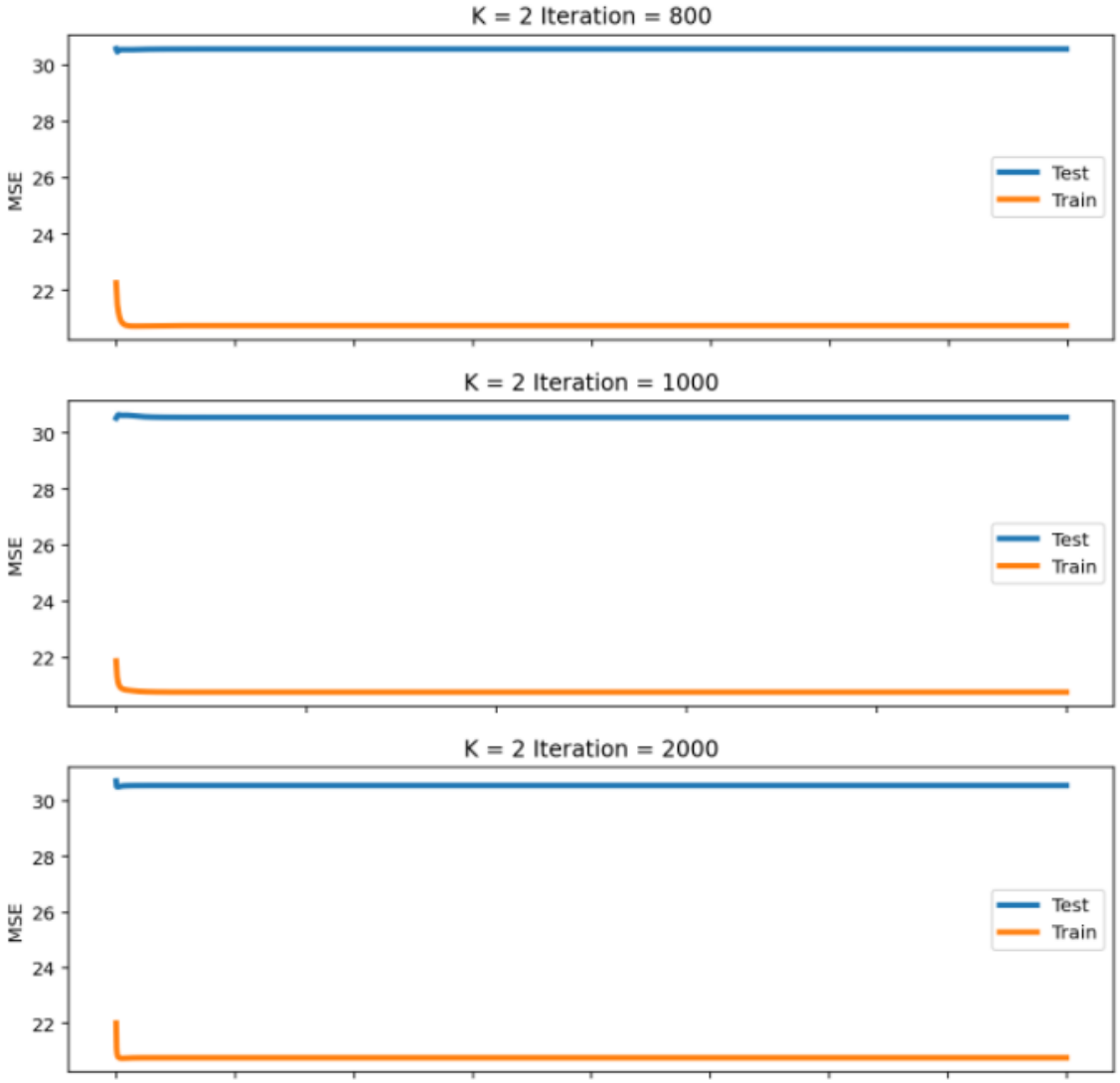
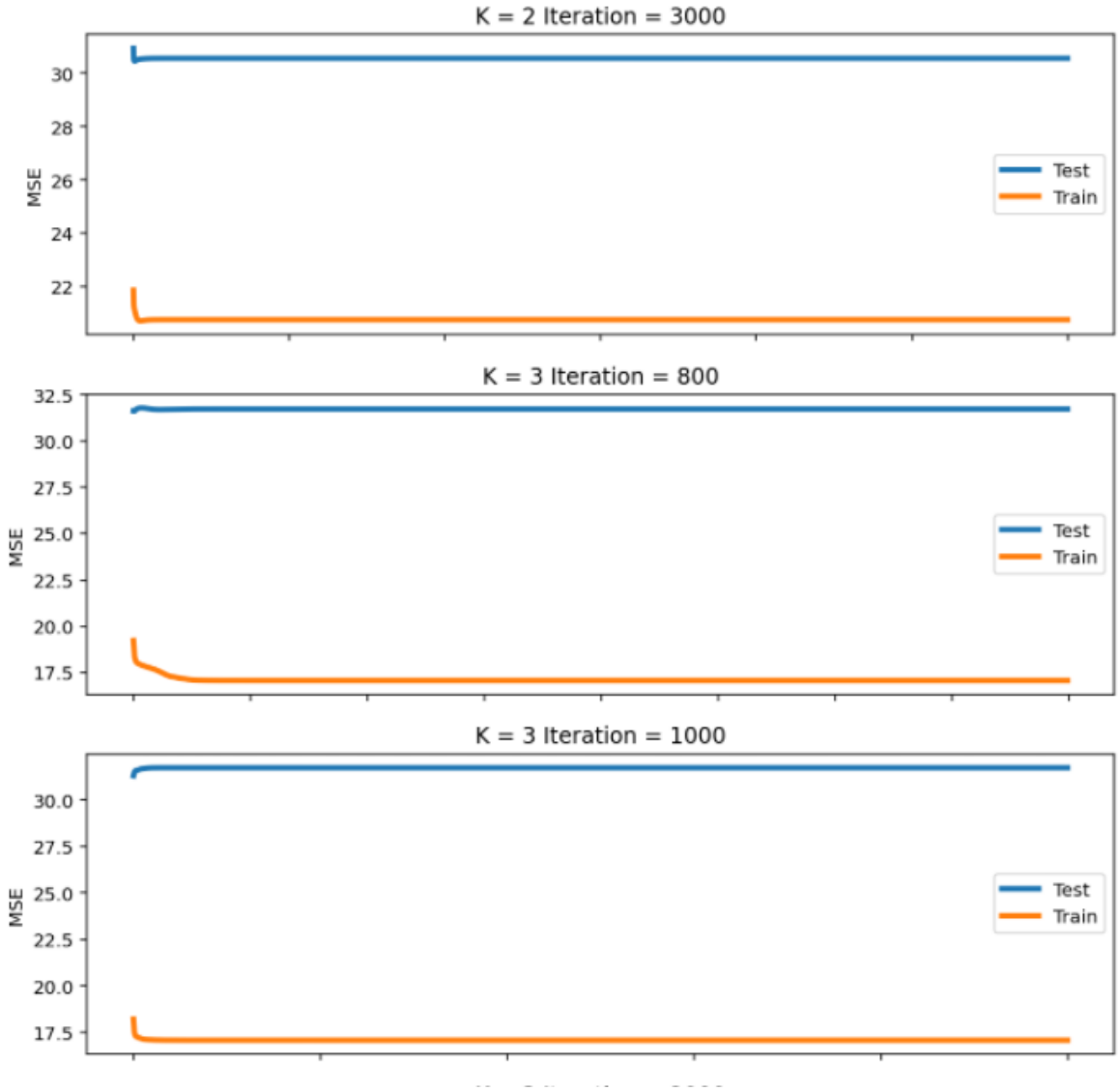
