CS 5722, Fall 2014 **Homework 13**
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1a

The equation is:

$$
\begin{aligned}
f(x) &= x + ((x + (((x + (cos(x - x) - (x - x))) * x) * x)) * x) \\
&= x + ((x + (((x + (cos(0) - 0)) * x) * x)) * x) \\
&= x + ((x + (((x + 1) * x) * x)) * x) \\
&= x + ((x + ((x^2 + x) * x)) * x) \\
&= x + ((x + x^3 + x^2) * x) \\
&= x + (x^2 + x^4 + x^3) \\
&= x^4 + x^3 + x^2 + x
\end{aligned}
$$

b

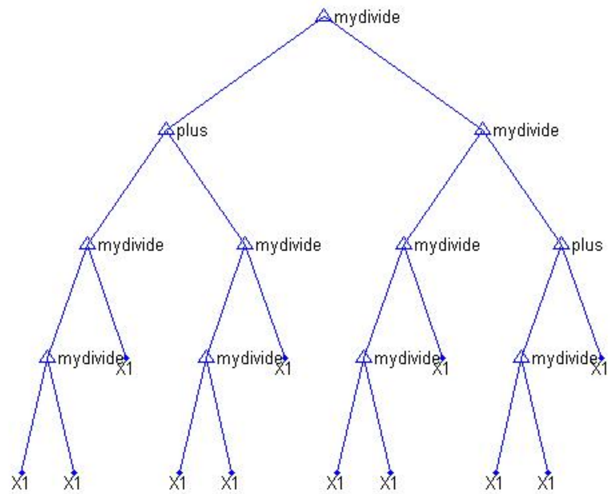
The only unnecessary term is $(-XX)$ that is subtracted from the cosine term. The subtree $(-(COS(-XX))(-XX))$ could simply be $(COS(-XX))$.

2a

Objective: $X^2/2 + 2X + 2$
Terminal Set: X Function Set: addition, subtraction, multiplication, and protected division. Parameters: Population size 1000, max generations 151

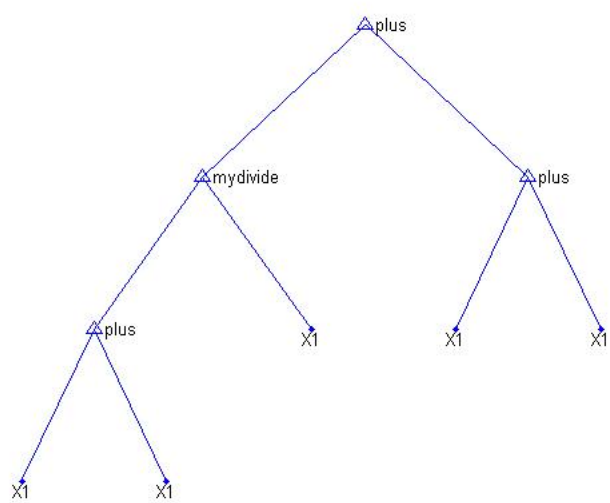
b

The best fitness at generation zero was 6.85 for a tree with 23 nodes, representing :



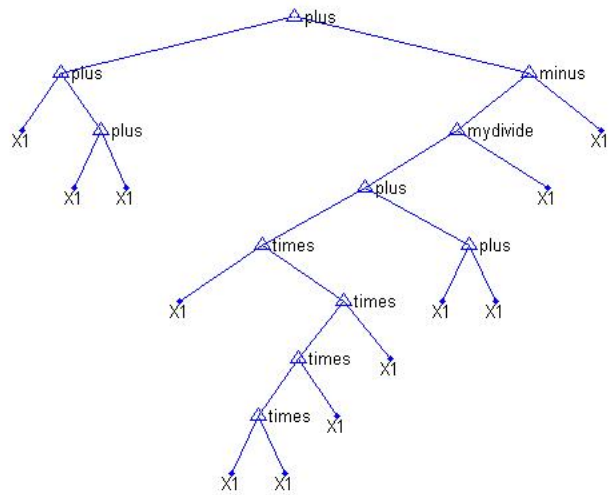
c

An intermediate solution was found at fitness 5.85 with 9 nodes, representing $2X + 2$. This solution was actually found quickly, in generation 1, and lasted for many generations as the best. It is significantly simpler than the first generation, and comes very close to approximating the real solution (has two terms correct, $2X + 2$). It is notably worse than the best solution, though, as it does not have any attempt at multiplication, which would give the remaining term:



d

The best-of-run individual had fitness 4.1462 and had 23 nodes. It represents $X^4 + 2X + 2$. This is closer to :



e

No, this was an approximation.

f

After many runs, the code continues to return to a fitness no better than 4.1462 as the best after 151 generations.

