Stavros Vassos, University of Athens, Greece stavrosv@di.uoa.gr May 2012

INTRODUCTION TO AI STRIPS PLANNING

.. and Applications to Video-games!

Course overview

- This course aims to
  - Provide an introduction to the AI techniques currently used for the decision making of non-player characters (NPCs) in commercial video games
  - Show how a simple AI technique from academic research (STRIPS planning) can be employed to advance the state-of-the art.

Course overview

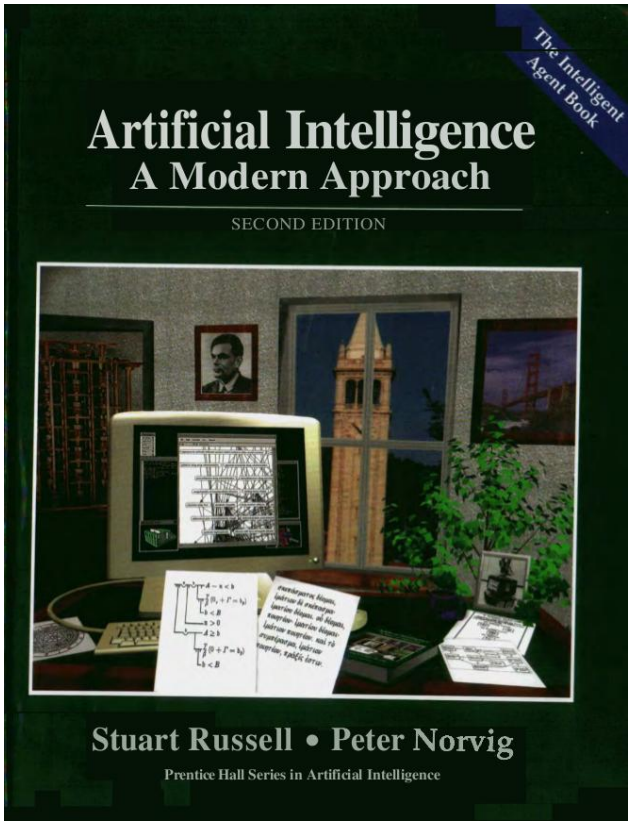
- This course aims to
  - Get you started with doing a research/programming project related to AI and video games!
    - Using AI tools for STRIPS planning
    - Using state-of-the-art game engines such as Unity3D and Source Engine (Half-life, Counter Strike, …)

