

Decision Making: Rules

Matthew Guzdial

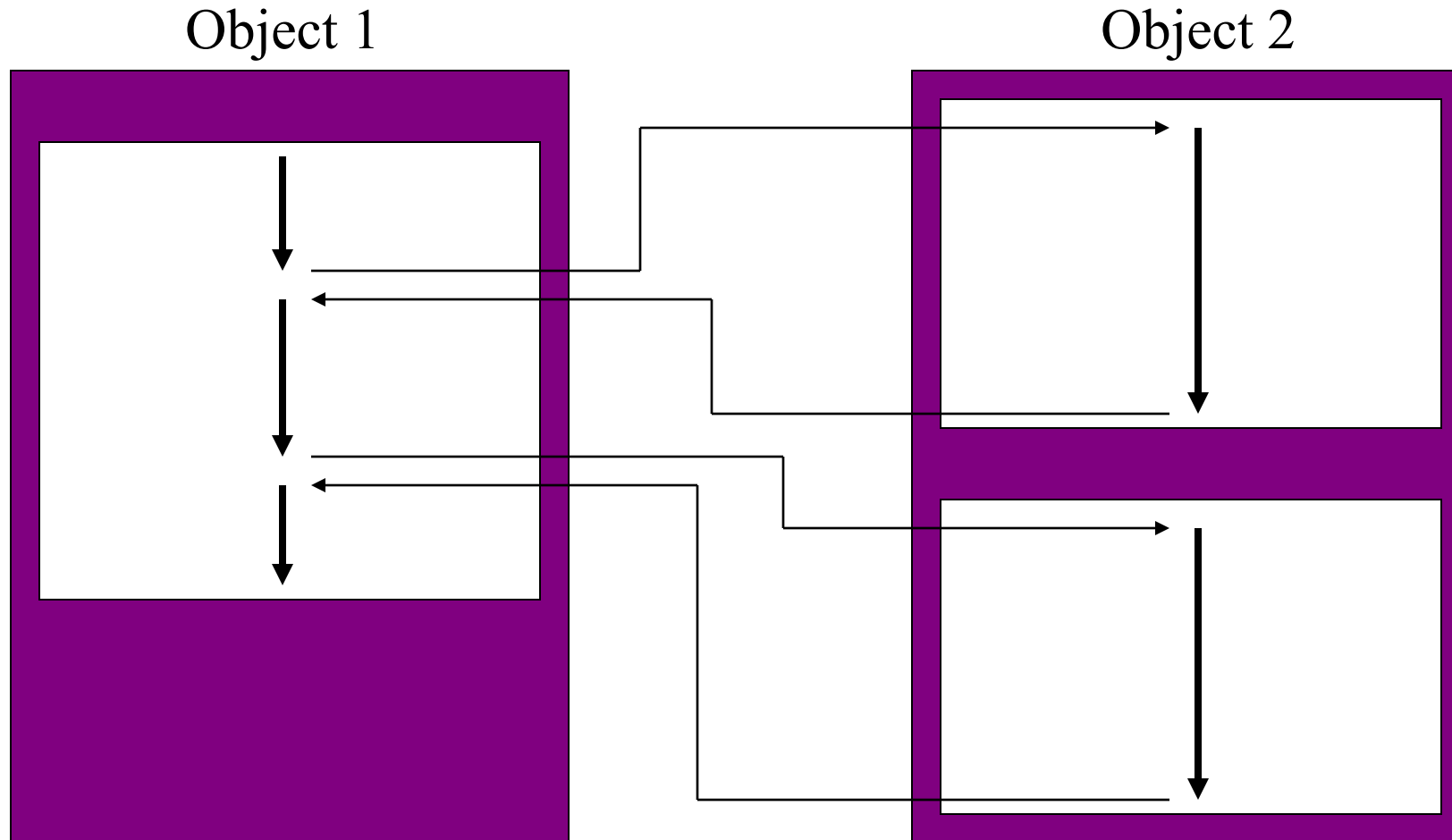
guzdial@ualberta.ca



Announcements

- Office hour (12pm-1pm) then evening office hours/help session (5:15pm-8pm)
- HW2 due this Monday at 11:55pm (with 23 hour grace period)
- Practice Quiz today, Quiz 2 next Friday
- <http://www.gameapro.com> (resource for after the class)

Review: Game Engines



A single game loop calls Update() on all objects

Simplest Way To Define Enemy Behavior?

