lung-cancer-efficientnet-4

July 14, 2024

[1]:
```
import os
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import tensorflow as tf
from tensorflow.keras import layers
import seaborn as sns
from sklearn.metrics import confusion_matrix, classification_report
import cv2
```

```
2024-04-01 15:31:04.337542: E
external/local_xla/xla/stream_executor/cuda/cuda_dnn.cc:9261] Unable to register
cuDNN factory: Attempting to register factory for plugin cuDNN when one has
already been registered
2024-04-01 15:31:04.337651: E
external/local_xla/xla/stream_executor/cuda/cuda_fft.cc:607] Unable to register
cuFFT factory: Attempting to register factory for plugin cuFFT when one has
already been registered
2024-04-01 15:31:04.494395: E
external/local_xla/xla/stream_executor/cuda/cuda_blas.cc:1515] Unable to
register cuBLAS factory: Attempting to register factory for plugin cuBLAS when
one has already been registered
```

[2]:
```
SEED = 15243
np.random.seed(SEED)
os.environ["PYTHONHASHSEED"] = str(SEED)
tf.random.set_seed(SEED)
plt.rc("axes.spines", right=False, top=False)
plt.rc("font", family="serif")
```

[3]:
```
BATCH_SIZE = 25
DATA_DIR = ("/kaggle/input/lung-and-colon-cancer-histopathological-images/
 ↪lung_colon_image_set/lung_image_sets")

IMG_SIZE = 256
MAX_EPOCHS = 100
class_names = ["lung_n", "lung_aca", "lung_scc"]
```

```
class_details = ["No Cancer", "Adenocarcinoma", "Squamous Cell Carcinoma"]
```

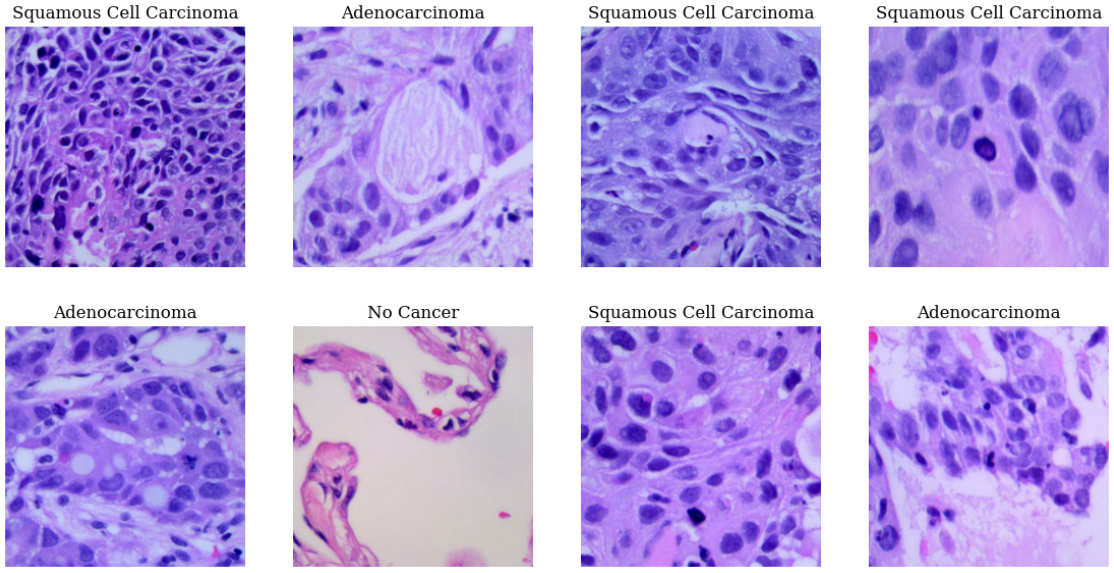
[4]:
```
train_ds = tf.keras.preprocessing.image_dataset_from_directory(
    DATA_DIR,
    batch_size=BATCH_SIZE,
    image_size=(IMG_SIZE, IMG_SIZE),
    class_names=class_names,
    seed=45,
    subset="training",
    validation_split=0.2
)
```

```
Found 15000 files belonging to 3 classes.
Using 12000 files for training.
```

[5]:
```
validation_ds = tf.keras.preprocessing.image_dataset_from_directory(
    DATA_DIR,
    batch_size=BATCH_SIZE,
    image_size=(IMG_SIZE, IMG_SIZE),
    class_names=class_names,
    seed=45,
    subset="validation",
    validation_split=0.2
)
```

```
Found 15000 files belonging to 3 classes.
Using 3000 files for validation.
```

[6]:
```
plt.figure(figsize=(14, 7))
for images, labels in train_ds.take(1):
    labels = labels.numpy()
    for i in range(8):
        ax = plt.subplot(2, 4, i + 1)
        plt.imshow(images[i].numpy().astype("uint8"))
        plt.title(class_details[labels[i]])
        plt.axis("off")
```



[7]:
```
AUTOTUNE = tf.data.AUTOTUNE
train_ds = train_ds.cache(".cached-data").prefetch(buffer_size=AUTOTUNE)
validation_ds = validation_ds.cache().prefetch(buffer_size=AUTOTUNE)
def compile_and_fit_model(model: tf.keras.Sequential) -> tf.keras.callbacks.
 ↪History:
    model.compile(
        optimizer="adam",
        loss="sparse_categorical_crossentropy",
        metrics=["accuracy"]
    )
    early_stopping = tf.keras.callbacks.EarlyStopping(
        monitor="val_loss",
        min_delta=1e-4,
        patience=5,
        mode="auto",
        restore_best_weights=True
    )
    reduce_lr = tf.keras.callbacks.ReduceLROnPlateau(
        monitor="val_loss",
        factor=0.2,
        patience=5,
        min_lr=0.001
    )
    history = model.fit(
        train_ds,
        validation_data=validation_ds,
        epochs=MAX_EPOCHS,
        steps_per_epoch=50,
```

```
        callbacks=[early_stopping, reduce_lr]
    )
    performance_df = pd.DataFrame(history.history)
    fig, axes = plt.subplots(nrows=1, ncols=2, figsize=(12, 4))
    for ax, metric in zip(axes.flat, ["accuracy", "loss"]):
        performance_df.filter(like=metric).plot(ax=ax)
        ax.set_title(metric.title(), size=15, pad=20)
    return history
```

