Programming Assignment 2

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In this programming assignment, an RBF network was implemented to learn the function $h(x) = 0.5 + 0.4\sin(2\pi x)$ and the following are the results and inferences that were documented. For this purpose, the learning rate values were chosen from [0.01, 0.02] and number of bases were varied from 2, 4, 7, 11, 16.

The neural network performs in polar ways when it's trained with a common variance and when trained with different cluster variances. When we train the network with a common variance, we are not giving the network an opportunity to get influenced by outliers in the dataset.

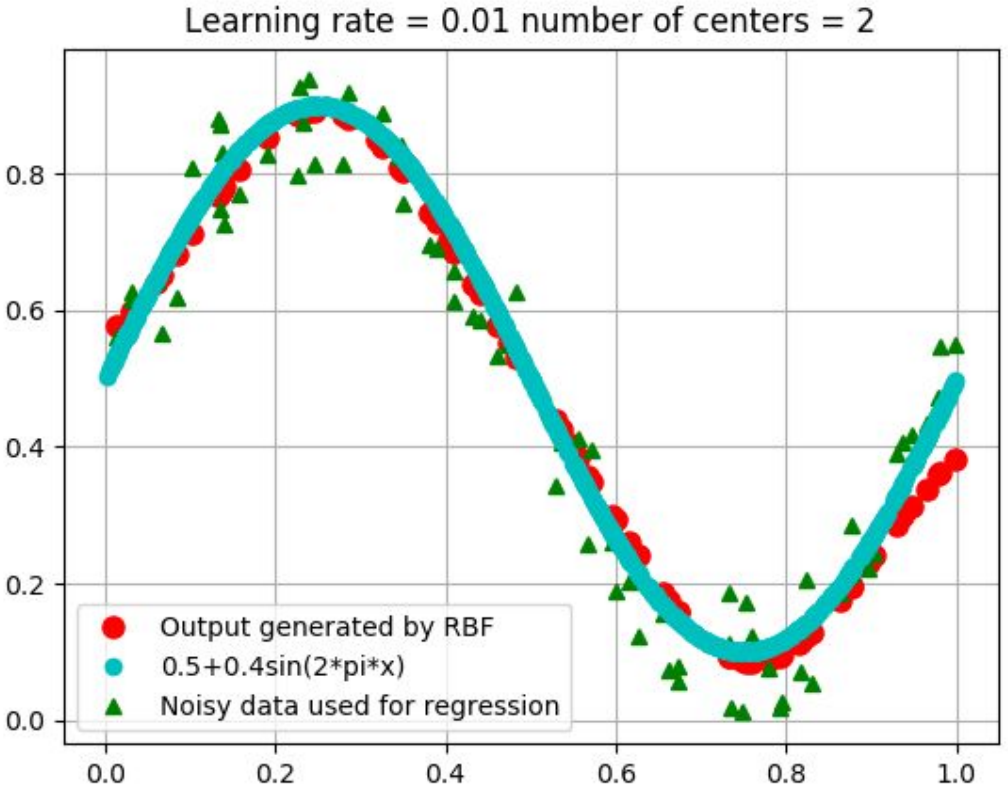
For the case where network was trained with different cluster variances:-

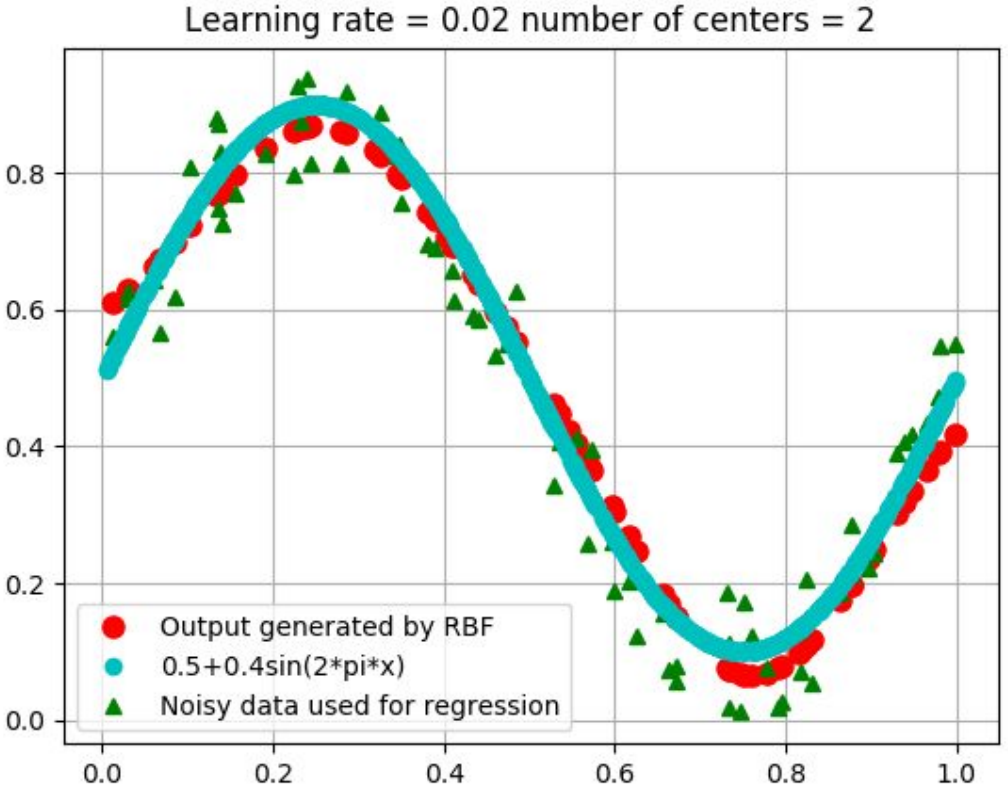
- The network performance is very much affected by the choice of the number of bases and the learning rate values.
- The network's performance seems to be better with smaller number of bases.
- And, the network does a better job for the smaller learning rate value.

