Name : Vrajkumar Patel
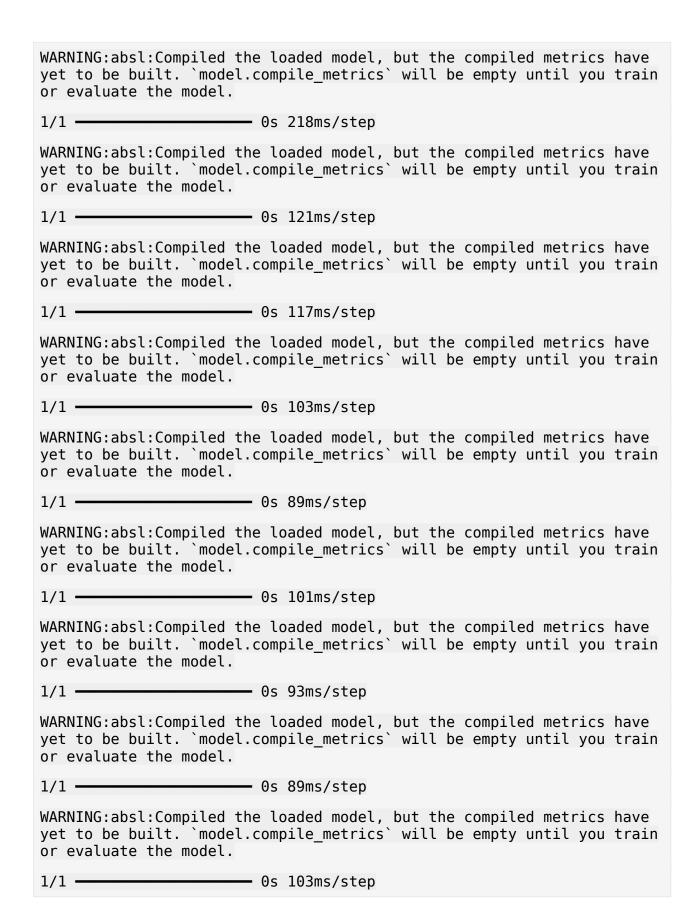
Hand Gesture Recognition Database

```python
#importing libraries
import tensorflow as tf
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten,
Dense, Dropout
from tensorflow.keras.optimizers import Adam
import cv2
import numpy as np

# Data Augmentation
data_gen = ImageDataGenerator(
    rescale=1.0/255,
    rotation_range=30,
    width_shift_range=0.2,
    height_shift_range=0.2,
    shear_range=0.2,
    zoom_range=0.2,
    horizontal_flip=True,
    fill_mode='nearest',
    validation_split=0.2  # Split the data into training and
validation sets
)

# Data Generators
train_generator = data_gen.flow_from_directory(
    r'C:/Users/ASUS/OneDrive -
techno/Desktop/SCT_ML_TASKS/Task-4/leapGestRecog',  # Update this path
to the location of your dataset
    target_size=(128, 128),
    batch_size=32,
    class_mode='categorical',
    subset='training'
)

validation_generator = data_gen.flow_from_directory(
    r'C:/Users/ASUS/OneDrive -
techno/Desktop/SCT_ML_TASKS/Task-4/leapGestRecog',  # Update this path
to the location of your dataset
    target_size=(128, 128),
    batch_size=32,
    class_mode='categorical',
    subset='validation'
)
```

```
Found 32000 images belonging to 11 classes.
Found 8000 images belonging to 11 classes.

#model building
model = Sequential([
    Conv2D(32, (3, 3), activation='relu', input_shape=(128, 128, 3)),
    MaxPooling2D((2, 2)),
    Conv2D(64, (3, 3), activation='relu'),
    MaxPooling2D((2, 2)),
    Conv2D(128, (3, 3), activation='relu'),
    MaxPooling2D((2, 2)),
    Flatten(),
    Dense(512, activation='relu'),
    Dropout(0.5),
    Dense(train_generator.num_classes, activation='softmax')
])

model.compile(optimizer=Adam(learning_rate=0.001),
loss='categorical_crossentropy', metrics=['accuracy'])
```

c:\Users\ASUS\AppData\Local\Programs\Python\Python312\Lib\site-
packages\keras\src\layers\convolutional\base_conv.py:99: UserWarning:
Do not pass an `input_shape`/`input_dim` argument to a layer. When
using Sequential models, prefer using an `Input(shape)` object as the
first layer in the model instead.
  super().__init__(

```
#model training
history = model.fit(
    train_generator,
    steps_per_epoch=train_generator.samples //
train_generator.batch_size,
    validation_data=validation_generator,
    validation_steps=validation_generator.samples //
validation_generator.batch_size,
    epochs=20
)
```