- A rule!
- A rule has two parts:
 - Condition: A logical expression that must resolve to true for the rule to “fire”.
 - Effect: What happens when the rule “fires”

Blocks World

Rules:

PickupBlock(x,y)

MoveBlock(x,y)

DropBlock(x,y)

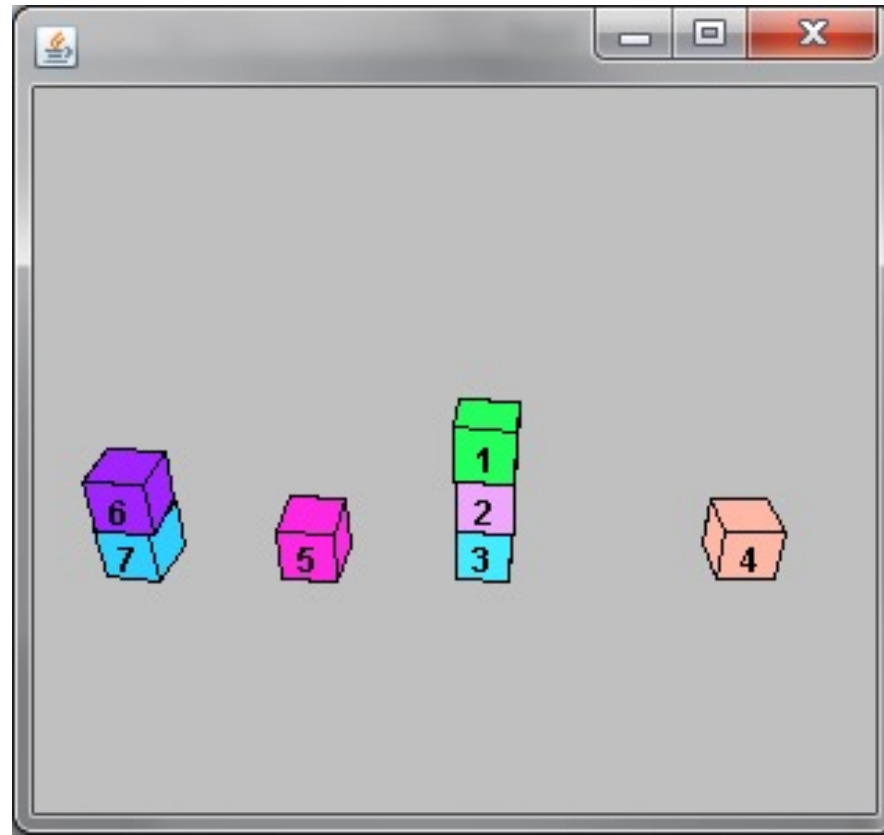
Facts:

Block_1 (5,3)

Block_2 (5,2)

Block_3 (5,1)

...



Blocks World

Rules:

PickupBlock(x,y)

 If !Block(x,y+1)

 Then set Block held

MoveBlock(x,y)

...

DropBlock(x,y)

...

Facts:

Block_1 (3,4)

Block_2 (3,5)

Block_3 (1,6)

Production/Rule System

- Facts are matched to rules “ifs” using pattern matching
- Rules become activated
 - Choose an active rule to “fire”
 - Some change to facts or to world
- Repeat

Facts

- Health(captain, 51)
- Health(Johnson, 38)
- Health(Sale, 42)
- Health(Whisker, 15)
- Holding(whisker, radio)
- Weapon(whisker, rifle)
- Weapon(johnson, pistol)
- Ammo(whisker, 36)
- Whisker
 - Health: 51
 - Holding: radio
- (captain
 (weapon (rifle (ammo 36) (clips 2))
 (health 51)
 (position ...)
)

 (radius (held-by whisker))

Rules

- IF whisker's health < 15 AND Whisker holding radio
- THEN Whisker: Radio-call "help!" on radio

- IF whisker's health = 0 AND whisker holding radio
- THEN
 - Remove(whisker holding radio)
 - Add(radio on ground)
 - Spawn radio on ground

- IF ?anyone health < 15
- THEN ...

Production Systems in Games Industry: Dialogue/Voice line Systems

- Apex Legends: <https://youtu.be/mOp51zYu-ys>
- Valorant: <https://youtu.be/zh-8QBazLos>
- Etc....

Turn the Environment into Facts



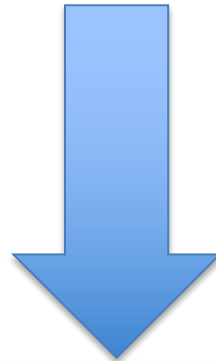
Tag = "soda_can"



Tag = "barrel"



Tag = "bird"



Agent Knowledge Base

Turn the Environment into Facts



Tag = "soda_can"



Tag = "barrel"



Tag = "bird"

Write Line of Dialogue for Each Fact

Example

<https://www.youtube.com/watch?v=j4elu6LxdZg>

What's going on here?

