

Material and Manufacturing Processes

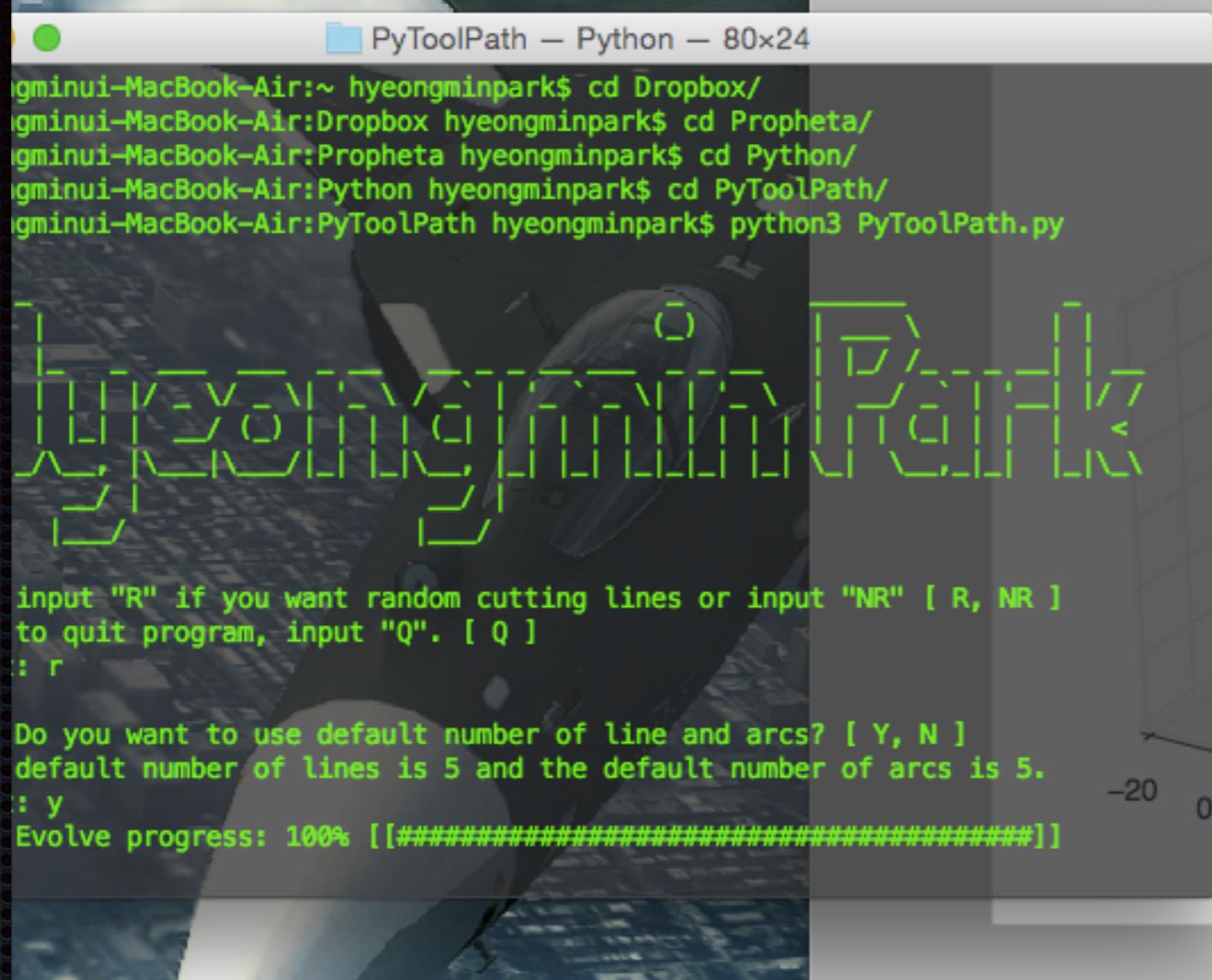
Term Project -

Tool path optimization program PyToolPath
with using order crossover genetic algorithm

