THE UNIVERSITY *of* EDINBURGH
informatics

Applied Machine Learning (AML)

Class Starting at 4:10pm

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Applied Machine Learning

Week 4: Linear Regression and Decision Trees

This session will be recorded.

Overview

1) Discussion of Week 3’s topics
2) Quiz questions
3) Outline your tasks this for week

https://tinyurl.com/aml2024

THE NOBEL PRIZE IN PHYSICS 2024

Illustrations: Niklas Elmehed

John J. Hopfield Geoffrey E. Hinton

"for foundational discoveries and inventions
that enable machine learning
with artificial neural networks"

THE ROYAL SWEDISH ACADEMY OF SCIENCES

Lab and Tutorial Times

Tutorials

Tutorial 8 (Fri 1pm, weeks 4, 6, 8, 10) has been removed from the timetable. If you were in that group you will have been assigned to a different group.

Labs

Lab 8 (Fri 11am, weeks 3, 5, 7, 9) has been **incorrectly** removed from the timetable. If you were in that group, you will have been re-assigned to a different group. This may get changed back later this week.

Apologies for any inconvenience caused.

Changing Lab/Tutorial Group

If your assigned time slot clashes with your other classes, you can submit a Group Change Request Form.

https://www.ed.ac.uk/timetabling-examinations/timetabling/personalised-timetables/student-timetables

However, we encourage you to only do this if you have a conflict. Otherwise, you should stay with the group you have been assigned.

No need to contact the course organisers about this.

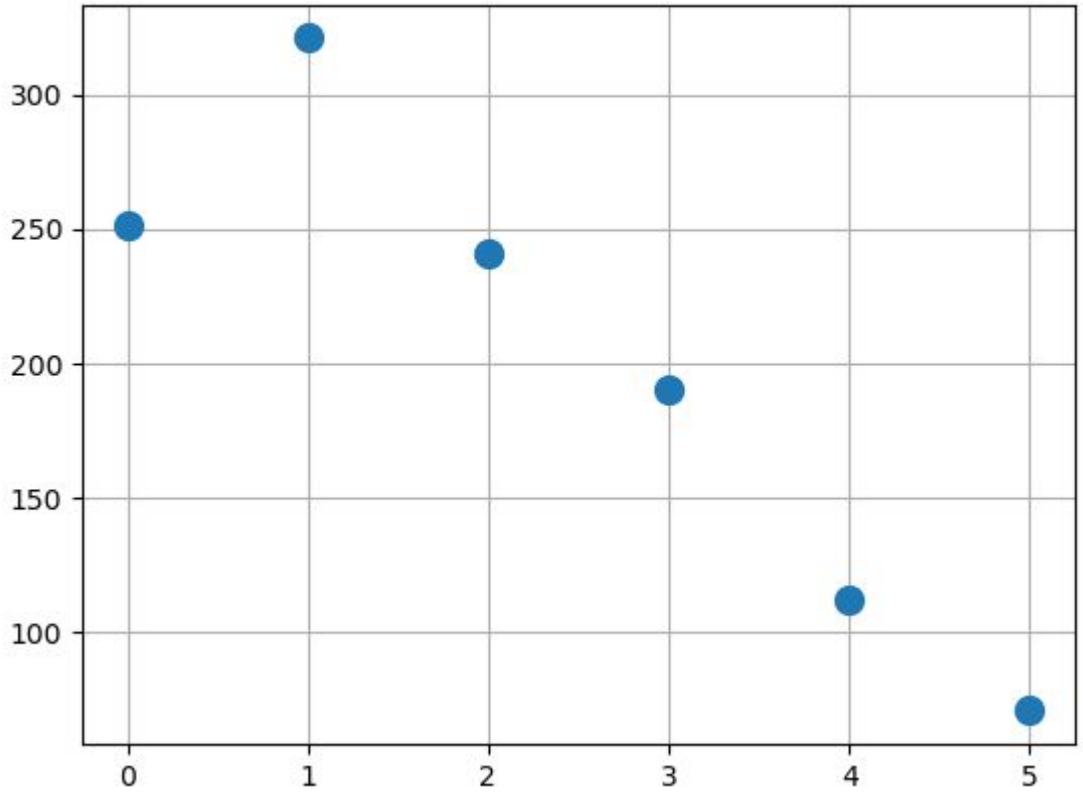
Coursework

- Info available on course webpage
  - https://groups.inf.ed.ac.uk/teaching/aml/mini-project