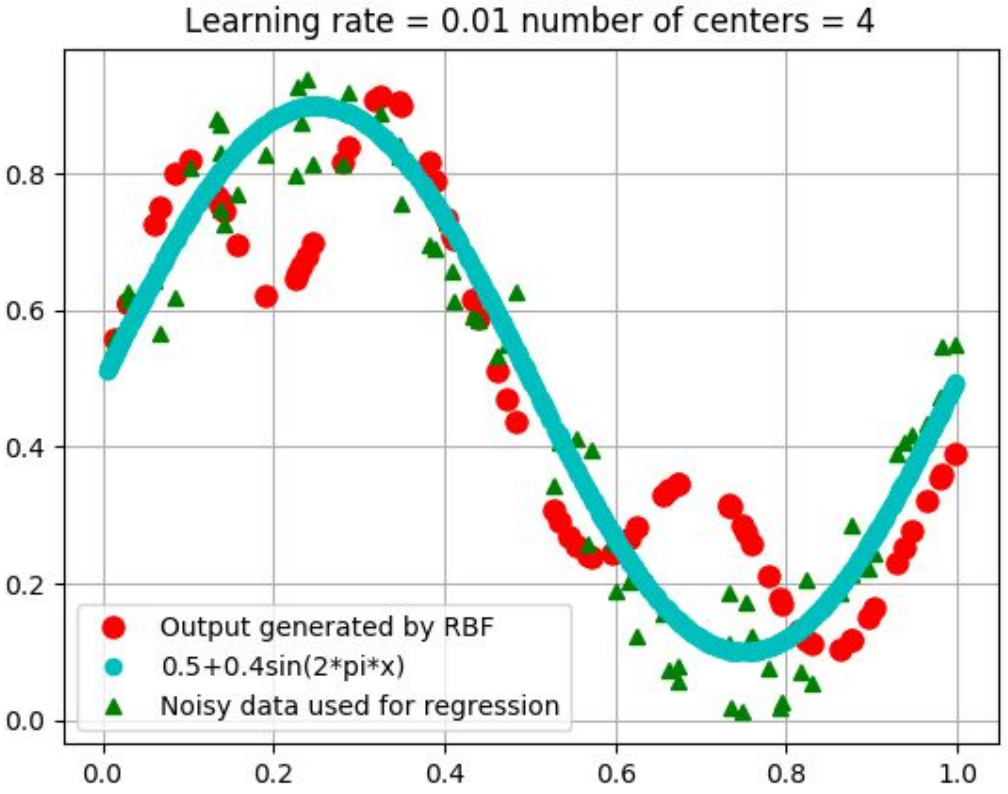
For the case where network was trained with a common variances:-

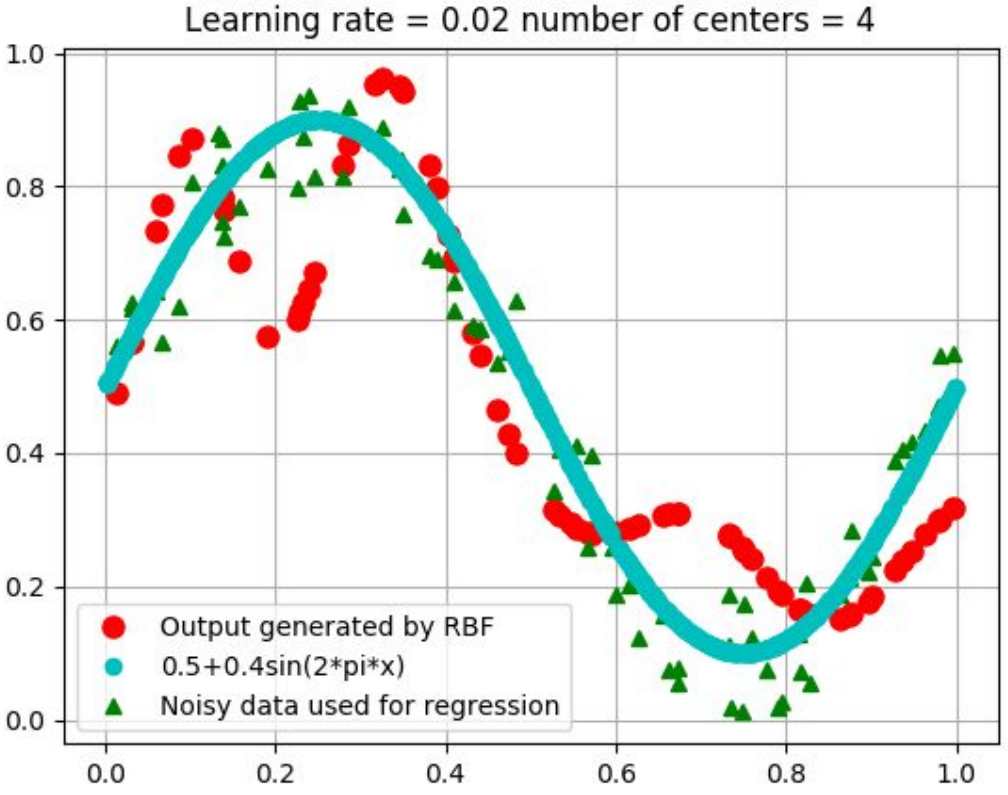
- The network's performance seems to be better with larger number of bases.
- And, the network does a better job for the higher learning rate value.

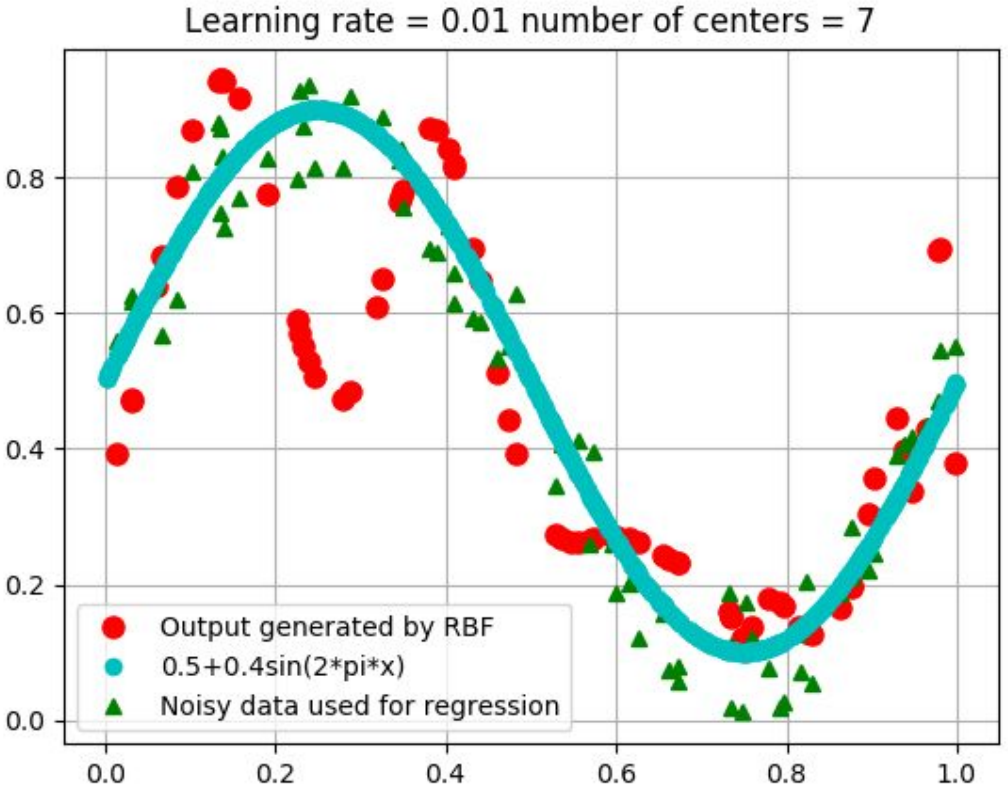
The following are the screenshots of the graphs generated by training system with different variances:-

