In [4]:
```
import numpy as np
from sklearn.datasets import fetch_lfw_people
from sklearn.model_selection import train_test_split
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.applications import VGG16
from tensorflow.keras.layers import Dense, Flatten
from tensorflow.keras.models import Model
from tensorflow.keras.layers import BatchNormalization, Dropout
from tensorflow.keras.optimizers import Adam
import matplotlib.pyplot as plt
from sklearn.datasets import fetch_lfw_people
from sklearn.preprocessing import OneHotEncoder
from tensorflow.keras.applications import VGG16
from sklearn.model_selection import train_test_split
from tensorflow.keras.preprocessing.image import img_to_array, array_to_img, l
from tensorflow.keras.applications.vgg16 import preprocess_input
from PIL import Image
from keras.models import load_model
from sklearn.metrics.pairwise import cosine_similarity
import warnings
```

In [75]:
```
lfw_people = fetch_lfw_people(min_faces_per_person=70, resize=0.4)

images = lfw_people.images
target_names = lfw_people.target_names
X = lfw_people.data
y = lfw_people.target
n_classes = target_names.shape[0]

n_samples, h, w = lfw_people.images.shape
X_resized = np.zeros((n_samples, 224, 224, 3))

for i in range(n_samples):
    img = X[i].reshape(h, w)
    img = Image.fromarray(np.uint8(img * 200))  # Умножаем на 255 для преобраз
    img = img.convert('RGB')  # Конвертируем в RGB
    img = img.resize((224, 224))  # Изменяем размер
    X_resized[i] = img_to_array(img)  #

# Нормализация изображений
X_resized = preprocess_input(X_resized)

encoder = OneHotEncoder()
y_onehot = encoder.fit_transform(y.reshape(-1, 1))


X_train, X_test, y_train, y_test = train_test_split(X_resized, y, test_size=0.


# Выведем несколько
n_images = 7
plt.figure(figsize=(15, 8))
```

```
for i in range(n_images):
    plt.subplot(1, n_images, i + 1)
    plt.imshow(array_to_img(X_test[i]))
    plt.title(f"{y_test[i]}: {target_names[y_test[i]]}")
    plt.axis('off')

plt.show()
```

In [76]:
```
datagen = ImageDataGenerator(
    rotation_range=20,
    width_shift_range=0.2,
    height_shift_range=0.2,
    shear_range=0.2,
    zoom_range=0.2,
    horizontal_flip=True,
    fill_mode='nearest'
)

datagen.fit(X_train)

train_generator = datagen.flow(X_train, y_train, batch_size=32)
validation_generator = datagen.flow(X_test, y_test, batch_size=32)


base_model = VGG16(weights='imagenet', include_top=False, input_shape=(224, 22
for layer in base_model.layers:
    layer.trainable = False

x = base_model.output
x = Flatten()(x)
x = Dense(256, activation='relu')(x)
x = Dropout(0.5)(x)
predictions = Dense(n_classes, activation='softmax')(x)

model = Model(inputs=base_model.input, outputs=predictions)
model.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metric

# Обучение модели
with warnings.catch_warnings():
    warnings.simplefilter("ignore")
    model.fit(train_generator,
          steps_per_epoch=len(X_train) // 32,
          epochs=10,
          validation_data=validation_generator,
          validation_steps=len(X_test) // 32)
```

```
Epoch 1/10
30/30 ━━━━━━━━━━━━━━━━━━━━ 67s 2s/step - accuracy: 0.3211 - loss: 14.9486 - va
l_accuracy: 0.5134 - val_loss: 1.4056
Epoch 2/10
30/30 ━━━━━━━━━━━━━━━━━━━━ 16s 479ms/step - accuracy: 0.5000 - loss: 1.3161 - v
al_accuracy: 0.5179 - val_loss: 1.4622
Epoch 3/10
30/30 ━━━━━━━━━━━━━━━━━━━━ 72s 2s/step - accuracy: 0.4742 - loss: 1.5310 - va
l_accuracy: 0.5402 - val_loss: 1.1562
Epoch 4/10
30/30 ━━━━━━━━━━━━━━━━━━━━ 15s 464ms/step - accuracy: 0.4688 - loss: 1.3074 - v
al_accuracy: 0.4821 - val_loss: 1.2855
Epoch 5/10
30/30 ━━━━━━━━━━━━━━━━━━━━ 72s 2s/step - accuracy: 0.4982 - loss: 1.3808 - va
l_accuracy: 0.6250 - val_loss: 1.0951
Epoch 6/10
30/30 ━━━━━━━━━━━━━━━━━━━━ 15s 467ms/step - accuracy: 0.6562 - loss: 1.4439 - v
al_accuracy: 0.6071 - val_loss: 1.0603
Epoch 7/10
30/30 ━━━━━━━━━━━━━━━━━━━━ 70s 2s/step - accuracy: 0.5254 - loss: 1.2022 - va
l_accuracy: 0.6027 - val_loss: 1.1430
Epoch 8/10
30/30 ━━━━━━━━━━━━━━━━━━━━ 15s 463ms/step - accuracy: 0.5625 - loss: 1.6752 - v
al_accuracy: 0.6607 - val_loss: 1.0330
Epoch 9/10
30/30 ━━━━━━━━━━━━━━━━━━━━ 70s 2s/step - accuracy: 0.6104 - loss: 1.1570 - va
l_accuracy: 0.7098 - val_loss: 0.8314
Epoch 10/10
30/30 ━━━━━━━━━━━━━━━━━━━━ 15s 464ms/step - accuracy: 0.5312 - loss: 1.2072 - v
al_accuracy: 0.6875 - val_loss: 0.8782
```

