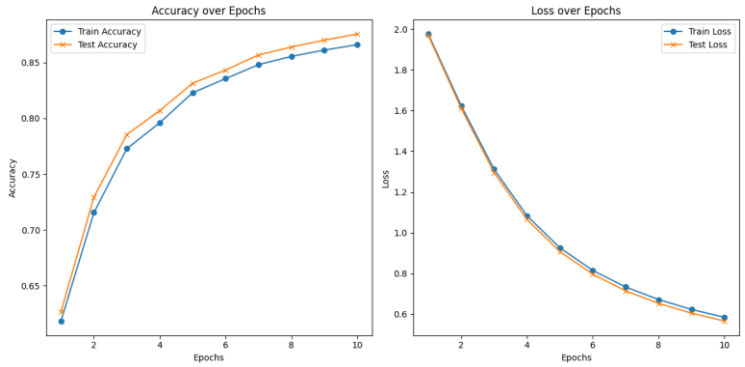
24052620 Eda Rupçalı HOMEWORK2

A) Bu modele eklediğimiz Adam ve RMSProp optimizerleriyle birlikte accuracy tablolarını ve grafiklerini incelediğimizde accuracy değerlerinin sigmoid + momentum ve ReLu + momentum'da en düşüklerde, ReLu + Adam ve ReLu + RMSProp'ta en yükseklerde olduğunu görebiliriz. Accuracy değeri yüksek çıkan algoritmalar derin ağlar ve karmaşık veri setleri için daha uygun. ReLU'nun daha hızlı öğrenmesi ve Adam veya RMSProp'un öğrenme hızlarını dinamik olarak ayarlaması, modelin daha hızlı ve doğru bir şekilde eğitilmesini sağlıyor.

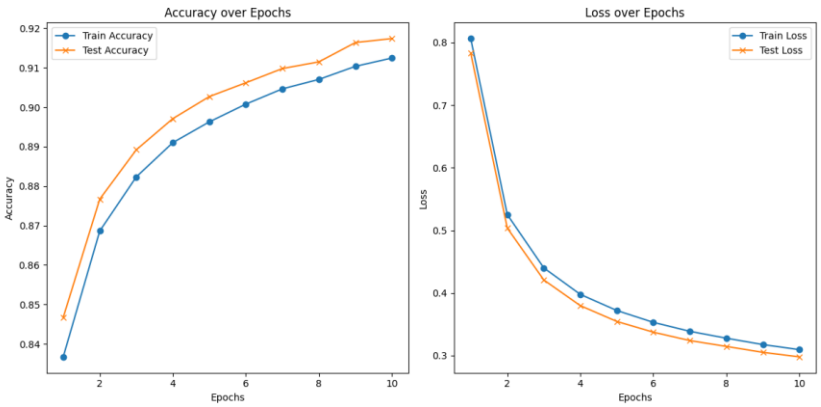
Sigmoid + Momentum

```
Epoch 1/10 - Train Loss: 1.9752, Train Acc: 0.6184, Test Loss: 1.9686, Test Acc: 0.6268
Epoch 2/10 - Train Loss: 1.6236, Train Acc: 0.7156, Test Loss: 1.6108, Test Acc: 0.7294
Epoch 3/10 - Train Loss: 1.3115, Train Acc: 0.7728, Test Loss: 1.2947, Test Acc: 0.7855
Epoch 4/10 - Train Loss: 1.0833, Train Acc: 0.7961, Test Loss: 1.0650, Test Acc: 0.8069
Epoch 5/10 - Train Loss: 0.9257, Train Acc: 0.8229, Test Loss: 0.9071, Test Acc: 0.8315
Epoch 6/10 - Train Loss: 0.8146, Train Acc: 0.8356, Test Loss: 0.7960, Test Acc: 0.8433
Epoch 7/10 - Train Loss: 0.7334, Train Acc: 0.8481, Test Loss: 0.7146, Test Acc: 0.8568
Epoch 8/10 - Train Loss: 0.6716, Train Acc: 0.8555, Test Loss: 0.6529, Test Acc: 0.8639
Epoch 9/10 - Train Loss: 0.6233, Train Acc: 0.8612, Test Loss: 0.6051, Test Acc: 0.8701
Epoch 10/10 - Train Loss: 0.5846, Train Acc: 0.8659, Test Loss: 0.5663, Test Acc: 0.8755
```



