TRABALHO PRÁTICO
- Sistemas Nebulosos

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QUESTÃO 1: Modelagem de sistema estático monovariável

Aproximar a função y=x^2

```
%_____________________________________________________________________
```

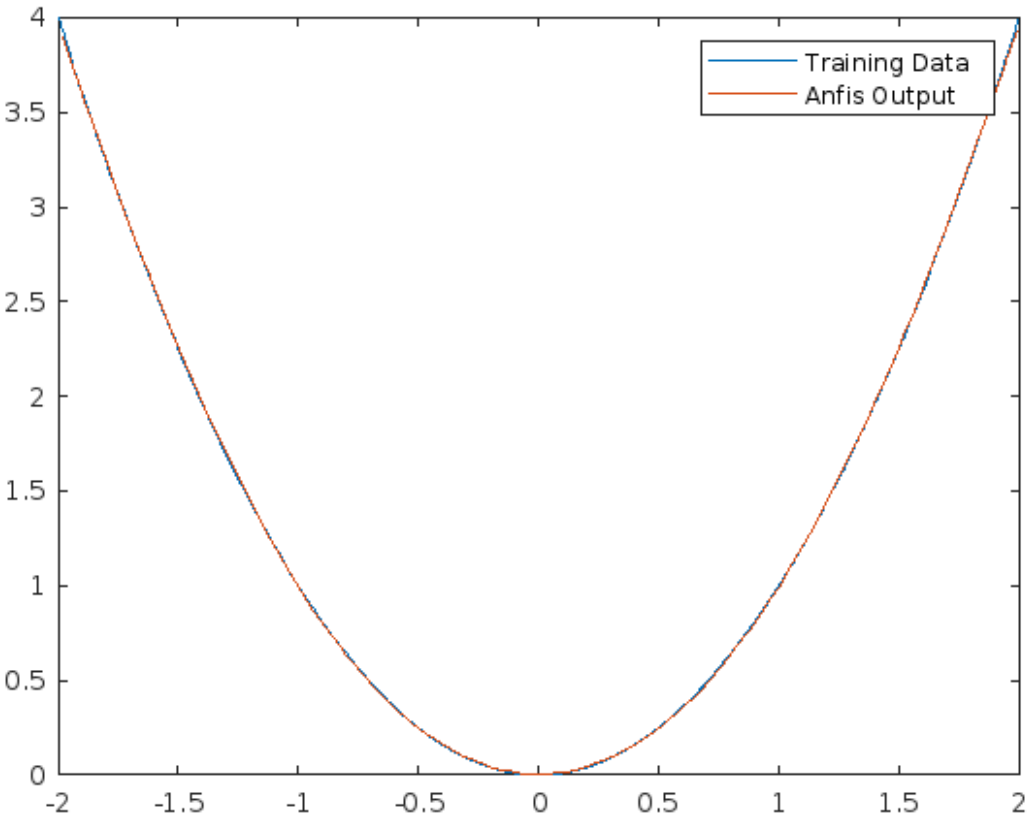
```
close all; clear; clc;

% Geração de dados
N = 1000;
X = (linspace(-2, 2, N)).';
y = (X.^2);

idx = randperm(length(y));
X_train = X(sort(idx(1:900)));
y_train = y(sort(idx(1:900)));
X_test = X(sort(idx(901:1000)));
y_test = y(sort(idx(901:1000)));
```

