1. SET UP AND LOAD DATA

1.1 Install Dependencies and Set Up

In [1]:

```
!pip install tensorflow opencv-python matplotlib
```

```
Requirement already satisfied: tensorflow in c:\users\akash sen\anaconda3\lib\site-packag
es (2.13.0)
Collecting opencv-python
  Using cached opencv_python-4.9.0.80-cp37-abi3-win_amd64.whl.metadata (20 kB)
Requirement already satisfied: matplotlib in c:\users\akash sen\anaconda3\lib\site-packag
es (3.3.4)
Requirement already satisfied: tensorflow-intel==2.13.0 in c:\users\akash sen\anaconda3\l
ib\site-packages (from tensorflow) (2.13.0)
Requirement already satisfied: absl-py>=1.0.0 in c:\users\akash sen\anaconda3\lib\site-pa
ckages (from tensorflow-intel==2.13.0->tensorflow) (2.1.0)
Requirement already satisfied: astunparse>=1.6.0 in c:\users\akash sen\anaconda3\lib\site
-packages (from tensorflow-intel==2.13.0->tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=23.1.21 in c:\users\akash sen\anaconda3\lib\s
ite-packages (from tensorflow-intel==2.13.0->tensorflow) (24.3.7)
Requirement already satisfied: gast<=0.4.0,>=0.2.1 in c:\users\akash sen\anaconda3\lib\si
te-packages (from tensorflow-intel==2.13.0->tensorflow) (0.4.0)
Requirement already satisfied: google-pasta>=0.1.1 in c:\users\akash sen\anaconda3\lib\si
te-packages (from tensorflow-intel==2.13.0->tensorflow) (0.2.0)
Requirement already satisfied: h5py>=2.9.0 in c:\users\akash sen\anaconda3\lib\site-packa
ges (from tensorflow-intel==2.13.0->tensorflow) (2.10.0)
Requirement already satisfied: libclang>=13.0.0 in c:\users\akash sen\anaconda3\lib\site-
packages (from tensorflow-intel==2.13.0->tensorflow) (16.0.6)
Requirement already satisfied: numpy<=1.24.3,>=1.22 in c:\users\akash sen\anaconda3\lib\s
ite-packages (from tensorflow-intel==2.13.0->tensorflow) (1.22.4)
Requirement already satisfied: opt-einsum>=2.3.2 in c:\users\akash sen\anaconda3\lib\site
-packages (from tensorflow-intel==2.13.0->tensorflow) (3.3.0)
Requirement already satisfied: packaging in c:\users\akash sen\anaconda3\lib\site-package
s (from tensorflow-intel==2.13.0->tensorflow) (20.9)
Requirement already satisfied: protobuf!=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!=4.21.4,!=4.2
1.5,<5.0.0dev,>=3.20.3 in c:\users\akash sen\anaconda3\lib\site-packages (from tensorflow
-intel==2.13.0->tensorflow) (4.25.1)
Requirement already satisfied: setuptools in c:\users\akash sen\anaconda3\lib\site-packag
es (from tensorflow-intel==2.13.0->tensorflow) (52.0.0.post20210125)
Requirement already satisfied: six>=1.12.0 in c:\users\akash sen\anaconda3\lib\site-packa
ges (from tensorflow-intel==2.13.0->tensorflow) (1.15.0)
Requirement already satisfied: termcolor>=1.1.0 in c:\users\akash sen\anaconda3\lib\site-
packages (from tensorflow-intel==2.13.0->tensorflow) (2.4.0)
Requirement already satisfied: typing-extensions<4.6.0,>=3.6.6 in c:\users\akash sen\anac
onda3\lib\site-packages (from tensorflow-intel==2.13.0->tensorflow) (4.3.0)
Requirement already satisfied: wrapt>=1.11.0 in c:\users\akash sen\anaconda3\lib\site-pac
kages (from tensorflow-intel==2.13.0->tensorflow) (1.12.1)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in c:\users\akash sen\anaconda3\lib\si
te-packages (from tensorflow-intel==2.13.0->tensorflow) (1.60.0)
Requirement already satisfied: tensorboard<2.14,>=2.13 in c:\users\akash sen\anaconda3\li
b\site-packages (from tensorflow-intel==2.13.0->tensorflow) (2.13.0)
Requirement already satisfied: tensorflow-estimator<2.14,>=2.13.0 in c:\users\akash sen\a
naconda3\lib\site-packages (from tensorflow-intel==2.13.0->tensorflow) (2.13.0)
Requirement already satisfied: keras<2.14,>=2.13.1 in c:\users\akash sen\anaconda3\lib\si
te-packages (from tensorflow-intel==2.13.0->tensorflow) (2.13.1)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in c:\users\akash sen
\anaconda3\lib\site-packages (from tensorflow-intel==2.13.0->tensorflow) (0.31.0)
Requirement already satisfied: cycler>=0.10 in c:\users\akash sen\anaconda3\lib\site-pack
ages (from matplotlib) (0.10.0)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\users\akash sen\anaconda3\lib\site
-packages (from matplotlib) (1.3.1)
Requirement already satisfied: pillow>=6.2.0 in c:\users\akash sen\anaconda3\lib\site-pac
kages (from matplotlib) (8.2.0)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.3 in c:\users\akash
sen\anaconda3\lib\site-packages (from matplotlib) (2.4.7)
```

```
Requirement already satisfied: python-dateutil>=2.1 in c:\users\akash sen\anaconda3\lib\s
ite-packages (from matplotlib) (2.8.1)
Requirement already satisfied: wheel<1.0,>=0.23.0 in c:\users\akash sen\anaconda3\lib\sit
e-packages (from astunparse>=1.6.0->tensorflow-intel==2.13.0->tensorflow) (0.36.2)
Requirement already satisfied: google-auth<3,>=1.6.3 in c:\users\akash sen\anaconda3\lib\
site-packages (from tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow) (2.25.
2)
Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in c:\users\akash sen\anaco
nda3\lib\site-packages (from tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflo
w) (1.0.0)
Requirement already satisfied: markdown>=2.6.8 in c:\users\akash sen\anaconda3\lib\site-p
ackages (from tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow) (3.5.2)
Requirement already satisfied: requests<3,>=2.21.0 in c:\users\akash sen\anaconda3\lib\si
te-packages (from tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow) (2.25.1)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in c:\users\akash se
n\anaconda3\lib\site-packages (from tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->te
nsorflow) (0.7.2)
Requirement already satisfied: werkzeug>=1.0.1 in c:\users\akash sen\anaconda3\lib\site-p
ackages (from tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow) (1.0.1)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in c:\users\akash sen\anaconda3\lib
\site-packages (from google-auth<3,>=1.6.3->tensorboard<2.14,>=2.13->tensorflow-intel==2.
13.0->tensorflow) (5.3.2)
Requirement already satisfied: pyasn1-modules>=0.2.1 in c:\users\akash sen\anaconda3\lib\
site-packages (from google-auth<3,>=1.6.3->tensorboard<2.14,>=2.13->tensorflow-intel==2.1
3.0->tensorflow) (0.3.0)
Requirement already satisfied: rsa<5,>=3.1.4 in c:\users\akash sen\anaconda3\lib\site-pac
kages (from google-auth<3,>=1.6.3->tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->ten
sorflow) (4.9)
Requirement already satisfied: requests-oauthlib>=0.7.0 in c:\users\akash sen\anaconda3\l
ib\site-packages (from google-auth-oauthlib<1.1,>=0.5->tensorboard<2.14,>=2.13->tensorflo
w-intel==2.13.0->tensorflow) (1.3.1)
Requirement already satisfied: importlib-metadata>=4.4 in c:\users\akash sen\anaconda3\li
b\site-packages (from markdown>=2.6.8->tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0-
>tensorflow) (7.0.2)
Requirement already satisfied: chardet<5,>=3.0.2 in c:\users\akash sen\anaconda3\lib\site
-packages (from requests<3,>=2.21.0->tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->t
ensorflow) (4.0.0)
Requirement already satisfied: idna<3,>=2.5 in c:\users\akash sen\anaconda3\lib\site-pack
ages (from requests<3,>=2.21.0->tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensor
flow) (2.10)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in c:\users\akash sen\anaconda3\lib\
site-packages (from requests<3,>=2.21.0->tensorboard<2.14,>=2.13->tensorflow-intel==2.13.
0->tensorflow) (1.26.4)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\akash sen\anaconda3\lib\sit
e-packages (from requests<3,>=2.21.0->tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->
tensorflow) (2020.12.5)
Requirement already satisfied: zipp>=0.5 in c:\users\akash sen\anaconda3\lib\site-package
s (from importlib-metadata>=4.4->markdown>=2.6.8->tensorboard<2.14,>=2.13->tensorflow-int
el==2.13.0->tensorflow) (3.4.1)
Requirement already satisfied: pyasn1<0.6.0,>=0.4.6 in c:\users\akash sen\anaconda3\lib\s
ite-packages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->tensorboard<2.14,>=2.13-
>tensorflow-intel==2.13.0->tensorflow) (0.5.1)
Requirement already satisfied: oauthlib>=3.0.0 in c:\users\akash sen\anaconda3\lib\site-p
ackages (from requests-oauthlib>=0.7.0->google-auth-oauthlib<1.1,>=0.5->tensorboard<2.14,
>=2.13->tensorflow-intel==2.13.0->tensorflow) (3.2.2)
Using cached opencv_python-4.9.0.80-cp37-abi3-win_amd64.whl (38.6 MB)
Installing collected packages: opencv-python
Successfully installed opencv-python-4.9.0.80
```

```
DEPRECATION: pyodbc 4.0.0-unsupported has a non-standard version number. pip 24.1 will en
force this behaviour change. A possible replacement is to upgrade to a newer version of p
yodbc or contact the author to suggest that they release a version with a conforming vers
ion number. Discussion can be found at https://github.com/pypa/pip/issues/12063
```

