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Beyond Polynomial Time Project

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1 Problem Statement

Exploring the NP-Hardness of the Angry Birds Game.

2 Background and Motivation

I love to play games and Angry Bird is one of the first games I and most of us have played at some point in time. While seemingly simple, this game involves complex decision-making to destroy all pigs in a level using a limited number of birds and considering obstacles such as blocks. A research has shown that **determining the optimal sequence of shots to clear a level is NP-hard**, meaning that as the level complexity increases, the problem becomes computationally infeasible to solve optimally using brute force methods.

3 Research Paper Reference

The primary reference to this problem is stated in a paper titled *"The Computational Complexity of Angry Birds and Similar Physics-Simulation Games"* written by **Matthew Stephenson, Jochen Renz, and Xiaoyu Ge** in 2016. This paper proves that **Angry Birds is NP-hard** and provides theoretical foundations for why the problem is combinatorially challenging.

4 Objectives

4.1 To generate synthetic datasets of Angry Birds levels with varying complexity (number of pigs, blocks, and birds).

4.2 To study the combinatorial complexity of clearing levels as the problem size increases.

4.3 To compare different algorithmic approaches (brute-force, approximation, heuristics) in terms of runtime and solution quality.