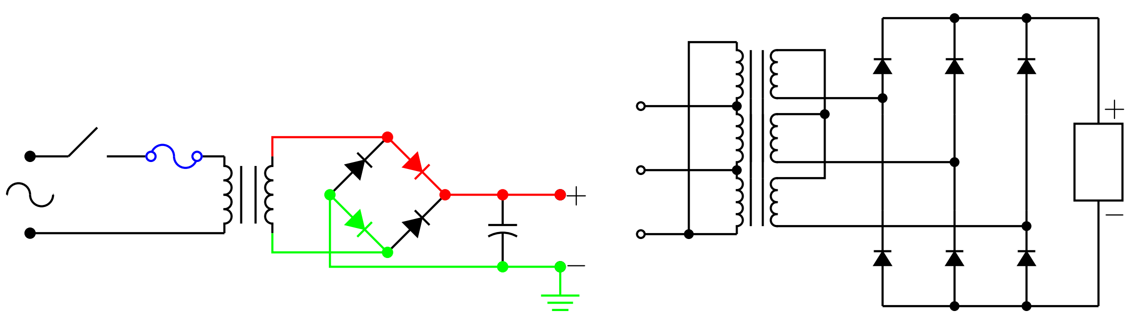


Figure 39: An elementary power supply circuit with colored elements, and a multiple-winding transformer with 3-phase rectifier `[pwrsupply.m4]`.

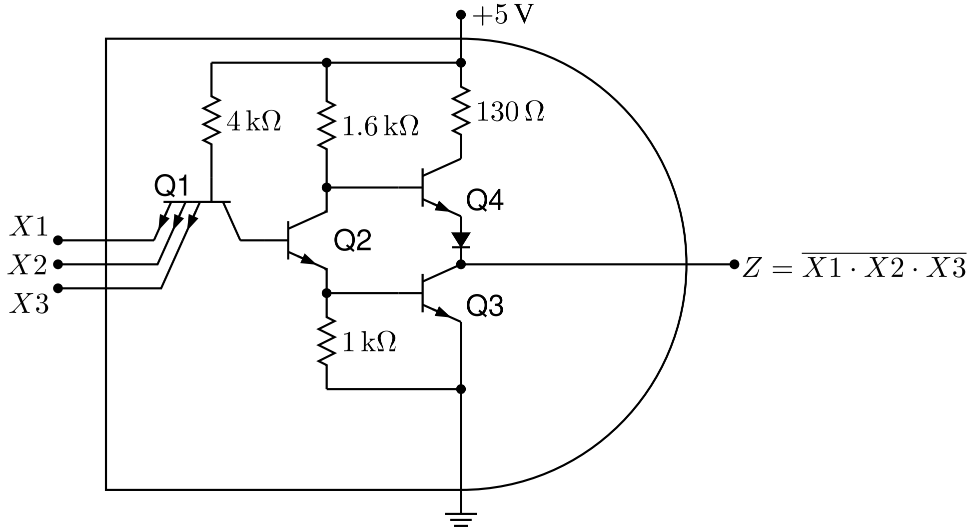


Figure 40: TTL NAND gate illustrating a transistor with multiple emitters `[TTLnand.m4]`.

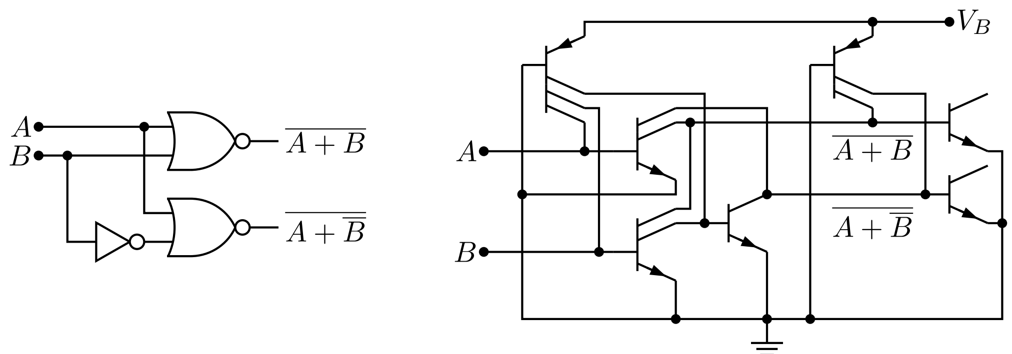


Figure 41: Gate circuit and equivalent embedded I^2L components illustrating multiple collectors `[I2L.m4]`.

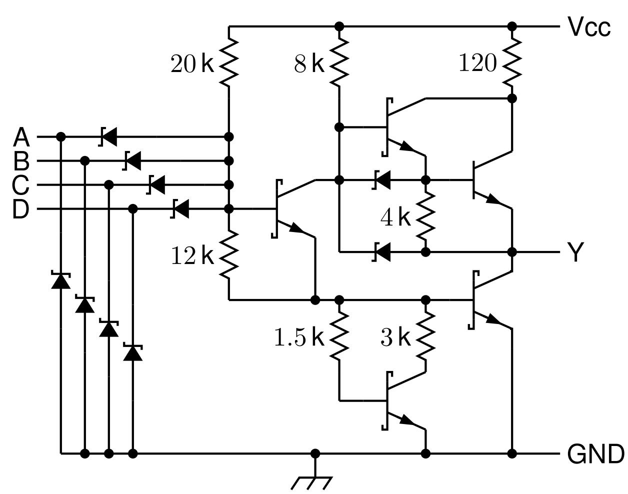


Figure 42: A 4-input NAND circuit illustrating the `S` (Schottky) option of `bi_trans` `[Schottky.m4]`.

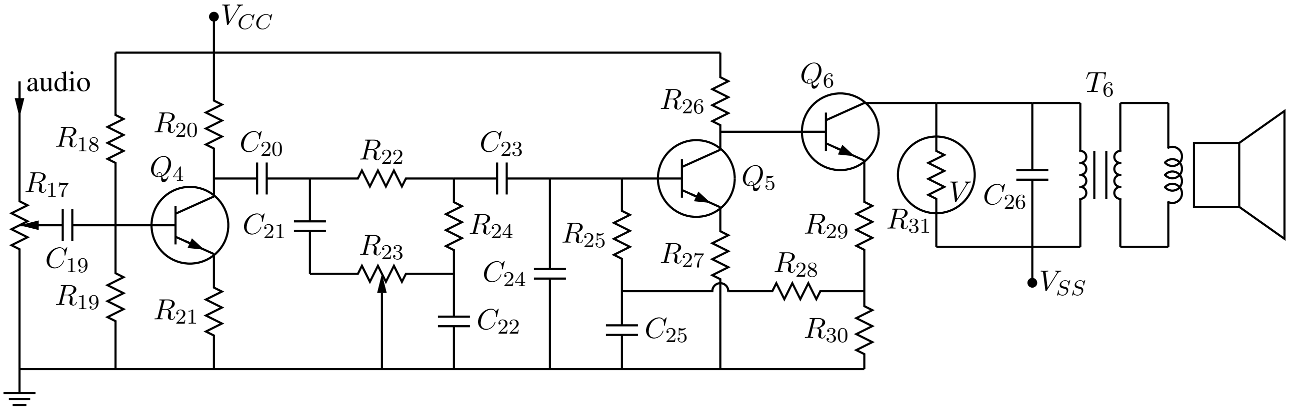


Figure 43: Transistor radio audio chain [ex11.m4].

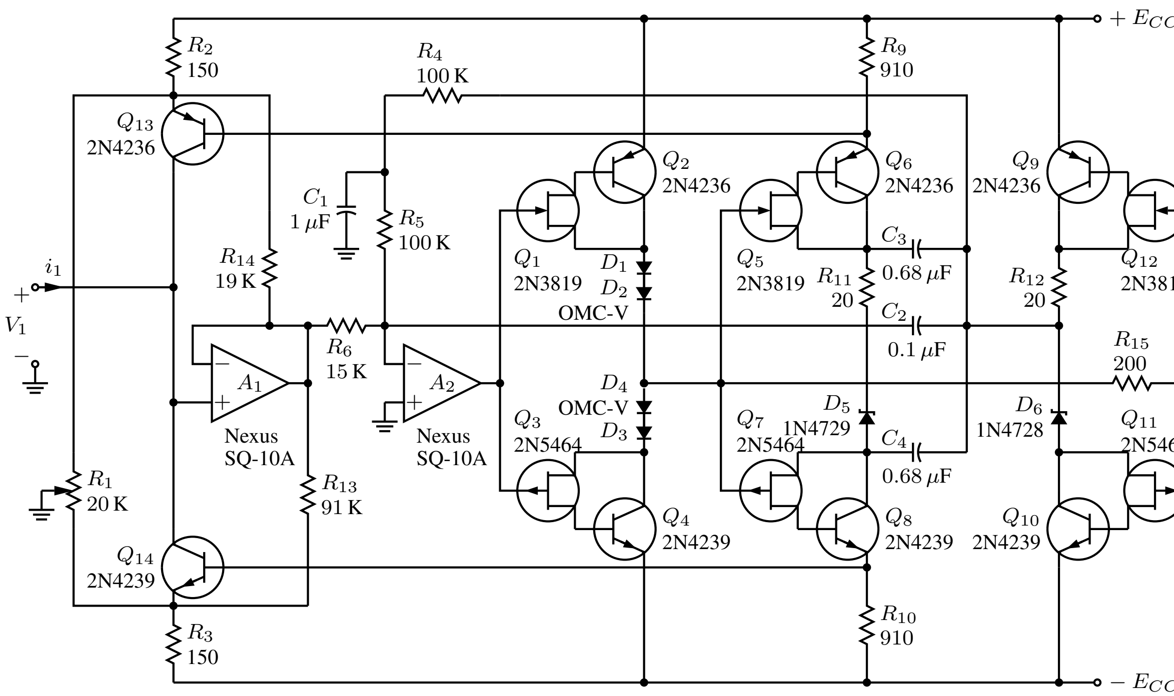


Figure 44: Realization of a controlled source (illustrating stacked element labels) [Csource.m4].

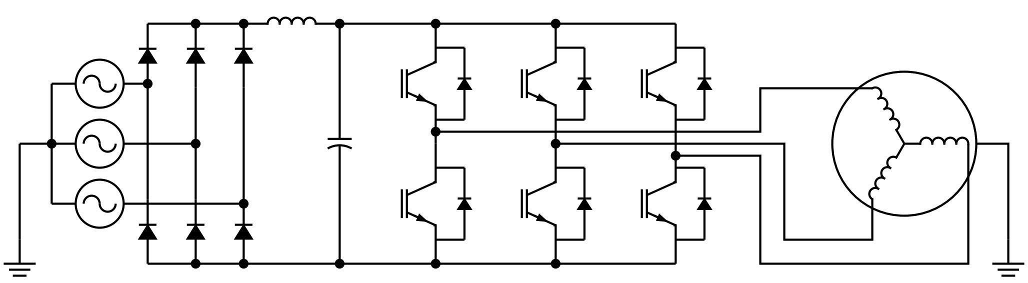


Figure 45: Synchronous machine driven by variable-speed drive and rectifier [Drive.m4].

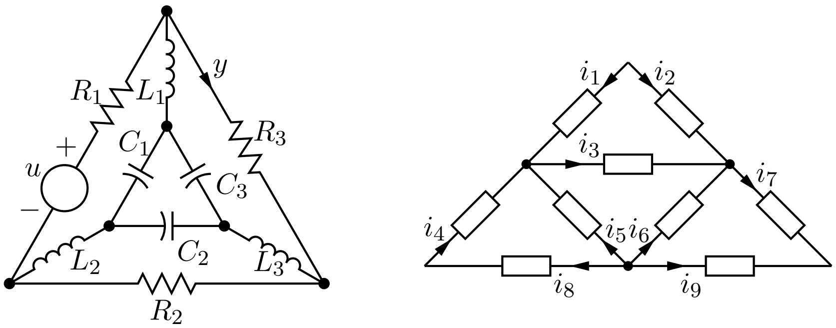


Figure 46: Labels on non-manhattan elements `[ex04.m4]`.

