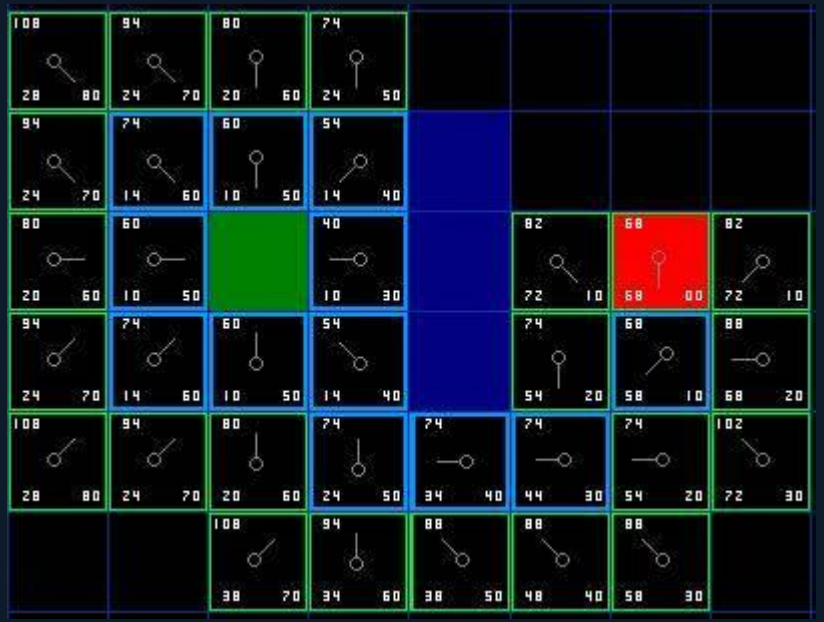
A* - Part 2



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Lecture Contents

- More Advanced A* Graphs
  - Choosing edge weights
  - One way paths
- A Variety of Heuristics
  - Grid Based Graphs
  - 8 Way Graphs
- Arbitrary Position Nodes
- Admissible and Nonadmissible Heuristics
- Breaking Ties

More Advanced A* Graphs

- So far we've described simple pathfinding graphs, where each edge weight is the distance between the two nodes.

- We can add a lot more variety to our graphs by adding a few more options.

Choosing Edge Weights

- So far we've only covered using the distances between nodes as the cost of the edges.

- There are many other weightings we could apply to our graphs.
  - Weightings based on *terrain types*
    - Swamps would be much slower than dry land.
  - Weightings based on danger levels
    - You might want your agents to avoid the enemy base or other dangerous areas.
  - Different types of agents
    - You might not store the weightings directly in the edges themselves.
      - Instead just store what kind of terrain it is
    - Different agents in the game could have their own table of weightings based on terrain types
      - A tank would have very different weightings to a bicycle

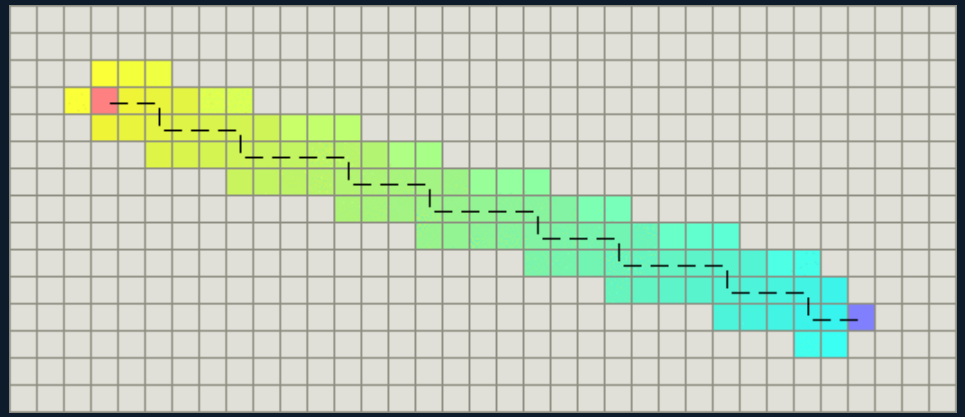
Choosing a Heuristic

- The Heuristic for an A* search has a huge impact on how fast the algorithm runs, as well as what your final path is.