For each character:

- once per ten seconds, find objects in vision cone*
- select one object and trigger a 'SeeObject' speech concept*

```
rule BluBot_ObjectSee_Cart
{
    criteria          ConceptSeeObject NotInCombat ObjectName=LaundryCart
    response          BluBot_See_LaundryCart // there's a laundry nearby!
}

rule BluBot_ObjectSee_Shoe
{
    criteria          ConceptSeeObject NotInCombat ObjectName=Shoe
    response          BluBot_See_Shoe // that's a shoe!
}

rule BluBot_ObjectSee_Crate
{
    criteria          ConceptSeeObject NotInCombat ObjectName=Crate SeenForklifts=0
    response          BluBot_See_Crate // how did this crate get here without a forklift?
}
```

Participation Question 1:

<https://forms.gle/XzjKokcYB7VYefbh8>

<https://tinyurl.com/guz-pq13a>

How could we extend this framework to allow for agents to have a conversation?

What about conversation?

What if we add an extra effect to each production rule that writes a *new fact* into the world?

1. See barrel
2. Say barrel_line && Write “seen barrel” to world
3. See barrel + “seen barrel”

Example 2

<https://www.youtube.com/watch?v=pYpCeqI993M>

What about long-term memory?

- Not something Overwatch/Apex Legends does.
- What if we change from writing a boolean “seen_barrel” to an integer?

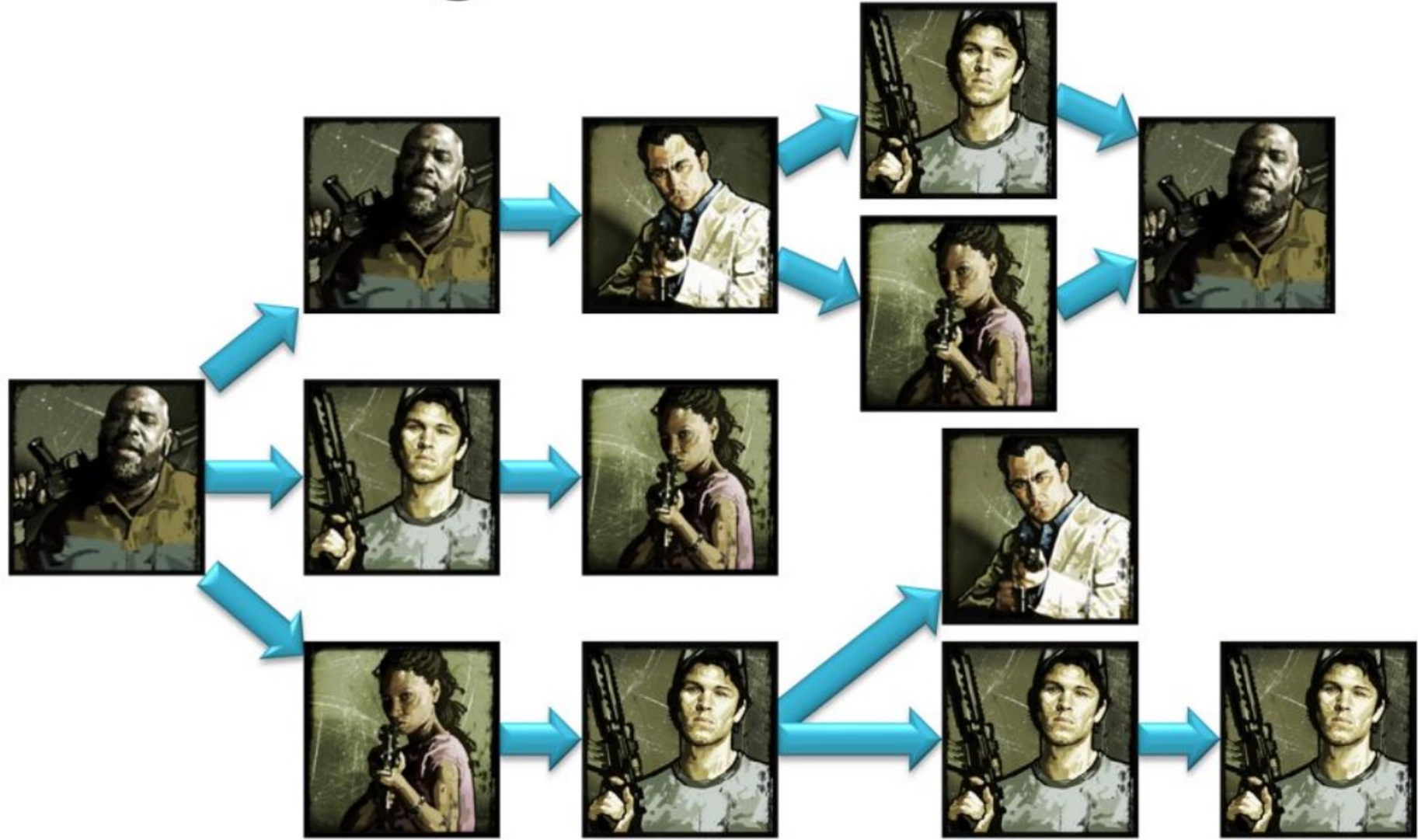
1. See barrel
2. Say barrel_line && Write “seen_barrel+=1” to world
3. See barrel + “seen_barrel==1”

