

# ML - FNN

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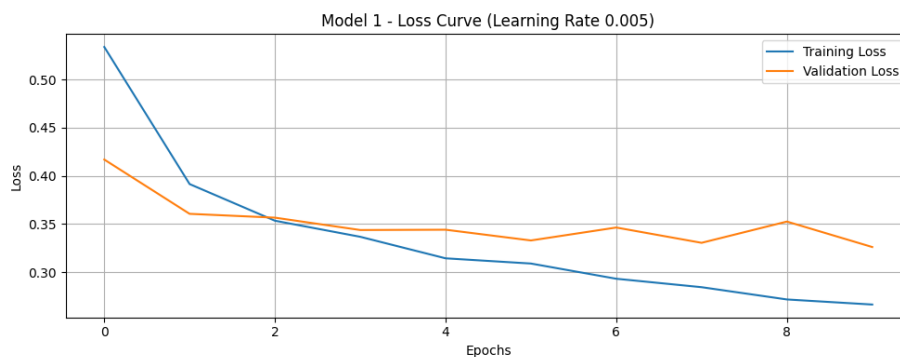
November 2024

# 1 Training with "learning rate = 0.005"

## 1.1 Model 1

### 1.1.1 Training Metrics

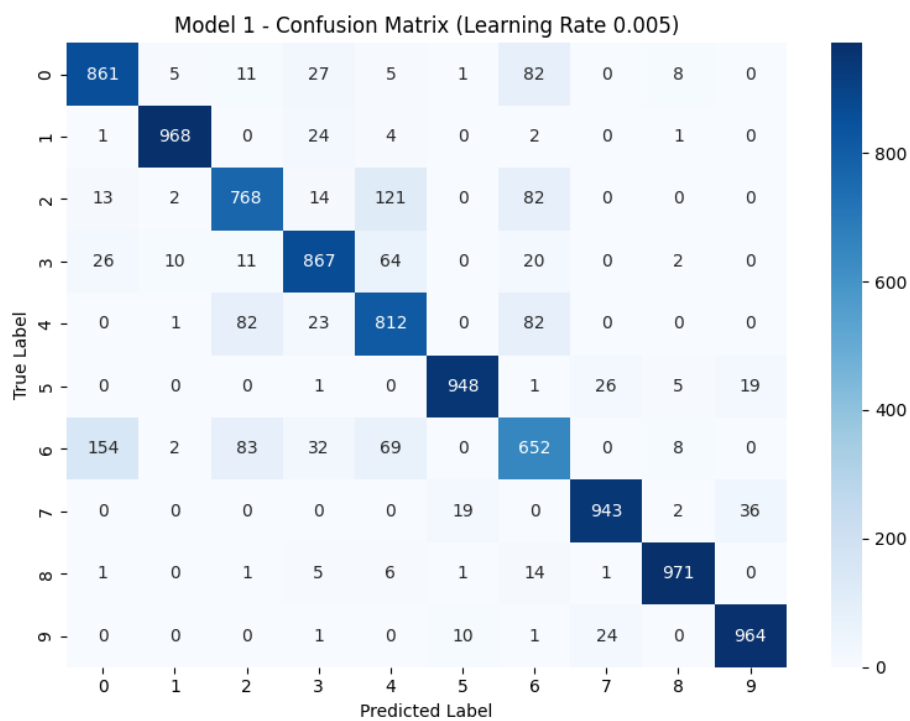
Epoch	Train Loss	Train Accuracy	Validation Loss	Validation Accuracy	Validation Macro-F1
1	0.5338	0.8438	0.4170	0.8495	0.8481
2	0.3915	0.8594	0.3606	0.8752	0.8732
3	0.3535	0.9062	0.3566	0.8720	0.8733
4	0.3368	0.8672	0.3438	0.8759	0.8759
5	0.3144	0.8750	0.3441	0.8742	0.8741
6	0.3090	0.9375	0.3330	0.8811	0.8796
7	0.2932	0.8672	0.3464	0.8792	0.8790
8	0.2845	0.9062	0.3305	0.8840	0.8836
9	0.2717	0.9297	0.3526	0.8730	0.8753
10	0.2665	0.8906	0.3262	0.8873	0.8870



