In [14]:
```
import numpy as np
import pandas as pd
from pathlib import Path
import os.path
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
import tensorflow as tf

from sklearn.metrics import confusion_matrix ,classification_report
```

In [15]:
```
image_dir=Path('/kaggle/input/indian-food-classification')
```

In [16]:
```
filepaths=list(image_dir.glob(r'**/*.jpg'))
labels=list(map(lambda x:os.path.split(os.path.split(x)[0])[1],filepaths))
filepaths=pd.Series(filepaths,name='Filepaths').astype(str)
labels=pd.Series(labels,name='Label')
images=pd.concat([filepaths,labels],axis=1)
category_samples=[]

for category in images['Label'].unique():
    category_slices=images.query('Label==@category')
    category_samples.append(category_slices.sample(frac=1,random_state=1))
image_df=pd.concat(category_samples,axis=0).sample(frac=1.0,random_state=1).
```

In [17]:
```
image_df
```

Out[17]:

| | Filepaths | Label |
|---|---|---|
| **0** | /kaggle/input/indian-food-classification/Food ... | chole_bhature |
| **1** | /kaggle/input/indian-food-classification/Food ... | chapati |
| **2** | /kaggle/input/indian-food-classification/Food ... | kadai_paneer |
| **3** | /kaggle/input/indian-food-classification/Food ... | kulfi |
| **4** | /kaggle/input/indian-food-classification/Food ... | samosa |
| **...** | ... | ... |
| **6248** | /kaggle/input/indian-food-classification/Food ... | chole_bhature |
| **6249** | /kaggle/input/indian-food-classification/Food ... | butter_naan |
| **6250** | /kaggle/input/indian-food-classification/Food ... | idli |
| **6251** | /kaggle/input/indian-food-classification/Food ... | momos |
| **6252** | /kaggle/input/indian-food-classification/Food ... | butter_naan |

6253 rows × 2 columns

In [18]:
```
image_df['Label'].value_counts()
```

Out[18]:
```
Label
chapati          413
kadai_paneer     412
chole_bhature    410
chai             381
fried_rice       353
pav_bhaji        353
butter_naan      328
dal_makhani      319
momos            319
masala_dosa      311
burger           309
idli             306
kaathi_rolls     293
jalebi           293
dhokla           289
pakode           278
pizza            261
samosa           261
kulfi            234
paani_puri       130
Name: count, dtype: int64
```

In [19]:
```
# This operation would be performed on the actual 'image_df' DataFrame
label_counts = image_df['Label'].value_counts().reset_index()
label_counts.columns = ['Label', 'Counts']
label_counts
```

Out[19]:

| | Label | Counts |
|---|---|---|
| **0** | chapati | 413 |
| **1** | kadai_paneer | 412 |
| **2** | chole_bhature | 410 |
| **3** | chai | 381 |
| **4** | fried_rice | 353 |
| **5** | pav_bhaji | 353 |
| **6** | butter_naan | 328 |
| **7** | dal_makhani | 319 |
| **8** | momos | 319 |
| **9** | masala_dosa | 311 |
| **10** | burger | 309 |
| **11** | idli | 306 |
| **12** | kaathi_rolls | 293 |
| **13** | jalebi | 293 |
| **14** | dhokla | 289 |
| **15** | pakode | 278 |
| **16** | pizza | 261 |
| **17** | samosa | 261 |
| **18** | kulfi | 234 |
| **19** | paani_puri | 130 |

In [20]:
```
IMG_SIZE = (256, 256)
BATCH_SIZE = 32
SEED = 42
PATH = "../input/indian-food-classification/Food Classification"
```

In [21]:
```
data_ds = tf.keras.preprocessing.image_dataset_from_directory(
    PATH,
    seed=SEED,
    image_size=IMG_SIZE,
    batch_size=BATCH_SIZE,
    label_mode="categorical"
)
```

```
Found 6269 files belonging to 20 classes.
```

In [22]:
```
# Get class names
classes = data_ds.class_names
```

In [23]:
```
classes
```

Out[23]:
```
['burger',
 'butter_naan',
 'chai',
 'chapati',
 'chole_bhature',
 'dal_makhani',
 'dhokla',
 'fried_rice',
 'idli',
 'jalebi',
 'kaathi_rolls',
 'kadai_paneer',
 'kulfi',
 'masala_dosa',
 'momos',
 'paani_puri',
 'pakode',
 'pav_bhaji',
 'pizza',
 'samosa']
```

In [24]:
```
# Get class names
classes = data_ds.class_names
```

In [25]:
```
classes
```

Out[25]:
```
['burger',
 'butter_naan',
 'chai',
 'chapati',
 'chole_bhature',
 'dal_makhani',
 'dhokla',
 'fried_rice',
 'idli',
 'jalebi',
 'kaathi_rolls',
 'kadai_paneer',
 'kulfi',
 'masala_dosa',
 'momos',
 'paani_puri',
 'pakode',
 'pav_bhaji',
 'pizza',
 'samosa']
```

# Detecting outliers

# Unusual Image size

This code identifies images in a dataset that have unusual sizes compared to the rest of the dataset. It begins by defining a path to the dataset and listing all the subdirectories, which correspond to different classes of images. For each image in these folders, the code reads the image using OpenCV, calculates its size in pixels by multiplying the width and height, and stores these sizes in a list. After converting the list of sizes into a NumPy array, the code calculates the z-scores—a statistical measure that indicates how many standard deviations a data point is from the mean of the dataset. It then identifies outliers as those images whose sizes have z-scores that exceed an absolute value of 3, which is a common threshold for outlier detection. These outliers are likely to be either much larger or smaller than the typical image size in the dataset. The indices of these outliers in the dataset are printed out, which can be used to further examine or process these specific images.

In [26]:
```
import os
import numpy as np
import cv2
from scipy.stats import zscore
import matplotlib.pyplot as plt

# Define the path to the dataset
PATH = "../input/indian-food-classification/Food Classification"

# List all the folders in the dataset
folders = [folder for folder in os.listdir(PATH) if os.path.isdir(os.path.jc

# Initialize a list to store image sizes and file paths
image_sizes = []
file_paths = []

# Loop through each folder (which corresponds to a class)
for folder in folders:
    # Get a list of all the file names of images in this folder
    image_files = os.listdir(os.path.join(PATH, folder))
    # Loop through each image file
    for image_file in image_files:
        # Define the path to the image
        image_path = os.path.join(PATH, folder, image_file)
        # Load the image
        image = cv2.imread(image_path)
        # Check if the image was loaded correctly
        if image is not None:
            # Get the size (in pixels) of the image
            size = image.shape[0] * image.shape[1]
            # Append the size and file path to our lists
            image_sizes.append(size)
            file_paths.append(image_path)

# Convert the list to a NumPy array
image_sizes = np.array(image_sizes)
```

```python
# Calculate z-scores for the image sizes
z_scores = zscore(image_sizes)

# Define a threshold for what we consider to be an outlier
threshold = 3

# Find indices of outliers
outlier_indices = np.where((z_scores > threshold) | (z_scores < -threshold))

# Exclude outliers
non_outlier_indices = np.setdiff1d(np.arange(len(file_paths)), outlier_indic
non_outlier_file_paths_1 = [file_paths[index] for index in non_outlier_indic

# Display the number of outliers
print(f"Found {len(outlier_indices)} outliers based on image size.")

#  print the paths of the outliers
for index in outlier_indices[:5]:
    print(file_paths[index])

# Display individual outliers
for index in outlier_indices[:5]:
    image = cv2.cvtColor(cv2.imread(file_paths[index]), cv2.COLOR_BGR2RGB)
    plt.figure()
    plt.imshow(image)
    plt.axis('off')
    plt.title(f"Outlier {index}")
    plt.show()

# Now can use non_outlier_file_paths for further processing
```

```
Found 168 outliers based on image size.
../input/indian-food-classification/Food Classification/momos/002.jpg
../input/indian-food-classification/Food Classification/momos/064.jpg
../input/indian-food-classification/Food Classification/momos/086.jpg
../input/indian-food-classification/Food Classification/momos/017.jpg
../input/indian-food-classification/Food Classification/momos/216.jpg
```

Outlier 62


Outlier 114

Outlier 126

Outlier 129

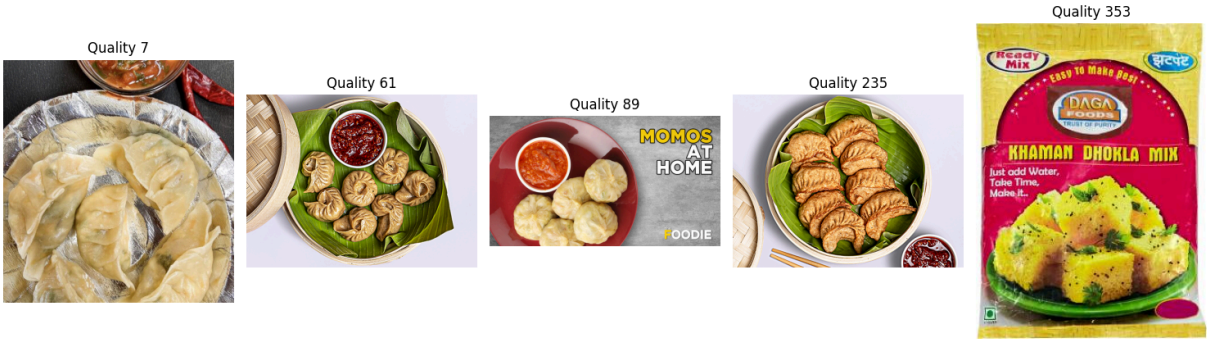

# Image Quality Outliers (using blur detection with Laplacian variance)

This code calculates the quality of images based on the variance of the Laplacian filter, which is a measure of sharpness or focus. Images with low variance in the Laplacian are typically blurry, and high variance indicates a sharp image. The code computes this focus measure for each image in the dataset and then uses a z-score to detect outliers, which are images that are significantly blurrier or sharper than the average. It displays the first few outlier images based on image quality.

In [27]:
```
import os
import cv2
import numpy as np
from scipy.stats import zscore
import matplotlib.pyplot as plt

# Define the path to the dataset
PATH = "../input/indian-food-classification/Food Classification"

# Function to calculate image quality using Laplacian variance
def calculate_image_quality(image_path):
    image = cv2.imread(image_path, cv2.IMREAD_GRAYSCALE)
    if image is None:
        return None
    focus_measure = cv2.Laplacian(image, cv2.CV_64F).var()
```

```
    return focus_measure

# Load images and compute quality
file_paths = []
quality_scores = []

for folder in os.listdir(PATH):
    folder_path = os.path.join(PATH, folder)
    if os.path.isdir(folder_path):
        for image_file in os.listdir(folder_path):
            image_path = os.path.join(folder_path, image_file)
            quality = calculate_image_quality(image_path)
            if quality is not None:  # Only add if the image was successfull
                file_paths.append(image_path)
                quality_scores.append(quality)

# Convert to NumPy array
quality_scores = np.array(quality_scores)

# Detect outliers
quality_outliers = np.where(zscore(quality_scores) > 3)[0]

# Exclude outliers from the dataset
non_outlier_indices = np.setdiff1d(np.arange(len(file_paths)), quality_outli
non_outlier_file_paths_2 = [file_paths[index] for index in non_outlier_indic
non_outlier_quality_scores = quality_scores[non_outlier_indices]

# Display outliers
def display_outliers(outlier_indices, file_paths, title):
    if len(outlier_indices) == 0:
        print(f"No outliers detected for {title}.")
        return

    plt.figure(figsize=(15, 5))
    for i, idx in enumerate(outlier_indices[:5]):  # Displaying only first 5
        image = cv2.cvtColor(cv2.imread(file_paths[idx]), cv2.COLOR_BGR2RGB)
        plt.subplot(1, 5, i + 1)
        plt.imshow(image)
        plt.title(f"{title} {idx}")
        plt.axis('off')
    plt.tight_layout()
    plt.show()

# Call the display function
print("Image Quality Outliers:")
display_outliers(quality_outliers, file_paths, "Quality")

# You can now use non_outlier_file_paths and non_outlier_quality_scores for
```

```
Image Quality Outliers:
```




# Color histogram

This code calculates the color histograms of the images. A color histogram represents the distribution of colors in an image; it counts how many times each color appears. This is done across the RGB color channels. The code then uses a z-score to detect images whose color distribution is significantly different from that of the majority of images. Outliers could be images that are overly bright, dark, or have an unusual color cast. It displays the first few outlier images based on color distribution.

In [28]:
```
import os
import cv2
import numpy as np
from scipy.stats import zscore
import matplotlib.pyplot as plt

# Define the path to the dataset
PATH = "../input/indian-food-classification/Food Classification"  # Replace

# Function to calculate color histogram
def calculate_color_histogram(image_path):
    image = cv2.imread(image_path)
    if image is None:
        return None
    hist = cv2.calcHist([image], [0, 1, 2], None, [8, 8, 8], [0, 256, 0, 256
    return hist.flatten()

# Function to display outliers
def display_outliers(outlier_indices, file_paths, title):
    plt.figure(figsize=(15, 5))
    for i, idx in enumerate(outlier_indices[:5]):  # Show up to the first 5
        image = cv2.imread(file_paths[idx])
        if image is None:
            continue
        image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
        plt.subplot(1, 5, i+1)
        plt.imshow(image)
        plt.axis('off')
        plt.title(f"{title} Outlier {idx}")
    plt.show()
```

```
# Load images and compute color histograms
file_paths_3 = []
color_histograms = []

for folder in os.listdir(PATH):
    folder_path = os.path.join(PATH, folder)
    if os.path.isdir(folder_path):
        for image_file in os.listdir(folder_path):
            image_path = os.path.join(folder_path, image_file)
            hist = calculate_color_histogram(image_path)
            if hist is not None:  # Skip if the image could not be read
                file_paths_3.append(image_path)
                color_histograms.append(hist)

# Convert to NumPy array
color_histograms = np.array(color_histograms)

# Detect outliers
color_outliers = np.where(zscore(color_histograms) > 3)[0]

# Filter out the outlier file paths
non_outlier_file_paths_3 = [file_paths_3[i] for i in range(len(file_paths_3)

# Call the display function
print("Color Histogram Outliers:")
display_outliers(color_outliers, file_paths_3, "Color")

# The non_outlier_file_paths_3 now contains the file paths without the outli
print("Stored non-outlier file paths.")
```

```
Color Histogram Outliers:
```


```
Stored non-outlier file paths.
```

In [29]:
```
print(non_outlier_file_paths_1[:5])
print(non_outlier_file_paths_2[:5])
print(non_outlier_file_paths_3[:5])
```

```
['../input/indian-food-classification/Food Classification/momos/208.jpg',
'../input/indian-food-classification/Food Classification/momos/029.jpg',
'../input/indian-food-classification/Food Classification/momos/014.jpg',
'../input/indian-food-classification/Food Classification/momos/275.jpg',
'../input/indian-food-classification/Food Classification/momos/212.jpg']
['../input/indian-food-classification/Food Classification/momos/208.jpg',
'../input/indian-food-classification/Food Classification/momos/029.jpg',
'../input/indian-food-classification/Food Classification/momos/014.jpg',
'../input/indian-food-classification/Food Classification/momos/275.jpg',
'../input/indian-food-classification/Food Classification/momos/212.jpg']
['../input/indian-food-classification/Food Classification/momos/208.jpg',
'../input/indian-food-classification/Food Classification/momos/029.jpg',
'../input/indian-food-classification/Food Classification/momos/014.jpg',
'../input/indian-food-classification/Food Classification/momos/275.jpg',
'../input/indian-food-classification/Food Classification/momos/239.jpg']
```

In [30]:
```
# Convert lists to sets
set_fp1 = set(non_outlier_file_paths_1)
set_fp2 = set(non_outlier_file_paths_2)
set_fp3 = set(non_outlier_file_paths_3)

# Find the intersection of the three sets
common_file_paths = list(set_fp1.intersection(set_fp2, set_fp3))
```

In [31]:
```
#print(len(common_file_paths))
cf = common_file_paths
```

In [39]:
```
type(cf)
```

Out[39]:
```
list
```

In [40]:
```
k=cf[0].split('/')
k=k[-2]
```

In [46]:
```

```

Out[46]:
```
4292
```

In [47]:
```
i=0
img_lable_after_removing_outlier=[]
for i in range(len(common_file_paths)):
    k=cf[i].split('/')
    img_lable_after_removing_outlier.append(k[-2])
```

In [50]:
```
import pandas as pd
import pandas as pd

series = pd.Series(img_lable_after_removing_outlier)

img_counts_after_removing_outlier = series.value_counts()
```

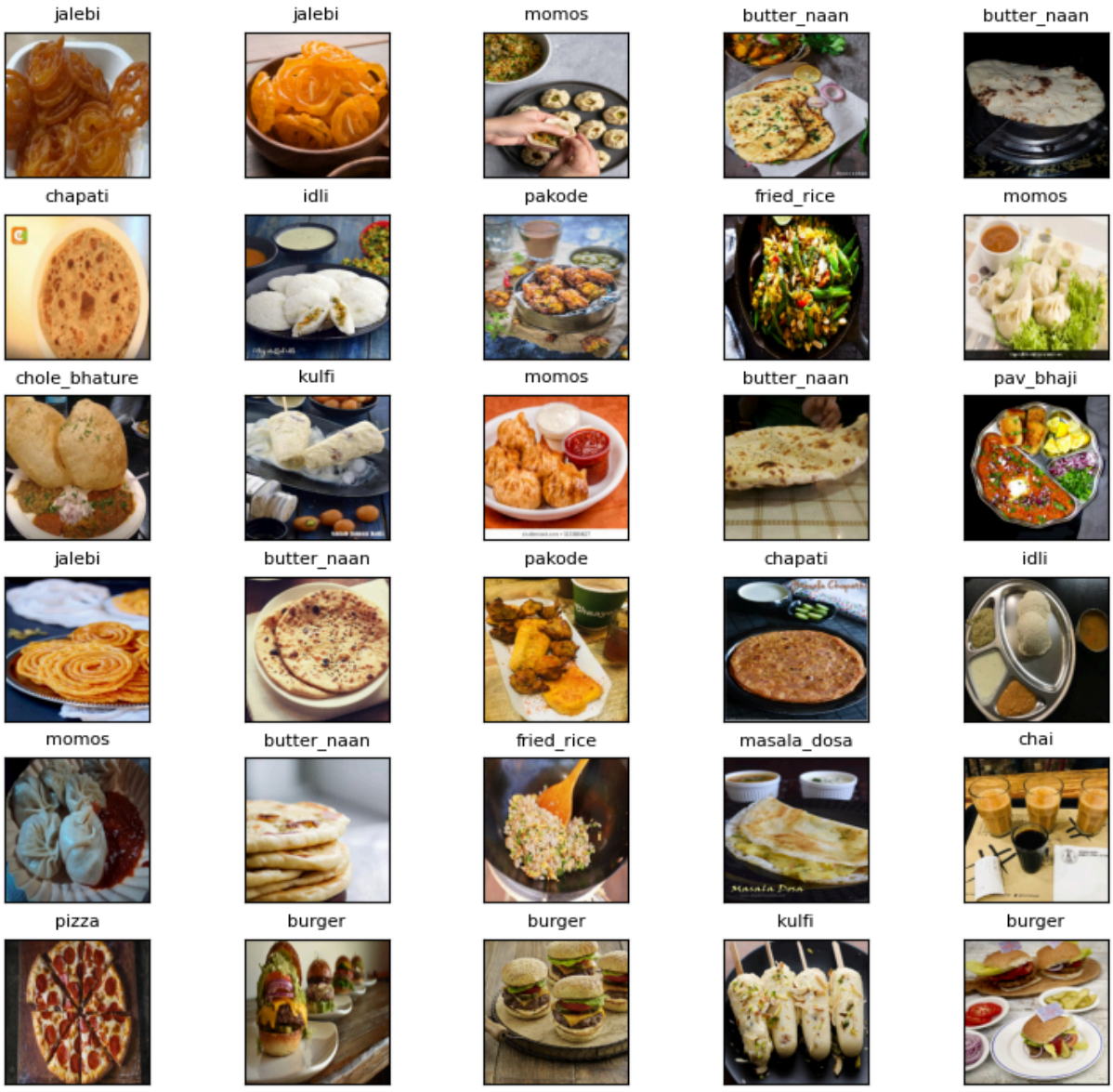
In [51]:
```
img_counts_after_removing_outlier
```

Out[51]:
```
chapati          303
chole_bhature    290
chai             273
kadai_paneer     270
pav_bhaji        254
momos            243
butter_naan      242
fried_rice       241
dal_makhani      231
idli             215
kaathi_rolls     204
masala_dosa      199
pakode           192
samosa           191
burger           187
jalebi           184
dhokla           177
kulfi            158
pizza            154
paani_puri        84
Name: count, dtype: int64
```

## Preview of some images

In [23]:
```
IMG_SIZE = (224, 224)  # VGG16 default image size

# Load images and labels
img = []
lbl = []
for file_path in common_file_paths:  # Replace with your actual file paths
    image = cv2.imread(file_path)
    if image is None:
        continue  # Skip files that aren't valid images
    image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
    image = cv2.resize(image, IMG_SIZE)
    img.append(image)

    label = file_path.split(os.path.sep)[-2]
    lbl.append(label)
```

In [24]:
```
# Display some pictures of the dataset
fig, axes = plt.subplots(nrows=6, ncols=5, figsize=(8, 7),
                         subplot_kw={'xticks': [], 'yticks': []})

for i, ax in enumerate(axes.flat):
#     ax.imshow(plt.imread(df_unique.Filepath[i]))
    ax.imshow(img[i])
    ax.set_title(lbl[i], fontsize = 8)
#     ax.set_title(df_unique.Labels[i], fontsize = 8)
plt.tight_layout(pad=0.5)
plt.show()
```




In [ ]:

# Transfer Learning with the EfficientNETV2L

In [25]:
```
import numpy as np
import cv2
import os
from sklearn.model_selection import train_test_split
from tensorflow.keras.applications import EfficientNetV2L
from tensorflow.keras.applications.efficientnet_v2 import preprocess_input
from tensorflow.keras.layers import Flatten, Dense, Dropout, BatchNormalizat
from tensorflow.keras.models import Model
from tensorflow.keras.optimizers import Adam
from sklearn.preprocessing import LabelEncoder
from tensorflow.keras.utils import to_categorical
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import matplotlib.pyplot as plt
```

```
IMG_SIZE = (224, 224)


images = []
labels = []
for file_path in common_file_paths:
    image = cv2.imread(file_path)
    if image is None:
        continue
    image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
    image = cv2.resize(image, IMG_SIZE)
    images.append(image)
    label = file_path.split(os.path.sep)[-2]
    labels.append(label)


images = np.array(images, dtype=np.float32)
labels = np.array(labels)
images = preprocess_input(images)


label_encoder = LabelEncoder()
labels_encoded = label_encoder.fit_transform(labels)
labels_one_hot = to_categorical(labels_encoded)


X_train, X_val, y_train, y_val = train_test_split(images, labels_one_hot, te


data_gen = ImageDataGenerator(rotation_range=20, zoom_range=0.15, width_shif


base_model = EfficientNetV2L(weights='imagenet', include_top=False, input_te

# Freeze base model layers and unfreeze the last 4 layers
for layer in base_model.layers[:-4]:
    layer.trainable = False


x = base_model.output
x = Flatten()(x)
x = Dense(4096, activation='relu')(x)
x = Dropout(0.5)(x)
x = BatchNormalization()(x)
x = Dense(4096, activation='relu')(x)
x = Dropout(0.5)(x)
predictions = Dense(len(label_encoder.classes_), activation='softmax')(x)
model = Model(inputs=base_model.input, outputs=predictions)


model.compile(optimizer=Adam(learning_rate=1e-5), loss='categorical_crossent


history = model.fit(data_gen.flow(X_train, y_train, batch_size=32), validati
```

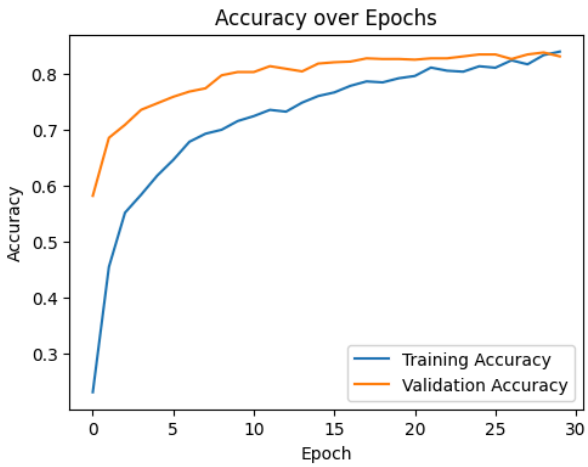
```
val_loss, val_accuracy = model.evaluate(X_val, y_val)
print(f'Validation accuracy: {val_accuracy * 100:.2f}%')


plt.figure(figsize=(12, 4))
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label='Training Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Accuracy over Epochs')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()

plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Training Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Loss over Epochs')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()

plt.show()
```

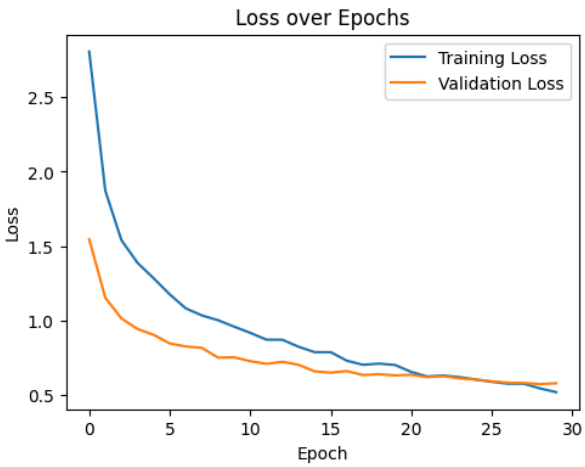
```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applic
ations/efficientnet_v2/efficientnetv2-l_notop.h5
473176280/473176280 [==============================] - 2s 0us/step
Epoch 1/30
```

```
2024-05-06 17:56:09.158838: E tensorflow/core/grappler/optimizers/meta_optim
izer.cc:954] layout failed: INVALID_ARGUMENT: Size of values 0 does not matc
h size of permutation 4 @ fanin shape inmodel/block1b_drop/dropout/SelectV2-
2-TransposeNHWCToNCHW-LayoutOptimizer
```

```
107/107 [==============================] - 81s 467ms/step - loss: 2.8053 - a
ccuracy: 0.2311 - val_loss: 1.5458 - val_accuracy: 0.5821
Epoch 2/30
107/107 [==============================] - 42s 388ms/step - loss: 1.8720 - a
ccuracy: 0.4549 - val_loss: 1.1536 - val_accuracy: 0.6857
Epoch 3/30
107/107 [==============================] - 41s 382ms/step - loss: 1.5405 - a
ccuracy: 0.5519 - val_loss: 1.0148 - val_accuracy: 0.7090
Epoch 4/30
107/107 [==============================] - 41s 383ms/step - loss: 1.3880 - a
ccuracy: 0.5839 - val_loss: 0.9442 - val_accuracy: 0.7357
Epoch 5/30
107/107 [==============================] - 41s 387ms/step - loss: 1.2845 - a
ccuracy: 0.6181 - val_loss: 0.9050 - val_accuracy: 0.7474
Epoch 6/30
107/107 [==============================] - 41s 382ms/step - loss: 1.1761 - a
ccuracy: 0.6463 - val_loss: 0.8471 - val_accuracy: 0.7590
Epoch 7/30
107/107 [==============================] - 41s 386ms/step - loss: 1.0822 - a
ccuracy: 0.6786 - val_loss: 0.8268 - val_accuracy: 0.7683
Epoch 8/30
107/107 [==============================] - 42s 387ms/step - loss: 1.0350 - a
ccuracy: 0.6930 - val_loss: 0.8174 - val_accuracy: 0.7742
Epoch 9/30
107/107 [==============================] - 41s 383ms/step - loss: 1.0030 - a
ccuracy: 0.7001 - val_loss: 0.7520 - val_accuracy: 0.7974
Epoch 10/30
107/107 [==============================] - 41s 381ms/step - loss: 0.9598 - a
ccuracy: 0.7157 - val_loss: 0.7540 - val_accuracy: 0.8033
Epoch 11/30
107/107 [==============================] - 41s 378ms/step - loss: 0.9183 - a
ccuracy: 0.7245 - val_loss: 0.7282 - val_accuracy: 0.8033
Epoch 12/30
107/107 [==============================] - 41s 383ms/step - loss: 0.8727 - a
ccuracy: 0.7357 - val_loss: 0.7103 - val_accuracy: 0.8137
Epoch 13/30
107/107 [==============================] - 41s 383ms/step - loss: 0.8717 - a
ccuracy: 0.7324 - val_loss: 0.7237 - val_accuracy: 0.8091
Epoch 14/30
107/107 [==============================] - 41s 383ms/step - loss: 0.8252 - a
ccuracy: 0.7486 - val_loss: 0.7041 - val_accuracy: 0.8044
Epoch 15/30
107/107 [==============================] - 41s 382ms/step - loss: 0.7885 - a
ccuracy: 0.7604 - val_loss: 0.6596 - val_accuracy: 0.8184
Epoch 16/30
107/107 [==============================] - 41s 382ms/step - loss: 0.7885 - a
ccuracy: 0.7668 - val_loss: 0.6515 - val_accuracy: 0.8207
Epoch 17/30
107/107 [==============================] - 41s 386ms/step - loss: 0.7312 - a
ccuracy: 0.7786 - val_loss: 0.6614 - val_accuracy: 0.8219
Epoch 18/30
107/107 [==============================] - 41s 383ms/step - loss: 0.7040 - a
ccuracy: 0.7865 - val_loss: 0.6352 - val_accuracy: 0.8277
Epoch 19/30
107/107 [==============================] - 41s 382ms/step - loss: 0.7117 - a
ccuracy: 0.7848 - val_loss: 0.6404 - val_accuracy: 0.8265
```

```
Epoch 20/30
107/107 [==============================] - 41s 380ms/step - loss: 0.7024 - a
ccuracy: 0.7921 - val_loss: 0.6327 - val_accuracy: 0.8265
Epoch 21/30
107/107 [==============================] - 41s 380ms/step - loss: 0.6559 - a
ccuracy: 0.7962 - val_loss: 0.6367 - val_accuracy: 0.8254
Epoch 22/30
107/107 [==============================] - 41s 380ms/step - loss: 0.6252 - a
ccuracy: 0.8112 - val_loss: 0.6206 - val_accuracy: 0.8277
Epoch 23/30
107/107 [==============================] - 41s 385ms/step - loss: 0.6319 - a
ccuracy: 0.8056 - val_loss: 0.6272 - val_accuracy: 0.8277
Epoch 24/30
107/107 [==============================] - 41s 381ms/step - loss: 0.6210 - a
ccuracy: 0.8039 - val_loss: 0.6126 - val_accuracy: 0.8312
Epoch 25/30
107/107 [==============================] - 41s 380ms/step - loss: 0.6051 - a
ccuracy: 0.8136 - val_loss: 0.6045 - val_accuracy: 0.8347
Epoch 26/30
107/107 [==============================] - 41s 385ms/step - loss: 0.5898 - a
ccuracy: 0.8109 - val_loss: 0.5931 - val_accuracy: 0.8347
Epoch 27/30
107/107 [==============================] - 41s 384ms/step - loss: 0.5767 - a
ccuracy: 0.8242 - val_loss: 0.5831 - val_accuracy: 0.8265
Epoch 28/30
107/107 [==============================] - 41s 381ms/step - loss: 0.5767 - a
ccuracy: 0.8171 - val_loss: 0.5821 - val_accuracy: 0.8347
Epoch 29/30
107/107 [==============================] - 41s 383ms/step - loss: 0.5451 - a
ccuracy: 0.8336 - val_loss: 0.5739 - val_accuracy: 0.8382
Epoch 30/30
107/107 [==============================] - 41s 383ms/step - loss: 0.5202 - a
ccuracy: 0.8398 - val_loss: 0.5799 - val_accuracy: 0.8312
27/27 [==============================] - 6s 216ms/step - loss: 0.5799 - accu
racy: 0.8312
Validation accuracy: 83.12%
```

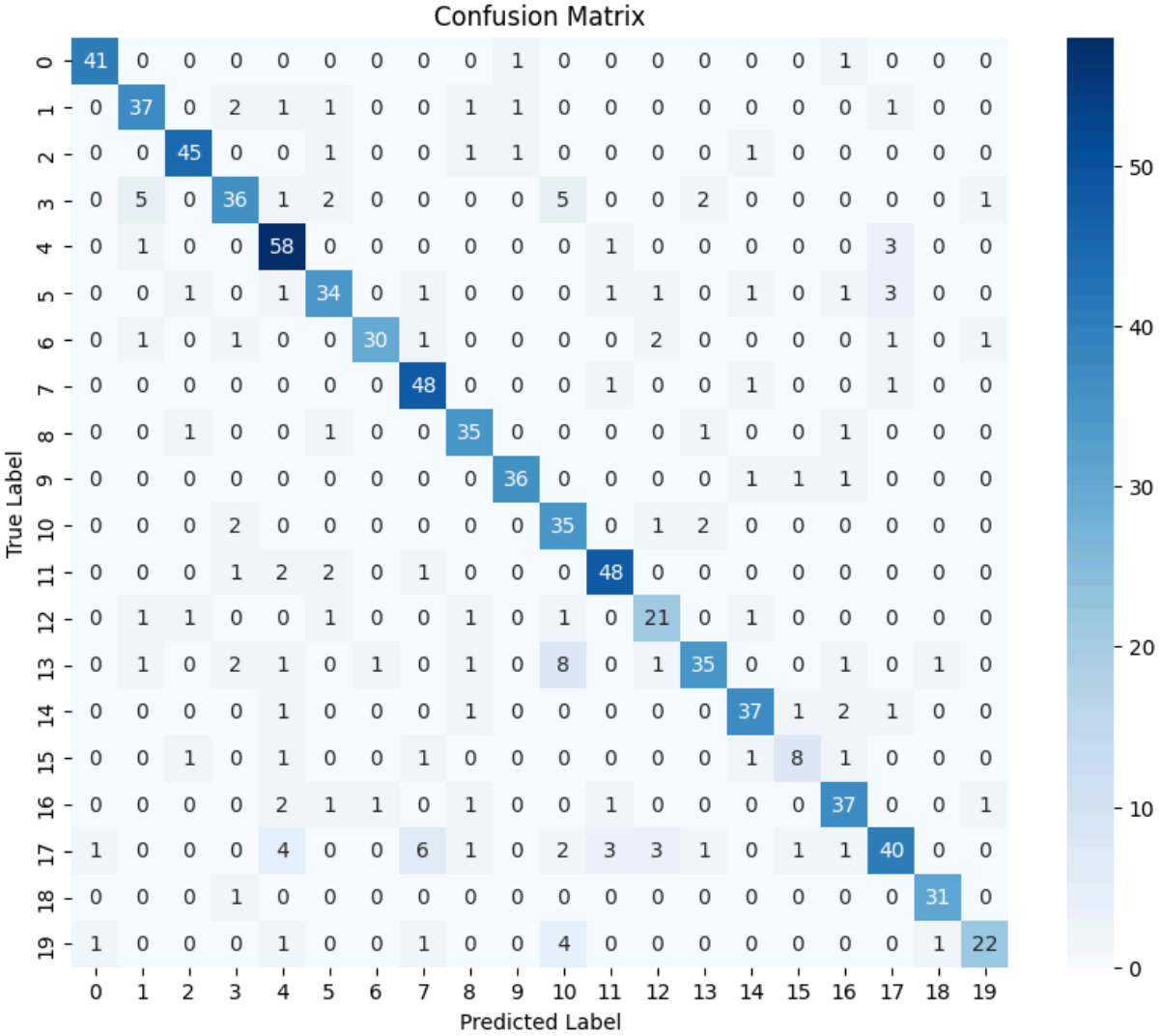



In [26]:
```
y_pred = model.predict(X_val)
y_pred_classes = np.argmax(y_pred, axis=1)
y_true = np.argmax(y_val, axis=1)
conf_matrix = confusion_matrix(y_true, y_pred_classes)
plt.figure(figsize=(10, 8))
```

```python
sns.heatmap(conf_matrix, annot=True, fmt='d', cmap='Blues')
plt.title('Confusion Matrix')
plt.ylabel('True Label')
plt.xlabel('Predicted Label')
plt.show()

# Calculate precision, recall, F1 score, and accuracy
report = classification_report(y_true, y_pred_classes, output_dict=True)
accuracy = report['accuracy']
precision = report['macro avg']['precision']
recall = report['macro avg']['recall']
f1_score = report['macro avg']['f1-score']

# Display the calculated metrics
print(f'Validation Accuracy: {accuracy:.4f}')
print(f'Precision: {precision:.4f}')
print(f'Recall: {recall:.4f}')
print(f'F1 Score: {f1_score:.4f}')
```

```
27/27 [==============================] - 12s 210ms/step
```




```
Validation Accuracy: 0.8312
Precision: 0.8334
Recall: 0.8270
F1 Score: 0.8266
```

