Roguelife 💀

Descriptive subtitle: Asynchronous Adversial Simulation Assisted Game Design based on Rule-Based and Reinforcement Learning Agents and Procedural Content Generation by Genetic Algorithms

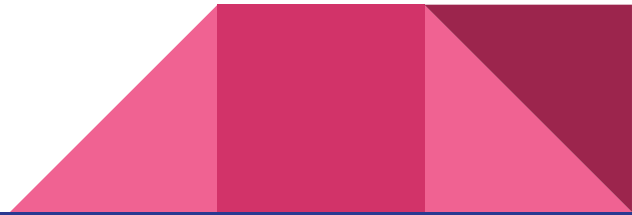
Cool subtitle: The game that lives

Vision

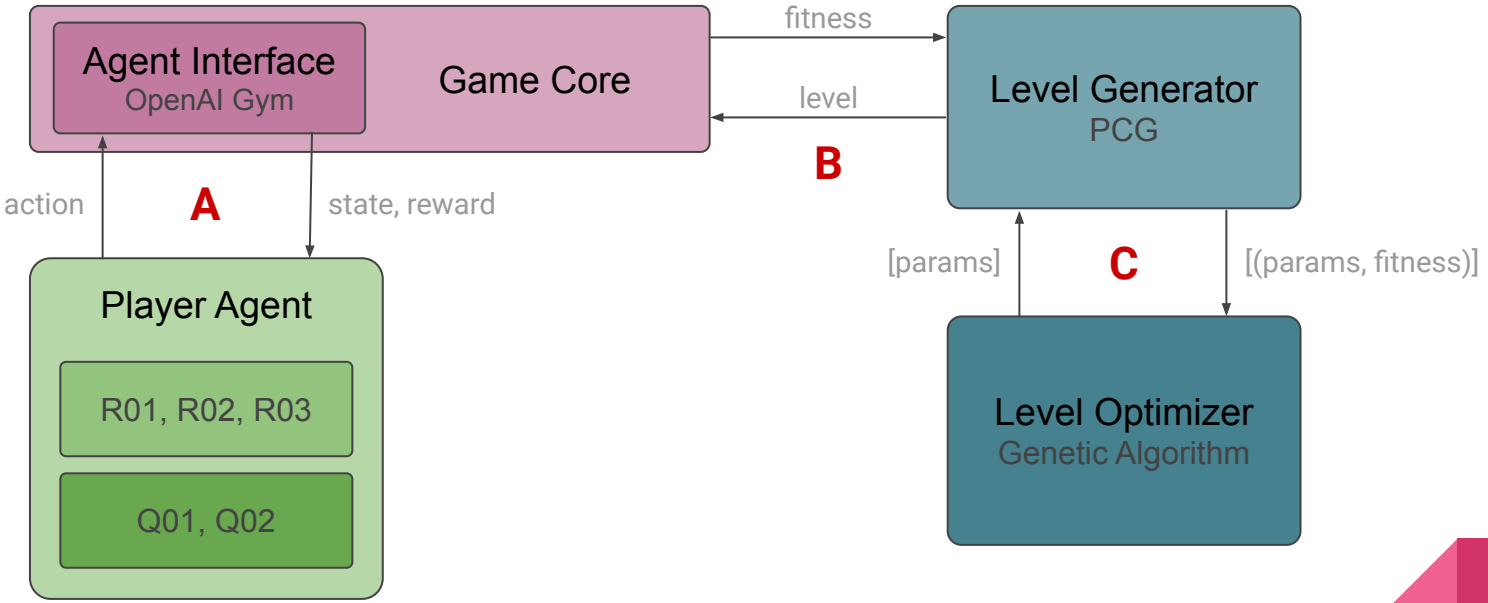
Having a player agent and a PCG learning simultaneously

Investigating how the game evolves as a response to different player strategies

Investigating the symbiosis between the agent and the generator



Architecture



Loops 🔁

A At every frame of the game

B At the end of every level

C After the generator has used an entire population of parameters

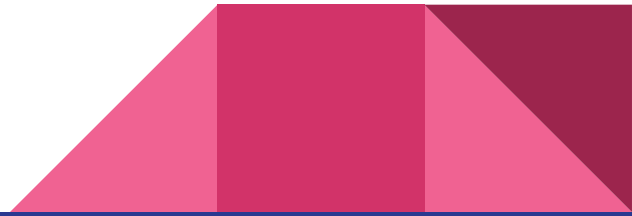
Flow

For each population of levels:

- Run the agent through the level
- Compute the fitness of the level

Return the population and the fitnesses to the genetic algorithm, and get a new generation in return, after a breeding step

Repeat



The Game

5 Skeletons
Rising from the grave after 20 steps

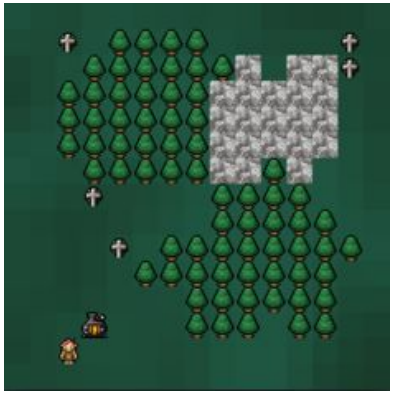
1 Base

Solid rocks

Cuttable trees

“Arrows”

Complex lore



The Generator

Bottom - Up approach based on tile proximity and refinement runs

Ensures that the maps generated are solvable (Both Skeletons or the Player can win, meaning none of them can end up trapped)

Based on 8 parameters , which are controlled by the Genetic Algorithm

The Agents

R01 - Rule-based, “The Shooter”

R02 - Rule-based, “The Defender”

R03 - Rule-based, “The Hunter Gravedigger”

R04 - Rule-based, “The Mad Man”

