IE 529   Fall 2016   Computational Assignment 2

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I. Lloyd's (K-means)Algorithm

1. In this part, the polynomial regression is conducted on the given dataset. The derivation is relatively simple, here we only give one simple version.

II. Greedy K-centers Algorithm

III. Single-Swap Algorithm

IV. Spectral Clustering Algorithm

V. Expectation Maximization (EM) Algorithm

```python
def polynomial_regression(x, y, degree, x_range):
    """ function to perform polynomial regression and compute least suares error

        Parameters:
        _____
        x: input array, should have one dimension
        y: fit goal, shoule have one dimension
        degree: polynomial degress

        return:
        _____
        w: weight matrix, the first value is intercept
        prediction: predicted values
        error: least squares error
    """

    n = len(x)
    # map x into multiple columns
    X = np.zeros((n, degree + 1))
    X[:, 0] = 1
    for i in range(1, degree + 1):
        X[:, i] = x ** i

    # reshape y into n by 1 format
    Y = np.array([y]).T

    # compute w, prediction and error
    w = np.dot(np.dot(np.linalg.inv(np.dot(X.T, X)), X.T), Y)
    error = np.sum((np.dot(X, w) - Y) ** 2)

    # compute the prediction
    new_X = np.zeros((len(x_range), degree + 1))
    new_X[:, 0] = 1
    for i in range(1, degree + 1):
        new_X[:, i] = x_range ** i
    prediction = np.dot(new_X, w)

    return w, error, prediction
```

Listing 1: Python example