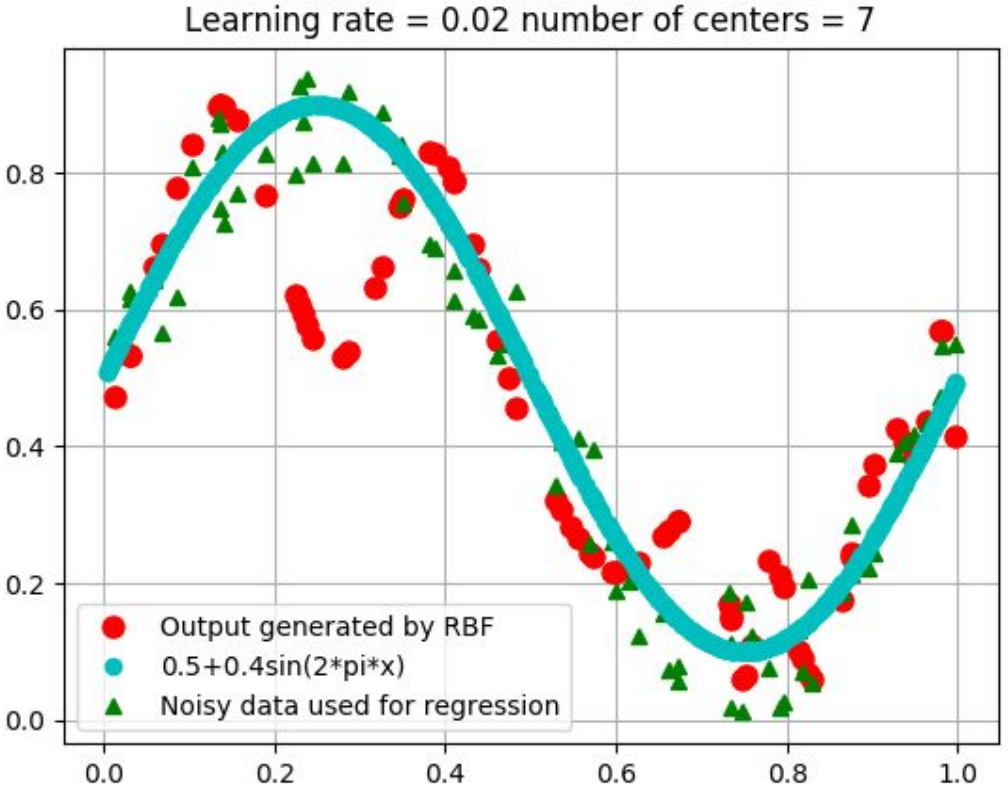

Learning rate = 0.01 number of centers = 2
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
0.0
0.2
0.4
0.6
0.8
1.0

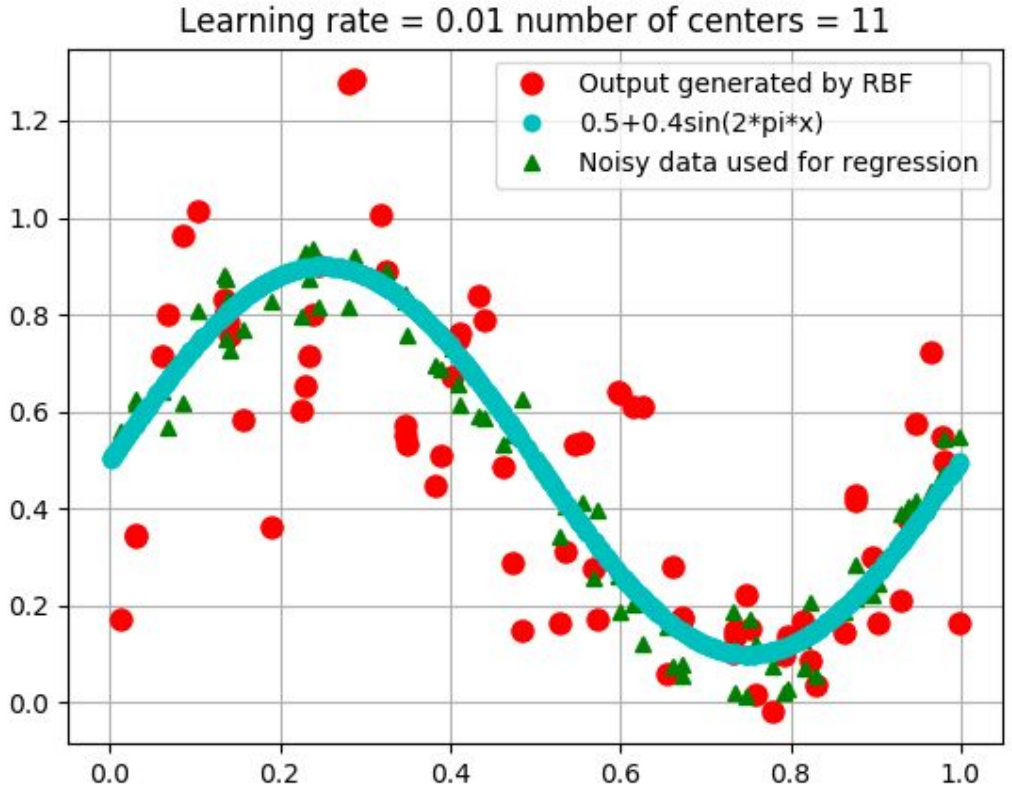

Learning rate = 0.02 number of centers = 2
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
0.0
0.2
0.4
0.6
0.8
1.0

