```
import tensorflow as tf
import numpy as np
import cv2 as cv
from tensorflow.keras.applications import VGG19
from tensorflow.keras.applications import InceptionV3
from tensorflow.keras.applications import ResNet50
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout, Flatten, Conv2D, MaxPooling2D, Input
from tensorflow.keras.models import Model
from tensorflow.keras.callbacks import ReduceLROnPlateau
import matplotlib.pyplot as plt

# Load and preprocess the data
(x_train, y_train), (x_test, y_test) = tf.keras.datasets.cifar10.load_data()
x_train = x_train.astype('float32') / 255.0
x_test = x_test.astype('float32') / 255.0

# Define the input shape
input_shape = (32, 32, 3)

# Define the VGG19 model
vgg19_base = VGG19(weights='imagenet', include_top=False, input_shape=input_shape)
vgg19_model = Sequential()
vgg19_model.add(vgg19_base)
vgg19_model.add(Flatten())
vgg19_model.add(Dense(512, activation='relu'))
vgg19_model.add(Dropout(0.5))
vgg19_model.add(Dense(10, activation='softmax'))

# Compile the VGG19 model
vgg19_model.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accuracy'])

# Define the InceptionV3 model
inception_base = InceptionV3(weights='imagenet', include_top=False, input_shape=input_shape)
inception_model = Sequential()
inception_model.add(inception_base)
inception_model.add(Flatten())
inception_model.add(Dense(512, activation='relu'))
inception_model.add(Dropout(0.5))
inception_model.add(Dense(10, activation='softmax'))

# Compile the InceptionV3 model
inception_model.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accuracy'])

# Define the ResNet50 model
resnet_base = ResNet50(weights='imagenet', include_top=False, input_shape=input_shape)
resnet_model = Sequential()
resnet_model.add(resnet_base)
resnet_model.add(Flatten())
resnet_model.add(Dense(512, activation='relu'))
resnet_model.add(Dropout(0.5))
resnet_model.add(Dense(10, activation='softmax'))

# Compile the ResNet50 model
resnet_model.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accuracy'])

# Define the ReduceLROnPlateau callback
reduce_lr = ReduceLROnPlateau(monitor='val_loss', factor=0.1, patience=5, verbose=1, min_lr=1e-6)

# Train the VGG19 model
vgg19_history = vgg19_model.fit(x_train, y_train, epochs=50, batch_size=64, validation_data=(x_test, y_test), callbacks=[reduce_lr])

# Train the InceptionV3 model
inception_history = inception_model.fit(x_train, y_train, epochs=50, batch_size=64, validation_data=(x_test, y_test), callbacks=[reduce_lr])

# Train the ResNet50 model
resnet_history = resnet_model.fit(x_train, y_train, epochs=50, batch_size=64, validation_data=(x_test, y_test), callbacks=[reduce_lr])

# Evaluate the models on the test data
vgg19_loss, vgg19_accuracy = vgg19_model.evaluate(x_test, y_test)
inception_loss, inception_accuracy = inception_model.evaluate(x_test, y_test)
resnet_loss, resnet_accuracy = resnet_model.evaluate(x_test, y_test)

# Print the accuracy of the models
print('VGG19 accuracy:', vgg19_accuracy)
print('InceptionV3 accuracy:', inception_accuracy)
print('ResNet50 accuracy:', resnet_accuracy)

# Plot the training and validation accuracy
plt.plot(vgg19_history.history['accuracy'], label='VGG19')
plt.plot(inception_history.history['accuracy'], label='InceptionV3')
plt.plot(resnet_history.history['accuracy'], label='ResNet50')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend(loc='lower right')
plt.show()
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/vgg19/vgg19_weights_tf_dim_ordering_tf_kernels_notop.h5
80134624/80134624 [==============================] - 1s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/inception_v3/inception_v3_weights_tf_dim_ordering_tf_kernels_notop.h5
87916544/87916544 [==============================] - 1s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/resnet/resnet50_weights_tf_dim_ordering_tf_kernels_notop.h5
94765736/94765736 [==============================] - 1s 0us/step
Epoch 1/50
782/782 [==============================] - 1ms 1ms/step - loss: 2.3026 - accuracy: 0.1000 - val_loss: 2.3026 - val_accuracy: 0.1000 - lr: 1.0000e-06
Epoch 2/50
782/782 [==============================] - 1ms 1ms/step - loss: 2.3026 - accuracy: 0.1000 - val_loss: 2.3026 - val_accuracy: 0.1000 - lr: 1.0000e-06
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Epoch 9/50
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Epoch 37/50
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Epoch 50/50
782/782 [==============================] - 1ms 1ms/step - loss: 2.3026 - accuracy: 0.1000 - val_loss: 2.3026 - val_accuracy: 0.1000 - lr: 1.0000e-06
VGG19 accuracy: 0.1000
InceptionV3 accuracy: 0.1000
ResNet50 accuracy: 0.1000
```

```
# Plot the training and validation loss
plt.plot(vgg19_history.history['loss'], label='VGG19')
plt.plot(inception_history.history['loss'], label='InceptionV3')
plt.plot(resnet_history.history['loss'], label='ResNet50')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend(loc='upper right')
plt.show()

# Save the models
vgg19_model.save('vgg19_model.h5')
inception_model.save('inception_model.h5')
resnet_model.save('resnet_model.h5')

# Load the saved models
from tensorflow.keras.models import load_model
vgg19_model = load_model('vgg19_model.h5')
inception_model = load_model('inception_model.h5')
resnet_model = load_model('resnet_model.h5')

# Evaluate the models on the test data
vgg19_loss, vgg19_accuracy = vgg19_model.evaluate(x_test, y_test)
inception_loss, inception_accuracy = inception_model.evaluate(x_test, y_test)
resnet_loss, resnet_accuracy = resnet_model.evaluate(x_test, y_test)

# Print the accuracy of the models
print('VGG19 accuracy:', vgg19_accuracy)
print('InceptionV3 accuracy:', inception_accuracy)
print('ResNet50 accuracy:', resnet_accuracy)
```



```
WARNING:keras:Layer dense_3 has 262144000 trainable weights, which is unusually many.
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```