Q01 - Reinforcement learning by DQN

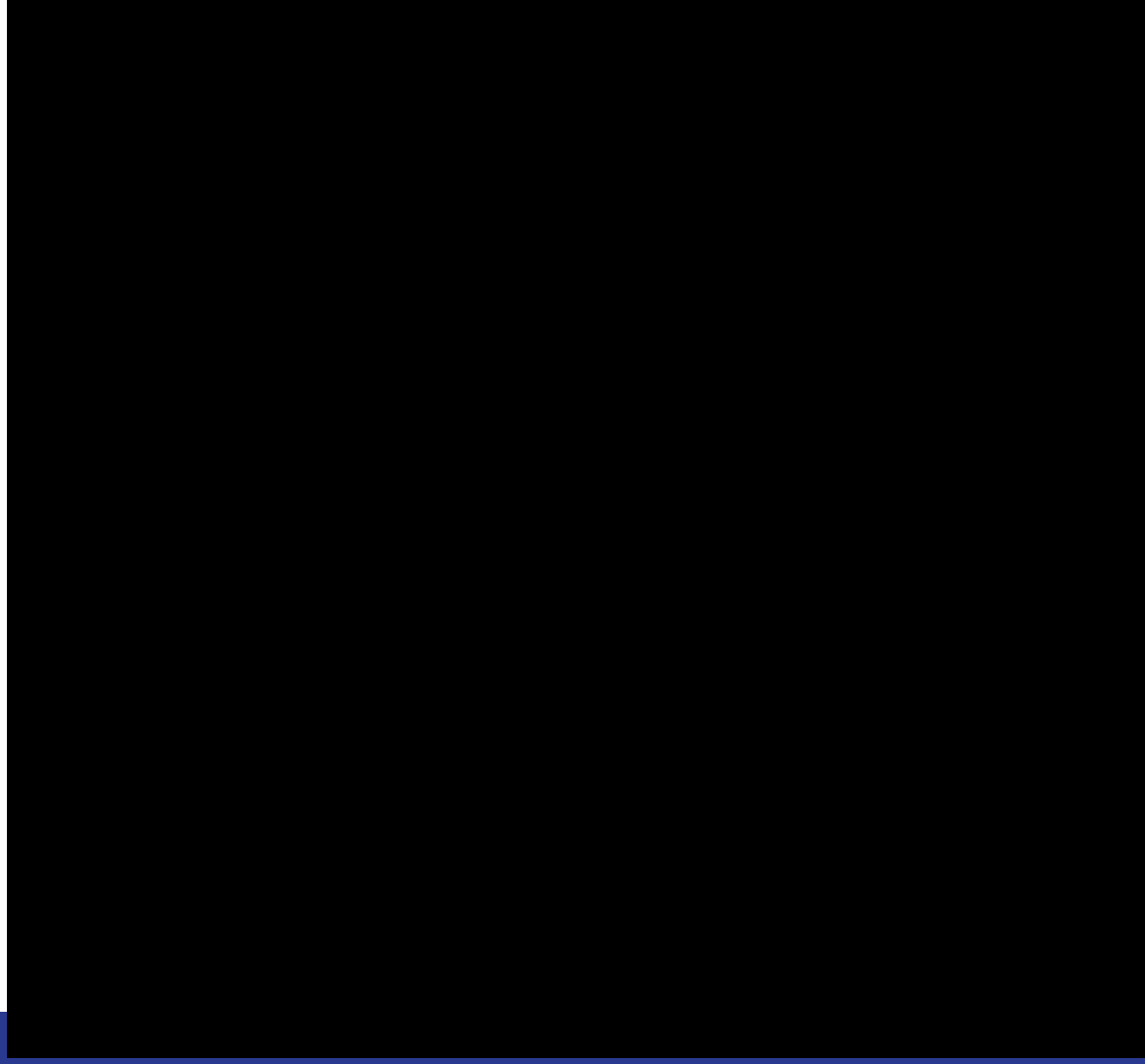


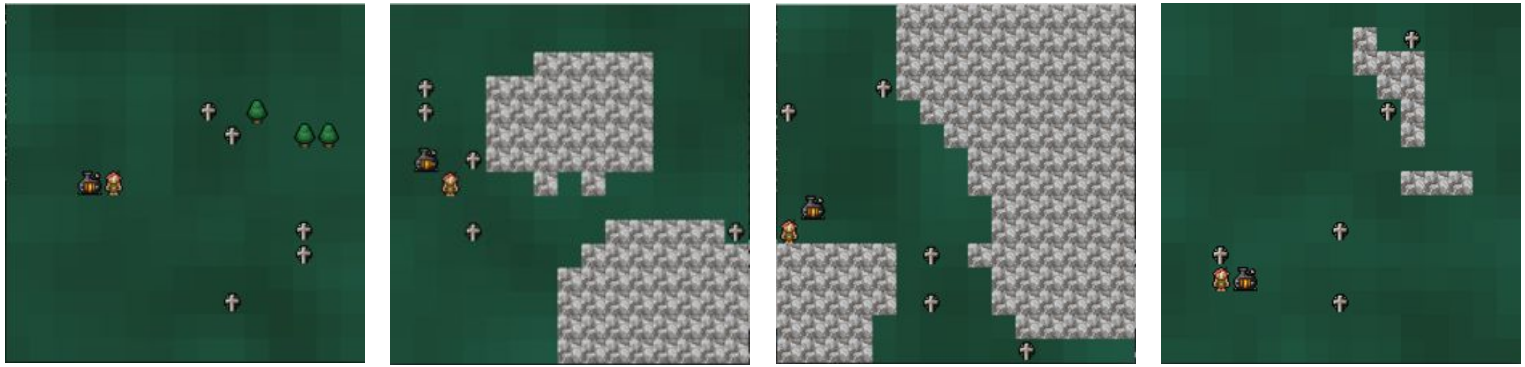
Exhibit A - Before the graves

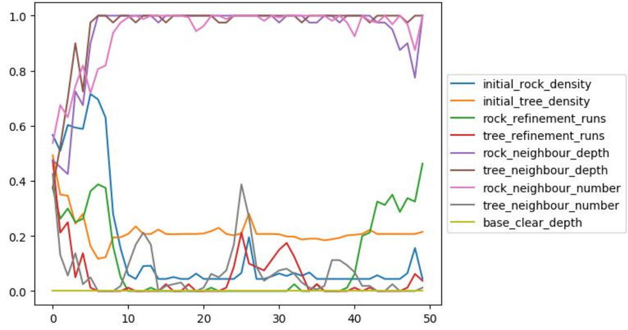
The evolution quickly optimized for density