[8]:
```
pretrained_efficientnet_base = tf.keras.applications.efficientnet.
 ↪EfficientNetB1(
    include_top=False, weights="imagenet", pooling="avg",
)
pretrained_efficientnet_base.trainable = False
efficientnet_model = tf.keras.Sequential([
    layers.Input(shape=(IMG_SIZE, IMG_SIZE, 3)),
    pretrained_efficientnet_base,
    layers.Dense(128, activation="relu"),
    layers.Dense(3, activation="softmax")
])
efficientnet_model.summary()
```

```
Downloading data from https://storage.googleapis.com/keras-
applications/efficientnetb1_notop.h5
27018416/27018416 [==============================] - 0s 0us/step
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 efficientnetb1 (Functional  (None, 1280)              6575239
 )

 dense (Dense)               (None, 128)               163968

 dense_1 (Dense)             (None, 3)                 387

=================================================================
Total params: 6739594 (25.71 MB)
Trainable params: 164355 (642.01 KB)
Non-trainable params: 6575239 (25.08 MB)
_________________________________________________________________
```

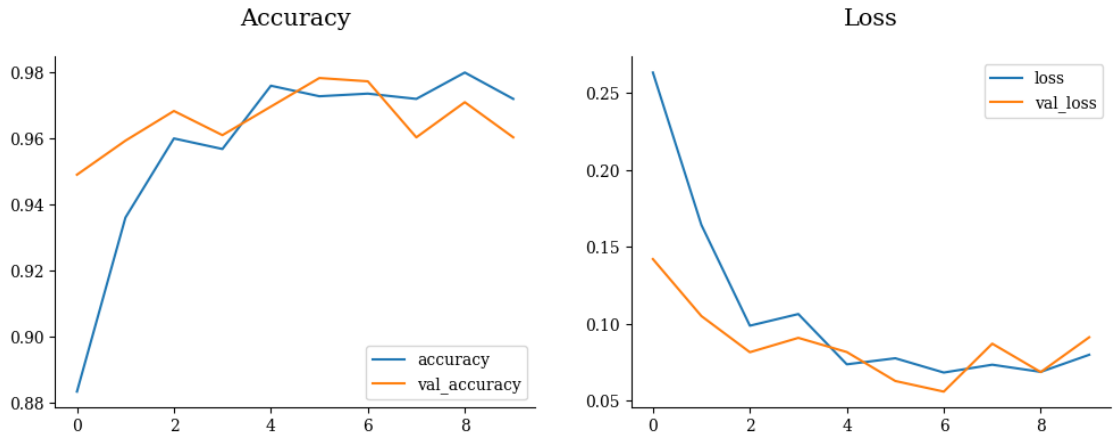
[9]:
```
efficientnet_history = compile_and_fit_model(efficientnet_model)
```

```
Epoch 1/100

2024-04-01 15:31:51.657213: E
tensorflow/core/grappler/optimizers/meta_optimizer.cc:961] layout failed:
```

```
INVALID_ARGUMENT: Size of values 0 does not match size of permutation 4 @ fanin
shape
insequential/efficientnetb1/block1b_drop/dropout/SelectV2-2-TransposeNHWCToNCHW-
LayoutOptimizer
WARNING: All log messages before absl::InitializeLog() is called are written to
STDERR
I0000 00:00:1711985515.543982     109 device_compiler.h:186] Compiled cluster
using XLA!  This line is logged at most once for the lifetime of the process.

50/50 [==============================] - 33s 394ms/step - loss: 0.2633 -
accuracy: 0.8832 - val_loss: 0.1419 - val_accuracy: 0.9490 - lr: 0.0010
Epoch 2/100
50/50 [==============================] - 13s 264ms/step - loss: 0.1642 -
accuracy: 0.9360 - val_loss: 0.1049 - val_accuracy: 0.9593 - lr: 0.0010
Epoch 3/100
50/50 [==============================] - 13s 267ms/step - loss: 0.0986 -
accuracy: 0.9600 - val_loss: 0.0813 - val_accuracy: 0.9683 - lr: 0.0010
Epoch 4/100
50/50 [==============================] - 13s 264ms/step - loss: 0.1062 -
accuracy: 0.9568 - val_loss: 0.0907 - val_accuracy: 0.9610 - lr: 0.0010
Epoch 5/100
50/50 [==============================] - 13s 264ms/step - loss: 0.0734 -
accuracy: 0.9760 - val_loss: 0.0814 - val_accuracy: 0.9697 - lr: 0.0010
Epoch 6/100
50/50 [==============================] - 13s 266ms/step - loss: 0.0774 -
accuracy: 0.9728 - val_loss: 0.0626 - val_accuracy: 0.9783 - lr: 0.0010
Epoch 7/100
50/50 [==============================] - 13s 267ms/step - loss: 0.0681 -
accuracy: 0.9736 - val_loss: 0.0557 - val_accuracy: 0.9773 - lr: 0.0010
Epoch 8/100
50/50 [==============================] - 13s 266ms/step - loss: 0.0732 -
accuracy: 0.9720 - val_loss: 0.0869 - val_accuracy: 0.9603 - lr: 0.0010
Epoch 9/100
50/50 [==============================] - 13s 264ms/step - loss: 0.0685 -
accuracy: 0.9800 - val_loss: 0.0684 - val_accuracy: 0.9710 - lr: 0.0010
Epoch 10/100
50/50 [==============================] - 12s 238ms/step - loss: 0.0797 -
accuracy: 0.9720 - val_loss: 0.0911 - val_accuracy: 0.9603 - lr: 0.0010
```



[10]:
```
'''def get_predictions(model, dataset):
    y_true = []
    y_pred = []

    for images, labels in dataset:
        y_true.extend(labels.numpy())
        predictions = model.predict(images)
        y_pred.extend(np.argmax(predictions, axis=1))

    return np.array(y_true), np.array(y_pred)


train_true, train_pred = get_predictions(efficientnet_model, train_ds)
val_true, val_pred = get_predictions(efficientnet_model, validation_ds)

train_conf_matrix = confusion_matrix(train_true, train_pred)
train_class_report = classification_report(train_true, train_pred,␣
 ↪target_names=class_details)

val_conf_matrix = confusion_matrix(val_true, val_pred)
val_class_report = classification_report(val_true, val_pred,␣
 ↪target_names=class_details)

print("Confusion Matrix (Training Set):\n", train_conf_matrix)
print("\nClassification Report (Training Set):\n", train_class_report)

print("\nConfusion Matrix (Validation Set):\n", val_conf_matrix)
print("\nClassification Report (Validation Set):\n", val_class_report)'''
```

