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


D = 3 #Banyak Variabel
maxIterasi = 100 #Iterasi
HMS = 7 #Harmony Memory Search
BB = 0 #Batas bawah
BA = 1 #Batas atas

HMCR = 0.9 #Harmony Memory Consideration Rate
PAR = 0.5 #Pitch Adjustment Rate
BW = HMCR*(1-PAR) #Bandwidth


def HarmonyMemory(HMS, D, BA, BB):
  HM = np.empty((HMS,D)) #Nilai didalam Harmony Memory
  for i in range(HMS):
    for j in range(D):
      #Membangkitkan nilai acak
......HM[i][j]=(random.random()*(BA--BB))++BB
```



```
HM = HarmonyMemory(HMS, D, BA,BB)
print(HM)
```

```
    [[0.0963584  0.22579648 0.35418792]
     [0.05526352 0.23495672 0.03662776]
     [0.33765971 0.73243532 0.24154105]
     [0.71330956 0.4668491  0.06536853]
     [0.89189186 0.08509817 0.30169944]
     [0.53517705 0.76209457 0.66499882]
     [0.31728848 0.33079549 0.64880331]]
```

```
def Fitness(populasi):
  sz = populasi.shape
  HMS = sz[0]
  dimensi = sz[1]

  #Menyimpan nilai Objective tiap individu pada inisialisasi Fit
  Fit = np.empty(HMS)

  for i in range(HMS):
    d = 0
```

```
    #Mencari nilai variabel dan disimpan dalam inisialiasi d
    for j in range(dimensi):
        #Permasalahan linear = 15x-x^2
      d = np.sum( (15*( populasi[i][j] )) - (( populasi[i][j] )**2) )

    Fit[i] = d #menyimpan nilai d didalam HM
  return Fit

F = Fitness(HM)
print(F)
```

```
    [5.18736965 0.5480748  3.56477374 0.97625486 4.43446898 9.53275892
     9.31110385]
```

```
def NewHarmony(populasi, PAR, j):
  sz = populasi.shape
  HMS = sz[0]
  dimensi = sz[1]

  #Memilih 3 individu dari populasi secara acak
  r1 = random.randint(0,HMS - 1)
  r2 = random.randint(0,HMS - 1)
  r3 = random.randint(0,HMS - 1)

  #Untuk mengantisipasi nilai error maka setiap hasil di modulo HMS
```



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

  v = HM[r3][j] + PAR*(HM[r1][j]-HM[r2][j]) #Nilai koordinat baru
  return v

v = NewHarmony(HM,PAR,1)
print(v)
```

```
    0.19800237253949965
```

```
def ImprovisasiHarmony(HM):
  #HM = HarmonyMemory(HMS, D, BA,BB)
  print("Inisialiasi Harmony Memory :\n",HM)
  F = Fitness(HM)
  print("\nNilai Fitness per-Individu :\n",F)
  #v = NewHarmony(HM,PAR,1)
  newHM = np.empty((1,D))
  FitBest = np.empty((maxIterasi+1))
```

```
    FitBest[0] = F.min()
    t = 0
    while t < maxIterasi:
      for i in range(HMS):
        for j in range(D):
          #Pemilihan Acak
          randHMS = random.randint(0,HMS)
          #Harmony Memory Consideration Rate
          if randHMS < HMCR:
            #HMrand = random.randint(0,HM)
            newHM[0][j] = HM[i][j]
            #Pitch Adjustment
            if randHMS < PAR:
              newHM[0][j] = newHM[0][j] - (randHMS*BW)
              #newHM[0][j] = newHM[0][j] * (1-PAR)
            else :
              newHM[0][j] = newHM[0][j] + (randHMS*BW)
          else :
            newHM[0][j] = HM[i][j]
      #Replacement
      FitU = Fitness(newHM)

      if FitU < F[i]:
        F[i] = FitU
        for j in range(D):
```



```
      t+=1
      return FitBest
IndBest = ImprovisasiHarmony(HM)
```

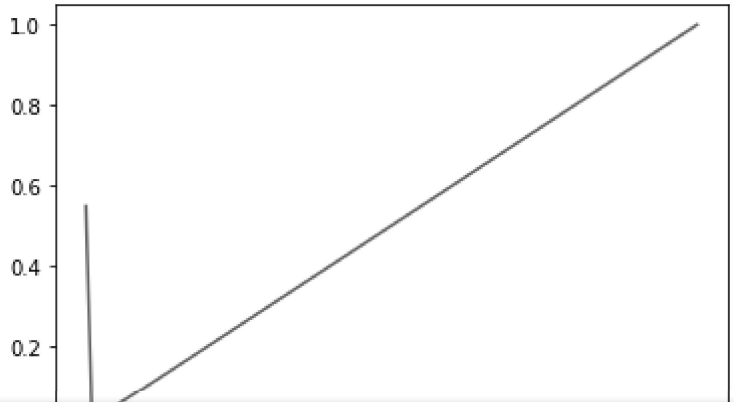
```
Inisialiasi Harmony Memory :
 [[0.0963584  0.22579648 0.35418792]
 [0.05526352 0.23495672 0.03662776]
 [0.33765971 0.73243532 0.24154105]
 [0.71330956 0.4668491  0.06536853]
 [0.89189186 0.08509817 0.30169944]
 [0.53517705 0.76209457 0.66499882]
 [0.31728848 0.33079549 0.64880331]]

Nilai Fitness per-Individu :
 [5.18736965 0.5480748  3.56477374 0.97625486 4.43446898 9.53275892
 9.31110385]
```

```
print("\nIndividu Terbaik :\n",IndBest)
```

```
Individu Terbaik :
 [0.5480748 0.01      0.02      0.03      0.04      0.05      0.06
 0.07      0.08      0.09      0.1       0.11      0.12      0.13
```

```
0.14    0.15    0.16    0.17    0.18    0.19    0.2
0.21    0.22    0.23    0.24    0.25    0.26    0.27
0.28    0.29    0.3     0.31    0.32    0.33    0.34
0.35    0.36    0.37    0.38    0.39    0.4     0.41
0.42    0.43    0.44    0.45    0.46    0.47    0.48
0.49    0.5     0.51    0.52    0.53    0.54    0.55
0.56    0.57    0.58    0.59    0.6     0.61    0.62
0.63    0.64    0.65    0.66    0.67    0.68    0.69
0.7     0.71    0.72    0.73    0.74    0.75    0.76
0.77    0.78    0.79    0.8     0.81    0.82    0.83
0.84    0.85    0.86    0.87    0.88    0.89    0.9
0.91    0.92    0.93    0.94    0.95    0.96    0.97
0.98    0.99    1.      ]
```

```
x = np.linspace(0,1,maxIterasi + 1)
plt.plot(x, IndBest, label='f=F')
plt.show()
```



Tidak dapat terhubung ke layanan reCAPTCHA. Periksa koneksi internet Anda, lalu muat ulang untuk mendapatkan tantangan reCAPTCHA.