

assign_anfis

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1 Laporan Praktikum Sistem Kendali Cerdas

2 Abdul Mujiburrohman Luthfi (19507334027)

Berikut adalah arti/ makna dari syntax-syntax yang ada dalam kode dibawah. Sumber nya sendiri diambil dari dokumentasi setiap library yang kami panggil untuk proyek ini. Source code sudah disediakan oleh Dosen dan saya akan mengupas setiap syntax yang ada

```
[1]: import anfis
import membership.mfDerivs
import membership.membershipfunction
import numpy as np
```

Hal pertama yang kita lakukan adalah memanggil library yang akan kita gunakan. Dalam kasus kali ini kita akan ketambahan library anfis dan beberapa file tambahan lainnya. Berikut makna kode syntax yang ada diatas

- import anfis : memanggil library anfis. Library ini bisa di download langsung menggunakan terminal conda, maupun meng-clone dari GitHub (<https://github.com/twmeggs/anfis>)
- import membership.mfDerivs : dari membership, dipanggil lah mfDervis
- import membership.membershipfunction : dari membership, dipanggil lah membershipfunction
- import numpy as np : memanggil library numpy dengan sebutan np

```
[2]: ts = np.loadtxt("trainingSet.txt", usecols=[1,2,3])#numpy.loadtxt('c:
↪ \Python_fiddling\myProject\MF\trainingSet.txt',usecols=[1,2,3])
ts
```

```
[2]: array([[ -1.00000000e+01,  -1.00000000e+01,   2.95958969e-03],
          [ -1.00000000e+01,  -8.00000000e+00,  -6.72789715e-03],
          [ -1.00000000e+01,  -6.00000000e+00,   2.53346550e-03],
          [ -1.00000000e+01,  -4.00000000e+00,   1.02929134e-02],
          [ -1.00000000e+01,  -2.00000000e+00,  -2.47338498e-02],
          [ -1.00000000e+01,   0.00000000e+00,  -5.44021111e-02],
          [ -1.00000000e+01,   2.00000000e+00,  -2.47338498e-02],
          [ -1.00000000e+01,   4.00000000e+00,   1.02929134e-02],
          [ -1.00000000e+01,   6.00000000e+00,   2.53346550e-03],
          [ -1.00000000e+01,   8.00000000e+00,  -6.72789715e-03],
          [ -1.00000000e+01,   1.00000000e+01,   2.95958969e-03],
```

```

[-8.00000000e+00, -1.00000000e+01, -6.72789715e-03],
[-8.00000000e+00, -8.00000000e+00, 1.52942147e-02],
[-8.00000000e+00, -6.00000000e+00, -5.75920890e-03],
[-8.00000000e+00, -4.00000000e+00, -2.33983997e-02],
[-8.00000000e+00, -2.00000000e+00, 5.62263067e-02],
[-8.00000000e+00, 0.00000000e+00, 1.23669781e-01],
[-8.00000000e+00, 2.00000000e+00, 5.62263067e-02],
[-8.00000000e+00, 4.00000000e+00, -2.33983997e-02],
[-8.00000000e+00, 6.00000000e+00, -5.75920890e-03],
[-8.00000000e+00, 8.00000000e+00, 1.52942147e-02],
[-8.00000000e+00, 1.00000000e+01, -6.72789715e-03],
[-6.00000000e+00, -1.00000000e+01, 2.53346550e-03],
[-6.00000000e+00, -8.00000000e+00, -5.75920890e-03],
[-6.00000000e+00, -6.00000000e+00, 2.16869502e-03],
[-6.00000000e+00, -4.00000000e+00, 8.81093109e-03],
[-6.00000000e+00, -2.00000000e+00, -2.11726495e-02],
[-6.00000000e+00, 0.00000000e+00, -4.65692497e-02],
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[-6.00000000e+00, 4.00000000e+00, 8.81093109e-03],
[-6.00000000e+00, 6.00000000e+00, 2.16869502e-03],
[-6.00000000e+00, 8.00000000e+00, -5.75920890e-03],
[-6.00000000e+00, 1.00000000e+01, 2.53346550e-03],
[-4.00000000e+00, -1.00000000e+01, 1.02929134e-02],
[-4.00000000e+00, -8.00000000e+00, -2.33983997e-02],
[-4.00000000e+00, -6.00000000e+00, 8.81093109e-03],
[-4.00000000e+00, -4.00000000e+00, 3.57968761e-02],
[-4.00000000e+00, -2.00000000e+00, -8.60198202e-02],
[-4.00000000e+00, 0.00000000e+00, -1.89200624e-01],
[-4.00000000e+00, 2.00000000e+00, -8.60198202e-02],
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[-4.00000000e+00, 6.00000000e+00, 8.81093109e-03],
[-4.00000000e+00, 8.00000000e+00, -2.33983997e-02],
[-4.00000000e+00, 1.00000000e+01, 1.02929134e-02],
[-2.00000000e+00, -1.00000000e+01, -2.47338498e-02],
[-2.00000000e+00, -8.00000000e+00, 5.62263067e-02],
[-2.00000000e+00, -6.00000000e+00, -2.11726495e-02],
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[-2.00000000e+00, -2.00000000e+00, 2.06705453e-01],
[-2.00000000e+00, 0.00000000e+00, 4.54648713e-01],
[-2.00000000e+00, 2.00000000e+00, 2.06705453e-01],
[-2.00000000e+00, 4.00000000e+00, -8.60198202e-02],
[-2.00000000e+00, 6.00000000e+00, -2.11726495e-02],
[-2.00000000e+00, 8.00000000e+00, 5.62263067e-02],
[-2.00000000e+00, 1.00000000e+01, -2.47338498e-02],
[ 0.00000000e+00, -1.00000000e+01, -5.44021111e-02],
[ 0.00000000e+00, -8.00000000e+00, 1.23669781e-01],
[ 0.00000000e+00, -6.00000000e+00, -4.65692497e-02],

