

**Michael Cerny Green, Ahmed Khalifa, M Charity,  
and Julian Togelius**

Persona-driven  
Dominant/Submissive Map  
(PDSM) Generation

# Overview



Generate tutorial levels (thesis)



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## AUTOMATIC VIDEO GAME TUTORIAL GENERATION

MC Green  
NEW YORK UNIVERSITY

2022

### Persona-driven Dominant/Submissive Map (PDSM) Generation for Tutorials

M Cerny Green, A Khalifa, M Charity, J Togelius  
arXiv e-prints, arXiv: 2204.05217

2022

### Predicting Personas Using Mechanic Frequencies and Game State Traces

M Cerny Green, A Khalifa, M Charity, D Bhaumik, J Togelius  
arXiv e-prints, arXiv: 2203.13351

1 \* 2022

### Game Mechanic Alignment Theory

M Cerny Green, A Khalifa, P Bontrager, R Canaan, J Togelius  
International Conference on the Foundations of Digital Games (FDG)

4 \* 2021

### Mech-Elites: Illuminating the Mechanic Space of GVG-AI

M Charity, MC Green, A Khalifa, J Togelius  
International Conference on the Foundations of Digital Games, 1-10

19 2020

### Mario level generation from mechanics using scene stitching

MC Green, L Mugrai, A Khalifa, J Togelius  
2020 IEEE Conference on Games (CoG), 49-56

16 2020

### Automatic Critical Mechanic Discovery Using Playtraces in Video Games

MC Green, A Khalifa, GAB Barros, T Machado, J Togelius  
International Conference on the Foundations of Digital Games (FDG)

4 \* 2019

### Intentional Computational Level Design

A Khalifa, MC Green, G Barros, J Togelius  
Genetic and Evolutionary Computation Conference (GECCO)

42 2019

### Generating Levels That Teach Mechanics

MC Green, A Khalifa, GAB Barros, A Nealen, J Togelius  
PCG Workshop at the Foundations of Digital Games Conference (FDG)

26 2018

### AtDelfi: Automatically Designing Legible, Full Instructions For Games

MC Green, A Khalifa, GAB Barros, T Machado, A Nealen, J Togelius  
Foundations of Digital Games Conference (FDG)

30 2018

### “Press Space To Fire”: Automatic Video Game Tutorial Generation

MC Green, A Khalifa, GAB Barros, J Togelius  
EXAG Workshop at AIIDE 2017

28 2017

# Overview



Generate tutorial levels (thesis)



Levels that encourage or  
discourage playstyles

# Playstyle



Why?

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Tutorials

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Curriculum learning

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Dynamic difficulty adjustment

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Experience-driven content  
generation

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# Minidungeons 2

The image shows a screenshot of the Unity game engine interface for the game Minidungeons 2. The top half of the screen displays the game's title "Minidungeons 2". Below the title, the Unity interface includes a menu bar with File, Edit, Assets, GameObject, Component, Window, Help, and a toolbar with various icons. The main workspace shows a 2D pixel art dungeon level. The level features a central purple floor and brown brick walls. Several characters are present: a player character with a sword and shield at the bottom center; a horned enemy with a sword near the top center; two green enemies with hats and swords on the left and right sides; and a black enemy with a sword at the bottom right. There are also three small vials (red, blue, and yellow) on the right side. A window titled "Controls" is open on the left, listing the following key bindings:

- Arrow Keys -- Move
- [SPACE] -- Enter javelin mode
- L&R Arrow Keys -- Aim javelin
- [ESC] -- Exit javelin mode
- [m] -- Mute audio/sounds