### 1.1.2 Test Results

- **Test Loss:** 0.3586
- **Test Accuracy:** 0.8754

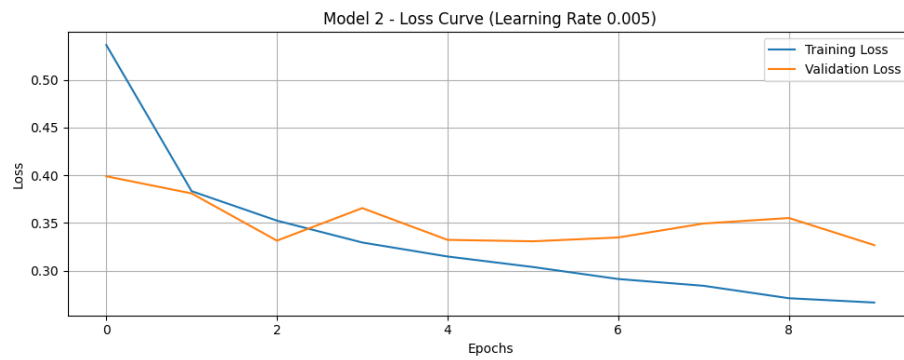
## 1.2 Confusion Matrix



## 1.3 Model 2

### 1.3.1 Training Metrics

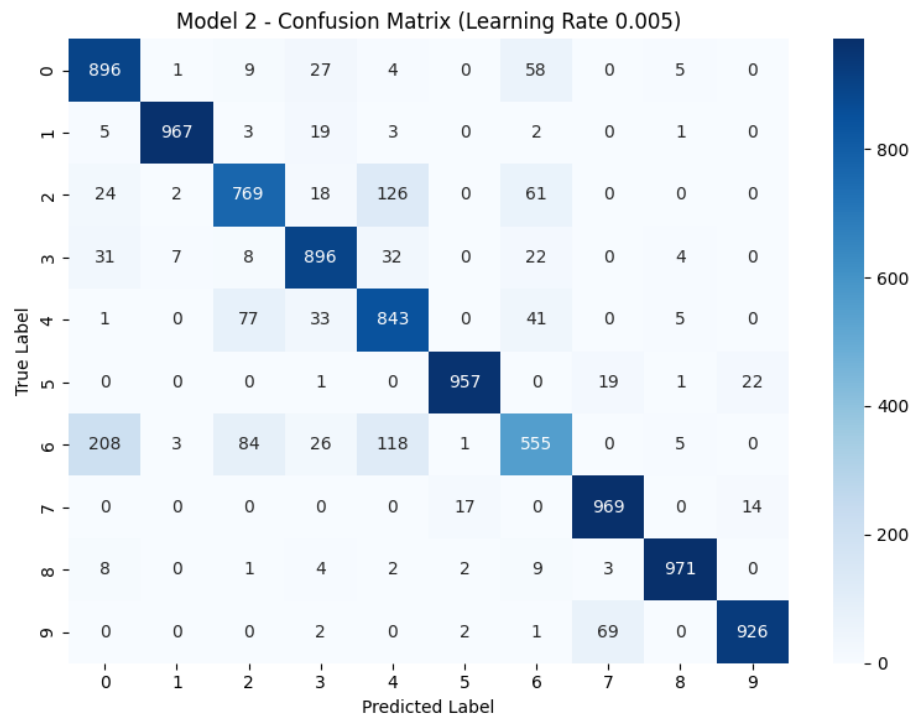
Epoch	Train Loss	Train Accuracy	Validation Loss	Validation Accuracy	Validation Macro-F1
1	0.5365	0.8594	0.3989	0.8597	0.8555
2	0.3832	0.8984	0.3809	0.8662	0.8636
3	0.3524	0.9141	0.3314	0.8798	0.8793
4	0.3294	0.9062	0.3655	0.8698	0.8661
5	0.3148	0.8594	0.3322	0.8825	0.8825
6	0.3037	0.8594	0.3307	0.8825	0.8818
7	0.2912	0.9219	0.3347	0.8830	0.8815
8	0.2841	0.8906	0.3493	0.8773	0.8752
9	0.2710	0.8984	0.3551	0.8752	0.8758
10	0.2665	0.8594	0.3267	0.8856	0.8840



### 1.3.2 Test Results

- Test Loss: 0.3579
- Test Accuracy: 0.8749

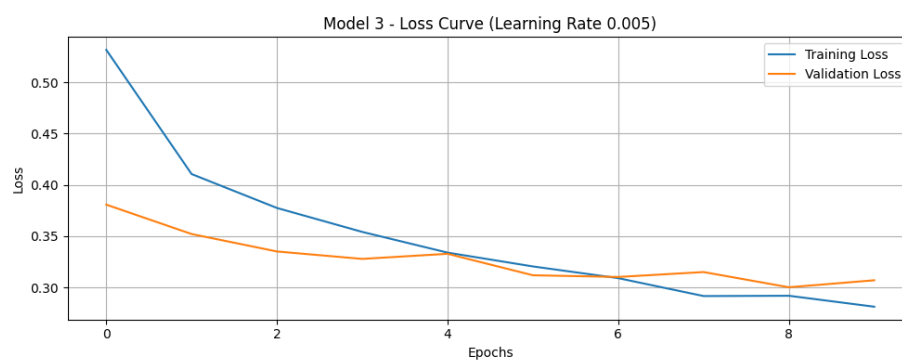
### 1.4 Confusion Matrix



## 1.5 Model 3

### 1.5.1 Training Metrics

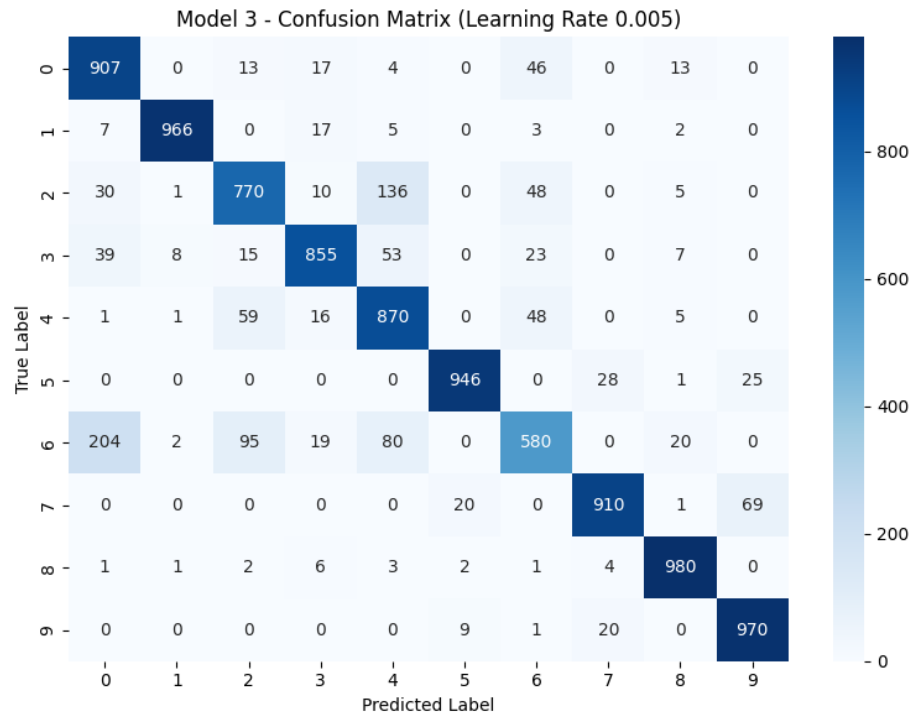
Epoch	Train Loss	Train Accuracy	Validation Loss	Validation Accuracy	Validation Macro-F1
1	0.5317	0.8438	0.3807	0.8642	0.8635
2	0.4105	0.8203	0.3520	0.8711	0.8714
3	0.3774	0.8672	0.3350	0.8781	0.8767
4	0.3541	0.9062	0.3278	0.8787	0.8773
5	0.3339	0.8594	0.3327	0.8802	0.8793
6	0.3204	0.8281	0.3118	0.8862	0.8862
7	0.3090	0.8203	0.3101	0.8869	0.8853
8	0.2915	0.9297	0.3149	0.8870	0.8863
9	0.2918	0.8672	0.3001	0.8906	0.8914
10	0.2811	0.8828	0.3069	0.8890	0.8873