In [77]:
```
from sklearn.model_selection import train_test_split

loss, accuracy = model.evaluate(X_test, y_test)
print(f'Loss: {loss}, Accuracy: {accuracy}')
```

```
8/8 ━━━━━━━━━━━━━━━━━━━━ 14s 2s/step - accuracy: 0.7045 - loss: 0.8029
Loss: 0.7921999096870422, Accuracy: 0.7090163826942444
```

In [78]:
```
model.save('face_recognition_model_v8.keras')
```

Тест

In [86]:
```
i = 8 # выбор картинки из тестовой выборки
```

In [87]:
```
plt.figure(figsize=(7, 3))
plt.imshow(array_to_img(X_test[i]))
plt.title(f"{y_test[i]}: {target_names[y_test[i]]}")
plt.axis('off')
plt.show()
```

In [88]:
```
prediction = model.predict(np.expand_dims(X_test[i].reshape(224, 224, 3), axis
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 139ms/step
```

In [89]:
```
print(f"распознан класс: {np.argmax(prediction)}")
```

```
распознан класс: 3
```

Тестирование с моими картинками

In [99]:
```
model = load_model('face_recognition_model_v4.keras')
```

In [100…
```
from keras.preprocessing import image
from keras.applications.vgg16 import preprocess_input
import numpy as np

def get_embedding(img_path):
    img = image.load_img(img_path, target_size=(224, 224))
    img_array = image.img_to_array(img)
    img_array = np.expand_dims(img_array, axis=0)
    img_array = preprocess_input(img_array)
    embedding = model.predict(img_array)
    return embedding

your_image_embedding = get_embedding("vlada_images/1.png")
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 206ms/step
```

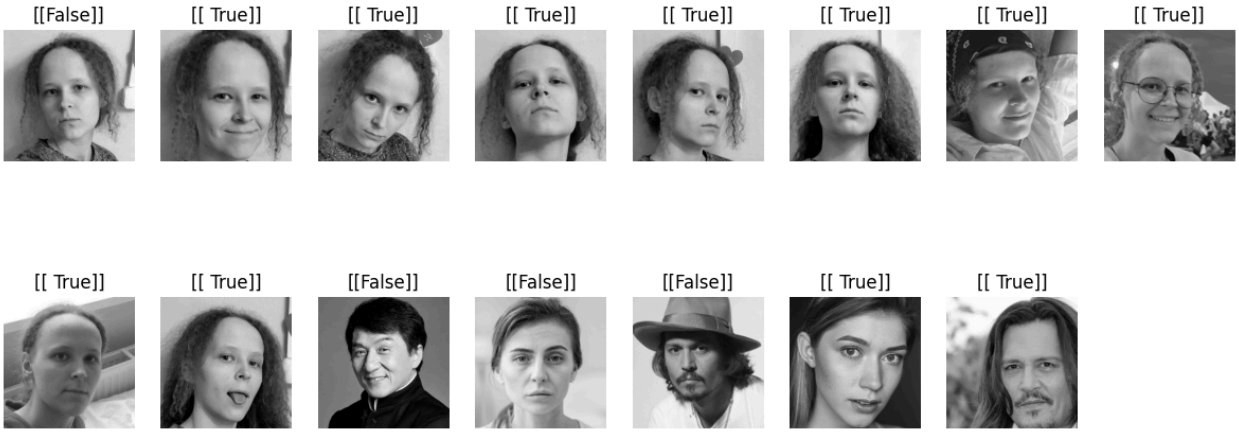
In [101…
```
def is_not_you(your_embedding, test_embedding, threshold=0.5):
    similarity = cosine_similarity(your_embedding, test_embedding)
    return similarity < threshold

plt.figure(figsize=(15, 6))
N = 16
s_me = 0
```

```
s_not_me = 0
for i in range(1, N):
    file_name = f"vlada_images/{i}.png"
    test_embedding = get_embedding(file_name)
    result = is_not_you(your_image_embedding, test_embedding)

    plt.subplot(2, int(N/2), i)
    plt.imshow(Image.open(file_name))
    plt.title(f"{result}")
    plt.axis('off')
    if i <= 10 and result:
        s_me += 1
    if i > 10 and result:
        s_not_me += 1
plt.show()
print(f"Итого \n меня распознано {s_me}/10, \n ошибочно меня распознано {s_not
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 134ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 152ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 128ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 122ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 124ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 144ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 125ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 136ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 131ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 133ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 124ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 127ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 123ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 131ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 133ms/step
```




```
Итого
 меня распознано 9/10,
 ошибочно меня распознано 2/5
```

In [ ]: