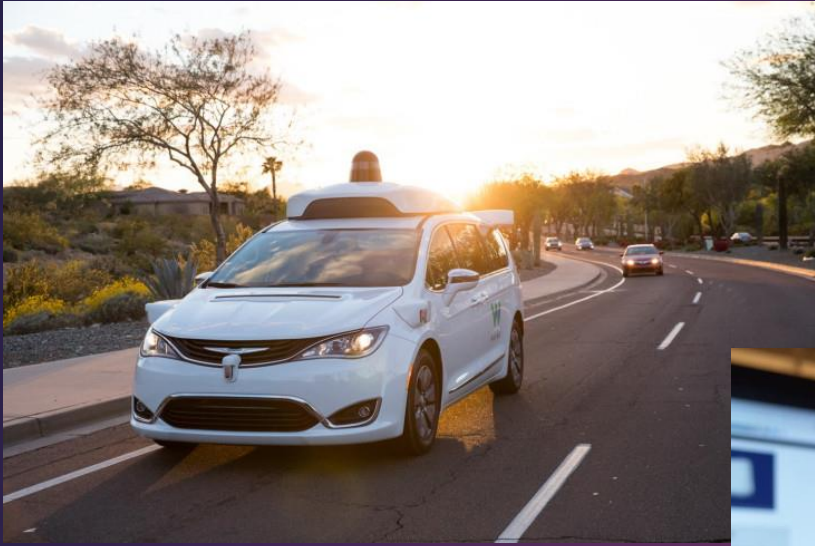


# Dungeons and DQNs

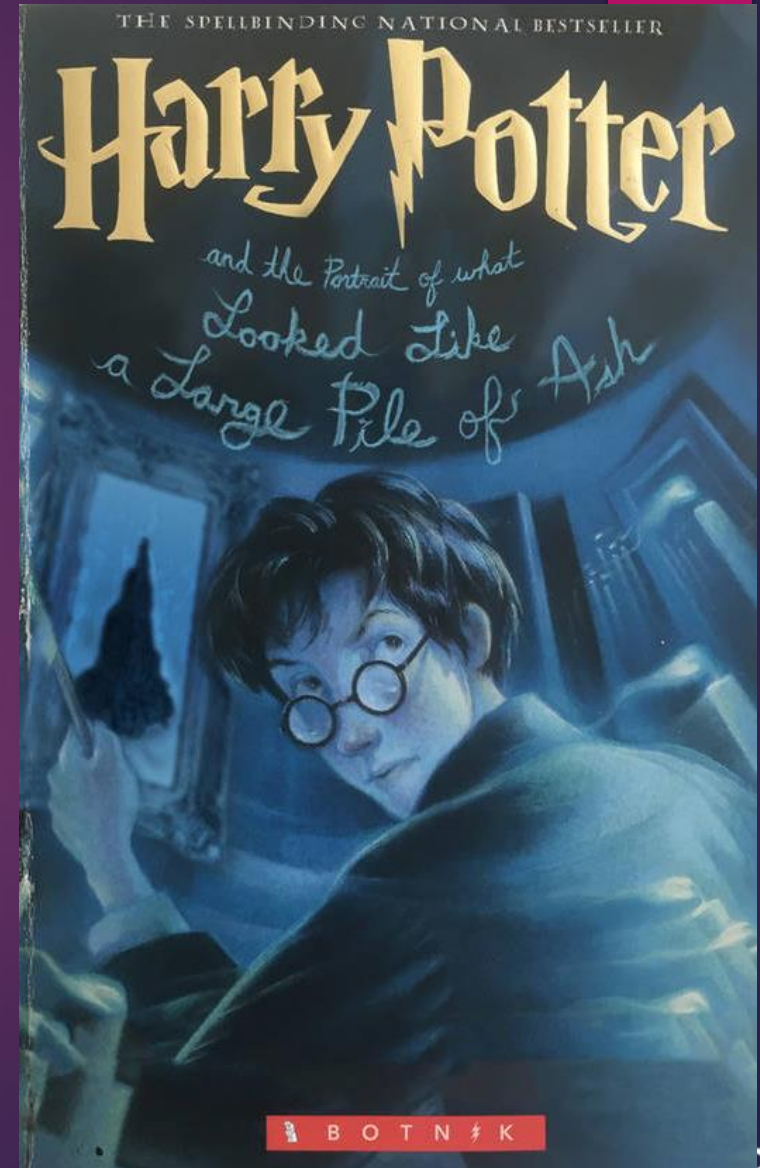
Toward Reinforcement Learning  
Agents that Play Tabletop Roleplaying  
Games