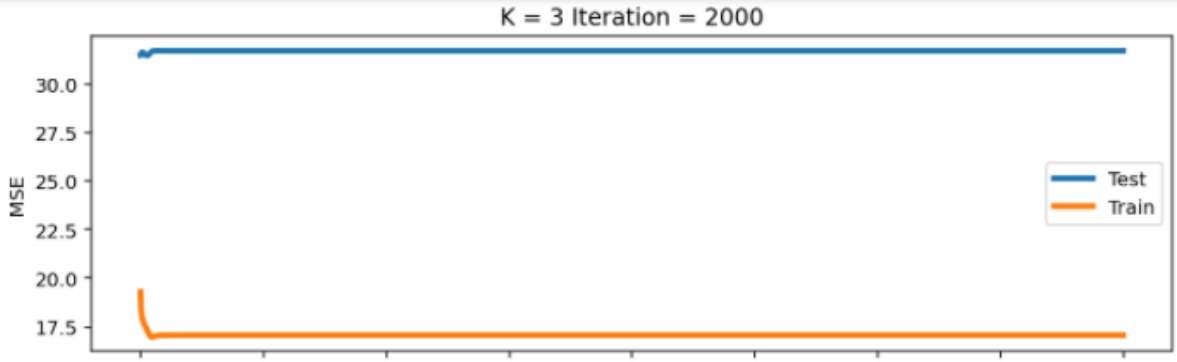
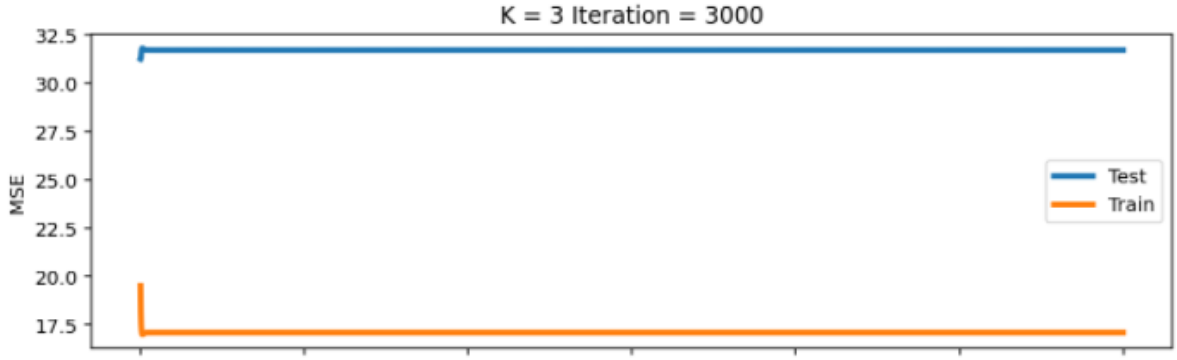
ID: 170104082

