Defferential Evolution (eralize rosenbrock)

```
import numpy as np
import random
from array import *
import matplotlib.pyplot as plt
import statistics as st
import math
```

```
D = 10 # Dimensi dari permasalahan
maxit = 99 #Max iterasi
#maxit = 495 #Max iterasi
ukuranPopulasi = 10
LB = -30 #Batas Bawah
UB = 30 #Batas Atas
CR = 0.9
F = 0.5
```

```
import random
def initPopulasi(ukuranPopulasi, D, UB, LB): #Inisialisasi setiap baris kolom
    P = np.empty((ukuranPopulasi,D))
    for i in range(ukuranPopulasi):
        for j in range(D):
            P[i][j]= (random.random()*(UB-LB))+LB
    return P

P = initPopulasi(ukuranPopulasi, D, UB, LB)
print(P)
```

```
[[ -4.31989349  -6.02052172 -29.5944793  -16.05092933  17.32842641
   27.09911361  19.61629467  15.80666967  -1.44566903 -15.57844307]
 [-19.66339459  21.15936886  15.88259604 -15.84049668 -11.50072269
   -6.32702278  25.97403914  -7.66430191  20.79945561   5.19040482]
 [ -4.4608596  -24.99790406  27.86278004  12.16987262 -22.31485918
    9.62225434  20.0708507  -11.07587077  20.36860179  -9.18549819]
 [-26.09522786  16.28695527  -1.27574002  16.70712843 -28.08497075
  -28.99156568  12.68388522   4.38982582  19.16753501   7.94150965]
 [ 26.14859167 -11.94087323  27.51315127   3.42793625 -25.35915512
   21.43179972  14.28349115   3.73670237  14.40532017 -19.34638537]
 [ -2.05596653  -6.35502848  12.41003877 -23.75985261  22.009279
   -7.22870203  15.48147474 -13.0578926   -0.1819396   -6.7545737 ]
 [ -6.6042105    3.03539158  -1.25727846   2.68786527 -10.90488097
  -25.6389763    6.11014714  16.92081144  -0.94923841  -8.1950749 ]
 [ 19.13849986 -11.07323146  27.64585637  -7.27243905  19.2814311
    6.80544275  25.74049504  22.41729553 -28.04585842 -26.84749239]
 [-12.46969618  13.48106911 -24.08536713  19.27557991 -25.67674258
  -17.30789429 -20.2444812   13.84886958 -14.4622641  -20.69932867]
 [ 26.1300471   -9.62219131 -17.85807845 -11.32324955 -11.91313974
   -3.69262528  18.52933747 -16.20897858 -23.83022307  -1.300887  ]]
```

```
def Fitness_Func(populasi):
    ukuran = populasi.shape
    ukuranPopulasi = ukuran[0]
    dimensi = ukuran[1]

    Fobj = np.empty(ukuranPopulasi)

    for i in range (ukuranPopulasi):
        d = 0
        for j in range (dimensi):
            #d = d + populasi[i][j]**2
            #d = d + np.sum(np.abs(populasi[i][j])) + np.product(np.abs(populasi[i][j])) #
            d = d + np.sum(100*(populasi[i][j]+1)-(populasi[i][j]))**2 + (populasi[i][j]-1
            # d =  d + np.sum( (populasi[i][j]**2) - (10*math.cos(2*math.pi*populasi[i][j]
        Fobj[i] = d
    return Fobj

Fobj = Fitness_Func(P)
print(Fobj)
```

```
[30645533.79752161 27147336.29914287 31672437.71651385 33938339.16500393
 35455031.36859612 17121019.4301655  11661807.45655456 44141965.41514488
 32530557.45484405 24119803.95882684]
```

```
def crossOver(populasi,F,j):
    ukuran = populasi.shape
    ukuranPopulasi = ukuran[0]
    Dimensi = ukuran[1]

    r1 = random.randint(0, ukuranPopulasi-1)
    r2 = random.randint(0, ukuranPopulasi-1)
    r3 = random.randint(0, ukuranPopulasi-1)

    while r1 == r2:
        r2 = (r2 + 1)%ukuranPopulasi

    while r3 == r1 or r3 == r2:
        r3 = (r3 + 1)%ukuranPopulasi

    v = P[r3][j] + F*(P[r1][j] - P[r2][j])
    return v

v = crossOver(P,F,1)
print(v)
```

```
-18.66911261762329
```

```