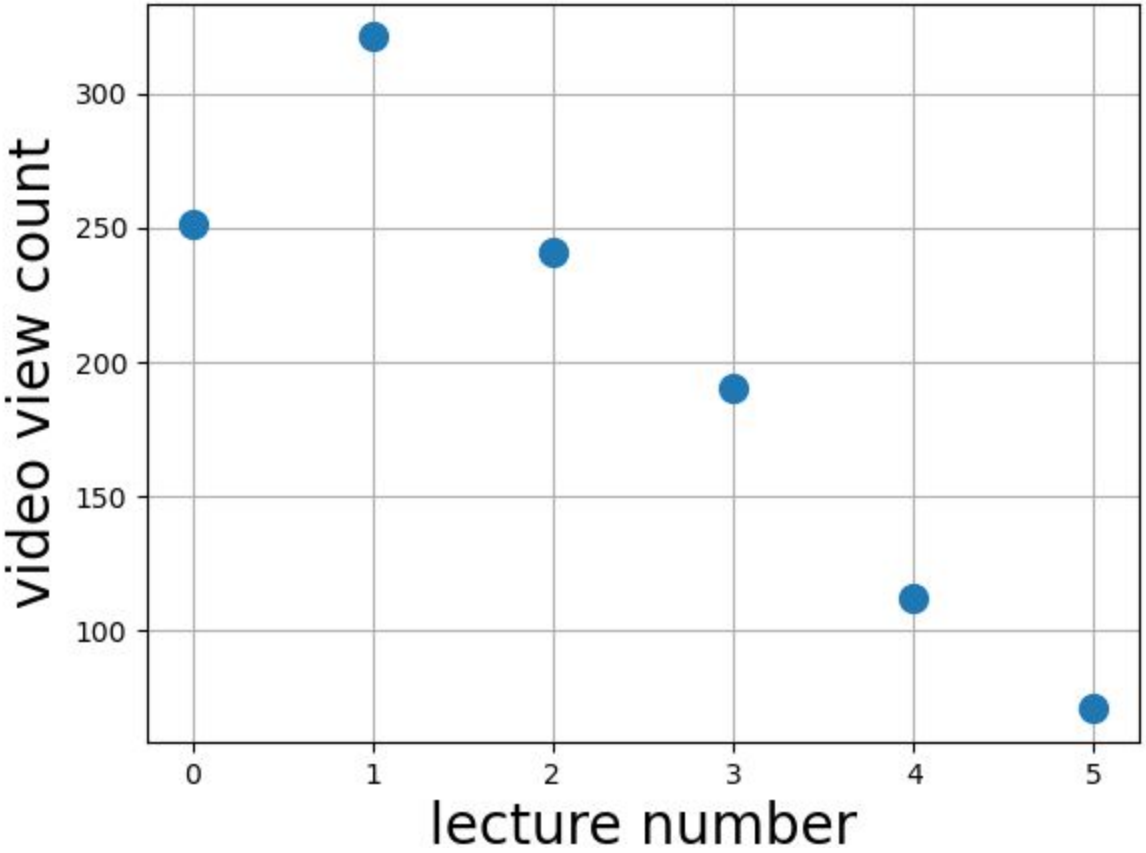
- If you have not already been assigned a group, we will allocate you this week. This will be online ~tomorrow.

- If you have questions about the CW, check the FAQ, and if not answered, post them as private messages on Piazza.