In [2]:

```
!pip list
```

```
Package                           Version
--------------------------------- -------------------
absl-py                           2.1.0
aiohttp                           3.8.6
```

```
aiosignal                         1.3.1
alabaster                         0.7.12
anaconda-client                   1.7.2
anaconda-navigator                2.0.3
anaconda-project                  0.9.1
anyio                             2.2.0
appdirs                           1.4.4
argh                              0.26.2
argon2-cffi                       20.1.0
asn1crypto                        1.4.0
astroid                           2.5
astropy                           4.2.1
astunparse                        1.6.3
async-generator                   1.10
async-timeout                     4.0.3
atomicwrites                      1.4.0
attrs                             20.3.0
audioread                         3.0.1
autocorrect                       2.6.1
autopep8                          1.5.6
Babel                             2.9.0
backcall                          0.2.0
backports.functools-lru-cache     1.6.4
backports.shutil-get-terminal-size 1.0.0
backports.tempfile                1.0
backports.weakref                 1.0.post1
bard                              0.1
bardapi                           0.1.38
bcrypt                            3.2.0
beautifulsoup4                    4.9.3
bitarray                          1.9.2
bkcharts                          0.2
black                             19.10b0
bleach                            3.3.0
bokeh                             2.3.2
boto                              2.49.0
Bottleneck                        1.3.2
brotlipy                          0.7.0
browser-cookie3                   0.19.1
cachetools                        5.3.2
certifi                           2020.12.5
cffi                              1.14.5
chardet                           4.0.0
charset-normalizer                3.3.0
click                             7.1.2
cloudpickle                       1.6.0
clyent                            1.2.2
colorama                          0.4.4
comtypes                          1.1.9
conda                             4.10.1
conda-build                       3.21.4
conda-content-trust               0+unknown
conda-package-handling            1.7.3
conda-repo-cli                    1.0.4
conda-token                       0.3.0
conda-verify                      3.4.2
contextlib2                       0.6.0.post1
cryptography                      3.4.7
cycler                            0.10.0
Cython                            0.29.23
cytoolz                           0.11.0
dask                              2021.4.0
decorator                         5.0.6
deep-translator                   1.11.4
defusedxml                        0.7.1
diff-match-patch                  20200713
distributed                       2021.4.0
docutils                          0.17
emoji                             2.9.0
entrypoints                       0.3
et-xmlfile                        1.0.1
fastcache                         1.1.0
```

