به نام خدا

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۴۰۰۱۳۱۰۲۷

تمرین سری دوم شبکه های عصبی

۱)

در ابتدا کتابخانه های مورد نیاز را وارد کرده ایم. سپس در بلاک بعدی داده ها را فراخوانی کرده ایم. سپس برای دسترسی به داده ها به صورت NaN تمام داده هایی که missing value آنها با ؟ است جا به جا میکنیم.

سپس بر اساس اطلاعات درون فایل توضیحات دیتاست نوع بعضی از ویژگی ها را عوض میکنیم. ویژگی های ۲ ، ۳ ، ۸ ، ۱۱ ، ۱۴ ، ۱۵ با توجه به توضیحات از نوع گسسته هستند و در این دیتاست نوع انها از نوع object است که برای کار هایی که در ادامه نیاز است و به دنبال توضیحات خواهد آمد ، به نوع float تبدیل شده است.

اطلاعات دیتاست به حالت زیر تغییر پیدا کرده است :

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 690 entries, 0 to 689
Data columns (total 16 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   0       678 non-null    object
 1   1       678 non-null    float64
 2   2       690 non-null    float64
 3   3       684 non-null    object
 4   4       684 non-null    object
 5   5       681 non-null    object
 6   6       681 non-null    object
 7   7       690 non-null    float64
 8   8       690 non-null    object
 9   9       690 non-null    object
 10  10      690 non-null    float64
 11  11      690 non-null    object
 12  12      690 non-null    object
 13  13      677 non-null    float64
 14  14      690 non-null    float64
 15  15      690 non-null    object
dtypes: float64(6), object(10)
memory usage: 86.4+ KB
```

داده های گمشده برای هر ویژگی به شرح زیر است:

```
0     12
1     12
2      0
3      6
4      6
5      9
6      9
7      0
8      0
9      0
10     0
11     0
12     0
13    13
14     0
15     0
dtype: int64
```

در ادامه و بلاک بعدی برای داده هایی که مقدار آنها به صورت float هستند ، برای پر کردن مقدار داده های گمشده از تابع median استفاده کرده و به جای مقادیر آنها ، مقدار میانه انها را قرار میدهیم. دلیل استفاده از این تابع این است که در این دیتاست داده های ویژگی ۲ و ۱۴ که مقدار عددی دارند و نوع توزیع انها به صورت skewed است بهتر است به جای mean از تابع median استفاده شود.

با انجام این کار ویژگی های دارای مقدار گمشده به حالت زیر تبدیل میشوند :

```
0     12
1      0
2      0
3      6
4      6
5      9
6      9
7      0
8      0
9      0
10     0
11     0
12     0
13     0
14     0
15     0
dtype: int64
```

در مورد ویژگی های ۱ ، ۴ ، ۵ ، ۶ ، ۷ که نوع انها از نوع object است و به صورت categorical هستند نیز از حالتی استفاده میشود که در این ویژگی ها بیشترین تعدادی که از یک مقدار موجود است را پیدا کرده و آن مقدار را برای داده های گمشده قرار داده میشود. این کار همانند کاری است که برای داده های float انجام شده است و همانند آنها مقداری که بیشترین تعداد را دارد قرار داده میشود. و در ادامه تعداد مقادیر گمشده به صورت زیر تبدیل میشود :

```
0     0
1     0
2     0
3     0
4     0
5     0
6     0
7     0
8     0
9     0
10    0
11    0
12    0
13    0
14    0
15    0
dtype: int64
```

در ادامه نیاز است برای ادامه کار های خود ، داده های categorical را به داده های numerical تبدیل کنیم پس از کتابخانه LabelEncoder استفاده کرده و داده های categorical را تبدیل میکنیم. علت استفاده از این متد برای تبدیل این است که اطلاعات دقیقی نسبت به داده های ورودی در دسترس نیست و دقیقا نمیدانیم که ترتیب داده ها به چه صورت است.

شکل کلی داده ها در این مرحله به صورت زیر خواهد بود :

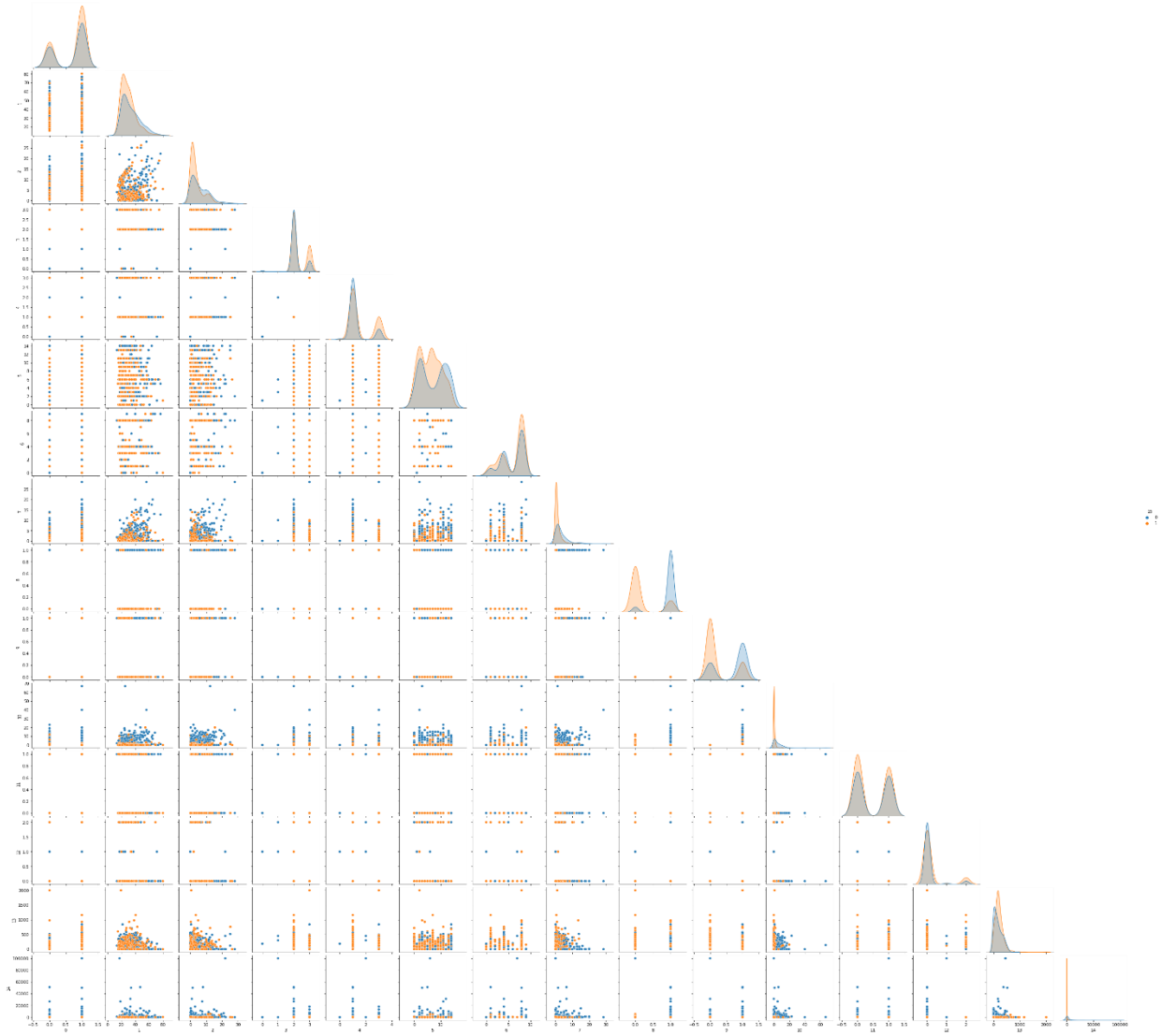
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	30.83	0.000	2	1	13	8	1.25	1	1	1.0	0	0	202.0	0.0	0
1	0	58.67	4.460	2	1	11	4	3.04	1	1	6.0	0	0	43.0	560.0	0
2	0	24.50	0.500	2	1	11	4	1.50	1	0	0.0	0	0	280.0	824.0	0
3	1	27.83	1.540	2	1	13	8	3.75	1	1	5.0	1	0	100.0	3.0	0
4	1	20.17	5.625	2	1	13	8	1.71	1	0	0.0	0	2	120.0	0.0	0

سپس در مرحله آخر نیاز است که داده ها را rescale کنیم تا در بازه مناسبی قرار داشته باشند. برای این کار از کتابخانه MinMaxScaler استفاده کرده تا داده ها را در یک بازه خاص محدود کنیم. با استفاده از این کتابخانه و بازه feature_range=(۰،۱) و تابع fit_transform داده ها را در این بازه محدود میکنیم. شکل کلی داده های جدید به صورت زیر خواهد بود:

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1.0	0.256842	0.000000	0.666667	0.333333	0.928571	0.888889	0.043860	1.0	1.0	0.014925	0.0	0.0	0.1010	0.00000	0.0
1	0.0	0.675489	0.159286	0.666667	0.333333	0.785714	0.444444	0.106667	1.0	1.0	0.089552	0.0	0.0	0.0215	0.00560	0.0
2	0.0	0.161654	0.017857	0.666667	0.333333	0.785714	0.444444	0.052632	1.0	0.0	0.000000	0.0	0.0	0.1400	0.00824	0.0
3	1.0	0.211729	0.055000	0.666667	0.333333	0.928571	0.888889	0.131579	1.0	1.0	0.074627	1.0	0.0	0.0500	0.00003	0.0
4	1.0	0.096541	0.200893	0.666667	0.333333	0.928571	0.888889	0.060000	1.0	0.0	0.000000	0.0	1.0	0.0600	0.00000	0.0

۲)

ابتدا ویژگی ۱۶ را به عنوان مقدار target در متغیر y قرار میدهیم. سپس با استفاده از کتابخانه seaborn نمودار داده ها را رسم میکنیم. با استفاده از تابع sns.pairplot(df, hue=15, corner=True) داده ها را رسم کرده ایم. نمودار داده ها به شرح زیر است:



با توجه به داده های رسم شده ، برخی از ویژگی ها قابلیت جداپذیری خطی را دارند و میتوان کلاس ها را از یکدیگر جدا کرد اما در برخی از ویژگی ها داده ها درون یکدیگر قرار دارند و قابلی تفکیک خطی وجود ندارد . با توجه به این نمودار ها و بررسی جدا پذیری ویژگی ها ، میتوان به این نتیجه رسید که با در نظر گرفتن تمام داده ها ، این دیتاست به صورت خطی جداپذیر نخواهد بود.

در ادامه برای جدا کردن داده ها از یکدیگر از کتابخانه train_test_split استفاده کرده ایم. ابتدا ۰٫۳ داده ها را برای داده های تست و اعتبار سنجی جدا میکنیم. سپس دوباره ۰٫۳۳۳ این داده ها را برای داده اعتبار سنجی و باقی را برای تست استفاده میکنیم.

۳)

در ابتدا برای استفاده از تنسورفلو کتابخانه آن را وارد میکنیم و از این کتابخانه keras را فراخوانی میکنیم.

```
from tensorflow import keras
```

سپس با استفاده از دستور زیر تنسوربرد را فراخوانی میکنیم.