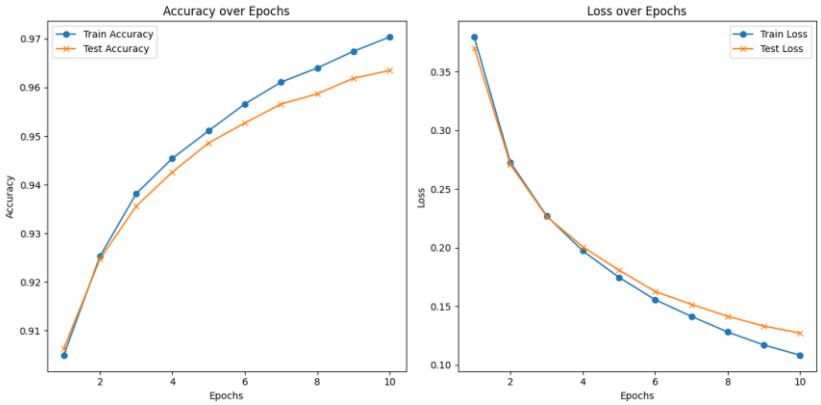
ReLu + Momentum

```
Epoch 1/10 - Train Loss: 0.8062, Train Acc: 0.8367, Test Loss: 0.7830, Test Acc: 0.8467
Epoch 2/10 - Train Loss: 0.5252, Train Acc: 0.8686, Test Loss: 0.5037, Test Acc: 0.8767
Epoch 3/10 - Train Loss: 0.4401, Train Acc: 0.8823, Test Loss: 0.4208, Test Acc: 0.8892
Epoch 4/10 - Train Loss: 0.3978, Train Acc: 0.8910, Test Loss: 0.3798, Test Acc: 0.8971
Epoch 5/10 - Train Loss: 0.3720, Train Acc: 0.8963, Test Loss: 0.3546, Test Acc: 0.9027
Epoch 6/10 - Train Loss: 0.3531, Train Acc: 0.9008, Test Loss: 0.3374, Test Acc: 0.9062
Epoch 7/10 - Train Loss: 0.3388, Train Acc: 0.9046, Test Loss: 0.3240, Test Acc: 0.9098
Epoch 8/10 - Train Loss: 0.3278, Train Acc: 0.9071, Test Loss: 0.3147, Test Acc: 0.9115
Epoch 9/10 - Train Loss: 0.3176, Train Acc: 0.9104, Test Loss: 0.3052, Test Acc: 0.9164
Epoch 10/10 - Train Loss: 0.3095, Train Acc: 0.9125, Test Loss: 0.2980, Test Acc: 0.9174
```



