Predict Bike Sharing Demand with AutoGluon Template

Project: Predict Bike Sharing Demand with AutoGluon

This notebook is a template with each step that you need to complete for the project.

Please fill in your code where there are explicit `?` markers in the notebook. You are welcome to add more cells and code as you see fit.

Once you have completed all the code implementations, please export your notebook as a HTML file so the reviews can view your code. Make sure you have all outputs correctly outputted.

`File-> Export Notebook As... -> Export Notebook as HTML`

There is a writeup to complete as well after all code implememtation is done. Please answer all questions and attach the necessary tables and charts. You can complete the writeup in either markdown or PDF.

Completing the code template and writeup template will cover all of the rubric points for this project.

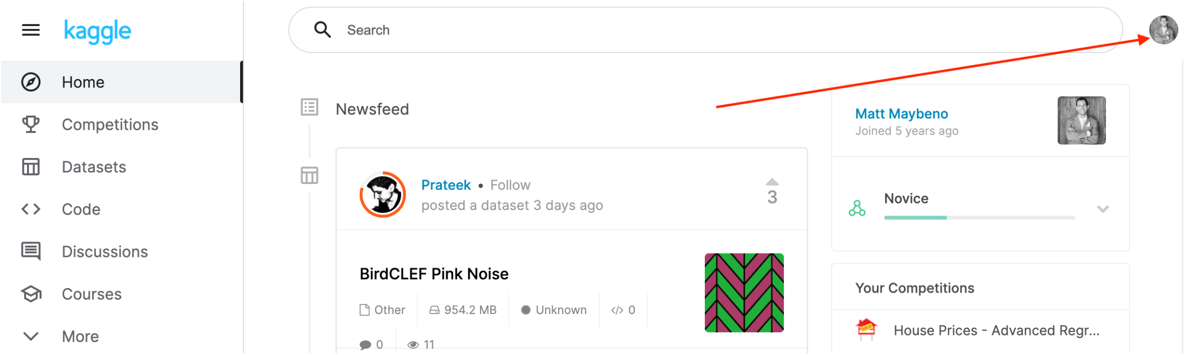
The rubric contains "Stand Out Suggestions" for enhancing the project beyond the minimum requirements. The stand out suggestions are optional. If you decide to pursue the "stand out suggestions", you can include the code in this notebook and also discuss the results in the writeup file.

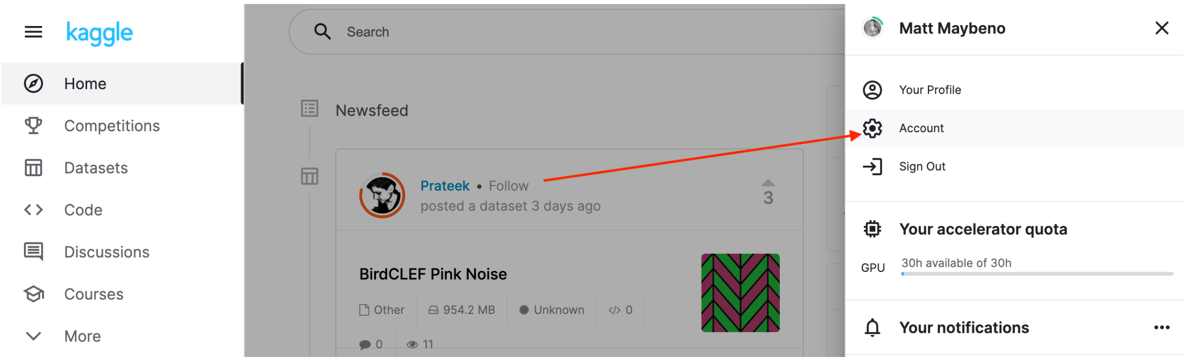
Step 1: Create an account with Kaggle

Create Kaggle Account and download API key

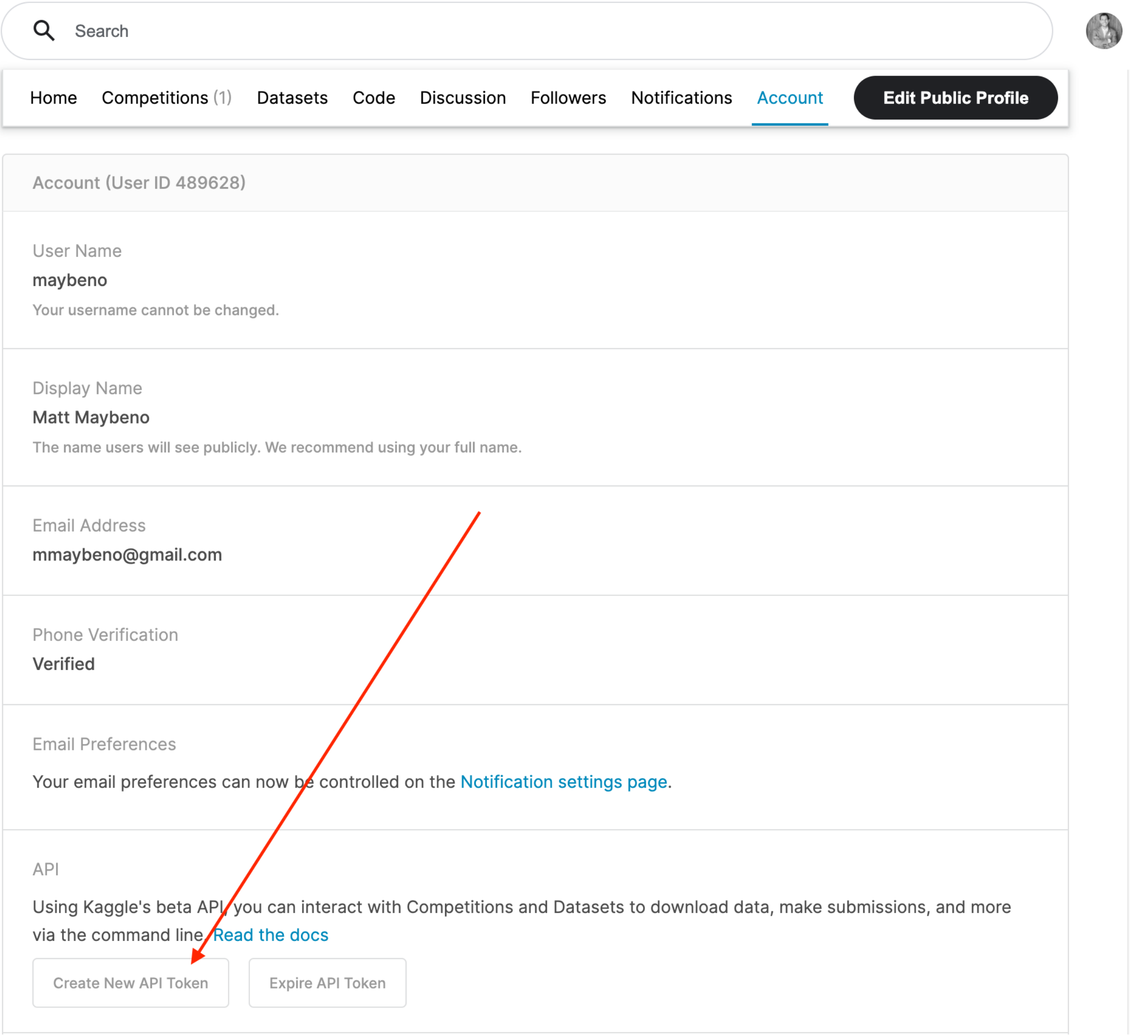
Below is example of steps to get the API username and key. Each student will have their own username and key.

1. Open account settings.





2. Scroll down to API and click Create New API Token.



Account (User ID 489628)

User Name

maybeno

Your username cannot be changed.

Display Name

Matt Maybeno

The name users will see publicly. We recommend using your full name.

Email Address

mmaybeno@gmail.com

Phone Verification

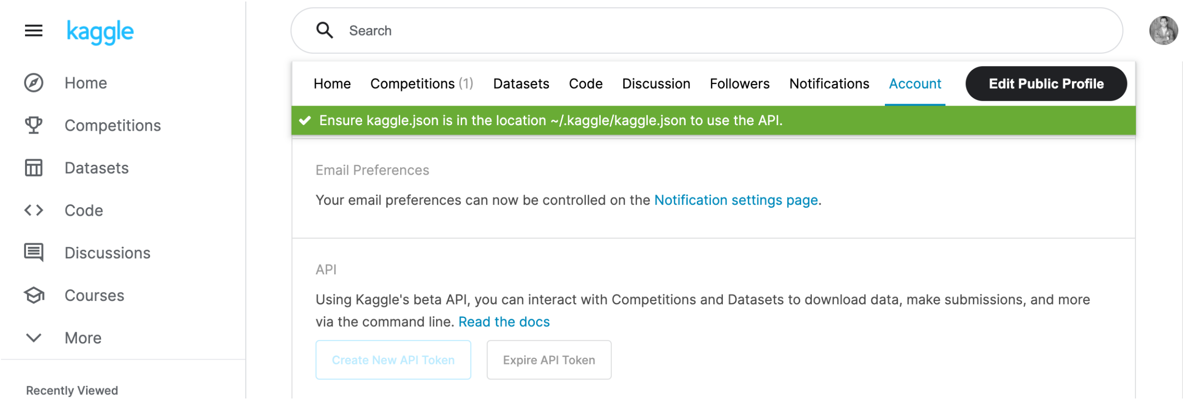
Verified

Email Preferences

Your email preferences can now be controlled on the Notification settings page.

API

Using Kaggle's beta API, you can interact with Competitions and Datasets to download data, make submissions, and more via the command line. Read the docs



✔ Ensure kaggle.json is in the location ~/.kaggle/kaggle.json to use the API.

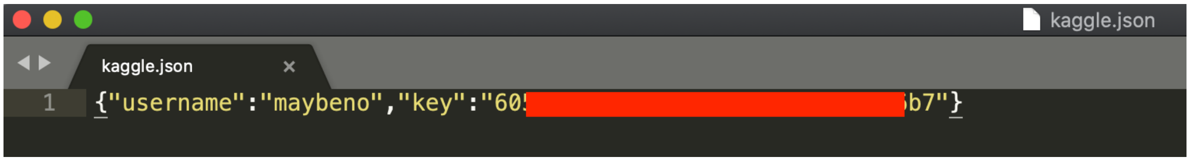
Email Preferences

Your email preferences can now be controlled on the Notification settings page.

API

Using Kaggle's beta API, you can interact with Competitions and Datasets to download data, make submissions, and more via the command line. Read the docs

3. Open up `kaggle.json` and use the username and key.



```
{"username":"maybeno","key":"60[redacted]b7"}
```

Step 2: Download the Kaggle dataset using the kaggle python library

Open up Sagemaker Studio and use starter template

1. Notebook should be using a `ml.t3.medium` instance (2 vCPU + 4 GiB)
2. Notebook should be using kernal: `Python 3 (MXNet 1.8 Python 3.7 CPU Optimized)`

