

Game AI Techniques: A Brief Overview

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Agenda

- A little about me
- What is game AI?
- Architecture of AI agents
- Randomness
- Logical reasoning
 - Rule-based systems
 - Decision trees
- Finite state machines
- Search and planning
 - MCTS
 - Evolutionary Planning
- How/where to begin?

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Who Am I?

■ Academia

- 2007-2011: B.Sc. in Software Engineering, University of Kashan, Iran
- 2011-2013: M.Sc. in AI, Sharif University of Technology, Iran
- 2013-2017: Ph.D. in AI, Isfahan University of Technology, Iran (Dropped Out)
- 2017-Present: Ph.D. in Computer and Video Games, Aalto University, Finland

■ Industry

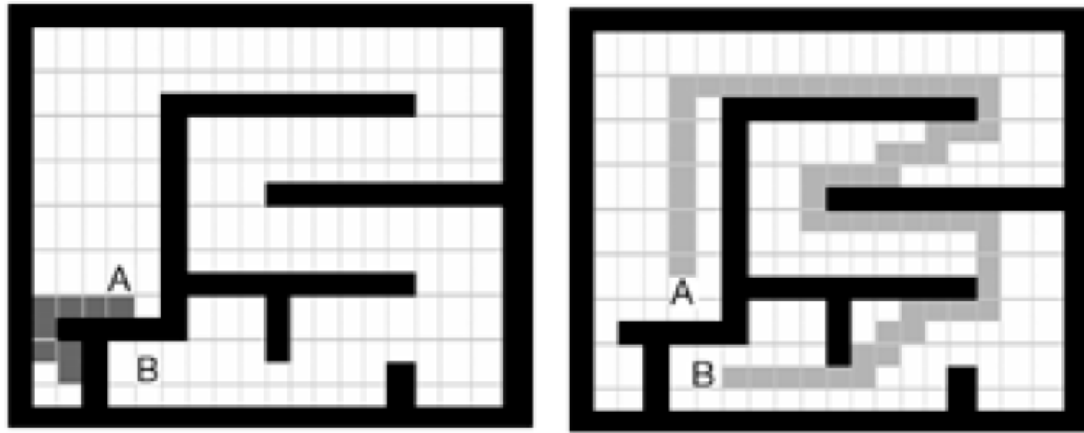
- 2011-2012: E.T. Armies (AI Programmer)
- 2012-2013: Awakening: Burning Ashes (Lead Programmer)
- 2016-2017: Cut (Gameplay and AI Programmer)



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What Is Game AI?



Comparison between A* and a human path finder. Left: initial problem. Middle: human. Right: A*

Definition

- Game AI consists of techniques used to produce the illusion of intelligence in the behavior of non-playable characters (NPCs).
- AIs must be entities that provide just the right amount of complexity to be challenging and engaging, but not more than that.



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Architecture of AI Agents



Sense

- All AIs need to be aware of their surroundings.
- What should be sensed and how?
 - It largely depends on the type of game you are creating.



Think

- Thinking stage is when the actual AI happens!
- Luckily, many games require only simple decision-making processes.
- A lot of games praised for their great AI have been built with relatively simple algorithms!
- A lot more on this later!

High-Level vs Low-Level Thinking

- High-level planning
- Low-level control



Act

- Many games exaggerate this part much like in a theater play, so the character's intentions are obvious and personality is conveyed.
- From AI developer's point of view, this part is the simplest one!

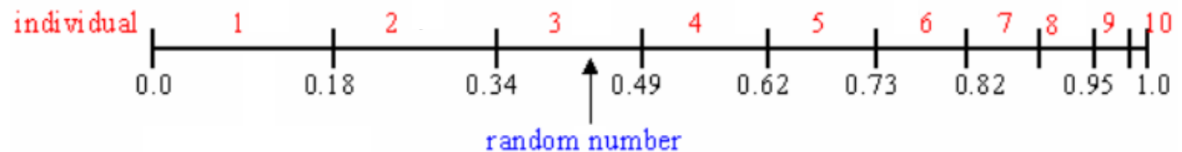


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The Power of Randomness

- If there are n possible actions with equal probability:
 - Pick a random integer between 1 and n and take the corresponding action.
- If there are 2 possible actions with probabilities p_1 and $1 - p_1$:
 - Pick a random number $0 \leq r \leq 1$, take action 1 if $r \leq p_1$ and take action 2 otherwise.
- Roulette wheel selection:



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Rule-Based Systems

- Rule-based systems allows us to model many behaviors that are tricky to model using FSMs.
- We test the left hand side of each expression (the conditions) in order, and then execute the right hand side (the action) of the first rule that is activated.
- Example:
 1. If in contact with an enemy \Rightarrow combat
 2. If an enemy is closer than 10 meters and I'm stronger than him \Rightarrow chase him
 3. If an enemy is closer than 10 meters \Rightarrow escape him
 4. If we have a command from our leader pending \Rightarrow execute it
 5. If a friendly soldier is fighting and I have a ranged weapon \Rightarrow shoot at the enemy
 6. Stay still

