

# Description for the MCTS ft. Blocks Generator

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## 1. Introduction

Our level generator generates fun block levels for Angry Birds. Inspired by the work of Graves [1], we use Monte Carlo Tree Search (MCTS) to place super-blocks (a structure of blocks) and pig/TNT islands to create fun block levels. The differences between our generator and Graves' are that our generator creates a super-block each time according to some rules that ensures stability, but Graves' generator uses a set of pre-determined stable structures. In addition, super-blocks and pig/TNT islands are randomly placed in our generator, while such objects are placed in a zig-zag fashion in Graves' generator.

## 2. MCTS approach for level generation

In order to create a super-block, a block type and its material are selected randomly from the list of usable blocks. Such selected blocks are then stacked up subject to some rules, sometimes with a pig on the top, to a predefined height. Next, a platform is added under a super-block (Fig. 1 Top). A platform is also added under a pig (or TNT) to form a pig (or TNT) island (Fig. 1 Bottom).

We use MCTS to find the best combination of super-blocks, pig islands, and TNT islands in the usable area in terms of maximizing

1. variety of blocks
2. usage of pig or TNT islands
3. proximity of the proportion of the used area to the golden ratio (1.62)

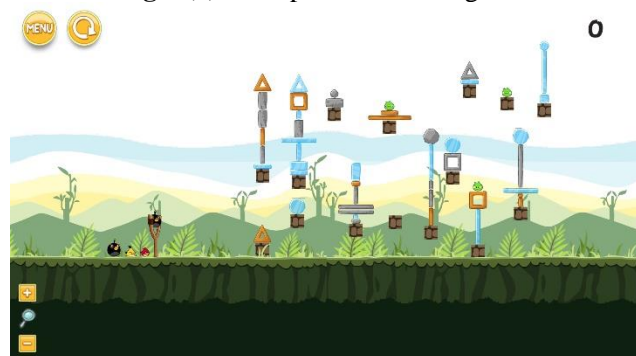
Examples of resulting levels are shown in Fig 2.



**Fig.1** Examples of super-blocks (top) and a pig/TNT island (bottom)



**Fig. 2(a)** Example of a resulting level



**Fig. 2(b)** Example of a resulting level



**Fig. 2(c)** Example of a resulting level

## 3. Adjustment of level difficulty

We assign the number of pigs in all levels to Competition's  $max$  while the number of birds to  $max+1$ . We divide the area into four sub-areas. If the number of initially assigned pigs is more than  $max$ , one pig will be removed from the sub-area with the highest number of pigs. This is repeated until the number of pigs becomes  $max$ . If the number of initially assigned pigs is less than Competition's  $max$ , new pigs will be placed before the slingshot.

## Reference

[1] M. Graves, Procedural Content Generation of Angry Birds Levels Using Monte Carlo Tree Search, Master of Science in Engineering Thesis, The University of Texas at Austin, December 2016.

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