

# Automatic Critical Mechanic Discovery Using Playtraces in Video Games

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# Takeaway



WHAT: Develop a method of critical mechanic discovery



WHY: Tutorial generation

# Takeaway



WHAT: Develop a method of critical **mechanic** discovery



WHY: Tutorial generation

# Game Mechanic (n.):

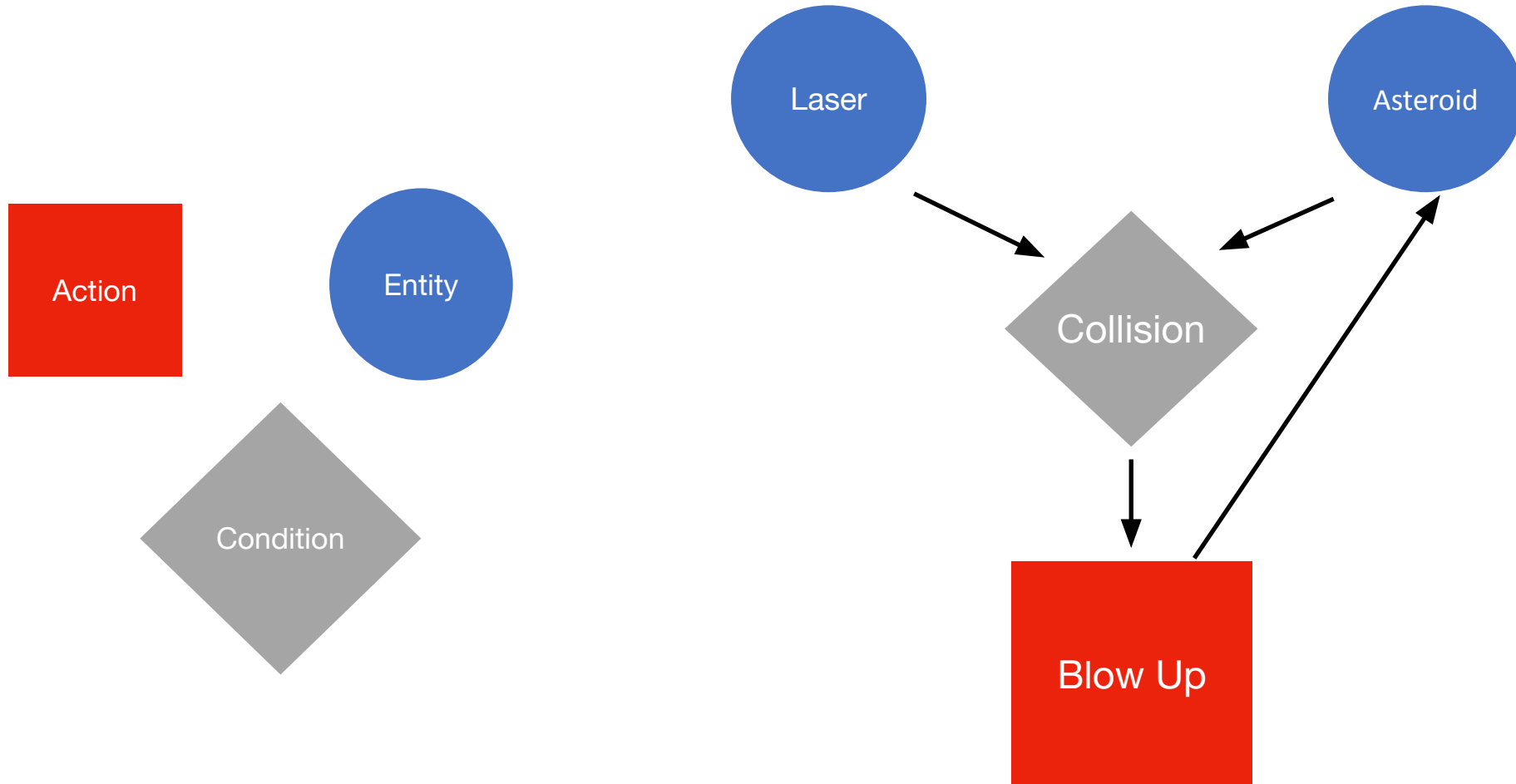
*Any event in the game that involves game entities and changes the game's state.*