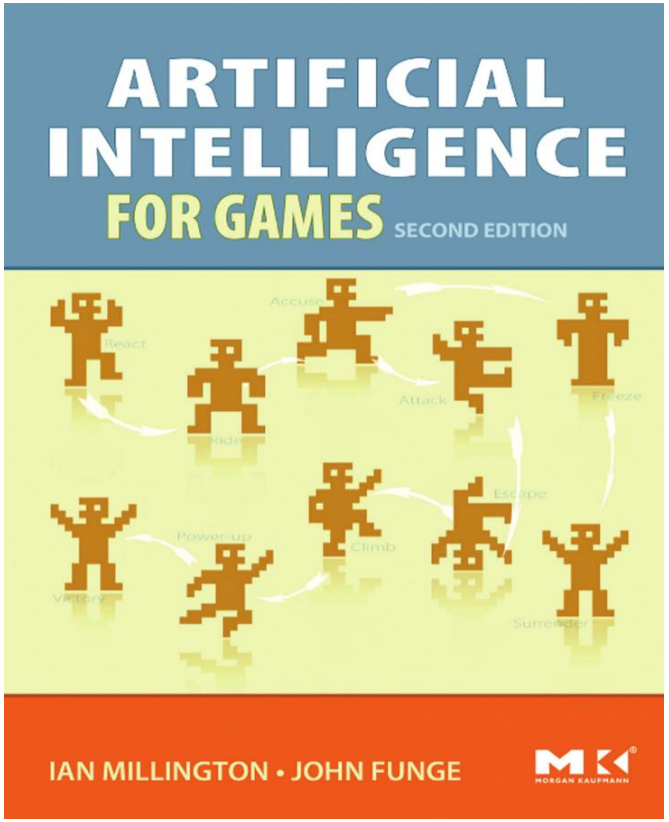
Course overview

- Lecture 1: Game-inspired competitions for AI research, AI decision making for non-player characters in games
- Lecture 2: STRIPS planning, state-space search
- Lecture 3: Planning Domain Definition Language (PDDL), using an award winning planner to solve Sokoban
- Lecture 4: Planning graphs, domain independent heuristics for STRIPS planning
- Lecture 5: Employing STRIPS planning in games: SimpleFPS, iThinkUnity3D, SmartWorkersRTS
- Lecture 6: Planning beyond STRIPS

Course overview

- Material based on the following textbooks, research papers, and student projects at University of Athens:





Course overview

- Lecture 1: **Game-inspired competitions for AI research,** AI decision making for non-player characters in games
- Lecture 2: STRIPS planning, state-space search
- Lecture 3: Planning Domain Definition Language (PDDL), using an award winning planner to solve Sokoban
- Lecture 4: Planning graphs, domain independent heuristics for STRIPS planning
- Lecture 5: Employing STRIPS planning in games: SimpleFPS, iThinkUnity3D, SmartWorkersRTS
- Lecture 6: Planning beyond STRIPS

Artificial Intelligence and Video Games

- Is academic AI useful to (commercial) video games?

- Are (commercial) video games useful to academic AI?

Artificial Intelligence and Video Games

- Is academic AI useful to (commercial) video games?
  - Academics say: Yes! …
  - Game developers say: No! …
- Are (commercial) video games useful to academic AI?

Artificial Intelligence and Video Games

- Is academic AI useful to (commercial) video games?
  - Academics say: Yes! …
  - Game developers say: No! …
- Are (commercial) video games useful to academic AI?
  - Puzzle games: complex logical problems
  - Strategy games: complex resource management and decision making problems
  - First-person games: non-player characters as autonomous agents

Artificial Intelligence and Video Games

- Are (commercial) video games useful to academic AI?
  - Often, the real-world problems are too difficult/complex to handle
  - Video games offer a **level of abstraction** that allows the AI academic community to experiment focusing on one aspect of the problem each time
  - E.g., think of an autonomous robotic bartender
    - In a bar in Rome
    - In a controlled environment specifically for this purpose
    - In a MMORPG (massively multiplayer online RPG)

Artificial Intelligence and Video Games

- Performing simple actions in the real world is difficult

Artificial Intelligence and Video Games

- Acting (and sensing) in video-game worlds is easy!

Artificial Intelligence and Video Games

- Acting (and sensing) in video-game worlds is easy!
- ..and AI can focus on, e.g., decision making

Artificial Intelligence and Video Games

- Video-game worlds feature common objects and realistic physics

Artificial Intelligence and Video Games

- Video-game worlds feature realistic navigation characteristics

Artificial Intelligence and Video Games

- Video-game worlds feature interaction with other characters!

Artificial Intelligence and Video Games

- Non Player Characters (NPCs)

Artificial Intelligence and Video Games

- Are video games useful to academic AI?
  - **AI Competitions** for research problems of academic AI based on **commercial video games**

Annual Starcraft Competition at AIIDE

- http://webdocs.cs.ualberta.ca/~cdavid/starcraftaicomp

  - Artificial Intelligence & Interactive Digital Entertainment

  - Starcraft Real-time Strategy game

Annual Starcraft Competition at AIIDE

- http://webdocs.cs.ualberta.ca/~cdavid/starcraftaicomp
  - Brood War Application Programming Interface
    - C++ API
    - Retrieve information about the state of the game
    - Control units and buildings
    - http://code.google.com/p/bwapi/
  - Registration deadline: 1 July