In [27]:
```
model.summary()
```

```
Model: "model"
__________________________________________________________________________________________________
 Layer (type)                Output Shape                 Param #   Connected to
==================================================================================================
 input_1 (InputLayer)        [(None, 224, 224, 3)]        0         []

 rescaling (Rescaling)       (None, 224, 224, 3)          0         ['input_1[0][0]']

 stem_conv (Conv2D)          (None, 112, 112, 32)         864       ['rescaling[0][0]']

 stem_bn (BatchNormalizatio  (None, 112, 112, 32)         128       ['stem_conv[0][0]']
 n)

 stem_activation (Activatio  (None, 112, 112, 32)         0         ['stem_bn[0][0]']
 n)

 block1a_project_conv (Conv  (None, 112, 112, 32)         9216      ['stem_activation[0][0]']
 2D)

 block1a_project_bn (BatchN  (None, 112, 112, 32)         128       ['block1a_project_conv[0][0]']
 ormalization)

 block1a_project_activation  (None, 112, 112, 32)         0         ['block1a_project_bn[0][0]']
  (Activation)

 block1a_add (Add)           (None, 112, 112, 32)         0         ['block1a_project_activation[0
                                                                    ][0]',
                                                                     'stem_activation[0][0]']

 block1b_project_conv (Conv  (None, 112, 112, 32)         9216      ['block1a_add[0][0]']
 2D)

 block1b_project_bn (BatchN  (None, 112, 112, 32)         128       ['block1b_project_conv[0][0]']
 ormalization)

 block1b_project_activation  (None, 112, 112, 32)         0         ['block1b_project_bn[0][0]']
  (Activation)

 block1b_drop (Dropout)      (None, 112, 112, 32)         0         ['block1b_project_activation[0
                                                                    ][0]']
```

```
 block1b_add (Add)           (None, 112, 112, 32)         0         ['block1
b_drop[0][0]',
                                                                    'block1
a_add[0][0]']

 block1c_project_conv (Conv  (None, 112, 112, 32)         9216      ['block1
b_add[0][0]']
 2D)

 block1c_project_bn (BatchN  (None, 112, 112, 32)         128       ['block1
c_project_conv[0][0]']
 ormalization)

 block1c_project_activation  (None, 112, 112, 32)         0         ['block1
c_project_bn[0][0]']
  (Activation)

 block1c_drop (Dropout)      (None, 112, 112, 32)         0         ['block1
c_project_activation[0
                                                                   ][0]']

 block1c_add (Add)           (None, 112, 112, 32)         0         ['block1
c_drop[0][0]',
                                                                    'block1
b_add[0][0]']

 block1d_project_conv (Conv  (None, 112, 112, 32)         9216      ['block1
c_add[0][0]']
 2D)

 block1d_project_bn (BatchN  (None, 112, 112, 32)         128       ['block1
d_project_conv[0][0]']
 ormalization)

 block1d_project_activation  (None, 112, 112, 32)         0         ['block1
d_project_bn[0][0]']
  (Activation)

 block1d_drop (Dropout)      (None, 112, 112, 32)         0         ['block1
d_project_activation[0
                                                                   ][0]']

 block1d_add (Add)           (None, 112, 112, 32)         0         ['block1
d_drop[0][0]',
                                                                    'block1
c_add[0][0]']

 block2a_expand_conv (Conv2  (None, 56, 56, 128)          36864     ['block1
d_add[0][0]']
 D)

 block2a_expand_bn (BatchNo  (None, 56, 56, 128)          512       ['block2
a_expand_conv[0][0]']
 rmalization)
```

```
 block2a_expand_activation   (None, 56, 56, 128)          0         ['block2
a_expand_bn[0][0]']
 (Activation)

 block2a_project_conv (Conv  (None, 56, 56, 64)           8192      ['block2
a_expand_activation[0]
 2D)                                                                [0]']

 block2a_project_bn (BatchN  (None, 56, 56, 64)           256       ['block2
a_project_conv[0][0]']
 ormalization)

 block2b_expand_conv (Conv2  (None, 56, 56, 256)          147456    ['block2
a_project_bn[0][0]']
 D)

 block2b_expand_bn (BatchNo  (None, 56, 56, 256)          1024      ['block2
b_expand_conv[0][0]']
 rmalization)

 block2b_expand_activation   (None, 56, 56, 256)          0         ['block2
b_expand_bn[0][0]']
 (Activation)

 block2b_project_conv (Conv  (None, 56, 56, 64)           16384     ['block2
b_expand_activation[0]
 2D)                                                                [0]']

 block2b_project_bn (BatchN  (None, 56, 56, 64)           256       ['block2
b_project_conv[0][0]']
 ormalization)

 block2b_drop (Dropout)      (None, 56, 56, 64)           0         ['block2
b_project_bn[0][0]']

 block2b_add (Add)           (None, 56, 56, 64)           0         ['block2
b_drop[0][0]',
                                                                    'block2
a_project_bn[0][0]']

 block2c_expand_conv (Conv2  (None, 56, 56, 256)          147456    ['block2
b_add[0][0]']
 D)

 block2c_expand_bn (BatchNo  (None, 56, 56, 256)          1024      ['block2
c_expand_conv[0][0]']
 rmalization)

 block2c_expand_activation   (None, 56, 56, 256)          0         ['block2
c_expand_bn[0][0]']
 (Activation)

 block2c_project_conv (Conv  (None, 56, 56, 64)           16384     ['block2
c_expand_activation[0]
 2D)                                                                [0]']
```

```
 block2c_project_bn (BatchN  (None, 56, 56, 64)           256       ['block2
c_project_conv[0][0]']
 ormalization)

 block2c_drop (Dropout)      (None, 56, 56, 64)           0         ['block2
c_project_bn[0][0]']

 block2c_add (Add)           (None, 56, 56, 64)           0         ['block2
c_drop[0][0]',
                                                                    'block2
b_add[0][0]']

 block2d_expand_conv (Conv2  (None, 56, 56, 256)          147456    ['block2
c_add[0][0]']
 D)

 block2d_expand_bn (BatchNo  (None, 56, 56, 256)          1024      ['block2
d_expand_conv[0][0]']
 rmalization)

 block2d_expand_activation   (None, 56, 56, 256)          0         ['block2
d_expand_bn[0][0]']
 (Activation)

 block2d_project_conv (Conv  (None, 56, 56, 64)           16384     ['block2
d_expand_activation[0]
 2D)                                                                [0]']

 block2d_project_bn (BatchN  (None, 56, 56, 64)           256       ['block2
d_project_conv[0][0]']
 ormalization)

 block2d_drop (Dropout)      (None, 56, 56, 64)           0         ['block2
d_project_bn[0][0]']

 block2d_add (Add)           (None, 56, 56, 64)           0         ['block2
d_drop[0][0]',
                                                                    'block2
c_add[0][0]']

 block2e_expand_conv (Conv2  (None, 56, 56, 256)          147456    ['block2
d_add[0][0]']
 D)

 block2e_expand_bn (BatchNo  (None, 56, 56, 256)          1024      ['block2
e_expand_conv[0][0]']
 rmalization)

 block2e_expand_activation   (None, 56, 56, 256)          0         ['block2
e_expand_bn[0][0]']
 (Activation)

 block2e_project_conv (Conv  (None, 56, 56, 64)           16384     ['block2
e_expand_activation[0]
 2D)                                                                [0]']
```

```
 block2e_project_bn (BatchN  (None, 56, 56, 64)           256       ['block2
e_project_conv[0][0]']
 ormalization)

 block2e_drop (Dropout)      (None, 56, 56, 64)           0         ['block2
e_project_bn[0][0]']

 block2e_add (Add)           (None, 56, 56, 64)           0         ['block2
e_drop[0][0]',
                                                                   'block2
d_add[0][0]']

 block2f_expand_conv (Conv2  (None, 56, 56, 256)          147456    ['block2
e_add[0][0]']
 D)

 block2f_expand_bn (BatchNo  (None, 56, 56, 256)          1024      ['block2
f_expand_conv[0][0]']
 rmalization)

 block2f_expand_activation   (None, 56, 56, 256)          0         ['block2
f_expand_bn[0][0]']
 (Activation)

 block2f_project_conv (Conv  (None, 56, 56, 64)           16384     ['block2
f_expand_activation[0]
 2D)                                                               [0]']

 block2f_project_bn (BatchN  (None, 56, 56, 64)           256       ['block2
f_project_conv[0][0]']
 ormalization)

 block2f_drop (Dropout)      (None, 56, 56, 64)           0         ['block2
f_project_bn[0][0]']

 block2f_add (Add)           (None, 56, 56, 64)           0         ['block2
f_drop[0][0]',
                                                                   'block2
e_add[0][0]']

 block2g_expand_conv (Conv2  (None, 56, 56, 256)          147456    ['block2
f_add[0][0]']
 D)

 block2g_expand_bn (BatchNo  (None, 56, 56, 256)          1024      ['block2
g_expand_conv[0][0]']
 rmalization)

 block2g_expand_activation   (None, 56, 56, 256)          0         ['block2
g_expand_bn[0][0]']
 (Activation)

 block2g_project_conv (Conv  (None, 56, 56, 64)           16384     ['block2
g_expand_activation[0]
 2D)                                                               [0]']
```

```
 block2g_project_bn (BatchN  (None, 56, 56, 64)          256       ['block2
g_project_conv[0][0]']
 ormalization)

 block2g_drop (Dropout)      (None, 56, 56, 64)          0         ['block2
g_project_bn[0][0]']

 block2g_add (Add)           (None, 56, 56, 64)          0         ['block2
g_drop[0][0]',
                                                                   'block2
f_add[0][0]']

 block3a_expand_conv (Conv2  (None, 28, 28, 256)         147456    ['block2
g_add[0][0]']
 D)

 block3a_expand_bn (BatchNo  (None, 28, 28, 256)         1024      ['block3
a_expand_conv[0][0]']
 rmalization)

 block3a_expand_activation   (None, 28, 28, 256)         0         ['block3
a_expand_bn[0][0]']
 (Activation)

 block3a_project_conv (Conv  (None, 28, 28, 96)          24576     ['block3
a_expand_activation[0]
 2D)                                                               [0]']

 block3a_project_bn (BatchN  (None, 28, 28, 96)          384       ['block3
a_project_conv[0][0]']
 ormalization)

 block3b_expand_conv (Conv2  (None, 28, 28, 384)         331776    ['block3
a_project_bn[0][0]']
 D)

 block3b_expand_bn (BatchNo  (None, 28, 28, 384)         1536      ['block3
b_expand_conv[0][0]']
 rmalization)

 block3b_expand_activation   (None, 28, 28, 384)         0         ['block3
b_expand_bn[0][0]']
 (Activation)

 block3b_project_conv (Conv  (None, 28, 28, 96)          36864     ['block3
b_expand_activation[0]
 2D)                                                               [0]']

 block3b_project_bn (BatchN  (None, 28, 28, 96)          384       ['block3
b_project_conv[0][0]']
 ormalization)

 block3b_drop (Dropout)      (None, 28, 28, 96)          0         ['block3
b_project_bn[0][0]']

 block3b_add (Add)           (None, 28, 28, 96)          0         ['block3
```

```
b_drop[0][0]',
                                                                 'block3
a_project_bn[0][0]']

 block3c_expand_conv (Conv2  (None, 28, 28, 384)          331776    ['block3
b_add[0][0]']
 D)

 block3c_expand_bn (BatchNo  (None, 28, 28, 384)          1536      ['block3
c_expand_conv[0][0]']
 rmalization)

 block3c_expand_activation   (None, 28, 28, 384)          0         ['block3
c_expand_bn[0][0]']
 (Activation)

 block3c_project_conv (Conv  (None, 28, 28, 96)           36864     ['block3
c_expand_activation[0]
 2D)                                                               [0]']

 block3c_project_bn (BatchN  (None, 28, 28, 96)           384       ['block3
c_project_conv[0][0]']
 ormalization)

 block3c_drop (Dropout)      (None, 28, 28, 96)           0         ['block3
c_project_bn[0][0]']

 block3c_add (Add)           (None, 28, 28, 96)           0         ['block3
c_drop[0][0]',
                                                                  'block3
b_add[0][0]']

 block3d_expand_conv (Conv2  (None, 28, 28, 384)          331776    ['block3
c_add[0][0]']
 D)

 block3d_expand_bn (BatchNo  (None, 28, 28, 384)          1536      ['block3
d_expand_conv[0][0]']
 rmalization)

 block3d_expand_activation   (None, 28, 28, 384)          0         ['block3
d_expand_bn[0][0]']
 (Activation)

 block3d_project_conv (Conv  (None, 28, 28, 96)           36864     ['block3
d_expand_activation[0]
 2D)                                                               [0]']

 block3d_project_bn (BatchN  (None, 28, 28, 96)           384       ['block3
d_project_conv[0][0]']
 ormalization)

 block3d_drop (Dropout)      (None, 28, 28, 96)           0         ['block3
d_project_bn[0][0]']

 block3d_add (Add)           (None, 28, 28, 96)           0         ['block3
```

```
d_drop[0][0]',
                                                                 'block3
c_add[0][0]']

 block3e_expand_conv (Conv2  (None, 28, 28, 384)          331776    ['block3
d_add[0][0]']
 D)

 block3e_expand_bn (BatchNo  (None, 28, 28, 384)          1536      ['block3
e_expand_conv[0][0]']
 rmalization)

 block3e_expand_activation   (None, 28, 28, 384)          0         ['block3
e_expand_bn[0][0]']
 (Activation)

 block3e_project_conv (Conv  (None, 28, 28, 96)           36864     ['block3
e_expand_activation[0]
 2D)                                                               [0]']

 block3e_project_bn (BatchN  (None, 28, 28, 96)           384       ['block3
e_project_conv[0][0]']
 ormalization)

 block3e_drop (Dropout)      (None, 28, 28, 96)           0         ['block3
e_project_bn[0][0]']

 block3e_add (Add)           (None, 28, 28, 96)           0         ['block3
e_drop[0][0]',
                                                                  'block3
d_add[0][0]']

 block3f_expand_conv (Conv2  (None, 28, 28, 384)          331776    ['block3
e_add[0][0]']
 D)

 block3f_expand_bn (BatchNo  (None, 28, 28, 384)          1536      ['block3
f_expand_conv[0][0]']
 rmalization)

 block3f_expand_activation   (None, 28, 28, 384)          0         ['block3
f_expand_bn[0][0]']
 (Activation)

 block3f_project_conv (Conv  (None, 28, 28, 96)           36864     ['block3
f_expand_activation[0]
 2D)                                                               [0]']

 block3f_project_bn (BatchN  (None, 28, 28, 96)           384       ['block3
f_project_conv[0][0]']
 ormalization)

 block3f_drop (Dropout)      (None, 28, 28, 96)           0         ['block3
f_project_bn[0][0]']

 block3f_add (Add)           (None, 28, 28, 96)           0         ['block3
```

```
f_drop[0][0]',
                                                                 'block3
e_add[0][0]']

 block3g_expand_conv (Conv2  (None, 28, 28, 384)          331776    ['block3
f_add[0][0]']
 D)

 block3g_expand_bn (BatchNo  (None, 28, 28, 384)          1536      ['block3
g_expand_conv[0][0]']
 rmalization)

 block3g_expand_activation   (None, 28, 28, 384)          0         ['block3
g_expand_bn[0][0]']
 (Activation)

 block3g_project_conv (Conv  (None, 28, 28, 96)           36864     ['block3
g_expand_activation[0]
 2D)                                                               [0]']

 block3g_project_bn (BatchN  (None, 28, 28, 96)           384       ['block3
g_project_conv[0][0]']
 ormalization)

 block3g_drop (Dropout)      (None, 28, 28, 96)           0         ['block3
g_project_bn[0][0]']

 block3g_add (Add)           (None, 28, 28, 96)           0         ['block3
g_drop[0][0]',
                                                                 'block3
f_add[0][0]']

 block4a_expand_conv (Conv2  (None, 28, 28, 384)          36864     ['block3
g_add[0][0]']
 D)

 block4a_expand_bn (BatchNo  (None, 28, 28, 384)          1536      ['block4
a_expand_conv[0][0]']
 rmalization)

 block4a_expand_activation   (None, 28, 28, 384)          0         ['block4
a_expand_bn[0][0]']
 (Activation)

 block4a_dwconv2 (Depthwise  (None, 14, 14, 384)          3456      ['block4
a_expand_activation[0]
 Conv2D)                                                           [0]']

 block4a_bn (BatchNormaliza  (None, 14, 14, 384)          1536      ['block4
a_dwconv2[0][0]']
 tion)

 block4a_activation (Activa  (None, 14, 14, 384)          0         ['block4
a_bn[0][0]']
 tion)
```

```
 block4a_se_squeeze (Global  (None, 384)                0         ['block4
a_activation[0][0]']
 AveragePooling2D)

 block4a_se_reshape (Reshap  (None, 1, 1, 384)          0         ['block4
a_se_squeeze[0][0]']
 e)

 block4a_se_reduce (Conv2D)  (None, 1, 1, 24)           9240      ['block4
a_se_reshape[0][0]']

 block4a_se_expand (Conv2D)  (None, 1, 1, 384)          9600      ['block4
a_se_reduce[0][0]']

 block4a_se_excite (Multipl  (None, 14, 14, 384)        0         ['block4
a_activation[0][0]',
 y)                                                               'block4
a_se_expand[0][0]']

 block4a_project_conv (Conv  (None, 14, 14, 192)        73728     ['block4
a_se_excite[0][0]']
 2D)

 block4a_project_bn (BatchN  (None, 14, 14, 192)        768       ['block4
a_project_conv[0][0]']
 ormalization)

 block4b_expand_conv (Conv2  (None, 14, 14, 768)        147456    ['block4
a_project_bn[0][0]']
 D)

 block4b_expand_bn (BatchNo  (None, 14, 14, 768)        3072      ['block4
b_expand_conv[0][0]']
 rmalization)

 block4b_expand_activation   (None, 14, 14, 768)        0         ['block4
b_expand_bn[0][0]']
 (Activation)

 block4b_dwconv2 (Depthwise  (None, 14, 14, 768)        6912      ['block4
b_expand_activation[0]
 Conv2D)                                                          [0]']

 block4b_bn (BatchNormaliza  (None, 14, 14, 768)        3072      ['block4
b_dwconv2[0][0]']
 tion)

 block4b_activation (Activa  (None, 14, 14, 768)        0         ['block4
b_bn[0][0]']
 tion)

 block4b_se_squeeze (Global  (None, 768)                0         ['block4
b_activation[0][0]']
 AveragePooling2D)

 block4b_se_reshape (Reshap  (None, 1, 1, 768)          0         ['block4
```

```
b_se_squeeze[0][0']
 e)

 block4b_se_reduce (Conv2D)  (None, 1, 1, 48)             36912     ['block4
b_se_reshape[0][0']

 block4b_se_expand (Conv2D)  (None, 1, 1, 768)            37632     ['block4
b_se_reduce[0][0']

 block4b_se_excite (Multipl  (None, 14, 14, 768)          0         ['block4
b_activation[0][0]',
 y)                                                                  'block4
b_se_expand[0][0']

 block4b_project_conv (Conv  (None, 14, 14, 192)          147456    ['block4
b_se_excite[0][0']
 2D)

 block4b_project_bn (BatchN  (None, 14, 14, 192)          768       ['block4
b_project_conv[0][0']
 ormalization)

 block4b_drop (Dropout)      (None, 14, 14, 192)          0         ['block4
b_project_bn[0][0']

 block4b_add (Add)           (None, 14, 14, 192)          0         ['block4
b_drop[0][0]',
                                                                     'block4
a_project_bn[0][0']

 block4c_expand_conv (Conv2  (None, 14, 14, 768)          147456    ['block4
b_add[0][0']
 D)

 block4c_expand_bn (BatchNo  (None, 14, 14, 768)          3072      ['block4
c_expand_conv[0][0']
 rmalization)

 block4c_expand_activation   (None, 14, 14, 768)          0         ['block4
c_expand_bn[0][0']
 (Activation)

 block4c_dwconv2 (Depthwise  (None, 14, 14, 768)          6912      ['block4
c_expand_activation[0]
 Conv2D)                                                             [0]']

 block4c_bn (BatchNormaliza  (None, 14, 14, 768)          3072      ['block4
c_dwconv2[0][0']
 tion)

 block4c_activation (Activa  (None, 14, 14, 768)          0         ['block4
c_bn[0][0']
 tion)

 block4c_se_squeeze (Global  (None, 768)                  0         ['block4
c_activation[0][0']
```

```
 AveragePooling2D)

 block4c_se_reshape (Reshap  (None, 1, 1, 768)           0         ['block4
c_se_squeeze[0][0]']
 e)

 block4c_se_reduce (Conv2D)  (None, 1, 1, 48)            36912     ['block4
c_se_reshape[0][0]']

 block4c_se_expand (Conv2D)  (None, 1, 1, 768)           37632     ['block4
c_se_reduce[0][0]']

 block4c_se_excite (Multipl  (None, 14, 14, 768)         0         ['block4
c_activation[0][0]',
 y)                                                      'block4
c_se_expand[0][0]']

 block4c_project_conv (Conv  (None, 14, 14, 192)         147456    ['block4
c_se_excite[0][0]']
 2D)

 block4c_project_bn (BatchN  (None, 14, 14, 192)         768       ['block4
c_project_conv[0][0]']
 ormalization)

 block4c_drop (Dropout)      (None, 14, 14, 192)         0         ['block4
c_project_bn[0][0]']

 block4c_add (Add)           (None, 14, 14, 192)         0         ['block4
c_drop[0][0]',
                                                         'block4
b_add[0][0]']

 block4d_expand_conv (Conv2  (None, 14, 14, 768)         147456    ['block4
c_add[0][0]']
 D)

 block4d_expand_bn (BatchNo  (None, 14, 14, 768)         3072      ['block4
d_expand_conv[0][0]']
 rmalization)

 block4d_expand_activation   (None, 14, 14, 768)         0         ['block4
d_expand_bn[0][0]']
 (Activation)

 block4d_dwconv2 (Depthwise  (None, 14, 14, 768)         6912      ['block4
d_expand_activation[0]
 Conv2D)                                                 [0]']

 block4d_bn (BatchNormaliza  (None, 14, 14, 768)         3072      ['block4
d_dwconv2[0][0]']
 tion)

 block4d_activation (Activa  (None, 14, 14, 768)         0         ['block4
d_bn[0][0]']
 tion)
```

```
 block4d_se_squeeze (Global  (None, 768)                 0         ['block4
d_activation[0][0]']
 AveragePooling2D)

 block4d_se_reshape (Reshap  (None, 1, 1, 768)           0         ['block4
d_se_squeeze[0][0]']
 e)

 block4d_se_reduce (Conv2D)  (None, 1, 1, 48)            36912     ['block4
d_se_reshape[0][0]']

 block4d_se_expand (Conv2D)  (None, 1, 1, 768)           37632     ['block4
d_se_reduce[0][0]']

 block4d_se_excite (Multipl  (None, 14, 14, 768)         0         ['block4
d_activation[0][0]',
 y)                                                                  'block4
d_se_expand[0][0]']

 block4d_project_conv (Conv  (None, 14, 14, 192)         147456    ['block4
d_se_excite[0][0]']
 2D)

 block4d_project_bn (BatchN  (None, 14, 14, 192)         768       ['block4
d_project_conv[0][0]']
 ormalization)

 block4d_drop (Dropout)      (None, 14, 14, 192)         0         ['block4
d_project_bn[0][0]']

 block4d_add (Add)           (None, 14, 14, 192)         0         ['block4
d_drop[0][0]',
                                                                    'block4
c_add[0][0]']

 block4e_expand_conv (Conv2  (None, 14, 14, 768)         147456    ['block4
d_add[0][0]']
 D)

 block4e_expand_bn (BatchNo  (None, 14, 14, 768)         3072      ['block4
e_expand_conv[0][0]']
 rmalization)

 block4e_expand_activation   (None, 14, 14, 768)         0         ['block4
e_expand_bn[0][0]']
 (Activation)

 block4e_dwconv2 (Depthwise  (None, 14, 14, 768)         6912      ['block4
e_expand_activation[0]
 Conv2D)                                                            [0]']

 block4e_bn (BatchNormaliza  (None, 14, 14, 768)         3072      ['block4
e_dwconv2[0][0]']
 tion)
```

```
 block4e_activation (Activa  (None, 14, 14, 768)          0         ['block4
e_bn[0][0]']
 tion)

 block4e_se_squeeze (Global  (None, 768)                  0         ['block4
e_activation[0][0]']
 AveragePooling2D)

 block4e_se_reshape (Reshap  (None, 1, 1, 768)            0         ['block4
e_se_squeeze[0][0]']
 e)

 block4e_se_reduce (Conv2D)  (None, 1, 1, 48)             36912     ['block4
e_se_reshape[0][0]']

 block4e_se_expand (Conv2D)  (None, 1, 1, 768)            37632     ['block4
e_se_reduce[0][0]']

 block4e_se_excite (Multipl  (None, 14, 14, 768)          0         ['block4
e_activation[0][0]',
 y)                                                                  'block4
e_se_expand[0][0]']

 block4e_project_conv (Conv  (None, 14, 14, 192)          147456    ['block4
e_se_excite[0][0]']
 2D)

 block4e_project_bn (BatchN  (None, 14, 14, 192)          768       ['block4
e_project_conv[0][0]']
 ormalization)

 block4e_drop (Dropout)      (None, 14, 14, 192)          0         ['block4
e_project_bn[0][0]']

 block4e_add (Add)           (None, 14, 14, 192)          0         ['block4
e_drop[0][0]',
                                                                     'block4
d_add[0][0]']

 block4f_expand_conv (Conv2  (None, 14, 14, 768)          147456    ['block4
e_add[0][0]']
 D)

 block4f_expand_bn (BatchNo  (None, 14, 14, 768)          3072      ['block4
f_expand_conv[0][0]']
 rmalization)