- As such we want to be able to understand all the options of heuristic available to us.

Heuristics for Different Graph Types

- 4-way Grids
  - Manhattan Distance (x diff + y diff)
  - If there are no obstacles, this is a perfect heuristic for 4 way grids

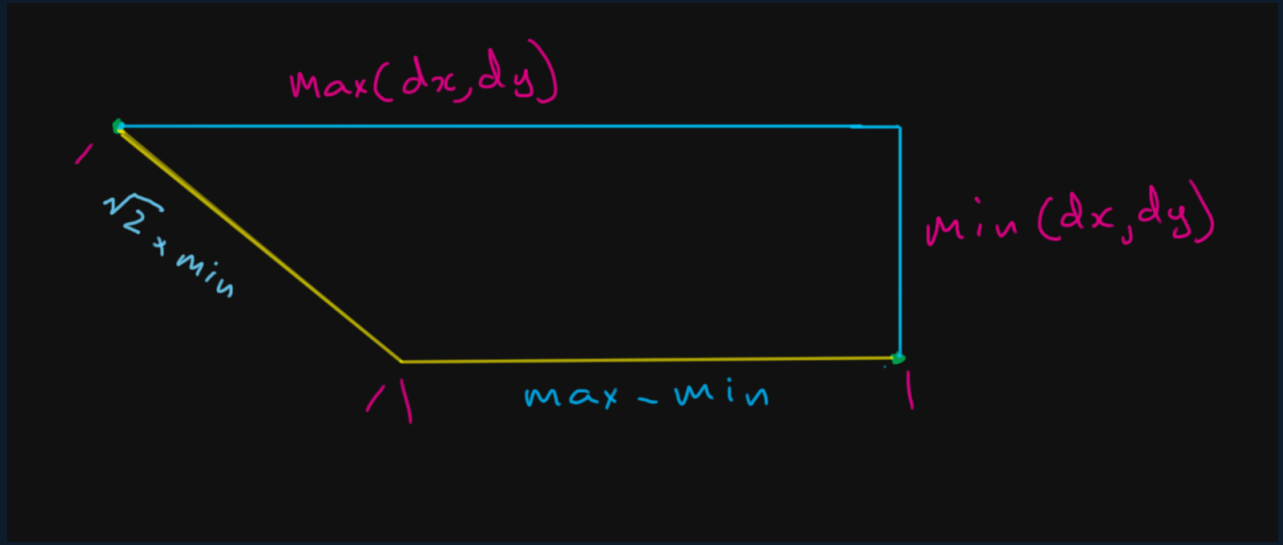


Heuristics for Different Graph Types

- 8-way grids
  - For 8 way grids, we think about the fact that we can only move in straight lines or at 45 degree angles.
  - We have more freedom than 4 way grids, but using the straight line heuristic still isn’t quite accurate.
  - Diagonal movement is efficient, so we want to move as far as we can diagonally and then add the rest of the trip length to the end.

