Embodied Interactions for AI Literacy in Higher Education

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What is Unplugged?

- No computers required
- Low cost, common equipment
- Cooperative and collaborative
- Learning by doing
- AI Unplugged (Lindner et al, 2019)

www.csunplugged.org

www.aiunplugged.org

In Higher Education

Challenges:

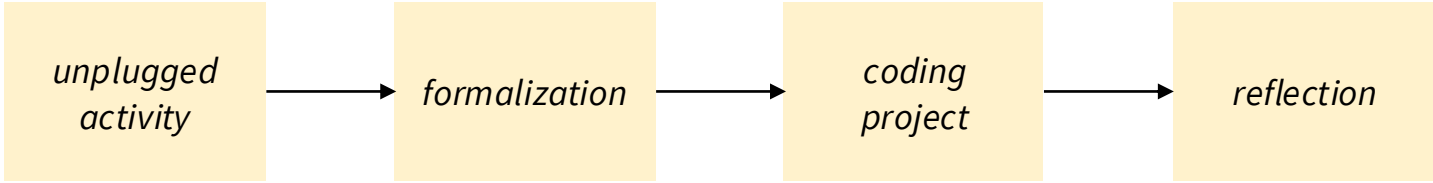
- Low level technical details
- High level mathematics
- How can we help students reason like AI agents before asking them to code one?

Opportunities:

- Making the math natural
- Accessible
- Engaging

Context

- Intro to AI summer session at Georgia Tech
- Sophomore/Junior level, mostly CS majors
- Pilot new in-class instructional methods
- Same summative assessments



"Being able to do these activities definitely kept me accountable and also engaged."

Design Goals

- No computers required, solvable by hand
- Transitions well to mathematical formalism
- Low barrier to entry
- Familiar, game-like mechanics – leveraging prior experience
- Maintaining the rigor of higher education
- First-person decision making

“The in class activities really broke concepts down to their core components and allowed us to be the components and perform actions, the way that they would be performed by an AI agent.”

Activities

Becoming Search

Search: How does an agent know what actions to take to achieve a goal?

- Reason without high-level bird’s-eye view
- Limited local information
- Role of the search frontier
- Heuristics without exhaustive search

ALGORITHM

Orchestrates the other roles

SUCCESSOR

Reports all connections from a given state

+ Connection names

GOAL TEST

Reports if a state meets goal conditions

+ Heuristic evaluation

FRONTIER

Handles and orders states to be visited

Queue = BFS
Stack = DFS
*Priority = A**

- Early social collaboration
- Students invented different record-keeping schemes
- Local changes affect collective outcome
- Understanding how to encapsulate functionality in code

“I think that was really important for me visualizing it in my head how these algorithms work. What does one part of the algorithm know and what one part does it not know and what steps do I have to take to make sure the entire system works?”

“There was an assignment where you gave us different roles with different backgrounds, and I was happy leaving class because I learned a lot that day.”

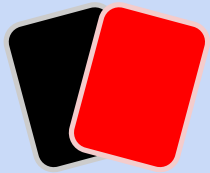
MDPs - Red and Black Jack

- How can an agent make decisions when outcomes are uncertain?
- Gridworld:
  - Transitions and rewards are arbitrary
  - Complex value iteration
- Red and Black Jack:
  - Transitions and rewards follow from the application
  - Value iteration by hand