### 1.5.2 Test Results

- **Test Loss:** 0.3441
- **Test Accuracy:** 0.8754

## 1.6 Confusion Matrix

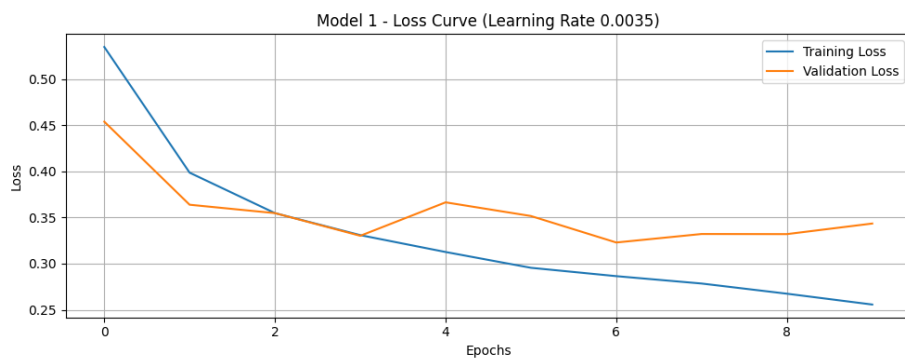


## 2 Training with "learning rate = 0.0035"

### 2.1 Model 1

#### 2.1.1 Training Metrics

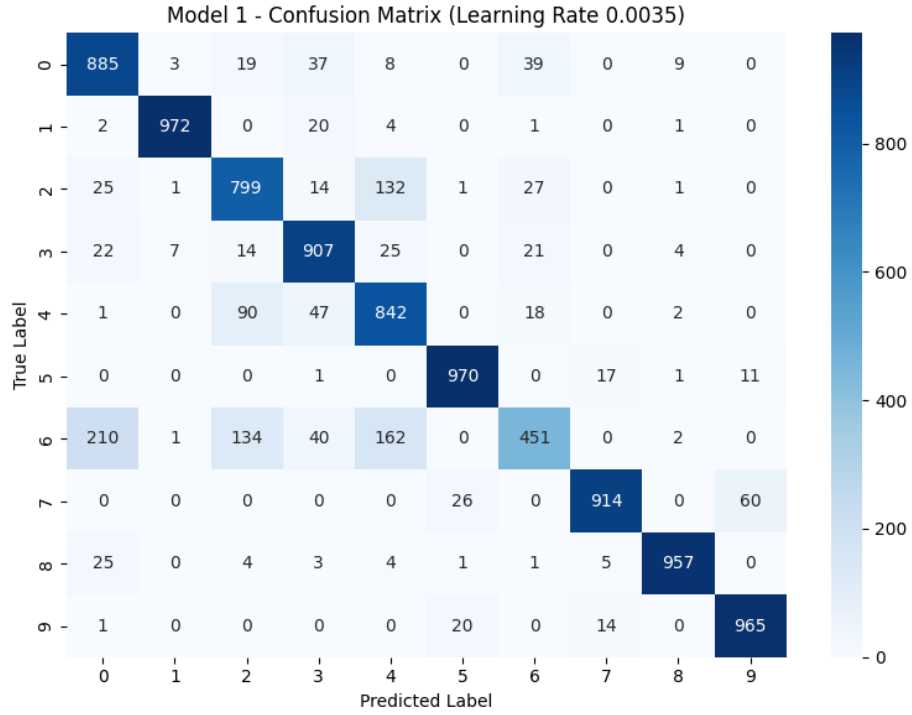
Epoch	Train Loss	Train Accuracy	Validation Loss	Validation Accuracy	Validation Macro-F1
1	0.5346	0.8203	0.4538	0.8378	0.8361
2	0.3985	0.8594	0.3638	0.8693	0.8687
3	0.3548	0.8750	0.3547	0.8721	0.8722
4	0.3309	0.8906	0.3302	0.8819	0.8804
5	0.3126	0.8906	0.3664	0.8713	0.8677
6	0.2955	0.9219	0.3516	0.8778	0.8770
7	0.2865	0.8906	0.3229	0.8838	0.8836
8	0.2785	0.9062	0.3321	0.8842	0.8835
9	0.2675	0.9062	0.3320	0.8837	0.8829
10	0.2558	0.8906	0.3435	0.8808	0.8772



#### 2.1.2 Test Results

- **Test Loss:** 0.3841
- **Test Accuracy:** 0.8662

## 2.2 Confusion Matrix

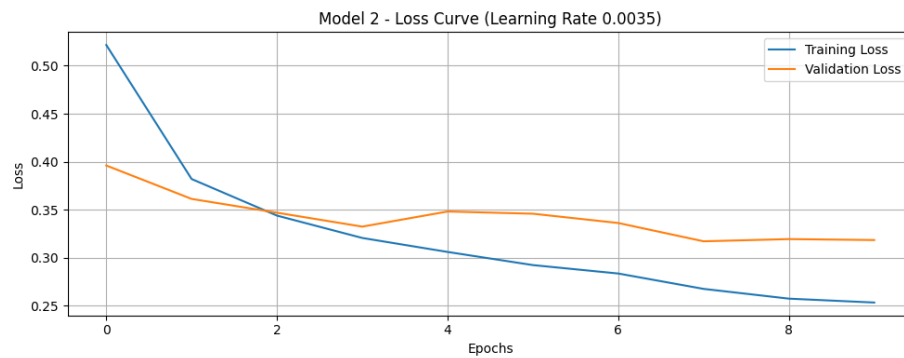


## 2.3 Model 2

### 2.3.1 Training Metrics

Epoch	Train Loss	Train Accuracy	Validation Loss	Validation Accuracy	Validation Macro-F1
1	0.5216	0.8203	0.3961	0.8599	0.8607
2	0.3820	0.8984	0.3613	0.8723	0.8718
3	0.3439	0.8281	0.3469	0.8737	0.8719
4	0.3206	0.8438	0.3324	0.8812	0.8785
5	0.3060	0.9062	0.3482	0.8715	0.8702
6	0.2923	0.9141	0.3458	0.8792	0.8790
7	0.2836	0.8828	0.3362	0.8784	0.8790
8	0.2675	0.8672	0.3171	0.8901	0.8906
9	0.2574	0.8984	0.3194	0.8907	0.8903
10	0.2533	0.9297	0.3184	0.8872	0.8874

