A Game-Based Competition as Instrument for Teaching Artificial Intelligence

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Educational Approaches

Learning by Doing
Learning is an active process where the student can interact with the context and modify it.

Constructivism
Learning as results of two factors:
- Cooperation with others
- Features of the task

Case Study

Game Competition
Context: Artificial Intelligence course
Master Degree in Computer Engineering, University of Bologna
Task: create an agent capable of playing a game
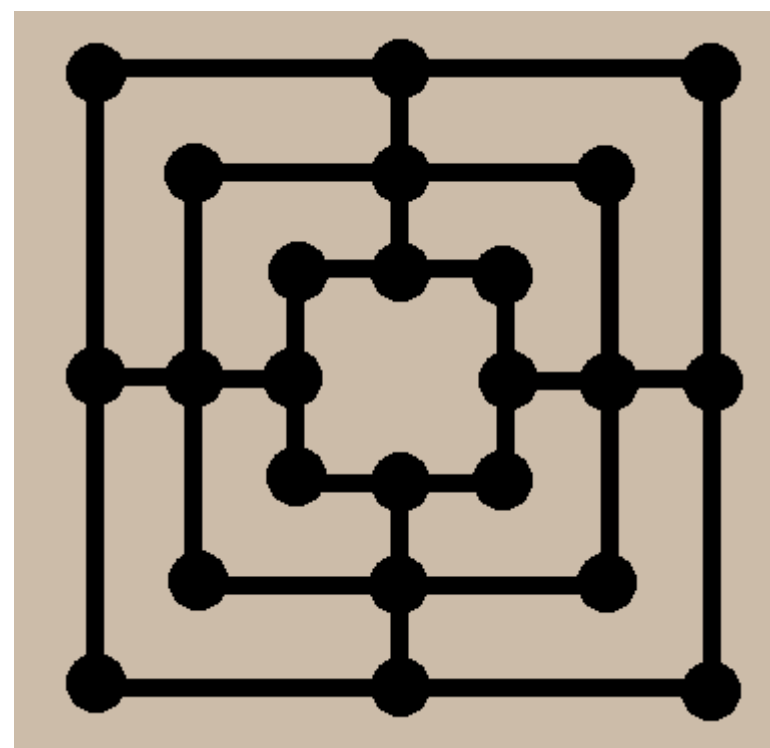**Test:** round robin tournament between agents, and presentation to the class
Available time: 8-10 weeks
Reward: 2 bonus points out of 30 on the course final grade
Participants: 63 students divided in 25 teams over 3 years

Challenge

Nine Men's Morris Game

- 2 players
- Perfect information
- Does not involve chance

Rules
- Place and move 9 checkers along the lines
- When 3 checkers are aligned, remove an opponent's checker

Goals
- Remove 7 adversary's checkers
  or
- Leave adversary without the possibility to move

Interesting for AI
3 different phases of the game, each one with slightly different rules

Suitable as students challenge
- Small state space complexity: about 10^{11} (Chess: 10^{43}, Go: 10^{172})
- Well-known game: it has been solved and deeply studied

🌐 http://ai.unibo.it/mulinochallenge

Students' Opinion

Students' opinion gathered through a questionnaire, asking to evaluate different aspects of the experience
5 possible answers between 1 (totally disagree) and 5 (totally disagree)

Examples:
1) The experience enables the consolidation of theoretical concepts on AI
2) The experience allows new concepts on AI to be acquired
10) Competing in a challenge promotes motivation and interest
15) The experience allows knowledge on cooperation and teamwork to be acquired
19) My general assessment for this practice/experience is positive

Students' answers: average values and standard deviations
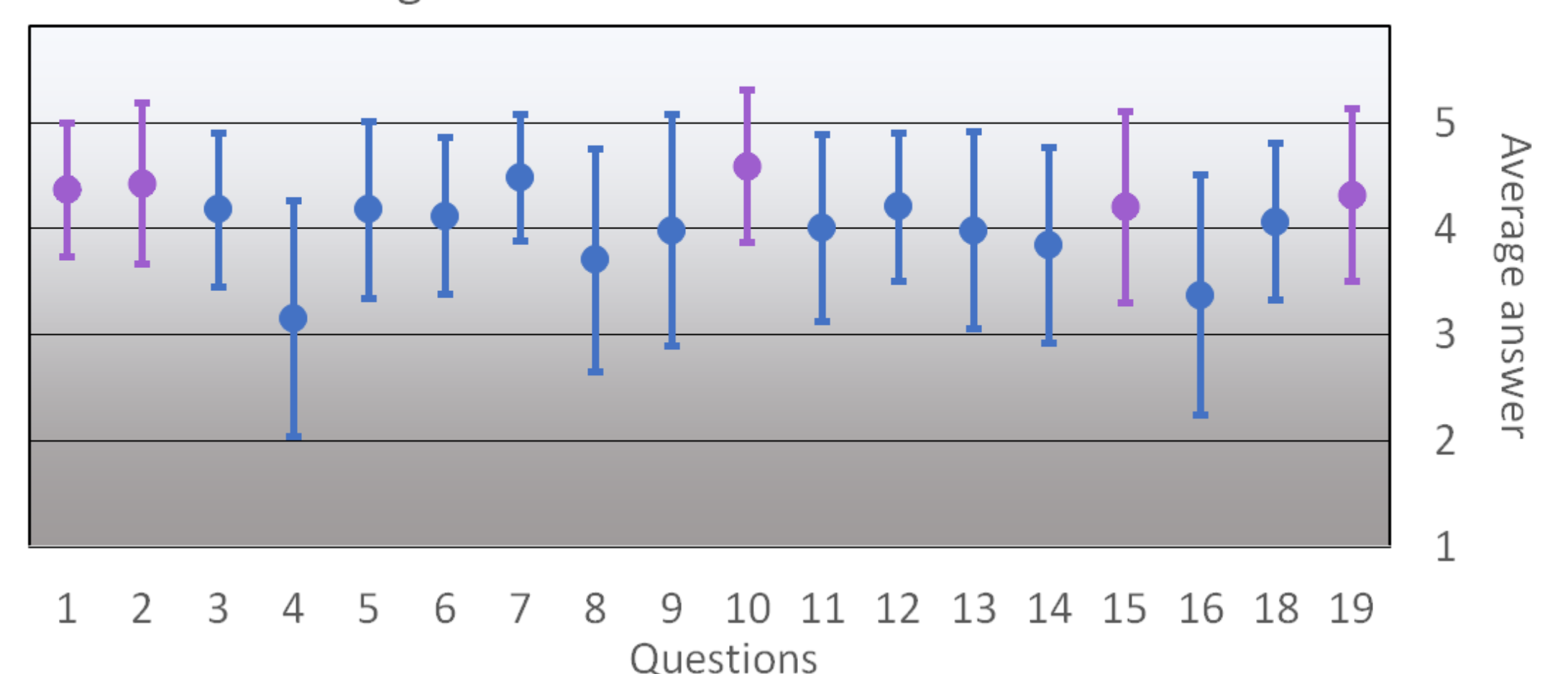
Results and Discussion

New knowledge acquisition
Autonomous study of AI techniques not taught during the course

(Genetic Algorithms, Neuroevolution, Negamax, NegaScout, BNS)

Knowledge consolidation, motivation improvement
Students declare themselves as more motivated by the challenge, and that it has helped them to learn the course concepts

Better course exam performance
- At average, better final marks: 0.67 points higher
- Smaller percentage of exam failure: 5% against 15%

Important Elements
- Community environment of discussion
- Open source code of previous year agents

Suggested improvements
- No programming language bias
- More time to study new algorithms and techniques

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