CMP9764M AR – Week 2 - cLearning from Humans 2

Learning from Humans: Methods

Basic RL and feedback simulation

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Learning from Humans

There are two ways from learning from Humans:

* Learning from humans in general
  + General characteristics of people in terms of psychology, physical properties, etc.
* Learning from humans through interaction
  + Learning directly from humans, in terms of skills, expertise, knowledge, etc.

Learning from humans in general

**Human Aware Navigation**

Autonomy for mobile robots requires navigation

Autonomy for mobile robots requires navigation capabilities

Obstacle avoidance clearly required

* Preventing robot damage
* Human safety!

Goals(Kruse et al, 2013):

1. Comfort - absence of annoyance and stress for humans
2. Naturalness - similarity of robot behaviour to humans
3. Sociability - adherence to high-level cultural constraints

May be necessary to reduce efficiency (in terms of speed/distance to goal) in the service of these goals.

Learning from Humans through ‘direct’ interaction

**Learning from Demonstration (LfD)**

Generally: “category of algorithms in which a policy is derived based on demonstrated data” (Argall et al, 2009)

Subset of supervised learning: agent presented with labelled training data, learns function approximation. (Because the human is providing the instructions)

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**LfD key issues**

Nehaniv & Dautenhahn (2001):

* What to imitate? How to imitate? When to imitate? From whom to imitate?
* LfD How generally only addresses the first two issues

The “correspondence problem”

Particularly for learning from human demonstrations

How to make the mapping between human morphology and machine morphology.

* Perceptual equivalence: how robots perceive the world, and whether they have access to the relevant information?
* Physical equivalence: can the robot actually perform the desired action?

**Interactive Machine Learning (IML)**

Essentially:

Machine learning in which there is a human in the learning loop, where the human provides input in order to improve the outcome of the learning, therefore the human is integrated into the learning.

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**IML principles**

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The idea is that a much faster update is provided to the system through the user, there is no need to go via a machine learning expert.

**Interactive Reinforcement Learning (IRL)**

A more specific case of IML: using specifically Reinforcement Leaning algorithms.

In this context, the human observer/trainer/supervisor has a clear means of influencing learning:

* The Reward

Question is, how should this reward be manipulated by the human to best effect?

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**Humans providing feedback**

Three main characteristics of human feedback to a reinforcement learning agent (Thomaz et al, 2008).

Use the reward to provide both instantaneous feedback and future-directed guidance.

There is a positive bias to the feedback – possibility that this is used as a means of motivation.

Feedback behaviour is changed as they learn about the learning agent.

**IRL example: Q-Learning**

Start with standard Q-Learning

* The Bellman equation:

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How could a human intervene?

Could set the value of r – setting the reward for a given action in a given state

Caveat – human needs enough time to apply the reward – would this need to be enforced by the algorithm / context?

<https://medium.freecodecamp.org/an-introduction-to-q-learning-reinforcement-learning-14ac0b4493cc>

Humans needs enough time to provide a reward otherwise the reward feedback wouldn’t be meaningful.

IRL example: TAMER (Inspired by clicker training for dogs)

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**IRL application: learning about objects**

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**IRL for Social HRI**

How to enable a robot to learn (aspects of) social interaction with a human?

Using the IRL perspective

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**Some open questions…**

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