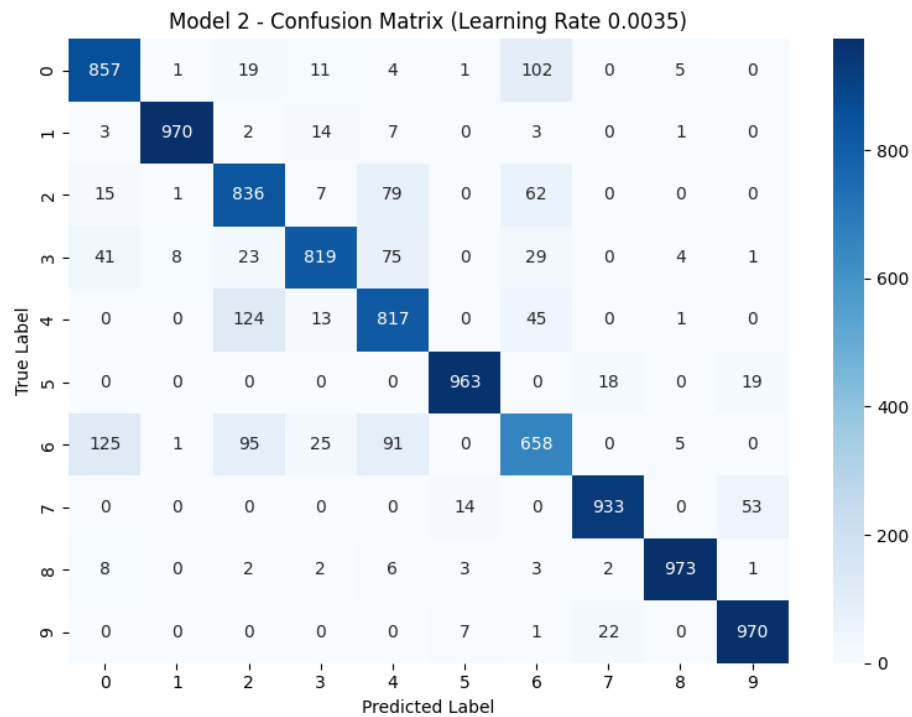




### 2.3.2 Test Results

- Test Loss: 0.3422
- Test Accuracy: 0.8796

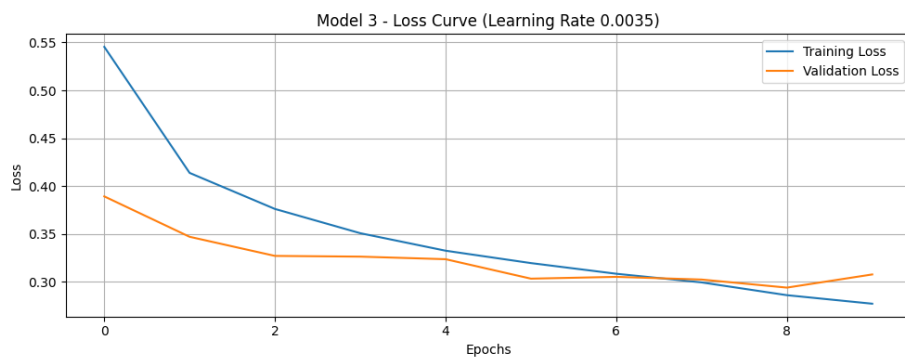
## 2.4 Confusion Matrix



## 2.5 Model 3

### 2.5.1 Training Metrics

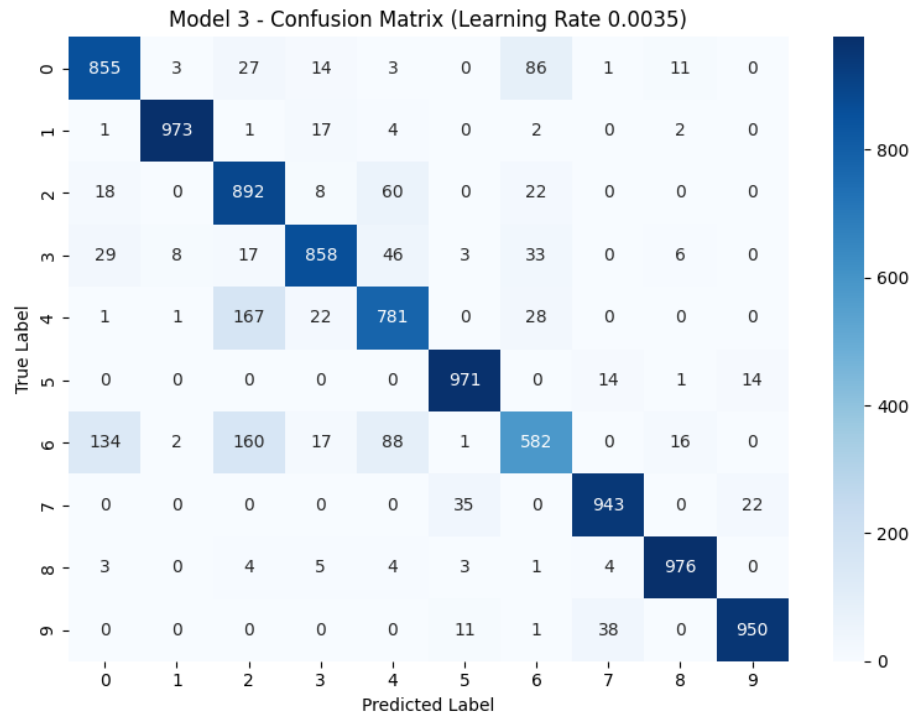
Epoch	Train Loss	Train Accuracy	Validation Loss	Validation Accuracy	Validation Macro-F1
1	0.5454	0.7734	0.3893	0.8574	0.8530
2	0.4138	0.8828	0.3471	0.8734	0.8724
3	0.3762	0.8672	0.3272	0.8798	0.8796
4	0.3509	0.8750	0.3264	0.8792	0.8793
5	0.3326	0.8672	0.3237	0.8822	0.8788
6	0.3197	0.8828	0.3034	0.8905	0.8882
7	0.3085	0.8984	0.3053	0.8873	0.8847
8	0.2995	0.8438	0.3025	0.8886	0.8894
9	0.2862	0.8984	0.2941	0.8929	0.8931
10	0.2773	0.8672	0.3078	0.8867	0.8857