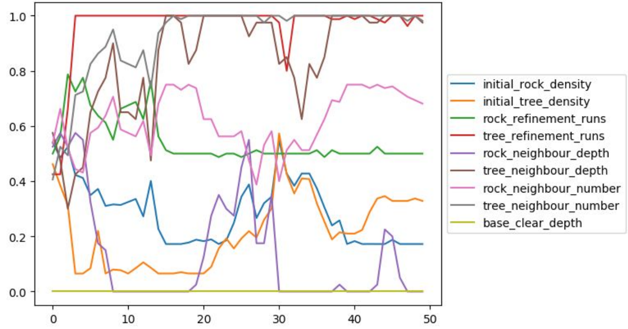
Happens both in R01 and Q01

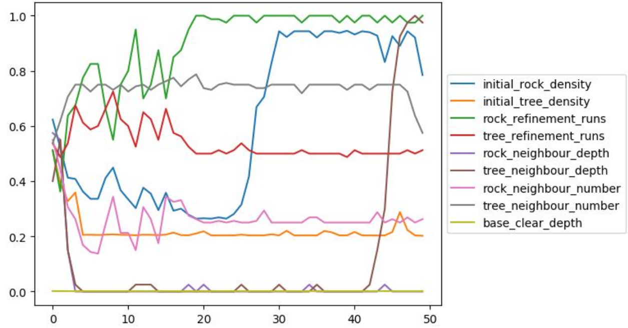
Exhibit B - Agents - R01

R01 - Rule-based, “The Shooter”




initial_rock_density
initial_tree_density
rock_refinement_runs
tree_refinement_runs
rock_neighbour_depth
tree_neighbour_depth
rock_neighbour_number
tree_neighbour_number
base_clear_depth

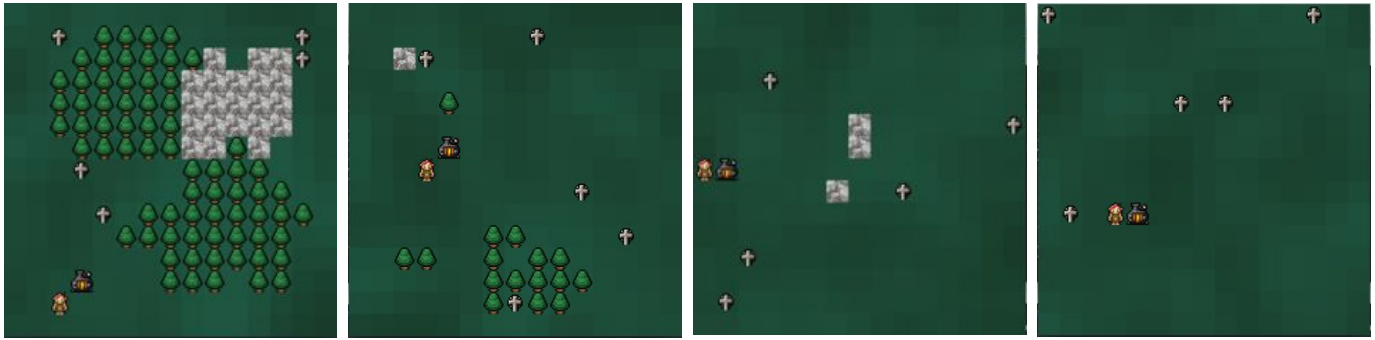

initial_rock_density
initial_tree_density
rock_refinement_runs
tree_refinement_runs
rock_neighbour_depth
tree_neighbour_depth
rock_neighbour_number
tree_neighbour_number
base_clear_depth


initial_rock_density
initial_tree_density
rock_refinement_runs
tree_refinement_runs
rock_neighbour_depth
tree_neighbour_depth
rock_neighbour_number
tree_neighbour_number
base_clear_depth

