RLlib: Industry-Grade, Scalable Reinforcement Learning

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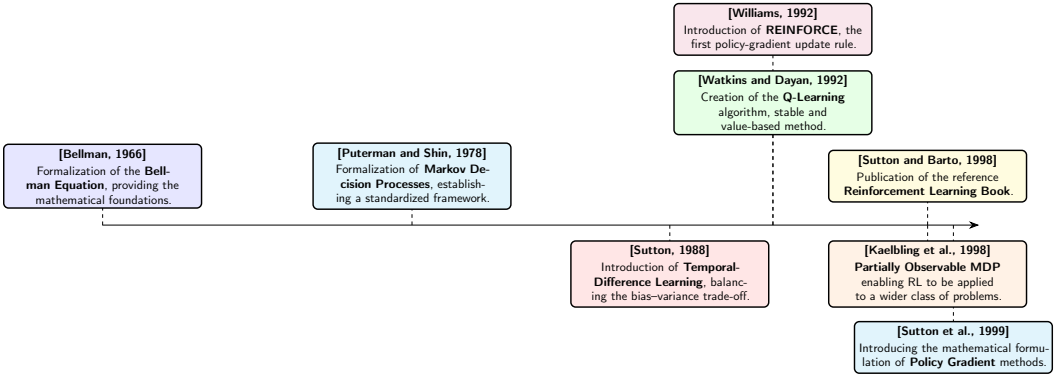
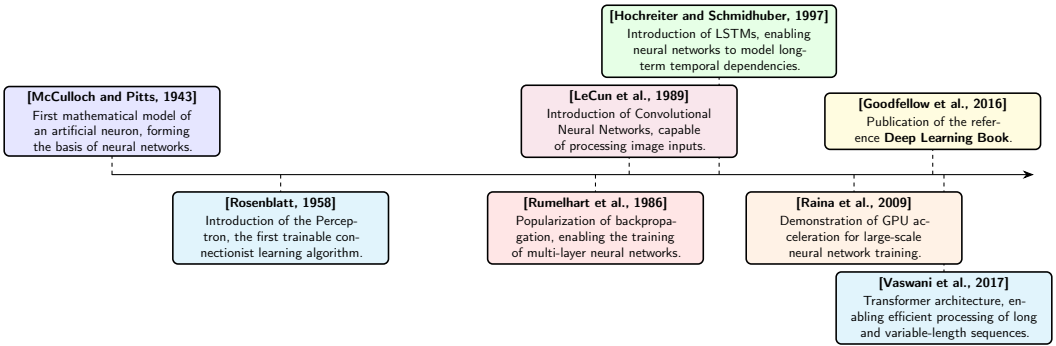
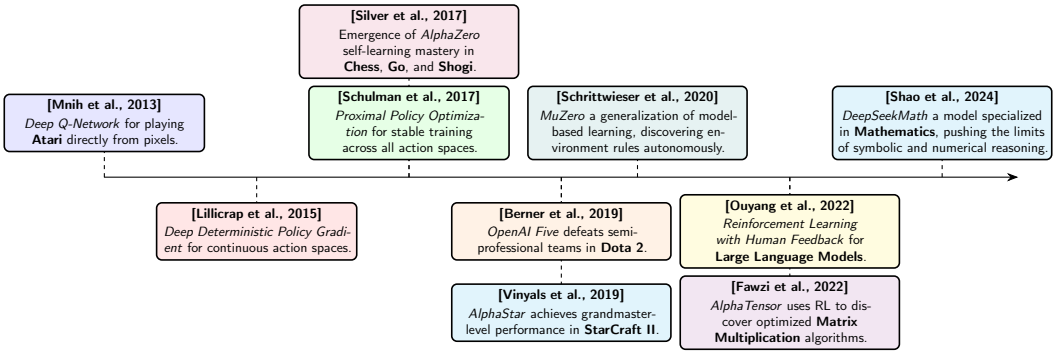

[Bellman, 1966]
Formalization of the **Bellman Equation**, providing the mathematical foundations.
[Puterman and Shin, 1978]
Formalization of **Markov Decision Processes**, establishing a standardized framework.
[Williams, 1992]
Introduction of **REINFORCE**, the first policy-gradient update rule.
[Watkins and Dayan, 1992]
Creation of the **Q-Learning** algorithm, stable and value-based method.
[Sutton, 1988]
Introduction of **Temporal-Difference Learning**, balancing the bias–variance trade-off.
[Sutton and Barto, 1998]
Publication of the reference **Reinforcement Learning Book**.
[Kaelbling et al., 1998]
Partially Observable MDP enabling RL to be applied to a wider class of problems.
[Sutton et al., 1999]
Introducing the mathematical formulation of **Policy Gradient** methods.


[McCulloch and Pitts, 1943]
First mathematical model of an artificial neuron, forming the basis of neural networks.
[Rosenblatt, 1958]
Introduction of the Perceptron, the first trainable connectionist learning algorithm.
[Hochreiter and Schmidhuber, 1997]
Introduction of LSTMs, enabling neural networks to model long-term temporal dependencies.
[LeCun et al., 1989]
Introduction of Convolutional Neural Networks, capable of processing image inputs.
[Rumelhart et al., 1986]
Popularization of backpropagation, enabling the training of multi-layer neural networks.
[Goodfellow et al., 2016]
Publication of the reference Deep Learning Book.
[Raina et al., 2009]
Demonstration of GPU acceleration for large-scale neural network training.
[Vaswani et al., 2017]
Transformer architecture, enabling efficient processing of long and variable-length sequences.


[Silver et al., 2017]
Emergence of *AlphaZero* self-learning mastery in **Chess**, **Go**, and **Shogi**.
[Mnih et al., 2013]
Deep Q-Network for playing **Atari** directly from pixels.
[Schulman et al., 2017]
Proximal Policy Optimization for stable training across all action spaces.
[Schrittwieser et al., 2020]
MuZero a generalization of model-based learning, discovering environment rules autonomously.
[Shao et al., 2024]
DeepSeekMath a model specialized in **Mathematics**, pushing the limits of symbolic and numerical reasoning.
[Lillicrap et al., 2015]
Deep Deterministic Policy Gradient for continuous action spaces.
[Berner et al., 2019]
OpenAI Five defeats semi-professional teams in **Dota 2**.
[Ouyang et al., 2022]
Reinforcement Learning with Human Feedback for **Large Language Models**.
[Vinyals et al., 2019]
AlphaStar achieves grandmaster-level performance in **StarCraft II**.
[Fawzi et al., 2022]
AlphaTensor uses RL to discover optimized **Matrix Multiplication** algorithms.

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Dynamic programming.
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Playing atari with deep reinforcement learning.
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Training language models to follow instructions with human feedback.
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