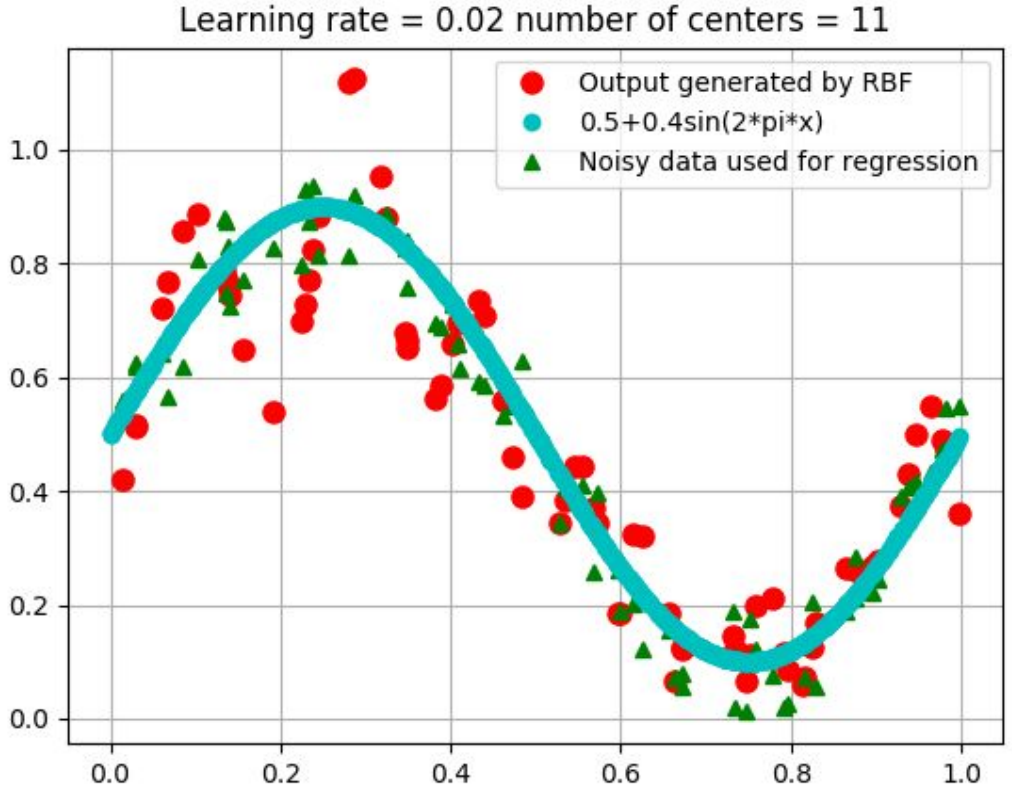

Learning rate = 0.01 number of centers = 4
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
0.0
0.2
0.4
0.6
0.8
1.0

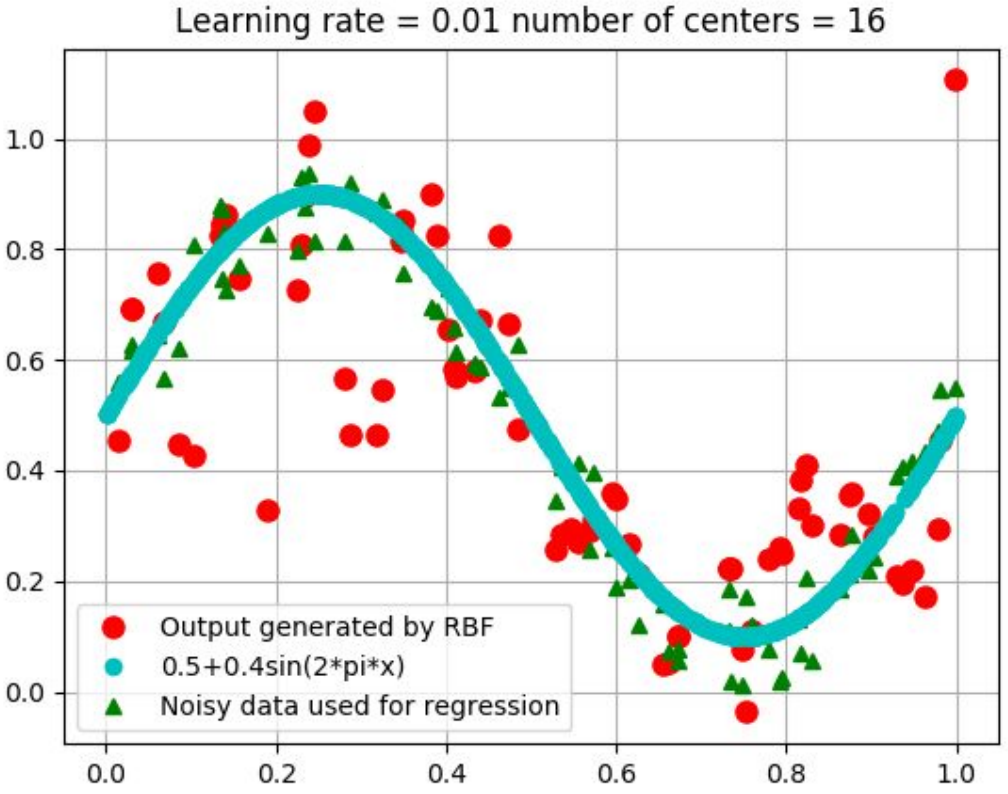

Learning rate = 0.02 number of centers = 4
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
0.0
0.2
0.4
0.6
0.8
1.0

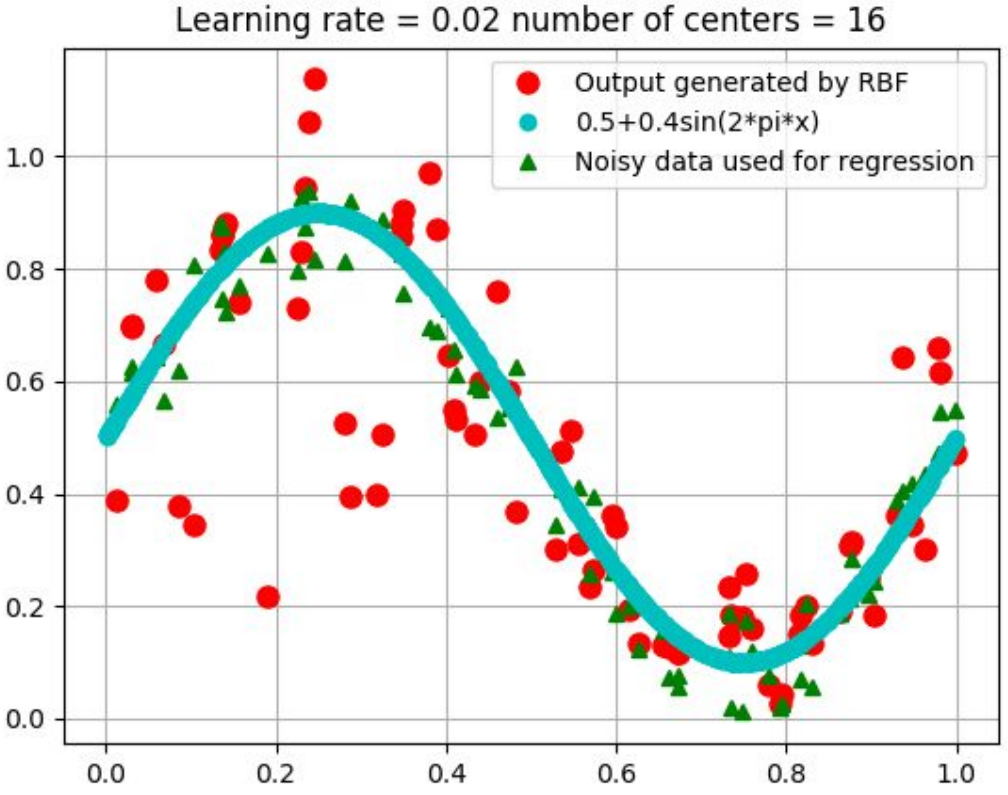

Learning rate = 0.01 number of centers = 7
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
0.0
0.2
0.4
0.6
0.8
1.0


