

```
!pip install numpy==1.23.5 tensorflow==2.12.0
```

```
Collecting numpy==1.23.5
  Downloading numpy-1.23.5-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (2.3 kB)
Collecting tensorflow==2.12.0
  Downloading tensorflow-2.12.0-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (3.4 kB)
Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (1.4.0)
Requirement already satisfied: astunparse>=1.6.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (1.6.3)
Requirement already satisfied: flatbuffers>=2.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (25.2.10)
Collecting gast<=0.4.0,>=0.2.1 (from tensorflow==2.12.0)
  Downloading gast-0.4.0-py3-none-any.whl.metadata (1.1 kB)
Requirement already satisfied: google-pasta>=0.1.1 in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (0.2.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (1.71.0)
Requirement already satisfied: h5py>=2.9.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (3.13.0)
Requirement already satisfied: jax>=0.3.15 in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (0.5.2)
Collecting keras<2.13,>=2.12.0 (from tensorflow==2.12.0)
  Downloading keras-2.12.0-py2.py3-none-any.whl.metadata (1.4 kB)
Requirement already satisfied: libclang>=13.0.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (18.1.1)
Requirement already satisfied: opt-einsum>=2.3.2 in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (3.4.0)
Requirement already satisfied: packaging in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (24.2)
Collecting protobuf!=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!=4.21.4,!=4.21.5,<5.0.0dev,>=3.20.3 (from tensorflow==2.12.0)
  Downloading protobuf-4.25.6-cp37-abi3-manylinux2014_x86_64.whl.metadata (541 bytes)
Requirement already satisfied: setuptools in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (75.2.0)
Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (1.17.0)
Collecting tensorboard<2.13,>=2.12 (from tensorflow==2.12.0)
  Downloading tensorboard-2.12.3-py3-none-any.whl.metadata (1.8 kB)
Collecting tensorflow-estimator<2.13,>=2.12.0 (from tensorflow==2.12.0)
  Downloading tensorflow_estimator-2.12.0-py2.py3-none-any.whl.metadata (1.3 kB)
Requirement already satisfied: termcolor>=1.1.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (3.0.1)
Requirement already satisfied: typing-extensions>=3.6.6 in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (4.13.2)
Collecting wrapt<1.15,>=1.11.0 (from tensorflow==2.12.0)
  Downloading wrapt-1.14.1-cp311-cp311-manylinux_2_5_x86_64.manylinux1_x86_64.manylinux2014_x86_64.whl.metadata (6.7 kB)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /usr/local/lib/python3.11/dist-packages (from tensorflow==2.12.0) (0.23.1)
Requirement already satisfied: wheel<1.0,>=0.23.0 in /usr/local/lib/python3.11/dist-packages (from astunparse>=1.6.0->tensorflow==2.12.0) (0.37.1)
Requirement already satisfied: jaxlib<=0.5.2,>=0.5.1 in /usr/local/lib/python3.11/dist-packages (from jax>=0.3.15->tensorflow==2.12.0) (0.5.1)
Requirement already satisfied: ml_dtypes>=0.4.0 in /usr/local/lib/python3.11/dist-packages (from jax>=0.3.15->tensorflow==2.12.0) (0.4.1)
INFO: pip is looking at multiple versions of jax to determine which version is compatible with other requirements. This could take a while.
Collecting jax>=0.3.15 (from tensorflow==2.12.0)
  Downloading jax-0.6.0-py3-none-any.whl.metadata (22 kB)
Collecting jaxlib<=0.6.0,>=0.6.0 (from jax>=0.3.15->tensorflow==2.12.0)
  Downloading jaxlib-0.6.0-cp311-cp311-manylinux2014_x86_64.whl.metadata (1.2 kB)
Collecting ml_dtypes>=0.5.0 (from jax>=0.3.15->tensorflow==2.12.0)
  Downloading ml_dtypes-0.5.1-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (21 kB)
Collecting jax>=0.3.15 (from tensorflow==2.12.0)
  Downloading jax-0.5.3-py3-none-any.whl.metadata (22 kB)
Collecting jaxlib<=0.5.3,>=0.5.3 (from jax>=0.3.15->tensorflow==2.12.0)
  Downloading jaxlib-0.5.3-cp311-cp311-manylinux2014_x86_64.whl.metadata (1.2 kB)
```

```
Collecting jax>=0.3.15 (from tensorflow==2.12.0)
  Downloading jax-0.5.1-py3-none-any.whl.metadata (22 kB)
  Downloading jax-0.5.0-py3-none-any.whl.metadata (22 kB)
Collecting jaxlib<=0.5.0,>=0.5.0 (from jax>=0.3.15->tensorflow==2.12.0)
  Downloading jaxlib-0.5.0-cp311-cp311-manylinux2014_x86_64.whl.metadata (978 bytes)
Collecting jax>=0.3.15 (from tensorflow==2.12.0)
  Downloading jax-0.4.38-py3-none-any.whl.metadata (22 kB)
Collecting jaxlib<=0.4.38,>=0.4.38 (from jax>=0.3.15->tensorflow==2.12.0)
  Downloading jaxlib-0.4.38-cp311-cp311-manylinux2014_x86_64.whl.metadata (1.0 kB)
Collecting jax>=0.3.15 (from tensorflow==2.12.0)
  Downloading jax-0.4.37-py3-none-any.whl.metadata (22 kB)
Collecting jaxlib<=0.4.37,>=0.4.36 (from jax>=0.3.15->tensorflow==2.12.0)
  Downloading jaxlib-0.4.36-cp311-cp311-manylinux2014_x86_64.whl.metadata (1.0 kB)
Collecting jax>=0.3.15 (from tensorflow==2.12.0)
  Downloading jax-0.4.36-py3-none-any.whl.metadata (22 kB)
INFO: pip is still looking at multiple versions of jax to determine which version is compatible with other requirements. This could take a
  Downloading jax-0.4.35-py3-none-any.whl.metadata (22 kB)
Collecting jaxlib<=0.4.35,>=0.4.34 (from jax>=0.3.15->tensorflow==2.12.0)
  Downloading jaxlib-0.4.35-cp311-cp311-manylinux2014_x86_64.whl.metadata (983 bytes)
Collecting jax>=0.3.15 (from tensorflow==2.12.0)
  Downloading jax-0.4.34-py3-none-any.whl.metadata (22 kB)
Collecting jaxlib<=0.4.34,>=0.4.34 (from jax>=0.3.15->tensorflow==2.12.0)
  Downloading jaxlib-0.4.34-cp311-cp311-manylinux2014_x86_64.whl.metadata (983 bytes)
Collecting jax>=0.3.15 (from tensorflow==2.12.0)
  Downloading jax-0.4.33-py3-none-any.whl.metadata (22 kB)
Collecting jaxlib<=0.4.33,>=0.4.33 (from jax>=0.3.15->tensorflow==2.12.0)
  Downloading jaxlib-0.4.33-cp311-cp311-manylinux2014_x86_64.whl.metadata (983 bytes)
Collecting jax>=0.3.15 (from tensorflow==2.12.0)
  Downloading jax-0.4.31-py3-none-any.whl.metadata (22 kB)
Collecting jaxlib<=0.4.31,>=0.4.30 (from jax>=0.3.15->tensorflow==2.12.0)
  Downloading jaxlib-0.4.31-cp311-cp311-manylinux2014_x86_64.whl.metadata (983 bytes)
Collecting jax>=0.3.15 (from tensorflow==2.12.0)
  Downloading jax-0.4.30-py3-none-any.whl.metadata (22 kB)
Collecting jaxlib<=0.4.30,>=0.4.27 (from jax>=0.3.15->tensorflow==2.12.0)
  Downloading jaxlib-0.4.30-cp311-cp311-manylinux2014_x86_64.whl.metadata (1.0 kB)
Requirement already satisfied: scipy>=1.9 in /usr/local/lib/python3.11/dist-packages (from jax>=0.3.15->tensorflow==2.12.0) (1.14.1)
Requirement already satisfied: google-auth<3,>=1.6.3 in /usr/local/lib/python3.11/dist-packages (from tensorboard<2.13,>=2.12->tensorflow==
Collecting google-auth-oauthlib<1.1,>=0.5 (from tensorboard<2.13,>=2.12->tensorflow==2.12.0)
  Downloading google_auth_oauthlib-1.0.0-py2.py3-none-any.whl.metadata (2.7 kB)
Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.11/dist-packages (from tensorboard<2.13,>=2.12->tensorflow==2.12.0)
Requirement already satisfied: requests<3,>=2.21.0 in /usr/local/lib/python3.11/dist-packages (from tensorboard<2.13,>=2.12->tensorflow==2.
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in /usr/local/lib/python3.11/dist-packages (from tensorboard<2.13,>=2.
Requirement already satisfied: werkzeug>=1.0.1 in /usr/local/lib/python3.11/dist-packages (from tensorboard<2.13,>=2.12->tensorflow==2.12.0
Requirement already satisfied: cachetools<6.0,>=2.0.0 in /usr/local/lib/python3.11/dist-packages (from google-auth<3,>=1.6.3->tensorboard<2.
Requirement already satisfied: pyasn1-modules>=0.2.1 in /usr/local/lib/python3.11/dist-packages (from google-auth<3,>=1.6.3->tensorboard<2.
Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.11/dist-packages (from google-auth<3,>=1.6.3->tensorboard<2.13,>=2.1
```

```
Requirement already satisfied: requests-oauthlib>=0.7.0 in /usr/local/lib/python3.11/dist-packages (from google-auth-oauthlib<1.1,>=0.5->te
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorboard<2
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=2.12->
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=
Requirement already satisfied: MarkupSafe>=2.1.1 in /usr/local/lib/python3.11/dist-packages (from werkzeug>=1.0.1->tensorboard<2.13,>=2.12-
Requirement already satisfied: pyasn1<0.7.0,>=0.6.1 in /usr/local/lib/python3.11/dist-packages (from pyasn1-modules>=0.2.1->google-auth<3,>
Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.11/dist-packages (from requests-oauthlib>=0.7.0->google-auth-oauth
Downloading numpy-1.23.5-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (17.1 MB)
    ━━━━━━━━━━━━━━━━ 17.1/17.1 MB 33.8 MB/s eta 0:00:00
Downloading tensorflow-2.12.0-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (586.0 MB)
    ━━━━━━━━━━━━━━━━ 586.0/586.0 MB 3.2 MB/s eta 0:00:00
Downloading gast-0.4.0-py3-none-any.whl (9.8 kB)
Downloading jax-0.4.30-py3-none-any.whl (2.0 MB)
    ━━━━━━━━━━━━━━ 2.0/2.0 MB 81.6 MB/s eta 0:00:00
Downloading keras-2.12.0-py2.py3-none-any.whl (1.7 MB)
    ━━━━━━━━━━━━ 1.7/1.7 MB 83.7 MB/s eta 0:00:00
Downloading protobuf-4.25.6-cp37-abi3-manylinux2014_x86_64.whl (294 kB)
    ━━━━━━━━━━━━ 294.6/294.6 kB 28.0 MB/s eta 0:00:00
Downloading tensorboard-2.12.3-py3-none-any.whl (5.6 MB)
    ━━━━━━━━━━ 5.6/5.6 MB 96.9 MB/s eta 0:00:00
Downloading tensorflow_estimator-2.12.0-py2.py3-none-any.whl (440 kB)
    ━━━━━━━━━━ 440.7/440.7 kB 38.8 MB/s eta 0:00:00
Downloading wrapt-1.14.1-cp311-cp311-manylinux_2_5_x86_64.manylinux1_x86_64.manylinux_2_17_x86_64.manylinux2014_x86_64.whl (78 kB)
    ━━━━━━━━ 78.4/78.4 kB 8.2 MB/s eta 0:00:00
Downloading google_auth_oauthlib-1.0.0-py2.py3-none-any.whl (18 kB)
Downloading jaxlib-0.4.30-cp311-cp311-manylinux2014_x86_64.whl (79.6 MB)
    ━━━━━━━━ 79.6/79.6 MB 10.0 MB/s eta 0:00:00
Installing collected packages: wrapt, tensorflow-estimator, protobuf, numpy, keras, gast, jaxlib, google-auth-oauthlib, tensorboard, jax, t
Attempting uninstall: wrapt
    Found existing installation: wrapt 1.17.2
    Uninstalling wrapt-1.17.2:
        Successfully uninstalled wrapt-1.17.2
Attempting uninstall: protobuf
    Found existing installation: protobuf 5.29.4
    Uninstalling protobuf-5.29.4:
        Successfully uninstalled protobuf-5.29.4
Attempting uninstall: numpy
    Found existing installation: numpy 2.0.2
    Uninstalling numpy-2.0.2:
        Successfully uninstalled numpy-2.0.2
Attempting uninstall: keras
    Found existing installation: keras 3.8.0
    Uninstalling keras-3.8.0:
        Successfully uninstalled keras-3.8.0
Attempting uninstall: gast
```

```
Found existing installation: gast 0.6.0
Uninstalling gast-0.6.0:
  Successfully uninstalled gast-0.6.0
Attempting uninstall: jaxlib
Found existing installation: jaxlib 0.5.1
Uninstalling jaxlib-0.5.1:
  Successfully uninstalled jaxlib-0.5.1
Attempting uninstall: google-auth-oauthlib
Found existing installation: google-auth-oauthlib 1.2.1
Uninstalling google-auth-oauthlib-1.2.1:
  Successfully uninstalled google-auth-oauthlib-1.2.1
Attempting uninstall: tensorboard
Found existing installation: tensorboard 2.18.0
Uninstalling tensorboard-2.18.0:
  Successfully uninstalled tensorboard-2.18.0
Attempting uninstall: jax
Found existing installation: jax 0.5.2
Uninstalling jax-0.5.2:
  Successfully uninstalled jax-0.5.2
Attempting uninstall: tensorflow
Found existing installation: tensorflow 2.18.0
Uninstalling tensorflow-2.18.0:
  Successfully uninstalled tensorflow-2.18.0
```

