NEAT + **Novelty Search** for PCG generates comparable video game levels **faster** with **less domain knowledge** and **no data requirements.**

PCGNN: Using NEAT and Novelty Search for Diverse and fast level generation

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Introduction

Video games are popular, but content is **slow** and **expensive** to develop manually. Procedural Content Generation (PCG) can help with this.

Problems – Current Methods

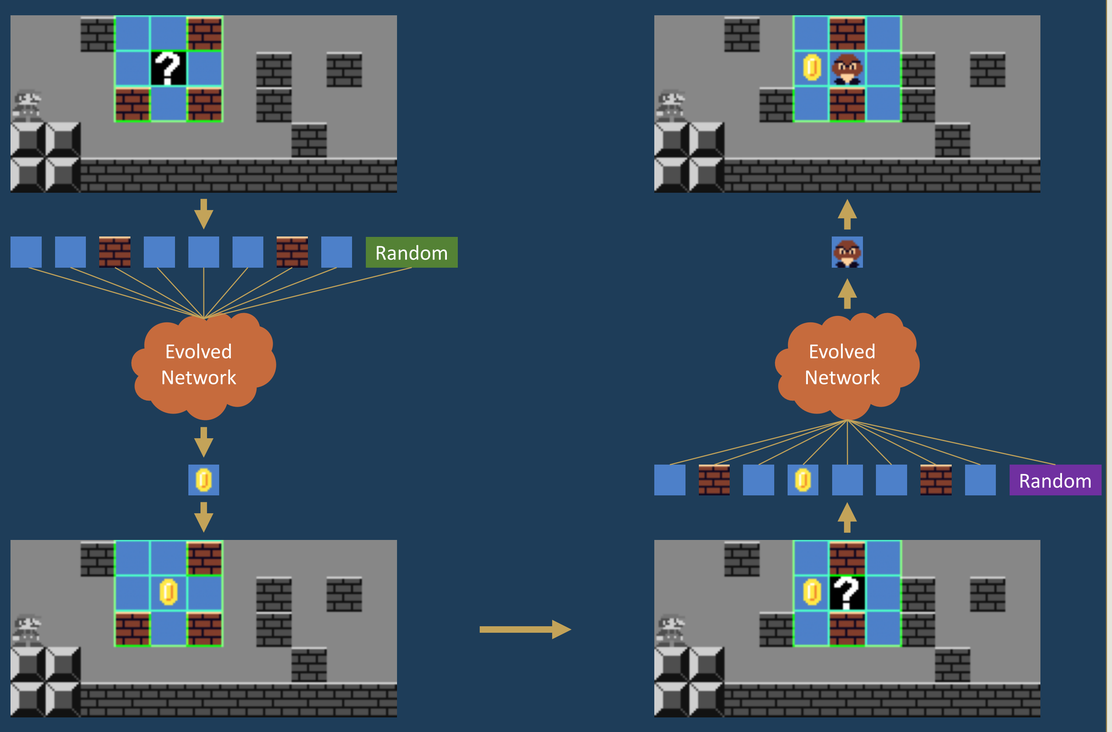
- Slow [1, 2]
- Need Data [3]
- Domain Specific Reward Engineering [4]

Method - Solutions

Learn a **Neural Network**	⟶	**Fast generation (inference)**
Evolve it using a **Genetic Algorithm** (NEAT)	⟶	**No data requirements**
Fitness functions – **solvability** & **novelty**	⟶	**Domain independent**
Novelty: Reward **Diversity**	⟶	**Exploration + diverse levels**

Generation

Generate levels for 2D tilemaps using a Neural Network



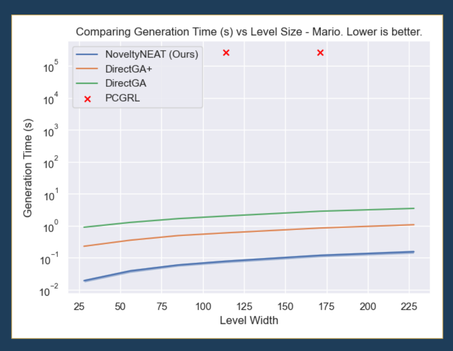
Performed sequentially for all tiles **using previous predictions as input + random perturbations**