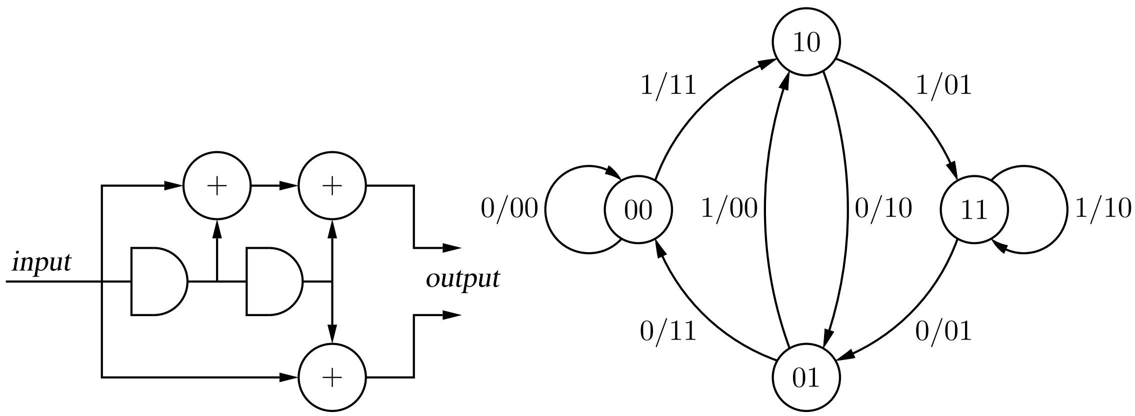


Figure 47: A rate $1/2$ binary convolutional coder and its state diagram `[ex16.m4]`.

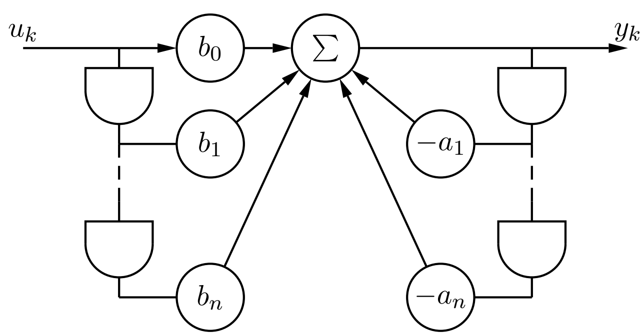


Figure 48: Digital filter `[ex03.m4]`.

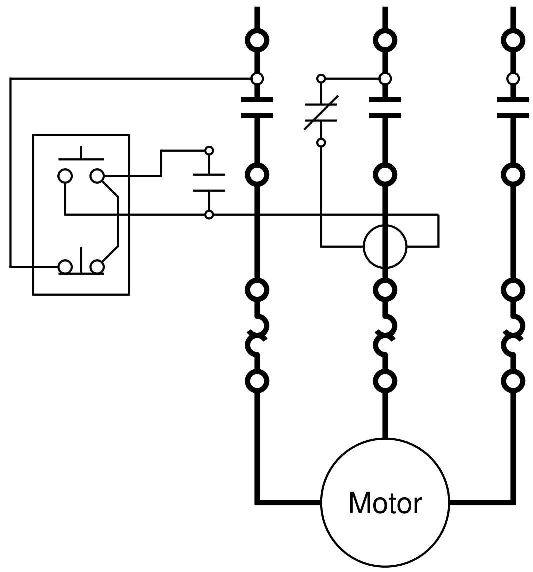


Figure 49: Motor control connections [MotorControl.m4].

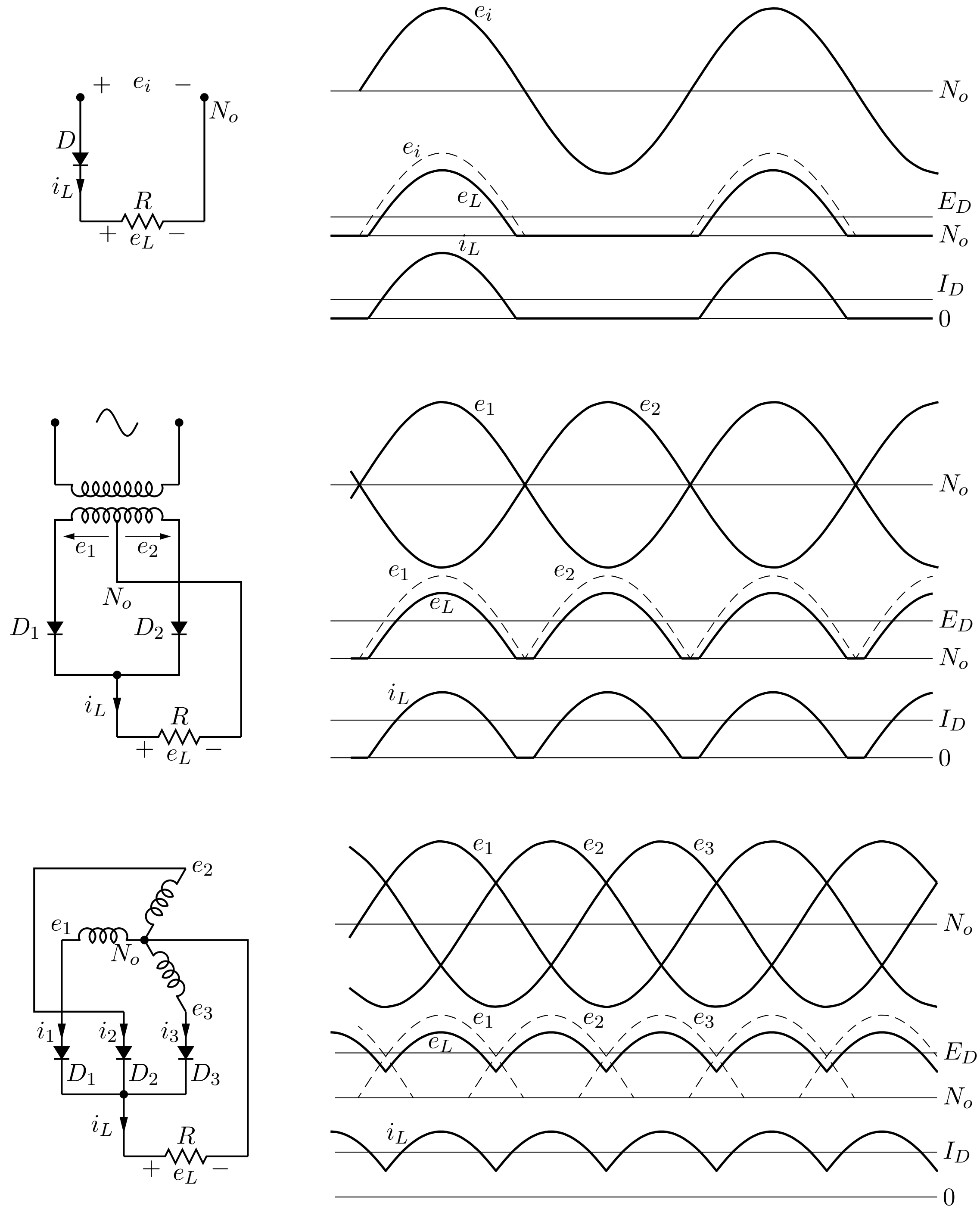


Figure 50: Rectifier circuits and waveforms `[Rectifiers.m4]`.

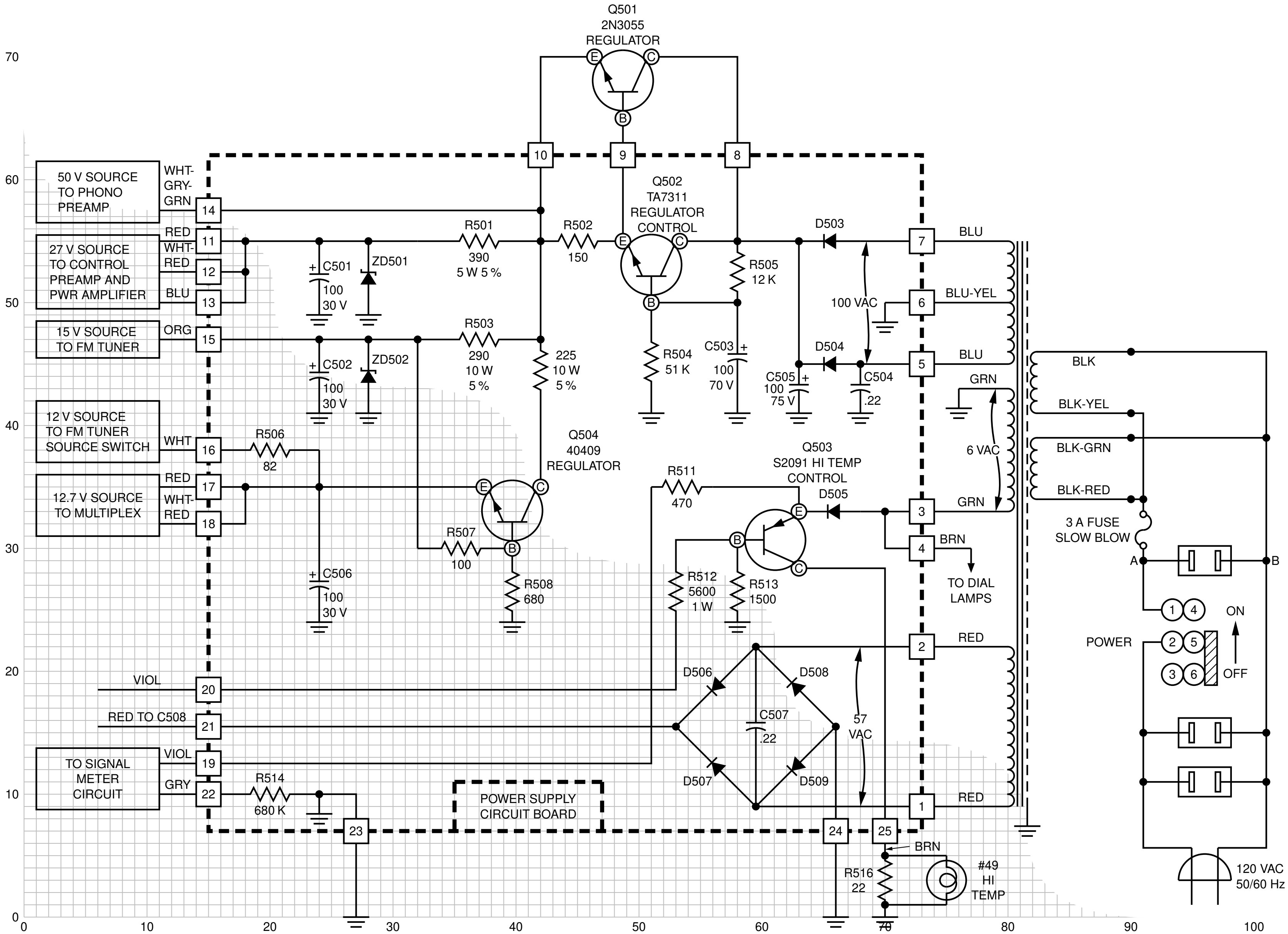


Figure 51: The power supply of a Heathkit AR-15 (Now, *that* was a receiver!) with custom transformer and other elements, drawn on a grid (partially shown) to aid in placement [Heathkit.m4].

