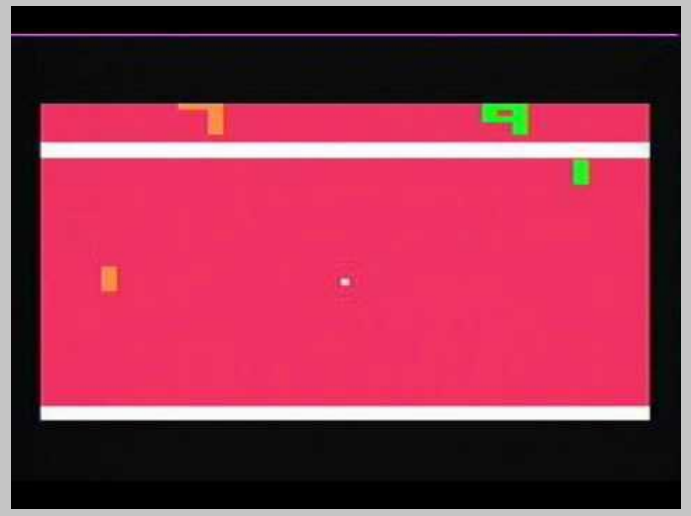
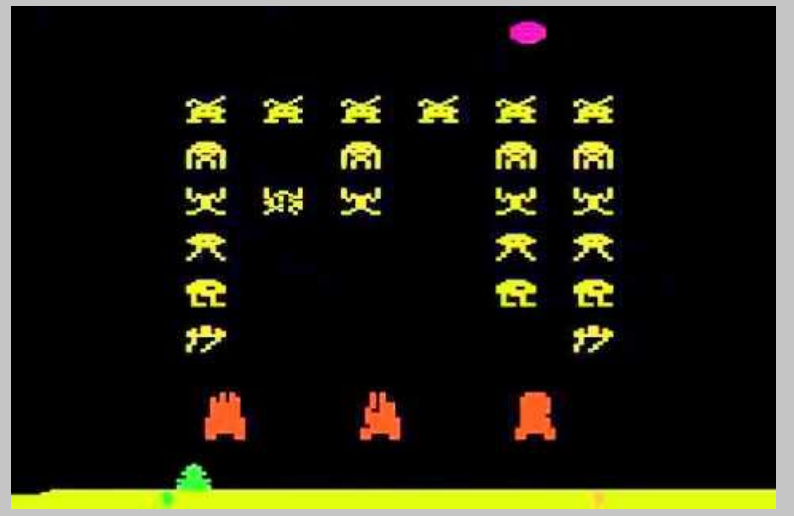
Remember these?





Playing Atari Games using RL

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Motivation

May be we can design game players for each one of them!

But, how about an AI agent who can **learn** to play them **all**!

This is where the concept of a *general game player* come into the picture.

In this project we are trying to implement a deep reinforced learning based agent to play multiple video games.

Problem Statement

Learning to play *Breakout* using a convolutional neural network model trained with a variant of Q-learning, whose input would be raw pixels and whose output would be a value function estimating future rewards.

Concepts Involved

Reinforcement Learning

Q-Learning

Convolutional Neural Network

Reinforcement Learning and Q-Learning

In a reinforcement learning model, an agent takes actions in an environment with the goal of maximising a cumulative reward.