ERROR: pip's dependency resolver does not currently take into account all the packages that are installed. This behaviour is the source of
tensorflow-text 2.18.1 requires tensorflow<2.19,>=2.18.0, but you have tensorflow 2.12.0 which is incompatible.
imbalanced-learn 0.13.0 requires numpy<3,>=1.24.3, but you have numpy 1.23.5 which is incompatible.
scikit-image 0.25.2 requires numpy>=1.24, but you have numpy 1.23.5 which is incompatible.
bigframes 1.42.0 requires numpy>=1.24.0, but you have numpy 1.23.5 which is incompatible.
flax 0.10.5 requires jax>=0.5.1, but you have jax 0.4.30 which is incompatible.
albumentations 2.0.5 requires numpy>=1.24.4, but you have numpy 1.23.5 which is incompatible.
grpcio-status 1.71.0 requires protobuf<6.0dev,>=5.26.1, but you have protobuf 4.25.6 which is incompatible.
ydf 0.11.0 requires protobuf<6.0.0,>=5.29.1, but you have protobuf 4.25.6 which is incompatible.
tensorflow-decision-forests 1.11.0 requires tensorflow==2.18.0, but you have tensorflow 2.12.0 which is incompatible.
blosc2 3.3.0 requires numpy>=1.26, but you have numpy 1.23.5 which is incompatible.
albucore 0.0.23 requires numpy>=1.24.4, but you have numpy 1.23.5 which is incompatible.
tf-keras 2.18.0 requires tensorflow<2.19,>=2.18, but you have tensorflow 2.12.0 which is incompatible.
chex 0.1.89 requires numpy>=1.24.1, but you have numpy 1.23.5 which is incompatible.
treescope 0.1.9 requires numpy>=1.25.2, but you have numpy 1.23.5 which is incompatible.
thinc 8.3.6 requires numpy<3.0.0,>=2.0.0, but you have numpy 1.23.5 which is incompatible.
xarray 2025.1.2 requires numpy>=1.24, but you have numpy 1.23.5 which is incompatible.
pymc 5.21.2 requires numpy>=1.25.0, but you have numpy 1.23.5 which is incompatible.
orbax-checkpoint 0.11.12 requires jax>=0.5.0, but you have jax 0.4.30 which is incompatible.