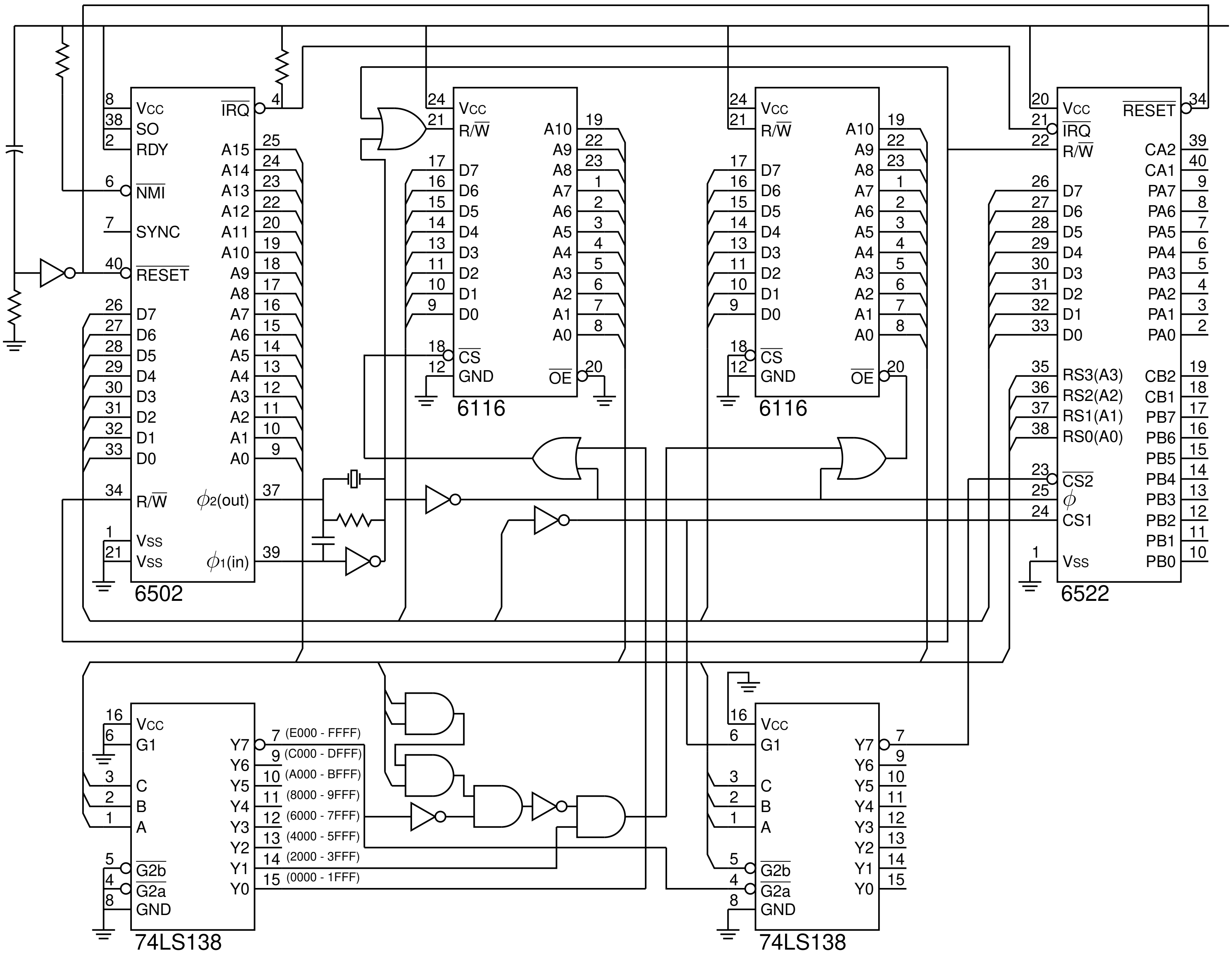


Figure 52: A digital circuit of moderate size, redrawn from M. P. Maclenan and G. M. Burns, "An Approach to Drawing Circuit Diagrams for Text Books," Tugboat (12)1, March 1991, pp. 66-69 `[lcct.m4]`.

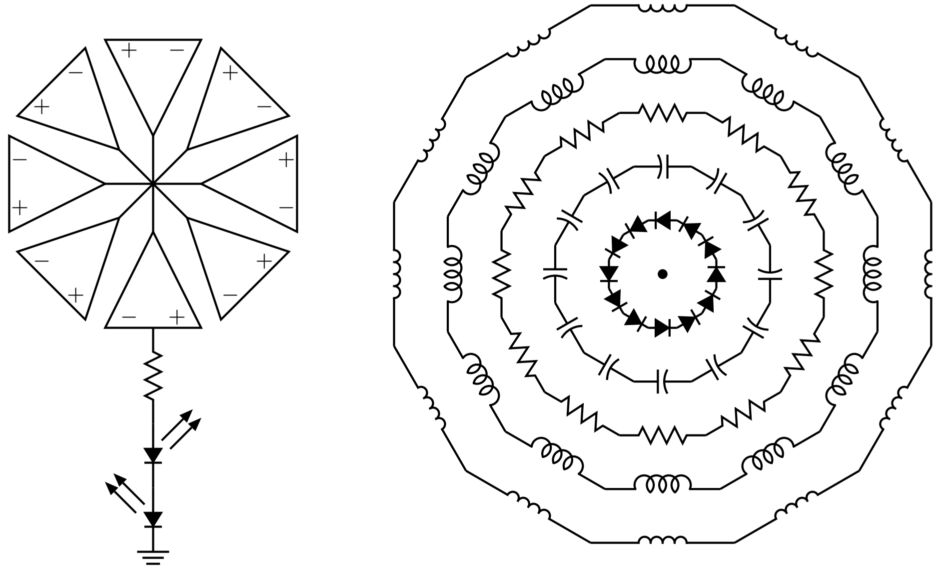


Figure 53: Elements at obtuse angles `[ex02.m4]`.

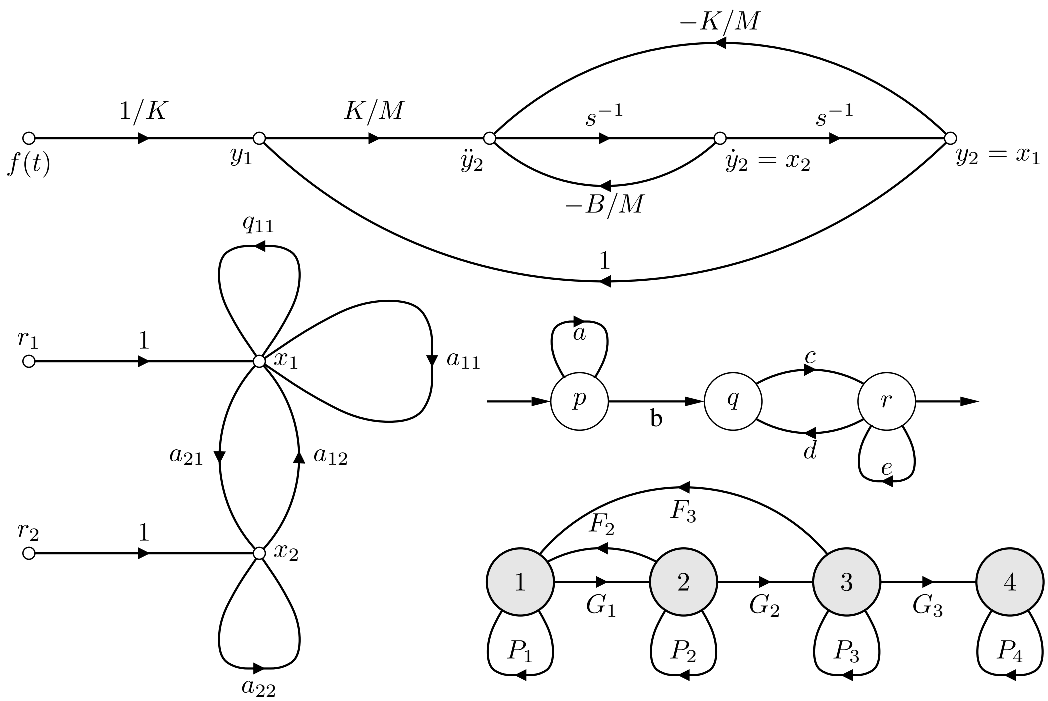


Figure 54: Signal-flow graphs `[sfg.m4]`.

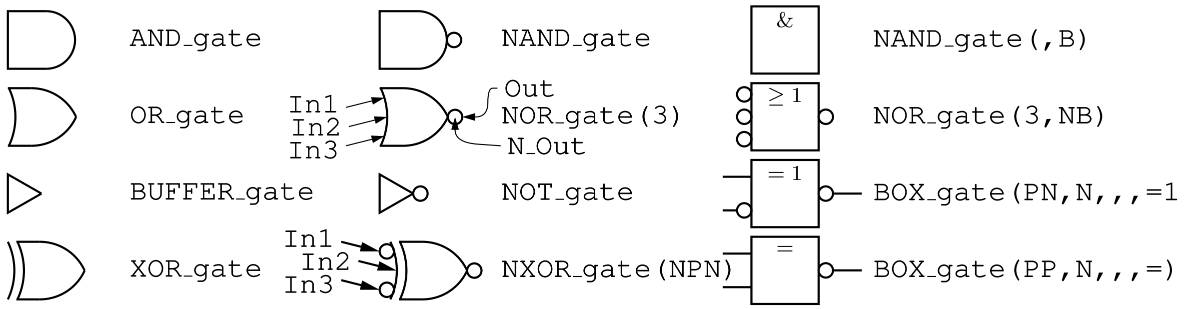


Figure 55: Basic logic gates [Logic.m4].

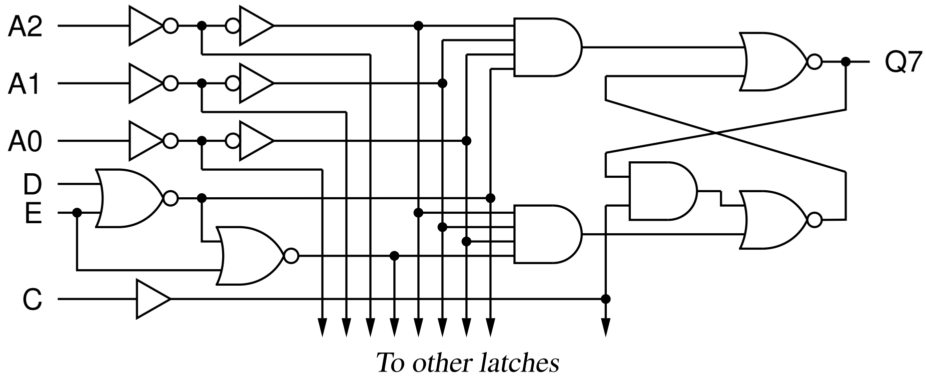


Figure 56: General-purpose latch: a small logic circuit [ex08.m4].

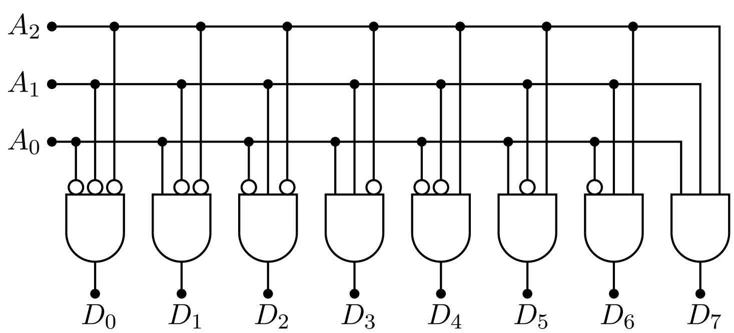


Figure 57: Decoder logic, constructed using the for_ macro [Decoder.m4].

