

CS F364

Design & Analysis of Algorithms

ALGORITHMS – DESIGN TECHNIQUES

Exact Solutions

- Search with Backtracking
- Examples: CNF-SAT, HAM-PATH

BACKTRACKING — EXAMPLE — CNF-SAT

- Input : Boolean formula S in CNF
 - A configuration:
 - (S', y) where S' is a Boolean formula in CNF and
 - y is a set of assignments to variables not in S'
 - such that making these assignments in S results in S'
 - “Promising configuration”
 - Most constrained of all formulas in F :
 - S' containing the smallest clause

- Input : Boolean formula S in CNF
 - Sub problems:
 - Locate the smallest clause C in S'
 - Pick a variable x_j that appears in C
 - Create subproblems by assigning $x_j=1$, $x_j=0$ and simplifying S' accordingly
 - Validation:
 - Assignment creates a contradiction: “dead end”
 - Assignment reduces S' to an empty clause: “found solution”

BACKTRACKING ALGORITHM FOR CNF-SAT

- Algorithm BACK_SAT(S): // S is a Boolean formula in CNF

$F = \{ (S, \{\}) \}$

while (F not empty) do {

 let (S1,A1) be the configuration in F containing the smallest clause;

 let C be the smallest clause in S1 and let x be any var. in C;

 for each b in {0, 1} {

 let S2 be the formula obtained by simplifying S1 with x=b;

 if (S2 is empty) then return A1 U {x=b} ;

 else if (S2 is a contradiction) then “ignore”; //backtrack!

 else F = F U { (S2, A1 U {x=b}) };

 }

}

return “no solution”

BACKTRACKING - EXAMPLE

○ Exercise: Hamiltonian Path

- Input : ?
- What is a configuration?
- What is a “Promising configuration”?
- What are sub problems?
- How do you validate?