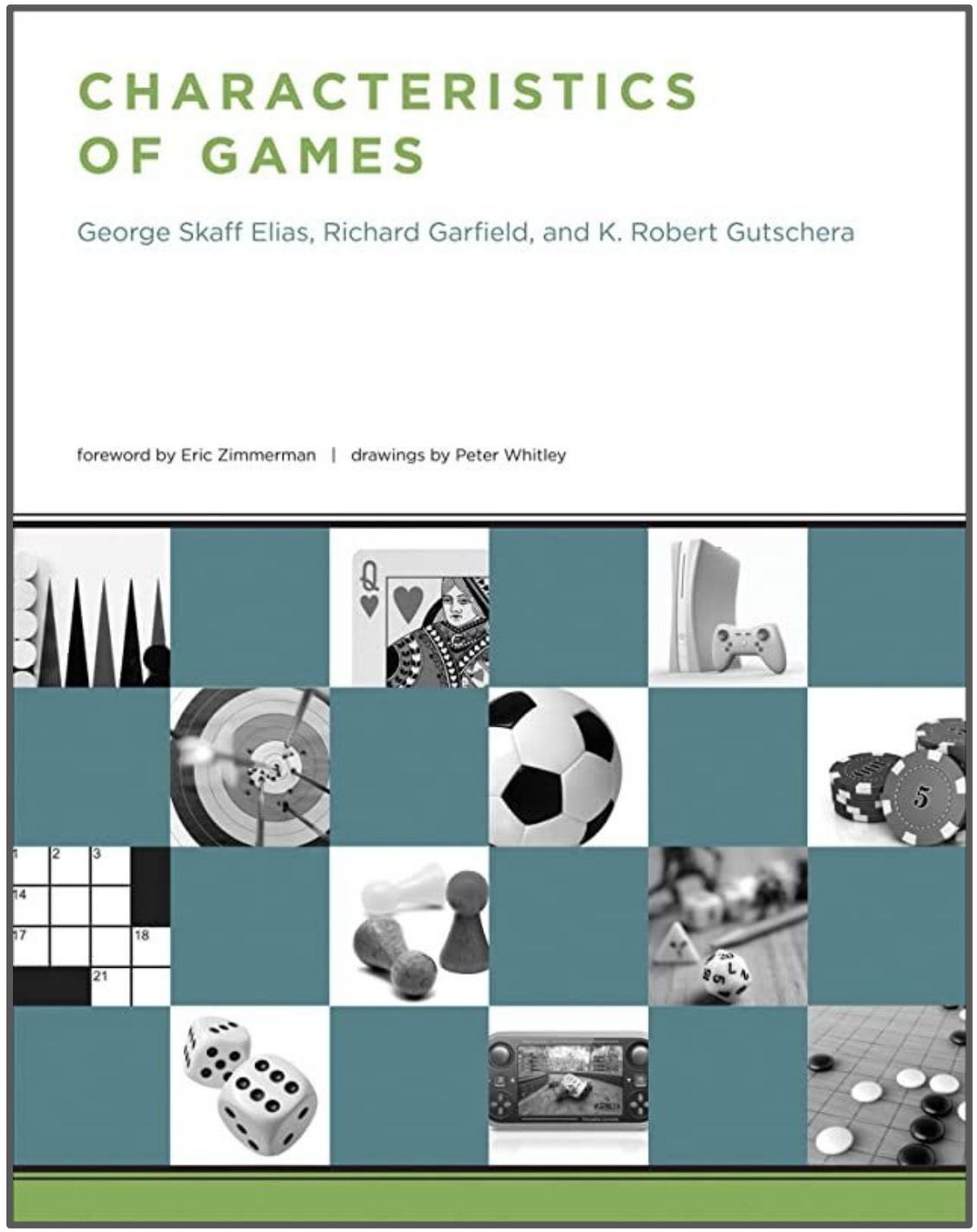
Lecture 2:
Characteristics of Games and (Skill) Depth

Game Design
Fall 2023

Julian Togelius and M Charity

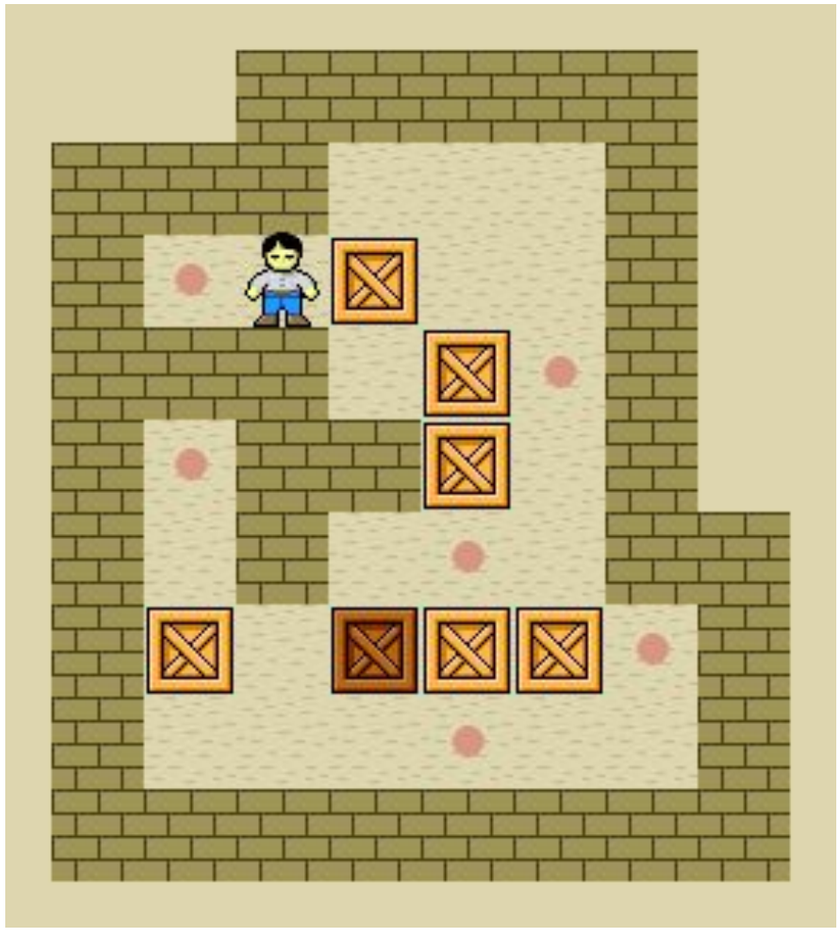
Just to name a few:

- ❑ Stochasticity vs. Observability vs. Time Granularity
- ❑ Length of playtime
- ❑ Systems
- ❑ Single vs. Multiplayer
- ❑ Heuristics
- ❑ Dexterity vs. Strategy



Stochasticity vs. Observability vs. Time Granularity

- *stochasticity* - will different outcomes happen from taking an action or the same actions every time?
  - deterministic vs. non-deterministic

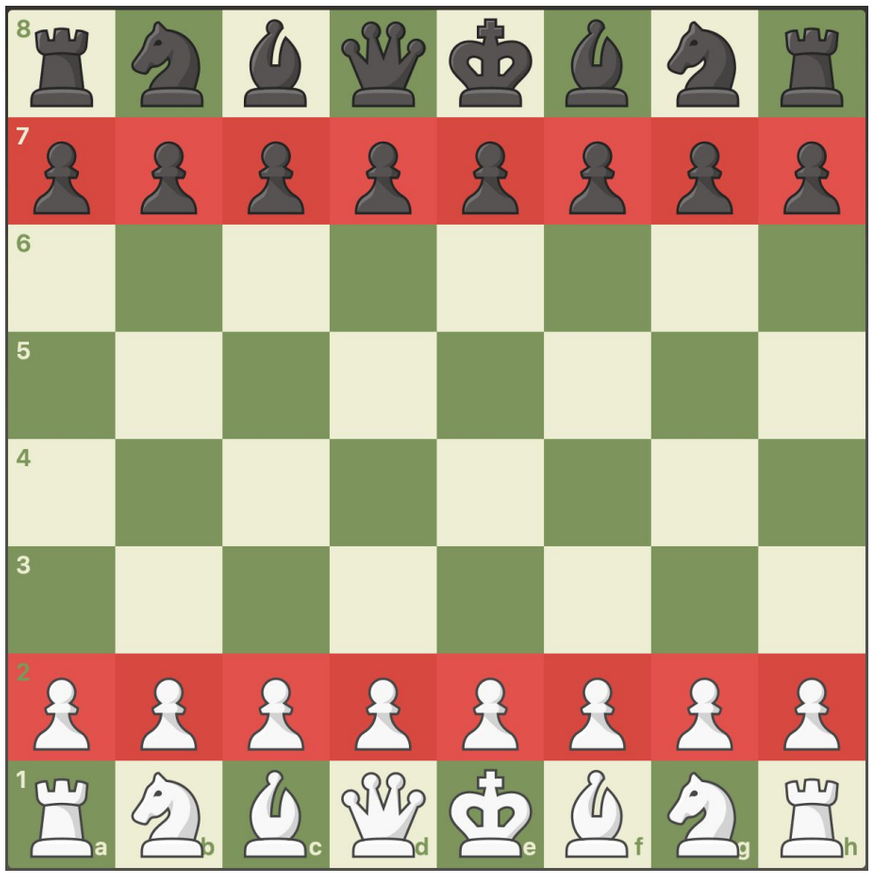


Deterministic (Sokoban)

Non-Deterministic (Caveblazers)

Stochasticity vs. Observability vs. Time Granularity

- *observability* - how much of the game is known vs. unknown
  - perfect information vs. imperfect information



Perfect Information (Chess)