```

```

[ 0.00000000e+00, -4.00000000e+00, -1.89200624e-01],
[ 0.00000000e+00, -2.00000000e+00,  4.54648713e-01],
[ 0.00000000e+00,  0.00000000e+00,  1.00000000e+00],
[ 0.00000000e+00,  2.00000000e+00,  4.54648713e-01],
[ 0.00000000e+00,  4.00000000e+00, -1.89200624e-01],
[ 0.00000000e+00,  6.00000000e+00, -4.65692497e-02],
[ 0.00000000e+00,  8.00000000e+00,  1.23669781e-01],
[ 0.00000000e+00,  1.00000000e+01, -5.44021111e-02],
[ 2.00000000e+00, -1.00000000e+01, -2.47338498e-02],
[ 2.00000000e+00, -8.00000000e+00,  5.62263067e-02],
[ 2.00000000e+00, -6.00000000e+00, -2.11726495e-02],
[ 2.00000000e+00, -4.00000000e+00, -8.60198202e-02],
[ 2.00000000e+00, -2.00000000e+00,  2.06705453e-01],
[ 2.00000000e+00,  0.00000000e+00,  4.54648713e-01],
[ 2.00000000e+00,  2.00000000e+00,  2.06705453e-01],
[ 2.00000000e+00,  4.00000000e+00, -8.60198202e-02],
[ 2.00000000e+00,  6.00000000e+00, -2.11726495e-02],
[ 2.00000000e+00,  8.00000000e+00,  5.62263067e-02],
[ 2.00000000e+00,  1.00000000e+01, -2.47338498e-02],
[ 4.00000000e+00, -1.00000000e+01,  1.02929134e-02],
[ 4.00000000e+00, -8.00000000e+00, -2.33983997e-02],
[ 4.00000000e+00, -6.00000000e+00,  8.81093109e-03],
[ 4.00000000e+00, -4.00000000e+00,  3.57968761e-02],
[ 4.00000000e+00, -2.00000000e+00, -8.60198202e-02],
[ 4.00000000e+00,  0.00000000e+00, -1.89200624e-01],
[ 4.00000000e+00,  2.00000000e+00, -8.60198202e-02],
[ 4.00000000e+00,  4.00000000e+00,  3.57968761e-02],
[ 4.00000000e+00,  6.00000000e+00,  8.81093109e-03],
[ 4.00000000e+00,  8.00000000e+00, -2.33983997e-02],
[ 4.00000000e+00,  1.00000000e+01,  1.02929134e-02],
[ 6.00000000e+00, -1.00000000e+01,  2.53346550e-03],
[ 6.00000000e+00, -8.00000000e+00, -5.75920890e-03],
[ 6.00000000e+00, -6.00000000e+00,  2.16869502e-03],
[ 6.00000000e+00, -4.00000000e+00,  8.81093109e-03],
[ 6.00000000e+00, -2.00000000e+00, -2.11726495e-02],
[ 6.00000000e+00,  0.00000000e+00, -4.65692497e-02],
[ 6.00000000e+00,  2.00000000e+00, -2.11726495e-02],
[ 6.00000000e+00,  4.00000000e+00,  8.81093109e-03],
[ 6.00000000e+00,  6.00000000e+00,  2.16869502e-03],
[ 6.00000000e+00,  8.00000000e+00, -5.75920890e-03],
[ 6.00000000e+00,  1.00000000e+01,  2.53346550e-03],
[ 8.00000000e+00, -1.00000000e+01, -6.72789715e-03],
[ 8.00000000e+00, -8.00000000e+00,  1.52942147e-02],
[ 8.00000000e+00, -6.00000000e+00, -5.75920890e-03],
[ 8.00000000e+00, -4.00000000e+00, -2.33983997e-02],
[ 8.00000000e+00, -2.00000000e+00,  5.62263067e-02],
[ 8.00000000e+00,  0.00000000e+00,  1.23669781e-01],