### 2.5.2 Test Results

- **Test Loss:** 0.3422
- **Test Accuracy:** 0.8781

## 2.6 Confusion Matrix

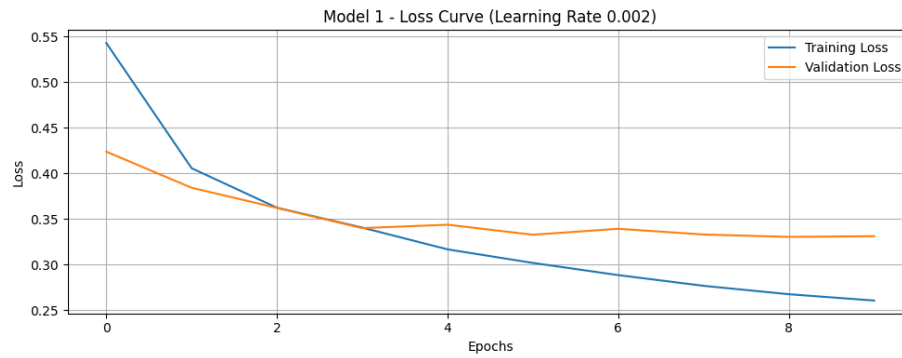


### 3 Training with "learning rate = 0.002"

#### 3.1 Model 1

##### 3.1.1 Training Metrics

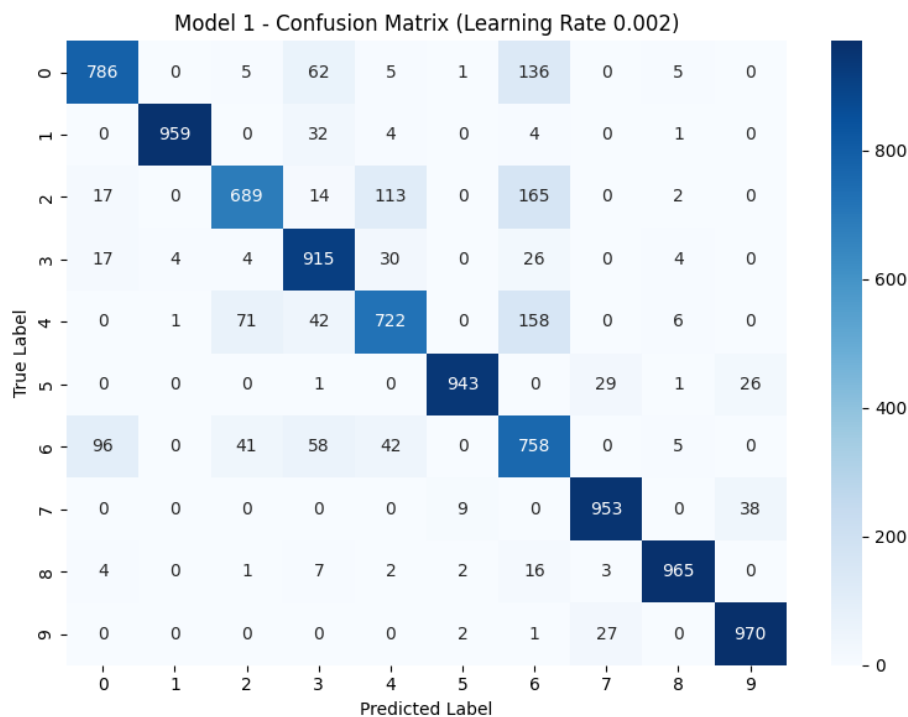
Epoch	Train Loss	Train Accuracy	Validation Loss	Validation Accuracy	Validation Macro-F1
1	0.5429	0.8359	0.4238	0.8518	0.8507
2	0.4057	0.8047	0.3843	0.8619	0.8597
3	0.3624	0.8750	0.3622	0.8702	0.8697
4	0.3406	0.8750	0.3400	0.8783	0.8800
5	0.3167	0.8750	0.3437	0.8766	0.8759
6	0.3018	0.8516	0.3328	0.8805	0.8787
7	0.2885	0.8750	0.3393	0.8793	0.8797
8	0.2768	0.9062	0.3330	0.8815	0.8795
9	0.2675	0.9297	0.3304	0.8808	0.8798
10	0.2606	0.8984	0.3312	0.8834	0.8843



##### 3.1.2 Test Results

- Test Loss: 0.3748
- Test Accuracy: 0.8660

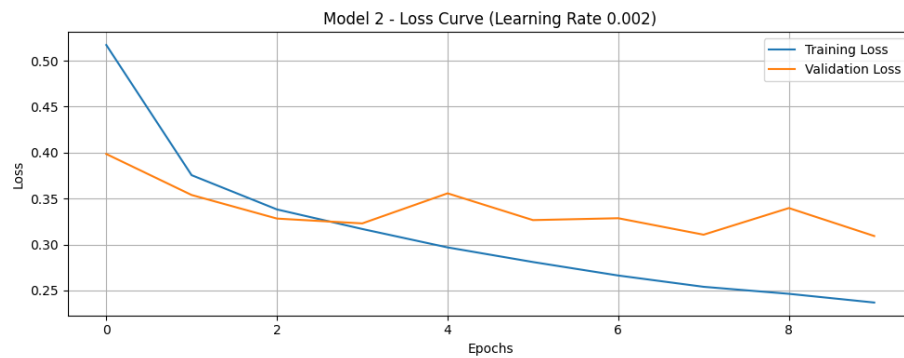
## 3.2 Confusion Matrix



## 3.3 Model 2

### 3.3.1 Training Metrics

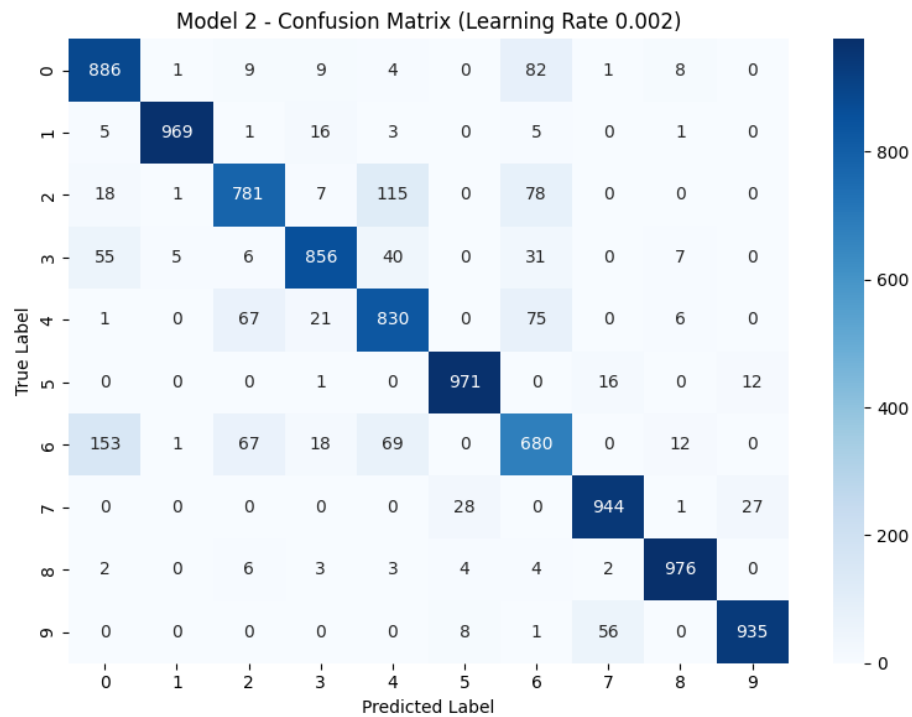
Epoch	Train Loss	Train Accuracy	Validation Loss	Validation Accuracy	Validation Macro-F1
1	0.5171	0.8984	0.3985	0.8572	0.8578
2	0.3754	0.9297	0.3539	0.8737	0.8733
3	0.3382	0.8281	0.3282	0.8790	0.8777
4	0.3169	0.8516	0.3230	0.8838	0.8832
5	0.2969	0.9219	0.3557	0.8770	0.8773
6	0.2809	0.9141	0.3266	0.8875	0.8877
7	0.2663	0.8516	0.3286	0.8836	0.8822
8	0.2540	0.8906	0.3107	0.8911	0.8896
9	0.2463	0.8984	0.3397	0.8796	0.8799
10	0.2369	0.8906	0.3092	0.8912	0.8915



### 3.3.2 Test Results

- Test Loss: 0.3407
- Test Accuracy: 0.8828

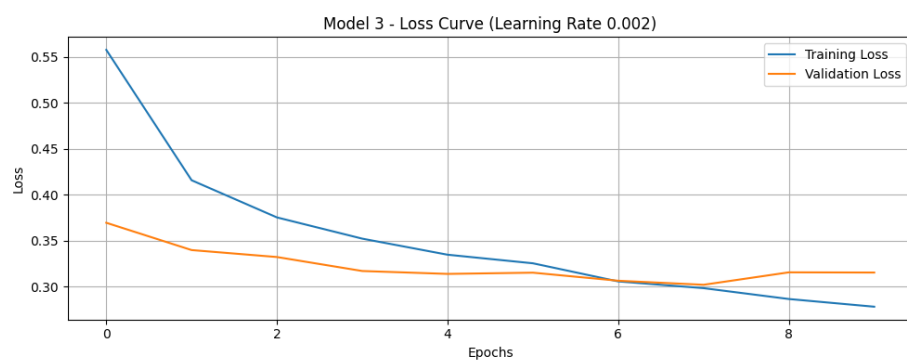
### 3.4 Confusion Matrix



## 3.5 Model 3

### 3.5.1 Training Metrics

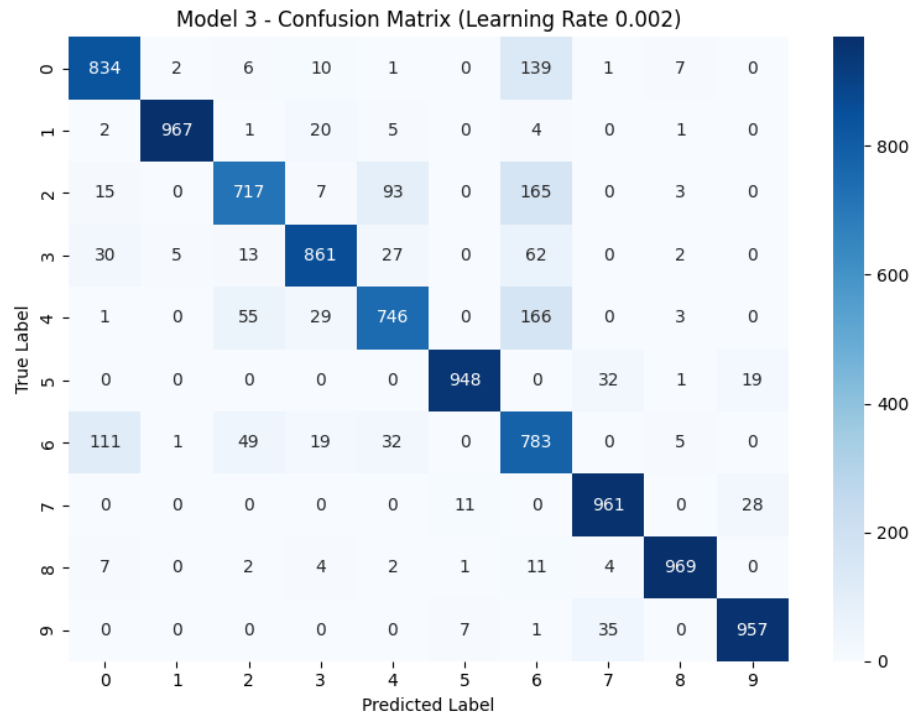
Epoch	Train Loss	Train Accuracy	Validation Loss	Validation Accuracy	Validation Macro-F1
1	0.5575	0.8516	0.3693	0.8667	0.8660
2	0.4156	0.8359	0.3396	0.8765	0.8751
3	0.3752	0.8516	0.3320	0.8790	0.8789
4	0.3520	0.8203	0.3168	0.8850	0.8845
5	0.3346	0.8750	0.3137	0.8848	0.8830
6	0.3252	0.8672	0.3150	0.8824	0.8805
7	0.3055	0.8906	0.3062	0.8868	0.8851
8	0.2982	0.9141	0.3018	0.8936	0.8942
9	0.2863	0.8906	0.3154	0.8852	0.8852
10	0.2780	0.9219	0.3152	0.8862	0.8886