Successfully installed gast-0.4.0 google-auth-oauthlib-1.0.0 jax-0.4.30 jaxlib-0.4.30 keras-2.12.0 numpy-1.23.5 protobuf-4.25.6 tensorboard

```
!pip install pycocotools
!pip install --upgrade scikit-learn scikit-image scipy
!pip install numpy==1.24
!pip install tensorflow-io
# !pip install --upgrade numpy jax
```

```
Requirement already satisfied: pycocotools in /usr/local/lib/python3.11/dist-packages (2.0.8)
Requirement already satisfied: matplotlib>=2.1.0 in /usr/local/lib/python3.11/dist-packages (from pycocotools) (3.10.0)
Requirement already satisfied: numpy in /usr/local/lib/python3.11/dist-packages (from pycocotools) (1.23.5)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=2.1.0->pycocotools) (1.3.2)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=2.1.0->pycocotools) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=2.1.0->pycocotools) (4.57.0)
Requirement already satisfied: kiwisolver>=1.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=2.1.0->pycocotools) (1.4.8)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=2.1.0->pycocotools) (24.2)
Requirement already satisfied: pillow>=8 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=2.1.0->pycocotools) (11.1.0)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=2.1.0->pycocotools) (3.2.3)
Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=2.1.0->pycocotools) (2.8.2)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-packages (from python-dateutil>=2.7->matplotlib>=2.1.0->pycocotools) (1.16.0)
Requirement already satisfied: scikit-learn in /usr/local/lib/python3.11/dist-packages (1.6.1)
Requirement already satisfied: scikit-image in /usr/local/lib/python3.11/dist-packages (0.25.2)
Requirement already satisfied: scipy in /usr/local/lib/python3.11/dist-packages (1.14.1)
Collecting scipy
  Downloading scipy-1.15.2-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (61 kB)
   62.0/62.0 kB 3.6 MB/s eta 0:00:00
Requirement already satisfied: numpy>=1.19.5 in /usr/local/lib/python3.11/dist-packages (from scikit-learn) (1.23.5)
Requirement already satisfied: joblib>=1.2.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn) (1.4.2)
Requirement already satisfied: threadpoolctl>=3.1.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn) (3.6.0)
Collecting numpy>=1.19.5 (from scikit-learn)
  Downloading numpy-2.2.4-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (62 kB)
   62.0/62.0 kB 3.8 MB/s eta 0:00:00
Requirement already satisfied: networkx>=3.0 in /usr/local/lib/python3.11/dist-packages (from scikit-image) (3.4.2)
Requirement already satisfied: pillow>=10.1 in /usr/local/lib/python3.11/dist-packages (from scikit-image) (11.1.0)
Requirement already satisfied: imageio!=2.35.0,>=2.33 in /usr/local/lib/python3.11/dist-packages (from scikit-image) (2.37.0)
Requirement already satisfied: tifffile>=2022.8.12 in /usr/local/lib/python3.11/dist-packages (from scikit-image) (2025.3.30)
Requirement already satisfied: packaging>=21 in /usr/local/lib/python3.11/dist-packages (from scikit-image) (24.2)
Requirement already satisfied: lazy-loader>=0.4 in /usr/local/lib/python3.11/dist-packages (from scikit-image) (0.4)
Downloading scipy-1.15.2-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (37.6 MB)
   37.6/37.6 MB 13.6 MB/s eta 0:00:00
Downloading numpy-2.2.4-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (16.4 MB)
   16.4/16.4 MB 71.3 MB/s eta 0:00:00
Installing collected packages: numpy, scipy
  Attempting uninstall: numpy
    Found existing installation: numpy 1.23.5
    Uninstalling numpy-1.23.5:
      Successfully uninstalled numpy-1.23.5
  Attempting uninstall: scipy
    Found existing installation: scipy 1.14.1
    Uninstalling scipy-1.14.1:
      Successfully uninstalled scipy-1.14.1
ERROR: pip's dependency resolver does not currently take into account all the packages that are installed. This behaviour is the source of tensorflow 2.12.0 requires numpy<1.24,>=1.22, but you have numpy 2.2.4 which is incompatible.
```