```

```
[ 8.00000000e+00,  2.00000000e+00,  5.62263067e-02],
[ 8.00000000e+00,  4.00000000e+00, -2.33983997e-02],
[ 8.00000000e+00,  6.00000000e+00, -5.75920890e-03],
[ 8.00000000e+00,  8.00000000e+00,  1.52942147e-02],
[ 8.00000000e+00,  1.00000000e+01, -6.72789715e-03],
[ 1.00000000e+01, -1.00000000e+01,  2.95958969e-03],
[ 1.00000000e+01, -8.00000000e+00, -6.72789715e-03],
[ 1.00000000e+01, -6.00000000e+00,  2.53346550e-03],
[ 1.00000000e+01, -4.00000000e+00,  1.02929134e-02],
[ 1.00000000e+01, -2.00000000e+00, -2.47338498e-02],
[ 1.00000000e+01,  0.00000000e+00, -5.44021111e-02],
[ 1.00000000e+01,  2.00000000e+00, -2.47338498e-02],
[ 1.00000000e+01,  4.00000000e+00,  1.02929134e-02],
[ 1.00000000e+01,  6.00000000e+00,  2.53346550e-03],
[ 1.00000000e+01,  8.00000000e+00, -6.72789715e-03],
[ 1.00000000e+01,  1.00000000e+01,  2.95958969e-03]])
```

Ts adalah data yang ada di trainingSet.Txt

```
[3]: X = ts[:,0:2]
      X
```

```
[3]: array([[ -10.,  -10.],
            [ -10.,  -8.],
            [ -10.,  -6.],
            [ -10.,  -4.],
            [ -10.,  -2.],
            [ -10.,   0.],
            [ -10.,   2.],
            [ -10.,   4.],
            [ -10.,   6.],
            [ -10.,   8.],
            [ -10.,  10.],
            [  -8., -10.],
            [  -8.,  -8.],
            [  -8.,  -6.],
            [  -8.,  -4.],
            [  -8.,  -2.],
            [  -8.,   0.],
            [  -8.,   2.],
            [  -8.,   4.],
            [  -8.,   6.],
            [  -8.,   8.],
            [  -8.,  10.],
            [  -6., -10.],
            [  -6.,  -8.],
            [  -6.,  -6.],
            [  -6.,  -4.]])
```

```

[ -6., -2.],
[ -6.,  0.],
[ -6.,  2.],
[ -6.,  4.],
[ -6.,  6.],
[ -6.,  8.],
[ -6., 10.],
[ -4., -10.],
[ -4., -8.],
[ -4., -6.],
[ -4., -4.],
[ -4., -2.],
[ -4.,  0.],
[ -4.,  2.],
[ -4.,  4.],
[ -4.,  6.],
[ -4.,  8.],
[ -4., 10.],
[ -2., -10.],
[ -2., -8.],
[ -2., -6.],
[ -2., -4.],
[ -2., -2.],
[ -2.,  0.],
[ -2.,  2.],
[ -2.,  4.],
[ -2.,  6.],
[ -2.,  8.],
[ -2., 10.],
[  0., -10.],
[  0., -8.],
[  0., -6.],
[  0., -4.],
[  0., -2.],
[  0.,  0.],
[  0.,  2.],
[  0.,  4.],
[  0.,  6.],
[  0.,  8.],
[  0., 10.],
[  2., -10.],
[  2., -8.],
[  2., -6.],
[  2., -4.],
[  2., -2.],
[  2.,  0.],
[  2.,  2.],

