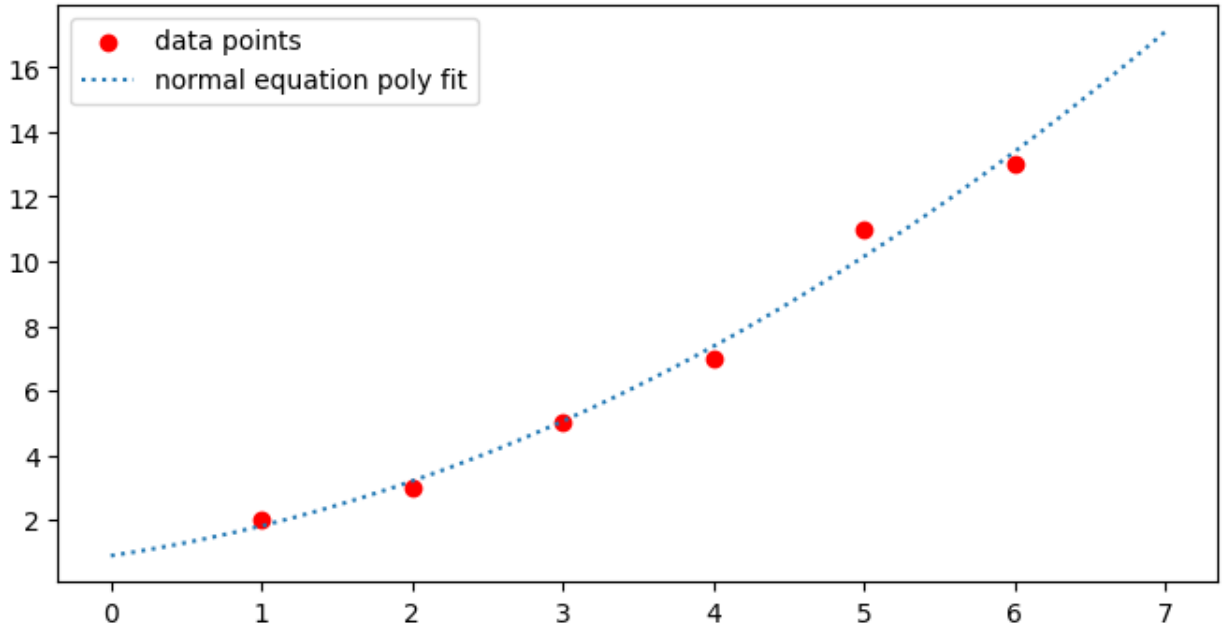
1

Vandermonde Matrix:

```
array([[  1.,   1.,   1.,   1.],
       [  1.,   2.,   4.,   8.],
       [  1.,   3.,   9.,  27.],
       [  1.,   4.,  16.,  64.],
       [  1.,   5.,  25., 125.],
       [  1.,   6.,  36., 216.],
       [  1.,   7.,  49., 343.],
       [  1.,   8.,  64., 512.],
       [  1.,   9.,  81., 729.]])
```

2

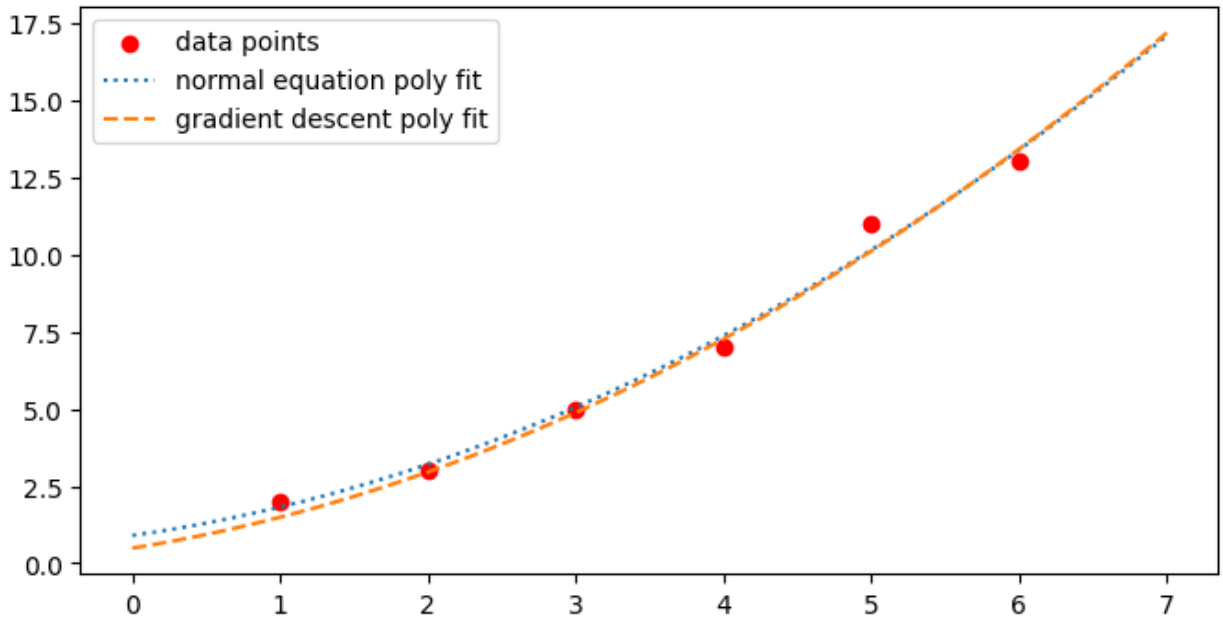
Estimated polynomial equation $= 0.2321x^2 + 0.6893x + 0.9000$
Mean squared error is 0.1821



