In [1]:

```
!pip install transformers
!pip install keras tf-models-official pydot graphviz
!pip install emot
```

```
Requirement already satisfied: transformers in /opt/conda/lib/python3.7/site-packages
(4.16.2)
Requirement already satisfied: huggingface-hub<1.0,>=0.1.0 in /opt/conda/lib/python3.7/s
ite-packages (from transformers) (0.4.0)
Requirement already satisfied: pyyaml>=5.1 in /opt/conda/lib/python3.7/site-packages (fr
om transformers) (6.0)
Requirement already satisfied: packaging>=20.0 in /opt/conda/lib/python3.7/site-packages
(from transformers) (21.3)
Requirement already satisfied: regex!=2019.12.17 in /opt/conda/lib/python3.7/site-packag
es (from transformers) (2021.11.10)
Requirement already satisfied: tokenizers!=0.11.3,>=0.10.1 in /opt/conda/lib/python3.7/s
ite-packages (from transformers) (0.11.6)
Requirement already satisfied: sacremoses in /opt/conda/lib/python3.7/site-packages (fro
m transformers) (0.0.49)
Requirement already satisfied: tqdm>=4.27 in /opt/conda/lib/python3.7/site-packages (fro
m transformers) (4.62.3)
Requirement already satisfied: filelock in /opt/conda/lib/python3.7/site-packages (from
transformers) (3.6.0)
Requirement already satisfied: importlib-metadata in /opt/conda/lib/python3.7/site-packa
ges (from transformers) (4.11.3)
Requirement already satisfied: requests in /opt/conda/lib/python3.7/site-packages (from
transformers) (2.26.0)
Requirement already satisfied: numpy>=1.17 in /opt/conda/lib/python3.7/site-packages (fr
om transformers) (1.20.3)
Requirement already satisfied: typing-extensions>=3.7.4.3 in /opt/conda/lib/python3.7/si
te-packages (from huggingface-hub<1.0,>=0.1.0->transformers) (4.1.1)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in /opt/conda/lib/python3.7/site
-packages (from packaging>=20.0->transformers) (3.0.6)
Requirement already satisfied: zipp>=0.5 in /opt/conda/lib/python3.7/site-packages (from
importlib-metadata->transformers) (3.6.0)
Requirement already satisfied: idna<4,>=2.5 in /opt/conda/lib/python3.7/site-packages (f
rom requests->transformers) (3.1)
Requirement already satisfied: certifi>=2017.4.17 in /opt/conda/lib/python3.7/site-packa
ges (from requests->transformers) (2021.10.8)
Requirement already satisfied: charset-normalizer~=2.0.0 in /opt/conda/lib/python3.7/sit
e-packages (from requests->transformers) (2.0.9)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in /opt/conda/lib/python3.7/site-pa
ckages (from requests->transformers) (1.26.7)
Requirement already satisfied: six in /opt/conda/lib/python3.7/site-packages (from sacre
moses->transformers) (1.16.0)
Requirement already satisfied: joblib in /opt/conda/lib/python3.7/site-packages (from sa
cremoses->transformers) (1.1.0)
Requirement already satisfied: click in /opt/conda/lib/python3.7/site-packages (from sac
remoses->transformers) (8.0.3)
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting
behaviour with the system package manager. It is recommended to use a virtual environmen
t instead: https://pip.pypa.io/warnings/venv
Requirement already satisfied: keras in /opt/conda/lib/python3.7/site-packages (2.6.0)
Collecting tf-models-official
  Downloading tf_models_official-2.8.0-py2.py3-none-any.whl (2.2 MB)
     |████████████████████████████████| 2.2 MB 624 kB/s
Requirement already satisfied: pydot in /opt/conda/lib/python3.7/site-packages (1.4.2)
Requirement already satisfied: graphviz in /opt/conda/lib/python3.7/site-packages (0.8.
4)
```

```
Requirement already satisfied: kaggle>=1.3.9 in /opt/conda/lib/python3.7/site-packages
 (from tf-models-official) (1.5.12)
Collecting gin-config
  Downloading gin_config-0.5.0-py3-none-any.whl (61 kB)
     |████████████████████████████████| 61 kB 4.8 MB/s
Collecting py-cpuinfo>=3.3.0
  Downloading py-cpuinfo-8.0.0.tar.gz (99 kB)
     |████████████████████████████████| 99 kB 6.0 MB/s
  Preparing metadata (setup.py) ... -   done
Requirement already satisfied: psutil>=5.4.3 in /opt/conda/lib/python3.7/site-packages
 (from tf-models-official) (5.9.0)
Collecting pyyaml<6.0,>=5.1
  Downloading PyYAML-5.4.1-cp37-cp37m-manylinux1_x86_64.whl (636 kB)
     |████████████████████████████████| 636 kB 36.0 MB/s
Requirement already satisfied: tensorflow-datasets in /opt/conda/lib/python3.7/site-pack
ages (from tf-models-official) (4.3.0)
Requirement already satisfied: scipy>=0.19.1 in /opt/conda/lib/python3.7/site-packages
 (from tf-models-official) (1.7.3)
Collecting tf-slim>=1.1.0
  Downloading tf_slim-1.1.0-py2.py3-none-any.whl (352 kB)
     |████████████████████████████████| 352 kB 40.6 MB/s
Collecting tensorflow-text~=2.8.0
  Downloading tensorflow_text-2.8.1-cp37-cp37m-manylinux_2_12_x86_64.manylinux2010_x86_6
4.whl (4.9 MB)
     |████████████████████████████████| 4.9 MB 38.9 MB/s
Requirement already satisfied: oauth2client in /opt/conda/lib/python3.7/site-packages (f
rom tf-models-official) (4.1.3)
Requirement already satisfied: opencv-python-headless in /opt/conda/lib/python3.7/site-p
ackages (from tf-models-official) (4.5.5.64)
Requirement already satisfied: matplotlib in /opt/conda/lib/python3.7/site-packages (fro
m tf-models-official) (3.5.1)
Requirement already satisfied: numpy>=1.15.4 in /opt/conda/lib/python3.7/site-packages
 (from tf-models-official) (1.20.3)
Requirement already satisfied: Cython in /opt/conda/lib/python3.7/site-packages (from tf
-models-official) (0.29.28)
Requirement already satisfied: google-api-python-client>=1.6.7 in /opt/conda/lib/python
3.7/site-packages (from tf-models-official) (1.12.11)
Collecting pycocotools
  Downloading pycocotools-2.0.4.tar.gz (106 kB)
     |████████████████████████████████| 106 kB 38.3 MB/s
  Installing build dependencies ... -   \   |   /   -   \   |   /   done
  Getting requirements to build wheel ... -   \   |   /   done
  Preparing metadata (pyproject.toml) ... -   \   |   /   done
Collecting tensorflow-model-optimization>=0.4.1
  Downloading tensorflow_model_optimization-0.7.2-py2.py3-none-any.whl (237 kB)
     |████████████████████████████████| 237 kB 43.3 MB/s
Requirement already satisfied: pandas>=0.22.0 in /opt/conda/lib/python3.7/site-packages
 (from tf-models-official) (1.3.5)
Requirement already satisfied: sentencepiece in /opt/conda/lib/python3.7/site-packages
 (from tf-models-official) (0.1.96)
Collecting tensorflow~=2.8.0
  Downloading tensorflow-2.8.0-cp37-cp37m-manylinux2010_x86_64.whl (497.5 MB)
     |████████████████████████████████| 497.5 MB 19 kB/s
Requirement already satisfied: six in /opt/conda/lib/python3.7/site-packages (from tf-mo
dels-official) (1.16.0)
Requirement already satisfied: tensorflow-hub>=0.6.0 in /opt/conda/lib/python3.7/site-pa
ckages (from tf-models-official) (0.12.0)
Collecting sacrebleu
  Downloading sacrebleu-2.0.0-py3-none-any.whl (90 kB)
     |████████████████████████████████| 90 kB 5.3 MB/s
```