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PyToolPath — Python — 80x24

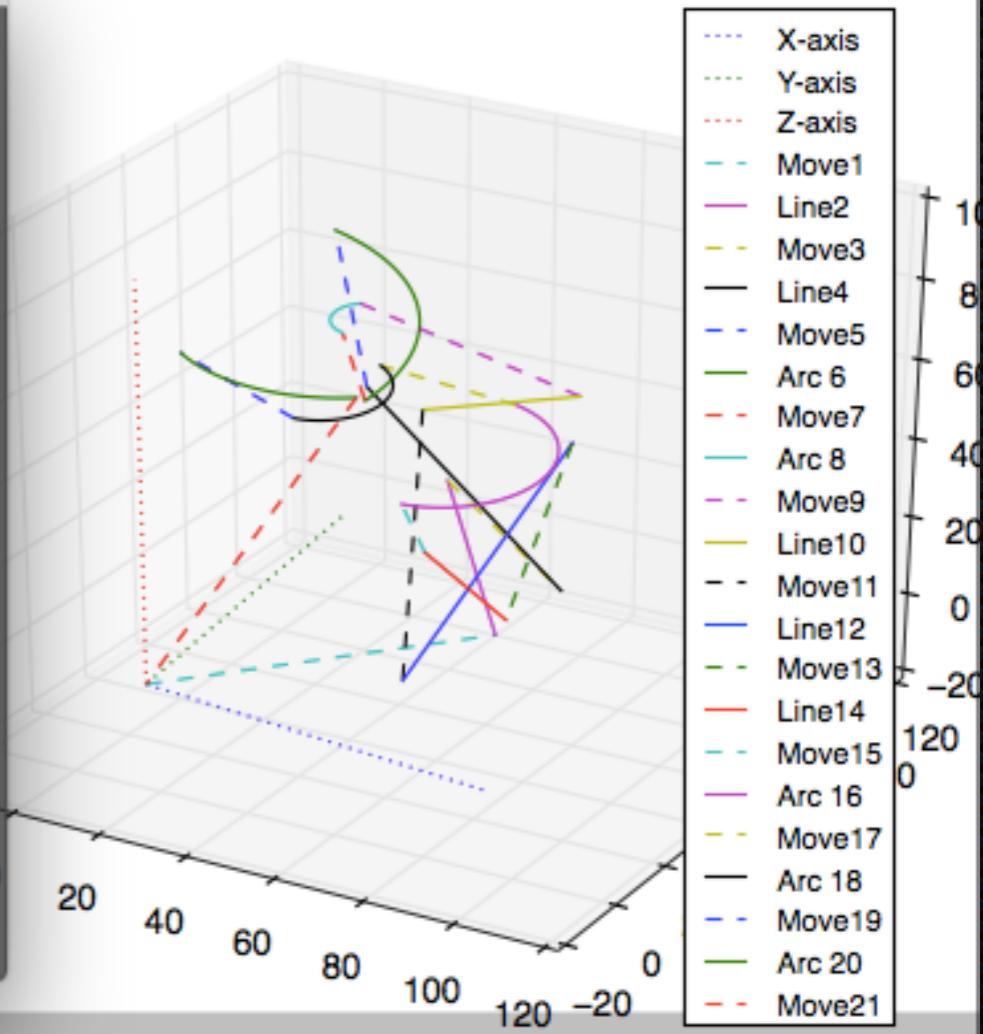
```
gminui-MacBook-Air:~ hyeongminpark$ cd Dropbox/  
gminui-MacBook-Air:Dropbox hyeongminpark$ cd Propheta/  
gminui-MacBook-Air:Propheta hyeongminpark$ cd Python/  
gminui-MacBook-Air:Python hyeongminpark$ cd PyToolPath/  
gminui-MacBook-Air:PyToolPath hyeongminpark$ python3 PyToolPath.py
```



The plot shows a 3D coordinate system with axes X, Y, and Z. The path consists of numerous segments, some solid and some dashed, representing different moves or components of the toolpath. The segments vary in color and thickness, and some are labeled with identifiers such as Move1, Line2, Move3, etc., from the legend.

input "R" if you want random cutting lines or input "NR" [R, NR]
to quit program, input "Q". [Q]
: r

Do you want to use default number of line and arcs? [Y, N]
default number of lines is 5 and the default number of arcs is 5.
: y
Evolve progress: 100% [#####]