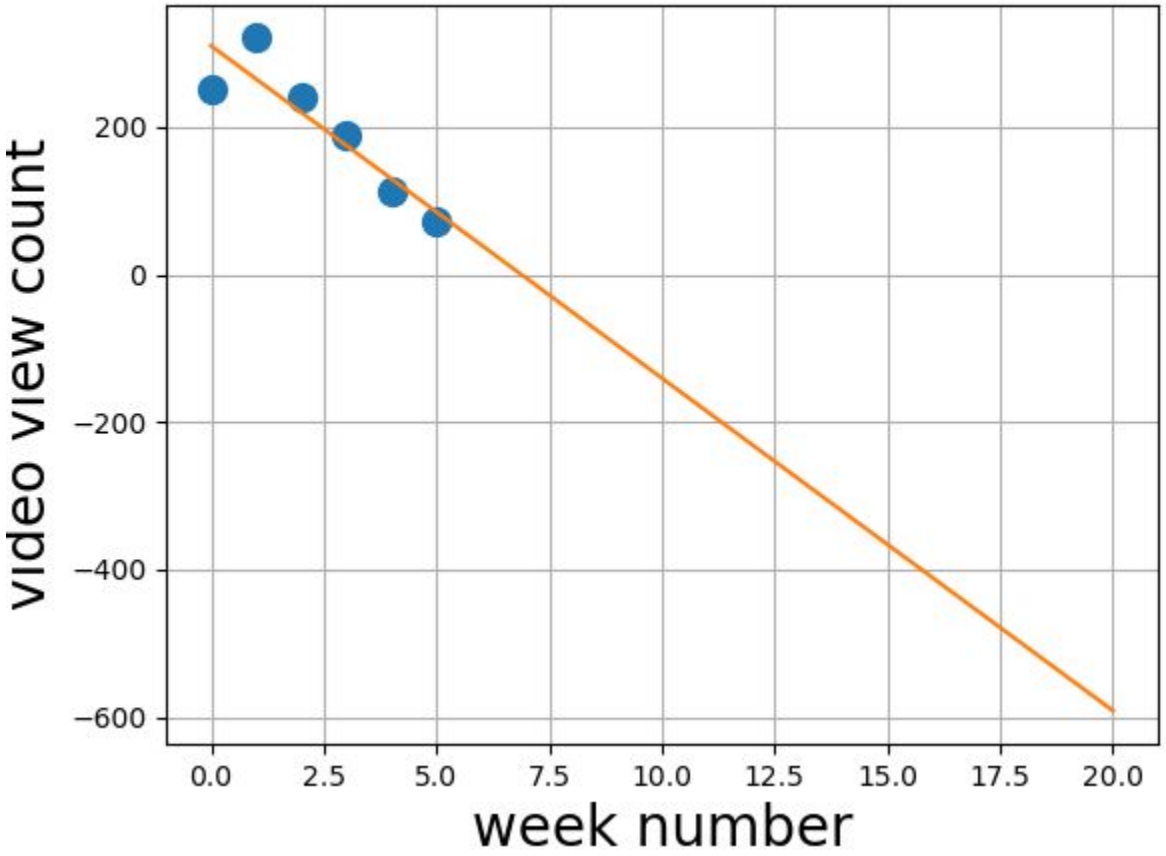
What data is this?



What data is this?



Future trend?



