

## ▪ Regression Techniques

- **Linear Regression**

MSE = 4.546160691426627e+20

- **Polynomial Regression**

MSE = 1.8150779187283406e+21

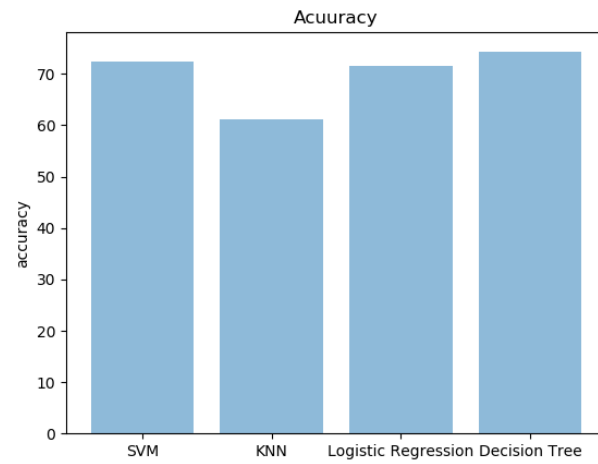
- **Ridge Regression**

MSE = 0.0202669588263172

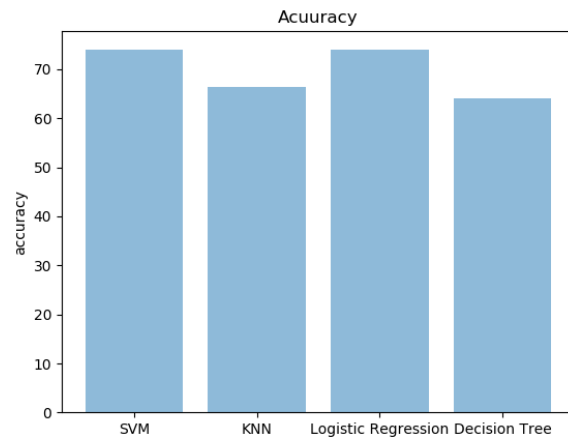
- **Lasso Regression**

MSE = 0.0188300698213641

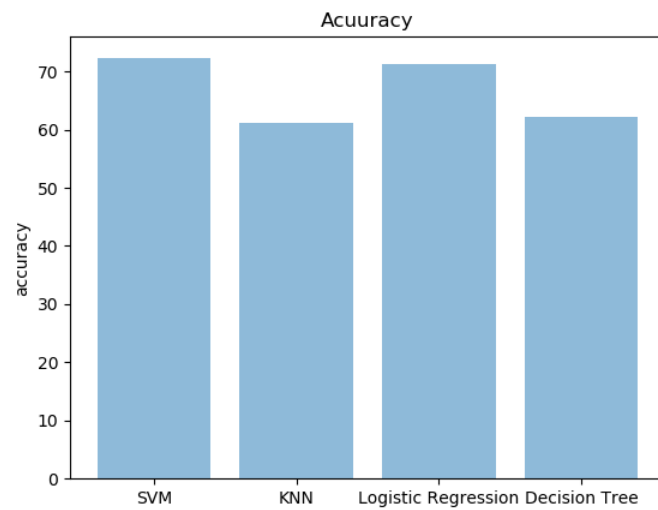
- **Classification Accuracy, Training Time and Testing Time**
  - **Classification Accuracy(without PCA)**



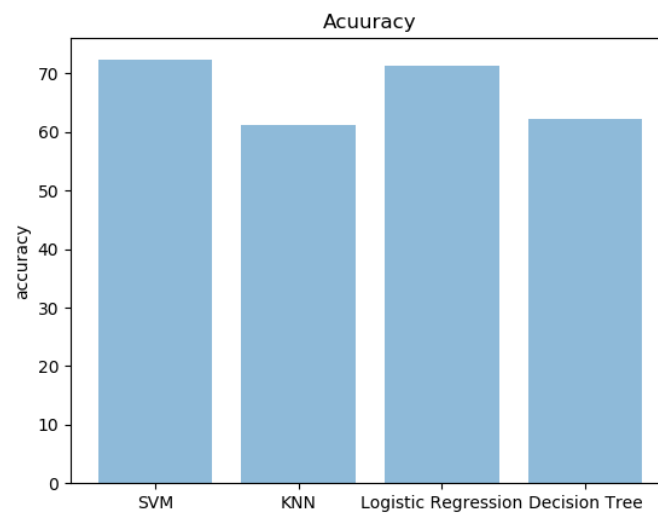
- **Classification Accuracy(PCA with 150 Components)**



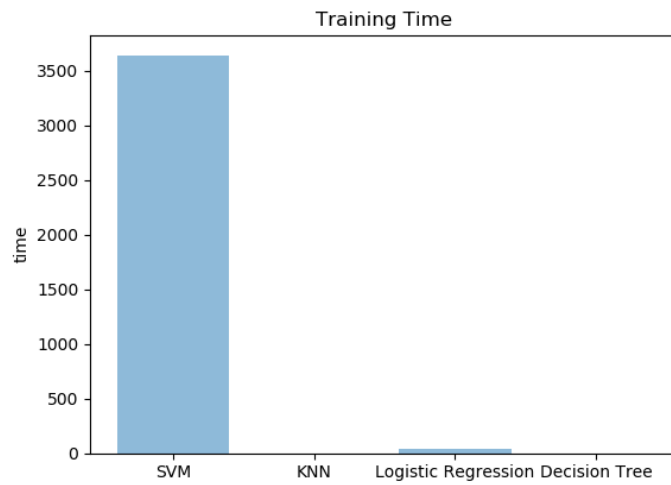
### o Classification Accuracy(PCA with 450 Components)



