Cognitive Science: All Fun and Games?

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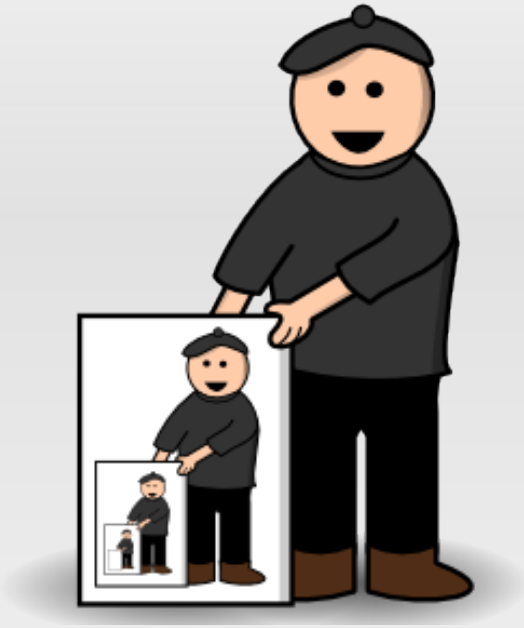
Rob Goldstone's Percepts and Concepts Lab
Indiana University 2009

Group Behavior

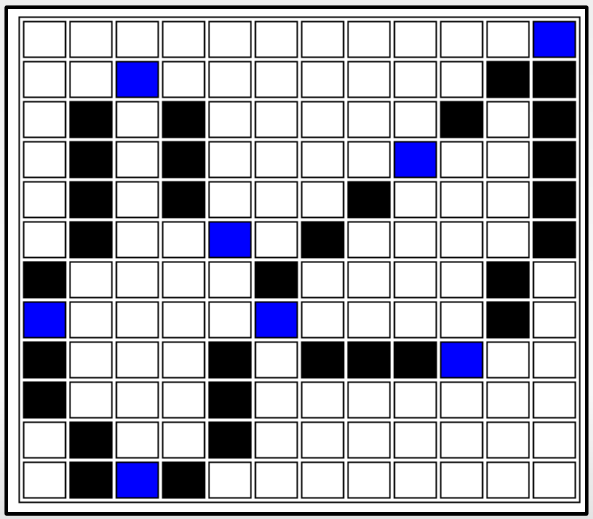
- Human behavior as a complex system
  - Emergent properties in group tasks
  - Decentralized computation
- Compare with ”natural systems”
  - Plants, animals, minerals
- Compare with agent-based models
  - Formalize underlying strategies
  - Analyze efficiency
  - Apply models to dissimilar systems

Games

- **Pixel**
  - Collective digital art
- Group Sum
  - Collaborative binary search
- Forager
  - Resource mining competition
- Flatland
  - Grid world with optional constraints



Pixel Overview

- Collective art – 2D black and white grid 
  - Players control individual pixels 
  - All changes are recorded
- Fixed group per session
  - No communication allowed (well...)
- Variety of modes
  - Diffuse / clustered / random
  - Traveling salesperson problem 

Pixel Overview

- Conditions
  - Clustered, Diffuse, or Random layout
  - Simple or Disjunctive instructions
- Experimental questions
  - Influence on final picture (3rd party ratings)
  - Time to solution (TTS)
  - Overall group behavior

Pixel Game

Pixel Game

”Draw a Circle”

Clustered

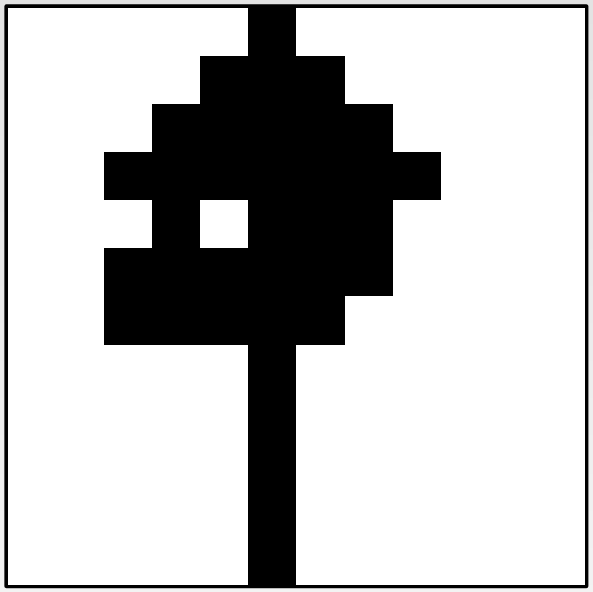
”Draw an Arrow”