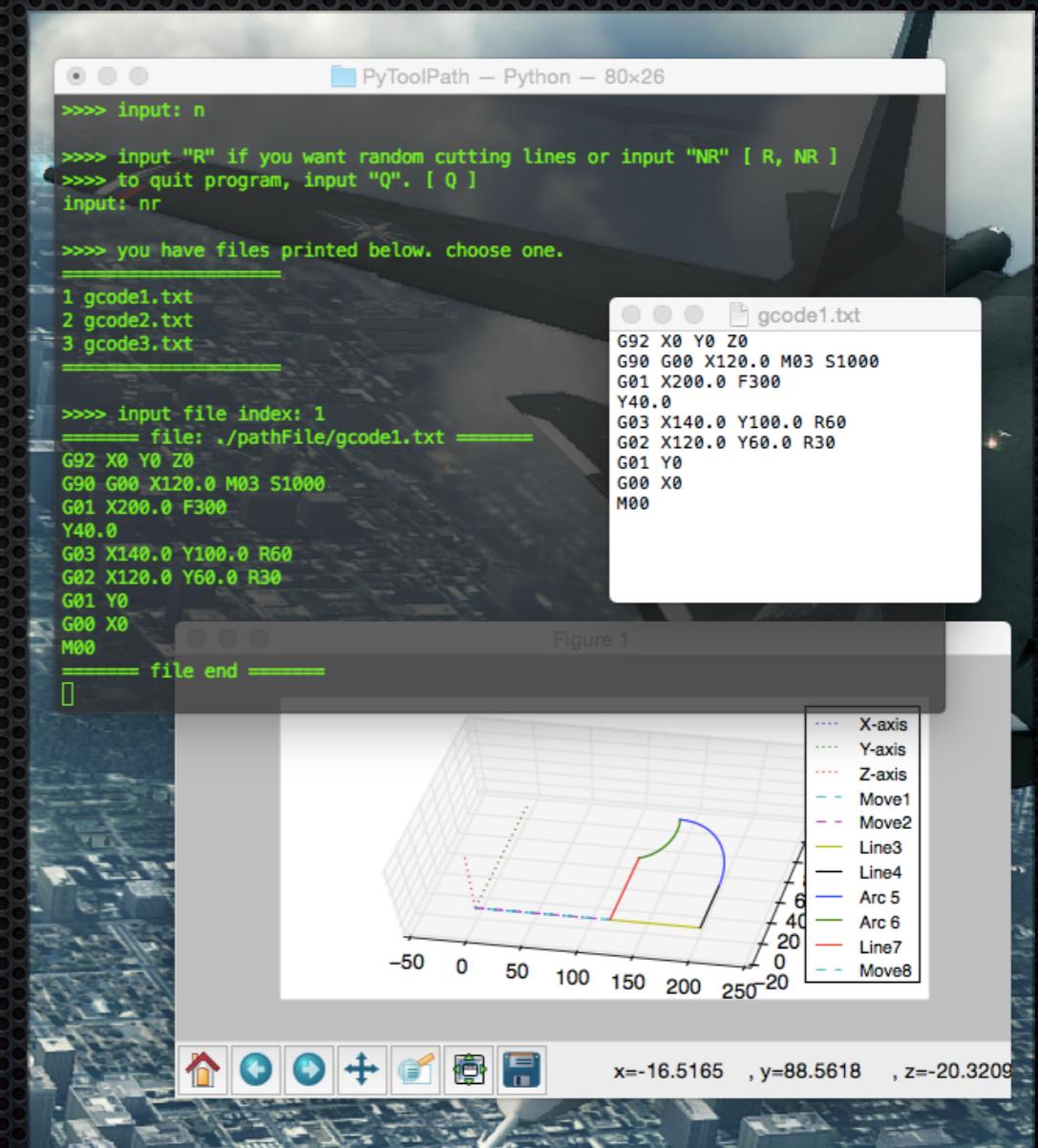


PyToolPath?

