

Project 3 - Santa Fe Trail

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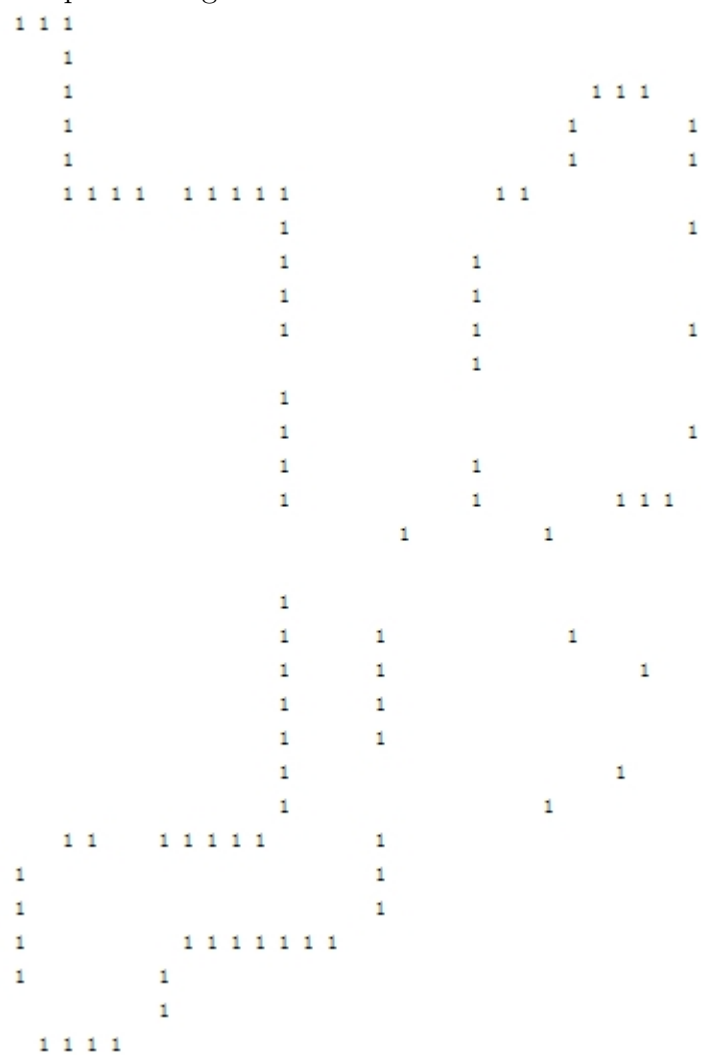
1 Abstract

For this project, I wrote a Genetic Programming to solve the Santa Fe Trail problem. My GP will generate several population of ants and do steady state GP to help ants find the best steps to find all foods.

And here's the basic information for my project.

Algorithm	Steady-state
Generation size	10
Population size	100
Selection method	Tournament (5 million times)
Crossover method	Swap two random subtrees in two parents (Max depth of 8)
Crossover rate	90% Non-terminal, 10% Terminal
Mutation method	Change the type of one random subnode re-generate that subnode based on the type
Operator/non-terminal set	prog2, prog3, iffoodahead
Terminal set	left, move, right
Fitness function	$fitness = Food_collected / Total_food$
Size control (if any)	Maximum 600 Steps, Maximum 8 depth of the tree

Graph showing the initial board.



Graph showing best evolved movement before program got trouble on size controlling (“A” move up, “>” move right, “V” move down, and “<” move left).

- Best of the ten generations:

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5000000
Best: 1.0000
Food Collected: 89
Terms: 457
Total move: 362
> > > A A      A >
      V A >      A
A > > > A      A > >
>      V A      < A
< A      V A      V >
< < V < < A > < < < < A
      < V      A
      < < A      A
      A >      A
      A      A
      A      A
      A      A
      A      A
      < < V
      A > >      V >
      < < < < A
      < < < < A
      V > < A      A >
      A A      < < A      V
      < < < < A A A      V >
      A > >      V > > A      V
      A      A      < < < A < V < < A
      A > >      A      < < < V      A
      A      A > A > >      V      A >
      < A A > >      < V > < A      V      A
      A > V > > A > > >      A      V      A
      < A      V >      < V      A      V > > >
      A V >      < A > < V      A
      < < A < A < < A >      V      A
      V > < < A V      A      < V      A >
      < < V      A A      < A A > > > > >
      V > > > > A      A < A
      A A >      < A
      < < A > < A      A
      < A A > >      < A

```

2 Discussion

2.1 Ant's generating

I created my ants by ramped half and half, to make sure the ants will have enough steps to move.

2.2 Mutation and Crossover

The mutation method is described above. Since I have Size control of max depth of 8, the crossover method will check if the children's depth exceeds 8. If one of the children exceed and another not, ignore the bad child and replace one loser by this good child.

2.3 Size control and Maximum steps

Basically, the Ant should stop until 600 steps or collected all the food, I believe most of my ants don't this requirement. Because of the limitation on max depth, most of my ants has less than 600 terminals, which means the steps will be much less.

2.4 Best fitness so far

The graph shows that my program works well. Although the ant's path to find the food is not perfect, but it at least collected all the food within limited steps. The graph showed above is the only one best path that have all the food collected, others still have several food are not collected.

2.5 Improve of the Santa Fe Trail

The most important thing that needs to be improved is the fitness function. We could add the consideration on total steps, the less step we have, the fitness would be better.