LARA J. MARTIN, SRIJAN SOOD, MARK O. RIEDL





It's an exciting time for AI

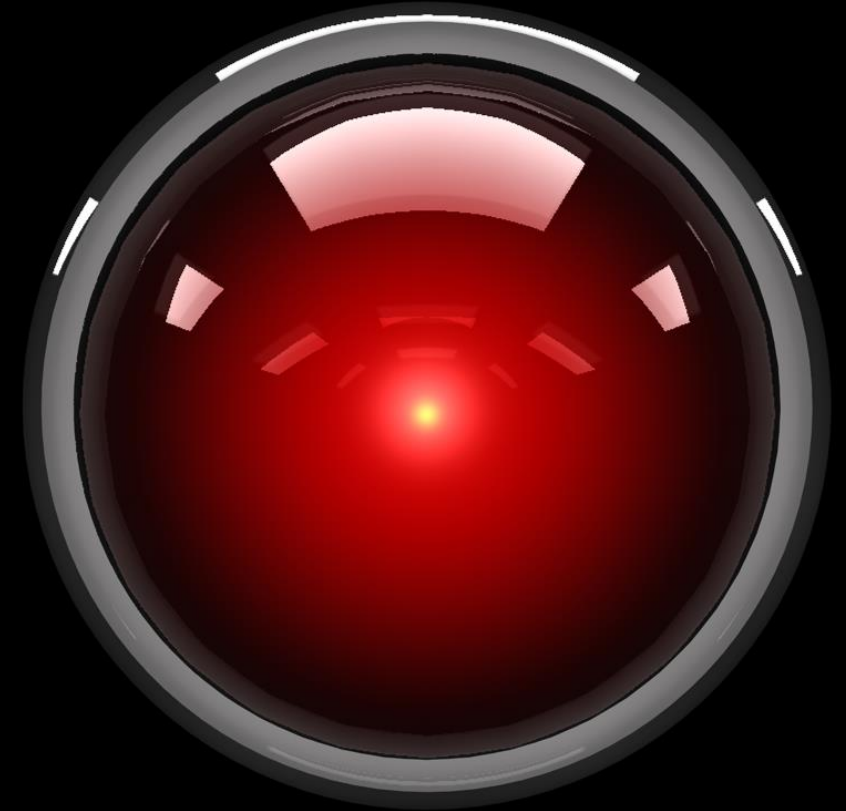


# Sometimes AI needs to “roleplay” or improvise

3



Open the pod bay doors, HAL.



I'm sorry, Dave. I'm afraid I can't do that.



# Or in the real world...

4



AI: You're doing a lot better today!

Patient: Give it to me straight, doc.

AI: You have 1 month to live.

# Consider Dungeons & Dragons

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- ▶ Players create characters to play & describe their character's actions
- ▶ Characters exist in a shared imaginary world
- ▶ Game/Dungeon Master (GM/DM) mediates and sets up scenarios—or campaigns