 block4f_expand_activation   (None, 14, 14, 768)          0         ['block4
f_expand_bn[0][0]']
 (Activation)

 block4f_dwconv2 (Depthwise  (None, 14, 14, 768)          6912      ['block4
f_expand_activation[0]
 Conv2D)                                                             [0]']

 block4f_bn (BatchNormaliza  (None, 14, 14, 768)          3072      ['block4
```

```
f_dwconv2[0][0]']
 tion)

 block4f_activation (Activa  (None, 14, 14, 768)          0         ['block4
f_bn[0][0]']
 tion)

 block4f_se_squeeze (Global  (None, 768)                  0         ['block4
f_activation[0][0]']
 AveragePooling2D)

 block4f_se_reshape (Reshap  (None, 1, 1, 768)            0         ['block4
f_se_squeeze[0][0]']
 e)

 block4f_se_reduce (Conv2D)  (None, 1, 1, 48)             36912     ['block4
f_se_reshape[0][0]']

 block4f_se_expand (Conv2D)  (None, 1, 1, 768)            37632     ['block4
f_se_reduce[0][0]']

 block4f_se_excite (Multipl  (None, 14, 14, 768)          0         ['block4
f_activation[0][0]',
 y)                                                                  'block4
f_se_expand[0][0]']

 block4f_project_conv (Conv  (None, 14, 14, 192)          147456    ['block4
f_se_excite[0][0]']
 2D)

 block4f_project_bn (BatchN  (None, 14, 14, 192)          768       ['block4
f_project_conv[0][0]']
 ormalization)

 block4f_drop (Dropout)      (None, 14, 14, 192)          0         ['block4
f_project_bn[0][0]']

 block4f_add (Add)           (None, 14, 14, 192)          0         ['block4
f_drop[0][0]',
                                                                     'block4
e_add[0][0]']

 block4g_expand_conv (Conv2  (None, 14, 14, 768)          147456    ['block4
f_add[0][0]']
 D)

 block4g_expand_bn (BatchNo  (None, 14, 14, 768)          3072      ['block4
g_expand_conv[0][0]']
 rmalization)

 block4g_expand_activation   (None, 14, 14, 768)          0         ['block4
g_expand_bn[0][0]']
 (Activation)

 block4g_dwconv2 (Depthwise  (None, 14, 14, 768)          6912      ['block4
g_expand_activation[0]
```

```
 Conv2D)                                                          [0]']

 block4g_bn (BatchNormaliza  (None, 14, 14, 768)          3072      ['block4
g_dwconv2[0][0]']
 tion)

 block4g_activation (Activa  (None, 14, 14, 768)          0         ['block4
g_bn[0][0]']
 tion)

 block4g_se_squeeze (Global  (None, 768)                  0         ['block4
g_activation[0][0]']
 AveragePooling2D)

 block4g_se_reshape (Reshap  (None, 1, 1, 768)            0         ['block4
g_se_squeeze[0][0]']
 e)

 block4g_se_reduce (Conv2D)  (None, 1, 1, 48)             36912     ['block4
g_se_reshape[0][0]']

 block4g_se_expand (Conv2D)  (None, 1, 1, 768)            37632     ['block4
g_se_reduce[0][0]']

 block4g_se_excite (Multipl  (None, 14, 14, 768)          0         ['block4
g_activation[0][0]',
 y)                                                               'block4
g_se_expand[0][0]']

 block4g_project_conv (Conv  (None, 14, 14, 192)          147456    ['block4
g_se_excite[0][0]']
 2D)

 block4g_project_bn (BatchN  (None, 14, 14, 192)          768       ['block4
g_project_conv[0][0]']
 ormalization)

 block4g_drop (Dropout)      (None, 14, 14, 192)          0         ['block4
g_project_bn[0][0]']

 block4g_add (Add)           (None, 14, 14, 192)          0         ['block4
g_drop[0][0]',
                                                                  'block4
f_add[0][0]']

 block4h_expand_conv (Conv2  (None, 14, 14, 768)          147456    ['block4
g_add[0][0]']
 D)

 block4h_expand_bn (BatchNo  (None, 14, 14, 768)          3072      ['block4
h_expand_conv[0][0]']
 rmalization)

 block4h_expand_activation   (None, 14, 14, 768)          0         ['block4
h_expand_bn[0][0]']
 (Activation)
```

```
 block4h_dwconv2 (Depthwise  (None, 14, 14, 768)          6912      ['block4
h_expand_activation[0]
 Conv2D)                                                            [0]']

 block4h_bn (BatchNormaliza  (None, 14, 14, 768)          3072      ['block4
h_dwconv2[0][0]']
 tion)

 block4h_activation (Activa  (None, 14, 14, 768)          0         ['block4
h_bn[0][0]']
 tion)

 block4h_se_squeeze (Global  (None, 768)                  0         ['block4
h_activation[0][0]']
 AveragePooling2D)

 block4h_se_reshape (Reshap  (None, 1, 1, 768)            0         ['block4
h_se_squeeze[0][0]']
 e)

 block4h_se_reduce (Conv2D)  (None, 1, 1, 48)             36912     ['block4
h_se_reshape[0][0]']

 block4h_se_expand (Conv2D)  (None, 1, 1, 768)            37632     ['block4
h_se_reduce[0][0]']

 block4h_se_excite (Multipl  (None, 14, 14, 768)          0         ['block4
h_activation[0][0]',
 y)                                                                  'block4
h_se_expand[0][0]']

 block4h_project_conv (Conv  (None, 14, 14, 192)          147456    ['block4
h_se_excite[0][0]']
 2D)

 block4h_project_bn (BatchN  (None, 14, 14, 192)          768       ['block4
h_project_conv[0][0]']
 ormalization)

 block4h_drop (Dropout)      (None, 14, 14, 192)          0         ['block4
h_project_bn[0][0]']

 block4h_add (Add)           (None, 14, 14, 192)          0         ['block4
h_drop[0][0]',
                                                                     'block4
g_add[0][0]']

 block4i_expand_conv (Conv2  (None, 14, 14, 768)          147456    ['block4
h_add[0][0]']
 D)

 block4i_expand_bn (BatchNo  (None, 14, 14, 768)          3072      ['block4
i_expand_conv[0][0]']
 rmalization)
```

```
 block4i_expand_activation   (None, 14, 14, 768)          0         ['block4
i_expand_bn[0][0]']
 (Activation)

 block4i_dwconv2 (Depthwise  (None, 14, 14, 768)          6912      ['block4
i_expand_activation[0]
 Conv2D)                                                            [0]']

 block4i_bn (BatchNormaliza  (None, 14, 14, 768)          3072      ['block4
i_dwconv2[0][0]']
 tion)

 block4i_activation (Activa  (None, 14, 14, 768)          0         ['block4
i_bn[0][0]']
 tion)

 block4i_se_squeeze (Global  (None, 768)                  0         ['block4
i_activation[0][0]']
 AveragePooling2D)

 block4i_se_reshape (Reshap  (None, 1, 1, 768)            0         ['block4
i_se_squeeze[0][0]']
 e)

 block4i_se_reduce (Conv2D)  (None, 1, 1, 48)             36912     ['block4
i_se_reshape[0][0]']

 block4i_se_expand (Conv2D)  (None, 1, 1, 768)            37632     ['block4
i_se_reduce[0][0]']

 block4i_se_excite (Multipl  (None, 14, 14, 768)          0         ['block4
i_activation[0][0]',
 y)                                                                  'block4
i_se_expand[0][0]']

 block4i_project_conv (Conv  (None, 14, 14, 192)          147456    ['block4
i_se_excite[0][0]']
 2D)

 block4i_project_bn (BatchN  (None, 14, 14, 192)          768       ['block4
i_project_conv[0][0]']
 ormalization)

 block4i_drop (Dropout)      (None, 14, 14, 192)          0         ['block4
i_project_bn[0][0]']

 block4i_add (Add)           (None, 14, 14, 192)          0         ['block4
i_drop[0][0]',
                                                                     'block4
h_add[0][0]']

 block4j_expand_conv (Conv2  (None, 14, 14, 768)          147456    ['block4
i_add[0][0]']
 D)

 block4j_expand_bn (BatchNo  (None, 14, 14, 768)          3072      ['block4
```

```
j_expand_conv[0][0]']
 rmalization)

 block4j_expand_activation   (None, 14, 14, 768)          0         ['block4
j_expand_bn[0][0]']
 (Activation)

 block4j_dwconv2 (Depthwise  (None, 14, 14, 768)          6912      ['block4
j_expand_activation[0]
 Conv2D)                                                            [0]']

 block4j_bn (BatchNormaliza  (None, 14, 14, 768)          3072      ['block4
j_dwconv2[0][0]']
 tion)

 block4j_activation (Activa  (None, 14, 14, 768)          0         ['block4
j_bn[0][0]']
 tion)

 block4j_se_squeeze (Global  (None, 768)                  0         ['block4
j_activation[0][0]']
 AveragePooling2D)

 block4j_se_reshape (Reshap  (None, 1, 1, 768)            0         ['block4
j_se_squeeze[0][0]']
 e)

 block4j_se_reduce (Conv2D)  (None, 1, 1, 48)             36912     ['block4
j_se_reshape[0][0]']

 block4j_se_expand (Conv2D)  (None, 1, 1, 768)            37632     ['block4
j_se_reduce[0][0]']

 block4j_se_excite (Multipl  (None, 14, 14, 768)          0         ['block4
j_activation[0][0]',
 y)                                                                  'block4
j_se_expand[0][0]']

 block4j_project_conv (Conv  (None, 14, 14, 192)          147456    ['block4
j_se_excite[0][0]']
 2D)

 block4j_project_bn (BatchN  (None, 14, 14, 192)          768       ['block4
j_project_conv[0][0]']
 ormalization)

 block4j_drop (Dropout)      (None, 14, 14, 192)          0         ['block4
j_project_bn[0][0]']

 block4j_add (Add)           (None, 14, 14, 192)          0         ['block4
j_drop[0][0]',
                                                                     'block4
i_add[0][0]']

 block5a_expand_conv (Conv2  (None, 14, 14, 1152)         221184    ['block4
j_add[0][0]']
```

```
 D)

 block5a_expand_bn (BatchNo  (None, 14, 14, 1152)         4608      ['block5
a_expand_conv[0][0]']
 rmalization)

 block5a_expand_activation   (None, 14, 14, 1152)         0         ['block5
a_expand_bn[0][0]']
 (Activation)

 block5a_dwconv2 (Depthwise  (None, 14, 14, 1152)         10368     ['block5
a_expand_activation[0]
 Conv2D)                                                            [0]']

 block5a_bn (BatchNormaliza  (None, 14, 14, 1152)         4608      ['block5
a_dwconv2[0][0]']
 tion)

 block5a_activation (Activa  (None, 14, 14, 1152)         0         ['block5
a_bn[0][0]']
 tion)

 block5a_se_squeeze (Global  (None, 1152)                 0         ['block5
a_activation[0][0]']
 AveragePooling2D)

 block5a_se_reshape (Reshap  (None, 1, 1, 1152)           0         ['block5
a_se_squeeze[0][0]']
 e)

 block5a_se_reduce (Conv2D)  (None, 1, 1, 48)             55344     ['block5
a_se_reshape[0][0]']

 block5a_se_expand (Conv2D)  (None, 1, 1, 1152)           56448     ['block5
a_se_reduce[0][0]']

 block5a_se_excite (Multipl  (None, 14, 14, 1152)         0         ['block5
a_activation[0][0]',
 y)                                                                  'block5
a_se_expand[0][0]']

 block5a_project_conv (Conv  (None, 14, 14, 224)          258048    ['block5
a_se_excite[0][0]']
 2D)

 block5a_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
a_project_conv[0][0]']
 ormalization)

 block5b_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
a_project_bn[0][0]']
 D)

 block5b_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block5
b_expand_conv[0][0]']
 rmalization)
```

```
 block5b_expand_activation   (None, 14, 14, 1344)         0         ['block5
b_expand_bn[0][0]']
 (Activation)

 block5b_dwconv2 (Depthwise  (None, 14, 14, 1344)         12096     ['block5
b_expand_activation[0]
 Conv2D)                                                             [0]']

 block5b_bn (BatchNormaliza  (None, 14, 14, 1344)         5376      ['block5
b_dwconv2[0][0]']
 tion)

 block5b_activation (Activa  (None, 14, 14, 1344)         0         ['block5
b_bn[0][0]']
 tion)

 block5b_se_squeeze (Global  (None, 1344)                 0         ['block5
b_activation[0][0]']
 AveragePooling2D)

 block5b_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
b_se_squeeze[0][0]']
 e)

 block5b_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
b_se_reshape[0][0]']

 block5b_se_expand (Conv2D)  (None, 1, 1, 1344)           76608     ['block5
b_se_reduce[0][0]']

 block5b_se_excite (Multipl  (None, 14, 14, 1344)         0         ['block5
b_activation[0][0]',
 y)                                                                   'block5
b_se_expand[0][0]']

 block5b_project_conv (Conv  (None, 14, 14, 224)          301056    ['block5
b_se_excite[0][0]']
 2D)

 block5b_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
b_project_conv[0][0]']
 ormalization)

 block5b_drop (Dropout)      (None, 14, 14, 224)          0         ['block5
b_project_bn[0][0]']

 block5b_add (Add)           (None, 14, 14, 224)          0         ['block5
b_drop[0][0]',
                                                                     'block5
a_project_bn[0][0]']

 block5c_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
b_add[0][0]']
 D)
```

```
 block5c_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block5
c_expand_conv[0][0]']
 rmalization)

 block5c_expand_activation   (None, 14, 14, 1344)         0         ['block5
c_expand_bn[0][0]']
 (Activation)

 block5c_dwconv2 (Depthwise  (None, 14, 14, 1344)         12096     ['block5
c_expand_activation[0]
 Conv2D)                                                             [0]']

 block5c_bn (BatchNormaliza  (None, 14, 14, 1344)         5376      ['block5
c_dwconv2[0][0]']
 tion)

 block5c_activation (Activa  (None, 14, 14, 1344)         0         ['block5
c_bn[0][0]']
 tion)

 block5c_se_squeeze (Global  (None, 1344)                 0         ['block5
c_activation[0][0]']
 AveragePooling2D)

 block5c_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
c_se_squeeze[0][0]']
 e)

 block5c_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
c_se_reshape[0][0]']

 block5c_se_expand (Conv2D)  (None, 1, 1, 1344)           76608     ['block5
c_se_reduce[0][0]']

 block5c_se_excite (Multipl  (None, 14, 14, 1344)         0         ['block5
c_activation[0][0]',
 y)                                                                  'block5
c_se_expand[0][0]']

 block5c_project_conv (Conv  (None, 14, 14, 224)          301056    ['block5
c_se_excite[0][0]']
 2D)

 block5c_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
c_project_conv[0][0]']
 ormalization)

 block5c_drop (Dropout)      (None, 14, 14, 224)          0         ['block5
c_project_bn[0][0]']

 block5c_add (Add)           (None, 14, 14, 224)          0         ['block5
c_drop[0][0]',
                                                                     'block5
b_add[0][0]']

 block5d_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
```

```
c_add[0][0']
 D)

 block5d_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block5
d_expand_conv[0][0']
 rmalization)

 block5d_expand_activation   (None, 14, 14, 1344)         0         ['block5
d_expand_bn[0][0']
 (Activation)

 block5d_dwconv2 (Depthwise  (None, 14, 14, 1344)         12096     ['block5
d_expand_activation[0]
 Conv2D)                                                            [0]']

 block5d_bn (BatchNormaliza  (None, 14, 14, 1344)         5376      ['block5
d_dwconv2[0][0']
 tion)

 block5d_activation (Activa  (None, 14, 14, 1344)         0         ['block5
d_bn[0][0']
 tion)

 block5d_se_squeeze (Global  (None, 1344)                 0         ['block5
d_activation[0][0']
 AveragePooling2D)

 block5d_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
d_se_squeeze[0][0']
 e)

 block5d_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
d_se_reshape[0][0']

 block5d_se_expand (Conv2D)  (None, 1, 1, 1344)           76608     ['block5
d_se_reduce[0][0']

 block5d_se_excite (Multipl  (None, 14, 14, 1344)         0         ['block5
d_activation[0][0',
 y)                                                                  'block5
d_se_expand[0][0']

 block5d_project_conv (Conv  (None, 14, 14, 224)          301056    ['block5
d_se_excite[0][0']
 2D)

 block5d_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
d_project_conv[0][0']
 ormalization)

 block5d_drop (Dropout)      (None, 14, 14, 224)          0         ['block5
d_project_bn[0][0']

 block5d_add (Add)           (None, 14, 14, 224)          0         ['block5
d_drop[0][0',
                                                                    'block5
```

```
c_add[0][0']

 block5e_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
d_add[0][0']
 D)

 block5e_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block5
e_expand_conv[0][0']
 rmalization)

 block5e_expand_activation   (None, 14, 14, 1344)         0         ['block5
e_expand_bn[0][0']
 (Activation)

 block5e_dwconv2 (Depthwise  (None, 14, 14, 1344)         12096     ['block5
e_expand_activation[0]
 Conv2D)                                                           [0]']

 block5e_bn (BatchNormaliza  (None, 14, 14, 1344)         5376      ['block5
e_dwconv2[0][0']
 tion)

 block5e_activation (Activa  (None, 14, 14, 1344)         0         ['block5
e_bn[0][0']
 tion)

 block5e_se_squeeze (Global  (None, 1344)                 0         ['block5
e_activation[0][0']
 AveragePooling2D)

 block5e_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
e_se_squeeze[0][0']
 e)

 block5e_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
e_se_reshape[0][0']

 block5e_se_expand (Conv2D)  (None, 1, 1, 1344)           76608     ['block5
e_se_reduce[0][0']

 block5e_se_excite (Multipl  (None, 14, 14, 1344)         0         ['block5
e_activation[0][0',
 y)                                                                 'block5
e_se_expand[0][0']

 block5e_project_conv (Conv  (None, 14, 14, 224)          301056    ['block5
e_se_excite[0][0']
 2D)

 block5e_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
e_project_conv[0][0']
 ormalization)

 block5e_drop (Dropout)      (None, 14, 14, 224)          0         ['block5
e_project_bn[0][0']
```

```
 block5e_add (Add)           (None, 14, 14, 224)          0         ['block5
e_drop[0][0]',
                                                                     'block5
d_add[0][0]']

 block5f_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
e_add[0][0]']
 D)

 block5f_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block5
f_expand_conv[0][0]']
 rmalization)

 block5f_expand_activation   (None, 14, 14, 1344)         0         ['block5
f_expand_bn[0][0]']
 (Activation)

 block5f_dwconv2 (Depthwise  (None, 14, 14, 1344)         12096     ['block5
f_expand_activation[0]
 Conv2D)                                                             [0]']

 block5f_bn (BatchNormaliza  (None, 14, 14, 1344)         5376      ['block5
f_dwconv2[0][0]']
 tion)

 block5f_activation (Activa  (None, 14, 14, 1344)         0         ['block5
f_bn[0][0]']
 tion)

 block5f_se_squeeze (Global  (None, 1344)                 0         ['block5
f_activation[0][0]']
 AveragePooling2D)

 block5f_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
f_se_squeeze[0][0]']
 e)

 block5f_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
f_se_reshape[0][0]']

 block5f_se_expand (Conv2D)  (None, 1, 1, 1344)           76608     ['block5
f_se_reduce[0][0]']

 block5f_se_excite (Multipl  (None, 14, 14, 1344)         0         ['block5
f_activation[0][0]',
 y)                                                                  'block5
f_se_expand[0][0]']

 block5f_project_conv (Conv  (None, 14, 14, 224)          301056    ['block5
f_se_excite[0][0]']
 2D)

 block5f_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
f_project_conv[0][0]']
 ormalization)
```

```
 block5f_drop (Dropout)      (None, 14, 14, 224)          0         ['block5
f_project_bn[0][0]']

 block5f_add (Add)           (None, 14, 14, 224)          0         ['block5
f_drop[0][0]',
                                                                     'block5
e_add[0][0]']

 block5g_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
f_add[0][0]']
 D)

 block5g_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block5
g_expand_conv[0][0]']
 rmalization)

 block5g_expand_activation   (None, 14, 14, 1344)         0         ['block5
g_expand_bn[0][0]']
 (Activation)

 block5g_dwconv2 (Depthwise  (None, 14, 14, 1344)         12096     ['block5
g_expand_activation[0]
 Conv2D)                                                             [0]']

 block5g_bn (BatchNormaliza  (None, 14, 14, 1344)         5376      ['block5
g_dwconv2[0][0]']
 tion)

 block5g_activation (Activa  (None, 14, 14, 1344)         0         ['block5
g_bn[0][0]']
 tion)

 block5g_se_squeeze (Global  (None, 1344)                 0         ['block5
g_activation[0][0]']
 AveragePooling2D)

 block5g_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
g_se_squeeze[0][0]']
 e)

 block5g_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
g_se_reshape[0][0]']

 block5g_se_expand (Conv2D)  (None, 1, 1, 1344)           76608     ['block5
g_se_reduce[0][0]']

 block5g_se_excite (Multipl  (None, 14, 14, 1344)         0         ['block5
g_activation[0][0]',
 y)                                                                  'block5
g_se_expand[0][0]']

 block5g_project_conv (Conv  (None, 14, 14, 224)          301056    ['block5
g_se_excite[0][0]']
 2D)

 block5g_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
```

```
g_project_conv[0][0']
 ormalization)

 block5g_drop (Dropout)      (None, 14, 14, 224)          0         ['block5
g_project_bn[0][0']

 block5g_add (Add)           (None, 14, 14, 224)          0         ['block5
g_drop[0][0',
                                                                    'block5
f_add[0][0']

 block5h_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
g_add[0][0']
 D)

 block5h_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block5
h_expand_conv[0][0']
 rmalization)

 block5h_expand_activation   (None, 14, 14, 1344)         0         ['block5
h_expand_bn[0][0']
 (Activation)

 block5h_dwconv2 (Depthwise  (None, 14, 14, 1344)         12096     ['block5
h_expand_activation[0]
 Conv2D)                                                            [0]']

 block5h_bn (BatchNormaliza  (None, 14, 14, 1344)         5376      ['block5
h_dwconv2[0][0']
 tion)

 block5h_activation (Activa  (None, 14, 14, 1344)         0         ['block5
h_bn[0][0']
 tion)

 block5h_se_squeeze (Global  (None, 1344)                 0         ['block5
h_activation[0][0']
 AveragePooling2D)

 block5h_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
h_se_squeeze[0][0']
 e)

 block5h_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
h_se_reshape[0][0']

 block5h_se_expand (Conv2D)  (None, 1, 1, 1344)           76608     ['block5
h_se_reduce[0][0']

 block5h_se_excite (Multipl  (None, 14, 14, 1344)         0         ['block5
h_activation[0][0']
 y)                                                                 'block5
h_se_expand[0][0']

 block5h_project_conv (Conv  (None, 14, 14, 224)          301056    ['block5
h_se_excite[0][0']
```

```
 2D)

 block5h_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
h_project_conv[0][0]']
 ormalization)

 block5h_drop (Dropout)      (None, 14, 14, 224)          0         ['block5
h_project_bn[0][0]']

 block5h_add (Add)           (None, 14, 14, 224)          0         ['block5
h_drop[0][0]',
                                                                    'block5
g_add[0][0]']

 block5i_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
h_add[0][0]']
 D)

 block5i_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block5
i_expand_conv[0][0]']
 rmalization)

 block5i_expand_activation   (None, 14, 14, 1344)         0         ['block5
i_expand_bn[0][0]']
 (Activation)

 block5i_dwconv2 (Depthwise  (None, 14, 14, 1344)         12096     ['block5
i_expand_activation[0]
 Conv2D)                                                            [0]']

 block5i_bn (BatchNormaliza  (None, 14, 14, 1344)         5376      ['block5
i_dwconv2[0][0]']
 tion)

 block5i_activation (Activa  (None, 14, 14, 1344)         0         ['block5
i_bn[0][0]']
 tion)

 block5i_se_squeeze (Global  (None, 1344)                 0         ['block5
i_activation[0][0]']
 AveragePooling2D)

 block5i_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
i_se_squeeze[0][0]']
 e)

 block5i_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
i_se_reshape[0][0]']

 block5i_se_expand (Conv2D)  (None, 1, 1, 1344)           76608     ['block5
i_se_reduce[0][0]']

 block5i_se_excite (Multipl  (None, 14, 14, 1344)         0         ['block5
i_activation[0][0]',
 y)                                                                 'block5
i_se_expand[0][0]']
```

```
 block5i_project_conv (Conv  (None, 14, 14, 224)          301056    ['block5
i_se_excite[0][0]']
 2D)

 block5i_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
i_project_conv[0][0]']
 ormalization)

 block5i_drop (Dropout)      (None, 14, 14, 224)          0         ['block5
i_project_bn[0][0]']

 block5i_add (Add)           (None, 14, 14, 224)          0         ['block5
i_drop[0][0]',
                                                                     'block5