### o Classification Accuracy(PCA with 950 Components)



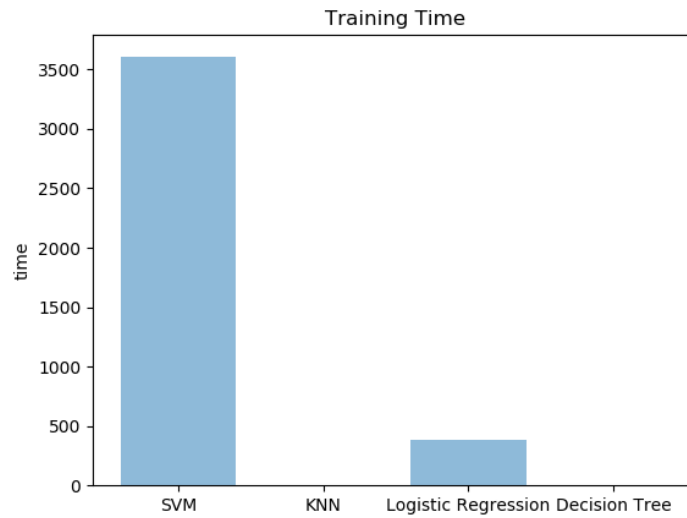
### o Training Time(without PCA)



### o Training Time (PCA with 150 Components)



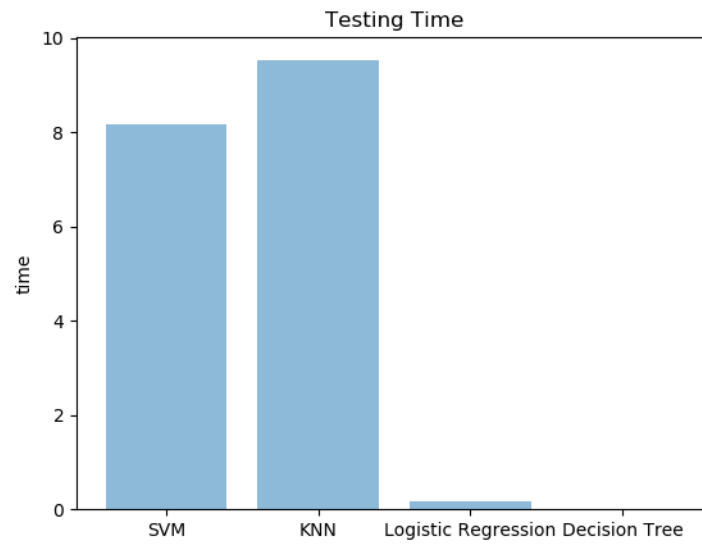
### o Training Time (PCA with 450 Components)



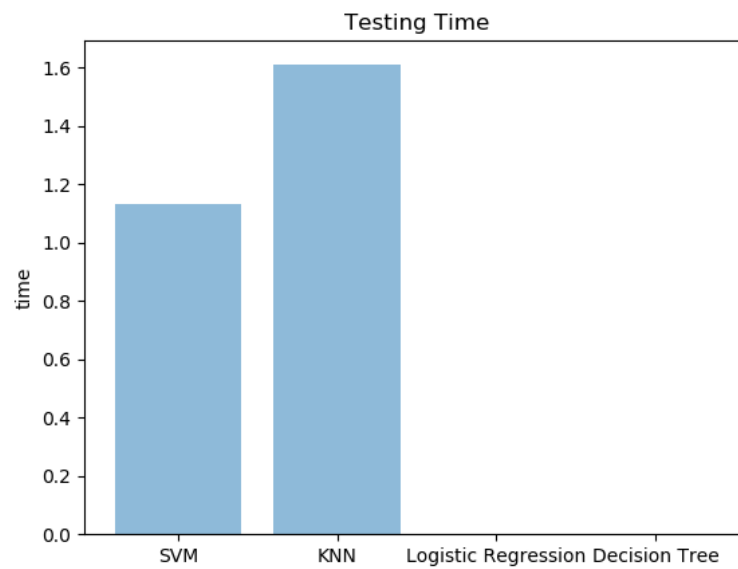
### o Training Time (PCA with 950 Components)



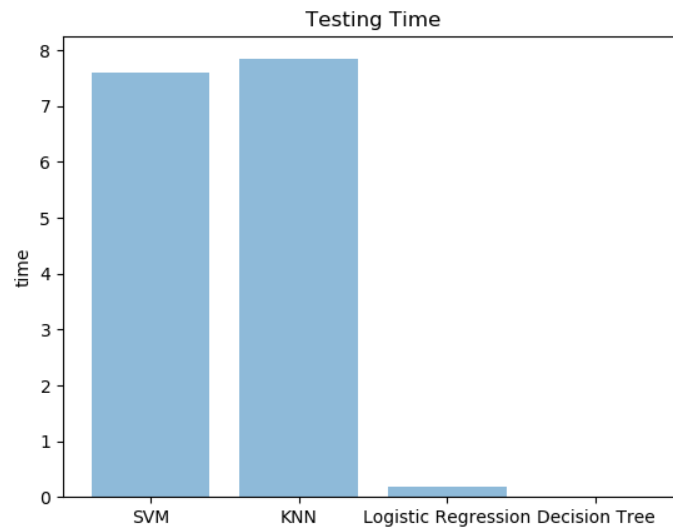
### o Testing Time(without PCA)