# Outline

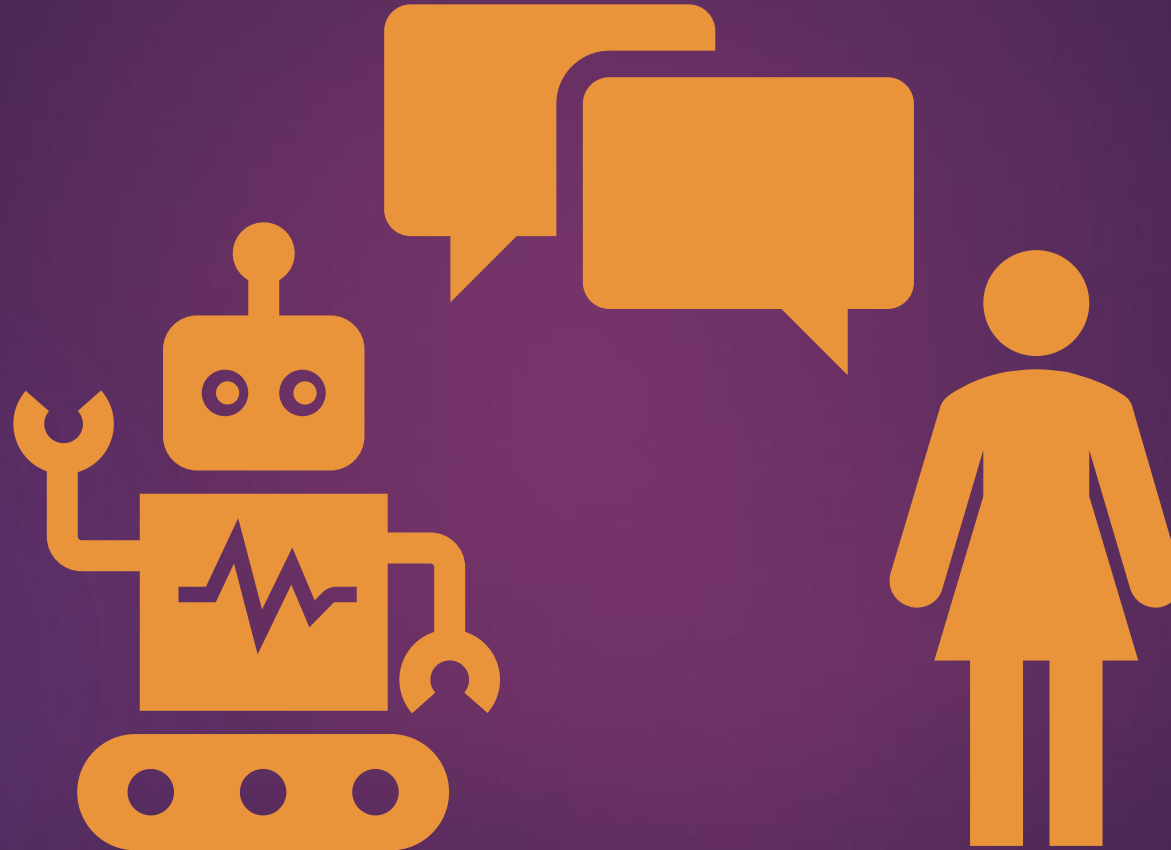
6

- ▶ Why D&D?
- ▶ TRPGs compared to other media
- ▶ Our starting point



# 1) Unlimited Actions

7



## 2) Unexpected Consequences

8





### 3) Dynamic, Continuous World

9



# 4) Distributed Game World

10



# 5) Intrinsic Reward

11



## 6) Collaborative

12





# Outline

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- ▶ Why D&D?
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# Using *Interactive Fiction* for Roleplaying

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You find yourself in a dungeon. You see a FLASK.  
Obvious exits are NORTH and SOUTH.  
What do you do?

> Get flask

You can't get the flask!  
I'm certainly not going to tell you why not.

- ▶ Constrains to a preexisting story, uncovered through puzzles



Example adapted from Homestar Runner's "video games" Strong Bad Email

# Using *Experience Management* for Roleplaying

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> show proprietor the puzzle box

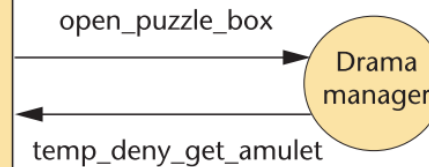
The proprietor takes the puzzle box and turns it over in his hands carefully. "Now, this is a tricky one," he says. "Frightfully difficult, unless you know the catch of course." His fingers flicker dexterously over the box, sliding a panel here, pressing a corner in there. Suddenly the lid pops open with a faint snick.

