Greedy Search Algorithms

- Greedy search
  - A greedy search algorithm is an algorithm that uses a heuristic for making *locally optimal choices* at each stage with the hope of finding a global optimum.
  - No backtracking!
    - No reevaluating choices that the algorithm committed to earlier.

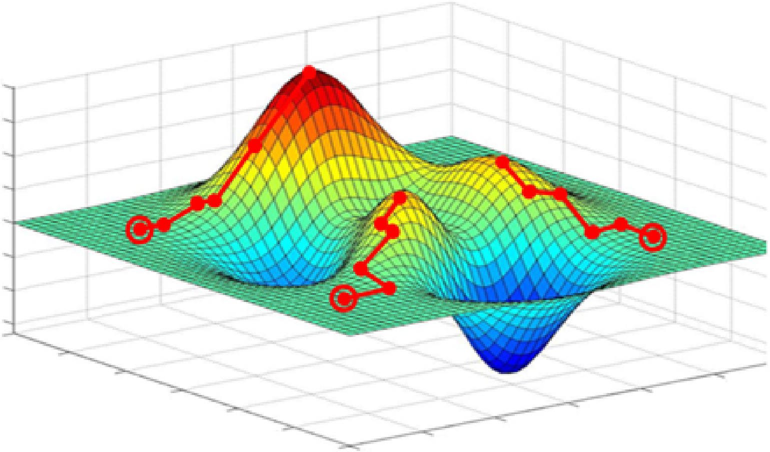
Hill Climbing Search

- Perhaps the most well known greedy search.
- Hill climbing tries to find the optimum (top of the hill) by essentially looking at the local gradient and following the curve in the direction of the steepest ascent.
- Problem: easily trapped in a local optimum (local small hill top)

Hill Climbing Algorithm

```
currentNode = startNode;
loop do
     L = NEIGHBORS(currentNode);
     nextEval = -INF;
     nextNode = NULL;
     for all x in L
        if (EVAL(x) > nextEval)
             nextNode = x;
             nextEval = EVAL(x);
         end if
     end for
     if nextEval <= EVAL(currentNode)
        //Return current node since no better neighbors exist
        return currentNode;
     end if
     currentNode = nextNode;
 end do
```

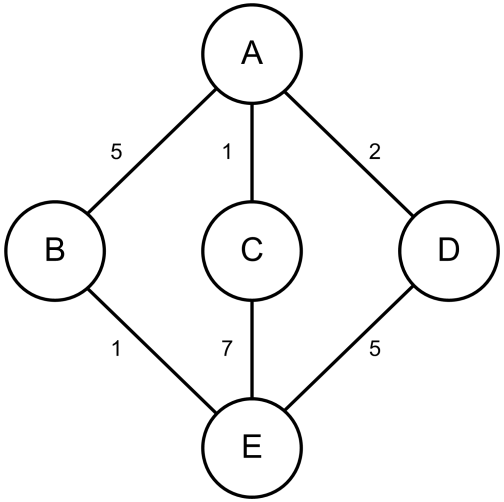
Note: Solutions are very sensitive to the search starting position.



Source: http://en.wikipedia.org/wiki/Hill_climbing

Algorithm Comparison

- Let’s compare UCS with Hill climbing

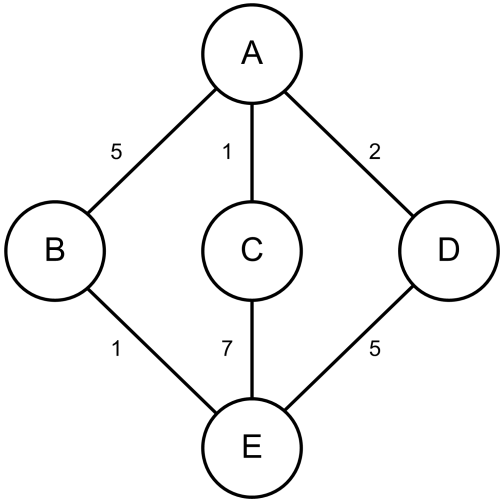


•We will find that UCS will use backtracking to recover from an initial wrong guess.

•We will also find that Hill Climbing will get stuck with its initial bad guess and will compute a sub-optimal solution.