3

$T = 7140$

Estimated polynomial equation $= 0.2304x^2 + 0.7725x + 0.4894$
Mean Squared Error is 0.2181 (19.7% larger than Part 2)



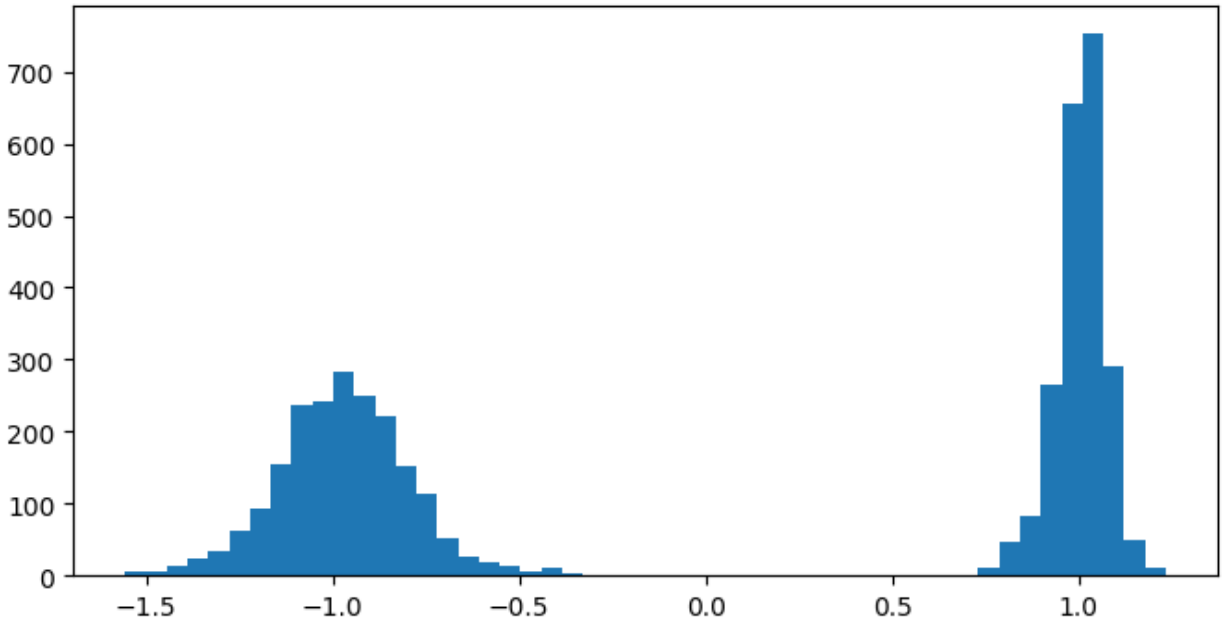
4

Training Error = 0.32%

Training Confusion Matrix = $\begin{bmatrix} 2062 & 3 \\ 10 & 2332 \end{bmatrix}$

Testing Error = 1.18%

Testing Confusion Matrix = $\begin{bmatrix} 2043 & 23 \\ 29 & 2313 \end{bmatrix}$



Since the two histograms are very far apart, it is not very difficult to separate the two classes

5

```
[[0.   0.32 0.82 0.4  0.39 0.98 0.7  0.16 0.83 0.41]
 [1.18 0.   0.88 0.8  0.14 0.57 0.18 0.55 1.74 0.34]
 [2.17 2.26 0.   1.95 0.87 1.23 0.99 0.89 2.04 0.67]
 [1.18 1.9  3.82 0.   0.24 2.58 0.33 0.96 2.45 1.24]
 [0.63 1.12 2.13 1.21 0.   0.58 0.37 0.76 0.44 2.15]
 [2.4  1.53 2.98 5.72 1.96 0.   1.41 0.2  2.37 0.73]
 [1.64 0.86 2.36 1.65 1.29 3.68 0.   0.   0.85 0.14]
 [0.84 1.61 2.52 1.83 2.62 1.46 1.05 0.   0.57 2.61]
 [1.56 4.21 3.83 4.71 1.2  5.17 2.27 1.87 0.   1.24]
 [1.18 1.08 1.89 2.6  4.89 2.58 0.72 5.15 3.05 0.  ]]
```

6

Training Error = 14.05%
Training Confusion matrix:

```
 [[1987    2    4    5    8   20   25    0   21    2]
 [   0 2306    9    7    4    4    8    0   30    3]
 [  28   86 1673   50   34    1   68   38   70    6]
 [  13   51   60 1859   10   36   24   27   51   45]
 [   5   31   19    1 1849   19   15    9   27  102]
 [  44   28    9  186   34 1321   69   12  138   52]
 [  36   20   19    0   23   26 1900    0   17    0]
 [  12   68   24   13   41    2    0 1902    5  127]
 [  30  164   16   77   36   77   15    6 1550   51]
 [  27   19    8   46  129    4    2  140   20 1703]]
```

Testing Error = 15.55%
Testing Confusion matrix:

```
 [[1961    3    7    9   13   12   25    3   24    1]
 [   2 2236   16    6    7    7    5    7   27    0]
 [  37   80 1683   77   41    4   99   30   57   15]
 [  13   50   82 1831    8   37   10   49   56   39]
 [   2   39   19    7 1712   18   19    9   33  137]
 [  55   31   15  178   37 1306   67   20  145   48]
 [  43   28   30    1   20   33 1923    0   18    0]
 [  25   62   17   22   58    2    3 1878    9  131]
 [  25  165   23   87   49   88   29    6 1527   42]
 [  26   21    6   34  141    4    1  157   23 1677]]
```