fernet	1.0.1
filelock	3.0.12
flake8	3.9.0
Flask	1.1.2
flatbuffers	24.3.7
frozenlist	1.4.0
fsspec	0.9.0
future	0.18.2
gast	0.4.0
gevent	21.1.2
glob2	0.7
google-api-core	2.15.0
google-auth	2.25.2
google-auth-oauthlib	1.0.0
google-cloud-core	2.4.1
google-cloud-translate	3.13.0
google-pasta	0.2.0
googleapis-common-protos	1.62.0
greenlet	1.0.0
grpcio	1.60.0
grpcio-status	1.60.0
h11	0.14.0
h2	4.1.0
h5py	2.10.0
HeapDict	1.0.1
hpack	4.0.0
html5lib	1.1
httpcore	1.0.2
httpx	0.25.2
hyperframe	6.0.1
idna	2.10
imagecodecs	2021.3.31
imageio	2.9.0
imagesize	1.2.0
importlib_metadata	7.0.2
iniconfig	1.1.1
intervaltree	3.1.0
ipykernel	5.3.4
ipython	7.22.0
ipython-genutils	0.2.0
ipywidgets	7.6.3
isort	5.8.0
itsdangerous	1.1.0
jdcal	1.4.1
jedi	0.17.2
Jinja2	2.11.3
joblib	1.0.1
json5	0.9.5
jsonschema	3.2.0
jupyter	1.0.0
jupyter-client	6.1.12
jupyter-console	6.4.0
jupyter-core	4.7.1
jupyter-packaging	0.7.12
jupyter-server	1.4.1
jupyterlab	3.0.14
jupyterlab-pygments	0.1.2
jupyterlab-server	2.4.0
jupyterlab-widgets	1.0.0
keras	2.13.1
keyring	22.3.0
kiwisolver	1.3.1
langdetect	1.0.9
lazy_loader	0.3
lazy-object-proxy	1.6.0
libarchive-c	2.9
libclang	16.0.6
librosa	0.10.1
llvmlite	0.36.0
locket	0.2.1
lxml	4.6.3
lz4	4.3.2

Markdown	3.5.2
MarkupSafe	1.1.1
matplotlib	3.3.4
mccabe	0.6.1
menuinst	1.4.16
mistune	0.8.4
mkl-fft	1.3.0
mkl-random	1.2.1
mkl-service	2.3.0
mock	4.0.3
more-itertools	8.7.0
mpmath	1.2.1
msgpack	1.0.2
multidict	6.0.4
multipledispatch	0.6.0
mypy-extensions	0.4.3
navigator-updater	0.2.1
nbclassic	0.2.6
nbclient	0.5.3
nbconvert	6.0.7
nbformat	5.1.3
nest-asyncio	1.5.1
networkx	2.5
nltk	3.6.1
nose	1.3.7
notebook	6.3.0
numba	0.53.1
numexpr	2.7.3
numpy	1.22.4
numpydoc	1.1.0
oauthlib	3.2.2
olefile	0.46
openai	0.28.1
opencv-python	4.9.0.80
openpyxl	3.0.7
opt-einsum	3.3.0
packaging	20.9
pandas	1.2.4
pandocfilters	1.4.3
paramiko	2.7.2
parso	0.7.0
partd	1.2.0
path	15.1.2
pathlib2	2.3.5
pathspec	0.7.0
patsy	0.5.1
pep8	1.7.1
pexpect	4.8.0
pickleshare	0.7.5
Pillow	8.2.0
pip	24.0
pkginfo	1.7.0
platformdirs	4.2.0
pluggy	0.13.1
ply	3.11
pooch	1.8.1
prometheus-client	0.10.1
prompt-toolkit	3.0.17
proto-plus	1.23.0
protobuf	4.25.1
psutil	5.8.0
ptyprocess	0.7.0
py	1.10.0
pyaes	1.6.1
pyasn1	0.5.1
pyasn1-modules	0.3.0
pycodestyle	2.6.0
pycosat	0.6.3
pycparser	2.20
pycryptodomex	3.19.0
pycurl	7.43.0.6
pydocstyle	6.0.0