Annual Starcraft Competition at AIIDE

- Krasi0 vs Skynet (2011): youtube link

Ms Pac-Man vs Ghost Team Competition

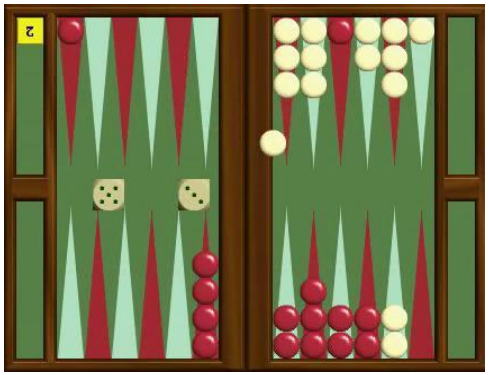
- http://www.pacman-vs-ghosts.net
  - Build a program that controls Ms Pac-Man or one of the ghosts
  - The game server transmits the state of the game as an **image**, 15 times per second
  - Java API
  - Registration deadline: 27 May

General Game Playing Competition

- http://games.stanford.edu/

- You build a program that plays chess

- So, it's smart!
  Can it play backgammon then?



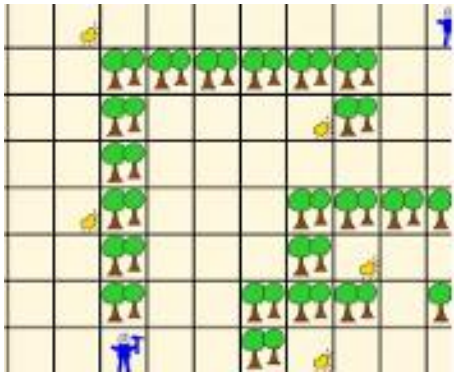
General Game Playing Competition

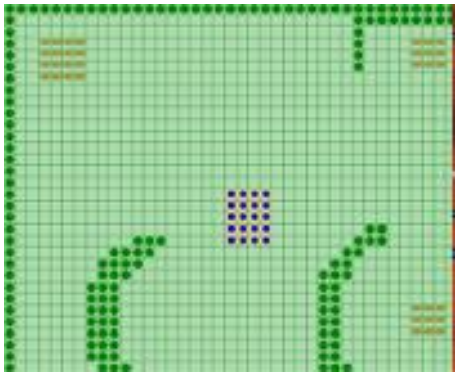
- http://games.stanford.edu/

  - Build a program that plays board games.. all of them!
  - In the beginning of each match the program receives a description of the game to play in a language that resembles PDDL
  - C++, Java, Prolog API, ...