Diffuse

Pixel Results

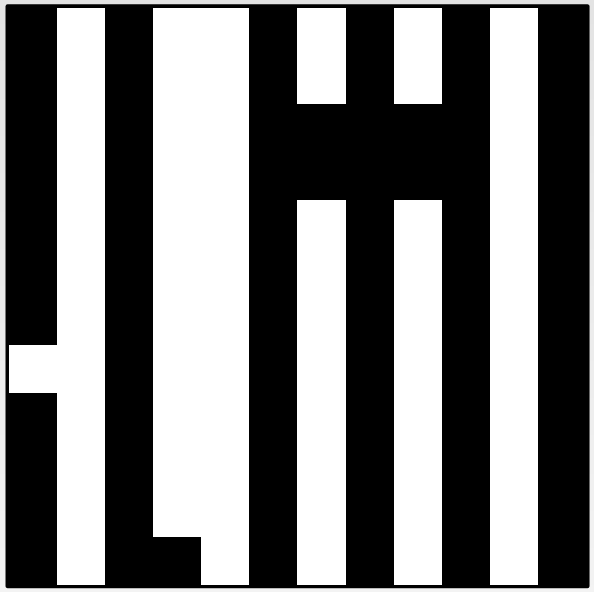
Should be...

Arrow



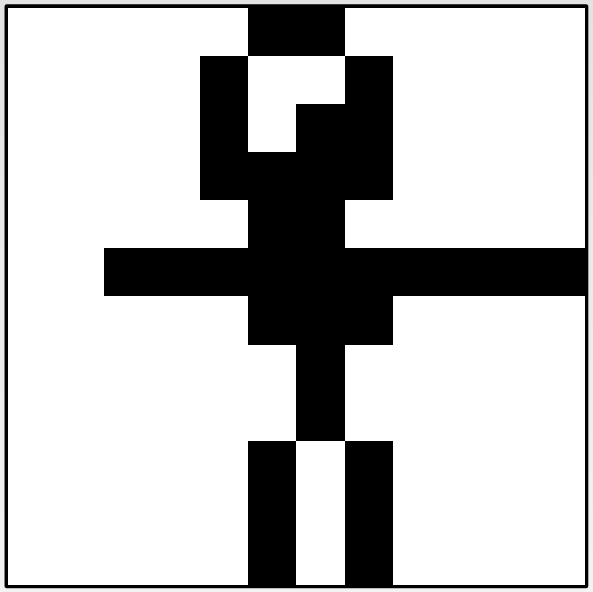
Birdhouse?

Stripes



Labryinth?

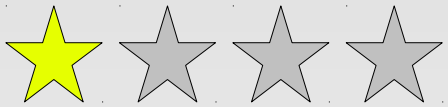
Stick Figure

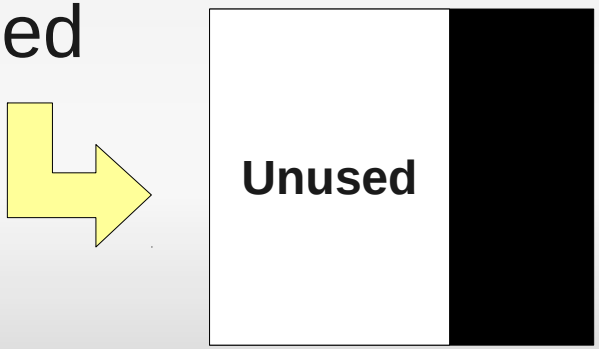


xkcd?

Looks like...