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Requirement already satisfied: tensorflow-addons in /opt/conda/lib/python3.7/site-packag
es (from tf-models-official) (0.14.0)
Requirement already satisfied: Pillow in /opt/conda/lib/python3.7/site-packages (from tf
-models-official) (8.2.0)
Collecting seqeval
  Downloading seqeval-1.2.2.tar.gz (43 kB)
     |████████████████████████████████| 43 kB 1.3 MB/s
  Preparing metadata (setup.py) ... -   done
Requirement already satisfied: pyparsing>=2.1.4 in /opt/conda/lib/python3.7/site-package
s (from pydot) (3.0.6)
Requirement already satisfied: uritemplate<4dev,>=3.0.0 in /opt/conda/lib/python3.7/site
-packages (from google-api-python-client>=1.6.7->tf-models-official) (3.0.1)
Requirement already satisfied: google-api-core<3dev,>=1.21.0 in /opt/conda/lib/python3.
7/site-packages (from google-api-python-client>=1.6.7->tf-models-official) (1.31.5)
Requirement already satisfied: google-auth<3dev,>=1.16.0 in /opt/conda/lib/python3.7/sit
e-packages (from google-api-python-client>=1.6.7->tf-models-official) (1.35.0)
Requirement already satisfied: httplib2<1dev,>=0.15.0 in /opt/conda/lib/python3.7/site-p
ackages (from google-api-python-client>=1.6.7->tf-models-official) (0.20.2)
Requirement already satisfied: google-auth-httplib2>=0.0.3 in /opt/conda/lib/python3.7/s
ite-packages (from google-api-python-client>=1.6.7->tf-models-official) (0.1.0)
Requirement already satisfied: requests in /opt/conda/lib/python3.7/site-packages (from
 kaggle>=1.3.9->tf-models-official) (2.26.0)
Requirement already satisfied: tqdm in /opt/conda/lib/python3.7/site-packages (from kagg
le>=1.3.9->tf-models-official) (4.62.3)
Requirement already satisfied: certifi in /opt/conda/lib/python3.7/site-packages (from k
aggle>=1.3.9->tf-models-official) (2021.10.8)
Requirement already satisfied: python-slugify in /opt/conda/lib/python3.7/site-packages
 (from kaggle>=1.3.9->tf-models-official) (5.0.2)
Requirement already satisfied: urllib3 in /opt/conda/lib/python3.7/site-packages (from k
aggle>=1.3.9->tf-models-official) (1.26.7)
Requirement already satisfied: python-dateutil in /opt/conda/lib/python3.7/site-packages
(from kaggle>=1.3.9->tf-models-official) (2.8.2)
Requirement already satisfied: pytz>=2017.3 in /opt/conda/lib/python3.7/site-packages (f
rom pandas>=0.22.0->tf-models-official) (2021.3)
Requirement already satisfied: absl-py>=0.4.0 in /opt/conda/lib/python3.7/site-packages
 (from tensorflow~=2.8.0->tf-models-official) (0.15.0)
Requirement already satisfied: termcolor>=1.1.0 in /opt/conda/lib/python3.7/site-package
s (from tensorflow~=2.8.0->tf-models-official) (1.1.0)
Collecting tensorboard<2.9,>=2.8
  Downloading tensorboard-2.8.0-py3-none-any.whl (5.8 MB)
     |████████████████████████████████| 5.8 MB 27.6 MB/s
Requirement already satisfied: keras-preprocessing>=1.1.1 in /opt/conda/lib/python3.7/si
te-packages (from tensorflow~=2.8.0->tf-models-official) (1.1.2)
Collecting tensorflow-io-gcs-filesystem>=0.23.1
  Downloading tensorflow_io_gcs_filesystem-0.24.0-cp37-cp37m-manylinux_2_12_x86_64.manyl
inux2010_x86_64.whl (2.1 MB)
     |████████████████████████████████| 2.1 MB 29.7 MB/s
Requirement already satisfied: protobuf>=3.9.2 in /opt/conda/lib/python3.7/site-packages
(from tensorflow~=2.8.0->tf-models-official) (3.19.4)
Requirement already satisfied: h5py>=2.9.0 in /opt/conda/lib/python3.7/site-packages (fr
om tensorflow~=2.8.0->tf-models-official) (3.1.0)
Collecting tf-estimator-nightly==2.8.0.dev2021122109
  Downloading tf_estimator_nightly-2.8.0.dev2021122109-py2.py3-none-any.whl (462 kB)
     |████████████████████████████████| 462 kB 34.2 MB/s
Requirement already satisfied: grpcio<2.0,>=1.24.3 in /opt/conda/lib/python3.7/site-pack
ages (from tensorflow~=2.8.0->tf-models-official) (1.43.0)
Requirement already satisfied: setuptools in /opt/conda/lib/python3.7/site-packages (fro
m tensorflow~=2.8.0->tf-models-official) (59.5.0)
Requirement already satisfied: google-pasta>=0.1.1 in /opt/conda/lib/python3.7/site-pack
ages (from tensorflow~=2.8.0->tf-models-official) (0.2.0)
```

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Requirement already satisfied: typing-extensions>=3.6.6 in /opt/conda/lib/python3.7/site
-packages (from tensorflow~=2.8.0->tf-models-official) (4.1.1)
Requirement already satisfied: opt-einsum>=2.3.2 in /opt/conda/lib/python3.7/site-packag
es (from tensorflow~=2.8.0->tf-models-official) (3.3.0)
Collecting keras
  Downloading keras-2.8.0-py2.py3-none-any.whl (1.4 MB)
     |████████████████████████████████| 1.4 MB 28.7 MB/s
Requirement already satisfied: gast>=0.2.1 in /opt/conda/lib/python3.7/site-packages (fr
om tensorflow~=2.8.0->tf-models-official) (0.4.0)
Collecting libclang>=9.0.1
  Downloading libclang-13.0.0-py2.py3-none-manylinux1_x86_64.whl (14.5 MB)
     |████████████████████████████████| 14.5 MB 39.3 MB/s
Requirement already satisfied: flatbuffers>=1.12 in /opt/conda/lib/python3.7/site-packag
es (from tensorflow~=2.8.0->tf-models-official) (1.12)
Requirement already satisfied: wrapt>=1.11.0 in /opt/conda/lib/python3.7/site-packages
 (from tensorflow~=2.8.0->tf-models-official) (1.13.3)
Requirement already satisfied: astunparse>=1.6.0 in /opt/conda/lib/python3.7/site-packag
es (from tensorflow~=2.8.0->tf-models-official) (1.6.3)
Requirement already satisfied: dm-tree~=0.1.1 in /opt/conda/lib/python3.7/site-packages
 (from tensorflow-model-optimization>=0.4.1->tf-models-official) (0.1.6)
Requirement already satisfied: kiwisolver>=1.0.1 in /opt/conda/lib/python3.7/site-packag
es (from matplotlib->tf-models-official) (1.3.2)
Requirement already satisfied: cycler>=0.10 in /opt/conda/lib/python3.7/site-packages (f
rom matplotlib->tf-models-official) (0.11.0)
Requirement already satisfied: packaging>=20.0 in /opt/conda/lib/python3.7/site-packages
(from matplotlib->tf-models-official) (21.3)
Requirement already satisfied: fonttools>=4.22.0 in /opt/conda/lib/python3.7/site-packag
es (from matplotlib->tf-models-official) (4.28.4)
Requirement already satisfied: pyasn1>=0.1.7 in /opt/conda/lib/python3.7/site-packages
 (from oauth2client->tf-models-official) (0.4.8)
Requirement already satisfied: rsa>=3.1.4 in /opt/conda/lib/python3.7/site-packages (fro
m oauth2client->tf-models-official) (4.8)
Requirement already satisfied: pyasn1-modules>=0.0.5 in /opt/conda/lib/python3.7/site-pa
ckages (from oauth2client->tf-models-official) (0.2.7)
Requirement already satisfied: regex in /opt/conda/lib/python3.7/site-packages (from sac
rebleu->tf-models-official) (2021.11.10)
Requirement already satisfied: tabulate>=0.8.9 in /opt/conda/lib/python3.7/site-packages
(from sacrebleu->tf-models-official) (0.8.9)
Requirement already satisfied: colorama in /opt/conda/lib/python3.7/site-packages (from
 sacrebleu->tf-models-official) (0.4.4)
Requirement already satisfied: portalocker in /opt/conda/lib/python3.7/site-packages (fr
om sacrebleu->tf-models-official) (2.4.0)
Requirement already satisfied: scikit-learn>=0.21.3 in /opt/conda/lib/python3.7/site-pac
kages (from seqeval->tf-models-official) (1.0.1)
Requirement already satisfied: typeguard>=2.7 in /opt/conda/lib/python3.7/site-packages
 (from tensorflow-addons->tf-models-official) (2.13.3)
Requirement already satisfied: promise in /opt/conda/lib/python3.7/site-packages (from t
ensorflow-datasets->tf-models-official) (2.3)
Requirement already satisfied: attrs>=18.1.0 in /opt/conda/lib/python3.7/site-packages
 (from tensorflow-datasets->tf-models-official) (21.2.0)
Requirement already satisfied: importlib-resources in /opt/conda/lib/python3.7/site-pack
ages (from tensorflow-datasets->tf-models-official) (5.4.0)
Requirement already satisfied: future in /opt/conda/lib/python3.7/site-packages (from te
nsorflow-datasets->tf-models-official) (0.18.2)
Requirement already satisfied: dill in /opt/conda/lib/python3.7/site-packages (from tens
orflow-datasets->tf-models-official) (0.3.4)
Requirement already satisfied: tensorflow-metadata in /opt/conda/lib/python3.7/site-pack
ages (from tensorflow-datasets->tf-models-official) (1.5.0)
