Assignment 6.2.a: CIFAR10

In [ ]:

```
import sys
import pandas as pd
import numpy as np

import matplotlib.pyplot as plt

from keras.datasets import cifar10
from keras.models import Sequential

from keras.layers import Conv2D
from keras.layers import MaxPooling2D
from keras.layers import Dense
from keras.layers import Flatten
from keras.layers import Dropout

from tensorflow.keras.utils import to_categorical
from tensorflow.keras.optimizers import SGD

from keras.preprocessing import image
from keras.preprocessing.image import ImageDataGenerator

from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
```

Import Data

In [3]:

```
(x_train, y_train), (x_test, y_test) = cifar10.load_data()
```

In [4]:

```
y_train = to_categorical(y_train)
y_test = to_categorical(y_test)
```

Format Photos

In [5]:

```
train_norm = x_train.astype('float32')
test_norm = x_test.astype('float32')

train_norm = train_norm / 255.0
test_norm = test_norm / 255.0
```

Initiating a Model

In [6]:

```
model = Sequential()
model.add(Conv2D(32, (3, 3), activation='relu', kernel_initializer='he_unifo
model.add(Conv2D(32, (3, 3), activation='relu', kernel_initializer='he_unifo
model.add(MaxPooling2D((2, 2)))
model.add(Flatten())
model.add(Dense(128, activation='relu', kernel_initializer='he_uniform'))
model.add(Dense(10, activation='softmax'))
```

In [7]:

```
opt = SGD(learning_rate=0.001, momentum=0.9)
```

In [8]:

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

In [9]:

```
history = model.fit(x_train, y_train, epochs=5, batch_size=64, validation_da
```

```
Epoch 1/5
782/782 [==============================] - 120s 152ms/step - loss: 17648.50
59 - accuracy: 0.0986 - val_loss: 2.3026 - val_accuracy: 0.1000
Epoch 2/5
782/782 [==============================] - 121s 155ms/step - loss: 2.3027 -
accuracy: 0.0985 - val_loss: 2.3026 - val_accuracy: 0.1000
Epoch 3/5
782/782 [==============================] - 140s 179ms/step - loss: 2.3026 -
accuracy: 0.0974 - val_loss: 2.3026 - val_accuracy: 0.1000
Epoch 4/5
782/782 [==============================] - 131s 167ms/step - loss: 2.3026 -
accuracy: 0.0986 - val_loss: 2.3026 - val_accuracy: 0.1000
Epoch 5/5
782/782 [==============================] - 116s 148ms/step - loss: 2.3026 -
accuracy: 0.0965 - val_loss: 2.3026 - val_accuracy: 0.1000
```

Saving the Model

In [10]:

```
model.save('results/model-6-2-a')
```

```
INFO:tensorflow:Assets written to: results/model-6-2-a/assets
```

Saving the Predictions

In [11]:

```
pred = model.predict(x_test)

pred = pd.DataFrame(pred)
pred.to_csv('results/model-6-2-a/predictions.csv')
```

Saving the Metrics

In [12]:

```
test_loss, test_acc = model.evaluate(x_test, y_test)
```

```
313/313 [==============================] - 5s 15ms/step - loss: 2.3026 - ac
curacy: 0.1000
```

In [13]:

```
print("Test Accuracy: ", test_acc)
print("Test Loss: ", test_loss)
```

```
Test Accuracy:  0.10000000149011612
Test Loss:  2.302586078643799
```

In [14]:

```
lines = ['Test Accuracy:  0.10000000149011612', 'Test Loss:  2.3025860786437
```

In [15]:

```
with open('results/model-6-2-a/metrics.txt', 'w') as f:
    f.write('\n'.join(lines))
```

Saving the Validation Plots

In [16]:

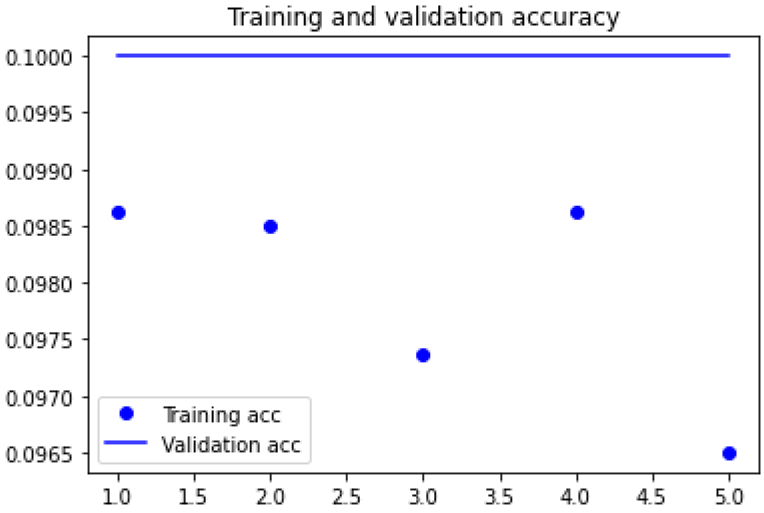
```
acc = history.history['accuracy']
val_acc = history.history['val_accuracy']

loss = history.history['loss']
val_loss = history.history['val_loss']
```