Install packages

In [7]:

```
!pip install -U pip
!pip install -U setuptools wheel
!pip install -U "mxnet<2.0.0" bokeh==2.0.1
!pip install autogluon --no-cache-dir
# Without --no-cache-dir, smaller aws instances may have trouble installing
```

```
Requirement already satisfied: pip in /usr/local/lib/python3.7/site-packages (22.3)
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: setuptools in /usr/local/lib/python3.7/site-packages (65.
5.0)
Requirement already satisfied: wheel in /usr/local/lib/python3.7/site-packages (0.37.1)
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
Requirement already satisfied: mxnet<2.0.0 in /usr/local/lib/python3.7/site-packages (1.
9.1)
Requirement already satisfied: bokeh==2.0.1 in /usr/local/lib/python3.7/site-packages
 (2.0.1)
Requirement already satisfied: PyYAML>=3.10 in /usr/local/lib/python3.7/site-packages (f
rom bokeh==2.0.1) (5.4.1)
Requirement already satisfied: typing-extensions>=3.7.4 in /usr/local/lib/python3.7/site
-packages (from bokeh==2.0.1) (4.1.1)
Requirement already satisfied: packaging>=16.8 in /usr/local/lib/python3.7/site-packages
(from bokeh==2.0.1) (21.3)
Requirement already satisfied: numpy>=1.11.3 in /usr/local/lib/python3.7/site-packages
 (from bokeh==2.0.1) (1.21.6)
Requirement already satisfied: python-dateutil>=2.1 in /usr/local/lib/python3.7/site-pac
kages (from bokeh==2.0.1) (2.8.2)
Requirement already satisfied: pillow>=4.0 in /usr/local/lib/python3.7/site-packages (fr
om bokeh==2.0.1) (9.0.1)
Requirement already satisfied: Jinja2>=2.7 in /usr/local/lib/python3.7/site-packages (fr
om bokeh==2.0.1) (3.0.3)
Requirement already satisfied: tornado>=5 in /usr/local/lib/python3.7/site-packages (fro
m bokeh==2.0.1) (6.1)
Requirement already satisfied: requests<3,>=2.20.0 in /usr/local/lib/python3.7/site-pack
ages (from mxnet<2.0.0) (2.22.0)
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```
Requirement already satisfied: graphviz<0.9.0,>=0.8.1 in /usr/local/lib/python3.7/site-p
ackages (from mxnet<2.0.0) (0.8.4)
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.7/site-packages
(from Jinja2>=2.7->bokeh==2.0.1) (2.0.1)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in /usr/local/lib/python3.7/site
-packages (from packaging>=16.8->bokeh==2.0.1) (3.0.6)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.7/site-packages (from
 python-dateutil>=2.1->bokeh==2.0.1) (1.16.0)
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in /usr/local/li
b/python3.7/site-packages (from requests<3,>=2.20.0->mxnet<2.0.0) (1.25.11)
Requirement already satisfied: chardet<3.1.0,>=3.0.2 in /usr/local/lib/python3.7/site-pa
ckages (from requests<3,>=2.20.0->mxnet<2.0.0) (3.0.4)
Requirement already satisfied: idna<2.9,>=2.5 in /usr/local/lib/python3.7/site-packages
 (from requests<3,>=2.20.0->mxnet<2.0.0) (2.8)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/site-packa
ges (from requests<3,>=2.20.0->mxnet<2.0.0) (2021.10.8)
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: autogluon in /usr/local/lib/python3.7/site-packages (0.5.
2)
Requirement already satisfied: autogluon.vision==0.5.2 in /usr/local/lib/python3.7/site-
packages (from autogluon) (0.5.2)
Requirement already satisfied: autogluon.features==0.5.2 in /usr/local/lib/python3.7/sit
e-packages (from autogluon) (0.5.2)
Requirement already satisfied: autogluon.core[all]==0.5.2 in /usr/local/lib/python3.7/si
te-packages (from autogluon) (0.5.2)
Requirement already satisfied: autogluon.timeseries[all]==0.5.2 in /usr/local/lib/python
3.7/site-packages (from autogluon) (0.5.2)
Requirement already satisfied: autogluon.tabular[all]==0.5.2 in /usr/local/lib/python3.
7/site-packages (from autogluon) (0.5.2)
Requirement already satisfied: autogluon.multimodal==0.5.2 in /usr/local/lib/python3.7/s
ite-packages (from autogluon) (0.5.2)
Requirement already satisfied: autogluon.text==0.5.2 in /usr/local/lib/python3.7/site-pa
ckages (from autogluon) (0.5.2)
Requirement already satisfied: numpy<1.23,>=1.21 in /usr/local/lib/python3.7/site-packag
es (from autogluon.core[all]==0.5.2->autogluon) (1.21.6)
Requirement already satisfied: distributed<=2021.11.2,>=2021.09.1 in /usr/local/lib/pyth
on3.7/site-packages (from autogluon.core[all]==0.5.2->autogluon) (2021.11.2)
Requirement already satisfied: requests in /usr/local/lib/python3.7/site-packages (from
 autogluon.core[all]==0.5.2->autogluon) (2.22.0)
Requirement already satisfied: scipy<1.8.0,>=1.5.4 in /usr/local/lib/python3.7/site-pack
ages (from autogluon.core[all]==0.5.2->autogluon) (1.7.3)
Requirement already satisfied: tqdm>=4.38.0 in /usr/local/lib/python3.7/site-packages (f
rom autogluon.core[all]==0.5.2->autogluon) (4.64.1)
Requirement already satisfied: scikit-learn<1.1,>=1.0.0 in /usr/local/lib/python3.7/site
-packages (from autogluon.core[all]==0.5.2->autogluon) (1.0.1)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.7/site-packages (fro
m autogluon.core[all]==0.5.2->autogluon) (3.5.0)
Requirement already satisfied: autogluon.common==0.5.2 in /usr/local/lib/python3.7/site-
packages (from autogluon.core[all]==0.5.2->autogluon) (0.5.2)
Requirement already satisfied: pandas!=1.4.0,<1.5,>=1.2.5 in /usr/local/lib/python3.7/si
te-packages (from autogluon.core[all]==0.5.2->autogluon) (1.3.4)
Requirement already satisfied: boto3 in /usr/local/lib/python3.7/site-packages (from aut
ogluon.core[all]==0.5.2->autogluon) (1.20.17)
Requirement already satisfied: dask<=2021.11.2,>=2021.09.1 in /usr/local/lib/python3.7/s
ite-packages (from autogluon.core[all]==0.5.2->autogluon) (2021.11.2)
Requirement already satisfied: hyperopt<0.2.8,>=0.2.7 in /usr/local/lib/python3.7/site-p
ackages (from autogluon.core[all]==0.5.2->autogluon) (0.2.7)
Requirement already satisfied: ray<1.14,>=1.13 in /usr/local/lib/python3.7/site-packages
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(from autogluon.core[all]==0.5.2->autogluon) (1.13.0)
Requirement already satisfied: psutil<6,>=5.7.3 in /usr/local/lib/python3.7/site-package
s (from autogluon.features==0.5.2->autogluon) (5.8.0)
Requirement already satisfied: torchvision<0.14.0 in /usr/local/lib/python3.7/site-packa
ges (from autogluon.multimodal==0.5.2->autogluon) (0.13.1)
Requirement already satisfied: sentencepiece<0.2.0,>=0.1.95 in /usr/local/lib/python3.7/
site-packages (from autogluon.multimodal==0.5.2->autogluon) (0.1.95)
Requirement already satisfied: timm<0.6.0 in /usr/local/lib/python3.7/site-packages (fro
m autogluon.multimodal==0.5.2->autogluon) (0.5.4)
Requirement already satisfied: torchtext<0.14.0 in /usr/local/lib/python3.7/site-package
s (from autogluon.multimodal==0.5.2->autogluon) (0.13.1)
Requirement already satisfied: pytorch-metric-learning<1.4.0,>=1.3.0 in /usr/local/lib/p
ython3.7/site-packages (from autogluon.multimodal==0.5.2->autogluon) (1.3.2)
Requirement already satisfied: pytorch-lightning<1.7.0,>=1.6.0 in /usr/local/lib/python
3.7/site-packages (from autogluon.multimodal==0.5.2->autogluon) (1.6.5)
Requirement already satisfied: torch<1.13,>=1.9 in /usr/local/lib/python3.7/site-package
s (from autogluon.multimodal==0.5.2->autogluon) (1.12.1)
Requirement already satisfied: transformers<4.21.0,>=4.18.0 in /usr/local/lib/python3.7/
site-packages (from autogluon.multimodal==0.5.2->autogluon) (4.20.1)
Requirement already satisfied: nptyping<1.5.0,>=1.4.4 in /usr/local/lib/python3.7/site-p
ackages (from autogluon.multimodal==0.5.2->autogluon) (1.4.4)
Requirement already satisfied: Pillow<9.1.0,>=9.0.1 in /usr/local/lib/python3.7/site-pac
kages (from autogluon.multimodal==0.5.2->autogluon) (9.0.1)
Requirement already satisfied: nlpaug<=1.1.10,>=1.1.10 in /usr/local/lib/python3.7/site-
packages (from autogluon.multimodal==0.5.2->autogluon) (1.1.10)
Requirement already satisfied: omegaconf<2.2.0,>=2.1.1 in /usr/local/lib/python3.7/site-
packages (from autogluon.multimodal==0.5.2->autogluon) (2.1.2)
Requirement already satisfied: fairscale<=0.4.6,>=0.4.5 in /usr/local/lib/python3.7/site
-packages (from autogluon.multimodal==0.5.2->autogluon) (0.4.6)
Requirement already satisfied: torchmetrics<0.8.0,>=0.7.2 in /usr/local/lib/python3.7/si
te-packages (from autogluon.multimodal==0.5.2->autogluon) (0.7.3)
Requirement already satisfied: smart-open<5.3.0,>=5.2.1 in /usr/local/lib/python3.7/site
-packages (from autogluon.multimodal==0.5.2->autogluon) (5.2.1)
Requirement already satisfied: scikit-image<0.20.0,>=0.19.1 in /usr/local/lib/python3.7/
site-packages (from autogluon.multimodal==0.5.2->autogluon) (0.19.3)
Requirement already satisfied: nltk<4.0.0,>=3.4.5 in /usr/local/lib/python3.7/site-packa
ges (from autogluon.multimodal==0.5.2->autogluon) (3.7)
Requirement already satisfied: protobuf<=3.18.1 in /usr/local/lib/python3.7/site-package
s (from autogluon.multimodal==0.5.2->autogluon) (3.18.1)
Requirement already satisfied: networkx<3.0,>=2.3 in /usr/local/lib/python3.7/site-packa
ges (from autogluon.tabular[all]==0.5.2->autogluon) (2.6.3)
Requirement already satisfied: lightgbm<3.4,>=3.3 in /usr/local/lib/python3.7/site-packa
ges (from autogluon.tabular[all]==0.5.2->autogluon) (3.3.3)
Requirement already satisfied: fastai<2.8,>=2.3.1 in /usr/local/lib/python3.7/site-packa
ges (from autogluon.tabular[all]==0.5.2->autogluon) (2.7.9)
Requirement already satisfied: xgboost<1.5,>=1.4 in /usr/local/lib/python3.7/site-packag
es (from autogluon.tabular[all]==0.5.2->autogluon) (1.4.2)
Requirement already satisfied: catboost<1.1,>=1.0 in /usr/local/lib/python3.7/site-packa
ges (from autogluon.tabular[all]==0.5.2->autogluon) (1.0.6)
Requirement already satisfied: autogluon-contrib-nlp==0.0.1b20220208 in /usr/local/lib/p
ython3.7/site-packages (from autogluon.text==0.5.2->autogluon) (0.0.1b20220208)
Requirement already satisfied: gluonts<0.10.0,>=0.8.0 in /usr/local/lib/python3.7/site-p
ackages (from autogluon.timeseries[all]==0.5.2->autogluon) (0.9.9)
Requirement already satisfied: pmdarima~=1.8.2 in /usr/local/lib/python3.7/site-packages
(from autogluon.timeseries[all]==0.5.2->autogluon) (1.8.5)
Requirement already satisfied: tbats~=1.1 in /usr/local/lib/python3.7/site-packages (fro
m autogluon.timeseries[all]==0.5.2->autogluon) (1.1.1)
Requirement already satisfied: sktime~=0.11.4 in /usr/local/lib/python3.7/site-packages
 (from autogluon.timeseries[all]==0.5.2->autogluon) (0.11.4)
Requirement already satisfied: gluoncv<0.10.6,>=0.10.5 in /usr/local/lib/python3.7/site-
```

```
packages (from autogluon.vision==0.5.2->autogluon) (0.10.5.post0)
Requirement already satisfied: contextvars in /usr/local/lib/python3.7/site-packages (fr
om autogluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->autogluon) (2.4)
Requirement already satisfied: sacremoses>=0.0.38 in /usr/local/lib/python3.7/site-packa
ges (from autogluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->autogluon) (0.0.
53)
Requirement already satisfied: flake8 in /usr/local/lib/python3.7/site-packages (from au
togluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->autogluon) (5.0.4)
Requirement already satisfied: yacs>=0.1.6 in /usr/local/lib/python3.7/site-packages (fr
om autogluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->autogluon) (0.1.8)
Requirement already satisfied: pyarrow in /usr/local/lib/python3.7/site-packages (from a
utogluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->autogluon) (6.0.1)
Requirement already satisfied: tokenizers>=0.9.4 in /usr/local/lib/python3.7/site-packag
es (from autogluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->autogluon) (0.12.
1)
Requirement already satisfied: regex in /usr/local/lib/python3.7/site-packages (from aut
ogluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->autogluon) (2022.9.13)
Requirement already satisfied: sacrebleu in /usr/local/lib/python3.7/site-packages (from
autogluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->autogluon) (2.3.1)
Requirement already satisfied: plotly in /usr/local/lib/python3.7/site-packages (from ca
tboost<1.1,>=1.0->autogluon.tabular[all]==0.5.2->autogluon) (5.4.0)
Requirement already satisfied: graphviz in /usr/local/lib/python3.7/site-packages (from
 catboost<1.1,>=1.0->autogluon.tabular[all]==0.5.2->autogluon) (0.8.4)
Requirement already satisfied: six in /usr/local/lib/python3.7/site-packages (from catbo
ost<1.1,>=1.0->autogluon.tabular[all]==0.5.2->autogluon) (1.16.0)
Requirement already satisfied: partd>=0.3.10 in /usr/local/lib/python3.7/site-packages
 (from dask<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (1.3.0)
Requirement already satisfied: cloudpickle>=1.1.1 in /usr/local/lib/python3.7/site-packa
ges (from dask<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (2.0.0)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.7/site-packages
(from dask<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (21.3)
Requirement already satisfied: toolz>=0.8.2 in /usr/local/lib/python3.7/site-packages (f
rom dask<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (0.12.0)
Requirement already satisfied: fsspec>=0.6.0 in /usr/local/lib/python3.7/site-packages
 (from dask<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (2021.11.1)
Requirement already satisfied: pyyaml in /usr/local/lib/python3.7/site-packages (from da
sk<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (5.4.1)
Requirement already satisfied: zict>=0.1.3 in /usr/local/lib/python3.7/site-packages (fr
om distributed<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (2.2.0)
Requirement already satisfied: msgpack>=0.6.0 in /usr/local/lib/python3.7/site-packages
 (from distributed<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (1.0.
4)
Requirement already satisfied: setuptools in /usr/local/lib/python3.7/site-packages (fro
m distributed<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (65.5.0)
Requirement already satisfied: tornado>=5 in /usr/local/lib/python3.7/site-packages (fro
m distributed<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (6.1)
Requirement already satisfied: jinja2 in /usr/local/lib/python3.7/site-packages (from di
stributed<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (3.0.3)
Requirement already satisfied: click>=6.6 in /usr/local/lib/python3.7/site-packages (fro
m distributed<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (8.0.4)
Requirement already satisfied: sortedcontainers!=2.0.0,!=2.0.1 in /usr/local/lib/python
3.7/site-packages (from distributed<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->
autogluon) (2.4.0)
Requirement already satisfied: tblib>=1.6.0 in /usr/local/lib/python3.7/site-packages (f
rom distributed<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (1.7.0)
Requirement already satisfied: pip in /usr/local/lib/python3.7/site-packages (from fasta
i<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon) (22.3)
Requirement already satisfied: fastcore<1.6,>=1.4.5 in /usr/local/lib/python3.7/site-pac
kages (from fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon) (1.5.27)
Requirement already satisfied: fastprogress>=0.2.4 in /usr/local/lib/python3.7/site-pack
```

```
ages (from fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon) (1.0.3)
Requirement already satisfied: spacy<4 in /usr/local/lib/python3.7/site-packages (from f
astai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon) (3.4.2)
Requirement already satisfied: fastdownload<2,>=0.0.5 in /usr/local/lib/python3.7/site-p
ackages (from fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon) (0.0.7)
Requirement already satisfied: portalocker in /usr/local/lib/python3.7/site-packages (fr
om gluoncv<0.10.6,>=0.10.5->autogluon.vision==0.5.2->autogluon) (2.3.2)
Requirement already satisfied: opencv-python in /usr/local/lib/python3.7/site-packages
 (from gluoncv<0.10.6,>=0.10.5->autogluon.vision==0.5.2->autogluon) (4.5.4.60)
Requirement already satisfied: autocfg in /usr/local/lib/python3.7/site-packages (from g
luoncv<0.10.6,>=0.10.5->autogluon.vision==0.5.2->autogluon) (0.0.8)
Requirement already satisfied: typing-extensions~=4.0 in /usr/local/lib/python3.7/site-p
ackages (from gluonts<0.10.0,>=0.8.0->autogluon.timeseries[all]==0.5.2->autogluon) (4.1.
1)
Requirement already satisfied: holidays>=0.9 in /usr/local/lib/python3.7/site-packages
 (from gluonts<0.10.0,>=0.8.0->autogluon.timeseries[all]==0.5.2->autogluon) (0.16)
Requirement already satisfied: pydantic~=1.1 in /usr/local/lib/python3.7/site-packages
 (from gluonts<0.10.0,>=0.8.0->autogluon.timeseries[all]==0.5.2->autogluon) (1.10.2)
Requirement already satisfied: py4j in /usr/local/lib/python3.7/site-packages (from hype
ropt<0.2.8,>=0.2.7->autogluon.core[all]==0.5.2->autogluon) (0.10.9.7)
Requirement already satisfied: future in /usr/local/lib/python3.7/site-packages (from hy
peropt<0.2.8,>=0.2.7->autogluon.core[all]==0.5.2->autogluon) (0.18.2)
Requirement already satisfied: wheel in /usr/local/lib/python3.7/site-packages (from lig
htgbm<3.4,>=3.3->autogluon.tabular[all]==0.5.2->autogluon) (0.37.1)
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.7/site-packag
es (from matplotlib->autogluon.core[all]==0.5.2->autogluon) (1.3.2)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.7/site-packag
es (from matplotlib->autogluon.core[all]==0.5.2->autogluon) (4.28.2)
Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.7/site-pac
kages (from matplotlib->autogluon.core[all]==0.5.2->autogluon) (2.8.2)
Requirement already satisfied: setuptools-scm>=4 in /usr/local/lib/python3.7/site-packag
es (from matplotlib->autogluon.core[all]==0.5.2->autogluon) (6.3.2)
Requirement already satisfied: pyparsing>=2.2.1 in /usr/local/lib/python3.7/site-package
s (from matplotlib->autogluon.core[all]==0.5.2->autogluon) (3.0.6)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.7/site-packages (f
rom matplotlib->autogluon.core[all]==0.5.2->autogluon) (0.11.0)
Requirement already satisfied: joblib in /usr/local/lib/python3.7/site-packages (from nl
tk<4.0.0,>=3.4.5->autogluon.multimodal==0.5.2->autogluon) (1.1.0)
Requirement already satisfied: typish>=1.7.0 in /usr/local/lib/python3.7/site-packages
 (from nptyping<1.5.0,>=1.4.4->autogluon.multimodal==0.5.2->autogluon) (1.9.3)
Requirement already satisfied: antlr4-python3-runtime==4.8 in /usr/local/lib/python3.7/s
ite-packages (from omegaconf<2.2.0,>=2.1.1->autogluon.multimodal==0.5.2->autogluon) (4.
8)
Requirement already satisfied: pytz>=2017.3 in /usr/local/lib/python3.7/site-packages (f
rom pandas!=1.4.0,<1.5,>=1.2.5->autogluon.core[all]==0.5.2->autogluon) (2021.3)
Requirement already satisfied: statsmodels!=0.12.0,>=0.11 in /usr/local/lib/python3.7/si
te-packages (from pmdarima~=1.8.2->autogluon.timeseries[all]==0.5.2->autogluon) (0.13.2)
Requirement already satisfied: Cython!=0.29.18,>=0.29 in /usr/local/lib/python3.7/site-p
ackages (from pmdarima~=1.8.2->autogluon.timeseries[all]==0.5.2->autogluon) (0.29.24)
Requirement already satisfied: urllib3 in /usr/local/lib/python3.7/site-packages (from p
mdarima~=1.8.2->autogluon.timeseries[all]==0.5.2->autogluon) (1.25.11)
Requirement already satisfied: pyDeprecate>=0.3.1 in /usr/local/lib/python3.7/site-packa
ges (from pytorch-lightning<1.7.0,>=1.6.0->autogluon.multimodal==0.5.2->autogluon) (0.3.
2)
Requirement already satisfied: tensorboard>=2.2.0 in /usr/local/lib/python3.7/site-packa
ges (from pytorch-lightning<1.7.0,>=1.6.0->autogluon.multimodal==0.5.2->autogluon) (2.1
0.1)
Requirement already satisfied: virtualenv in /usr/local/lib/python3.7/site-packages (fro
m ray<1.14,>=1.13->autogluon.core[all]==0.5.2->autogluon) (20.16.2)
Requirement already satisfied: grpcio<=1.43.0,>=1.28.1 in /usr/local/lib/python3.7/site-
```