Pixel Results

- Too few experiments
  - Undergrads are fickle in Spring
- Clustered → Poor rating 
- Disjunctive or clustered → Quicker TTS
  - Odd given choice involved (H or E, C or U)
- Any condition →
  - Linear decrease in average click rate
  - ~ 60% of pixels not changed



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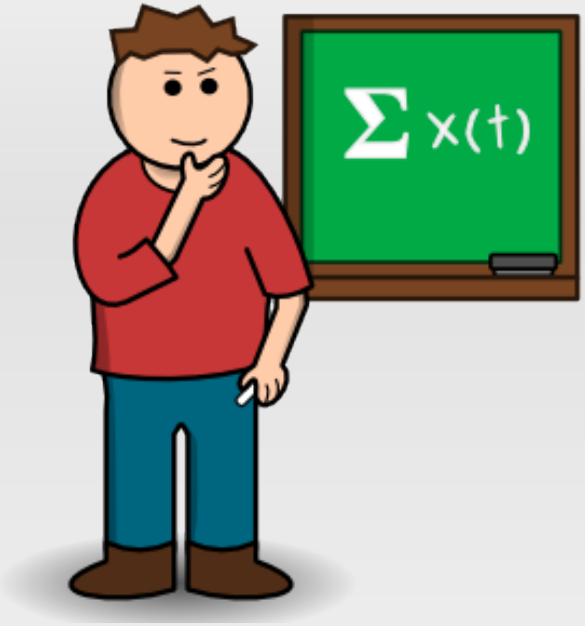
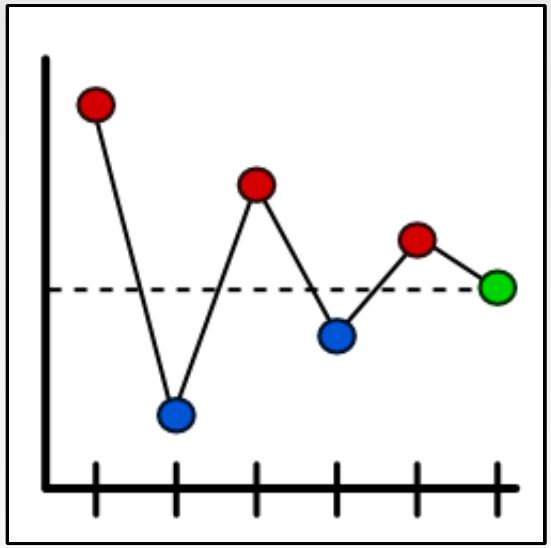