Multi-agent programming contest

- http://www.multiagentcontest.org/

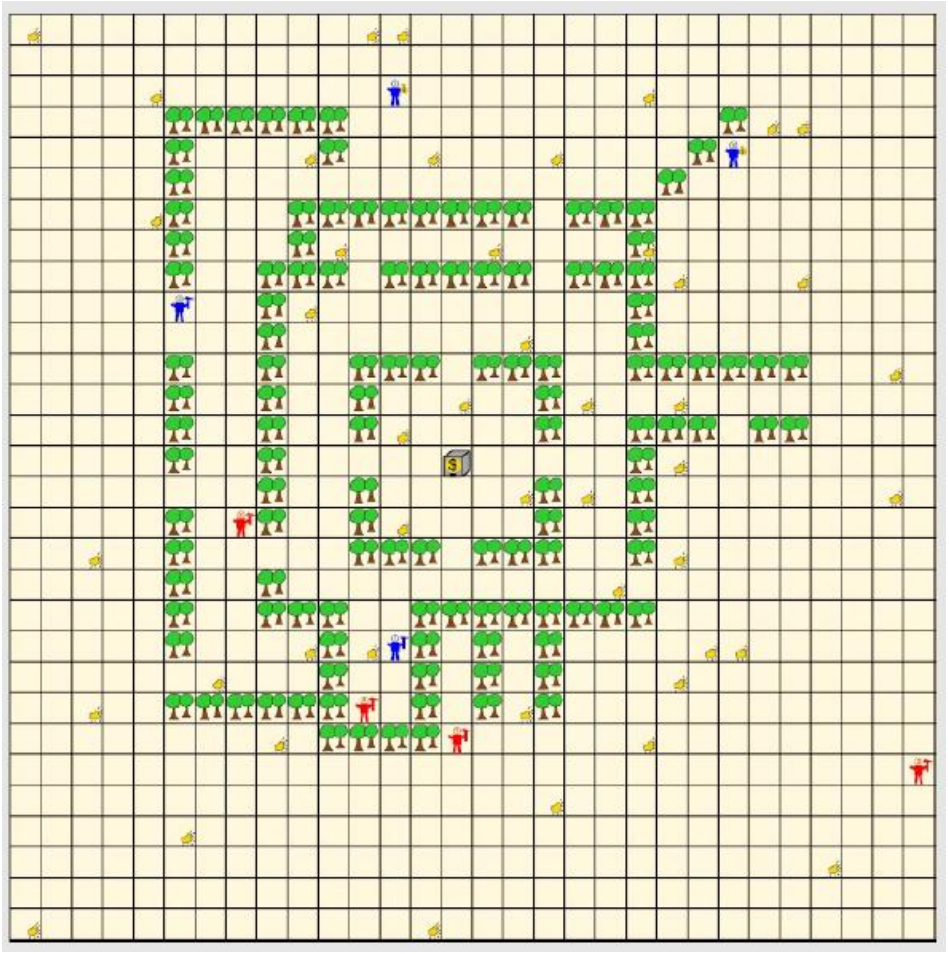


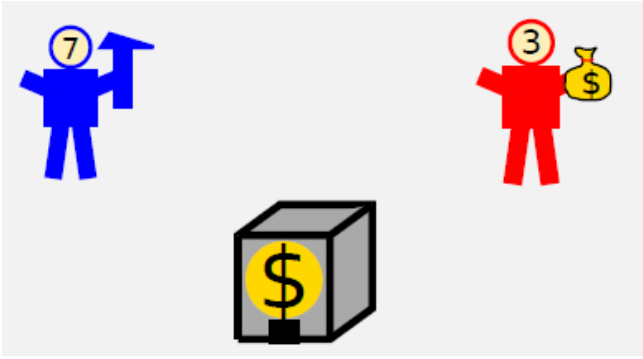


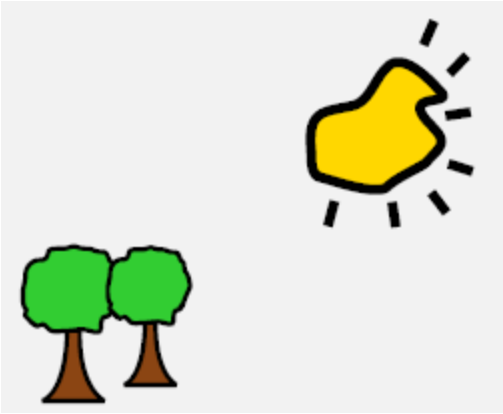
- Emphasis on multi-agent systems
- Since 2005 with different scenarios every year that force agents to work as a team