Interactive - Linear Regression

https://mlu-explain.github.io/linear-regression

Quiz Questions

Interactive - Decision Trees

https://mlu-explain.github.io/decision-tree

Quiz Questions

Polynomial Regression

- Up until now we have set $\phi(x) = [1, x]^\intercal$
- However, we can transform our inputs in different ways

- One example is **polynomial regression**, $\phi(x) = [1, x, x^2, ..., x^M]^\intercal$
- Here, the dimensionality of our weights $\boldsymbol{w}$ will be the same as $\phi(x)$

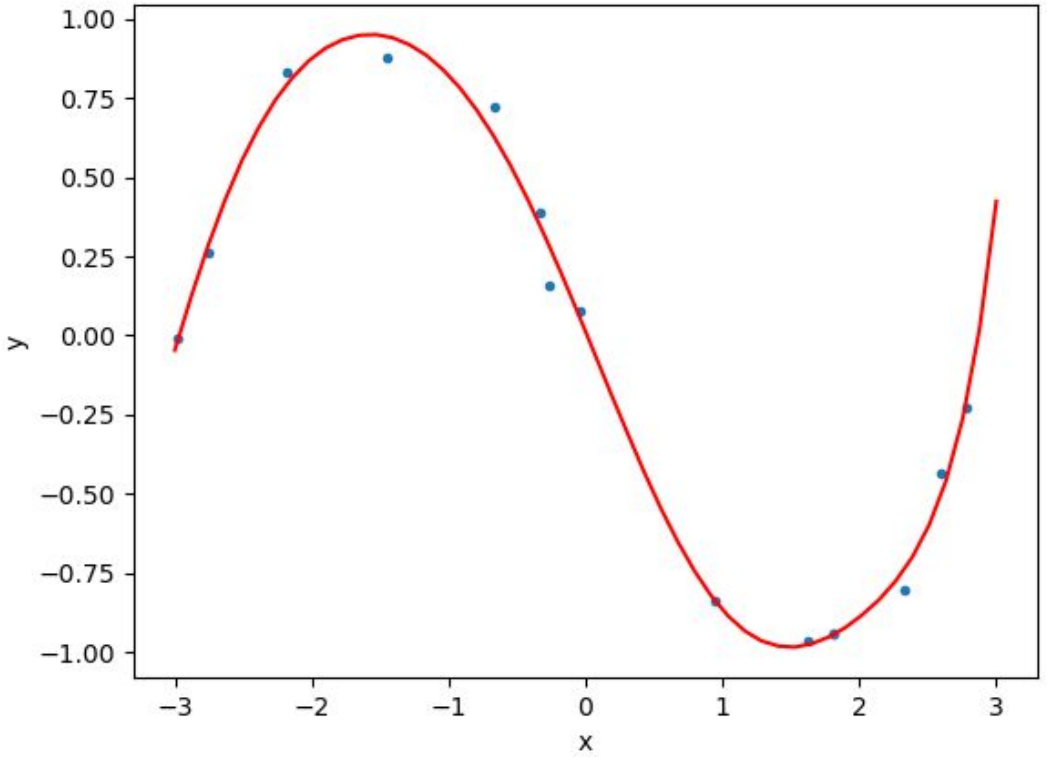
Basis Functions

- We can easily transform the original features $\boldsymbol{x}$ **non-linearly** into $\phi(\boldsymbol{x})$ and perform linear regression on the transformed features
- For example, we can use a set of M basis functions
  $\phi(\boldsymbol{x}) = [1, \psi_1(\boldsymbol{x}), \psi_2(\boldsymbol{x}), ..., \psi_M(\boldsymbol{x})]^\intercal$
- Each of these basis functions takes a vector as input and outputs a scalar value

Basis Functions

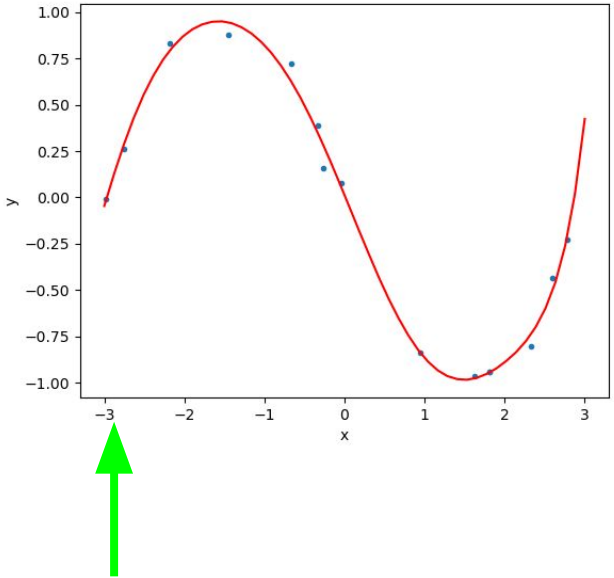
$$\phi(\boldsymbol{x}) = [1, \psi_1(\boldsymbol{x}), \psi_2(\boldsymbol{x}), ..., \psi_M(\boldsymbol{x})]^\intercal$$