He places the box on top of the display case. "And there you have it," he says. "A present for you."

> x display case

Inside the display case are a deck of tarot cards, an amulet, and a geode.

> ask for the amulet



► Intervenes in storyline to keep things “on track” for quality

Example from: Nelson, M. J., Mateas, M., Roberts, D. L., & Jr, C. L. I. (2006). Declarative Optimization-Based Drama Management in Interactive Fiction. *IEEE Computer Graphics and Applications*, 26(3), 32–41.



# Using *Automatic Story Generation* for Roleplaying

16

Once Sally began to run, John pulled out the gun and directed it at the bank guard. John wore a stern stare as he pointed the gun at Sally. Sally saw the gun and instantly screamed before she could stop herself. John told her she had one minute to get the money and shook the gun at her. John gave Sally a bag to put the banks money in.

- ▶ Generates new stories for well-defined domains; usually not collaborative



Story from: Li, B., Thakkar, M., Wang, Y., & Riedl, M. O. (2014). Storytelling with Adjustable Narrator Styles and Sentiments. In *Proceedings of the 2014 International Conference on Interactive Digital Storytelling*.



# Outline

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- ▶ Why D&D?
- ▶ TRPGs compared to other media
- ▶ Our starting point



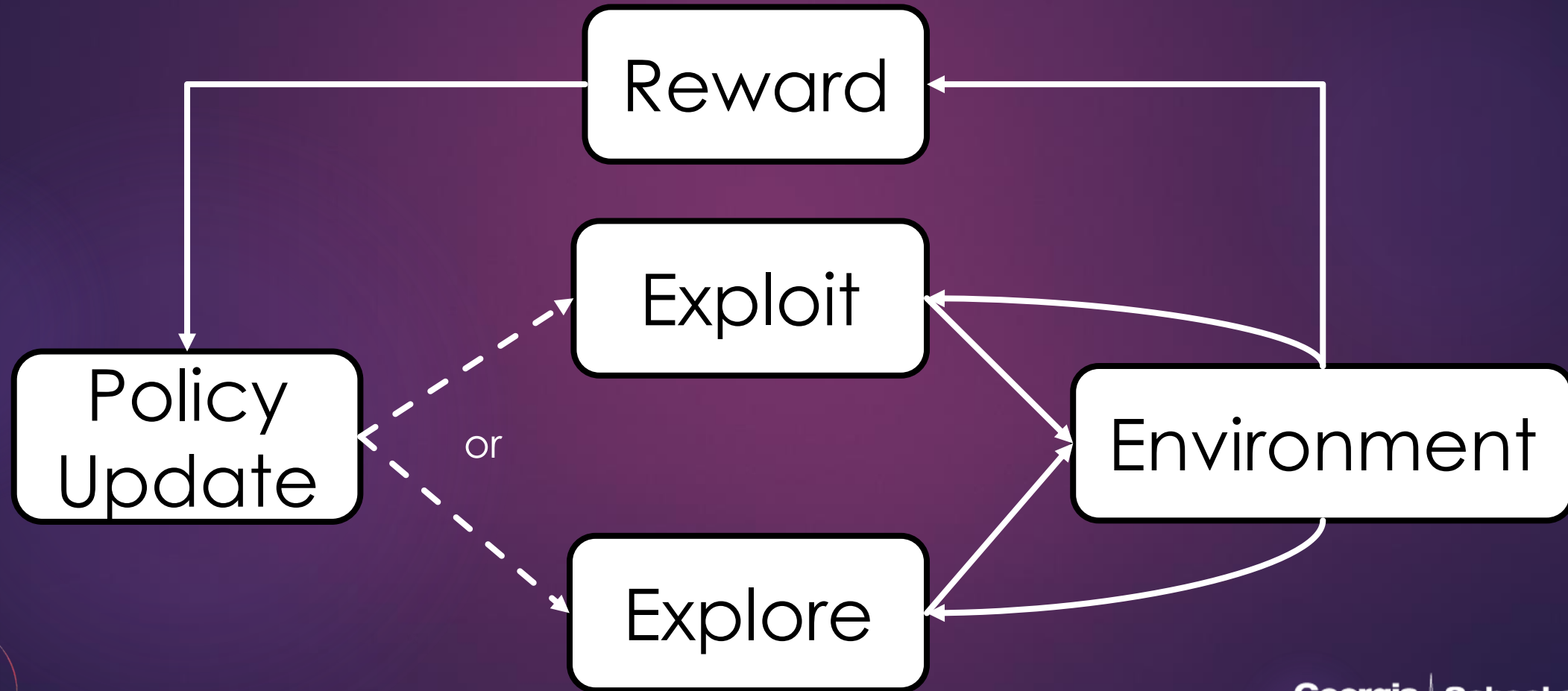
# “Simplified” D&D

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- ▶ No dice rolling (i.e. no combat, etc.)
- ▶ Agent is always in character
- ▶ DMs aren't refereeing



# Our Approach: Deep Reinforcement Learning



# Our Approach: Deep Reinforcement Learning

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Atari Games - 2015



Go - 2016



Doom - 2016



DOTA 2 - 2018



# But D&D isn't your average game...

21

- ▶ We need a pre-defined goal for RL so it knows how to get reward
- ▶ How are sentences used as actions?
  - ▶ We need a way of breaking them down so we can update the game state



# Working with Sentences

r 2 d 2 carrying some drinks on a tray strapped to his back passes yoda who uses his force powers to hog the drinks

## **Expected:**

obi wan and anakin are drinking happily when chewbacca takes a polaroid picture of anakin and obi wan

## **Predicted:**

can this block gives him the advantage to personally run around with a large stick of cheese



# Event Representation

- ▶ From sentence, extract event representation  
(S, V, D, M, P)
- ▶ Use our linguistic knowledge to bootstrap the RL

For example...

**Original sentence:** They're scanning for non-terrestrial technology.

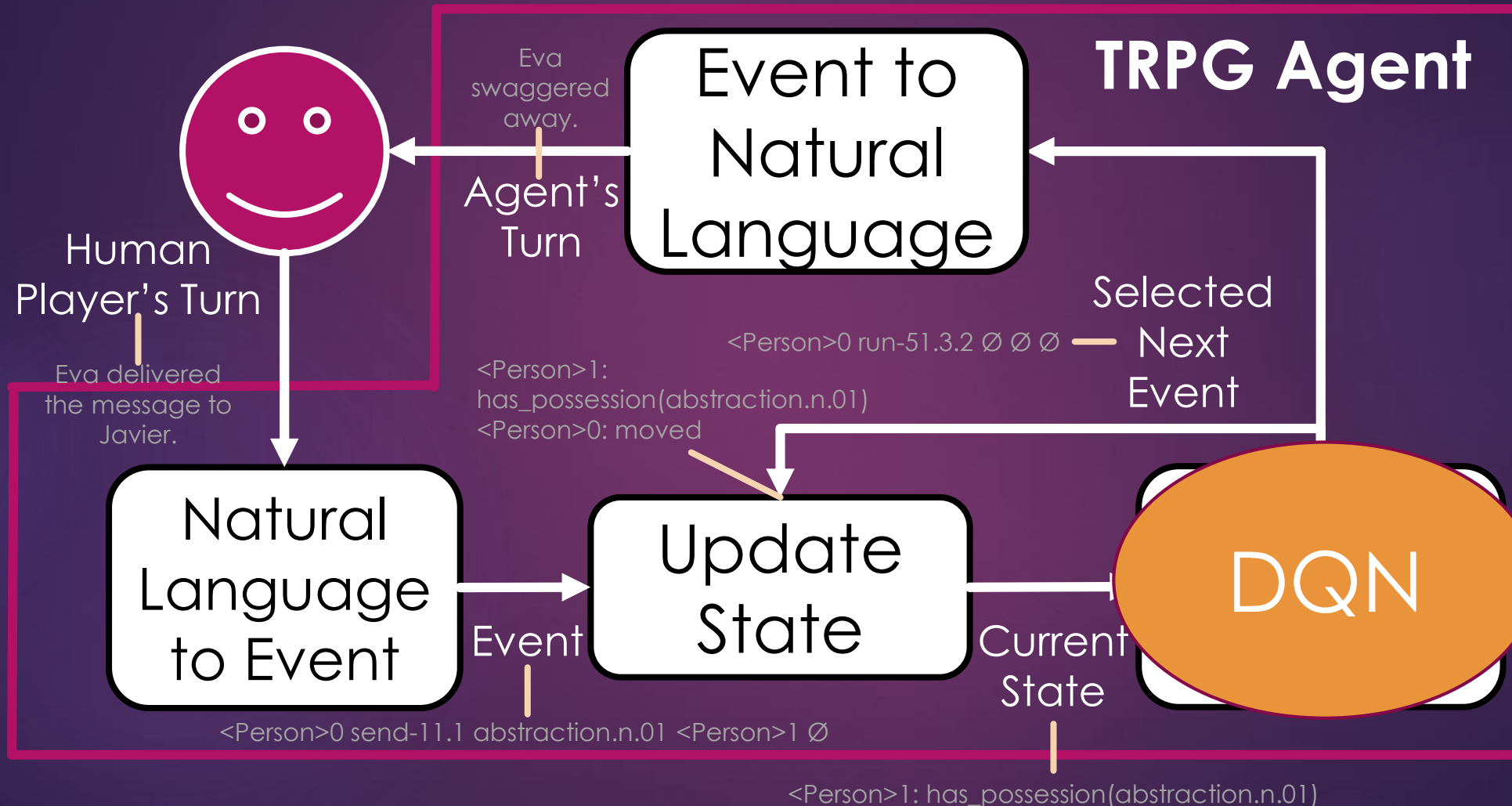
**Event:** they scan EmptyParameter technology for