Results

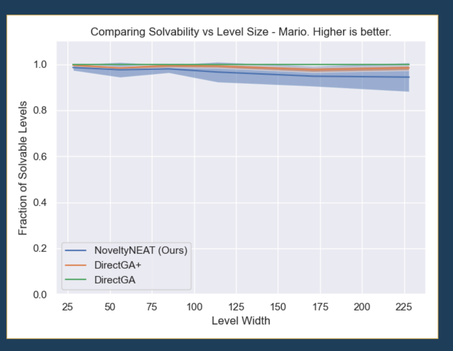
Fast, Comparable, Generalisable

Generates arbitrary sized levels with no retraining

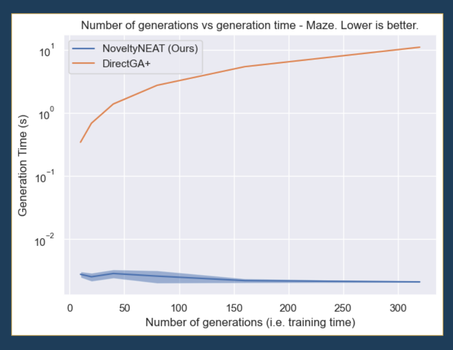
Fast



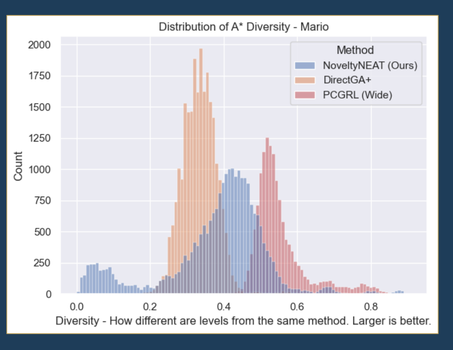
Mostly Solvable



More training: same generation time



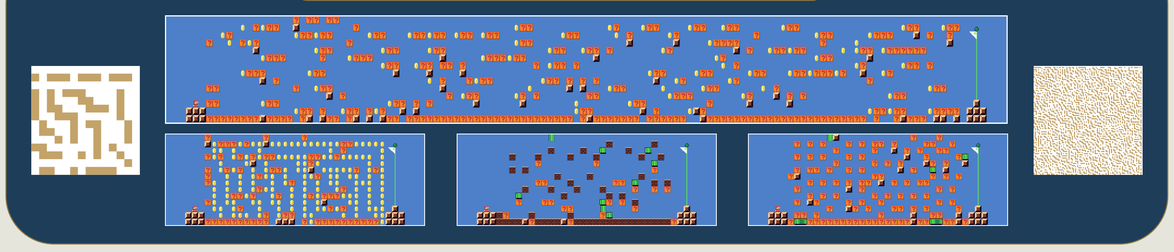
Comparable to Baselines



References

[1] Preuss, Mike, Antonios Liapis, and Julian Togelius. "Searching for good and diverse game levels." *2014 IEEE Conference on Computational Intelligence and Games*. IEEE, 2014.
[2] Liapis, Antonios, Georgios N. Yannakakis, and Julian Togelius. "Constrained novelty search: A study on game content generation." *Evolutionary computation* 23.1 (2015): 101-129.
[3] Schrum, Jacob, Vanessa Volz, and Sebastian Risi. ”CPPN2GAN: Combining compositional pattern producing networks and gans for large-scale pattern generation." *Proceedings of the 2020 Genetic and Evolutionary Computation Conference*. 2020.
[4] Khalifa, Ahmed, et al. "PCGRL: Procedural content generation via reinforcement learning." *Proceedings of the AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment*. Vol. 16. No. 1. 2020.

Levels



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Paper

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Code + Demo