Software Complexity

- # nesting levels of loops
- Size of each function
- # levels of indirection to reach oft-used functions
- # paths

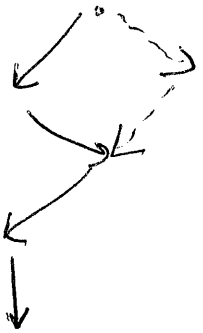
KLoC
1000 lines of executable code

Cyclomatic complexity

n branch points

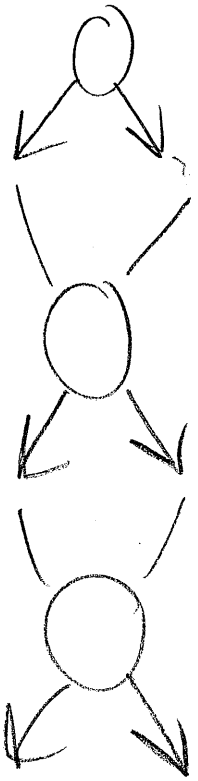
upper bound on # paths

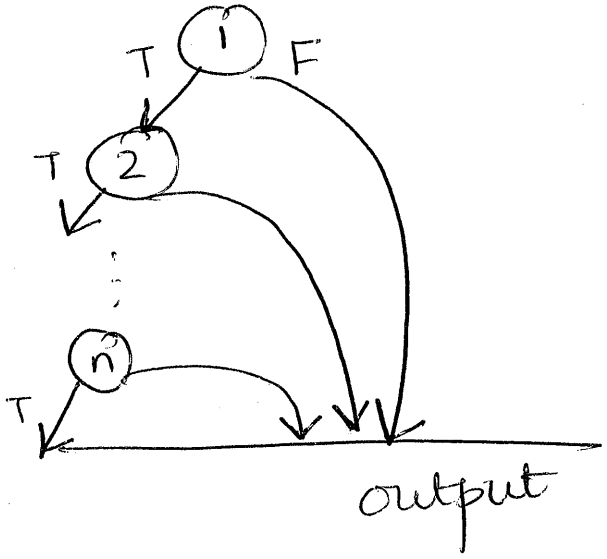
Lower bound on # paths



Symbolic execution

Upper bound for # paths = 2^n

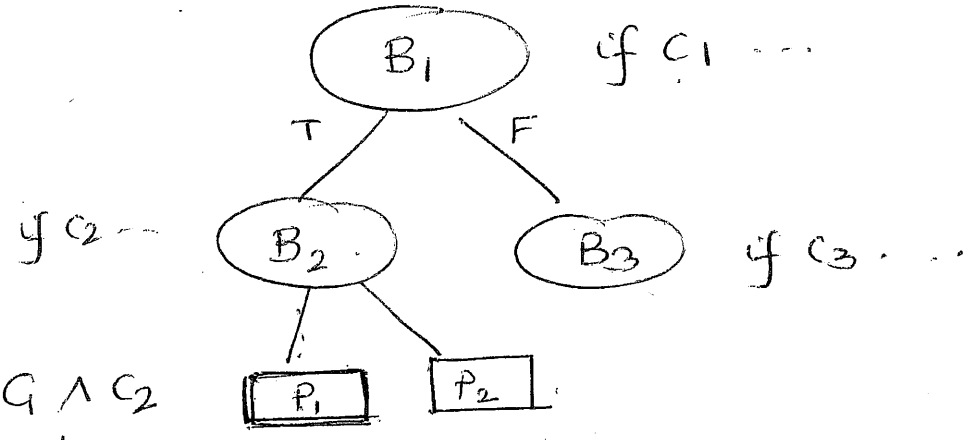




Lower bound for

paths = n+1

Branch testing



$c_1 \wedge c_2$

↓

SMT solver

↓

Concrete values of variables

Eg. c_1: $x > y$

c_2: $y > z \wedge z = 100$

} $c_1 \wedge c_2$: $(x, y, z) = (300, 200, 100)$

$c_1 \wedge !c_2 \equiv (x > y) \wedge (y < z \vee z != 100)$

$\equiv (x, y, z) = (70, 60, 101)$

$!(A \wedge B) = !A \vee !B$

$Z = X * Y$ E_1: $Z_1 = X * Y$

E_2: $Z_2 = (2X) * (2Y)$

$Z_3 = Z_2 / 4$

Look up: Recomputation with shifted operands (RESO) for a practical use of temporal redundancy.
Patel, Janak H., and Leona Y. Fung. "Concurrent Error Detection in ALU." IEEE Transactions on Computers 7 (1982): 589-595.