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ECE 1395

Homework 5

1b.

A black screen with white text

Description automatically generated

When sigma is too low, the model assigns more drop-off to farther away samples, and the prediction comes closer to a 1-NN model, which is overfit. When sigma is too high, it assigns less drop-off, so the model becomes underfit.

2.0

A collage of a few people

Description automatically generated

2.1a

A graph of numbers and a line

Description automatically generated with medium confidence

|  |  |  |
| --- | --- | --- |
| A graph of a number  Description automatically generated with medium confidence | A graph of a graph  Description automatically generated | A graph of a graph  Description automatically generated |

2.1b

A blurry image of a person's face

Description automatically generated

The figure clearly resembles a face. It is blurry due to the pictures being taken of various facial poses, but key facial features are visible.

2.1c

A graph with numbers and lines

Description automatically generated

|  |  |  |
| --- | --- | --- |
| A graph of a graph  Description automatically generated | A close-up of a grid  Description automatically generated | A graph of a graph  Description automatically generated with medium confidence |

2.1d

A graph with a line

Description automatically generated



2.1e



A group of images of a person's face

Description automatically generated

The eigenfaces are clearly distinct from the original images and retain much less detail. However, they clearly maintain essential facial features, such as eyes, nose, mouth, and facial shape.

2.2b



2.3a

A black and white screen with white text

Description automatically generated

The accuracy of KNN steadily decreases as k increases, with k=1 having the highest accuracy.

2.3b

Training Time

|  |  |  |
| --- | --- | --- |
|  | One-vs-One | One-vs-All |
| Linear | 0.019240856170654297 | 0.01748514175415039 |
| Polynomial | 0.019793272018432617 | 0.019698143005371094 |
| RBF | 0.02229619026184082 | 0.022463083267211914 |

Testing Time

|  |  |  |
| --- | --- | --- |
|  | One-vs-One | One-vs-All |
| Linear | 0.002153158187866211 | 0.0020782947540283203 |
| Polynomial | 0.002110004425048828 | 0.002087831497192383 |
| RBF | 0.003975868225097656 | 0.004006147384643555 |

Testing Accuracy

|  |  |  |
| --- | --- | --- |
|  | One-vs-One | One-vs-All |
| Linear | 0.95 | 0.95 |
| Polynomial | 0.8125 | 0.8125 |
| RBF | 0.95 | 0.95 |

3.

Features that would be useful for planning the locations of electric chargers include:

* Population density in given areas
* Density of existing electric car ownership
* Number of highways in terms of length per square mile
* Average income per capita
* Historic data regarding public opinion of electric vehicles in given areas
* Level of infrastructure of power grids