

## Properties of greedy search

Complete?? No—can get stuck in loops, e.g.,

lasi  $\rightarrow$  Neamt  $\rightarrow$  lasi  $\rightarrow$  Neamt  $\rightarrow$

Complete in finite space with repeated-state checking

Time??  $O(b^m)$ , but a good heuristic can give dramatic improvement

Space??  $O(b^m)$ —keeps all nodes in memory

Optimal?? No

## A\* search

Idea: avoid expanding paths that are already expensive

Evaluation function  $f(n) = g(n) + h(n)$

$g(n)$  = cost so far to reach  $n$

$h(n)$  = estimated cost to goal from  $n$

$f(n)$  = estimated total cost of path through  $n$  to goal

A\* search uses an **admissible** heuristic

i.e.,  $h(n) \leq h^*(n)$  where  $h^*(n)$  is the **true** cost from  $n$ .

(Also require  $h(n) \geq 0$ , so  $h(G) = 0$  for any goal  $G$ .)

E.g.,  $h_{\text{SLD}}(n)$  never overestimates the actual road distance

**Theorem:** A\* search is optimal

## Properties of $A^*$

Complete?? Yes, unless there are infinitely many nodes with  $f \leq f(G)$

Time?? Exponential in [relative error in  $h \times$  length of soln.]

Space?? Keeps all nodes in memory

Optimal?? Yes—cannot expand  $f_{i+1}$  until  $f_i$  is finished

$A^*$  expands all nodes with  $f(n) < C^*$

$A^*$  expands some nodes with  $f(n) = C^*$

$A^*$  expands no nodes with  $f(n) > C^*$