

# DEEP THREE MATCH: SOLVING THE GAME OF THREE MATCH WITH A LEARNED EVALUATION FUNCTION

by

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# CHAPTER 1

## PROPOSAL

### 1.1 Introduction

In this thesis I will build an artificial intelligent (A.I.) agent which will play and solve the game of three match (think Candy Crush or Bejewelled).

I will be investigating different ways of evaluating the game state. First, I will investigate ways of learning functions with hand-crafted features. Second, I will investigate ways of learning the features for the function. After implementing this function it will be integrated with the work of Elliott Davies.

### 1.2 Plan

In this section I outline the work required to complete this thesis. Each table represents a task, which is broken down into sub-tasks in the description section. A Gantt chart is also included at the end for a graphical view of the project time line.



Figure 1.1: The author's version of Three Match: Gem Island

Task	1. Complete game
Due	2017/06/13
Objectives	To build a challenging game for an AI agent to solve.
Description	1.1 Make a simple game for proof of concept 1.2 Implement matches for gems 1.3 Implement removable ice 1.4 Implement 'gravity' to pull down gems 1.5 Implement animations 1.6 Implement scoring system 1.7 Implement bonus gems 1.8 Implement combination scoring
Milestones	1.1 Making a simple game 1.6 A fully working game without bonuses
Deliverable	A complete game for the AI to solve

Task	2. Set up game for AI
Due	19/6/2017
Objectives	To get the game in a state for the AI to control.
Description	2.1 Design the game state representation 2.2 Implement methods to get game state 2.3 Implement methods for AI to call
Milestones	-
Deliverable	A game designed so that an AI can control it.

Task	3. Build naive AI version 1
Due	22/6/2017
Objectives	Proof of concept for getting an AI to control the game.
Description	3.1 Implement random policy/move selection 3.2 Connect AI to game 3.3 Collate training data from version 1
Milestones	-
Deliverable	A working AI which can control the game.

Task	4. Build naive AI version 2
Due	28/6/2017
Objectives	Proof of concept for using MCTS, evaluation function, and a policy
Description	4.1 Design sarch, policy, and evaluation function (s, p, e) 4.2 Implement s, p, e with 1-step look-ahead 4.3 Collate training data from version 2
Milestones	-
Deliverable	A naive version of the final design of the AI.

Task	5. Gather and collate training data
Due	27/6/2017
Objectives	To obtain the required training data for the neural networks.
Description	5.1 Set up game to output state to file 5.2 Set up game to distribute to users 5.3 Distrubute game to users
Milestones	-
Deliverable	Game to distribute - 22/06/17 Collated training data 27/07/17

Task	6. Build neural network 1 (NN1) with hand selected features.
Due	4/7/2017
Objectives	To build a NN which evaluates the game state
Description	6.1 Design and build NN1 6.2 Train NN1 6.3 Connect NN1 to game
Milestones	-
Deliverable	AI agent with working NN

Task	7. Build neural network 2 (NN2) with learned evaluation function.
Due	14/7/2017
Objectives	To build a NN which learns the function features and evaluates the game state.
Description	7.1 Design and build auto-encoder 7.2 Build NN2 with learned features 7.3 Train NN2 7.4 Connect NN1 to game
Milestones	-
Deliverable	AI agent with fully learned evaluation function.

Task	8. Integration of work with Elliott Davies
Due	21/7/2017
Objectives	Integration of work to build AI which can solve the game.
Description	8.1 Integration of work
Milestones	-
Deliverable	A working AI similar in design to AlphaGo

Task	9. Write dissertation
Due	13/8/2017
Objectives	To write a dissertation.
Description	9.1 Outline of dissertation 26/06/17 9.2 Literature review 21/06/17 9.3 Definition of problem 03/07/17 9.4 Solution to problem 03/07/17 9.5 Why is it novel 03/07/17 9.6 Methodology for NN1 06/07/17 9.7 Half draft 02/07/17 9.8 Full methodology including NN2, search, policy 24/07/17 9.9 Full draft 31/07/17 9.10 Final copy 13/08/17
Milestones	-
Deliverable	Half draft 02/07/17 Full draft 31/07/17

Gantt Chart