# Playstyles in Minidungeons 2

Runner



Treasure Collector



Monster Killer

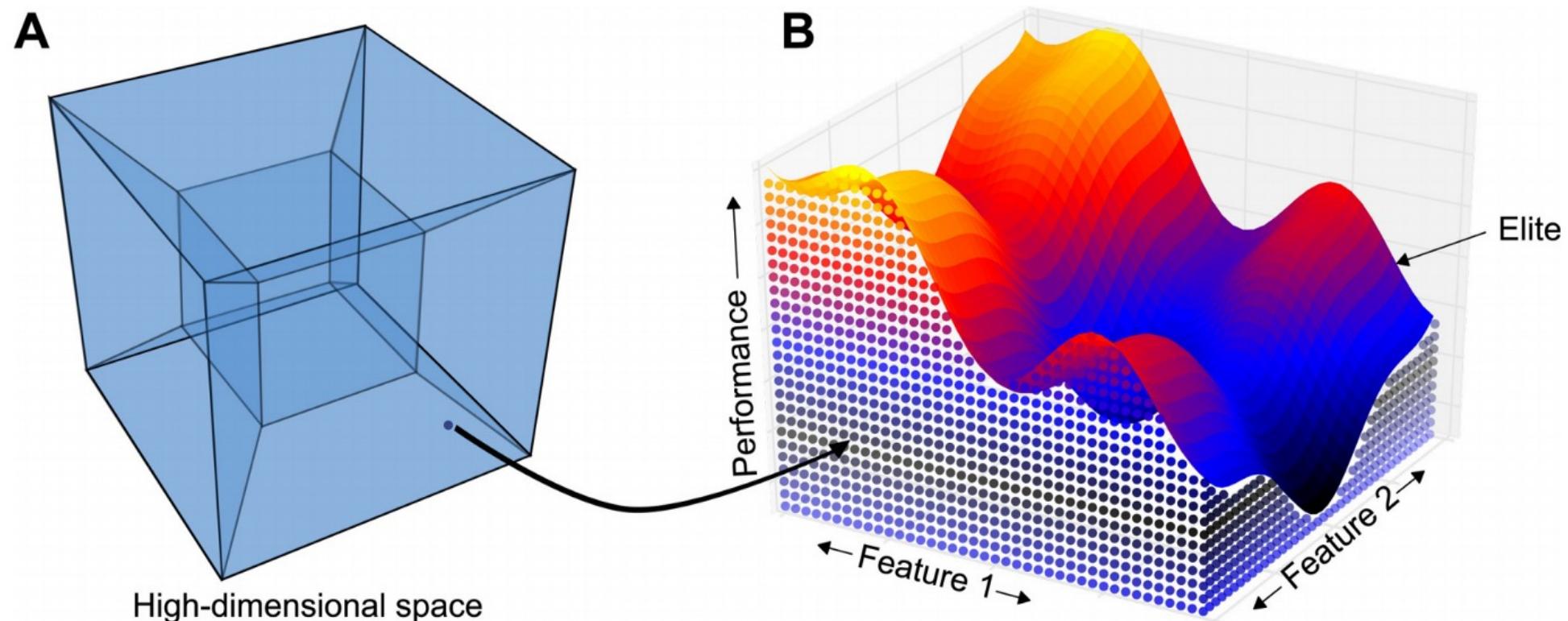


# Persona-dependent Levels

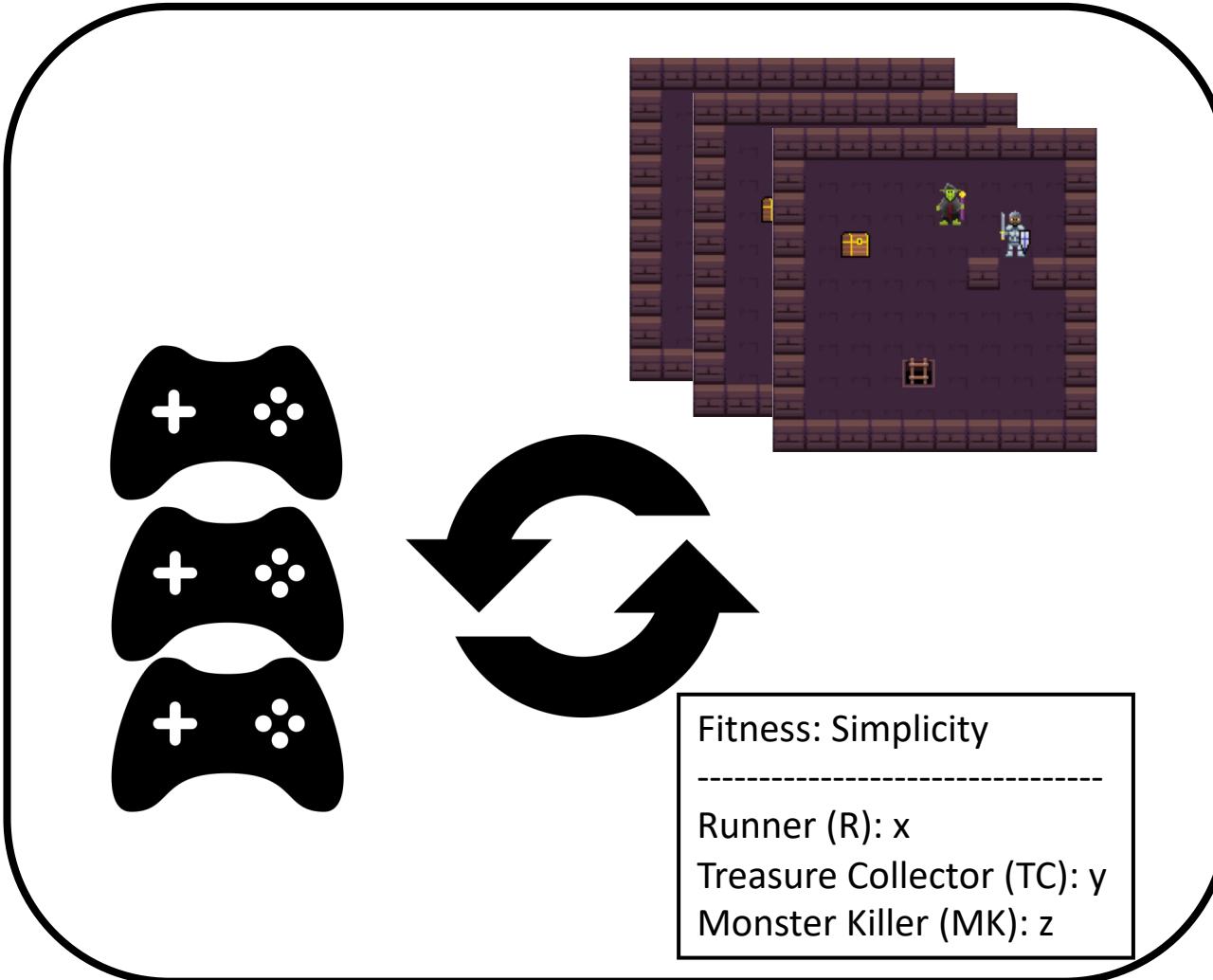