Example

<https://www.youtube.com/watch?v=2aozwfumnH4>

Left 4 Dead 2





Rule Matching

Query

```
{ who: nick, concept: onHit, curMap: circus, health: 0.66, nearAllies: 2, hitBy: zombieclown }
```

PASS Rule 1: { who = nick, concept = onHit } → *"ouch!"*

FAIL Rule 2: { who = nick, concept = onReload } → *"changing clips!"*

FAIL Rule 3: { who = nick, concept = onHit, health < 0.3 } → *"aaargh I'm dying!"*

PASS Rule 4: { who = nick, concept = onHit, nearAllies > 1 } → *"ow help!"*

PASS Rule 5: { who = nick, concept = onHit, curMap = circus } → *"This circus sucks!"*

PASS Rule 6: { who = nick, concept = onHit, hitBy = zombieclown } → *"Stupid clown!"*

PASS Rule 7: { who = nick, concept = onHit, hitBy = zombieclown, curMap = circus }
→ *"I hate circus clowns!"*



Final Example

<https://www.youtube.com/watch?v=T5-2EnX5-K0>

Production/rule systems

- Pros:
 - Don't need to specify response to every contingency
 - Can respond to novel conditions
- Cons:
 - Hard to author robust rule systems
 - Emergence vs. over-engineering
 - Hard to debug

Matching Runtime

What kind of specialized representations could we use to speed up the process of matching rules?

Answer: Trees! Less individual facts check as you can share them across the rules.

(PRACTICE) Quiz Link

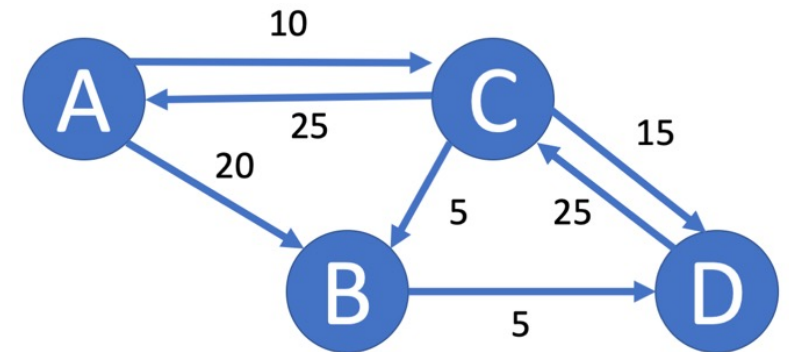
<https://forms.gle/wNju9P832tiFnLLg8>

<https://tinyurl.com/guz-pq13b>

1. Which of the following wouldn't help improve the performance of an MCTS pathfinder?

- a) Increasing number of rollouts
- b) Increasing the max depth (L) of each rollout
- c) Increasing the heuristic cost of each simulation by one
- d) None of the above

2. Given the graph to the right, fill in the final navigation table for APSP pathing. Assume starting location is the row and the goal is the column (Hint: Letters, not numbers).



3. Say we had 3 rules:

- 1. If barrels > 3 then say "wow lots of barrels!"
- 2. If barrels == 0 then say "wish I could see a barrel"
- 3. If barrels ≤ 3 and iteration < 3 then spawn barrel and say "oh a magical appearing barrel!"

What would be said on iteration 0 where (barrels=0)? What would be said on iteration 1? Assume a heuristic that the most conditions.

1. C

2.

	A	B	C	D
A	A	C	C	C
B	D	B	D	D
C	A	B	C	B
D	C	C	C	D

3. “Oh a magic appearing barrel!” and “Oh a magic appearing barrel!”