Searching and NetLogo

Artificial Intelligence @ Allegheny College

Janyl Jumadinova

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NetLogo

the Agent Based Modeling (ABM) language
NetLogo

NetLogo

the Agent Based Modeling (ABM) language

A language built specifically for agent based modeling

- a modeling environment
- interactively adjust parameters
- feedback through plots and visualizations
What is Modeling?

- A simplified mathematical representation of a system
- Only include features essential to explaining phenomenon of interest
Model Types
- deterministic
- stochastic
- evolving
Deterministic: flocking
Stochastic: network growth
Stochastic: termites
Evolving: genetic algorithms

[Graphs showing fitness and diversity plots with parameters setup, step, go, population size 100, crossover rate 70, mutation rate 0.5]
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- NetLogo is particularly well suited for modeling complex systems that develop over time.
- Using NetLogo you can create programs containing thousands of agents (called “turtles”) all operating independently.
- For us, NetLogo will serve as another programming environment in which to explore the Imperative, Procedural and Object-Oriented Paradigms.
NetLogo

Resources

- Documentation
  http://ccl.northwestern.edu/netlogo/docs/

- Quick Guide

- Dictionary (full list of commands and descriptions of them)
  http://ccl.northwestern.edu/netlogo/docs/dictionary.html
Example: Romania

On holiday in Romania; currently in Arad. Flight leaves tomorrow from Bucharest

**Formulate goal:** be in Bucharest

**Formulate problem:**
- **states:** various cities
- **actions:** drive between cities

**Find solution:** sequence of cities, e.g., Arad, Sibiu, Fagaras, Bucharest
Example: Romania

Can use Tree Search Algorithms (BFS, DFS)

**Special cases:** greedy search, $A^*$ search
Romania with step costs in km

<table>
<thead>
<tr>
<th>City</th>
<th>Distance to Bucharest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arad</td>
<td>366</td>
</tr>
<tr>
<td>Bucharest</td>
<td>0</td>
</tr>
<tr>
<td>Craiova</td>
<td>160</td>
</tr>
<tr>
<td>Dobrota</td>
<td>242</td>
</tr>
<tr>
<td>Eforie</td>
<td>161</td>
</tr>
<tr>
<td>Fagaras</td>
<td>178</td>
</tr>
<tr>
<td>Giurgiu</td>
<td>77</td>
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<tr>
<td>Hirsova</td>
<td>151</td>
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<tr>
<td>Iasi</td>
<td>226</td>
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<tr>
<td>Lugoj</td>
<td>244</td>
</tr>
<tr>
<td>Mehadia</td>
<td>241</td>
</tr>
<tr>
<td>Neamt</td>
<td>234</td>
</tr>
<tr>
<td>Oradea</td>
<td>380</td>
</tr>
<tr>
<td>Pitesti</td>
<td>98</td>
</tr>
<tr>
<td>Rimnicu Vilcea</td>
<td>193</td>
</tr>
<tr>
<td>Sibiu</td>
<td>253</td>
</tr>
<tr>
<td>Timisoara</td>
<td>329</td>
</tr>
<tr>
<td>Urziceni</td>
<td>80</td>
</tr>
<tr>
<td>Vaslui</td>
<td>199</td>
</tr>
<tr>
<td>Zerind</td>
<td>374</td>
</tr>
</tbody>
</table>
A* search

Idea:
avoid expanding paths that are already expensive
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

Romania with step costs
Example: Romania
A* Search

Arad

366 = 0 + 366
A* Search

![A* Search Diagram]

- Zerind
- Arad
- Sibiu
- Timisoara

- Zerind: 447 = 118 + 329
- Arad: 449 = 75 + 374
- Sibiu: 393 = 140 + 253
- Timisoara: 447 = 118 + 329
- Zerind: 449 = 75 + 374
A* Search
A* Search

Sink

Source

Zerind

Arad

Sibiu

Arad

Timisoara

Fagaras

Oradea

Rimnicu Vilcea

Craiova

Pitesti

Sibiu

447 = 118 + 329
449 = 75 + 374
646 = 280 + 366
415 = 239 + 176
526 = 366 + 160
553 = 300 + 253
417 = 317 + 100
671 = 291 + 380
A* Search

- Zerind
- Arad
- Sibiu
- Arad
- Timisoara
- Sibiu Bucharest
- Rimnicu Vilcea
- Fagaras
- Oradea
- Arad
- Sibiu
- Fagaras
- Oradea
- Rimnicu Vilcea
- Fagaras
- Oradea
- Rimnicu Vilcea
- Fagaras
- Oradea
- Rimnicu Vilcea

447 = 118 + 329
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