



Principles of
Expressive Machines



Eye Tracking in a Digital Hanabi Game

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Research Objectives



- Implement Hanabi in Unity
- Add eye-tracking capability
- Generate and analyze eye-tracking data
- Incorporate AI into the Unity version of the game
- AI uses eye-tracking data to inform its knowledge about players actions and the contents of it's hand.

About Hanabi

- Cooperative 2 - 5 person card game
- Each player can see everyone else's cards, but not their own
- Players work together to build sets, or "fireworks"
 - ordered from 1 to 5 in each color
- In a turn you can either
 - Hint to another player about their cards
 - Play a card
 - Discard a card



Unity Implementation



- Originally written in Python
- Implemented in Unity
 - C# scripting with Visual studio

Score: 0/25



Your Turn

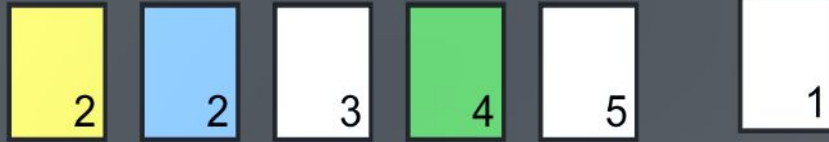
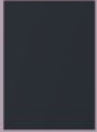
Moves:

Start Game

Score: 2/25



Your Turn



Moves:

The Computer attempted to play its green3 card, but it was discarded.

You attempted to play your white1 card, but it was discarded.

The Computer hinted your 1 cards.

You played your white1 card.

The Computer hinted your 1 cards.

You played your red1 card.

Your Turn

Moves:

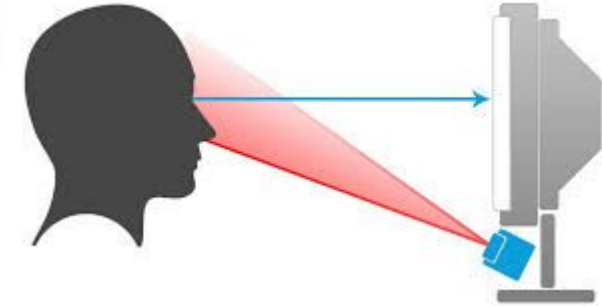
- The Computer attempted to play its blue2 card, but it was discarded.
- You hinted your opponent's blue cards.
- The Computer hinted your yellow cards.
- You hinted your opponent's 5 cards.
- The Computer attempted to play its green3 card, but it was discarded.
- You attempted to play your white 1 card, but it was discarded.
- The Computer hinted your 1 cards.
- You played your white card.
- The Computer hinted your 1 cards.
- You played your red 1 card.