Graphical implementation through text file I/O
and path optimization through genetic algorithm

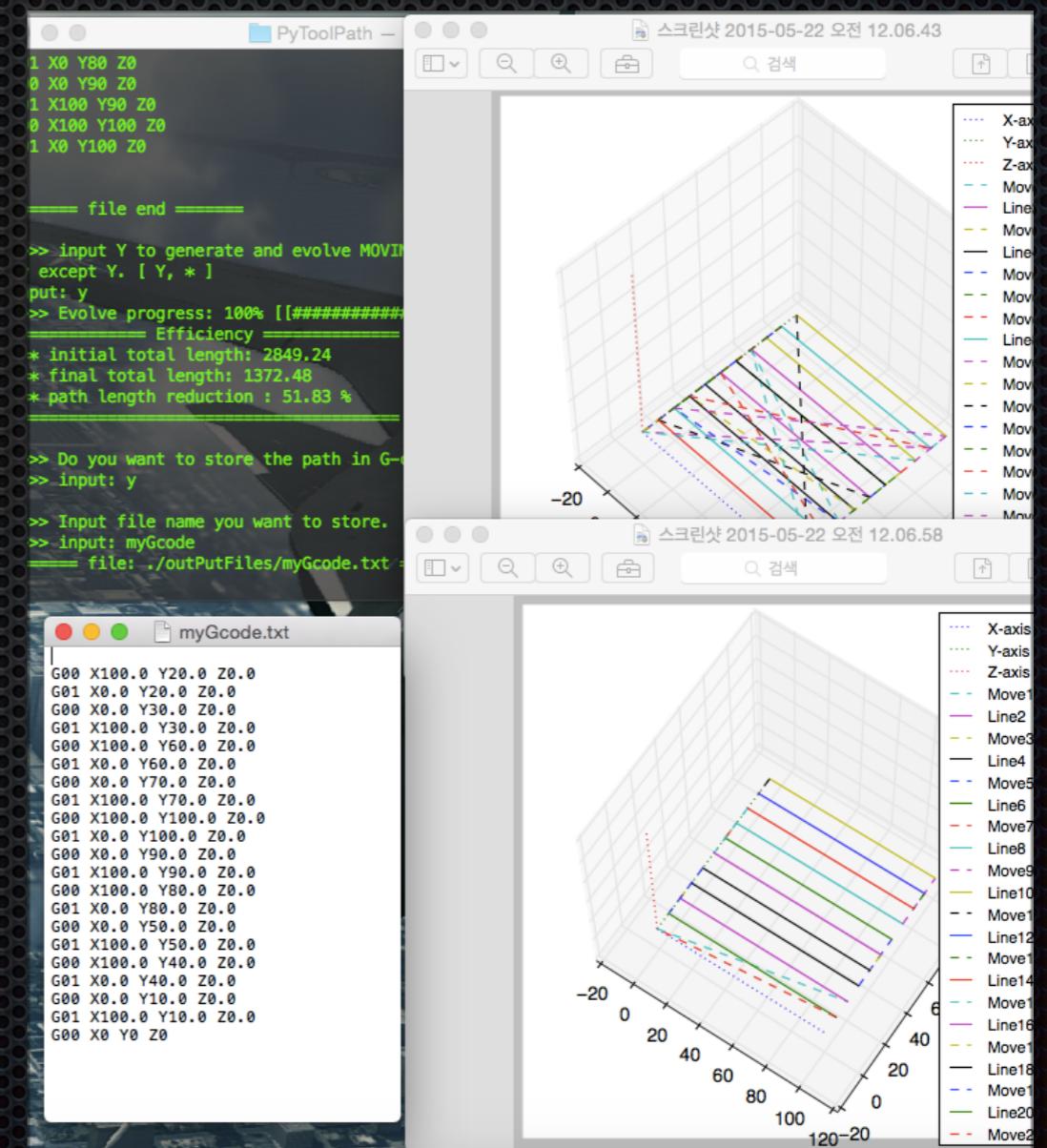
Features _1.

- Put G-code text files in specific directory, then it will be displayed in choice list.
- Select a G-code, then it will be converted as coordinate information and displayed with matplotlib



Features _2.

- Program optimizes tool path (G00 part of G-code) with crossover genetic algorithm.
- Print out the result of optimization (result graphic view and optimized length ratio) and save the new coordinate information as text file, with the form of G-code.



Features _3.