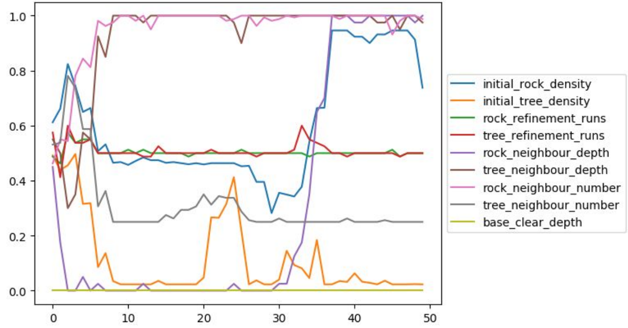
R01 - 3 runs

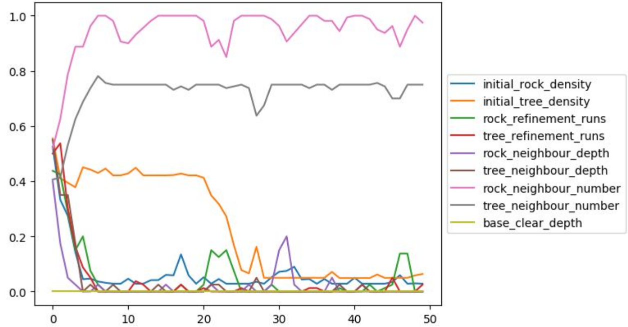
Exhibit B - Agents - R02

R02 - Rule-based, “The Defender”



R02 - 3 runs


initial_rock_density
initial_tree_density
rock_refinement_runs
tree_refinement_runs
rock_neighbour_depth
tree_neighbour_depth
rock_neighbour_number
tree_neighbour_number
base_clear_depth


initial_rock_density
initial_tree_density
rock_refinement_runs
tree_refinement_runs
rock_neighbour_depth
tree_neighbour_depth
rock_neighbour_number
tree_neighbour_number
base_clear_depth

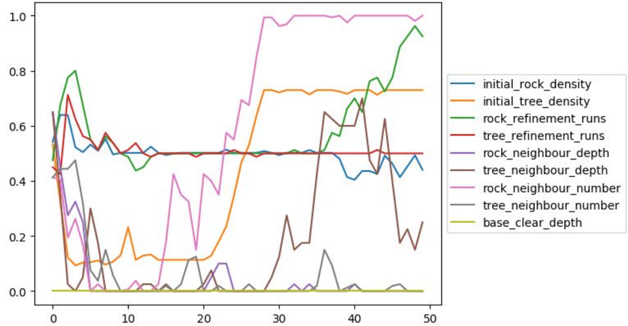
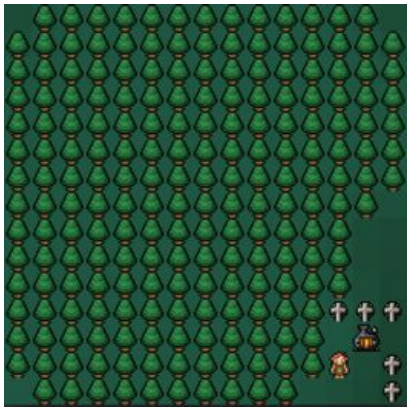
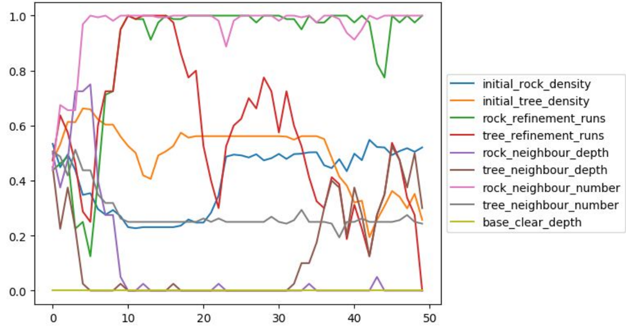

initial_rock_density
initial_tree_density
rock_refinement_runs
tree_refinement_runs
rock_neighbour_depth
tree_neighbour_depth
rock_neighbour_number
tree_neighbour_number
base_clear_depth

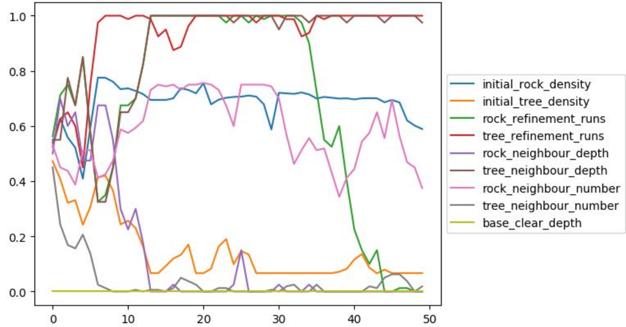
Exhibit B - Agents

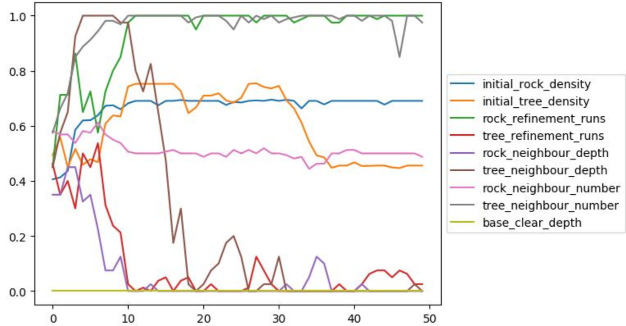
R03 - Rule-based, “The Hunter Gravedigger”