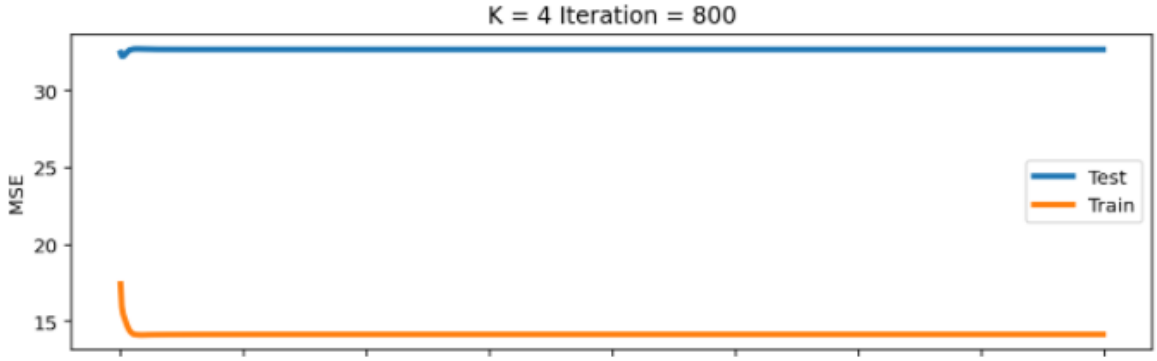
Loss Curves for Hyperparameters:

