

Playing Games for "Research Purposes" - Final Proposal



Tentative Timeline

Studying Complexity Theory [1st October - 15 October]

Aim:

1. Understand the Church-Turing Thesis
2. Understand the mathematical formulations of a Turing Machine
3. Basic complexity classes, e.g., P, NP, NPC, NP-Hard
4. Understanding Hierarchy Theorem
5. Understanding probabilistic complexity classes especially BPP
6. Studying quantum complexity classes especially BQP

Resources:

- Modern Complexity Theory (M20Temp11, IIIT-H) by Girish Varma
- Computational Complexity: A Modern Approach by Arora and Barak

- Introduction to Complexity Theory by Michael Sipser
- Undergraduate Complexity Theory by Ryan O'Donnell, CMU
- Graduate Complexity Theory by Ryan O' Donnell, CMU

Studying Reduction Proofs [16th October - 24th October]

Aim:

1. Understanding Reduction Proofs
2. Working out present proofs on Game/Puzzle Classification

Resources:

- Karp's 21 NP Complete Problems
- Erik Demaine's papers on Classification of Video Games
- Research publications and dissertations for Classification of Games and Puzzles

Studying Optimisation and Approximation [16th October - 24th October]*

1. Study basics of mathematical optimization
2. Understand how to use approxiamtion/optimization algorithms for optimization problems in order to enable us to create algorithms for a perfect or approximate winning strategy

Modeling the Game [1st November - 20th November]*

1. We construct a minimalistic model of the video game's level(s).
2. We simulate the level on a game engine.

Constructing a Reduction [25th October - 31st October]

For at least one of the planned games, we will construct a proof for classifying the game into a complexity class.

Optimisation Algorithm [1st November - 10th November]*

Based on the classification of the game, we construct an algorithm to solve the level.

Footnotes:

**not a major goal; shall be implemented/studied if time permits*

Member Roles

Common goals

- Understanding Complexity Theory
 - Understanding Reduction Proofs
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Specific goals

- For each member of the group, we have assigned games which they will understand. Our aim is to classify all the games into complexity classes. Our minimum goal is to classify at least one of the games.
 - We split ourselves into groups that will work on different parts of the subject required to achieve the reduction and construct the optimisation algorithm.
 - A small group will work on creating the model at the end while the rest work on the construction of the algorithm.
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Games*

- Zeeshan - Celeste
 - Arjo & Hrishi - Mario Bros
 - Shreyas - Cuphead
 - Pulak - Getting Over It
 - Shaanjeet - Cuphead
 - Ashwin - Geometry Dash
 - Kushagra - Road Rash
 - Manasvi - Pokemon
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Footnotes:

**We are not limiting the list of games to the ones mentioned above, these games only serve as a start for further exploration.*

THE END