initial_rock_density
initial_tree_density
rock_refinement_runs
tree_refinement_runs
rock_neighbour_depth
tree_neighbour_depth
rock_neighbour_number
tree_neighbour_number
base_clear_depth

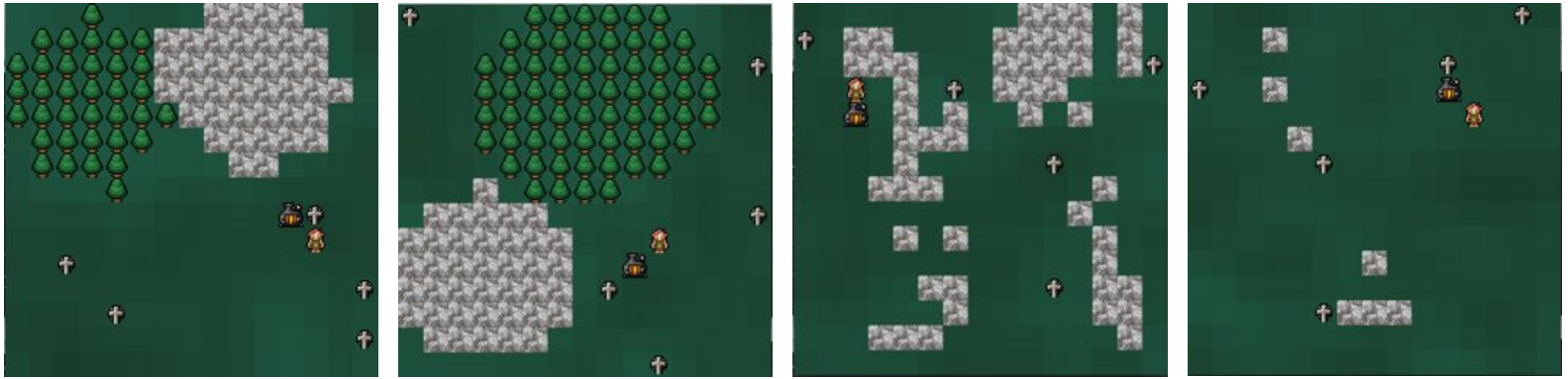

initial_rock_density
initial_tree_density
rock_refinement_runs
tree_refinement_runs
rock_neighbour_depth
tree_neighbour_depth
rock_neighbour_number
tree_neighbour_number
base_clear_depth

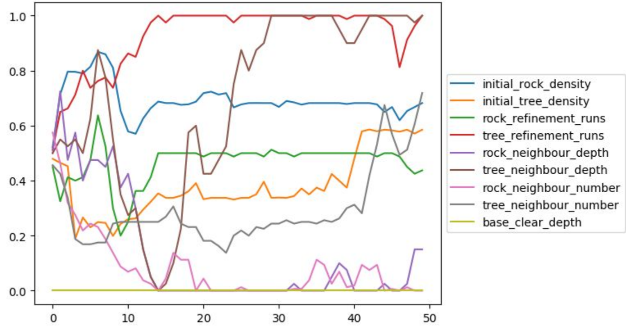

initial_rock_density
initial_tree_density
rock_refinement_runs
tree_refinement_runs
rock_neighbour_depth
tree_neighbour_depth
rock_neighbour_number
tree_neighbour_number
base_clear_depth