**Generalized Event:**

<PRP> assessment-34.1 EmptyParameter use.n.01 for

# The Proposed System Pipeline

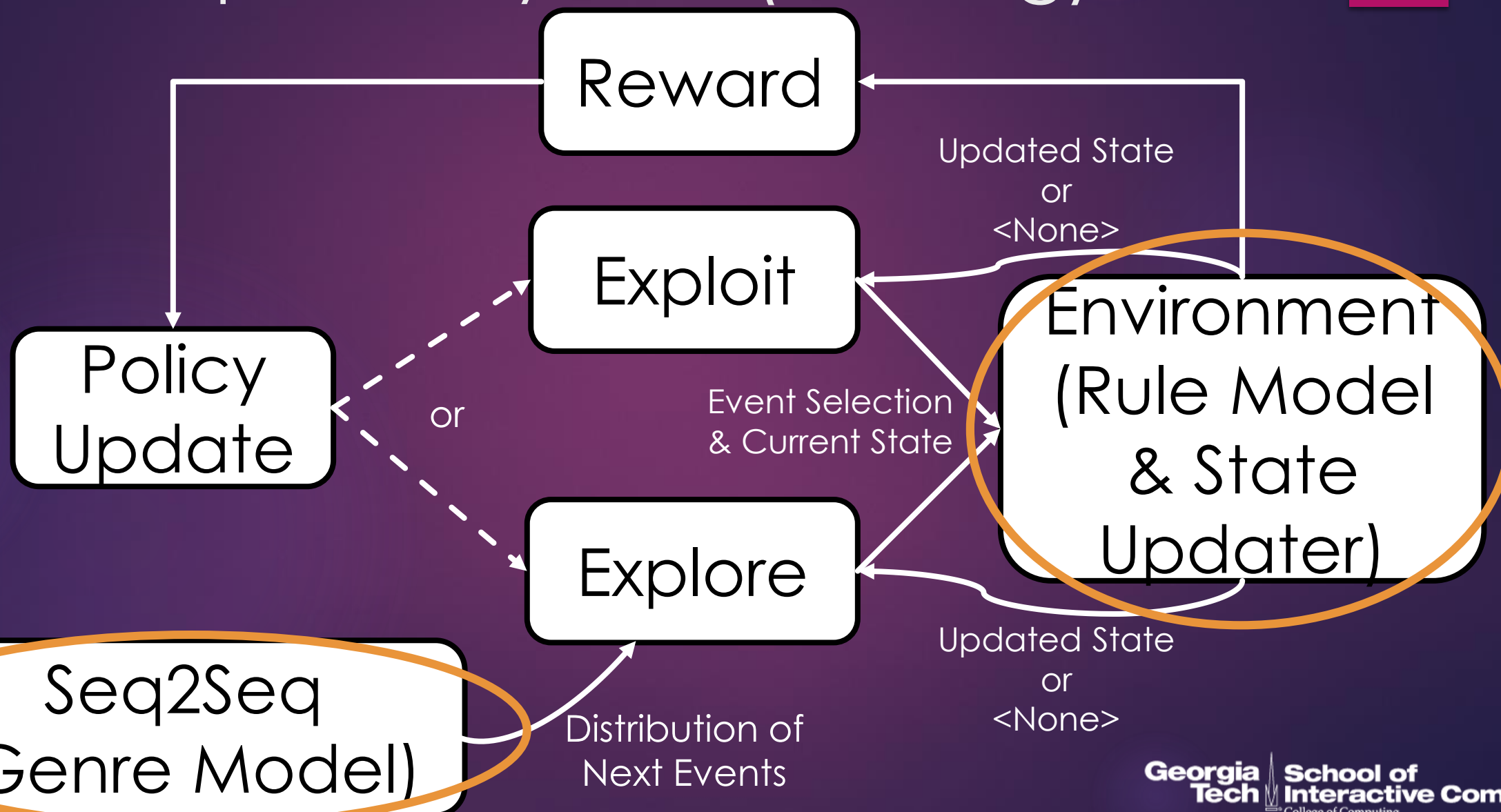
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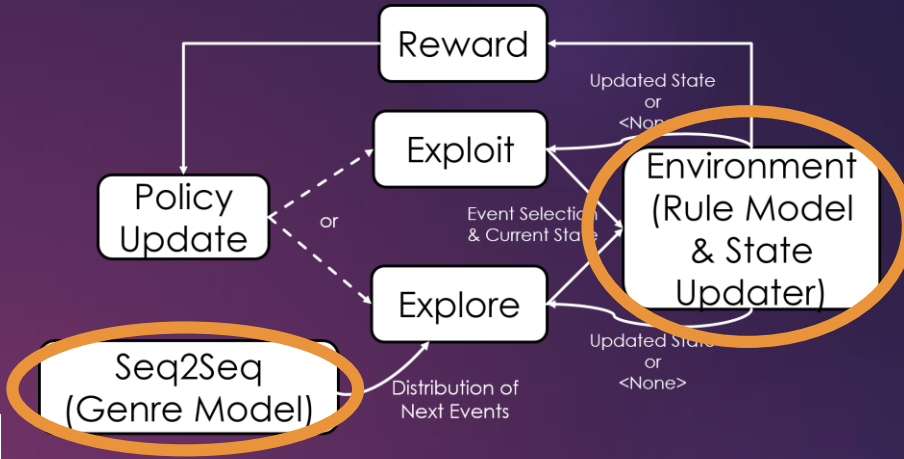
# The Proposed System (Training)

25



# World Model

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## 1. Genre Expectation Model

- ▶ Seq2Seq network generates next event in the story
- ▶ Trained on relevant genre

## 2. Commonsense Rules Model

- ▶ Things that aren't mentioned in stories (see: Principle of Minimal Departure)
- ▶ Temporal & physical rules

# How could our model be improved?

- ▶ What about other forms of reward besides “quest completion”?
- ▶ It could learn when to break rules



# Conclusion

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- ▶ TRPGs are the next AlphaGo



# Conclusion (In other words)

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1. AI research is moving fast, but it needs the ability to adapt in the moment
2. We think testing on TRPGs can help with this
3. Our first step is to create a DQN that takes events from a genre and uses general rules of the world





# Thank you!

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