# What makes a mechanic *critical*

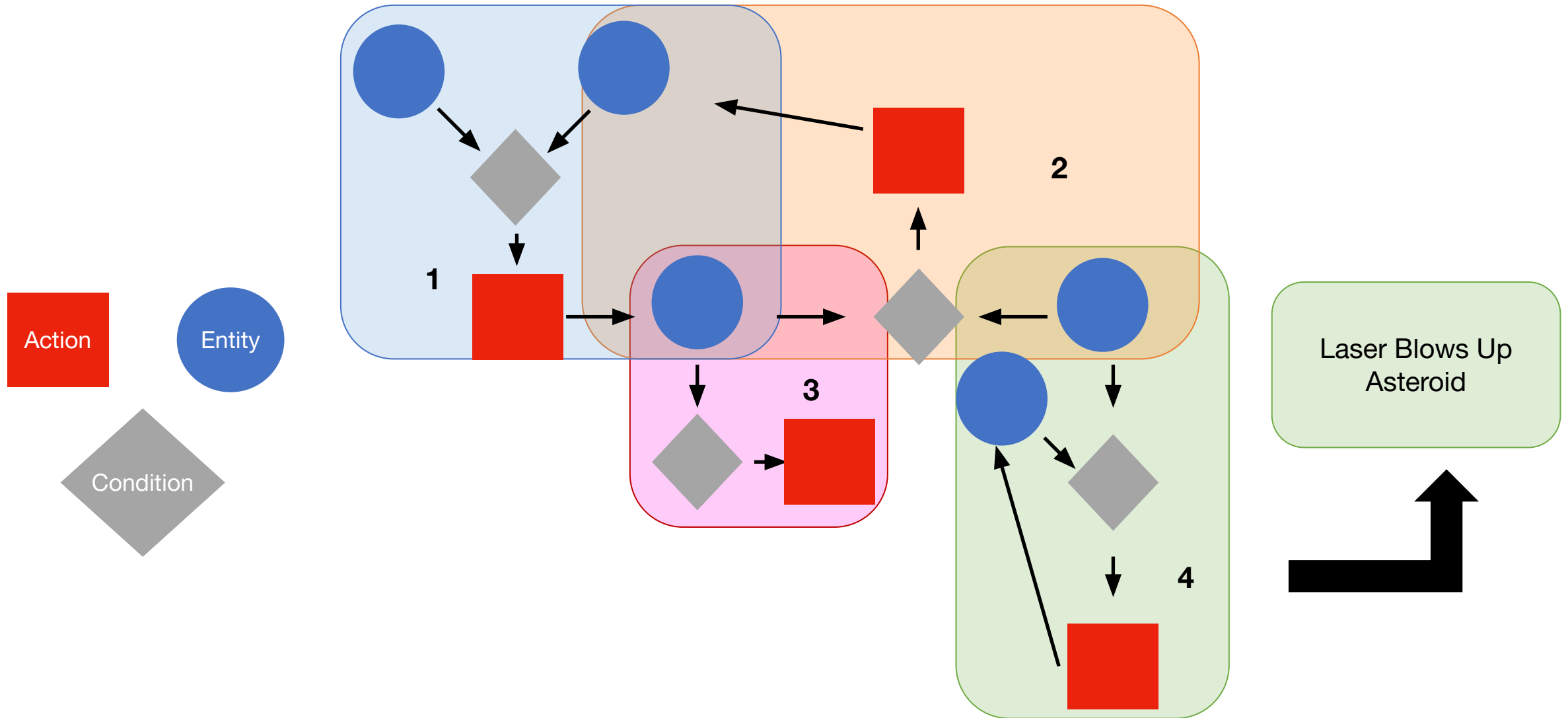
Must be triggered  
to win the level

Every winning  
playthrough will  
contain the set of  
critical mechanics

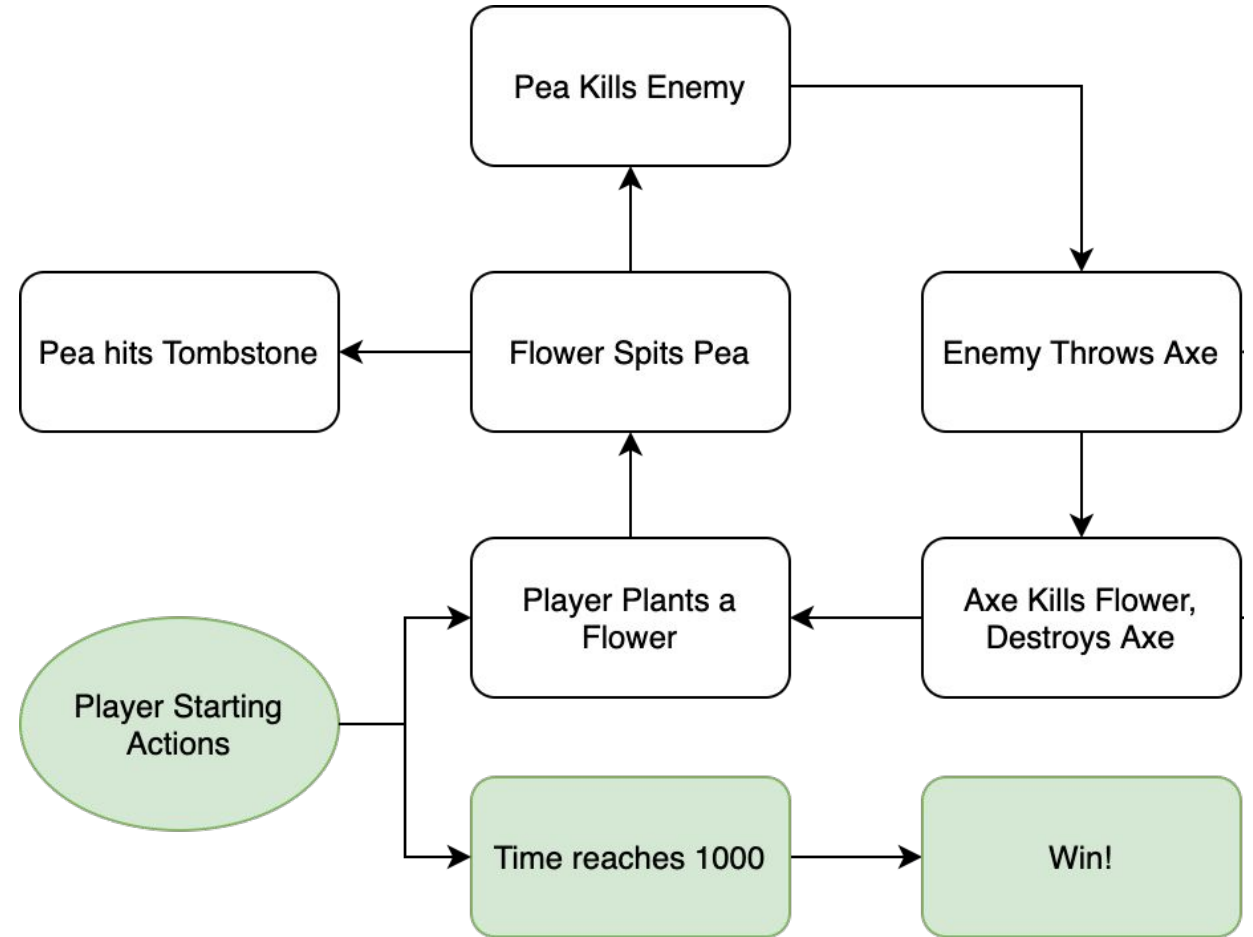
# Atomic Interaction Graph



# A Directed Mechanic Graph



# Uninformed Discovery

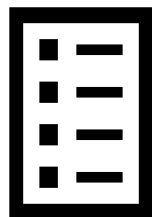
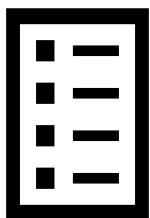
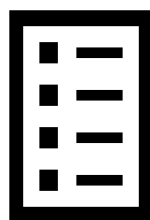
