Rice Image Classification with Deep Learning

The dataset includes 5 different rice types images with 15000 images for every category. And our task is to make a classification model that could correctly predict the 5 kinds of rice.

Rice Types

- Arborio
- Basmati
- Ipsala
- Jasmine
- Karacadag

Import libraries

In [1]:
```
# Building deep learning models
import tensorflow as tf
from tensorflow import keras
# For accessing pre-trained models
import tensorflow_hub as hub
# For separating train and test sets
from sklearn.model_selection import train_test_split

# For visualizations
import matplotlib.pyplot as plt
import matplotlib.image as img
import PIL.Image as Image
import cv2

import os
import numpy as np
import pathlib
```

Preparing our dataset

In [2]:
```
data_dir = "../input/rice-image-dataset/Rice_Image_Dataset" # Datasets path
data_dir = pathlib.Path(data_dir)
data_dir
```

Out[2]:
```
PosixPath('../input/rice-image-dataset/Rice_Image_Dataset')
```

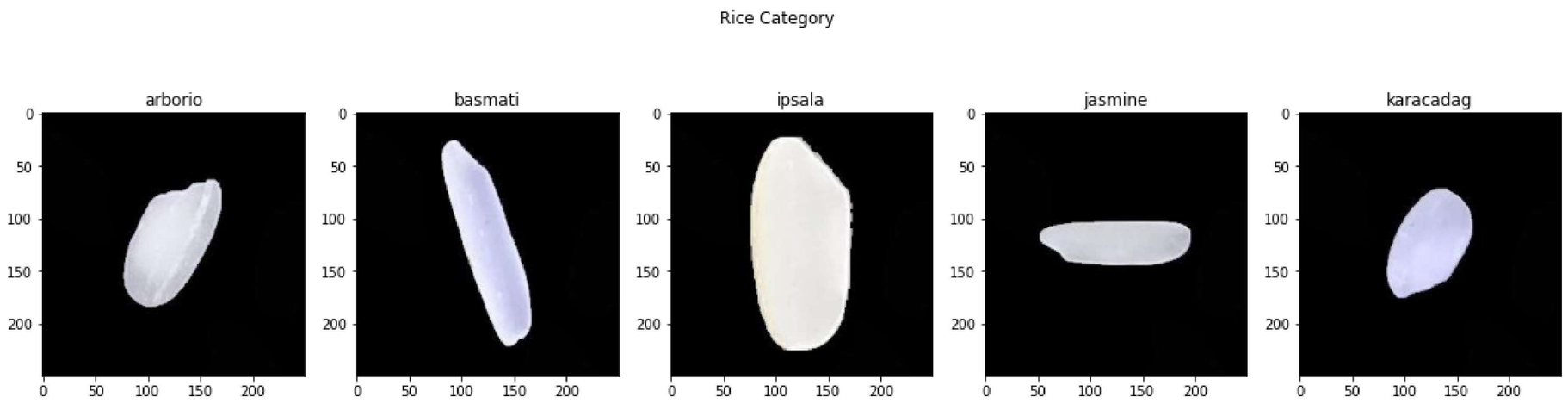
Separating the categories

In [3]:
```
arborio = list(data_dir.glob('Arborio/*'))[:600]
basmati = list(data_dir.glob('Basmati/*'))[:600]
ipsala = list(data_dir.glob('Ipsala/*'))[:600]
jasmine = list(data_dir.glob('Jasmine/*'))[:600]
karacadag = list(data_dir.glob('Karacadag/*'))[:600]
```

Checking samples

In [4]:
```
fig, ax = plt.subplots(ncols=5, figsize=(20,5))
fig.suptitle('Rice Category')
arborio_image = img.imread(arborio[0])
basmati_image = img.imread(basmati[0])
ipsala_image = img.imread(ipsala[0])
jasmine_image = img.imread(jasmine[0])
karacadag_image = img.imread(karacadag[0])

ax[0].set_title('arborio')
ax[1].set_title('basmati')
ax[2].set_title('ipsala')
ax[3].set_title('jasmine')
ax[4].set_title('karacadag')


ax[0].imshow(arborio_image)
ax[1].imshow(basmati_image)
ax[2].imshow(ipsala_image)
ax[3].imshow(jasmine_image)
ax[4].imshow(karacadag_image)
```