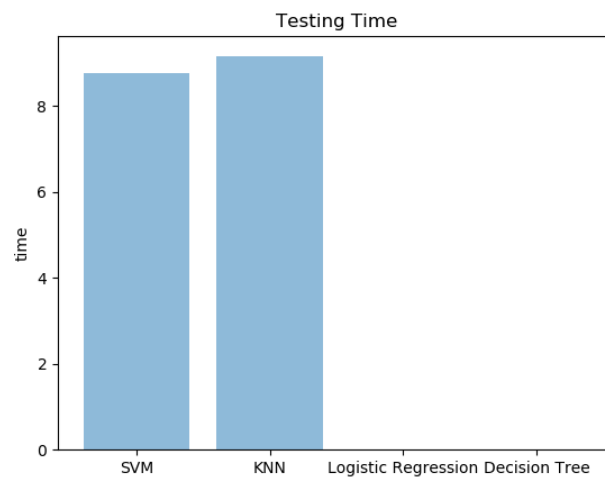
### o Testing Time (PCA with 150 Components)



### o Testing Time (PCA with 450 Components)



### o Testing Time (PCA with 950 Components)



## ▪ Feature Selection :

We took the first:

- 200 actor
- 200 director
- 200 original music composer
- 200 keyword
- 50 company
- All genres
- All production countries
- All spoken languages

### o Numerical features

- Budget
- Popularity
- Revenue
- Runtime
- Vote\_Countries
- Rate
- Released\_date

Ps :- In classification, The rate is mapped from (low, intermediate, high) to (1,2,3).

Ps :- The released\_date is converted to a range from 1 to 365 (which day in the year)



## ■ Hyperparameters effect

### - SVM(without PCA)

One VS Rest SVM accuracy with kernel=linear and c=0.1 is : 72.42455775234131%

One VS Rest SVM accuracy with kernel=poly and c=0.1 is : 60.77003121748179%

One VS Rest SVM accuracy with kernel=rbf and c=0.1 is : 60.77003121748179%

One VS Rest SVM accuracy with kernel=linear and c=1 is : 70.96774193548387%

One VS Rest SVM accuracy with kernel=poly and c=1 is : 60.77003121748179%

One VS Rest SVM accuracy with kernel=rbf and c=1 is : 60.77003121748179%

One VS Rest SVM accuracy with kernel=linear and c=1000 is : 66.8054110301769%

One VS Rest SVM accuracy with kernel=poly and c=1000 is : 60.77003121748179%

One VS Rest SVM accuracy with kernel=rbf and c=1000 is : 68.99063475546305%

### - KNN(without PCA)

```
0%|          | 0/19 [00:00<?, ?it/s]KNN accuracy: with n_neighbors=1 and weights=uniform is: 57.64828303850156%
5%|█         | 1/19 [00:10<03:01, 10.11s/it]KNN accuracy: with n_neighbors=2 and weights=uniform is: 53.17377731529657%
11%|██        | 2/19 [00:20<02:54, 10.24s/it]KNN accuracy: with n_neighbors=3 and weights=uniform is: 55.4630593132154%
16%|███       | 3/19 [00:31<02:47, 10.44s/it]KNN accuracy: with n_neighbors=4 and weights=uniform is: 55.254942767950055%
26%|████      | 5/19 [00:53<02:29, 10.70s/it]KNN accuracy: with n_neighbors=5 and weights=uniform is: 55.4630593132154%
KNN accuracy: with n_neighbors=6 and weights=uniform is: 57.02393340270552%
32%|█████     | 6/19 [01:04<02:19, 10.75s/it]KNN accuracy: with n_neighbors=7 and weights=uniform is: 57.33610822060354%
42%|██████    | 8/19 [01:26<01:59, 10.87s/it]KNN accuracy: with n_neighbors=8 and weights=uniform is: 57.75234131113424%
47%|███████   | 9/19 [01:37<01:49, 10.93s/it]KNN accuracy: with n_neighbors=9 and weights=uniform is: 58.27263267429761%
KNN accuracy: with n_neighbors=10 and weights=uniform is: 58.89698231009365%
53%|████████  | 10/19 [01:48<01:38, 10.90s/it]KNN accuracy: with n_neighbors=11 and weights=uniform is: 58.89698231009365%
63%|█████████ | 12/19 [02:09<01:15, 10.85s/it]KNN accuracy: with n_neighbors=12 and weights=uniform is: 59.5213319458897%
68%|██████████| 13/19 [02:20<01:04, 10.83s/it]KNN accuracy: with n_neighbors=13 and weights=uniform is: 59.31321540062435%
74%|██████████| 14/19 [02:31<00:54, 10.85s/it]KNN accuracy: with n_neighbors=14 and weights=uniform is: 59.5213319458897%
79%|██████████| 15/19 [02:42<00:43, 10.83s/it]KNN accuracy: with n_neighbors=15 and weights=uniform is: 59.20915712799167%
KNN accuracy: with n_neighbors=16 and weights=uniform is: 59.937565036420395%
89%|██████████| 17/19 [03:04<00:21, 10.87s/it]KNN accuracy: with n_neighbors=17 and weights=uniform is: 59.833506763787724%
95%|██████████| 18/19 [03:15<00:10, 10.88s/it]KNN accuracy: with n_neighbors=18 and weights=uniform is: 59.833506763787724%
KNN accuracy: with n_neighbors=19 and weights=uniform is: 59.72944849115505%

0%|          | 0/19 [00:00<?, ?it/s]KNN accuracy: with n_neighbors=1 and weights=distance is: 57.64828303850156%
11%|█         | 2/19 [00:21<02:57, 10.42s/it]KNN accuracy: with n_neighbors=2 and weights=distance is: 57.64828303850156%
16%|██        | 3/19 [00:31<02:48, 10.51s/it]KNN accuracy: with n_neighbors=3 and weights=distance is: 57.75234131113424%
21%|███       | 4/19 [00:42<02:38, 10.57s/it]KNN accuracy: with n_neighbors=4 and weights=distance is: 57.02393340270552%
KNN accuracy: with n_neighbors=5 and weights=distance is: 57.75234131113424%
32%|█████     | 6/19 [01:04<02:19, 10.73s/it]KNN accuracy: with n_neighbors=6 and weights=distance is: 59.105098855359%
37%|██████    | 7/19 [01:15<02:08, 10.75s/it]KNN accuracy: with n_neighbors=7 and weights=distance is: 58.89698231009365%
42%|███████   | 8/19 [01:26<01:58, 10.76s/it]KNN accuracy: with n_neighbors=8 and weights=distance is: 58.89698231009365%
KNN accuracy: with n_neighbors=9 and weights=distance is: 60.145681581685736%
53%|████████  | 10/19 [01:47<01:37, 10.85s/it]KNN accuracy: with n_neighbors=10 and weights=distance is: 60.24973985431842%
58%|█████████ | 11/19 [01:58<01:26, 10.82s/it]KNN accuracy: with n_neighbors=11 and weights=distance is: 60.561914672216446%
63%|██████████| 12/19 [02:09<01:15, 10.82s/it]KNN accuracy: with n_neighbors=12 and weights=distance is: 60.77003121748179%
KNN accuracy: with n_neighbors=13 and weights=distance is: 61.18626430801248%
68%|██████████| 13/19 [02:20<01:04, 10.82s/it]KNN accuracy: with n_neighbors=14 and weights=distance is: 59.833506763787724%
74%|██████████| 14/19 [02:31<00:54, 10.83s/it]KNN accuracy: with n_neighbors=15 and weights=distance is: 60.978147762747135%
79%|██████████| 15/19 [02:42<00:43, 10.91s/it]KNN accuracy: with n_neighbors=16 and weights=distance is: 60.45785639958376%
84%|██████████| 16/19 [02:53<00:32, 10.89s/it]KNN accuracy: with n_neighbors=17 and weights=distance is: 60.978147762747135%
89%|██████████| 17/19 [03:04<00:21, 10.90s/it]KNN accuracy: with n_neighbors=18 and weights=distance is: 59.62539021852237%
100%|██████████| 19/19 [03:25<00:00, 10.84s/it]
KNN accuracy: with n_neighbors=19 and weights=distance is: 60.24973985431842%
```

## - Regression(without PCA)

Logistic Regression accuracy: 71.48803329864725

Logistic Regression accuracy: 68.4703433922997

Logistic Regression accuracy: 68.36628511966701

## - Decision Tree(without PCA)

```
decision_tree accurecy with max features=sqrt and maxx depth=5 is 64.62018730489075
decision_tree accurecy with max features=sqrt and maxx depth=10 is 62.01873048907388
decision_tree accurecy with max features=sqrt and maxx depth=20 is 67.11758584807492
decision_tree accurecy with max features=sqrt and maxx depth=50 is 67.84599375650365
decision_tree accurecy with max features=sqrt and maxx depth=None is 64.20395421436004

decision_tree accurecy with max features=log2 and maxx depth=5 is 61.39438085327783
decision_tree accurecy with max features=log2 and maxx depth=10 is 61.602497398543186
decision_tree accurecy with max features=log2 and maxx depth=20 is 64.7242455775234
decision_tree accurecy with max features=log2 and maxx depth=50 is 64.09989594172737
decision_tree accurecy with max features=log2 and maxx depth=None is 61.49843912591051
decision_tree accurecy with max features=None and maxx depth=5 is 74.29760665972945
decision_tree accurecy with max features=None and maxx depth=10 is 72.42455775234131
decision_tree accurecy with max features=None and maxx depth=20 is 71.59209157127991
decision_tree accurecy with max features=None and maxx depth=50 is 69.19875130072842
decision_tree accurecy with max features=None and maxx depth=None is 70.0312174817898
```

## - SVM(with PCA – 150 components)

```
One VS Rest SVM accuracy with kernel=linear and c=0.1 is : 71.90426638917793%
One VS Rest SVM accuracy with kernel=poly and c=0.1 is : 60.77003121748179%
One VS Rest SVM accuracy with kernel=rbf and c=0.1 is : 60.77003121748179%
One VS Rest SVM accuracy with kernel=linear and c=1 is : 71.6961498439126%
One VS Rest SVM accuracy with kernel=poly and c=1 is : 60.77003121748179%
One VS Rest SVM accuracy with kernel=rbf and c=1 is : 67.63787721123829%
One VS Rest SVM accuracy with kernel=linear and c=1000 is : 72.00832466181062%
One VS Rest SVM accuracy with kernel=poly and c=1000 is : 60.87408949011447%
One VS Rest SVM accuracy with kernel=rbf and c=1000 is : 69.92715920915713%
```