24/07/2025, 20:00

ImageSegmentationIndustrialProject.ipynb - Colab

```
tensorlow-text 2.18.1 requires tensorflow<2.19,>=2.18.0, but you have tensorflow 2.12.0 which is incompatible.
flax 0.10.5 requires jax>=0.5.1, but you have jax 0.4.30 which is incompatible.
ydf 0.11.0 requires protobuf<6.0.0,>=5.29.1, but you have protobuf 4.25.6 which is incompatible.
tensorflow-decision-forests 1.11.0 requires tensorflow==2.18.0, but you have tensorflow 2.12.0 which is incompatible.
numba 0.60.0 requires numpy<2.1,>=1.22, but you have numpy 2.2.4 which is incompatible.
tf-keras 2.18.0 requires tensorflow<2.19,>=2.18, but you have tensorflow 2.12.0 which is incompatible.
orbax-checkpoint 0.11.12 requires jax>=0.5.0, but you have jax 0.4.30 which is incompatible.
```

Successfully installed numpy-2.2.4 scipy-1.15.2

Collecting numpy==1.24

```
  Downloading numpy-1.24.0-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (5.6 kB)
```

```
  Downloading numpy-1.24.0-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (17.3 MB)
```

17.3/17.3 MB 95.7 MB/s eta 0:00:00

Installing collected packages: numpy

Attempting uninstall: numpy

```
  Found existing installation: numpy 2.2.4
```

Uninstalling numpy-2.2.4:

```
  Successfully uninstalled numpy-2.2.4
```

```
ERROR: pip's dependency resolver does not currently take into account all the packages that are installed. This behaviour is the source of
tensorflow 2.12.0 requires numpy<1.24,>=1.22, but you have numpy 1.24.0 which is incompatible.
```

```
tensorflow-text 2.18.1 requires tensorflow<2.19,>=2.18.0, but you have tensorflow 2.12.0 which is incompatible.
```

```
imbalanced-learn 0.13.0 requires numpy<3,>=1.24.3, but you have numpy 1.24.0 which is incompatible.
```

```
seaborn 0.13.2 requires numpy!=1.24.0,>=1.20, but you have numpy 1.24.0 which is incompatible.
```

```
flax 0.10.5 requires jax>=0.5.1, but you have jax 0.4.30 which is incompatible.
```

```
albumentations 2.0.5 requires numpy>=1.24.4, but you have numpy 1.24.0 which is incompatible.
```

```
ydf 0.11.0 requires protobuf<6.0.0,>=5.29.1, but you have protobuf 4.25.6 which is incompatible.
```

```
tensorflow-decision-forests 1.11.0 requires tensorflow==2.18.0, but you have tensorflow 2.12.0 which is incompatible.
```

```
blosc2 3.3.0 requires numpy>=1.26, but you have numpy 1.24.0 which is incompatible.
```

```
albucore 0.0.23 requires numpy>=1.24.4, but you have numpy 1.24.0 which is incompatible.
```

```
tf-keras 2.18.0 requires tensorflow<2.19,>=2.18, but you have tensorflow 2.12.0 which is incompatible.
```

```
chex 0.1.89 requires numpy>=1.24.1, but you have numpy 1.24.0 which is incompatible.
```

```
treescope 0.1.9 requires numpy>=1.25.2, but you have numpy 1.24.0 which is incompatible.
```

```
thinc 8.3.6 requires numpy<3.0.0,>=2.0.0, but you have numpy 1.24.0 which is incompatible.
```

```
pymc 5.21.2 requires numpy>=1.25.0, but you have numpy 1.24.0 which is incompatible.
```

```
orbax-checkpoint 0.11.12 requires jax>=0.5.0, but you have jax 0.4.30 which is incompatible.
```

Successfully installed numpy-1.24.0

Collecting tensorflow-io

```
  Downloading tensorflow_io-0.37.1-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (14 kB)
```

```
Requirement already satisfied: tensorflow-io-gcs-filesystem==0.37.1 in /usr/local/lib/python3.11/dist-packages (from tensorflow-io) (0.37.1)
```

```
  Downloading tensorflow_io-0.37.1-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (49.6 MB)
```

49.6/49.6 MB 11.3 MB/s eta 0:00:00

Installing collected packages: tensorflow-io

```
ERROR: Operation cancelled by user
```

^C

```
!pip install tensorflow_datasets==4.9.3
```

```
→ Collecting tensorflow_datasets==4.9.3
  Downloading tensorflow_datasets-4.9.3-py3-none-any.whl.metadata (9.3 kB)
Requirement already satisfied: absl-py in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (1.4.0)
Requirement already satisfied: array-record in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (0.7.1)
Requirement already satisfied: click in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (8.1.8)
Requirement already satisfied: dm-tree in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (0.1.9)
Requirement already satisfied: etils>=0.9.0 in /usr/local/lib/python3.11/dist-packages (from etils[enp,epath,etree]>=0.9.0->tensorflow_dataset
Requirement already satisfied: numpy in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (1.24.0)
Requirement already satisfied: promise in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (2.3)
Requirement already satisfied: protobuf>=3.20 in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (4.25.6)
Requirement already satisfied: psutil in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (5.9.5)
Requirement already satisfied: requests>=2.19.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (2.32.3)
Requirement already satisfied: tensorflow-metadata in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (1.17.1)
Requirement already satisfied: termcolor in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (3.0.1)
Requirement already satisfied: toml in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (0.10.2)
Requirement already satisfied: tqdm in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (4.67.1)
Requirement already satisfied: wrapt in /usr/local/lib/python3.11/dist-packages (from tensorflow_datasets==4.9.3) (1.14.1)
Requirement already satisfied: einops in /usr/local/lib/python3.11/dist-packages (from etils[enp,epath,etree]>=0.9.0->tensorflow_datasets==4.9
Requirement already satisfied: fsspec in /usr/local/lib/python3.11/dist-packages (from etils[enp,epath,etree]>=0.9.0->tensorflow_datasets==4.9
Requirement already satisfied: importlib_resources in /usr/local/lib/python3.11/dist-packages (from etils[enp,epath,etree]>=0.9.0->tensorflow_
Requirement already satisfied: typing_extensions in /usr/local/lib/python3.11/dist-packages (from etils[enp,epath,etree]>=0.9.0->tensorflow_da
Requirement already satisfied: zipp in /usr/local/lib/python3.11/dist-packages (from etils[enp,epath,etree]>=0.9.0->tensorflow_datasets==4.9.3
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests>=2.19.0->tensorflow_datasets
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-packages (from requests>=2.19.0->tensorflow_datasets==4.9.3) (3.
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests>=2.19.0->tensorflow_datasets==4.9.
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.11/dist-packages (from requests>=2.19.0->tensorflow_datasets==4.9.
Requirement already satisfied: attrs>=18.2.0 in /usr/local/lib/python3.11/dist-packages (from dm-tree->tensorflow_datasets==4.9.3) (25.3.0)
Requirement already satisfied: six in /usr/local/lib/python3.11/dist-packages (from promise->tensorflow_datasets==4.9.3) (1.17.0)
Requirement already satisfied: googleapis-common-protos<2,>=1.56.4 in /usr/local/lib/python3.11/dist-packages (from tensorflow-metadata->tenso
  Downloading tensorflow_datasets-4.9.3-py3-none-any.whl (5.0 MB)
   ━━━━━━━━━━━━━━━━ 5.0/5.0 MB 48.8 MB/s eta 0:00:00
Installing collected packages: tensorflow_datasets
  Attempting uninstall: tensorflow_datasets
    Found existing installation: tensorflow-datasets 4.9.8
    Uninstalling tensorflow-datasets-4.9.8:
      Successfully uninstalled tensorflow-datasets-4.9.8
Successfully installed tensorflow_datasets-4.9.3
```

```
import os
import matplotlib
```

```
import matplotlib.pyplot as plt
import matplotlib.patches as patches
import matplotlib.colors as colors
# import seaborn as sns
import numpy as np

from random import shuffle
from PIL import Image

from pycocotools.coco import COCO

import tensorflow as tf
from tensorflow import keras
from tensorflow.keras import layers
import tensorflow_datasets as tfds
import matplotlib.pyplot as plt
import numpy as np
```

```
print("NumPy version:", np.__version__)
print("TensorFlow version:", tf.__version__)
```

```
→ NumPy version: 1.24.0
TensorFlow version: 2.12.0
```

```
dataset, info = tfds.load('oxford_iiit_pet:3.*.*', with_info=True)
```

```
→ Downloading and preparing dataset 773.52 MiB (download: 773.52 MiB, generated: 774.69 MiB, total: 1.51 GiB) to /root/tensorflow_datasets/oxford_iit_pet
DI Completed...: 100%      2/2 [01:01<00:00, 23.17s/ url]
DI Size...: 100%      773/773 [01:01<00:00, 24.79 MiB/s]
Extraction completed...: 100%      18473/18473 [01:01<00:00, 1309.72 file/s]
```