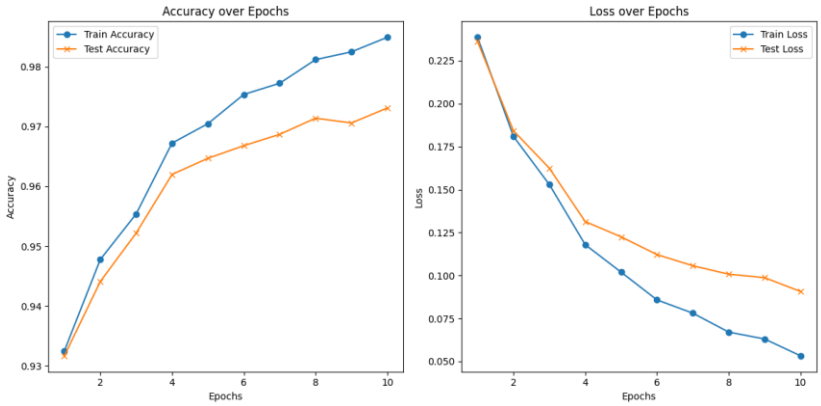
Sigmoid + Adam

```
Epoch 1/10 - Train Loss: 0.3797, Train Acc: 0.9049, Test Loss: 0.3703, Test Acc: 0.9063
Epoch 2/10 - Train Loss: 0.2727, Train Acc: 0.9253, Test Loss: 0.2708, Test Acc: 0.9247
Epoch 3/10 - Train Loss: 0.2271, Train Acc: 0.9382, Test Loss: 0.2265, Test Acc: 0.9356
Epoch 4/10 - Train Loss: 0.1972, Train Acc: 0.9454, Test Loss: 0.2007, Test Acc: 0.9426
Epoch 5/10 - Train Loss: 0.1746, Train Acc: 0.9511, Test Loss: 0.1807, Test Acc: 0.9486
Epoch 6/10 - Train Loss: 0.1555, Train Acc: 0.9566, Test Loss: 0.1626, Test Acc: 0.9527
Epoch 7/10 - Train Loss: 0.1413, Train Acc: 0.9611, Test Loss: 0.1516, Test Acc: 0.9566
Epoch 8/10 - Train Loss: 0.1280, Train Acc: 0.9640, Test Loss: 0.1414, Test Acc: 0.9587
Epoch 9/10 - Train Loss: 0.1169, Train Acc: 0.9675, Test Loss: 0.1330, Test Acc: 0.9619
Epoch 10/10 - Train Loss: 0.1082, Train Acc: 0.9704, Test Loss: 0.1271, Test Acc: 0.9635
```



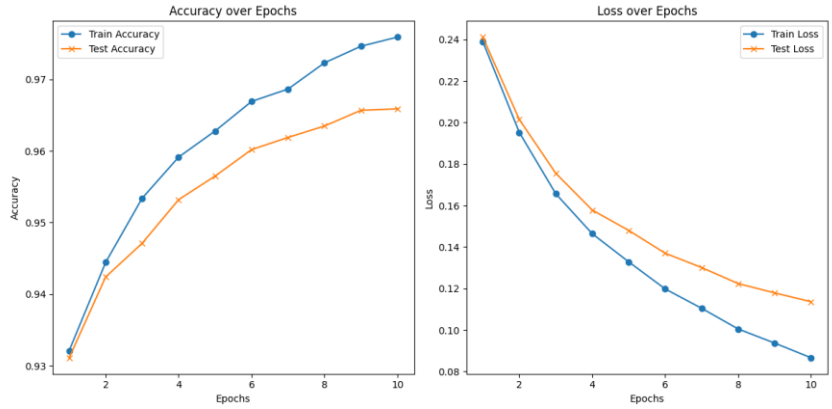
ReLu + Adam

```
Epoch 1/10 - Train Loss: 0.2386, Train Acc: 0.9325, Test Loss: 0.2361, Test Acc: 0.9317
Epoch 2/10 - Train Loss: 0.1809, Train Acc: 0.9478, Test Loss: 0.1842, Test Acc: 0.9441
Epoch 3/10 - Train Loss: 0.1529, Train Acc: 0.9554, Test Loss: 0.1624, Test Acc: 0.9522
Epoch 4/10 - Train Loss: 0.1179, Train Acc: 0.9672, Test Loss: 0.1314, Test Acc: 0.9620
Epoch 5/10 - Train Loss: 0.1020, Train Acc: 0.9705, Test Loss: 0.1225, Test Acc: 0.9647
Epoch 6/10 - Train Loss: 0.0858, Train Acc: 0.9754, Test Loss: 0.1122, Test Acc: 0.9668
Epoch 7/10 - Train Loss: 0.0781, Train Acc: 0.9772, Test Loss: 0.1057, Test Acc: 0.9687
Epoch 8/10 - Train Loss: 0.0671, Train Acc: 0.9812, Test Loss: 0.1008, Test Acc: 0.9714
Epoch 9/10 - Train Loss: 0.0631, Train Acc: 0.9825, Test Loss: 0.0987, Test Acc: 0.9706
Epoch 10/10 - Train Loss: 0.0533, Train Acc: 0.9849, Test Loss: 0.0907, Test Acc: 0.9731
```