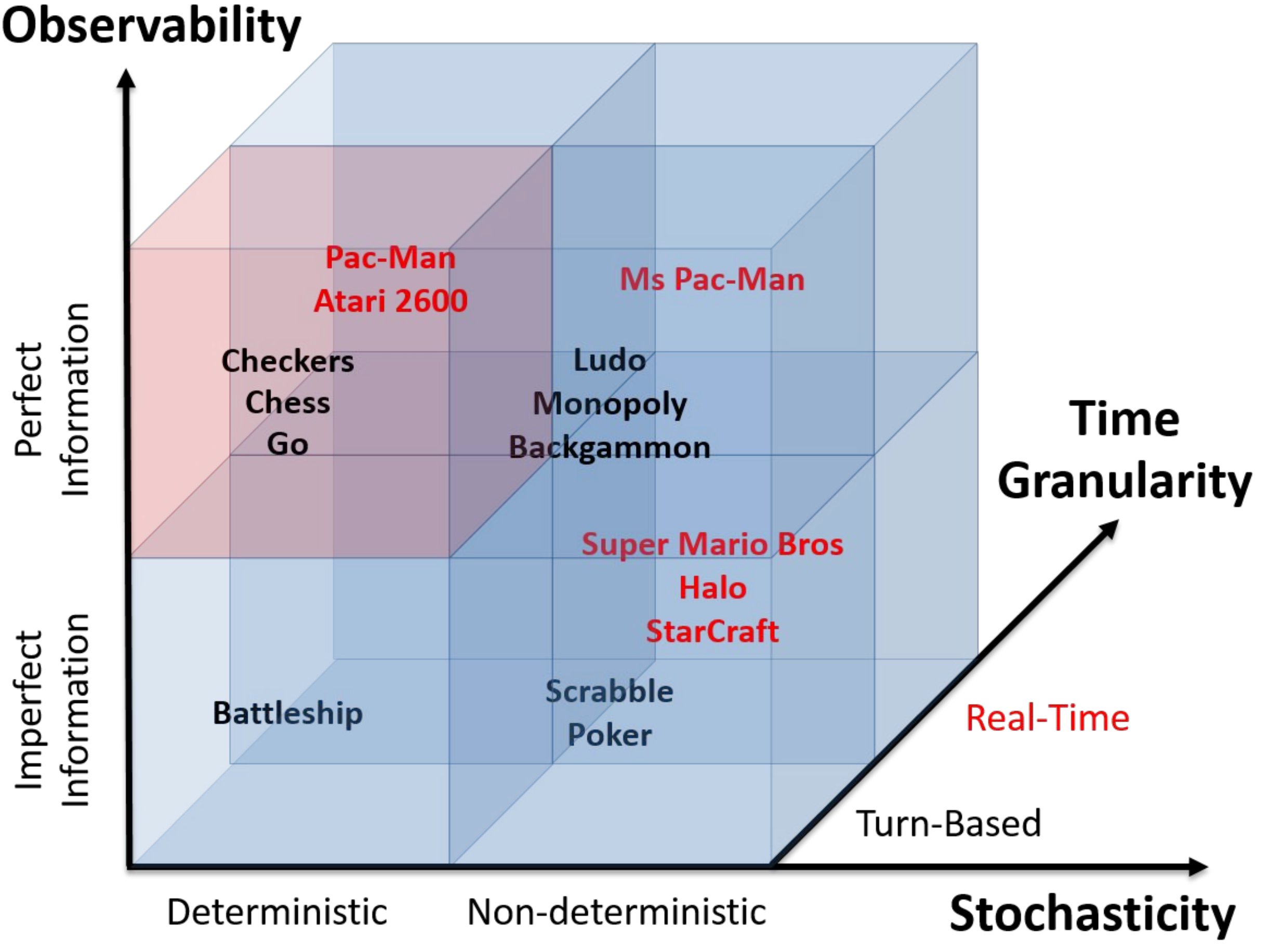
Imperfect Information (Battleship)

Stochasticity vs. Observability vs. Time Granularity

- *time granularity* - can you take as much time as you want to make an action or does it play in real-time?
  - turn-based vs. real time

Turn-based (Final Fantasy 3)

Real Time (Elden Ring)


Observability
Perfect Information
Imperfect Information
Pac-Man
Atari 2600
Ms Pac-Man
Checkers
Chess
Go
Ludo
Monopoly
Backgammon
Super Mario Bros
Halo
StarCraft
Scrabble
Poker
Battleship
Time
Granularity
Real-Time
Turn-Based
Deterministic
Non-deterministic
Stochasticity

Length of Playtime

- *round* - short and quick relative to the entire gameplay
- *session* - can vary in time from a few minutes to a few hours
- *“full game”* - encapsulates the entire gameplay from start to finish

- Note: A *session* can have multiple *rounds* and a *full game* can contain many sessions

Length of Playtime

Pokemon

Round
(1 battle)

Session
(Fighting a Gym)

Full Game
(Collecting badges)

Length of Playtime

Wario Ware

Round
(1 minigame)

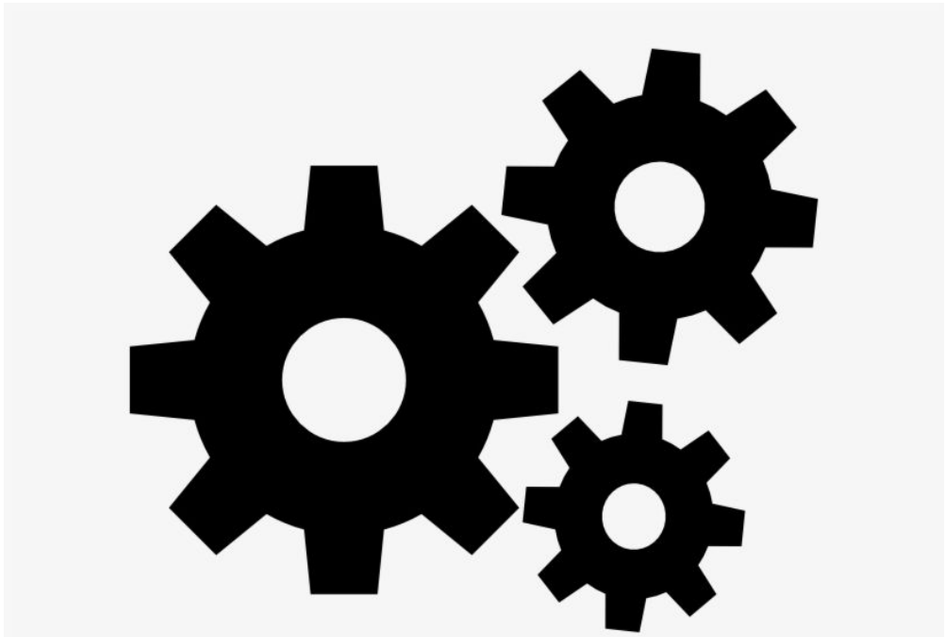
Session
(Multiple minigames)