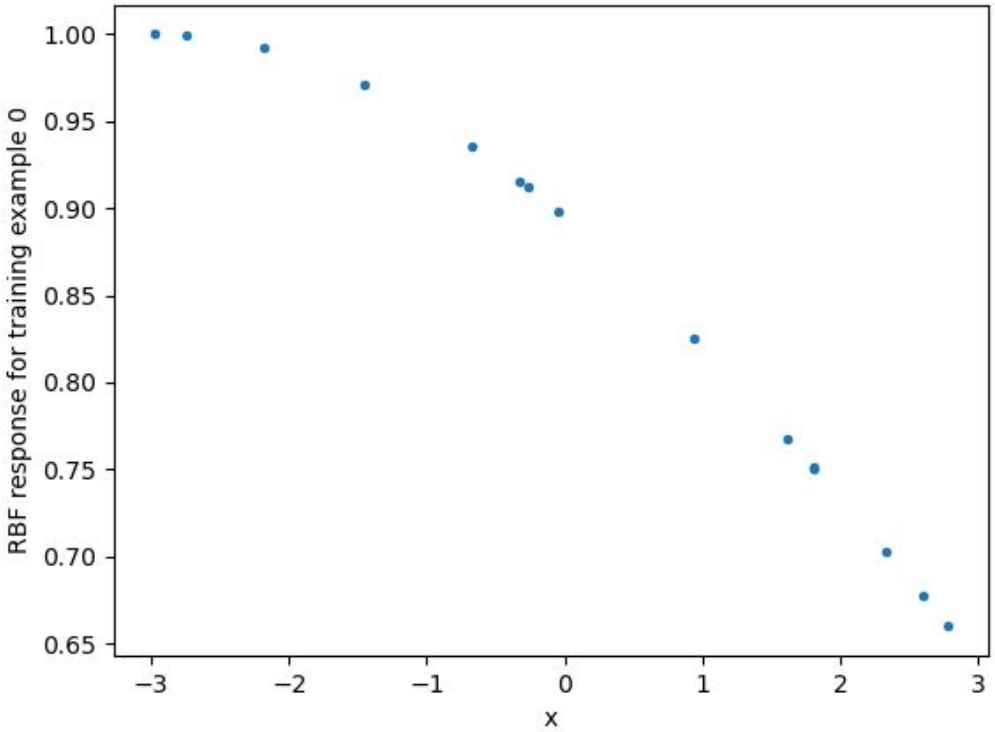
In this example, we have a RBF centred on each training point and we use the same value of σ^2 for each



Basis Functions

$$\psi_m(\boldsymbol{x}) = \exp\left(-0.5\frac{||\boldsymbol{x} - \boldsymbol{c}_m||^2}{\sigma_m^2}\right)$$