### 3.5.2 Test Results

- **Test Loss:** 0.3460
- **Test Accuracy:** 0.8743

### 3.6 Confusion Matrix



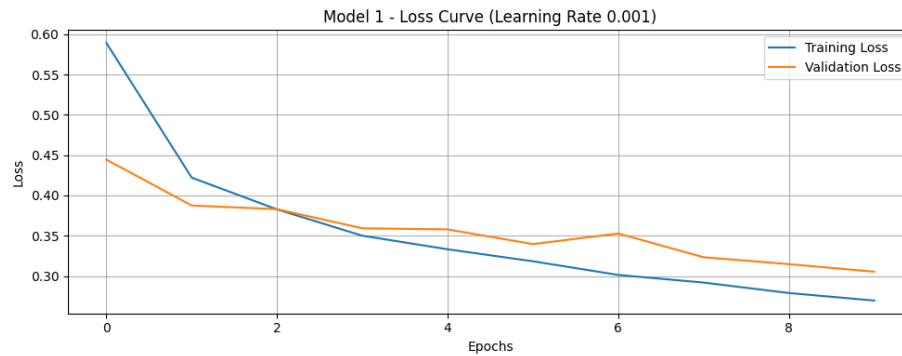


## 4 Training with "learning rate = 0.001"

### 4.1 Model 1

#### 4.1.1 Training Metrics

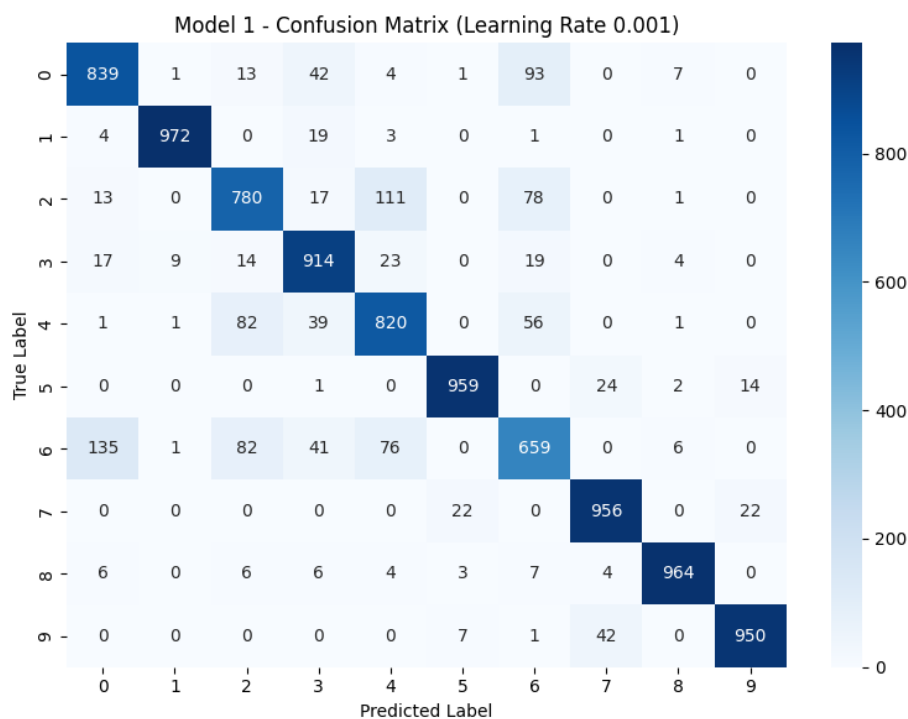
Epoch	Train Loss	Train Accuracy	Validation Loss	Validation Accuracy	Validation Macro-F1
1	0.5892	0.7891	0.4444	0.8451	0.8446
2	0.4221	0.8594	0.3875	0.8642	0.8644
3	0.3827	0.8359	0.3829	0.8651	0.8650
4	0.3500	0.8750	0.3592	0.8739	0.8743
5	0.3332	0.8438	0.3579	0.8725	0.8699
6	0.3183	0.9062	0.3396	0.8792	0.8788
7	0.3014	0.8906	0.3528	0.8758	0.8745
8	0.2919	0.8906	0.3233	0.8877	0.8872
9	0.2789	0.8984	0.3148	0.8909	0.8911
10	0.2696	0.8984	0.3054	0.8922	0.8918