```

```
[ 2.,  4.],
[ 2.,  6.],
[ 2.,  8.],
[ 2., 10.],
[ 4., -10.],
[ 4.,  -8.],
[ 4.,  -6.],
[ 4.,  -4.],
[ 4.,  -2.],
[ 4.,   0.],
[ 4.,   2.],
[ 4.,   4.],
[ 4.,   6.],
[ 4.,   8.],
[ 4.,  10.],
[ 6., -10.],
[ 6.,  -8.],
[ 6.,  -6.],
[ 6.,  -4.],
[ 6.,  -2.],
[ 6.,   0.],
[ 6.,   2.],
[ 6.,   4.],
[ 6.,   6.],
[ 6.,   8.],
[ 6.,  10.],
[ 8., -10.],
[ 8.,  -8.],
[ 8.,  -6.],
[ 8.,  -4.],
[ 8.,  -2.],
[ 8.,   0.],
[ 8.,   2.],
[ 8.,   4.],
[ 8.,   6.],
[ 8.,   8.],
[ 8.,  10.],
[10., -10.],
[10.,  -8.],
[10.,  -6.],
[10.,  -4.],
[10.,  -2.],
[10.,   0.],
[10.,   2.],
[10.,   4.],
[10.,   6.],
[10.,   8.],
```

```
[ 10., 10.]])
```

Data X diatas adalah data input yang diambil dari data Ts

```
[4]: Y = ts[:,2]
Y
```

```
[4]: array([ 0.00295959, -0.0067279 ,  0.00253347,  0.01029291, -0.02473385,
          -0.05440211, -0.02473385,  0.01029291,  0.00253347, -0.0067279 ,
           0.00295959, -0.0067279 ,  0.01529421, -0.00575921, -0.0233984 ,
           0.05622631,  0.12366978,  0.05622631, -0.0233984 , -0.00575921,
           0.01529421, -0.0067279 ,  0.00253347, -0.00575921,  0.0021687 ,
           0.00881093, -0.02117265, -0.04656925, -0.02117265,  0.00881093,
           0.0021687 , -0.00575921,  0.00253347,  0.01029291, -0.0233984 ,
           0.00881093,  0.03579688, -0.08601982, -0.18920062, -0.08601982,
           0.03579688,  0.00881093, -0.0233984 ,  0.01029291, -0.02473385,
           0.05622631, -0.02117265, -0.08601982,  0.20670545,  0.45464871,
           0.20670545, -0.08601982, -0.02117265,  0.05622631, -0.02473385,
          -0.05440211,  0.12366978, -0.04656925, -0.18920062,  0.45464871,
           1.          ,  0.45464871, -0.18920062, -0.04656925,  0.12366978,
          -0.05440211, -0.02473385,  0.05622631, -0.02117265, -0.08601982,
           0.20670545,  0.45464871,  0.20670545, -0.08601982, -0.02117265,
           0.05622631, -0.02473385,  0.01029291, -0.0233984 ,  0.00881093,
           0.03579688, -0.08601982, -0.18920062, -0.08601982,  0.03579688,
           0.00881093, -0.0233984 ,  0.01029291,  0.00253347, -0.00575921,
           0.0021687 ,  0.00881093, -0.02117265, -0.04656925, -0.02117265,
           0.00881093,  0.0021687 , -0.00575921,  0.00253347, -0.0067279 ,
           0.01529421, -0.00575921, -0.0233984 ,  0.05622631,  0.12366978,
           0.05622631, -0.0233984 , -0.00575921,  0.01529421, -0.0067279 ,
           0.00295959, -0.0067279 ,  0.00253347,  0.01029291, -0.02473385,
          -0.05440211, -0.02473385,  0.01029291,  0.00253347, -0.0067279 ,
           0.00295959])
```

```
[5]: mf = [[['gaussmf',{'mean':0.,'sigma':1.}],
             ['gaussmf',{'mean':-1.,'sigma':2.}],
             ['gaussmf',{'mean':-4.,'sigma':10.}],
             ['gaussmf',{'mean':-7.,'sigma':7.}]],
          [['gaussmf',{'mean':1.,'sigma':2.}],
             ['gaussmf',{'mean':2.,'sigma':3.}],
             ['gaussmf',{'mean':-2.,'sigma':10.}],
             ['gaussmf',{'mean':-10.5,'sigma':5.}]]]
mf
```

```
[5]: [['gaussmf', {'mean': 0.0, 'sigma': 1.0}],
       ['gaussmf', {'mean': -1.0, 'sigma': 2.0}],
       ['gaussmf', {'mean': -4.0, 'sigma': 10.0}],
       ['gaussmf', {'mean': -7.0, 'sigma': 7.0}]],
       [['gaussmf', {'mean': 1.0, 'sigma': 2.0}],
```

```
['gaussmf', {'mean': 2.0, 'sigma': 3.0}],
['gaussmf', {'mean': -2.0, 'sigma': 10.0}],
['gaussmf', {'mean': -10.5, 'sigma': 5.0}]]]
```

```
[6]: mfc = membership.membershipfunction.MemFuncs(mf)
mfc
```

```
[6]: <membership.membershipfunction.MemFuncs at 0x2a066f98310>
```