- Generate random cutting tool path and do apply / measure the performance of genetic algorithm.
- Graphical performance or detailed settings can be adjusted in constants.py

```
>>> input "R" if you want random cutting lines or input "NR" [ R, NR ]
>>> to quit program, input "Q". [ Q ]
input: r

>>> Do you want to use default number of line and arcs? [ Y, N ]
the default number of lines is 5 and the default number of arcs is 5.
input: y
>>> Evolve progress: 100% [[#####
===== Efficiency =====
*** initial total length: 1426.58
*** final total length: 1259.3
*** path length reduction : 11.73 %
=====

>>> Do you want to store the path in G-code? [ Y, N ]
>>> input: n

>>> input "R" if you want random cutting lines or input "NR" [ R, NR ]
>>> to quit program, input "Q". [ Q ]
input: r
>>> Do you want to use default number of line and arcs? [ Y, N ]
the default number of lines is 5 and the default number of arcs is 5.
input: y
>>> Evolve progress: 77% [[#####]]
```

```

# -*- coding: utf-8 -*-
__author__ = 'hyeongminpark'
""" Written by -

Date : May 21 2015
"""

#####
# 상수 설정
#####

#
### 그래픽 관련 설정
#


# 랜덤 툴패스 갯수 기본설정
CUTTING_LINE_COUNT = 5
CUTTING_ARC_COUNT = 5

# 원호보간 나누는 해상도
ARC_RESOLUTION = 100

# 랜덤 툴패스 크기
MAX_LENGTH = 100
MAX_ARC = 50

#
### 지네티 알고리즘 관련 설정
#

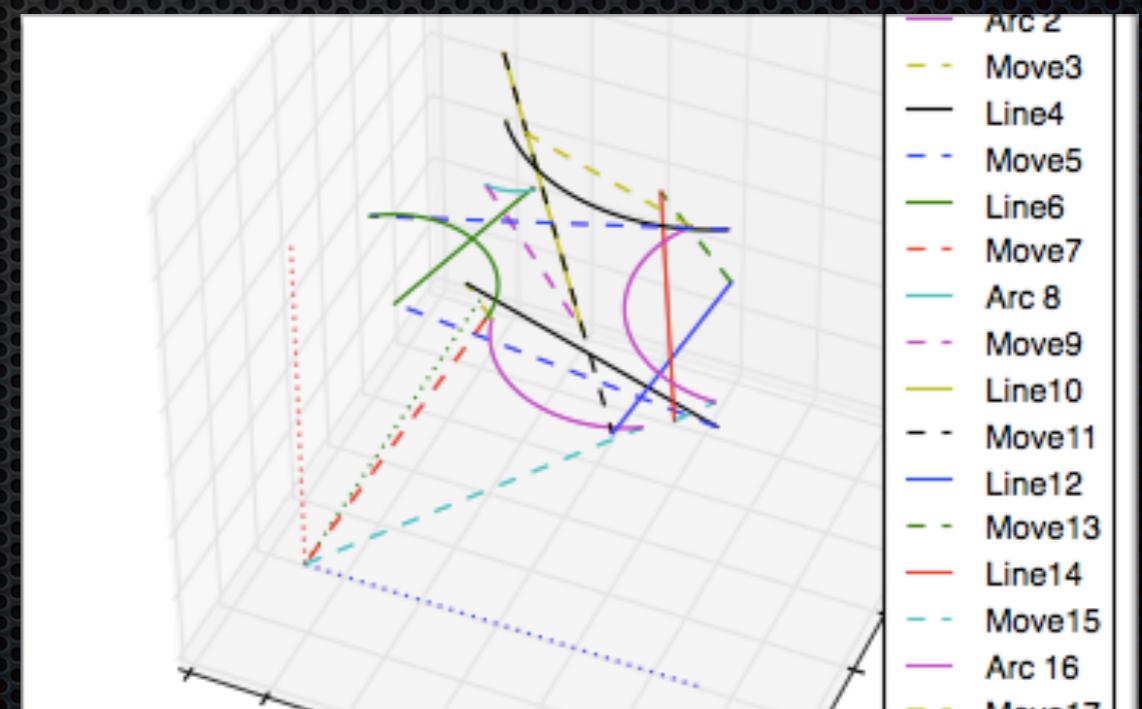
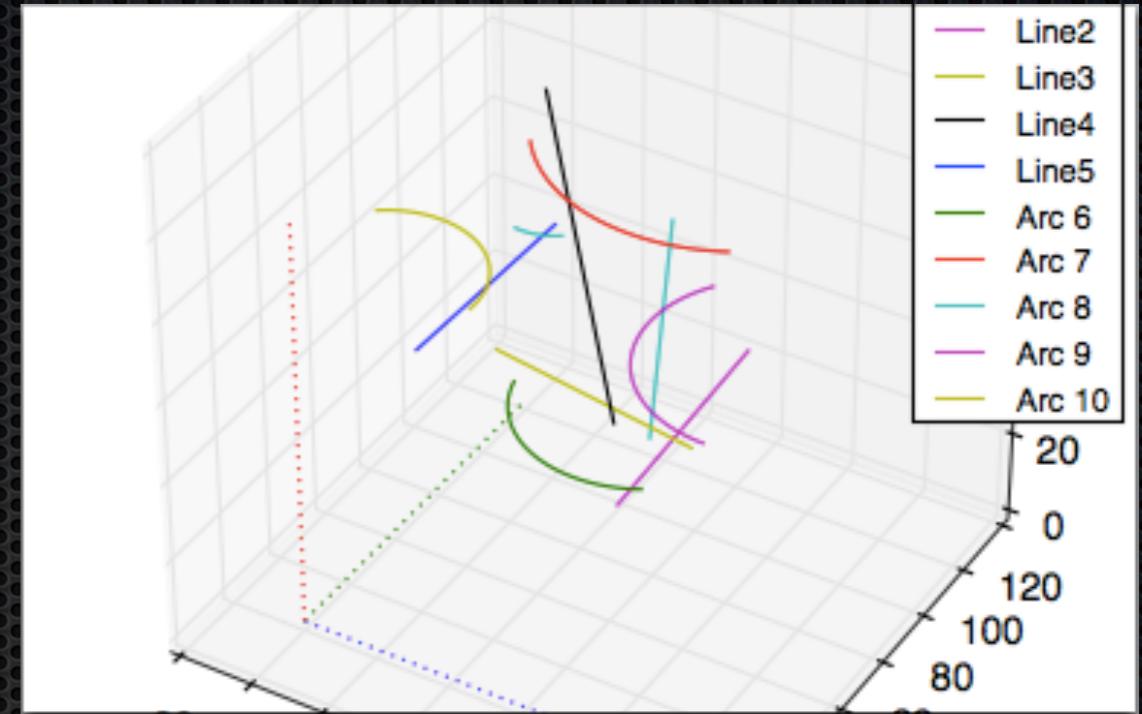

# 최초 유전자 폴 크기
POPULATION = 10

# 한 Generation 에서 부모세대의 생식 횟수( 한번의 생식에서 2개 자녀 생성)
BIRTHRATE = 10

# Generation 횟수
GENERATION = 2000

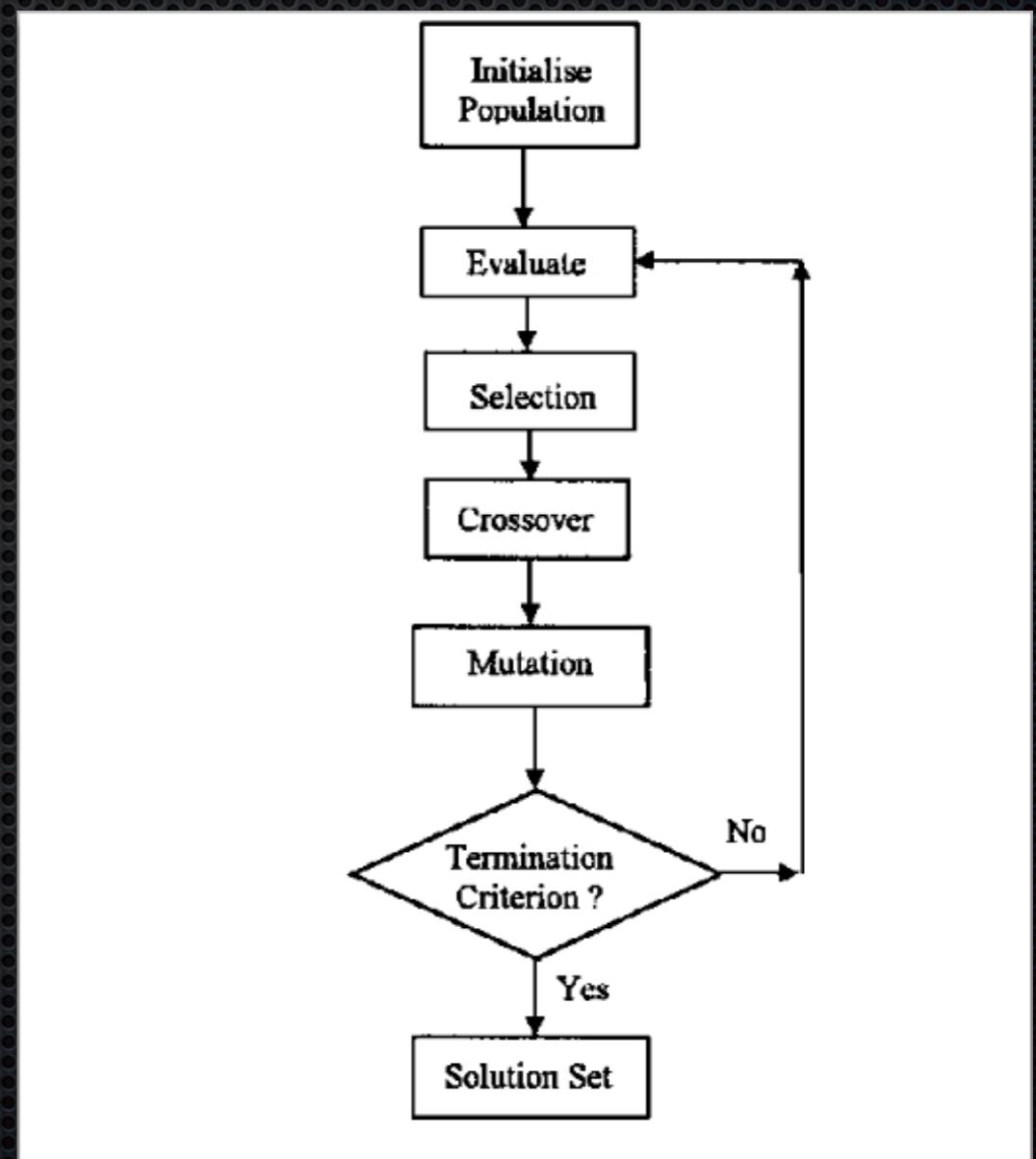
# 돌연변이 확률
MUTATION = 0.1