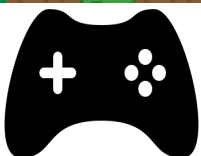


Michael Cerny Green, Ahmed Khalifa, Gabriella A.B. Barros, and Julian Togellius. 2017. "Press Space to Fire": Automatic Video Game Tutorial Generation.

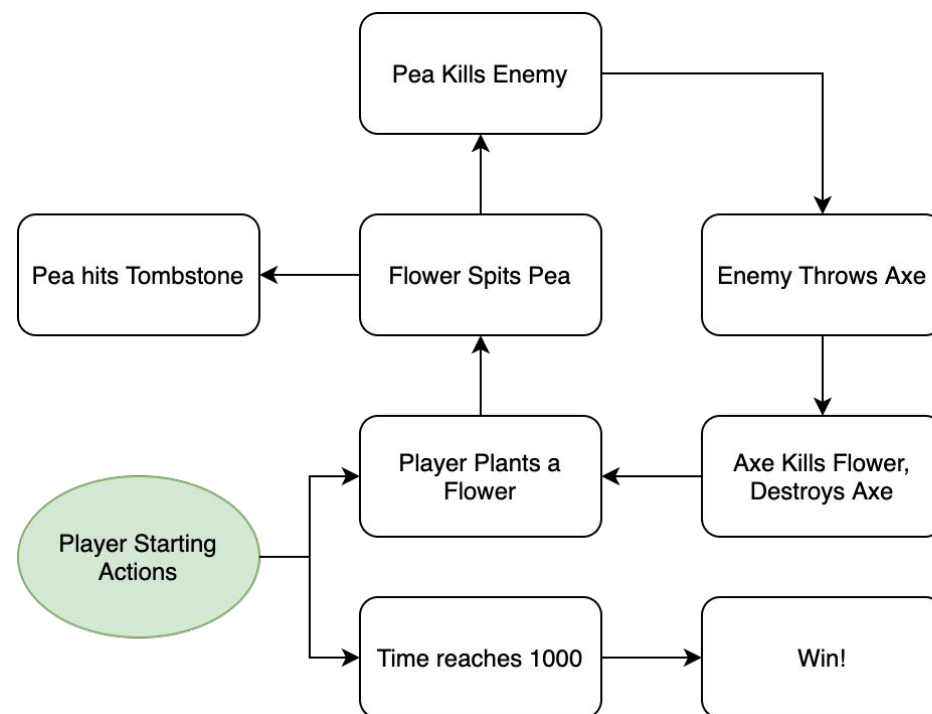
Michael Cerny Green, Ahmed Khalifa, Gabriella AB Barros, Tiago Machado, Andy Nealen, and Julian Togelius. 2018. AtDELFI: Automatically Designing Legible, Full Instructions for Games.