Decision Trees

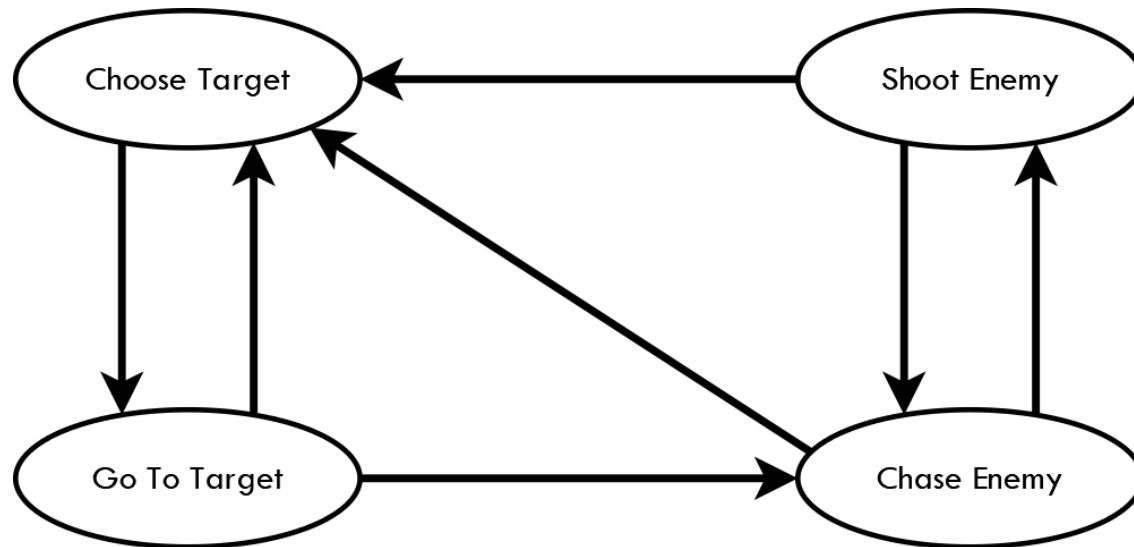
- Simply another formulation of rule-based systems.



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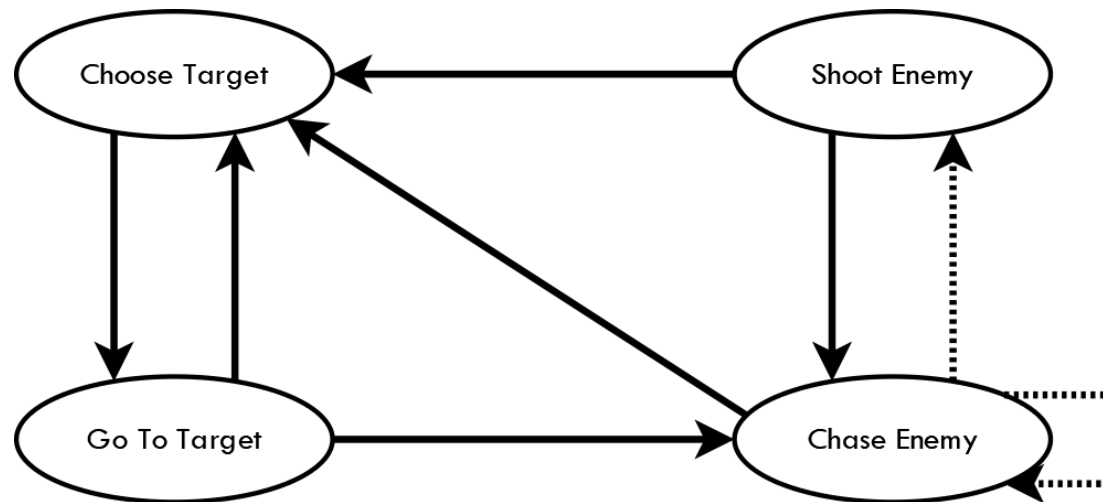
Finite State Machines (FSM)