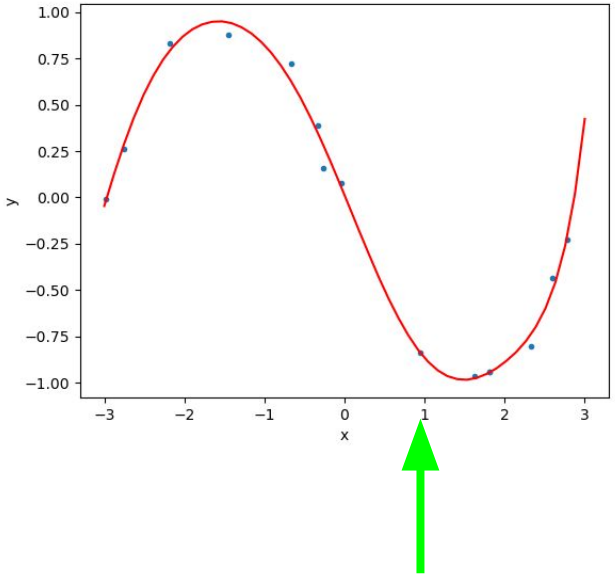


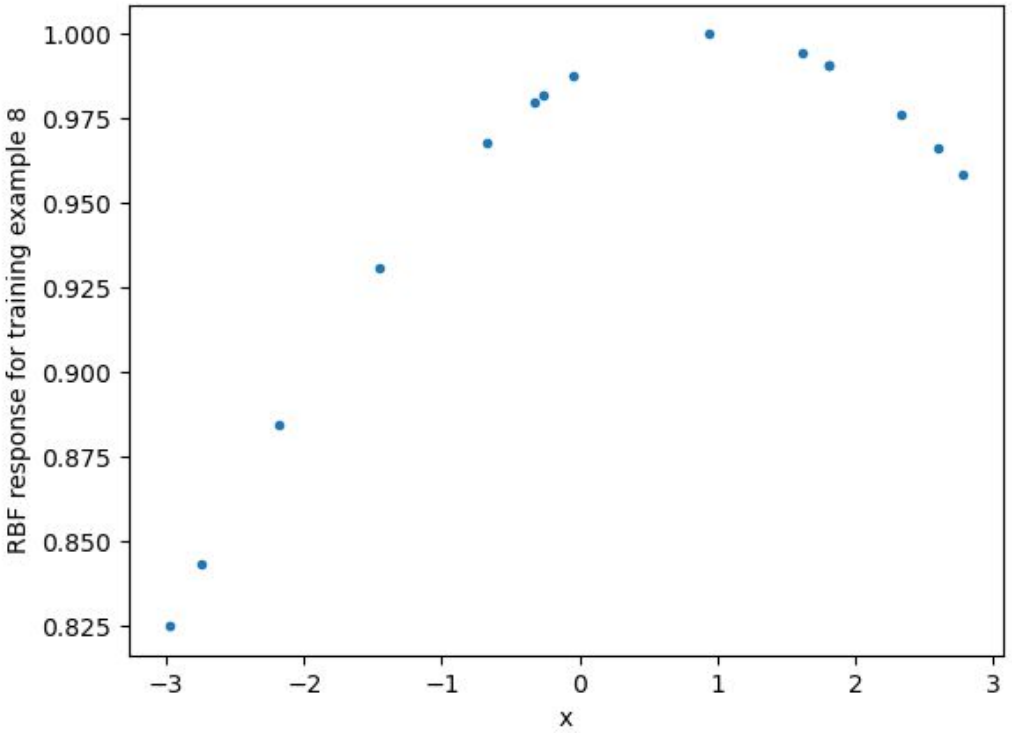


Here we plot responses of the different RBFs for the first training example

Basis Functions

$$\psi_m(\boldsymbol{x}) = \exp\left(-0.5\frac{||\boldsymbol{x} - \boldsymbol{c}_m||^2}{\sigma_m^2}\right)$$