#### 4.1.2 Test Results

- **Test Loss:** 0.3362
- **Test Accuracy:** 0.8813

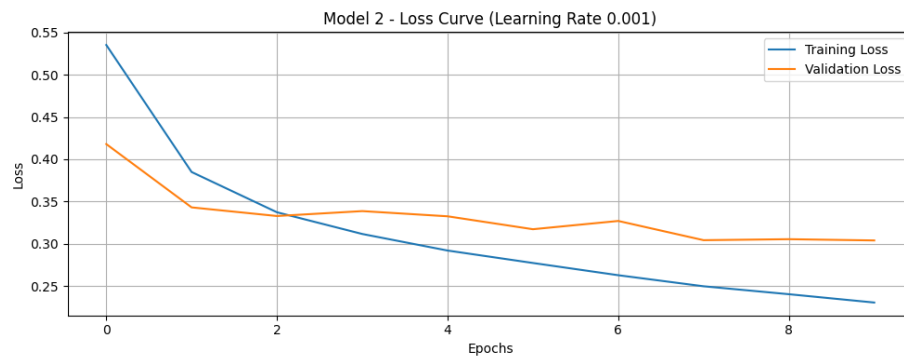
## 4.2 Confusion Matrix



## 4.3 Model 2

### 4.3.1 Training Metrics

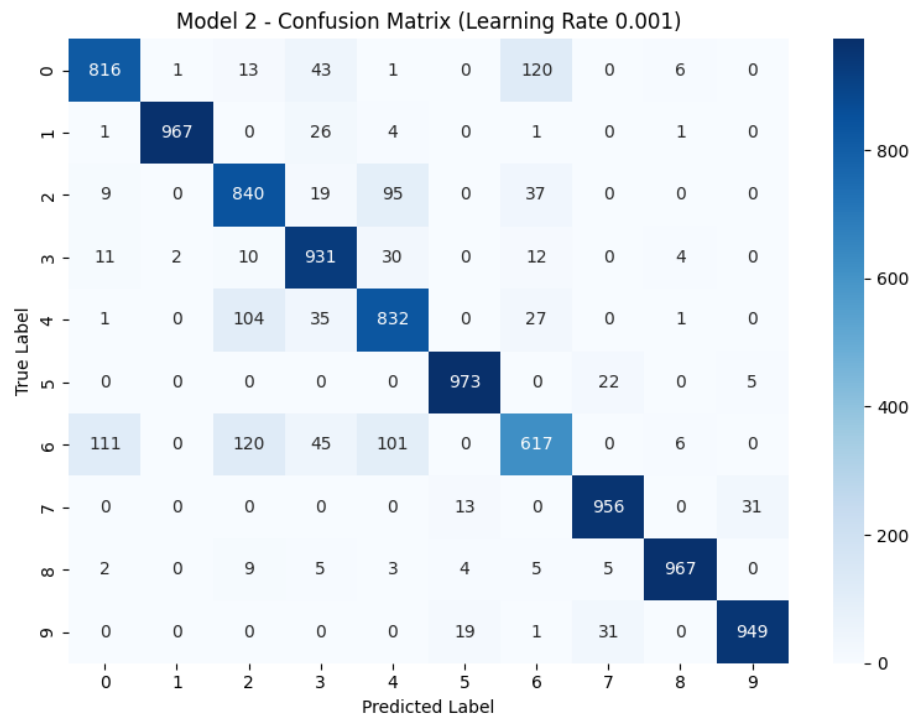
Epoch	Train Loss	Train Accuracy	Validation Loss	Validation Accuracy	Validation Macro-F1
1	0.5351	0.8516	0.4179	0.8534	0.8548
2	0.3849	0.8750	0.3431	0.8765	0.8758
3	0.3373	0.8984	0.3329	0.8792	0.8800
4	0.3116	0.8906	0.3387	0.8758	0.8774
5	0.2920	0.8750	0.3325	0.8803	0.8810
6	0.2773	0.9297	0.3172	0.8900	0.8891
7	0.2629	0.8906	0.3270	0.8855	0.8848
8	0.2498	0.9375	0.3043	0.8922	0.8916
9	0.2404	0.8750	0.3055	0.8940	0.8933
10	0.2306	0.9141	0.3040	0.8968	0.8960



#### 4.3.2 Test Results

- Test Loss: 0.3414
- Test Accuracy: 0.8848

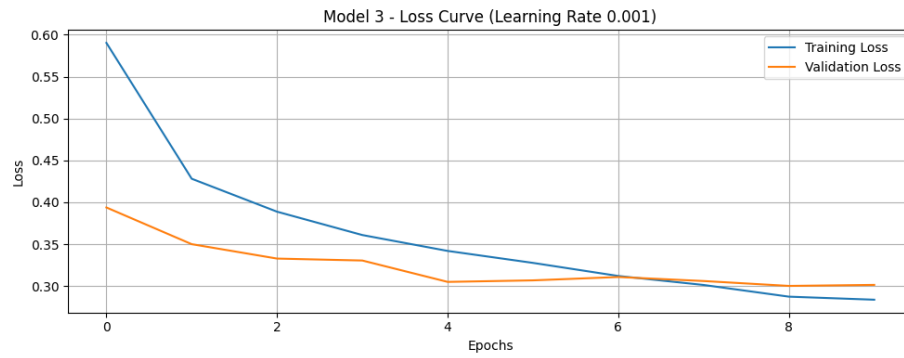
#### 4.4 Confusion Matrix



## 4.5 Model 3

### 4.5.1 Training Metrics

Epoch	Train Loss	Train Accuracy	Validation Loss	Validation Accuracy	Validation Macro-F1
1	0.5903	0.8672	0.3938	0.8594	0.8579
2	0.4281	0.8203	0.3500	0.8758	0.8747
3	0.3888	0.8828	0.3328	0.8790	0.8760
4	0.3609	0.8984	0.3305	0.8793	0.8782
5	0.3420	0.8984	0.3050	0.8881	0.8876
6	0.3277	0.8984	0.3068	0.8887	0.8896
7	0.3121	0.8516	0.3108	0.8881	0.8882
8	0.3013	0.8359	0.3060	0.8863	0.8861
9	0.2874	0.8516	0.3002	0.8905	0.8907
10	0.2837	0.8984	0.3014	0.8921	0.8917



### 4.5.2 Test Results

- **Test Loss:** 0.3384
- **Test Accuracy:** 0.8791

## 4.6 Confusion Matrix