[10]:
```
'def get_predictions(model, dataset):\n    y_true = []\n    y_pred = []\n\n
for images, labels in dataset:\n        y_true.extend(labels.numpy())\n
```

```
predictions = model.predict(images)\n
y_pred.extend(np.argmax(predictions, axis=1))\n\n    return np.array(y_true),
np.array(y_pred)\n\n\ntrain_true, train_pred =
get_predictions(efficientnet_model, train_ds)\nval_true, val_pred =
get_predictions(efficientnet_model, validation_ds)\n\ntrain_conf_matrix =
confusion_matrix(train_true, train_pred)\ntrain_class_report =
classification_report(train_true, train_pred,
target_names=class_details)\n\nval_conf_matrix = confusion_matrix(val_true,
val_pred)\nval_class_report = classification_report(val_true, val_pred,
target_names=class_details)\n\nprint("Confusion Matrix (Training Set):\n",
train_conf_matrix)\nprint("\nClassification Report (Training Set):\n",
train_class_report)\n\nprint("\nConfusion Matrix (Validation Set):\n",
val_conf_matrix)\nprint("\nClassification Report (Validation Set):\n",
val_class_report)'
```

[11]:
```
validation_predictions = []
validation_labels = []

for images, labels in validation_ds:
    validation_predictions.extend(np.argmax(efficientnet_model.predict(images),␣
 ↪axis=1))
    validation_labels.extend(labels.numpy())

conf_matrix = confusion_matrix(validation_labels, validation_predictions)

class_report = classification_report(validation_labels, validation_predictions,␣
 ↪target_names=class_details)

plt.figure(figsize=(8, 6))
sns.heatmap(conf_matrix, annot=True, fmt="d", cmap="Blues",␣
 ↪xticklabels=class_details, yticklabels=class_details)
plt.xlabel("Predicted Labels")
plt.ylabel("True Labels")
plt.title("Confusion Matrix")
plt.show()

print("Classification Report:")
print(class_report)
```

```
1/1 [==============================] - 2s 2s/step
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1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 49ms/step
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1/1 [==============================] - 0s 50ms/step
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1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 40ms/step
```
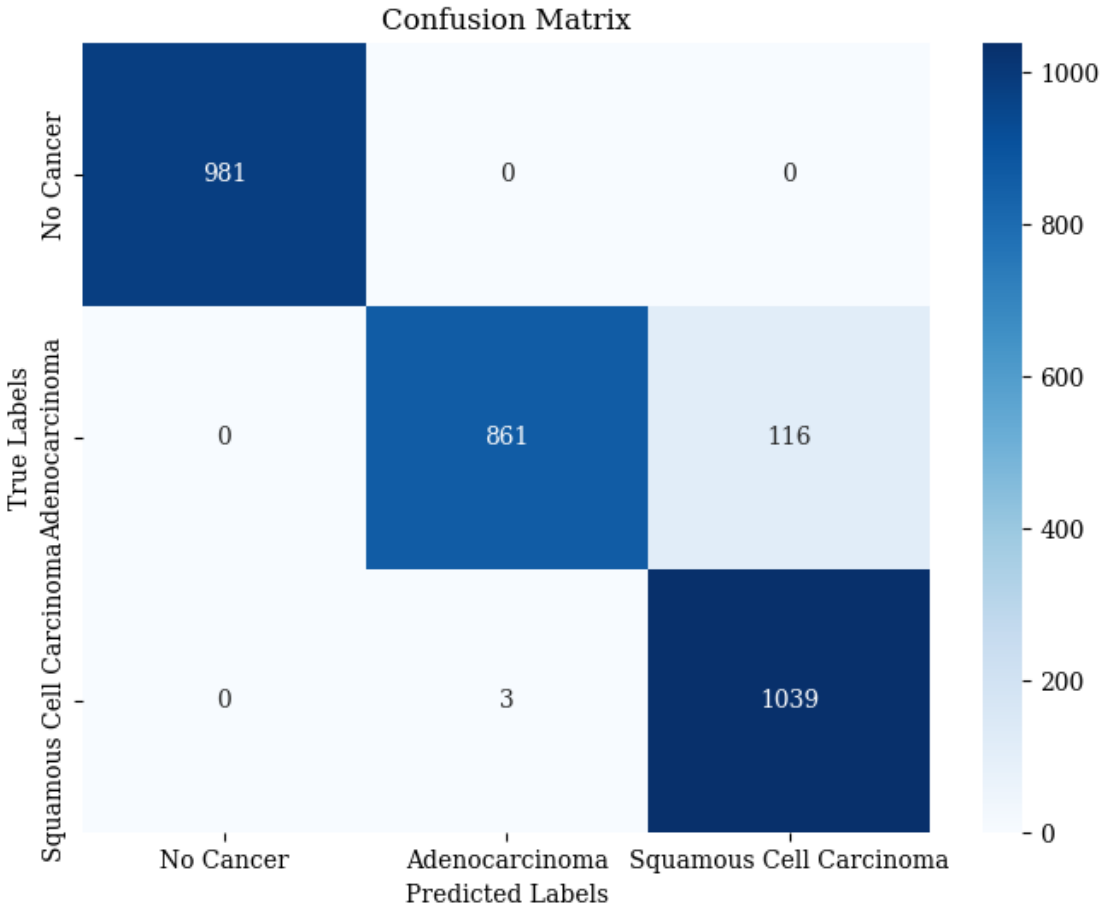
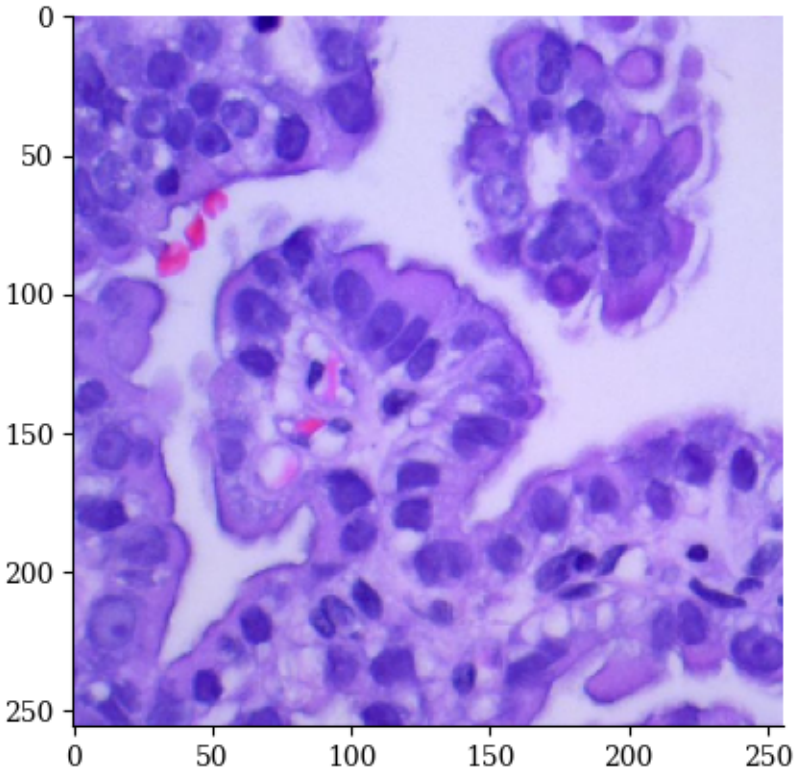




```
Classification Report:
                         precision    recall  f1-score   support
```