h_add[0][0]']

 block5j_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
i_add[0][0]']
 D)

 block5j_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block5
j_expand_conv[0][0]']
 rmalization)

 block5j_expand_activation   (None, 14, 14, 1344)         0         ['block5
j_expand_bn[0][0]']
 (Activation)

 block5j_dwconv2 (Depthwise  (None, 14, 14, 1344)         12096     ['block5
j_expand_activation[0]
 Conv2D)                                                             [0]']

 block5j_bn (BatchNormaliza  (None, 14, 14, 1344)         5376      ['block5
j_dwconv2[0][0]']
 tion)

 block5j_activation (Activa  (None, 14, 14, 1344)         0         ['block5
j_bn[0][0]']
 tion)

 block5j_se_squeeze (Global  (None, 1344)                 0         ['block5
j_activation[0][0]']
 AveragePooling2D)

 block5j_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
j_se_squeeze[0][0]']
 e)

 block5j_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
j_se_reshape[0][0]']

 block5j_se_expand (Conv2D)  (None, 1, 1, 1344)           76608     ['block5
j_se_reduce[0][0]']

 block5j_se_excite (Multipl  (None, 14, 14, 1344)         0         ['block5
```

```
j_activation[0][0]',
 y)                                                              'block5
j_se_expand[0][0]']

 block5j_project_conv (Conv  (None, 14, 14, 224)          301056    ['block5
j_se_excite[0][0]']
 2D)

 block5j_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
j_project_conv[0][0]']
 ormalization)

 block5j_drop (Dropout)      (None, 14, 14, 224)          0         ['block5
j_project_bn[0][0]']

 block5j_add (Add)           (None, 14, 14, 224)          0         ['block5
j_drop[0][0]',
                                                                  'block5
i_add[0][0]']

 block5k_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
j_add[0][0]']
 D)

 block5k_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block5
k_expand_conv[0][0]']
 rmalization)

 block5k_expand_activation   (None, 14, 14, 1344)         0         ['block5
k_expand_bn[0][0]']
 (Activation)

 block5k_dwconv2 (Depthwise  (None, 14, 14, 1344)         12096     ['block5
k_expand_activation[0]
 Conv2D)                                                          [0]']

 block5k_bn (BatchNormaliza  (None, 14, 14, 1344)         5376      ['block5
k_dwconv2[0][0]']
 tion)

 block5k_activation (Activa  (None, 14, 14, 1344)         0         ['block5
k_bn[0][0]']
 tion)

 block5k_se_squeeze (Global  (None, 1344)                 0         ['block5
k_activation[0][0]']
 AveragePooling2D)

 block5k_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
k_se_squeeze[0][0]']
 e)

 block5k_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
k_se_reshape[0][0]']

 block5k_se_expand (Conv2D)  (None, 1, 1, 1344)           76608     ['block5
```

```
k_se_reduce[0][0]']

 block5k_se_excite (Multipl  (None, 14, 14, 1344)         0         ['block5
k_activation[0][0]',
 y)                                                                  'block5
k_se_expand[0][0]']

 block5k_project_conv (Conv  (None, 14, 14, 224)          301056    ['block5
k_se_excite[0][0]']
 2D)

 block5k_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
k_project_conv[0][0]']
 ormalization)

 block5k_drop (Dropout)      (None, 14, 14, 224)          0         ['block5
k_project_bn[0][0]']

 block5k_add (Add)           (None, 14, 14, 224)          0         ['block5
k_drop[0][0]',
                                                                     'block5
j_add[0][0]']

 block5l_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
k_add[0][0]']
 D)

 block5l_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block5
l_expand_conv[0][0]']
 rmalization)

 block5l_expand_activation   (None, 14, 14, 1344)         0         ['block5
l_expand_bn[0][0]']
 (Activation)

 block5l_dwconv2 (Depthwise  (None, 14, 14, 1344)         12096     ['block5
l_expand_activation[0]
 Conv2D)                                                             [0]']

 block5l_bn (BatchNormaliza  (None, 14, 14, 1344)         5376      ['block5
l_dwconv2[0][0]']
 tion)

 block5l_activation (Activa  (None, 14, 14, 1344)         0         ['block5
l_bn[0][0]']
 tion)

 block5l_se_squeeze (Global  (None, 1344)                 0         ['block5
l_activation[0][0]']
 AveragePooling2D)

 block5l_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
l_se_squeeze[0][0]']
 e)

 block5l_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
```

```
l_se_reshape[0][0']

 block5l_se_expand (Conv2D)  (None, 1, 1, 1344)          76608     ['block5
l_se_reduce[0][0']

 block5l_se_excite (Multipl  (None, 14, 14, 1344)        0         ['block5
l_activation[0][0',
 y)                                                                  'block5
l_se_expand[0][0']

 block5l_project_conv (Conv  (None, 14, 14, 224)         301056    ['block5
l_se_excite[0][0']
 2D)

 block5l_project_bn (BatchN  (None, 14, 14, 224)         896       ['block5
l_project_conv[0][0']
 ormalization)

 block5l_drop (Dropout)      (None, 14, 14, 224)         0         ['block5
l_project_bn[0][0']

 block5l_add (Add)           (None, 14, 14, 224)         0         ['block5
l_drop[0][0',
                                                                    'block5
k_add[0][0']

 block5m_expand_conv (Conv2  (None, 14, 14, 1344)        301056    ['block5
l_add[0][0']
 D)

 block5m_expand_bn (BatchNo  (None, 14, 14, 1344)        5376      ['block5
m_expand_conv[0][0']
 rmalization)

 block5m_expand_activation   (None, 14, 14, 1344)        0         ['block5
m_expand_bn[0][0']
 (Activation)

 block5m_dwconv2 (Depthwise  (None, 14, 14, 1344)        12096     ['block5
m_expand_activation[0]
 Conv2D)                                                            [0]']

 block5m_bn (BatchNormaliza  (None, 14, 14, 1344)        5376      ['block5
m_dwconv2[0][0']
 tion)

 block5m_activation (Activa  (None, 14, 14, 1344)        0         ['block5
m_bn[0][0']
 tion)

 block5m_se_squeeze (Global  (None, 1344)                0         ['block5
m_activation[0][0']
 AveragePooling2D)

 block5m_se_reshape (Reshap  (None, 1, 1, 1344)          0         ['block5
m_se_squeeze[0][0']
```

```
 e)

 block5m_se_reduce (Conv2D)  (None, 1, 1, 56)            75320     ['block5
m_se_reshape[0][0]']

 block5m_se_expand (Conv2D)  (None, 1, 1, 1344)          76608     ['block5
m_se_reduce[0][0]']

 block5m_se_excite (Multipl  (None, 14, 14, 1344)        0         ['block5
m_activation[0][0]',
 y)                                                                  'block5
m_se_expand[0][0]']

 block5m_project_conv (Conv  (None, 14, 14, 224)         301056    ['block5
m_se_excite[0][0]']
 2D)

 block5m_project_bn (BatchN  (None, 14, 14, 224)         896       ['block5
m_project_conv[0][0]']
 ormalization)

 block5m_drop (Dropout)      (None, 14, 14, 224)         0         ['block5
m_project_bn[0][0]']

 block5m_add (Add)           (None, 14, 14, 224)         0         ['block5
m_drop[0][0]',
                                                                    'block5
l_add[0][0]']

 block5n_expand_conv (Conv2  (None, 14, 14, 1344)        301056    ['block5
m_add[0][0]']
 D)

 block5n_expand_bn (BatchNo  (None, 14, 14, 1344)        5376      ['block5
n_expand_conv[0][0]']
 rmalization)

 block5n_expand_activation   (None, 14, 14, 1344)        0         ['block5
n_expand_bn[0][0]']
 (Activation)

 block5n_dwconv2 (Depthwise  (None, 14, 14, 1344)        12096     ['block5
n_expand_activation[0]
 Conv2D)                                                            [0]']

 block5n_bn (BatchNormaliza  (None, 14, 14, 1344)        5376      ['block5
n_dwconv2[0][0]']
 tion)

 block5n_activation (Activa  (None, 14, 14, 1344)        0         ['block5
n_bn[0][0]']
 tion)

 block5n_se_squeeze (Global  (None, 1344)                0         ['block5
n_activation[0][0]']
 AveragePooling2D)
```

```
 block5n_se_reshape (Reshap  (None, 1, 1, 1344)          0         ['block5
n_se_squeeze[0][0]']
 e)

 block5n_se_reduce (Conv2D)  (None, 1, 1, 56)            75320     ['block5
n_se_reshape[0][0]']

 block5n_se_expand (Conv2D)  (None, 1, 1, 1344)          76608     ['block5
n_se_reduce[0][0]']

 block5n_se_excite (Multipl  (None, 14, 14, 1344)        0         ['block5
n_activation[0][0]',
 y)                                                                  'block5
n_se_expand[0][0]']

 block5n_project_conv (Conv  (None, 14, 14, 224)         301056    ['block5
n_se_excite[0][0]']
 2D)

 block5n_project_bn (BatchN  (None, 14, 14, 224)         896       ['block5
n_project_conv[0][0]']
 ormalization)

 block5n_drop (Dropout)      (None, 14, 14, 224)         0         ['block5
n_project_bn[0][0]']

 block5n_add (Add)           (None, 14, 14, 224)         0         ['block5
n_drop[0][0]',
                                                                    'block5
m_add[0][0]']

 block5o_expand_conv (Conv2  (None, 14, 14, 1344)        301056    ['block5
n_add[0][0]']
 D)

 block5o_expand_bn (BatchNo  (None, 14, 14, 1344)        5376      ['block5
o_expand_conv[0][0]']
 rmalization)

 block5o_expand_activation   (None, 14, 14, 1344)        0         ['block5
o_expand_bn[0][0]']
 (Activation)

 block5o_dwconv2 (Depthwise  (None, 14, 14, 1344)        12096     ['block5
o_expand_activation[0]
 Conv2D)                                                            [0]']

 block5o_bn (BatchNormaliza  (None, 14, 14, 1344)        5376      ['block5
o_dwconv2[0][0]']
 tion)

 block5o_activation (Activa  (None, 14, 14, 1344)        0         ['block5
o_bn[0][0]']
 tion)
```

```
 block5o_se_squeeze (Global  (None, 1344)                0         ['block5
o_activation[0][0]']
 AveragePooling2D)

 block5o_se_reshape (Reshap  (None, 1, 1, 1344)          0         ['block5
o_se_squeeze[0][0]']
 e)

 block5o_se_reduce (Conv2D)  (None, 1, 1, 56)            75320     ['block5
o_se_reshape[0][0]']

 block5o_se_expand (Conv2D)  (None, 1, 1, 1344)          76608     ['block5
o_se_reduce[0][0]']

 block5o_se_excite (Multipl  (None, 14, 14, 1344)        0         ['block5
o_activation[0][0]',
 y)                                                                  'block5
o_se_expand[0][0]']

 block5o_project_conv (Conv  (None, 14, 14, 224)         301056    ['block5
o_se_excite[0][0]']
 2D)

 block5o_project_bn (BatchN  (None, 14, 14, 224)         896       ['block5
o_project_conv[0][0]']
 ormalization)

 block5o_drop (Dropout)      (None, 14, 14, 224)         0         ['block5
o_project_bn[0][0]']

 block5o_add (Add)           (None, 14, 14, 224)         0         ['block5
o_drop[0][0]',
                                                                    'block5
n_add[0][0]']

 block5p_expand_conv (Conv2  (None, 14, 14, 1344)        301056    ['block5
o_add[0][0]']
 D)

 block5p_expand_bn (BatchNo  (None, 14, 14, 1344)        5376      ['block5
p_expand_conv[0][0]']
 rmalization)

 block5p_expand_activation   (None, 14, 14, 1344)        0         ['block5
p_expand_bn[0][0]']
 (Activation)

 block5p_dwconv2 (Depthwise  (None, 14, 14, 1344)        12096     ['block5
p_expand_activation[0]
 Conv2D)                                                            [0]']

 block5p_bn (BatchNormaliza  (None, 14, 14, 1344)        5376      ['block5
p_dwconv2[0][0]']
 tion)

 block5p_activation (Activa  (None, 14, 14, 1344)        0         ['block5
```

```
p_bn[0][0]']
 tion)

 block5p_se_squeeze (Global  (None, 1344)                0         ['block5
p_activation[0][0]']
 AveragePooling2D)

 block5p_se_reshape (Reshap  (None, 1, 1, 1344)          0         ['block5
p_se_squeeze[0][0]']
 e)

 block5p_se_reduce (Conv2D)  (None, 1, 1, 56)            75320     ['block5
p_se_reshape[0][0]']

 block5p_se_expand (Conv2D)  (None, 1, 1, 1344)          76608     ['block5
p_se_reduce[0][0]']

 block5p_se_excite (Multipl  (None, 14, 14, 1344)        0         ['block5
p_activation[0][0]',
 y)                                                                  'block5
p_se_expand[0][0]']

 block5p_project_conv (Conv  (None, 14, 14, 224)         301056    ['block5
p_se_excite[0][0]']
 2D)

 block5p_project_bn (BatchN  (None, 14, 14, 224)         896       ['block5
p_project_conv[0][0]']
 ormalization)

 block5p_drop (Dropout)      (None, 14, 14, 224)         0         ['block5
p_project_bn[0][0]']

 block5p_add (Add)           (None, 14, 14, 224)         0         ['block5
p_drop[0][0]',
                                                                    'block5
o_add[0][0]']

 block5q_expand_conv (Conv2  (None, 14, 14, 1344)        301056    ['block5
p_add[0][0]']
 D)

 block5q_expand_bn (BatchNo  (None, 14, 14, 1344)        5376      ['block5
q_expand_conv[0][0]']
 rmalization)

 block5q_expand_activation   (None, 14, 14, 1344)        0         ['block5
q_expand_bn[0][0]']
 (Activation)

 block5q_dwconv2 (Depthwise  (None, 14, 14, 1344)        12096     ['block5
q_expand_activation[0]
 Conv2D)                                                            [0]']

 block5q_bn (BatchNormaliza  (None, 14, 14, 1344)        5376      ['block5
q_dwconv2[0][0]']
```

```
 tion)

 block5q_activation (Activa  (None, 14, 14, 1344)         0         ['block5
q_bn[0][0]']
 tion)

 block5q_se_squeeze (Global  (None, 1344)                 0         ['block5
q_activation[0][0]']
 AveragePooling2D)

 block5q_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
q_se_squeeze[0][0]']
 e)

 block5q_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
q_se_reshape[0][0]']

 block5q_se_expand (Conv2D)  (None, 1, 1, 1344)           76608     ['block5
q_se_reduce[0][0]']

 block5q_se_excite (Multipl  (None, 14, 14, 1344)         0         ['block5
q_activation[0][0]',
 y)                                                                  'block5
q_se_expand[0][0]']

 block5q_project_conv (Conv  (None, 14, 14, 224)          301056    ['block5
q_se_excite[0][0]']
 2D)

 block5q_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
q_project_conv[0][0]']
 ormalization)

 block5q_drop (Dropout)      (None, 14, 14, 224)          0         ['block5
q_project_bn[0][0]']

 block5q_add (Add)           (None, 14, 14, 224)          0         ['block5
q_drop[0][0]',
                                                                     'block5
p_add[0][0]']

 block5r_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
q_add[0][0]']
 D)

 block5r_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block5
r_expand_conv[0][0]']
 rmalization)

 block5r_expand_activation   (None, 14, 14, 1344)         0         ['block5
r_expand_bn[0][0]']
 (Activation)

 block5r_dwconv2 (Depthwise  (None, 14, 14, 1344)         12096     ['block5
r_expand_activation[0]
 Conv2D)                                                             [0]']
```

```
 block5r_bn (BatchNormaliza  (None, 14, 14, 1344)         5376      ['block5
r_dwconv2[0][0]']
 tion)

 block5r_activation (Activa  (None, 14, 14, 1344)         0         ['block5
r_bn[0][0]']
 tion)

 block5r_se_squeeze (Global  (None, 1344)                 0         ['block5
r_activation[0][0]']
 AveragePooling2D)

 block5r_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
r_se_squeeze[0][0]']
 e)

 block5r_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
r_se_reshape[0][0]']

 block5r_se_expand (Conv2D)  (None, 1, 1, 1344)           76608     ['block5
r_se_reduce[0][0]']

 block5r_se_excite (Multipl  (None, 14, 14, 1344)         0         ['block5
r_activation[0][0]',
 y)                                                                  'block5
r_se_expand[0][0]']

 block5r_project_conv (Conv  (None, 14, 14, 224)          301056    ['block5
r_se_excite[0][0]']
 2D)

 block5r_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
r_project_conv[0][0]']
 ormalization)

 block5r_drop (Dropout)      (None, 14, 14, 224)          0         ['block5
r_project_bn[0][0]']

 block5r_add (Add)           (None, 14, 14, 224)          0         ['block5
r_drop[0][0]',
                                                                     'block5
q_add[0][0]']

 block5s_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
r_add[0][0]']
 D)

 block5s_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block5
s_expand_conv[0][0]']
 rmalization)

 block5s_expand_activation   (None, 14, 14, 1344)         0         ['block5
s_expand_bn[0][0]']
 (Activation)
```

```
 block5s_dwconv2 (Depthwise  (None, 14, 14, 1344)         12096     ['block5
s_expand_activation[0]
 Conv2D)                                                            [0]']

 block5s_bn (BatchNormaliza  (None, 14, 14, 1344)         5376      ['block5
s_dwconv2[0][0]']
 tion)

 block5s_activation (Activa  (None, 14, 14, 1344)         0         ['block5
s_bn[0][0]']
 tion)

 block5s_se_squeeze (Global  (None, 1344)                 0         ['block5
s_activation[0][0]']
 AveragePooling2D)

 block5s_se_reshape (Reshap  (None, 1, 1, 1344)           0         ['block5
s_se_squeeze[0][0]']
 e)

 block5s_se_reduce (Conv2D)  (None, 1, 1, 56)             75320     ['block5
s_se_reshape[0][0]']

 block5s_se_expand (Conv2D)  (None, 1, 1, 1344)           76608     ['block5
s_se_reduce[0][0]']

 block5s_se_excite (Multipl  (None, 14, 14, 1344)         0         ['block5
s_activation[0][0]',
 y)                                                                  'block5
s_se_expand[0][0]']

 block5s_project_conv (Conv  (None, 14, 14, 224)          301056    ['block5
s_se_excite[0][0]']
 2D)

 block5s_project_bn (BatchN  (None, 14, 14, 224)          896       ['block5
s_project_conv[0][0]']
 ormalization)

 block5s_drop (Dropout)      (None, 14, 14, 224)          0         ['block5
s_project_bn[0][0]']

 block5s_add (Add)           (None, 14, 14, 224)          0         ['block5
s_drop[0][0]',
                                                                    'block5
r_add[0][0]']

 block6a_expand_conv (Conv2  (None, 14, 14, 1344)         301056    ['block5
s_add[0][0]']
 D)

 block6a_expand_bn (BatchNo  (None, 14, 14, 1344)         5376      ['block6
a_expand_conv[0][0]']
 rmalization)

 block6a_expand_activation   (None, 14, 14, 1344)         0         ['block6
```

```
a_expand_bn[0][0']
 (Activation)

 block6a_dwconv2 (Depthwise  (None, 7, 7, 1344)          12096     ['block6
a_expand_activation[0]
 Conv2D)                                                          [0]']

 block6a_bn (BatchNormaliza  (None, 7, 7, 1344)          5376      ['block6
a_dwconv2[0][0']
 tion)

 block6a_activation (Activa  (None, 7, 7, 1344)          0         ['block6
a_bn[0][0']
 tion)

 block6a_se_squeeze (Global  (None, 1344)                0         ['block6
a_activation[0][0']
 AveragePooling2D)

 block6a_se_reshape (Reshap  (None, 1, 1, 1344)          0         ['block6
a_se_squeeze[0][0']
 e)

 block6a_se_reduce (Conv2D)  (None, 1, 1, 56)            75320     ['block6
a_se_reshape[0][0']

 block6a_se_expand (Conv2D)  (None, 1, 1, 1344)          76608     ['block6
a_se_reduce[0][0']

 block6a_se_excite (Multipl  (None, 7, 7, 1344)          0         ['block6
a_activation[0][0',
 y)                                                               'block6
a_se_expand[0][0']

 block6a_project_conv (Conv  (None, 7, 7, 384)           516096    ['block6
a_se_excite[0][0']
 2D)

 block6a_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
a_project_conv[0][0']
 ormalization)

 block6b_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
a_project_bn[0][0']
 D)

 block6b_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
b_expand_conv[0][0']
 rmalization)

 block6b_expand_activation   (None, 7, 7, 2304)          0         ['block6
b_expand_bn[0][0']
 (Activation)

 block6b_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
b_expand_activation[0]
```

```
 Conv2D)                                                          [0]']

 block6b_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
b_dwconv2[0][0]']
 tion)

 block6b_activation (Activa  (None, 7, 7, 2304)          0         ['block6
b_bn[0][0]']
 tion)

 block6b_se_squeeze (Global  (None, 2304)                0         ['block6
b_activation[0][0]']
 AveragePooling2D)

 block6b_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
b_se_squeeze[0][0]']
 e)

 block6b_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
b_se_reshape[0][0]']

 block6b_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
b_se_reduce[0][0]']

 block6b_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
b_activation[0][0]',
 y)                                                               'block6
b_se_expand[0][0]']

 block6b_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
b_se_excite[0][0]']
 2D)

 block6b_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
b_project_conv[0][0]']
 ormalization)

 block6b_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
b_project_bn[0][0]']

 block6b_add (Add)           (None, 7, 7, 384)           0         ['block6
b_drop[0][0]',
                                                                  'block6
a_project_bn[0][0]']

 block6c_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
b_add[0][0]']
 D)

 block6c_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
c_expand_conv[0][0]']
 rmalization)

 block6c_expand_activation   (None, 7, 7, 2304)          0         ['block6
c_expand_bn[0][0]']
 (Activation)
```

```
 block6c_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
c_expand_activation[0]
 Conv2D)                                                          [0]']

 block6c_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
c_dwconv2[0][0]']
 tion)

 block6c_activation (Activa  (None, 7, 7, 2304)          0         ['block6
c_bn[0][0]']
 tion)

 block6c_se_squeeze (Global  (None, 2304)                0         ['block6
c_activation[0][0]']
 AveragePooling2D)

 block6c_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
c_se_squeeze[0][0]']
 e)

 block6c_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
c_se_reshape[0][0]']

 block6c_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
c_se_reduce[0][0]']

 block6c_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
c_activation[0][0]',
 y)                                                               'block6
c_se_expand[0][0]']

 block6c_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
c_se_excite[0][0]']
 2D)

 block6c_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
c_project_conv[0][0]']
 ormalization)

 block6c_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
c_project_bn[0][0]']

 block6c_add (Add)           (None, 7, 7, 384)           0         ['block6
c_drop[0][0]',
                                                                  'block6
b_add[0][0]']

 block6d_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
c_add[0][0]']
 D)

 block6d_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
d_expand_conv[0][0]']
 rmalization)
```

```
 block6d_expand_activation   (None, 7, 7, 2304)          0         ['block6
d_expand_bn[0][0]']
 (Activation)

 block6d_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
d_expand_activation[0]
 Conv2D)                                                           [0]']

 block6d_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
d_dwconv2[0][0]']
 tion)

 block6d_activation (Activa  (None, 7, 7, 2304)          0         ['block6
d_bn[0][0]']
 tion)

 block6d_se_squeeze (Global  (None, 2304)                0         ['block6
d_activation[0][0]']
 AveragePooling2D)

 block6d_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
d_se_squeeze[0][0]']
 e)

 block6d_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
d_se_reshape[0][0]']

 block6d_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
d_se_reduce[0][0]']

 block6d_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
d_activation[0][0]',
 y)                                                                'block6
d_se_expand[0][0]']

 block6d_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
d_se_excite[0][0]']
 2D)

 block6d_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
d_project_conv[0][0]']
 ormalization)

 block6d_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
d_project_bn[0][0]']

 block6d_add (Add)           (None, 7, 7, 384)           0         ['block6
d_drop[0][0]',
                                                                   'block6
c_add[0][0]']

 block6e_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