Learning rate = 0.02 number of centers = 7
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
0.0
0.2
0.4
0.6
0.8
1.0

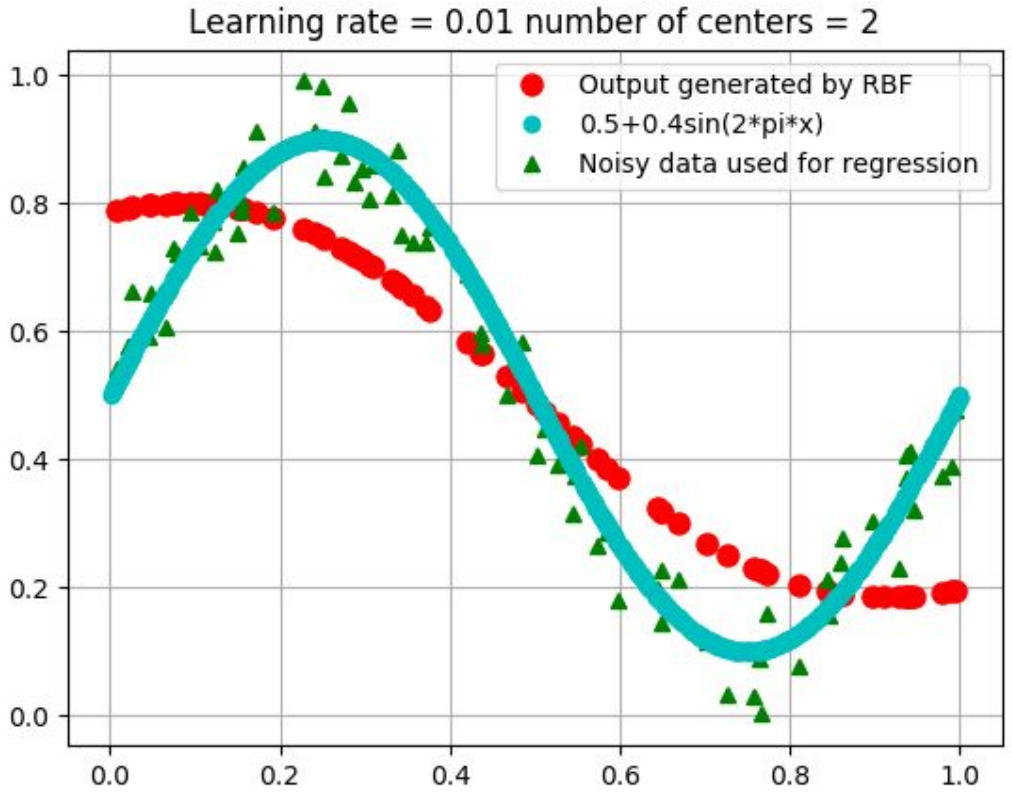

Learning rate = 0.01 number of centers = 11
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

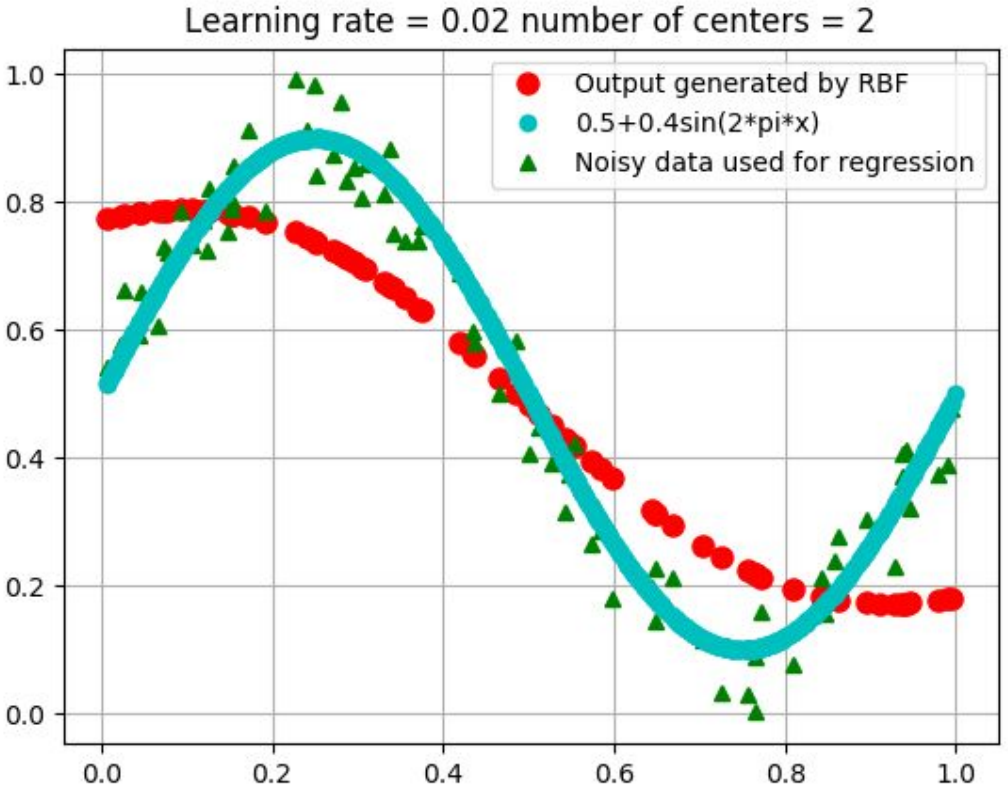

Learning rate = 0.02 number of centers = 11
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