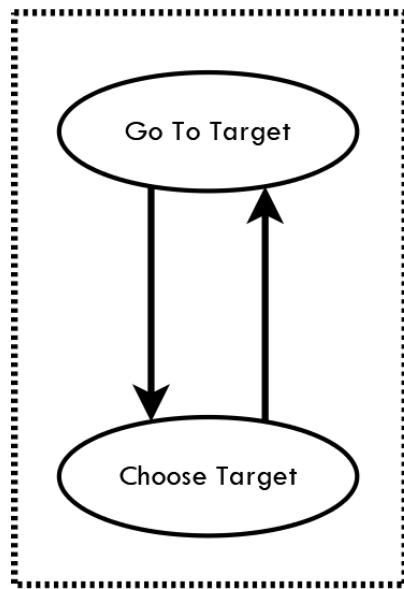
FSM Variations

- Basic
- Non-deterministic
- Parallel
- Synchronized
- Hybrid

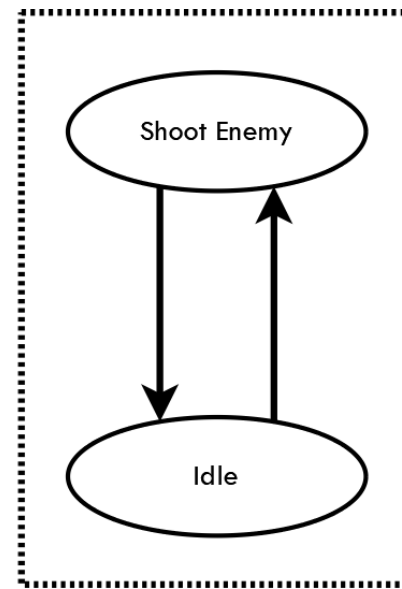
Non-Deterministic FSM



Parallel FSM

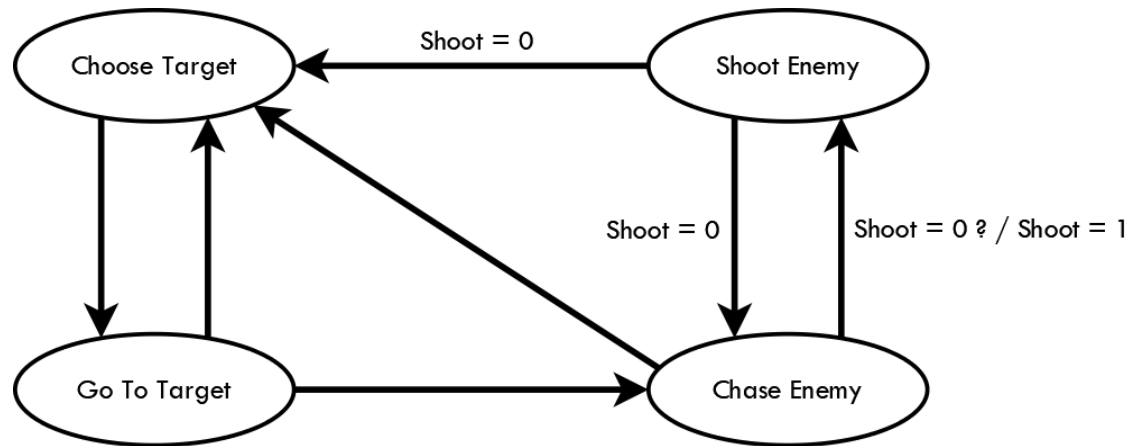


Locomotion FSM



Fighting FSM

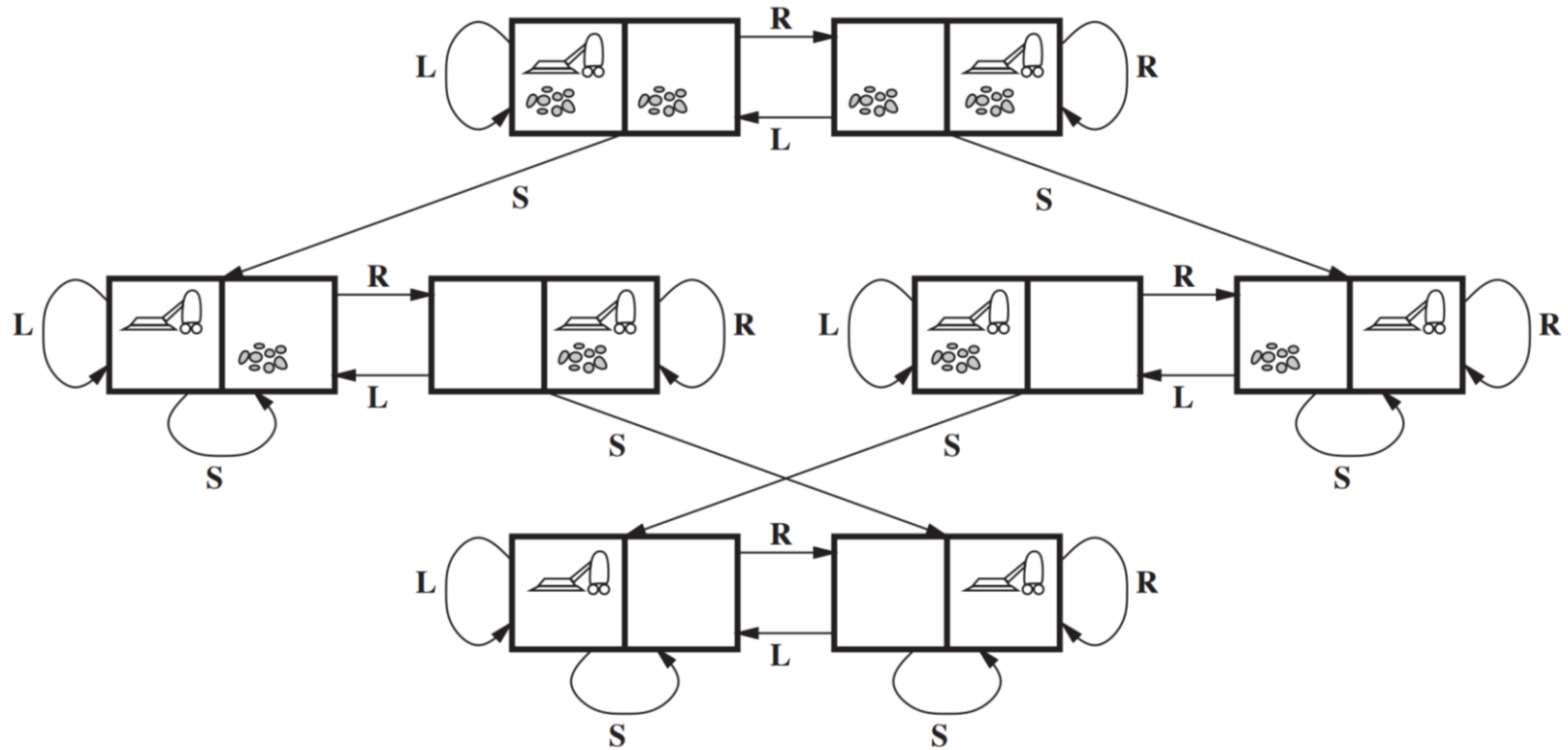
Synchronized FSM