d_add[0][0]']
 D)

 block6e_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
```

```
e_expand_conv[0][0]']
 rmalization)

 block6e_expand_activation   (None, 7, 7, 2304)          0         ['block6
e_expand_bn[0][0]']
 (Activation)

 block6e_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
e_expand_activation[0]
 Conv2D)                                                           [0]']

 block6e_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
e_dwconv2[0][0]']
 tion)

 block6e_activation (Activa  (None, 7, 7, 2304)          0         ['block6
e_bn[0][0]']
 tion)

 block6e_se_squeeze (Global  (None, 2304)                0         ['block6
e_activation[0][0]']
 AveragePooling2D)

 block6e_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
e_se_squeeze[0][0]']
 e)

 block6e_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
e_se_reshape[0][0]']

 block6e_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
e_se_reduce[0][0]']

 block6e_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
e_activation[0][0]',
 y)                                                                 'block6
e_se_expand[0][0]']

 block6e_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
e_se_excite[0][0]']
 2D)

 block6e_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
e_project_conv[0][0]']
 ormalization)

 block6e_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
e_project_bn[0][0]']

 block6e_add (Add)           (None, 7, 7, 384)           0         ['block6
e_drop[0][0]',
                                                                    'block6
d_add[0][0]']

 block6f_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
e_add[0][0]']
```

```
 D)

 block6f_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
f_expand_conv[0][0]']
 rmalization)

 block6f_expand_activation   (None, 7, 7, 2304)          0         ['block6
f_expand_bn[0][0]']
 (Activation)

 block6f_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
f_expand_activation[0]
 Conv2D)                                                           [0]']

 block6f_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
f_dwconv2[0][0]']
 tion)

 block6f_activation (Activa  (None, 7, 7, 2304)          0         ['block6
f_bn[0][0]']
 tion)

 block6f_se_squeeze (Global  (None, 2304)                0         ['block6
f_activation[0][0]']
 AveragePooling2D)

 block6f_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
f_se_squeeze[0][0]']
 e)

 block6f_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
f_se_reshape[0][0]']

 block6f_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
f_se_reduce[0][0]']

 block6f_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
f_activation[0][0]',
 y)                                                                'block6
f_se_expand[0][0]']

 block6f_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
f_se_excite[0][0]']
 2D)

 block6f_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
f_project_conv[0][0]']
 ormalization)

 block6f_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
f_project_bn[0][0]']

 block6f_add (Add)           (None, 7, 7, 384)           0         ['block6
f_drop[0][0]',
                                                                   'block6
e_add[0][0]']
```

```
 block6g_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
f_add[0][0]']
 D)

 block6g_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
g_expand_conv[0][0]']
 rmalization)

 block6g_expand_activation   (None, 7, 7, 2304)          0         ['block6
g_expand_bn[0][0]']
 (Activation)

 block6g_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
g_expand_activation[0]
 Conv2D)                                                           [0]']

 block6g_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
g_dwconv2[0][0]']
 tion)

 block6g_activation (Activa  (None, 7, 7, 2304)          0         ['block6
g_bn[0][0]']
 tion)

 block6g_se_squeeze (Global  (None, 2304)                0         ['block6
g_activation[0][0]']
 AveragePooling2D)

 block6g_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
g_se_squeeze[0][0]']
 e)

 block6g_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
g_se_reshape[0][0]']

 block6g_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
g_se_reduce[0][0]']

 block6g_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
g_activation[0][0]',
 y)                                                                'block6
g_se_expand[0][0]']

 block6g_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
g_se_excite[0][0]']
 2D)

 block6g_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
g_project_conv[0][0]']
 ormalization)

 block6g_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
g_project_bn[0][0]']

 block6g_add (Add)           (None, 7, 7, 384)           0         ['block6
```

```
g_drop[0][0]',
                                                                 'block6
f_add[0][0]']

 block6h_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
g_add[0][0]']
 D)

 block6h_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
h_expand_conv[0][0]']
 rmalization)

 block6h_expand_activation   (None, 7, 7, 2304)          0         ['block6
h_expand_bn[0][0]']
 (Activation)

 block6h_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
h_expand_activation[0]
 Conv2D)                                                           [0]']

 block6h_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
h_dwconv2[0][0]']
 tion)

 block6h_activation (Activa  (None, 7, 7, 2304)          0         ['block6
h_bn[0][0]']
 tion)

 block6h_se_squeeze (Global  (None, 2304)                0         ['block6
h_activation[0][0]']
 AveragePooling2D)

 block6h_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
h_se_squeeze[0][0]']
 e)

 block6h_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
h_se_reshape[0][0]']

 block6h_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
h_se_reduce[0][0]']

 block6h_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
h_activation[0][0]',
 y)                                                                'block6
h_se_expand[0][0]']

 block6h_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
h_se_excite[0][0]']
 2D)

 block6h_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
h_project_conv[0][0]']
 ormalization)

 block6h_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
```

```
h_project_bn[0][0']

 block6h_add (Add)           (None, 7, 7, 384)           0         ['block6
h_drop[0][0]',
                                                                   'block6
g_add[0][0']

 block6i_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
h_add[0][0']
 D)

 block6i_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
i_expand_conv[0][0']
 rmalization)

 block6i_expand_activation   (None, 7, 7, 2304)          0         ['block6
i_expand_bn[0][0']
 (Activation)

 block6i_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
i_expand_activation[0]
 Conv2D)                                                           [0]']

 block6i_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
i_dwconv2[0][0']
 tion)

 block6i_activation (Activa  (None, 7, 7, 2304)          0         ['block6
i_bn[0][0']
 tion)

 block6i_se_squeeze (Global  (None, 2304)                0         ['block6
i_activation[0][0']
 AveragePooling2D)

 block6i_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
i_se_squeeze[0][0']
 e)

 block6i_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
i_se_reshape[0][0']

 block6i_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
i_se_reduce[0][0']

 block6i_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
i_activation[0][0]',
 y)                                                                'block6
i_se_expand[0][0']

 block6i_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
i_se_excite[0][0']
 2D)

 block6i_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
i_project_conv[0][0']
```

```
 ormalization)

 block6i_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
i_project_bn[0][0]']

 block6i_add (Add)           (None, 7, 7, 384)           0         ['block6
i_drop[0][0]',
                                                                  'block6
h_add[0][0]']

 block6j_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
i_add[0][0]']
 D)

 block6j_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
j_expand_conv[0][0]']
 rmalization)

 block6j_expand_activation   (None, 7, 7, 2304)          0         ['block6
j_expand_bn[0][0]']
 (Activation)

 block6j_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
j_expand_activation[0]
 Conv2D)                                                          [0]']

 block6j_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
j_dwconv2[0][0]']
 tion)

 block6j_activation (Activa  (None, 7, 7, 2304)          0         ['block6
j_bn[0][0]']
 tion)

 block6j_se_squeeze (Global  (None, 2304)                0         ['block6
j_activation[0][0]']
 AveragePooling2D)

 block6j_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
j_se_squeeze[0][0]']
 e)

 block6j_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
j_se_reshape[0][0]']

 block6j_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
j_se_reduce[0][0]']

 block6j_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
j_activation[0][0]',
 y)                                                               'block6
j_se_expand[0][0]']

 block6j_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
j_se_excite[0][0]']
 2D)
```

```
 block6j_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
j_project_conv[0][0]']
 ormalization)

 block6j_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
j_project_bn[0][0]']

 block6j_add (Add)           (None, 7, 7, 384)           0         ['block6
j_drop[0][0]',
                                                                   'block6
i_add[0][0]']

 block6k_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
j_add[0][0]']
 D)

 block6k_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
k_expand_conv[0][0]']
 rmalization)

 block6k_expand_activation   (None, 7, 7, 2304)          0         ['block6
k_expand_bn[0][0]']
 (Activation)

 block6k_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
k_expand_activation[0]
 Conv2D)                                                           [0]']

 block6k_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
k_dwconv2[0][0]']
 tion)

 block6k_activation (Activa  (None, 7, 7, 2304)          0         ['block6
k_bn[0][0]']
 tion)

 block6k_se_squeeze (Global  (None, 2304)                0         ['block6
k_activation[0][0]']
 AveragePooling2D)

 block6k_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
k_se_squeeze[0][0]']
 e)

 block6k_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
k_se_reshape[0][0]']

 block6k_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
k_se_reduce[0][0]']

 block6k_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
k_activation[0][0]',
 y)                                                                'block6
k_se_expand[0][0]']
```

```
 block6k_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
k_se_excite[0][0]']
 2D)

 block6k_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
k_project_conv[0][0]']
 ormalization)

 block6k_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
k_project_bn[0][0]']

 block6k_add (Add)           (None, 7, 7, 384)           0         ['block6
k_drop[0][0]',
                                                                   'block6
j_add[0][0]']

 block6l_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
k_add[0][0]']
 D)

 block6l_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
l_expand_conv[0][0]']
 rmalization)

 block6l_expand_activation   (None, 7, 7, 2304)          0         ['block6
l_expand_bn[0][0]']
 (Activation)

 block6l_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
l_expand_activation[0]
 Conv2D)                                                           [0]']

 block6l_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
l_dwconv2[0][0]']
 tion)

 block6l_activation (Activa  (None, 7, 7, 2304)          0         ['block6
l_bn[0][0]']
 tion)

 block6l_se_squeeze (Global  (None, 2304)                0         ['block6
l_activation[0][0]']
 AveragePooling2D)

 block6l_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
l_se_squeeze[0][0]']
 e)

 block6l_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
l_se_reshape[0][0]']

 block6l_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
l_se_reduce[0][0]']

 block6l_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
l_activation[0][0]',
```

```
 y)                                                                  'block6
l_se_expand[0][0]']

 block6l_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
l_se_excite[0][0]']
 2D)

 block6l_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
l_project_conv[0][0]']
 ormalization)

 block6l_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
l_project_bn[0][0]']

 block6l_add (Add)           (None, 7, 7, 384)           0         ['block6
l_drop[0][0]',
                                                                    'block6
k_add[0][0]']

 block6m_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
l_add[0][0]']
 D)

 block6m_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
m_expand_conv[0][0]']
 rmalization)

 block6m_expand_activation   (None, 7, 7, 2304)          0         ['block6
m_expand_bn[0][0]']
 (Activation)

 block6m_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
m_expand_activation[0]
 Conv2D)                                                            [0]']

 block6m_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
m_dwconv2[0][0]']
 tion)

 block6m_activation (Activa  (None, 7, 7, 2304)          0         ['block6
m_bn[0][0]']
 tion)

 block6m_se_squeeze (Global  (None, 2304)                0         ['block6
m_activation[0][0]']
 AveragePooling2D)

 block6m_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
m_se_squeeze[0][0]']
 e)

 block6m_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
m_se_reshape[0][0]']

 block6m_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
m_se_reduce[0][0]']
```

```
 block6m_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
m_activation[0][0]',
 y)                                                                  'block6
m_se_expand[0][0]']

 block6m_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
m_se_excite[0][0]']
 2D)

 block6m_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
m_project_conv[0][0]']
 ormalization)

 block6m_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
m_project_bn[0][0]']

 block6m_add (Add)           (None, 7, 7, 384)           0         ['block6
m_drop[0][0]',
                                                                    'block6
l_add[0][0]']

 block6n_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
m_add[0][0]']
 D)

 block6n_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
n_expand_conv[0][0]']
 rmalization)

 block6n_expand_activation   (None, 7, 7, 2304)          0         ['block6
n_expand_bn[0][0]']
 (Activation)

 block6n_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
n_expand_activation[0]
 Conv2D)                                                           [0]']

 block6n_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
n_dwconv2[0][0]']
 tion)

 block6n_activation (Activa  (None, 7, 7, 2304)          0         ['block6
n_bn[0][0]']
 tion)

 block6n_se_squeeze (Global  (None, 2304)                0         ['block6
n_activation[0][0]']
 AveragePooling2D)

 block6n_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
n_se_squeeze[0][0]']
 e)

 block6n_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
n_se_reshape[0][0]']
```

```
 block6n_se_expand (Conv2D)  (None, 1, 1, 2304)           223488    ['block6
n_se_reduce[0][0]']

 block6n_se_excite (Multipl  (None, 7, 7, 2304)           0         ['block6
n_activation[0][0]',
 y)                                                                  'block6
n_se_expand[0][0]']

 block6n_project_conv (Conv  (None, 7, 7, 384)            884736    ['block6
n_se_excite[0][0]']
 2D)

 block6n_project_bn (BatchN  (None, 7, 7, 384)            1536      ['block6
n_project_conv[0][0]']
 ormalization)

 block6n_drop (Dropout)      (None, 7, 7, 384)            0         ['block6
n_project_bn[0][0]']

 block6n_add (Add)           (None, 7, 7, 384)            0         ['block6
n_drop[0][0]',
                                                                     'block6
m_add[0][0]']

 block6o_expand_conv (Conv2  (None, 7, 7, 2304)           884736    ['block6
n_add[0][0]']
 D)

 block6o_expand_bn (BatchNo  (None, 7, 7, 2304)           9216      ['block6
o_expand_conv[0][0]']
 rmalization)

 block6o_expand_activation   (None, 7, 7, 2304)           0         ['block6
o_expand_bn[0][0]']
 (Activation)

 block6o_dwconv2 (Depthwise  (None, 7, 7, 2304)           20736     ['block6
o_expand_activation[0]
 Conv2D)                                                             [0]']

 block6o_bn (BatchNormaliza  (None, 7, 7, 2304)           9216      ['block6
o_dwconv2[0][0]']
 tion)

 block6o_activation (Activa  (None, 7, 7, 2304)           0         ['block6
o_bn[0][0]']
 tion)

 block6o_se_squeeze (Global  (None, 2304)                 0         ['block6
o_activation[0][0]']
 AveragePooling2D)

 block6o_se_reshape (Reshap  (None, 1, 1, 2304)           0         ['block6
o_se_squeeze[0][0]']
 e)
```

```
 block6o_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
o_se_reshape[0][0]']

 block6o_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
o_se_reduce[0][0]']

 block6o_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
o_activation[0][0]',
 y)                                                                  'block6
o_se_expand[0][0]']

 block6o_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
o_se_excite[0][0]']
 2D)

 block6o_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
o_project_conv[0][0]']
 ormalization)

 block6o_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
o_project_bn[0][0]']

 block6o_add (Add)           (None, 7, 7, 384)           0         ['block6
o_drop[0][0]',
                                                                    'block6
n_add[0][0]']

 block6p_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
o_add[0][0]']
 D)

 block6p_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
p_expand_conv[0][0]']
 rmalization)

 block6p_expand_activation   (None, 7, 7, 2304)          0         ['block6
p_expand_bn[0][0]']
 (Activation)

 block6p_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
p_expand_activation[0]
 Conv2D)                                                           [0]']

 block6p_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
p_dwconv2[0][0]']
 tion)

 block6p_activation (Activa  (None, 7, 7, 2304)          0         ['block6
p_bn[0][0]']
 tion)

 block6p_se_squeeze (Global  (None, 2304)                0         ['block6
p_activation[0][0]']
 AveragePooling2D)
```

```
 block6p_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
p_se_squeeze[0][0]']
 e)

 block6p_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
p_se_reshape[0][0]']

 block6p_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
p_se_reduce[0][0]']

 block6p_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
p_activation[0][0]',
 y)                                                                  'block6
p_se_expand[0][0]']

 block6p_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
p_se_excite[0][0]']
 2D)

 block6p_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
p_project_conv[0][0]']
 ormalization)

 block6p_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
p_project_bn[0][0]']

 block6p_add (Add)           (None, 7, 7, 384)           0         ['block6
p_drop[0][0]',
                                                                    'block6
o_add[0][0]']

 block6q_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
p_add[0][0]']
 D)

 block6q_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
q_expand_conv[0][0]']
 rmalization)

 block6q_expand_activation   (None, 7, 7, 2304)          0         ['block6
q_expand_bn[0][0]']
 (Activation)

 block6q_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
q_expand_activation[0]
 Conv2D)                                                           [0]']

 block6q_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
q_dwconv2[0][0]']
 tion)

 block6q_activation (Activa  (None, 7, 7, 2304)          0         ['block6
q_bn[0][0]']
 tion)

 block6q_se_squeeze (Global  (None, 2304)                0         ['block6
```

```
q_activation[0][0]']
 AveragePooling2D)

 block6q_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
q_se_squeeze[0][0]']
 e)

 block6q_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
q_se_reshape[0][0]']

 block6q_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
q_se_reduce[0][0]']

 block6q_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
q_activation[0][0]',
 y)                                                      'block6
q_se_expand[0][0]']

 block6q_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
q_se_excite[0][0]']
 2D)

 block6q_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
q_project_conv[0][0]']
 ormalization)

 block6q_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
q_project_bn[0][0]']

 block6q_add (Add)           (None, 7, 7, 384)           0         ['block6
q_drop[0][0]',
                                                         'block6
p_add[0][0]']

 block6r_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
q_add[0][0]']
 D)

 block6r_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
r_expand_conv[0][0]']
 rmalization)

 block6r_expand_activation   (None, 7, 7, 2304)          0         ['block6
r_expand_bn[0][0]']
 (Activation)

 block6r_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
r_expand_activation[0]
 Conv2D)                                                 [0]']

 block6r_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
r_dwconv2[0][0]']
 tion)

 block6r_activation (Activa  (None, 7, 7, 2304)          0         ['block6
r_bn[0][0]']
```

```
 tion)

 block6r_se_squeeze (Global  (None, 2304)                0         ['block6
r_activation[0][0]']
 AveragePooling2D)

 block6r_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
r_se_squeeze[0][0]']
 e)

 block6r_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
r_se_reshape[0][0]']

 block6r_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
r_se_reduce[0][0]']

 block6r_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
r_activation[0][0]',
 y)                                                                  'block6
r_se_expand[0][0]']

 block6r_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
r_se_excite[0][0]']
 2D)

 block6r_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
r_project_conv[0][0]']
 ormalization)

 block6r_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
r_project_bn[0][0]']

 block6r_add (Add)           (None, 7, 7, 384)           0         ['block6
r_drop[0][0]',
                                                                    'block6
q_add[0][0]']

 block6s_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
r_add[0][0]']
 D)

 block6s_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
s_expand_conv[0][0]']
 rmalization)

 block6s_expand_activation   (None, 7, 7, 2304)          0         ['block6
s_expand_bn[0][0]']
 (Activation)

 block6s_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
s_expand_activation[0]
 Conv2D)                                                            [0]']

 block6s_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
s_dwconv2[0][0]']
 tion)
```

```
 block6s_activation (Activa  (None, 7, 7, 2304)          0         ['block6
s_bn[0][0]']
 tion)

 block6s_se_squeeze (Global  (None, 2304)                0         ['block6
s_activation[0][0]']
 AveragePooling2D)

 block6s_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
s_se_squeeze[0][0]']
 e)

 block6s_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
s_se_reshape[0][0]']

 block6s_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
s_se_reduce[0][0]']

 block6s_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
s_activation[0][0]',