Group Sum Overview

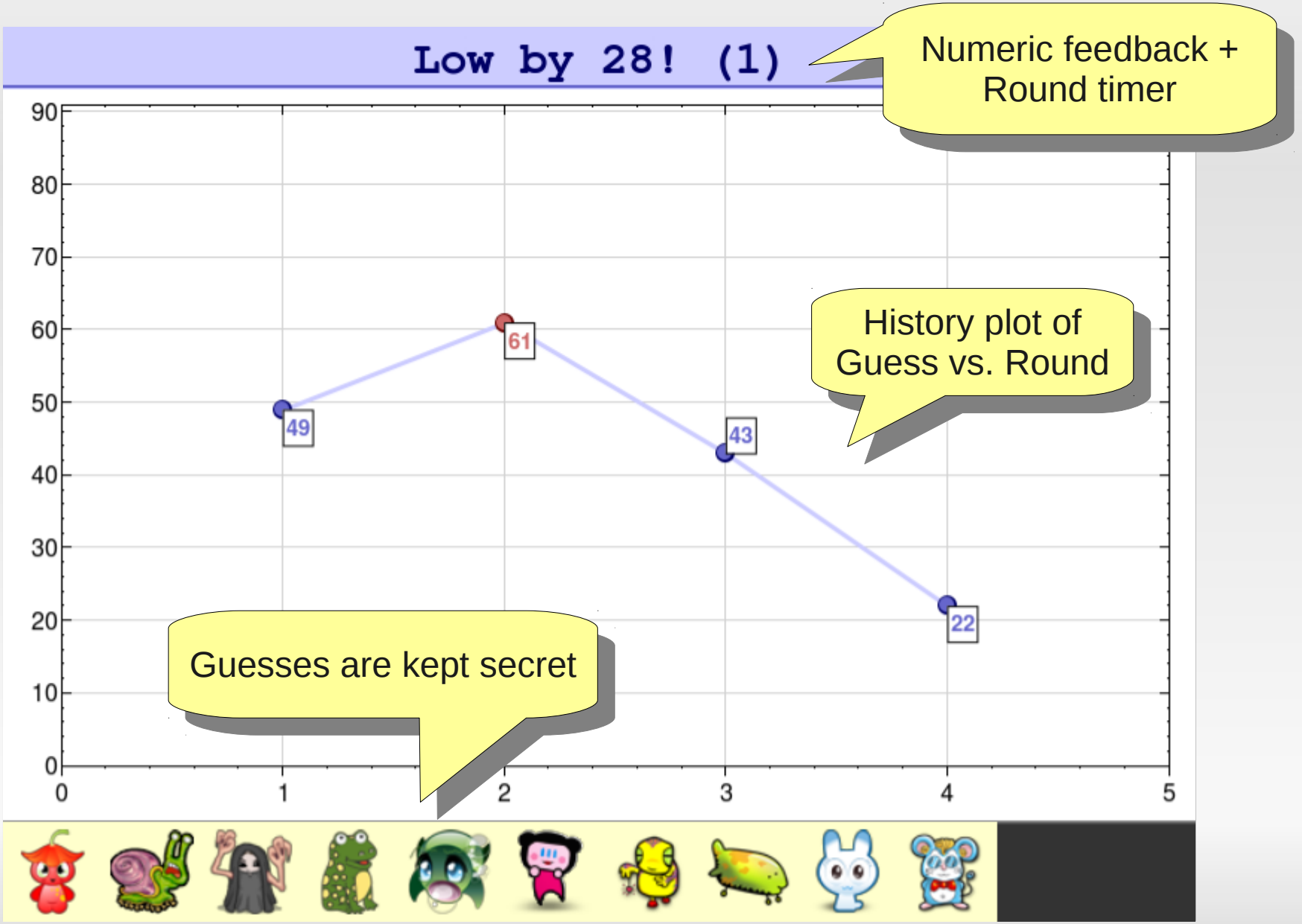
- High / low number game
  - ”Collaborative binary search” sounds fancier
  - All guesses are summed
  - No communication allowed
- Feedback after each round
  - Numeric: ”High by 10”
  - Non-numeric: ”Too Low”
- History of guesses available
  - Color-coded line plot



Group Sum Overview

- Goldstone and Roberts 2009
- Experiment hypotheses
  - Members will compensate for each other
  - Feedback will influence coordination
  - Larger groups (10+) will have more difficulty
  - Variability will change over time:
    - Decreased within-participant
    - Increased between-participant

Group Sum Game



Group Sum Results

- Numeric feedback → Quicker TTS (~2 rounds)
- Small vs. Large groups (~7 vs. 12 rounds)
- Individual reactivity proportional to feedback
  - Not optimal if everyone does this, but flexible
- Role differentiation in large groups
  - Some individuals are inactive, very active, etc.
  - Diffusion of responsibility
- Homogeneous roles in small groups
  - Between-participant variance decreases

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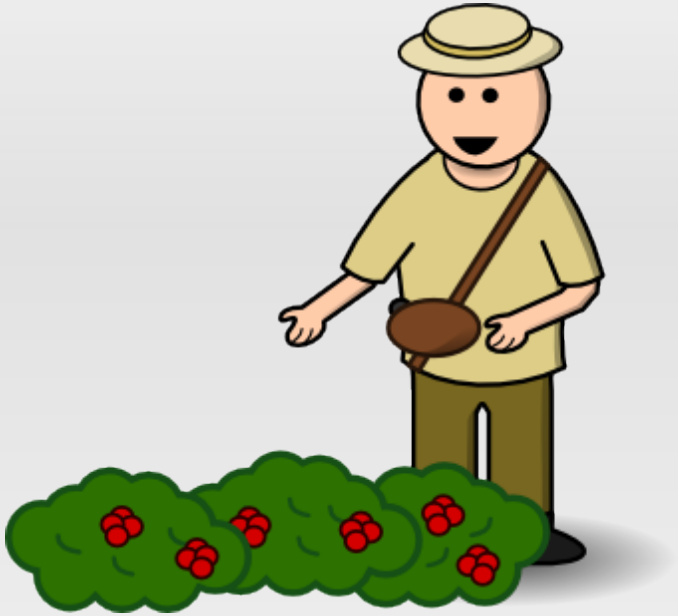
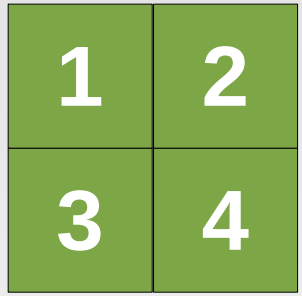