Requirement already satisfied: wheel<1.0,>=0.23.0 in /opt/conda/lib/python3.7/site-packa
ges (from astunparse>=1.6.0->tensorflow~=2.8.0->tf-models-official) (0.37.0)
```

```
Requirement already satisfied: googleapis-common-protos<2.0dev,>=1.6.0 in /opt/conda/li
b/python3.7/site-packages (from google-api-core<3dev,>=1.21.0->google-api-python-client>
=1.6.7->tf-models-official) (1.53.0)
Requirement already satisfied: cachetools<5.0,>=2.0.0 in /opt/conda/lib/python3.7/site-p
ackages (from google-auth<3dev,>=1.16.0->google-api-python-client>=1.6.7->tf-models-offi
cial) (4.2.4)
Requirement already satisfied: cached-property in /opt/conda/lib/python3.7/site-packages
(from h5py>=2.9.0->tensorflow~=2.8.0->tf-models-official) (1.5.2)
Requirement already satisfied: idna<4,>=2.5 in /opt/conda/lib/python3.7/site-packages (f
rom requests->kaggle>=1.3.9->tf-models-official) (3.1)
Requirement already satisfied: charset-normalizer~=2.0.0 in /opt/conda/lib/python3.7/sit
e-packages (from requests->kaggle>=1.3.9->tf-models-official) (2.0.9)
Requirement already satisfied: joblib>=0.11 in /opt/conda/lib/python3.7/site-packages (f
rom scikit-learn>=0.21.3->seqeval->tf-models-official) (1.1.0)
Requirement already satisfied: threadpoolctl>=2.0.0 in /opt/conda/lib/python3.7/site-pac
kages (from scikit-learn>=0.21.3->seqeval->tf-models-official) (3.0.0)
Requirement already satisfied: google-auth-oauthlib<0.5,>=0.4.1 in /opt/conda/lib/python
3.7/site-packages (from tensorboard<2.9,>=2.8->tensorflow~=2.8.0->tf-models-official)
 (0.4.6)
Requirement already satisfied: tensorboard-data-server<0.7.0,>=0.6.0 in /opt/conda/lib/p
ython3.7/site-packages (from tensorboard<2.9,>=2.8->tensorflow~=2.8.0->tf-models-officia
l) (0.6.1)
Requirement already satisfied: werkzeug>=0.11.15 in /opt/conda/lib/python3.7/site-packag
es (from tensorboard<2.9,>=2.8->tensorflow~=2.8.0->tf-models-official) (2.0.2)
Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in /opt/conda/lib/python3.
7/site-packages (from tensorboard<2.9,>=2.8->tensorflow~=2.8.0->tf-models-official) (1.
8.0)
Requirement already satisfied: markdown>=2.6.8 in /opt/conda/lib/python3.7/site-packages
(from tensorboard<2.9,>=2.8->tensorflow~=2.8.0->tf-models-official) (3.3.6)
Requirement already satisfied: zipp>=3.1.0 in /opt/conda/lib/python3.7/site-packages (fr
om importlib-resources->tensorflow-datasets->tf-models-official) (3.6.0)
Requirement already satisfied: text-unidecode>=1.3 in /opt/conda/lib/python3.7/site-pack
ages (from python-slugify->kaggle>=1.3.9->tf-models-official) (1.3)
Collecting absl-py>=0.4.0
  Downloading absl_py-0.12.0-py3-none-any.whl (129 kB)
     |████████████████████████████████| 129 kB 37.0 MB/s
Requirement already satisfied: requests-oauthlib>=0.7.0 in /opt/conda/lib/python3.7/site
-packages (from google-auth-oauthlib<0.5,>=0.4.1->tensorboard<2.9,>=2.8->tensorflow~=2.
8.0->tf-models-official) (1.3.0)
Requirement already satisfied: importlib-metadata>=4.4 in /opt/conda/lib/python3.7/site-
packages (from markdown>=2.6.8->tensorboard<2.9,>=2.8->tensorflow~=2.8.0->tf-models-offi
cial) (4.11.3)
Requirement already satisfied: oauthlib>=3.0.0 in /opt/conda/lib/python3.7/site-packages
(from requests-oauthlib>=0.7.0->google-auth-oauthlib<0.5,>=0.4.1->tensorboard<2.9,>=2.8-
>tensorflow~=2.8.0->tf-models-official) (3.1.1)
Building wheels for collected packages: py-cpuinfo, pycocotools, seqeval
  Building wheel for py-cpuinfo (setup.py) ... -   \   done
  Created wheel for py-cpuinfo: filename=py_cpuinfo-8.0.0-py3-none-any.whl size=22258 sh
a256=e8382ca4169b67f0b73249629d3a0c2ef5a21bc6ac0919c1774c1331498d7723
  Stored in directory: /root/.cache/pip/wheels/d2/f1/1f/041add21dc9c4220157f1bd2bd6afe1f
1a49524c3396b94401
  Building wheel for pycocotools (pyproject.toml) ... -   \   |   /   -   \   |   /   -
 \   |   /   done
  Created wheel for pycocotools: filename=pycocotools-2.0.4-cp37-cp37m-linux_x86_64.whl
 size=370023 sha256=c0615b9b45e66f1e494d02b8d9038e2c58ff98dbed892eabf51e3213182836dd
  Stored in directory: /root/.cache/pip/wheels/a3/5f/fa/f011e578cc76e1fc5be8dce30b3eb9fd
00f337e744b3bba59b
  Building wheel for seqeval (setup.py) ... -   \   |   done
  Created wheel for seqeval: filename=seqeval-1.2.2-py3-none-any.whl size=16181 sha256=e
04de6109e1425fefdc4a026953d04dc799502e4609024edcc7f9fc70ff6d784
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  Stored in directory: /root/.cache/pip/wheels/05/96/ee/7cac4e74f3b19e3158dce26a20a1c86b
3533c43ec72a549fd7
Successfully built py-cpuinfo pycocotools seqeval
Installing collected packages: absl-py, tf-estimator-nightly, tensorflow-io-gcs-filesyst
em, tensorboard, libclang, keras, tensorflow, tf-slim, tensorflow-text, tensorflow-model
-optimization, seqeval, sacrebleu, pyyaml, pycocotools, py-cpuinfo, gin-config, tf-model
s-official
  Attempting uninstall: absl-py
    Found existing installation: absl-py 0.15.0
    Uninstalling absl-py-0.15.0:
      Successfully uninstalled absl-py-0.15.0
  Attempting uninstall: tensorboard
    Found existing installation: tensorboard 2.6.0
    Uninstalling tensorboard-2.6.0:
      Successfully uninstalled tensorboard-2.6.0
  Attempting uninstall: keras
    Found existing installation: keras 2.6.0
    Uninstalling keras-2.6.0:
      Successfully uninstalled keras-2.6.0
  Attempting uninstall: tensorflow
    Found existing installation: tensorflow 2.6.2
    Uninstalling tensorflow-2.6.2:
      Successfully uninstalled tensorflow-2.6.2
  Attempting uninstall: pyyaml
    Found existing installation: PyYAML 6.0
    Uninstalling PyYAML-6.0:
      Successfully uninstalled PyYAML-6.0
ERROR: pip's dependency resolver does not currently take into account all the packages t
hat are installed. This behaviour is the source of the following dependency conflicts.
explainable-ai-sdk 1.3.2 requires xai-image-widget, which is not installed.
dask-cudf 21.10.1 requires cupy-cuda114, which is not installed.
tfx-bsl 1.5.0 requires numpy<1.20,>=1.16, but you have numpy 1.20.3 which is incompatibl
e.
tfx-bsl 1.5.0 requires pyarrow<6,>=1, but you have pyarrow 6.0.1 which is incompatible.
tensorflow-transform 1.5.0 requires numpy<1.20,>=1.16, but you have numpy 1.20.3 which i
s incompatible.
tensorflow-transform 1.5.0 requires pyarrow<6,>=1, but you have pyarrow 6.0.1 which is i
ncompatible.
tensorflow-transform 1.5.0 requires tensorflow!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.*,!=2.4.*,!=
2.5.*,!=2.6.*,<2.8,>=1.15.2, but you have tensorflow 2.8.0 which is incompatible.
tensorflow-io 0.21.0 requires tensorflow<2.7.0,>=2.6.0, but you have tensorflow 2.8.0 wh
ich is incompatible.
tensorflow-io 0.21.0 requires tensorflow-io-gcs-filesystem==0.21.0, but you have tensorf
low-io-gcs-filesystem 0.24.0 which is incompatible.
ortools 9.3.10459 requires absl-py>=0.13, but you have absl-py 0.12.0 which is incompati
ble.
dask-cudf 21.10.1 requires dask==2021.09.1, but you have dask 2022.2.0 which is incompat
ible.
dask-cudf 21.10.1 requires distributed==2021.09.1, but you have distributed 2022.2.0 whi
ch is incompatible.
Successfully installed absl-py-0.12.0 gin-config-0.5.0 keras-2.8.0 libclang-13.0.0 py-cp
uinfo-8.0.0 pycocotools-2.0.4 pyyaml-5.4.1 sacrebleu-2.0.0 seqeval-1.2.2 tensorboard-2.
8.0 tensorflow-2.8.0 tensorflow-io-gcs-filesystem-0.24.0 tensorflow-model-optimization-
0.7.2 tensorflow-text-2.8.1 tf-estimator-nightly-2.8.0.dev2021122109 tf-models-official-
2.8.0 tf-slim-1.1.0
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting
behaviour with the system package manager. It is recommended to use a virtual environmen
t instead: https://pip.pypa.io/warnings/venv
Collecting emot
  Downloading emot-3.1-py3-none-any.whl (61 kB)
```

```
     |████████████████████████████████| 61 kB 11 kB/s
Installing collected packages: emot
Successfully installed emot-3.1
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting
behaviour with the system package manager. It is recommended to use a virtual environmen
t instead: https://pip.pypa.io/warnings/venv
```

Importing libraries

In [2]:

```
#essentials
import re
import os
import csv
import glob
import string
import random
import requests
import numpy as np
import pandas as pd
from datetime import datetime

#preprocessing
from wordcloud import WordCloud
from wordcloud import STOPWORDS
from tqdm.autonotebook import tqdm
import nltk
nltk.download('stopwords')
nltk.download('words')
nltk.download('punkt')
nltk.download('wordnet')
nltk.download('averaged_perceptron_tagger')
import urllib.request
from nltk import pos_tag # For Parts of Speech tagging
from textblob import TextBlob # TextBlob - Python library for processing textual data
from nltk.tokenize import word_tokenize
from nltk.corpus import stopwords, words # get stopwords from NLTK library & get all wo
from nltk.tokenize import word_tokenize # to create word tokens
from nltk.stem import WordNetLemmatizer # to reduce words to orginal form
from emot.emo_unicode import UNICODE_EMOJI # For emojis
from emot.emo_unicode import EMOTICONS_EMO # For EMOTICONS
def extract_emojis(s):
  return ''.join(c for c in s if c in emoji.UNICODE_EMOJI)

#ploting
import seaborn as sns
import matplotlib.pyplot as plt

#model
from sklearn.model_selection import StratifiedKFold

#evaluation
from sklearn.metrics import precision_score, recall_score, f1_score
```

```
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:16: TqdmExperimentalWarnin
g: Using `tqdm.autonotebook.tqdm` in notebook mode. Use `tqdm.tqdm` instead to force con
sole mode (e.g. in jupyter console)
  app.launch_new_instance()
```

```
[nltk_data] Downloading package stopwords to /usr/share/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package words to /usr/share/nltk_data...
[nltk_data]   Package words is already up-to-date!
[nltk_data] Downloading package punkt to /usr/share/nltk_data...
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package wordnet to /usr/share/nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
[nltk_data] Downloading package averaged_perceptron_tagger to
[nltk_data]     /usr/share/nltk_data...
[nltk_data]   Package averaged_perceptron_tagger is already up-to-
[nltk_data]       date!
```

In [3]:
```
from transformers import BertTokenizer, BertForMaskedLM
```

loading data

In [4]:
```
train_df = pd.read_csv('../input/raw-emotions-dataset/train.csv', encoding= 'unicode_es
test_df= pd.read_csv('../input/raw-emotions-dataset/test.csv', encoding= 'unicode_escap
train_df.head()
```

Out[4]:

	text	label
0	that Rutgers game was an abomination. An affro...	anger
1	I get mad over something so minuscule I try to...	anger
2	I get mad over something so minuscule I try to...	anger
3	eyes have been dilated. I hate the world right...	anger
4	One chosen by the CLP members! MP seats are no...	anger

In [5]:
```
test_df.head()
```

Out[5]:

	text	label
0	#afraid of the #quiet ones they are the ones w...	fear
1	he's a horrible person and now i gag when i se...	fear
2	pedicure is supposed to be nice but honestly I...	fear
3	you need to band together not apart #nevertrum...	fear
4	you need to band together not apart #nevertrum...	fear

In [6]:
```
print("Training Set Shape :", train_df.shape)
print("Test Set Shape :", test_df.shape)
```

```
Training Set Shape : (1870, 2)
Test Set Shape : (1578, 2)
```

In [7]:
```
train_df.describe()
```

Out[7]:

	text	label
count	1870	1790
unique	1850	4
top	always unhappy and easily offended.	fear
freq	2	569

In [8]:
```
test_df.text=test_df.text.astype(str)
```

In [9]:
```
test_df.dtypes
```

Out[9]:
```
text     object
label    object
dtype: object
```

1 Data preprocessing

In this stage, we will;

Creating Meta Features : Word Count Unique word count Mean word length Length of the text URL count Hashtag count Mention (@)count stop word count Punctuation count

In [10]:
```
# function to obtain adjectives from text
def getAdjectives(text):
    text = word_tokenize(text)  # convert string to tokens
    text = [word for (word, tag) in pos_tag(text)
            if tag == "JJ"]  # pos_tag module in NLTK library
    return " ".join(text)  # join words with a space in between them
def preprocessTextSentiments(text):

    text_tokens = word_tokenize(text)
    lemmatizer = WordNetLemmatizer() # instatiate an object WordNetLemmatizer Class
    lemma_words = [lemmatizer.lemmatize(w) for w in text_tokens]
    return " ".join(lemma_words)
```

In [ ]:
```
```

In [11]:
```
def clean_df(df):
    #word count
    df['word_count'] = df['text'].apply( lambda x: len(str(x).split()))
    #Unique word count
    df['unique_wordcount'] = df['text'].apply(lambda x: len(set(str(x).split())))

    #Mean word length
    df['mean_word_length'] = df['text'].apply(lambda x: round(np.mean([len(w) for w in

    #Length of the text
    df['text_length'] = df['text'].apply(lambda x: len(x))
```

```
    #hashtag count
    df['hashtags'] = df['text'].apply( lambda x: len(re.findall('#.*',x)))

    #mention (@)
    df['mention_count'] = df['text'].apply( lambda x: len(re.findall('@.*',x)))

    # stopword count
    df['stopwords'] = df['text'].apply( lambda x: len([w for w in x.lower().split() if

    #punctuation count
    df['punctuation_count'] = df['text'].apply( lambda x: len( re.findall('[%s]' %strin

    # Apply getAdjectives function to the new 'Processed Text' column to generate a new
    df['text_Adjectives'] = df['text'].apply(getAdjectives)

    return df
```