Dataset oxford_iit_pet downloaded and prepared to /root/tensorflow_datasets/oxford_iit_pet/3.2.0. Subsequent calls will reuse this data.

Start coding or [generate](#) with AI.

```
print("Dataset Info:")
print(info)
```

```
→ Dataset Info:
tfds.core.DatasetInfo(
    name='oxford_iit_pet',
    full_name='oxford_iit_pet/3.2.0',
    description="""
The Oxford-IIIT pet dataset is a 37 category pet image dataset with roughly 200
images for each class. The images have large variations in scale, pose and
lighting. All images have an associated ground truth annotation of breed.
""",
    homepage='http://www.robots.ox.ac.uk/~vgg/data/pets/',
    data_dir=PosixGPath('/tmp/tmpj8l4a7i_tfds'),
    file_format=tfrecord,
    download_size=773.52 MiB,
    dataset_size=774.69 MiB,
    features=FeaturesDict({
        'file_name': Text(shape=(), dtype=string),
```

```
'image': Image(shape=(None, None, 3), dtype=uint8),
'label': ClassLabel(shape=(), dtype=int64, num_classes=37),
'segmentation_mask': Image(shape=(None, None, 1), dtype=uint8),
'species': ClassLabel(shape=(), dtype=int64, num_classes=2),
}),
supervised_keys=('image', 'label'),
disable_shuffling=False,
splits={
    'test': <SplitInfo num_examples=3669, num_shards=4>,
    'train': <SplitInfo num_examples=3680, num_shards=4>,
},
citation="""@InProceedings{parkhi12a,
    author      = "Parkhi, O. M. and Vedaldi, A. and Zisserman, A. and Jawahar, C.~V.",
    title       = "Cats and Dogs",
    booktitle   = "IEEE Conference on Computer Vision and Pattern Recognition",
    year        = "2012",
}""",
)
num_classes = info.features['label'].num_classes
class_names = info.features['label'].names
print(f"\nNumber of classes: {num_classes}")
#print(f"Class names: {class_names}")
class_names
```



Number of classes: 37
['Abyssinian',
'american_bulldog',
'american_pit_bull_terrier',
'basset_hound',
'beagle',
'Bengal',
'Birman',
'Bombay',
'boxer',
'British_Shorthair',
'chihuahua',
'Egyptian_Mau',
'english_cocker_spaniel',
'english_setter',
'german_shorthaired',
'great_pyrenees',
'havanese',