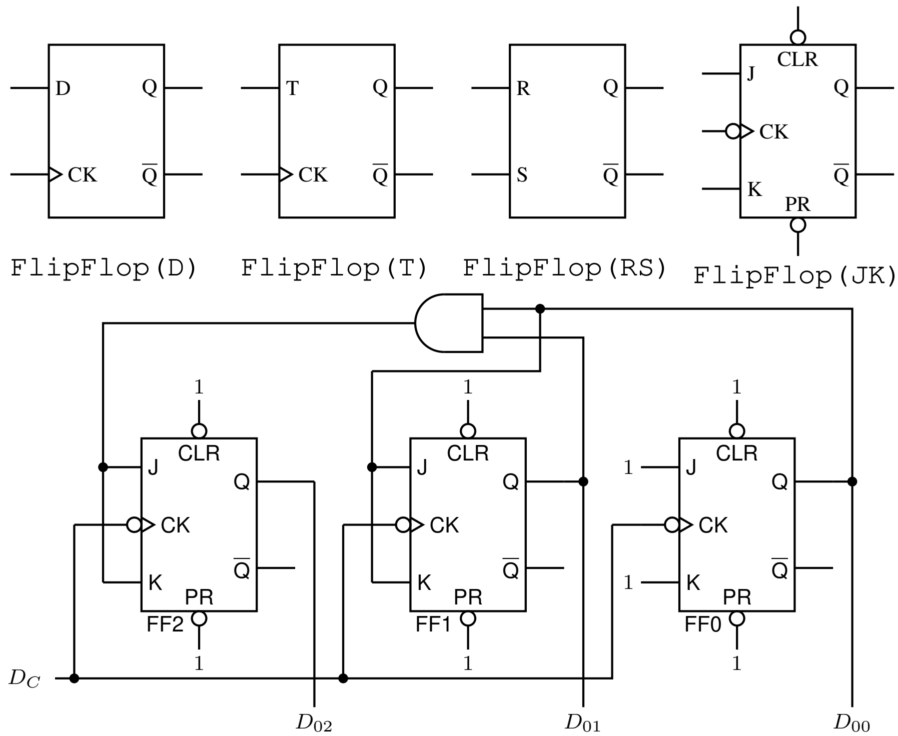


Figure 58: Some flip-flops [ex21.m4].

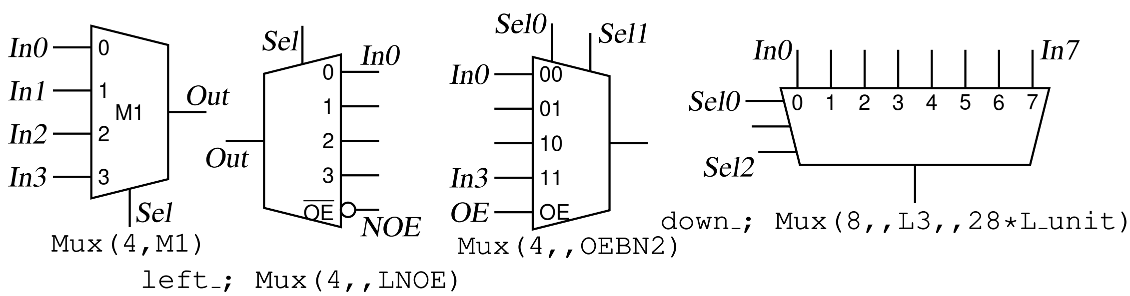


Figure 59: Multiplexer [Multiplexer.m4].

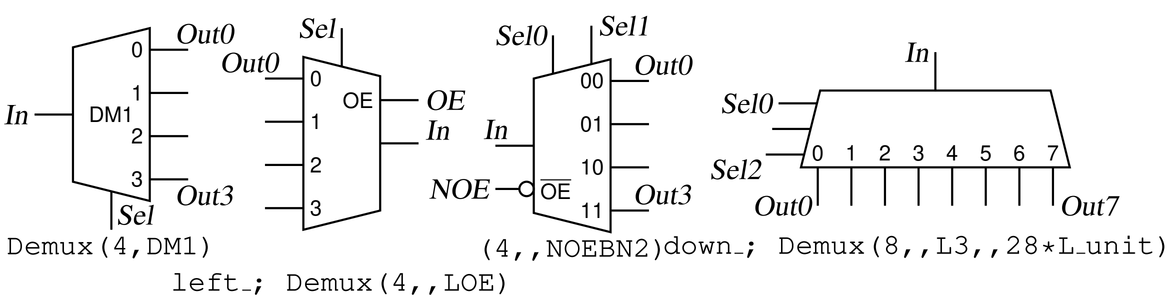


Figure 60: Demultiplexer [Demultiplexer.m4].

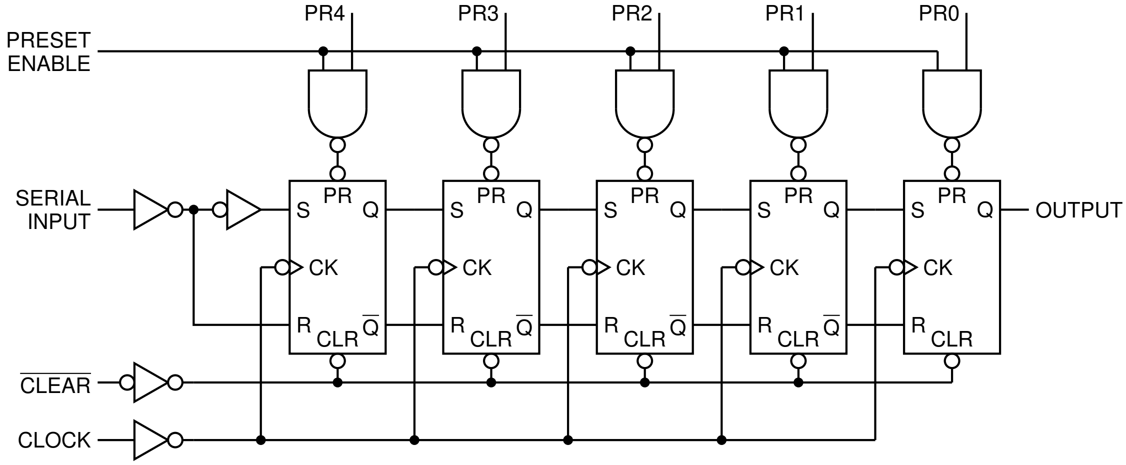
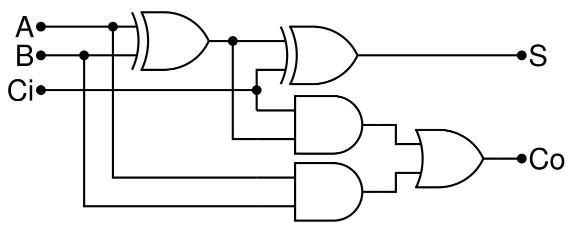


Figure 61: A 5-bit shift register drawn using a custom flip-flop [ShiftR.m4].



A	B	Ci	Co	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
0	1	1	0	0
1	1	0	1	0
1	1	1	1	1

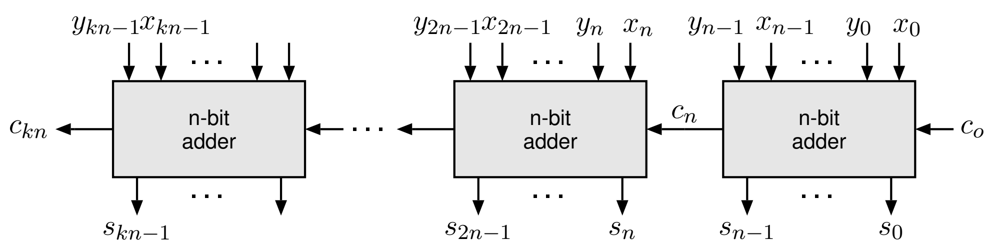
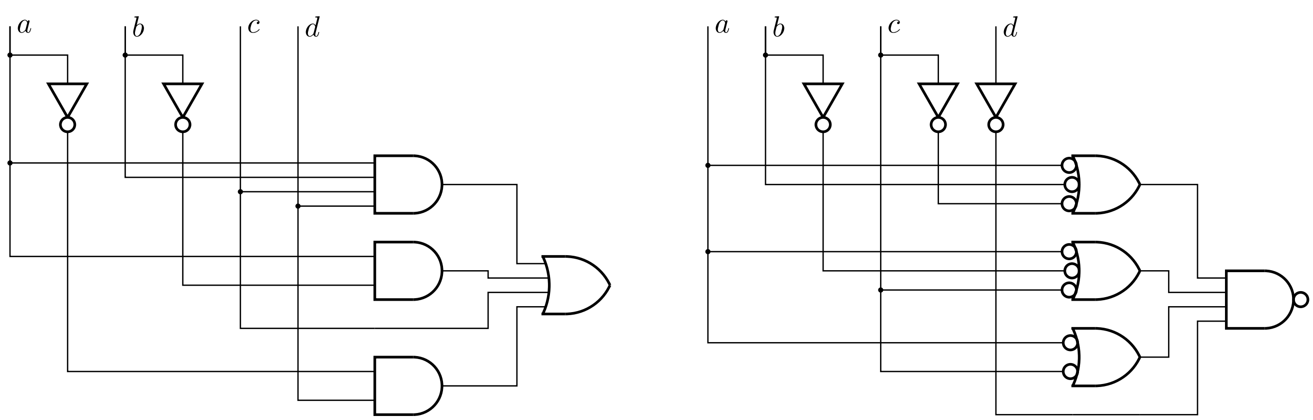


Figure 62: A full adder and a cascade of n-bit adders [Adder.m4].



`CanLogic(AND,,OR,,abcd,a~b,c,~ad)` `CanLogic(OR,N,NAND,,ab~c,a~bc,ac,~d)`

Figure 63: A way of automatically drawing two-layer logic diagrams [CanLogic.m4].

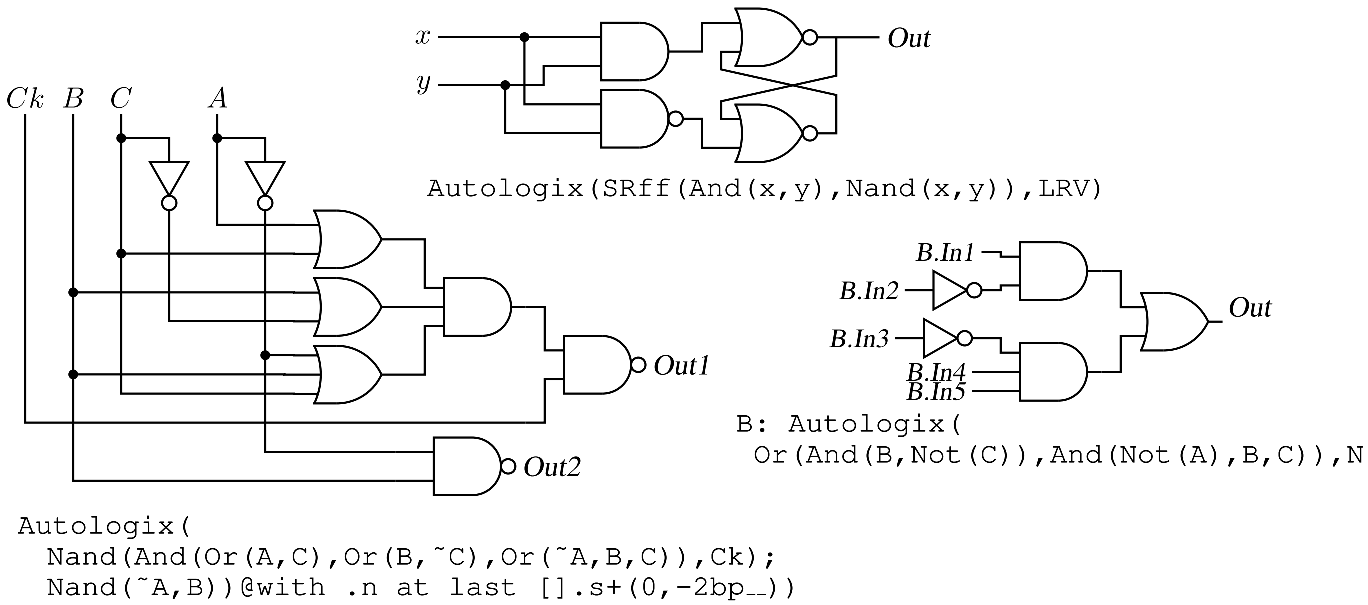


Figure 64: The `Autologix(`*Boolean expression*; *Boolean expression...* , *options*`)` macro automatically draws Boolean expressions in function notation. The function tree is drawn, then a row or column of inputs, then the connections. The default result is on the left, a custom element at the top, and a tree of gates only is shown on the right. `[Alogix.m4]`.