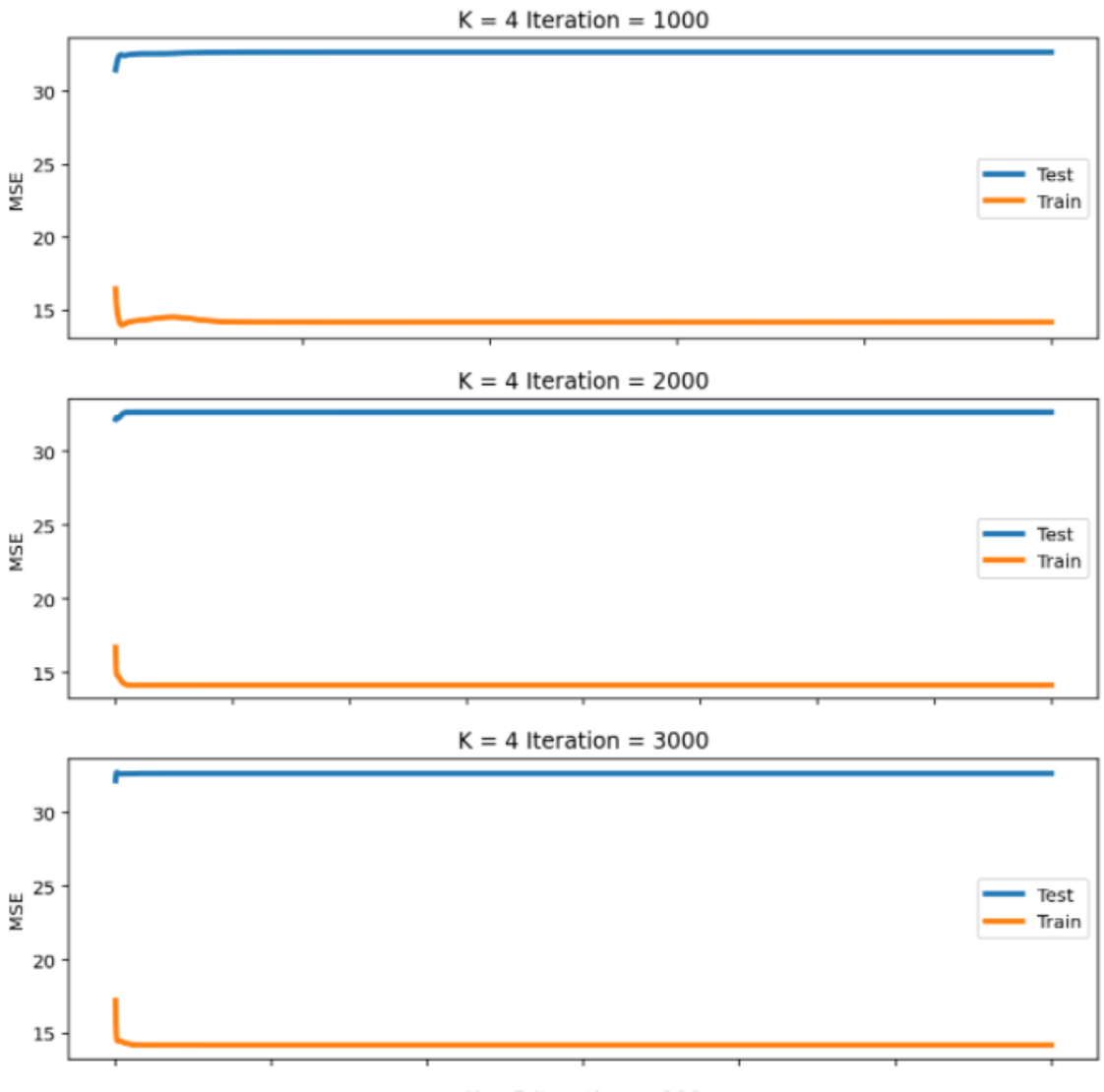


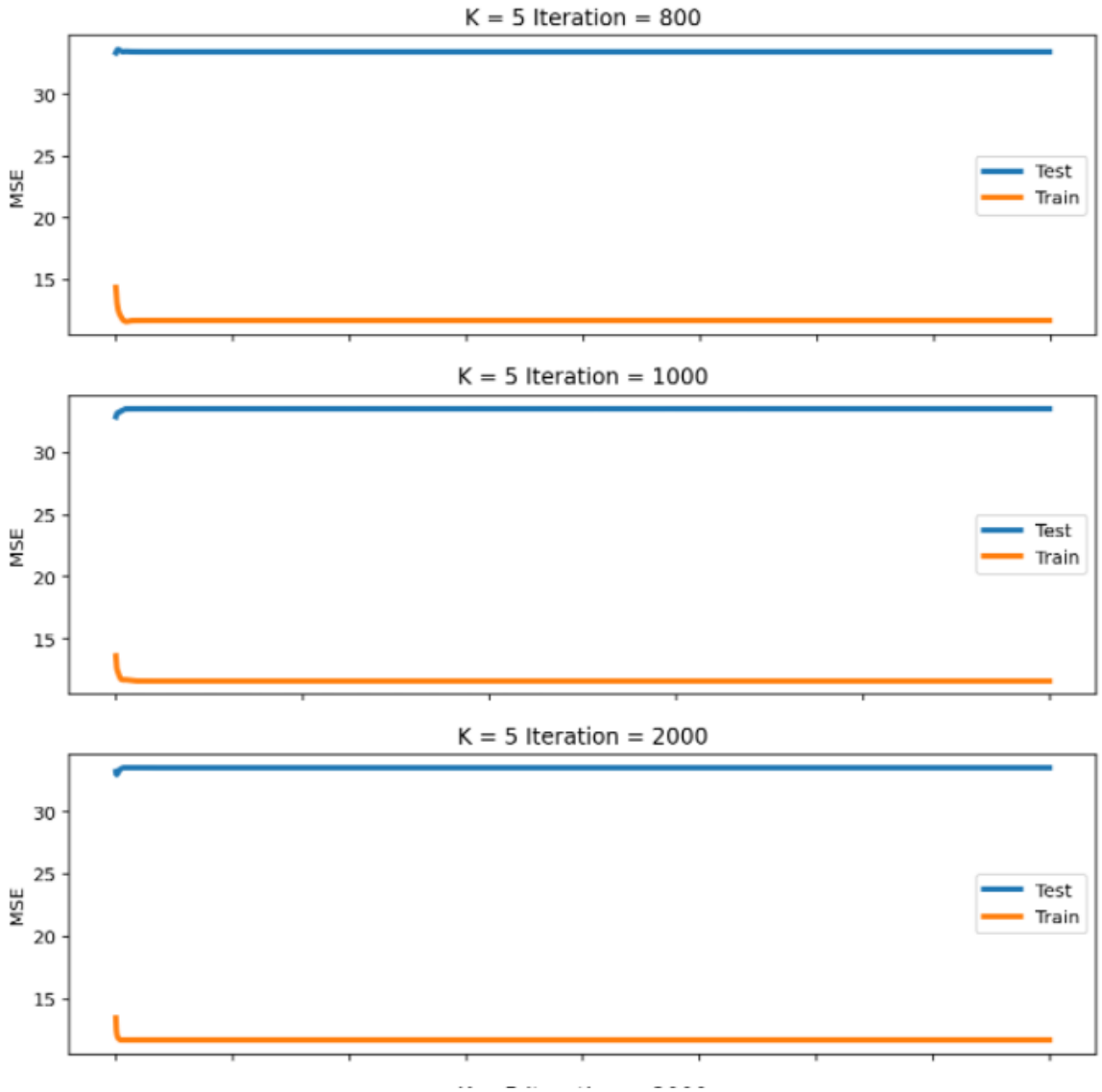

K = 2 Iteration = 3000
MSE
30
28
26
24
22
Test
Train
K = 3 Iteration = 800
MSE
32.5
30.0
27.5
25.0
22.5
20.0
17.5
Test
Train
K = 3 Iteration = 1000
MSE
30.0
27.5
25.0
22.5
20.0
17.5
Test
Train


K = 3 Iteration = 2000
MSE
30.0
27.5
25.0
22.5
20.0
17.5
Test
Train


K = 3 Iteration = 3000
MSE
32.5
30.0
27.5
25.0
22.5
20.0
17.5
Test
Train


K = 4 Iteration = 800
MSE
30
25
20
15
Test
Train


K = 4 Iteration = 1000
MSE
30
25
20
15
Test
Train
K = 4 Iteration = 2000
MSE
30
25
20
15
Test
Train
K = 4 Iteration = 3000
MSE
30
25
20
15
Test
Train


K = 5 Iteration = 800
MSE
30
25
20
15
Test
Train
K = 5 Iteration = 1000
MSE
30
25
20
15
Test
Train
K = 5 Iteration = 2000
MSE
30
25
20
15
Test
Train