3a

The summary of the Santa Fe policy from lecture is:

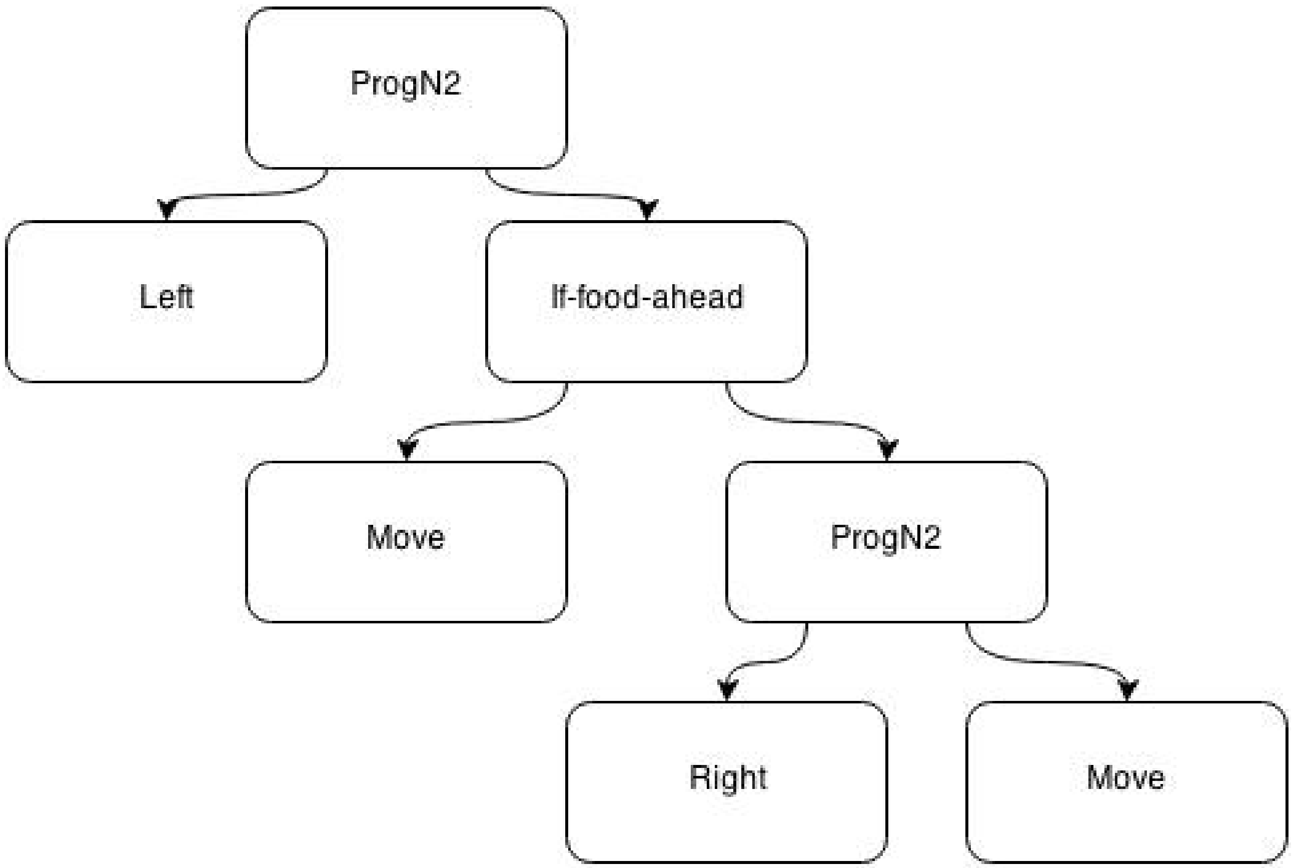
1. Move ahead if there is food
2. If no food turn left and move ahead if food
3. Otherwise turn right twice and move ahead if food
4. Otherwise turn left and move even though there is no food

This is not optimal for the Los Altos trail. The main reason is that it needs the ant to be directly next to a piece of food for it to change its direction. This does not happen at locations 116, 130, 136, and 148 on the Los Altos trail. At these locations the Santa Fe policy would cause the ant to continue moving forward, it would never turn to continue following the food path.

b

We would use the same functions and terminals for finding a solution to the Los Altos trail problem. Since the Los Altos trail has certain instances where the next food item is 2 steps away, all that is required is that the ant search within a radius of 2 squares before deciding on a direction. Thus, if there is no food reachable within one move, then the ant searches all neighboring squares 2 moves away (this can be done efficiently with breadth first search). The Los Altos policy would otherwise be indentical to the Santa Fe policy.

4



5a

1 piece of food is eaten, the one at the start. The 10 steps taken are:

[Move, Move, Move, Move, Move, Move, Move, Move, Move, Nothing]

b

3 pieces of food are eaten. The 10 steps taken are:

[Right, Left, Move, Right, Move, Move, Right, Left, Move, Right]