Learning Montezuma’s Revenge from a Single Demonstration (18.07)

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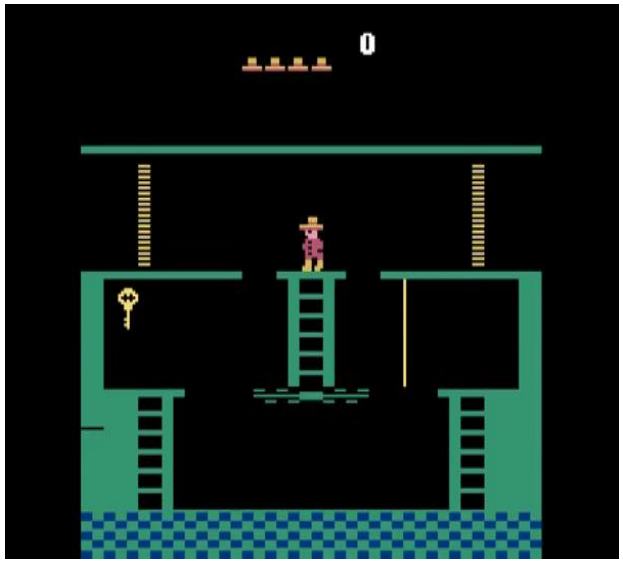
Exploration and Learning

- **Exploration**: Find action sequence with positive reward
- **Learning**: Remember and generalize action sequence
- Need both for a successful agent

Montezuma’s Revenge

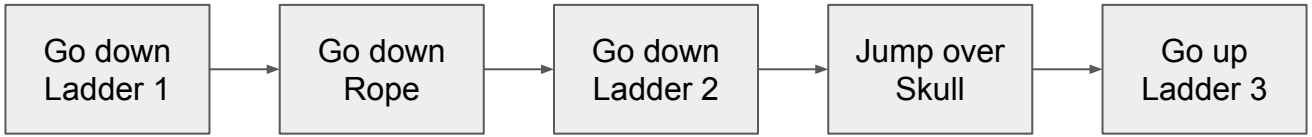
- One of the hardest games in Atari 2600
- Sparse rewards → Exploration is difficult