Heuristics for Different Graph Types

- 8-way grids



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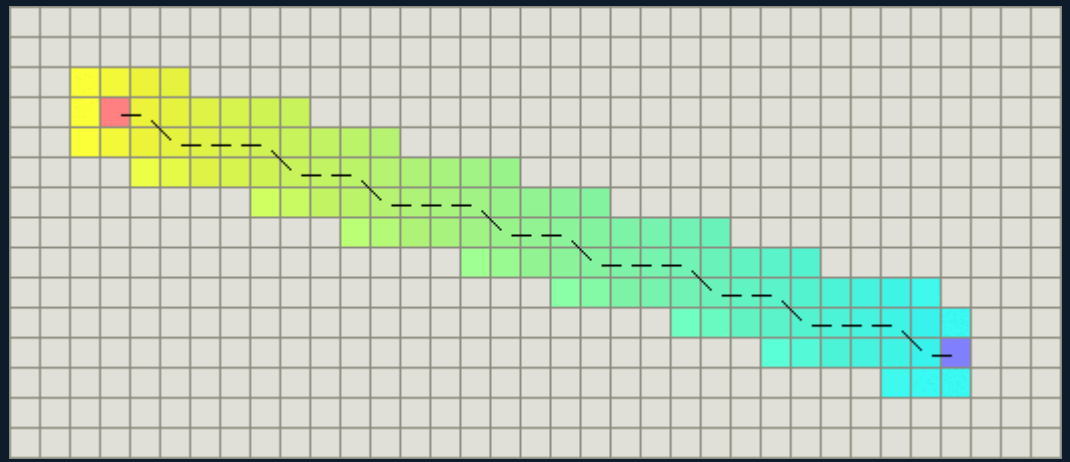
Heuristics for Different Graph Types

- 8-way grids
  - Sqrt(2) * min(dx, dy) + (max(dx, dy) – min (dx, dy))



Heuristics for Different Graph Types

- Arbitrary Nodes
  - Straight Line distance

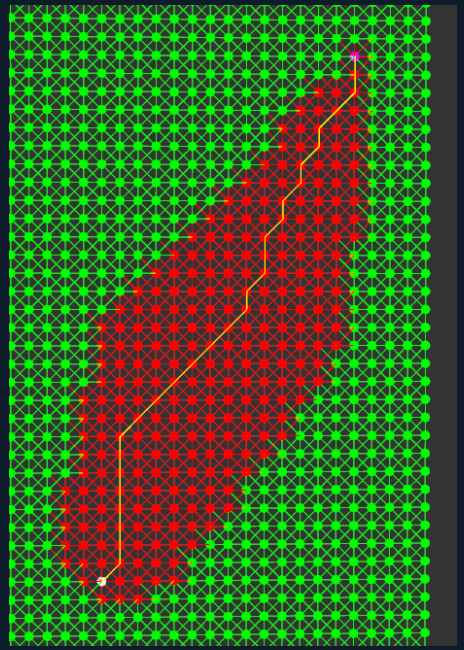
Admissible Heuristics

- An admissible heuristic is one that always underestimates how close the node is to the goal.
- All the heuristics we've looked at so far have been admissible.
- An admissible heuristic will guarantee A* gives the shortest path.

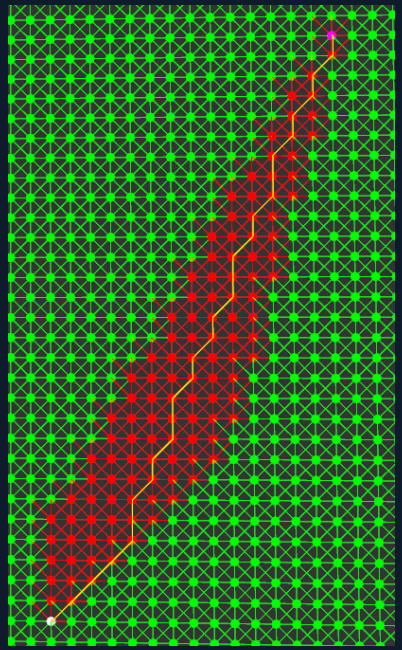
Inadmissible Heuristics

- Inadmissible Heuristics are ones that sometimes overestimate how close you are to the goal
- Inadmissible heuristics no longer guarantee shortest path, however they can mean that A* might pick fewer nodes, leading to faster execution.
- The simplest form of inadmissible heuristic is to just multiply your H value by a constant.
- This works really well in empty spaces, but can cause problems when navigating more complex areas.

Inadmissible Heuristics



F = G + H



F = G + (H * 1.075)

Choosing a Heuristic

- There is no one size fits all best heuristic

- You need to choose the best one for your graph and the entities that will be traversing it.

Questions?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