 y)                                                                  'block6
s_se_expand[0][0]']

 block6s_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
s_se_excite[0][0]']
 2D)

 block6s_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
s_project_conv[0][0]']
 ormalization)

 block6s_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
s_project_bn[0][0]']

 block6s_add (Add)           (None, 7, 7, 384)           0         ['block6
s_drop[0][0]',
                                                                    'block6
r_add[0][0]']

 block6t_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
s_add[0][0]']
 D)

 block6t_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
t_expand_conv[0][0]']
 rmalization)

 block6t_expand_activation   (None, 7, 7, 2304)          0         ['block6
t_expand_bn[0][0]']
 (Activation)

 block6t_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
t_expand_activation[0]
 Conv2D)                                                            [0]']
```

```
 block6t_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
t_dwconv2[0][0]']
 tion)

 block6t_activation (Activa  (None, 7, 7, 2304)          0         ['block6
t_bn[0][0]']
 tion)

 block6t_se_squeeze (Global  (None, 2304)                0         ['block6
t_activation[0][0]']
 AveragePooling2D)

 block6t_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
t_se_squeeze[0][0]']
 e)

 block6t_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
t_se_reshape[0][0]']

 block6t_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
t_se_reduce[0][0]']

 block6t_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
t_activation[0][0]',
 y)                                                                  'block6
t_se_expand[0][0]']

 block6t_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
t_se_excite[0][0]']
 2D)

 block6t_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
t_project_conv[0][0]']
 ormalization)

 block6t_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
t_project_bn[0][0]']

 block6t_add (Add)           (None, 7, 7, 384)           0         ['block6
t_drop[0][0]',
                                                                    'block6
s_add[0][0]']

 block6u_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
t_add[0][0]']
 D)

 block6u_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
u_expand_conv[0][0]']
 rmalization)

 block6u_expand_activation   (None, 7, 7, 2304)          0         ['block6
u_expand_bn[0][0]']
 (Activation)

 block6u_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
```

```
u_expand_activation[0]
 Conv2D)                                                          [0]']

 block6u_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
u_dwconv2[0][0]']
 tion)

 block6u_activation (Activa  (None, 7, 7, 2304)          0         ['block6
u_bn[0][0]']
 tion)

 block6u_se_squeeze (Global  (None, 2304)                0         ['block6
u_activation[0][0]']
 AveragePooling2D)

 block6u_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
u_se_squeeze[0][0]']
 e)

 block6u_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
u_se_reshape[0][0]']

 block6u_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
u_se_reduce[0][0]']

 block6u_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
u_activation[0][0]',
 y)                                                               'block6
u_se_expand[0][0]']

 block6u_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
u_se_excite[0][0]']
 2D)

 block6u_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
u_project_conv[0][0]']
 ormalization)

 block6u_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
u_project_bn[0][0]']

 block6u_add (Add)           (None, 7, 7, 384)           0         ['block6
u_drop[0][0]',
                                                                  'block6
t_add[0][0]']

 block6v_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
u_add[0][0]']
 D)

 block6v_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
v_expand_conv[0][0]']
 rmalization)

 block6v_expand_activation   (None, 7, 7, 2304)          0         ['block6
v_expand_bn[0][0]']
```

```
 (Activation)

 block6v_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
v_expand_activation[0]
 Conv2D)                                                          [0]']

 block6v_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
v_dwconv2[0][0]']
 tion)

 block6v_activation (Activa  (None, 7, 7, 2304)          0         ['block6
v_bn[0][0]']
 tion)

 block6v_se_squeeze (Global  (None, 2304)                0         ['block6
v_activation[0][0]']
 AveragePooling2D)

 block6v_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
v_se_squeeze[0][0]']
 e)

 block6v_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
v_se_reshape[0][0]']

 block6v_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
v_se_reduce[0][0]']

 block6v_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
v_activation[0][0]',
 y)                                                               'block6
v_se_expand[0][0]']

 block6v_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
v_se_excite[0][0]']
 2D)

 block6v_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
v_project_conv[0][0]']
 ormalization)

 block6v_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
v_project_bn[0][0]']

 block6v_add (Add)           (None, 7, 7, 384)           0         ['block6
v_drop[0][0]',
                                                                  'block6
u_add[0][0]']

 block6w_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
v_add[0][0]']
 D)

 block6w_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
w_expand_conv[0][0]']
 rmalization)
```

```
 block6w_expand_activation   (None, 7, 7, 2304)          0         ['block6
w_expand_bn[0][0]']
 (Activation)

 block6w_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
w_expand_activation[0]
 Conv2D)                                                           [0]']

 block6w_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
w_dwconv2[0][0]']
 tion)

 block6w_activation (Activa  (None, 7, 7, 2304)          0         ['block6
w_bn[0][0]']
 tion)

 block6w_se_squeeze (Global  (None, 2304)                0         ['block6
w_activation[0][0]']
 AveragePooling2D)

 block6w_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
w_se_squeeze[0][0]']
 e)

 block6w_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
w_se_reshape[0][0]']

 block6w_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
w_se_reduce[0][0]']

 block6w_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
w_activation[0][0]',
 y)                                                                'block6
w_se_expand[0][0]']

 block6w_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
w_se_excite[0][0]']
 2D)

 block6w_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
w_project_conv[0][0]']
 ormalization)

 block6w_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
w_project_bn[0][0]']

 block6w_add (Add)           (None, 7, 7, 384)           0         ['block6
w_drop[0][0]',
                                                                   'block6
v_add[0][0]']

 block6x_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
w_add[0][0]']
 D)
```

```
 block6x_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block6
x_expand_conv[0][0]']
 rmalization)

 block6x_expand_activation   (None, 7, 7, 2304)          0         ['block6
x_expand_bn[0][0]']
 (Activation)

 block6x_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block6
x_expand_activation[0]
 Conv2D)                                                           [0]']

 block6x_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block6
x_dwconv2[0][0]']
 tion)

 block6x_activation (Activa  (None, 7, 7, 2304)          0         ['block6
x_bn[0][0]']
 tion)

 block6x_se_squeeze (Global  (None, 2304)                0         ['block6
x_activation[0][0]']
 AveragePooling2D)

 block6x_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block6
x_se_squeeze[0][0]']
 e)

 block6x_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block6
x_se_reshape[0][0]']

 block6x_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block6
x_se_reduce[0][0]']

 block6x_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block6
x_activation[0][0]',
 y)                                                                 'block6
x_se_expand[0][0]']

 block6x_project_conv (Conv  (None, 7, 7, 384)           884736    ['block6
x_se_excite[0][0]']
 2D)

 block6x_project_bn (BatchN  (None, 7, 7, 384)           1536      ['block6
x_project_conv[0][0]']
 ormalization)

 block6x_drop (Dropout)      (None, 7, 7, 384)           0         ['block6
x_project_bn[0][0]']

 block6x_add (Add)           (None, 7, 7, 384)           0         ['block6
x_drop[0][0]',
                                                                    'block6
w_add[0][0]']

 block6y_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
```

```
x_add[0][0]']
 D)

 block6y_expand_bn (BatchNo  (None, 7, 7, 2304)           9216      ['block6
y_expand_conv[0][0]']
 rmalization)

 block6y_expand_activation   (None, 7, 7, 2304)           0         ['block6
y_expand_bn[0][0]']
 (Activation)

 block6y_dwconv2 (Depthwise  (None, 7, 7, 2304)           20736     ['block6
y_expand_activation[0]
 Conv2D)                                                           [0]']

 block6y_bn (BatchNormaliza  (None, 7, 7, 2304)           9216      ['block6
y_dwconv2[0][0]']
 tion)

 block6y_activation (Activa  (None, 7, 7, 2304)           0         ['block6
y_bn[0][0]']
 tion)

 block6y_se_squeeze (Global  (None, 2304)                 0         ['block6
y_activation[0][0]']
 AveragePooling2D)

 block6y_se_reshape (Reshap  (None, 1, 1, 2304)           0         ['block6
y_se_squeeze[0][0]']
 e)

 block6y_se_reduce (Conv2D)  (None, 1, 1, 96)             221280    ['block6
y_se_reshape[0][0]']

 block6y_se_expand (Conv2D)  (None, 1, 1, 2304)           223488    ['block6
y_se_reduce[0][0]']

 block6y_se_excite (Multipl  (None, 7, 7, 2304)           0         ['block6
y_activation[0][0]',
 y)                                                                 'block6
y_se_expand[0][0]']

 block6y_project_conv (Conv  (None, 7, 7, 384)            884736    ['block6
y_se_excite[0][0]']
 2D)

 block6y_project_bn (BatchN  (None, 7, 7, 384)            1536      ['block6
y_project_conv[0][0]']
 ormalization)

 block6y_drop (Dropout)      (None, 7, 7, 384)            0         ['block6
y_project_bn[0][0]']

 block6y_add (Add)           (None, 7, 7, 384)            0         ['block6
y_drop[0][0]',
                                                                    'block6
```

```
x_add[0][0']

 block7a_expand_conv (Conv2  (None, 7, 7, 2304)          884736    ['block6
y_add[0][0']
 D)

 block7a_expand_bn (BatchNo  (None, 7, 7, 2304)          9216      ['block7
a_expand_conv[0][0']
 rmalization)

 block7a_expand_activation   (None, 7, 7, 2304)          0         ['block7
a_expand_bn[0][0']
 (Activation)

 block7a_dwconv2 (Depthwise  (None, 7, 7, 2304)          20736     ['block7
a_expand_activation[0]
 Conv2D)                                                           [0]']

 block7a_bn (BatchNormaliza  (None, 7, 7, 2304)          9216      ['block7
a_dwconv2[0][0']
 tion)

 block7a_activation (Activa  (None, 7, 7, 2304)          0         ['block7
a_bn[0][0']
 tion)

 block7a_se_squeeze (Global  (None, 2304)                0         ['block7
a_activation[0][0']
 AveragePooling2D)

 block7a_se_reshape (Reshap  (None, 1, 1, 2304)          0         ['block7
a_se_squeeze[0][0']
 e)

 block7a_se_reduce (Conv2D)  (None, 1, 1, 96)            221280    ['block7
a_se_reshape[0][0']

 block7a_se_expand (Conv2D)  (None, 1, 1, 2304)          223488    ['block7
a_se_reduce[0][0']

 block7a_se_excite (Multipl  (None, 7, 7, 2304)          0         ['block7
a_activation[0][0',
 y)                                                                'block7
a_se_expand[0][0']

 block7a_project_conv (Conv  (None, 7, 7, 640)           1474560   ['block7
a_se_excite[0][0']
 2D)

 block7a_project_bn (BatchN  (None, 7, 7, 640)           2560      ['block7
a_project_conv[0][0']
 ormalization)

 block7b_expand_conv (Conv2  (None, 7, 7, 3840)          2457600   ['block7
a_project_bn[0][0']
 D)
```

```
 block7b_expand_bn (BatchNo  (None, 7, 7, 3840)          15360     ['block7
b_expand_conv[0][0]']
 rmalization)

 block7b_expand_activation   (None, 7, 7, 3840)          0         ['block7
b_expand_bn[0][0]']
 (Activation)

 block7b_dwconv2 (Depthwise  (None, 7, 7, 3840)          34560     ['block7
b_expand_activation[0]
 Conv2D)                                                           [0]']

 block7b_bn (BatchNormaliza  (None, 7, 7, 3840)          15360     ['block7
b_dwconv2[0][0]']
 tion)

 block7b_activation (Activa  (None, 7, 7, 3840)          0         ['block7
b_bn[0][0]']
 tion)

 block7b_se_squeeze (Global  (None, 3840)                0         ['block7
b_activation[0][0]']
 AveragePooling2D)

 block7b_se_reshape (Reshap  (None, 1, 1, 3840)          0         ['block7
b_se_squeeze[0][0]']
 e)

 block7b_se_reduce (Conv2D)  (None, 1, 1, 160)           614560    ['block7
b_se_reshape[0][0]']

 block7b_se_expand (Conv2D)  (None, 1, 1, 3840)          618240    ['block7
b_se_reduce[0][0]']

 block7b_se_excite (Multipl  (None, 7, 7, 3840)          0         ['block7
b_activation[0][0]',
 y)                                                                'block7
b_se_expand[0][0]']

 block7b_project_conv (Conv  (None, 7, 7, 640)           2457600   ['block7
b_se_excite[0][0]']
 2D)

 block7b_project_bn (BatchN  (None, 7, 7, 640)           2560      ['block7
b_project_conv[0][0]']
 ormalization)

 block7b_drop (Dropout)      (None, 7, 7, 640)           0         ['block7
b_project_bn[0][0]']

 block7b_add (Add)           (None, 7, 7, 640)           0         ['block7
b_drop[0][0]',
                                                                   'block7
a_project_bn[0][0]']
```

```
 block7c_expand_conv (Conv2  (None, 7, 7, 3840)          2457600   ['block7
b_add[0][0]']
 D)

 block7c_expand_bn (BatchNo  (None, 7, 7, 3840)          15360     ['block7
c_expand_conv[0][0]']
 rmalization)

 block7c_expand_activation   (None, 7, 7, 3840)          0         ['block7
c_expand_bn[0][0]']
 (Activation)

 block7c_dwconv2 (Depthwise  (None, 7, 7, 3840)          34560     ['block7
c_expand_activation[0]
 Conv2D)                                                           [0]']

 block7c_bn (BatchNormaliza  (None, 7, 7, 3840)          15360     ['block7
c_dwconv2[0][0]']
 tion)

 block7c_activation (Activa  (None, 7, 7, 3840)          0         ['block7
c_bn[0][0]']
 tion)

 block7c_se_squeeze (Global  (None, 3840)                0         ['block7
c_activation[0][0]']
 AveragePooling2D)

 block7c_se_reshape (Reshap  (None, 1, 1, 3840)          0         ['block7
c_se_squeeze[0][0]']
 e)

 block7c_se_reduce (Conv2D)  (None, 1, 1, 160)           614560    ['block7
c_se_reshape[0][0]']

 block7c_se_expand (Conv2D)  (None, 1, 1, 3840)          618240    ['block7
c_se_reduce[0][0]']

 block7c_se_excite (Multipl  (None, 7, 7, 3840)          0         ['block7
c_activation[0][0]',
 y)                                                                'block7
c_se_expand[0][0]']

 block7c_project_conv (Conv  (None, 7, 7, 640)           2457600   ['block7
c_se_excite[0][0]']
 2D)

 block7c_project_bn (BatchN  (None, 7, 7, 640)           2560      ['block7
c_project_conv[0][0]']
 ormalization)

 block7c_drop (Dropout)      (None, 7, 7, 640)           0         ['block7
c_project_bn[0][0]']

 block7c_add (Add)           (None, 7, 7, 640)           0         ['block7
c_drop[0][0]',
```

```
                                                                  'block7
b_add[0][0]']

 block7d_expand_conv (Conv2  (None, 7, 7, 3840)          2457600   ['block7
c_add[0][0]']
 D)

 block7d_expand_bn (BatchNo  (None, 7, 7, 3840)          15360     ['block7
d_expand_conv[0][0]']
 rmalization)

 block7d_expand_activation   (None, 7, 7, 3840)          0         ['block7
d_expand_bn[0][0]']
 (Activation)

 block7d_dwconv2 (Depthwise  (None, 7, 7, 3840)          34560     ['block7
d_expand_activation[0]
 Conv2D)                                                          [0]']

 block7d_bn (BatchNormaliza  (None, 7, 7, 3840)          15360     ['block7
d_dwconv2[0][0]']
 tion)

 block7d_activation (Activa  (None, 7, 7, 3840)          0         ['block7
d_bn[0][0]']
 tion)

 block7d_se_squeeze (Global  (None, 3840)                0         ['block7
d_activation[0][0]']
 AveragePooling2D)

 block7d_se_reshape (Reshap  (None, 1, 1, 3840)          0         ['block7
d_se_squeeze[0][0]']
 e)

 block7d_se_reduce (Conv2D)  (None, 1, 1, 160)           614560    ['block7
d_se_reshape[0][0]']

 block7d_se_expand (Conv2D)  (None, 1, 1, 3840)          618240    ['block7
d_se_reduce[0][0]']

 block7d_se_excite (Multipl  (None, 7, 7, 3840)          0         ['block7
d_activation[0][0]',
 y)                                                               'block7
d_se_expand[0][0]']

 block7d_project_conv (Conv  (None, 7, 7, 640)           2457600   ['block7
d_se_excite[0][0]']
 2D)

 block7d_project_bn (BatchN  (None, 7, 7, 640)           2560      ['block7
d_project_conv[0][0]']
 ormalization)

 block7d_drop (Dropout)      (None, 7, 7, 640)           0         ['block7
d_project_bn[0][0]']
```

```
 block7d_add (Add)           (None, 7, 7, 640)            0         ['block7
d_drop[0][0]',
                                                                     'block7
c_add[0][0]']

 block7e_expand_conv (Conv2  (None, 7, 7, 3840)           2457600   ['block7
d_add[0][0]']
 D)

 block7e_expand_bn (BatchNo  (None, 7, 7, 3840)           15360     ['block7
e_expand_conv[0][0]']
 rmalization)

 block7e_expand_activation   (None, 7, 7, 3840)           0         ['block7
e_expand_bn[0][0]']
 (Activation)

 block7e_dwconv2 (Depthwise  (None, 7, 7, 3840)           34560     ['block7
e_expand_activation[0]
 Conv2D)                                                             [0]']

 block7e_bn (BatchNormaliza  (None, 7, 7, 3840)           15360     ['block7
e_dwconv2[0][0]']
 tion)

 block7e_activation (Activa  (None, 7, 7, 3840)           0         ['block7
e_bn[0][0]']
 tion)

 block7e_se_squeeze (Global  (None, 3840)                 0         ['block7
e_activation[0][0]']
 AveragePooling2D)

 block7e_se_reshape (Reshap  (None, 1, 1, 3840)           0         ['block7
e_se_squeeze[0][0]']
 e)

 block7e_se_reduce (Conv2D)  (None, 1, 1, 160)            614560    ['block7
e_se_reshape[0][0]']

 block7e_se_expand (Conv2D)  (None, 1, 1, 3840)           618240    ['block7
e_se_reduce[0][0]']

 block7e_se_excite (Multipl  (None, 7, 7, 3840)           0         ['block7
e_activation[0][0]',
 y)                                                                  'block7
e_se_expand[0][0]']

 block7e_project_conv (Conv  (None, 7, 7, 640)            2457600   ['block7
e_se_excite[0][0]']
 2D)

 block7e_project_bn (BatchN  (None, 7, 7, 640)            2560      ['block7
e_project_conv[0][0]']
 ormalization)
```

```
 block7e_drop (Dropout)      (None, 7, 7, 640)           0         ['block7
e_project_bn[0][0]']

 block7e_add (Add)           (None, 7, 7, 640)           0         ['block7
e_drop[0][0]',
                                                                   'block7
d_add[0][0]']

 block7f_expand_conv (Conv2  (None, 7, 7, 3840)          2457600   ['block7
e_add[0][0]']
 D)

 block7f_expand_bn (BatchNo  (None, 7, 7, 3840)          15360     ['block7
f_expand_conv[0][0]']
 rmalization)

 block7f_expand_activation   (None, 7, 7, 3840)          0         ['block7
f_expand_bn[0][0]']
 (Activation)

 block7f_dwconv2 (Depthwise  (None, 7, 7, 3840)          34560     ['block7
f_expand_activation[0]
 Conv2D)                                                           [0]']

 block7f_bn (BatchNormaliza  (None, 7, 7, 3840)          15360     ['block7
f_dwconv2[0][0]']
 tion)

 block7f_activation (Activa  (None, 7, 7, 3840)          0         ['block7
f_bn[0][0]']
 tion)

 block7f_se_squeeze (Global  (None, 3840)                0         ['block7
f_activation[0][0]']
 AveragePooling2D)

 block7f_se_reshape (Reshap  (None, 1, 1, 3840)          0         ['block7
f_se_squeeze[0][0]']
 e)

 block7f_se_reduce (Conv2D)  (None, 1, 1, 160)           614560    ['block7
f_se_reshape[0][0]']

 block7f_se_expand (Conv2D)  (None, 1, 1, 3840)          618240    ['block7
f_se_reduce[0][0]']

 block7f_se_excite (Multipl  (None, 7, 7, 3840)          0         ['block7
f_activation[0][0]',
 y)                                                                'block7
f_se_expand[0][0]']

 block7f_project_conv (Conv  (None, 7, 7, 640)           2457600   ['block7
f_se_excite[0][0]']
 2D)
```

```
 block7f_project_bn (BatchN  (None, 7, 7, 640)           2560      ['block7
f_project_conv[0][0]']
 ormalization)

 block7f_drop (Dropout)      (None, 7, 7, 640)           0         ['block7
f_project_bn[0][0]']

 block7f_add (Add)           (None, 7, 7, 640)           0         ['block7
f_drop[0][0]',
                                                                   'block7
e_add[0][0]']

 block7g_expand_conv (Conv2  (None, 7, 7, 3840)          2457600   ['block7
f_add[0][0]']
 D)

 block7g_expand_bn (BatchNo  (None, 7, 7, 3840)          15360     ['block7
g_expand_conv[0][0]']
 rmalization)

 block7g_expand_activation   (None, 7, 7, 3840)          0         ['block7
g_expand_bn[0][0]']
 (Activation)

 block7g_dwconv2 (Depthwise  (None, 7, 7, 3840)          34560     ['block7
g_expand_activation[0]
 Conv2D)                                                           [0]']

 block7g_bn (BatchNormaliza  (None, 7, 7, 3840)          15360     ['block7
g_dwconv2[0][0]']
 tion)

 block7g_activation (Activa  (None, 7, 7, 3840)          0         ['block7
g_bn[0][0]']
 tion)

 block7g_se_squeeze (Global  (None, 3840)                0         ['block7
g_activation[0][0]']
 AveragePooling2D)

 block7g_se_reshape (Reshap  (None, 1, 1, 3840)          0         ['block7
g_se_squeeze[0][0]']
 e)

 block7g_se_reduce (Conv2D)  (None, 1, 1, 160)           614560    ['block7
g_se_reshape[0][0]']

 block7g_se_expand (Conv2D)  (None, 1, 1, 3840)          618240    ['block7
g_se_reduce[0][0]']

 block7g_se_excite (Multipl  (None, 7, 7, 3840)          0         ['block7
g_activation[0][0]',
 y)                                                                'block7
g_se_expand[0][0]']

 block7g_project_conv (Conv  (None, 7, 7, 640)           2457600   ['block7
```

```
g_se_excite[0][0']
 2D)

 block7g_project_bn (BatchN  (None, 7, 7, 640)           2560      ['block7
g_project_conv[0][0']
 ormalization)

 block7g_drop (Dropout)      (None, 7, 7, 640)           0         ['block7
g_project_bn[0][0']

 block7g_add (Add)           (None, 7, 7, 640)           0         ['block7
g_drop[0][0',
                                                                  'block7
f_add[0][0']

 top_conv (Conv2D)           (None, 7, 7, 1280)          819200    ['block7
g_add[0][0']

 top_bn (BatchNormalization  (None, 7, 7, 1280)          5120      ['top_co
nv[0][0']
 )

 top_activation (Activation  (None, 7, 7, 1280)          0         ['top_bn
[0][0']
 )

 flatten (Flatten)           (None, 62720)               0         ['top_ac
tivation[0][0']

 dense (Dense)               (None, 4096)                2569052   ['flatte
n[0][0']
                                                         16

 dropout (Dropout)           (None, 4096)                0         ['dense
[0][0']

 batch_normalization (Batch  (None, 4096)                16384     ['dropou
t[0][0']
 Normalization)

 dense_1 (Dense)             (None, 4096)                1678131   ['batch_
normalization[0][0']
                                                         2

 dropout_1 (Dropout)         (None, 4096)                0         ['dense_
1[0][0']

 dense_2 (Dense)             (None, 20)                  81940     ['dropou
t_1[0][0']

==================================================================================
Total params: 391531700 (1.46 GB)
Trainable params: 274598420 (1.02 GB)
Non-trainable params: 116933280 (446.07 MB)
```

```
_________________________________________________________________
```