## - KNN(with PCA – 150 components)

```
[ 0 100 150]]
KNN accuracy: with n_neighbors=1 and weights=uniform is: 59.31321540062435%
5%| | 1/19 [00:01<00:18, 1.03s/it]KNN accuracy: with n_neighbors=2 and weights=uniform is: 55.77523413111343%
11%| | 2/19 [00:02<00:17, 1.04s/it]KNN accuracy: with n_neighbors=3 and weights=uniform is: 56.91987513007284%
16%| | 3/19 [00:03<00:16, 1.04s/it]KNN accuracy: with n_neighbors=4 and weights=uniform is: 60.87408949011447%
21%| | 4/19 [00:04<00:15, 1.05s/it]KNN accuracy: with n_neighbors=5 and weights=uniform is: 61.706555671175856%
26%| | 5/19 [00:05<00:14, 1.06s/it]KNN accuracy: with n_neighbors=6 and weights=uniform is: 61.49843912591051%
32%| | 6/19 [00:06<00:13, 1.07s/it]KNN accuracy: with n_neighbors=7 and weights=uniform is: 63.683662851196665%
37%| | 7/19 [00:07<00:12, 1.07s/it]KNN accuracy: with n_neighbors=8 and weights=uniform is: 63.371488033298654%
42%| | 8/19 [00:08<00:11, 1.08s/it]KNN accuracy: with n_neighbors=9 and weights=uniform is: 62.955254942767944%
47%| | 9/19 [00:09<00:10, 1.08s/it]KNN accuracy: with n_neighbors=10 and weights=uniform is: 63.683662851196665%
58%| | 11/19 [00:11<00:08, 1.09s/it]KNN accuracy: with n_neighbors=11 and weights=uniform is: 63.89177939646202%
KNN accuracy: with n_neighbors=12 and weights=uniform is: 62.85119667013528%
68%| | 13/19 [00:14<00:06, 1.09s/it]KNN accuracy: with n_neighbors=13 and weights=uniform is: 63.579604578563995%
KNN accuracy: with n_neighbors=14 and weights=uniform is: 63.05931321540063%
79%| | 15/19 [00:16<00:04, 1.11s/it]KNN accuracy: with n_neighbors=15 and weights=uniform is: 62.7471383975026%
KNN accuracy: with n_neighbors=16 and weights=uniform is: 62.01873048907388%
89%| | 17/19 [00:18<00:02, 1.10s/it]KNN accuracy: with n_neighbors=17 and weights=uniform is: 62.64308012486993%
95%| | 18/19 [00:19<00:01, 1.10s/it]KNN accuracy: with n_neighbors=18 and weights=uniform is: 61.39438085327783%
KNN accuracy: with n_neighbors=19 and weights=uniform is: 62.01873048907388%
```

```

0%|          | 0/19 [00:00<?, ?it/s]KNN accuracy: with n_neighbors=1 and weights=distance is: 59.31321540062435%
5%|          | 1/19 [00:01<00:18, 1.05s/it]KNN accuracy: with n_neighbors=2 and weights=distance is: 59.31321540062435%
11%|         | 2/19 [00:02<00:17, 1.05s/it]KNN accuracy: with n_neighbors=3 and weights=distance is: 58.58480749219564%
21%|         | 4/19 [00:04<00:15, 1.06s/it]KNN accuracy: with n_neighbors=4 and weights=distance is: 61.706555671175856%
KNN accuracy: with n_neighbors=5 and weights=distance is: 63.26742976066597%
26%|         | 5/19 [00:05<00:14, 1.07s/it]KNN accuracy: with n_neighbors=6 and weights=distance is: 62.85119667013528%
32%|         | 6/19 [00:06<00:13, 1.07s/it]KNN accuracy: with n_neighbors=7 and weights=distance is: 64.82830385015609%
42%|         | 8/19 [00:08<00:11, 1.09s/it]KNN accuracy: with n_neighbors=8 and weights=distance is: 64.62018730489075%
KNN accuracy: with n_neighbors=9 and weights=distance is: 63.78772112382934%
53%|         | 10/19 [00:10<00:09, 1.09s/it]KNN accuracy: with n_neighbors=10 and weights=distance is: 63.99583766909469%
KNN accuracy: with n_neighbors=11 and weights=distance is: 64.93236212278876%
63%|         | 12/19 [00:12<00:07, 1.09s/it]KNN accuracy: with n_neighbors=12 and weights=distance is: 63.89177939646202%
KNN accuracy: with n_neighbors=13 and weights=distance is: 64.62018730489075%
74%|         | 14/19 [00:15<00:05, 1.11s/it]KNN accuracy: with n_neighbors=14 and weights=distance is: 63.89177939646202%
79%|         | 15/19 [00:16<00:04, 1.10s/it]KNN accuracy: with n_neighbors=15 and weights=distance is: 63.683662851196665%
84%|         | 16/19 [00:17<00:03, 1.10s/it]KNN accuracy: with n_neighbors=16 and weights=distance is: 62.955254942767944%
KNN accuracy: with n_neighbors=17 and weights=distance is: 63.26742976066597%
95%|         | 18/19 [00:19<00:01, 1.12s/it]KNN accuracy: with n_neighbors=18 and weights=distance is: 62.12278876170656%
KNN accuracy: with n_neighbors=19 and weights=distance is: 62.539021852237255%

```

## - Regression(with PCA – 150 components)

Logistic Regression accuracy: 71.27991675338188

Logistic Regression accuracy: 70.0312174817898

Logistic Regression accuracy: 69.51092611862643

## - Decision Tree(with PCA – 150 components)

decision\_tree accuracy with max features=sqrt and max depth=5 is 63.89177939646202

decision\_tree accuracy with max features=sqrt and max depth=10 is 63.89177939646202

decision\_tree accuracy with max features=sqrt and max depth=20 is 59.20915712799167

decision\_tree accuracy with max features=sqrt and max depth=50 is 57.33610822060354

decision\_tree accuracy with max features=sqrt and max depth=None is 55.359001040582726

decision\_tree accuracy with max features=log2 and max depth=5 is 61.18626430801248

decision\_tree accuracy with max features=log2 and max depth=10 is 58.27263267429761

decision\_tree accuracy with max features=log2 and max depth=20 is 57.44016649323621

decision\_tree accuracy with max features=log2 and max depth=50 is 55.56711758584808

decision\_tree accuracy with max features=log2 and max depth=None is 55.98335067637878

decision\_tree accuracy with max features=None and max depth=5 is 63.99583766909469

decision\_tree accuracy with max features=None and max depth=10 is 61.18626430801248

decision\_tree accuracy with max features=None and max depth=20 is 58.48074921956295

decision\_tree accuracy with max features=None and max depth=50 is 59.001040582726326

decision\_tree accuracy with max features=None and max depth=None is 57.54422476586889