P = initPopulasi(ukuranPopulasi, D, UB, LB)
print("Inisialisasi Populasi :\n",P)
print(P)
```

```
    Fobj = Fitness_Func(P)
    print(Fobj)
    print("\nFungsi Objective :\n",Fobj)

    U = np.empty((1,D))
    bestFobj = np.empty((maxit+1))
    bestFobj[0] = Fobj.min()

    for it in range(maxit):
        for i in range(ukuranPopulasi):
            for j in range(D):
                U[0][j] = P[i][j]

            jrand=random.randint(0,D)

            for j in range(D):
                if random.random() < CR or j == jrand:
                    v = crossOver(P,F,j)
                    U[0][j] = v

            FobjU = Fitness_Func(U)

            if FobjU < Fobj[i]:
                Fobj[i] = FobjU
                for j in range(D):
                    P[i][j] = U[0][j]

        bestFobj[it+1] = Fobj.min()

        print("\nNilai Optimal : \n",bestFobj)

        for i in range(30):
            bestFobj
```

```
 Inisialisasi Populasi :
  [[ 2.76538672e+01 -2.41834931e+00 -2.07668918e+01  2.55738482e+01
   -1.97898906e+01  1.29980616e+01 -1.15494851e+01 -1.28038952e+01
   -2.21968268e+01 -1.23471296e+01]
  [-2.37316795e+01 -1.32519009e+01  1.32451957e+01  2.60949485e+00
   -2.11674218e+01 -2.84559232e+01 -2.11370052e+01 -6.51475397e+00
    2.47609704e+01  2.30640972e+01]
  [-9.81943352e+00  1.44826017e+01 -6.98666575e+00  9.69643278e-01
   -5.65126867e+00 -4.35295278e-01  3.50701233e+00  4.47610438e+00
    1.97174421e+01 -2.56733030e+01]
  [-5.41109074e+00  1.98407165e+01  1.93486889e+01  2.43605721e+01
    2.53719421e+01  7.96486211e+00  1.37399935e+01 -1.01555999e+01
    2.25483196e+01  1.30189202e+01]
  [-1.50228557e+01 -2.16656642e+01  5.34191993e+00 -2.10786936e+01
    1.14136360e-02 -1.82487205e+01  5.01486390e+00 -2.75323322e+01
    7.78635199e+00 -9.14879299e+00]
  [ 1.20167600e+00  2.97671086e+01 -1.89998739e+01  1.74630847e+01
   -2.27596325e+01  2.70254223e+01  1.67691892e+01  2.66150128e+01
   -1.29934191e+00 -1.02050155e+01]
  [-1.27494808e+01 -1.71745698e+01 -1.83660737e+01  2.24157033e+01
    2.47942879e+01 -1.28663427e+01  9.10940221e-01  4.66708244e+00
   -1.09894837e+01  2.27501461e+00]
  [-2.11469027e+01  2.53214847e+01  2.53637706e+01 -2.33698006e+01
```

```
        -8.88206982e+00 -2.14927150e+01 -1.60319044e+01  1.06107812e+01
         2.93289287e+00  2.62867218e+01]
       [ 2.28759769e+01 -2.90500167e+01 -2.57077757e+01 -2.84465301e+01
        -2.22951980e+01 -2.86014267e+01 -2.14236683e+01  2.15321996e+00
        -9.15574085e+00  1.42813828e+00]
       [ 8.25334220e-01 -1.35051517e+01  1.77194771e+01  4.17057689e+00
         2.95748897e+01  1.76727050e+01 -2.06633841e+01  2.39500975e+01
        -2.13180970e+01  8.23166322e+00]]
      [[ 2.76538672e+01 -2.41834931e+00 -2.07668918e+01  2.55738482e+01
        -1.97898906e+01  1.29980616e+01 -1.15494851e+01 -1.28038952e+01
        -2.21968268e+01 -1.23471296e+01]
       [-2.37316795e+01 -1.32519009e+01  1.32451957e+01  2.60949485e+00
        -2.11674218e+01 -2.84559232e+01 -2.11370052e+01 -6.51475397e+00
         2.47609704e+01  2.30640972e+01]
       [-9.81943352e+00  1.44826017e+01 -6.98666575e+00  9.69643278e-01
        -5.65126867e+00 -4.35295278e-01  3.50701233e+00  4.47610438e+00
         1.97174421e+01 -2.56733030e+01]
       [-5.41109074e+00  1.98407165e+01  1.93486889e+01  2.43605721e+01