Kode diatas perintah untuk mencetak membershipfunction layer

```
[8]: anf = anfis.ANFIS(X, Y, mfc)
anf
```

```
[8]: <anfis.ANFIS at 0x2a066f88520>
```

Untuk menjalankan anfis, masukan nilai x sebagai input, y sebagai output, dan mfc yang merupakan bentuk dari membershipfunction yang digunakan

```
[9]: anf.trainHybridJangOffLine(epochs=20)
```

```
current error: 0.3219713313023785
current error: 0.32064969677858995
current error: 0.31935983596565765
current error: 0.31809648196624235
current error: 0.3167312506084613
current error: 0.3152546970544939
current error: 0.31365648102579224
current error: 0.3119254351798975
current error: 0.3100497693046117
current error: 0.3080174986461968
current error: 0.30581722267280165
current error: 0.3034394205120782
current error: 0.3008784504785918
current error: 0.2981353844740636
current error: 0.2952214986702718
current error: 0.29216105234656203
current error: 0.28898684515575307
current error: 0.2856912569141177
current error: 0.28184647973208704
```

```
[9]: array([[ -1.19786767e-02],
           [  5.19007695e-03],
           [  1.50858291e-02],
           [  5.66106857e-03],
           [ -1.66125571e-02],
           [  2.58351102e-03],
           [  3.35328470e-02],
           [  2.84855950e-02],
```


[1.63883100e-03],
[-1.66157597e-03],
[5.15880107e-03],
[-1.03492980e-02],
[6.03637357e-03],
[1.49551447e-02],
[5.02809128e-03],
[-2.20156604e-02],
[-1.51514181e-02],
[1.22868327e-02],
[1.84446227e-02],
[4.90866622e-03],
[5.85381401e-04],
[1.93971607e-03],
[-7.45887383e-03],
[7.98275085e-03],
[1.35220824e-02],
[2.54597153e-04],
[-3.13692042e-02],
[-4.34094757e-02],
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[-6.68501004e-02],
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[-8.67631020e-03],
[9.89335235e-03],
[8.22092577e-03],
[-3.31788514e-02],
[-5.62570770e-02],
[1.68241103e-01],
[3.75131950e-01],
[1.80234108e-01],
[-4.11688230e-02],
[-1.39472862e-02],
[1.67155871e-02],
[-2.19169364e-02],