UCS Algorithm

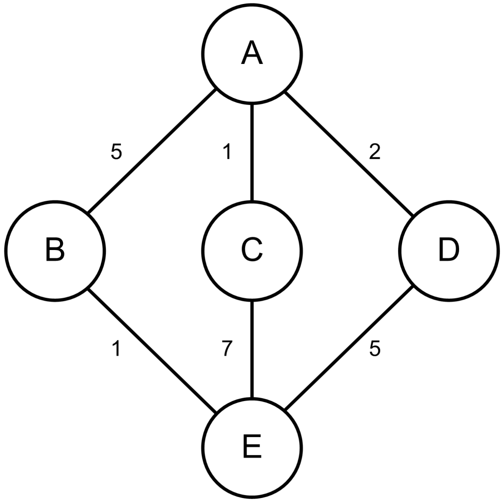
```
OPEN = [initial state]
while OPEN is not empty
do
 0. Sort OPEN according to g(n).
 1. Remove the best node from OPEN, call it n.
 2. If n is the goal state, return n as the solution.
 3. Create n's successors.
 4. For each successor do:
       add it to OPEN.
done
```



g(n) = cumulative cost of path so far.

Hill Climbing

```
currentNode = startNode;
loop do
    L = NEIGHBORS(currentNode);
    nextCost = INF;
    nextNode = NULL;
    for all x in L
      if (HOPCOST(x) < nextCost)
          nextNode = x;
          nextCost = HOPCOST(x);
       end if
    end for
    if nextNode == targetNode
      return “computed path from startNode to nextNode”;
    end if
    currentNode = nextNode;
 end do
```

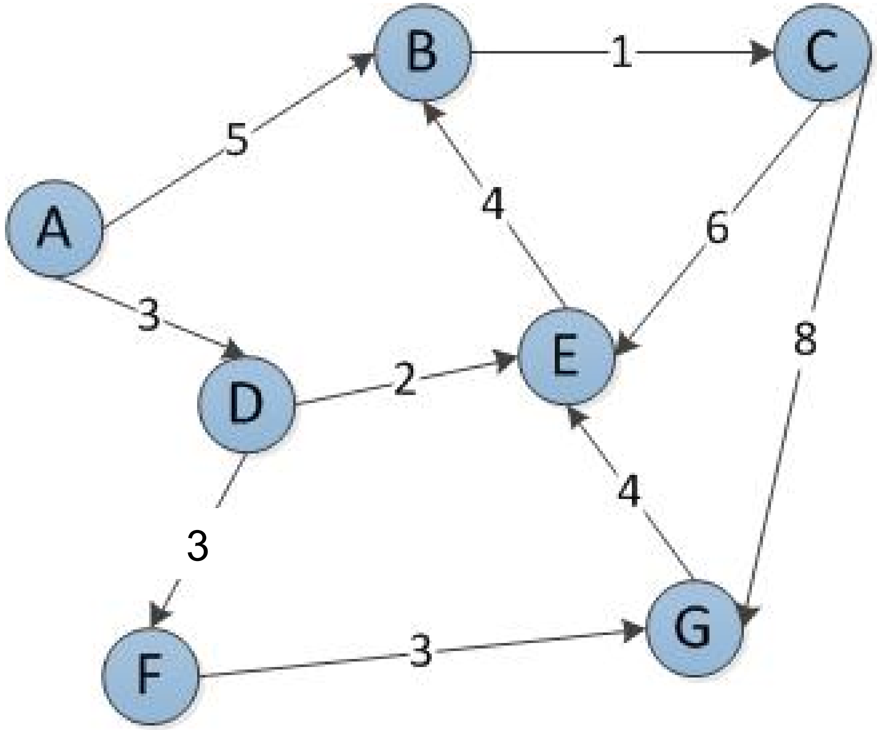


Note: the algorithm has been slightly modified for minimum path finding in a graph.

Observations

- Greedy algorithms can save us a lot of computation (no sorting of the priority queue necessary, no exploration of other alternatives)
- But there are no guarantees of finding the (optimal) solution.

Try it!



Use

1. Hill Climbing (graphs)
2. UCS
3. Best-FS

to find the cheapest Path from A to G.

Note: for h(n) in Best-FS use the number of remaining nodes in the path n