Multi-agent programming contest

- http://www.multiagentcontest.org/

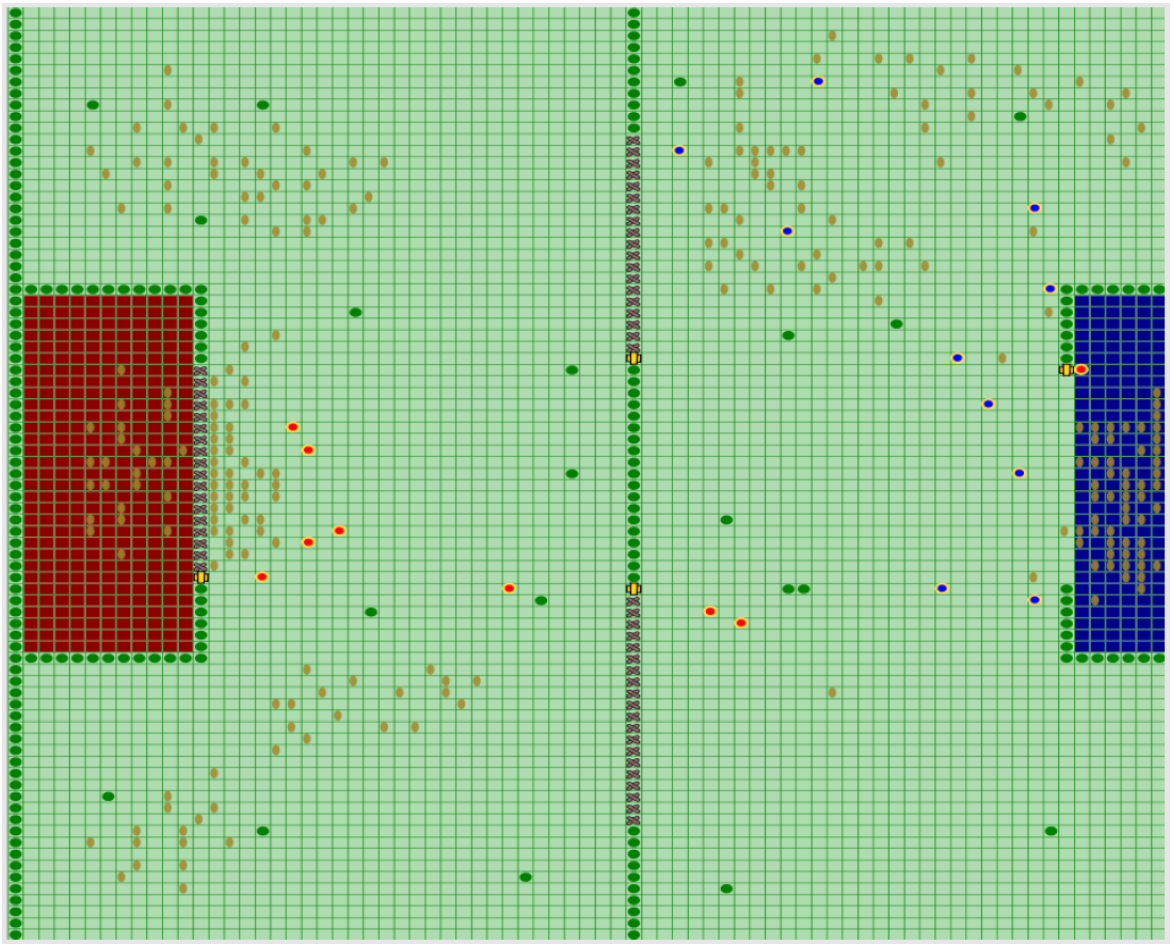






Multi-agent programming contest

- http://www.multiagentcontest.org/



Artificial Intelligence and Video Games

- People do AI research (e.g., M.Sc., Ph.D.) based on techniques and results on such competitions

Artificial Intelligence and Video Games

- Is academic AI useful to (commercial) **video games**?

Artificial Intelligence and Video Games

- Is academic AI useful to (commercial) **video games**?
  - Path finding
  - Realistic motion
  - Models of emotion
  - Decision making
  - Learning
  - Nonlinear story telling
  - …

Artificial Intelligence and Video Games

- Is academic AI useful to (commercial) **video games**?

- Let's focus on
  - Games with non-player characters (NPCs)
  - E.g., First-Person Shooter (FPS) games

  - The decision making process of an NPC

Artificial Intelligence and Video Games

- Video Games:
  - Finite State Machines
  - Decision Diagrams
  - Behavior Trees
  - Goal Oriented Action Planning
- Academic AI on agents:
  - Knowledge representation, First-order logic, Classical planning, Planning with preferences, …
  - Belief-Desire-Intention architecture, Agent-based programming, …
  - Probabilistic reasoning, Bayesian networks, Utility theory, Markov Decision Processes, …

Artificial Intelligence and Video Games

- Video Games:
  - Finite State Machines
  - Decision Diagrams
  - Behavior Trees
  - Goal Oriented Action Planning
- Academic AI on agents:
  - Knowledge representation, First-order logic, Classical planning, Planning with preferences, …
  - Belief-Desire-Intention architecture, Agent-based programming, …
  - Probabilistic reasoning, Bayesian networks, Utility theory, Markov Decision Processes, …

Artificial Intelligence and Video Games

- Next:
  - Finite State Machines (FSMs)
  - Behavior Trees (BTs)
  - Goal Oriented Action Planning (GOAP)