Epoch 1/20

c:\Users\ASUS\AppData\Local\Programs\Python\Python312\Lib\site-
packages\keras\src\trainers\data_adapters\py_dataset_adapter.py:122:
UserWarning: Your `PyDataset` class should call
`super().__init__(**kwargs)` in its constructor. `**kwargs` can
include `workers`, `use_multiprocessing`, `max_queue_size`. Do not
pass these arguments to `fit()`, as they will be ignored.
  self._warn_if_super_not_called()

1000/1000 ──────────────── 515s 511ms/step - accuracy: 0.5080 -
loss: 1.7562 - val_accuracy: 0.2981 - val_loss: 2.2011
Epoch 2/20

```
1000/1000 ———————————————— 0s 76us/step - accuracy: 0.0000e+00 -
loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
Epoch 3/20

c:\Users\ASUS\AppData\Local\Programs\Python\Python312\Lib\
contextlib.py:158: UserWarning: Your input ran out of data;
interrupting training. Make sure that your dataset or generator can
generate at least `steps_per_epoch * epochs` batches. You may need to
use the `.repeat()` function when building your dataset.
  self.gen.throw(value)

1000/1000 ———————————————— 600s 599ms/step - accuracy: 0.5390 -
loss: 1.3079 - val_accuracy: 0.1800 - val_loss: 2.2722
Epoch 4/20
1000/1000 ———————————————— 0s 14us/step - accuracy: 0.0000e+00 -
loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
Epoch 5/20
1000/1000 ———————————————— 596s 594ms/step - accuracy: 0.5566 -
loss: 1.1172 - val_accuracy: 0.1611 - val_loss: 2.5099
Epoch 6/20
1000/1000 ———————————————— 0s 14us/step - accuracy: 0.0000e+00 -
loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
Epoch 7/20
1000/1000 ———————————————— 500s 498ms/step - accuracy: 0.5645 -
loss: 1.0012 - val_accuracy: 0.1475 - val_loss: 3.4014
Epoch 8/20
1000/1000 ———————————————— 0s 15us/step - accuracy: 0.0000e+00 -
loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
Epoch 9/20
1000/1000 ———————————————— 500s 498ms/step - accuracy: 0.5782 -
loss: 0.9273 - val_accuracy: 0.1384 - val_loss: 3.0944
Epoch 10/20
1000/1000 ———————————————— 0s 13us/step - accuracy: 0.0000e+00 -
loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
Epoch 11/20
1000/1000 ———————————————— 500s 498ms/step - accuracy: 0.5755 -
loss: 0.8817 - val_accuracy: 0.1301 - val_loss: 3.6215
Epoch 12/20
1000/1000 ———————————————— 0s 20us/step - accuracy: 0.0000e+00 -
loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
Epoch 13/20
1000/1000 ———————————————— 505s 504ms/step - accuracy: 0.5890 -
loss: 0.8482 - val_accuracy: 0.1283 - val_loss: 3.5277
Epoch 14/20
1000/1000 ———————————————— 0s 11us/step - accuracy: 0.0000e+00 -
loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
Epoch 15/20
1000/1000 ———————————————— 503s 502ms/step - accuracy: 0.5853 -
loss: 0.8162 - val_accuracy: 0.1115 - val_loss: 3.6109
Epoch 16/20
```

```
1000/1000 ━━━━━━━━━━━━━━━━━━━━ 0s 13us/step - accuracy: 0.0000e+00 -
loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
Epoch 17/20
1000/1000 ━━━━━━━━━━━━━━━━━━━━ 504s 503ms/step - accuracy: 0.5804 -
loss: 0.8038 - val_accuracy: 0.1297 - val_loss: 4.0359
Epoch 18/20
1000/1000 ━━━━━━━━━━━━━━━━━━━━ 0s 12us/step - accuracy: 0.0000e+00 -
loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
Epoch 19/20
1000/1000 ━━━━━━━━━━━━━━━━━━━━ 499s 497ms/step - accuracy: 0.5855 -
loss: 0.7805 - val_accuracy: 0.1106 - val_loss: 4.4607
Epoch 20/20
1000/1000 ━━━━━━━━━━━━━━━━━━━━ 0s 13us/step - accuracy: 0.0000e+00 -
loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00

#model evaluation
loss, accuracy = model.evaluate(validation_generator)
print(f'Validation Accuracy: {accuracy * 100:.2f}%')

250/250 ━━━━━━━━━━━━━━━━━━━━ 57s 227ms/step - accuracy: 0.1103 - loss:
4.4910
Validation Accuracy: 11.12%

#save and load model
model.save('hand_gesture_recognition_model.h5')

loaded_model =
tf.keras.models.load_model('hand_gesture_recognition_model.h5')

WARNING:absl:You are saving your model as an HDF5 file via
`model.save()` or `keras.saving.save_model(model)`. This file format
is considered legacy. We recommend using instead the native Keras
format, e.g. `model.save('my_model.keras')` or
`keras.saving.save_model(model, 'my_model.keras')`.
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

#real time prediction
import cv2
import numpy as np
import tensorflow as tf
capture = cv2.VideoCapture(0)
while True:
    ret, frame = capture.read()
    if not ret:
        break
    img = cv2.resize(frame, (128, 128))
    img = img / 255.0
    img = np.expand_dims(img, axis=0)
```

```python
    loaded_model =
tf.keras.models.load_model('hand_gesture_recognition_model.h5')

    prediction = loaded_model.predict(img)
    gesture = np.argmax(prediction, axis=1)

    cv2.putText(frame, f'Gesture: {gesture}', (10, 30),
cv2.FONT_HERSHEY_SIMPLEX, 1, (255, 0, 0), 2, cv2.LINE_AA)
    cv2.imshow('Hand Gesture Recognition', frame)

    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

capture.release()
cv2.destroyAllWindows()
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 93ms/step

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1/1 ──────────────────── 0s 93ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 95ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 99ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
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1/1 ──────────────────── 0s 99ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 121ms/step
```