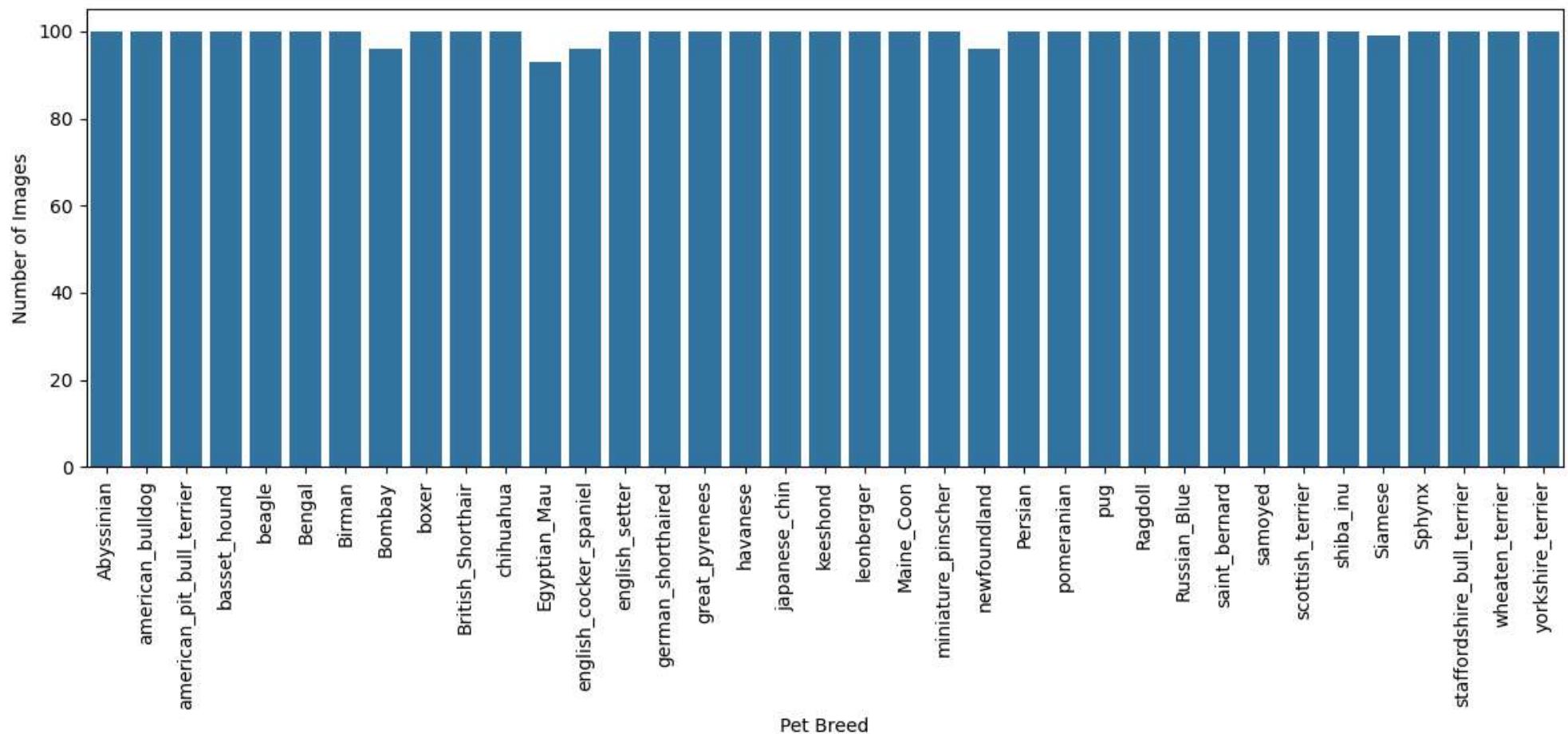
```
'japanese_chin',
'keeshond',
leonberger',
'Maine_Coon',
'miniature_pinscher',
'newfoundland',
'Persian',
'pomeranian',
'pug',
'Ragdoll',
'Russian_Blue',
'saint_bernard',
samoyed',
'scottish_terrier',
'shiba_inu',
'Siamese',
'Sphynx',
'staffordshire_bull_terrier',
'wheaten_terrier',
'yorkshire_terrier']
```

```
train_dataset = dataset['train']
label_counts = np.zeros(num_classes)
for datapoint in tfds.as_numpy(train_dataset):
    # Access the 'label' and potentially other relevant data
    image = datapoint['image']
    label = datapoint['label']
    # Use the accessed data
    label_counts[label] += 1
```

```
import seaborn as sns
plt.figure(figsize=(12, 6))
sns.barplot(x=class_names, y=label_counts)
plt.xticks(rotation=90)
plt.title("Class Distribution in Oxford-IIIT Pets Dataset")
plt.xlabel("Pet Breed")
plt.ylabel("Number of Images")
plt.tight_layout()
plt.show()
```



Class Distribution in Oxford-IIIT Pets Dataset



Start coding or [generate](#) with AI.

```
def resize(input_image, input_mask):  
    input_image = tf.image.resize(input_image, (128, 128), method="nearest")  
    input_mask = tf.image.resize(input_mask, (128, 128), method="nearest")  
    return input_image, input_mask
```

```
def augment(input_image, input_mask):
    if tf.random.uniform(() > 0.5:
        # Random flipping of the image and mask
        input_image = tf.image.flip_left_right(input_image)
        input_mask = tf.image.flip_left_right(input_mask)
    return input_image, input_mask

def normalize(input_image, input_mask):
    input_image = tf.cast(input_image, tf.float32) / 255.0
    input_mask -= 1
    return input_image, input_mask

def load_image_train(datapoint):
    input_image = datapoint["image"]
    input_mask = datapoint["segmentation_mask"]
    input_image, input_mask = resize(input_image, input_mask)
    input_image, input_mask = augment(input_image, input_mask)
    input_image, input_mask = normalize(input_image, input_mask)
    return input_image, input_mask

def load_image_test(datapoint):
    input_image = datapoint["image"]
    input_mask = datapoint["segmentation_mask"]
    input_image, input_mask = resize(input_image, input_mask)
    input_image, input_mask = normalize(input_image, input_mask)
    return input_image, input_mask

train_dataset = dataset["train"].map(load_image_train, num_parallel_calls=tf.data.AUTOTUNE)
test_dataset = dataset["test"].map(load_image_test, num_parallel_calls=tf.data.AUTOTUNE)

dataset["train"]

↳ <_PrefetchDataset element_spec={'file_name': TensorSpec(shape=(), dtype=tf.string, name=None), 'image': TensorSpec(shape=(None, None, 3), dtype=tf.uint8, name=None), 'label': TensorSpec(shape=(), dtype=tf.int64, name=None), 'segmentation_mask': TensorSpec(shape=(None, None, 1), dtype=tf.uint8, name=None), 'species': TensorSpec(shape=(), dtype=tf.int64, name=None)}>

train_dataset
```

```
↳ <_ParallelMapDataset element_spec=(TensorSpec(shape=(128, 128, 3), dtype=tf.float32, name=None), TensorSpec(shape=(128, 128, 1), dtype=tf.uint8, name=None))>

BATCH_SIZE = 64
BUFFER_SIZE = 1000
train_batches = train_dataset.cache().shuffle(BUFFER_SIZE).batch(BATCH_SIZE).repeat()
train_batches = train_batches.prefetch(buffer_size=tf.data.experimental.AUTOTUNE)
validation_batches = test_dataset.take(3000).batch(BATCH_SIZE)
test_batches = test_dataset.skip(3000).take(669).batch(BATCH_SIZE)

train_batches

↳ <_PrefetchDataset element_spec=(TensorSpec(shape=(None, 128, 128, 3), dtype=tf.float32, name=None), TensorSpec(shape=(None, 128, 128, 1), dtype=tf.uint8, name=None))>

validation_batches

↳ <_BatchDataset element_spec=(TensorSpec(shape=(None, 128, 128, 3), dtype=tf.float32, name=None), TensorSpec(shape=(None, 128, 128, 1), dtype=tf.uint8, name=None))>

test_batches

↳ <_BatchDataset element_spec=(TensorSpec(shape=(None, 128, 128, 3), dtype=tf.float32, name=None), TensorSpec(shape=(None, 128, 128, 1), dtype=tf.uint8, name=None))>

def display(display_list):
    plt.figure(figsize=(15, 15))
    title = ["Input Image", "True Mask", "Predicted Mask"]
    for i in range(len(display_list)):
        plt.subplot(1, len(display_list), i+1)
        plt.title(title[i])
        plt.imshow(tf.keras.utils.array_to_img(display_list[i]))
        plt.axis("off")
    plt.show()
sample_batch = next(iter(train_batches))
random_index = np.random.choice(sample_batch[0].shape[0])
sample_image, sample_mask = sample_batch[0][random_index], sample_batch[1][random_index]
display([sample_image, sample_mask])
```