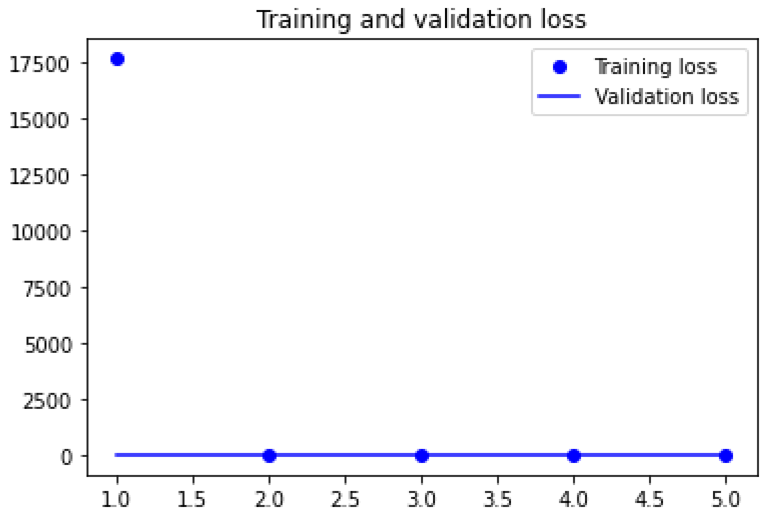
In [17]:

```
epochs = range(1, len(acc) + 1)
```

In [18]:

```
plt.plot(epochs, acc, 'bo', label='Training acc')
plt.plot(epochs, val_acc, 'b', label='Validation acc')
plt.title('Training and validation accuracy')
plt.legend()

plt.figure()

plt.plot(epochs, loss, 'bo', label='Training loss')
plt.plot(epochs, val_loss, 'b', label='Validation loss')
plt.title('Training and validation loss')

plt.legend()

plt.show()
```





In [19]:

```
plt.savefig('results/model-6-2-a/validationplot.jpg')
```

```
<Figure size 432x288 with 0 Axes>
```

Assignment 6.2.b: CIFAR10 with Dropout & Augmentation

Initiating the Model

In [20]:

```
modelB = Sequential()
modelB.add(Conv2D(32,kernel_size=(3,3),activation='relu',input_shape=(32, 32
modelB.add(MaxPooling2D(pool_size=(2, 2)))
modelB.add(Flatten())
modelB.add(Dense(16, activation='relu'))
modelB.add(Dense(1, activation='sigmoid'))
```

In [21]:

```
modelB.compile(loss='binary_crossentropy',
              optimizer='adam',
              metrics=['accuracy'])
```

Image Augmentation

In [22]:

```
train_datagen = ImageDataGenerator(
      rotation_range=40,
      width_shift_range=0.2,
      height_shift_range=0.2,
      shear_range=0.2,
      zoom_range=0.2,
      horizontal_flip=True,
      fill_mode='nearest')

test_datagen = ImageDataGenerator(rescale=1./255)
```

In [23]:

```
train_generator = train_datagen.flow(x_train, y_train, batch_size=32)
```

In [24]:

```
validation_generator = train_datagen.flow(x_train, y_train, batch_size=32)
```

In [25]:

```
test_generator = test_datagen.flow(x_test, batch_size=1)
```

Fitting the Model

In [26]:

```
historyB = modelB.fit(
      train_generator,
      steps_per_epoch=100,
      epochs=10,
      validation_data=validation_generator,
      validation_steps=50)
```

```
Epoch 1/10
100/100 [==============================] - 9s 85ms/step - loss: 1.9452 - ac
curacy: 0.8600 - val_loss: 0.3813 - val_accuracy: 0.8960
Epoch 2/10
100/100 [==============================] - 7s 71ms/step - loss: 0.3712 - ac
curacy: 0.8968 - val_loss: 0.3678 - val_accuracy: 0.8960
Epoch 3/10
100/100 [==============================] - 10s 102ms/step - loss: 0.3631 -
accuracy: 0.8983 - val_loss: 0.3594 - val_accuracy: 0.9000
Epoch 4/10
100/100 [==============================] - 11s 106ms/step - loss: 0.3545 -
accuracy: 0.8985 - val_loss: 0.3516 - val_accuracy: 0.9000
Epoch 5/10
100/100 [==============================] - 14s 139ms/step - loss: 0.3468 -
accuracy: 0.9000 - val_loss: 0.3454 - val_accuracy: 0.9000
Epoch 6/10
100/100 [==============================] - 8s 80ms/step - loss: 0.3427 - ac
curacy: 0.9000 - val_loss: 0.3382 - val_accuracy: 0.9000
Epoch 7/10
100/100 [==============================] - 7s 72ms/step - loss: 0.3402 - ac
curacy: 0.8998 - val_loss: 0.3399 - val_accuracy: 0.8995
Epoch 8/10
100/100 [==============================] - 5s 54ms/step - loss: 0.3387 - ac
curacy: 0.8998 - val_loss: 0.3384 - val_accuracy: 0.9000
Epoch 9/10
100/100 [==============================] - 8s 81ms/step - loss: 0.3371 - ac
curacy: 0.9000 - val_loss: 0.3363 - val_accuracy: 0.9000
Epoch 10/10
100/100 [==============================] - 5s 49ms/step - loss: 0.3355 - ac
curacy: 0.9000 - val_loss: 0.3352 - val_accuracy: 0.9000
```

