ECE183DA (Winter 2022)

Design of Robotic Systems I

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Problem set 3 | Discretization and function approximation

Key takeaways

After this lecture, you should understand:

- Scaling issues in MDP solving;
- How to approximate the solution to a continuous space (or large discrete space) MDP by solving a smaller MDP;
- How to derive discretization as a special case of solving MDPs in (basis) function space; and
- The impact of the choice of basis as you solve a large MDP using function approximation.

Assignment

Consider the planning problem of circumnavigating the Earth by sea[1] with a holonomic ocean-going robot boat. In order to succeed, you must start and end in Los Angeles, making a complete loop around the world having passed through the antipode of LA off the coast of Madagascar[2].

3(a). Define the 2D position of your robot on the surface of the Earth by it's latitude and longitude coordinates. In two or three English sentences, explain: Is this position sufficient to represent the state of the robot for this task? Why or why not? If not, what more would you need?

3(b). Consider discretizing the (continuous) robot position by a lattice (grid) decomposition of the lat/lon coordinates. In two or three English sentences, explain why this might not be a computationally effective method of discretization.

3(c). In two or three English sentences: choose and defend a small set of basis functions (features) on the state you described in 3(a) that you could use for value function approximation on this specified task.

3(d). Would you be willing to let us use your correct responses as (anonymized) examples for the class?

[1] https://en.wikipedia.org/wiki/Circumnavigation#Definition

[2] https://www.geodatos.net/en/antipodes/united-states/los-angeles