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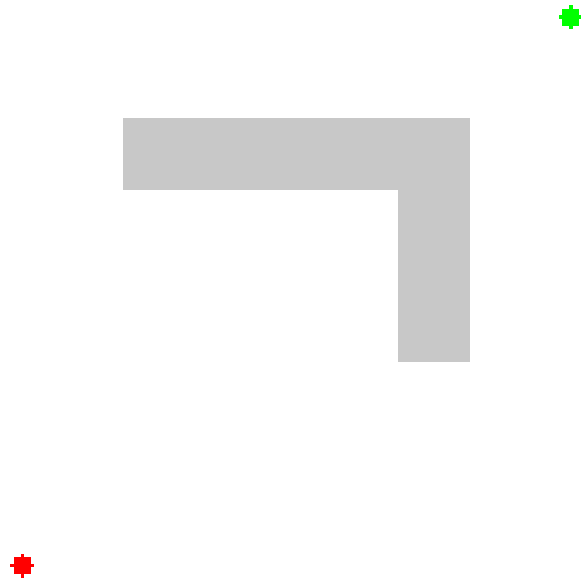
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Search and Planning

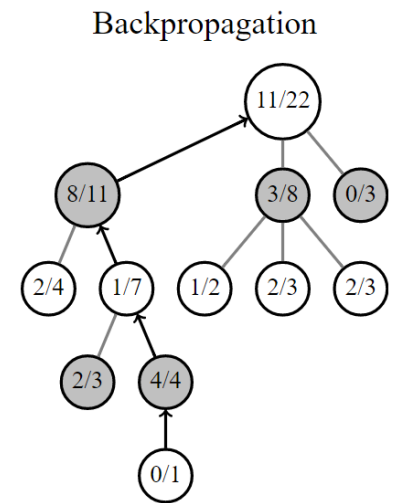
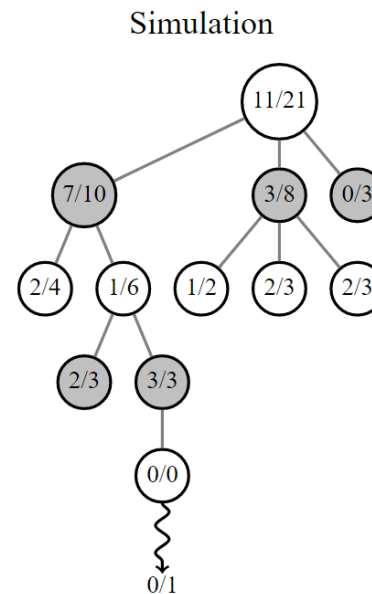
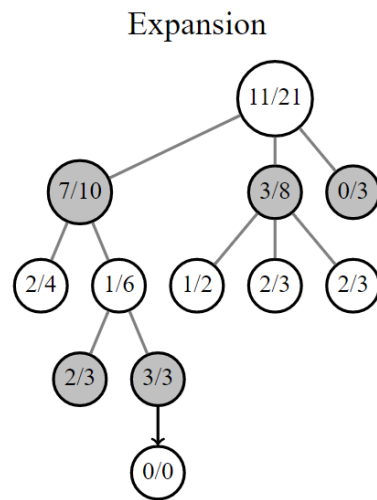
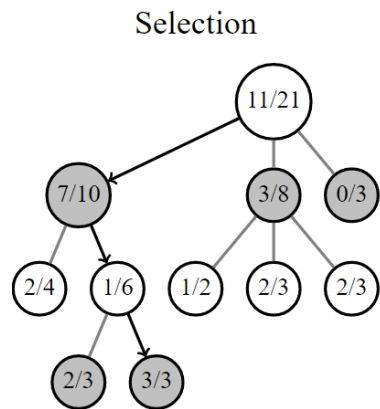