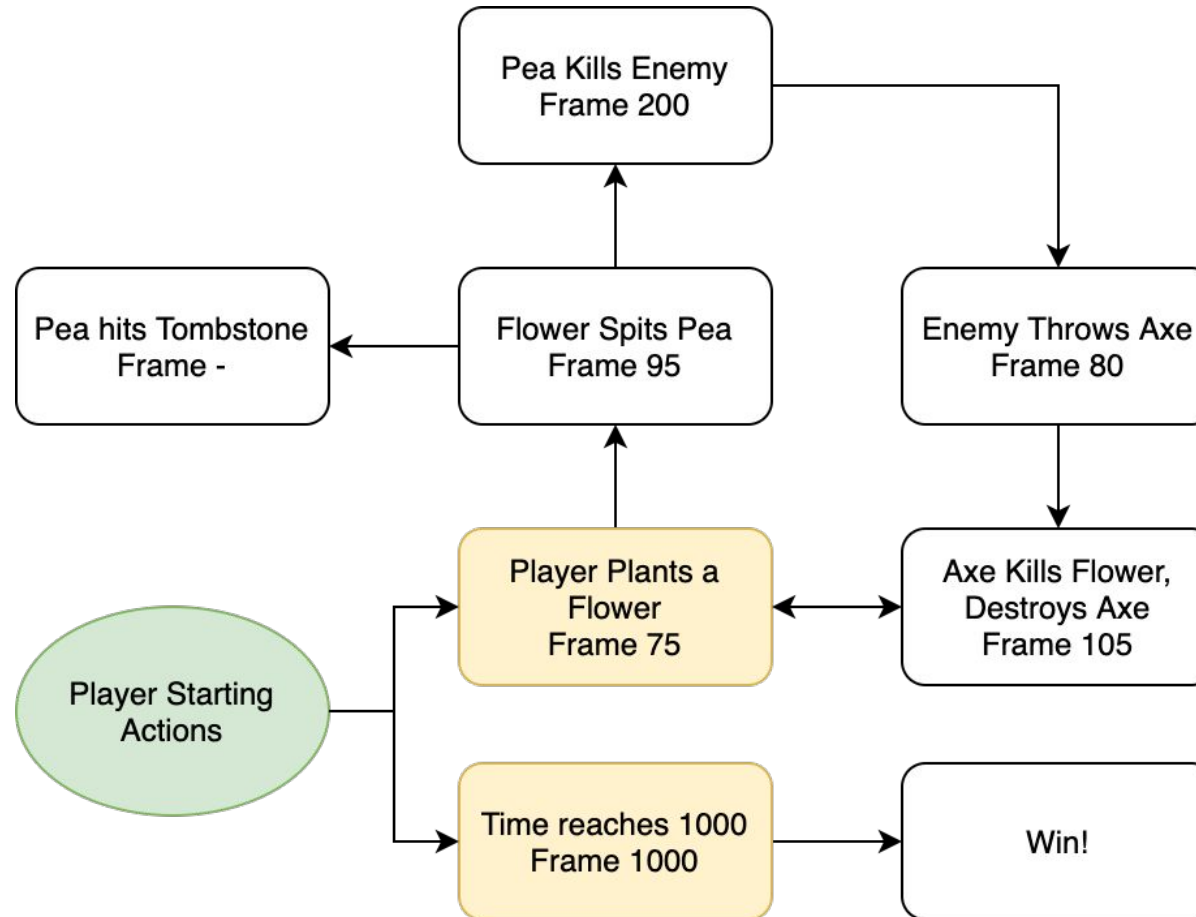
# Informed Discovery



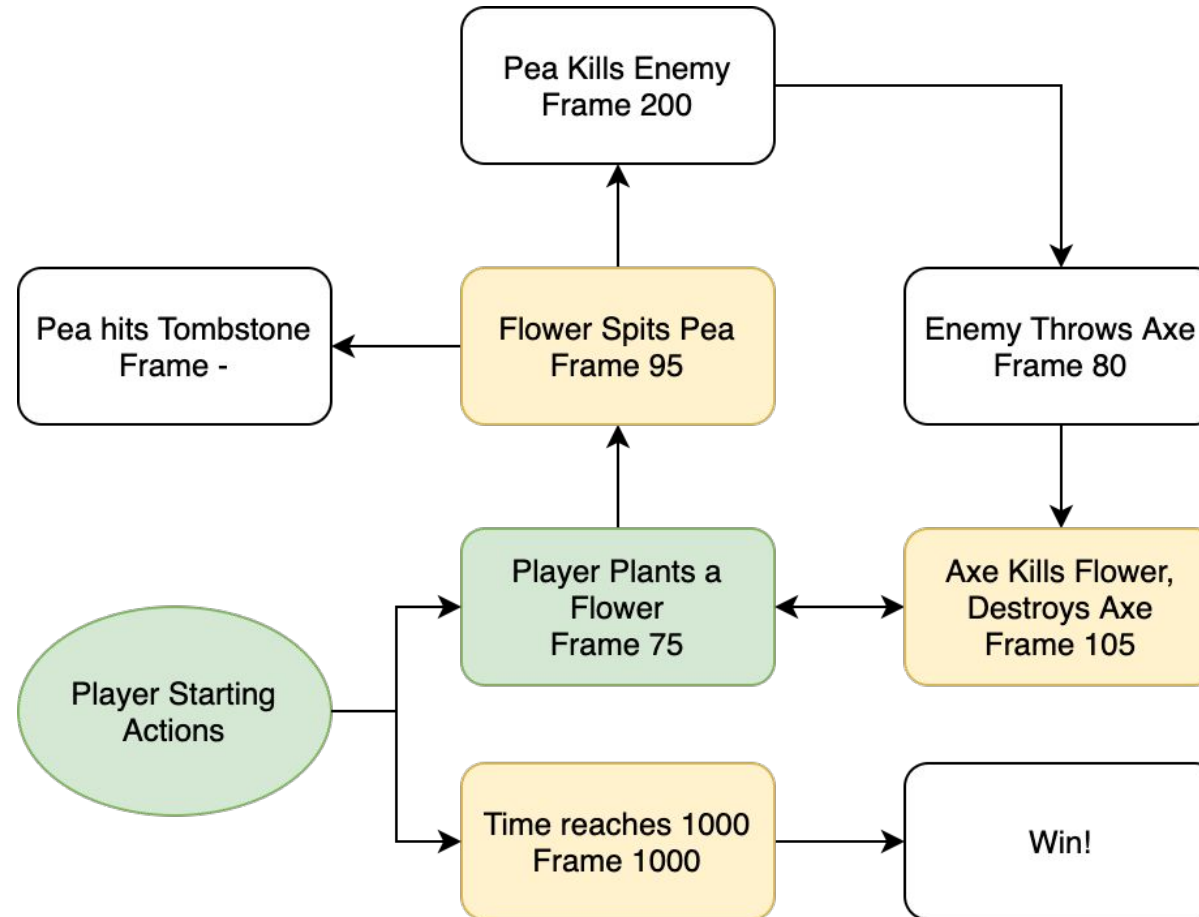
Unique  
Win