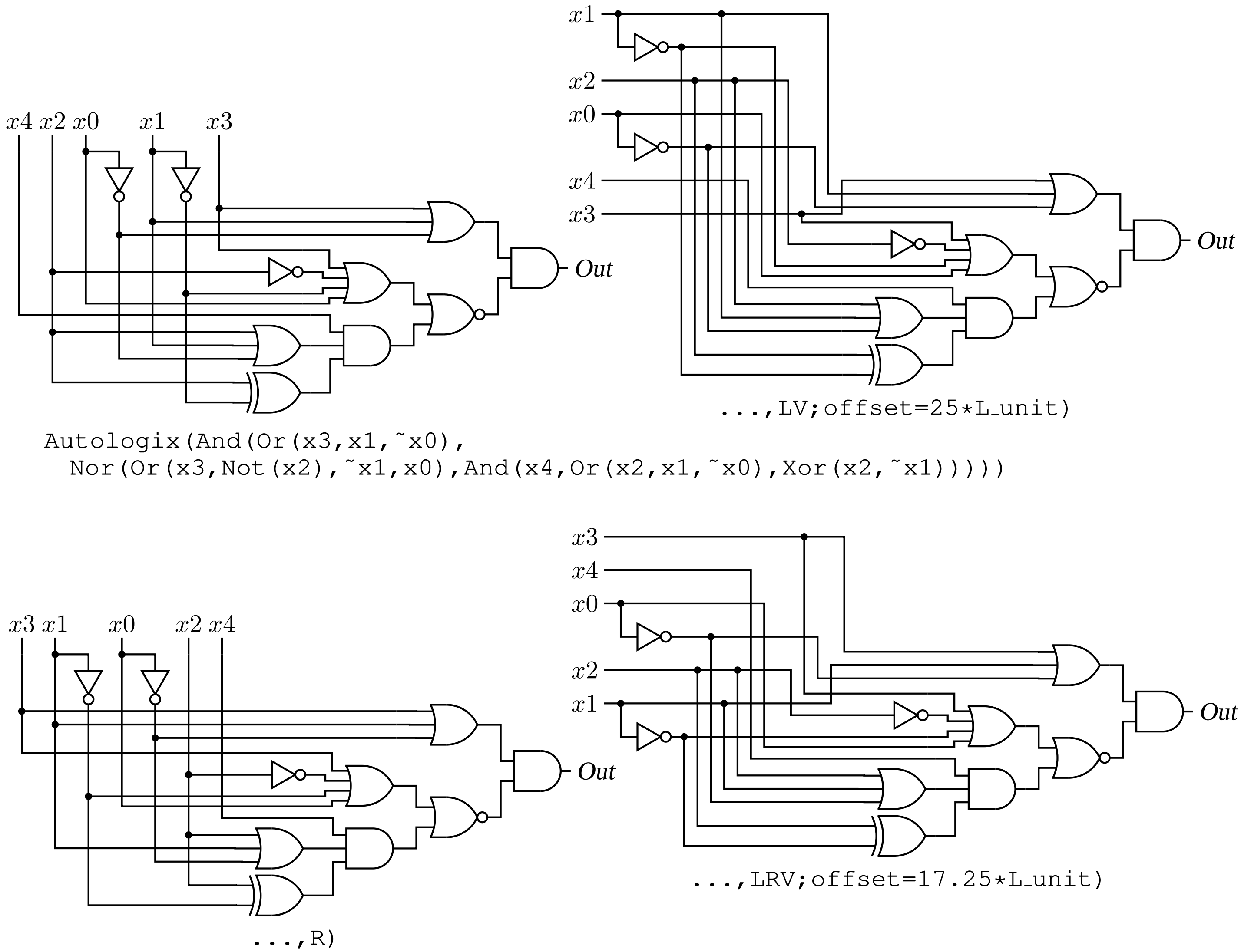


Figure 65: The `Autologix` macro can draw inputs on the left but the added drawing complexity may require hand tuning with second-argument options: `L` puts the inputs on the left, `R` reverses their order, `V` scans the input arguments in reverse order, and `offset=`*value* displaces the array of inputs `[ABlogix.m4]`.

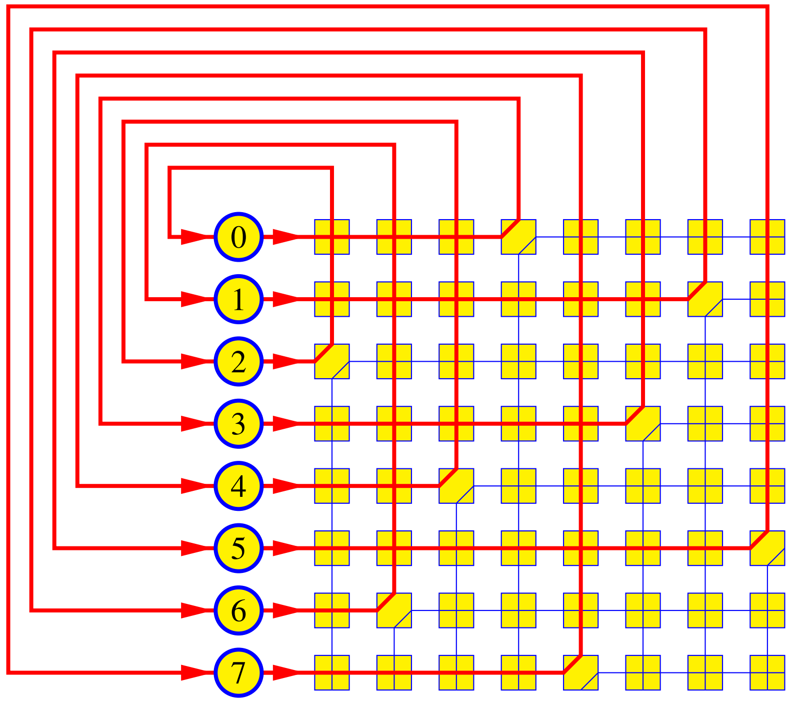


Figure 66: A crossbar switch [Crossbar.m4].

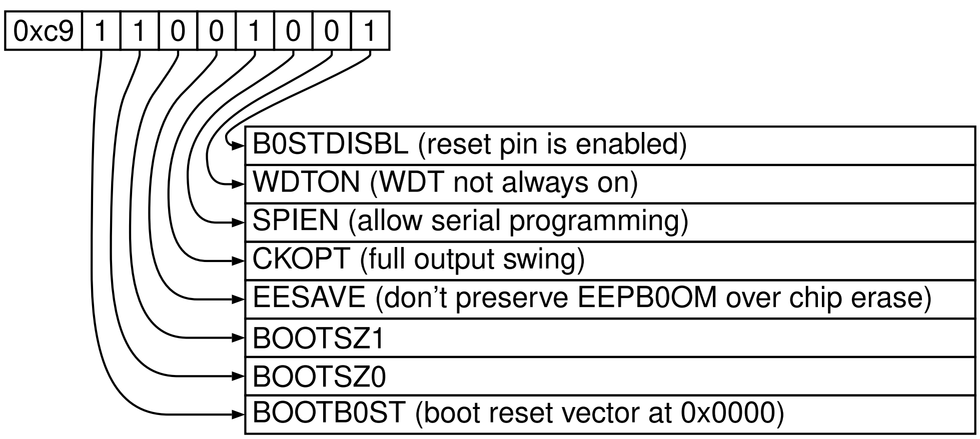


Figure 67: Elementary splines [Byte.m4].

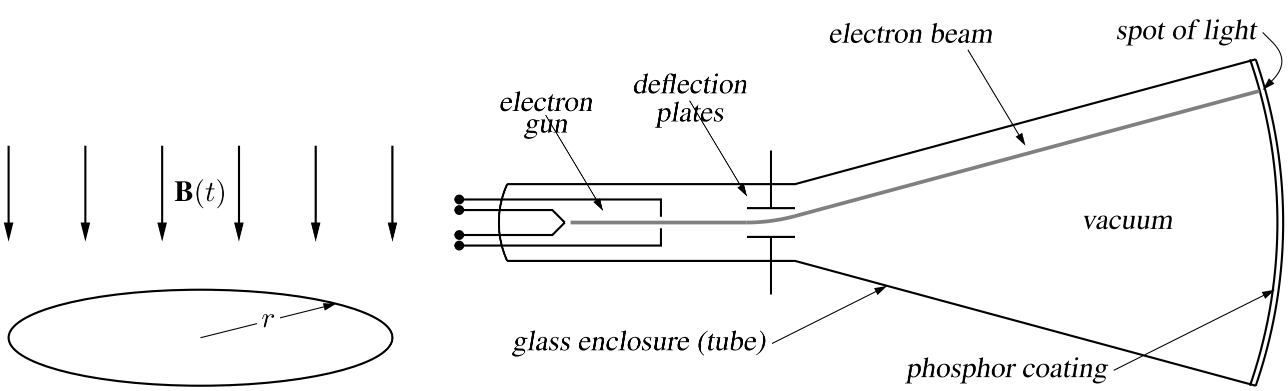


Figure 68: Line diagrams [ex00.m4] [ex07.m4].

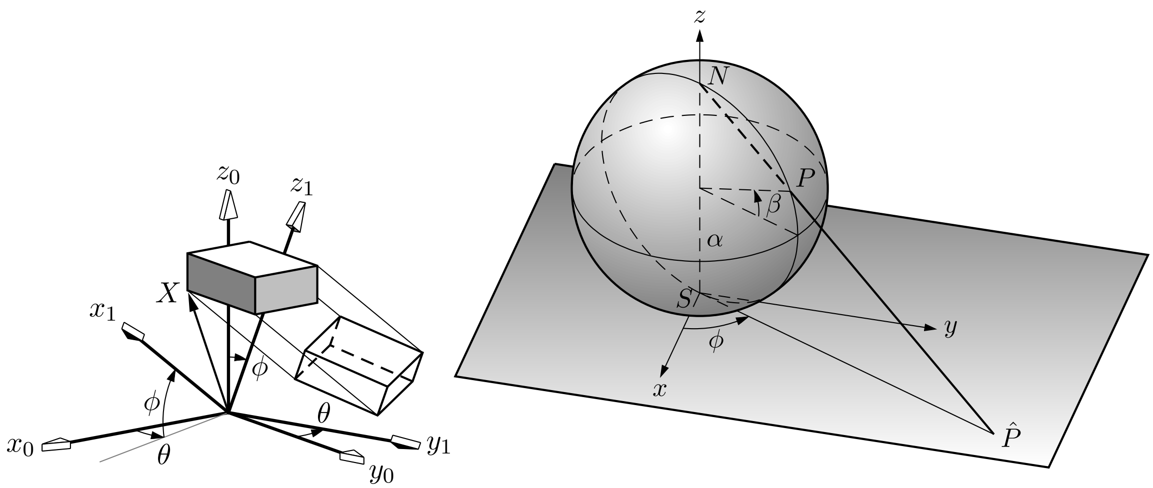


Figure 69: Test of `project` and other `lib3D` macros, showing the projection of a solid onto the y_1, z_1 plane by sighting along the x_1 axis. `[exp.m4]` `[Globe.m4]`.

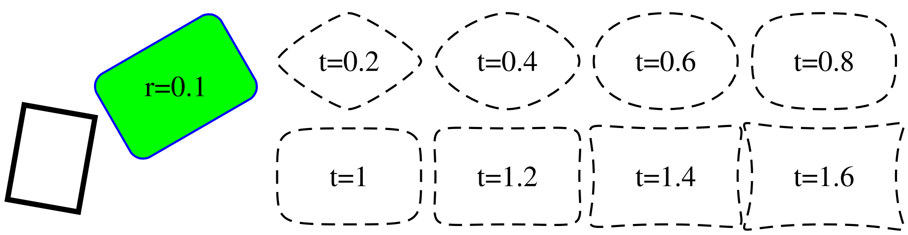


Figure 70: The macro `rotbox(`*wid*,*ht*,*type*,`[r|t=`*val*`])` draws a box in the current direction `[Rotbox.m4]`.