Out[4]:
```
<matplotlib.image.AxesImage at 0x7aa63d204890>
```



Assigning a separate dictionary for images and their corresponding labels

In [5]:
```
# Contains the images path
df_images = {
    'arborio' : arborio,
    'basmati' : basmati,
    'ipsala' : ipsala,
    'jasmine' : jasmine,
    'karacadag': karacadag
}

# Contains numerical labels for the categories
df_labels = {
    'arborio' : 0,
    'basmati' : 1,
    'ipsala' : 2,
    'jasmine' : 3,
```

```
    'karacadag': 4
}
```

Since the MobileNetv2 training images dimensions are 224 by 224 by 3, we have to reshape our categories into that

In [6]:
```
img = cv2.imread(str(df_images['arborio'][0])) # Converting it into numerical arrays
img.shape # Its currently 250 by 250 by 3
```

Out[6]:
```
(250, 250, 3)
```

In [7]:
```
X, y = [], [] # X = images, y = labels
for label, images in df_images.items():
    for image in images:
        img = cv2.imread(str(image))
        resized_img = cv2.resize(img, (224, 224)) # Resizing the images to be able to pass on MobileNetv2 model
        X.append(resized_img)
        y.append(df_labels[label])
```

Splitting the data and standarization

In [8]:
```
# Standarizing
X = np.array(X)
X = X/255
y = np.array(y)
```

In [9]:
```
# Separating data into training, test and validation sets
X_train, X_test_val, y_train, y_test_val = train_test_split(X, y)
X_test, X_val, y_test, y_val = train_test_split(X_test_val, y_test_val)
```

Creating the Model

In [10]:
```
mobile_net = 'https://tfhub.dev/google/tf2-preview/mobilenet_v2/feature_vector/4' # MobileNetv4 link
mobile_net = hub.KerasLayer(
        mobile_net, input_shape=(224,224, 3), trainable=False) # Removing the last layer
```

In [11]:
```
num_label = 5 # number of labels

model = keras.Sequential([
    mobile_net,
    keras.layers.Dense(num_label)
])

model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
keras_layer (KerasLayer)     (None, 1280)              2257984
_________________________________________________________________
dense (Dense)                (None, 5)                 6405
=================================================================
Total params: 2,264,389
Trainable params: 6,405
Non-trainable params: 2,257,984
_________________________________________________________________
```

Training the Model

In [12]:
```
model.compile(
  optimizer="adam",
  loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits=True),
  metrics=['acc'])

history = model.fit(X_train, y_train, epochs=10, validation_data=(X_val, y_val))
```

```
Epoch 1/10
71/71 [==============================] - 12s 44ms/step - loss: 0.5659 - acc: 0.8307 - val_loss: 0.2153 - val_acc: 0.9468
Epoch 2/10
71/71 [==============================] - 2s 29ms/step - loss: 0.1713 - acc: 0.9622 - val_loss: 0.1290 - val_acc: 0.9734
Epoch 3/10
71/71 [==============================] - 2s 31ms/step - loss: 0.1152 - acc: 0.9716 - val_loss: 0.1104 - val_acc: 0.9840
Epoch 4/10
71/71 [==============================] - 2s 30ms/step - loss: 0.0939 - acc: 0.9796 - val_loss: 0.0992 - val_acc: 0.9787
Epoch 5/10
71/71 [==============================] - 2s 29ms/step - loss: 0.0812 - acc: 0.9827 - val_loss: 0.0797 - val_acc: 0.9894
Epoch 6/10
71/71 [==============================] - 2s 29ms/step - loss: 0.0655 - acc: 0.9831 - val_loss: 0.0754 - val_acc: 0.9894
Epoch 7/10
71/71 [==============================] - 2s 29ms/step - loss: 0.0591 - acc: 0.9884 - val_loss: 0.0692 - val_acc: 0.9787
Epoch 8/10
71/71 [==============================] - 2s 29ms/step - loss: 0.0522 - acc: 0.9876 - val_loss: 0.0623 - val_acc: 0.9840
Epoch 9/10
71/71 [==============================] - 2s 29ms/step - loss: 0.0465 - acc: 0.9920 - val_loss: 0.0677 - val_acc: 0.9840
Epoch 10/10
71/71 [==============================] - 2s 29ms/step - loss: 0.0434 - acc: 0.9902 - val_loss: 0.0591 - val_acc: 0.9894
```

