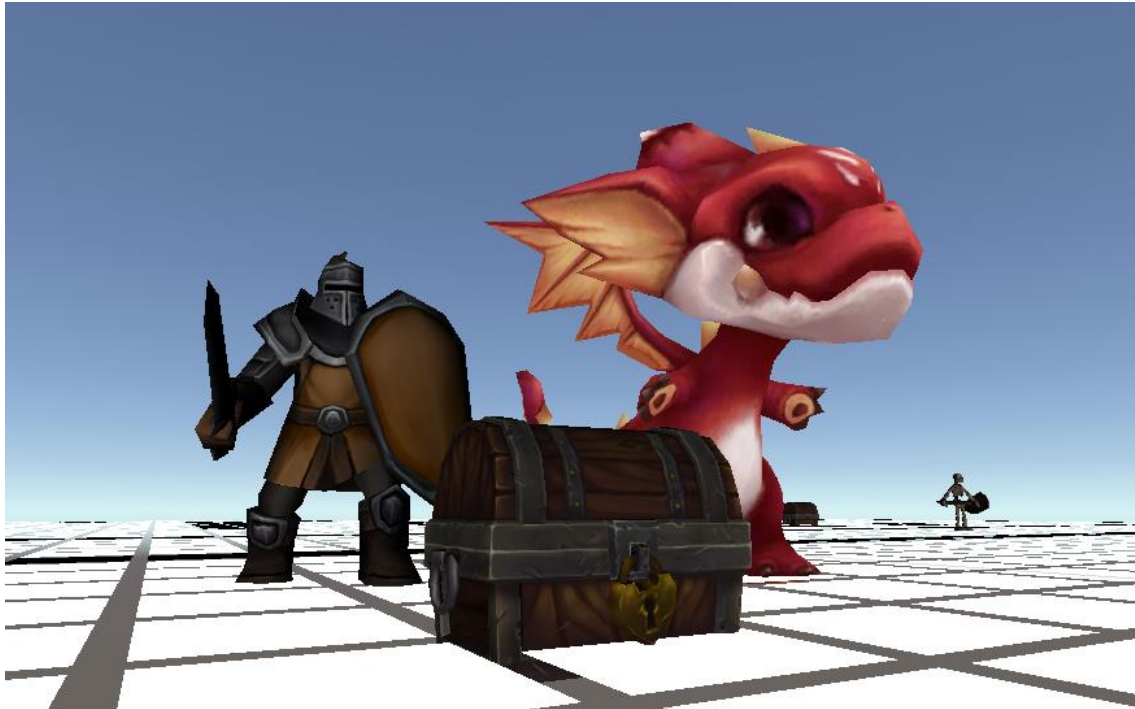


Inteligência Artificial para Jogos

2024-2025

2.º IAJ Project –Decision Making and MCTS



The second project of the IAJ Course will consist on the work performed for Lecture 5, 6, 7, 8, 9 plus a small number of extra requirements that will be described next (we will call them Secret Levels). For this second project, you will need to write a report from 4 to 6 pages, explaining and justifying the decisions made by your group in terms of implementation, describing performance tests and corresponding analysis. **Explain the rationale and describe the heuristics used.** Additionally, you should also include any analysis and discussions made for the requirements in the Lecture Guides 5-9.

You should submit a zip file (named P2 Group XX, where XX is your group number) with both Unity source code and with the report (a pdf/doc file) via Fenix¹, **until 14:59 of October 13th**. I will accept submissions after the deadline, but with a 0.5 value penalty for each hour after the deadline.

Secret and Bonus Levels: Secret levels are part of your project that were not covered in the Lectures' Guides. Bonus Levels will contribute to substituting your lowest paper quiz with a better grade, they will not affect the grade of the project.

Important Note: More than the code written in the project, it is important that you master the different algorithms and learn to work with them. In the project discussion you will be asked to discuss details on the algorithms, their implementations, and/or exemplify on the board or paper how they work.

¹ To reduce the Project's size, before creating the zip delete the Library folder from the project!

Level 1 – State Machines (2 points)

- a) Implement a Patrol FSM, only for the orcs, where they move between 2 positions and if they see the player they are able to pursue him. If they are too far from the Player they should give up and return to the Patrol behavior.
- b) Implement a “Shout” action where if an orc sees the player it warns the other orcs and they all know where the shout came from. Add a shouting sound to increase immersion and a visual clue to understand who shouted.
- c) Improve your behavior tree to account for the new action of the orcs. **In the report include a diagram of your State Machine, using the book’s formalism.**

Level 2 – GOB and GOAP (1+2 points)

- a. Implement the GOB and the GOAP Decision making algorithms as described in the lecture Guides.

Level 3 – Sir Uthgard Actions (1 point)

- a. Implement the actions described in the lecture guides:
- b. Include all the methods necessary for the GOB, GOAP and MCTS algorithms.

Level 4 – MCTS and Biased MCTS (2+2 points)

- a. Implement the MCTS Decision making algorithms as described in the lecture Guides.

Level 5 – Orcs Formation! (1.5 points)

- a. Implement the coordinated movement algorithms as described in the lecture Guides.

Secret Level 1 – Optimizing World State Representation (2 points)

- The implementation used to represent a World Model is flexible but it is not the most efficient one. Create an alternative World Model implementation similar to F.E.A.R's system, where you have a fixed size array (or more than one fixed size array) with all data that represents the state of the world (instead of using a recursive model of dictionaries). You will need one array position for each property, and another for each consumable resource and enemy (to represent whether it was already picked up /destroyed or not). You can also remove the goals if you are not using them in MCTS). Alternatively you can use a class with Properties defined as part of the class, and make a copy of the instance whenever a new child is generated. Choose the easiest one for you to implement.
- **Test both versions and compare them in terms of efficiency.**

Secret Level 2 – Limited Payout MCTS (2 points)

- Another form of making MCTS more efficient is to limit the depth of a payout (usually by a defined depth) and using an heuristic function to estimate the quality of a state (or likelihood of victory) as a reward when backpropagating the reward of a payout. Implement this variation. Describe and explain the rationale for the heuristics implemented in the report.

Secret Level 3 – Comparison of Decision-Making algorithms (2.5 points)

- Compare the Decision-Making algorithms implemented: GOB, GOAP MCTS, MCTS+BiasedPayout, MCTS+Limited+Biased Payout. Analyze factors such as processing time, number of iterations performed and quality of behaviour (which should be measured in terms of win rate%, or some other reasonable metric(s) if your Sir Uthgard is not winning...). Select one of the variants as your main algorithm and justify. Make 10 runs at least for each algorithm, **using the old maze without added formation orcs** but with the Monster SMs you developed and all actions active. If you feel courageous you can use Stochastic World, but that is not mandatory for the comparison...

Report Quality (2 points)