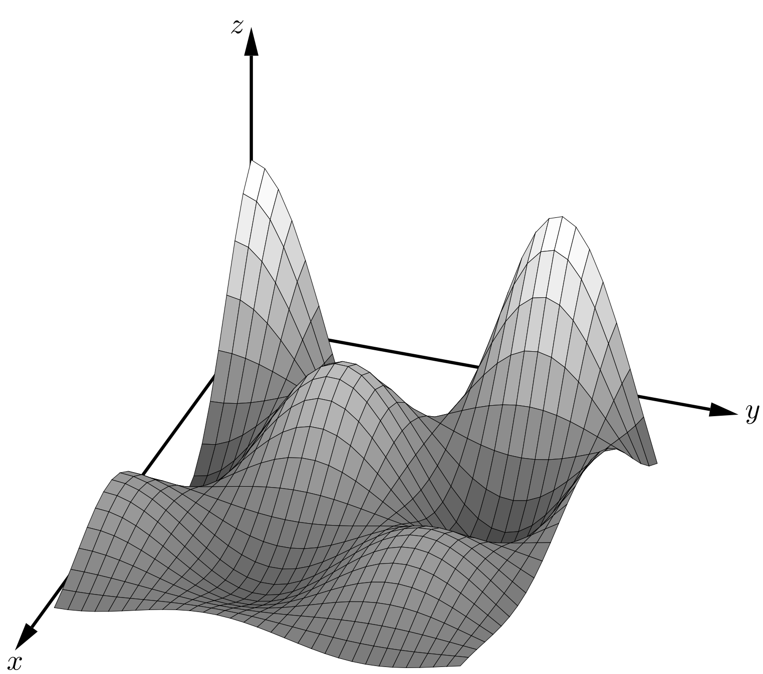
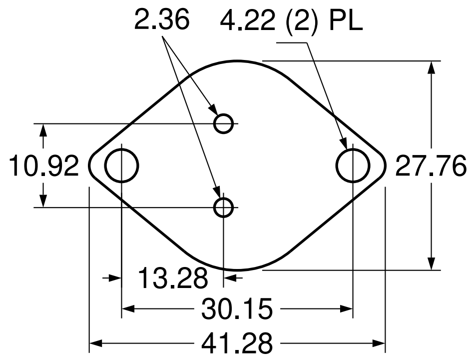
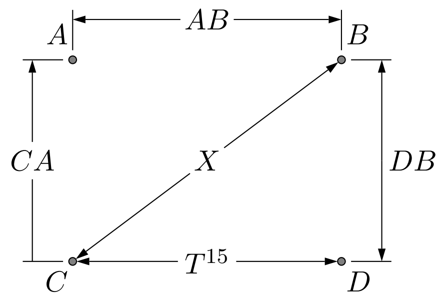
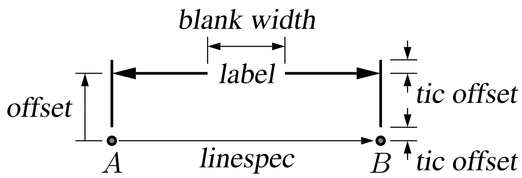


Figure 71: Plotting a surface using a gray scale `[graysurf.m4]`.






```
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)
```




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

Figure 72: 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` `[ex09.m4]`.

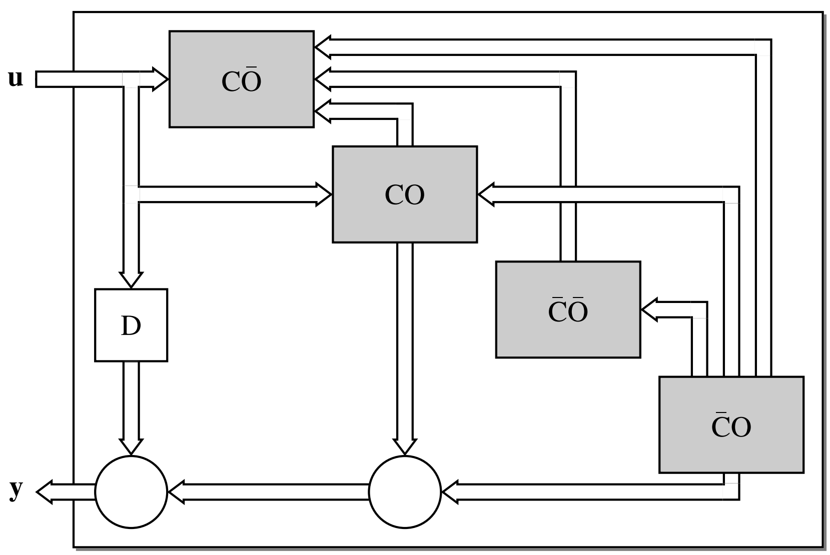
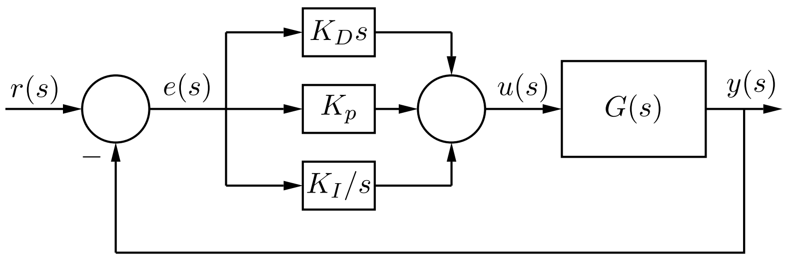
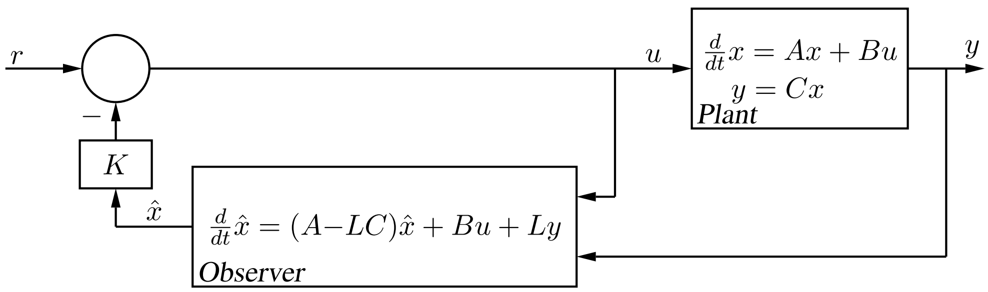


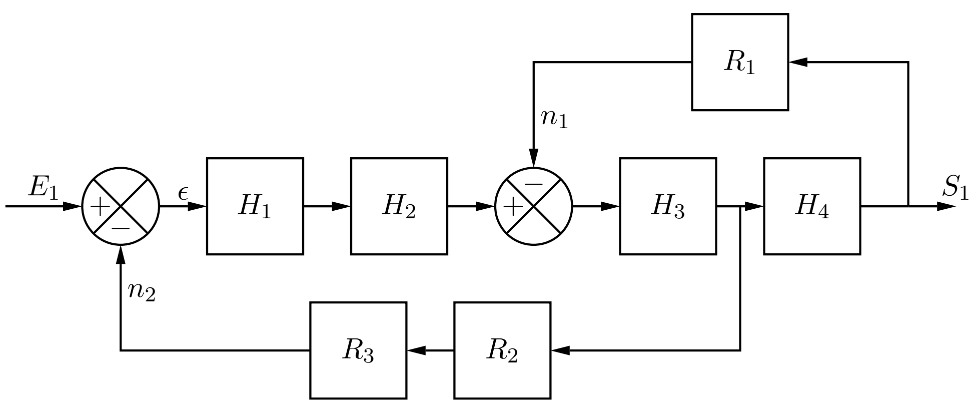
Figure 73: Use of `darrow` `[ex05.m4]`.



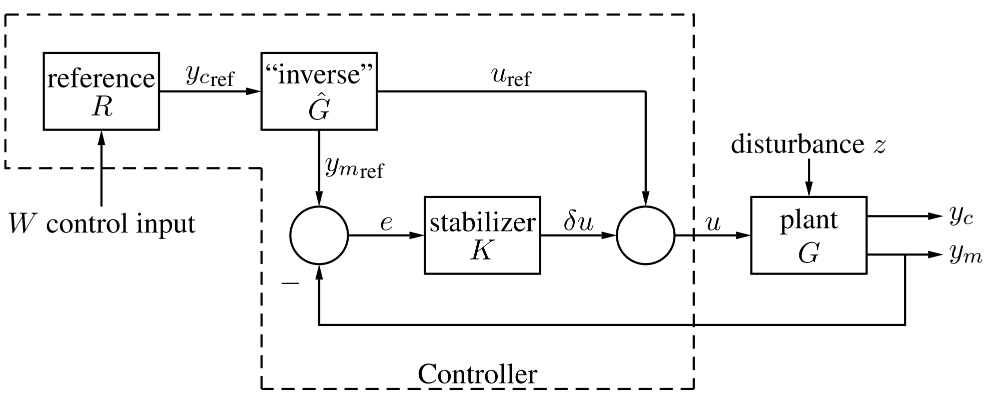
(a) PID control



(b) Output feedback with a full-order observer



(c) A multiblock example



(d) Nonlinear feedforward (for performance) and small-signal feedback (for stability)

Figure 74: Control-system block diagrams that do not require m4 `[control.m4]`.

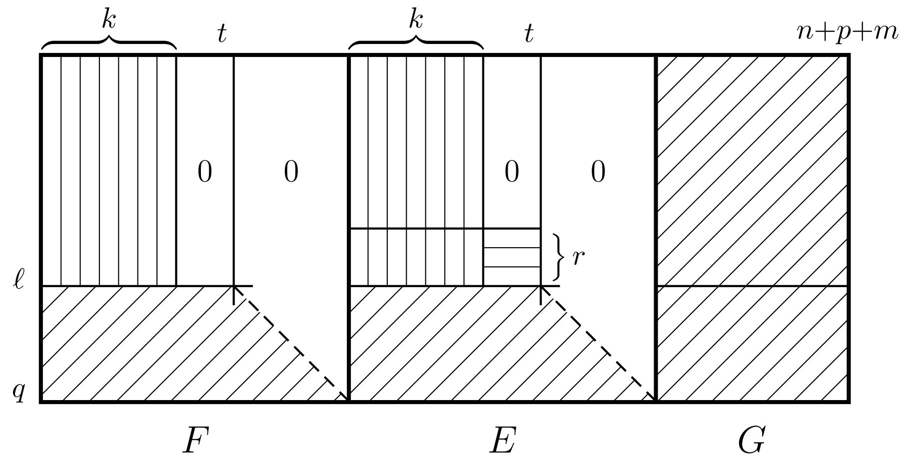


Figure 75: Crosshatching by `for` loops `[ex06.m4]`.

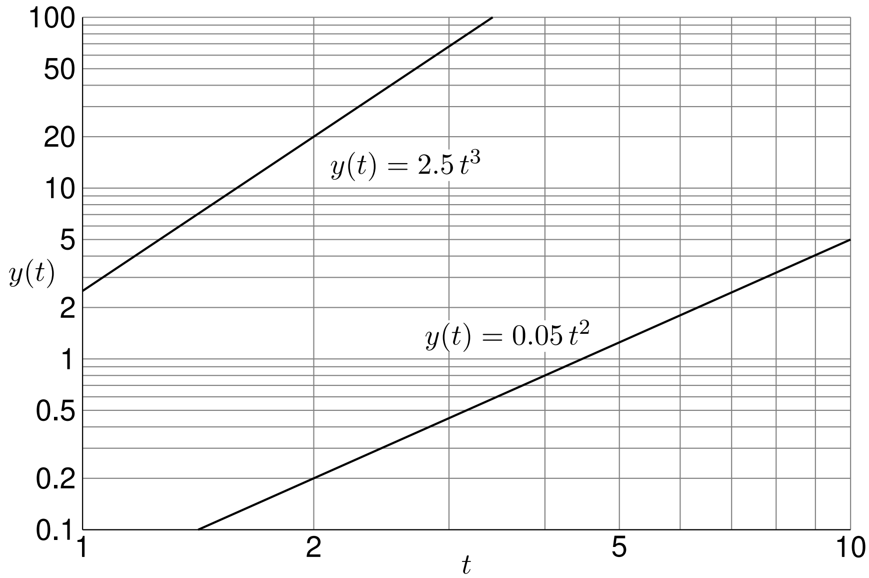


Figure 76: A graph drawn using the pic language `[Loglog.m4]`.