[4.16532870e-02],
[-8.07087368e-03],
[-1.00935922e-01],
[-9.32715288e-02],
[4.85986212e-01],
[9.17442711e-01],
[3.92340049e-01],
[-1.52942095e-01],
[-7.37961579e-02],
[3.96021736e-02],
[-3.35218412e-02],
[1.05294807e-02],
[1.02821355e-03],
[-3.63494134e-02],
[-4.57539376e-02],
[1.87440108e-01],
[3.88783789e-01],
[1.81959082e-01],
[-5.77450417e-02],
[-3.98734901e-02],
[9.09681648e-03],
[-1.40147915e-02],
[-5.09975919e-03],
[6.65924262e-03],
[7.34173725e-03],
[-5.39915093e-03],
[-1.55039587e-02],
[-8.42034935e-03],
[-6.90367996e-03],
[-6.92735177e-03],
[2.98982764e-05],
[-5.31592304e-04],
[-5.35489399e-03],
[-4.49669454e-03],
[6.52995724e-03],
[9.79897230e-03],
[-1.11705951e-03],
[-3.40038407e-02],
[-5.97837945e-02],
[-5.28040615e-02],
[-2.64330768e-02],
[-2.72285325e-03],
[1.01888553e-03],
[-2.37782564e-03],
[-5.52198283e-03],
[5.31835303e-03],
[8.75121326e-03],

```

[-3.00335877e-04],
[-2.15349229e-02],
[-2.88011302e-02],
[-1.82299860e-02],
[-5.88363424e-03],
[ 2.96900379e-04],
[ 6.10633596e-04],
[ 6.93581907e-04],
[-7.10373225e-03],
[ 3.80643521e-03],
[ 7.49023497e-03],
[ 8.59608739e-04],
[-2.72155797e-03],
[ 1.88244330e-02],
[ 3.52702041e-02],
[ 2.68190309e-02],
[ 6.63871097e-03],
[ 3.49026511e-04],
[ 4.04438988e-03]])

```

Perintah diatas berfungsi untuk mentraining dengan parameter (epochs=20) dimana ada 20 kali iterasi untuk menghasilkan nilai error.

```

[10]: import anfis
import membership.mfDerivs
import membership.membershipfunction
import numpy

ts = numpy.loadtxt("trainingSet.txt", usecols=[1,2,3])#numpy.loadtxt('c:
→\\Python_fiddling\\myProject\\MF\\trainingSet.txt',usecols=[1,2,3])
X = ts[:,0:2]
Y = ts[:,2]

mf = [[['gaussmf',{'mean':0., 'sigma':1.}],
        ['gaussmf',{'mean':-1., 'sigma':2.}],
        ['gaussmf',{'mean':-4., 'sigma':10.}],
        ['gaussmf',{'mean':-7., 'sigma':7.}]],
      [['gaussmf',{'mean':1., 'sigma':2.}],
        ['gaussmf',{'mean':2., 'sigma':3.}],
        ['gaussmf',{'mean':-2., 'sigma':10.}],
        ['gaussmf',{'mean':-10.5, 'sigma':5.}]]]

mfc = membership.membershipfunction.MemFuncs(mf)
anf = anfis.ANFIS(X, Y, mfc)
anf.trainHybridJangOffLine(epochs=20)

```

```

#print(round(anf.consequents[-1][0],6))
#print(round(anf.consequents[-2][0],6))
#print(round(anf.fittedValues[9][0],6))
#if round(anf.consequents[-1][0],6) == -5.275538 and round(anf.
    ↳consequents[-2][0],6) == -1.990703 and round(anf.fittedValues[9][0],6) == 0.
    ↳002249:
#         print('test is good')

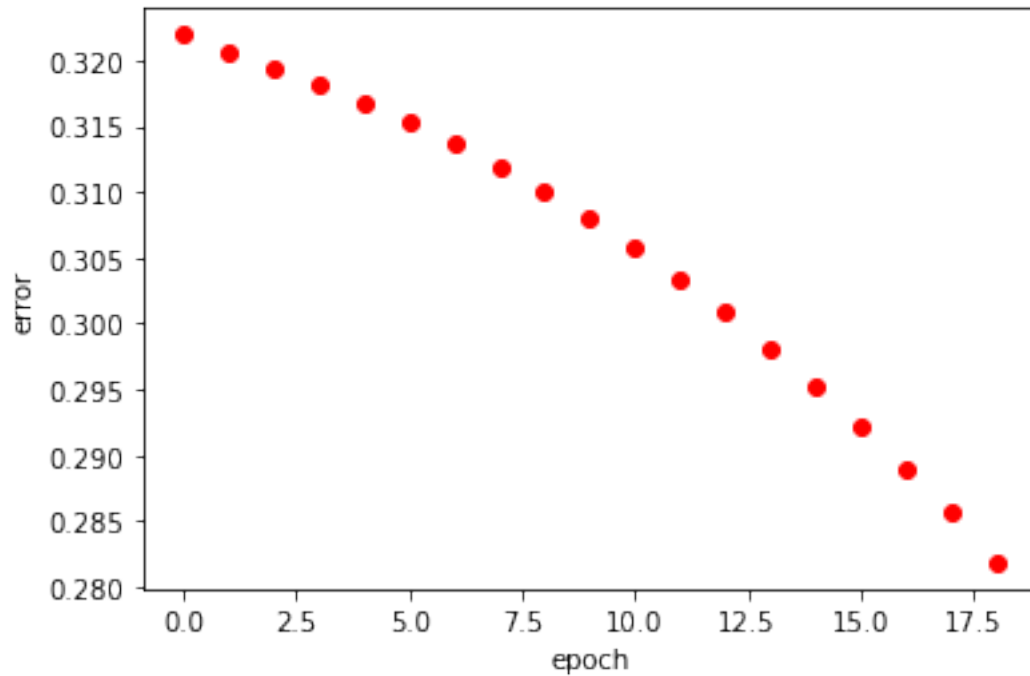
print("Plotting errors")
anf.plotErrors()
print("Plotting results")
anf.plotResults()