```
%load_ext tensorboard
```

و در ادامه یک callback در مسیر ./logs ایجاد میکنیم.

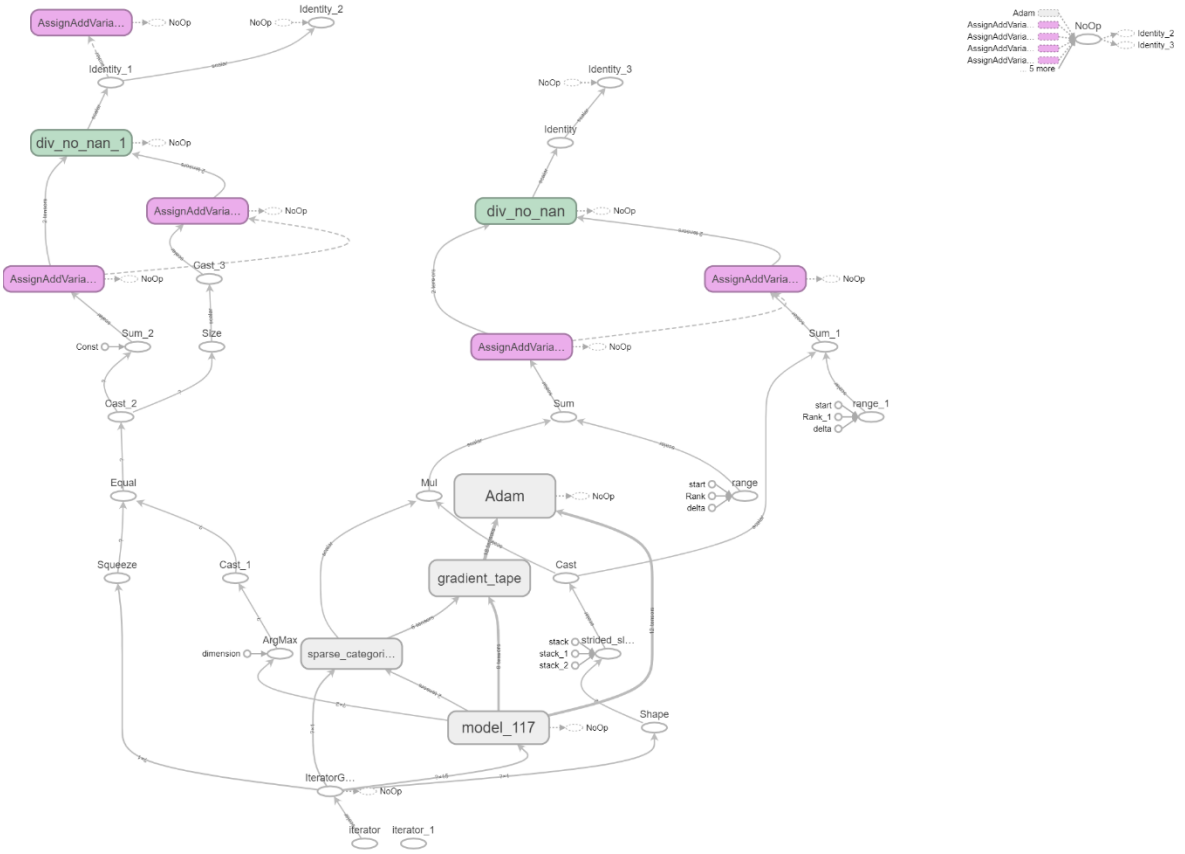
سپس مدل خود را میسازیم. برای این سوال یک شبکه عصبی ۵ لایه ایجاد کرده ایم. ۱ لایه به عنوان ورودی ، ۱ لایه به عنوان خروجی و ۳ لایه به عنوان لایه مخفی ایجاد کرده ایم. تعداد نود های آن به صورت ۱۵ به عنوان ورودی ، ۱۲ نود لایه دوم ، ۸ نود لایه سوم ، ۴ نود لایه چهارم و ۲ نود برای لایه خروجی ایجاد کرده ایم.

سپس برای کامپایلر آن ، برای optimizer از adam ، برای loss از SparseCategoricalCrossentropy و برای metrics از accuracy استفاده کرده ایم. در مرحله بعد مدل خود را fit کرده ایم و کد آن را به صورت زیر نوشته ایم.

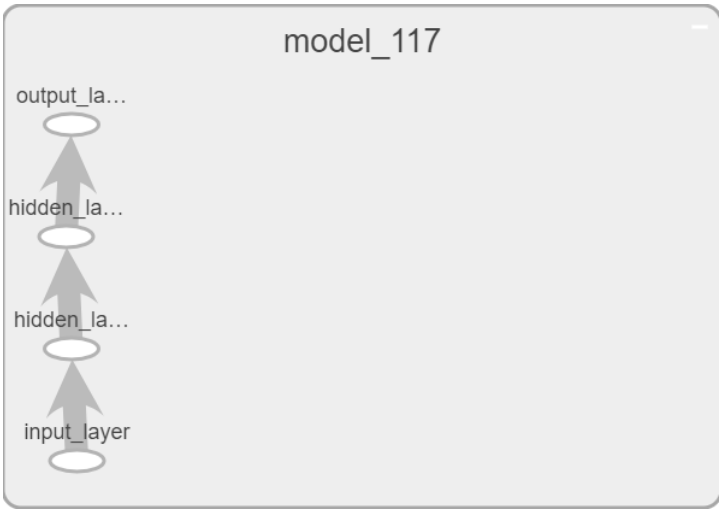
```
model.fit(X_train , y_train , epochs=30 , validation_data =(X_valid, y_valid) , callbacks=[tb_callBack])
```

تعداد تکرار خود را ۳۰ قرار داده ، داده هایی که برای اعتبار سنجی ساخته ایم را برای ورودی داده و کالبک مورد نیاز برای تنسوربرد را نیز برای ورودی داده ایم. مقدار خروجی این تابع به علت طولانی بودن در انتهای گزارش آورده شده است.

در ادامه گراف این مدل طراحی شده به صورت زیر خواهد بود :



و گراف keras مدل نیز به صورت زیر خواهد بود:

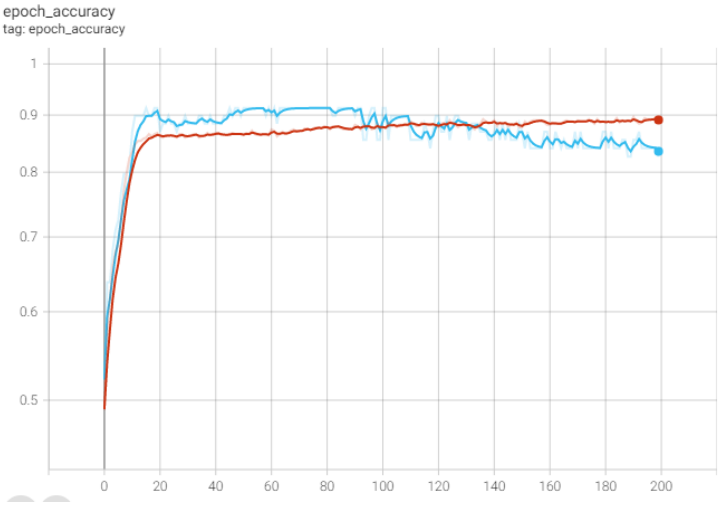


۴)

در تمام آزمایشات ۱ لایه ورودی با ۱۵ نود و ۱ لایه خروجی با ۲ نود قرار داده شده است.

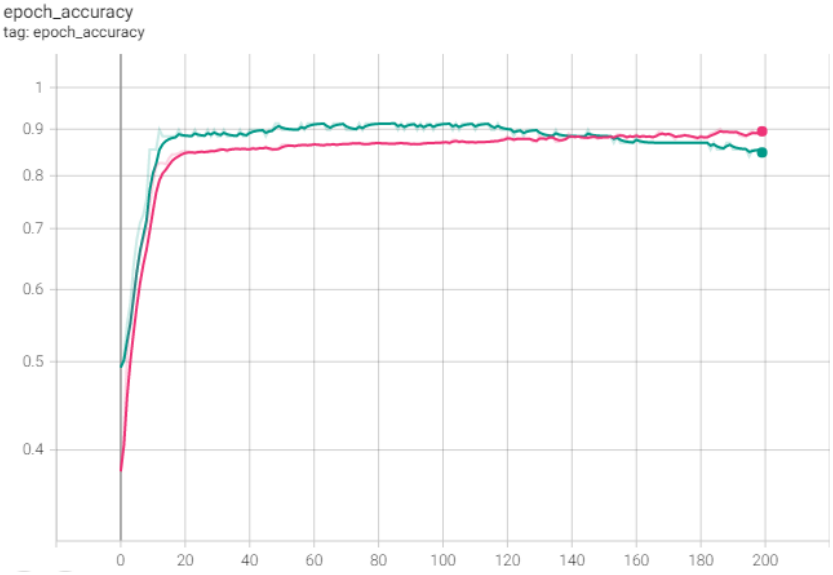
آزمایش ۱)

تعداد لایه ها : ۱ لایه مخفی – ۱۶ نود – مقدار ۰/۸۷ صحت تست – ۰/۸۹ اموزش



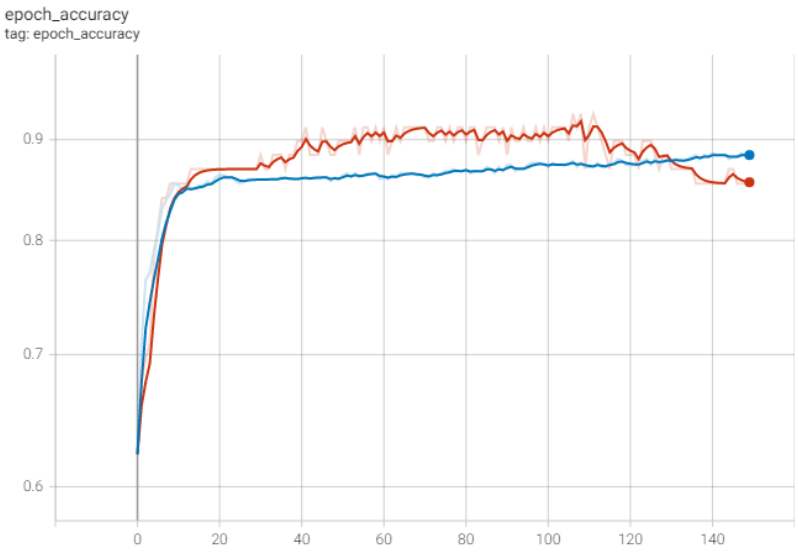
آزمایش ۲)

تعداد لایه ها : ۱ لایه مخفی – ۱۲ نود – مقدار ۰/۸۶ صحت تست – ۰/۹ اموزش



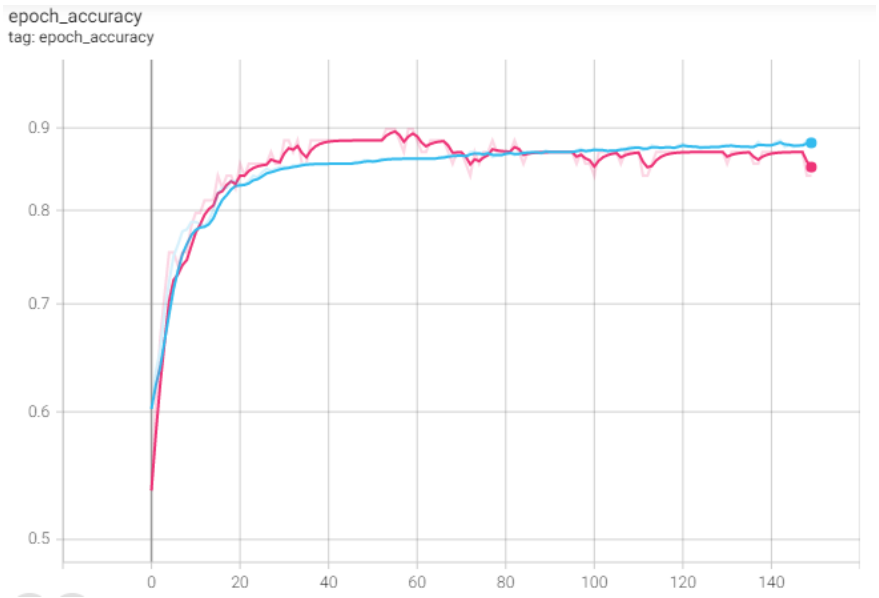
آزمایش ۳)

تعداد لایه ها : ۱ لایه مخفی – ۱۰ نود – مقدار ۰/۸۸ صحت تست – ۰/۸۸ اموزش



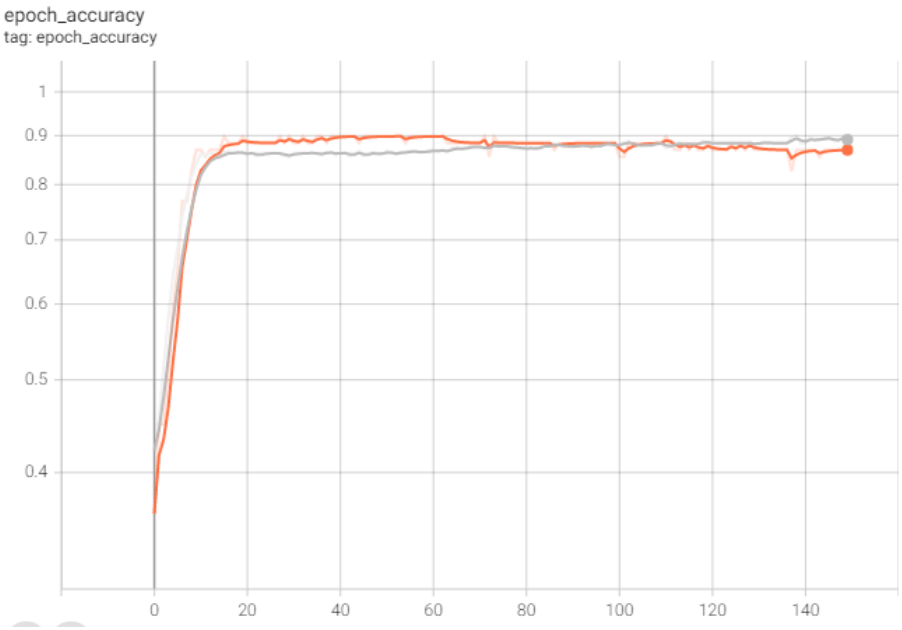
آزمایش ۴)

تعداد لایه ها : ۱ لایه مخفی – ۸ نود – مقدار ۰/۸۸ صحت تست – ۰/۸۹ اموزش



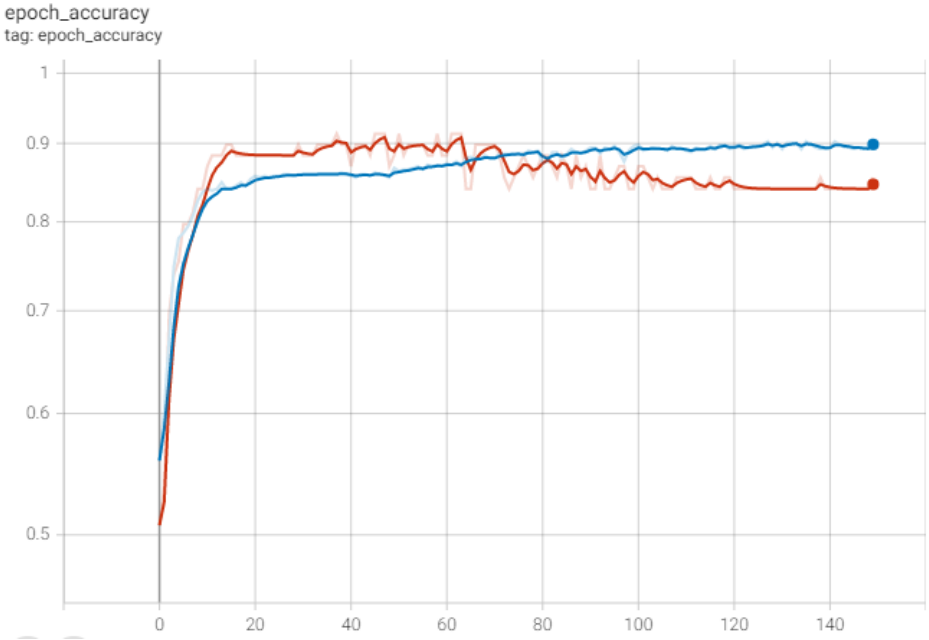
آزمایش ۵)

تعداد لایه ها : ۱ لایه مخفی – ۱۸ نود – مقدار ۰/۸۸ صحت تست – ۰/۸۹ اموزش



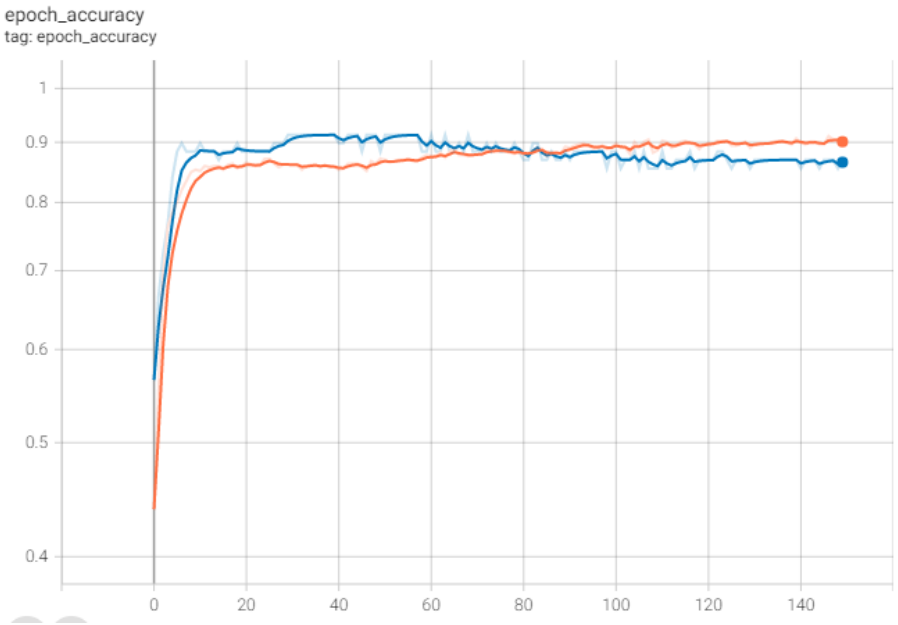
آزمایش ۶)

تعداد لایه ها : ۱ لایه مخفی – ۲۲ نود – مقدار ۰/۸۸ صحت تست – ۰/۹۰ اموزش



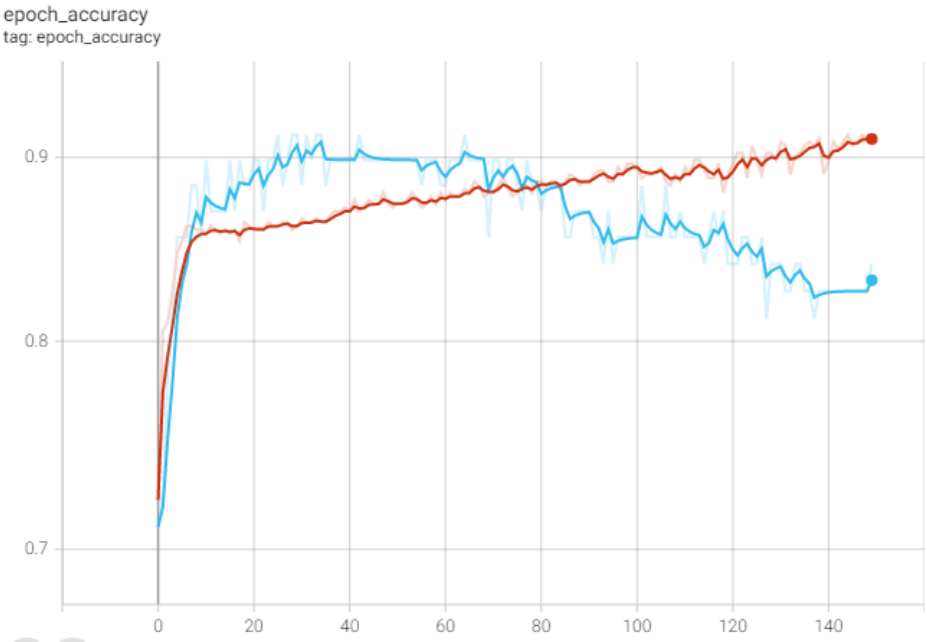
آزمایش ۷)

تعداد لایه ها : ۱ لایه مخفی – ۳۰ نود – مقدار ۰/۸۸ صحت تست – ۰/۹۰ اموزش



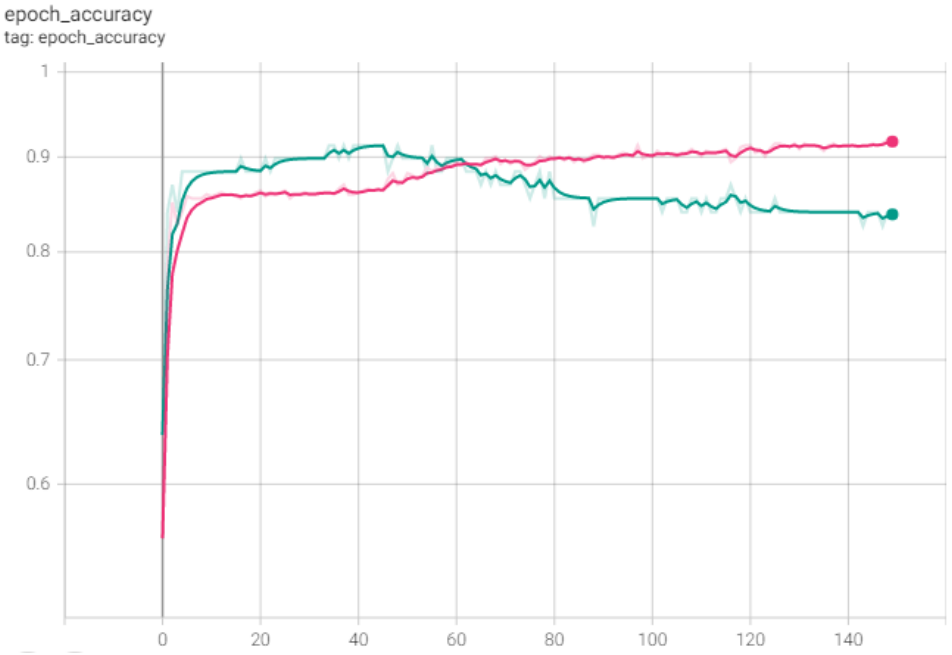
آزمایش ۸)

تعداد لایه ها : ۱ لایه مخفی – ۴۰ نود – مقدار ۰/۸۹ صحت تست – ۰/۹۱ اموزش



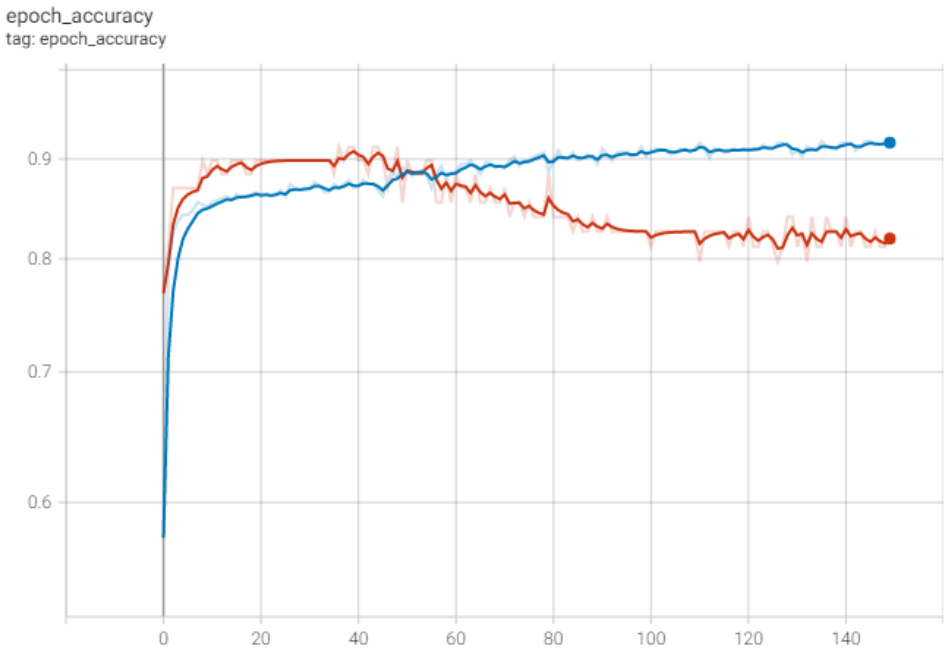
آزمایش ۹)

تعداد لایه ها : ۱ لایه مخفی – ۵۰ نود – مقدار ۰/۸۸ صحت تست – ۰/۹۲ اموزش



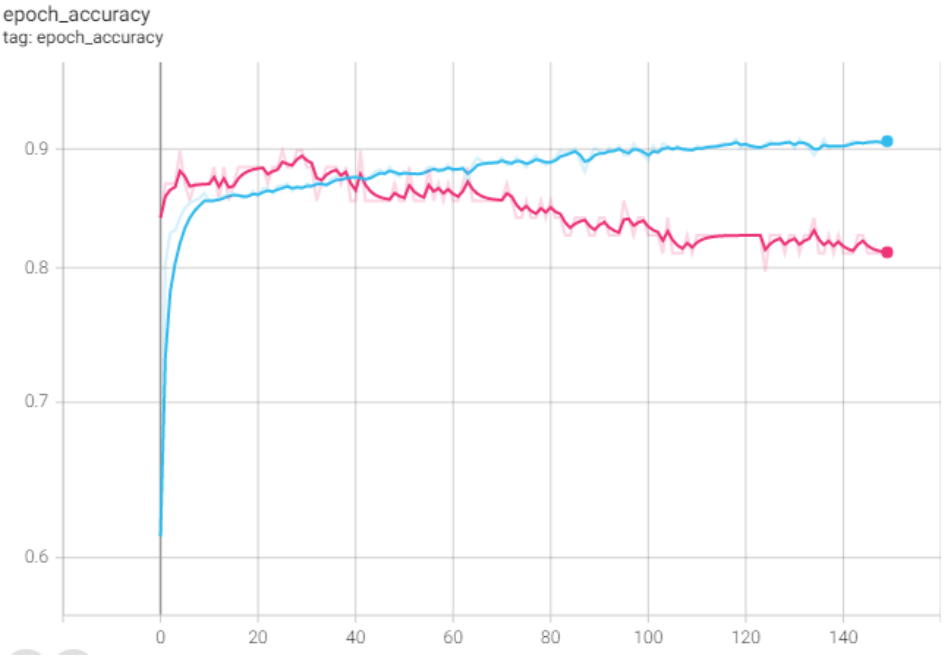
آزمایش ۱۰)

تعداد لایه ها : ۱ لایه مخفی – ۶۰ نود – مقدار ۰/۸۸ صحت تست – ۰/۹۲ اموزش



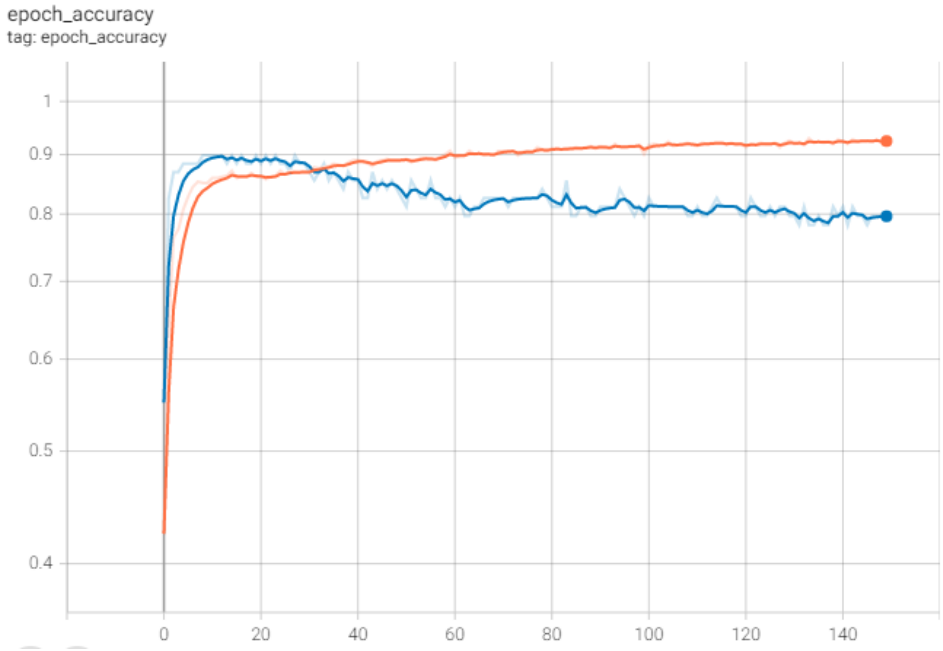
آزمایش ۱۱)

تعداد لایه ها : ۱ لایه مخفی – ۷۰ نود – مقدار ۰/۸۶ صحت تست – ۰/۹۱ اموزش



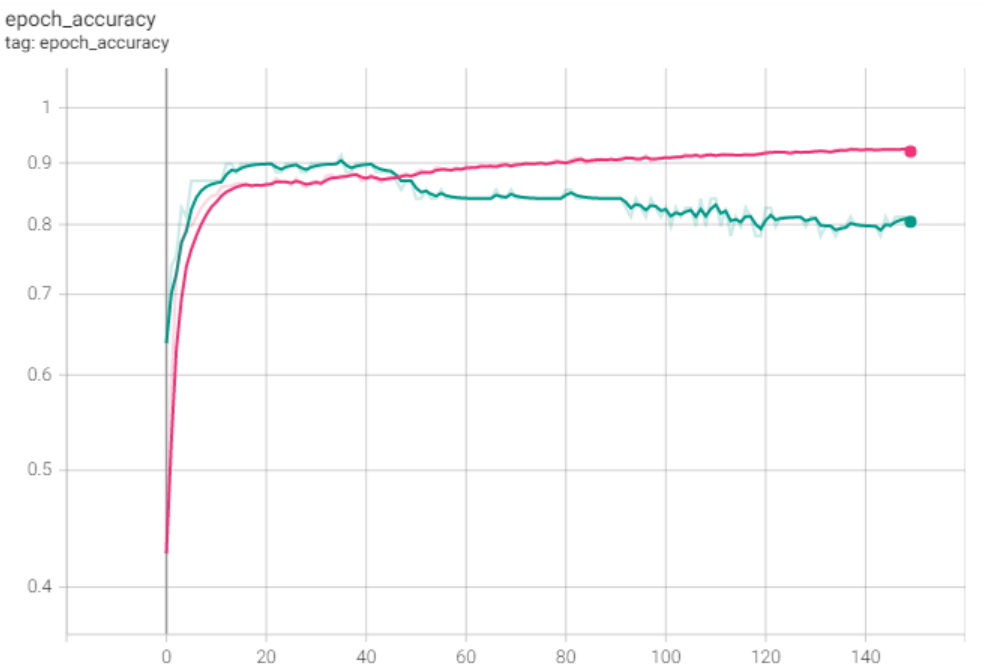
آزمایش ۱۲)

تعداد لایه ها : ۲ لایه مخفی – ۳۰ نود – ۲۰ نود – مقدار ۰/۹۰ صحت تست – ۰/۹۲۵ اموزش



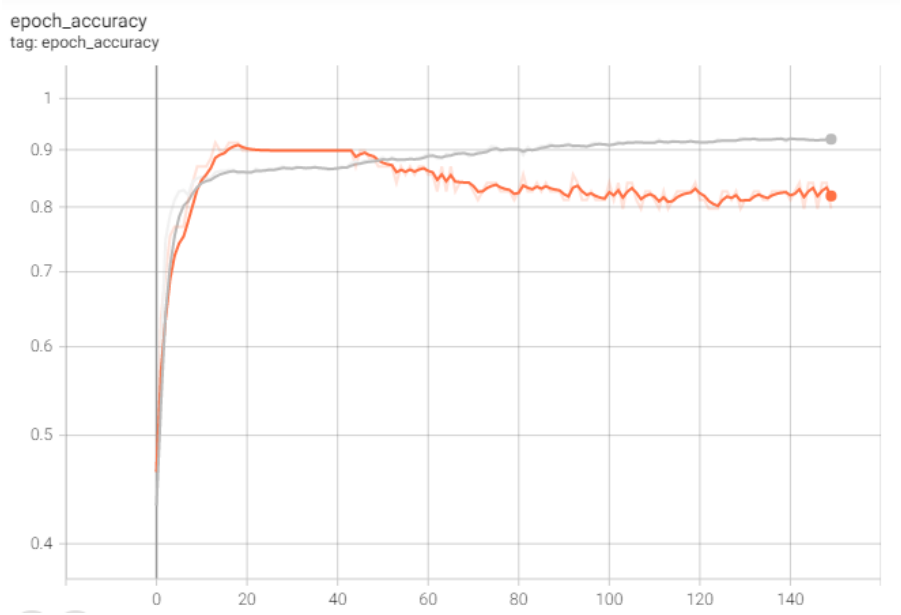
آزمایش ۱۳)

تعداد لایه ها : ۲ لایه مخفی – ۳۰ نود – ۱۲ نود – مقدار ۰/۸۴ صحت تست – ۰/۹۱ اموزش



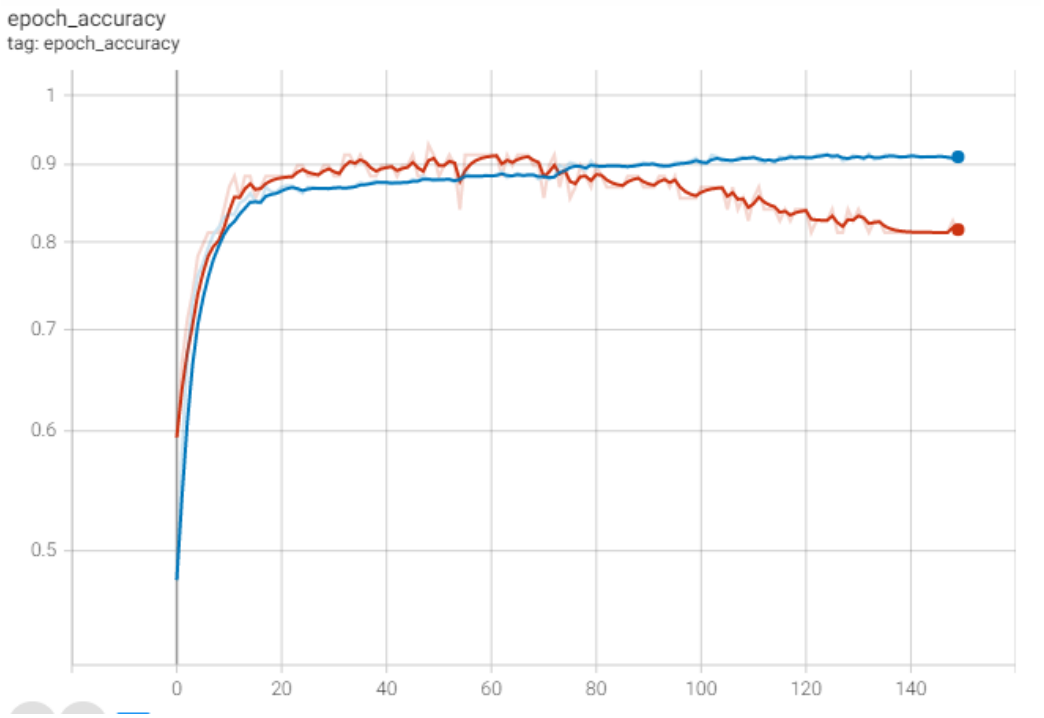
آزمایش ۱۴)

تعداد لایه ها : ۲ لایه مخفی – ۲۰ نود – ۱۲ نود – مقدار ۰/۸۵ صحت تست – ۰/۹۲ اموزش



آزمایش ۱۵)

تعداد لایه ها : ۲ لایه مخفی – ۱۶ نود – ۸ نود – مقدار ۰/۸۵ صحت تست – ۰/۹۱ اموزش