In [32]:
```
print(base_model.input)
print(base_model.outputs)
```

```
KerasTensor(type_spec=TensorSpec(shape=(None, 224, 224, 3), dtype=tf.float3
2, name='input_1'), name='input_1', description="created by layer 'input_
1'")
[<KerasTensor: shape=(None, 7, 7, 1280) dtype=float32 (created by layer 'top
_activation')>]
```

In [28]:
```
# import pickle
# with open('EfficientNetV2L_Transferlearning_20_cusine.pkl', 'wb') as f:
#     pickle.dump(model, f)
```

In [30]:
```
# from IPython.display import FileLink
# FileLink('EfficientNetV2L_Transferlearning_20_cusine.pkl')
```

Out[30]: EfficientNetV2L_Transferlearning_20_cusine.pkl

In [ ]:

In [ ]:

==========

# Transfer Learning

In [ ]:
```
import numpy as np
import cv2
from sklearn.model_selection import train_test_split
from tensorflow.keras.applications import VGG16
from tensorflow.keras.applications.vgg16 import preprocess_input
from tensorflow.keras.layers import Flatten, Dense, Input
from tensorflow.keras.models import Model
from tensorflow.keras.optimizers import Adam
from sklearn.preprocessing import LabelEncoder
from tensorflow.keras.utils import to_categorical

# Define constants
IMG_SIZE = (224, 224)  # VGG16 default image size

# Load images and labels
images = []
labels = []
for file_path in common_file_paths:  # Replace with your actual file paths
    image = cv2.imread(file_path)
    if image is None:
        continue  # Skip files that aren't valid images
    image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
```

```
    image = cv2.resize(image, IMG_SIZE)
    images.append(image)

    label = file_path.split(os.path.sep)[-2]
    labels.append(label)

# Convert lists to NumPy arrays
images = np.array(images, dtype=np.float32)
labels = np.array(labels)

# Preprocess images for VGG16
images = preprocess_input(images)

# Encode labels to integers
label_encoder = LabelEncoder()
labels_encoded = label_encoder.fit_transform(labels)
labels_one_hot = to_categorical(labels_encoded)

# Split the data into training and validation sets
X_train, X_val, y_train, y_val = train_test_split(images, labels_one_hot, te

# Load VGG16 pre-trained model without the top classification layer
base_model = VGG16(weights='imagenet', include_top=False, input_tensor=Input

# Freeze the layers of the base model
for layer in base_model.layers:
    layer.trainable = False

# Create the custom top layers for our dataset
x = base_model.output
x = Flatten()(x)
x = Dense(4096, activation='relu')(x)
x = Dense(4096, activation='relu')(x)
predictions = Dense(len(label_encoder.classes_), activation='softmax')(x)

# This is the model we will train
model = Model(inputs=base_model.input, outputs=predictions)

# Compile the model
model.compile(optimizer=Adam(learning_rate=1e-4), loss='categorical_crossent

# Train the model
history = model.fit(X_train, y_train, validation_data=(X_val, y_val), epochs

# Evaluate the model on the validation set
val_loss, val_accuracy = model.evaluate(X_val, y_val)
print(f'Validation accuracy: {val_accuracy * 100:.2f}%')

# Optionally plot the training history
plt.figure(figsize=(12, 4))
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label='Training Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.legend()
plt.title('Accuracy over epochs')
plt.xlabel('Epoch')
```

```
plt.ylabel('Accuracy')

plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Training Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.legend()
plt.title('Loss over epochs')
plt.xlabel('Epoch')
plt.ylabel('Loss')

plt.show()
```

In [ ]:
```
from sklearn.metrics import confusion_matrix, classification_report
import seaborn as sns
import matplotlib.pyplot as plt

# Predict labels for validation set
y_pred = model.predict(X_val)
y_pred_classes = np.argmax(y_pred, axis=1)
y_true_classes = np.argmax(y_val, axis=1)

# Calculate the confusion matrix
conf_matrix = confusion_matrix(y_true_classes, y_pred_classes)

# Plot the confusion matrix
plt.figure(figsize=(10, 10))
sns.heatmap(conf_matrix, annot=True, fmt='g', cmap='RdPu')
plt.xlabel('Predicted labels')
plt.ylabel('True labels')
plt.title('Confusion Matrix')
plt.show()

# Calculate precision, recall, F1 score, and accuracy
report = classification_report(y_true_classes, y_pred_classes, output_dict=T
accuracy = report['accuracy']
precision = report['macro avg']['precision']
recall = report['macro avg']['recall']
f1_score = report['macro avg']['f1-score']

# Display the calculated metrics
print(f'Validation Accuracy: {accuracy:.4f}')
print(f'Precision: {precision:.4f}')
print(f'Recall: {recall:.4f}')
print(f'F1 Score: {f1_score:.4f}')
```

In [ ]:
```
import numpy as np
import cv2
import os
from sklearn.model_selection import train_test_split
from tensorflow.keras.applications import VGG16
from tensorflow.keras.applications.vgg16 import preprocess_input
from tensorflow.keras.layers import Flatten, Dense, Dropout, BatchNormalizat
from tensorflow.keras.models import Model
from tensorflow.keras.optimizers import Adam
from sklearn.preprocessing import LabelEncoder
```

```
from tensorflow.keras.utils import to_categorical
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import matplotlib.pyplot as plt

# Constants
IMG_SIZE = (224, 224)  # VGG16 default image size

# Load and preprocess images
images = []
labels = []
for file_path in common_file_paths:  # Replace with your actual file paths
    image = cv2.imread(file_path)
    if image is None:
        continue
    image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
    image = cv2.resize(image, IMG_SIZE)
    images.append(image)
    label = file_path.split(os.path.sep)[-2]
    labels.append(label)

# Convert to NumPy arrays and preprocess
images = np.array(images, dtype=np.float32)
labels = np.array(labels)
images = preprocess_input(images)

# Encode labels
label_encoder = LabelEncoder()
labels_encoded = label_encoder.fit_transform(labels)
labels_one_hot = to_categorical(labels_encoded)

# Split data
X_train, X_val, y_train, y_val = train_test_split(images, labels_one_hot, te

# Data augmentation
data_gen = ImageDataGenerator(rotation_range=20, zoom_range=0.15, width_shif

# Load VGG16 model
base_model = VGG16(weights='imagenet', include_top=False, input_tensor=Input

# Freeze base model layers and unfreeze the last 4 layers
for layer in base_model.layers[:-4]:
    layer.trainable = False

# Model architecture
x = base_model.output
x = Flatten()(x)
x = Dense(4096, activation='relu')(x)
x = Dropout(0.5)(x)
x = BatchNormalization()(x)
x = Dense(4096, activation='relu')(x)
x = Dropout(0.5)(x)
predictions = Dense(len(label_encoder.classes_), activation='softmax')(x)
model = Model(inputs=base_model.input, outputs=predictions)

# Compile model
model.compile(optimizer=Adam(learning_rate=1e-5), loss='categorical_crossent
```

```
# Train model
history = model.fit(data_gen.flow(X_train, y_train, batch_size=32), validati

# Evaluate model
val_loss, val_accuracy = model.evaluate(X_val, y_val)
print(f'Validation accuracy: {val_accuracy * 100:.2f}%')

# Plotting training history
plt.figure(figsize=(12, 4))
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label='Training Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Accuracy over Epochs')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()

plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Training Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Loss over Epochs')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()

plt.show()
```

In [ ]:

```
from sklearn.metrics import confusion_matrix, classification_report
import seaborn as sns
import matplotlib.pyplot as plt

# Predict labels for validation set
y_pred = model.predict(X_val)
y_pred_classes = np.argmax(y_pred, axis=1)
y_true_classes = np.argmax(y_val, axis=1)

# Calculate the confusion matrix
conf_matrix = confusion_matrix(y_true_classes, y_pred_classes)

# Plot the confusion matrix
plt.figure(figsize=(10, 10))
sns.heatmap(conf_matrix, annot=True, fmt='g', cmap='RdPu')
plt.xlabel('Predicted labels')
plt.ylabel('True labels')
plt.title('Confusion Matrix')
plt.show()

# Calculate precision, recall, F1 score, and accuracy
report = classification_report(y_true_classes, y_pred_classes, output_dict=T
accuracy = report['accuracy']
precision = report['macro avg']['precision']
recall = report['macro avg']['recall']
f1_score = report['macro avg']['f1-score']

# Display the calculated metrics
```

```
print(f'Validation Accuracy: {accuracy:.4f}')
print(f'Precision: {precision:.4f}')
print(f'Recall: {recall:.4f}')
print(f'F1 Score: {f1_score:.4f}')
```

# CNN with transfer learning

In [ ]:

```
import os
import cv2
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from tensorflow.keras.applications.vgg16 import VGG16
from tensorflow.keras.layers import Flatten, Dense, Dropout, BatchNormalizat
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.callbacks import ReduceLROnPlateau, EarlyStopping
from sklearn.preprocessing import LabelEncoder
from tensorflow.keras.utils import to_categorical
from tensorflow.keras.models import Sequential
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from sklearn.metrics import confusion_matrix
import seaborn as sns

# Define image size and batch size
IMG_SIZE = (128, 128)
BATCH_SIZE = 32

# Load images and labels
images = []
labels = []
for file_path in common_file_paths:
    image = cv2.imread(file_path)
    image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
    image = cv2.resize(image, IMG_SIZE)
    images.append(image)
    label = file_path.split(os.path.sep)[-2]
    labels.append(label)

# Convert lists to NumPy arrays and normalize
images = np.array(images) / 255.0
labels = np.array(labels)

# One-hot encoding of labels
label_encoder = LabelEncoder()
labels_encoded = label_encoder.fit_transform(labels)
labels_one_hot = to_categorical(labels_encoded)

# Split the data
X_train, X_val, y_train, y_val = train_test_split(images, labels_one_hot, te

# Data augmentation
data_augmentation = ImageDataGenerator(
    rotation_range=20,
    zoom_range=0.15,
```

```
    width_shift_range=0.2,
    height_shift_range=0.2,
    shear_range=0.15,
    horizontal_flip=True,
    fill_mode="nearest"
)

# Load pre-trained VGG16 model
base_model = VGG16(weights='imagenet', include_top=False, input_shape=(IMG_S

# Freeze layers in the base model
for layer in base_model.layers:
    layer.trainable = False

# Building the model
model = Sequential([
    base_model,
    GlobalAveragePooling2D(),
    Dense(512, activation='relu'),
    BatchNormalization(),
    Dropout(0.5),
    Dense(256, activation='relu'),
    BatchNormalization(),
    Dropout(0.5),
    Dense(len(label_encoder.classes_), activation='softmax')
])

# Compile the model
optimizer = Adam(lr=1e-3)
model.compile(optimizer=optimizer, loss='categorical_crossentropy', metrics=

# Callbacks
reduce_lr = ReduceLROnPlateau(monitor='val_loss', factor=0.2, patience=5, mi
early_stopping = EarlyStopping(monitor='val_loss', patience=10, verbose=1, r

# Train the model
history = model.fit(
    data_augmentation.flow(X_train, y_train, batch_size=BATCH_SIZE),
    validation_data=(X_val, y_val),
    epochs=50,
    callbacks=[reduce_lr, early_stopping]
)

# Evaluate the model
val_loss, val_accuracy = model.evaluate(X_val, y_val)
print(f'Validation accuracy: {val_accuracy * 100:.2f}%')

# Plot training history
plt.figure(figsize=(12, 5))
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label='Training Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Accuracy over Epochs')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()
```

```
plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Training Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Loss over Epochs')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()
plt.show()

# Confusion Matrix
y_pred = model.predict(X_val)
y_pred_classes = np.argmax(y_pred, axis=1)
y_true = np.argmax(y_val, axis=1)
conf_matrix = confusion_matrix(y_true, y_pred_classes)
plt.figure(figsize=(10, 8))
sns.heatmap(conf_matrix, annot=True, fmt='d', cmap='Blues')
plt.title('Confusion Matrix')
plt.ylabel('True Label')
plt.xlabel('Predicted Label')
plt.show()

# Calculate precision, recall, F1 score, and accuracy
report = classification_report(y_true, y_pred_classes, output_dict=True)
accuracy = report['accuracy']
precision = report['macro avg']['precision']
recall = report['macro avg']['recall']
f1_score = report['macro avg']['f1-score']

# Display the calculated metrics
print(f'Validation Accuracy: {accuracy:.4f}')
print(f'Precision: {precision:.4f}')
print(f'Recall: {recall:.4f}')
print(f'F1 Score: {f1_score:.4f}')
```

In [ ]:

```
import os
import cv2
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from tensorflow.keras.applications.vgg16 import VGG16
from tensorflow.keras.layers import Flatten, Dense, Dropout, BatchNormalizat
from tensorflow.keras.optimizers import Adam, RMSprop
from tensorflow.keras.callbacks import ReduceLROnPlateau, EarlyStopping
from sklearn.preprocessing import LabelEncoder
from tensorflow.keras.utils import to_categorical
from tensorflow.keras.models import Sequential
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from sklearn.metrics import confusion_matrix
import seaborn as sns

# Define image size and batch size
IMG_SIZE = (128, 128)
BATCH_SIZE = 32

# Load images and labels
```

```
images = []
labels = []
for file_path in common_file_paths:
    image = cv2.imread(file_path)
    image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
    image = cv2.resize(image, IMG_SIZE)
    images.append(image)
    label = file_path.split(os.path.sep)[-2]
    labels.append(label)

# Convert lists to NumPy arrays and normalize
images = np.array(images) / 255.0
labels = np.array(labels)

# One-hot encoding of labels
label_encoder = LabelEncoder()
labels_encoded = label_encoder.fit_transform(labels)
labels_one_hot = to_categorical(labels_encoded)

# Split the data
X_train, X_val, y_train, y_val = train_test_split(images, labels_one_hot, te

# Data augmentation
data_augmentation = ImageDataGenerator(
    rotation_range=20,
    zoom_range=0.15,
    width_shift_range=0.2,
    height_shift_range=0.2,
    shear_range=0.15,
    horizontal_flip=True,
    fill_mode="nearest"
)

# Load pre-trained VGG16 model
base_model = VGG16(weights='imagenet', include_top=False, input_shape=(IMG_S

# Freeze layers in the base model
for layer in base_model.layers:
    layer.trainable = False

# Building the model
model = Sequential([
    base_model,
    GlobalAveragePooling2D(),
    Dense(512, activation='relu'),
    BatchNormalization(),
    Dropout(0.5),
    Dense(256, activation='relu'),
    BatchNormalization(),
    Dropout(0.5),
    Dense(len(label_encoder.classes_), activation='softmax')
])

# Compile the model
optimizer = RMSprop(lr=1e-5)
model.compile(optimizer=optimizer, loss='categorical_crossentropy', metrics=
```

```
# Callbacks
reduce_lr = ReduceLROnPlateau(monitor='val_loss', factor=0.2, patience=5, mi
early_stopping = EarlyStopping(monitor='val_loss', patience=10, verbose=1, r

# Train the model
history = model.fit(
    data_augmentation.flow(X_train, y_train, batch_size=BATCH_SIZE),
    validation_data=(X_val, y_val),
    epochs=50,
    callbacks=[reduce_lr, early_stopping]
)

# Evaluate the model
val_loss, val_accuracy = model.evaluate(X_val, y_val)
print(f'Validation accuracy: {val_accuracy * 100:.2f}%')

# Plot training history
plt.figure(figsize=(12, 5))
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label='Training Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Accuracy over Epochs')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()

plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Training Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Loss over Epochs')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()
plt.show()

# Confusion Matrix
y_pred = model.predict(X_val)
y_pred_classes = np.argmax(y_pred, axis=1)
y_true = np.argmax(y_val, axis=1)
conf_matrix = confusion_matrix(y_true, y_pred_classes)
plt.figure(figsize=(10, 8))
sns.heatmap(conf_matrix, annot=True, fmt='d', cmap='Blues')
plt.title('Confusion Matrix')
plt.ylabel('True Label')
plt.xlabel('Predicted Label')
plt.show()
# Calculate precision, recall, F1 score, and accuracy
report = classification_report(y_true_classes, y_pred_classes, output_dict=T
accuracy = report['accuracy']
precision = report['macro avg']['precision']
recall = report['macro avg']['recall']
f1_score = report['macro avg']['f1-score']

# Display the calculated metrics
print(f'Validation Accuracy: {accuracy:.4f}')
```

```
print(f'Precision: {precision:.4f}')
print(f'Recall: {recall:.4f}')
print(f'F1 Score: {f1_score:.4f}')
```

# transfer lerning with new imagnet models

In [ ]:

```
import numpy as np
import cv2
import os
from sklearn.model_selection import train_test_split
from tensorflow.keras.applications import EfficientNetV2M
from tensorflow.keras.applications.efficientnet_v2 import preprocess_input
from tensorflow.keras.layers import Flatten, Dense, Dropout, BatchNormalizat
from tensorflow.keras.models import Model
from tensorflow.keras.optimizers import Adam
from sklearn.preprocessing import LabelEncoder
from tensorflow.keras.utils import to_categorical
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import matplotlib.pyplot as plt

# Constants
IMG_SIZE = (224, 224)  # VGG16 default image size

# Load and preprocess images
images = []
labels = []
for file_path in common_file_paths:  # Replace with your actual file paths
    image = cv2.imread(file_path)
    if image is None:
        continue
    image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
    image = cv2.resize(image, IMG_SIZE)
    images.append(image)
    label = file_path.split(os.path.sep)[-2]
    labels.append(label)

# Convert to NumPy arrays and preprocess
images = np.array(images, dtype=np.float32)
labels = np.array(labels)
images = preprocess_input(images)

# Encode labels
label_encoder = LabelEncoder()
labels_encoded = label_encoder.fit_transform(labels)
labels_one_hot = to_categorical(labels_encoded)

# Split data
X_train, X_val, y_train, y_val = train_test_split(images, labels_one_hot, te

# Data augmentation
data_gen = ImageDataGenerator(rotation_range=20, zoom_range=0.15, width_shif
```

```
# Load EfficientNetV2M model
base_model = EfficientNetV2M(weights='imagenet', include_top=False, input_te

# Freeze base model layers and unfreeze the last 4 layers
for layer in base_model.layers[:-4]:
    layer.trainable = False

# Model architecture
x = base_model.output
x = Flatten()(x)
x = Dense(4096, activation='relu')(x)
x = Dropout(0.5)(x)
x = BatchNormalization()(x)
x = Dense(4096, activation='relu')(x)
x = Dropout(0.5)(x)
predictions = Dense(len(label_encoder.classes_), activation='softmax')(x)
model = Model(inputs=base_model.input, outputs=predictions)

# Compile model
model.compile(optimizer=Adam(learning_rate=1e-5), loss='categorical_crossent

# Train model
history = model.fit(data_gen.flow(X_train, y_train, batch_size=32), validati

# Evaluate model
val_loss, val_accuracy = model.evaluate(X_val, y_val)
print(f'Validation accuracy: {val_accuracy * 100:.2f}%')

# Plotting training history
plt.figure(figsize=(12, 4))
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label='Training Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Accuracy over Epochs')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()

plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Training Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Loss over Epochs')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()

plt.show()
```

In [ ]:

```
# Confusion Matrix
y_pred = model.predict(X_val)
y_pred_classes = np.argmax(y_pred, axis=1)
y_true = np.argmax(y_val, axis=1)
conf_matrix = confusion_matrix(y_true, y_pred_classes)
plt.figure(figsize=(10, 8))
sns.heatmap(conf_matrix, annot=True, fmt='d', cmap='Blues')
plt.title('Confusion Matrix')
```

```
plt.ylabel('True Label')
plt.xlabel('Predicted Label')
plt.show()

# Calculate precision, recall, F1 score, and accuracy
report = classification_report(y_true, y_pred_classes, output_dict=True)
accuracy = report['accuracy']
precision = report['macro avg']['precision']
recall = report['macro avg']['recall']
f1_score = report['macro avg']['f1-score']

# Display the calculated metrics
print(f'Validation Accuracy: {accuracy:.4f}')
print(f'Precision: {precision:.4f}')
print(f'Recall: {recall:.4f}')
print(f'F1 Score: {f1_score:.4f}')
```

In [ ]:

```
import numpy as np
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import os
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from tensorflow.keras.applications import EfficientNetV2L
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from tensorflow.keras.layers import Flatten, Dense, Dropout, BatchNormalizat
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from tensorflow.keras.optimizers import Adam
from sklearn.preprocessing import LabelEncoder
from tensorflow.keras.utils import to_categorical
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import matplotlib.pyplot as plt

# Constants
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# Load and preprocess images
images = []
labels = []
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    image = cv2.imread(file_path)
    if image is None:
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    image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
    image = cv2.resize(image, IMG_SIZE)
    images.append(image)
    label = file_path.split(os.path.sep)[-2]
    labels.append(label)

# Convert to NumPy arrays and preprocess
images = np.array(images, dtype=np.float32)
labels = np.array(labels)
images = preprocess_input(images)

# Encode labels
label_encoder = LabelEncoder()
labels_encoded = label_encoder.fit_transform(labels)
labels_one_hot = to_categorical(labels_encoded)
```

```
# Split data
X_train, X_val, y_train, y_val = train_test_split(images, labels_one_hot, te

# Data augmentation
data_gen = ImageDataGenerator(rotation_range=20, zoom_range=0.15, width_shif

# Load EfficientNetV2M model
base_model = EfficientNetV2L(weights='imagenet', include_top=False, input_te

# Freeze base model layers and unfreeze the last 4 layers
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x = Flatten()(x)
x = Dense(4096, activation='relu')(x)
x = Dropout(0.5)(x)
x = BatchNormalization()(x)
x = Dense(4096, activation='relu')(x)
x = Dropout(0.5)(x)
predictions = Dense(len(label_encoder.classes_), activation='softmax')(x)
model = Model(inputs=base_model.input, outputs=predictions)

# Compile model
model.compile(optimizer=Adam(learning_rate=1e-5), loss='categorical_crossent

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history = model.fit(data_gen.flow(X_train, y_train, batch_size=32), validati

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# Plotting training history
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plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Accuracy over Epochs')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()

plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Training Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Loss over Epochs')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()

plt.show()
```

In [ ]:
```
# Confusion Matrix
y_pred = model.predict(X_val)
y_pred_classes = np.argmax(y_pred, axis=1)
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sns.heatmap(conf_matrix, annot=True, fmt='d', cmap='Blues')
plt.title('Confusion Matrix')
plt.ylabel('True Label')
plt.xlabel('Predicted Label')
plt.show()

# Calculate precision, recall, F1 score, and accuracy
report = classification_report(y_true, y_pred_classes, output_dict=True)
accuracy = report['accuracy']
precision = report['macro avg']['precision']
recall = report['macro avg']['recall']
f1_score = report['macro avg']['f1-score']

# Display the calculated metrics
print(f'Validation Accuracy: {accuracy:.4f}')
print(f'Precision: {precision:.4f}')
print(f'Recall: {recall:.4f}')
print(f'F1 Score: {f1_score:.4f}')
```

In [ ]:
```

```

In [ ]:
```

```