Saving the Model

In [27]:

```
modelB.save('results/model-6-2-b')
```

```
INFO:tensorflow:Assets written to: results/model-6-2-b/assets
```

Saving the Predictions

In [28]:

```
predB = modelB.predict(validation_generator)

predB = pd.DataFrame(predB)
predB.to_csv('results/model-6-2-b/predictions.csv')
```

Saving the Metrics

```
In [31]: test_lossB, test_accB = modelB.evaluate(validation_generator)
```

```
1563/1563 [==============================] - 43s 27ms/step - loss: 0.3345 -
accuracy: 0.9000
```

```
In [32]: print("Test Accuracy: ", test_accB)
         print("Test Loss: ", test_lossB)
```

```
Test Accuracy:  0.9000139236450195
Test Loss:  0.3345222771167755
```

```
In [33]: lines = ['Test Accuracy:  0.9000139236450195', 'Test Loss:  0.33452227711677
```

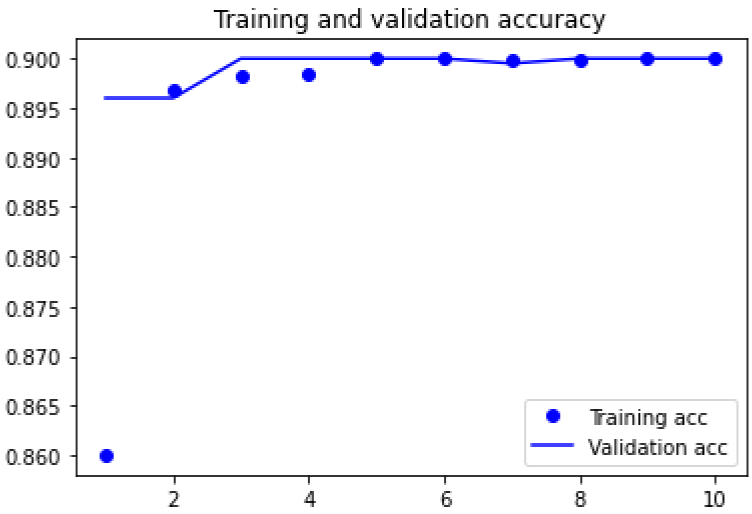
```
In [34]: with open('results/model-6-2-b/metrics.txt', 'w') as f:
             f.write('\n'.join(lines))
```

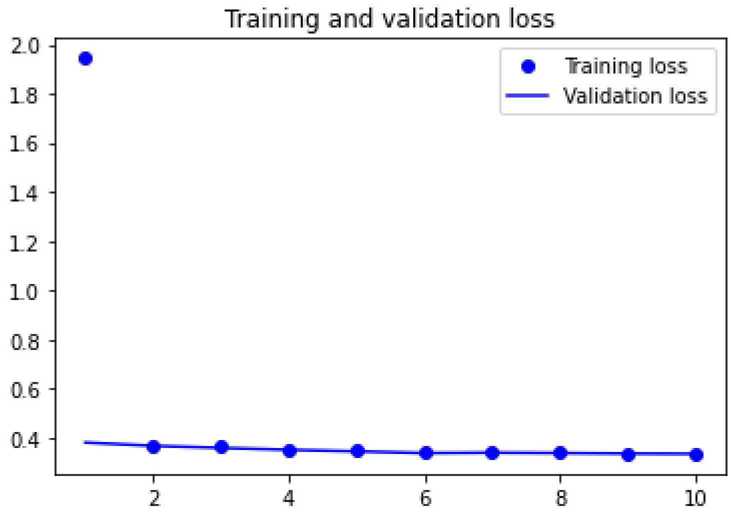
Saving the Validation Plots

```
In [39]: acc = historyB.history['accuracy']
         val_acc = historyB.history['val_accuracy']

         loss = historyB.history['loss']
         val_loss = historyB.history['val_loss']
```

```
In [40]: epochs = range(1, len(acc) + 1)
```

```
In [41]: plt.plot(epochs, acc, 'bo', label='Training acc')
         plt.plot(epochs, val_acc, 'b', label='Validation acc')
         plt.title('Training and validation accuracy')
         plt.legend()

         plt.figure()

         plt.plot(epochs, loss, 'bo', label='Training loss')
         plt.plot(epochs, val_loss, 'b', label='Validation loss')
         plt.title('Training and validation loss')

         plt.legend()

         plt.show()
```





```
In [42]: plt.savefig('results/model-6-2-b/validationplot.jpg')
```

```
<Figure size 432x288 with 0 Axes>
```