با توجه به مقدار صحت اموزش و ازمایش و نمودار رسم شده برای صحت اموزش و اعتبار سنجی میتوان به این نتیجه رسیده که برای این دیتاست و با توجه درصد اختلاف بین حالات مختلف به این صورت که برای حالت ۲ لایه مخفی ، بهترین درصد اموزش ۹۲/۵٪ به دست آمده است در حالی که برای حالت ۱ لایه مخفی با مقدار نهایی ۹۲٪ به دست امده و مقدار اندکی تفاوت در صحت تست وجود دارد که میتوان از آن صرف نظر کرد. پس در مورد لایه ، مقدار ۱ لایه حالت بهینه تری دارد. در مورد تعداد نود ها ، در حالت ۵۰ نود بهترین نتیجه را با مقدار ۹۲٪ دارد اما در حالت ۱۸ نود مقدار صحت به ۸۹٪ کاهش یافته است که این کاهش ۳٪ نسبت به افزایش مقدار زیاد نود ها ۵۰ نود حالت بهتری دارد پس بهینه ترین حالت برای تعداد نود ها نیز ۱۸ نود است.

سوال ۵)

برای بیش برازش کردن این شبکه ، میتوان چندین کار انجام داد. میتوان شبکه عصبی را پیچیده کرد به صورتی که تعداد لایه ها را افزایش دهیم و در هر لایه تعداد زیادی نود قرار دهیم. همچنین میتوان تعداد تکرار های اجرای شبکه را افزایش داد. این مراحل را میتوان به صورتی انجام داد که مقدار صحت آموزش برابر ۱ باشد و مقدار تابع loss برابر ۰ شود. در این صورت شبکه تمام داده ها را به جای آموزش ، حفظ میکند و در این حالت بیش برازش صورت میگیرد.

اگر برای مثال شبکه را به ۵ شبکه تبدیل کنیم : ۱ لایه ورودی با ۱۵ نود ، لایه مخفی اول با ۱۰۲۴ نود ، لایه مخفی دوم با ۵۱۲ نود ، لایه مخفی سوم با ۱۲۸ نود و لایه خروجی با ۲ نود با ۳۰۰ تکرار در نظر بگیریم.

در این صورت با توجه به پیاده سازی انجام شده مقدار تابع loss بسیار نزدیک به ۰ بوده و صحت اموزش تقریبا برابر ۱ است. اما با توجه به اینکه مقدار صحت تست برابر ۸۱٪ است اما مقدار تابع loss برای آن تقریبا برابر ۲٫۳ است که مقدار بسیار بزرگی نسبت به داده اموزش است. در این مثال مقدار صحت اعتبارسنجی برابر ۷۸٪ است. مقدار خروجی های تابع fit برای این سوال در انتهای گزارش نوشته شده است.

سوال ۶)

برای تعمیم پذیری بهتر شبکه چندین راه برای بهبود شبکه امکان پذیر است. یکی از این راه ها روش dropout است که بر روی بعضی نود های شبکه اعمال میشود و راه دوم استفاده از regularization است.

در این سوال از روش دوم استفاده میکنیم. برای این کار لازم است به لایه های مخفی شبکه پارامتر activity_regularizer را اضافه کنیم و یکی از خطا های l1 یا l2 را استفاده کنیم. با استفاده از این خطا ها ، یک پنالتی بر روی وزن های قرار داده میشود که اجازه بزرگ شدن بیش از اندازه آن ها را نمیدهد و به این صورت شبکه از overfitting دور میشود.

برای پیاده سازی این روش ، از یک شبکه با ۱ لایه مخفی با ۱۸ نود استفاده میکنیم . در این لایه با استفاده از خطای l2 سعی میکنیم کاری کنیم که شبکه از overfitting دورتر شده و تعمیم پذیری آن افزایش یابد.

یافتن مقدار درست خطا یکی از چالش های این روش است. اگر مقدار آن نامناسب باشد شبکه به سمت underfitting رفته و عملا به حالت اشتباهی وارد میشود. ممکن است این مقدار نوعی نادرست باشد که سیستم بیشتر به سمت overfitting برود.

در همین مثال اگر مقدار خطای l2 را برابر ۰/۱ قرار دهیم مقدار صحت آموزش افزایش یافته و به مقدار ۹۱٪ میرسد در حالی که مقدار صحت آزمایش کاهش یافته و به ۸۴٪ میرسد.

در سمت مقابل اگر مقدار خطای l2 را برابر ۰/۰۲ در نظر بگیریم ، مقدار صحت اموزش آن تغییری نکرده اما مقدار صحت تست آن از ۸۶٪ به ۹۰٪ افزایش پیدا میکند که این افزایش مقدار صحت تست نشان از بهبود عملکرد داده شبکه به روی داده های تستی است که تا به حال آن ها را ندیده است.

مقدار دقیق خروجی تابع fit سوال ۶ در انتهای گزارش قرار داده شده است.

مقدار خروجی تابع FIT سوال ۳ :