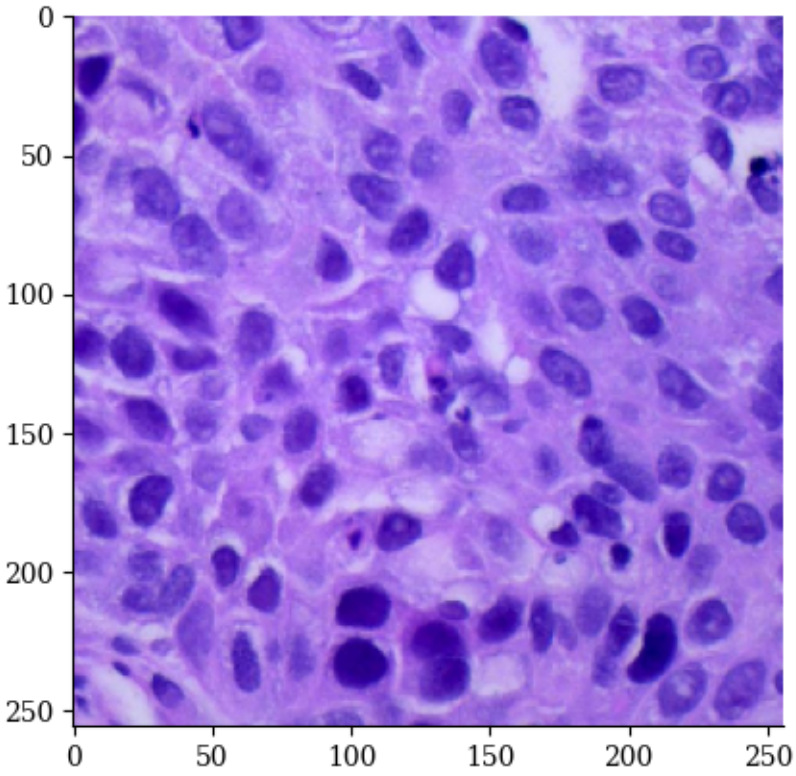
```
                    No Cancer       1.00      1.00      1.00       981
                Adenocarcinoma       1.00      0.88      0.94       977
Squamous Cell Carcinoma              0.90      1.00      0.95      1042

                     accuracy                           0.96      3000
                    macro avg       0.97      0.96      0.96      3000
                 weighted avg       0.96      0.96      0.96      3000
```

[12]:
```
prediction_folder="/kaggle/input/prediction-set/pred"
image_files = os.listdir(prediction_folder)
from keras.preprocessing import image
model=efficientnet_model
for image_file in image_files:
    print(image_file)
    img = os.path.join(prediction_folder, image_file)
    img = image.load_img(img,target_size=(IMG_SIZE, IMG_SIZE))
    imag = image.img_to_array(img)
    imaga = np.expand_dims(imag,axis=0)
    ypred = model.predict(imaga)
    print(ypred)
    a=np.argmax(ypred,-1)
    if a==0:
          op="no cancer "
    elif a==1:
          op="adinocarcinoma"
    else:
          op="squamous cell carcinoma"
    plt.imshow(img)
    plt.show()
    print("THE UPLOADED IMAGE IS SUSPECTED AS: "+str(op))
```

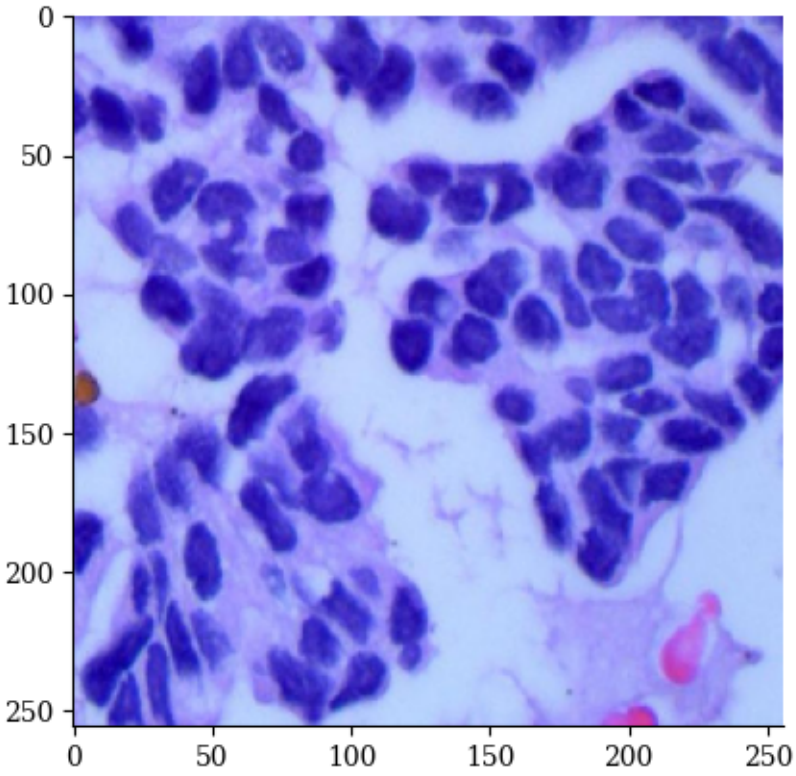
```
lungaca10.jpeg
1/1 [==============================] - 1s 1s/step
[[2.8404582e-05 9.9996638e-01 5.1903121e-06]]
```