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WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 218ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 121ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 117ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 103ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 89ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
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1/1 ──────────────────── 0s 101ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
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1/1 ──────────────────── 0s 93ms/step

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1/1 ──────────────────── 0s 89ms/step

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1/1 ──────────────────── 0s 103ms/step
```

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1/1 ──────────────────── 0s 103ms/step

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1/1 ──────────────────── 0s 94ms/step

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yet to be built. `model.compile_metrics` will be empty until you train
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1/1 ──────────────────── 0s 91ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
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1/1 ──────────────────── 0s 86ms/step

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1/1 ──────────────────── 0s 95ms/step

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or evaluate the model.

1/1 ──────────────────── 0s 106ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 97ms/step
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 88ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
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or evaluate the model.

1/1 ──────────────────── 0s 106ms/step

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yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 90ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 127ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 82ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 84ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 87ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 91ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 91ms/step
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 86ms/step

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yet to be built. `model.compile_metrics` will be empty until you train
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1/1 ──────────────────── 0s 90ms/step

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yet to be built. `model.compile_metrics` will be empty until you train
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1/1 ──────────────────── 0s 99ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 94ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 161ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 145ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 161ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 116ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 86ms/step
```

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WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 92ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 100ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
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1/1 ──────────────────── 0s 99ms/step

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1/1 ──────────────────── 0s 101ms/step

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yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 99ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 183ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 107ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 186ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 204ms/step
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 130ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 371ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 95ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 153ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 159ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 236ms/step

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yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 161ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 174ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 157ms/step
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────────── 0s 109ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────────── 0s 104ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────────── 0s 116ms/step

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yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────────── 0s 110ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────────── 0s 88ms/step

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yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────────── 0s 95ms/step

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yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────────── 0s 156ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────────── 0s 90ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────────── 0s 92ms/step
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 86ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 108ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 105ms/step

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yet to be built. `model.compile_metrics` will be empty until you train
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1/1 ──────────────────── 0s 111ms/step

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1/1 ──────────────────── 0s 111ms/step