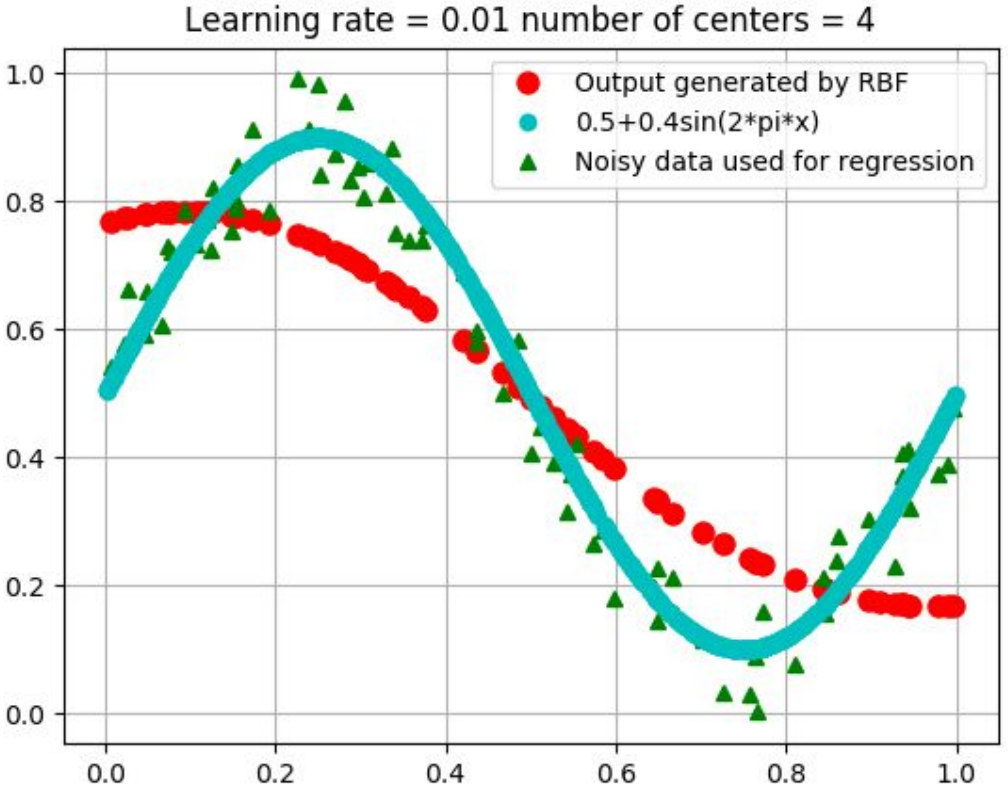

Learning rate = 0.01 number of centers = 16
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
0.0
0.2
0.4
0.6
0.8
1.0

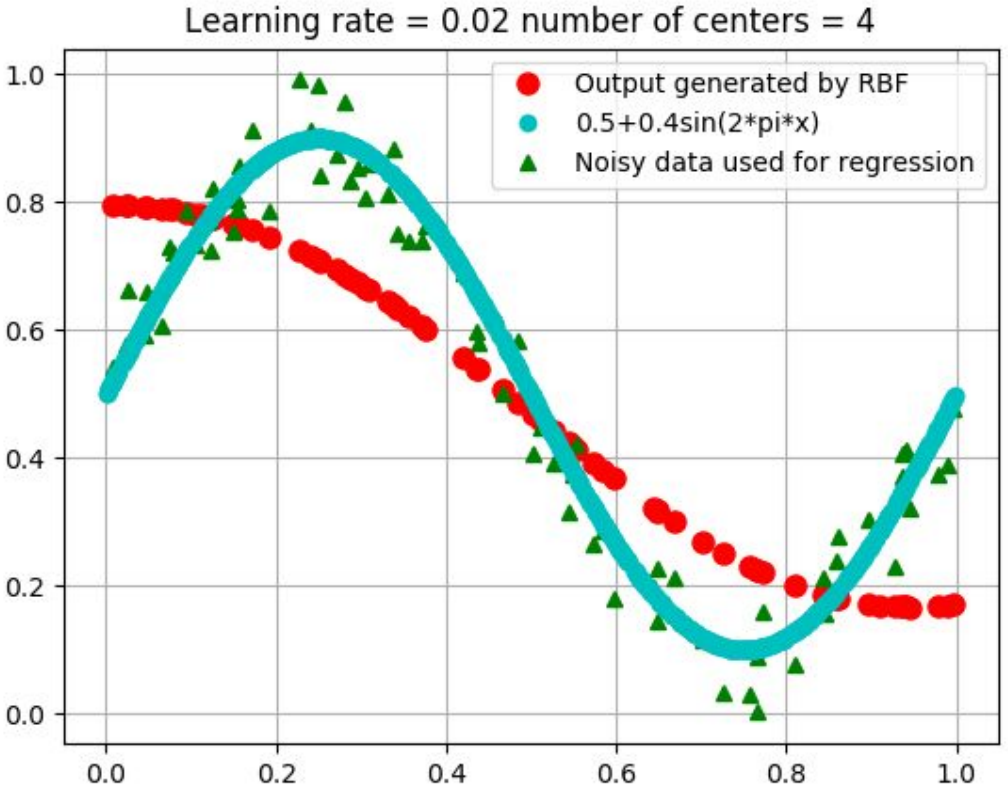

Learning rate = 0.02 number of centers = 16
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
0.0
0.2
0.4
0.6
0.8
1.0

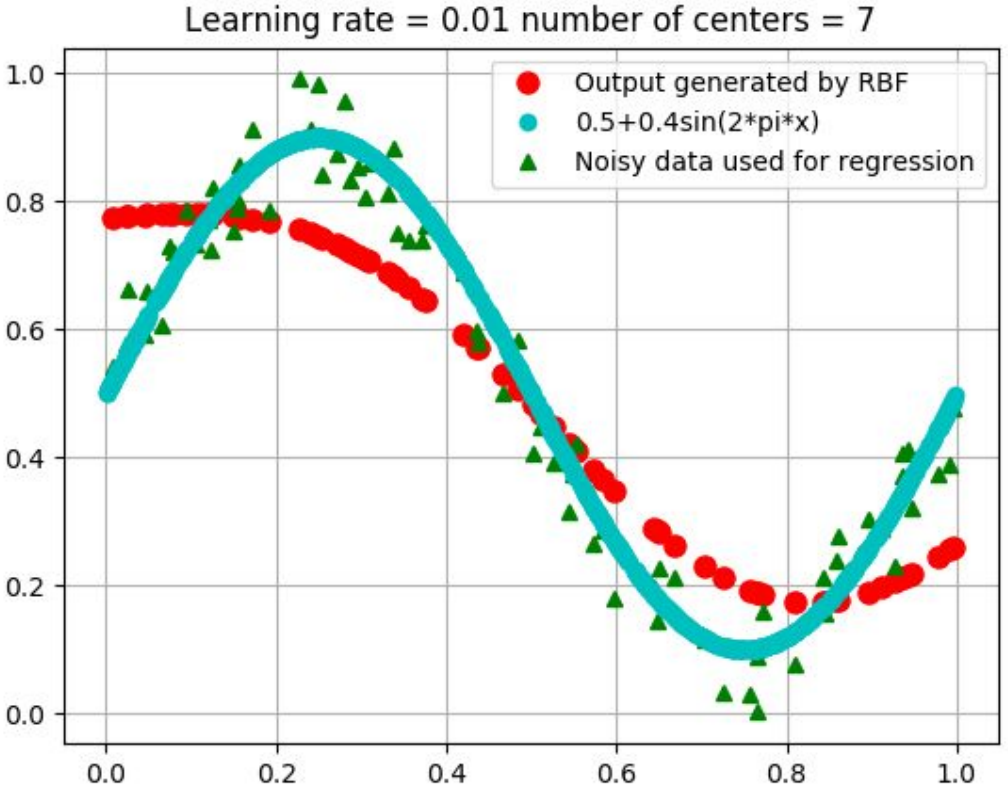
The following are the screenshots of the graphs generated by training system with same variances:-

