Neural Networks for Control

Week 4, Lecture 1

Neural Networks for Control

Announcements:
HW 2 Due on 10/22
Data sets for HW 2 are online

Suggested reading:
NN control papers (Shepherd and Miikkulainen)
Sections 12.4, 12.6 and 16.5 Passino

Homework Expectations

• Presentation 3 pts
  – Clarity
  – Figures
  – Writing

• Analysis 5 pts
  – Answering questions
  – Insight (classification problem?)
  – Results (data set 2? 3?)
  – Working code

• Thoroughness 2 pts
  – Validation set?
  – Statistical significance
Problem Definitions

- Do we know what are good robot actions?
  - YES: Supervised learning
    Drive around with the training “on” to generate input/output pairs
  - NO: Unsupervised learning (critic based learning)
    Explore parameters till you find “right behavior”

- Online/Offline?
  - Offline: train/search for a complete solution before implementing
  - Online: take action, evaluate, take next action etc.

Example: Robot Control

- Robot observe environment through some sensors
• Robots observe environment through some sensors
• Sensors fed into a neural network

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• Sensors fed into neural network
• Output of neural network determines direction/velocity of rover
Sensor Inputs
Desired Heading

Autonomous
Robot

heading

Sensor Inputs
Desired Heading

Neuro Controller

Steering

Autonomous
Robot

Heading

Kagan Tumer
Oregon State University
Robot Control

Sensor Inputs
Desired Heading

Neuro Controller
Steering
Autonomous Robot
Heading

Neural Network Training Signal

Robot Control : Learn with a Teacher

Sensor Inputs
Desired Heading

Neuro Controller
Steering Error
Steering
Autonomous Robot
Heading

Kagan Tumer
Oregon State University
1. At t=0 initialize a neural network
1. At $t=0$ initialize a neural network

2. Let neural network pick heading

3. Compute heading error using teacher
Neuro-Control with a teacher

1. At t=0 initialize a neural network
2. Let neural network pick heading
3. Compute heading error using teacher
4. Use error to update neural network weights
5. Go to step 2
1. At $t=0$ initialize $N=10$ neural networks

2. Pick a network using $\epsilon$-greedy alg ($\epsilon=.1$)
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3. Randomly modify network parameters
4. Use network on this agent for 15 steps
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5. Evaluate network performance
6. Re-insert network into pool
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2. Pick a network using $\epsilon$-greedy alg ($\epsilon=.1$)
3. Randomly modify network parameters
4. Use network on this agent for 15 steps
5. Evaluate network performance
6. Re-insert network into pool
7. Remove worst network from pool
8. Go to step 2
Questions

- Algorithm
  - Evolutionary with $k=10$
  - Only 1 successor generated (instead of $k$) at each iteration

- Online/Offline
  - Online

- Supervised/Unsupervised
  - Unsupervised

- Deterministic/Stochastic
  - Stochastic

- Modifications?