0.15	0.36	0.81	1
0.06		0.12	-1
0.02	0.02	0.05	0.0

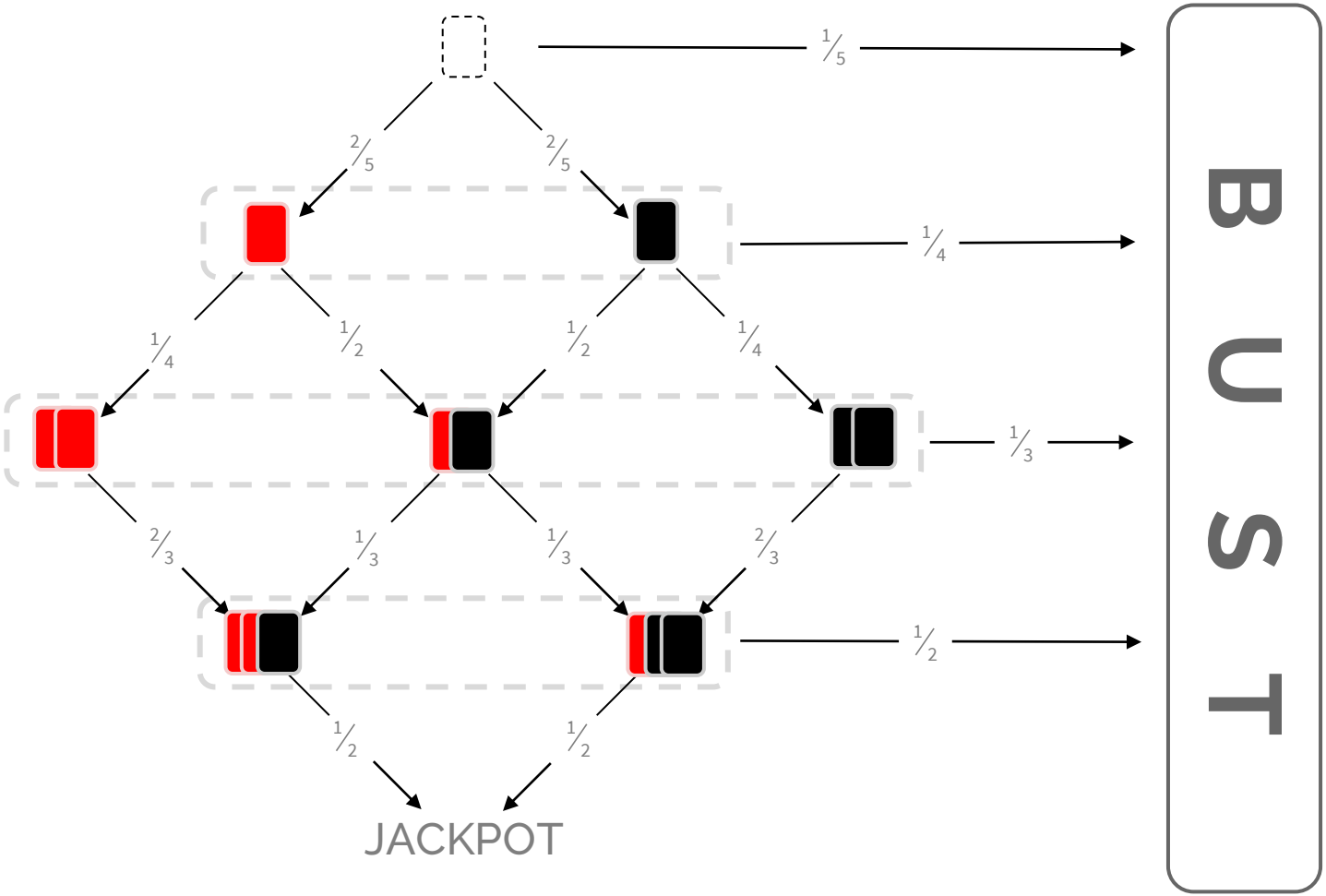
HIT DECK

STAND DECK



SCORING

BUST:	-5 points
SINGLE:	1 point
DOUBLE:	5 points
TRIPLE:	15 points
JACKPOT:	30 points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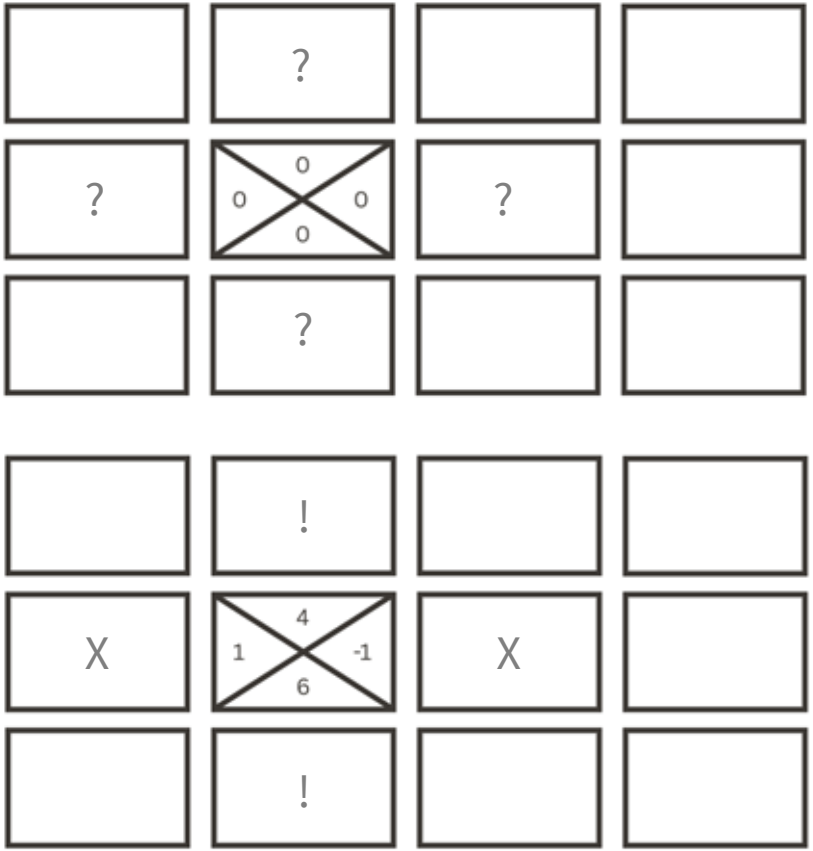
JACKPOT
BUST

- Contrast Search’s sequence of actions with a policy for all states
- Predict when to hit vs when to stand
- Got to see their predicted policy proven with math
- Discussed how changing the decks or rewards would change policy

“I do think the hands on activities were the most valuable part of this course. I feel like doing a small example helps you understand the basics and then you can extrapolate it to a bigger problem more easily.”

Reinforcement Learning - Human Episodes

- How can an agent make decisions from rewards without prior knowledge of the transition probabilities?
- Easy to “use” a Q-table, hard to build one – what to do with an empty table?
- Reward propagation
- Everyone runs the maze, explore vs exploit
- One student = one episode



- All actions start at 0
- Flip a coin: random or best
- Propagate reward back to previous card with discount
- Table converges after many students explore

- Understand how to build a Q-table
- Necessity of multiple episodes to propagate reward
- Students hoped for explore early, exploit later
- Epsilon-decay seems obvious

“Like one that stands out to me is we played an almost like maze game where we rotated through everybody in the class playing three different models …. I was like how does a computer understand loss and reward? But then doing it, it's a lot more simple than I was giving it credit for.”

Reflection

Challenges & Future Direction

- Time intensive
- Expectation of passive instruction
- Smaller summer semester, smaller classes
- Scaling to 300+ student semester? Instructional team coordination
- Repeating activities in different contexts

Successes & Opportunities

- Same material covered
- Higher attendance, high participation
- Easier transition to mathematics and coding
- Leverages prior experience with probability and data structures

“I just remembered those methods really helped me feel more comfortable in the class. I was able to ask more questions and I actually enjoyed the content because I felt like I was doing something fun with each activity and I also felt it was a more safe environment for me to be able to ask questions.”

Thank you!