GENETIC PROGRAMMING TEST 1º
Applying “Sequence Distance”

ELEMENTS THAT WILL CHANGE DURING TEST:

VARIABLES
Population size
Crossover number
Mutation (Standard)
Mutate Number
Mutate Operation
Initial Depth of Trees
Length Max of Tree

TECHNIQUES
cut
slipcut
slipcutup
peal
pealup
infaro
infaroup
outfaro
outfaroup

First we will test how well our GP model performs using the same variable inputs and just changing the techniques. This way we will be able to evaluate if the performance of our algorithm varies depending on the techniques.

SETUP:
The setup for the first test is the following:

Population size	1000
Crossover number	500
Mutation (Standard)	200
Mutate Number	0
Mutate Operation	0
Initial Depth of Trees	4
Length Max of Tree	20

So from a total of 100%, 50% will be crossovered and 20% of the crossover will be mutated.

Our **objective function** will be the **distance** between the **output deck** and the **desired deck**.
As the algorithm is stochastic each test will be **run three times** to get the **average answer**.
The distance to be used is “**Sequence Distance**” (specific distance created for this problem).

1. PART: TECHNIQUE ANALYISIS:

We have to analize the performance of the algorithm depending the techniques taking into account the next conditions: **number of techniques**, **order of techniques**, and **used techniques**.

FIRST TEST: (goal: **test** the performace of **each technique separately**)
For this experiment we will change the **number of techniques** but we will NOT take into account the **order of techniques** or **used techniques**, thus, we will just use one technique at a time.

Experiment Model:
we will just use one technique at a time and we will increase the amount of that same technique, (the numbers on left of the techniques mean the number of times that we will apply that technique to the deck: 2, 4, 8, 16, 32 times).

We will analyze our output depending on two variables. **Punctuation** and **number of generation** we achieved each punctuation:

Experiment 1: cutting

cut	2	cut	4	cut	8	cut	16	cut	32

Expected output: we expect the performance will always remain equal because no matter how many times you cut the deck, the deck order is never altered, just displaced from its original position.

Experiment 2: slipcutting

slipcut	2	slipcut	4	slipcut	8	slipcut	16	slipcut	32

Expected output: taking into account that our model analizes sequences, a slipcut is just displacing one card to a random place (like an insert on an array), thus, our model may possibly not work very well. We also expect that while increasing number of times we apply a technique, the model will have more difficulty finding a proper solution.

Experiment 3: slipcutup-ing

slipcutup	2	slipcutup	4	slipcutup	8	slipcutup	16	slipcutup	32

Expected output: we expect same output as slipcut because its the same principle but with the deck facing up.

Experiment 4: pealing

peal	2	peal	4	peal	8	peal	16	peal	32

Expected output: our model is keen on finding sequences so it is supposed to work better than slipcutting, however, if we increase the amount of times we apply pealings the model may have more difficulty finding a proper solution.

Experiment 5: pealup-ing

pealup	2	pealup	4	pealup	8	pealup	16	pealup	32

Expected output: we expect same output as pealing because its the same principle but with the deck facing up.

Experiment 6: infaro-ing

infaro	2	infaro	4	infaro	8	infaro	16	infaro	32

Expected output: again, our model is keen on finding sequences so it is supposed to work better than slipcutting and in a similar way to pealing, also, if we increase the amount of times we apply infaros the model may have more difficulty finding a proper solution.

Experiment 7: infaroup-ing

infaroup	2	infaroup	4	infaroup	8	infaroup	16	infaroup	32

Expected output: we expect same output as infaro-ing because its the same principle but with the deck facing up.

Experiment 8: outfaro-ing

outfaro	2	outfaro	4	outfaro	8	outfaro	16	outfaro	32

Expected output: we expect same output as infaro-ing because its the same principle but with the first packet above the left packet.

Experiment 9: outfaroup-ing

outfaroup	2	outfaroup	4	outfaroup	8	outfaroup	16	outfaroup	32

Expected output: we expect same output as outfaro-ing because its the same principle but with the deck facing up.

Conclusion of outputs: on **insertion** (infaro, outfaro, infaroup and outfaroup)and **inversion** (peal and pealup) techniques we expect a **good performance** as our model is proper for analyzing sequences and each time we **increase number of techniques** will probably get **harder**., on **cutting** we expect **always** the same **good performance** as explained before, on **insertion** (slipcut and slipcutup) techniques we expect probably a **bad performance** and while increasing how many times we apply a technique we expect **performance** to **get worse**.