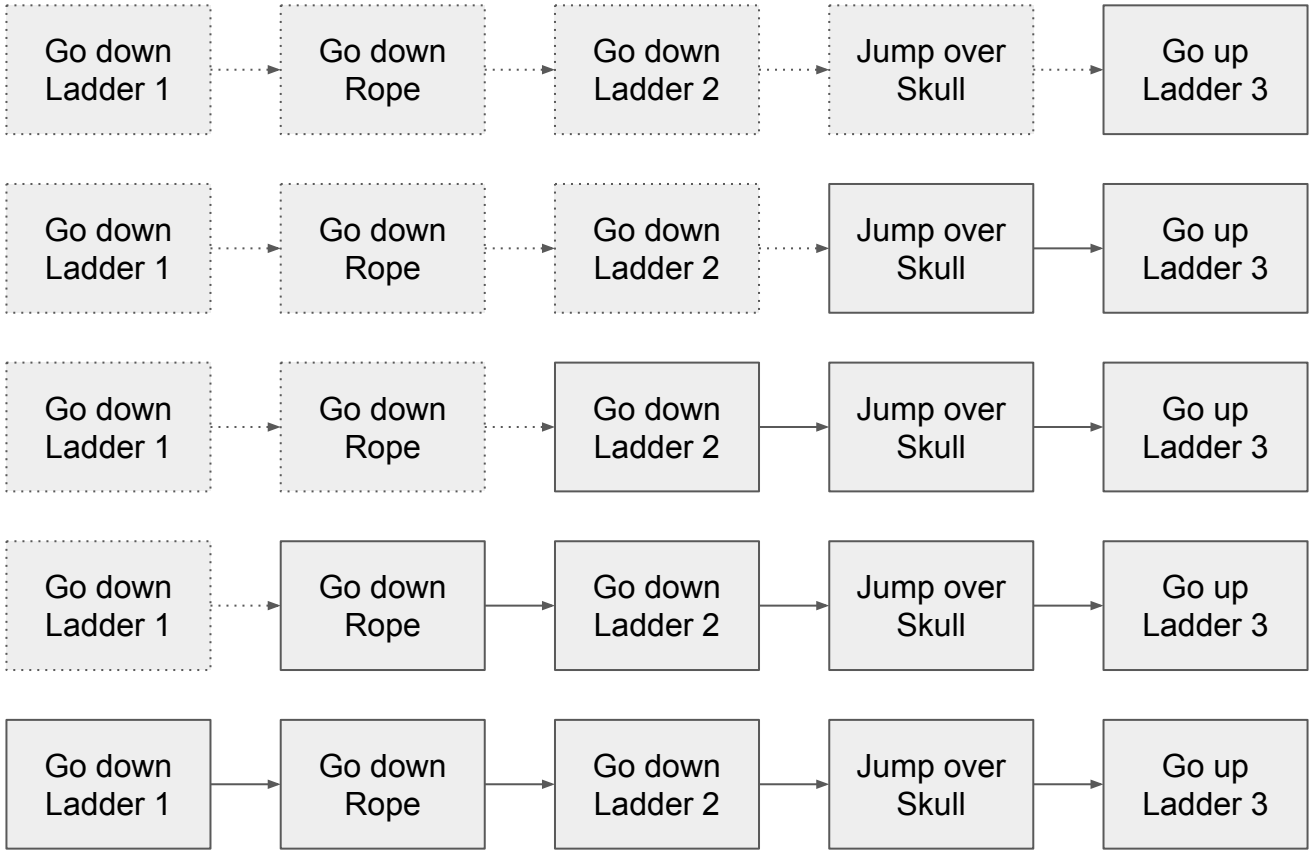


https://www.retrogames.cz/play_124-Atari2600.php?language=EN

Simplifying Exploration with Demonstrations

- Solution: Shorten the episode
  - Start the agent near the end of demonstration
  - Train agent until it ties or beats the demonstrator's score
  - Gradually move starting point back in time




Go down Ladder 1
Go down Rope
Go down Ladder 2
Jump over Skull
Go up Ladder 3
Go down Ladder 1
Go down Rope
Go down Ladder 2
Jump over Skull
Go up Ladder 3
Go down Ladder 1
Go down Rope
Go down Ladder 2
Jump over Skull
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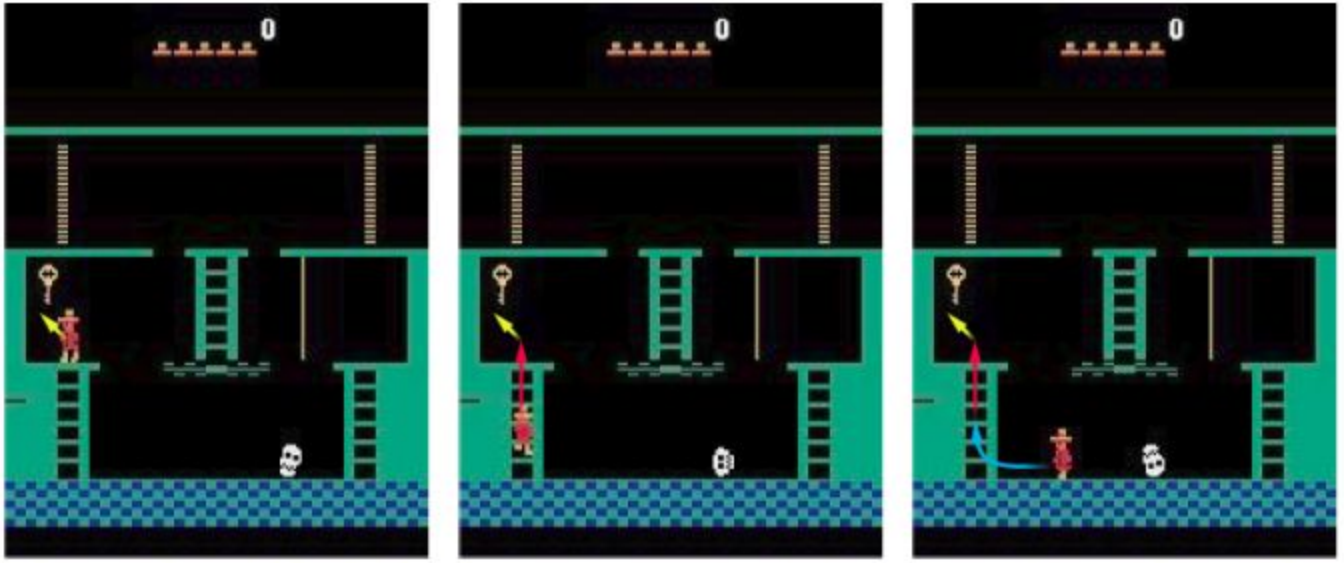