A*

A*

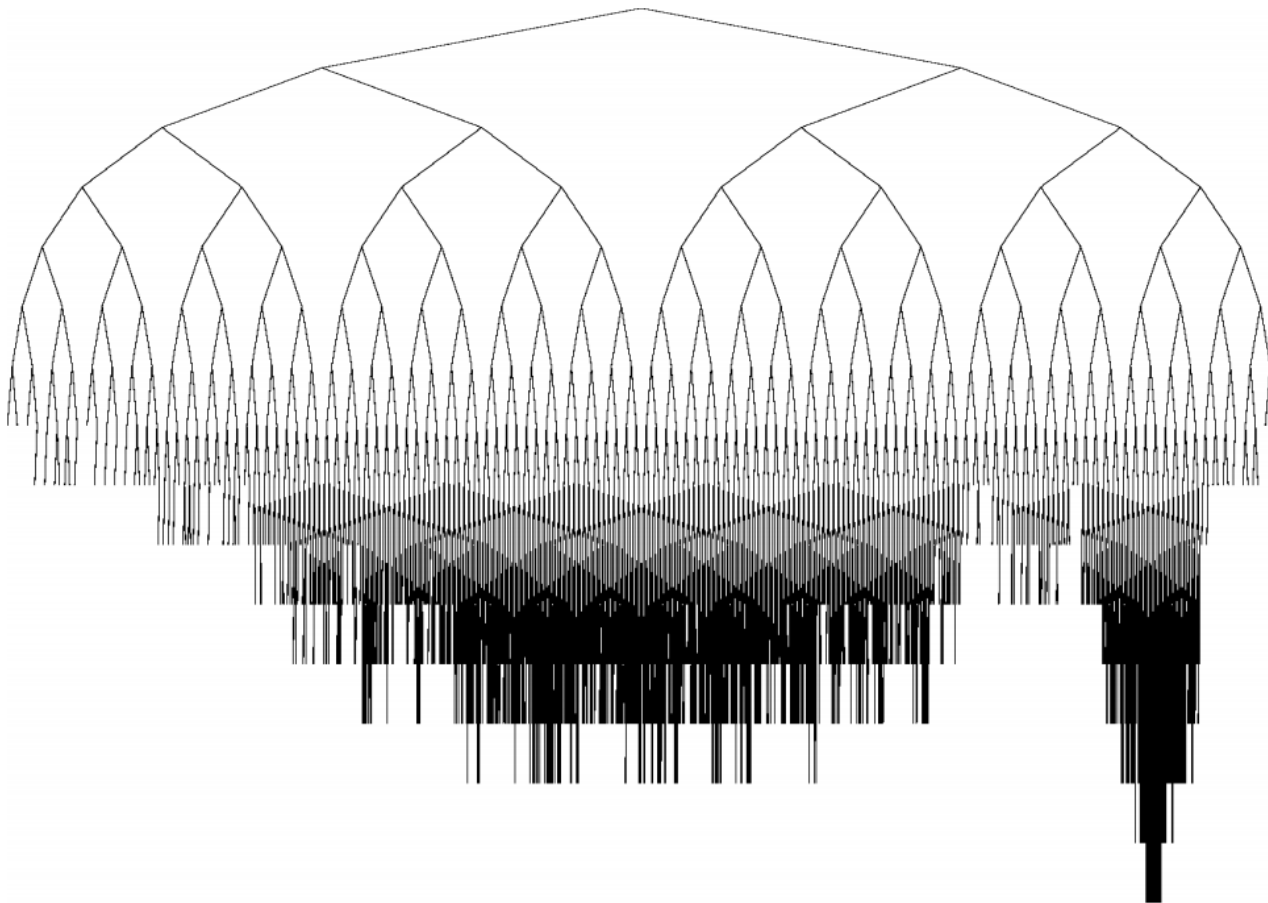


Monte Carlo Tree Search (MCTS)