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packages (from ray<1.14,>=1.13->autogluon.core[all]==0.5.2->autogluon) (1.43.0)
Requirement already satisfied: jsonschema in /usr/local/lib/python3.7/site-packages (fro
m ray<1.14,>=1.13->autogluon.core[all]==0.5.2->autogluon) (4.16.0)
Requirement already satisfied: aiosignal in /usr/local/lib/python3.7/site-packages (from
ray<1.14,>=1.13->autogluon.core[all]==0.5.2->autogluon) (1.2.0)
Requirement already satisfied: filelock in /usr/local/lib/python3.7/site-packages (from
 ray<1.14,>=1.13->autogluon.core[all]==0.5.2->autogluon) (3.8.0)
Requirement already satisfied: attrs in /usr/local/lib/python3.7/site-packages (from ray
<1.14,>=1.13->autogluon.core[all]==0.5.2->autogluon) (21.2.0)
Requirement already satisfied: frozenlist in /usr/local/lib/python3.7/site-packages (fro
m ray<1.14,>=1.13->autogluon.core[all]==0.5.2->autogluon) (1.3.1)
Requirement already satisfied: tabulate in /usr/local/lib/python3.7/site-packages (from
 ray<1.14,>=1.13->autogluon.core[all]==0.5.2->autogluon) (0.8.9)
Requirement already satisfied: tensorboardX>=1.9 in /usr/local/lib/python3.7/site-packag
es (from ray<1.14,>=1.13->autogluon.core[all]==0.5.2->autogluon) (2.5.1)
Requirement already satisfied: chardet<3.1.0,>=3.0.2 in /usr/local/lib/python3.7/site-pa
ckages (from requests->autogluon.core[all]==0.5.2->autogluon) (3.0.4)
Requirement already satisfied: idna<2.9,>=2.5 in /usr/local/lib/python3.7/site-packages
 (from requests->autogluon.core[all]==0.5.2->autogluon) (2.8)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/site-packa
ges (from requests->autogluon.core[all]==0.5.2->autogluon) (2021.10.8)
Requirement already satisfied: tifffile>=2019.7.26 in /usr/local/lib/python3.7/site-pack
ages (from scikit-image<0.20.0,>=0.19.1->autogluon.multimodal==0.5.2->autogluon) (2021.1
1.2)
Requirement already satisfied: PyWavelets>=1.1.1 in /usr/local/lib/python3.7/site-packag
es (from scikit-image<0.20.0,>=0.19.1->autogluon.multimodal==0.5.2->autogluon) (1.3.0)
Requirement already satisfied: imageio>=2.4.1 in /usr/local/lib/python3.7/site-packages
 (from scikit-image<0.20.0,>=0.19.1->autogluon.multimodal==0.5.2->autogluon) (2.13.1)
Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.7/site-pac
kages (from scikit-learn<1.1,>=1.0.0->autogluon.core[all]==0.5.2->autogluon) (3.0.0)
Requirement already satisfied: deprecated>=1.2.13 in /usr/local/lib/python3.7/site-packa
ges (from sktime~=0.11.4->autogluon.timeseries[all]==0.5.2->autogluon) (1.2.13)
Requirement already satisfied: numba>=0.53 in /usr/local/lib/python3.7/site-packages (fr
om sktime~=0.11.4->autogluon.timeseries[all]==0.5.2->autogluon) (0.53.1)
Requirement already satisfied: huggingface-hub<1.0,>=0.1.0 in /usr/local/lib/python3.7/s
ite-packages (from transformers<4.21.0,>=4.18.0->autogluon.multimodal==0.5.2->autogluon)
(0.10.1)
Requirement already satisfied: importlib-metadata in /usr/local/lib/python3.7/site-packa
ges (from transformers<4.21.0,>=4.18.0->autogluon.multimodal==0.5.2->autogluon) (4.2.0)
Requirement already satisfied: botocore<1.24.0,>=1.23.17 in /usr/local/lib/python3.7/sit
e-packages (from boto3->autogluon.core[all]==0.5.2->autogluon) (1.23.17)
Requirement already satisfied: s3transfer<0.6.0,>=0.5.0 in /usr/local/lib/python3.7/site
-packages (from boto3->autogluon.core[all]==0.5.2->autogluon) (0.5.0)
Requirement already satisfied: jmespath<1.0.0,>=0.7.1 in /usr/local/lib/python3.7/site-p
ackages (from boto3->autogluon.core[all]==0.5.2->autogluon) (0.10.0)
Requirement already satisfied: wrapt<2,>=1.10 in /usr/local/lib/python3.7/site-packages
 (from deprecated>=1.2.13->sktime~=0.11.4->autogluon.timeseries[all]==0.5.2->autogluon)
 (1.14.1)
Requirement already satisfied: aiohttp in /usr/local/lib/python3.7/site-packages (from f
sspec>=0.6.0->dask<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (3.8.
3)
Requirement already satisfied: convertdate>=2.3.0 in /usr/local/lib/python3.7/site-packa
ges (from holidays>=0.9->gluonts<0.10.0,>=0.8.0->autogluon.timeseries[all]==0.5.2->autog
luon) (2.4.0)
Requirement already satisfied: korean-lunar-calendar in /usr/local/lib/python3.7/site-pa
ckages (from holidays>=0.9->gluonts<0.10.0,>=0.8.0->autogluon.timeseries[all]==0.5.2->au
togluon) (0.3.1)
Requirement already satisfied: hijri-converter in /usr/local/lib/python3.7/site-packages
(from holidays>=0.9->gluonts<0.10.0,>=0.8.0->autogluon.timeseries[all]==0.5.2->autogluo
n) (2.2.4)
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Requirement already satisfied: llvmlite<0.37,>=0.36.0rc1 in /usr/local/lib/python3.7/sit
e-packages (from numba>=0.53->sktime~=0.11.4->autogluon.timeseries[all]==0.5.2->autogluo
n) (0.36.0)
Requirement already satisfied: locket in /usr/local/lib/python3.7/site-packages (from pa
rtd>=0.3.10->dask<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon) (1.0.0)
Requirement already satisfied: tomli>=1.0.0 in /usr/local/lib/python3.7/site-packages (f
rom setuptools-scm>=4->matplotlib->autogluon.core[all]==0.5.2->autogluon) (1.2.2)
Requirement already satisfied: spacy-legacy<3.1.0,>=3.0.10 in /usr/local/lib/python3.7/s
ite-packages (from spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluo
n) (3.0.10)
Requirement already satisfied: preshed<3.1.0,>=3.0.2 in /usr/local/lib/python3.7/site-pa
ckages (from spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon) (3.
0.8)
Requirement already satisfied: spacy-loggers<2.0.0,>=1.0.0 in /usr/local/lib/python3.7/s
ite-packages (from spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluo
n) (1.0.3)
Requirement already satisfied: cymem<2.1.0,>=2.0.2 in /usr/local/lib/python3.7/site-pack
ages (from spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon) (2.0.
7)
Requirement already satisfied: catalogue<2.1.0,>=2.0.6 in /usr/local/lib/python3.7/site-
packages (from spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon)
 (2.0.8)
Requirement already satisfied: pathy>=0.3.5 in /usr/local/lib/python3.7/site-packages (f
rom spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon) (0.6.2)
Requirement already satisfied: murmurhash<1.1.0,>=0.28.0 in /usr/local/lib/python3.7/sit
e-packages (from spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon)
 (1.0.9)
Requirement already satisfied: thinc<8.2.0,>=8.1.0 in /usr/local/lib/python3.7/site-pack
ages (from spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon) (8.1.
5)
Requirement already satisfied: langcodes<4.0.0,>=3.2.0 in /usr/local/lib/python3.7/site-
packages (from spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon)
 (3.3.0)
Requirement already satisfied: wasabi<1.1.0,>=0.9.1 in /usr/local/lib/python3.7/site-pac
kages (from spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon) (0.1
0.1)
Requirement already satisfied: srsly<3.0.0,>=2.4.3 in /usr/local/lib/python3.7/site-pack
ages (from spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon) (2.4.
5)
Requirement already satisfied: typer<0.5.0,>=0.3.0 in /usr/local/lib/python3.7/site-pack
ages (from spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.2->autogluon) (0.4.
2)
Requirement already satisfied: patsy>=0.5.2 in /usr/local/lib/python3.7/site-packages (f
rom statsmodels!=0.12.0,>=0.11->pmdarima~=1.8.2->autogluon.timeseries[all]==0.5.2->autog
luon) (0.5.3)
Requirement already satisfied: absl-py>=0.4 in /usr/local/lib/python3.7/site-packages (f
rom tensorboard>=2.2.0->pytorch-lightning<1.7.0,>=1.6.0->autogluon.multimodal==0.5.2->au
togluon) (1.3.0)
Requirement already satisfied: werkzeug>=1.0.1 in /usr/local/lib/python3.7/site-packages
(from tensorboard>=2.2.0->pytorch-lightning<1.7.0,>=1.6.0->autogluon.multimodal==0.5.2->
autogluon) (2.0.2)
Requirement already satisfied: google-auth<3,>=1.6.3 in /usr/local/lib/python3.7/site-pa
ckages (from tensorboard>=2.2.0->pytorch-lightning<1.7.0,>=1.6.0->autogluon.multimodal==
0.5.2->autogluon) (2.13.0)
Requirement already satisfied: google-auth-oauthlib<0.5,>=0.4.1 in /usr/local/lib/python
3.7/site-packages (from tensorboard>=2.2.0->pytorch-lightning<1.7.0,>=1.6.0->autogluon.m
ultimodal==0.5.2->autogluon) (0.4.6)
Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.7/site-packages
(from tensorboard>=2.2.0->pytorch-lightning<1.7.0,>=1.6.0->autogluon.multimodal==0.5.2->
autogluon) (3.3.4)
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Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in /usr/local/lib/python3.
7/site-packages (from tensorboard>=2.2.0->pytorch-lightning<1.7.0,>=1.6.0->autogluon.mul
timodal==0.5.2->autogluon) (1.8.1)
Requirement already satisfied: tensorboard-data-server<0.7.0,>=0.6.0 in /usr/local/lib/p
ython3.7/site-packages (from tensorboard>=2.2.0->pytorch-lightning<1.7.0,>=1.6.0->autogl
uon.multimodal==0.5.2->autogluon) (0.6.1)
Requirement already satisfied: heapdict in /usr/local/lib/python3.7/site-packages (from
 zict>=0.1.3->distributed<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon)
(1.0.1)
Requirement already satisfied: immutables>=0.9 in /usr/local/lib/python3.7/site-packages
(from contextvars->autogluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->autoglu
on) (0.19)
Requirement already satisfied: pycodestyle<2.10.0,>=2.9.0 in /usr/local/lib/python3.7/si
te-packages (from flake8->autogluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->
autogluon) (2.9.1)
Requirement already satisfied: pyflakes<2.6.0,>=2.5.0 in /usr/local/lib/python3.7/site-p
ackages (from flake8->autogluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->auto
gluon) (2.5.0)
Requirement already satisfied: mccabe<0.8.0,>=0.7.0 in /usr/local/lib/python3.7/site-pac
kages (from flake8->autogluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->autogl
uon) (0.7.0)
Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.7/site-packages (from
importlib-metadata->transformers<4.21.0,>=4.18.0->autogluon.multimodal==0.5.2->autogluo
n) (3.6.0)
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.7/site-packages
(from jinja2->distributed<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->autogluon)
(2.0.1)
Requirement already satisfied: importlib-resources>=1.4.0 in /usr/local/lib/python3.7/si
te-packages (from jsonschema->ray<1.14,>=1.13->autogluon.core[all]==0.5.2->autogluon)
 (5.10.0)
Requirement already satisfied: pkgutil-resolve-name>=1.3.10 in /usr/local/lib/python3.7/
site-packages (from jsonschema->ray<1.14,>=1.13->autogluon.core[all]==0.5.2->autogluon)
 (1.3.10)
Requirement already satisfied: pyrsistent!=0.17.0,!=0.17.1,!=0.17.2,>=0.14.0 in /usr/loc
al/lib/python3.7/site-packages (from jsonschema->ray<1.14,>=1.13->autogluon.core[all]==
0.5.2->autogluon) (0.18.1)
Requirement already satisfied: tenacity>=6.2.0 in /usr/local/lib/python3.7/site-packages
(from plotly->catboost<1.1,>=1.0->autogluon.tabular[all]==0.5.2->autogluon) (8.0.1)
Requirement already satisfied: colorama in /usr/local/lib/python3.7/site-packages (from
 sacrebleu->autogluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->autogluon) (0.
4.3)
Requirement already satisfied: lxml in /usr/local/lib/python3.7/site-packages (from sacr
ebleu->autogluon-contrib-nlp==0.0.1b20220208->autogluon.text==0.5.2->autogluon) (4.9.1)
Requirement already satisfied: platformdirs<3,>=2 in /usr/local/lib/python3.7/site-packa
ges (from virtualenv->ray<1.14,>=1.13->autogluon.core[all]==0.5.2->autogluon) (2.5.2)
Requirement already satisfied: distlib<1,>=0.3.1 in /usr/local/lib/python3.7/site-packag
es (from virtualenv->ray<1.14,>=1.13->autogluon.core[all]==0.5.2->autogluon) (0.3.6)
Requirement already satisfied: pymeeus<=1,>=0.3.13 in /usr/local/lib/python3.7/site-pack
ages (from convertdate>=2.3.0->holidays>=0.9->gluonts<0.10.0,>=0.8.0->autogluon.timeseri
es[all]==0.5.2->autogluon) (0.5.11)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in /usr/local/lib/python3.7/site-p
ackages (from google-auth<3,>=1.6.3->tensorboard>=2.2.0->pytorch-lightning<1.7.0,>=1.6.0
->autogluon.multimodal==0.5.2->autogluon) (5.2.0)
Requirement already satisfied: pyasn1-modules>=0.2.1 in /usr/local/lib/python3.7/site-pa
ckages (from google-auth<3,>=1.6.3->tensorboard>=2.2.0->pytorch-lightning<1.7.0,>=1.6.0-
>autogluon.multimodal==0.5.2->autogluon) (0.2.8)
Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.7/site-packages
 (from google-auth<3,>=1.6.3->tensorboard>=2.2.0->pytorch-lightning<1.7.0,>=1.6.0->autog
luon.multimodal==0.5.2->autogluon) (4.7.2)
Requirement already satisfied: requests-oauthlib>=0.7.0 in /usr/local/lib/python3.7/site
```