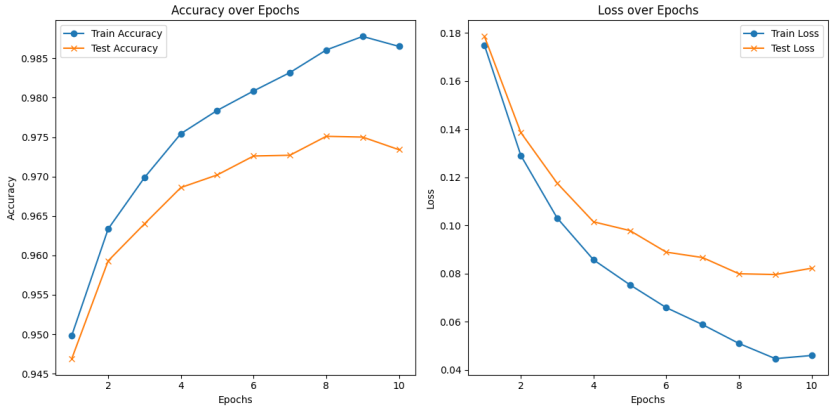
Sigmoid + RMSProp

```
Epoch 1/10 - Train Loss: 0.2390, Train Acc: 0.9321, Test Loss: 0.2412, Test Acc: 0.9311
Epoch 2/10 - Train Loss: 0.1952, Train Acc: 0.9444, Test Loss: 0.2015, Test Acc: 0.9424
Epoch 3/10 - Train Loss: 0.1657, Train Acc: 0.9534, Test Loss: 0.1755, Test Acc: 0.9471
Epoch 4/10 - Train Loss: 0.1464, Train Acc: 0.9591, Test Loss: 0.1578, Test Acc: 0.9532
Epoch 5/10 - Train Loss: 0.1328, Train Acc: 0.9628, Test Loss: 0.1480, Test Acc: 0.9565
Epoch 6/10 - Train Loss: 0.1198, Train Acc: 0.9669, Test Loss: 0.1370, Test Acc: 0.9602
Epoch 7/10 - Train Loss: 0.1104, Train Acc: 0.9687, Test Loss: 0.1301, Test Acc: 0.9619
Epoch 8/10 - Train Loss: 0.1005, Train Acc: 0.9723, Test Loss: 0.1224, Test Acc: 0.9635
Epoch 9/10 - Train Loss: 0.0937, Train Acc: 0.9747, Test Loss: 0.1179, Test Acc: 0.9657
Epoch 10/10 - Train Loss: 0.0866, Train Acc: 0.9759, Test Loss: 0.1136, Test Acc: 0.9659
```



ReLu + RMSProp

```
Epoch 1/10 - Train Loss: 0.1749, Train Acc: 0.9498, Test Loss: 0.1786, Test Acc: 0.9469
Epoch 2/10 - Train Loss: 0.1291, Train Acc: 0.9634, Test Loss: 0.1386, Test Acc: 0.9593
Epoch 3/10 - Train Loss: 0.1031, Train Acc: 0.9699, Test Loss: 0.1176, Test Acc: 0.9640
Epoch 4/10 - Train Loss: 0.0858, Train Acc: 0.9754, Test Loss: 0.1016, Test Acc: 0.9686
Epoch 5/10 - Train Loss: 0.0754, Train Acc: 0.9784, Test Loss: 0.0979, Test Acc: 0.9702
Epoch 6/10 - Train Loss: 0.0659, Train Acc: 0.9808, Test Loss: 0.0890, Test Acc: 0.9726
Epoch 7/10 - Train Loss: 0.0588, Train Acc: 0.9832, Test Loss: 0.0867, Test Acc: 0.9727
Epoch 8/10 - Train Loss: 0.0510, Train Acc: 0.9860, Test Loss: 0.0800, Test Acc: 0.9751
Epoch 9/10 - Train Loss: 0.0447, Train Acc: 0.9878, Test Loss: 0.0797, Test Acc: 0.9750
Epoch 10/10 - Train Loss: 0.0460, Train Acc: 0.9865, Test Loss: 0.0823, Test Acc: 0.9734
```