SECOND TEST: (goal: test performance of combined techniques separately (**used techniques**)) The goal of the second test is to analyze the performance mixing different techniques at pairs. As we have 9 techniques (infaro, infaroup, outfaro, outfaroup, slipcut, slipcutup, peal, pealup, cut) that would mean testing 9^2 combinations (technically speaking (9^2)-9 as reapeated combinations have already been tested) which means testing around 81 combinations. Instead we are going to make group of similar techniques as the performace may be the same:

INTERCALATION TECHNIQUES:
-infaro
-infaroup
-outfaro
-outfaroup

INSERTION TECHNIQUES:
-slipcut
-slipcutup

INVERSION TECHNIQUES:
-peal
-pealup

CUTTING TECHNIQUES:
-cut

Now instead of having 9 techniques we have grouped them into 4 groups => (4^2)-4=12 combinations:

INTERCALATION	INSERTION
INTERCALATION	INVERSION
INTERCALATION	CUTTING
INSERTION	INTERCALATION
INSERTION	INVERSION
INSERTION	CUTTING
INVERSION	INTERCALATION
INVERSION	INSERTION
INVERSION	CUTTING
CUTTING	INTERCALATION
CUTTING	INSERTION
CUTTING	INVERSION

Note: we have assumed that techniques from the same group will have the same performance, for being sure we can also make an extra test to confirm that later.

Note: for intercalation we will use: infaro; for inversion we will use peal; for insertion we will use: slipcut; for cutting we will use: cut;

Experiment Model:

Based on our expected conclusions extracted from the previous experiment we will now assume the following:
-our model is good with intercalation but will get harder with number of techniques.
-our model is good with pealing but will get harder with number of techniques.
-our model is good with cutting as it only displaces the deck no matter nomber of techniques.
-our model is not that good with insertion and will also get harder with number of techniques.

Experiment 1: INTERCALATION - INSERTION

INTER	2	INTER	4	INTER	8	INTER	16	INTER	32
INSER		INSER		INSER		INSER		INSER	

Expected output: in between the bad performance of insertion and the good performance of intercalation.

Experiment 2: INTERCALATION - INVERSION

INTER	2	INTER	4	INTER	8	INTER	16	INTER	32
INVER		INVER		INVER		INVER		INVER	

Expected output: same performance as only insertion or only intercalation.

Experiment 3: INTERCALATION - CUTTING

INTER	2	INTER	4	INTER	8	INTER	16	INTER	32
CUT		CUT		CUT		CUT		CUT	

Expected output: we dont know.

Experiment 4: INSERTION - INTERCALATION

INSER	2	INSER	4	INSER	8	INSER	16	INSER	32
INTER		INTER		INTER		INTER		INTER	

Expected output: in between the bad performance of insertion and the good performance of intercalation.

Experiment 5: INSERTION - INVERSION

INSER	2	INSER	4	INSER	8	INSER	16	INSER	32
INVER		INVER		INVER		INVER		INVER	

Expected output: in between the bad performance of insertion and the good performance of intercalation.

Experiment 6: INSERTION - CUTTING

INSER	2	INSER	4	INSER	8	INSER	16	INSER	32
CUT		CUT		CUT		CUT		CUT	

Expected output:
we dont know.

Experiment 7: INVERSION - INTERCALATION

INVER	2	INVER	4	INVER	8	INVER	16	INVER	32
INTER		INTER		INTER		INTER		INTER	

Expected output: same performance as only insertion or only intercalation.

Experiment 8: INVERSION - INSERTION

INVER	2	INVER	4	INVER	8	INVER	16	INVER	32
INSER		INSER		INSER		INSER		INSER	

Expected output:

Experiment 9: INVERSION - CUTTING

INVER	2	INVER	4	INVER	8	INVER	16	INVER	32
CUT		CUT		CUT		CUT		CUT	

Expected output:
we dont know.

Experiment 10: CUTTING - INTERCALATION

CUT	2	CUT	4	CUT	8	CUT	16	CUT	32
INTER		INTER		INTER		INTER		INTER	

Expected output: we dont know.

Experiment 11: CUTTING - INSERTION

CUT	2	CUT	4	CUT	8	CUT	16	CUT	32
INSER		INSER		INSER		INSER		INSER	

Expected output: we dont know.

Experiment 12: CUTTING - INVERSION

CUT	2	CUT	4	CUT	8	CUT	16	CUT	32
INVER		INVER		INVER		INVER		INVER	

Expected output: we dont know.

Conclusion of outputs: supposedly inversion and intercalation have similar performance, so, if we combine both we should get that inverting N times or intercalating N times will have the same effect as combining both techniques N times. (example: 32 inversions or 32 intercalations should get same performance as 32 inversions and intercalations (16 inversions + 16 intercalations)).

So supposedly inversions and intercalations will be in the same performace type.

Then we have insertion, we expect its performace to be bad and later on even worse, so, if we mix it with inversion or intercalation (which performance may be good and worsen with time) we will have something like between the bad performance of insertion and the good performance of inversions and intercalations.

So supposedly mixing inversions or intercalations with insertions will be better than just insetions but worse than intercalations or inversions.

Finally, we have the cutting, we dont know how the cutting will affect the other two groups (insertions – inversions and intercalations).

2. PART: GP EVOLUTION ANALYSIS:

FIRST TEST:
AFTER FINISHING 1.st PART.