Input Image



True Mask



```
def double_conv_block(x, n_filters):
    # Conv2D then ReLU activation
    x = layers.Conv2D(n_filters, 3, padding = "same", activation = "relu", kernel_initializer = "he_normal")(x)
    # Conv2D then ReLU activation
    x = layers.Conv2D(n_filters, 3, padding = "same", activation = "relu", kernel_initializer = "he_normal")(x)
    return x

def downsample_block(x, n_filters):
    f = double_conv_block(x, n_filters)
```

```
p = layers.MaxPool2D(2)(f)
p = layers.Dropout(0.3)(p)
return f, p

def upsample_block(x, conv_features, n_filters):
    # upsample
    x = layers.Conv2DTranspose(n_filters, 3, 2, padding="same")(x)
    # concatenate
    x = layers.concatenate([x, conv_features])
    # dropout
    x = layers.Dropout(0.3)(x)
    # Conv2D twice with ReLU activation
    x = double_conv_block(x, n_filters)
    return x

def build_unet_model():
    # inputs
    inputs = layers.Input(shape=(128,128,3))
    # encoder: contracting path - downsample
    # 1 - downsample
    f1, p1 = downsample_block(inputs, 64)
    # 2 - downsample
    f2, p2 = downsample_block(p1, 128)
    # 3 - downsample
    f3, p3 = downsample_block(p2, 256)
    # 4 - downsample
    f4, p4 = downsample_block(p3, 512)
    # 5 - bottleneck
    bottleneck = double_conv_block(p4, 1024)
    # decoder: expanding path - upsample
    # 6 - upsample
    u6 = upsample_block(bottleneck, f4, 512)
    # 7 - upsample
    u7 = upsample_block(u6, f3, 256)
    # 8 - upsample
    u8 = upsample_block(u7, f2, 128)
    # 9 - upsample
    u9 = upsample_block(u8, f1, 64)
    # outputs
    outputs = layers.Conv2D(3, 1, padding="same", activation = "softmax")(u9)
```

```
# unet model with Keras Functional API
unet_model = tf.keras.Model(inputs, outputs, name="U-Net")
return unet_model
```

```
unet_model = build_unet_model()
```

```
unet_model.summary()
```

→ Model: "U-Net"

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	[None, 128, 128, 3]	0	[]
conv2d (Conv2D)	(None, 128, 128, 64)	1792	['input_1[0][0]']
conv2d_1 (Conv2D)	(None, 128, 128, 64)	36928	['conv2d[0][0]']
max_pooling2d (MaxPooling2D)	(None, 64, 64, 64)	0	['conv2d_1[0][0]']
dropout (Dropout)	(None, 64, 64, 64)	0	['max_pooling2d[0][0]']
conv2d_2 (Conv2D)	(None, 64, 64, 128)	73856	['dropout[0][0]']
conv2d_3 (Conv2D)	(None, 64, 64, 128)	147584	['conv2d_2[0][0]']
max_pooling2d_1 (MaxPooling2D)	(None, 32, 32, 128)	0	['conv2d_3[0][0]']
dropout_1 (Dropout)	(None, 32, 32, 128)	0	['max_pooling2d_1[0][0]']
conv2d_4 (Conv2D)	(None, 32, 32, 256)	295168	['dropout_1[0][0]']
conv2d_5 (Conv2D)	(None, 32, 32, 256)	590080	['conv2d_4[0][0]']
max_pooling2d_2 (MaxPooling2D)	(None, 16, 16, 256)	0	['conv2d_5[0][0]']
dropout_2 (Dropout)	(None, 16, 16, 256)	0	['max_pooling2d_2[0][0]']
conv2d_6 (Conv2D)	(None, 16, 16, 512)	1180160	['dropout_2[0][0]']

conv2d_7 (Conv2D)	(None, 16, 16, 512)	2359808	['conv2d_6[0][0]']
max_pooling2d_3 (MaxPooling2D)	(None, 8, 8, 512)	0	['conv2d_7[0][0]']
dropout_3 (Dropout)	(None, 8, 8, 512)	0	['max_pooling2d_3[0][0]']
conv2d_8 (Conv2D)	(None, 8, 8, 1024)	4719616	['dropout_3[0][0]']
conv2d_9 (Conv2D)	(None, 8, 8, 1024)	9438208	['conv2d_8[0][0]']
conv2d_transpose (Conv2DTranspose)	(None, 16, 16, 512)	4719104	['conv2d_9[0][0]']
concatenate (Concatenate)	(None, 16, 16, 1024)	0	['conv2d_transpose[0][0]', 'conv2d_7[0][0]']
dropout_4 (Dropout)	(None, 16, 16, 1024)	0	['concatenate[0][0]']
conv2d_10 (Conv2D)	(None, 16, 16, 512)	4719104	['dropout_4[0][0]']
conv2d_11 (Conv2D)	(None, 16, 16, 512)	2359808	['conv2d_10[0][0]']

```

import tensorflow as tf
import tensorflow.keras.backend as K

# Dice Coefficient
def dice_coef(y_true, y_pred, smooth=1e-6):
    # One-hot encode true labels
    y_true = tf.cast(y_true, tf.int32)
    y_true_onehot = tf.one_hot(y_true, depth=tf.shape(y_pred)[-1])  # Automatically match channels
    y_pred = tf.cast(y_pred, tf.float32)

    # Remove unnecessary dims
    if len(tf.shape(y_pred)) == 5:
        y_pred = tf.squeeze(y_pred, axis=-2)

    y_true_f = K.flatten(y_true_onehot)
    y_pred_f = K.flatten(y_pred)

    intersection = K.sum(y_true_f * y_pred_f)
    return (2. * intersection + smooth) / (K.sum(y_true_f) + K.sum(y_pred_f) + smooth)

```

```
# Intersection over Union
def iou(y_true, y_pred, smooth=1e-6):
    y_true = tf.cast(y_true, tf.int32)
    y_true_onehot = tf.one_hot(y_true, depth=tf.shape(y_pred)[-1])
    y_pred = tf.cast(y_pred, tf.float32)

    # Remove extra dim if present
    if len(tf.shape(y_pred)) == 5:
        y_pred = tf.squeeze(y_pred, axis=-2)

    intersection = tf.reduce_sum(y_true_onehot * y_pred)
    union = tf.reduce_sum(y_true_onehot + y_pred - y_true_onehot * y_pred)
    return (intersection + smooth) / (union + smooth)
```