```
-packages (from google-auth-oauthlib<0.5,>=0.4.1->tensorboard>=2.2.0->pytorch-lightning<
1.7.0,>=1.6.0->autogluon.multimodal==0.5.2->autogluon) (1.3.1)
Requirement already satisfied: confection<1.0.0,>=0.0.1 in /usr/local/lib/python3.7/site
-packages (from thinc<8.2.0,>=8.1.0->spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]
==0.5.2->autogluon) (0.0.3)
Requirement already satisfied: blis<0.8.0,>=0.7.8 in /usr/local/lib/python3.7/site-packa
ges (from thinc<8.2.0,>=8.1.0->spacy<4->fastai<2.8,>=2.3.1->autogluon.tabular[all]==0.5.
2->autogluon) (0.7.9)
Requirement already satisfied: multidict<7.0,>=4.5 in /usr/local/lib/python3.7/site-pack
ages (from aiohttp->fsspec>=0.6.0->dask<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.
5.2->autogluon) (6.0.2)
Requirement already satisfied: charset-normalizer<3.0,>=2.0 in /usr/local/lib/python3.7/
site-packages (from aiohttp->fsspec>=0.6.0->dask<=2021.11.2,>=2021.09.1->autogluon.core
[all]==0.5.2->autogluon) (2.1.1)
Requirement already satisfied: yarl<2.0,>=1.0 in /usr/local/lib/python3.7/site-packages
 (from aiohttp->fsspec>=0.6.0->dask<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2->
autogluon) (1.8.1)
Requirement already satisfied: async-timeout<5.0,>=4.0.0a3 in /usr/local/lib/python3.7/s
ite-packages (from aiohttp->fsspec>=0.6.0->dask<=2021.11.2,>=2021.09.1->autogluon.core[a
ll]==0.5.2->autogluon) (4.0.2)
Requirement already satisfied: asynctest==0.13.0 in /usr/local/lib/python3.7/site-packag
es (from aiohttp->fsspec>=0.6.0->dask<=2021.11.2,>=2021.09.1->autogluon.core[all]==0.5.2
->autogluon) (0.13.0)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in /usr/local/lib/python3.7/site-pac
kages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->tensorboard>=2.2.0->pytorch-li
ghtning<1.7.0,>=1.6.0->autogluon.multimodal==0.5.2->autogluon) (0.4.8)
Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.7/site-packages
(from requests-oauthlib>=0.7.0->google-auth-oauthlib<0.5,>=0.4.1->tensorboard>=2.2.0->py
torch-lightning<1.7.0,>=1.6.0->autogluon.multimodal==0.5.2->autogluon) (3.2.2)
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
```

In [8]:

```
!pip install -U kaggle
```

```
Requirement already satisfied: kaggle in /usr/local/lib/python3.7/site-packages (1.5.12)
Requirement already satisfied: certifi in /usr/local/lib/python3.7/site-packages (from k
aggle) (2021.10.8)
Requirement already satisfied: tqdm in /usr/local/lib/python3.7/site-packages (from kagg
le) (4.64.1)
Requirement already satisfied: urllib3 in /usr/local/lib/python3.7/site-packages (from k
aggle) (1.25.11)
Requirement already satisfied: six>=1.10 in /usr/local/lib/python3.7/site-packages (from
kaggle) (1.16.0)
Requirement already satisfied: python-slugify in /usr/local/lib/python3.7/site-packages
(from kaggle) (6.1.2)
Requirement already satisfied: requests in /usr/local/lib/python3.7/site-packages (from
kaggle) (2.22.0)
Requirement already satisfied: python-dateutil in /usr/local/lib/python3.7/site-packages
(from kaggle) (2.8.2)
Requirement already satisfied: text-unidecode>=1.3 in /usr/local/lib/python3.7/site-pack
ages (from python-slugify->kaggle) (1.3)
Requirement already satisfied: idna<2.9,>=2.5 in /usr/local/lib/python3.7/site-packages
(from requests->kaggle) (2.8)
Requirement already satisfied: chardet<3.1.0,>=3.0.2 in /usr/local/lib/python3.7/site-pa
ckages (from requests->kaggle) (3.0.4)
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
```

Setup Kaggle API Key

In [9]:

```
# create the .kaggle directory and an empty kaggle.json file
!mkdir -p /root/.kaggle
!touch /root/.kaggle/kaggle.json
!chmod 600 /root/.kaggle/kaggle.json
```

In [11]:

```
!echo "KAGGLE_USERNAME= mostafasayedali" >> .env
!echo "KAGGLE_KEY= e9fa2cb40c940ffd0924fc9b2714a5ed" >> .env
#kaggle_username = "mostafasayedali"
#kaggle_key = "e9fa2cb40c940ffd0924fc9b2714a5ed"

!pip install python-dotenv
from dotenv import dotenv_values

CONFIG = dotenv_values('.env')

kaggle_username = CONFIG['KAGGLE_USERNAME']
kaggle_key = CONFIG['KAGGLE_KEY']
```

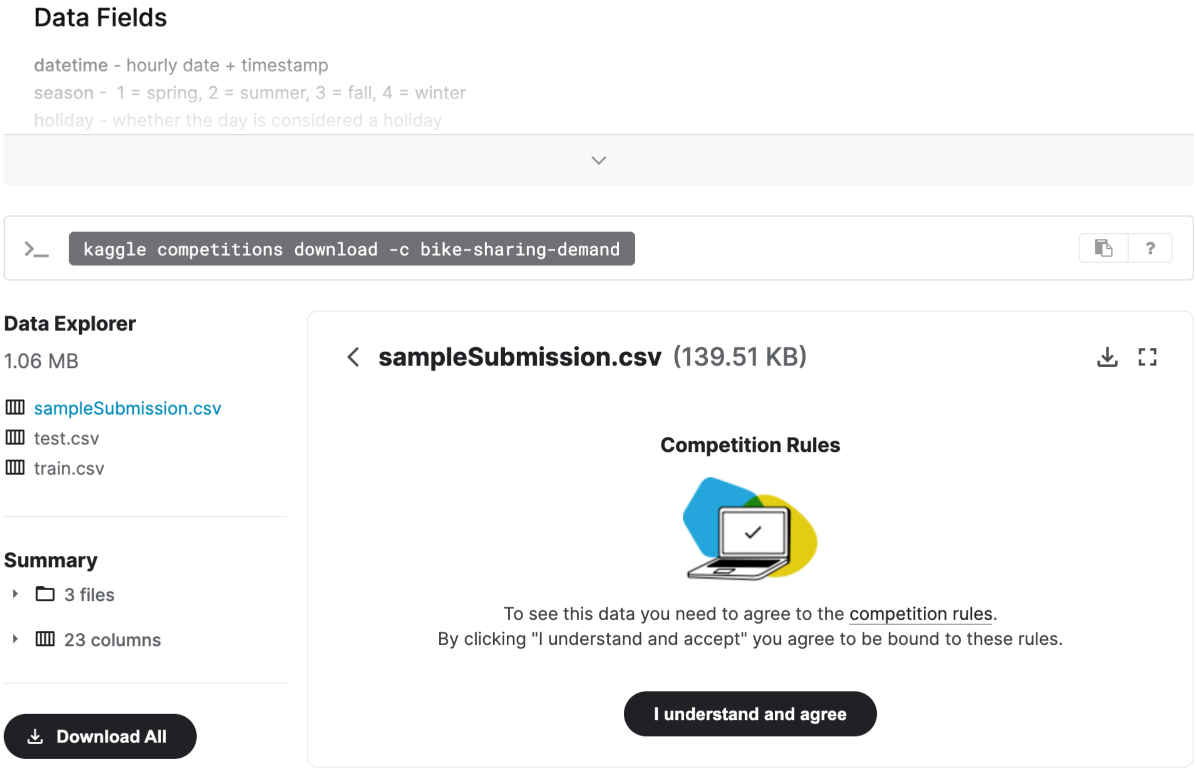
```
Requirement already satisfied: python-dotenv in /usr/local/lib/python3.7/site-packages
(0.21.0)
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting
behaviour with the system package manager. It is recommended to use a virtual environmen
t instead: https://pip.pypa.io/warnings/venv
```

In [12]:

```
# Fill in your user name and key from creating the kaggle account and API token file
import json
# Save API token the kaggle.json file
with open("/root/.kaggle/kaggle.json", "w") as f:
    f.write(json.dumps({"username": kaggle_username, "key": kaggle_key}))
```

Download and explore dataset

Go to the bike sharing demand competition and agree to the terms



Data Fields

datetime - hourly date + timestamp
season - 1 = spring, 2 = summer, 3 = fall, 4 = winter
holiday - whether the day is considered a holiday

```
kaggle competitions download -c bike-sharing-demand
```

Data Explorer
1.06 MB

- sampleSubmission.csv
- test.csv
- train.csv

Summary
- 3 files
- 23 columns

sampleSubmission.csv (139.51 KB)

Competition Rules

To see this data you need to agree to the competition rules.
By clicking "I understand and accept" you agree to be bound to these rules.

In [13]:

```
# Download the dataset, it will be in a .zip file so you'll need to unzip it as well.
!kaggle competitions download -c bike-sharing-demand
# If you already downloaded it you can use the -o command to overwrite the file
!unzip -o bike-sharing-demand.zip
```

```
bike-sharing-demand.zip: Skipping, found more recently modified local copy (use --force
to force download)
Archive:  bike-sharing-demand.zip
  inflating: sampleSubmission.csv
  inflating: test.csv
  inflating: train.csv
```

In [14]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import datetime as dt
sns.set()
%matplotlib inline
```

In [15]:

```
# Create the train dataset in pandas by reading the csv
# Set the parsing of the datetime column so you can use some of the `dt` features in pa
train = pd.read_csv("train.csv" , parse_dates= ['datetime'])
train.head()
```

Out[15]:

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	casual	regist
0	2011-01-01 00:00:00	1	0	0	1	9.84	14.395	81	0.0	3	

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	casual	regist
1	2011-01-01 01:00:00	1	0	0	1	9.02	13.635	80	0.0	8	
2	2011-01-01 02:00:00	1	0	0	1	9.02	13.635	80	0.0	5	
3	2011-01-01 03:00:00	1	0	0	1	9.84	14.395	75	0.0	3	
4	2011-01-01 04:00:00	1	0	0	1	9.84	14.395	75	0.0	0	

In [16]:

```
# Simple output of the train dataset to view some of the min/max/varition of the datase
train.describe()
```

Out[16]:

	season	holiday	workingday	weather	temp	atemp	humidity
count	10886.000000	10886.000000	10886.000000	10886.000000	10886.00000	10886.000000	10886.000000
mean	2.506614	0.028569	0.680875	1.418427	20.23086	23.655084	61.886460
std	1.116174	0.166599	0.466159	0.633839	7.79159	8.474601	19.245033
min	1.000000	0.000000	0.000000	1.000000	0.82000	0.760000	0.000000
25%	2.000000	0.000000	0.000000	1.000000	13.94000	16.665000	47.000000
50%	3.000000	0.000000	1.000000	1.000000	20.50000	24.240000	62.000000
75%	4.000000	0.000000	1.000000	2.000000	26.24000	31.060000	77.000000
max	4.000000	1.000000	1.000000	4.000000	41.00000	45.455000	100.000000

In [17]:

```
# Create the test pandas dataframe in pandas by reading the csv, remember to parse the
test = pd.read_csv("test.csv", parse_dates= ['datetime'])
test.head()
```

Out[17]:

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed
0	2011-01-20 00:00:00	1	0	1	1	10.66	11.365	56	26.0027
1	2011-01-20 01:00:00	1	0	1	1	10.66	13.635	56	0.0000
2	2011-01-20 02:00:00	1	0	1	1	10.66	13.635	56	0.0000
3	2011-01-20 03:00:00	1	0	1	1	10.66	12.880	56	11.0014
4	2011-01-20 04:00:00	1	0	1	1	10.66	12.880	56	11.0014

In [18]:

```
# Same thing as train and test dataset
```

```
submission = pd.read_csv("sampleSubmission.csv")
submission.head()
```

Out[18]:

	datetime	count
0	2011-01-20 00:00:00	0
1	2011-01-20 01:00:00	0
2	2011-01-20 02:00:00	0
3	2011-01-20 03:00:00	0
4	2011-01-20 04:00:00	0

Step 3: Train a model using AutoGluon’s Tabular Prediction

Requirements:

- We are predicting `count`, so it is the label we are setting.
- Ignore `casual` and `registered` columns as they are also not present in the test dataset.
- Use the `root_mean_squared_error` as the metric to use for evaluation.
- Set a time limit of 10 minutes (600 seconds).
- Use the preset `best_quality` to focus on creating the best model.