Full Game
(Playing all minigames)

Systems

- how game elements interact with each other
  - player, object, enemy, ally, abstract items, etc

1. *conditional*
   a. if X, then Y
2. *combination*
   a. X + Y, makes Z
3. *feedback loops*
   a. AI behavior + state trees; if X, then Y, else Z
4. *resources*
   a. turn # X into ## Y; use X to Y



Systems

Zelda: Breath of the Wild

Conditional

Combination

Feedback Loop

Resources

Single vs Multiplayer

- *single-player* - can someone play the game by themselves?
- *multi-player* - can multiple people play the game?
  - co-op - players work together towards a goal
  - competitive - players play against each other for the same goal

- *Sync vs. Async* - can players interact with each other in real-time or at different times?

Single vs Multiplayer (in the same game)

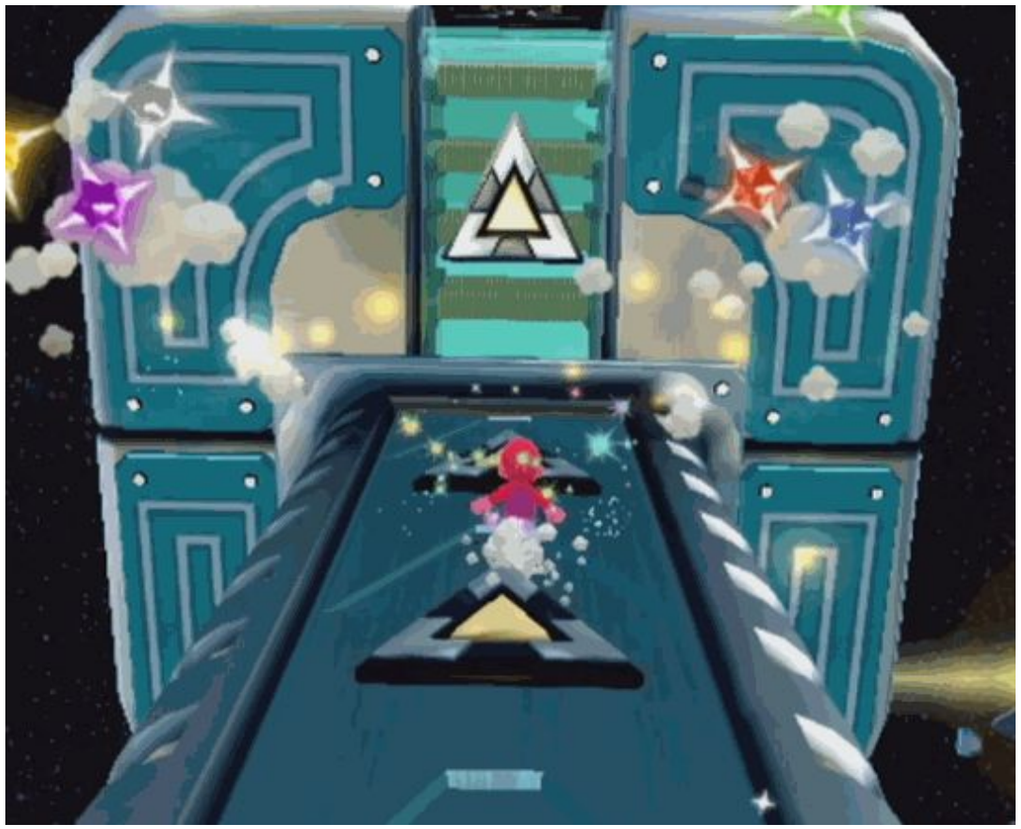
Mario Party

Single player vs Multiplayer (competitive)

😕 🤩

Single vs Multiplayer (in the same game)

Super Mario Galaxy



Single player

vs

Multiplayer
(co-op)

😁

🤨

Single vs Multiplayer (in the same game)

Overcooked

Single player vs Multiplayer (co-op)

😖 😂

Single vs Multiplayer (in the same game)