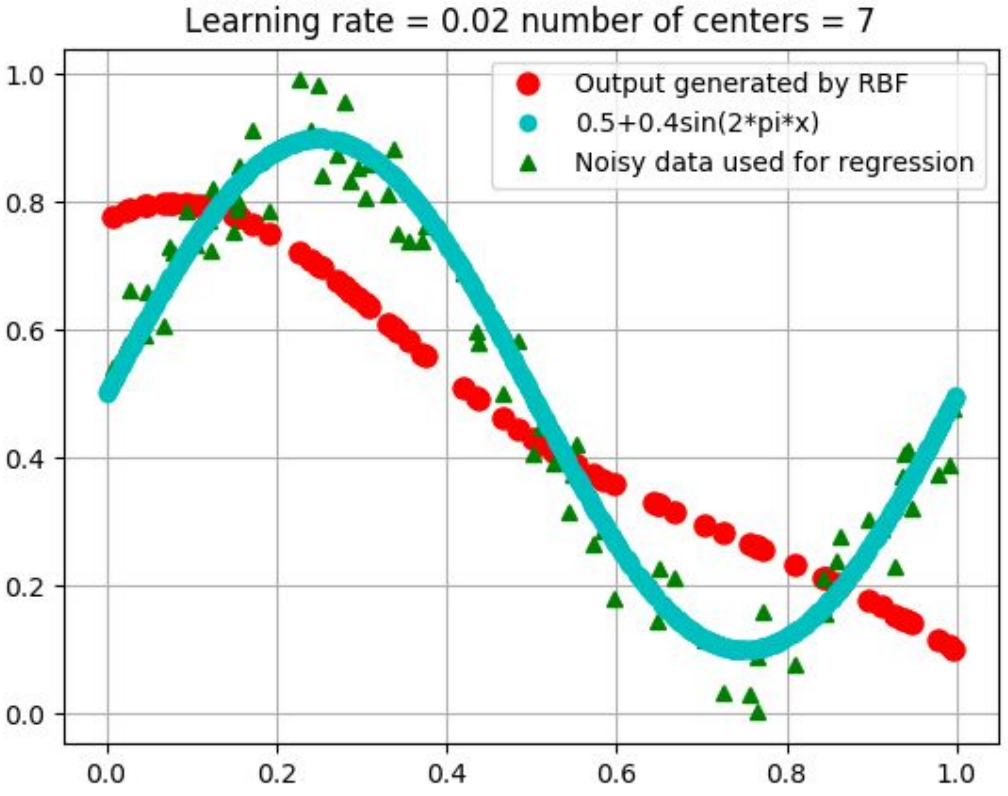


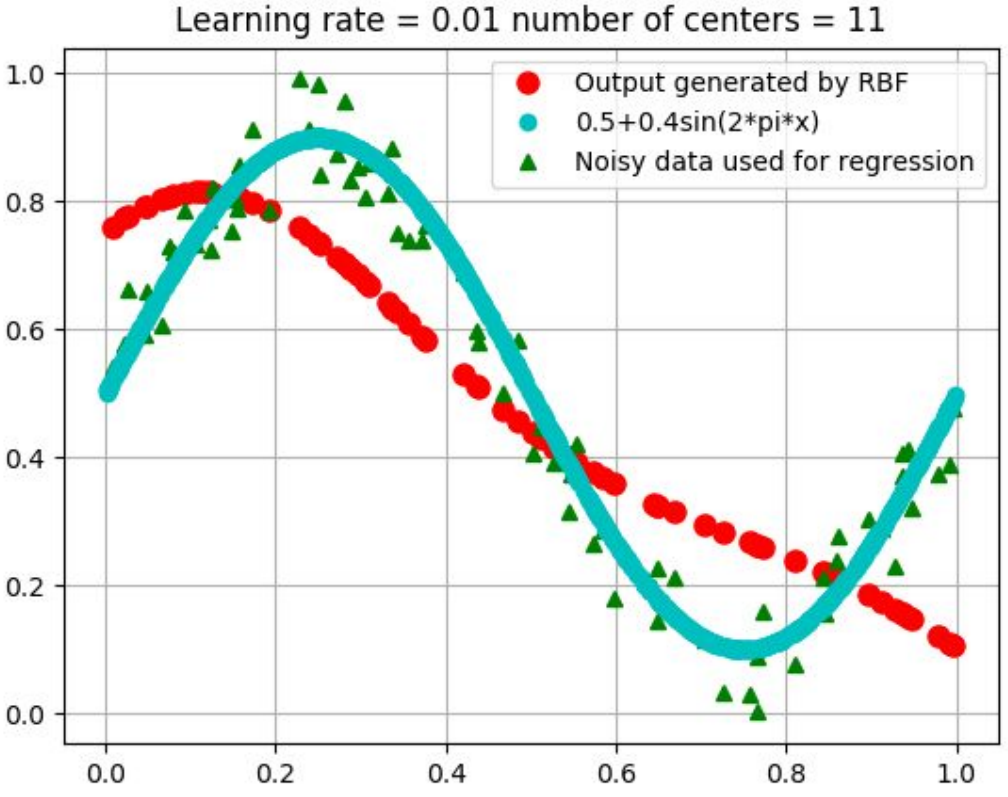

Learning rate = 0.02 number of centers = 2
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