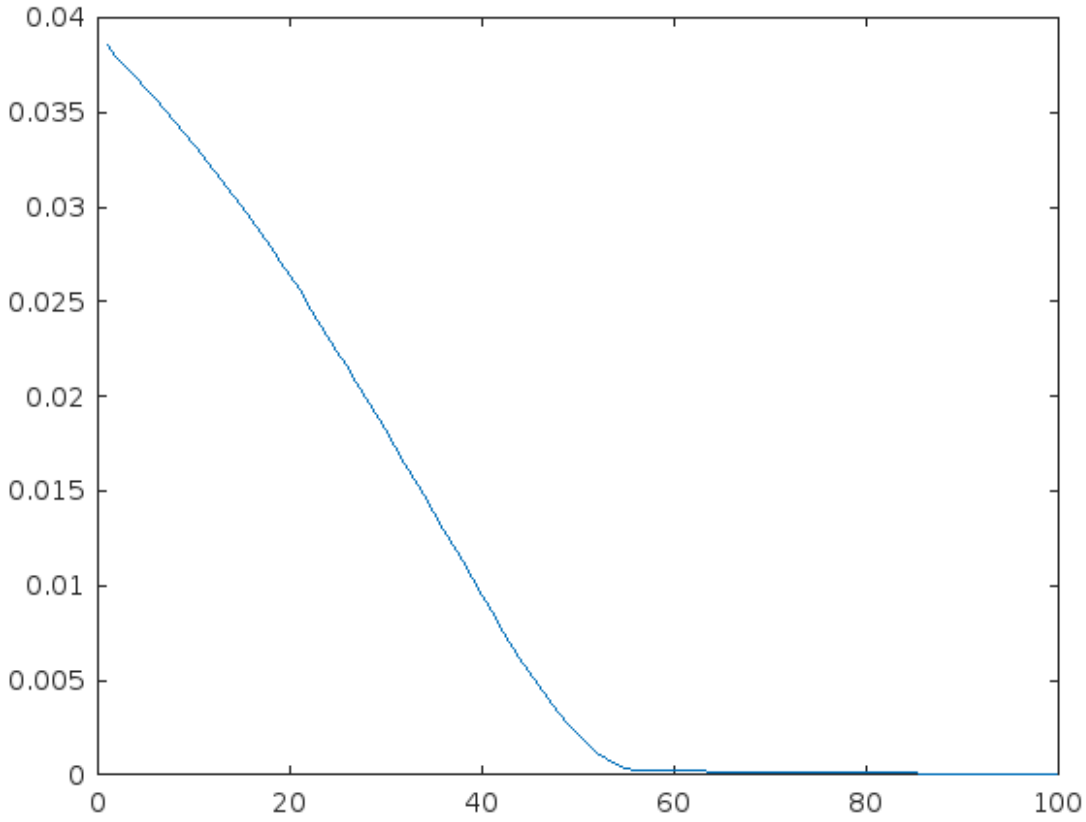
Generate FIS Using Grid Partitioning

```
options = genfisOptions('GridPartition');
options.NumMembershipFunctions = 2;
in_fis = genfis(X_train,y_train,options);

options = anfisOptions;
options.InitialFIS = in_fis;
options.EpochNumber = 100;
options.DisplayStepSize = 0;
options.DisplayErrorValues = 0;
[out_fis,ERROR] = anfis([X_train y_train],options);
ys=evalfis(out_fis, X_test);
figure(1)
```

```
plot(X_train, y_train, X_test, ys)
legend('Training Data','Anfis Output');
figure(2)
plot(ERROR.^2)
fprintf('MSE: %.2E', ERROR(20)^2);
```

```
ANFIS info:
 Number of nodes: 12
 Number of linear parameters: 4
 Number of nonlinear parameters: 6
 Total number of parameters: 10
 Number of training data pairs: 900
 Number of checking data pairs: 0
 Number of fuzzy rules: 2

Minimal training RMSE = 0.00770448
MSE: 2.64E-02
```