Minecraft

Single player

😊

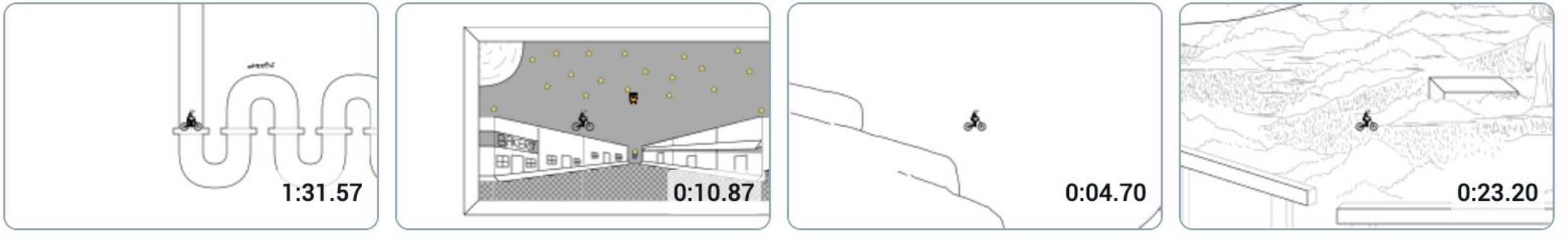
Multiplayer
(co-op and competitive)

😝

Async Online Multiplayer Mechanics

Messages (Elden Ring)

Design codes (Animal Crossing)



Level editors / creation (Free Rider)

Depth in Strategic Games

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Abstract

This paper explores the question of whether it's possible to discover a well-defined property of game systems that corresponds to what game designers and players mean by the term "depth." We propose a measurable property of a game's formal system, which we call '*d*', that corresponds to the capacity of a game to absorb dedicated problem-solving attention and allow for sustained, long-term learning. To define this property we develop a formal model that measures how susceptible a game is to partial solutions under conditions of steadily increasing computational resources. We then sketch out several directions for using the model to investigate questions about the structural properties of games that produce these effects.

One challenge with the informal use of the word "depth" is that it is often used as a binary term, implying a quality that games either do or don't have. The real picture is much more complex; every game exists along a spectrum of depth. Moreover, the same game may exhibit different levels of depth in relation to different player communities, or in relation to the same community at different times. We are interested in examining depth as a quality that all games have to various degrees, understanding how this quality is related to a game's formal structure, and developing conceptual tools that allow us to explore this relationship with greater precision.

Depth is often referred to by game developers (Pulsipher and Others 2011; Kiley 2013; Ghostcrawler 2016) and in scholarly research (Browne 2008; Nielsen et al. 2015;

