Enhancements for Monte Carlo Tree Search in The Mario AI Framework

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Abstract

(Bare copy/paste-ish fra projektbasen, skal skrives om!) In this experiment we explore different implementations and enhancements of the Monte Carlo Tree Search algorithm for an AI, in order to evaluate their performance and results in the Super Mario AI Benchmark tool. We have implemented the basic MCTS algorithm in the Mario AI Framework and characterised the performance and identification of the strengths and weaknesses of the algorithm relative to the framework. We have identified a set of refinements and alterations of the algorithm and through implementation and evaluation of these individually we came up with compositions that greatly increase the performance of the AI.

1 Introduction

In this experiment we explore different implementations and enhancements of the Monte Carlo Tree Search (MCTS) algorithm for an AI, in order to evaluate their performance and results in the Super Mario AI Benchmark tool. The MCTS algorithm has shown great results in various classical board games but has (to our knowledge) not been tested on a real-time physics-based game like Super Mario. Like some of the games that MCTS has proven effective in, Super Mario has a great branching factor of the state space but differs in that simulating actions is quite computationally heavy. These differences make several modifications of the core algorithm interesting for our experiment because they can help build the tree in a manner that uses the simulations more effectively.

2 Background

- Om MCTS [1]
- Om UCB og UCT [1] måske også [4]
- (kort!) Om The Mario AI Framework [5]

3 Approach and Improvements

3.1 Monte Carlo Tree Search with UCT

Kilde [1]

3.2 Domain knowledge

3.2.1 Limited actions

Hvis vi er nødt til at begrænse ham til ikke at bruge ↓ til alle de andre implementationer skal det fremgå her!

3.2.2 Hole detection

Hvis vi er nødt til at bruge hulgenkendelse til alle de andre implementationer skal det fremgå her!

3.3 Softmax Backup

$$exploitation = Q * maxReward + (1 - Q) * averageReward \tag{1}$$

We use equation 1 to calculate the exploration part for the confidence of nodes

3.4 Macro actions

[3]

3.5 Heuristic Partial Tree Expansion Policy

3.6 Checkpoints

3.7 (Combination)

4 Results

Method	**Score**
Softmax backup q = 0 (UCT)	34,162
Softmax backup q = $\frac{1}{8}$	-
Softmax backup q = $\frac{1}{4}$	34,387
Softmax backup q = $\frac{1}{2}$	34,147
Softmax backup q = 1	26,842

Table 1: Results of using Softmax backup with different q values

Method	**Avg. number of nodes**	**Score**
MCTS w/ UCT, limit = 0	-	-
MCTS w/ UCT, limit = 1	-	-
MCTS w/ UCT, limit = 2	-	-
MCTS w/ UCT, limit = 4	-	-
MCTS w/ UCT, limit = 8	-	-
MCTS w/ UCT, limit = 16	-	-
MCTS w/ UCT, limit = ∞	-	-

Table 2: Results of using UCT with a different limit for random moves

Her er noget mere tekst, reference til figur 1

Figure 1: Mario being followed

5 Conclusion

References

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