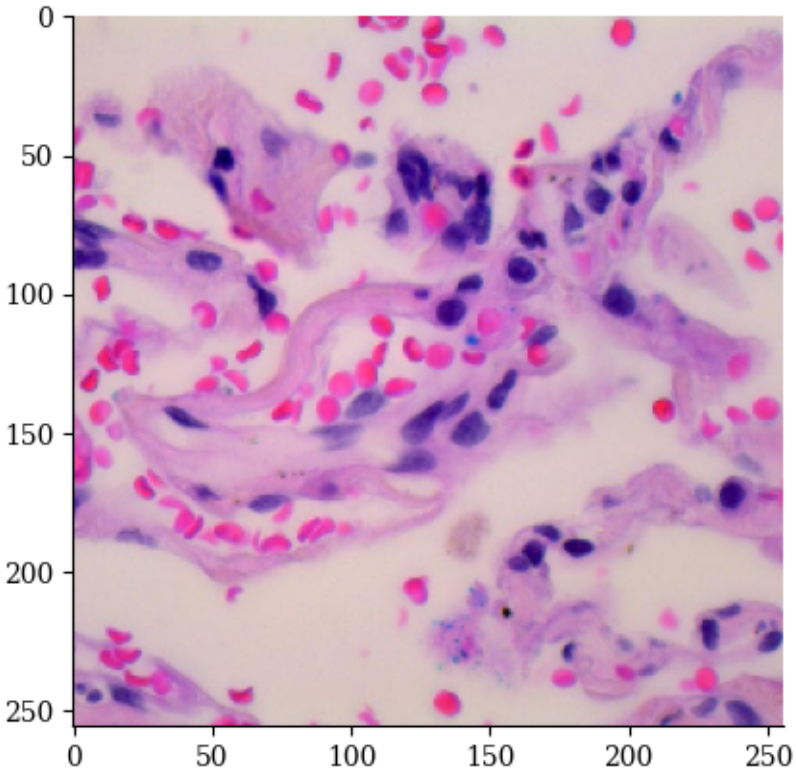

```
THE UPLOADED IMAGE IS SUSPECTED AS: adinocarcinoma
lungscc1007.jpeg
1/1 [==============================] - 0s 30ms/step
[[2.0589576e-08 8.1440201e-04 9.9918562e-01]]
```



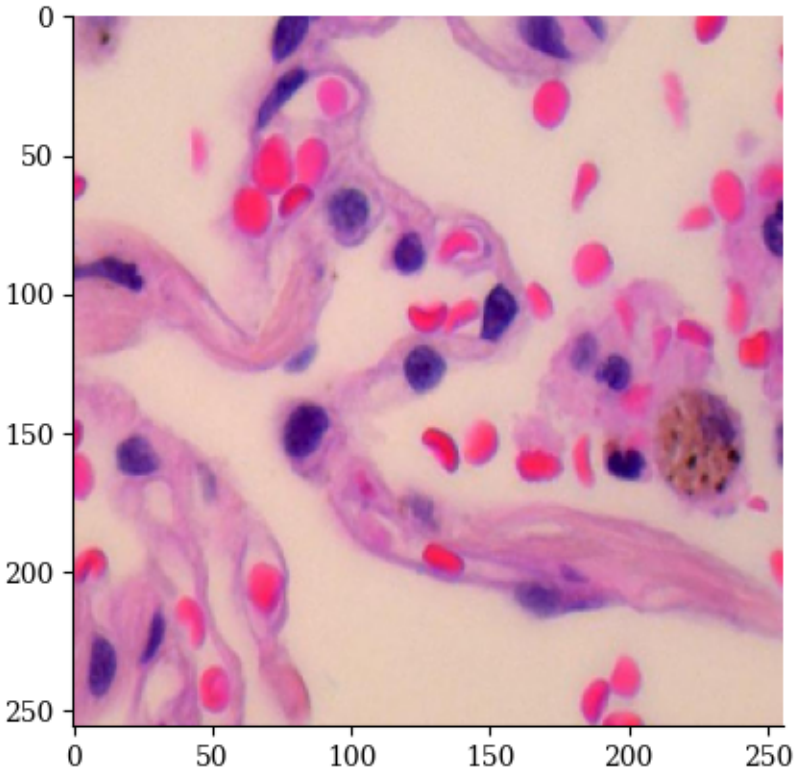

```
THE UPLOADED IMAGE IS SUSPECTED AS: squamous cell carcinoma
lungaca1013.jpeg
1/1 [==============================] - 0s 32ms/step
[[7.572352e-04 9.987735e-01 4.692499e-04]]
```



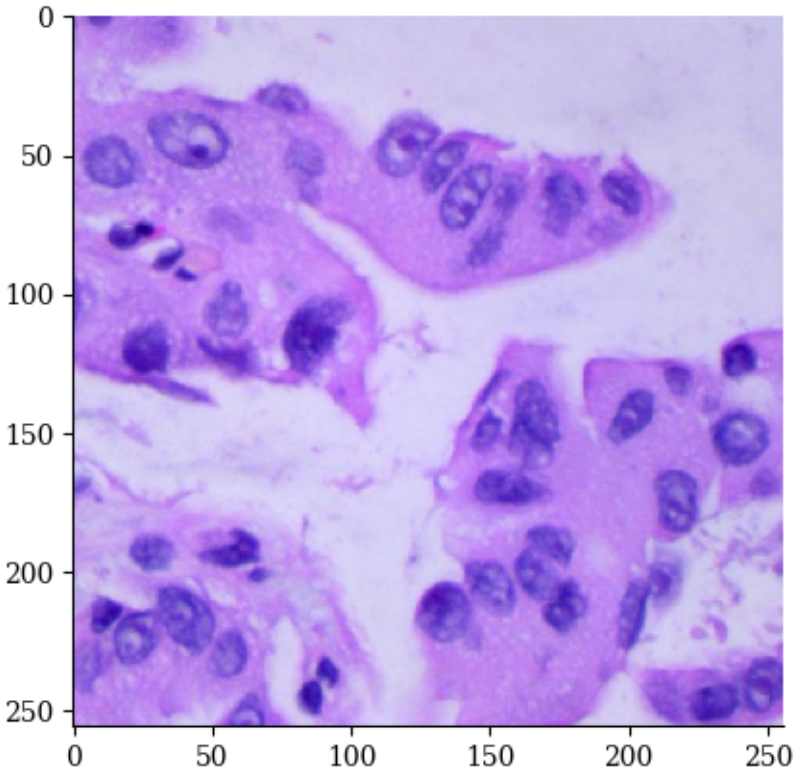

```
THE UPLOADED IMAGE IS SUSPECTED AS: adinocarcinoma
lungn1009.jpeg
1/1 [==============================] - 0s 30ms/step
[[9.9999678e-01 3.1839709e-06 9.6623598e-09]]
```



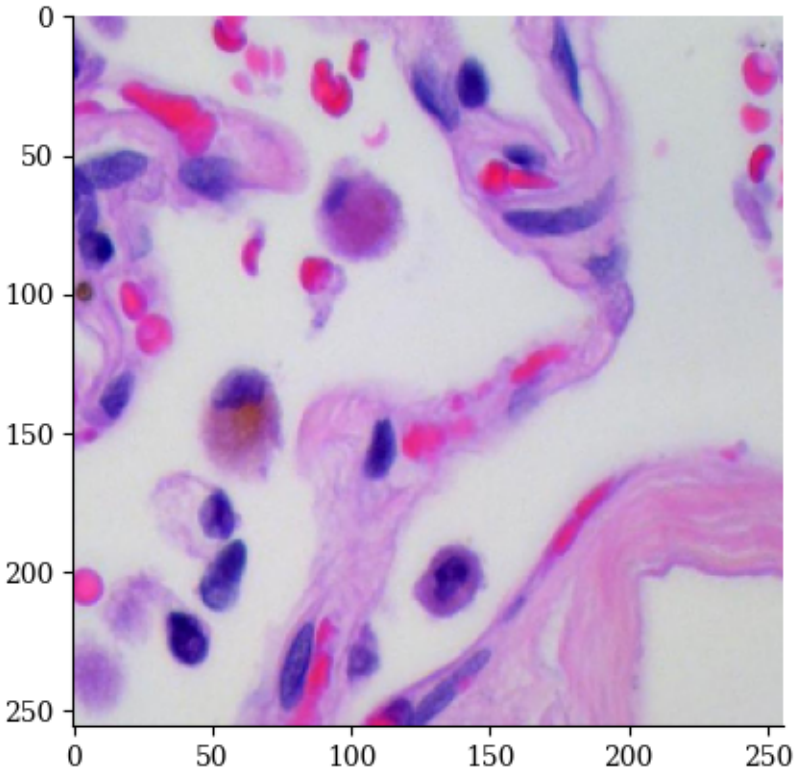

```
THE UPLOADED IMAGE IS SUSPECTED AS: no cancer
lungn1011.jpeg
1/1 [==============================] - 0s 30ms/step
[[9.9987662e-01 1.2273827e-04 5.5031956e-07]]
```



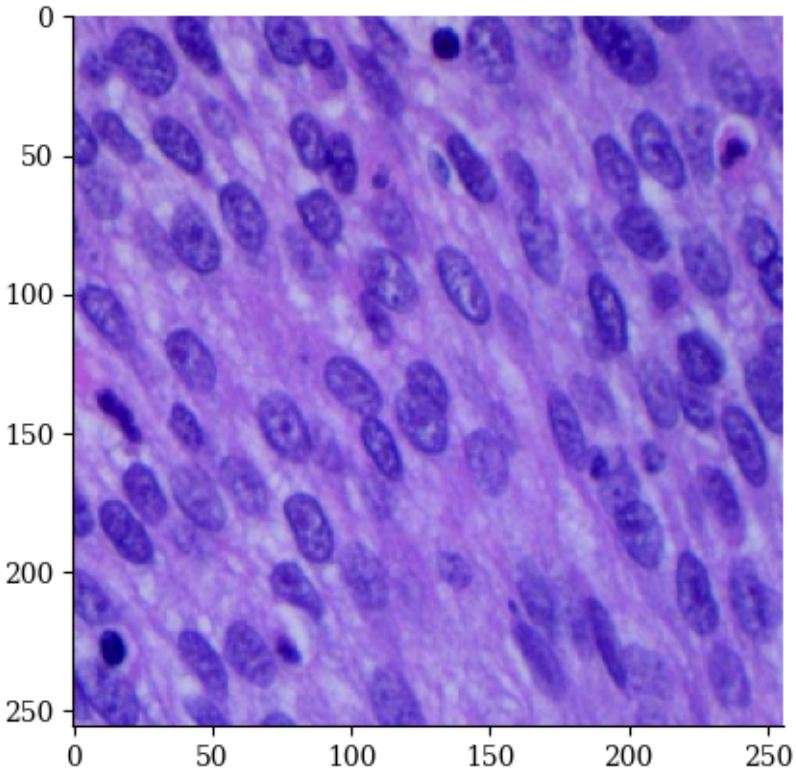

```
THE UPLOADED IMAGE IS SUSPECTED AS: no cancer
lungaca1010.jpeg
1/1 [==============================] - 0s 30ms/step
[[7.0734782e-06 9.9920624e-01 7.8676629e-04]]
```



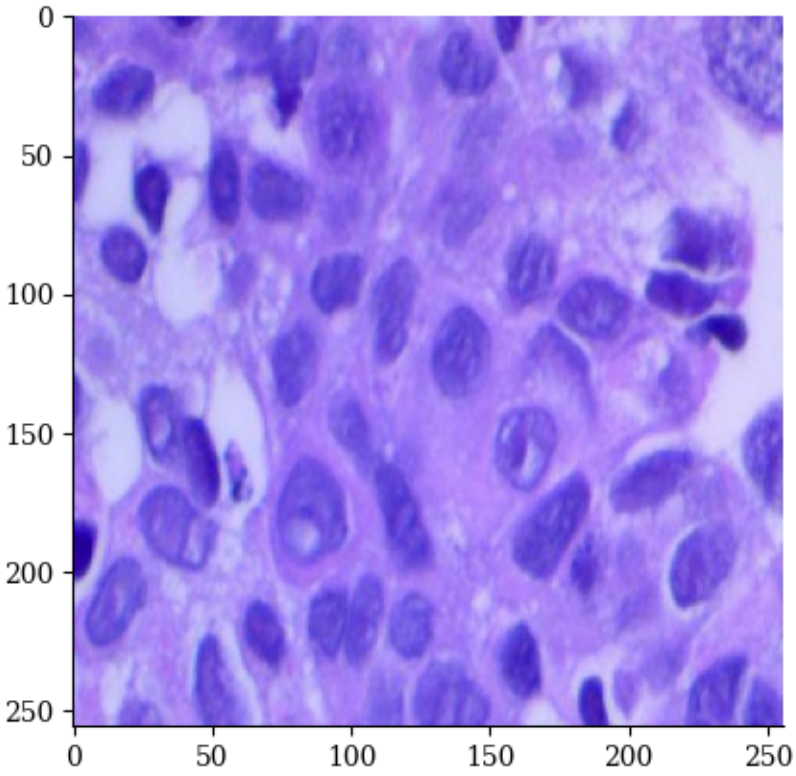

```
THE UPLOADED IMAGE IS SUSPECTED AS: adinocarcinoma
lungn1019.jpeg
1/1 [==============================] - 0s 30ms/step
[[9.9979693e-01 2.0269291e-04 3.6211517e-07]]
```