         2.53719421e+01  7.96486211e+00  1.37399935e+01 -1.01555999e+01
         2.25483196e+01  1.30189202e+01]
       [-1.50228557e+01 -2.16656642e+01  5.34191993e+00 -2.10786936e+01
         1.14136360e-02 -1.82487205e+01  5.01486390e+00 -2.75323322e+01
         7.78635199e+00 -9.14879299e+00]
       [ 1.20167600e+00  2.97671086e+01 -1.89998739e+01  1.74630847e+01
        -2.27596325e+01  2.70254223e+01  1.67691892e+01  2.66150128e+01
        -1.29934191e+00 -1.02050155e+01]
       [-1.27494808e+01 -1.71745698e+01 -1.83660737e+01  2.24157033e+01
         2.47942879e+01 -1.28663427e+01  9.10940221e-01  4.66708244e+00
        -1.09894837e+01  2.27501461e+00]
       [-2.11469027e+01  2.53214847e+01  2.53637706e+01 -2.33698006e+01
        -8.88206982e+00 -2.14927150e+01 -1.60319044e+01  1.06107812e+01
         2.93289287e+00  2.62867218e+01]
       [ 2.28759769e+01 -2.90500167e+01 -2.57077757e+01 -2.84465301e+01
        -2.22951980e+01 -2.86014267e+01 -2.14236683e+01  2.15321996e+00
        -9.15574085e+00  1.42813828e+00]
```

```
import statistics as st
print("Nilai Mean : ",st.mean(bestFobj))
print("Nilai Standard Deviation : ",st.stdev(bestFobj))
print("Nilai Minimal : ",np.min(bestFobj))
```

```
Nilai Mean :  2661784.5095996186
Nilai Standard Deviation :  4672830.927810584
Nilai Minimal :  1994.4194605694136
```

```
x = np.linspace(0, 1, maxit+1)
plt.plot(x, bestFobj, label= 'f=Fobj')
plt.show()
```

Genetic Algorithm

```
import numpy as np
import random
from array import *
import matplotlib.pyplot as plt
import statistics as st
import math


N = 3
rows, cols = (N, 4)
induk = [[0 for i in range(cols)] for j in range(rows)]
print (induk)

N_Anak = 6
rows, cols = (N_Anak, 4)
anak = [[0 for i in range(cols)] for j in range(rows)]
print(anak)
```

```
[[0, 0, 0, 0], [0, 0, 0, 0], [0, 0, 0, 0]]
[[0, 0, 0, 0], [0, 0, 0, 0], [0, 0, 0, 0], [0, 0, 0, 0], [0, 0, 0, 0], [0, 0, 0, 0]]
```

```
#Inisialiasi Parameter
Pc = 0.9
Pm = 0.1

for i in range(N):
    a = random.randint(0, 15)
    induk[i] = [int (x) for x in '{:04b}'.format(a)]
    print(a, induk[i])
```

```
7 [0, 1, 1, 1]
7 [0, 1, 1, 1]
8 [1, 0, 0, 0]
```

```
#Function cross over
def crossover(ind1=[], ind2=[]):
    anak1 = [0, 0, 0, 0]
    anak2 = [0, 0, 0, 0]


    anak1[0] = ind1[0]
    anak1[1] = ind1[1]
    anak1[2] = ind2[2]
    anak1[3] = ind2[3]

    anak2[0] = ind2[0]
    anak2[1] = ind2[1]
    anak2[2] = ind1[2]
    anak2[3] = ind1[3]

    return anak1, anak2


#Function  mutasi
def mutasi(ind=[]):
    ind[1] = 1 - ind[1]
    return ind



#Function hitung Int
def hitungInt(ind = []):
    a = ind[3] * 1
    a = a + ind[2] * 2
    a = a + ind[1] * 4
    a = a + ind[0] * 8
    return a



#Buat function untuk melakukan hitung fitness
def hitungFitness(ind = []):
    a = hitungInt(ind)
    #y = a**2 #sphere
    #y = np.sum(np.abs(a)) + np.product(np.abs(a)) #schwefel 2.22
    y = np.sum(100*(a+1)-(a))**2 + (a-1)**2 #Generalize rosenbrock
    # y = np.sum( (a**2) - (10*math.cos(2*math.pi*a)) + 10 ) #rastrigins

    return y


i = 1
#epochs = 495
epochs = 99
MaxFitness = [0 for i in range(epochs)]
angkaFitness = [0 for i in range(epochs)]

#nilai fitness induk
for j in range(N):
    if (hitungFitness(induk[j])>MaxFitness[0]):
          MaxFitness[0] = hitungFitness(induk[j])

  #'epochs' kali
  for i in range(30):
    while i < epochs:
      print("Iterasi: ", i+1)