Forager Overview

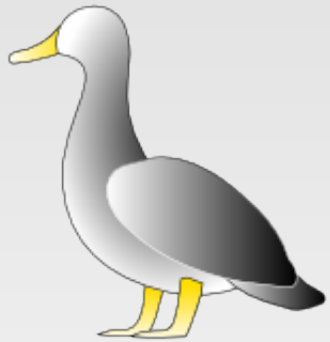
- Individuals compete for resources ()
- World is divided into plots
  - Different resource probabilities
  - Probabilities can vary through time
  - Resources are randomly distributed
- Players are free to move
  - Travel time penalty
  - Others may follow suit



Forager Game

Forager Results

- None yet!
- Similar to Goldstone and Ashpole 2004
  - **Visible** or invisible peers, resources
  - Consistent undermatching
- Experiment differences
  - Coarser grid and resource distribution
  - Individual score is hidden
- Second Life
  - Two resource pools
  - Real money, sort of...



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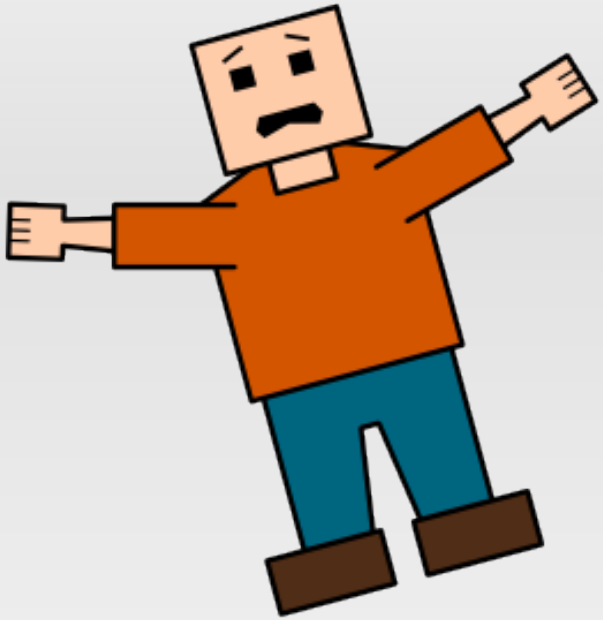
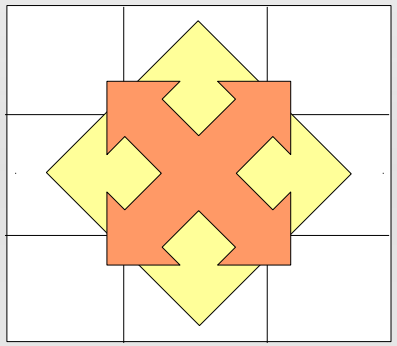
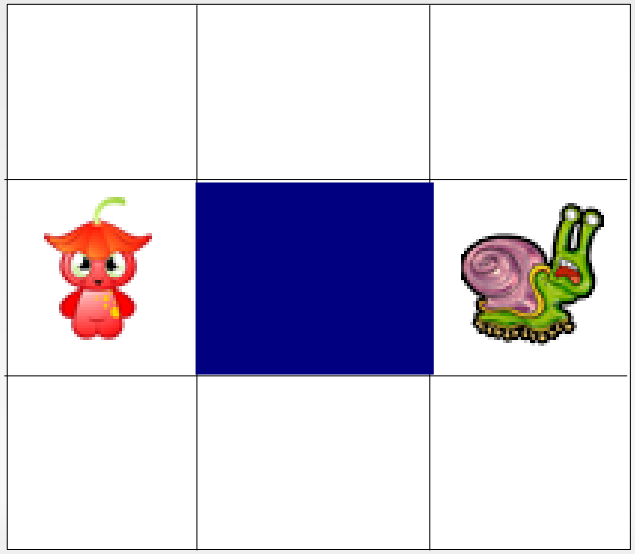