pyerfa	1.7.3
pyflakes	2.2.0
Pygments	2.8.1
pylint	2.7.4
pyls-black	0.4.6
pyls-spyder	0.3.2
pyodbc	4.0.0-unsupported
pyOpenSSL	20.0.1
pyparsing	2.4.7
pyreadline	2.1
pyrsistent	0.17.3
PySocks	1.7.1
pytest	6.2.3
python-dateutil	2.8.1
python-jsonrpc-server	0.4.0
python-language-server	0.36.2
pytz	2021.1
PyWavelets	1.1.1
pywin32	227
pywin32-ctypes	0.2.0
pywinpty	0.5.7
PyYAML	5.4.1
pyzmq	20.0.0
QDarkStyle	2.8.1
QtAwesome	1.0.2
qtconsole	5.0.3
QtPy	1.9.0
regex	2021.4.4
requests	2.25.1
requests-oauthlib	1.3.1
rope	0.18.0
rsa	4.9
Rtree	0.9.7
ruamel-yaml-conda	0.15.100
scikit-image	0.18.1
scikit-learn	0.24.1
scipy	1.6.2
seaborn	0.11.1
Send2Trash	1.5.0
setuptools	52.0.0.post20210125
simplegeneric	0.8.1
singledispatch	0.0.0
sip	4.19.13
six	1.15.0
sniffio	1.2.0
snowballstemmer	2.1.0
sortedcollections	2.1.0
sortedcontainers	2.3.0
soundfile	0.12.1
soupsieve	2.2.1
soxr	0.3.7
Sphinx	4.0.1
sphinxcontrib-applehelp	1.0.2
sphinxcontrib-devhelp	1.0.2
sphinxcontrib-htmlhelp	1.0.3
sphinxcontrib-jsmath	1.0.1
sphinxcontrib-qthelp	1.0.3
sphinxcontrib-serializinghtml	1.1.4
sphinxcontrib-websupport	1.2.4
spyder	4.2.5
spyder-kernels	1.10.2
SQLAlchemy	1.4.7
statsmodels	0.12.2
sympy	1.8
tables	3.6.1
tblib	1.7.0
tensorboard	2.13.0
tensorboard-data-server	0.7.2
tensorflow	2.13.0
tensorflow-estimator	2.13.0
tensorflow-intel	2.13.0
tensorflow-io-gcs-filesystem	0.31.0

```
termcolor                       2.4.0
terminado                       0.9.4
testpath                        0.4.4
textblob                        0.17.1
textdistance                    4.2.1
threadpoolctl                   2.1.0
three-merge                     0.1.1
tifffile                        2021.4.8
toml                            0.10.2
toolz                           0.11.1
torch                           2.1.2
tornado                         6.1
tqdm                            4.59.0
traitlets                       5.0.5
typed-ast                       1.4.2
typing_extensions               4.3.0
ujson                           4.0.2
unicodecsv                      0.14.1
urllib3                         1.26.4
watchdog                        1.0.2
wcwidth                         0.2.5
webencodings                    0.5.1
Werkzeug                        1.0.1
wheel                           0.36.2
widgetsnbextension              3.5.1
win-inet-pton                   1.1.0
win-unicode-console             0.5
wincertstore                    0.2
wrapt                           1.12.1
xlrd                            2.0.1
XlsxWriter                      1.3.8
xlwings                         0.23.0
xlwt                            1.3.0
xmltodict                       0.12.0
yapf                            0.31.0
yarl                            1.9.2
zict                            2.0.0
zipp                            3.4.1
zope.event                      4.5.0
zope.interface                  5.3.0
```

In [3]:

```
import tensorflow as tf
import os
```

In [4]:

```
os.path.join('data','happy')
```

Out[4]:

```
'data\\happy'
```

In [5]:

```
os.listdir('data')
```

Out[5]:

```
['happy', 'sad']
```

1.2 Removing Dodgy Images

In [6]:

```
import cv2
import imghdr
```

In [7]:

```
data_dir='data'
```

In [8]:

```
image_exts=['jpeg','jpg','bmp','png']
```

In [9]:

```
for image_class in os.listdir(data_dir):
  for image in os.listdir(os.path.join(data_dir,image_class)):
    image_path=os.path.join(data_dir,image_class,image)
    try:
      img=cv2.imread(image_path)
      tip=imghdr.what(image_path)
      if tip not in image_exts:
        print("Image not in image_exts list {}".format(image_path))
        os.remove(image_path)
    except Exception as e:
      print("Issue with the Image {}".format(image_path))
```

```
Image not in image_exts list data\happy\7a33db66d63847be9b8d0a634e465dc4.webp
Image not in image_exts list data\happy\casual-portrait-in-positive-view-big-smile-beauti
ful-model-posing-1554086789.jpg
Image not in image_exts list data\happy\close-portrait-smiling-handsome-man-260nw-1011569
245.jpg
Image not in image_exts list data\happy\collage-faces-diverse-people-122527097_prevstill.
jpeg
Image not in image_exts list data\happy\depositphotos_19066015-stock-photo-mosaic-people-
portraits.jpg
Image not in image_exts list data\happy\depositphotos_391577690-stock-photo-cheerful-woma
n-outstretched-hands-sitting.jpg
Image not in image_exts list data\happy\guilherme-stecanella-375176-unsplash.jpg
Image not in image_exts list data\happy\happy-home.jpg
Image not in image_exts list data\happy\Happy20People.jpg
Image not in image_exts list data\happy\stock-photo-collage-of-many-different-happy-human
-faces-of-modern-people-83672029.jpg
Image not in image_exts list data\happy\traitshappypeople.jpg
Image not in image_exts list data\happy\y-faces-of-people-happy-men-and-women-expressing-
different-positive-emotions.jpg
Image not in image_exts list data\sad\32495400.jpg
Image not in image_exts list data\sad\39681222.jpg
Image not in image_exts list data\sad\46955446.jpg
Image not in image_exts list data\sad\article-2029228-01C3E98B000004B0-620_233x423.jpg
Image not in image_exts list data\sad\depositphotos_11207956-stock-photo-thoughtful-man-i
n-the-living.jpg
Image not in image_exts list data\sad\depositphotos_86851530-stock-photo-close-up-of-afri
can-young.jpg
Image not in image_exts list data\sad\depressed-frustrated-young-indian-woman-260nw-21846
79453.jpg
Image not in image_exts list data\sad\group-stressful-university-students-waiting-260nw-4
81536121.jpg
Image not in image_exts list data\sad\many-sad-faces-our-group-260nw-51922987.jpg
Image not in image_exts list data\sad\middle-aged-asia-people-old-260nw-2274179825.jpg
Image not in image_exts list data\sad\portrait-sad-man-600nw-126009806.jpg
Image not in image_exts list data\sad\sad-aged-woman-home-260nw-160900928.jpg
Image not in image_exts list data\sad\sad-black-man-260nw-567014449.jpg
Image not in image_exts list data\sad\sad-young-woman-feeling-stressed-footage-107160392_
icon1.jpeg
Image not in image_exts list data\sad\set-diversity-people-sad-face-260nw-657494353.jpg
Image not in image_exts list data\sad\silhouette-depressed-man-sitting-on-260nw-150236508
2.jpg
Image not in image_exts list data\sad\stressful-students-waiting-exam-test-260nw-39127875
7.jpg
```