## - SVM(with PCA – 150 components)

One VS Rest SVM accuracy with kernel=linear and c=0.1 is : 71.90426638917793%

One VS Rest SVM accuracy with kernel=poly and c=0.1 is : 60.77003121748179%

One VS Rest SVM accuracy with kernel=rbf and c=0.1 is : 60.77003121748179%

One VS Rest SVM accuracy with kernel=linear and c=1 is : 70.34339229968782%

One VS Rest SVM accuracy with kernel=poly and c=1 is : 60.77003121748179%

One VS Rest SVM accuracy with kernel=rbf and c=1 is : 61.29032258064516%

One VS Rest SVM accuracy with kernel=linear and c=1000 is : 67.11758584807492%

One VS Rest SVM accuracy with kernel=poly and c=1000 is : 60.77003121748179%

One VS Rest SVM accuracy with kernel=rbf and c=1000 is : 70.4474505723205%

## - KNN(with PCA – 450 components)

```
KNN accuracy: with n_neighbors=1 and weights=uniform is: 55.04682622268471%
11%|██████| 2/19 [00:07<01:04, 3.82s/it]KNN accuracy: with n_neighbors=2 and weights=uniform is: 52.34131113423517%
KNN accuracy: with n_neighbors=3 and weights=uniform is: 55.4630593132154%
21%|██████| 4/19 [00:15<00:57, 3.83s/it]KNN accuracy: with n_neighbors=4 and weights=uniform is: 56.71175858480749%
KNN accuracy: with n_neighbors=5 and weights=uniform is: 58.58480749219564%
26%|██████| 5/19 [00:19<00:53, 3.85s/it]KNN accuracy: with n_neighbors=6 and weights=uniform is: 58.376690946930275%
37%|██████| 7/19 [00:26<00:46, 3.85s/it]KNN accuracy: with n_neighbors=7 and weights=uniform is: 59.20915712799167%
KNN accuracy: with n_neighbors=8 and weights=uniform is: 59.62539021852237%
42%|██████| 8/19 [00:30<00:42, 3.86s/it]KNN accuracy: with n_neighbors=9 and weights=uniform is: 60.561914672216446%
47%|██████| 9/19 [00:34<00:38, 3.86s/it]KNN accuracy: with n_neighbors=10 and weights=uniform is: 61.08220603537981%
53%|██████| 10/19 [00:38<00:34, 3.87s/it]KNN accuracy: with n_neighbors=11 and weights=uniform is: 60.77003121748179%
63%|██████| 12/19 [00:46<00:27, 3.89s/it]KNN accuracy: with n_neighbors=12 and weights=uniform is: 60.45785639958376%
KNN accuracy: with n_neighbors=13 and weights=uniform is: 61.602497398543186%
68%|██████| 13/19 [00:50<00:23, 3.88s/it]KNN accuracy: with n_neighbors=14 and weights=uniform is: 60.561914672216446%
74%|██████| 14/19 [00:54<00:19, 3.88s/it]KNN accuracy: with n_neighbors=15 and weights=uniform is: 61.08220603537981%
84%|██████| 16/19 [01:01<00:11, 3.90s/it]KNN accuracy: with n_neighbors=16 and weights=uniform is: 60.04162330905307%
KNN accuracy: with n_neighbors=17 and weights=uniform is: 60.66597294484911%
95%|██████| 18/19 [01:09<00:03, 3.88s/it]KNN accuracy: with n_neighbors=18 and weights=uniform is: 59.72944849115505%
KNN accuracy: with n_neighbors=19 and weights=uniform is: 59.937565036420395%

5%|██████| 1/19 [00:03<01:07, 3.77s/it]KNN accuracy: with n_neighbors=1 and weights=distance is: 55.04682622268471%
11%|██████| 2/19 [00:07<01:04, 3.78s/it]KNN accuracy: with n_neighbors=2 and weights=distance is: 55.04682622268471%
16%|██████| 3/19 [00:11<01:00, 3.80s/it]KNN accuracy: with n_neighbors=3 and weights=distance is: 57.54422476586889%
KNN accuracy: with n_neighbors=4 and weights=distance is: 58.58480749219564%
21%|██████| 4/19 [00:15<00:57, 3.83s/it]KNN accuracy: with n_neighbors=5 and weights=distance is: 58.48074921956295%
26%|██████| 5/19 [00:19<00:53, 3.84s/it]KNN accuracy: with n_neighbors=6 and weights=distance is: 59.937565036420395%
32%|██████| 6/19 [00:23<00:50, 3.86s/it]KNN accuracy: with n_neighbors=7 and weights=distance is: 61.18626430801248%
42%|██████| 8/19 [00:30<00:42, 3.88s/it]KNN accuracy: with n_neighbors=8 and weights=distance is: 60.978147762747135%
KNN accuracy: with n_neighbors=9 and weights=distance is: 62.12278876170656%
53%|██████| 10/19 [00:39<00:37, 4.15s/it]KNN accuracy: with n_neighbors=10 and weights=distance is: 61.914672216441204%
58%|██████| 11/19 [00:43<00:32, 4.08s/it]KNN accuracy: with n_neighbors=11 and weights=distance is: 62.43496357960458%
KNN accuracy: with n_neighbors=12 and weights=distance is: 61.39438085327783%
68%|██████| 13/19 [00:51<00:23, 3.97s/it]KNN accuracy: with n_neighbors=13 and weights=distance is: 62.64308012486993%
KNN accuracy: with n_neighbors=14 and weights=distance is: 61.914672216441204%
74%|██████| 14/19 [00:55<00:19, 3.95s/it]KNN accuracy: with n_neighbors=15 and weights=distance is: 62.01873048907388%
79%|██████| 15/19 [00:59<00:15, 3.94s/it]KNN accuracy: with n_neighbors=16 and weights=distance is: 60.978147762747135%
89%|██████| 17/19 [01:06<00:07, 3.92s/it]KNN accuracy: with n_neighbors=17 and weights=distance is: 61.29032258064516%
KNN accuracy: with n_neighbors=18 and weights=distance is: 60.45785639958376%
95%|██████| 18/19 [01:10<00:03, 3.93s/it]KNN accuracy: with n_neighbors=19 and weights=distance is: 61.08220603537981%
```