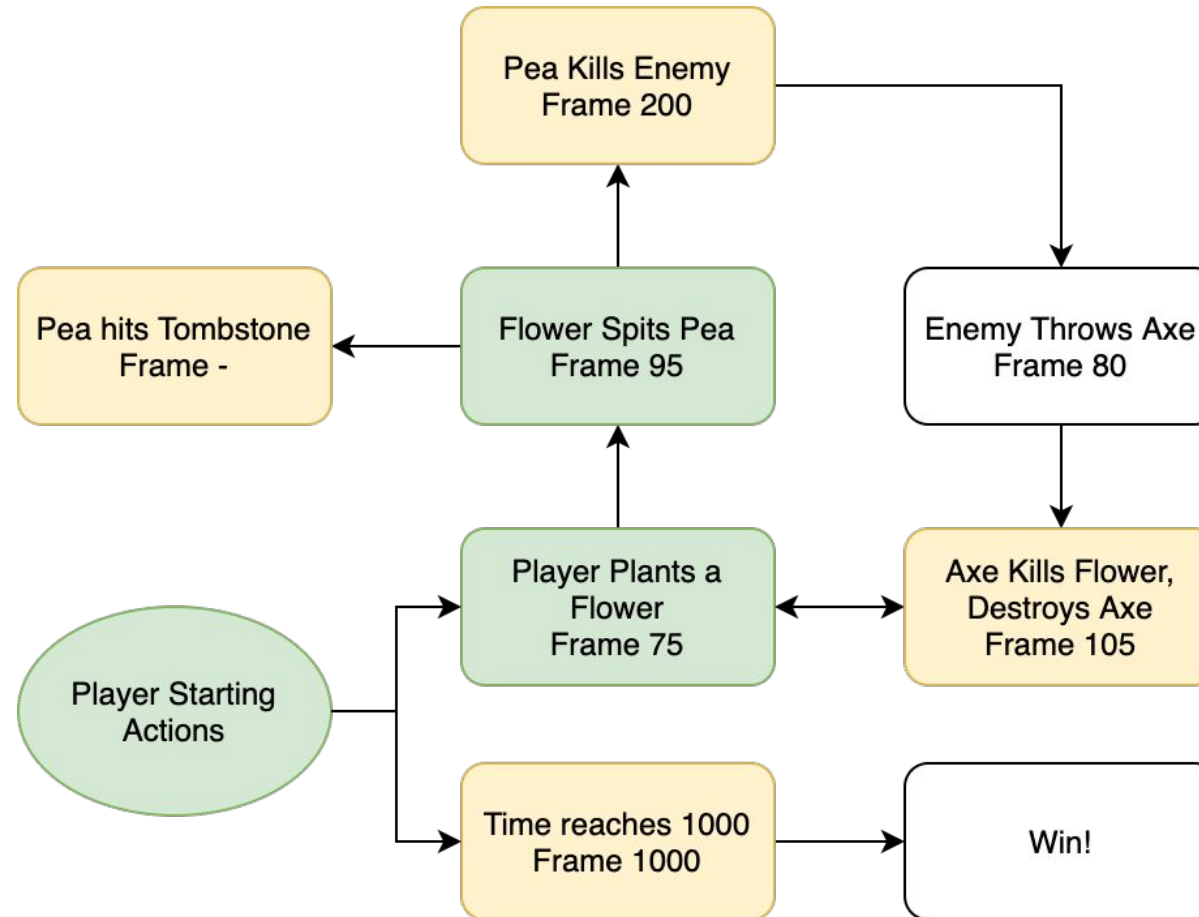
# Informed Discovery



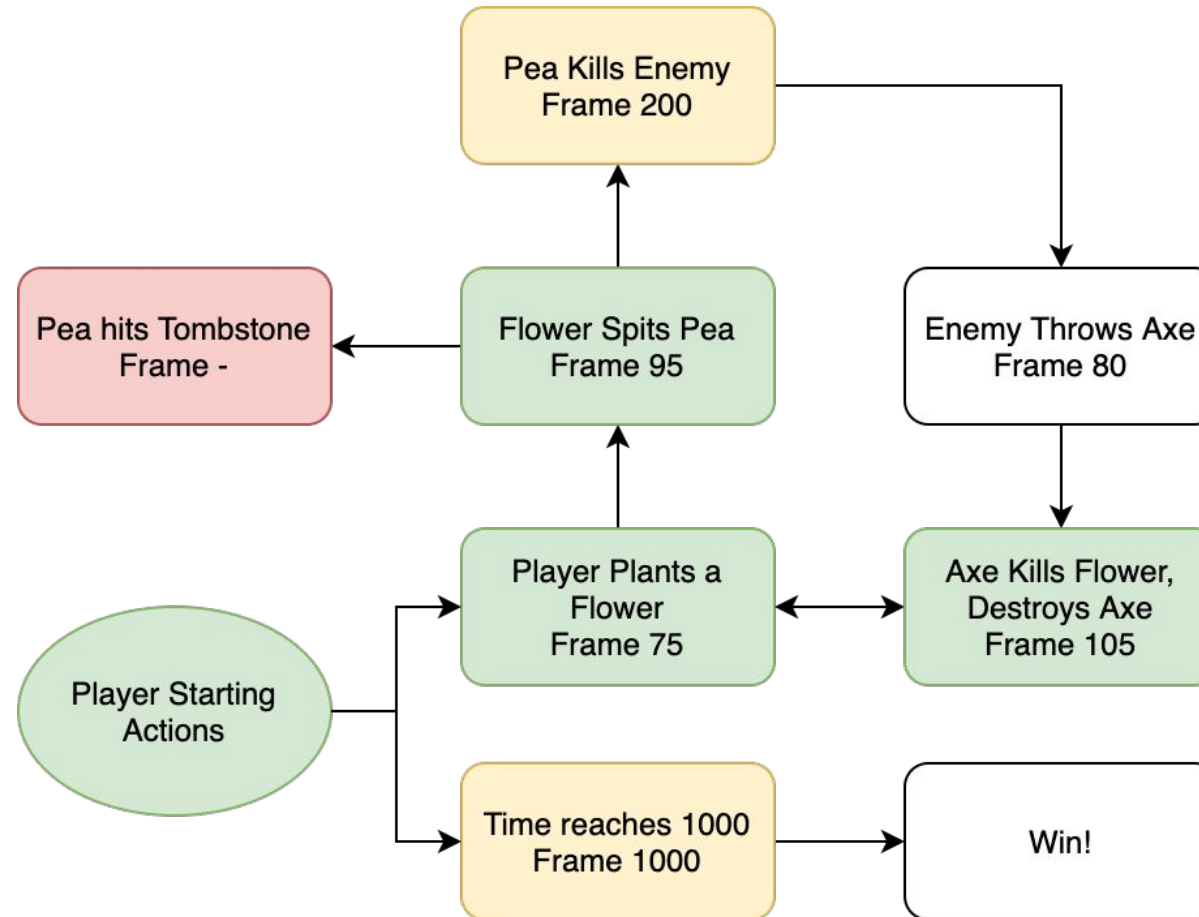
# Informed Discovery