B) L1 regularizasyonu kullandığımızda doğruluğumuz çok düşük çıktı, L1 regularizasyonu modelin ağırlıklarını sıfırlayarak bazı özellikleri tamamen etkisiz hale getirmeyi hedefler fakat bizim modelimizde önemli bazı özellikleri de sıfırlamış, bu özelliklerin gereksiz şekilde sıfırlanması sonucu modelin öğrenme kapasitesinin azalmasına neden olmuş olabilir. Bu durumda veri setimizdeki önemli özellikleri dikkate alarak, L2 regularizasyonu kullanmak daha iyi bir sonuç verebilir.

L1 Regularization

```
Epoch 1: 1.40s, train acc=0.10, train loss=5.12, test acc=0.10, test loss=5.13
Epoch 2: 2.93s, train acc=0.10, train loss=4.87, test acc=0.10, test loss=4.88
Epoch 3: 4.33s, train acc=0.10, train loss=4.87, test acc=0.10, test loss=4.87
Epoch 4: 5.72s, train acc=0.11, train loss=4.83, test acc=0.11, test loss=4.83
Epoch 5: 7.15s, train acc=0.10, train loss=4.94, test acc=0.10, test loss=4.94
Epoch 6: 8.56s, train acc=0.10, train loss=4.87, test acc=0.10, test loss=4.87
Epoch 7: 9.95s, train acc=0.11, train loss=4.91, test acc=0.11, test loss=4.90
Epoch 8: 12.19s, train acc=0.10, train loss=4.82, test acc=0.10, test loss=4.82
Epoch 9: 13.69s, train acc=0.10, train loss=4.80, test acc=0.10, test loss=4.80
Epoch 10: 15.11s, train acc=0.10, train loss=4.86, test acc=0.10, test loss=4.87
```

L2 Regularization

```
Epoch 1: 1.29s, train acc=0.86, train loss=1.58, test acc=0.87, test loss=1.55
Epoch 2: 2.61s, train acc=0.85, train loss=1.60, test acc=0.85, test loss=1.59
Epoch 3: 3.95s, train acc=0.85, train loss=1.60, test acc=0.85, test loss=1.58
Epoch 4: 5.26s, train acc=0.84, train loss=1.59, test acc=0.85, test loss=1.57
Epoch 5: 6.68s, train acc=0.86, train loss=1.57, test acc=0.87, test loss=1.56
Epoch 6: 7.98s, train acc=0.85, train loss=1.58, test acc=0.86, test loss=1.56
Epoch 7: 9.31s, train acc=0.87, train loss=1.54, test acc=0.87, test loss=1.52
Epoch 8: 10.63s, train acc=0.85, train loss=1.56, test acc=0.86, test loss=1.54
Epoch 9: 11.94s, train acc=0.86, train loss=1.57, test acc=0.86, test loss=1.55
Epoch 10: 13.26s, train acc=0.85, train loss=1.58, test acc=0.86, test loss=1.56
```

No Regularization

```
Epoch 1: 1.29s, train acc=0.96, train loss=0.15, test acc=0.95, test loss=0.16
Epoch 2: 2.58s, train acc=0.97, train loss=0.10, test acc=0.96, test loss=0.11
Epoch 3: 3.84s, train acc=0.97, train loss=0.08, test acc=0.97, test loss=0.11
Epoch 4: 5.13s, train acc=0.98, train loss=0.06, test acc=0.97, test loss=0.09
Epoch 5: 6.43s, train acc=0.98, train loss=0.06, test acc=0.97, test loss=0.10
Epoch 6: 7.84s, train acc=0.99, train loss=0.04, test acc=0.97, test loss=0.09
Epoch 7: 9.12s, train acc=0.99, train loss=0.04, test acc=0.97, test loss=0.08
Epoch 8: 10.42s, train acc=0.99, train loss=0.03, test acc=0.97, test loss=0.09
Epoch 9: 11.70s, train acc=0.99, train loss=0.03, test acc=0.97, test loss=0.09
Epoch 10: 13.00s, train acc=0.99, train loss=0.02, test acc=0.98, test loss=0.09
```