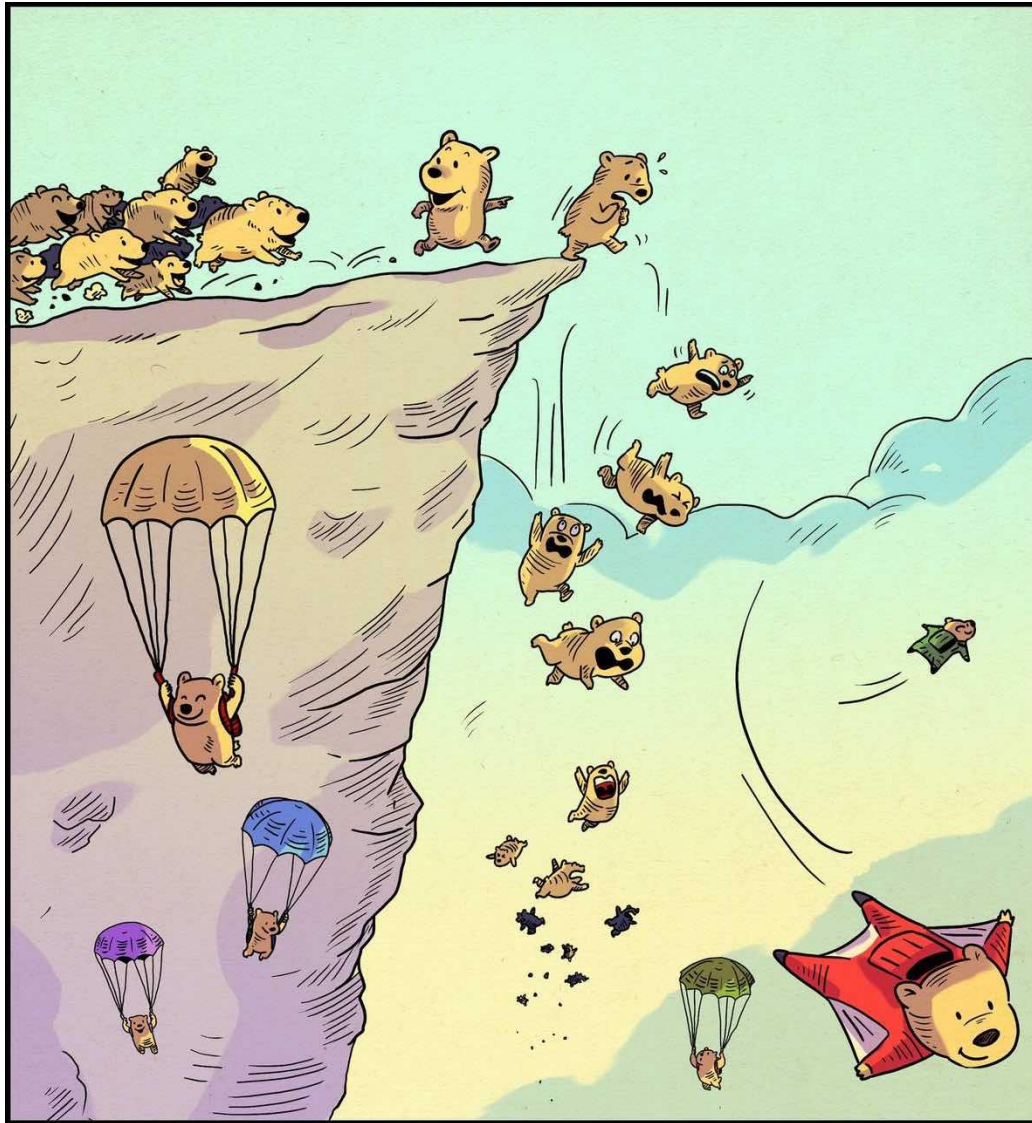


MCTS Characteristics

- Aheuristic
- Anytime
- Asymmetric

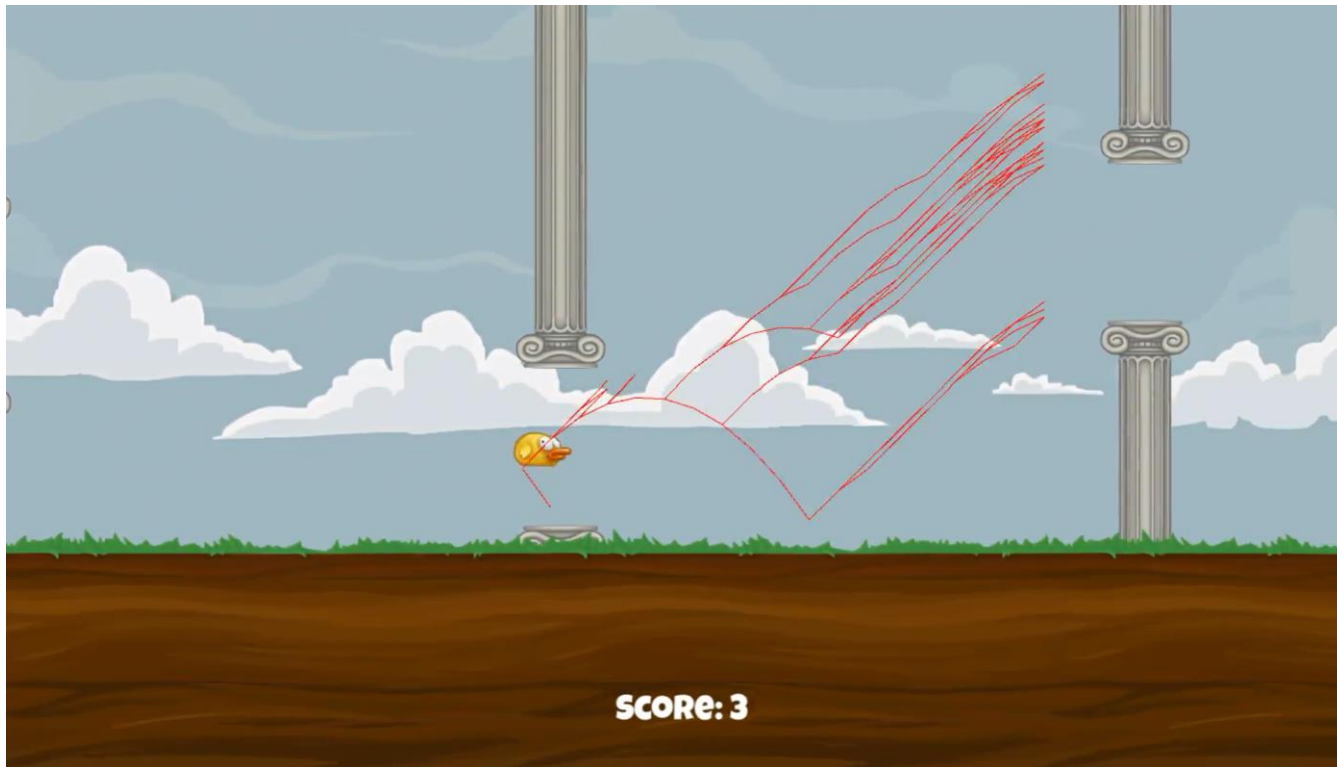
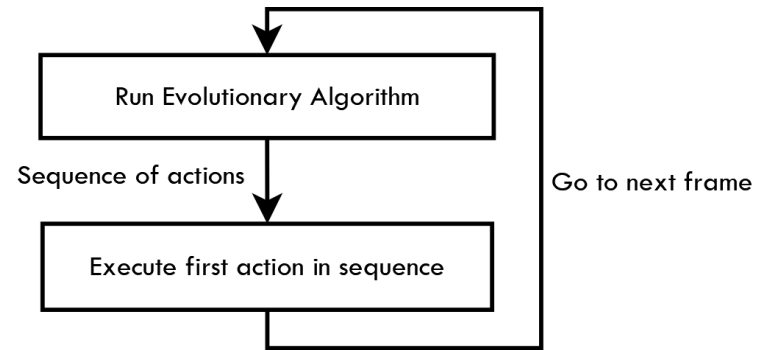


Evolutionary Planning



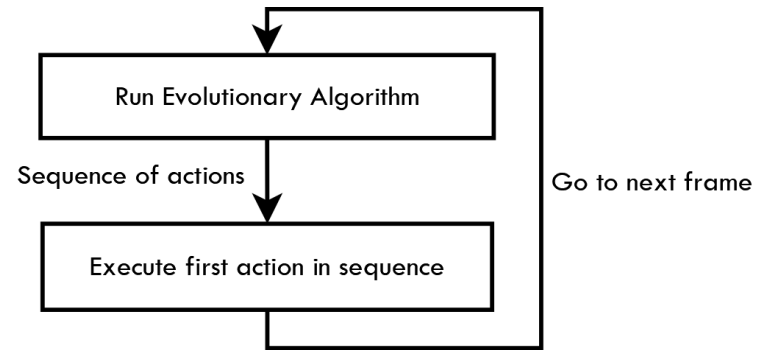
Rolling (Receding) Horizon Evolution

- Genetic algorithm (for discrete actions)
- Evolution strategy (for continuous actions)



