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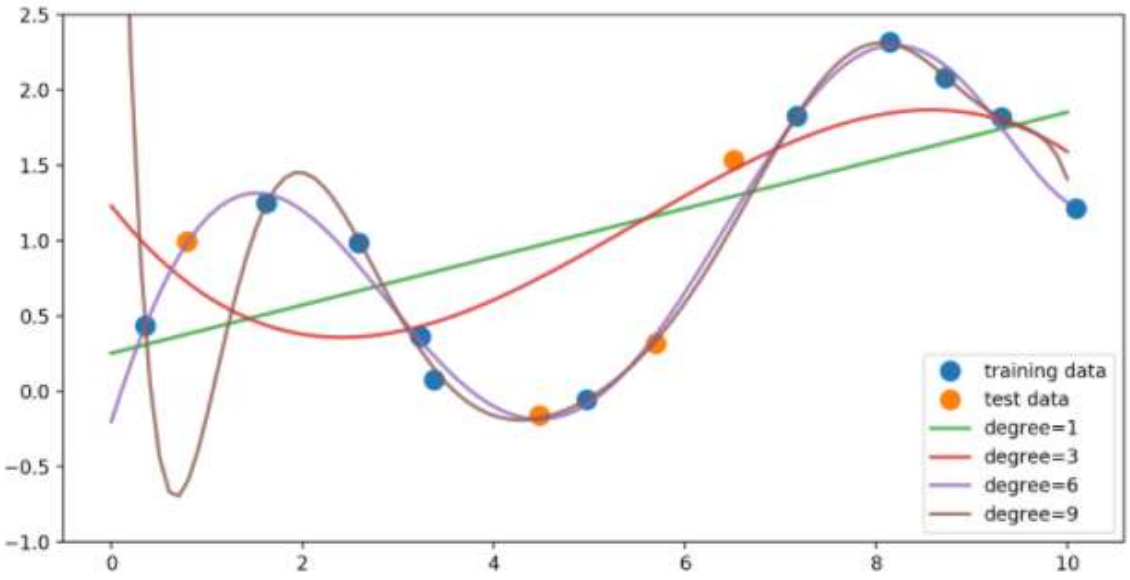
ML Lab-01

Question 1

Write a function that fits a polynomial LinearRegression model on the *training data* `X_train` for degrees 1, 3, 6, and 9. (Use PolynomialFeatures in sklearn.preprocessing to create the polynomial features and then fit a linear regression model) For each model, find 100 predicted values over the interval x = 0 to 10 (e.g. `np.linspace(0,10,100)`) and store this in a numpy array. The first row of this array should correspond to the output from the model trained on degree 1, the second row degree 3, the third row degree 6, and the fourth row degree 9.



First, run the following block to set up the variables needed for later sections.

```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split


np.random.seed(0)
n = 15
x = np.linspace(0,10,n) + np.random.randn(n)/5
y = np.sin(x)+x/6 + np.random.randn(n)/10


X_train, X_test, y_train, y_test = train_test_split(x, y, random_state=0)
```

Question 2 ¶

Write a function that fits a polynomial LinearRegression model on the training data `X_train` for degrees 0 through 9. For each model compute the R^2 (coefficient of determination) regression score on the training data as well as the the test data, and return both of these arrays in a tuple.

This function should return one tuple of numpy arrays (`r2_train, r2_test`). Both arrays should have shape `(10,)`

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Question 3

Based on the R^2 scores from question 2 (degree levels 0 through 9), what degree level corresponds to a model that is underfitting? What degree level corresponds to a model that is overfitting? What choice of degree level would provide a model with good generalization performance on this dataset?

Hint: Try plotting the R^2 scores from question 2 to visualize the relationship between degree level and R^2. Remember to comment out the import matplotlib line before submission.

Question 4

Training models on high degree polynomial features can result in overly complex models that overfit, so we often use regularized versions of the model to constrain model complexity, as we saw with Ridge and Lasso linear regression.

For this question, train two models: a non-regularized LinearRegression model (default parameters) on polynomial features of degree 12. Return the R^2 score for the LinearRegression model's test sets.

*This function should return one value `(LinearRegression_R2_test_score)