Figure 77: Conestoga Sailing Club (illustrating the filling of arbitrary shapes) `[csc.m4]`.

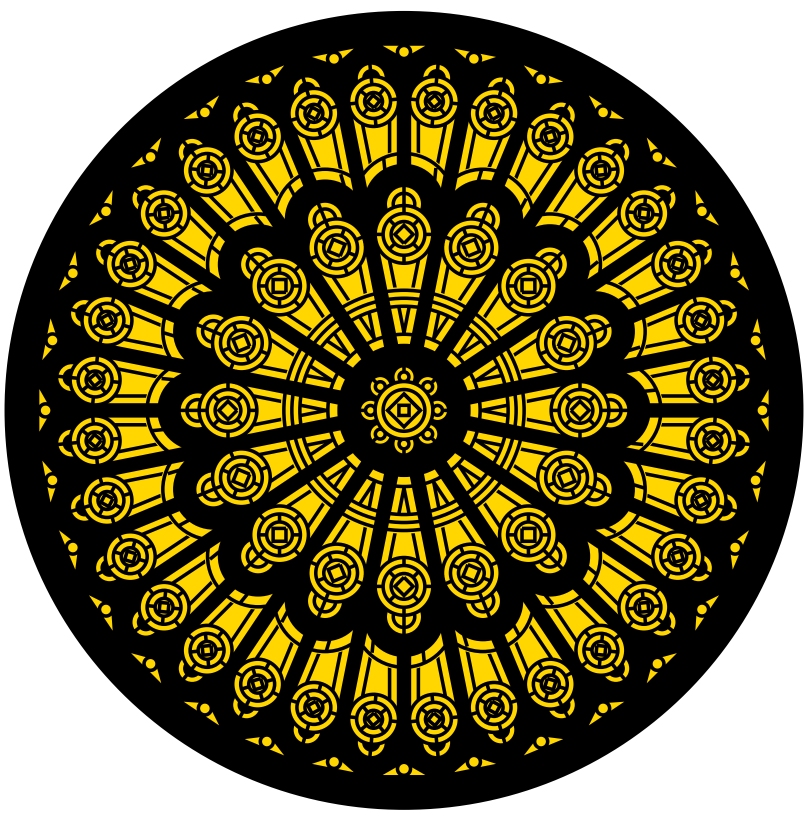


Figure 78: Redrawn from a detail of the set design for the musical *Dracula,* used for testing `dpic`. This diagram consumes much LaTeX main memory but can be produced as the raw postscript output of `dpic -r` since no text formatting is required `[rose.m4]`.

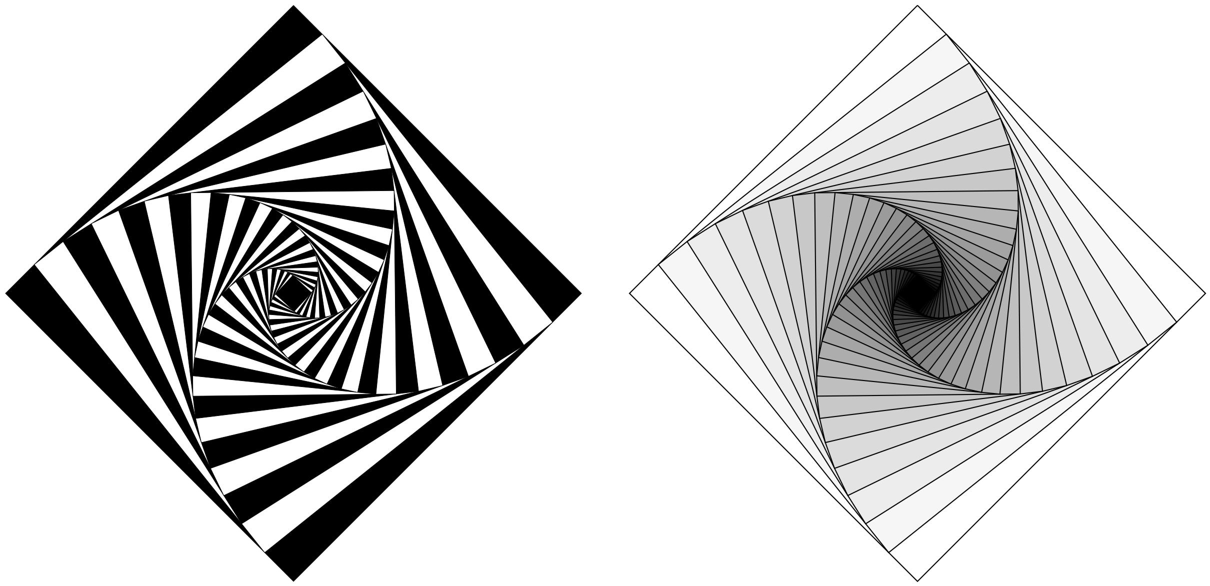


Figure 79: Variations on M. Goossens, S. Rahtz, and F. Mittelbach, *The LaTeX Graphics Companion,* Addison-Wesley 1997, pp. 57-58 `[diamond.m4]`.

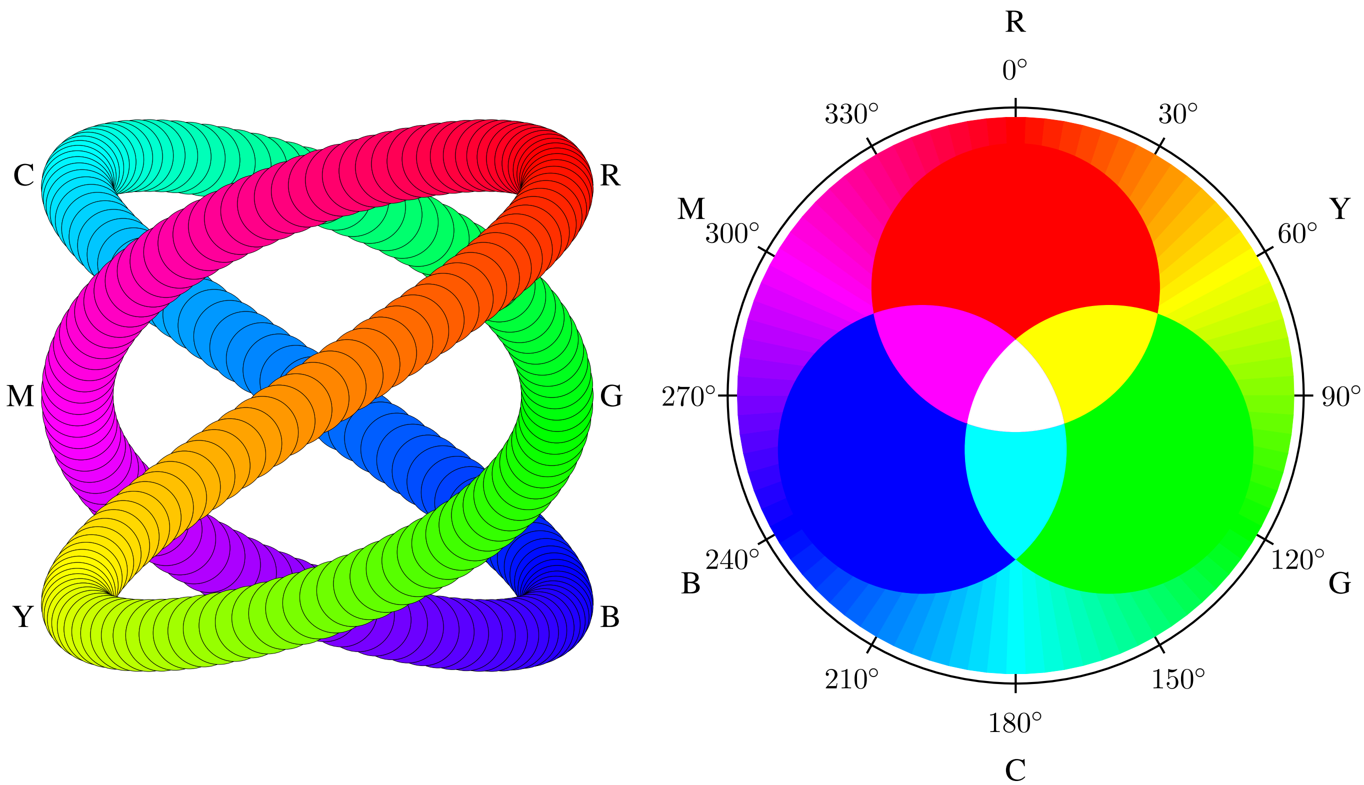


Figure 80: An exercise in calculating RGB colours `[worm.m4]`.

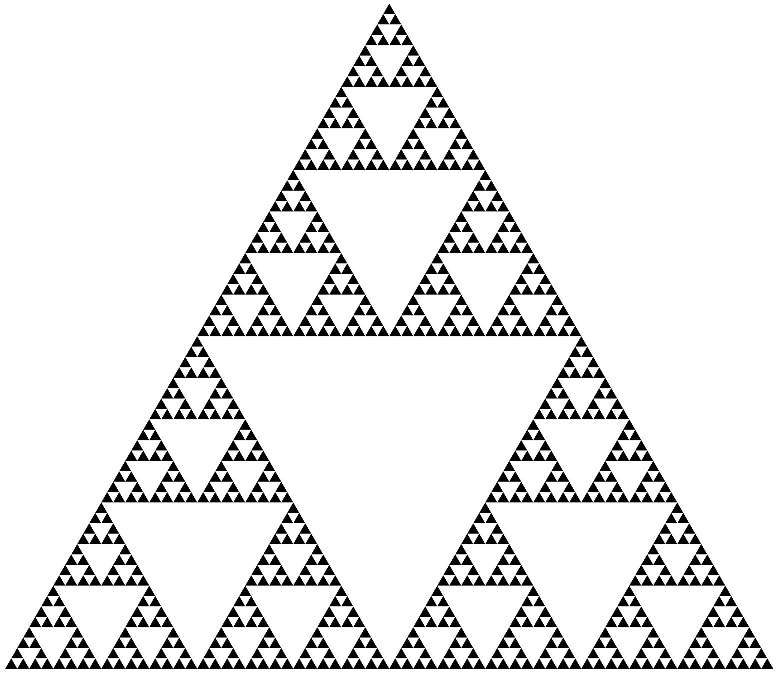


Figure 81: The Sierpinski triangle: a test of pic macro recursion [Sierpinski.m4].

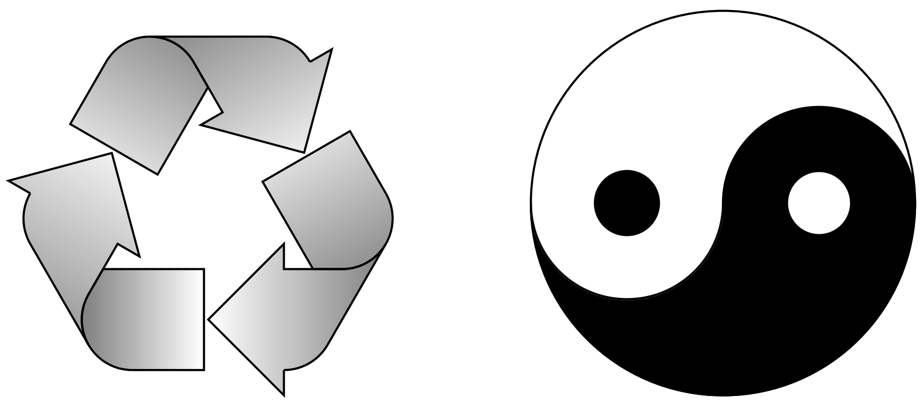


Figure 82: Modest repetition and partial fill [recycle.m4][yinyang.m4].

