Genetic Algorithms for Inductive Program Synthesis

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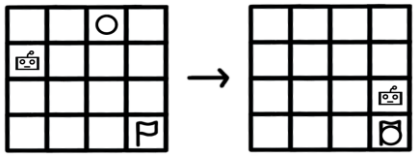
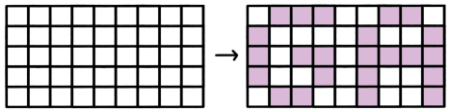
1. Background

Inductive Program Synthesis

Robot Domain



ASCII Art Domain



String Domain

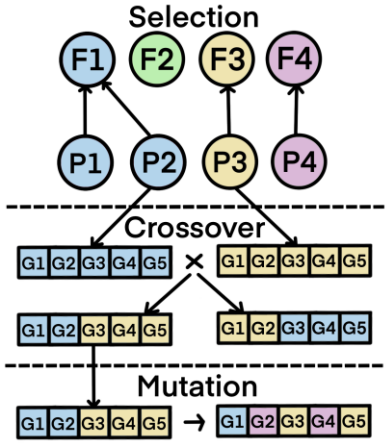
"Genetic Algorithm" → "GA"

Brute

- Best-first search
- Stuck in local optima

VanillaGP

- Genetic Algorithm



- Created to circumvent local optima
- Outperforms Brute on 1/3 domains

2. Research question

Are there **alternatives** for the **components** of VanillaGP that will allow it to solve a higher percentage of tasks within the given domains during the same time frame?

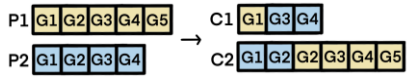
3. VanillaGP Implementations

Selection:

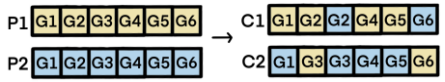
Stochastic Universal Sampling (SUS)

Crossover:

One-Point Crossover

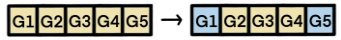


N-Point Crossover

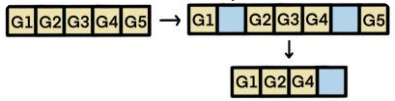


Mutation:

Classical Mutation



Uniform Mutation by Addition and Deletion



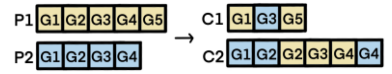
4. Selection

Roulette Wheel Selection

Lexicase
Down-Sampled Lexicase (DSLS)
Combined Lexicase
Tournament
Truncation

5. Crossover

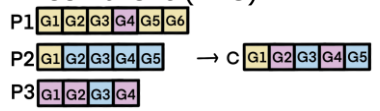
Two-Point



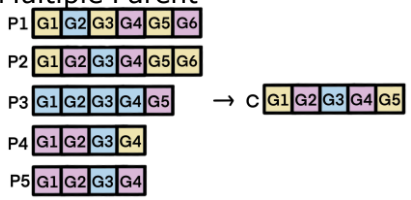
Uniform

Queen Bee

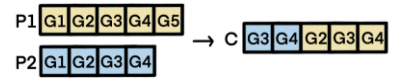
Three Parent (TPC)



Multiple Parent

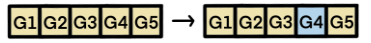


Random

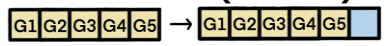


6. Mutation

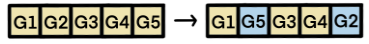
One Mutation Per Solution (OMPS)



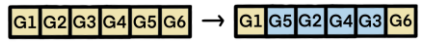
Altered OMPS (AOMPS)



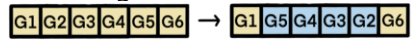
Interchanging Mutation



Scramble Mutation



Reversing Mutation

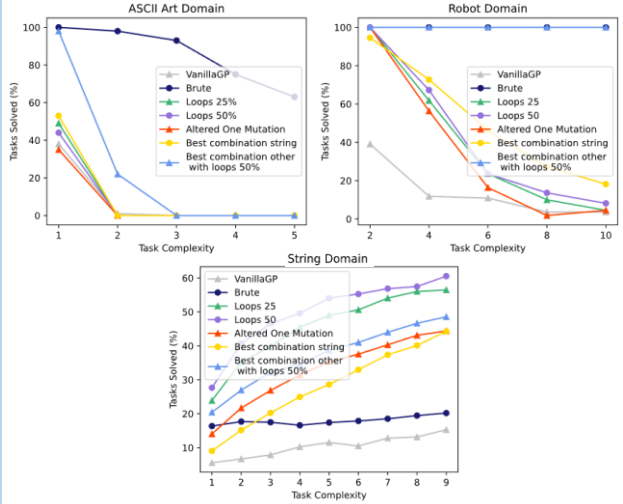


7. Combinations

Many combinations, most did not perform significantly better

- Main limitation is lack of loops in programs

One more alternative, AOMPS with more loops



- Performs much better
- DSLS, TPC, Loops AOMPS
  - Robot domain
  - ASCII Art domain
- SUS, One-Point, Loops AOMPS
  - String domain

8. Conclusions

Answer to research question: Yes

Best performance on domains:

- Robot: 100%
- ASCII Art: 24%
- String: 50%

Biggest limitations on performance:

- Max Iterations
- Time-out
- Lack of Loops