# RLlib: Industry-Grade, Scalable Reinforcement Learning

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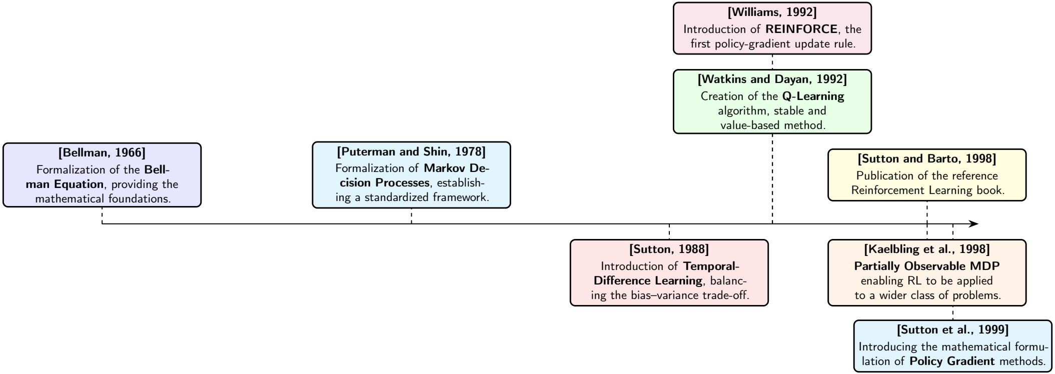


**[Bellman, 1966]**
Formalization of the **Bellman Equation**, providing the mathematical foundations.

**[Puterman and Shin, 1978]**
Formalization of **Markov Decision Processes**, establishing a standardized framework.

**[Sutton, 1988]**
Introduction of **Temporal-Difference Learning**, balancing the bias–variance trade-off.

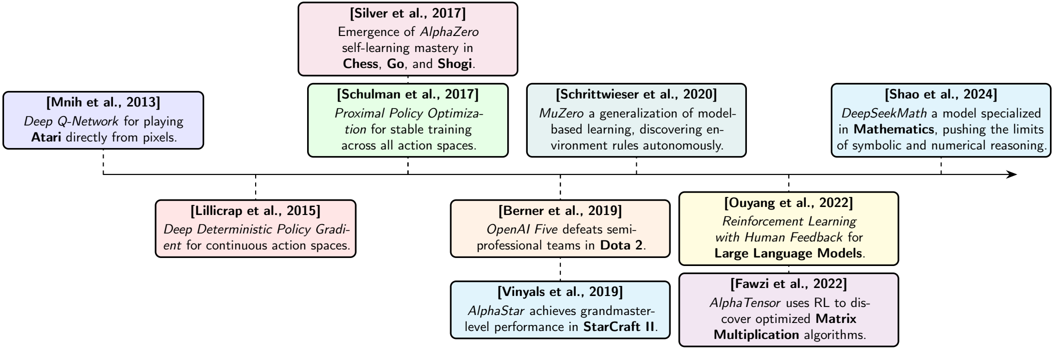
**[Watkins and Dayan, 1992]**
Creation of the **Q-Learning** algorithm, stable and value-based method.

**[Williams, 1992]**
Introduction of **REINFORCE**, the first policy-gradient update rule.

**[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.



**[Mnih et al., 2013]**
*Deep Q-Network* for playing **Atari** directly from pixels.

**[Lillicrap et al., 2015]**
*Deep Deterministic Policy Gradient* for continuous action spaces.

**[Silver et al., 2017]**
Emergence of *AlphaZero* self-learning mastery in **Chess**, **Go**, and **Shogi**.

**[Schulman et al., 2017]**
*Proximal Policy Optimization* for stable training across all action spaces.

**[Berner et al., 2019]**
*OpenAI Five* defeats semi-professional teams in **Dota 2**.

**[Vinyals et al., 2019]**
*AlphaStar* achieves grandmaster-level performance in **StarCraft II**.

**[Schrittwieser et al., 2020]**
*MuZero* a generalization of model-based learning, discovering environment rules autonomously.

**[Ouyang et al., 2022]**
*Reinforcement Learning with Human Feedback* for **Large Language Models**.

**[Fawzi et al., 2022]**
*AlphaTensor* uses RL to discover optimized **Matrix Multiplication** algorithms.

**[Shao et al., 2024]**
*DeepSeekMath* a model specialized in **Mathematics**, pushing the limits of symbolic and numerical reasoning.

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Discovering faster matrix multiplication algorithms with reinforcement learning.
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