In [12]:
```
train_df=clean_df(train_df)
test_df=clean_df(test_df)
```

In [13]:
```
train_df.head()
```

Out[13]:

	text	label	word_count	unique_wordcount	mean_word_length	text_length	hashtags	ment
0	that Rutgers game was an abomination. An affro...	anger	19	19	4.16	97	0	
1	I get mad over something so minuscule I try to...	anger	24	21	4.17	123	0	
2	I get mad over something so minuscule I try to...	anger	25	22	4.24	130	1	
3	eyes have been dilated. I hate the world right...	anger	22	19	4.00	109	0	
4	One chosen by the CLP members! MP seats are no...	anger	22	21	4.27	115	1	

In [14]:
```
#function removes '@',  http links, punctuations, emojis, and stop words from data
def preprocess(text):
```

```
    '''
Apply preprocess function to the 'text' column to generate a new column called 'Process
This function will;
1. remove urls,
2. remove @ and #.
3. Remove punctuations
4. Remove emojis
5. remove stop words
'''
    # Remove user @ references and '#' from text
    text = re.sub(r'\@\w+|\#|\d+', '', text)

    # Remove punctuations
    text = re.sub('[%s]' % re.escape(string.punctuation),'',text)

    # Typos, slang and informal abbreviations
    text = re.sub(r"w/e", "whatever", text)
    text = re.sub(r"w/", "with", text)
    text = re.sub(r"USAgov", "USA government", text)
    text = re.sub(r"recentlu", "recently", text)
    text = re.sub(r"Ph0tos", "Photos", text)
    text = re.sub(r"amirite", "am I right", text)
    text = re.sub(r"exp0sed", "exposed", text)
    text = re.sub(r"<3", "love", text)
    text = re.sub(r"amageddon", "armageddon", text)
    text = re.sub(r"Trfc", "Traffic", text)
    text = re.sub(r"8/5/2015", "2015-08-05", text)
    text = re.sub(r"WindStorm", "Wind Storm", text)
    text = re.sub(r"8/6/2015", "2015-08-06", text)
    text = re.sub(r"10:38PM", "10:38 PM", text)
    text = re.sub(r"10:30pm", "10:30 PM", text)
    text = re.sub(r"16yr", "16 year", text)
    text = re.sub(r"lmao", "laughing my ass off", text)
    text = re.sub(r"TRAUMATISED", "traumatized", text)

    # Character entity references
    text = re.sub(r"&gt;", ">", text)
    text = re.sub(r"&lt;", "<", text)
    text = re.sub(r"&amp;", "&", text)

    # Contractions
    text = re.sub(r"he's", "he is", text)
    text = re.sub(r"there's", "there is", text)
    text = re.sub(r"We're", "We are", text)
    text = re.sub(r"That's", "That is", text)
    text = re.sub(r"won't", "will not", text)
    text = re.sub(r"they're", "they are", text)
    text = re.sub(r"Can't", "Cannot", text)
    text = re.sub(r"wasn't", "was not", text)
    text = re.sub(r"don\x89Ûªt", "do not", text)
    text = re.sub(r"aren't", "are not", text)
    text = re.sub(r"isn't", "is not", text)
    text = re.sub(r"What's", "What is", text)
    text = re.sub(r"haven't", "have not", text)
    text = re.sub(r"hasn't", "has not", text)
    text = re.sub(r"There's", "There is", text)
    text = re.sub(r"He's", "He is", text)
    text = re.sub(r"It's", "It is", text)
    text = re.sub(r"You're", "You are", text)
```

```
    text = re.sub(r"I'M", "I am", text)
    text = re.sub(r"shouldn't", "should not", text)
    text = re.sub(r"wouldn't", "would not", text)
    text = re.sub(r"i'm", "I am", text)
    text = re.sub(r"I\x89Ûªm", "I am", text)
    text = re.sub(r"I'm", "I am", text)
    text = re.sub(r"Isn't", "is not", text)
    text = re.sub(r"Here's", "Here is", text)
    text = re.sub(r"you've", "you have", text)
    text = re.sub(r"you\x89Ûªve", "you have", text)
    text = re.sub(r"we're", "we are", text)
    text = re.sub(r"what's", "what is", text)
    text = re.sub(r"couldn't", "could not", text)
    text = re.sub(r"we've", "we have", text)
    text = re.sub(r"it\x89Ûªs", "it is", text)
    text = re.sub(r"doesn\x89Ûªt", "does not", text)
    text = re.sub(r"It\x89Ûªs", "It is", text)
    text = re.sub(r"Here\x89Ûªs", "Here is", text)
    text = re.sub(r"who's", "who is", text)
    text = re.sub(r"I\x89Ûªve", "I have", text)
    text = re.sub(r"y'all", "you all", text)
    text = re.sub(r"can\x89Ûªt", "cannot", text)
    text = re.sub(r"would've", "would have", text)
    text = re.sub(r"it'll", "it will", text)
    text = re.sub(r"we'll", "we will", text)
    text = re.sub(r"wouldn\x89Ûªt", "would not", text)
    text = re.sub(r"We've", "We have", text)
    text = re.sub(r"he'll", "he will", text)
    text = re.sub(r"Y'all", "You all", text)
    text = re.sub(r"Weren't", "Were not", text)
    text = re.sub(r"Didn't", "Did not", text)
    text = re.sub(r"they'll", "they will", text)
    text = re.sub(r"they'd", "they would", text)
    text = re.sub(r"DON'T", "DO NOT", text)
    text = re.sub(r"That\x89Ûªs", "That is", text)
    text = re.sub(r"they've", "they have", text)
    text = re.sub(r"i'd", "I would", text)
    text = re.sub(r"should've", "should have", text)
    text = re.sub(r"You\x89Ûªre", "You are", text)
    text = re.sub(r"where's", "where is", text)
    text = re.sub(r"Don\x89Ûªt", "Do not", text)
    text = re.sub(r"we'd", "we would", text)
    text = re.sub(r"i'll", "I will", text)
    text = re.sub(r"weren't", "were not", text)
    text = re.sub(r"They're", "They are", text)
    text = re.sub(r"Can\x89Ûªt", "Cannot", text)
    text = re.sub(r"you\x89Ûªll", "you will", text)
    text = re.sub(r"I\x89Ûªd", "I would", text)
    text = re.sub(r"let's", "let us", text)
    text = re.sub(r"it's", "it is", text)
    text = re.sub(r"can't", "cannot", text)
    text = re.sub(r"don't", "do not", text)
    text = re.sub(r"you're", "you are", text)
    text = re.sub(r"i've", "I have", text)
    text = re.sub(r"that's", "that is", text)
    text = re.sub(r"i'll", "I will", text)
    text = re.sub(r"doesn't", "does not", text)
    text = re.sub(r"i'd", "I would", text)
    text = re.sub(r"didn't", "did not", text)
    text = re.sub(r"ain't", "am not", text)
```

```
    text = re.sub(r"you'll", "you will", text)
    text = re.sub(r"I've", "I have", text)
    text = re.sub(r"Don't", "do not", text)
    text = re.sub(r"I'll", "I will", text)
    text = re.sub(r"I'd", "I would", text)
    text = re.sub(r"Let's", "Let us", text)
    text = re.sub(r"you'd", "You would", text)
    text = re.sub(r"It's", "It is", text)
    text = re.sub(r"Ain't", "am not", text)
    text = re.sub(r"Haven't", "Have not", text)
    text = re.sub(r"Could've", "Could have", text)
    text = re.sub(r"youve", "you have", text)
    text = re.sub(r"donå«t", "do not", text)

    # Special characters
    text = re.sub(r"\x89Û_", "", text)
    text = re.sub(r"\x89ÛÒ", "", text)
    text = re.sub(r"\x89ÛÓ", "", text)
    text = re.sub(r"\x89ÛÏWhen", "When", text)
    text = re.sub(r"\x89ÛÏ", "", text)
    text = re.sub(r"China\x89Ûªs", "China's", text)
    text = re.sub(r"let\x89Ûªs", "let's", text)
    text = re.sub(r"\x89Û÷", "", text)
    text = re.sub(r"\x89Ûª", "", text)
    text = re.sub(r"\x89Û\x9d", "", text)
    text = re.sub(r"å_", "", text)
    text = re.sub(r"\x89Û¢", "", text)
    text = re.sub(r"\x89Û¢åÊ", "", text)
    text = re.sub(r"fromåÊwounds", "from wounds", text)
    text = re.sub(r"åÊ", "", text)
    text = re.sub(r"åÈ", "", text)
    text = re.sub(r"JapÌ_n", "Japan", text)
    text = re.sub(r"Ì©", "e", text)
    text = re.sub(r"å¨", "", text)
    text = re.sub(r"SuruÌ¤", "Suruc", text)
    text = re.sub(r"åÇ", "", text)
    text = re.sub(r"å£3million", "3 million", text)
    text = re.sub(r"åÀ", "", text)

    #reduce text to lowercase
    text = text.lower()

    #convert string to tokens
    PRE_TRAINED_MODEL_NAME = 'bert-base-cased'
    tokenizer = BertTokenizer.from_pretrained(PRE_TRAINED_MODEL_NAME)
    tokens = tokenizer.tokenize(text)

    # Remove stopwords
    filtered_words = [w for w in tokens if w not in stop_words]
    filtered_words = [w for w in filtered_words if w not in emojis]
    filtered_words = [w for w in filtered_words if w in word_list]

    return text
    # Remove punctuations
    unpunctuated_words = [char for char in filtered_words if char not in string.punctua
    unpunctuated_words = ' '.join(unpunctuated_words)

    return "".join(unpunctuated_words)  # join words with a space in between them
```