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1/1 ──────────────────── 0s 119ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 108ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 106ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 96ms/step
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 90ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 126ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 108ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 109ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 108ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 107ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 112ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 116ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 118ms/step
```
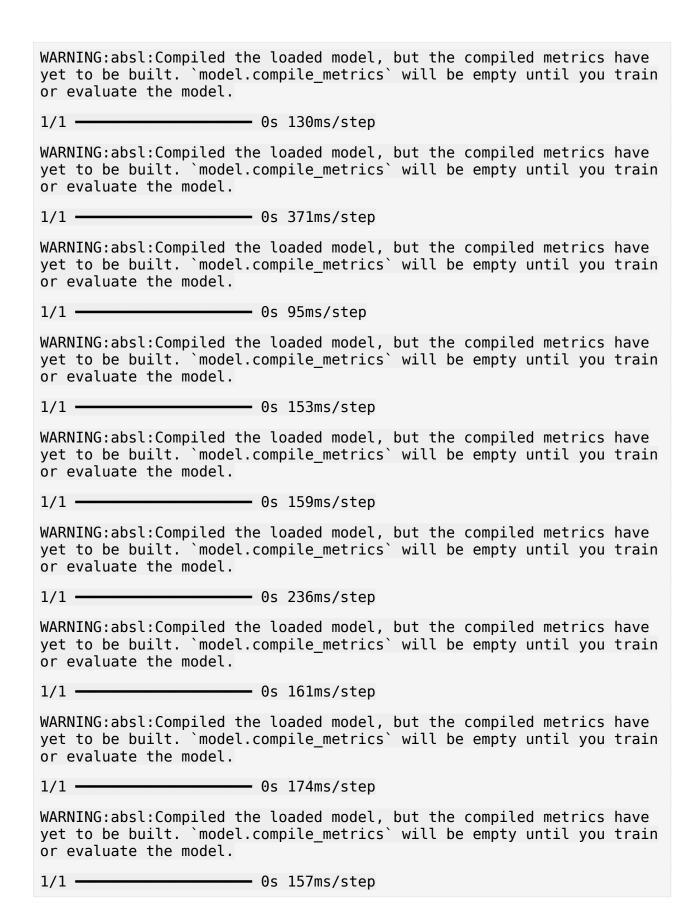
```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 124ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 124ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 88ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 88ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 91ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 154ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 98ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 145ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 94ms/step
```
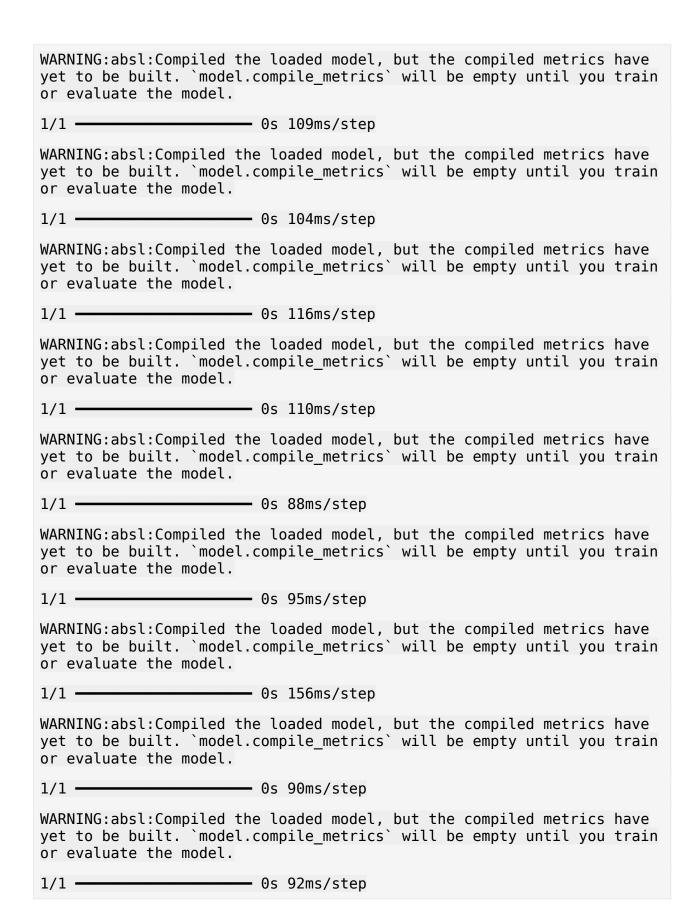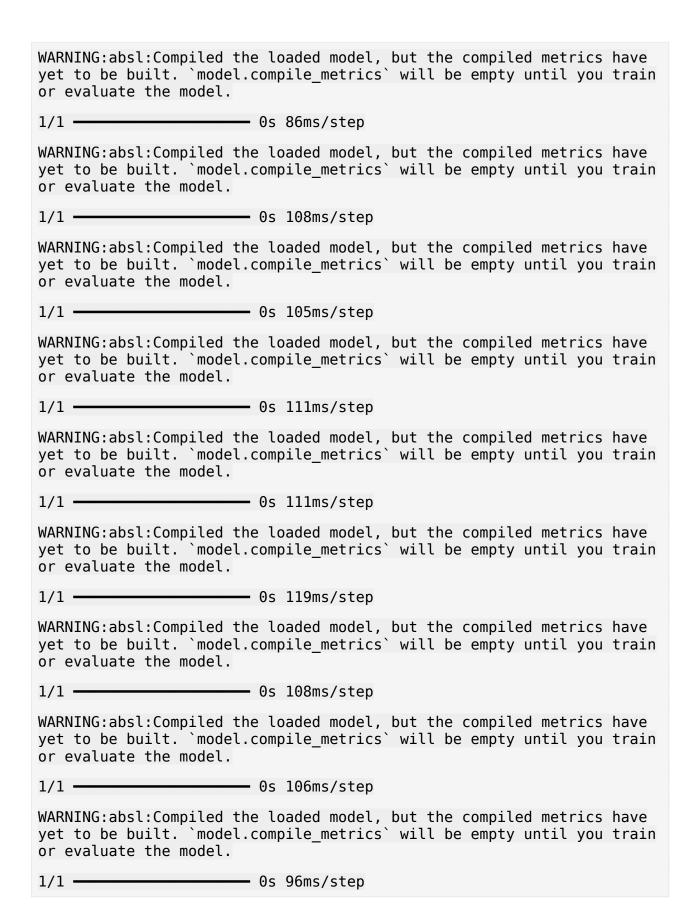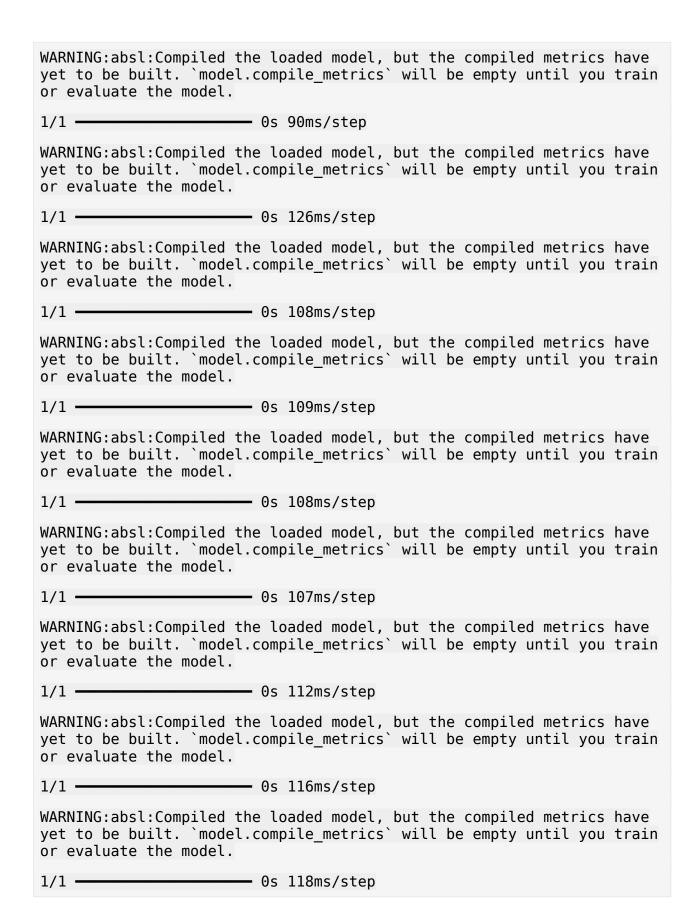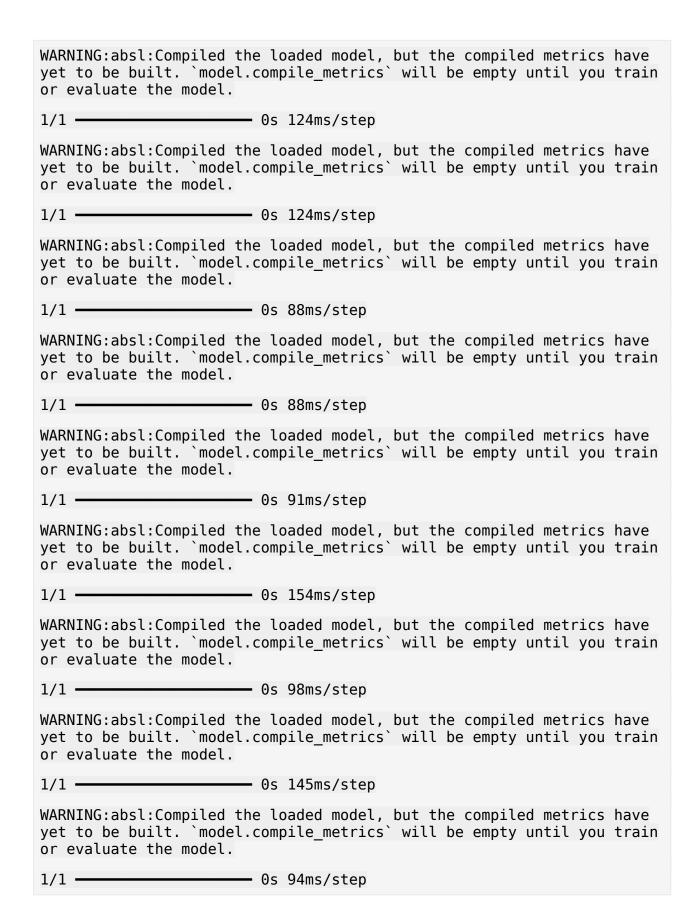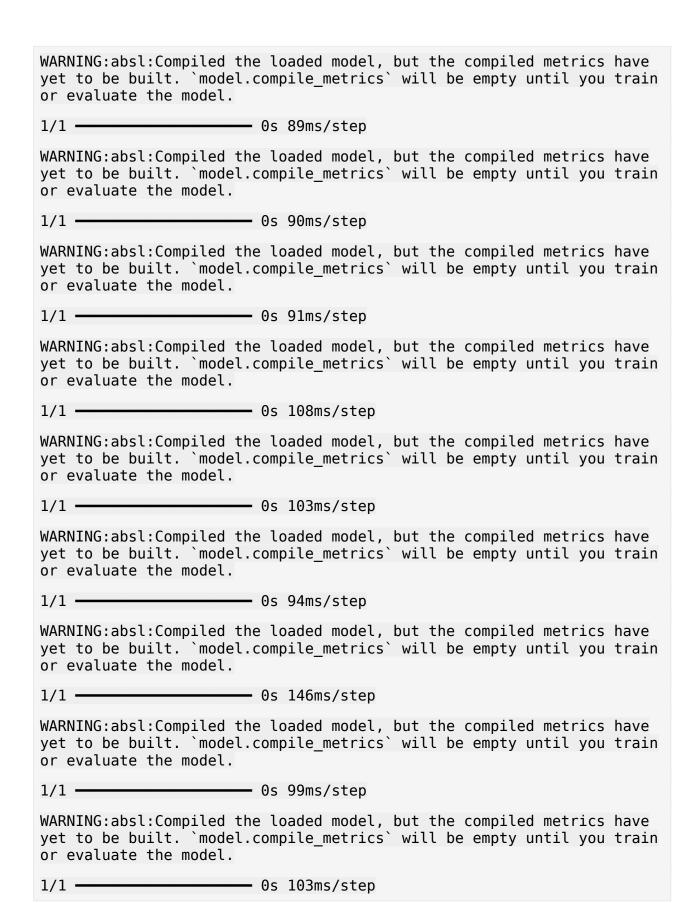
```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 89ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 90ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 91ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 108ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 103ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 94ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 146ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 99ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────────── 0s 103ms/step
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 99ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 103ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 125ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 95ms/step

WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ──────────────── 0s 152ms/step
```