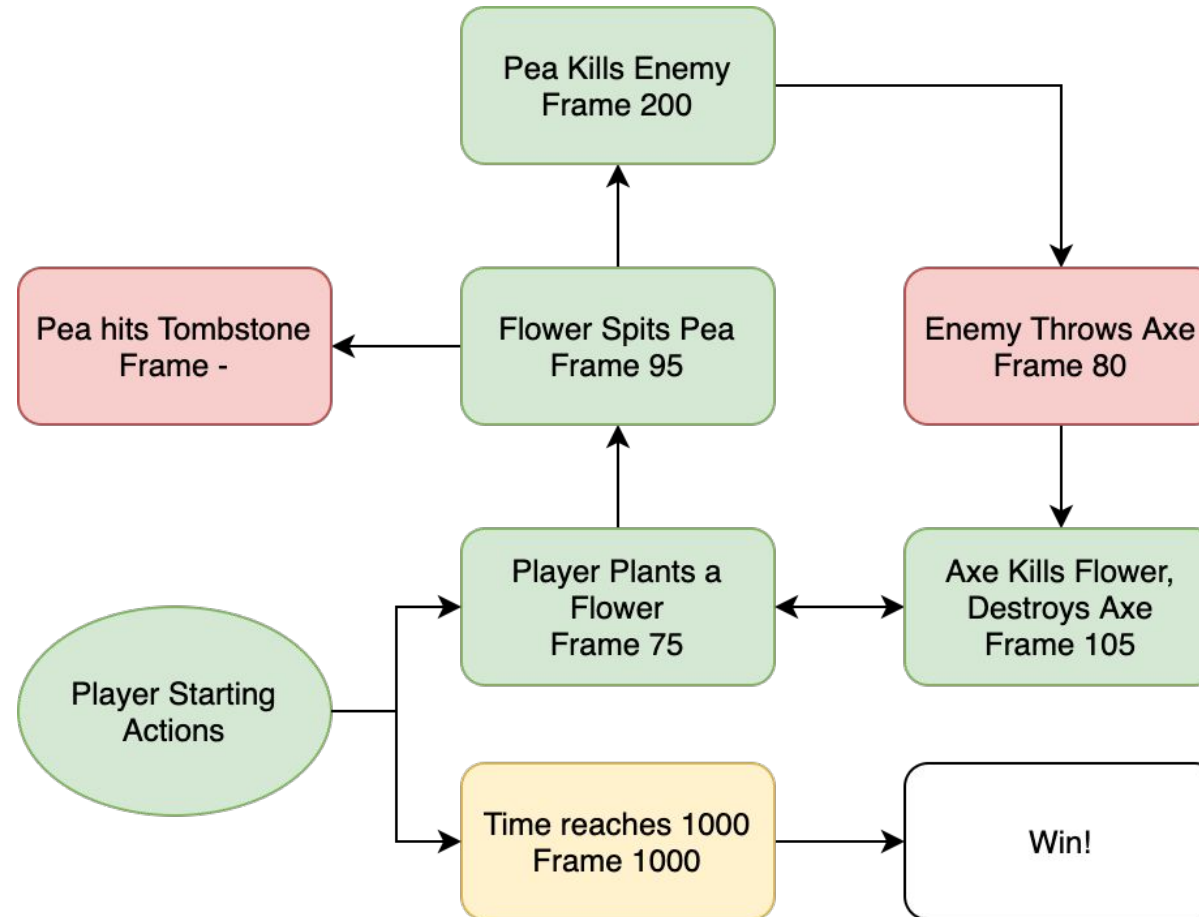
# Informed Discovery



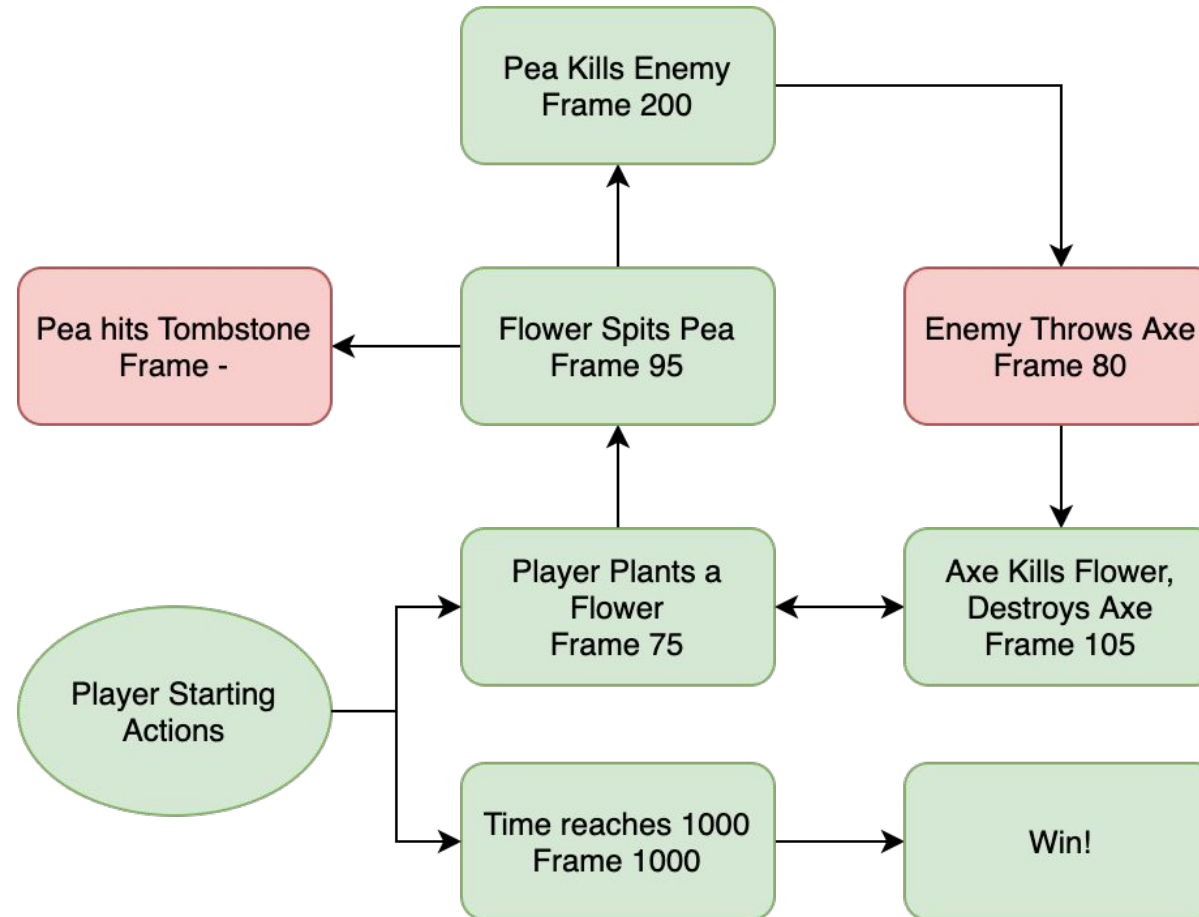
