0.08872556686401367  seconds to run KMEANS on FRUITS data set

0.058255910873413086  seconds to run KMEANS on Phones data set

1.500706672668457  seconds to run EM on FRUITS data set

0.3164100646972656  seconds to run EM on Phones data set

Part_2 ----------

0.007944107055664062  seconds to run PCA transformation on Fruits database

0.003977775573730469  seconds to run PCA transformation on Phones database

0.12709975242614746  seconds to run ICA transformation on Fruits database

0.007990360260009766  seconds to run ICA transformation on Phones database

0.0010061264038085938  seconds to run RP transformation on Fruits database

0.0  seconds to run RP transformation on Phones database

0.42757678031921387  seconds to run MLLE transformation on Fruits database

1.3517377376556396  seconds to run MLLE transformation on Phones database

Part 3

2.676436185836792  seconds for part_3 Fruits dataset KMeans method PCA dimencity reduction method

Part 3

2.732170343399048  seconds for part_3 Fruits dataset KMeans method ICA dimencity reduction method

Part 3

2.3473634719848633  seconds for part_3 Fruits dataset KMeans method RP dimencity reduction method

Part 3

3.334258556365967  seconds for part_3 Fruits dataset KMeans method MLLE dimencity reduction method

Part 3

13.415616273880005  seconds for part_3 Fruits dataset EM method PCA dimencity reduction method

Part 3

19.28747057914734  seconds for part_3 Fruits dataset EM method ICA dimencity reduction method

Part 3

19.881259202957153  seconds for part_3 Fruits dataset EM method RP dimencity reduction method

Part 3

24.28786826133728 seconds for part_3 Fruits dataset EM method MLLE dimencity reduction method

Part 3

3.237240791320801 seconds for part_3 Phones dataset KMeans method PCA dimencity reduction method

Part 3

4.2278265953063965 seconds for part_3 Phones dataset KMeans method ICA dimencity reduction method

Part 3

4.318183183670044 seconds for part_3 Phones dataset KMeans method RP dimencity reduction method

Part 3

5.7879557609558105 seconds for part_3 Phones dataset KMeans method MLLE dimencity reduction method

Part 3

14.463568687438965 seconds for part_3 Phones dataset EM method PCA dimencity reduction method

Part 3

43.947240114212036 seconds for part_3 Phones dataset EM method ICA dimencity reduction method

Part 3

30.693021774291992 seconds for part_3 Phones dataset EM method RP dimencity reduction method

Part 3

38.774616718292236 seconds for part_3 Phones dataset EM method MLLE dimencity reduction method

0.08646535873413086 seconds to train vanilla NN on Fruits dataset

Part 4 ----------

---

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0.0 | 1.0000 | 0.6667 | 0.8000 | 15 |
| 1.0 | 0.7391 | 0.7391 | 0.7391 | 23 |

| | | | | |
|---|---|---|---|---|
| 2.0 | 0.9524 | 0.9091 | 0.9302 | 44 |
| 3.0 | 0.7647 | 1.0000 | 0.8667 | 13 |
| 4.0 | 0.9167 | 1.0000 | 0.9565 | 33 |
| 5.0 | 0.9737 | 0.9737 | 0.9737 | 38 |
| 6.0 | 0.7143 | 0.7143 | 0.7143 | 14 |
| accuracy | | | 0.8889 | 180 |
| macro avg | 0.8658 | 0.8576 | 0.8544 | 180 |
| weighted avg | 0.8950 | 0.8889 | 0.8876 | 180 |

---

Part 4 ----------

0.08185219764709473 seconds to train PCA NN on Fruits dataset

---

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0.0 | 1.0000 | 0.8667 | 0.9286 | 15 |
| 1.0 | 0.8182 | 0.7826 | 0.8000 | 23 |
| 2.0 | 0.9545 | 0.9545 | 0.9545 | 44 |
| 3.0 | 0.8125 | 1.0000 | 0.8966 | 13 |
| 4.0 | 0.9697 | 0.9697 | 0.9697 | 33 |
| 5.0 | 0.9744 | 1.0000 | 0.9870 | 38 |
| 6.0 | 0.7692 | 0.7143 | 0.7407 | 14 |
| accuracy | | | 0.9222 | 180 |
| macro avg | 0.8998 | 0.8983 | 0.8967 | 180 |
| weighted avg | 0.9232 | 0.9222 | 0.9214 | 180 |