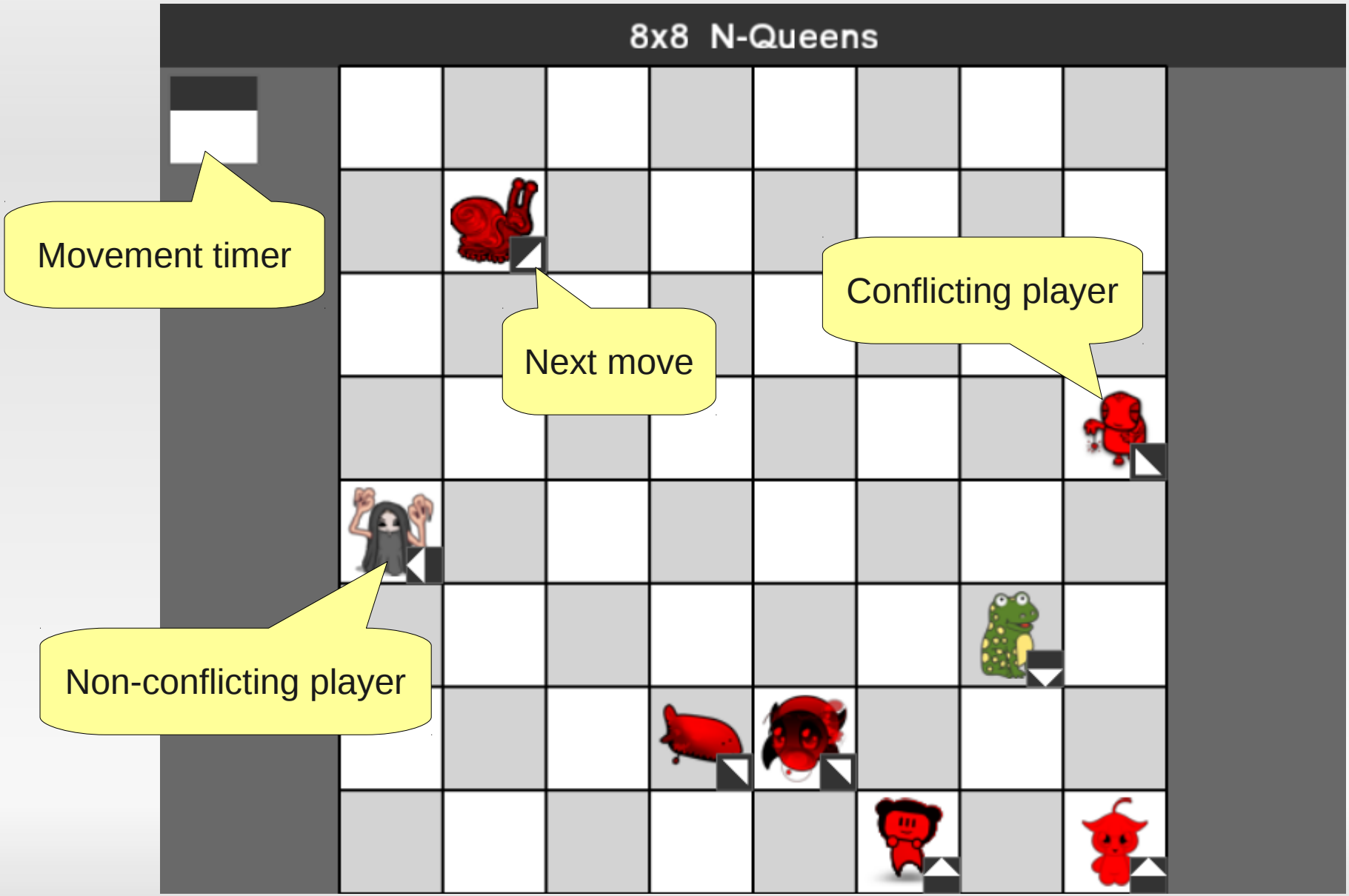
Flatland Overview

- 2D grid world
  - Players are free to move around
  - Collisions, obstacles
  - Synchronized team movement
- Game modes
  - Free form
  - Predator-prey
  - N-Queens