```
Epoch 1/150
16/16 [==============================] - 0s 14ms/step - loss: 0.6324 - accuracy: 0.6770 - val_loss: 0.5615 - val_accu
racy: 0.8116
Epoch 2/150
16/16 [==============================] - 0s 6ms/step - loss: 0.5732 - accuracy: 0.7371 - val_loss: 0.5268 - val_accur
acy: 0.8406
Epoch 3/150
16/16 [==============================] - 0s 6ms/step - loss: 0.5311 - accuracy: 0.7867 - val_loss: 0.4829 - val_accur
acy: 0.8406
Epoch 4/150
16/16 [==============================] - 0s 6ms/step - loss: 0.4928 - accuracy: 0.8054 - val_loss: 0.4335 - val_accur
acy: 0.8551
Epoch 5/150
16/16 [==============================] - 0s 6ms/step - loss: 0.4619 - accuracy: 0.8095 - val_loss: 0.4084 - val_accur
acy: 0.8696
Epoch 6/150
16/16 [==============================] - 0s 6ms/step - loss: 0.4376 - accuracy: 0.8240 - val_loss: 0.3755 - val_accur
acy: 0.8551
Epoch 7/150
16/16 [==============================] - 0s 7ms/step - loss: 0.4190 - accuracy: 0.8261 - val_loss: 0.3507 - val_accur
acy: 0.8551
Epoch 8/150
16/16 [==============================] - 0s 7ms/step - loss: 0.4024 - accuracy: 0.8282 - val_loss: 0.3460 - val_accur
acy: 0.8551
Epoch 9/150
16/16 [==============================] - 0s 5ms/step - loss: 0.3923 - accuracy: 0.8427 - val_loss: 0.3358 - val_accur
acy: 0.8696
Epoch 10/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3839 - accuracy: 0.8385 - val_loss: 0.3250 - val_accur
acy: 0.8841
Epoch 11/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3722 - accuracy: 0.8489 - val_loss: 0.3208 - val_accur
acy: 0.8696
Epoch 12/150
16/16 [==============================] - 0s 8ms/step - loss: 0.3623 - accuracy: 0.8447 - val_loss: 0.3075 - val_accur
acy: 0.8551
Epoch 13/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3554 - accuracy: 0.8406 - val_loss: 0.3111 - val_accur
acy: 0.8551
Epoch 14/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3560 - accuracy: 0.8592 - val_loss: 0.3184 - val_accur
acy: 0.8551
Epoch 15/150
```

16/16 [==============================] - 0s 6ms/step - loss: 0.3475 - accuracy: 0.8489 - val_loss: 0.3070 - val_accuracy: 0.8696
Epoch 16/150
16/16 [==============================] - 0s 9ms/step - loss: 0.3434 - accuracy: 0.8592 - val_loss: 0.3115 - val_accuracy: 0.8406
Epoch 17/150
16/16 [==============================] - 0s 13ms/step - loss: 0.3410 - accuracy: 0.8696 - val_loss: 0.3131 - val_accuracy: 0.8551
Epoch 18/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3384 - accuracy: 0.8592 - val_loss: 0.3037 - val_accuracy: 0.8696
Epoch 19/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3356 - accuracy: 0.8696 - val_loss: 0.3028 - val_accuracy: 0.8696
Epoch 20/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3312 - accuracy: 0.8696 - val_loss: 0.3005 - val_accuracy: 0.8696
Epoch 21/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3300 - accuracy: 0.8654 - val_loss: 0.2987 - val_accuracy: 0.8841
Epoch 22/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3255 - accuracy: 0.8778 - val_loss: 0.3029 - val_accuracy: 0.8696
Epoch 23/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3296 - accuracy: 0.8592 - val_loss: 0.3022 - val_accuracy: 0.8841
Epoch 24/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3253 - accuracy: 0.8737 - val_loss: 0.3058 - val_accuracy: 0.8696
Epoch 25/150
16/16 [==============================] - 0s 5ms/step - loss: 0.3206 - accuracy: 0.8696 - val_loss: 0.3029 - val_accuracy: 0.8841
Epoch 26/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3168 - accuracy: 0.8758 - val_loss: 0.3069 - val_accuracy: 0.8696
Epoch 27/150
16/16 [==============================] - 0s 7ms/step - loss: 0.3165 - accuracy: 0.8737 - val_loss: 0.3049 - val_accuracy: 0.8841
Epoch 28/150
16/16 [==============================] - 0s 9ms/step - loss: 0.3128 - accuracy: 0.8675 - val_loss: 0.3024 - val_accuracy: 0.8841
Epoch 29/150
16/16 [==============================] - 0s 8ms/step - loss: 0.3152 - accuracy: 0.8696 - val_loss: 0.3106 - val_accuracy: 0.8696

Epoch 30/150
16/16 [==============================] - 0s 7ms/step - loss: 0.3094 - accuracy: 0.8778 - val_loss: 0.3024 - val_accuracy: 0.8986
Epoch 31/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3069 - accuracy: 0.8778 - val_loss: 0.3107 - val_accuracy: 0.8696
Epoch 32/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3035 - accuracy: 0.8861 - val_loss: 0.3094 - val_accuracy: 0.8986
Epoch 33/150
16/16 [==============================] - 0s 13ms/step - loss: 0.3015 - accuracy: 0.8861 - val_loss: 0.3154 - val_accuracy: 0.8551
Epoch 34/150
16/16 [==============================] - 0s 15ms/step - loss: 0.3044 - accuracy: 0.8923 - val_loss: 0.3124 - val_accuracy: 0.8696
Epoch 35/150
16/16 [==============================] - 0s 10ms/step - loss: 0.3011 - accuracy: 0.8923 - val_loss: 0.3117 - val_accuracy: 0.8696
Epoch 36/150
16/16 [==============================] - 0s 9ms/step - loss: 0.2982 - accuracy: 0.8861 - val_loss: 0.3104 - val_accuracy: 0.8841
Epoch 37/150
16/16 [==============================] - 0s 9ms/step - loss: 0.2954 - accuracy: 0.8861 - val_loss: 0.3142 - val_accuracy: 0.8696
Epoch 38/150
16/16 [==============================] - 0s 11ms/step - loss: 0.2951 - accuracy: 0.9006 - val_loss: 0.3159 - val_accuracy: 0.8551
Epoch 39/150
16/16 [==============================] - 0s 8ms/step - loss: 0.2922 - accuracy: 0.8965 - val_loss: 0.3110 - val_accuracy: 0.8841
Epoch 40/150
16/16 [==============================] - 0s 7ms/step - loss: 0.3007 - accuracy: 0.8799 - val_loss: 0.3141 - val_accuracy: 0.8696
Epoch 41/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2916 - accuracy: 0.8986 - val_loss: 0.3209 - val_accuracy: 0.8551
Epoch 42/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2907 - accuracy: 0.8861 - val_loss: 0.3221 - val_accuracy: 0.8551
Epoch 43/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2873 - accuracy: 0.8944 - val_loss: 0.3272 - val_accuracy: 0.8551
Epoch 44/150

16/16 [==============================] - 0s 5ms/step - loss: 0.2879 - accuracy: 0.8882 - val_loss: 0.3281 - val_accuracy: 0.8551
Epoch 45/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2872 - accuracy: 0.8903 - val_loss: 0.3284 - val_accuracy: 0.8406
Epoch 46/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2832 - accuracy: 0.9068 - val_loss: 0.3237 - val_accuracy: 0.8551
Epoch 47/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2837 - accuracy: 0.8903 - val_loss: 0.3203 - val_accuracy: 0.8406
Epoch 48/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2828 - accuracy: 0.9027 - val_loss: 0.3286 - val_accuracy: 0.8406
Epoch 49/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2816 - accuracy: 0.8882 - val_loss: 0.3245 - val_accuracy: 0.8551
Epoch 50/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2771 - accuracy: 0.8944 - val_loss: 0.3344 - val_accuracy: 0.8406
Epoch 51/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2835 - accuracy: 0.9110 - val_loss: 0.3313 - val_accuracy: 0.8406
Epoch 52/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2787 - accuracy: 0.8861 - val_loss: 0.3286 - val_accuracy: 0.8551
Epoch 53/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2754 - accuracy: 0.8903 - val_loss: 0.3331 - val_accuracy: 0.8406
Epoch 54/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2731 - accuracy: 0.8965 - val_loss: 0.3299 - val_accuracy: 0.8551
Epoch 55/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2729 - accuracy: 0.8944 - val_loss: 0.3351 - val_accuracy: 0.8406
Epoch 56/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2721 - accuracy: 0.9048 - val_loss: 0.3342 - val_accuracy: 0.8406
Epoch 57/150
16/16 [==============================] - 0s 9ms/step - loss: 0.2713 - accuracy: 0.9006 - val_loss: 0.3391 - val_accuracy: 0.8406
Epoch 58/150
16/16 [==============================] - 0s 8ms/step - loss: 0.2736 - accuracy: 0.9089 - val_loss: 0.3483 - val_accuracy: 0.8261

Epoch 59/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2678 - accuracy: 0.9027 - val_loss: 0.3401 - val_accuracy: 0.8406
Epoch 60/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2686 - accuracy: 0.8986 - val_loss: 0.3438 - val_accuracy: 0.8261
Epoch 61/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2668 - accuracy: 0.9048 - val_loss: 0.3562 - val_accuracy: 0.8116
Epoch 62/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2690 - accuracy: 0.9048 - val_loss: 0.3551 - val_accuracy: 0.8261
Epoch 63/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2641 - accuracy: 0.9089 - val_loss: 0.3586 - val_accuracy: 0.8261
Epoch 64/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2632 - accuracy: 0.9089 - val_loss: 0.3646 - val_accuracy: 0.8406
Epoch 65/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2630 - accuracy: 0.9089 - val_loss: 0.3725 - val_accuracy: 0.8261
Epoch 66/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2641 - accuracy: 0.9110 - val_loss: 0.3627 - val_accuracy: 0.8261
Epoch 67/150
16/16 [==============================] - 0s 8ms/step - loss: 0.2594 - accuracy: 0.9110 - val_loss: 0.3613 - val_accuracy: 0.8551
Epoch 68/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2608 - accuracy: 0.9089 - val_loss: 0.3584 - val_accuracy: 0.8261
Epoch 69/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2593 - accuracy: 0.9048 - val_loss: 0.3582 - val_accuracy: 0.8261
Epoch 70/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2588 - accuracy: 0.9089 - val_loss: 0.3613 - val_accuracy: 0.8261
Epoch 71/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2583 - accuracy: 0.9048 - val_loss: 0.3631 - val_accuracy: 0.8261
Epoch 72/150
16/16 [==============================] - 0s 9ms/step - loss: 0.2641 - accuracy: 0.9068 - val_loss: 0.3707 - val_accuracy: 0.8406
Epoch 73/150

16/16 [==============================] - 0s 8ms/step - loss: 0.2577 - accuracy: 0.9089 - val_loss: 0.3660 - val_accuracy: 0.8406
Epoch 74/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2575 - accuracy: 0.9089 - val_loss: 0.3741 - val_accuracy: 0.8406
Epoch 75/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2546 - accuracy: 0.9151 - val_loss: 0.3821 - val_accuracy: 0.8406
Epoch 76/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2541 - accuracy: 0.9110 - val_loss: 0.3780 - val_accuracy: 0.8261
Epoch 77/150
16/16 [==============================] - 0s 8ms/step - loss: 0.2514 - accuracy: 0.9110 - val_loss: 0.3793 - val_accuracy: 0.8261
Epoch 78/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2540 - accuracy: 0.9130 - val_loss: 0.3855 - val_accuracy: 0.7971
Epoch 79/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2486 - accuracy: 0.9089 - val_loss: 0.3846 - val_accuracy: 0.8116
Epoch 80/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2474 - accuracy: 0.9089 - val_loss: 0.3901 - val_accuracy: 0.7971
Epoch 81/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2477 - accuracy: 0.9151 - val_loss: 0.3901 - val_accuracy: 0.7971
Epoch 82/150
16/16 [==============================] - 0s 8ms/step - loss: 0.2510 - accuracy: 0.9110 - val_loss: 0.3904 - val_accuracy: 0.7971
Epoch 83/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2658 - accuracy: 0.9027 - val_loss: 0.4010 - val_accuracy: 0.7971
Epoch 84/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2529 - accuracy: 0.9006 - val_loss: 0.3918 - val_accuracy: 0.8406
Epoch 85/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2467 - accuracy: 0.9151 - val_loss: 0.3949 - val_accuracy: 0.7971
Epoch 86/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2450 - accuracy: 0.9089 - val_loss: 0.3910 - val_accuracy: 0.8261
Epoch 87/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2507 - accuracy: 0.9151 - val_loss: 0.3862 - val_accuracy: 0.8261

Epoch 88/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2442 - accuracy: 0.9068 - val_loss: 0.3902 - val_accuracy: 0.8116
Epoch 89/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2410 - accuracy: 0.9089 - val_loss: 0.3952 - val_accuracy: 0.7971
Epoch 90/150
16/16 [==============================] - 0s 8ms/step - loss: 0.2433 - accuracy: 0.9151 - val_loss: 0.3985 - val_accuracy: 0.8116
Epoch 91/150
16/16 [==============================] - 0s 8ms/step - loss: 0.2450 - accuracy: 0.9110 - val_loss: 0.3985 - val_accuracy: 0.7971
Epoch 92/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2415 - accuracy: 0.9130 - val_loss: 0.4034 - val_accuracy: 0.8116
Epoch 93/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2409 - accuracy: 0.9151 - val_loss: 0.4100 - val_accuracy: 0.8116
Epoch 94/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2390 - accuracy: 0.9110 - val_loss: 0.4026 - val_accuracy: 0.8261
Epoch 95/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2399 - accuracy: 0.9151 - val_loss: 0.4053 - val_accuracy: 0.8116
Epoch 96/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2379 - accuracy: 0.9110 - val_loss: 0.4079 - val_accuracy: 0.8261
Epoch 97/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2361 - accuracy: 0.9151 - val_loss: 0.4122 - val_accuracy: 0.7971
Epoch 98/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2371 - accuracy: 0.9151 - val_loss: 0.4113 - val_accuracy: 0.8116
Epoch 99/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2372 - accuracy: 0.9110 - val_loss: 0.4188 - val_accuracy: 0.7971
Epoch 100/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2352 - accuracy: 0.9151 - val_loss: 0.4147 - val_accuracy: 0.7971
Epoch 101/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2328 - accuracy: 0.9151 - val_loss: 0.4193 - val_accuracy: 0.7971
Epoch 102/150

16/16 [==============================] - 0s 7ms/step - loss: 0.2324 - accuracy: 0.9172 - val_loss: 0.4216 - val_accuracy: 0.7971
Epoch 103/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2334 - accuracy: 0.9130 - val_loss: 0.4290 - val_accuracy: 0.7971
Epoch 104/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2322 - accuracy: 0.9193 - val_loss: 0.4323 - val_accuracy: 0.7971
Epoch 105/150
16/16 [==============================] - 0s 8ms/step - loss: 0.2325 - accuracy: 0.9172 - val_loss: 0.4298 - val_accuracy: 0.7971
Epoch 106/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2308 - accuracy: 0.9151 - val_loss: 0.4301 - val_accuracy: 0.7971
Epoch 107/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2379 - accuracy: 0.9151 - val_loss: 0.4250 - val_accuracy: 0.7971
Epoch 108/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2282 - accuracy: 0.9151 - val_loss: 0.4343 - val_accuracy: 0.7971
Epoch 109/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2310 - accuracy: 0.9172 - val_loss: 0.4294 - val_accuracy: 0.7971
Epoch 110/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2295 - accuracy: 0.9151 - val_loss: 0.4276 - val_accuracy: 0.7971
Epoch 111/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2286 - accuracy: 0.9172 - val_loss: 0.4364 - val_accuracy: 0.7971
Epoch 112/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2283 - accuracy: 0.9151 - val_loss: 0.4348 - val_accuracy: 0.7971
Epoch 113/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2336 - accuracy: 0.9068 - val_loss: 0.4382 - val_accuracy: 0.8406
Epoch 114/150
16/16 [==============================] - 0s 8ms/step - loss: 0.2434 - accuracy: 0.9006 - val_loss: 0.4394 - val_accuracy: 0.7971
Epoch 115/150
16/16 [==============================] - 0s 8ms/step - loss: 0.2365 - accuracy: 0.9172 - val_loss: 0.4456 - val_accuracy: 0.7971
Epoch 116/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2284 - accuracy: 0.9110 - val_loss: 0.4403 - val_accuracy: 0.8261

Epoch 117/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2343 - accuracy: 0.9130 - val_loss: 0.4399 - val_accuracy: 0.7971
Epoch 118/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2335 - accuracy: 0.9089 - val_loss: 0.4417 - val_accuracy: 0.8406
Epoch 119/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2277 - accuracy: 0.9151 - val_loss: 0.4447 - val_accuracy: 0.7971
Epoch 120/150
16/16 [==============================] - 0s 8ms/step - loss: 0.2270 - accuracy: 0.9172 - val_loss: 0.4436 - val_accuracy: 0.7971
Epoch 121/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2252 - accuracy: 0.9172 - val_loss: 0.4477 - val_accuracy: 0.7971
Epoch 122/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2229 - accuracy: 0.9193 - val_loss: 0.4577 - val_accuracy: 0.7971
Epoch 123/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2249 - accuracy: 0.9151 - val_loss: 0.4560 - val_accuracy: 0.7971
Epoch 124/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2216 - accuracy: 0.9193 - val_loss: 0.4579 - val_accuracy: 0.7971
Epoch 125/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2205 - accuracy: 0.9193 - val_loss: 0.4549 - val_accuracy: 0.7971
Epoch 126/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2205 - accuracy: 0.9172 - val_loss: 0.4493 - val_accuracy: 0.8261
Epoch 127/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2235 - accuracy: 0.9089 - val_loss: 0.4535 - val_accuracy: 0.7971
Epoch 128/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2203 - accuracy: 0.9172 - val_loss: 0.4631 - val_accuracy: 0.7826
Epoch 129/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2151 - accuracy: 0.9213 - val_loss: 0.4615 - val_accuracy: 0.7971
Epoch 130/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2224 - accuracy: 0.9110 - val_loss: 0.4680 - val_accuracy: 0.7971
Epoch 131/150

16/16 [==============================] - 0s 6ms/step - loss: 0.2166 - accuracy: 0.9130 - val_loss: 0.4662 - val_accuracy: 0.7971
Epoch 132/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2198 - accuracy: 0.9213 - val_loss: 0.4661 - val_accuracy: 0.7826
Epoch 133/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2151 - accuracy: 0.9172 - val_loss: 0.4669 - val_accuracy: 0.7971
Epoch 134/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2178 - accuracy: 0.9213 - val_loss: 0.4788 - val_accuracy: 0.7826
Epoch 135/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2144 - accuracy: 0.9213 - val_loss: 0.4700 - val_accuracy: 0.7971
Epoch 136/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2137 - accuracy: 0.9193 - val_loss: 0.4727 - val_accuracy: 0.7971
Epoch 137/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2155 - accuracy: 0.9151 - val_loss: 0.4727 - val_accuracy: 0.8116
Epoch 138/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2136 - accuracy: 0.9151 - val_loss: 0.4807 - val_accuracy: 0.7826
Epoch 139/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2101 - accuracy: 0.9213 - val_loss: 0.4773 - val_accuracy: 0.7971
Epoch 140/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2112 - accuracy: 0.9193 - val_loss: 0.4825 - val_accuracy: 0.7826
Epoch 141/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2085 - accuracy: 0.9213 - val_loss: 0.4837 - val_accuracy: 0.7971
Epoch 142/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2081 - accuracy: 0.9193 - val_loss: 0.4852 - val_accuracy: 0.7971
Epoch 143/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2069 - accuracy: 0.9213 - val_loss: 0.4865 - val_accuracy: 0.7826
Epoch 144/150
16/16 [==============================] - 0s 7ms/step - loss: 0.2069 - accuracy: 0.9213 - val_loss: 0.4833 - val_accuracy: 0.7826
Epoch 145/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2075 - accuracy: 0.9172 - val_loss: 0.4924 - val_accuracy: 0.7826

Epoch 146/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2055 - accuracy: 0.9172 - val_loss: 0.4946 - val_accuracy: 0.7971
Epoch 147/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2069 - accuracy: 0.9172 - val_loss: 0.4988 - val_accuracy: 0.7826
Epoch 148/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2078 - accuracy: 0.9234 - val_loss: 0.5001 - val_accuracy: 0.7826
Epoch 149/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2079 - accuracy: 0.9172 - val_loss: 0.4978 - val_accuracy: 0.7826
Epoch 150/150
16/16 [==============================] - 0s 6ms/step - loss: 0.2060 - accuracy: 0.9193 - val_loss: 0.5024 - val_accuracy: 0.7826

مقدار خروجی تابع fit برای سوال ۵:

```
Epoch 1/300
16/16 [==============================] - 1s 29ms/step - loss: 0.4600 - accuracy: 0.8033 - val_loss: 0.3138 - val_accu
racy: 0.8841
Epoch 2/300
16/16 [==============================] - 0s 29ms/step - loss: 0.3644 - accuracy: 0.8675 - val_loss: 0.3131 - val_accu
racy: 0.8841
Epoch 3/300
16/16 [==============================] - 0s 31ms/step - loss: 0.3220 - accuracy: 0.8675 - val_loss: 0.3698 - val_acc
uracy: 0.7971
Epoch 4/300
16/16 [==============================] - 0s 28ms/step - loss: 0.3266 - accuracy: 0.8820 - val_loss: 0.3602 - val_acc
uracy: 0.8261
Epoch 5/300
16/16 [==============================] - 0s 23ms/step - loss: 0.3082 - accuracy: 0.8758 - val_loss: 0.3438 - val_acc
uracy: 0.8261
Epoch 6/300
16/16 [==============================] - 0s 24ms/step - loss: 0.2928 - accuracy: 0.8841 - val_loss: 0.3851 - val_accu
racy: 0.8551
Epoch 7/300
16/16 [==============================] - 0s 23ms/step - loss: 0.2983 - accuracy: 0.8696 - val_loss: 0.3944 - val_acc
uracy: 0.8116
Epoch 8/300
16/16 [==============================] - 0s 22ms/step - loss: 0.2818 - accuracy: 0.8944 - val_loss: 0.4163 - val_accu
racy: 0.7971
Epoch 9/300
16/16 [==============================] - 0s 23ms/step - loss: 0.2501 - accuracy: 0.9110 - val_loss: 0.4656 - val_accu
racy: 0.8116
Epoch 10/300
16/16 [==============================] - 0s 28ms/step - loss: 0.2731 - accuracy: 0.8986 - val_loss: 0.5326 - val_acc
uracy: 0.7826
Epoch 11/300
16/16 [==============================] - 0s 22ms/step - loss: 0.2532 - accuracy: 0.9048 - val_loss: 0.4443 - val_acc
uracy: 0.8696
Epoch 12/300
16/16 [==============================] - 0s 23ms/step - loss: 0.2485 - accuracy: 0.9048 - val_loss: 0.4889 - val_acc
uracy: 0.8551
Epoch 13/300
16/16 [==============================] - 0s 23ms/step - loss: 0.2443 - accuracy: 0.9068 - val_loss: 0.5112 - val_accu
racy: 0.8116
Epoch 14/300
16/16 [==============================] - 0s 22ms/step - loss: 0.2298 - accuracy: 0.9130 - val_loss: 0.6874 - val_acc
uracy: 0.7536
```