Promote/dissuade playstyles



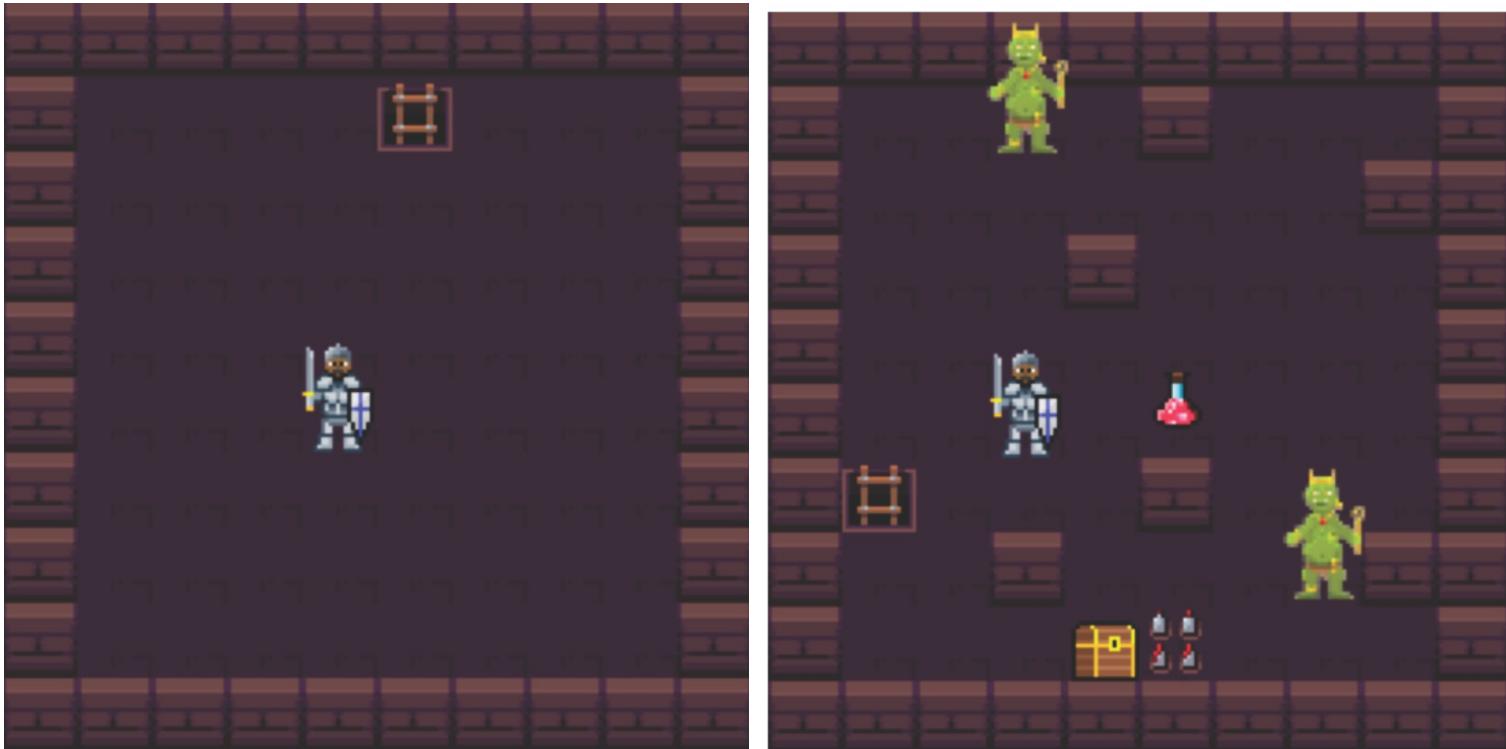
# MAP-Elites



# Evolution Process



# Results



R: 4 | TC: 4 | MK: 4  
Fitness: 0.67

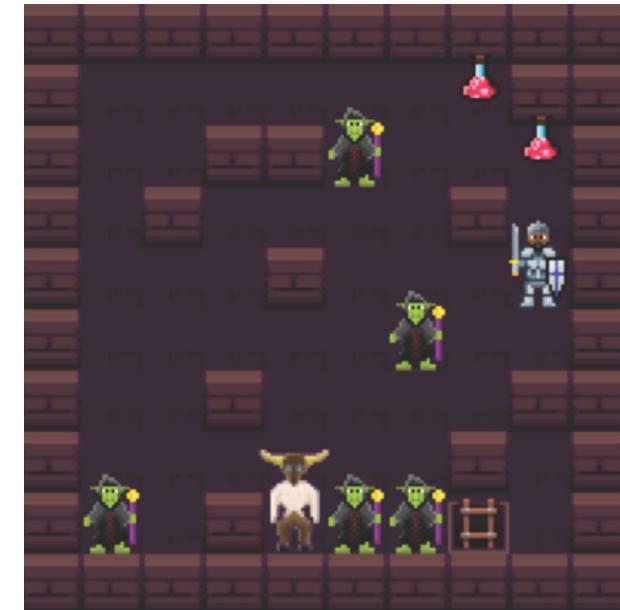