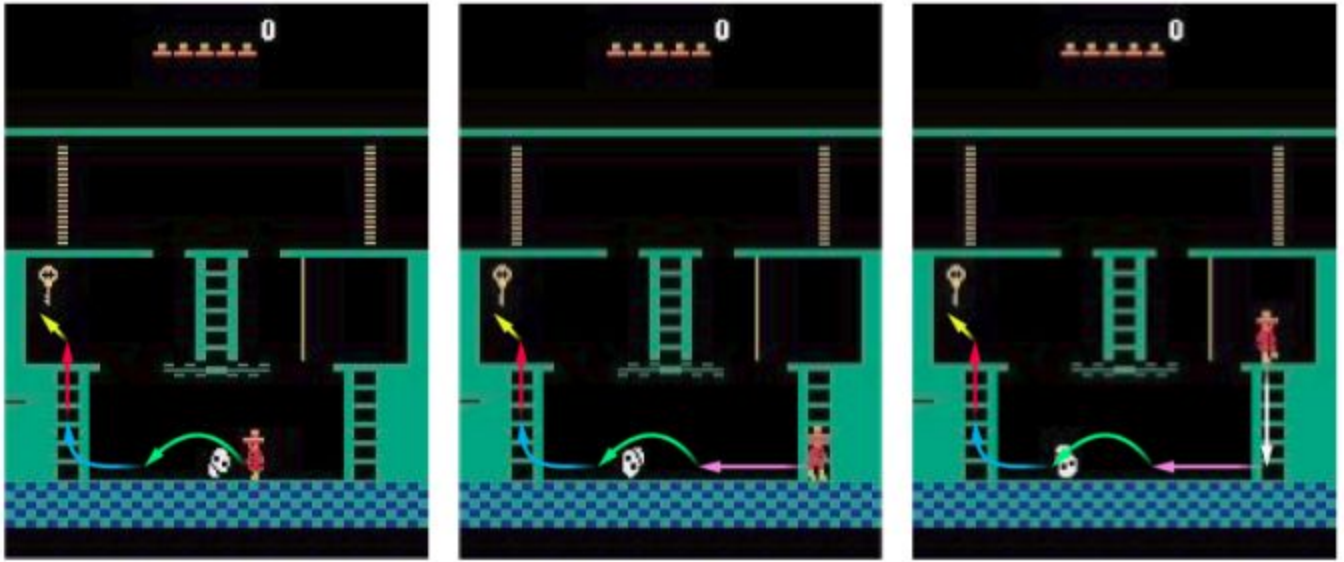

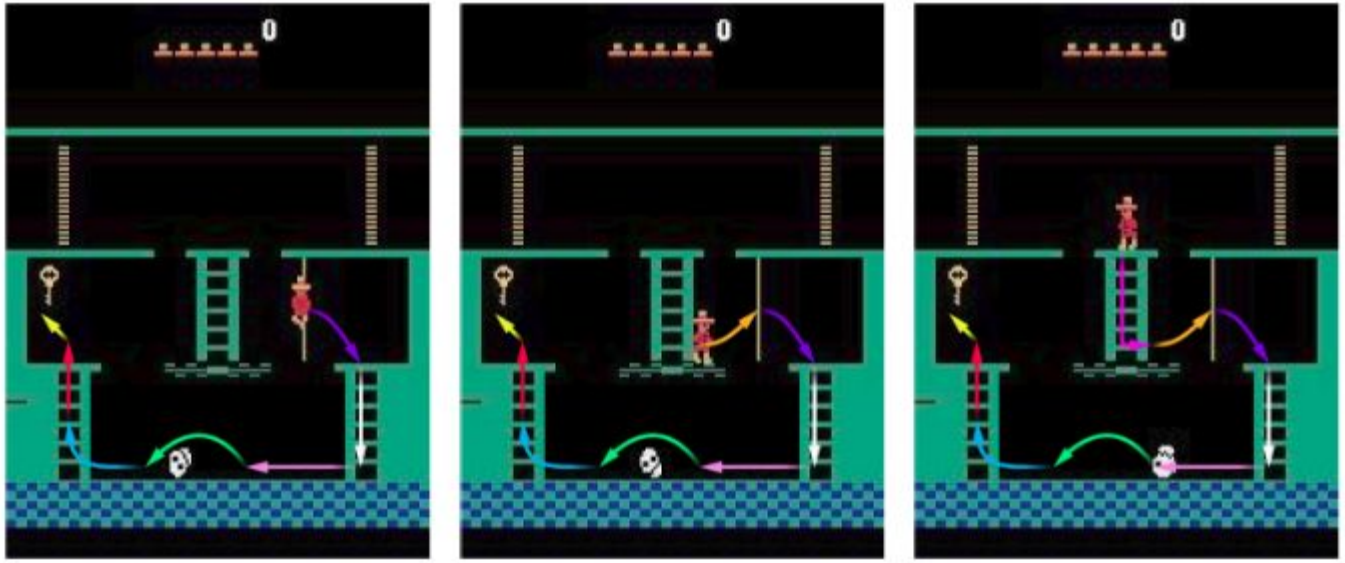

Result

- 74500 points on Montezuma’s Revenge (State of the Art)
- Surpasses demo score of 71500
- Exploits emulator flaw

Comparison with DeepMind’s approach

- DeepMind’s approach
  - Less control over environment needed
  - Agents imitate the demo
- This approach
  - Need full game states in demo
  - Directly optimize game score → Less overfitting for sub-optimal demo
  - Better in multiplayer games where performance should be optimized against various opponents

Remaining Challenges

- Agent cannot reach exact state in demo
  - Agent needs to generalize between similar states
  - Problematic in *Gravitar* or *Pitfall*
- Careful hyperparameter tuning needed
- High variance in each run
- NN does not generalize as well as human

https://blog.openai.com/openai-baselines-ppo/

Thank you!

Original content by OpenAI

- Learning Montezuma's Revenge from a Single Demonstration

You can find more content in

- github.com/seungjaeryanlee
- www.endtoend.ai