R03 - 3 runs

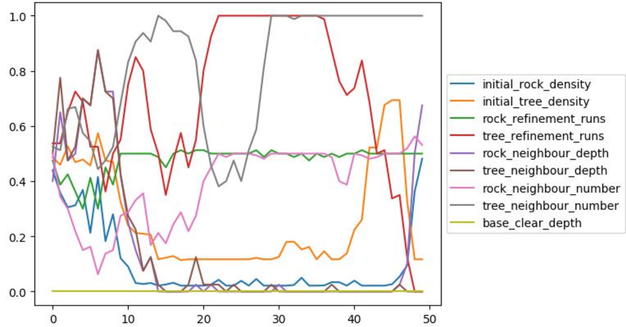
Exhibit B - Agents

R04 - Rule-based, “The Mad Man”

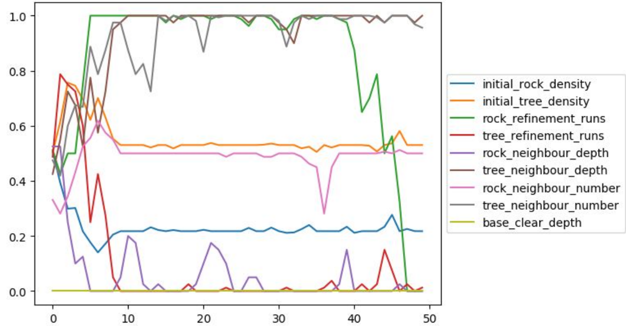




1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
initial_rock_density
initial_tree_density
rock_refinement_runs
tree_refinement_runs
rock_neighbour_depth
tree_neighbour_depth
rock_neighbour_number
tree_neighbour_number
base_clear_depth



1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
initial_rock_density
initial_tree_density
rock_refinement_runs
tree_refinement_runs
rock_neighbour_depth
tree_neighbour_depth
rock_neighbour_number
tree_neighbour_number
base_clear_depth



1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
initial_rock_density
initial_tree_density
rock_refinement_runs
tree_refinement_runs
rock_neighbour_depth
tree_neighbour_depth
rock_neighbour_number
tree_neighbour_number
base_clear_depth

R04 - 3 runs

Our Contributions

The architecture

The code - Everything except the RL is home-cooked

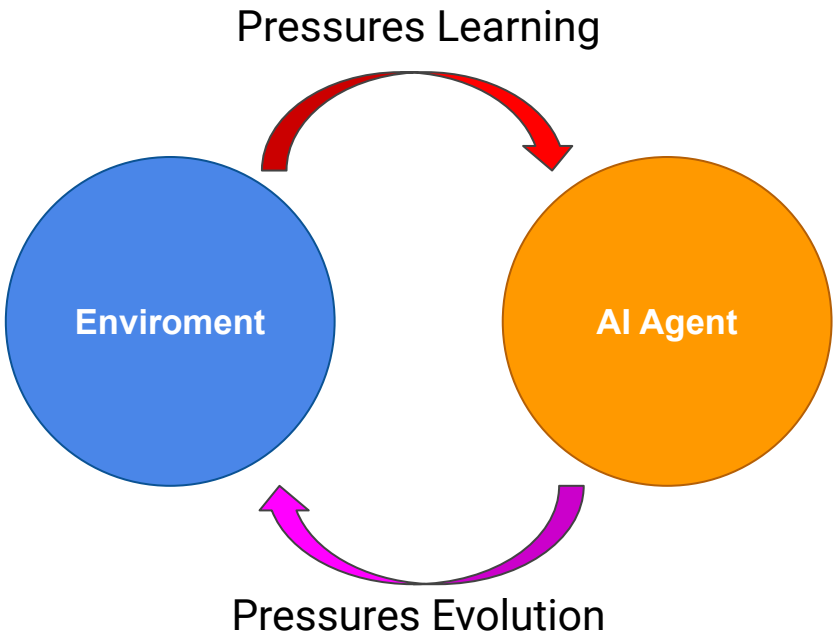
Initial experimental results and observations

“Research questions”

Zero-player game

How can an evolving environment help training (eg. by enforcing exploration)

How can an learning agent help level generation (eg. by exploiting design weaknesses)



More research questions

Will the environment evolve against a non-learning agent?

Should the agent be pre-trained to a certain level before the environment begins evolving?

At what rate should each learning algorithm be run?

Applications

Better training?

Better content?

More robust agents?

Automated gameplay testing

Future work

Refinement

Way longer runs

Investigate symbiosis in RL vs. generator

If our findings are novel and meaningful - write a paper


Thank you!
Eat fresh