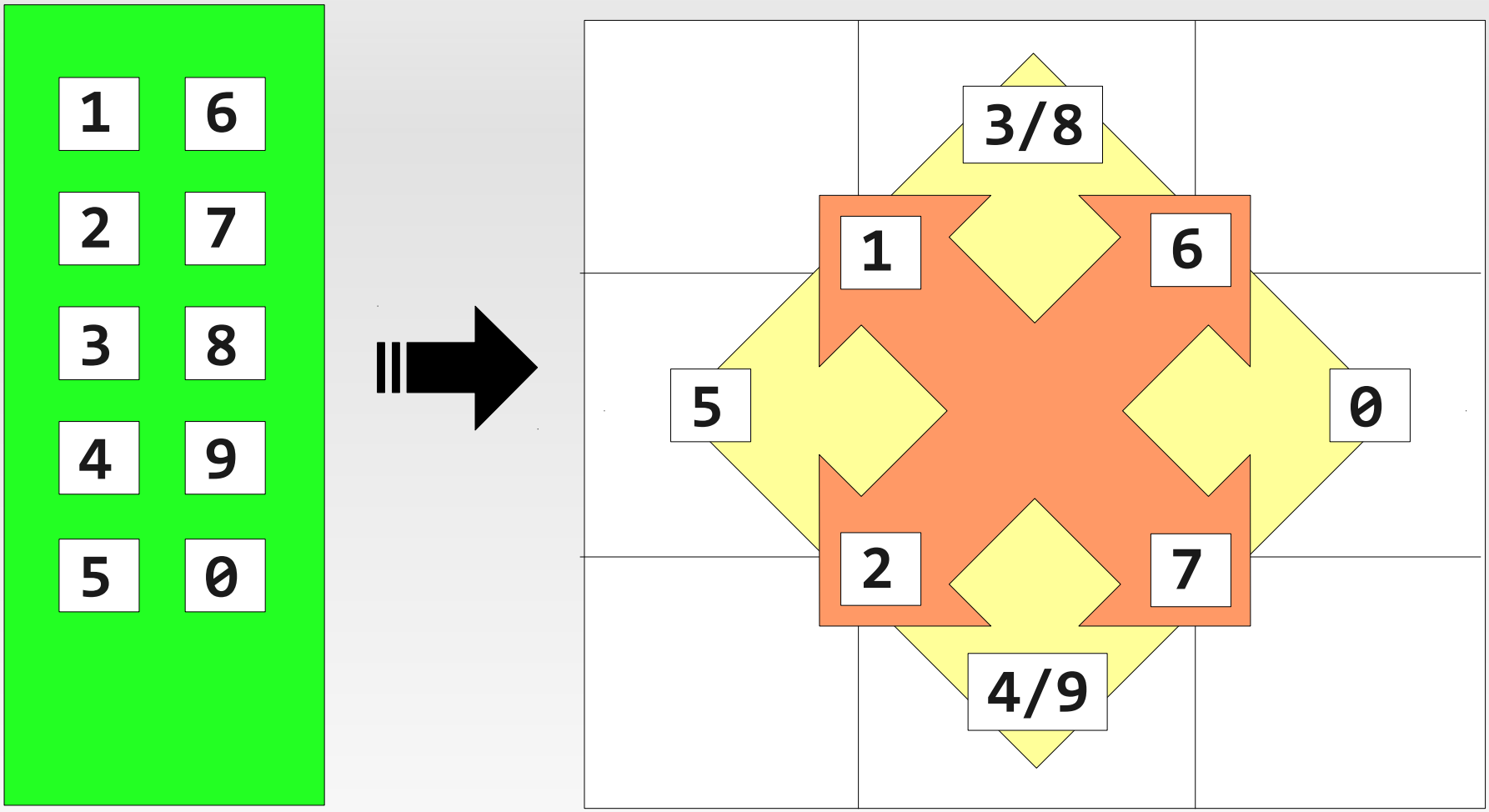




Flatland N-Queens Game



Flatland Game Controls



Future Work

- Pixel
  - More experiments, paper
  - Time-series analysis of data
- Forager
  - Same undermatching result?
  - Similar group migrations?
- Flatland
  - Predator-prey with obstacles
  - N-Queens – anyone but CS people?

Thank You - Questions?