---

Part 4 ----------

0.09794163703918457 seconds to train ICA NN on Fruits dataset

---

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0.0 | 1.0000 | 0.8000 | 0.8889 | 15 |
| 1.0 | 0.6786 | 0.8261 | 0.7451 | 23 |
| 2.0 | 0.9535 | 0.9318 | 0.9425 | 44 |
| 3.0 | 0.8125 | 1.0000 | 0.8966 | 13 |
| 4.0 | 1.0000 | 1.0000 | 1.0000 | 33 |
| 5.0 | 1.0000 | 0.9737 | 0.9867 | 38 |
| 6.0 | 0.8182 | 0.6429 | 0.7200 | 14 |
| accuracy | | | 0.9111 | 180 |
| macro avg | 0.8947 | 0.8821 | 0.8828 | 180 |
| weighted avg | 0.9199 | 0.9111 | 0.9121 | 180 |

---

Part 4 ----------

0.08001232147216797 seconds to train RP NN on Fruits dataset

---

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0.0 | 0.8571 | 0.8000 | 0.8276 | 15 |
| 1.0 | 0.8462 | 0.4783 | 0.6111 | 23 |
| 2.0 | 0.9149 | 0.9773 | 0.9451 | 44 |
| 3.0 | 0.7059 | 0.9231 | 0.8000 | 13 |
| 4.0 | 1.0000 | 0.9697 | 0.9846 | 33 |
| 5.0 | 1.0000 | 0.9737 | 0.9867 | 38 |

| | | | | |
|---|---|---|---|---|
| 6.0 | 0.5500 | 0.7857 | 0.6471 | 14 |
| accuracy | | | 0.8778 | 180 |
| macro avg | 0.8392 | 0.8440 | 0.8289 | 180 |
| weighted avg | 0.8914 | 0.8778 | 0.8750 | 180 |

---

Part 4 ----------

0.09442424774169922 seconds to train MLLE NN on Fruits dataset

---

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0.0 | 0.9286 | 0.8667 | 0.8966 | 15 |
| 1.0 | 0.6429 | 0.7826 | 0.7059 | 23 |
| 2.0 | 0.9286 | 0.8864 | 0.9070 | 44 |
| 3.0 | 0.8571 | 0.9231 | 0.8889 | 13 |
| 4.0 | 0.9429 | 1.0000 | 0.9706 | 33 |
| 5.0 | 1.0000 | 0.9737 | 0.9867 | 38 |
| 6.0 | 0.8000 | 0.5714 | 0.6667 | 14 |
| accuracy | | | 0.8889 | 180 |
| macro avg | 0.8714 | 0.8577 | 0.8603 | 180 |
| weighted avg | 0.8946 | 0.8889 | 0.8889 | 180 |

---

Part 5 ----------

0.0851747989654541 seconds to train Vanila KMeans NN on Fruits dataset

---

| | precision | recall | f1-score | support |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 0 | 1.0000 | 1.0000 | 1.0000 | 18 |
| 1 | 0.9730 | 1.0000 | 0.9863 | 36 |
| 2 | 1.0000 | 0.9375 | 0.9677 | 32 |
| 3 | 0.9000 | 0.9000 | 0.9000 | 20 |
| 4 | 1.0000 | 1.0000 | 1.0000 | 29 |
| 5 | 1.0000 | 1.0000 | 1.0000 | 23 |
| 6 | 0.9565 | 1.0000 | 0.9778 | 22 |
| accuracy | | | 0.9778 | 180 |
| macro avg | 0.9756 | 0.9768 | 0.9760 | 180 |
| weighted avg | 0.9782 | 0.9778 | 0.9777 | 180 |