R: 4 | TC: 2 | MK: 2  
Fitness: 0.56

# Balanced Levels

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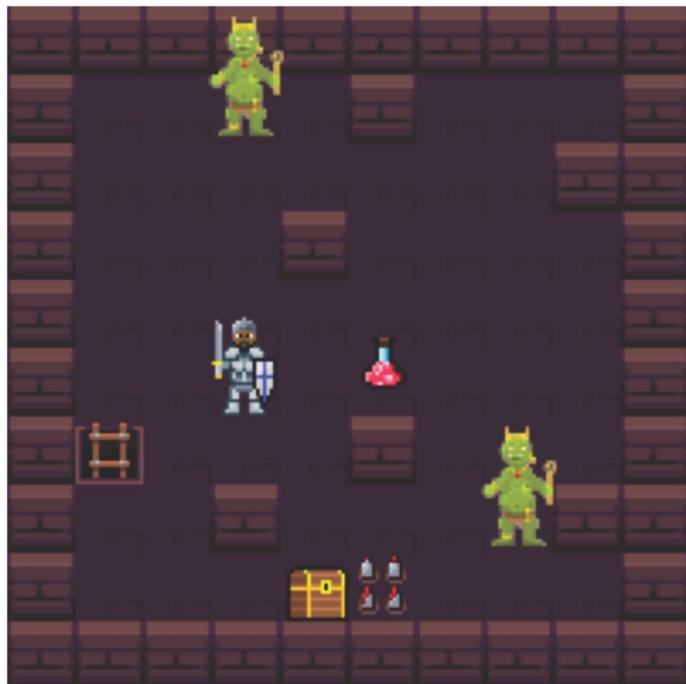
R: 4 | TC: 4 | MK: 4  
Fitness: 0.67