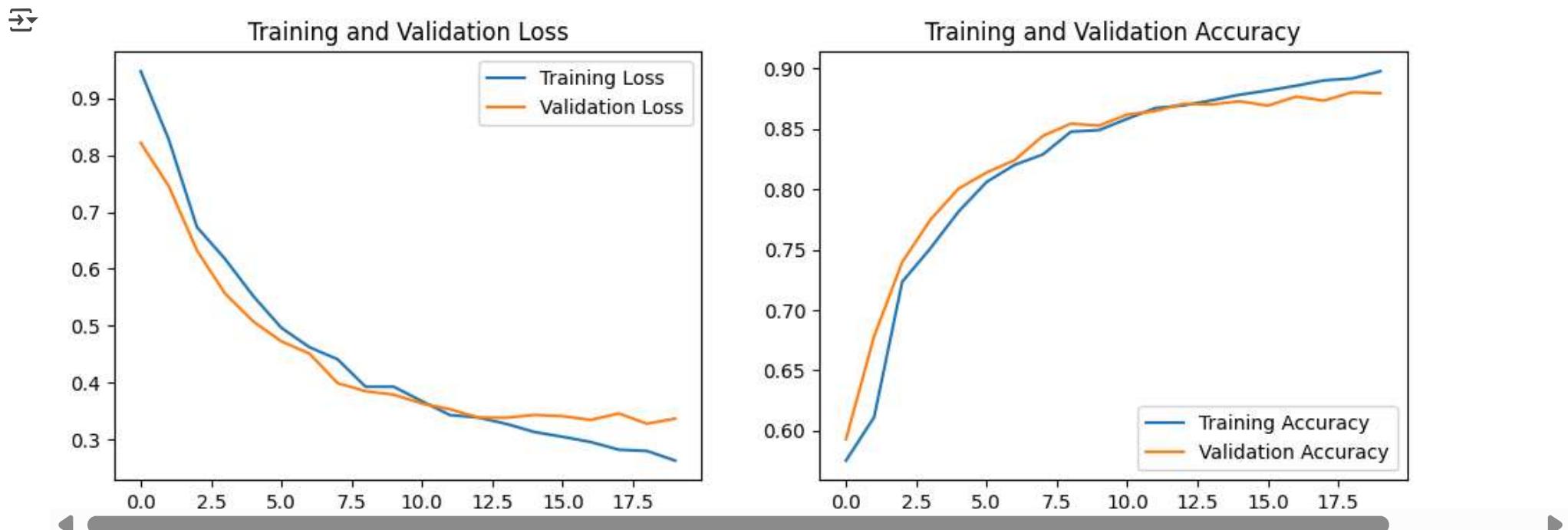
```
unet_model.compile(optimizer=tf.keras.optimizers.Adam(),
                    loss="sparse_categorical_crossentropy",
                    metrics=["accuracy"])
```

```
NUM_EPOCHS = 20
TRAIN_LENGTH = info.splits["train"].num_examples
STEPS_PER_EPOCH = TRAIN_LENGTH // BATCH_SIZE
VAL_SUBSPLITS = 5
TEST_LENGTH = info.splits["test"].num_examples
VALIDATION_STEPS = TEST_LENGTH // BATCH_SIZE // VAL_SUBSPLITS
model_history = unet_model.fit(train_batches,
                                epochs=NUM_EPOCHS,
                                steps_per_epoch=STEPS_PER_EPOCH,
                                validation_steps=VALIDATION_STEPS,
                                validation_data=test_batches)
```

Epoch 1/20
57/57 [=====] - 5423s 95s/step - loss: 0.9566 - accuracy: 0.5755 - val_loss: 0.8230 - val_accuracy: 0.5879
Epoch 2/20
57/57 [=====] - 5345s 95s/step - loss: 0.7029 - accuracy: 0.7089 - val_loss: 0.6532 - val_accuracy: 0.7352
Epoch 3/20
30/57 [=====>.....] - ETA: 40:29 - loss: 0.6512 - accuracy: 0.7364

```
plt.figure(figsize=(12,4))
plt.subplot(1 , 2 ,1 )
plt.plot(model_history.history['loss'], label='Training Loss')
plt.plot(model_history.history['val_loss'], label='Validation Loss')
plt.title('Training and Validation Loss')
plt.legend()

plt.subplot(1 , 2 ,2 )
plt.plot(model_history.history['accuracy'], label='Training Accuracy')
plt.plot(model_history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Training and Validation Accuracy')
plt.legend()
plt.show()
```



```
def create_mask(pred_mask):
    pred_mask = tf.argmax(pred_mask, axis=-1)
    pred_mask = pred_mask[..., tf.newaxis]
    return pred_mask[0]

def show_predictions(dataset=None, num=1):
    if dataset:
```

```
for image, mask in dataset.take(num):
    pred_mask = unet_model.predict(image)
    display([image[0], mask[0], create_mask(pred_mask)])
else:
    display([sample_image, sample_mask,
             create_mask(model.predict(sample_image[tf.newaxis, ...]))])
count = 0
for i in test_batches:
    count +=1
print("number of batches:", count)
```

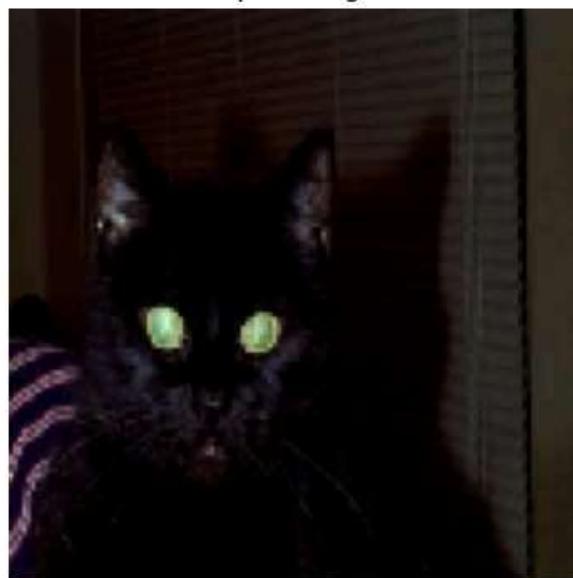
→ number of batches: 11

```
show_predictions(train_batches, 3)
```

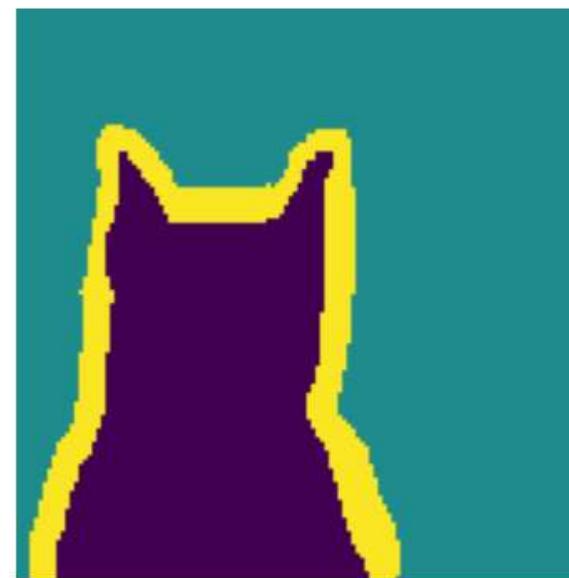
2/2

13s 171ms/step

Input Image



True Mask



Predicted Mask



2/2

0s 177ms/step

Input Image



True Mask



Predicted Mask