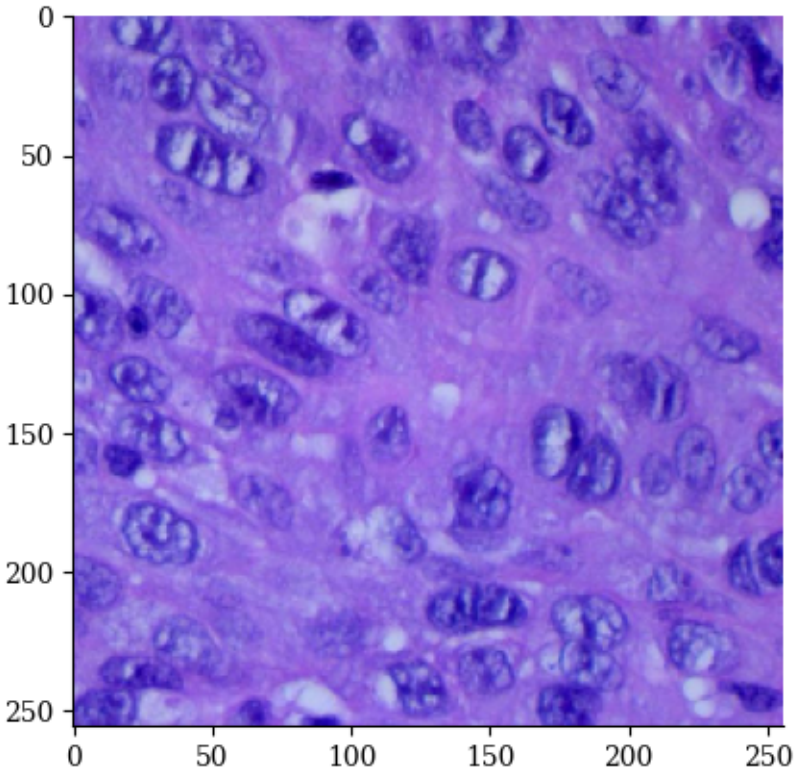

```
THE UPLOADED IMAGE IS SUSPECTED AS: no cancer
lungscc100.jpeg
1/1 [==============================] - 0s 29ms/step
[[2.4100750e-09 1.2405758e-05 9.9998760e-01]]
```



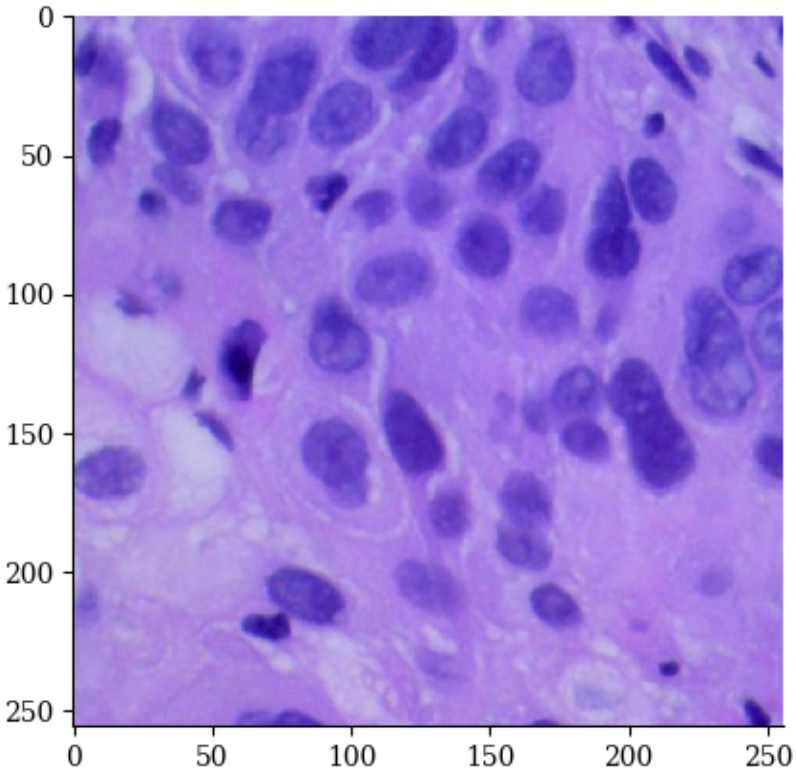

```
THE UPLOADED IMAGE IS SUSPECTED AS: squamous cell carcinoma
lungscc1010.jpeg
1/1 [==============================] - 0s 31ms/step
[[4.0803428e-08 2.5102727e-02 9.7489727e-01]]
```



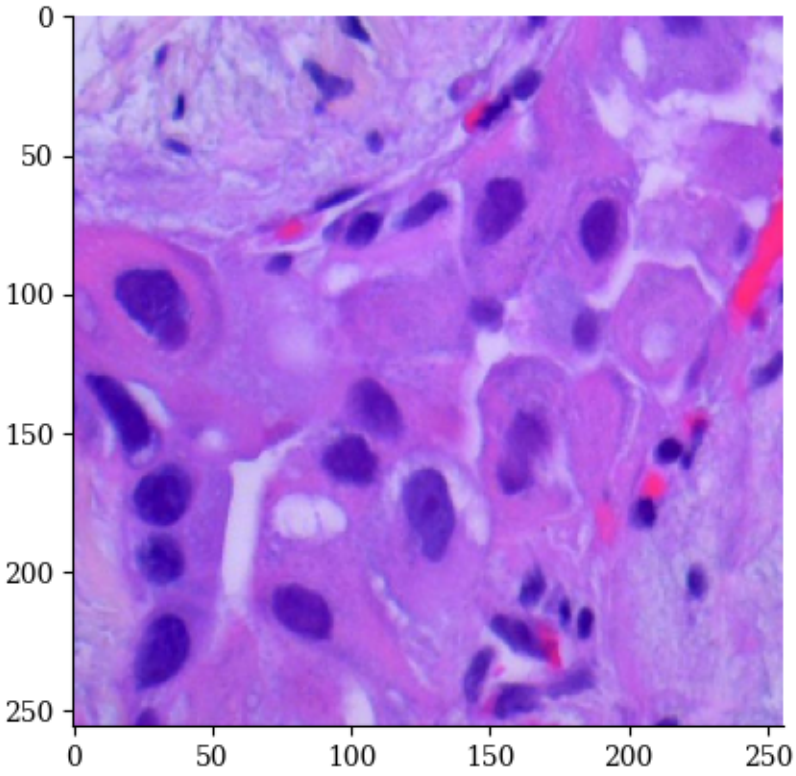

```
THE UPLOADED IMAGE IS SUSPECTED AS: squamous cell carcinoma
lungscc1.jpeg
1/1 [==============================] - 0s 33ms/step
[[2.4777516e-09 6.8083033e-04 9.9931920e-01]]
```