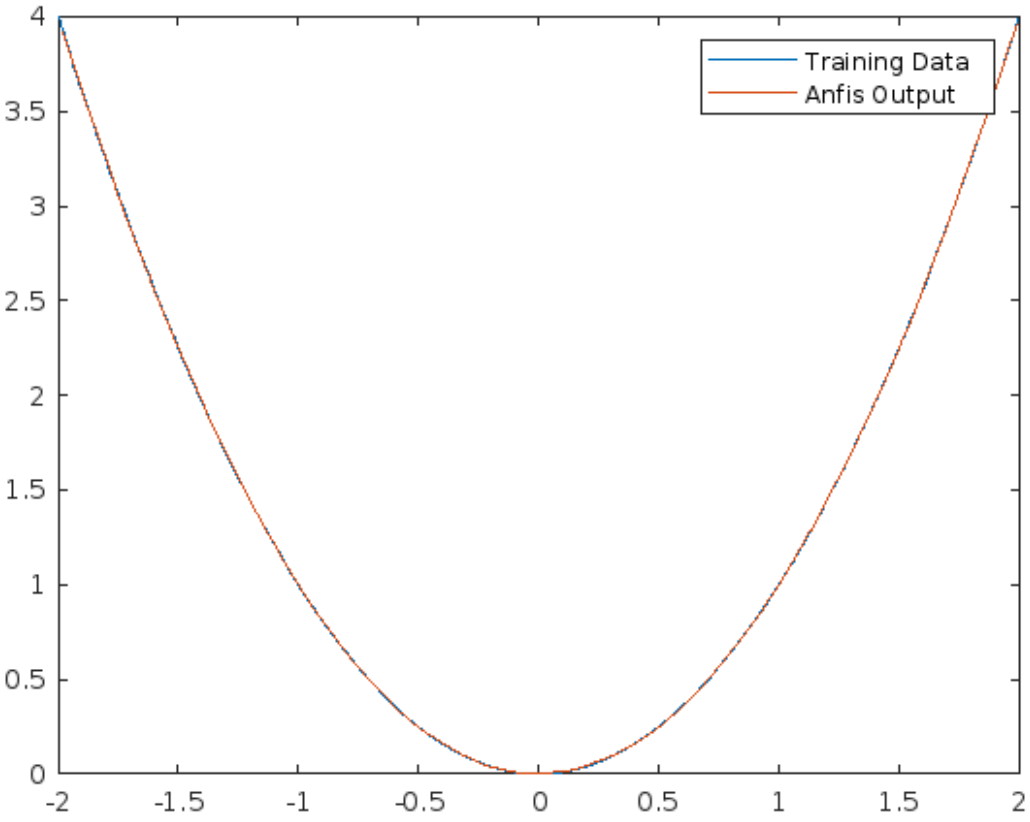


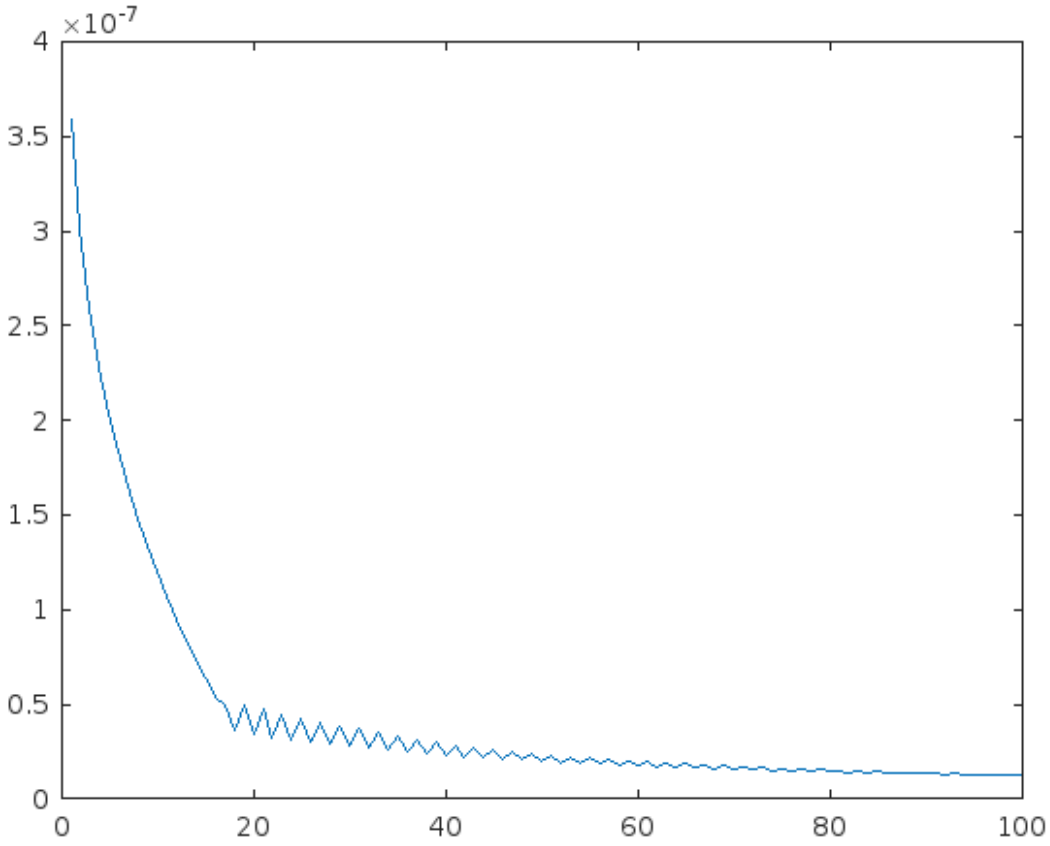
Generate FIS Using Subtractive Clustering

```
options = genfisOptions('SubtractiveClustering');
in_fis = genfis(X_train,y_train,options);

options = anfisOptions;
options.InitialFIS = in_fis;
options.EpochNumber = 100;
options.DisplayStepSize = 0;
options.DisplayErrorValues = 0;
[out_fis,ERROR] = anfis([X_train y_train],options);
ys=evalfis(out_fis, X_test);
figure(3)
plot(X_train, y_train, X_test, ys)
legend('Training Data','Anfis Output');
figure(4)
plot(ERROR.^2)
fprintf('MSE: %.2E', ERROR(20)^2);
```

```
ANFIS info:
 Number of nodes: 24
 Number of linear parameters: 10
```

```
 Number of nonlinear parameters: 10
 Total number of parameters: 20
 Number of training data pairs: 900
 Number of checking data pairs: 0
 Number of fuzzy rules: 5

Minimal training RMSE = 0.00011105
MSE: 3.42E-08
```