1.3 Load Data

In [10]:

```
tf.data.Dataset??
```

```
Init signature: tf.data.Dataset(variant_tensor)
Source:
```

```
    # (dataset_ops -> choose_from_datasets_op -> dataset_ops).
    # pylint: disable=g-import-not-at-top,protected-access
    from tensorflow.python.data.ops import choose_from_datasets_op
    return choose_from_datasets_op._choose_from_datasets(
        datasets, choice_dataset, stop_on_empty_dataset)
    # pylint: enable=g-import-not-at-top,protected-access
File:           c:\users\akash sen\anaconda3\lib\site-packages\tensorflow\python\data\ops
\dataset_ops.py
Type:           ABCMeta
Subclasses:     DatasetV1, DatasetSource, UnaryDataset, _VariantDataset, TFRecordDatasetV
2, _PerDeviceGenerator, _ReincarnatedPerDeviceGenerator
```

In [11]:

```
import numpy as np
from matplotlib import pyplot as plt
```

In [12]:

```
data=tf.keras.utils.image_dataset_from_directory('data')
```

```
Found 327 files belonging to 2 classes.
```

In [13]:

```
#get another batch from iterator
data_iterator=data.as_numpy_iterator()
```

In [14]:

```
batch = data_iterator.next()
```

In [15]:

```
#images represented as numpy arrays
batch[0].shape
```

Out[15]:

```
(32, 256, 256, 3)
```

In [16]:

```
len(batch)
```

Out[16]:

```
2
```

In [17]:

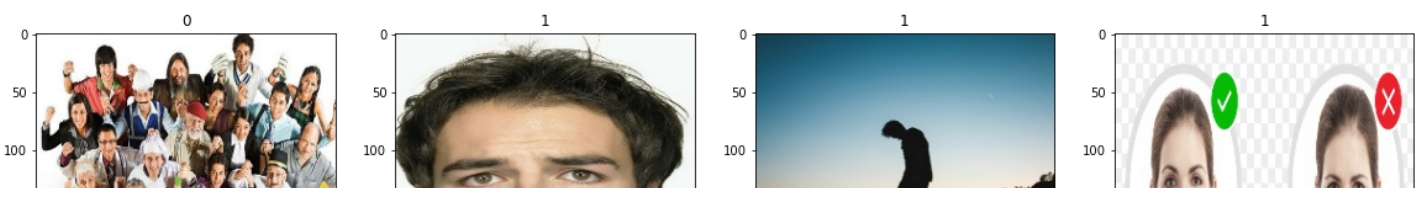
```
#Class 1 = SAD People
#Class 0 = HAPPY People
batch[1]
```

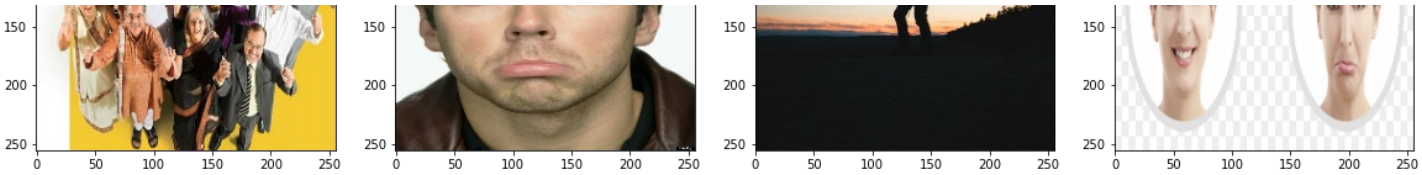
Out[17]:

```
array([0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1,
       0, 1, 1, 1, 0, 0, 0, 1, 0, 1])
```

In [18]:

```
fig,ax=plt.subplots(ncols=4,figsize=(20,20))
for idx,img in enumerate(batch[0][:4]):
  ax[idx].imshow(img.astype(int))
  ax[idx].title.set_text(batch[1][idx])
```





In [19]:

```
scaled=batch[0]/255
print(scaled.min())
print(scaled.max())
```

```
0.0
1.0
```