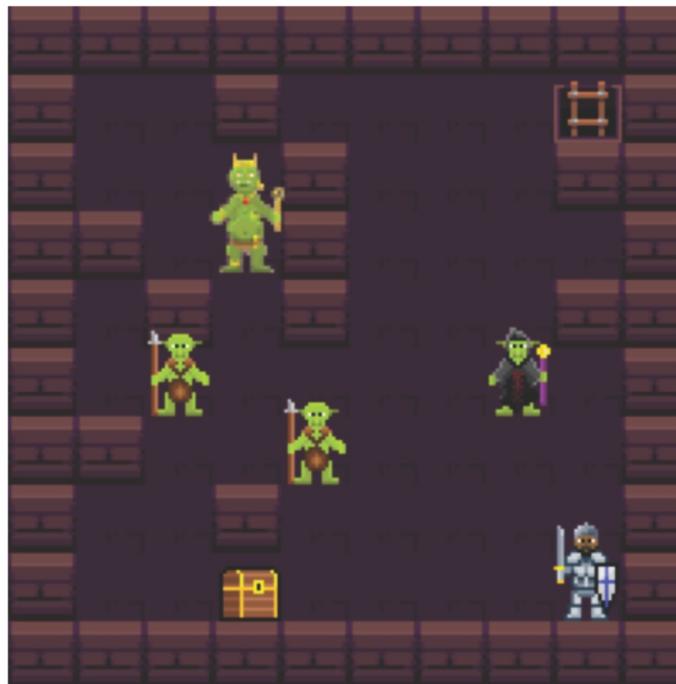
R: 0 | TC: 0 | MK: 0  
Fitness: 0.53

# Unbalanced Levels

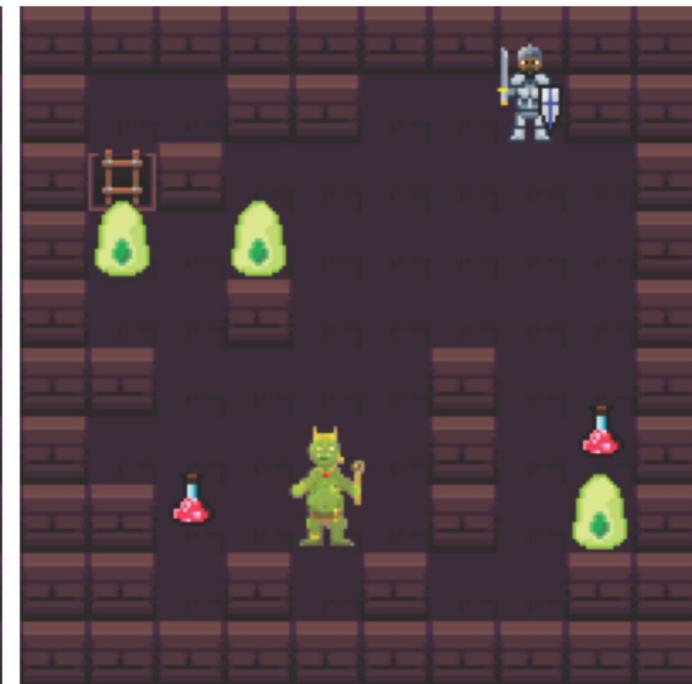
## Dominant and Submissive



R: 4 | TC: 2 | MK: 2  
Fitness: 0.56



R: 3 | TC: 2 | MK: 1  
Fitness: 0.56



R: 4 | TC: 2 | MK: 2  
Fitness: 0.55

# Unbalanced Levels

## Runner Dominant

- Runner
- Treasure Collector
- Monster Killer

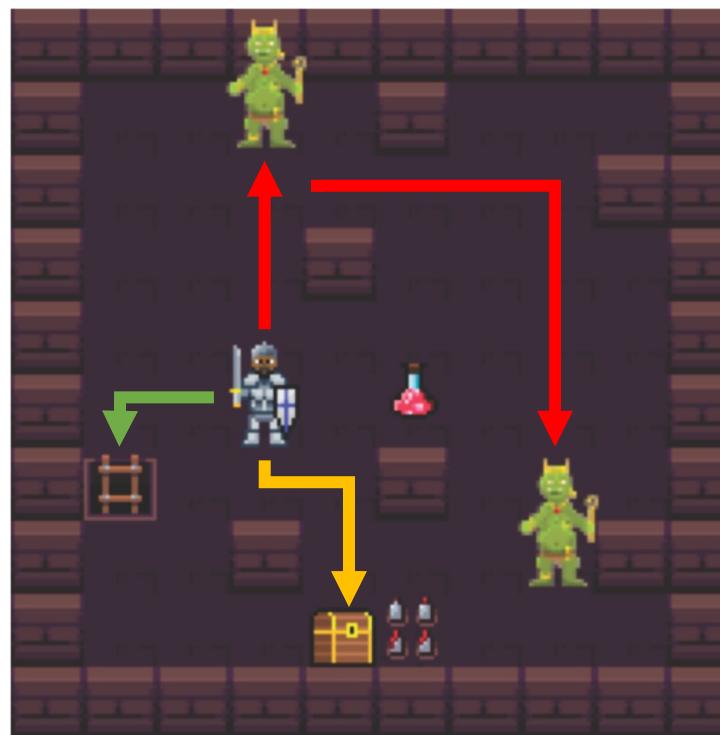


R: 4 | TC: 2 | MK: 2  
Fitness: 0.56

# Unbalanced Levels

## Runner Dominant

- Runner