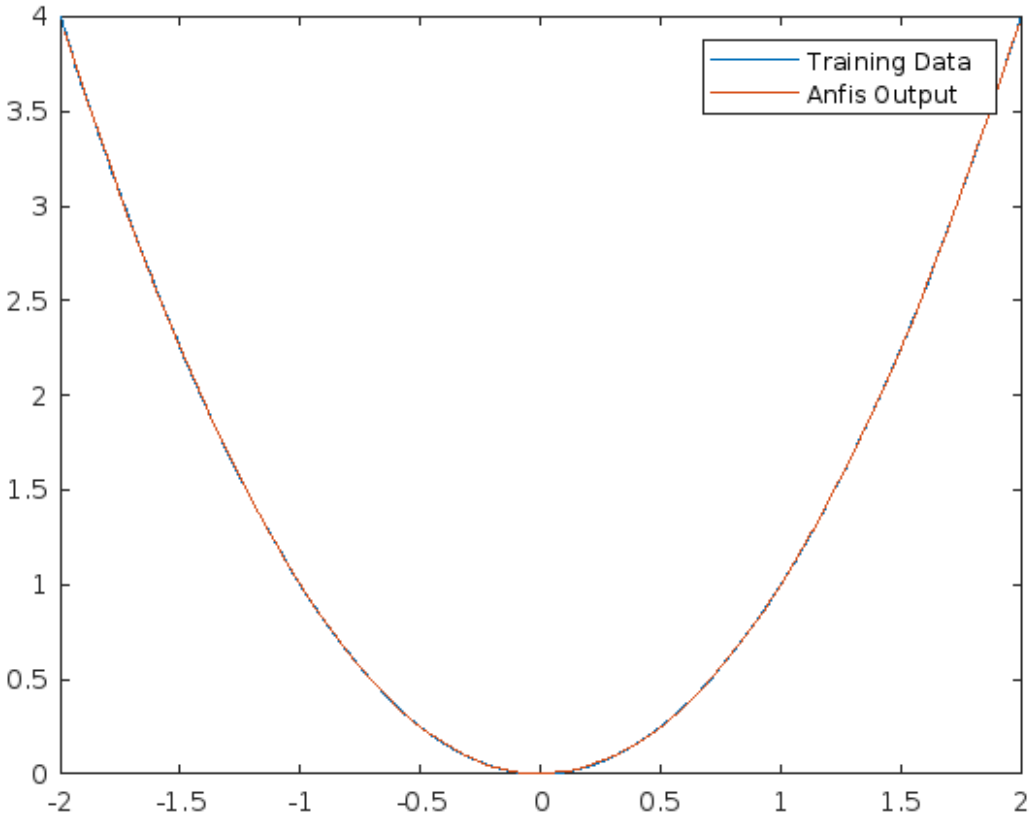


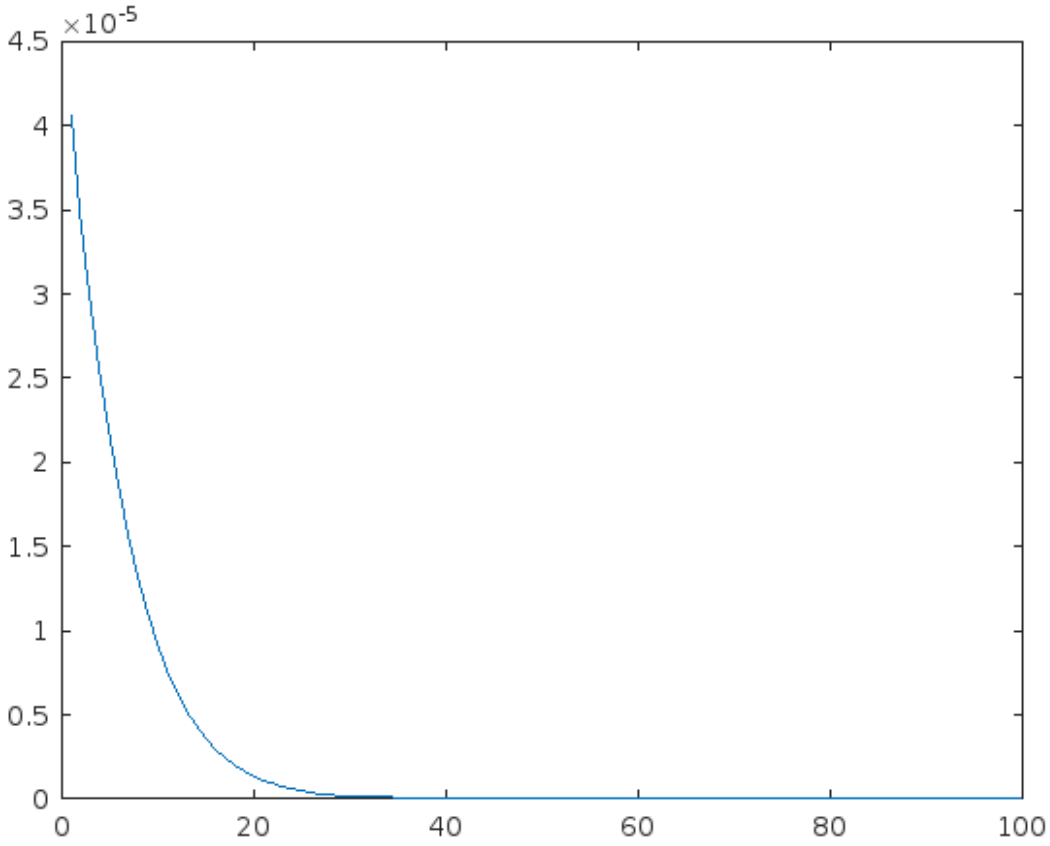


Generate FIS Using FCM Clustering

```
options = genfisOptions('FCMClustering');
options.Verbose = false;
in_fis = genfis(X_train,y_train,options);

options = anfisOptions;
options.InitialFIS = in_fis;
options.EpochNumber = 100;
options.DisplayStepSize = 0;
options.DisplayErrorValues = 0;
[out_fis,ERROR] = anfis([X_train y_train],options);
ys=evalfis(out_fis, X_test);
figure(5)
plot(X_train, y_train, X_test, ys)
legend('Training Data','Anfis Output');
figure(6)
plot(ERROR.^2)
fprintf('MSE: %.2E', ERROR(20)^2);


ANFIS info:
 Number of nodes: 24
```

```
 Number of linear parameters: 10
 Number of nonlinear parameters: 10
 Total number of parameters: 20
 Number of training data pairs: 900
 Number of checking data pairs: 0
 Number of fuzzy rules: 5

Minimal training RMSE = 8.23071e-05
MSE: 1.36E-06
```





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