      #Reproduksi
      a = random.random()
      if (a<Pc):
          #Cross over
          anak[0], anak[1] = crossover(induk[0], induk[1])
          anak[2], anak[3] = crossover(induk[0], induk[2])
          anak[4], anak[5] = crossover(induk[1], induk[2])
      else:
          #Mutasi
          for j in range(N):
              induk [j] = mutasi(induk[j])
      #Elistism
      minFitness = 30
      idx = 0
      idxanak = 0
      #minFitness (induk terburuk)
      for j in range(len(induk)):
          if (hitungFitness(induk[j])<minFitness):
              minFitness = hitungFitness(induk[j])
              idx = j

      #cari maxFit (Anak terbaik)
      maxFit = -30
      for j in range(len(anak)):
          if (hitungFitness(anak[j])>maxFit):
              maxFit = hitungFitness(anak[j])
              idxanak = j
      #Individual replacement
      if (minFitness < maxFit):
          induk[idx] = anak[idxanak]

      #Populasi induk yang paling baik
      for j in range(N):
          if (hitungFitness(induk[j])>MaxFitness[i]):
              MaxFitness[i] = hitungFitness(induk[j])
      i+=1

      print(MaxFitness)
```

Streaming output truncated to the last 5000 lines.

```
Iterasi:  36
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  37
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  38
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  39
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  40
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  41
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  42
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  43
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  44
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  45
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  46
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  47
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  48
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  49
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  50
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  51
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  52
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  53
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  54
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  55
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  56
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  57
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  58
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  59
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  60
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Iterasi:  61
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  62
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
Iterasi:  63
[1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 1413821, 2512421, 2512421,
```
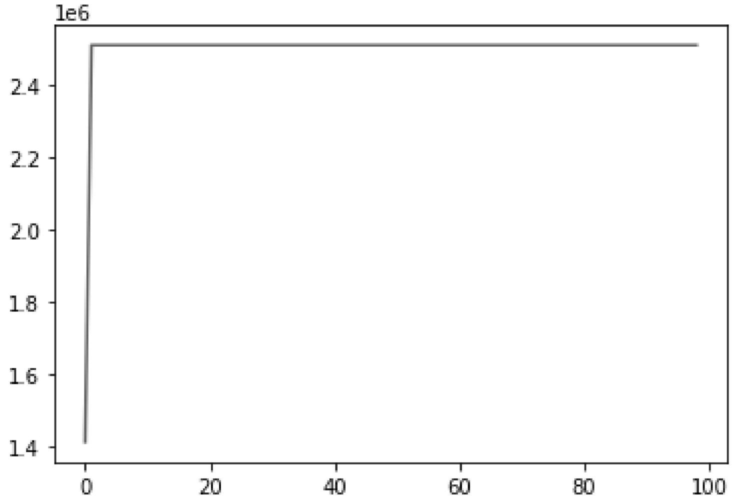

```
print("Nilai Mean : ", st.mean(MaxFitness))
print("Nilai Standard Deviation : ", st.stdev(MaxFitness))
print("Nilai Minimal : ",np.min(MaxFitness))
```

```
Nilai Mean :  2501324
Nilai Standard Deviation :  110413.45438396536
Nilai Minimal :  1413821
```

```
x = [i for i in range(epochs)]
plt.plot(x, MaxFitness)
```

```
[<matplotlib.lines.Line2D at 0x7fbf2cf028d0>]
```


1e6
2.4
2.2
2.0
1.8
1.6
1.4
0
20
40
60
80
100