In [15]:
```
# Defining my NLTK stop words
stop_words = list(stopwords.words('english'))
alphabets = list(string.ascii_lowercase)
stop_words = stop_words + alphabets
word_list = words.words()  # all words in English language
emojis = list(UNICODE_EMOJI.keys())  # full list of emojis
```

In [16]:
```
train_df['Processed_Text'] = train_df['text'].apply(preprocess)
test_df['Processed_Text'] = test_df['text'].apply(preprocess)
```

Downloading: 100% 29.0/29.0 [00:00<00:00, 909B/s]

Downloading: 100% 208k/208k [00:00<00:00, 515kB/s]

Downloading: 100% 426k/426k [00:00<00:00, 567kB/s]

Downloading: 100% 570/570 [00:00<00:00, 18.6kB/s]

In [17]:
```
#printing results for better analysis
print(train_df['text'][19])
print(train_df['Processed_Text'][19])
```

```
scrubbed hands 5 times before trying to put them in.
scrubbed hands  times before trying to put them in
```

In [18]:
```
train_df[['text','Processed_Text']].head()
```

Out[18]:

	text	Processed_Text
0	that Rutgers game was an abomination. An affro...	that rutgers game was an abomination an affron...
1	I get mad over something so minuscule I try to...	i get mad over something so minuscule i try to...
2	I get mad over something so minuscule I try to...	i get mad over something so minuscule i try to...
3	eyes have been dilated. I hate the world right...	eyes have been dilated i hate the world right ...
4	One chosen by the CLP members! MP seats are no...	one chosen by the clp members mp seats are not...

In [19]:
```
train_df.to_csv('preprocessedEmotionTrain.csv')
test_df.to_csv('preprocessedEmotionTest.csv')
```

In [20]:
```
train_df.head()
```

Out[20]:

	text	label	word_count	unique_wordcount	mean_word_length	text_length	hashtags	ment
0	that Rutgers game was an abomination. An affro...	anger	19	19	4.16	97	0	

	text	label	word_count	unique_wordcount	mean_word_length	text_length	hashtags	ment
1	I get mad over something so minuscule I try to...	anger	24	21	4.17	123	0	
2	I get mad over something so minuscule I try to...	anger	25	22	4.24	130	1	
3	eyes have been dilated. I hate the world right...	anger	22	19	4.00	109	0	
4	One chosen by the CLP members! MP seats are no...	anger	22	21	4.27	115	1	

In [21]:
```
train_df=train_df.dropna()
test_df=test_df.dropna()
```

In [22]:
```
classes = train_df.label.unique()
classes
```

Out[22]:
```
array(['anger', 'sadness', 'fear', 'joy'], dtype=object)
```

In [23]:
```
happy_df = train_df.loc[train_df['label']=='joy']['Processed_Text'] #joy tweets
happy_df = happy_df.apply(lambda x: ' '.join([w for w in x.split() if w not in STOPWORD
happy_df.head()
```

Out[23]:
```
469    got back seeing burslem amazing face still hur...
470    dear evening absolute hilarity dont think laug...
471                        waiting week game cheer friday
472    thank much gloria youre sweet thoughtful made ...
473    feel blessed work family nanny nothing love am...
Name: Processed_Text, dtype: object
```

In [24]:
```
angry_df = train_df.loc[train_df['label']=='anger']['Processed_Text'] #anger tweets
angry_df = angry_df.apply(lambda x: ' '.join([w for w in x.split() if w not in STOPWORD
angry_df.head()
```

Out[24]:
```
0    rutgers game abomination affront god man must ...
1    mad something minuscule try ruin somebodies li...
2    mad something minuscule try ruin somebodies li...
3    eyes dilated hate world right now rage thousan...
4    one chosen clp members mp seats people dole ma...
Name: Processed_Text, dtype: object
```

In [25]:
```
sad_df = train_df.loc[train_df['label']=="sadness"]['Processed_Text'] #optimism tweets
sad_df = sad_df.apply(lambda x: ' '.join([w for w in x.split() if w not in STOPWORDS]))
sad_df.head()
```

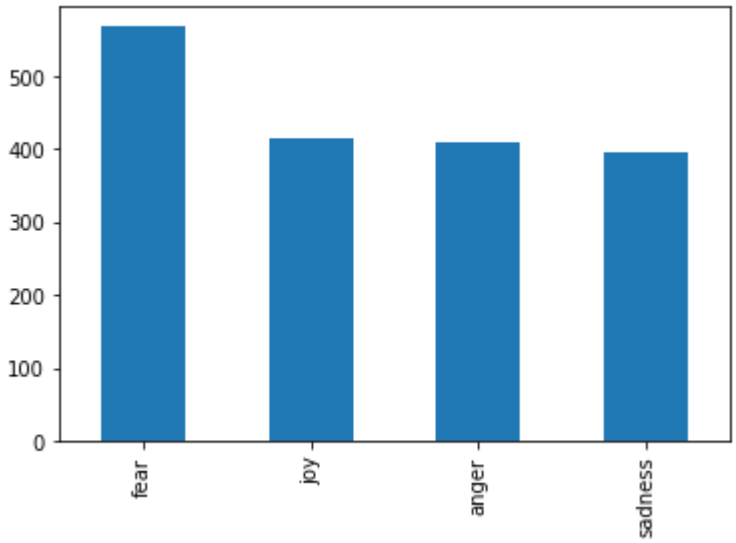
Out[25]:
```
37                                    sucks depression
38                          worthless always depression
39                                    worthless always
40    fibromyalgia really bad lately good mental sta...
41      think ima lay bed day sulk life hitting hard rn
Name: Processed_Text, dtype: object
```

In [26]:
```
neutral_df = train_df.loc[train_df['label']== 'fear']['Processed_Text'] #optimism tweet
neutral_df = neutral_df.apply(lambda x: ' '.join([w for w in x.split() if w not in STOP
neutral_df.head()
```

Out[26]:
```
426      know going one nights takes act god fall asleep
427    w rock jack black kevin hartare kidding wtf th...
428    w rock jack black kevin hartare kidding wtf th...
429    concerns amp anxiety dont matter return favor ...
430     goes butterflies stomach nervous anxietyproblems
Name: Processed_Text, dtype: object
```

In [27]:
```
#Distribution of classes
train_df['label'].value_counts().plot(kind = 'bar')
```

