Hierarchical Reinforcement Learning

Introduction

Cliff Li
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Cake

Source: reddit.com/u/GreekElisium
Deficiencies of classical Reinforcement Learning

- Huge state and action spaces
- Credit assignment
- Transfer learning
- Overfitting (Overspecialization)
- Knowledge representation
Hierarchical Reinforcement Learning in a nutshell

Bake a cake

Beat eggs with sugar
Add flour and cocoa

Crack eggs into bowl
Pour sugar into bowl

Grab egg
Crack egg against counter

Simultaneously contract flexor digitorum profundis and flexor pollicis longus
Benefits of Hierarchical Reinforcement Learning

- Structured exploration in state and action spaces
- Easier propagation of rewards
- Enables transfer learning
- Generalization through abstraction
- Better knowledge representation
Semi-Markov Decision Processes (SMDP) and Options
Between MDPs and semi-MDPs: A framework for temporal abstraction in reinforcement learning (Sutton et al., 1999)
Between MDPs and semi-MDPs: A framework for temporal abstraction in reinforcement learning (Sutton et al., 1999)
Between MDPs and semi-MDPs: A framework for temporal abstraction in reinforcement learning (Sutton et al., 1999)
Feudal Reinforcement Learning (Dayan and Hinton, 1993)
Challenges of Hierarchical Reinforcement Learning

- Learning options
- Meaningful hierarchies
- Collapsing hierarchies into single policy
- Updating lower-level policies affects higher-level performance
FeUdal Networks for Hierarchical Reinforcement Learning
(Vezhnevets et al., 2017)
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References