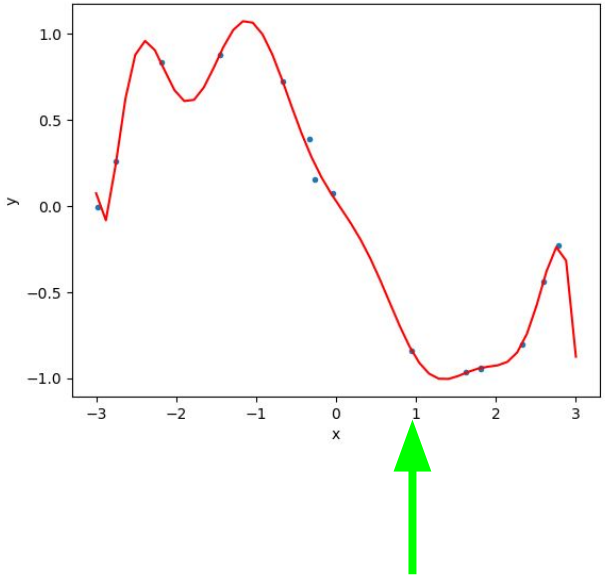


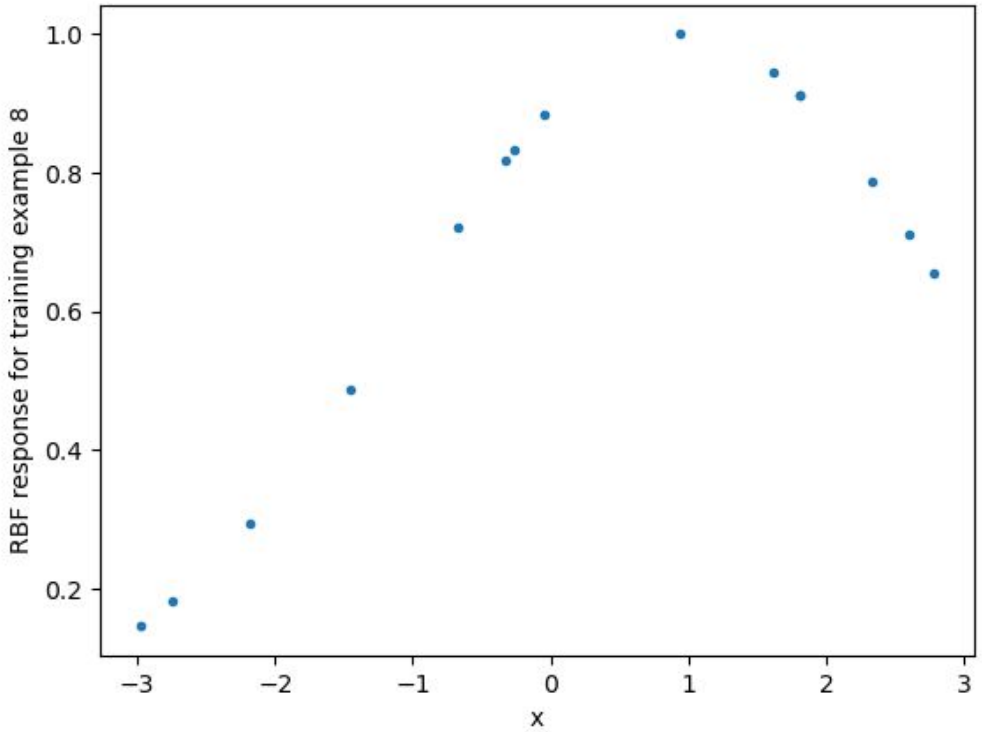


Here we plot responses of the different RBFs for a different training example

Basis Functions

$$\psi_m(\boldsymbol{x}) = \exp\left(-0.5\frac{||\boldsymbol{x} - \boldsymbol{c}_m||^2}{\sigma_m^2}\right)$$





Here we decrease the variance of the RBF

Week 4: Your tasks for this week

1) Complete Tutorial 1 - solutions will be online next week
2) Watch the videos for Week 4 - **Representing Data** and **Exploratory Data Analysis**
    a) Ask questions on Piazza if stuck
3) Start the coursework - due in Week 10
    a) Groups will be online soon
    b) We will discuss progress reports soon
4) Start Lab 2 - link in Week 5