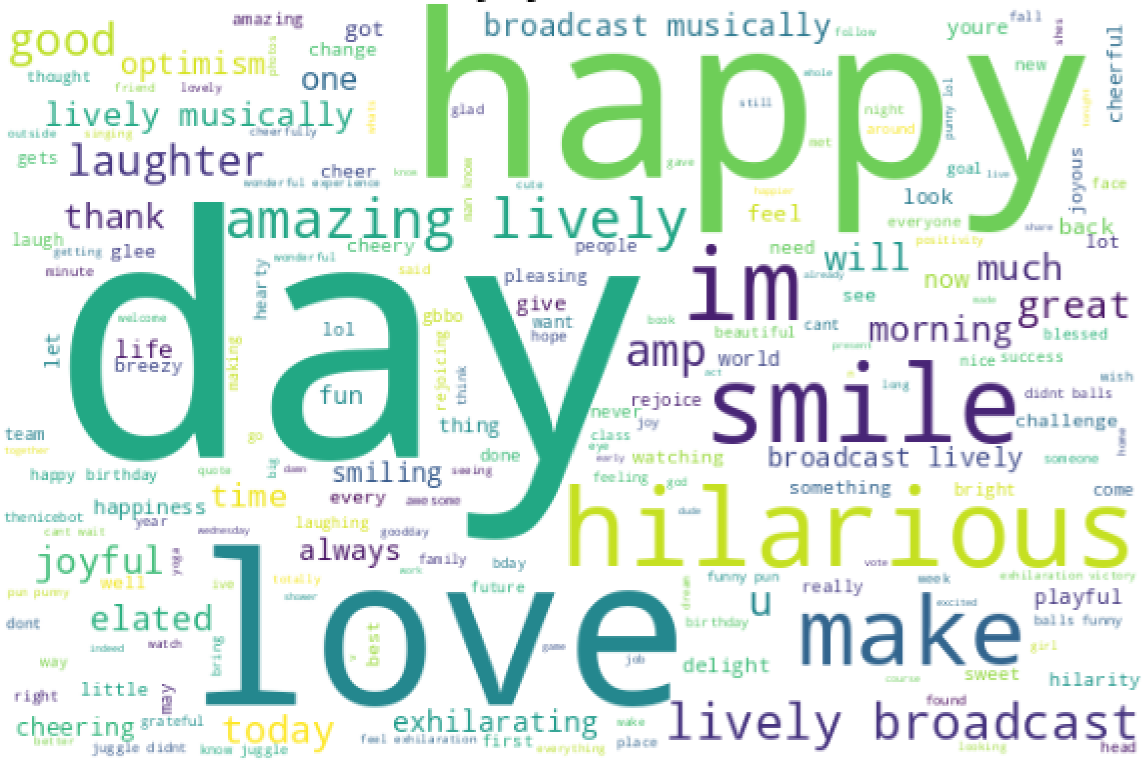
Out[27]:
```
<AxesSubplot:>
```



In [28]:
```
plt.figure(figsize=(20,7))
wordcloud1 = WordCloud(background_color ='white',width=600, height= 400).generate(' '.j
plt.imshow(wordcloud1)
plt.axis('off')
plt.title('Joy text',fontsize=25)
```

Out[28]:
```
Text(0.5, 1.0, 'Joy text')
```

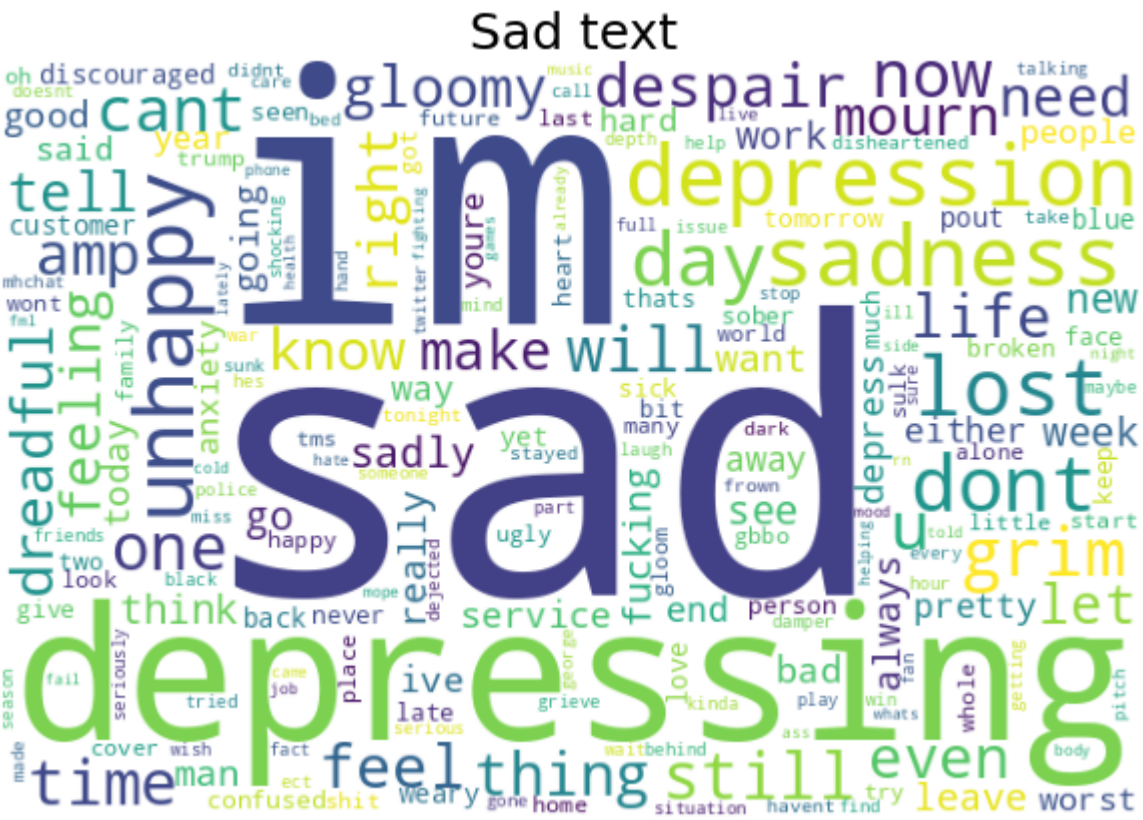
Joy text




```
In [29]:
```

```python
plt.figure(figsize=(20,7))
wordcloud2 = WordCloud(background_color ='white',width =600, height =400).generate(' '.
plt.imshow(wordcloud2)
plt.axis('off')
plt.title('Sad text',fontsize=25)
```

```
Out[29]: Text(0.5, 1.0, 'Sad text')
```



In [30]:

```
plt.figure(figsize=(20,7))
wordcloud2 = WordCloud(background_color ='white',width =600, height =400).generate(' '.
plt.imshow(wordcloud2)
plt.axis('off')
plt.title('Angry text',fontsize=25)
```

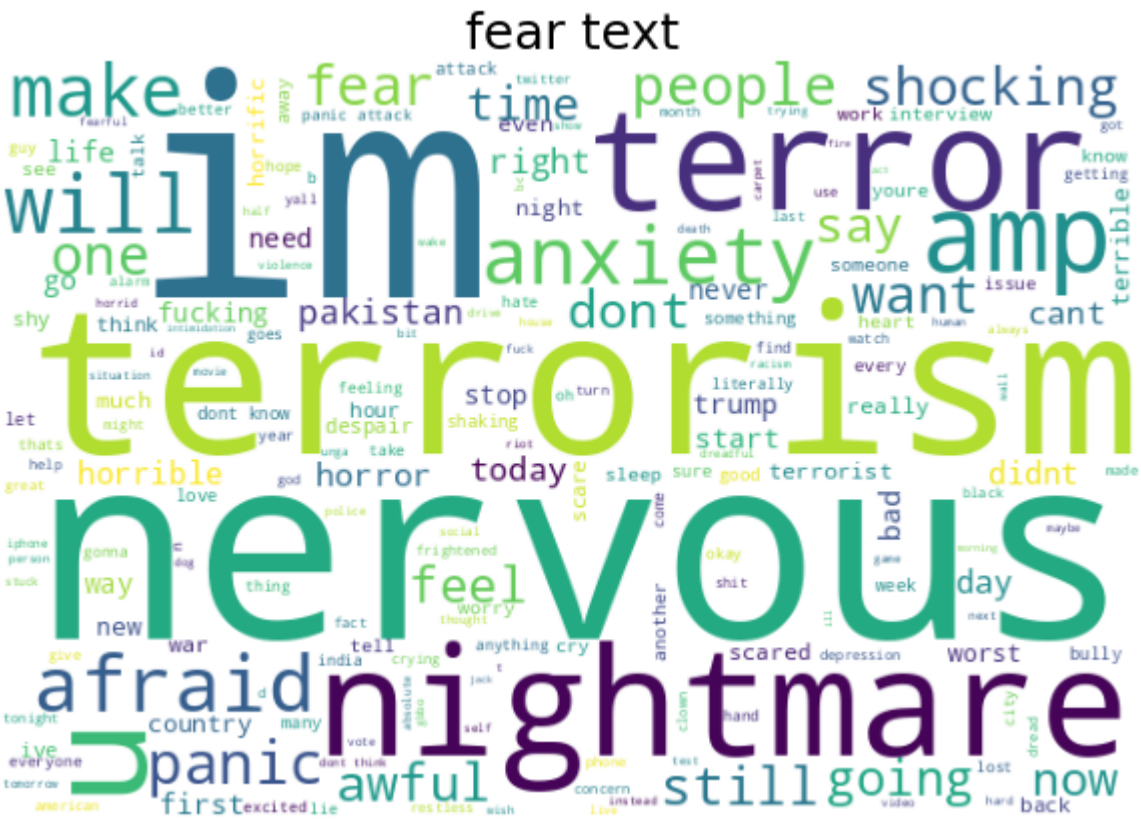
Out[30]:

```
Text(0.5, 1.0, 'Angry text')
```