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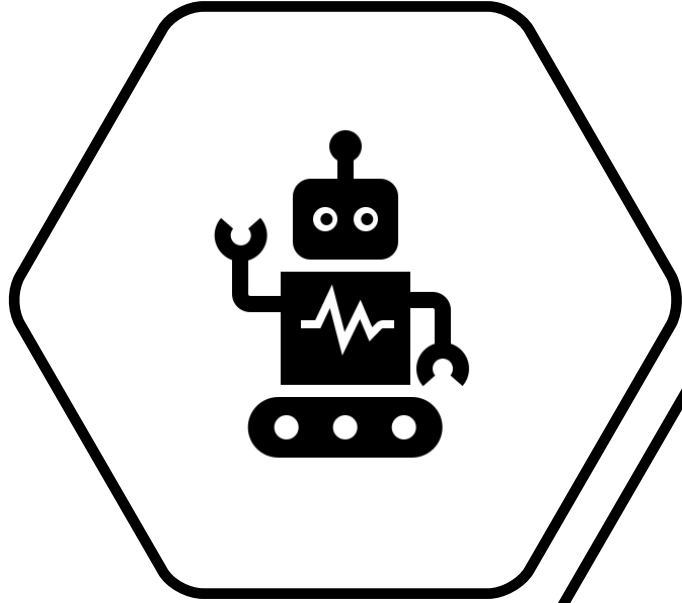
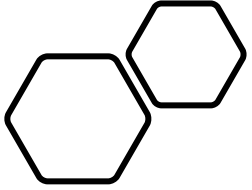