```
Epoch 15/300
16/16 [==============================] - 0s 27ms/step - loss: 0.3008 - accuracy: 0.8778 - val_loss: 0.5327 - val_acc
uracy: 0.7681
Epoch 16/300
16/16 [==============================] - 0s 24ms/step - loss: 0.2512 - accuracy: 0.9027 - val_loss: 0.4921 - val_accu
racy: 0.8261
Epoch 17/300
16/16 [==============================] - 0s 25ms/step - loss: 0.2078 - accuracy: 0.9255 - val_loss: 0.6115 - val_acc
uracy: 0.7826
Epoch 18/300
16/16 [==============================] - 0s 24ms/step - loss: 0.2404 - accuracy: 0.9130 - val_loss: 0.5215 - val_accu
racy: 0.8406
Epoch 19/300
16/16 [==============================] - 0s 27ms/step - loss: 0.1976 - accuracy: 0.9296 - val_loss: 0.6120 - val_acc
uracy: 0.7971
Epoch 20/300
16/16 [==============================] - 0s 26ms/step - loss: 0.2037 - accuracy: 0.9234 - val_loss: 0.7069 - val_acc
uracy: 0.8116
Epoch 21/300
16/16 [==============================] - 0s 23ms/step - loss: 0.1884 - accuracy: 0.9337 - val_loss: 0.7055 - val_acc
uracy: 0.8116
Epoch 22/300
16/16 [==============================] - 0s 24ms/step - loss: 0.1854 - accuracy: 0.9255 - val_loss: 0.7674 - val_acc
uracy: 0.7826
Epoch 23/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1713 - accuracy: 0.9420 - val_loss: 0.8028 - val_accu
racy: 0.7971
Epoch 24/300
16/16 [==============================] - 0s 23ms/step - loss: 0.1615 - accuracy: 0.9337 - val_loss: 0.9415 - val_accu
racy: 0.7536
Epoch 25/300
16/16 [==============================] - 0s 20ms/step - loss: 0.1586 - accuracy: 0.9358 - val_loss: 0.8780 - val_acc
uracy: 0.7971
Epoch 26/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1618 - accuracy: 0.9441 - val_loss: 1.0063 - val_accu
racy: 0.7971
Epoch 27/300
16/16 [==============================] - 0s 21ms/step - loss: 0.1749 - accuracy: 0.9358 - val_loss: 0.9395 - val_acc
uracy: 0.7826
Epoch 28/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1577 - accuracy: 0.9420 - val_loss: 0.9484 - val_acc
uracy: 0.7681
Epoch 29/300
```

16/16 [==============================] - 0s 25ms/step - loss: 0.1413 - accuracy: 0.9524 - val_loss: 0.8934 - val_accu
racy: 0.8116
Epoch 30/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1415 - accuracy: 0.9441 - val_loss: 0.8673 - val_accu
racy: 0.8261
Epoch 31/300
16/16 [==============================] - 0s 23ms/step - loss: 0.1452 - accuracy: 0.9482 - val_loss: 1.0891 - val_accu
racy: 0.7971
Epoch 32/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1200 - accuracy: 0.9545 - val_loss: 1.0975 - val_accu
racy: 0.7681
Epoch 33/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1056 - accuracy: 0.9627 - val_loss: 1.1346 - val_accu
racy: 0.7971
Epoch 34/300
16/16 [==============================] - 0s 24ms/step - loss: 0.1419 - accuracy: 0.9503 - val_loss: 0.9507 - val_accu
racy: 0.7826
Epoch 35/300
16/16 [==============================] - 0s 24ms/step - loss: 0.1340 - accuracy: 0.9441 - val_loss: 1.0493 - val_accu
racy: 0.8261
Epoch 36/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1109 - accuracy: 0.9565 - val_loss: 1.1089 - val_accu
racy: 0.7826
Epoch 37/300
16/16 [==============================] - 0s 25ms/step - loss: 0.1019 - accuracy: 0.9648 - val_loss: 1.3647 - val_accu
racy: 0.7971
Epoch 38/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1052 - accuracy: 0.9565 - val_loss: 1.1659 - val_accu
racy: 0.8261
Epoch 39/300
16/16 [==============================] - 0s 23ms/step - loss: 0.1345 - accuracy: 0.9482 - val_loss: 1.0562 - val_accu
racy: 0.7971
Epoch 40/300
16/16 [==============================] - 0s 20ms/step - loss: 0.1096 - accuracy: 0.9627 - val_loss: 1.2278 - val_acc
uracy: 0.7826
Epoch 41/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1063 - accuracy: 0.9627 - val_loss: 1.3063 - val_accu
racy: 0.8116
Epoch 42/300
16/16 [==============================] - 0s 21ms/step - loss: 0.1004 - accuracy: 0.9648 - val_loss: 1.5128 - val_accu
racy: 0.7971
Epoch 43/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1020 - accuracy: 0.9586 - val_loss: 1.4905 - val_accu
racy: 0.7971

Epoch 44/300
16/16 [==============================] - 0s 20ms/step - loss: 0.1711 - accuracy: 0.9193 - val_loss: 1.2094 - val_accuracy: 0.7826
Epoch 45/300
16/16 [==============================] - 0s 20ms/step - loss: 0.1692 - accuracy: 0.9358 - val_loss: 1.2816 - val_accuracy: 0.7536
Epoch 46/300
16/16 [==============================] - 0s 21ms/step - loss: 0.1523 - accuracy: 0.9358 - val_loss: 1.2648 - val_accuracy: 0.7971
Epoch 47/300
16/16 [==============================] - 0s 20ms/step - loss: 0.1185 - accuracy: 0.9586 - val_loss: 1.2817 - val_accuracy: 0.7826
Epoch 48/300
16/16 [==============================] - 0s 21ms/step - loss: 0.1002 - accuracy: 0.9607 - val_loss: 1.3765 - val_accuracy: 0.8261
Epoch 49/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0773 - accuracy: 0.9752 - val_loss: 1.5629 - val_accuracy: 0.7971
Epoch 50/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0885 - accuracy: 0.9731 - val_loss: 1.6383 - val_accuracy: 0.7681
Epoch 51/300
16/16 [==============================] - 0s 19ms/step - loss: 0.0754 - accuracy: 0.9752 - val_loss: 1.7004 - val_accuracy: 0.7971
Epoch 52/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0710 - accuracy: 0.9710 - val_loss: 1.7511 - val_accuracy: 0.8116
Epoch 53/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0755 - accuracy: 0.9669 - val_loss: 1.7782 - val_accuracy: 0.7681
Epoch 54/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0788 - accuracy: 0.9752 - val_loss: 1.6999 - val_accuracy: 0.7826
Epoch 55/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0676 - accuracy: 0.9689 - val_loss: 1.8225 - val_accuracy: 0.7391
Epoch 56/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0961 - accuracy: 0.9545 - val_loss: 1.6853 - val_accuracy: 0.7826
Epoch 57/300
16/16 [==============================] - 0s 25ms/step - loss: 0.1191 - accuracy: 0.9524 - val_loss: 1.4628 - val_accuracy: 0.8116
Epoch 58/300

16/16 [==============================] - 0s 21ms/step - loss: 0.0682 - accuracy: 0.9710 - val_loss: 1.6954 - val_accu
racy: 0.7681
Epoch 59/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0598 - accuracy: 0.9814 - val_loss: 1.7369 - val_accu
racy: 0.7826
Epoch 60/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0532 - accuracy: 0.9793 - val_loss: 1.9059 - val_acc
uracy: 0.7826
Epoch 61/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0526 - accuracy: 0.9731 - val_loss: 1.9917 - val_accu
racy: 0.7681
Epoch 62/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0485 - accuracy: 0.9814 - val_loss: 2.0356 - val_accu
racy: 0.7826
Epoch 63/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0450 - accuracy: 0.9814 - val_loss: 2.1790 - val_accu
racy: 0.7536
Epoch 64/300
16/16 [==============================] - 0s 23ms/step - loss: 0.1390 - accuracy: 0.9400 - val_loss: 1.5992 - val_acc
uracy: 0.7826
Epoch 65/300
16/16 [==============================] - 0s 21ms/step - loss: 0.1433 - accuracy: 0.9420 - val_loss: 1.3917 - val_accu
racy: 0.7536
Epoch 66/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1480 - accuracy: 0.9379 - val_loss: 1.4687 - val_accu
racy: 0.7826
Epoch 67/300
16/16 [==============================] - 0s 20ms/step - loss: 0.1097 - accuracy: 0.9524 - val_loss: 1.4209 - val_accu
racy: 0.7681
Epoch 68/300
16/16 [==============================] - 0s 25ms/step - loss: 0.0803 - accuracy: 0.9669 - val_loss: 1.7316 - val_acc
uracy: 0.7971
Epoch 69/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0549 - accuracy: 0.9793 - val_loss: 1.7878 - val_accu
racy: 0.7971
Epoch 70/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0557 - accuracy: 0.9793 - val_loss: 2.0392 - val_acc
uracy: 0.7391
Epoch 71/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0460 - accuracy: 0.9855 - val_loss: 2.0381 - val_acc
uracy: 0.7826
Epoch 72/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0398 - accuracy: 0.9855 - val_loss: 2.2056 - val_acc
uracy: 0.7536

Epoch 73/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0428 - accuracy: 0.9834 - val_loss: 2.2863 - val_acc
uracy: 0.7681
Epoch 74/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0519 - accuracy: 0.9752 - val_loss: 2.2574 - val_acc
uracy: 0.7826
Epoch 75/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0449 - accuracy: 0.9793 - val_loss: 2.2622 - val_acc
uracy: 0.7971
Epoch 76/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0869 - accuracy: 0.9689 - val_loss: 2.2481 - val_accu
racy: 0.7971
Epoch 77/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0828 - accuracy: 0.9731 - val_loss: 1.9107 - val_accu
racy: 0.7826
Epoch 78/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0579 - accuracy: 0.9834 - val_loss: 1.8694 - val_acc
uracy: 0.7971
Epoch 79/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0472 - accuracy: 0.9793 - val_loss: 2.1106 - val_accu
racy: 0.7826
Epoch 80/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0421 - accuracy: 0.9834 - val_loss: 1.9715 - val_accu
racy: 0.7971
Epoch 81/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0742 - accuracy: 0.9627 - val_loss: 1.7611 - val_accu
racy: 0.8551
Epoch 82/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0763 - accuracy: 0.9752 - val_loss: 1.7748 - val_acc
uracy: 0.7826
Epoch 83/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0866 - accuracy: 0.9648 - val_loss: 1.8145 - val_accu
racy: 0.7536
Epoch 84/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0829 - accuracy: 0.9689 - val_loss: 1.7795 - val_acc
uracy: 0.7536
Epoch 85/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0552 - accuracy: 0.9793 - val_loss: 2.1804 - val_acc
uracy: 0.7536
Epoch 86/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0590 - accuracy: 0.9772 - val_loss: 2.1634 - val_acc
uracy: 0.8261
Epoch 87/300

16/16 [==============================] - 0s 21ms/step - loss: 0.0661 - accuracy: 0.9772 - val_loss: 2.1260 - val_accu
racy: 0.7681
Epoch 88/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0572 - accuracy: 0.9793 - val_loss: 2.0648 - val_acc
uracy: 0.7826
Epoch 89/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0386 - accuracy: 0.9834 - val_loss: 2.2950 - val_acc
uracy: 0.7826
Epoch 90/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0647 - accuracy: 0.9772 - val_loss: 2.1462 - val_acc
uracy: 0.7391
Epoch 91/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0428 - accuracy: 0.9855 - val_loss: 2.2790 - val_acc
uracy: 0.7681
Epoch 92/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0347 - accuracy: 0.9855 - val_loss: 2.4504 - val_acc
uracy: 0.7826
Epoch 93/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0307 - accuracy: 0.9876 - val_loss: 2.5048 - val_acc
uracy: 0.7681
Epoch 94/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0305 - accuracy: 0.9876 - val_loss: 2.6457 - val_acc
uracy: 0.7971
Epoch 95/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0243 - accuracy: 0.9896 - val_loss: 2.7790 - val_acc
uracy: 0.7971
Epoch 96/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0686 - accuracy: 0.9710 - val_loss: 2.6184 - val_accu
racy: 0.7971
Epoch 97/300
16/16 [==============================] - 0s 21ms/step - loss: 0.2281 - accuracy: 0.9255 - val_loss: 2.0372 - val_accu
racy: 0.7536
Epoch 98/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1773 - accuracy: 0.9420 - val_loss: 1.4837 - val_accu
racy: 0.7971
Epoch 99/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0907 - accuracy: 0.9689 - val_loss: 1.6976 - val_acc
uracy: 0.7246
Epoch 100/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0586 - accuracy: 0.9772 - val_loss: 2.2736 - val_acc
uracy: 0.8116
Epoch 101/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0704 - accuracy: 0.9772 - val_loss: 2.0703 - val_acc
uracy: 0.7826

Epoch 102/300
16/16 [==============================] - 0s 25ms/step - loss: 0.0413 - accuracy: 0.9814 - val_loss: 2.1896 - val_accu
racy: 0.7826
Epoch 103/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0337 - accuracy: 0.9814 - val_loss: 2.2304 - val_acc
uracy: 0.7971
Epoch 104/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0315 - accuracy: 0.9896 - val_loss: 2.3819 - val_acc
uracy: 0.7681
Epoch 105/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0322 - accuracy: 0.9834 - val_loss: 2.4542 - val_acc
uracy: 0.7536
Epoch 106/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0310 - accuracy: 0.9917 - val_loss: 2.6130 - val_accu
racy: 0.7971
Epoch 107/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0434 - accuracy: 0.9752 - val_loss: 2.5445 - val_acc
uracy: 0.7681
Epoch 108/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0432 - accuracy: 0.9855 - val_loss: 2.6813 - val_acc
uracy: 0.7681
Epoch 109/300
16/16 [==============================] - 0s 25ms/step - loss: 0.0338 - accuracy: 0.9834 - val_loss: 2.6788 - val_acc
uracy: 0.8116
Epoch 110/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0299 - accuracy: 0.9896 - val_loss: 2.8154 - val_acc
uracy: 0.7391
Epoch 111/300
16/16 [==============================] - 0s 21ms/step - loss: 0.1747 - accuracy: 0.9586 - val_loss: 2.2275 - val_accu
racy: 0.7391
Epoch 112/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0761 - accuracy: 0.9772 - val_loss: 2.4715 - val_accu
racy: 0.8261
Epoch 113/300
16/16 [==============================] - 0s 21ms/step - loss: 0.1102 - accuracy: 0.9607 - val_loss: 2.0880 - val_accu
racy: 0.7826
Epoch 114/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0652 - accuracy: 0.9772 - val_loss: 2.0598 - val_acc
uracy: 0.7536
Epoch 115/300
16/16 [==============================] - 0s 24ms/step - loss: 0.0437 - accuracy: 0.9834 - val_loss: 2.2227 - val_acc
uracy: 0.7536
Epoch 116/300

16/16 [==============================] - 0s 22ms/step - loss: 0.0372 - accuracy: 0.9876 - val_loss: 2.4067 - val_acc
uracy: 0.7681
Epoch 117/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0347 - accuracy: 0.9834 - val_loss: 2.5095 - val_acc
uracy: 0.7536
Epoch 118/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0298 - accuracy: 0.9876 - val_loss: 2.4956 - val_acc
uracy: 0.7681
Epoch 119/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0248 - accuracy: 0.9876 - val_loss: 2.5994 - val_acc
uracy: 0.7826
Epoch 120/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0589 - accuracy: 0.9834 - val_loss: 2.6378 - val_acc
uracy: 0.8261
Epoch 121/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0475 - accuracy: 0.9814 - val_loss: 2.4662 - val_accu
racy: 0.7971
Epoch 122/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0819 - accuracy: 0.9689 - val_loss: 2.8336 - val_acc
uracy: 0.7391
Epoch 123/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0629 - accuracy: 0.9731 - val_loss: 2.4606 - val_acc
uracy: 0.7681
Epoch 124/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0462 - accuracy: 0.9855 - val_loss: 2.5279 - val_acc
uracy: 0.8116
Epoch 125/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0299 - accuracy: 0.9876 - val_loss: 2.7453 - val_acc
uracy: 0.7826
Epoch 126/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0254 - accuracy: 0.9876 - val_loss: 2.6753 - val_acc
uracy: 0.7971
Epoch 127/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0191 - accuracy: 0.9938 - val_loss: 2.9728 - val_acc
uracy: 0.7826
Epoch 128/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0192 - accuracy: 0.9917 - val_loss: 2.9184 - val_accu
racy: 0.7826
Epoch 129/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0246 - accuracy: 0.9876 - val_loss: 3.0911 - val_accu
racy: 0.7536
Epoch 130/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0262 - accuracy: 0.9876 - val_loss: 2.9486 - val_acc
uracy: 0.7681

Epoch 131/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0276 - accuracy: 0.9855 - val_loss: 3.0022 - val_acc
uracy: 0.7826
Epoch 132/300
16/16 [==============================] - 0s 19ms/step - loss: 0.0286 - accuracy: 0.9855 - val_loss: 3.0122 - val_accu
racy: 0.7826
Epoch 133/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0261 - accuracy: 0.9896 - val_loss: 3.0579 - val_acc
uracy: 0.7681
Epoch 134/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0217 - accuracy: 0.9896 - val_loss: 3.1437 - val_accu
racy: 0.7681
Epoch 135/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0227 - accuracy: 0.9876 - val_loss: 3.1632 - val_accu
racy: 0.7391
Epoch 136/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0261 - accuracy: 0.9814 - val_loss: 3.1674 - val_accu
racy: 0.7681
Epoch 137/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0179 - accuracy: 0.9938 - val_loss: 3.2073 - val_acc
uracy: 0.7246
Epoch 138/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0241 - accuracy: 0.9896 - val_loss: 3.2332 - val_accu
racy: 0.7826
Epoch 139/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0170 - accuracy: 0.9917 - val_loss: 3.2799 - val_acc
uracy: 0.7971
Epoch 140/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0195 - accuracy: 0.9896 - val_loss: 3.3879 - val_acc
uracy: 0.7681
Epoch 141/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0391 - accuracy: 0.9855 - val_loss: 3.2624 - val_acc
uracy: 0.7826
Epoch 142/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0619 - accuracy: 0.9731 - val_loss: 2.8977 - val_acc
uracy: 0.7391
Epoch 143/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0434 - accuracy: 0.9876 - val_loss: 2.8887 - val_acc
uracy: 0.8261
Epoch 144/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0322 - accuracy: 0.9855 - val_loss: 2.7546 - val_acc
uracy: 0.7681
Epoch 145/300

16/16 [==============================] - 0s 23ms/step - loss: 0.0504 - accuracy: 0.9814 - val_loss: 2.7465 - val_acc
uracy: 0.7391
Epoch 146/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0765 - accuracy: 0.9545 - val_loss: 2.8222 - val_acc
uracy: 0.7536
Epoch 147/300
16/16 [==============================] - 0s 25ms/step - loss: 0.0755 - accuracy: 0.9731 - val_loss: 2.5866 - val_acc
uracy: 0.8406
Epoch 148/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0445 - accuracy: 0.9834 - val_loss: 2.7814 - val_acc
uracy: 0.7536
Epoch 149/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0410 - accuracy: 0.9834 - val_loss: 2.8949 - val_accu
racy: 0.7681
Epoch 150/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0240 - accuracy: 0.9917 - val_loss: 2.9812 - val_accu
racy: 0.7681
Epoch 151/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0196 - accuracy: 0.9896 - val_loss: 3.0607 - val_acc
uracy: 0.7681
Epoch 152/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0177 - accuracy: 0.9959 - val_loss: 3.1641 - val_accu
racy: 0.7826
Epoch 153/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0150 - accuracy: 0.9959 - val_loss: 3.2480 - val_accu
racy: 0.7681
Epoch 154/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0153 - accuracy: 0.9938 - val_loss: 3.3284 - val_accu
racy: 0.7681
Epoch 155/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0172 - accuracy: 0.9938 - val_loss: 3.3449 - val_acc
uracy: 0.7681
Epoch 156/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0159 - accuracy: 0.9938 - val_loss: 3.4629 - val_acc
uracy: 0.7681
Epoch 157/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0209 - accuracy: 0.9896 - val_loss: 3.3027 - val_acc
uracy: 0.7681
Epoch 158/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0493 - accuracy: 0.9814 - val_loss: 2.7838 - val_acc
uracy: 0.8116
Epoch 159/300
16/16 [==============================] - 0s 19ms/step - loss: 0.0372 - accuracy: 0.9896 - val_loss: 3.0143 - val_accu
racy: 0.7391

Epoch 160/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0261 - accuracy: 0.9896 - val_loss: 3.3188 - val_accu
racy: 0.7391
Epoch 161/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0356 - accuracy: 0.9876 - val_loss: 3.2469 - val_acc
uracy: 0.7391
Epoch 162/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0333 - accuracy: 0.9855 - val_loss: 3.1861 - val_accu
racy: 0.7391
Epoch 163/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0250 - accuracy: 0.9876 - val_loss: 3.2925 - val_acc
uracy: 0.7826
Epoch 164/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0298 - accuracy: 0.9876 - val_loss: 3.3397 - val_acc
uracy: 0.7391
Epoch 165/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0203 - accuracy: 0.9938 - val_loss: 3.4018 - val_accu
racy: 0.7536
Epoch 166/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0434 - accuracy: 0.9814 - val_loss: 3.3268 - val_acc
uracy: 0.7826
Epoch 167/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1155 - accuracy: 0.9545 - val_loss: 2.4424 - val_accu
racy: 0.8116
Epoch 168/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0843 - accuracy: 0.9627 - val_loss: 2.6643 - val_acc
uracy: 0.7971
Epoch 169/300
16/16 [==============================] - 0s 20ms/step - loss: 0.1109 - accuracy: 0.9503 - val_loss: 2.7504 - val_accu
racy: 0.7681
Epoch 170/300
16/16 [==============================] - 0s 25ms/step - loss: 0.1605 - accuracy: 0.9400 - val_loss: 1.9546 - val_accu
racy: 0.7681
Epoch 171/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0804 - accuracy: 0.9627 - val_loss: 1.7743 - val_acc
uracy: 0.8116
Epoch 172/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0945 - accuracy: 0.9689 - val_loss: 2.0958 - val_acc
uracy: 0.7391
Epoch 173/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0633 - accuracy: 0.9752 - val_loss: 1.9000 - val_acc
uracy: 0.7971
Epoch 174/300

16/16 [==============================] - 0s 22ms/step - loss: 0.0373 - accuracy: 0.9876 - val_loss: 2.0319 - val_acc
uracy: 0.7536
Epoch 175/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0288 - accuracy: 0.9938 - val_loss: 2.3161 - val_accu
racy: 0.7681
Epoch 176/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0239 - accuracy: 0.9876 - val_loss: 2.3531 - val_acc
uracy: 0.8116
Epoch 177/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0233 - accuracy: 0.9896 - val_loss: 2.5347 - val_acc
uracy: 0.7536
Epoch 178/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0267 - accuracy: 0.9896 - val_loss: 2.5060 - val_acc
uracy: 0.8116
Epoch 179/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0350 - accuracy: 0.9876 - val_loss: 2.5166 - val_acc
uracy: 0.7391
Epoch 180/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0273 - accuracy: 0.9896 - val_loss: 2.3601 - val_acc
uracy: 0.7681
Epoch 181/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0176 - accuracy: 0.9938 - val_loss: 2.4509 - val_acc
uracy: 0.7681
Epoch 182/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0156 - accuracy: 0.9917 - val_loss: 2.5947 - val_acc
uracy: 0.7826
Epoch 183/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0168 - accuracy: 0.9938 - val_loss: 2.7301 - val_accu
racy: 0.7536
Epoch 184/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0259 - accuracy: 0.9938 - val_loss: 2.7287 - val_acc
uracy: 0.7826
Epoch 185/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0159 - accuracy: 0.9938 - val_loss: 2.8164 - val_accu
racy: 0.7681
Epoch 186/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0187 - accuracy: 0.9938 - val_loss: 2.6981 - val_accu
racy: 0.8116
Epoch 187/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0198 - accuracy: 0.9917 - val_loss: 2.8057 - val_acc
uracy: 0.7536
Epoch 188/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0298 - accuracy: 0.9876 - val_loss: 2.7653 - val_acc
uracy: 0.7971

Epoch 189/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0183 - accuracy: 0.9938 - val_loss: 2.8830 - val_acc
uracy: 0.7536
Epoch 190/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0222 - accuracy: 0.9917 - val_loss: 2.7685 - val_acc
uracy: 0.7826
Epoch 191/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0229 - accuracy: 0.9896 - val_loss: 2.8505 - val_acc
uracy: 0.7536
Epoch 192/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0248 - accuracy: 0.9917 - val_loss: 2.6939 - val_acc
uracy: 0.8261
Epoch 193/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0269 - accuracy: 0.9917 - val_loss: 2.7005 - val_acc
uracy: 0.7681
Epoch 194/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0221 - accuracy: 0.9917 - val_loss: 2.7761 - val_accu
racy: 0.7536
Epoch 195/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0148 - accuracy: 0.9938 - val_loss: 2.8209 - val_acc
uracy: 0.8116
Epoch 196/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0098 - accuracy: 0.9979 - val_loss: 2.9325 - val_acc
uracy: 0.8116
Epoch 197/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0152 - accuracy: 0.9917 - val_loss: 2.9885 - val_acc
uracy: 0.7826
Epoch 198/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0166 - accuracy: 0.9959 - val_loss: 2.9973 - val_acc
uracy: 0.7826
Epoch 199/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0286 - accuracy: 0.9876 - val_loss: 2.9808 - val_acc
uracy: 0.7826
Epoch 200/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0235 - accuracy: 0.9855 - val_loss: 2.8794 - val_acc
uracy: 0.8116
Epoch 201/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0317 - accuracy: 0.9834 - val_loss: 3.2200 - val_accu
racy: 0.7246
Epoch 202/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0435 - accuracy: 0.9834 - val_loss: 3.0229 - val_acc
uracy: 0.7536
Epoch 203/300

16/16 [==============================] - 0s 20ms/step - loss: 0.0339 - accuracy: 0.9814 - val_loss: 2.8241 - val_accu
racy: 0.7681
Epoch 204/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0263 - accuracy: 0.9917 - val_loss: 2.7691 - val_accu
racy: 0.7681
Epoch 205/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0210 - accuracy: 0.9917 - val_loss: 2.8337 - val_accu
racy: 0.8116
Epoch 206/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0161 - accuracy: 0.9938 - val_loss: 3.0002 - val_accu
racy: 0.7826
Epoch 207/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0137 - accuracy: 0.9959 - val_loss: 3.0922 - val_acc
uracy: 0.7971
Epoch 208/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0112 - accuracy: 0.9959 - val_loss: 3.2114 - val_accu
racy: 0.7971
Epoch 209/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0106 - accuracy: 0.9959 - val_loss: 3.2936 - val_acc
uracy: 0.7971
Epoch 210/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0110 - accuracy: 0.9959 - val_loss: 3.3498 - val_acc
uracy: 0.7971
Epoch 211/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0096 - accuracy: 0.9959 - val_loss: 3.3858 - val_acc
uracy: 0.7971
Epoch 212/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0092 - accuracy: 0.9959 - val_loss: 3.4296 - val_acc
uracy: 0.7971
Epoch 213/300
16/16 [==============================] - 0s 18ms/step - loss: 0.0095 - accuracy: 0.9959 - val_loss: 3.4831 - val_acc
uracy: 0.7971
Epoch 214/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0089 - accuracy: 0.9959 - val_loss: 3.5194 - val_acc
uracy: 0.7971
Epoch 215/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0087 - accuracy: 0.9959 - val_loss: 3.5622 - val_acc
uracy: 0.7971
Epoch 216/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0086 - accuracy: 0.9979 - val_loss: 3.5927 - val_acc
uracy: 0.7971
Epoch 217/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0085 - accuracy: 0.9959 - val_loss: 3.6307 - val_acc
uracy: 0.7971

Epoch 218/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0086 - accuracy: 0.9979 - val_loss: 3.6594 - val_acc
uracy: 0.7971
Epoch 219/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0091 - accuracy: 0.9979 - val_loss: 3.6932 - val_acc
uracy: 0.7971
Epoch 220/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0083 - accuracy: 0.9959 - val_loss: 3.7165 - val_acc
uracy: 0.7971
Epoch 221/300
16/16 [==============================] - 0s 19ms/step - loss: 0.0082 - accuracy: 0.9979 - val_loss: 3.7455 - val_acc
uracy: 0.7971
Epoch 222/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0082 - accuracy: 0.9979 - val_loss: 3.7772 - val_acc
uracy: 0.7971
Epoch 223/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0084 - accuracy: 0.9979 - val_loss: 3.8055 - val_acc
uracy: 0.7971
Epoch 224/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0096 - accuracy: 0.9959 - val_loss: 3.7088 - val_acc
uracy: 0.7971
Epoch 225/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0180 - accuracy: 0.9959 - val_loss: 3.7900 - val_acc
uracy: 0.7826
Epoch 226/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0310 - accuracy: 0.9938 - val_loss: 3.7221 - val_accu
racy: 0.7971
Epoch 227/300
16/16 [==============================] - 0s 19ms/step - loss: 0.0159 - accuracy: 0.9896 - val_loss: 3.6034 - val_acc
uracy: 0.7971
Epoch 228/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0172 - accuracy: 0.9917 - val_loss: 3.6350 - val_accu
racy: 0.7681
Epoch 229/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0135 - accuracy: 0.9959 - val_loss: 3.5280 - val_acc
uracy: 0.7826
Epoch 230/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0164 - accuracy: 0.9938 - val_loss: 3.5433 - val_acc
uracy: 0.7826
Epoch 231/300
16/16 [==============================] - 0s 19ms/step - loss: 0.0127 - accuracy: 0.9938 - val_loss: 3.4859 - val_acc
uracy: 0.7971
Epoch 232/300

16/16 [==============================] - 0s 22ms/step - loss: 0.0159 - accuracy: 0.9938 - val_loss: 3.5445 - val_acc
uracy: 0.7681
Epoch 233/300
16/16 [==============================] - 0s 25ms/step - loss: 0.0530 - accuracy: 0.9834 - val_loss: 3.4821 - val_acc
uracy: 0.7246
Epoch 234/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0686 - accuracy: 0.9772 - val_loss: 2.9067 - val_acc
uracy: 0.8261
Epoch 235/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0957 - accuracy: 0.9689 - val_loss: 2.4740 - val_acc
uracy: 0.7971
Epoch 236/300
16/16 [==============================] - 0s 22ms/step - loss: 0.1103 - accuracy: 0.9627 - val_loss: 2.0973 - val_acc
uracy: 0.7826
Epoch 237/300
16/16 [==============================] - 0s 21ms/step - loss: 0.1096 - accuracy: 0.9627 - val_loss: 2.0794 - val_acc
uracy: 0.7826
Epoch 238/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0592 - accuracy: 0.9731 - val_loss: 2.0180 - val_accu
racy: 0.7681
Epoch 239/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0587 - accuracy: 0.9731 - val_loss: 2.2431 - val_accu
racy: 0.7681
Epoch 240/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0374 - accuracy: 0.9896 - val_loss: 2.5922 - val_acc
uracy: 0.7536
Epoch 241/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0235 - accuracy: 0.9938 - val_loss: 2.5239 - val_acc
uracy: 0.7391
Epoch 242/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0250 - accuracy: 0.9959 - val_loss: 2.7445 - val_acc
uracy: 0.7826
Epoch 243/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0126 - accuracy: 0.9959 - val_loss: 2.8512 - val_acc
uracy: 0.7681
Epoch 244/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0103 - accuracy: 0.9979 - val_loss: 2.9293 - val_acc
uracy: 0.7681
Epoch 245/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0142 - accuracy: 0.9959 - val_loss: 2.9998 - val_acc
uracy: 0.7681
Epoch 246/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0150 - accuracy: 0.9938 - val_loss: 2.9654 - val_acc
uracy: 0.7681

Epoch 247/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0086 - accuracy: 0.9979 - val_loss: 2.9838 - val_acc
uracy: 0.7681
Epoch 248/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0094 - accuracy: 0.9959 - val_loss: 3.0660 - val_acc
uracy: 0.7681
Epoch 249/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0097 - accuracy: 0.9938 - val_loss: 3.1094 - val_acc
uracy: 0.7681
Epoch 250/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0112 - accuracy: 0.9938 - val_loss: 3.1403 - val_accu
racy: 0.7681
Epoch 251/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0098 - accuracy: 0.9938 - val_loss: 3.1862 - val_acc
uracy: 0.7681
Epoch 252/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0096 - accuracy: 0.9959 - val_loss: 3.2158 - val_acc
uracy: 0.7681
Epoch 253/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0090 - accuracy: 0.9959 - val_loss: 3.2588 - val_acc
uracy: 0.7681
Epoch 254/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0078 - accuracy: 0.9979 - val_loss: 3.3462 - val_acc
uracy: 0.7681
Epoch 255/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0685 - accuracy: 0.9814 - val_loss: 2.9521 - val_accu
racy: 0.8116
Epoch 256/300
16/16 [==============================] - 0s 21ms/step - loss: 0.1072 - accuracy: 0.9710 - val_loss: 2.1337 - val_accu
racy: 0.7536
Epoch 257/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0714 - accuracy: 0.9710 - val_loss: 2.1694 - val_accu
racy: 0.7536
Epoch 258/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0308 - accuracy: 0.9896 - val_loss: 2.3124 - val_acc
uracy: 0.7826
Epoch 259/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0206 - accuracy: 0.9938 - val_loss: 2.4235 - val_acc
uracy: 0.7826
Epoch 260/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0155 - accuracy: 0.9959 - val_loss: 2.5830 - val_acc
uracy: 0.7826
Epoch 261/300

16/16 [==============================] - 0s 20ms/step - loss: 0.0111 - accuracy: 0.9959 - val_loss: 2.6831 - val_accu
racy: 0.7826
Epoch 262/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0127 - accuracy: 0.9938 - val_loss: 2.8061 - val_accu
racy: 0.7826
Epoch 263/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0119 - accuracy: 0.9917 - val_loss: 2.7842 - val_accu
racy: 0.7826
Epoch 264/300
16/16 [==============================] - 0s 24ms/step - loss: 0.0100 - accuracy: 0.9959 - val_loss: 2.8733 - val_acc
uracy: 0.7826
Epoch 265/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0113 - accuracy: 0.9938 - val_loss: 2.9469 - val_acc
uracy: 0.7826
Epoch 266/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0108 - accuracy: 0.9938 - val_loss: 2.9438 - val_acc
uracy: 0.7826
Epoch 267/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0100 - accuracy: 0.9938 - val_loss: 2.9598 - val_acc
uracy: 0.7826
Epoch 268/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0115 - accuracy: 0.9938 - val_loss: 3.0045 - val_accu
racy: 0.7826
Epoch 269/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0108 - accuracy: 0.9959 - val_loss: 3.0472 - val_acc
uracy: 0.7826
Epoch 270/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0074 - accuracy: 0.9979 - val_loss: 3.1212 - val_accu
racy: 0.7826
Epoch 271/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0094 - accuracy: 0.9938 - val_loss: 3.1426 - val_acc
uracy: 0.7826
Epoch 272/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0088 - accuracy: 0.9938 - val_loss: 3.1868 - val_acc
uracy: 0.7826
Epoch 273/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0067 - accuracy: 0.9979 - val_loss: 3.2280 - val_acc
uracy: 0.7826
Epoch 274/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0066 - accuracy: 0.9959 - val_loss: 3.2798 - val_acc
uracy: 0.7826
Epoch 275/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0091 - accuracy: 0.9979 - val_loss: 3.2636 - val_acc
uracy: 0.7681

Epoch 276/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0131 - accuracy: 0.9917 - val_loss: 3.2442 - val_accu
racy: 0.7826
Epoch 277/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0129 - accuracy: 0.9938 - val_loss: 3.1572 - val_acc
uracy: 0.7826
Epoch 278/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0119 - accuracy: 0.9938 - val_loss: 3.1311 - val_accur
acy: 0.7826
Epoch 279/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0087 - accuracy: 0.9959 - val_loss: 3.1828 - val_acc
uracy: 0.7826
Epoch 280/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0089 - accuracy: 0.9959 - val_loss: 3.2317 - val_acc
uracy: 0.7826
Epoch 281/300
16/16 [==============================] - 0s 25ms/step - loss: 0.0071 - accuracy: 0.9959 - val_loss: 3.3082 - val_acc
uracy: 0.7826
Epoch 282/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0118 - accuracy: 0.9938 - val_loss: 3.3114 - val_accu
racy: 0.7826
Epoch 283/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0120 - accuracy: 0.9917 - val_loss: 3.3518 - val_accu
racy: 0.7826
Epoch 284/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0091 - accuracy: 0.9959 - val_loss: 3.4152 - val_acc
uracy: 0.7826
Epoch 285/300
16/16 [==============================] - 0s 29ms/step - loss: 0.0156 - accuracy: 0.9938 - val_loss: 3.4008 - val_acc
uracy: 0.7826
Epoch 286/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0079 - accuracy: 0.9938 - val_loss: 3.3756 - val_acc
uracy: 0.7826
Epoch 287/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0104 - accuracy: 0.9938 - val_loss: 3.3509 - val_acc
uracy: 0.7826
Epoch 288/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0119 - accuracy: 0.9938 - val_loss: 3.3848 - val_accu
racy: 0.7826
Epoch 289/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0114 - accuracy: 0.9938 - val_loss: 3.4710 - val_accu
racy: 0.7826
Epoch 290/300

16/16 [==============================] - 0s 22ms/step - loss: 0.0175 - accuracy: 0.9938 - val_loss: 3.4630 - val_acc
uracy: 0.7826
Epoch 291/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0250 - accuracy: 0.9938 - val_loss: 3.2269 - val_acc
uracy: 0.7826
Epoch 292/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0096 - accuracy: 0.9959 - val_loss: 3.2573 - val_acc
uracy: 0.7826
Epoch 293/300
16/16 [==============================] - 0s 23ms/step - loss: 0.0082 - accuracy: 0.9979 - val_loss: 3.3234 - val_acc
uracy: 0.7826
Epoch 294/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0065 - accuracy: 0.9979 - val_loss: 3.3950 - val_acc
uracy: 0.7826
Epoch 295/300
16/16 [==============================] - 0s 24ms/step - loss: 0.0074 - accuracy: 0.9979 - val_loss: 3.4406 - val_acc
uracy: 0.7826
Epoch 296/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0074 - accuracy: 0.9959 - val_loss: 3.4958 - val_acc
uracy: 0.7826
Epoch 297/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0059 - accuracy: 0.9979 - val_loss: 3.5315 - val_acc
uracy: 0.7826
Epoch 298/300
16/16 [==============================] - 0s 22ms/step - loss: 0.0063 - accuracy: 0.9959 - val_loss: 3.5761 - val_acc
uracy: 0.7826
Epoch 299/300
16/16 [==============================] - 0s 21ms/step - loss: 0.0066 - accuracy: 0.9979 - val_loss: 3.5955 - val_acc
uracy: 0.7826
Epoch 300/300
16/16 [==============================] - 0s 20ms/step - loss: 0.0059 - accuracy: 0.9979 - val_loss: 3.6537 - val_acc
uracy: 0.7826

5/5 - 0s - loss: 2.2748 - accuracy: 0.8116 - 64ms/epoch - 13ms/step

مقدار تابع fit سوال ۶ :