2. Preproccess Data

2.1 Scale Data

In [20]:

```
data = data.map(lambda x, y: (x/255, y))
```

In [21]:

```
scaled_iterator = data.as_numpy_iterator().next()
```

In [22]:

```
scaled_iterator[0].min()
```

Out[22]:

```
0.0
```

2.2 Split Data

In [23]:

```
len(data)
```

Out[23]:

```
11
```

In [24]:

```
train_size=int(len(data)*.7)
val_size=int(len(data)*.2)
test_size=int(len(data)*.1)+1
```

In [25]:

```
train=data.take(train_size)
val=data.skip(train_size).take(val_size)
test=data.skip(train_size+val_size).take(test_size)
```

3. Deep Learning Model

3.1 Build Deep Learning Model

In [26]:

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Dense, Flatten, Dropout
```

In [27]:

```
model=Sequential()
```

In [28]:

```
model.add(Conv2D(16, (3, 3), strides=1, activation='relu', input_shape=(256, 256, 3)))
model.add(MaxPooling2D())

model.add(Conv2D(32, (3, 3), strides=1, activation='relu'))
model.add(MaxPooling2D())

model.add(Conv2D(16, (3, 3), strides=1, activation='relu'))
model.add(MaxPooling2D())

model.add(Flatten())

model.add(Dense(256, activation='relu'))
model.add(Dense(1, activation='sigmoid'))
```

In [29]:

```
model.compile(optimizer='adam', loss=tf.keras.losses.BinaryCrossentropy(), metrics=['acc
uracy'])
```

In [30]:

```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 254, 254, 16)      448

 max_pooling2d (MaxPooling2  (None, 127, 127, 16)      0
 D)

 conv2d_1 (Conv2D)           (None, 125, 125, 32)      4640

 max_pooling2d_1 (MaxPoolin  (None, 62, 62, 32)        0
 g2D)

 conv2d_2 (Conv2D)           (None, 60, 60, 16)        4624

 max_pooling2d_2 (MaxPoolin  (None, 30, 30, 16)        0
 g2D)

 flatten (Flatten)           (None, 14400)             0

 dense (Dense)               (None, 256)               3686656

 dense_1 (Dense)             (None, 1)                 257

=================================================================
Total params: 3696625 (14.10 MB)
Trainable params: 3696625 (14.10 MB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

3.2 Train Data

In [31]:

```
logdir='logs'
```

In [32]:

```
tensorboard_callbacks=tf.keras.callbacks.TensorBoard(log_dir=logdir)
```

In [33]:

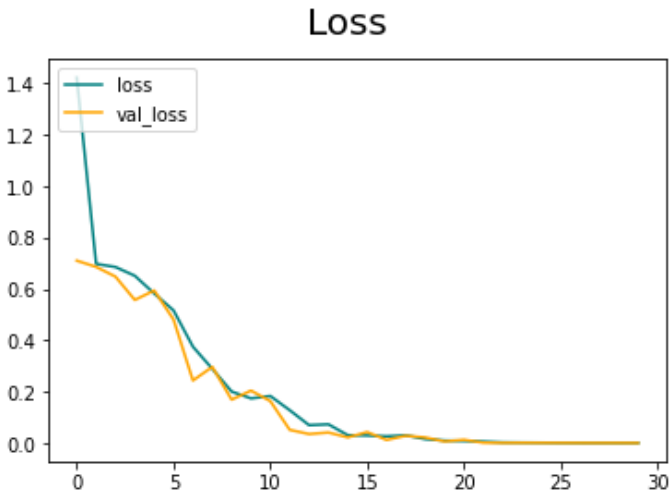
```
hist=model.fit(train,epochs=30,validation_data=val,callbacks=[tensorboard_callbacks])
```

```
Epoch 1/30
7/7 [==============================] - 23s 3s/step - loss: 1.4225 - accuracy: 0.4777 - va
l_loss: 0.7101 - val_accuracy: 0.4531
Epoch 2/30
7/7 [==============================] - 19s 2s/step - loss: 0.6975 - accuracy: 0.4598 - va
l_loss: 0.6859 - val_accuracy: 0.6562
Epoch 3/30
7/7 [==============================] - 19s 2s/step - loss: 0.6854 - accuracy: 0.5982 - va
l_loss: 0.6478 - val_accuracy: 0.6719
Epoch 4/30
7/7 [==============================] - 18s 2s/step - loss: 0.6512 - accuracy: 0.7188 - va
l_loss: 0.5572 - val_accuracy: 0.7812
Epoch 5/30
7/7 [==============================] - 19s 2s/step - loss: 0.5824 - accuracy: 0.6830 - va
l_loss: 0.5941 - val_accuracy: 0.5938
Epoch 6/30
7/7 [==============================] - 20s 2s/step - loss: 0.5165 - accuracy: 0.7277 - va
l_loss: 0.4809 - val_accuracy: 0.7500
Epoch 7/30
7/7 [==============================] - 19s 2s/step - loss: 0.3753 - accuracy: 0.8393 - va
l_loss: 0.2435 - val_accuracy: 0.9531
Epoch 8/30
7/7 [==============================] - 19s 2s/step - loss: 0.2892 - accuracy: 0.8750 - va
l_loss: 0.2966 - val_accuracy: 0.8438
Epoch 9/30
7/7 [==============================] - 18s 2s/step - loss: 0.2006 - accuracy: 0.9152 - va
l_loss: 0.1691 - val_accuracy: 0.9531
Epoch 10/30
7/7 [==============================] - 20s 2s/step - loss: 0.1740 - accuracy: 0.9330 - va
l_loss: 0.2043 - val_accuracy: 0.9219
Epoch 11/30
7/7 [==============================] - 19s 2s/step - loss: 0.1833 - accuracy: 0.9375 - va
l_loss: 0.1633 - val_accuracy: 0.9844
Epoch 12/30
7/7 [==============================] - 18s 2s/step - loss: 0.1280 - accuracy: 0.9464 - va
l_loss: 0.0516 - val_accuracy: 0.9844
Epoch 13/30
7/7 [==============================] - 19s 2s/step - loss: 0.0699 - accuracy: 0.9821 - va
l_loss: 0.0353 - val_accuracy: 0.9844
Epoch 14/30
7/7 [==============================] - 18s 2s/step - loss: 0.0731 - accuracy: 0.9777 - va
l_loss: 0.0412 - val_accuracy: 1.0000
Epoch 15/30
7/7 [==============================] - 18s 2s/step - loss: 0.0308 - accuracy: 1.0000 - va
l_loss: 0.0222 - val_accuracy: 1.0000
Epoch 16/30
7/7 [==============================] - 19s 2s/step - loss: 0.0295 - accuracy: 0.9955 - va
l_loss: 0.0429 - val_accuracy: 0.9844
Epoch 17/30
7/7 [==============================] - 19s 2s/step - loss: 0.0264 - accuracy: 0.9911 - va
l_loss: 0.0124 - val_accuracy: 1.0000
Epoch 18/30
7/7 [==============================] - 20s 2s/step - loss: 0.0302 - accuracy: 0.9911 - va
l_loss: 0.0284 - val_accuracy: 1.0000
Epoch 19/30
7/7 [==============================] - 19s 2s/step - loss: 0.0156 - accuracy: 1.0000 - va
l_loss: 0.0218 - val_accuracy: 1.0000
Epoch 20/30
7/7 [==============================] - 19s 2s/step - loss: 0.0099 - accuracy: 1.0000 - va
l_loss: 0.0066 - val_accuracy: 1.0000
Epoch 21/30
7/7 [==============================] - 18s 2s/step - loss: 0.0086 - accuracy: 1.0000 - va
l_loss: 0.0129 - val_accuracy: 1.0000
Epoch 22/30
7/7 [==============================] - 17s 2s/step - loss: 0.0059 - accuracy: 1.0000 - va
l_loss: 0.0016 - val_accuracy: 1.0000
Epoch 23/30
7/7 [==============================] - 18s 2s/step - loss: 0.0028 - accuracy: 1.0000 - va
```

```
l_loss: 8.5356e-04 - val_accuracy: 1.0000
Epoch 24/30
7/7 [==============================] - 18s 2s/step - loss: 0.0021 - accuracy: 1.0000 - va
l_loss: 0.0012 - val_accuracy: 1.0000
Epoch 25/30
7/7 [==============================] - 17s 2s/step - loss: 0.0017 - accuracy: 1.0000 - va
l_loss: 0.0010 - val_accuracy: 1.0000
Epoch 26/30
7/7 [==============================] - 18s 2s/step - loss: 0.0012 - accuracy: 1.0000 - va
l_loss: 8.5319e-04 - val_accuracy: 1.0000
Epoch 27/30
7/7 [==============================] - 18s 2s/step - loss: 7.8340e-04 - accuracy: 1.0000
- val_loss: 6.7078e-04 - val_accuracy: 1.0000
Epoch 28/30
7/7 [==============================] - 17s 2s/step - loss: 7.2747e-04 - accuracy: 1.0000
- val_loss: 5.5654e-04 - val_accuracy: 1.0000
Epoch 29/30
7/7 [==============================] - 18s 2s/step - loss: 6.1745e-04 - accuracy: 1.0000
- val_loss: 6.9852e-04 - val_accuracy: 1.0000
Epoch 30/30
7/7 [==============================] - 17s 2s/step - loss: 5.3535e-04 - accuracy: 1.0000
- val_loss: 4.2156e-04 - val_accuracy: 1.0000
```

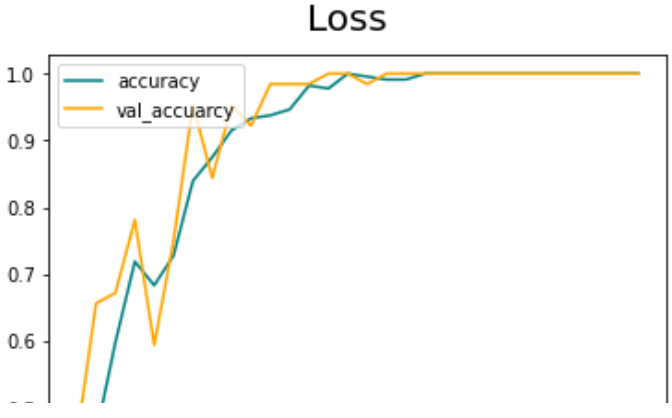
In [34]:

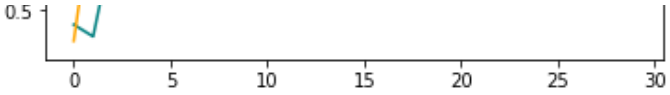
```
fig=plt.figure()
plt.plot(hist.history['loss'],color='teal',label='loss')
plt.plot(hist.history['val_loss'],color='orange',label='val_loss')
fig.suptitle('Loss', fontsize=20)
plt.legend(loc="upper left")
plt.show()
```



In [35]:

```
fig=plt.figure()
plt.plot(hist.history['accuracy'],color='teal',label='accuracy')
plt.plot(hist.history['val_accuracy'],color='orange',label='val_accuarcy')
fig.suptitle('Loss', fontsize=20)
plt.legend(loc="upper left")
plt.show()
```





4. Evaluate Performance

4.1 Evaluate

In [36]:

```
from tensorflow.keras.metrics import Precision, Recall, BinaryAccuracy
```