```



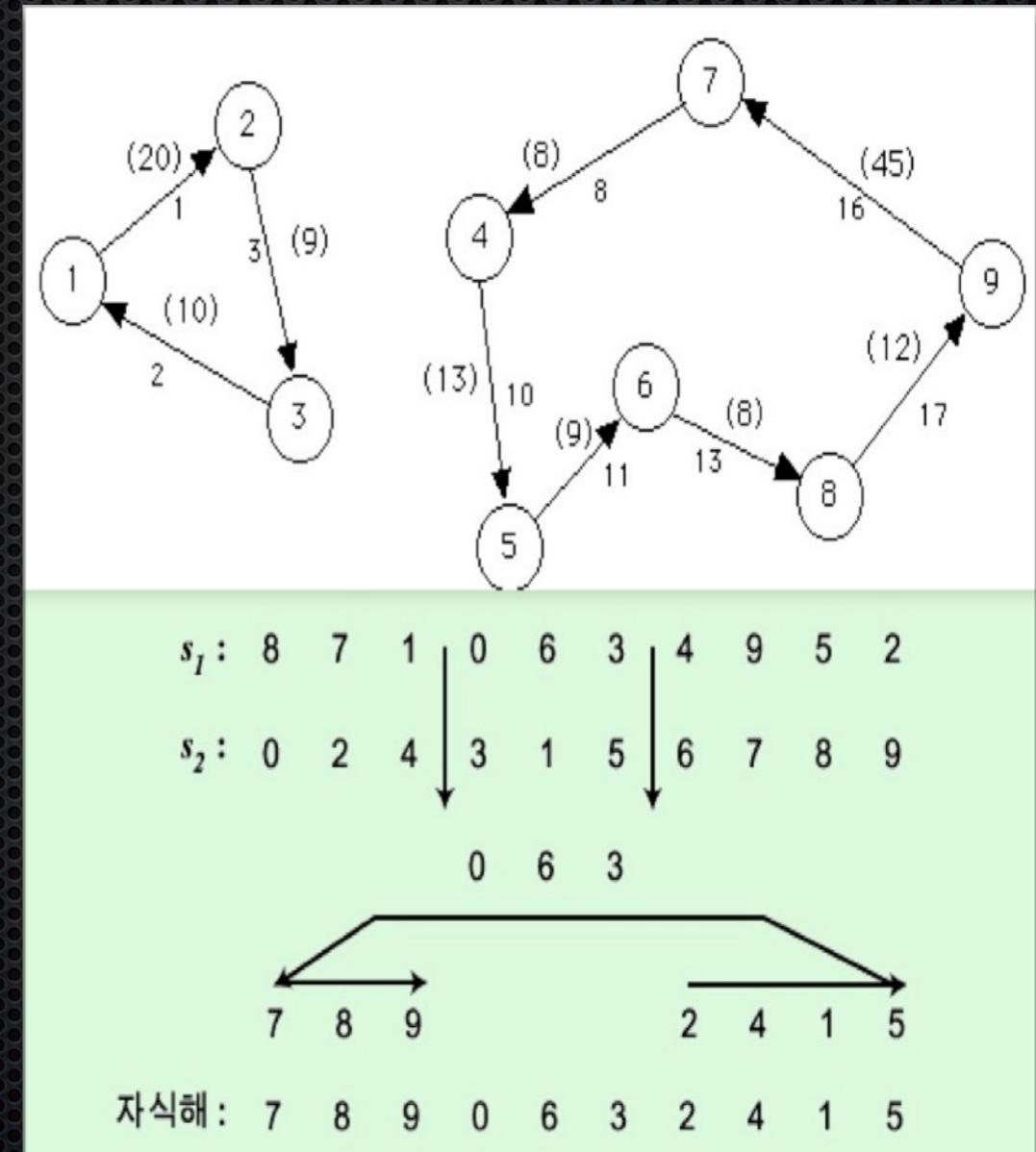
HowTo_1 (genetic algorithm).

- Assumed the problem as the one of Traveling Salesman Problem and applied genetic algorithm to get the better solution.
- Individuals in every generation will be evaluated by the fitness on environment quantitatively. And the survivors became new parents.



HowTo_2 (genetic algorithm).

- Parents data(cutting tool path) of every generations is considered as gene. The data crossover performed for genetic diversity. And sometimes, a mutation occurs. And they became children.
- To avoid “Impossible solution” problem which often occurs in traveling salesman problem, Order Crossover has been used for this project.



HowTo_3 (3d graphic).

- With G-code provided as text file, Convert coordinate path and attributes of tool path as Python list.
- Python based scientific package Numpy and it's graphical extension matplotlib used for graphical representation.

Line plots

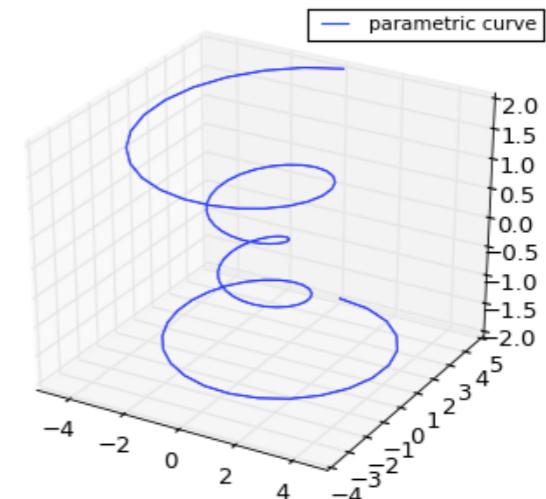
Axes3D.plot(xs, ys, *args, **kwargs)

Plot 2D or 3D data.

Argument	Description
xs, ys	X, y coordinates of vertices
zs	z value(s), either one for all points or one for each point.
zdir	Which direction to use as z ('x', 'y' or 'z') when plotting a 2D set.

Other arguments are passed on to [plot\(\)](#)

([Source code](#), [png](#), [hires.png](#), [pdf](#))



Scatter plots

Thank you.

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