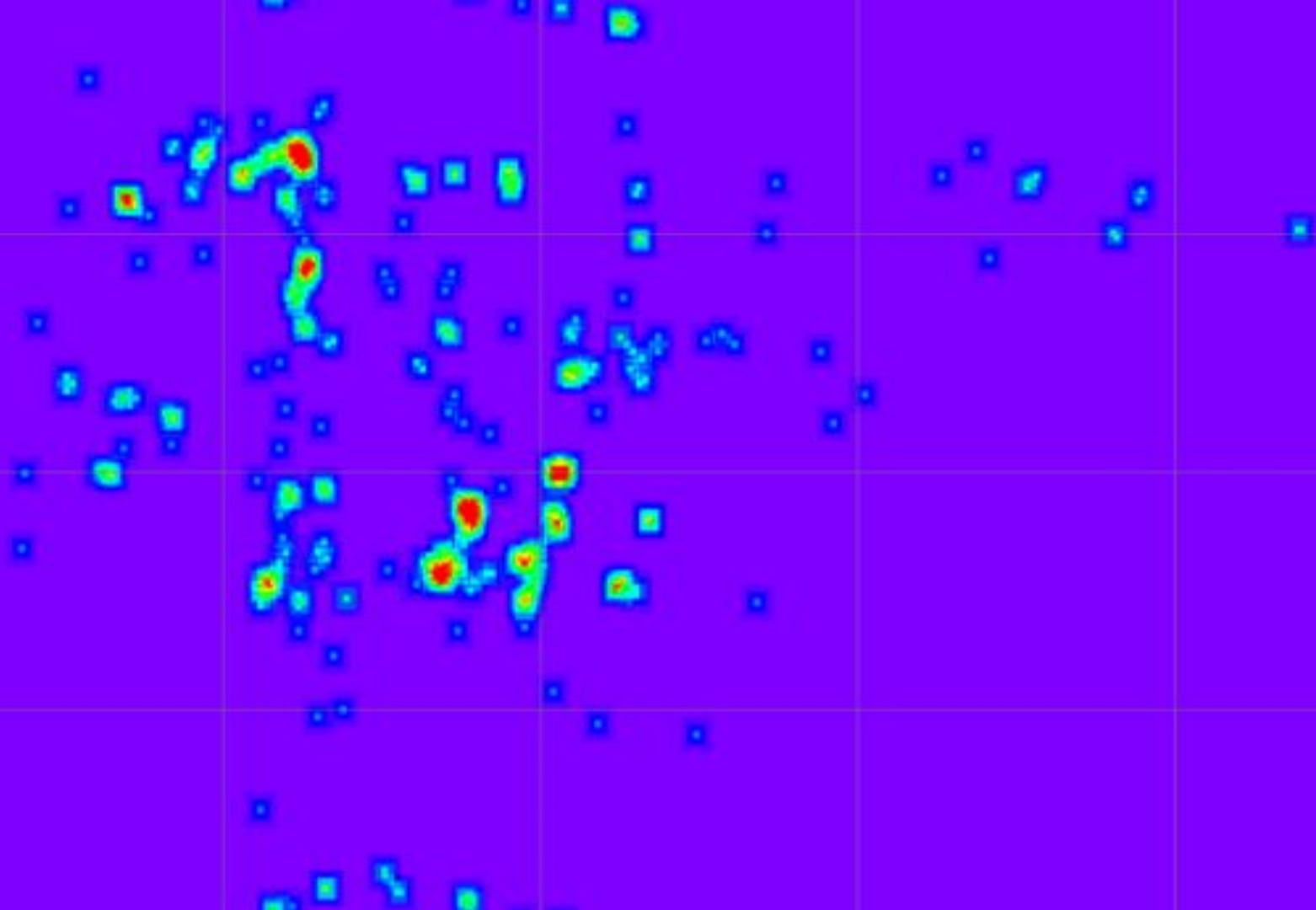
Score: 2/25

Restart

Eye Tracking Component

- USB plugs into computer
- Tutorials available immediately
- Has Unity SDK
- Can make profiles for different people
- Easy calibration





Heat Map Interpretation

- Depicts a player's gaze while playing Hanabi on our Unity implementation.
- Corresponds to same space as the screenshots in column 2.
- Uses HSV color scale from purple to Red, wherein:
 - Red areas have highest gaze activity, and the purple/blue sections have little to none.



Discussion of Findings

- The eye-tracker is able to detect which areas of the board a player is looking at, and how often.
- This data can potentially be used to determine player intentions
 - Which cards a player is deciding between, etc..
- AI gains ability to interpret information through non-verbal communication



Future Work

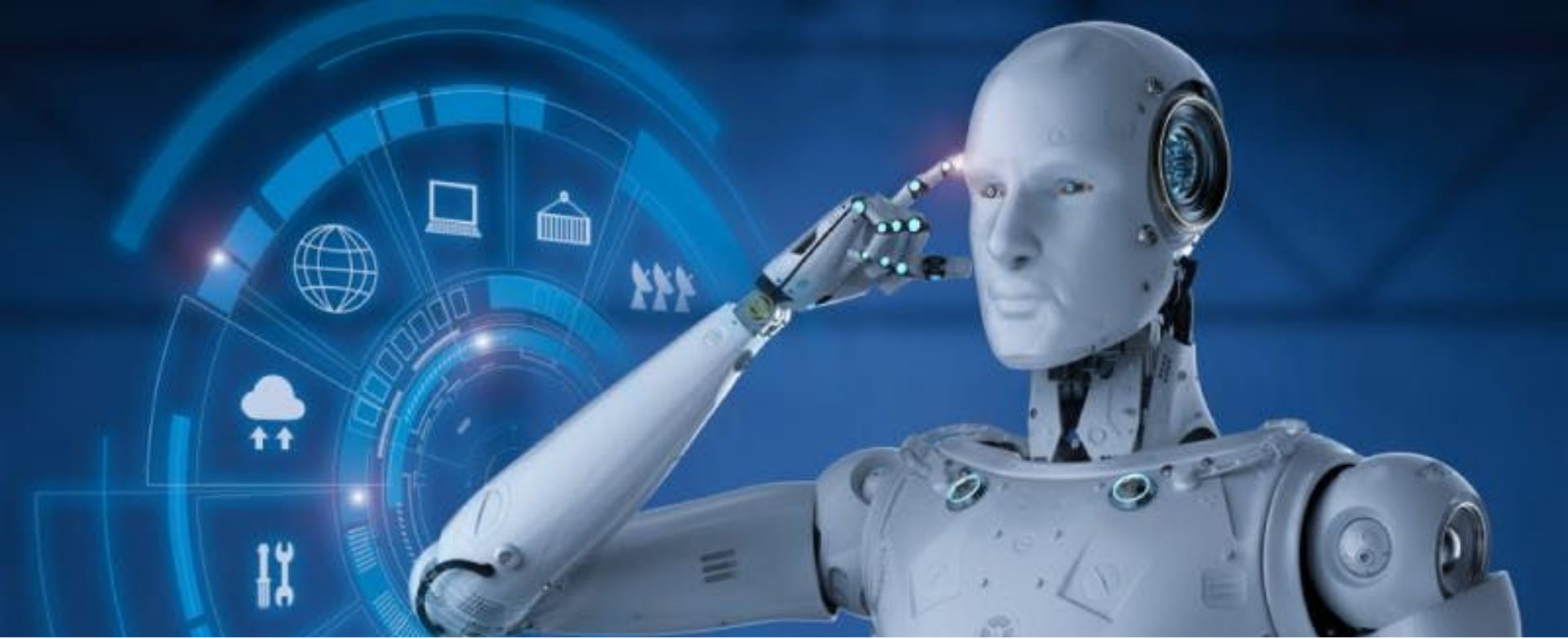
- Support for up to 5 players
 - AI then must choose which player to hint to, if any.
- Analyzing eye-tracking data
- AI utilizing eye-tracking data to make decisions and further it's knowledge of the game at a particular state.



Broader Implications

- Humans use non-verbal communication techniques
- AI being able to utilize this data has many implications such as:
 - Intention recognition
 - Improving game-play
 - More flawless human-computer interaction in many fields
 - Artificial intelligence becoming increasingly more human-like





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