```

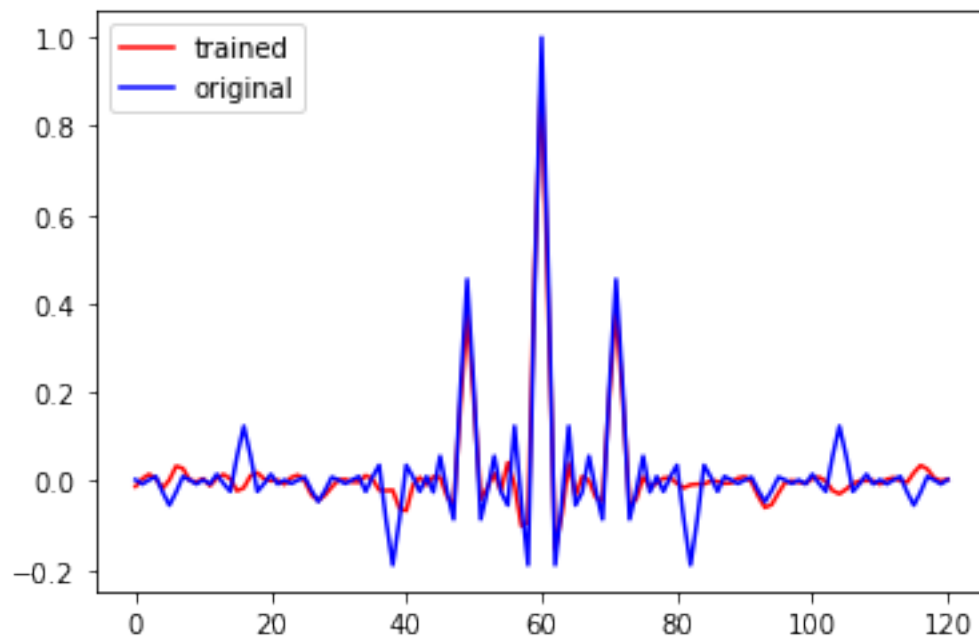
```

current error: 0.3219713313023785
current error: 0.32064969677858995
current error: 0.31935983596565765
current error: 0.31809648196624235
current error: 0.3167312506084613
current error: 0.3152546970544939
current error: 0.31365648102579224
current error: 0.3119254351798975
current error: 0.3100497693046117
current error: 0.3080174986461968
current error: 0.30581722267280165
current error: 0.3034394205120782
current error: 0.3008784504785918
current error: 0.2981353844740636
current error: 0.2952214986702718
current error: 0.29216105234656203
current error: 0.28898684515575307
current error: 0.2856912569141177
current error: 0.28184647973208704
Plotting errors

```



Plotting results



Plotting error diatas terlihat pada saat awal training. Plotting Result adalah gambar perbandingan antara sinyal keluaran dengan sinyal hasil trained/ output yang diprediksi yang berdasarkan hasil

training. nilainya tidak terlalu jauh dari hasil original. Sinyal trained bisa mengikuti sinyal original walaupun ada beberapa titik-titik yang mungkin sedikit terlambat/ nilainya tidak sesuai dengan hasil originalnya. Hal tersebut dapat dilakukan perbaikan agar nilai hasil trained-nya mendekati nilai original.