In [19]:

```
train.drop(columns = ["casual", "registered"], axis= 1 , inplace= True)
train.head()
```

Out[19]:

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	count
0	2011-01-01 00:00:00	1	0	0	1	9.84	14.395	81	0.0	16
1	2011-01-01 01:00:00	1	0	0	1	9.02	13.635	80	0.0	40
2	2011-01-01 02:00:00	1	0	0	1	9.02	13.635	80	0.0	32
3	2011-01-01 03:00:00	1	0	0	1	9.84	14.395	75	0.0	13
4	2011-01-01 04:00:00	1	0	0	1	9.84	14.395	75	0.0	1

In [20]:

```
train['weather'] = train['weather'].map({1: 'clear',2:  'few clouds', 3: 'partly cloudy
train['season'] = train['season'].map({1 : 'spring', 2 : 'summer', 3 : 'fall', 4 : 'win
test['weather'] = test['weather'].map({1: 'clear',2:  'few clouds', 3: 'partly cloudy',
test['season'] = test['season'].map({1 : 'spring', 2 : 'summer', 3 : 'fall', 4 : 'winte
```

In [23]:

```
train = pd.get_dummies(train, drop_first=True)
test = pd.get_dummies(test, drop_first=True)
```

In [26]:

```
train.columns
```

Out[26]:

```
Index(['datetime', 'holiday', 'workingday', 'temp', 'atemp', 'humidity',
       'windspeed', 'count', 'season_spring', 'season_summer', 'season_winter',
       'weather_cloudy', 'weather_few clouds', 'weather_partly cloudy'],
      dtype='object')
```

In [27]:

```
test.columns
```

Out[27]:

```
Index(['datetime', 'holiday', 'workingday', 'temp', 'atemp', 'humidity',
       'windspeed', 'season_spring', 'season_summer', 'season_winter',
       'weather_cloudy', 'weather_few clouds', 'weather_partly cloudy'],
      dtype='object')
```

In [28]:

```
train.head(20)
```

Out[28]:

	datetime	holiday	workingday	temp	atemp	humidity	windspeed	count	season_spring	season_
0	2011-01-01 00:00:00	0	0	9.84	14.395	81	0.0000	16	1	
1	2011-01-01 01:00:00	0	0	9.02	13.635	80	0.0000	40	1	
2	2011-01-01 02:00:00	0	0	9.02	13.635	80	0.0000	32	1	
3	2011-01-01 03:00:00	0	0	9.84	14.395	75	0.0000	13	1	
4	2011-01-01 04:00:00	0	0	9.84	14.395	75	0.0000	1	1	
5	2011-01-01 05:00:00	0	0	9.84	12.880	75	6.0032	1	1	
6	2011-01-01 06:00:00	0	0	9.02	13.635	80	0.0000	2	1	
7	2011-01-01 07:00:00	0	0	8.20	12.880	86	0.0000	3	1	
8	2011-01-01 08:00:00	0	0	9.84	14.395	75	0.0000	8	1	
9	2011-01-01 09:00:00	0	0	13.12	17.425	76	0.0000	14	1	

	datetime	holiday	workingday	temp	atemp	humidity	windspeed	count	season_spring	season_
10	2011-01-01 10:00:00	0	0	15.58	19.695	76	16.9979	36	1	
11	2011-01-01 11:00:00	0	0	14.76	16.665	81	19.0012	56	1	
12	2011-01-01 12:00:00	0	0	17.22	21.210	77	19.0012	84	1	
13	2011-01-01 13:00:00	0	0	18.86	22.725	72	19.9995	94	1	
14	2011-01-01 14:00:00	0	0	18.86	22.725	72	19.0012	106	1	
15	2011-01-01 15:00:00	0	0	18.04	21.970	77	19.9995	110	1	
16	2011-01-01 16:00:00	0	0	17.22	21.210	82	19.9995	93	1	
17	2011-01-01 17:00:00	0	0	18.04	21.970	82	19.0012	67	1	
18	2011-01-01 18:00:00	0	0	17.22	21.210	88	16.9979	35	1	
19	2011-01-01 19:00:00	0	0	17.22	21.210	88	16.9979	37	1	

In [31]:

```
from autogluon.tabular import TabularPredictor
predictor = TabularPredictor(label = 'count',eval_metric = "root_mean_squared_error", p
```

```
No path specified. Models will be saved in: "AutogluonModels/ag-20221025_183303/"
Presets specified: ['best_quality']
Stack configuration (auto_stack=True): num_stack_levels=1, num_bag_folds=8, num_bag_sets
=20
Beginning AutoGluon training ... Time limit = 600s
AutoGluon will save models to "AutogluonModels/ag-20221025_183303/"
AutoGluon Version:  0.5.2
Python Version:     3.7.10
Operating System:   Linux
Train Data Rows:    10886
Train Data Columns: 13
Label Column: count
Preprocessing data ...
```

```
Using Feature Generators to preprocess the data ...
Fitting AutoMLPipelineFeatureGenerator...
        Available Memory:                    3110.13 MB
        Train Data (Original)  Memory Usage: 0.68 MB (0.0% of available memory)
        Inferring data type of each feature based on column values. Set feature_metadata
_in to manually specify special dtypes of the features.
        Stage 1 Generators:
                Fitting AsTypeFeatureGenerator...
                        Note: Converting 8 features to boolean dtype as they only contai
n 2 unique values.
        Stage 2 Generators:
                Fitting FillNaFeatureGenerator...
        Stage 3 Generators:
                Fitting IdentityFeatureGenerator...
                Fitting DatetimeFeatureGenerator...
        Stage 4 Generators:
                Fitting DropUniqueFeatureGenerator...
        Types of features in original data (raw dtype, special dtypes):
                ('datetime', []) : 1 | ['datetime']
                ('float', [])    : 3 | ['temp', 'atemp', 'windspeed']
                ('int', [])      : 9 | ['holiday', 'workingday', 'humidity', 'season_spr
ing', 'season_summer', ...]
        Types of features in processed data (raw dtype, special dtypes):
                ('float', [])                : 3 | ['temp', 'atemp', 'windspeed']
                ('int', [])                  : 1 | ['humidity']
                ('int', ['bool'])            : 8 | ['holiday', 'workingday', 'season_spr
ing', 'season_summer', 'season_winter', ...]
                ('int', ['datetime_as_int']) : 5 | ['datetime', 'datetime.year', 'dateti
me.month', 'datetime.day', 'datetime.dayofweek']
        0.4s = Fit runtime
        13 features in original data used to generate 17 features in processed data.
        Train Data (Processed) Memory Usage: 0.87 MB (0.0% of available memory)
Data preprocessing and feature engineering runtime = 0.49s ...
AutoGluon will gauge predictive performance using evaluation metric: 'root_mean_squared_
error'
        This metric's sign has been flipped to adhere to being higher_is_better. The met
ric score can be multiplied by -1 to get the metric value.
        To change this, specify the eval_metric parameter of Predictor()
AutoGluon will fit 2 stack levels (L1 to L2) ...
Fitting 11 L1 models ...
Fitting model: KNeighborsUnif_BAG_L1 ... Training model for up to 399.58s of the 599.51s
of remaining time.
        -101.5462        = Validation score   (-root_mean_squared_error)
        0.04s    = Training   runtime
        0.11s    = Validation runtime
Fitting model: KNeighborsDist_BAG_L1 ... Training model for up to 399.2s of the 599.14s
of remaining time.
        -84.1251         = Validation score   (-root_mean_squared_error)
        0.03s    = Training   runtime
        0.1s     = Validation runtime
Fitting model: LightGBMXT_BAG_L1 ... Training model for up to 398.85s of the 598.78s of
remaining time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
2022-10-25 18:33:08,315 WARNING services.py:2013 -- WARNING: The object store is using /
tmp instead of /dev/shm because /dev/shm has only 416284672 bytes available. This will h
arm performance! You may be able to free up space by deleting files in /dev/shm. If you
are inside a Docker container, you can increase /dev/shm size by passing '--shm-size=0.9
9gb' to 'docker run' (or add it to the run_options list in a Ray cluster config). Make s
ure to set this to more than 30% of available RAM.
```

```
        -131.1821        = Validation score   (-root_mean_squared_error)
        54.54s   = Training   runtime
        5.28s    = Validation runtime
Fitting model: LightGBM_BAG_L1 ... Training model for up to 336.05s of the 535.98s of re
maining time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -130.8126        = Validation score   (-root_mean_squared_error)
        26.92s   = Training   runtime
        1.29s    = Validation runtime
Fitting model: RandomForestMSE_BAG_L1 ... Training model for up to 305.87s of the 505.8s
of remaining time.
        -117.2301        = Validation score   (-root_mean_squared_error)
        11.3s    = Training   runtime
        0.53s    = Validation runtime
Fitting model: CatBoost_BAG_L1 ... Training model for up to 291.32s of the 491.26s of re
maining time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -130.6561        = Validation score   (-root_mean_squared_error)
        203.31s  = Training   runtime
        0.1s     = Validation runtime
Fitting model: ExtraTreesMSE_BAG_L1 ... Training model for up to 85.03s of the 284.96s o
f remaining time.
        -124.8743        = Validation score   (-root_mean_squared_error)
        5.34s    = Training   runtime
        0.51s    = Validation runtime
Fitting model: NeuralNetFastAI_BAG_L1 ... Training model for up to 76.5s of the 276.43s
of remaining time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -136.2606        = Validation score   (-root_mean_squared_error)
        82.64s   = Training   runtime
        0.48s    = Validation runtime
Completed 1/20 k-fold bagging repeats ...
Fitting model: WeightedEnsemble_L2 ... Training model for up to 360.0s of the 189.78s of
remaining time.
        -84.1251         = Validation score   (-root_mean_squared_error)
        0.54s    = Training   runtime
        0.0s     = Validation runtime
Fitting 9 L2 models ...
Fitting model: LightGBMXT_BAG_L2 ... Training model for up to 189.16s of the 189.13s of
remaining time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -61.2703         = Validation score   (-root_mean_squared_error)
        50.29s   = Training   runtime
        2.92s    = Validation runtime
Fitting model: LightGBM_BAG_L2 ... Training model for up to 134.89s of the 134.87s of re
maining time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -54.8771         = Validation score   (-root_mean_squared_error)
        23.21s   = Training   runtime
        0.24s    = Validation runtime
Fitting model: RandomForestMSE_BAG_L2 ... Training model for up to 108.68s of the 108.66
s of remaining time.
        -53.3213         = Validation score   (-root_mean_squared_error)
        26.99s   = Training   runtime
        0.59s    = Validation runtime
```

```
Fitting model: CatBoost_BAG_L2 ... Training model for up to 78.62s of the 78.6s of remai
ning time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -55.2088         = Validation score   (-root_mean_squared_error)
        70.61s   = Training   runtime
        0.08s    = Validation runtime
Fitting model: ExtraTreesMSE_BAG_L2 ... Training model for up to 5.11s of the 5.09s of r
emaining time.
        -53.7804         = Validation score   (-root_mean_squared_error)
        9.17s    = Training   runtime
        0.58s    = Validation runtime
Completed 1/20 k-fold bagging repeats ...
Fitting model: WeightedEnsemble_L3 ... Training model for up to 360.0s of the -7.37s of
remaining time.
        -52.6837         = Validation score   (-root_mean_squared_error)
        0.37s    = Training   runtime
        0.0s     = Validation runtime
AutoGluon training complete, total runtime = 607.95s ... Best model: "WeightedEnsemble_L
3"
TabularPredictor saved. To load, use: predictor = TabularPredictor.load("AutogluonModel
s/ag-20221025_183303/")
```

Review AutoGluon's training run with ranking of models that did the best.

In [32]:

```
predictor.fit_summary()
```

```
*** Summary of fit() ***
Estimated performance of each model:
                     model   score_val  pred_time_val    fit_time  pred_time_val_margina
l  fit_time_marginal  stack_level  can_infer  fit_order
0      WeightedEnsemble_L3  -52.683737       9.906088  514.476438                0.00086
8           0.365389            3       True         15
1   RandomForestMSE_BAG_L2  -53.321345       8.996426  411.120387                0.59309
6          26.994454            2       True         12
2     ExtraTreesMSE_BAG_L2  -53.780370       8.988183  393.297396                0.58485
4           9.171463            2       True         14
3          LightGBM_BAG_L2  -54.877149       8.643315  407.337172                0.23998
5          23.211239            2       True         11
4          CatBoost_BAG_L2  -55.208800       8.487285  454.733893                0.08395
5          70.607960            2       True         13
5        LightGBMXT_BAG_L2  -61.270313      11.322817  434.412179                2.91948
8          50.286246            2       True         10
6    KNeighborsDist_BAG_L1  -84.125061       0.103863    0.026872                0.10386
3           0.026872            1       True          2
7      WeightedEnsemble_L2  -84.125061       0.104935    0.562587                0.00107
2           0.535716            2       True          9
8    KNeighborsUnif_BAG_L1 -101.546199       0.105610    0.039457                0.10561
0           0.039457            1       True          1
9   RandomForestMSE_BAG_L1 -117.230130       0.533201   11.303427                0.53320
1          11.303427            1       True          5
10    ExtraTreesMSE_BAG_L1 -124.874295       0.514982    5.342822                0.51498
2           5.342822            1       True          7
11         CatBoost_BAG_L1 -130.656137       0.100591  203.310478                0.10059
1         203.310478            1       True          6
12         LightGBM_BAG_L1 -130.812602       1.292242   26.921990                1.29224
2          26.921990            1       True          4
```

```
13       LightGBMXT_BAG_L1 -131.182139       5.277046   54.543251                5.27704
6          54.543251            1       True          3
14  NeuralNetFastAI_BAG_L1 -136.260610       0.475795   82.637637                0.47579
5          82.637637            1       True          8
Number of models trained: 15
Types of models trained:
{'StackerEnsembleModel_LGB', 'StackerEnsembleModel_NNFastAiTabular', 'WeightedEnsembleMo
del', 'StackerEnsembleModel_RF', 'StackerEnsembleModel_CatBoost', 'StackerEnsembleModel_
KNN', 'StackerEnsembleModel_XT'}
Bagging used: True  (with 8 folds)
Multi-layer stack-ensembling used: True  (with 3 levels)
Feature Metadata (Processed):
(raw dtype, special dtypes):
('float', [])                : 3 | ['temp', 'atemp', 'windspeed']
('int', [])                  : 1 | ['humidity']
('int', ['bool'])            : 8 | ['holiday', 'workingday', 'season_spring', 'season_su
mmer', 'season_winter', ...]
('int', ['datetime_as_int']) : 5 | ['datetime', 'datetime.year', 'datetime.month', 'date
time.day', 'datetime.dayofweek']
Plot summary of models saved to file: AutogluonModels/ag-20221025_183303/SummaryOfModel
s.html
*** End of fit() summary ***
```