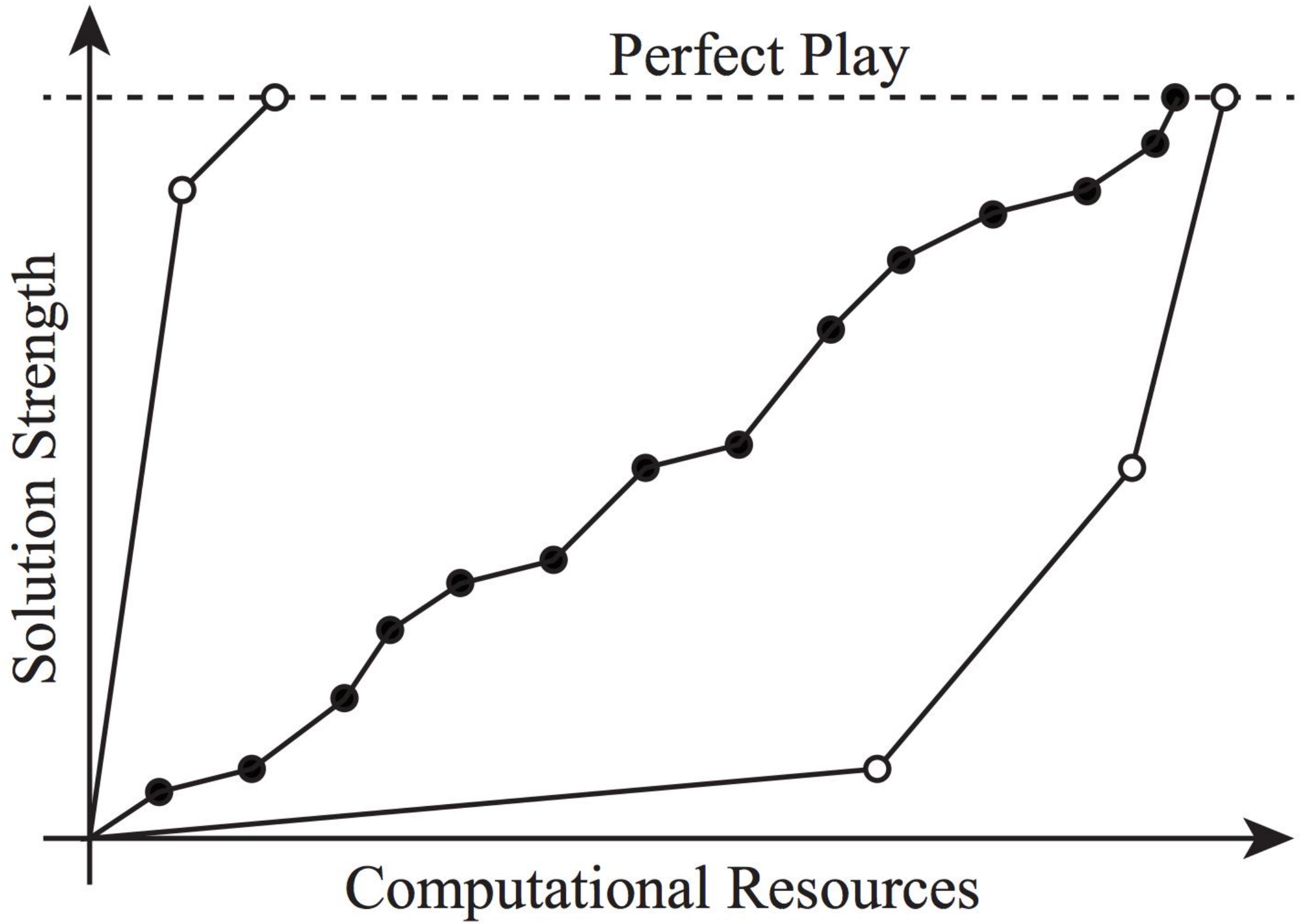


Figure 1: Strategy ladder steps and solution strength, as function of computational resources

Heuristics

What are heuristics?

Heuristics

What makes a set of heuristics “Good”?

They…

1. exist at all levels of gameplay (beginning, middle, and end)
2. vary in accessibility and has lots of satisfaction all around
3. lie somewhere between gut-feeling and brute-force