---

Part 5 ----------

0.08803343772888184 seconds to train Vanila EM NN on Fruits dataset

---

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 0.9000 | 0.8182 | 0.8571 | 11 |
| 1 | 0.9474 | 0.9730 | 0.9600 | 37 |
| 2 | 1.0000 | 0.9706 | 0.9851 | 34 |
| 3 | 0.9524 | 0.9524 | 0.9524 | 42 |
| 4 | 0.9643 | 1.0000 | 0.9818 | 27 |
| 5 | 0.9583 | 1.0000 | 0.9787 | 23 |
| 6 | 0.8000 | 0.6667 | 0.7273 | 6 |
| accuracy | | | 0.9556 | 180 |
| macro avg | 0.9318 | 0.9115 | 0.9203 | 180 |

weighted avg 0.9546 0.9556 0.9546 180

---

Part 5 ----------

0.04544496536254883 seconds to train PCA KMeans NN on Fruits dataset

---

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 1.0000 | 0.9444 | 0.9714 | 18 |
| 1 | 0.9730 | 1.0000 | 0.9863 | 36 |
| 2 | 1.0000 | 0.9375 | 0.9677 | 32 |
| 3 | 0.8889 | 0.8000 | 0.8421 | 20 |
| 4 | 0.9677 | 1.0000 | 0.9836 | 30 |
| 5 | 0.9583 | 1.0000 | 0.9787 | 23 |
| 6 | 0.9130 | 1.0000 | 0.9545 | 21 |
| accuracy | | | 0.9611 | 180 |
| macro avg | 0.9573 | 0.9546 | 0.9549 | 180 |
| weighted avg | 0.9614 | 0.9611 | 0.9604 | 180 |

---

Part 5 ----------

0.1085207462310791 seconds to train PCA EM NN on Fruits dataset

---

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 1.0000 | 0.9091 | 0.9524 | 11 |
| 1 | 1.0000 | 1.0000 | 1.0000 | 37 |
| 2 | 1.0000 | 0.9706 | 0.9851 | 34 |

| | | | | |
|---|---|---|---|---|
| 3 | 0.9512 | 1.0000 | 0.9750 | 39 |
| 4 | 0.9643 | 1.0000 | 0.9818 | 27 |
| 5 | 0.8889 | 1.0000 | 0.9412 | 24 |
| 6 | 1.0000 | 0.5000 | 0.6667 | 8 |
| accuracy | | | 0.9667 | 180 |
| macro avg | 0.9721 | 0.9114 | 0.9289 | 180 |
| weighted avg | 0.9693 | 0.9667 | 0.9635 | 180 |

---

Part 5 ----------

0.1070399284362793 seconds to train ICA KMeans NN on Fruits dataset

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| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 0.9773 | 0.9149 | 0.9451 | 47 |
| 1 | 0.9091 | 0.9677 | 0.9375 | 31 |
| 2 | 1.0000 | 1.0000 | 1.0000 | 27 |
| 3 | 0.9130 | 0.9545 | 0.9333 | 22 |
| 4 | 0.9737 | 0.9737 | 0.9737 | 38 |
| 5 | 0.8667 | 0.8667 | 0.8667 | 15 |
| accuracy | | | 0.9500 | 180 |
| macro avg | 0.9400 | 0.9463 | 0.9427 | 180 |
| weighted avg | 0.9511 | 0.9500 | 0.9501 | 180 |

---

Part 5 ----------

0.11214470863342285 seconds to train ICA EM NN on Fruits dataset

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| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 0.9565 | 0.8148 | 0.8800 | 27 |
| 1 | 0.9714 | 1.0000 | 0.9855 | 34 |
| 2 | 1.0000 | 1.0000 | 1.0000 | 37 |
| 3 | 0.9062 | 0.9667 | 0.9355 | 30 |
| 5 | 0.8462 | 0.8800 | 0.8627 | 25 |
| 6 | 1.0000 | 1.0000 | 1.0000 | 27 |
| accuracy | | | 0.9500 | 180 |
| macro avg | 0.9467 | 0.9436 | 0.9440 | 180 |
| weighted avg | 0.9511 | 0.9500 | 0.9494 | 180 |