In [37]:

```
pre=Precision()
re=Recall()
acc=BinaryAccuracy()
```

In [38]:

```
len(test)
```

Out[38]:

```
2
```

In [39]:

```
for batch in test.as_numpy_iterator():
  x, y=batch
  yhat=model.predict(x)
  pre.update_state(y,yhat)
  re.update_state(y,yhat)
  acc.update_state(y,yhat)
```

```
1/1 [==============================] - 1s 1s/step
1/1 [==============================] - 0s 190ms/step
```

In [40]:

```
print(f'Precision:{pre.result().numpy()},Recall:{re.result().numpy()},Accuracy:{acc.resul
t().numpy()}')
```

```
Precision:1.0,Recall:1.0,Accuracy:1.0
```

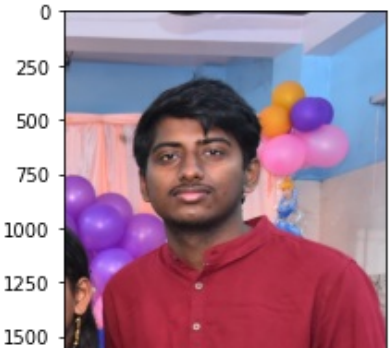
4.2 Sad Test

In [ ]:

```
import cv2
```

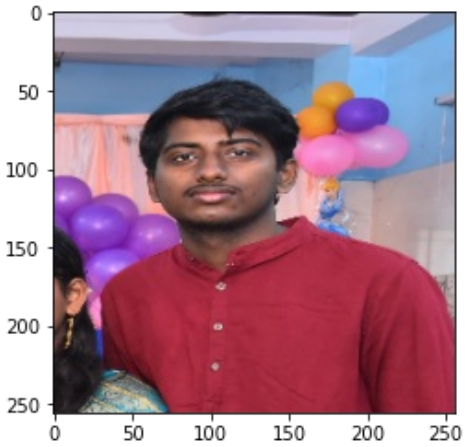
In [41]:

```
img=cv2.imread('image.jpg')
plt.imshow(cv2.cvtColor(img, cv2.COLOR_BGR2RGB))
plt.show()
```



In [42]:

```
resize = tf.image.resize(img, (256, 256))
resize1=resize.numpy().astype('uint8')
rgb_image = cv2.cvtColor(resize1, cv2.COLOR_BGR2RGB)
plt.imshow(rgb_image)
plt.show()
```



In [43]:

```
np.expand_dims(resize,0).shape
```

Out[43]:

```
(1, 256, 256, 3)
```

In [44]:

```
yhat=model.predict(np.expand_dims(resize/255,0))
```

```
1/1 [==============================] - 0s 383ms/step
```

In [45]:

```
yhat
```

Out[45]:

```
array([[0.99983764]], dtype=float32)
```

In [46]:

```
if yhat>0.5:
  print(f'Predicted class is Sad')
else:
  print(f'Predicted class is Happy')
```

```
Predicted class is Sad
```

4.3 Happy Test

In [47]:

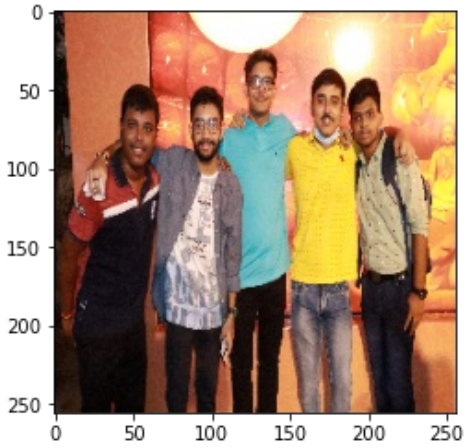
```
import cv2
```

In [48]:

```
img=cv2.imread('happy.jpg')
plt.imshow(cv2.cvtColor(img, cv2.COLOR_BGR2RGB))
plt.show()
```

In [49]:

```
resize = tf.image.resize(img, (256, 256))
resize1=resize.numpy().astype('uint8')
rgb_image = cv2.cvtColor(resize1, cv2.COLOR_BGR2RGB)
plt.imshow(rgb_image)
plt.show()
```



In [50]:

```
np.expand_dims(resize,0).shape
```

Out[50]:

```
(1, 256, 256, 3)
```

In [51]:

```
yhat=model.predict(np.expand_dims(resize/255,0))
```

```
1/1 [==============================] - 0s 498ms/step
```

In [52]:

```
yhat
```

Out[52]:

```
array([[0.00240089]], dtype=float32)
```

In [53]:

```
if yhat>0.5:
  print(f'Predicted class is Sad')
else:
  print(f'Predicted class is Happy')
```

```
Predicted class is Happy
```

5. Save the Model

5. Save the Model

5.1 Save the Model

In [54]:

```
from tensorflow.keras.models import load_model
```

In [55]:

```
model.save(os.path.join('models','happysadmodel.h5'))
```

```
c:\Users\akash sen\anaconda3\lib\site-packages\keras\src\engine\training.py:3000: UserWarning: You are saving your model as an HDF5 file via `model.save()`. This file format is considered legacy. We recommend using instead the native Keras format, e.g. `model.save('my_model.keras')`.
  saving_api.save_model(
```

In [56]:

```
new_model=load_model(os.path.join('models','happysadmodel.h5'))
```

In [57]:

```
yhatnew=new_model.predict(np.expand_dims(resize/255,0))
```

```
1/1 [==============================] - 0s 189ms/step
```

In [58]:

```
if yhatnew>0.5:
  print(f'Predicted class is Sad')
else:
  print(f'Predicted class is Happy')
```

```
Predicted class is Happy
```