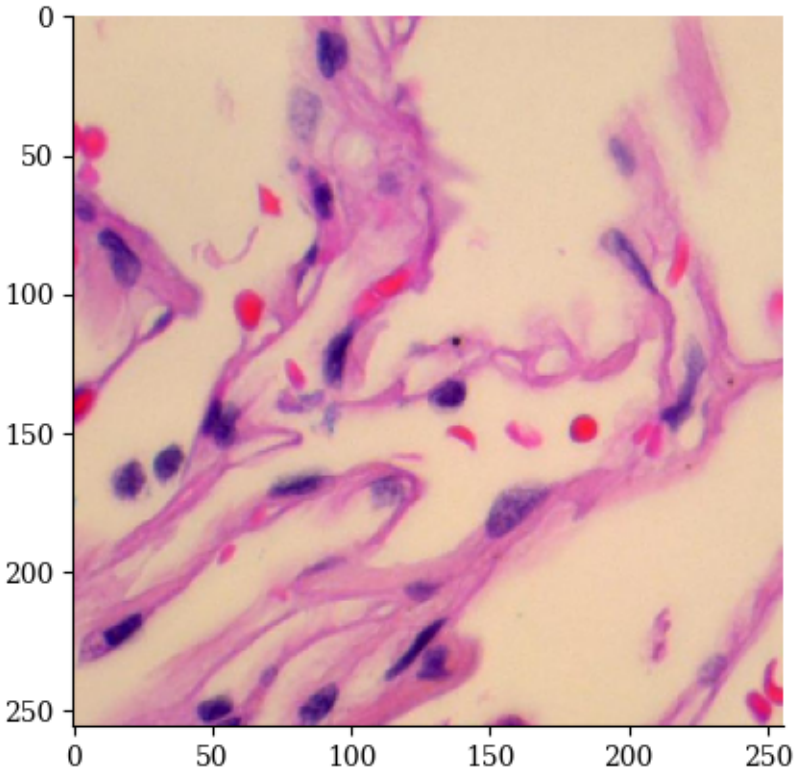

```
THE UPLOADED IMAGE IS SUSPECTED AS: squamous cell carcinoma
lungscc1005.jpeg
1/1 [==============================] - 0s 31ms/step
[[2.2098314e-08 3.5357254e-04 9.9964643e-01]]
```



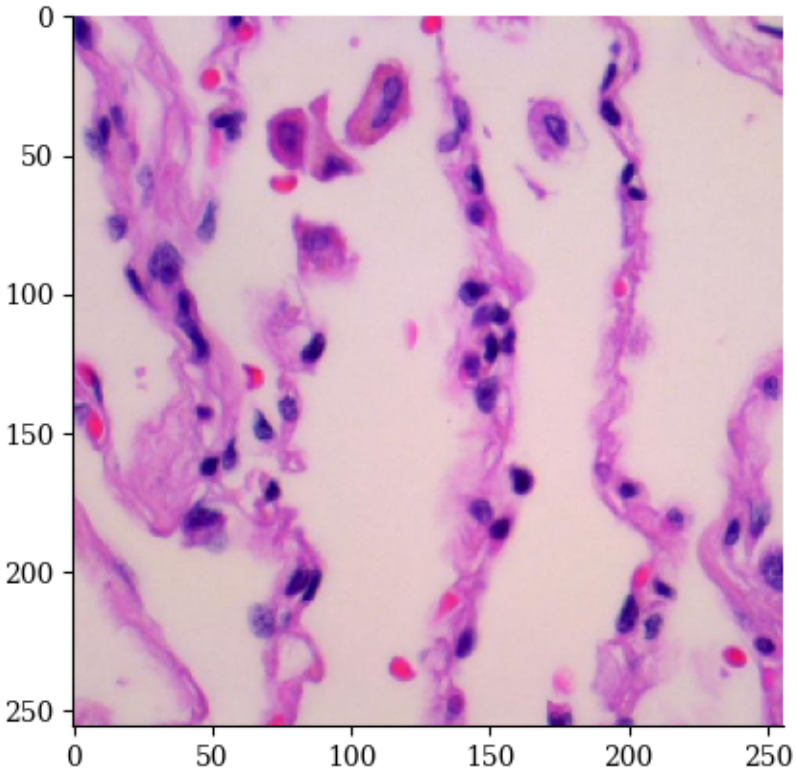

```
THE UPLOADED IMAGE IS SUSPECTED AS: squamous cell carcinoma
lungaca1.jpeg
1/1 [==============================] - 0s 30ms/step
[[8.5493220e-06 9.9021775e-01 9.7737452e-03]]
```



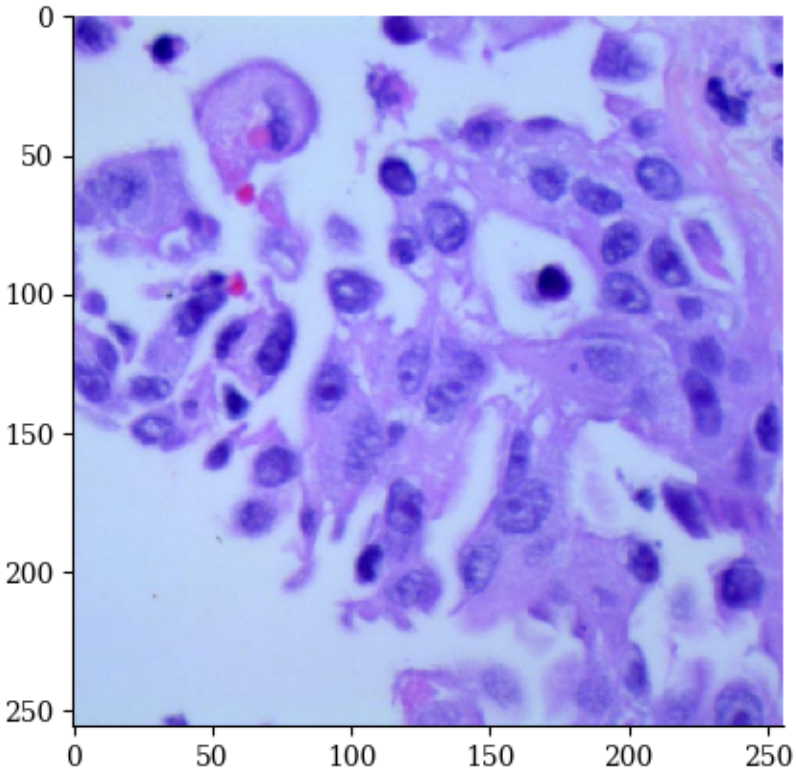

```
THE UPLOADED IMAGE IS SUSPECTED AS: adinocarcinoma
lungn1000.jpeg
1/1 [==============================] - 0s 29ms/step
[[9.9999630e-01 3.6429306e-06 3.0045606e-09]]
```




```
THE UPLOADED IMAGE IS SUSPECTED AS: no cancer
lungn1.jpeg
1/1 [==============================] - 0s 35ms/step
[[9.9928230e-01 7.1495719e-04 2.7659325e-06]]
```




```
THE UPLOADED IMAGE IS SUSPECTED AS: no cancer
lungaca1023.jpeg
1/1 [==============================] - 0s 30ms/step
[[1.4573052e-05 9.9216568e-01 7.8197625e-03]]
```



THE UPLOADED IMAGE IS SUSPECTED AS: adinocarcinoma