## - Regression(with PCA – 450 components)

Logistic Regression accuracy: 71.27991675338188

Logistic Regression accuracy: 68.67845993756504

Logistic Regression accuracy: 67.95005202913632

## - Decision Tree(with PCA – 450 components)

```
decision_tree accuracy with max features=sqrt and maxx depth=5 is 63.78772112382934
decision_tree accuracy with max features=sqrt and maxx depth=10 is 56.81581685744017
decision_tree accuracy with max features=sqrt and maxx depth=20 is 56.50364203954214
decision_tree accuracy with max features=sqrt and maxx depth=50 is 54.00624349635797
decision_tree accuracy with max features=sqrt and maxx depth=None is 54.526534859521334

decision_tree accuracy with max features=log2 and maxx depth=5 is 61.706555671175856
decision_tree accuracy with max features=log2 and maxx depth=10 is 57.54422476586889
decision_tree accuracy with max features=log2 and maxx depth=20 is 53.38189386056192
decision_tree accuracy with max features=log2 and maxx depth=50 is 51.508844953173785
decision_tree accuracy with max features=log2 and maxx depth=None is 54.73465140478668

decision_tree accuracy with max features=None and maxx depth=5 is 63.26742976066597
decision_tree accuracy with max features=None and maxx depth=10 is 62.539021852237255
decision_tree accuracy with max features=None and maxx depth=20 is 57.44016649323621
decision_tree accuracy with max features=None and maxx depth=50 is 58.376690946930275
decision_tree accuracy with max features=None and maxx depth=None is 58.27263267429761
```



## - SVM(with PCA – 950 components)

```
One VS Rest SVM accuracy with kernel=linear and c=0.1 is : 72.32049947970863%
One VS Rest SVM accuracy with kernel=poly and c=0.1 is : 60.77003121748179%
One VS Rest SVM accuracy with kernel=rbf and c=0.1 is : 60.77003121748179%
One VS Rest SVM accuracy with kernel=linear and c=1 is : 70.23933402705515%
One VS Rest SVM accuracy with kernel=poly and c=1 is : 60.77003121748179%
One VS Rest SVM accuracy with kernel=rbf and c=1 is : 60.77003121748179%
One VS Rest SVM accuracy with kernel=linear and c=1000 is : 66.3891779396462%
One VS Rest SVM accuracy with kernel=poly and c=1000 is : 60.77003121748179%
One VS Rest SVM accuracy with kernel=rbf and c=1000 is : 69.09469302809573%
```