```
Epoch 1/150
16/16 [==============================] - 0s 11ms/step - loss: 0.7631 - accuracy: 0.4513 - val_loss: 0.6883 - val_accu
racy: 0.6812
Epoch 2/150
16/16 [==============================] - 0s 4ms/step - loss: 0.7178 - accuracy: 0.5901 - val_loss: 0.6697 - val_accur
acy: 0.7391
Epoch 3/150
16/16 [==============================] - 0s 4ms/step - loss: 0.6875 - accuracy: 0.6812 - val_loss: 0.6502 - val_accur
acy: 0.8116
Epoch 4/150
16/16 [==============================] - 0s 4ms/step - loss: 0.6611 - accuracy: 0.7764 - val_loss: 0.6279 - val_accur
acy: 0.7826
Epoch 5/150
16/16 [==============================] - 0s 4ms/step - loss: 0.6353 - accuracy: 0.7971 - val_loss: 0.6043 - val_accur
acy: 0.8116
Epoch 6/150
16/16 [==============================] - 0s 4ms/step - loss: 0.6100 - accuracy: 0.8199 - val_loss: 0.5795 - val_accur
acy: 0.8551
Epoch 7/150
16/16 [==============================] - 0s 4ms/step - loss: 0.5834 - accuracy: 0.8323 - val_loss: 0.5536 - val_accu
racy: 0.8696
Epoch 8/150
16/16 [==============================] - 0s 4ms/step - loss: 0.5577 - accuracy: 0.8302 - val_loss: 0.5254 - val_accu
racy: 0.8841
Epoch 9/150
16/16 [==============================] - 0s 4ms/step - loss: 0.5323 - accuracy: 0.8261 - val_loss: 0.4992 - val_accur
acy: 0.8841
Epoch 10/150
16/16 [==============================] - 0s 4ms/step - loss: 0.5100 - accuracy: 0.8302 - val_loss: 0.4762 - val_accur
acy: 0.8841
Epoch 11/150
16/16 [==============================] - 0s 4ms/step - loss: 0.4913 - accuracy: 0.8385 - val_loss: 0.4580 - val_accur
acy: 0.8841
Epoch 12/150
16/16 [==============================] - 0s 6ms/step - loss: 0.4750 - accuracy: 0.8427 - val_loss: 0.4431 - val_accur
acy: 0.8841
Epoch 13/150
16/16 [==============================] - 0s 4ms/step - loss: 0.4607 - accuracy: 0.8509 - val_loss: 0.4243 - val_accu
racy: 0.8841
Epoch 14/150
16/16 [==============================] - 0s 4ms/step - loss: 0.4479 - accuracy: 0.8530 - val_loss: 0.4112 - val_accur
acy: 0.8696
```