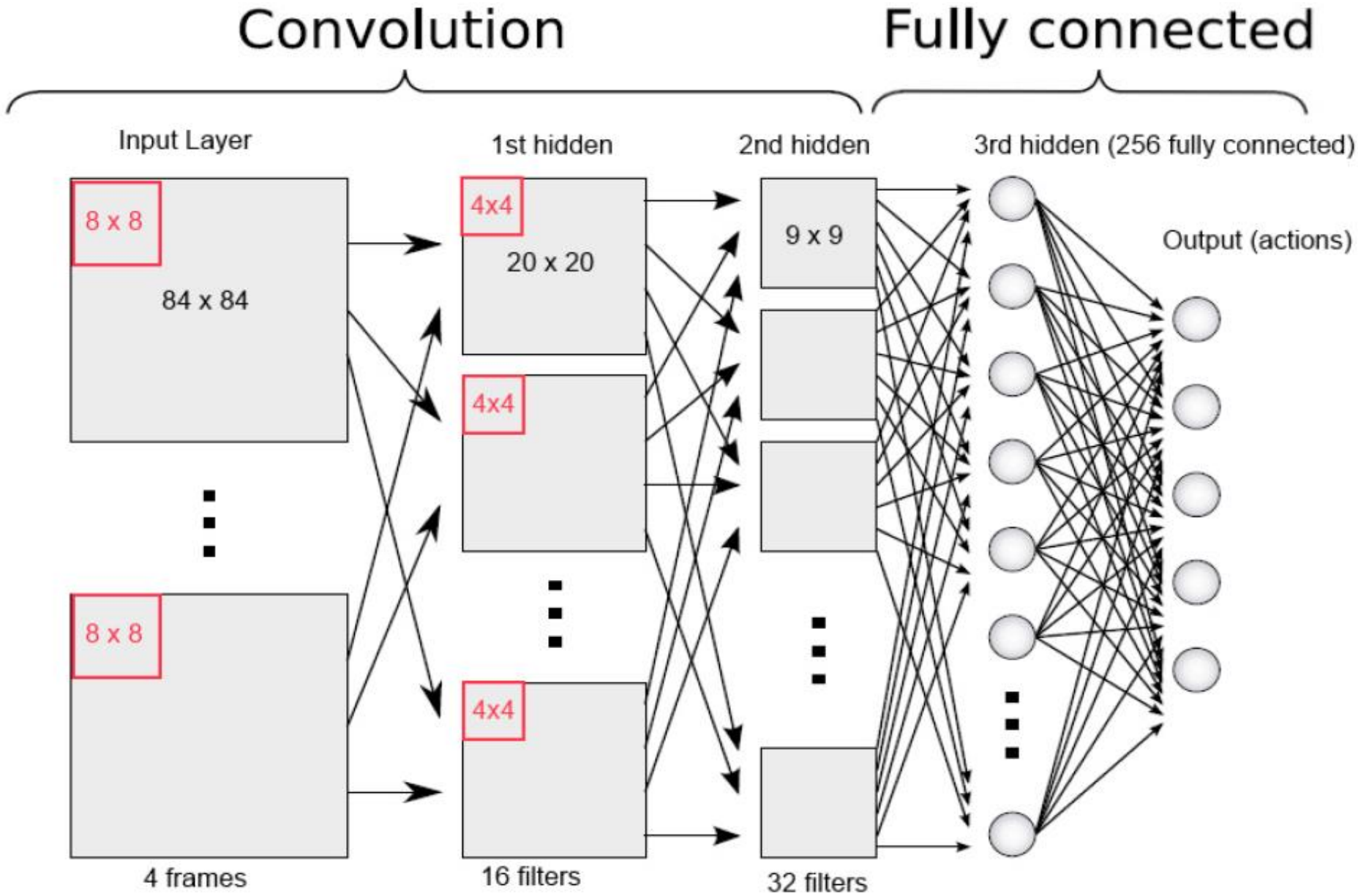
Q-learning is a model free form of RL

Algorithm:

$$
\begin{aligned}
&Initialize\ \boldsymbol{Q}(\boldsymbol{s},\boldsymbol{a})\ arbitrarily\\
&Repeat\ (for\ each\ episode):\\
&Initialize\ \boldsymbol{S}\\
&Repeat\ (for\ each\ step\ of\ episode):\\
&Choose\ \boldsymbol{a}\ from\ \boldsymbol{s}\ using\ policy\ derived\ from\ \boldsymbol{Q}\\
&(e.g.\ \in -greedy)\\
&Take\ action\ \boldsymbol{a}, observe\ \boldsymbol{r}, \boldsymbol{s'}\\
&\boldsymbol{Q(s,a)} <-- \boldsymbol{Q(s,a)} + \boldsymbol{\alpha}[\boldsymbol{r} + \boldsymbol{\gamma}.\boldsymbol{max}\,\boldsymbol{Q}(\boldsymbol{s'},\boldsymbol{a'}) - \boldsymbol{Q(s,a)}]\\
&\boldsymbol{s} <-- \boldsymbol{s'}\\
&until\ \boldsymbol{s}\ is\ terminal
\end{aligned}
$$

Convolutional Neural Networks

- Suited for extracting features from images
- We take 4 images at a time, downscaled to 84x84 pixels
- Images taken as 2D matrices
- 2D matrices convolved with linear filters
- Weight matrices for multiple image


Convolution
Fully connected
Input Layer
1st hidden
2nd hidden
3rd hidden (256 fully connected)
8 x 8
84 x 84
8 x 8
4x4
20 x 20
4x4
4x4
9 x 9
Output (actions)
4 frames
16 filters
32 filters
Nodes: 84 x 84 x 4 20 x 20 x 16 9 x 9 x 32 256 4
Weights: 8 x 8 x 4 x 16 4 x 4 x 16 x 32 9 x 9 x 32 x 256 256 x 4

Arcade Learning Environment

- It is built on top of Stella, open-source Atari 2600 emulator
- Built in C++, Support for over 50 games
- Can programmatically input player commands
- Outputs Image of the game screen, score and the state of the game

References

[1] The Arcade Learning Environment: An Evaluation Platform for General Agents by Marc G. Bellemare, Yavar Naddaf, Joel Veness, and Michael Bowling Journal of Artificial Intelligence Research 47, pp. 253-279, 2013.

[2] Stella Emulator: http://stella.sourceforge.net/

[3] Playing Atari with Deep Reinforcement Learning by Volodymyr Mnih, Koray Kavukcuoglu, David Silver, Alex Graves, Ioannis Antonoglou, Daan Wierstra, Martin Riedmiller NIPS Deep Learning Workshop, 2013.

Any Questions ??