Out[32]:

```
{'model_types': {'KNeighborsUnif_BAG_L1': 'StackerEnsembleModel_KNN',
  'KNeighborsDist_BAG_L1': 'StackerEnsembleModel_KNN',
  'LightGBMXT_BAG_L1': 'StackerEnsembleModel_LGB',
  'LightGBM_BAG_L1': 'StackerEnsembleModel_LGB',
  'RandomForestMSE_BAG_L1': 'StackerEnsembleModel_RF',
  'CatBoost_BAG_L1': 'StackerEnsembleModel_CatBoost',
  'ExtraTreesMSE_BAG_L1': 'StackerEnsembleModel_XT',
  'NeuralNetFastAI_BAG_L1': 'StackerEnsembleModel_NNFastAiTabular',
  'WeightedEnsemble_L2': 'WeightedEnsembleModel',
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  'LightGBM_BAG_L2': 'StackerEnsembleModel_LGB',
  'RandomForestMSE_BAG_L2': 'StackerEnsembleModel_RF',
  'CatBoost_BAG_L2': 'StackerEnsembleModel_CatBoost',
  'ExtraTreesMSE_BAG_L2': 'StackerEnsembleModel_XT',
  'WeightedEnsemble_L3': 'WeightedEnsembleModel'},
 'model_performance': {'KNeighborsUnif_BAG_L1': -101.54619908446061,
  'KNeighborsDist_BAG_L1': -84.12506123181602,
  'LightGBMXT_BAG_L1': -131.18213930253248,
  'LightGBM_BAG_L1': -130.8126020728498,
  'RandomForestMSE_BAG_L1': -117.23012965771233,
  'CatBoost_BAG_L1': -130.6561372257993,
  'ExtraTreesMSE_BAG_L1': -124.87429515305618,
  'NeuralNetFastAI_BAG_L1': -136.2606100769395,
  'WeightedEnsemble_L2': -84.12506123181602,
  'LightGBMXT_BAG_L2': -61.27031270903325,
  'LightGBM_BAG_L2': -54.87714857679695,
  'RandomForestMSE_BAG_L2': -53.32134511309139,
  'CatBoost_BAG_L2': -55.20880020311221,
  'ExtraTreesMSE_BAG_L2': -53.780369942245194,
  'WeightedEnsemble_L3': -52.68373714221127},
 'model_best': 'WeightedEnsemble_L3',
 'model_paths': {'KNeighborsUnif_BAG_L1': 'AutogluonModels/ag-20221025_183303/models/KNe
ighborsUnif_BAG_L1/',
  'KNeighborsDist_BAG_L1': 'AutogluonModels/ag-20221025_183303/models/KNeighborsDist_BAG
_L1/',
  'LightGBMXT_BAG_L1': 'AutogluonModels/ag-20221025_183303/models/LightGBMXT_BAG_L1/',
  'LightGBM_BAG_L1': 'AutogluonModels/ag-20221025_183303/models/LightGBM_BAG_L1/',
  'RandomForestMSE_BAG_L1': 'AutogluonModels/ag-20221025_183303/models/RandomForestMSE_B
```

```
AG_L1/',
  'CatBoost_BAG_L1': 'AutogluonModels/ag-20221025_183303/models/CatBoost_BAG_L1/',
  'ExtraTreesMSE_BAG_L1': 'AutogluonModels/ag-20221025_183303/models/ExtraTreesMSE_BAG_L
1/',
  'NeuralNetFastAI_BAG_L1': 'AutogluonModels/ag-20221025_183303/models/NeuralNetFastAI_B
AG_L1/',
  'WeightedEnsemble_L2': 'AutogluonModels/ag-20221025_183303/models/WeightedEnsemble_L
2/',
  'LightGBMXT_BAG_L2': 'AutogluonModels/ag-20221025_183303/models/LightGBMXT_BAG_L2/',
  'LightGBM_BAG_L2': 'AutogluonModels/ag-20221025_183303/models/LightGBM_BAG_L2/',
  'RandomForestMSE_BAG_L2': 'AutogluonModels/ag-20221025_183303/models/RandomForestMSE_B
AG_L2/',
  'CatBoost_BAG_L2': 'AutogluonModels/ag-20221025_183303/models/CatBoost_BAG_L2/',
  'ExtraTreesMSE_BAG_L2': 'AutogluonModels/ag-20221025_183303/models/ExtraTreesMSE_BAG_L
2/',
  'WeightedEnsemble_L3': 'AutogluonModels/ag-20221025_183303/models/WeightedEnsemble_L
3/'},
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  'KNeighborsDist_BAG_L1': 0.026871681213378906,
  'LightGBMXT_BAG_L1': 54.5432505607605,
  'LightGBM_BAG_L1': 26.921990156173706,
  'RandomForestMSE_BAG_L1': 11.303426742553711,
  'CatBoost_BAG_L1': 203.3104784488678,
  'ExtraTreesMSE_BAG_L1': 5.3428215980529785,
  'NeuralNetFastAI_BAG_L1': 82.63763666152954,
  'WeightedEnsemble_L2': 0.5357155799865723,
  'LightGBMXT_BAG_L2': 50.286245822906494,
  'LightGBM_BAG_L2': 23.211239337921143,
  'RandomForestMSE_BAG_L2': 26.99445390701294,
  'CatBoost_BAG_L2': 70.60795974731445,
  'ExtraTreesMSE_BAG_L2': 9.171462774276733,
  'WeightedEnsemble_L3': 0.3653891086578369},
 'model_pred_times': {'KNeighborsUnif_BAG_L1': 0.10560965538024902,
  'KNeighborsDist_BAG_L1': 0.10386300086975098,
  'LightGBMXT_BAG_L1': 5.277045726776123,
  'LightGBM_BAG_L1': 1.2922420501708984,
  'RandomForestMSE_BAG_L1': 0.5332009792327881,
  'CatBoost_BAG_L1': 0.10059118270874023,
  'ExtraTreesMSE_BAG_L1': 0.5149822235107422,
  'NeuralNetFastAI_BAG_L1': 0.47579455375671387,
  'WeightedEnsemble_L2': 0.001071929931640625,
  'LightGBMXT_BAG_L2': 2.919487953186035,
  'LightGBM_BAG_L2': 0.23998522758483887,
  'RandomForestMSE_BAG_L2': 0.5930964946746826,
  'CatBoost_BAG_L2': 0.08395528793334961,
  'ExtraTreesMSE_BAG_L2': 0.5848538875579834,
  'WeightedEnsemble_L3': 0.0008676052093505859},
 'num_bag_folds': 8,
 'max_stack_level': 3,
 'model_hyperparams': {'KNeighborsUnif_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True,
   'use_child_oof': True},
  'KNeighborsDist_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True,
   'use_child_oof': True},
  'LightGBMXT_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'LightGBM_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'RandomForestMSE_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True,
   'use_child_oof': True},
  'CatBoost_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'ExtraTreesMSE_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True,
   'use_child_oof': True},
  'NeuralNetFastAI_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'WeightedEnsemble_L2': {'use_orig_features': False,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'LightGBMXT_BAG_L2': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'LightGBM_BAG_L2': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'RandomForestMSE_BAG_L2': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True,
   'use_child_oof': True},
  'CatBoost_BAG_L2': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'ExtraTreesMSE_BAG_L2': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True,
   'use_child_oof': True},
  'WeightedEnsemble_L3': {'use_orig_features': False,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True}},
 'leaderboard':                      model   score_val  pred_time_val    fit_time  \
 0      WeightedEnsemble_L3  -52.683737       9.906088  514.476438
 1   RandomForestMSE_BAG_L2  -53.321345       8.996426  411.120387
 2     ExtraTreesMSE_BAG_L2  -53.780370       8.988183  393.297396
 3          LightGBM_BAG_L2  -54.877149       8.643315  407.337172
```

```
4          CatBoost_BAG_L2  -55.208800       8.487285  454.733893
5        LightGBMXT_BAG_L2  -61.270313      11.322817  434.412179
6     KNeighborsDist_BAG_L1  -84.125061       0.103863    0.026872
7      WeightedEnsemble_L2  -84.125061       0.104935    0.562587
8     KNeighborsUnif_BAG_L1 -101.546199       0.105610    0.039457
9    RandomForestMSE_BAG_L1 -117.230130       0.533201   11.303427
10     ExtraTreesMSE_BAG_L1 -124.874295       0.514982    5.342822
11          CatBoost_BAG_L1 -130.656137       0.100591  203.310478
12          LightGBM_BAG_L1 -130.812602       1.292242   26.921990
13        LightGBMXT_BAG_L1 -131.182139       5.277046   54.543251
14   NeuralNetFastAI_BAG_L1 -136.260610       0.475795   82.637637

    pred_time_val_marginal  fit_time_marginal  stack_level  can_infer  \
0                 0.000868           0.365389            3       True
1                 0.593096          26.994454            2       True
2                 0.584854           9.171463            2       True
3                 0.239985          23.211239            2       True
4                 0.083955          70.607960            2       True
5                 2.919488          50.286246            2       True
6                 0.103863           0.026872            1       True
7                 0.001072           0.535716            2       True
8                 0.105610           0.039457            1       True
9                 0.533201          11.303427            1       True
10                0.514982           5.342822            1       True
11                0.100591         203.310478            1       True
12                1.292242          26.921990            1       True
13                5.277046          54.543251            1       True
14                0.475795          82.637637            1       True

    fit_order
0          15
1          12
2          14
3          11
4          13
5          10
6           2
7           9
8           1
9           5
10          7
11          6
12          4
13          3
14          8  }
```

Create predictions from test dataset

In [33]:

```
predictions =  predictor.predict(test)
predictions.head()
```

Out[33]:

```
0    24.014065
1    42.812611
2    46.037292
3    49.268745
4    51.266617
Name: count, dtype: float32
```

NOTE: Kaggle will reject the submission if we don't set everything to be > 0.

In [34]:

```python
# Describe the `predictions` series to see if there are any negative values
predictions.describe().T
```

Out[34]:

```
count    6493.000000
mean      101.211304
std        90.846016
min         3.126539
25%        20.161146
50%        62.639587
75%       171.132553
max       364.034668
Name: count, dtype: float64
```

In [35]:

```python
# How many negative values do we have?
len(predictions[predictions < 0])
```

Out[35]:

```
0
```

In [36]:

```python
# Set them to zero
predictions[predictions < 0] = 0
```

Set predictions to submission dataframe, save, and submit

In [37]:

```python
submission.head()
```

Out[37]:

	datetime	count
0	2011-01-20 00:00:00	0
1	2011-01-20 01:00:00	0
2	2011-01-20 02:00:00	0
3	2011-01-20 03:00:00	0
4	2011-01-20 04:00:00	0

In [39]:

```python
submission["count"] = predictions
submission.to_csv("submission.csv", index=False)
```

In [40]:

```python
submission.head()
```

Out[40]:

	datetime	count
0	2011-01-20 00:00:00	24.014065
1	2011-01-20 01:00:00	42.812611
2	2011-01-20 02:00:00	46.037292
3	2011-01-20 03:00:00	49.268745
4	2011-01-20 04:00:00	51.266617

In [41]:

```
!kaggle competitions submit -c bike-sharing-demand -f submission.csv -m "first raw subm
```

```
100%|██████████████████████████████████████████| 188k/188k [00:00<00:00, 346kB/s]
Successfully submitted to Bike Sharing Demand
```

View submission via the command line or in the web browser under the competition's page - `My Submissions`

In [42]:

```
!kaggle competitions submissions -c bike-sharing-demand | tail -n +1 | head -n 6
```

```
fileName                     date                 description                        sta
tus     publicScore  privateScore
---------------------------  -------------------  ---------------------------------  ---
-----  -----------  ------------
submission.csv               2022-10-25 18:51:57  first raw submission               com
plete  1.80679      1.80679
submission_new_hpo.csv       2022-10-25 16:52:35  new features with hyperparameters  com
plete  0.51909      0.51909
submission_new_features.csv  2022-10-25 15:52:18  new features                       com
plete  0.84208      0.84208
submission.csv               2022-10-25 14:35:11  first raw submission               com
plete  1.81052      1.81052
```

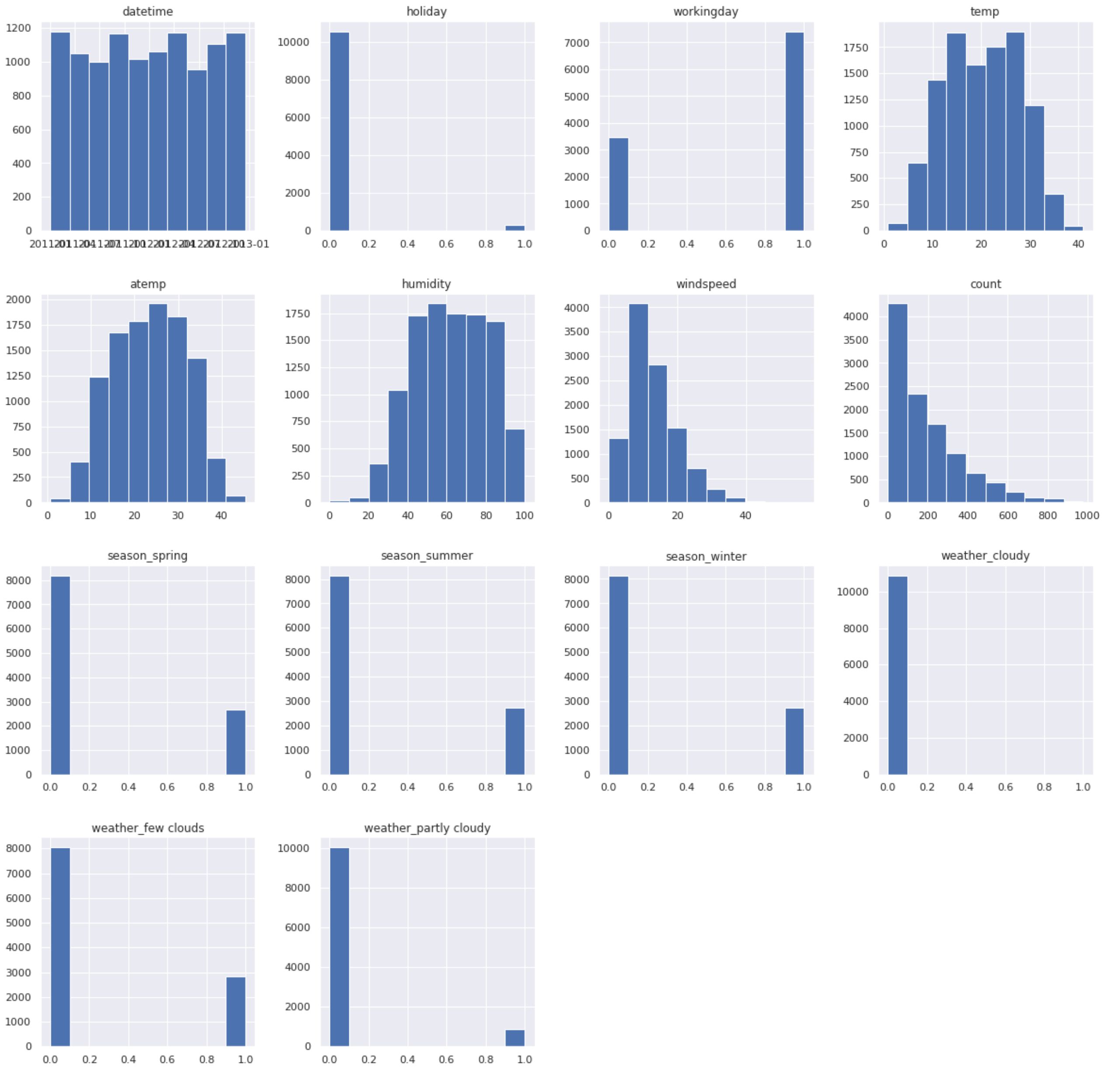
Initial score of `?`

Step 4: Exploratory Data Analysis and Creating an additional feature

- Any additional feature will do, but a great suggestion would be to separate out the datetime into hour, day, or month parts.

