IE 495 Lecture 18

October 31, 2000

Happy Halloween!

Reading for This Lecture

- Primary
  - Horowitz and Sahni, Chapter 8
  - Grama and Kumar, Parallel Search Algorithms...

Search Algorithms

Branch and Bound Methods

- *Branch and Bound* is a general method that can be used to solve many NP-complete problems.
- Components of Branch and Bound Algorithms
  - Definition of the state space.
  - Branching operation.
  - Feasibility checking operation.
  - Bounding operation.
  - Search order.

The Traveling Salesman Problem

- State Space
- Feasibility Checking
- Branching
- Upper Bounding
- Lower Bounding

Search Strategies

- Depth First
- Breadth First
- Highest Lower Bound
- Lowest Lower Bound
- Best First

More on Search Strategies

- Goal of Branch and Bound
  - Find the optimal solution as quickly as possible
  - Hence, try to minimize the size of the tree
- Minimizing the size of the tree
  - Need to find good upper bounds (feasible solutions).
  - Don't want to work on nodes with high lower bounds (extra work).
  - These are in conflict.

Diving Strategies

- Diving pros and cons
  - more efficient
  - leads to feasible solution
  - can lead to wasted computation.
- Dive periodically, search "best first" the rest of the time.
- Strategies
  - dive randomly
  - dive whenever current lower bound is within a specified percentage of the best.
  - dive whenever there is a high probability of finding a feasible solution.

Revised Branch and Bound

- Maintain a priority queue of candidate subproblems.
- Iterate
  - Pick a subproblem from the queue and process it.
    - Check feasibility.
    - Perform upper and lower bound.
  - Prune if infeasible or lower bound greater than or equal to upper bound.
  - Branch.
  - Consider retaining one (or more) subproblems.
  - Add remaining subproblems to the queue.

Incomplete Branch and Bound

- If we just want to find a "good" solution, we can perform incomplete branch and bound
  - Perform branch and bound
  - Stop whenever the solution is "good enough"
- Throughout the solution process, we have global lower and upper bounds that indicate the quality of our current solution.
- This works well in practice.