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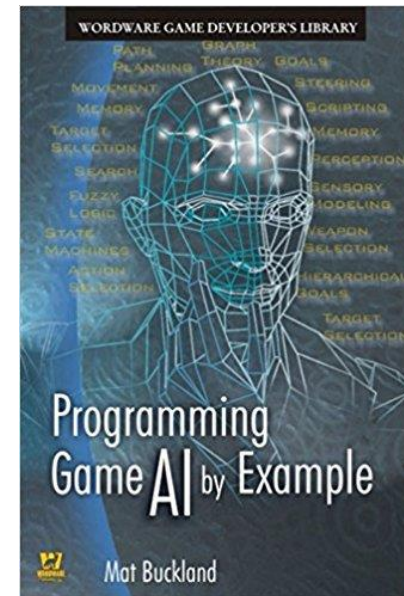
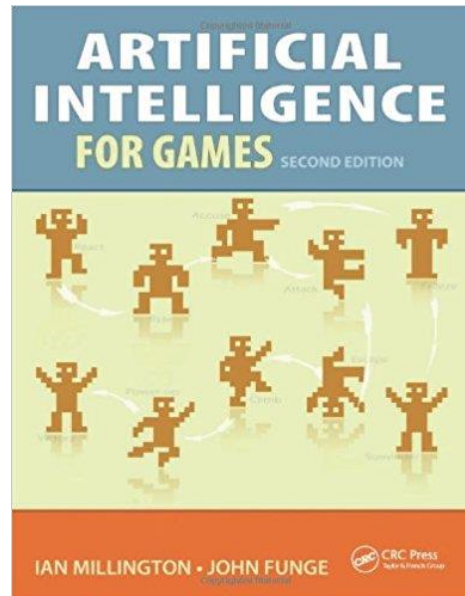
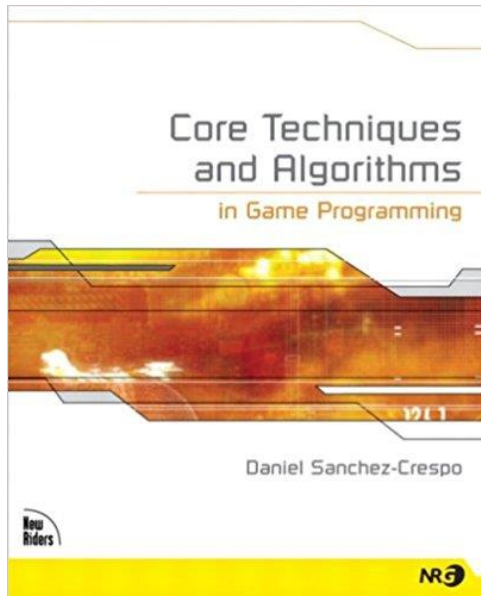


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How/Where to Begin?

■ Books



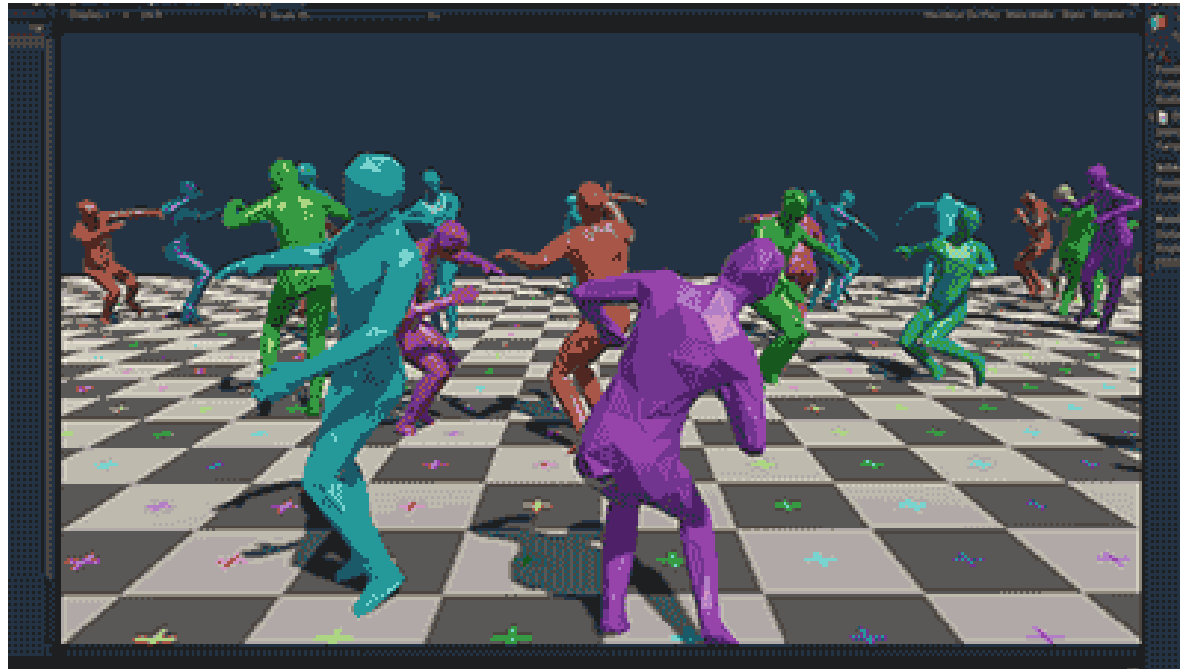
■ Websites

- AIGameDev.com (<http://aigamedev.com/>)

■ Courses

- The Principles of Modern Game AI (<https://courses.nucl.ai/>)

Thanks!



<https://github.com/keijiro/PuppetTest>