```
Epoch 15/150
16/16 [==============================] - 0s 4ms/step - loss: 0.4371 - accuracy: 0.8613 - val_loss: 0.3976 - val_accur
acy: 0.8841
Epoch 16/150
16/16 [==============================] - 0s 4ms/step - loss: 0.4286 - accuracy: 0.8634 - val_loss: 0.3870 - val_accu
racy: 0.8986
Epoch 17/150
16/16 [==============================] - 0s 4ms/step - loss: 0.4211 - accuracy: 0.8634 - val_loss: 0.3784 - val_accur
acy: 0.8696
Epoch 18/150
16/16 [==============================] - 0s 4ms/step - loss: 0.4154 - accuracy: 0.8551 - val_loss: 0.3710 - val_accur
acy: 0.8551
Epoch 19/150
16/16 [==============================] - 0s 4ms/step - loss: 0.4078 - accuracy: 0.8675 - val_loss: 0.3683 - val_accu
racy: 0.8841
Epoch 20/150
16/16 [==============================] - 0s 4ms/step - loss: 0.4034 - accuracy: 0.8696 - val_loss: 0.3622 - val_accu
racy: 0.8841
Epoch 21/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3989 - accuracy: 0.8530 - val_loss: 0.3568 - val_accu
racy: 0.8696
Epoch 22/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3946 - accuracy: 0.8551 - val_loss: 0.3544 - val_accur
acy: 0.8841
Epoch 23/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3932 - accuracy: 0.8716 - val_loss: 0.3577 - val_accur
acy: 0.8841
Epoch 24/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3897 - accuracy: 0.8634 - val_loss: 0.3476 - val_accu
racy: 0.8841
Epoch 25/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3856 - accuracy: 0.8592 - val_loss: 0.3450 - val_accu
racy: 0.8841
Epoch 26/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3833 - accuracy: 0.8654 - val_loss: 0.3443 - val_accur
acy: 0.8841
Epoch 27/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3821 - accuracy: 0.8675 - val_loss: 0.3450 - val_accur
acy: 0.8841
Epoch 28/150
16/16 [==============================] - 0s 3ms/step - loss: 0.3795 - accuracy: 0.8613 - val_loss: 0.3375 - val_accur
acy: 0.8841
Epoch 29/150
```

16/16 [==============================] - 0s 4ms/step - loss: 0.3775 - accuracy: 0.8571 - val_loss: 0.3354 - val_accur
acy: 0.8841
Epoch 30/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3742 - accuracy: 0.8613 - val_loss: 0.3372 - val_accur
acy: 0.8986
Epoch 31/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3736 - accuracy: 0.8634 - val_loss: 0.3382 - val_accu
racy: 0.8986
Epoch 32/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3722 - accuracy: 0.8675 - val_loss: 0.3340 - val_accu
racy: 0.8986
Epoch 33/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3707 - accuracy: 0.8696 - val_loss: 0.3371 - val_accur
acy: 0.8986
Epoch 34/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3693 - accuracy: 0.8696 - val_loss: 0.3306 - val_accu
racy: 0.8986
Epoch 35/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3668 - accuracy: 0.8654 - val_loss: 0.3295 - val_accu
racy: 0.8841
Epoch 36/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3653 - accuracy: 0.8716 - val_loss: 0.3303 - val_accur
acy: 0.8986
Epoch 37/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3639 - accuracy: 0.8675 - val_loss: 0.3278 - val_accu
racy: 0.8841
Epoch 38/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3626 - accuracy: 0.8696 - val_loss: 0.3275 - val_accu
racy: 0.8986
Epoch 39/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3611 - accuracy: 0.8737 - val_loss: 0.3255 - val_accur
acy: 0.8841
Epoch 40/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3611 - accuracy: 0.8654 - val_loss: 0.3243 - val_accur
acy: 0.8986
Epoch 41/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3589 - accuracy: 0.8696 - val_loss: 0.3251 - val_accur
acy: 0.8986
Epoch 42/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3582 - accuracy: 0.8696 - val_loss: 0.3243 - val_accu
racy: 0.8841
Epoch 43/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3567 - accuracy: 0.8696 - val_loss: 0.3248 - val_accu
racy: 0.8986

Epoch 44/150
16/16 [==============================] - 0s 6ms/step - loss: 0.3557 - accuracy: 0.8696 - val_loss: 0.3232 - val_accu
racy: 0.8986
Epoch 45/150
16/16 [==============================] - 0s 5ms/step - loss: 0.3543 - accuracy: 0.8696 - val_loss: 0.3226 - val_accu
racy: 0.8841
Epoch 46/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3542 - accuracy: 0.8737 - val_loss: 0.3245 - val_accu
racy: 0.8986
Epoch 47/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3521 - accuracy: 0.8716 - val_loss: 0.3229 - val_accur
acy: 0.8841
Epoch 48/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3518 - accuracy: 0.8675 - val_loss: 0.3210 - val_accur
acy: 0.8841
Epoch 49/150
16/16 [==============================] - 0s 5ms/step - loss: 0.3504 - accuracy: 0.8675 - val_loss: 0.3228 - val_accu
racy: 0.8986
Epoch 50/150
16/16 [==============================] - 0s 5ms/step - loss: 0.3489 - accuracy: 0.8675 - val_loss: 0.3225 - val_accu
racy: 0.8841
Epoch 51/150
16/16 [==============================] - 0s 5ms/step - loss: 0.3484 - accuracy: 0.8675 - val_loss: 0.3219 - val_accur
acy: 0.8841
Epoch 52/150
16/16 [==============================] - 0s 5ms/step - loss: 0.3474 - accuracy: 0.8716 - val_loss: 0.3226 - val_accur
acy: 0.8986
Epoch 53/150
16/16 [==============================] - 0s 5ms/step - loss: 0.3483 - accuracy: 0.8716 - val_loss: 0.3208 - val_accur
acy: 0.8986
Epoch 54/150
16/16 [==============================] - 0s 5ms/step - loss: 0.3451 - accuracy: 0.8737 - val_loss: 0.3232 - val_accur
acy: 0.9130
Epoch 55/150
16/16 [==============================] - 0s 5ms/step - loss: 0.3457 - accuracy: 0.8737 - val_loss: 0.3213 - val_accur
acy: 0.8986
Epoch 56/150
16/16 [==============================] - 0s 5ms/step - loss: 0.3440 - accuracy: 0.8758 - val_loss: 0.3195 - val_accur
acy: 0.8986
Epoch 57/150
16/16 [==============================] - 0s 7ms/step - loss: 0.3433 - accuracy: 0.8758 - val_loss: 0.3203 - val_accu
racy: 0.8986
Epoch 58/150

16/16 [==============================] - 0s 5ms/step - loss: 0.3426 - accuracy: 0.8758 - val_loss: 0.3211 - val_accuracy: 0.8986
Epoch 59/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3421 - accuracy: 0.8758 - val_loss: 0.3209 - val_accuracy: 0.8986
Epoch 60/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3409 - accuracy: 0.8737 - val_loss: 0.3181 - val_accuracy: 0.8841
Epoch 61/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3409 - accuracy: 0.8675 - val_loss: 0.3183 - val_accuracy: 0.8841
Epoch 62/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3417 - accuracy: 0.8696 - val_loss: 0.3202 - val_accuracy: 0.8986
Epoch 63/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3399 - accuracy: 0.8675 - val_loss: 0.3218 - val_accuracy: 0.8841
Epoch 64/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3394 - accuracy: 0.8654 - val_loss: 0.3221 - val_accuracy: 0.8986
Epoch 65/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3372 - accuracy: 0.8737 - val_loss: 0.3208 - val_accuracy: 0.8986
Epoch 66/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3364 - accuracy: 0.8820 - val_loss: 0.3216 - val_accuracy: 0.8986
Epoch 67/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3359 - accuracy: 0.8799 - val_loss: 0.3210 - val_accuracy: 0.8986
Epoch 68/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3353 - accuracy: 0.8799 - val_loss: 0.3215 - val_accuracy: 0.8986
Epoch 69/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3343 - accuracy: 0.8799 - val_loss: 0.3200 - val_accuracy: 0.8986
Epoch 70/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3338 - accuracy: 0.8778 - val_loss: 0.3193 - val_accuracy: 0.8986
Epoch 71/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3334 - accuracy: 0.8861 - val_loss: 0.3219 - val_accuracy: 0.8986
Epoch 72/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3321 - accuracy: 0.8799 - val_loss: 0.3196 - val_accuracy: 0.8986

Epoch 73/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3331 - accuracy: 0.8758 - val_loss: 0.3189 - val_accuracy: 0.8986
Epoch 74/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3324 - accuracy: 0.8737 - val_loss: 0.3189 - val_accuracy: 0.8986
Epoch 75/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3312 - accuracy: 0.8737 - val_loss: 0.3175 - val_accuracy: 0.8986
Epoch 76/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3320 - accuracy: 0.8696 - val_loss: 0.3168 - val_accuracy: 0.8986
Epoch 77/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3300 - accuracy: 0.8841 - val_loss: 0.3224 - val_accuracy: 0.8986
Epoch 78/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3297 - accuracy: 0.8799 - val_loss: 0.3212 - val_accuracy: 0.8986
Epoch 79/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3287 - accuracy: 0.8820 - val_loss: 0.3206 - val_accuracy: 0.8986
Epoch 80/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3282 - accuracy: 0.8820 - val_loss: 0.3175 - val_accuracy: 0.8986
Epoch 81/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3281 - accuracy: 0.8758 - val_loss: 0.3168 - val_accuracy: 0.8986
Epoch 82/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3274 - accuracy: 0.8799 - val_loss: 0.3168 - val_accuracy: 0.8986
Epoch 83/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3265 - accuracy: 0.8758 - val_loss: 0.3156 - val_accuracy: 0.8986
Epoch 84/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3261 - accuracy: 0.8758 - val_loss: 0.3169 - val_accuracy: 0.8986
Epoch 85/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3255 - accuracy: 0.8799 - val_loss: 0.3169 - val_accuracy: 0.8986
Epoch 86/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3247 - accuracy: 0.8799 - val_loss: 0.3166 - val_accuracy: 0.8986
Epoch 87/150

16/16 [==============================] - 0s 4ms/step - loss: 0.3245 - accuracy: 0.8737 - val_loss: 0.3166 - val_accuracy: 0.8986
Epoch 88/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3244 - accuracy: 0.8820 - val_loss: 0.3196 - val_accuracy: 0.8986
Epoch 89/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3229 - accuracy: 0.8841 - val_loss: 0.3174 - val_accuracy: 0.8986
Epoch 90/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3225 - accuracy: 0.8820 - val_loss: 0.3210 - val_accuracy: 0.8986
Epoch 91/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3229 - accuracy: 0.8820 - val_loss: 0.3274 - val_accuracy: 0.8986
Epoch 92/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3226 - accuracy: 0.8820 - val_loss: 0.3235 - val_accuracy: 0.8986
Epoch 93/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3214 - accuracy: 0.8820 - val_loss: 0.3202 - val_accuracy: 0.8986
Epoch 94/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3205 - accuracy: 0.8820 - val_loss: 0.3162 - val_accuracy: 0.8986
Epoch 95/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3207 - accuracy: 0.8716 - val_loss: 0.3146 - val_accuracy: 0.8986
Epoch 96/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3195 - accuracy: 0.8841 - val_loss: 0.3191 - val_accuracy: 0.8986
Epoch 97/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3201 - accuracy: 0.8778 - val_loss: 0.3150 - val_accuracy: 0.8986
Epoch 98/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3192 - accuracy: 0.8820 - val_loss: 0.3186 - val_accuracy: 0.8986
Epoch 99/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3183 - accuracy: 0.8861 - val_loss: 0.3181 - val_accuracy: 0.8986
Epoch 100/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3186 - accuracy: 0.8841 - val_loss: 0.3179 - val_accuracy: 0.8986
Epoch 101/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3174 - accuracy: 0.8861 - val_loss: 0.3190 - val_accuracy: 0.8841

Epoch 102/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3168 - accuracy: 0.8861 - val_loss: 0.3200 - val_accur
acy: 0.8841
Epoch 103/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3161 - accuracy: 0.8820 - val_loss: 0.3175 - val_accur
acy: 0.8986
Epoch 104/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3170 - accuracy: 0.8861 - val_loss: 0.3151 - val_accur
acy: 0.8986
Epoch 105/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3169 - accuracy: 0.8861 - val_loss: 0.3173 - val_accur
acy: 0.8986
Epoch 106/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3153 - accuracy: 0.8841 - val_loss: 0.3188 - val_accur
acy: 0.8841
Epoch 107/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3149 - accuracy: 0.8861 - val_loss: 0.3177 - val_accur
acy: 0.8841
Epoch 108/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3140 - accuracy: 0.8841 - val_loss: 0.3197 - val_accur
acy: 0.8841
Epoch 109/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3144 - accuracy: 0.8861 - val_loss: 0.3193 - val_accur
acy: 0.8841
Epoch 110/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3137 - accuracy: 0.8841 - val_loss: 0.3180 - val_accur
acy: 0.8841
Epoch 111/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3134 - accuracy: 0.8841 - val_loss: 0.3171 - val_accur
acy: 0.8841
Epoch 112/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3126 - accuracy: 0.8841 - val_loss: 0.3174 - val_accur
acy: 0.8841
Epoch 113/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3121 - accuracy: 0.8861 - val_loss: 0.3209 - val_accur
acy: 0.8696
Epoch 114/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3120 - accuracy: 0.8861 - val_loss: 0.3192 - val_accur
acy: 0.8841
Epoch 115/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3118 - accuracy: 0.8861 - val_loss: 0.3206 - val_accur
acy: 0.8841
Epoch 116/150

16/16 [==============================] - 0s 4ms/step - loss: 0.3112 - accuracy: 0.8882 - val_loss: 0.3205 - val_accur
acy: 0.8841
Epoch 117/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3102 - accuracy: 0.8882 - val_loss: 0.3229 - val_accur
acy: 0.8696
Epoch 118/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3102 - accuracy: 0.8903 - val_loss: 0.3218 - val_accur
acy: 0.8696
Epoch 119/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3095 - accuracy: 0.8882 - val_loss: 0.3202 - val_accu
racy: 0.8841
Epoch 120/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3090 - accuracy: 0.8882 - val_loss: 0.3190 - val_accur
acy: 0.8841
Epoch 121/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3085 - accuracy: 0.8861 - val_loss: 0.3192 - val_accur
acy: 0.8841
Epoch 122/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3085 - accuracy: 0.8861 - val_loss: 0.3183 - val_accur
acy: 0.8841
Epoch 123/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3081 - accuracy: 0.8841 - val_loss: 0.3189 - val_accur
acy: 0.8696
Epoch 124/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3073 - accuracy: 0.8903 - val_loss: 0.3214 - val_accur
acy: 0.8696
Epoch 125/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3080 - accuracy: 0.8903 - val_loss: 0.3235 - val_accu
racy: 0.8551
Epoch 126/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3075 - accuracy: 0.8882 - val_loss: 0.3170 - val_accur
acy: 0.8696
Epoch 127/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3081 - accuracy: 0.8903 - val_loss: 0.3234 - val_accur
acy: 0.8551
Epoch 128/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3060 - accuracy: 0.8923 - val_loss: 0.3176 - val_accur
acy: 0.8696
Epoch 129/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3050 - accuracy: 0.8882 - val_loss: 0.3182 - val_accur
acy: 0.8696
Epoch 130/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3050 - accuracy: 0.8903 - val_loss: 0.3193 - val_accur
acy: 0.8696

Epoch 131/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3047 - accuracy: 0.8903 - val_loss: 0.3187 - val_accuracy: 0.8696
Epoch 132/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3042 - accuracy: 0.8903 - val_loss: 0.3132 - val_accuracy: 0.8841
Epoch 133/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3040 - accuracy: 0.8923 - val_loss: 0.3224 - val_accuracy: 0.8696
Epoch 134/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3046 - accuracy: 0.8923 - val_loss: 0.3195 - val_accuracy: 0.8696
Epoch 135/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3030 - accuracy: 0.8882 - val_loss: 0.3172 - val_accuracy: 0.8696
Epoch 136/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3026 - accuracy: 0.8882 - val_loss: 0.3167 - val_accuracy: 0.8841
Epoch 137/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3022 - accuracy: 0.8903 - val_loss: 0.3179 - val_accuracy: 0.8696
Epoch 138/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3019 - accuracy: 0.8903 - val_loss: 0.3170 - val_accuracy: 0.8696
Epoch 139/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3033 - accuracy: 0.8841 - val_loss: 0.3170 - val_accuracy: 0.8696
Epoch 140/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3021 - accuracy: 0.8923 - val_loss: 0.3177 - val_accuracy: 0.8696
Epoch 141/150
16/16 [==============================] - 0s 4ms/step - loss: 0.3008 - accuracy: 0.8903 - val_loss: 0.3205 - val_accuracy: 0.8696
Epoch 142/150
16/16 [==============================] - 0s 5ms/step - loss: 0.3005 - accuracy: 0.8903 - val_loss: 0.3202 - val_accuracy: 0.8696
Epoch 143/150
16/16 [==============================] - 0s 5ms/step - loss: 0.3002 - accuracy: 0.8903 - val_loss: 0.3206 - val_accuracy: 0.8696
Epoch 144/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2998 - accuracy: 0.8903 - val_loss: 0.3217 - val_accuracy: 0.8696
Epoch 145/150

16/16 [==============================] - 0s 5ms/step - loss: 0.2999 - accuracy: 0.8903 - val_loss: 0.3239 - val_accu
racy: 0.8551
Epoch 146/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2998 - accuracy: 0.8903 - val_loss: 0.3213 - val_accur
acy: 0.8551
Epoch 147/150
16/16 [==============================] - 0s 4ms/step - loss: 0.2991 - accuracy: 0.8903 - val_loss: 0.3210 - val_accur
acy: 0.8551
Epoch 148/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2993 - accuracy: 0.8923 - val_loss: 0.3177 - val_accur
acy: 0.8551
Epoch 149/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2987 - accuracy: 0.8903 - val_loss: 0.3204 - val_accu
racy: 0.8696
Epoch 150/150
16/16 [==============================] - 0s 5ms/step - loss: 0.2979 - accuracy: 0.8903 - val_loss: 0.3216 - val_accur
acy: 0.8696

5/5 - 0s - loss: 0.3331 - accuracy: 0.9058 - 20ms/epoch - 4ms/step