In [43]:

```
# Create a histogram of all features to show the distribution of each one relative to t
train.hist(figsize= (20, 20))
plt.show()
```



In [79]:

```
train = pd.read_csv("train.csv" , parse_dates= ['datetime'])
train.head()
```

Out[79]:

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	casual	regist
0	2011-01-01 00:00:00	1	0	0	1	9.84	14.395	81	0.0	3	
1	2011-01-01 01:00:00	1	0	0	1	9.02	13.635	80	0.0	8	
2	2011-01-01 02:00:00	1	0	0	1	9.02	13.635	80	0.0	5	
3	2011-01-01 03:00:00	1	0	0	1	9.84	14.395	75	0.0	3	

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	casual	regist
4	2011-01-01 04:00:00	1	0	0	1	9.84	14.395	75	0.0	0	

In [80]:

```
train.drop(columns = ["casual", "registered"], axis= 1 , inplace= True)
train.head()
```

Out[80]:

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	count
0	2011-01-01 00:00:00	1	0	0	1	9.84	14.395	81	0.0	16
1	2011-01-01 01:00:00	1	0	0	1	9.02	13.635	80	0.0	40
2	2011-01-01 02:00:00	1	0	0	1	9.02	13.635	80	0.0	32
3	2011-01-01 03:00:00	1	0	0	1	9.84	14.395	75	0.0	13
4	2011-01-01 04:00:00	1	0	0	1	9.84	14.395	75	0.0	1

In [81]:

```
test = pd.read_csv("test.csv" , parse_dates= ['datetime'])
test.head()
```

Out[81]:

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed
0	2011-01-20 00:00:00	1	0	1	1	10.66	11.365	56	26.0027
1	2011-01-20 01:00:00	1	0	1	1	10.66	13.635	56	0.0000
2	2011-01-20 02:00:00	1	0	1	1	10.66	13.635	56	0.0000
3	2011-01-20 03:00:00	1	0	1	1	10.66	12.880	56	11.0014
4	2011-01-20 04:00:00	1	0	1	1	10.66	12.880	56	11.0014

In [82]:

```
# create a new feature
train["datetime"] = pd.to_datetime(train["datetime"])
test["datetime"] = pd.to_datetime(test["datetime"])
```

In [83]:

```
# Train Data
train['dayofweek'] = train.datetime.dt.dayofweek
train['hour'] =  train.datetime.dt.hour
train['day'] =  train.datetime.dt.day
train['month'] =  train.datetime.dt.month
train['year'] =  train.datetime.dt.year
```

In [84]:

```
print(train[['hour', 'datetime']].head(20))
print(train['hour'].value_counts())
```

```
    hour            datetime
0      0 2011-01-01 00:00:00
1      1 2011-01-01 01:00:00
2      2 2011-01-01 02:00:00
3      3 2011-01-01 03:00:00
4      4 2011-01-01 04:00:00
5      5 2011-01-01 05:00:00
6      6 2011-01-01 06:00:00
7      7 2011-01-01 07:00:00
8      8 2011-01-01 08:00:00
9      9 2011-01-01 09:00:00
10    10 2011-01-01 10:00:00
11    11 2011-01-01 11:00:00
12    12 2011-01-01 12:00:00
13    13 2011-01-01 13:00:00
14    14 2011-01-01 14:00:00
15    15 2011-01-01 15:00:00
16    16 2011-01-01 16:00:00
17    17 2011-01-01 17:00:00
18    18 2011-01-01 18:00:00
19    19 2011-01-01 19:00:00
12    456
13    456
22    456
21    456
20    456
19    456
18    456
17    456
16    456
15    456
14    456
23    456
11    455
10    455
9     455
8     455
7     455
6     455
0     455
1     454
5     452
2     448
4     442
3     433
Name: hour, dtype: int64
```

In [85]:

```
# Feature that categorizes hours
bins = [-np.inf, 0, 11, 12, 17, np.inf]
labels = ['MIDNIGHT', 'MORNING', 'MIDDAY', 'AFTERNOON', 'EVENING']
train['times of the day'] = pd.cut(train['hour'], bins= bins, labels= labels)
train['times of the day'] = train['times of the day'].str.lower()
```

In [86]:

```
train.head(30)
```

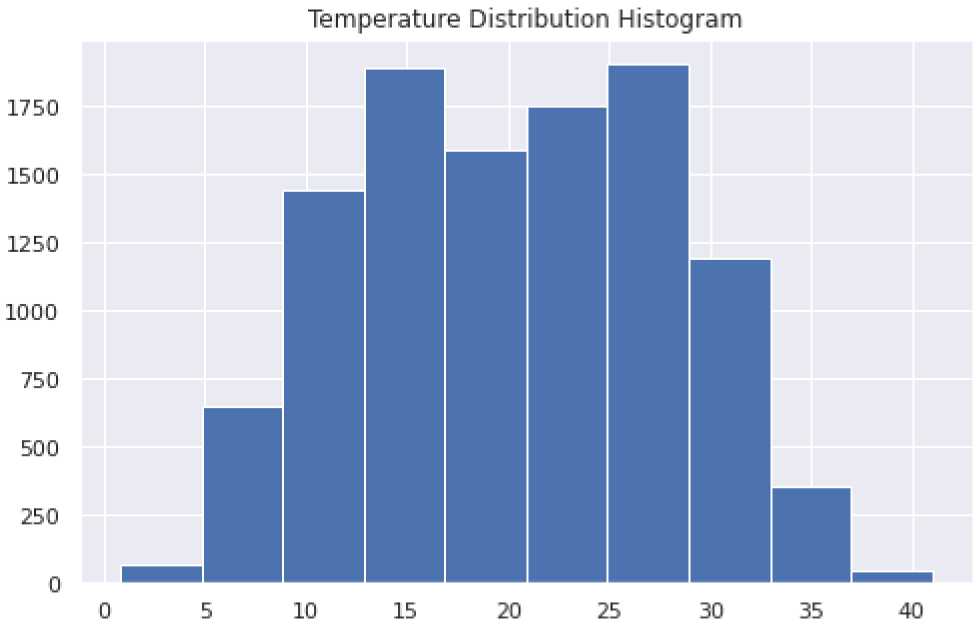
Out[86]:

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	count	dayc
0	2011-01-01 00:00:00	1	0	0	1	9.84	14.395	81	0.0000	16	
1	2011-01-01 01:00:00	1	0	0	1	9.02	13.635	80	0.0000	40	
2	2011-01-01 02:00:00	1	0	0	1	9.02	13.635	80	0.0000	32	
3	2011-01-01 03:00:00	1	0	0	1	9.84	14.395	75	0.0000	13	
4	2011-01-01 04:00:00	1	0	0	1	9.84	14.395	75	0.0000	1	
5	2011-01-01 05:00:00	1	0	0	2	9.84	12.880	75	6.0032	1	
6	2011-01-01 06:00:00	1	0	0	1	9.02	13.635	80	0.0000	2	
7	2011-01-01 07:00:00	1	0	0	1	8.20	12.880	86	0.0000	3	
8	2011-01-01 08:00:00	1	0	0	1	9.84	14.395	75	0.0000	8	
9	2011-01-01 09:00:00	1	0	0	1	13.12	17.425	76	0.0000	14	
10	2011-01-01 10:00:00	1	0	0	1	15.58	19.695	76	16.9979	36	
11	2011-01-01 11:00:00	1	0	0	1	14.76	16.665	81	19.0012	56	
12	2011-01-01 12:00:00	1	0	0	1	17.22	21.210	77	19.0012	84	
13	2011-01-01 13:00:00	1	0	0	2	18.86	22.725	72	19.9995	94	
14	2011-01-01 14:00:00	1	0	0	2	18.86	22.725	72	19.0012	106	

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	count	dayc
15	2011-01-01 15:00:00	1	0	0	2	18.04	21.970	77	19.9995	110	
16	2011-01-01 16:00:00	1	0	0	2	17.22	21.210	82	19.9995	93	
17	2011-01-01 17:00:00	1	0	0	2	18.04	21.970	82	19.0012	67	
18	2011-01-01 18:00:00	1	0	0	3	17.22	21.210	88	16.9979	35	
19	2011-01-01 19:00:00	1	0	0	3	17.22	21.210	88	16.9979	37	
20	2011-01-01 20:00:00	1	0	0	2	16.40	20.455	87	16.9979	36	
21	2011-01-01 21:00:00	1	0	0	2	16.40	20.455	87	12.9980	34	
22	2011-01-01 22:00:00	1	0	0	2	16.40	20.455	94	15.0013	28	
23	2011-01-01 23:00:00	1	0	0	2	18.86	22.725	88	19.9995	39	
24	2011-01-02 00:00:00	1	0	0	2	18.86	22.725	88	19.9995	17	
25	2011-01-02 01:00:00	1	0	0	2	18.04	21.970	94	16.9979	17	
26	2011-01-02 02:00:00	1	0	0	2	17.22	21.210	100	19.0012	9	
27	2011-01-02 03:00:00	1	0	0	2	18.86	22.725	94	12.9980	6	
28	2011-01-02 04:00:00	1	0	0	2	18.86	22.725	94	12.9980	3	
29	2011-01-02 06:00:00	1	0	0	3	17.22	21.210	77	19.9995	2	

In [87]:

```
train['temp'].hist(figsize= (8, 5));
plt.title('Temperature Distribution Histogram')
plt.show()
```


Temperature Distribution Histogram

In [88]:

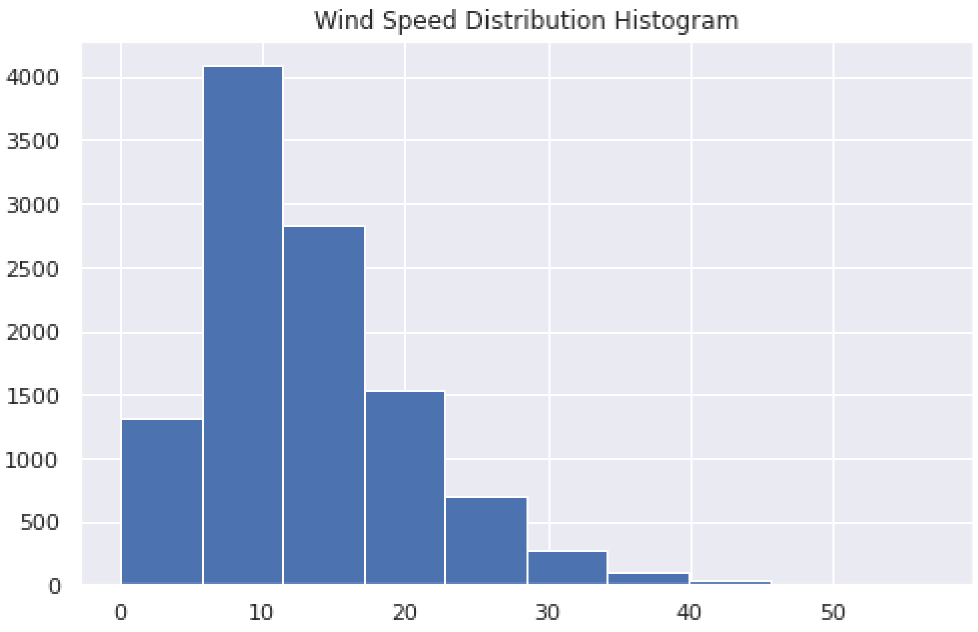
```
#Feature that categorizes hot/cold/mild temps from temp

bins = [-np.inf, 20, 30, np.inf]
labels = ['cold', 'mild', 'hot']
train['temp of the day'] = pd.cut(train['temp'], bins= bins, labels= labels)
train['temp of the day'].value_counts()
```

Out[88]:

```
cold    5308
mild    4334
hot     1244
Name: temp of the day, dtype: int64
```

In [89]:

```
train['windspeed'].hist(figsize= (8, 5));
plt.title('Wind Speed Distribution Histogram')
plt.show()
```



In [90]:

```
#Feature that categories Calm, Moderate, Strong.
bins = [-np.inf, 20, 38, np.inf]
labels = ['calm', 'moderate', 'strong']
train['windspeed of the day'] = pd.cut(train['windspeed'], bins= bins, labels= labels)
train['windspeed of the day'].value_counts()
```

Out[90]:

```
calm        9391
moderate    1428
strong        67
Name: windspeed of the day, dtype: int64
```

In [91]:

```
train[train['windspeed of the day'] == 'strong']
```

Out[91]:

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	count	c
265	2011-01-12 12:00:00	1	0	1	1	8.20	7.575	47	39.0007	55	
613	2011-02-08 17:00:00	1	0	1	1	9.02	9.090	32	39.0007	176	
750	2011-02-14 15:00:00	1	0	1	1	22.96	26.515	21	43.9989	90	
752	2011-02-14 17:00:00	1	0	1	1	18.86	22.725	33	40.9973	243	
753	2011-02-14 18:00:00	1	0	1	1	16.40	20.455	40	40.9973	205	
...	...	...	...	...	...	...	...	...	...	...	