## - KNN(with PCA – 950 components)

```
0%|          | 0/19 [00:00<?, ?it/s]KNN accuracy: with n_neighbors=1 and weights=uniform is: 57.33610822060354%
5%|          | 1/19 [00:07<02:23, 7.98s/it]KNN accuracy: with n_neighbors=2 and weights=uniform is: 52.96566077003122%
11%|         | 2/19 [00:16<02:16, 8.00s/it]KNN accuracy: with n_neighbors=3 and weights=uniform is: 55.4630593132154%
16%|         | 3/19 [00:24<02:10, 8.14s/it]KNN accuracy: with n_neighbors=4 and weights=uniform is: 55.56711758584808%
21%|         | 4/19 [00:32<02:03, 8.23s/it]KNN accuracy: with n_neighbors=5 and weights=uniform is: 55.359001040582726%
32%|        | 6/19 [00:50<01:50, 8.50s/it]KNN accuracy: with n_neighbors=6 and weights=uniform is: 57.33610822060354%
NN accuracy: with n_neighbors=7 and weights=uniform is: 56.71175858480749%
42%|        | 8/19 [01:07<01:33, 8.49s/it]KNN accuracy: with n_neighbors=8 and weights=uniform is: 57.44016649323621%
NN accuracy: with n_neighbors=9 and weights=uniform is: 58.06451612903226%
53%|        | 10/19 [01:24<01:16, 8.54s/it]KNN accuracy: with n_neighbors=10 and weights=uniform is: 59.20915712799167%
NN accuracy: with n_neighbors=11 and weights=uniform is: 58.688657648283%
58%|        | 11/19 [01:33<01:09, 8.64s/it]KNN accuracy: with n_neighbors=12 and weights=uniform is: 59.72944849115505%
68%|        | 13/19 [01:50<00:51, 8.59s/it]KNN accuracy: with n_neighbors=13 and weights=uniform is: 59.105098855359%
74%|        | 14/19 [01:59<00:43, 8.61s/it]KNN accuracy: with n_neighbors=14 and weights=uniform is: 59.62539021852237%
79%|        | 15/19 [02:07<00:34, 8.67s/it]KNN accuracy: with n_neighbors=15 and weights=uniform is: 58.58480749219564%
NN accuracy: with n_neighbors=16 and weights=uniform is: 59.31321540062435%
89%|        | 17/19 [02:25<00:17, 8.61s/it]KNN accuracy: with n_neighbors=17 and weights=uniform is: 58.89698231009365%
NN accuracy: with n_neighbors=18 and weights=uniform is: 59.41727367325702%
95%|        | 18/19 [02:33<00:08, 8.46s/it]KNN accuracy: with n_neighbors=19 and weights=uniform is: 59.31321540062435%

0%|          | 0/19 [00:00<?, ?it/s]KNN accuracy: with n_neighbors=1 and weights=distance is: 57.33610822060354%
5%|          | 1/19 [00:08<02:25, 8.06s/it]KNN accuracy: with n_neighbors=2 and weights=distance is: 57.33610822060354%
16%|         | 3/19 [00:23<02:07, 8.00s/it]KNN accuracy: with n_neighbors=3 and weights=distance is: 58.376690946930275%
KNN accuracy: with n_neighbors=4 and weights=distance is: 57.54422476586889%
21%|         | 4/19 [00:32<02:00, 8.06s/it]KNN accuracy: with n_neighbors=5 and weights=distance is: 57.44016649323621%
32%|         | 6/19 [00:48<01:44, 8.07s/it]KNN accuracy: with n_neighbors=6 and weights=distance is: 59.001040582726326%
37%|         | 7/19 [00:56<01:37, 8.09s/it]KNN accuracy: with n_neighbors=7 and weights=distance is: 58.89698231009365%
KNN accuracy: with n_neighbors=8 and weights=distance is: 58.79292403746098%
42%|         | 8/19 [01:04<01:28, 8.06s/it]KNN accuracy: with n_neighbors=9 and weights=distance is: 60.561914672216446%
47%|         | 9/19 [01:12<01:20, 8.10s/it]KNN accuracy: with n_neighbors=10 and weights=distance is: 60.04162330905307%
53%|         | 10/19 [01:21<01:13, 8.22s/it]KNN accuracy: with n_neighbors=11 and weights=distance is: 60.24973985431842%
63%|         | 12/19 [01:38<00:58, 8.38s/it]KNN accuracy: with n_neighbors=12 and weights=distance is: 61.08220603537981%
KNN accuracy: with n_neighbors=13 and weights=distance is: 61.18626430801248%
74%|         | 14/19 [01:55<00:42, 8.43s/it]KNN accuracy: with n_neighbors=14 and weights=distance is: 60.45785639958376%
79%|         | 15/19 [02:03<00:33, 8.45s/it]KNN accuracy: with n_neighbors=15 and weights=distance is: 60.66597294484911%
84%|         | 16/19 [02:12<00:25, 8.50s/it]KNN accuracy: with n_neighbors=16 and weights=distance is: 59.937565036420395%
KNN accuracy: with n_neighbors=17 and weights=distance is: 60.561914672216446%
95%|         | 18/19 [02:29<00:08, 8.48s/it]KNN accuracy: with n_neighbors=18 and weights=distance is: 59.62539021852237%
100%|        | 19/19 [02:37<00:00, 8.29s/it]
KNN accuracy: with n_neighbors=19 and weights=distance is: 59.833506763787724%
```

## - Regression(with PCA – 950 components)

```
Logistic Regression accuracy: 71.27991675338188
Logistic Regression accuracy: 69.09469302809573
Logistic Regression accuracy: 67.74193548387096
```

- Decision Tree(with PCA – 950 components)

```
decision_tree accurecy with max features=sqrt and maxx depth=5 is 58.79292403746098
decision_tree accurecy with max features=sqrt and maxx depth=10 is 58.48074921956295
decision_tree accurecy with max features=sqrt and maxx depth=20 is 55.87929240374609
decision_tree accurecy with max features=sqrt and maxx depth=50 is 56.50364203954214
decision_tree accurecy with max features=sqrt and maxx depth=None is 52.2372528616025

decision_tree accurecy with max features=log2 and maxx depth=5 is 61.810613943808534
decision_tree accurecy with max features=log2 and maxx depth=10 is 59.105098855359
decision_tree accurecy with max features=log2 and maxx depth=20 is 53.277835587929246
decision_tree accurecy with max features=log2 and maxx depth=50 is 50.57232049947971
decision_tree accurecy with max features=log2 and maxx depth=None is 53.798126951092605

decision_tree accurecy with max features=None and maxx depth=5 is 62.22684703433923
decision_tree accurecy with max features=None and maxx depth=10 is 57.8563995837669
decision_tree accurecy with max features=None and maxx depth=20 is 54.630593132154004
decision_tree accurecy with max features=None and maxx depth=50 is 54.94276795005203
decision_tree accurecy with max features=None and maxx depth=None is 54.31841831425598
```

- **PCA**

- The number of features are 1050 so we reduced it by using PCA to this values [ 150, 450, 950]
- We chose this PCA values from different ranges to reflect how different number of components effect the classification.

- **Conclusion**

- Dropping unnecessary features helps the model to decrease the MSE where no clear relation between them and the targeted feature.
- All computed MSE based on regression methods are different.
- Best regression method is the Lasso Regression.
- Best classification method is SVM without PCA(Ad0abost).
- Classification without PCA performs better than classification with PCA.