# Informed Discovery



# Informed Discovery



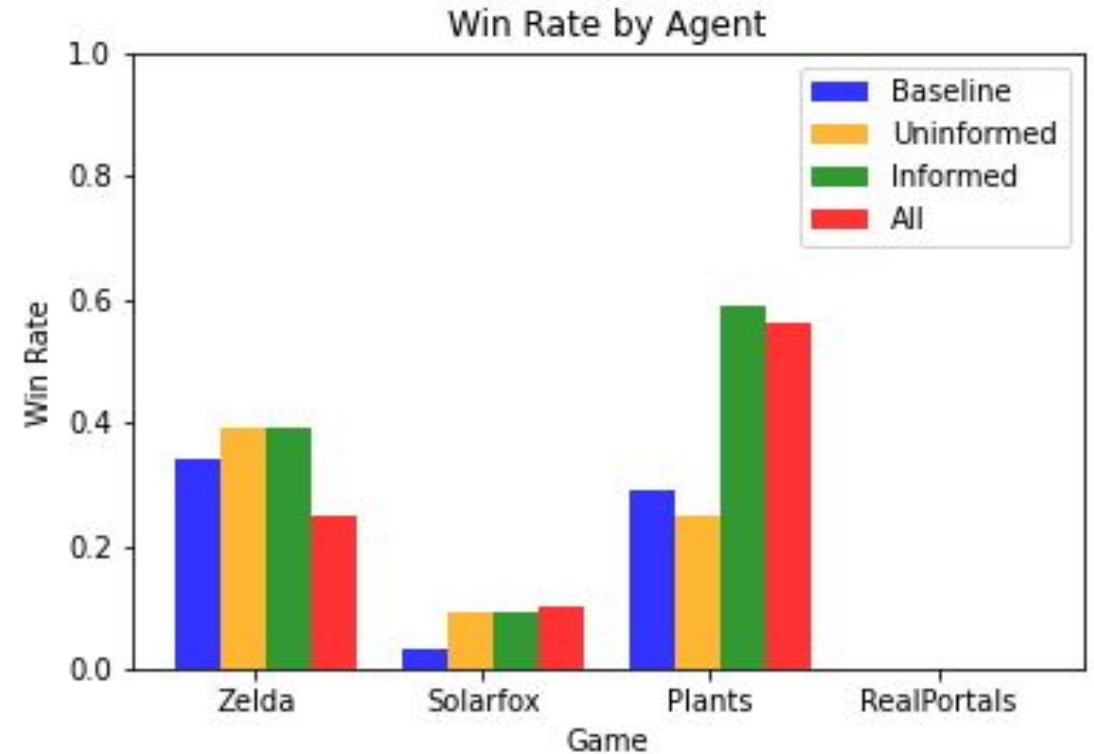
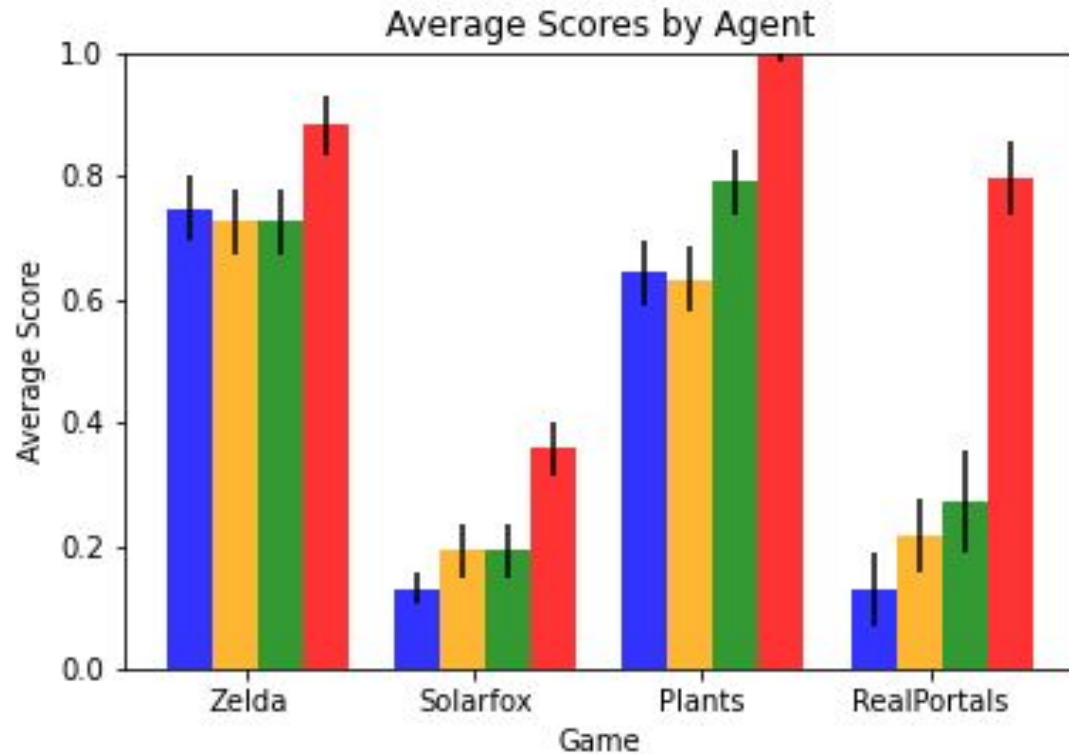


# Evaluating Critical Mechanic Discovery



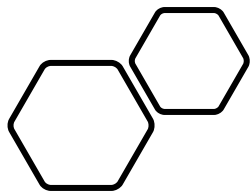
Game	Mechanic	Percentage	Informed Method	Uninformed Method
Solarfox	Avoid Flames	68%	X	X
	Collide with gems to pick them up	64%		
	Avoid Walls	18%		
	<b>Match Rate</b>	<b>-</b>	<b>45.45%</b>	<b>45.45%</b>
Zelda	Collide with the key to pick it up	80%	X	X
	Unlock the door with the key	80%	X	X
	Kill Enemies with Sword	76%		
	Avoid dying by colliding with Enemies	60%		
	Navigate the level walls using arrow keys	20%		
	Move quickly	12%		
	<b>Match Rate</b>	<b>-</b>	<b>48.8%</b>	<b>48.8%</b>
Plants	Press Space to use the shovel	100%	X	X
	Use the shovel on grass to plant plants	100%	X	
	Plants kill zombies by shooting pellets	76%	X	
	When plants get hit with axes, both are destroyed	53%	X	
	Protect the villagers from zombies for some time	35%	X	
	Add plants to different areas to get good coverage	29%		
	Axes don't affect player	6%		
	<b>Match Rate</b>	<b>-</b>	<b>81.8%</b>	<b>11.9%</b>
RealPortals	Press space to shoot a missile	72%	X	X
	If the missile collides with a wall, it turns into a portal	72%	X	
	If a potion collides with water, the water is turned into ground	72%	X	
	Unlock the door with the key	68%	X	
	Collide with the goal to capture it	52%	X	
	Collide with the key to pick it up	48%	X	
	Pick up different wands to toggle between portal types	44%	X	
	Teleport from the portal entrance to the portal exit	44%	X	
	Collide with a potion to push it	40%	X	
	Avoid dying by colliding with water or portal entrance with no exit	32%		
	If a potion collides with the portal entrance, it is teleported to the portal exit	16%	X	
	You can't go through the portal exit	0%	X	
	<b>Match Rate</b>	<b>-</b>	<b>94.3%</b>	<b>9.3%</b>

# Agent Reward Evaluation



# Shortcomings

- Can't find "negative space":
  - "Don't run into flames," "Avoid enemies"
- Limited to game graph. What if we have less information?
- Agent evaluations are challenging. How to present information to an agent properly?



# Future Work



## Tutorial Generation



## Other discovery methods?

Conditional probability

Hyperstate analysis