Evaluate the Model

Evaluate the model using accuracy, recall, precision and f1-score

In [13]:
```
model.evaluate(X_test,y_test)
```

```
18/18 [==============================] - 1s 32ms/step - loss: 0.0637 - acc: 0.9786
```

Out[13]:
```
[0.06372835487127304, 0.9786477088928223]
```

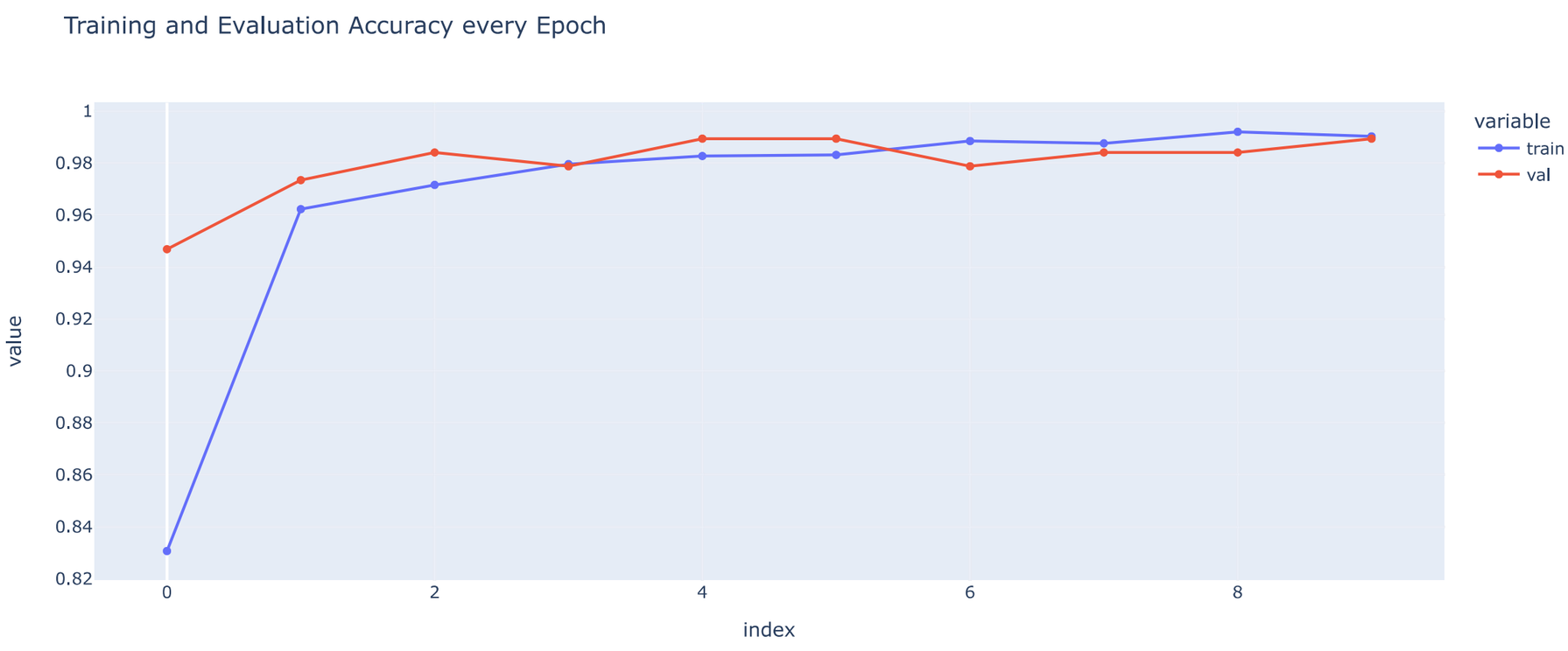
In [14]:
```
from sklearn.metrics import classification_report

y_pred = model.predict(X_test, batch_size=64, verbose=1)
y_pred_bool = np.argmax(y_pred, axis=1)

print(classification_report(y_test, y_pred_bool))
```

```
9/9 [==============================] - 1s 62ms/step
              precision    recall  f1-score   support

           0       0.99      0.97      0.98       116
           1       0.95      0.97      0.96       104
           2       1.00      0.99      1.00       125
           3       0.97      0.96      0.96       112
           4       0.97      1.00      0.99       105

    accuracy                           0.98       562
   macro avg       0.98      0.98      0.98       562
weighted avg       0.98      0.98      0.98       562
```