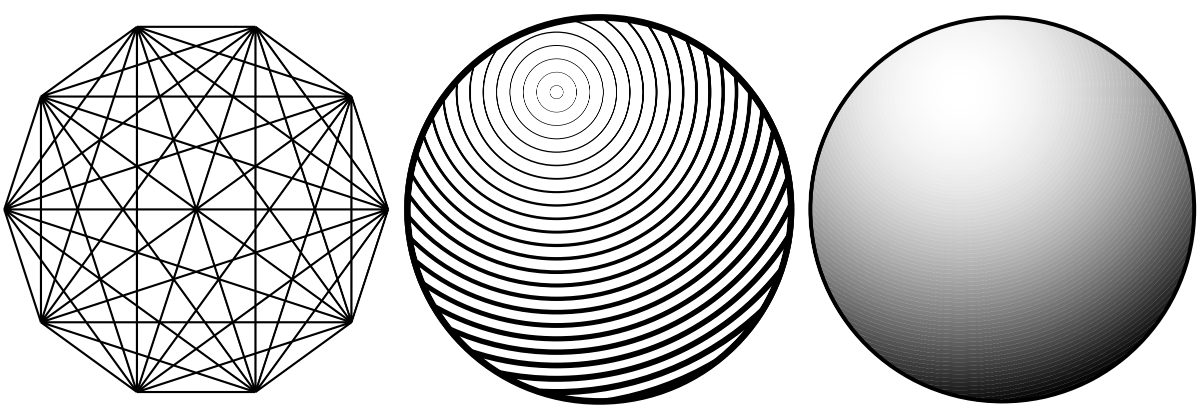


Figure 83: Simple diagrams that are easily drawn by looping [ex15.m4].

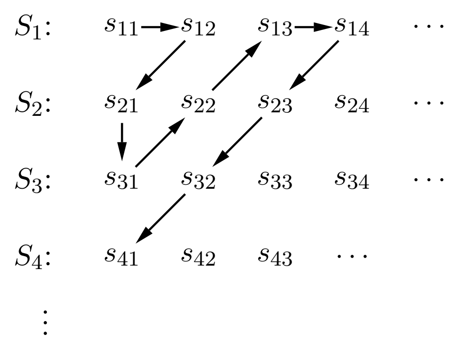


Figure 84: An example of enumeration `[Counting.m4]`.

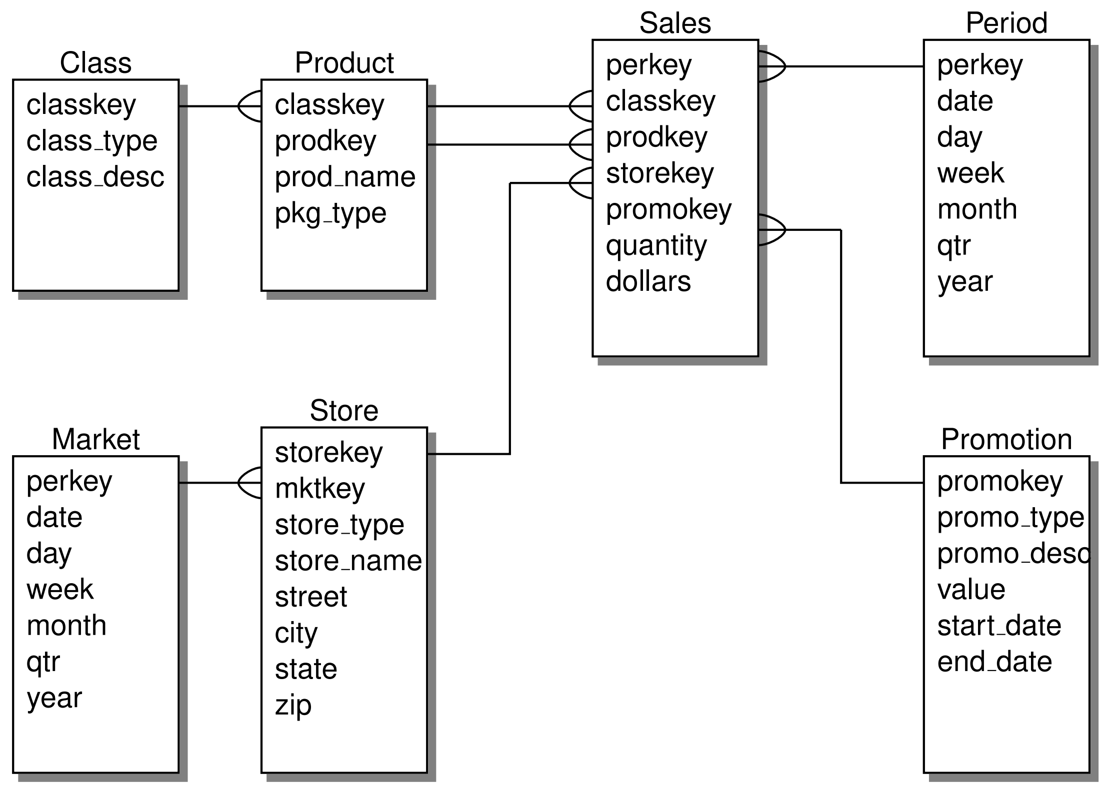


Figure 85: Illustrating `shadebox` and a custom crowfoot line termination `[Crow.m4]`.

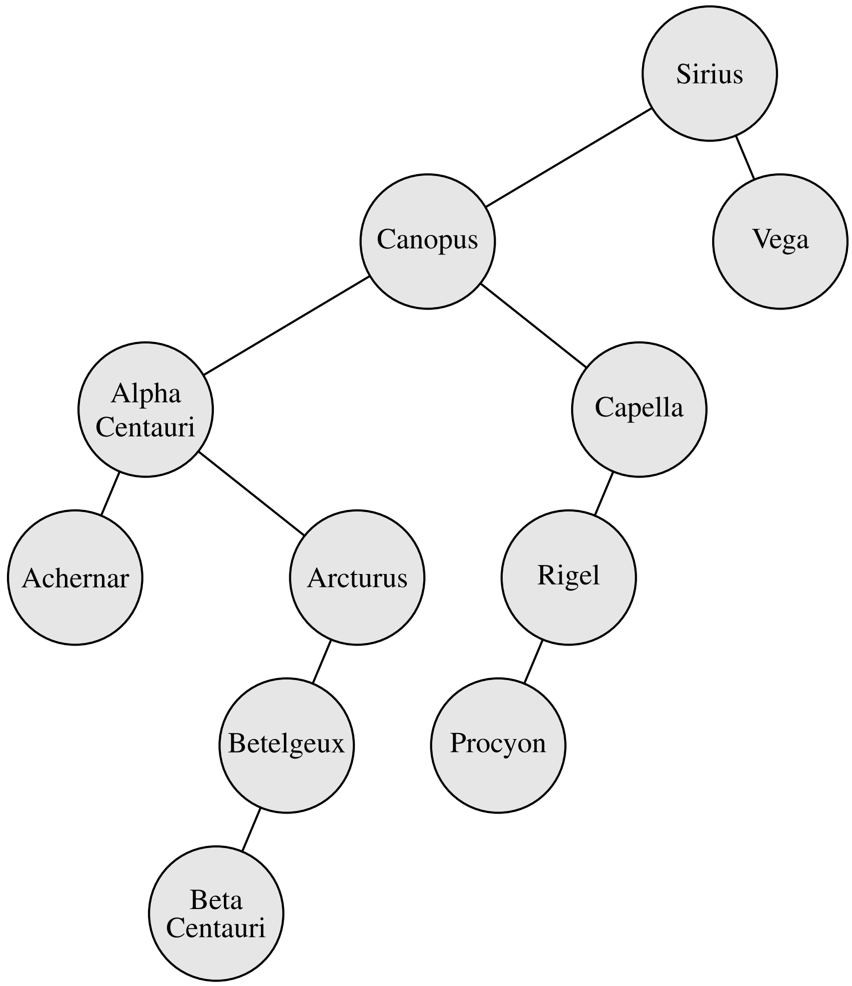


Figure 86: A binary tree [`Btree.m4`].

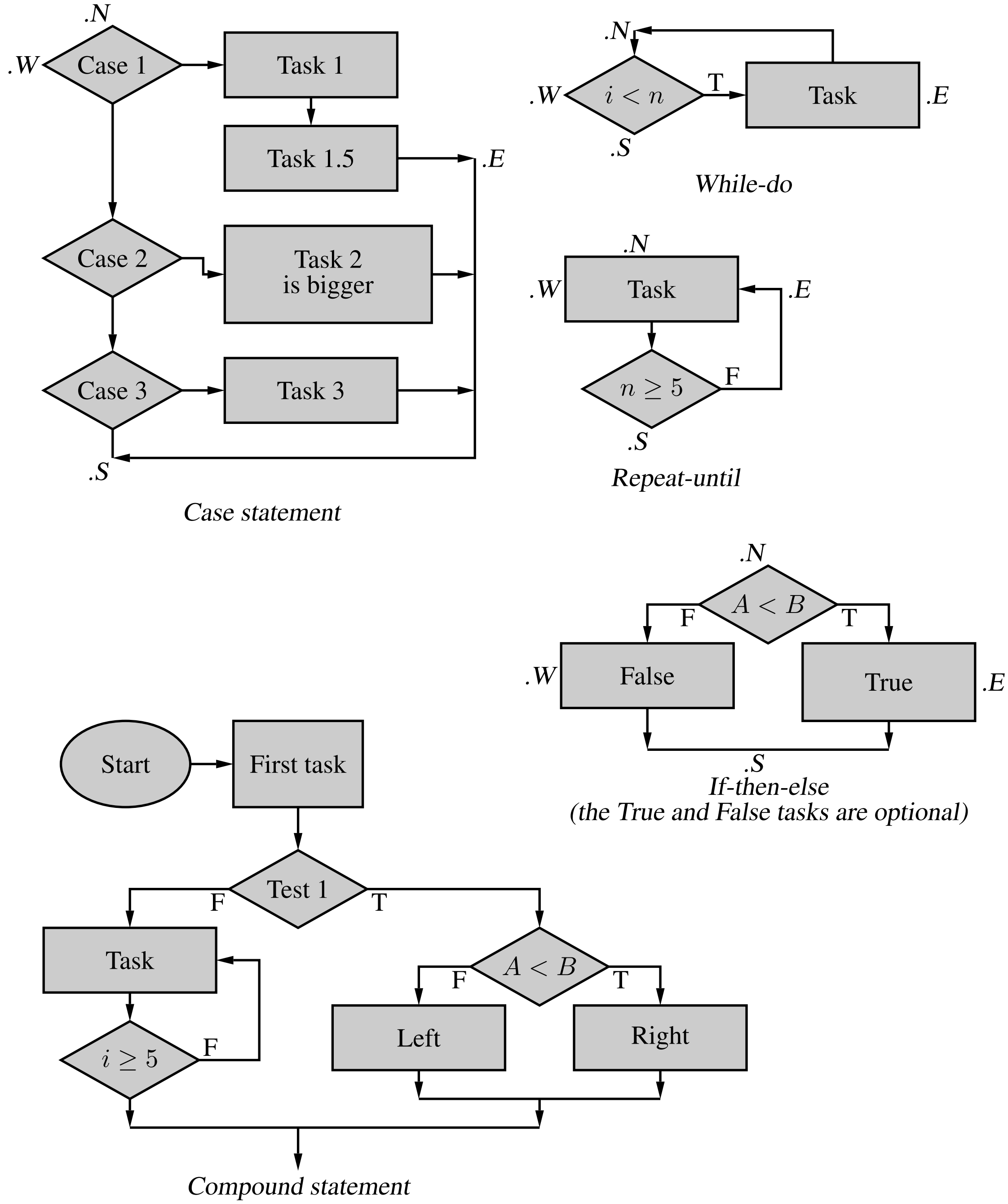


Figure 87: A flowchart sampler `[Flow.m4]`.

Figure 88: Overlaying a figure with line graphics [Incleps.m4].