- Treasure Collector
- Monster Killer

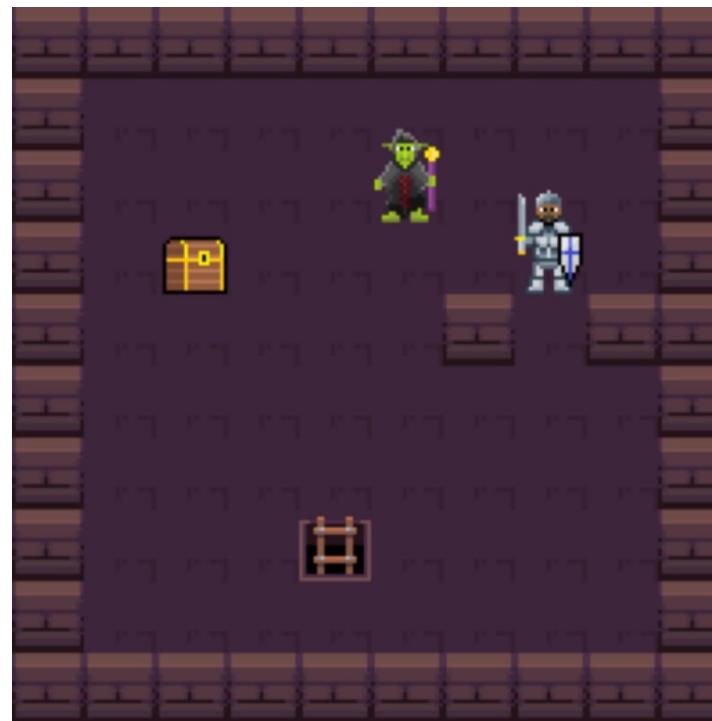


R: 4 | TC: 2 | MK: 2  
Fitness: 0.56

# Unbalanced Levels

## Runner Dominant

- Runner
- Treasure Collector
- Monster Killer

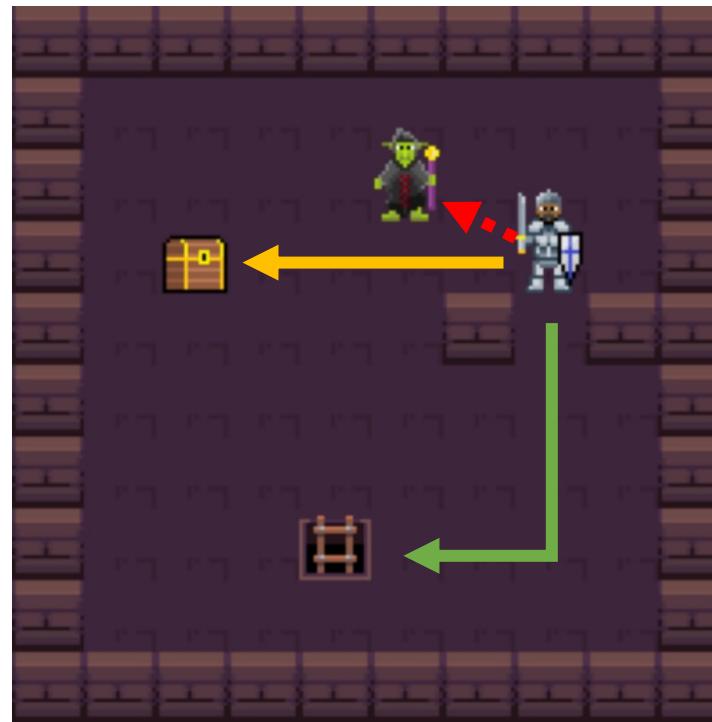


R: 4 | TC: 1 | MK: 4  
Fitness: 0.62

# Unbalanced Levels

## Treasure Collector Submissive

- Runner
- Treasure Collector
- Monster Killer



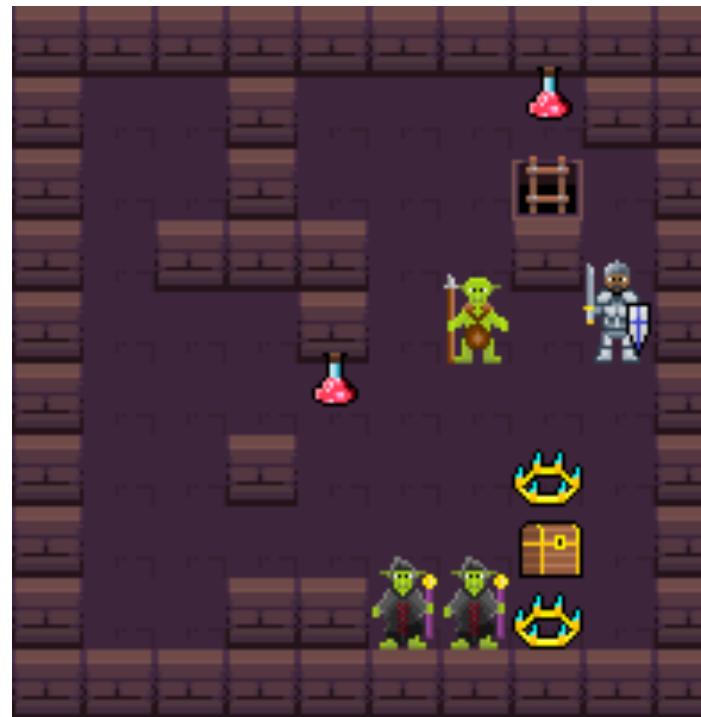
R: 4 | TC: 1 | MK: 4  
Fitness: 0.62

# Extremely Unbalanced Levels

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## Treasure Collector Submissive

- Runner
- Treasure Collector
- Monster Killer



R: 4 | TC: 0 | MK: 3  
Fitness: 0.506

# Extremely Unbalanced Levels

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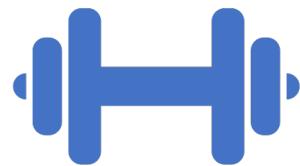
## Treasure Collector Submissive

- Runner
- Treasure Collector
- Monster Killer



R: 4 | TC: 0 | MK: 3  
Fitness: 0.506

# Tutorial Levels



Meant to be simple  
(simplicity fitness)