4. allow your players to take mental shortcuts and avoid overload

A game that both a novice and experienced player can find fun and get better at

Heuristics

Chess

- Control the center 4 squares
- Castle your king
- Develop your sphere of influence/zones of control
- Avoid doubling up pawns

Heuristics

Bad Heuristics (E.T.)

Good Heuristics (THPS)

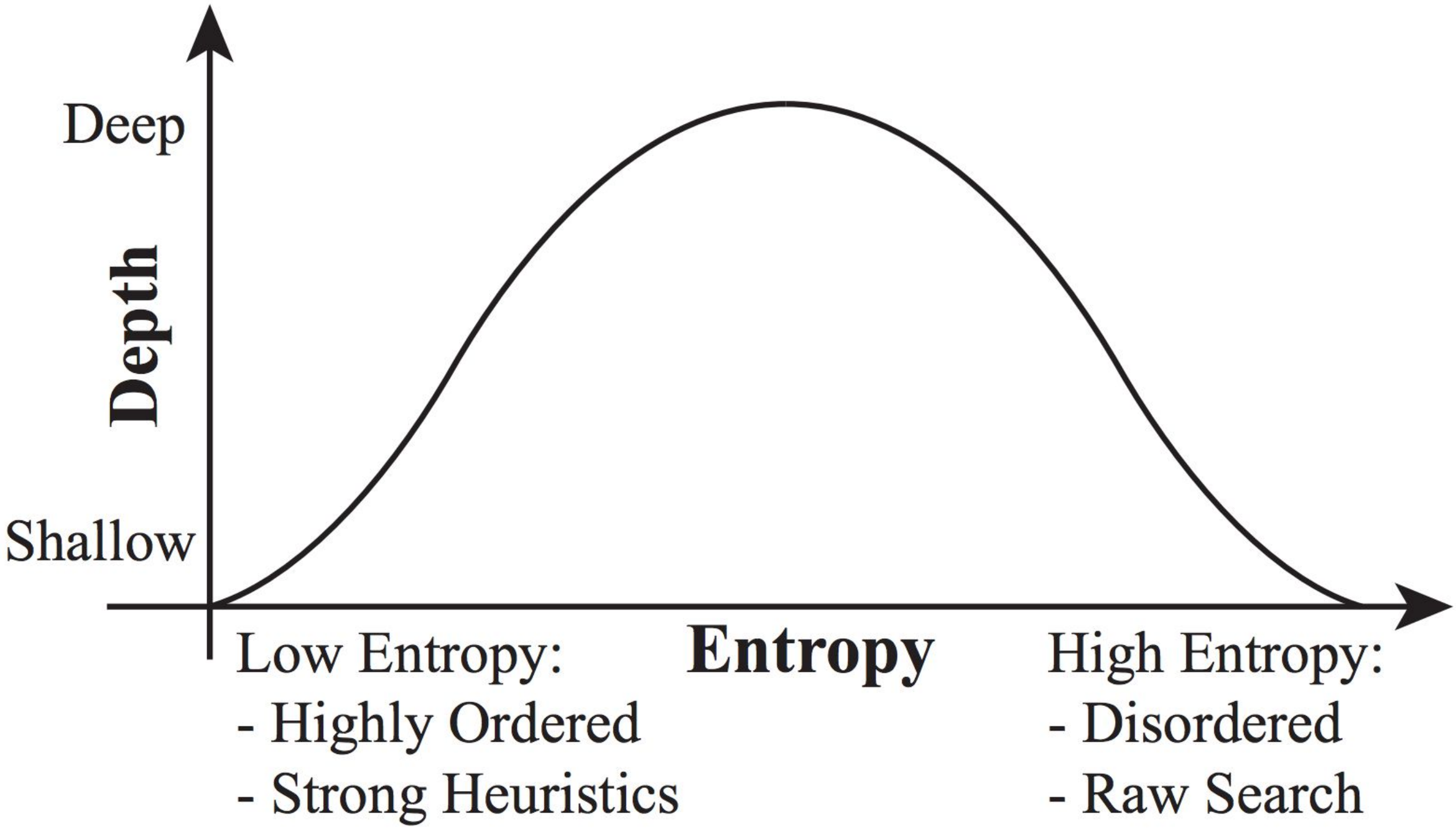
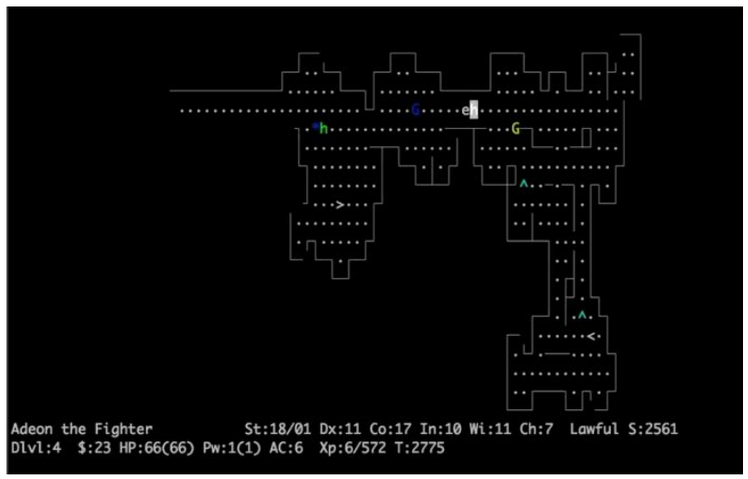


