ITCS 6150
Intelligent Systems

Lecture 2

Agents

What is an agent?

Perception

- Sensors receive input from environment
  - Sound/Voice data
  - Video/Image data
  - Signals registered within human brain (reading electrodes)

Action

- Impacts the environment
  - Move a robotic arm
  - Generates action shown on computer display

Evaluating agent programs

We agree on what an agent must do

Can we evaluate its quality?

Performance Metrics

- Very Important
- Frequently the hardest part of the research problem
- Design these to suit what you really want to happen

Rational Agent

For each percept sequence, a rational agent should select an action that maximizes its performance measure

Example: autonomous vacuum cleaner

- What is the performance measure?
  - Penalty for missing a spot?
  - Reward for speed?
  - Reward for conserving power?

Learning and Autonomy

Learning

- To update the agent function in light of observed performance of percept-sequence to action pairs
  - Explore new parts of state space
    - Learn from trial and error
  - Change classifiers that influence action selection

Adding intelligence to agent function

At design time

- Some agents are designed with clear procedure to improve performance over time. Really the engineer's intelligence.
  - Camera-based user identification

At run-time

- Agent executes complicated computation to map input to output

Between trials

- With experience, agent changes its program

Qualities of a task environment

Fully Observable

- All aspects of state are available
  - Volume of observables may be overwhelming

Partially Observable

- Some data is unavailable
  - Maze & Noisy sensors
  - Instruments played in polyphonic music and Medical datasets

Qualities of a task environment

Static

- Environment doesn't change over time
  - Crossword puzzle

Dynamic

- Environment changes over time
  - Driving a car

Semi-dynamic

- Environment is static, but performance metrics are dynamic
  - Drag racing

Qualities of a task environment

Towards a terse description of problem domains

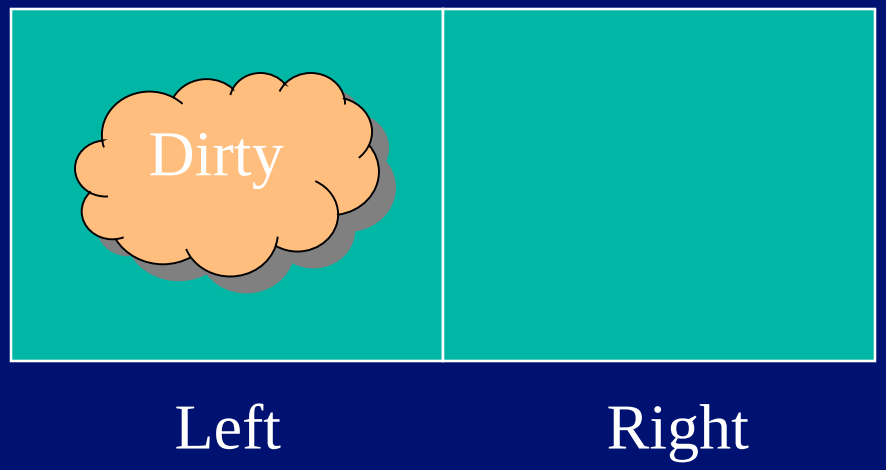
- State space: features, dimensionality, degrees of freedom
- Observable?
- Predictable?
- Dynamic?
- Continuous?

- Performance metric

Simple Reflex Agents

Randomization

- The vacuum cleaner problem



Model-based Reflex Agents

So when you can't see something, you model it!

- Create an internal variable to store your expectation of variables you can't observe
- If I throw a ball to you and it falls short, do I know why?
  - Aerodynamics, mass, my energy levels…
  - I do have a model
    - Ball falls short, throw harder

Model-based Reflex Agents

Admit it, you can't see and understand everything

Models are very important!

- We all use models to get through our lives
  - Psychologists have many names for these context-sensitive models
- Agents need models too

Goal-based Agents

Lacking moment-to-moment performance measure

Overall goal is known

How to get from A to B?

- Current actions have future consequences
- Search and Planning are used to explore paths through state space from A to B

Learning Agents

Learning Element

- Making improvements

Performance Element

- Selecting actions

Critic

- Provides learning element with feedback about progress

Problem Generator

- Provides suggestions for new tasks to explore state space

A taxi driver

Performance Element

- Knowledge of how to drive in traffic

Critic

- Observes tips from customers and horn honking from other cars

Learning Element

- Relates low tips to actions that may be the cause

Problem Generator

- Proposes new routes to try and improved driving skills