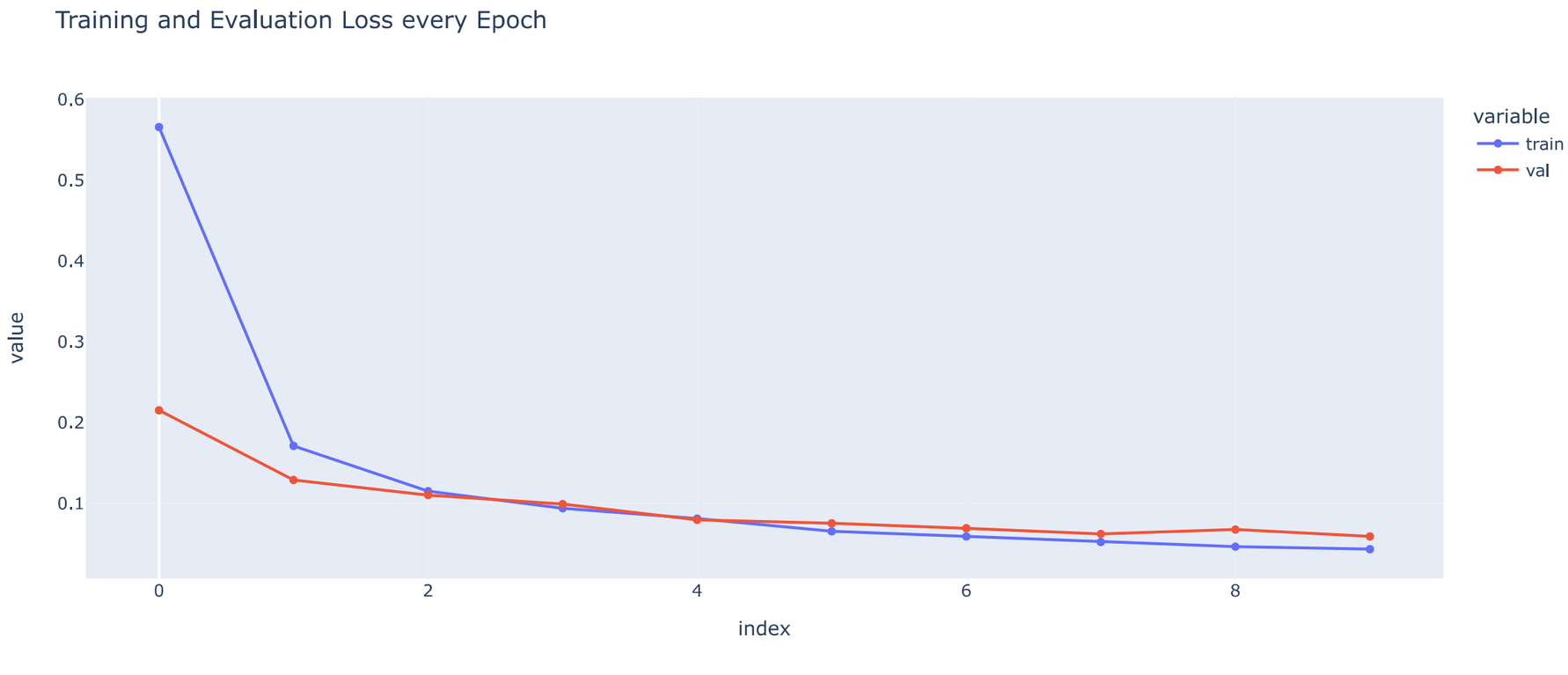
Visualizing the Model

On how the models accuracy and loss changed through-out the 5 epochs

In [15]:
```
from plotly.offline import iplot, init_notebook_mode
import plotly.express as px
import pandas as pd

init_notebook_mode(connected=True)

acc = pd.DataFrame({'train': history.history['acc'], 'val': history.history['val_acc']})

fig = px.line(acc, x=acc.index, y=acc.columns[0::], title='Training and Evaluation Accuracy every Epoch', markers=True)
fig.show()
```



In [16]:
```
loss = pd.DataFrame({'train': history.history['loss'], 'val': history.history['val_loss']})

fig = px.line(loss, x=loss.index, y=loss.columns[0::], title='Training and Evaluation Loss every Epoch', markers=True)
fig.show()
```


Training and Evaluation Loss every Epoch
value
index
variable
train
val
0.6
0.5
0.4
0.3
0.2
0.1
0
2
4
6
8