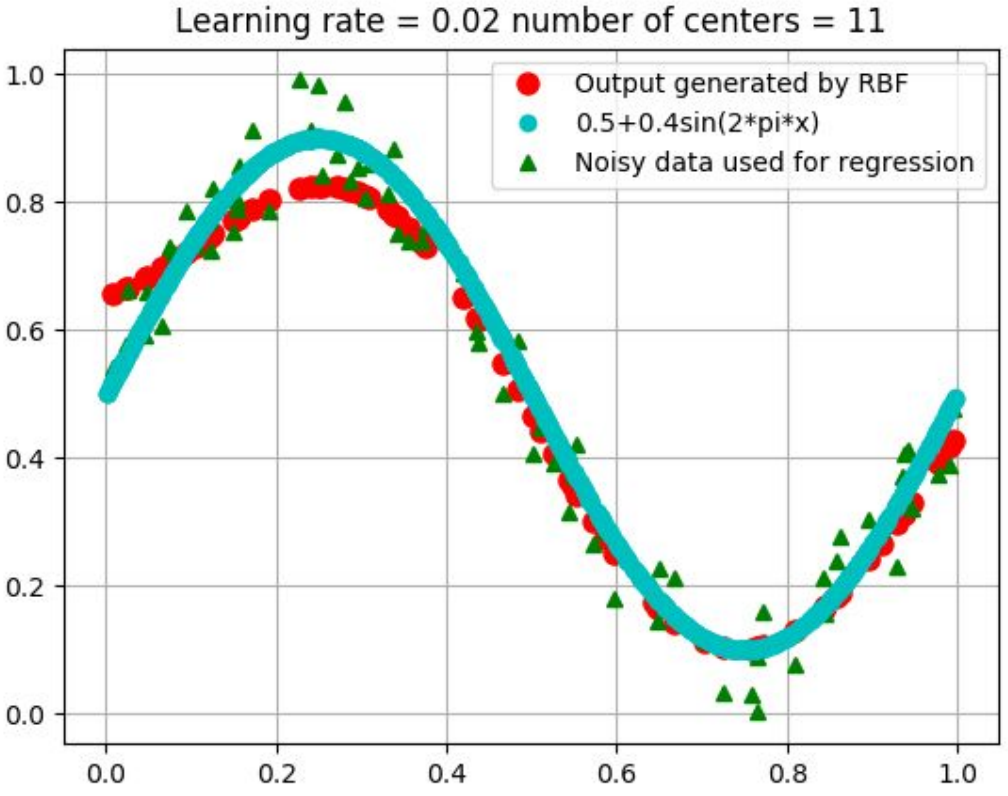

Learning rate = 0.01 number of centers = 4
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Learning rate = 0.02 number of centers = 4
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Learning rate = 0.01 number of centers = 7
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Learning rate = 0.02 number of centers = 7
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Learning rate = 0.01 number of centers = 11
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Learning rate = 0.02 number of centers = 11
Output generated by RBF
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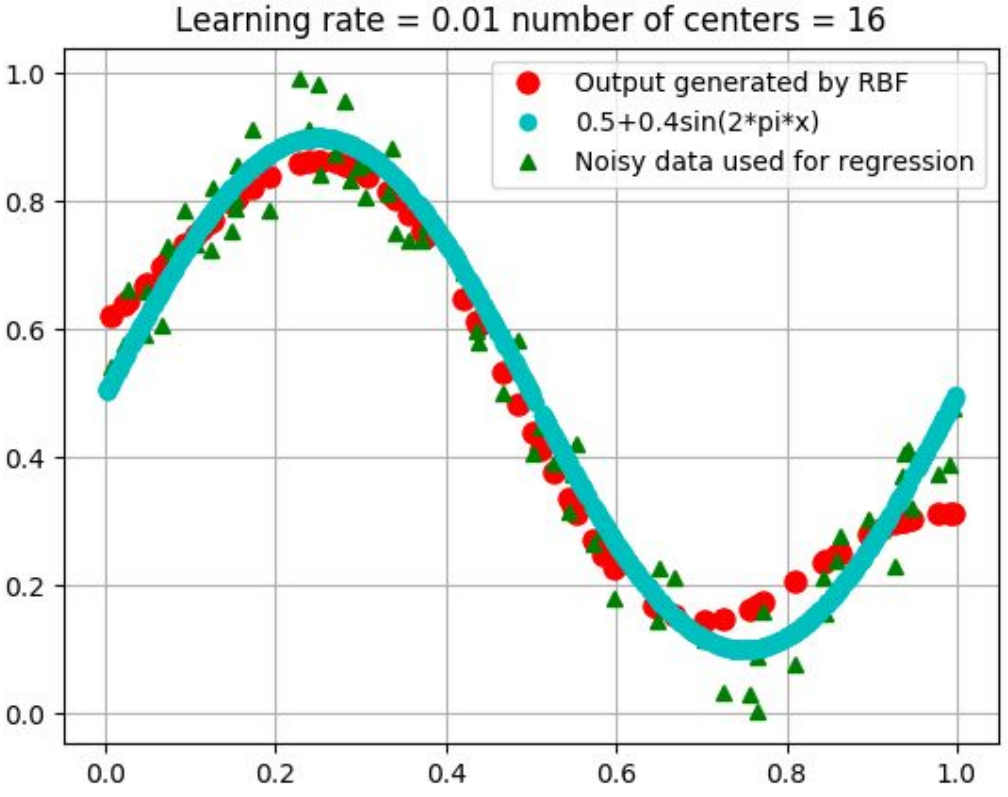
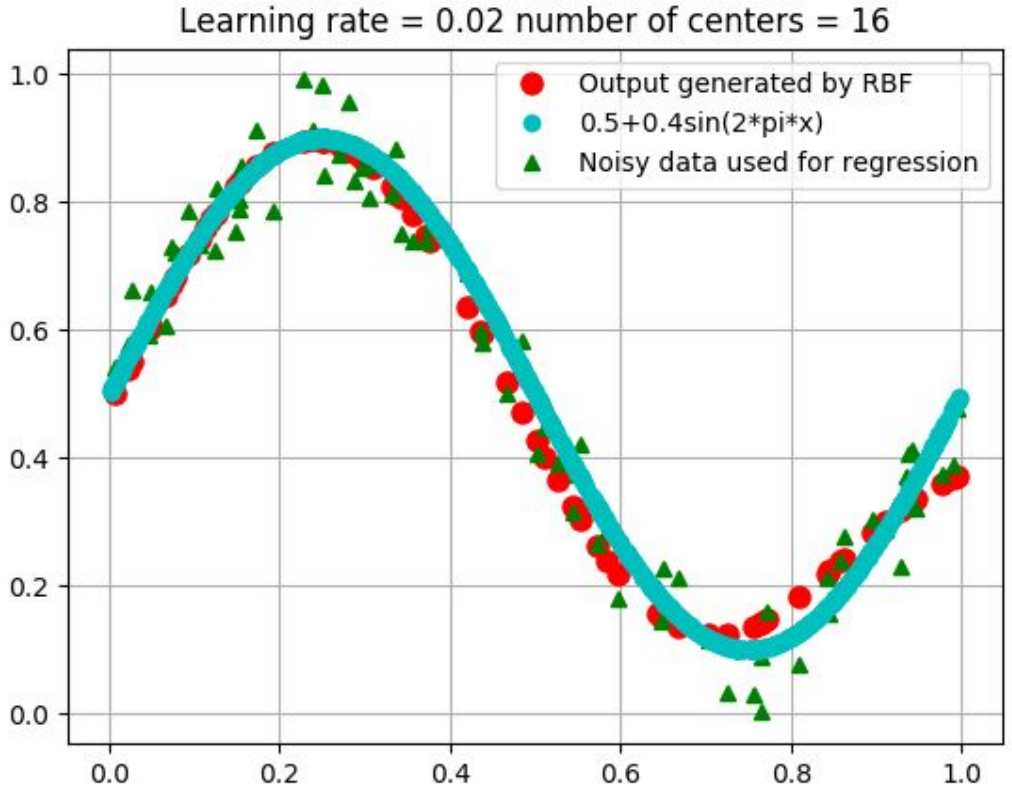
Noisy data used for regression
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Learning rate = 0.01 number of centers = 16
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Learning rate = 0.02 number of centers = 16
Output generated by RBF
0.5+0.4sin(2*pi*x)
Noisy data used for regression
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0