Angry text


```
plt.figure(figsize=(20,7))
wordcloud2 = WordCloud(background_color ='white',width =600, height =400).generate(' '.
plt.imshow(wordcloud2)
plt.axis('off')
plt.title('fear text',fontsize=25)
```

Out[31]: Text(0.5, 1.0, 'fear text')



Modeling

Train- Validate split

In [32]:
```
data = train_df[['label','Processed_Text' ]]
from sklearn.model_selection import train_test_split

X = data.Processed_Text.values
y = data.label.values

X_train, X_val, y_train, y_val =\
    train_test_split(X, y, test_size=0.2, random_state=2020)
```

In [33]:
```
from sklearn.feature_extraction.text import CountVectorizer, TfidfVectorizer
from sklearn.model_selection import StratifiedKFold, cross_val_score
```

In [34]:
```
def get_auc_CV(model):
    """
    Return the average AUC score from cross-validation.
    """
    # Set KFold to shuffle data before the split
    kf = StratifiedKFold(5, shuffle=True, random_state=1)

    # Get AUC scores
    auc = cross_val_score(
        model, X_train_tfidf, y_train, scoring="roc_auc", cv=kf)

    return auc.mean()
```

Naive Bayes Classifier

MultinominalNB

In [35]:
```
from sklearn.naive_bayes import MultinomialNB
from sklearn.pipeline import Pipeline
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.metrics import accuracy_score

nb = Pipeline([('vect', CountVectorizer()),
               ('tfidf', TfidfTransformer()),
               ('clf', MultinomialNB()),
              ])
nb.fit(X_train, y_train)
```

Out[35]:
```
Pipeline(steps=[('vect', CountVectorizer()), ('tfidf', TfidfTransformer()),
                ('clf', MultinomialNB())])
```

Evaluation on Validation Set

In [36]:
```
labels = ['optimism ',' anger','joy','sadness ']
```

In [37]:
```
%%time
from sklearn.metrics import classification_report
y_pred = nb.predict(X_val)

print('accuracy %s' % accuracy_score(y_pred, y_val))
print(classification_report(y_val, y_pred,target_names=labels))
```

```
accuracy 0.6731843575418994
              precision    recall  f1-score   support

   optimism       0.91      0.58      0.71        86
      anger       0.51      0.96      0.67       112
        joy       0.95      0.69      0.80        85
    sadness       0.77      0.32      0.45        75

   accuracy                           0.67       358
  macro avg       0.79      0.64      0.66       358
weighted avg       0.77      0.67      0.67       358

CPU times: user 22.6 ms, sys: 19 µs, total: 22.6 ms
Wall time: 21.7 ms
```

SVM classifier

In [38]:
```
from sklearn import svm


nb = Pipeline([('vect', CountVectorizer()),
               ('tfidf', TfidfTransformer()),
               ('clf', svm.SVC(kernel='poly', degree=4)),
```

```
                ])
nb.fit(X_train, y_train)
```

Out[38]:
```
Pipeline(steps=[('vect', CountVectorizer()), ('tfidf', TfidfTransformer()),
                ('clf', SVC(degree=4, kernel='poly'))])
```

In [39]:
```
%%time
from sklearn.metrics import classification_report
y_pred = nb.predict(X_val)

print('accuracy %s' % accuracy_score(y_pred, y_val))
print(classification_report(y_val, y_pred,target_names=labels))
```

```
accuracy 0.4664804469273743
              precision    recall  f1-score   support

   optimism       0.92      0.27      0.41        86
       anger       0.37      0.99      0.54       112
         joy       1.00      0.33      0.50        85
     sadness       0.83      0.07      0.12        75

    accuracy                           0.47       358
   macro avg       0.78      0.41      0.39       358
weighted avg       0.75      0.47      0.41       358

CPU times: user 81.9 ms, sys: 0 ns, total: 81.9 ms
Wall time: 81.7 ms
```

Enseble Extra tree

In [40]:
```
from sklearn.ensemble import ExtraTreesClassifier
from sklearn.datasets import make_classification

nb = Pipeline([('vect', CountVectorizer()),
               ('tfidf', TfidfTransformer()),
               ('clf', ExtraTreesClassifier(n_estimators=100, random_state=0)),
              ])
nb.fit(X_train, y_train)
```

Out[40]:
```
Pipeline(steps=[('vect', CountVectorizer()), ('tfidf', TfidfTransformer()),
                ('clf', ExtraTreesClassifier(random_state=0))])
```

In [41]:
```
%%time
y_pred = nb.predict(X_val)

print('accuracy %s' % accuracy_score(y_pred, y_val))
print(classification_report(y_val, y_pred,target_names=labels))
```

```
accuracy 0.835195530726257
              precision    recall  f1-score   support

   optimism       0.82      0.87      0.84        86
       anger       0.80      0.87      0.83       112
         joy       0.91      0.88      0.90        85
     sadness       0.84      0.69      0.76        75
```

```
    accuracy                           0.84       358
   macro avg       0.84      0.83      0.83       358
weighted avg       0.84      0.84      0.83       358

CPU times: user 69 ms, sys: 3.96 ms, total: 73 ms
Wall time: 72.7 ms
```

Train on whole training set:

In [42]:
```
nb.fit(X, y)
```

Out[42]:
```
Pipeline(steps=[('vect', CountVectorizer()), ('tfidf', TfidfTransformer()),
                ('clf', ExtraTreesClassifier(random_state=0))])
```

In [43]:
```
%%time

y_pred1 = nb.predict(X)

print('accuracy %s' % accuracy_score(y_pred1, y))
print(classification_report(y, y_pred1,target_names=labels))
```

```
accuracy 0.9916201117318436
              precision    recall  f1-score   support

   optimism       0.98      1.00      0.99       409
      anger       0.99      1.00      0.99       569
        joy       1.00      1.00      1.00       416
    sadness       1.00      0.96      0.98       396

    accuracy                           0.99      1790
   macro avg       0.99      0.99      0.99      1790
weighted avg       0.99      0.99      0.99      1790

CPU times: user 207 ms, sys: 0 ns, total: 207 ms
Wall time: 205 ms
```

Test set predictions:

In [44]:
```
X_Test = test_df.Processed_Text.values
y_Test = test_df.label.values
```

In [45]:
```
%%time

y_pred2 = nb.predict(X_Test)

print('accuracy %s' % accuracy_score(y_pred2, y_Test))
print(classification_report(y_Test, y_pred2,target_names=labels))
```

```
accuracy 0.8093023255813954
              precision    recall  f1-score   support

   optimism       0.81      0.75      0.78       350
```

```
       anger       0.77      0.82      0.80       472
         joy       0.90      0.88      0.89       356
     sadness       0.77      0.78      0.77       327

    accuracy                           0.81      1505
   macro avg       0.81      0.81      0.81      1505
weighted avg       0.81      0.81      0.81      1505

CPU times: user 181 ms, sys: 3.91 ms, total: 185 ms
Wall time: 183 ms
```