Use gentle unbalanced,  
nudge behavior



More stern unbalanced  
levels for “heavy play”

# Correlation to Difficulty

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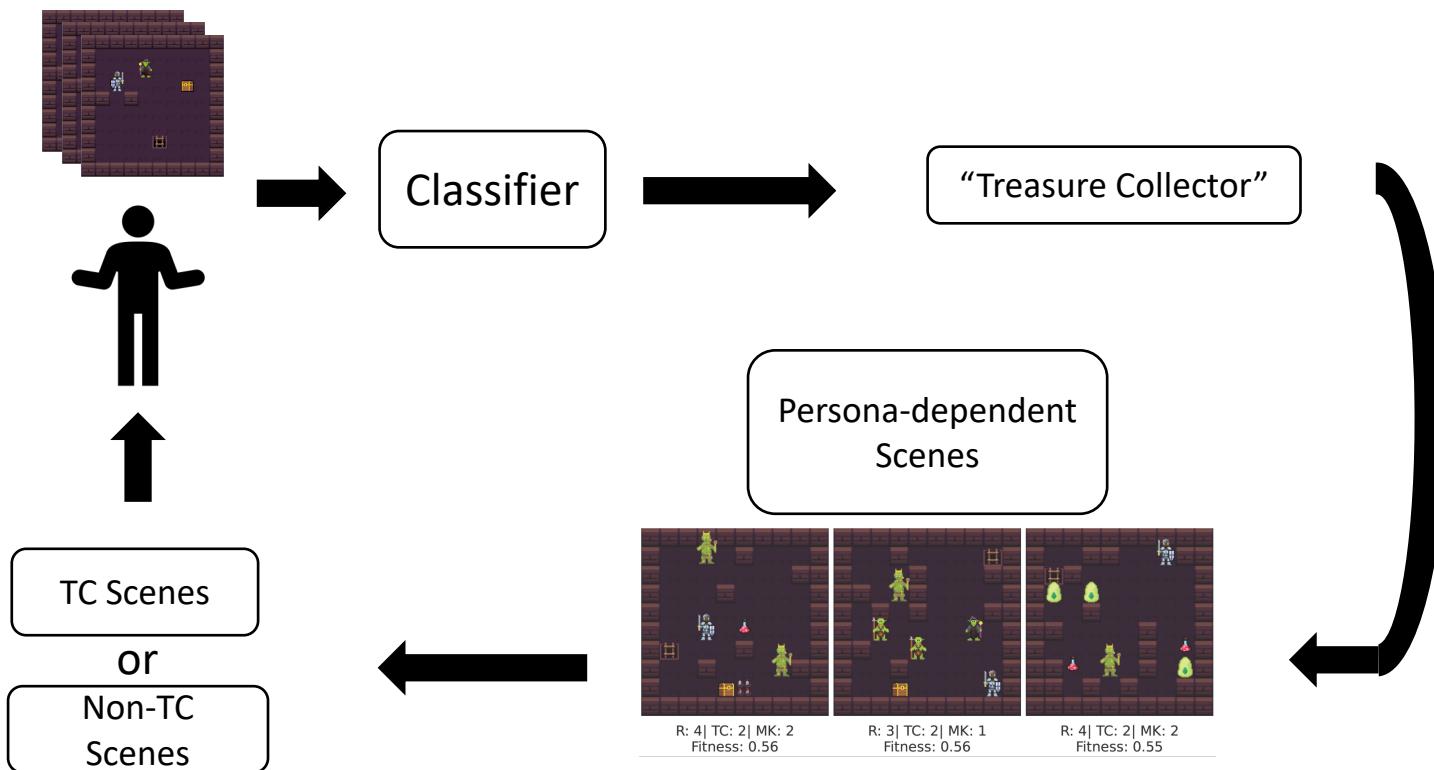
Lots of HP  
!= easy

Low HP  
~= hard

HP is  
currency

Strategic  
headroom

# Future Work: A Persona-dependent Pipeline



# Other Future Work

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Simplicity, a  
different fitness  
function?

Curriculum  
generation

Evolve new  
personas out of  
human data, or  
self-play

Questions?