---

Part 5 ----------

0.07550764083862305 seconds to train RP KMeans NN on Fruits dataset

---

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 0.9565 | 0.9167 | 0.9362 | 24 |
| 1 | 0.9524 | 0.9091 | 0.9302 | 22 |
| 2 | 1.0000 | 0.7391 | 0.8500 | 23 |
| 3 | 0.9412 | 1.0000 | 0.9697 | 32 |
| 4 | 0.9062 | 0.9667 | 0.9355 | 30 |
| 5 | 1.0000 | 1.0000 | 1.0000 | 20 |
| 6 | 0.8788 | 1.0000 | 0.9355 | 29 |
| accuracy | | | 0.9389 | 180 |

| | | | | |
|---|---|---|---|---|
| macro avg | 0.9479 | 0.9331 | 0.9367 | 180 |
| weighted avg | 0.9428 | 0.9389 | 0.9373 | 180 |

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Part 5 ----------

0.08957886695861816 seconds to train RP EM NN on Fruits dataset

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| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 0.9677 | 1.0000 | 0.9836 | 30 |
| 1 | 0.9333 | 0.9032 | 0.9180 | 31 |
| 2 | 0.8409 | 0.9487 | 0.8916 | 39 |
| 3 | 1.0000 | 0.9444 | 0.9714 | 36 |
| 4 | 0.8966 | 0.9286 | 0.9123 | 28 |
| 5 | 0.7000 | 0.8750 | 0.7778 | 8 |
| 6 | 0.5000 | 0.1250 | 0.2000 | 8 |
| accuracy | | | 0.9056 | 180 |
| macro avg | 0.8341 | 0.8179 | 0.8078 | 180 |
| weighted avg | 0.8970 | 0.9056 | 0.8949 | 180 |

---

Part 5 ----------

0.12456345558166504 seconds to train MLLE KMeans NN on Fruits dataset

---

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 1.0000 | 1.0000 | 1.0000 | 27 |
| 1 | 1.0000 | 0.9697 | 0.9846 | 33 |

| | | | | |
|---|---|---|---|---|
| 2 | 0.9211 | 1.0000 | 0.9589 | 35 |
| 3 | 1.0000 | 1.0000 | 1.0000 | 4 |
| 4 | 1.0000 | 1.0000 | 1.0000 | 37 |
| 5 | 1.0000 | 1.0000 | 1.0000 | 27 |
| 6 | 1.0000 | 0.8824 | 0.9375 | 17 |
| accuracy | | | 0.9833 | 180 |
| macro avg | 0.9887 | 0.9789 | 0.9830 | 180 |
| weighted avg | 0.9846 | 0.9833 | 0.9833 | 180 |

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Part 5 ----------

0.08753013610839844 seconds to train MLLE EM NN on Fruits dataset

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| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 0.9286 | 0.8125 | 0.8667 | 32 |
| 1 | 0.9268 | 1.0000 | 0.9620 | 38 |
| 2 | 0.8000 | 0.6667 | 0.7273 | 6 |
| 3 | 0.8621 | 0.8621 | 0.8621 | 29 |
| 4 | 0.9630 | 1.0000 | 0.9811 | 26 |
| 5 | 0.9412 | 1.0000 | 0.9697 | 32 |
| 6 | 1.0000 | 0.9412 | 0.9697 | 17 |
| accuracy | | | 0.9278 | 180 |
| macro avg | 0.9174 | 0.8975 | 0.9055 | 180 |
| weighted avg | 0.9272 | 0.9278 | 0.9260 | 180 |

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428.6317923069  seconds to run whole assignment on 8 logical cores CPU