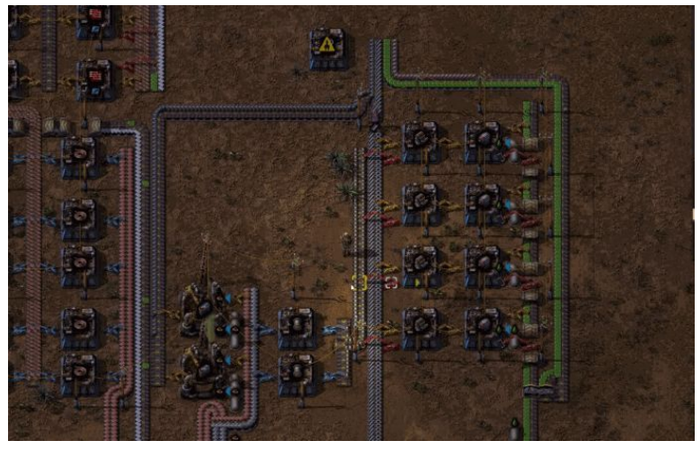
Figure 2: Maximizing depth requires a balance between heuristics and search.

Depth vs. Entropy

Deep



Nethack



Factorio

Disorder

Structure

Bubsy (SNES)

Pokemon Randomizers

Shallow

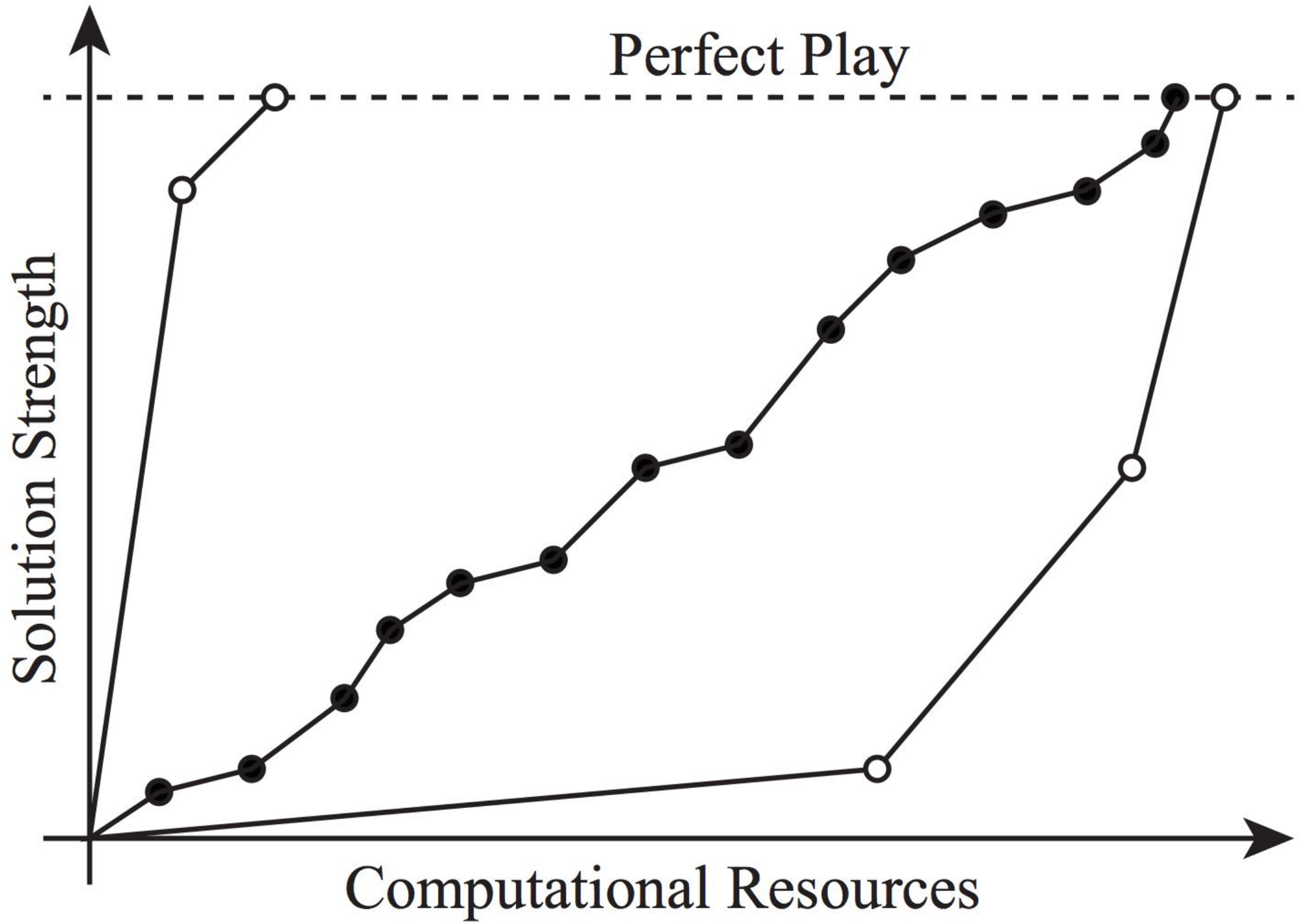


Figure 1: Strategy ladder steps and solution strength, as function of computational resources

Dexterity vs Strategy

dexterity - requires physical / reflexive ability to play well

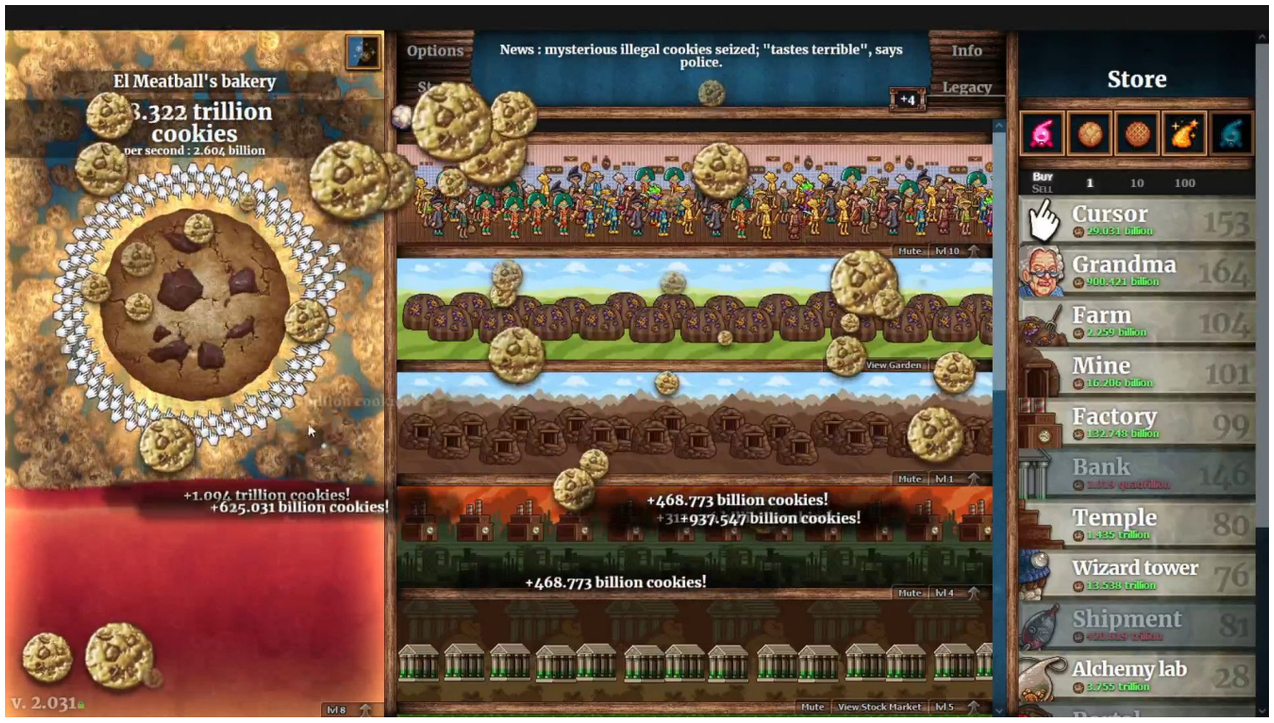
- point and click, button mash, combos, etc.

strategy - requires mental planning ability to play well

- thinking steps ahead, resource management, risk-taking, etc.

Dexterity

Cookie Clicker



Elden Ring

Low Dexterity

High Dexterity

Strategy

Craps

Low(er) Strategy

Starcraft (RTS)

High Strategy

Dexterity Required

Infinite Runners *(Canabalt, Flappy Bird)*

Interactive Puzzle Games *(Tetris, Puzzle Bobble)*

Real-Time Strategy *(Starcraft II, League of Legends)*

Standard Match-3 *(Bejeweled, Candy Crush)*

Mazes

Chess

Strategy Required

Your mission

- Build a simple game prototype that demonstrates at least 3 characteristics of games
  - Minimalist, if possible
- Argue how the characteristics are used and why they support developing deep playing skills
- Avoid: multiplayer, long games (more than 4 min), systems