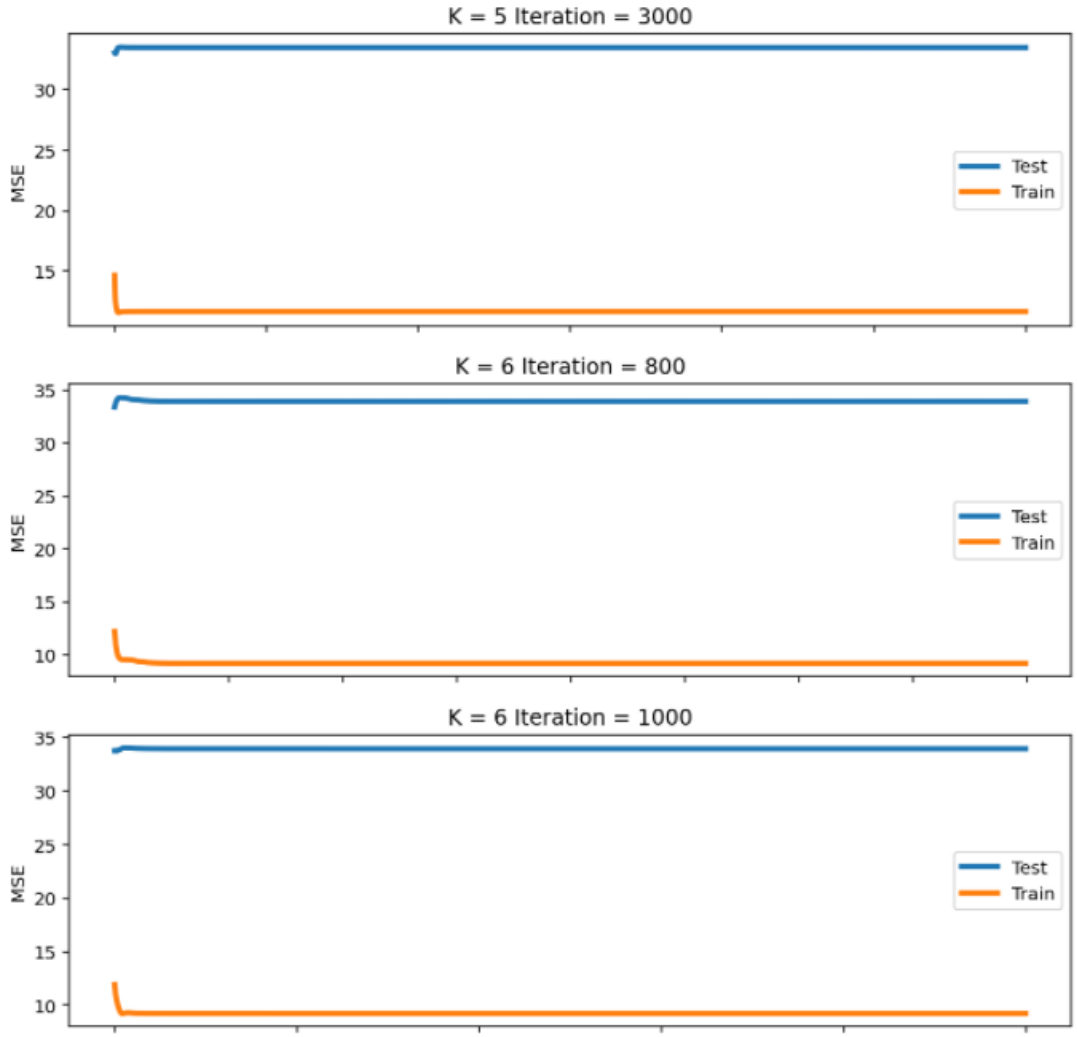


Fig-Loss curves for Hyperparameters K and iterations

HyperParameter Tuning:

GridSearchCV hyper parameter tuning technique is performed for getting the combination of hyperparameters that gives the smallest minimum squared error(MSE).

```
iterations=[800,1000,2000,3000]
K=[2,3,4,5,6,10,12]
```

Among these hyper parameters , K=2 and iteration=3000 gives the smallest MSE = 30.45

Cosine Similarities between all pairs of users:

Cosine similarities between all pairs of users:

	26062	3768	42704	2826	22922	21038	41762	7850	39250	1884	
26062	1.000000	0.344417	0.273235	-0.491742	-0.574108	0.050667	0.317969	-0.305980	-0.539872	0.760489	(
3768	0.344417	1.000000	0.833185	-0.774853	-0.560460	-0.312565	0.771827	0.478501	-0.216684	-0.275768	-(
42704	0.273235	0.833185	1.000000	-0.694482	-0.205042	0.098791	0.859272	0.312989	-0.220002	-0.282722	-(
2826	-0.491742	-0.774853	-0.694482	1.000000	0.807217	0.051484	-0.552276	0.124294	0.776769	0.130157	(
22922	-0.574108	-0.560460	-0.205042	0.807217	1.000000	0.316678	-0.174991	0.205891	0.745220	-0.123269	(
...	...	...	...	...	...	...	...	...	...	...	
12874	0.139384	0.768266	0.651049	-0.255015	-0.067600	-0.543266	0.832179	0.869625	0.329850	-0.151743	-(
48984	0.072407	-0.101914	0.347022	0.241924	0.622766	0.746728	0.130167	-0.078610	0.302279	0.100759	(
11304	0.957423	0.227026	0.150731	-0.494239	-0.624901	0.214379	0.087166	-0.524296	-0.641212	0.716385	(
10676	-0.674945	-0.562656	-0.303951	0.660579	0.771834	0.591484	-0.565917	-0.095417	0.566243	-0.389639	(
20724	0.464031	0.702180	0.356003	-0.581155	-0.703676	-0.095564	0.140157	0.093381	-0.234833	-0.061655	-(

Cosine Similarities between all pairs of movies:

Cosine similarities between all pairs of movies:

	0	314	628	942	1256	1570	1884	2198	2512	2826	3140	3454	3768
0	1.000000	0.577384	0.530667	0.570010	0.795306	0.632813	0.593908	0.235875	0.736754	0.333345	0.871564	0.433730	0.473786
314	0.577384	1.000000	0.602238	0.794208	0.892201	0.748607	0.494397	0.662904	0.887125	0.715605	0.802298	0.781501	0.874160
628	0.530667	0.602238	1.000000	0.932800	0.537593	0.820001	0.608971	0.863075	0.809662	0.675488	0.376934	0.599453	0.815622
942	0.570010	0.794208	0.932800	1.000000	0.713542	0.813421	0.754401	0.921695	0.938117	0.873067	0.568964	0.832301	0.899846
1256	0.795306	0.892201	0.537593	0.713542	1.000000	0.587102	0.529806	0.437862	0.832013	0.594531	0.955191	0.765197	0.649371
1570	0.632813	0.748607	0.820001	0.813421	0.587102	1.000000	0.533532	0.736175	0.866798	0.558067	0.536104	0.452967	0.927982
1884	0.593908	0.494397	0.608971	0.754401	0.529806	0.533532	1.000000	0.670893	0.791804	0.843956	0.545573	0.774663	0.578636
2198	0.235875	0.662904	0.863075	0.921695	0.437862	0.736175	0.670893	1.000000	0.797224	0.886182	0.261329	0.750573	0.882695
2512	0.736754	0.887125	0.809662	0.938117	0.832013	0.866798	0.791804	0.797224	1.000000	0.829792	0.771999	0.816064	0.910879
2826	0.333345	0.715605	0.675488	0.873067	0.594531	0.558067	0.843956	0.886182	0.829792	1.000000	0.479652	0.944675	0.767077

Suggestion of 5 movies for user id ‘26062’:

```
MovieIds-------Rating of user26062
[('314', 0.4183034432545269),
 ('1884', 1.9376907497417184),
 ('2198', -0.6246079144830606),
 ('2512', 1.213494169130356),
 ('3140', 2.6833295556358303)]
```

Results:

As we can see , we got many results after performing hyper parameter tuning(GridSearchCV). After trying so many combinations of K and iterations, it is found that K=2 and iterations=3000 gives the best result. For this, training MSE and testing MSE are found 21.10 and 30.45 respectively.

Application of Matrix Factorization:

The application of matrix factorization is applied in the Recommendation system. We can identify industries that stand to gain from recommendation systems:

Amazon

There are many e-commerce companies that generate accurate recommendations based on online customers' behaviour data.Such as- Amazon.com recommends many products based on item collaborative recommendations in their website.

Netflix:

Netflix is a data-driven company that uses recommendations of movies to the users to increase the customer satisfaction.

Social Media:

There are many social media websites like Facebook,Linkedin etc. that give “You may also know” or “You may also like” type recommendations to the users to enhance the user experiences.