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Reinforcement Learning - Introduction

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Trivia

Why should I care?

- At the very core deep learning can solve problem of classification, regression i.e. approximating complex functions.
- Reinforcement learning on the other hand help's us devise an optimum strategy to follow in our feat of maximizing reward.

Okay gang, let's see who the advanced AI really is.
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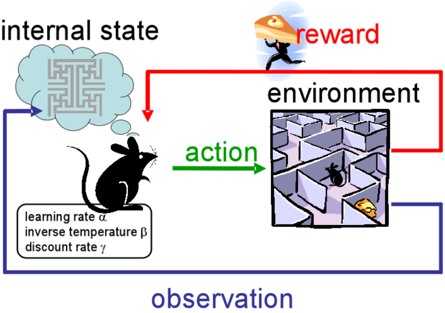
Trivia

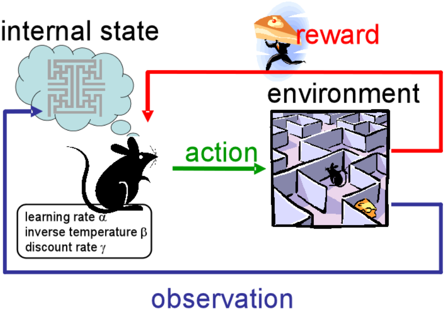
News

- RL Beats Humans at Dota 2. ▸ Link
- AlphaGo beats 18-time world champion Lee Sedol. ▸ Link
- Google has developed an approach to hyperparameter tuning using reinforcement learning that they call AutoML. ▸ Link

- **State** - It can be seen as a variable which directly affect the action taking mechanism. In an environment such as a maze, a state can be seen as the x, y coordinates of the agent.



- **Action** - Performing a particular action in a particular state takes you to the next state.
- The mouse can move in either of the four directions to reach the next block.

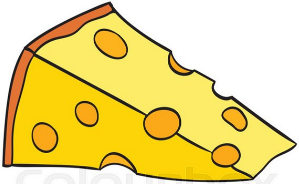


Introduction

Jargons

- **Agent** - It is an abstraction of the entity which acts and learns from previous experiences in hope to maximize reward.
- In this case our agent is - mouse.

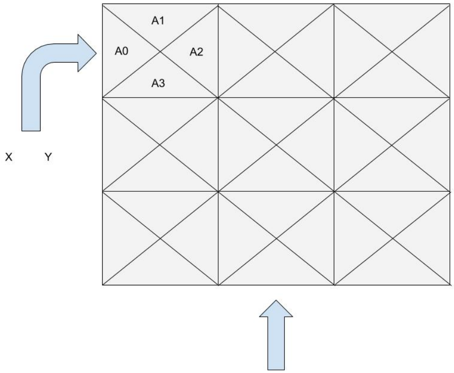
- **Reward** - It is the utility that our agent is trying to maximize.
- For our mouse reward is - cheese.



Introduction

Jargons

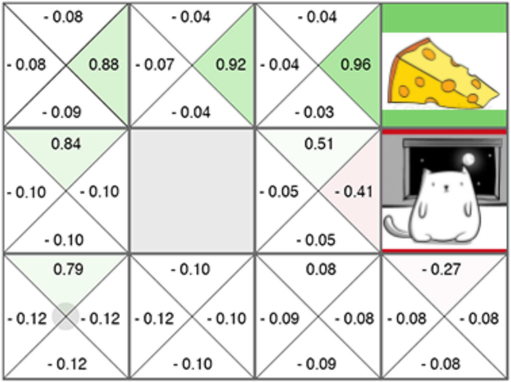
- **Environment** - Environment can be considered as a entity which takes in space-action and returns the next state and reward for that action.



Environment

Reinforcement Learning

Deep Q learning



What can be the best case scenario?

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Deep Q-Network Training

- Bellman Equation:

$$Q(s,a) = r + \gamma max_{a'} Q(s',a')$$

- Loss function (squared error):

$$L = \mathbb{E}[(\underbrace{\boldsymbol{r + \gamma max_{a'} Q(s',a')}}_{\textbf{target}} - Q(s,a))^2]$$

Why discount the reward by gamma?

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- So that rewards do not diverge as the time steps increase.

Why discount the reward by gamma?

- So that rewards do not diverge as the time steps increase.
- We will be running in circles.

Exploration!

- We take the optimum action but sometimes we take a random action with exploration probability ϵ so that surroundings are investigated for possible rewards.
- We decay this ϵ over time exponentially.

$$\epsilon = \epsilon_{min} + (\epsilon_{max} - \epsilon_{min}) * \exp^{(-\lambda * t)}$$

Reinforcement Learning

Deep Q learning

- **Explore** - Take random actions and create a queue of (current state, action, next state, reward).

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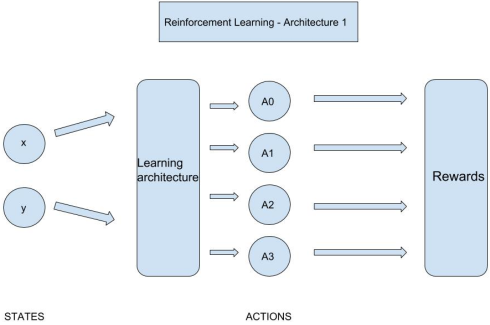
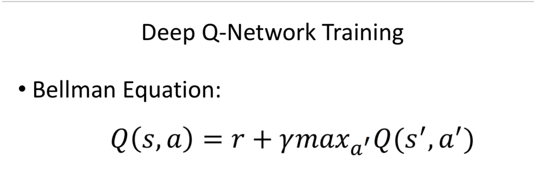
- **Play** - The model is tested by keeping the exploration probability as zero and stopping learning from experiences.

Reinforcement Learning

Deep Q learning





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Reinforcement Learning

Deep Q learning

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- Due to the max in the formula for setting targets, the network suffers from maximization bias, possibly leading to overestimation of the Q function's value and poor performance.

$$\underbrace{Q(s,a)}_{\text{TD target}} = r(s,a) + \underbrace{\gamma Q(s', \underbrace{argmax_a Q(s',a)}_{\text{DQN Network choose action for next state}})}_{\text{Target network calculates the Q value of taking that action at that state}}$$

Like most all machine learning algorithms all this comes at a price.

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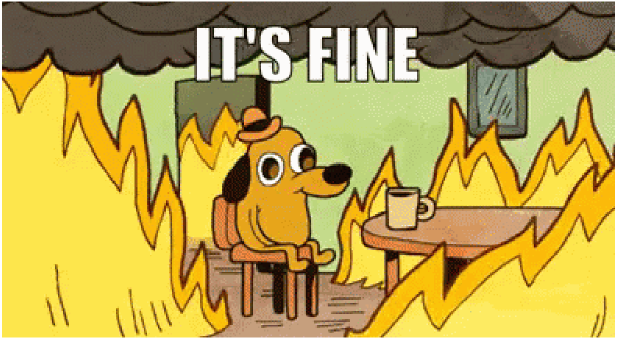

It uses a lot of system resources!

Reinforcement Learning

Breakout

Breakout by deepmind ▸ Link

Examples

openAI gym and fromscratchtoml

openAI gym provides an environment for your agent to learn and play around. ▸ Link

Code for machine learning algorithms from scratch - ▸ Link

Thank You