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	count	c
9481	2012-09-18 10:00:00	3	0	1	3	27.88	31.820	79	43.0006	160	
9482	2012-09-18 11:00:00	3	0	1	2	27.88	31.820	79	43.0006	151	
9484	2012-09-18 13:00:00	3	0	1	2	28.70	33.335	74	39.0007	114	
9754	2012-10-10 19:00:00	4	0	1	2	22.96	26.515	46	39.0007	566	
10263	2012-11-13 01:00:00	4	0	1	3	18.04	21.970	88	43.0006	5	

67 rows × 18 columns

In [92]:

```
# test Data
test['dayofweek'] = test.datetime.dt.dayofweek
test['hour'] =  test.datetime.dt.hour
test['day'] =  test.datetime.dt.day
test['month'] =  test.datetime.dt.month
test['year'] =  test.datetime.dt.year
```

In [93]:

```
print(test[['hour', 'datetime']].head(20))
print(test['hour'].value_counts())
```

```
    hour            datetime
0      0 2011-01-20 00:00:00
1      1 2011-01-20 01:00:00
2      2 2011-01-20 02:00:00
3      3 2011-01-20 03:00:00
4      4 2011-01-20 04:00:00
5      5 2011-01-20 05:00:00
6      6 2011-01-20 06:00:00
7      7 2011-01-20 07:00:00
8      8 2011-01-20 08:00:00
9      9 2011-01-20 09:00:00
10    10 2011-01-20 10:00:00
11    11 2011-01-20 11:00:00
12    12 2011-01-20 12:00:00
13    13 2011-01-20 13:00:00
14    14 2011-01-20 14:00:00
15    15 2011-01-20 15:00:00
16    16 2011-01-20 16:00:00
17    17 2011-01-20 17:00:00
18    18 2011-01-20 18:00:00
```

```
19    19 2011-01-20 19:00:00
17    274
16    274
13    273
15    273
14    273
12    272
22    272
21    272
20    272
19    272
18    272
23    272
11    272
10    272
9     272
8     272
7     272
0     271
1     270
6     270
2     267
5     265
3     264
4     255
Name: hour, dtype: int64
```

In [94]:

```
test.head()
```

Out[94]:

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	dayofweek	l
0	2011-01-20 00:00:00	1	0	1	1	10.66	11.365	56	26.0027	3	
1	2011-01-20 01:00:00	1	0	1	1	10.66	13.635	56	0.0000	3	
2	2011-01-20 02:00:00	1	0	1	1	10.66	13.635	56	0.0000	3	
3	2011-01-20 03:00:00	1	0	1	1	10.66	12.880	56	11.0014	3	
4	2011-01-20 04:00:00	1	0	1	1	10.66	12.880	56	11.0014	3	

In [95]:

```
# Feature that categorizes hours
bins = [-np.inf, 0, 11, 12, 17, np.inf]
labels = ['MIDNIGHT', 'MORNING', 'MIDDAY', 'AFTERNOON', 'EVENING']
test['times of the day'] = pd.cut(train['hour'], bins= bins, labels= labels)
test['times of the day'] = test['times of the day'].str.lower()
```

In [96]:

```
#Feature that categorizes hot/cold/mild temps from temp

bins = [-np.inf, 20, 30, np.inf]
labels = ['cold', 'mild', 'hot']
test['temp of the day'] = pd.cut(test['temp'], bins= bins, labels= labels)
test['temp of the day'].value_counts()
```

Out[96]:

```
cold    3021
mild    2601
hot      871
Name: temp of the day, dtype: int64
```

In [97]:

```
#Feature that categories Calm, Moderate, Strong.
bins = [-np.inf, 20, 38, np.inf]
labels = ['calm', 'moderate', 'strong']
test['windspeed of the day'] = pd.cut(test['windspeed'], bins= bins, labels= labels)
test['windspeed of the day'].value_counts()
```

Out[97]:

```
calm        5585
moderate     868
strong        40
Name: windspeed of the day, dtype: int64
```

In [98]:

```
test.head(20)
```

Out[98]:

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	dayofweek
0	2011-01-20 00:00:00	1	0	1	1	10.66	11.365	56	26.0027	3
1	2011-01-20 01:00:00	1	0	1	1	10.66	13.635	56	0.0000	3
2	2011-01-20 02:00:00	1	0	1	1	10.66	13.635	56	0.0000	3
3	2011-01-20 03:00:00	1	0	1	1	10.66	12.880	56	11.0014	3
4	2011-01-20 04:00:00	1	0	1	1	10.66	12.880	56	11.0014	3
5	2011-01-20 05:00:00	1	0	1	1	9.84	11.365	60	15.0013	3
6	2011-01-20 06:00:00	1	0	1	1	9.02	10.605	60	15.0013	3

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	dayofweek
7	2011-01-20 07:00:00	1	0	1	1	9.02	10.605	55	15.0013	3
8	2011-01-20 08:00:00	1	0	1	1	9.02	10.605	55	19.0012	3
9	2011-01-20 09:00:00	1	0	1	2	9.84	11.365	52	15.0013	3
10	2011-01-20 10:00:00	1	0	1	1	10.66	11.365	48	19.9995	3
11	2011-01-20 11:00:00	1	0	1	2	11.48	13.635	45	11.0014	3
12	2011-01-20 12:00:00	1	0	1	2	12.30	16.665	42	0.0000	3
13	2011-01-20 13:00:00	1	0	1	2	11.48	14.395	45	7.0015	3
14	2011-01-20 14:00:00	1	0	1	2	12.30	15.150	45	8.9981	3
15	2011-01-20 15:00:00	1	0	1	2	13.12	15.910	45	12.9980	3
16	2011-01-20 16:00:00	1	0	1	2	12.30	15.150	49	8.9981	3
17	2011-01-20 17:00:00	1	0	1	2	12.30	15.910	49	7.0015	3
18	2011-01-20 18:00:00	1	0	1	2	10.66	12.880	56	12.9980	3
19	2011-01-20 19:00:00	1	0	1	1	10.66	11.365	56	22.0028	3

Make category types for these so models know they are not just numbers

- AutoGluon originally sees these as ints, but in reality they are int representations of a category.
- Setting the dtype to category will classify these as categories in AutoGluon.

In [99]:

```
train.columns
```

Out[99]:

```
Index(['datetime', 'season', 'holiday', 'workingday', 'weather', 'temp',
       'atemp', 'humidity', 'windspeed', 'count', 'dayofweek', 'hour', 'day',
       'month', 'year', 'times of the day', 'temp of the day',
       'windspeed of the day'],
      dtype='object')
```

In [66]:

```
train["season"] =train["season"].astype("category")
train["weather"] = train["weather"].astype("category")
train["times of the day"] = train["times of the day"].astype("category")
train["temp of the day"] = train["temp of the day"].astype("category")
train["windspeed of the day"] = train["windspeed of the day"].astype("category")
test["season"] = test["season"].astype("category")
test["weather"] = test["weather"].astype("category")
test["times of the day"] = test["times of the day"].astype("category")
test["temp of the day"] = test["temp of the day"].astype("category")
test["windspeed of the day"] = test["windspeed of the day"].astype("category")
```

In [68]:

```
# View are new feature
pd.set_option('display.max_columns', 500)
train.head()
```

Out[68]:

	datetime	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	count	dayof
0	2011-01-01 00:00:00	1	0	0	1	9.84	14.395	81	0.0	16	
1	2011-01-01 01:00:00	1	0	0	1	9.02	13.635	80	0.0	40	
2	2011-01-01 02:00:00	1	0	0	1	9.02	13.635	80	0.0	32	
3	2011-01-01 03:00:00	1	0	0	1	9.84	14.395	75	0.0	13	
4	2011-01-01 04:00:00	1	0	0	1	9.84	14.395	75	0.0	1	

In [69]:

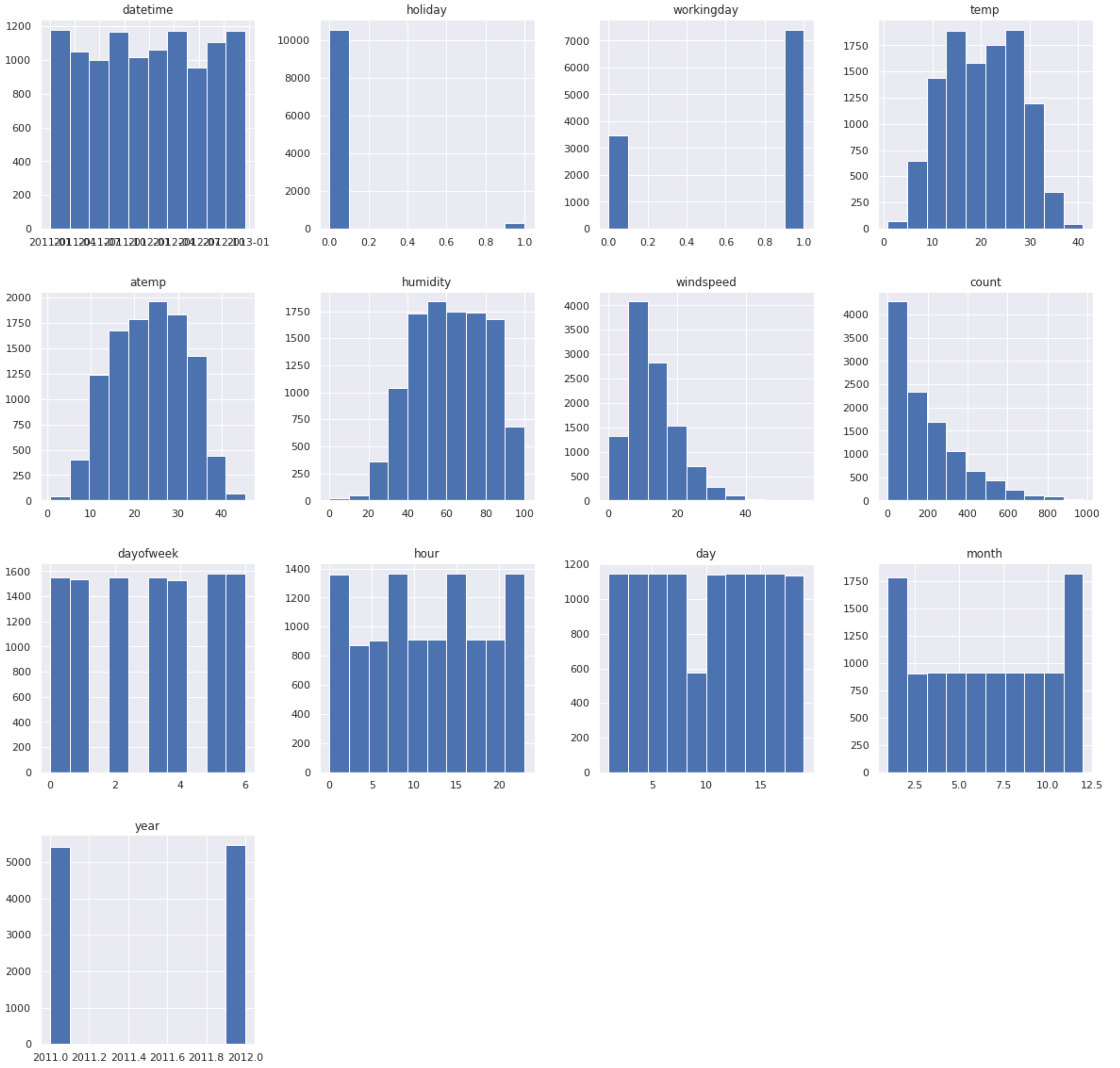
```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10886 entries, 0 to 10885
```

```
Data columns (total 18 columns):
 #   Column               Non-Null Count  Dtype         
---  ------               --------------  -----         
 0   datetime             10886 non-null  datetime64[ns]
 1   season               10886 non-null  category      
 2   holiday              10886 non-null  int64         
 3   workingday           10886 non-null  int64         
 4   weather              10886 non-null  category      
 5   temp                 10886 non-null  float64       
 6   atemp                10886 non-null  float64       
 7   humidity             10886 non-null  int64         
 8   windspeed            10886 non-null  float64       
 9   count                10886 non-null  int64         
 10  dayofweek            10886 non-null  int64         
 11  hour                 10886 non-null  int64         
 12  day                  10886 non-null  int64         
 13  month                10886 non-null  int64         
 14  year                 10886 non-null  int64         
 15  times of the day     10886 non-null  category      
 16  temp of the day      10886 non-null  category      
 17  windspeed of the day  10886 non-null  category      
dtypes: category(5), datetime64[ns](1), float64(3), int64(9)
memory usage: 1.1 MB
```

In [70]:

```
# View histogram of all features again now with the hour feature
train.hist(figsize= (20, 20))
plt.show()
```



In [71]:

```
train['weather'] = train['weather'].map({1: 'clear',2:  'few clouds', 3: 'partly cloudy
train['season'] = train['season'].map({1 : 'spring', 2 : 'summer', 3 : 'fall', 4 : 'win
test['weather'] = test['weather'].map({1: 'clear',2:  'few clouds', 3: 'partly cloudy',
test['season'] = test['season'].map({1 : 'spring', 2 : 'summer', 3 : 'fall', 4 : 'winte
```

In [72]:

```
train = pd.get_dummies(train, drop_first=True)
test = pd.get_dummies(test, drop_first=True)
```

In [73]:

```
train.head()
```

Out[73]:

	datetime	holiday	workingday	temp	atemp	humidity	windspeed	count	dayofweek	hour	day
0	2011-01-01 00:00:00	0	0	9.84	14.395	81	0.0	16	5	0	1

	datetime	holiday	workingday	temp	atemp	humidity	windspeed	count	dayofweek	hour	day
1	2011-01-01 01:00:00	0	0	9.02	13.635	80	0.0	40	5	1	1
2	2011-01-01 02:00:00	0	0	9.02	13.635	80	0.0	32	5	2	1
3	2011-01-01 03:00:00	0	0	9.84	14.395	75	0.0	13	5	3	1
4	2011-01-01 04:00:00	0	0	9.84	14.395	75	0.0	1	5	4	1

In [74]:

```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10886 entries, 0 to 10885
Data columns (total 27 columns):
 #   Column                        Non-Null Count  Dtype         
---  ------                        --------------  -----         
 0   datetime                      10886 non-null  datetime64[ns]
 1   holiday                       10886 non-null  int64         
 2   workingday                    10886 non-null  int64         
 3   temp                          10886 non-null  float64       
 4   atemp                         10886 non-null  float64       
 5   humidity                      10886 non-null  int64         
 6   windspeed                     10886 non-null  float64       
 7   count                         10886 non-null  int64         
 8   dayofweek                     10886 non-null  int64         
 9   hour                          10886 non-null  int64         
 10  day                           10886 non-null  int64         
 11  month                         10886 non-null  int64         
 12  year                          10886 non-null  int64         
 13  season_summer                 10886 non-null  uint8         
 14  season_fall                   10886 non-null  uint8         
 15  season_winter                 10886 non-null  uint8         
 16  weather_few clouds            10886 non-null  uint8         
 17  weather_partly cloudy         10886 non-null  uint8         
 18  weather_cloudy                10886 non-null  uint8         
 19  times of the day_evening      10886 non-null  uint8         
 20  times of the day_midday       10886 non-null  uint8         
 21  times of the day_midnight     10886 non-null  uint8         
 22  times of the day_morning      10886 non-null  uint8         
 23  temp of the day_mild          10886 non-null  uint8         
 24  temp of the day_hot           10886 non-null  uint8         
 25  windspeed of the day_moderate  10886 non-null  uint8         
 26  windspeed of the day_strong   10886 non-null  uint8         
dtypes: datetime64[ns](1), float64(3), int64(9), uint8(14)
memory usage: 1.2 MB
```

Step 5: Rerun the model with the same settings as before, just with more features

In [75]:

```
predictor_new_features = TabularPredictor(label = 'count',eval_metric = "root_mean_squa
```

```
No path specified. Models will be saved in: "AutogluonModels/ag-20221025_191659/"
Presets specified: ['best_quality']
Stack configuration (auto_stack=True): num_stack_levels=1, num_bag_folds=8, num_bag_sets
=20
Beginning AutoGluon training ... Time limit = 600s
AutoGluon will save models to "AutogluonModels/ag-20221025_191659/"
AutoGluon Version:  0.5.2
Python Version:     3.7.10
Operating System:   Linux
Train Data Rows:    10886
Train Data Columns: 26
Label Column: count
Preprocessing data ...
Using Feature Generators to preprocess the data ...
Fitting AutoMLPipelineFeatureGenerator...
        Available Memory:                    2204.01 MB
        Train Data (Original)  Memory Usage: 1.2 MB (0.1% of available memory)
        Inferring data type of each feature based on column values. Set feature_metadata
_in to manually specify special dtypes of the features.
        Stage 1 Generators:
                Fitting AsTypeFeatureGenerator...
                        Note: Converting 17 features to boolean dtype as they only conta
in 2 unique values.
        Stage 2 Generators:
                Fitting FillNaFeatureGenerator...
        Stage 3 Generators:
                Fitting IdentityFeatureGenerator...
                Fitting DatetimeFeatureGenerator...
        Stage 4 Generators:
                Fitting DropUniqueFeatureGenerator...
        Types of features in original data (raw dtype, special dtypes):
                ('datetime', []) :  1 | ['datetime']
                ('float', [])    :  3 | ['temp', 'atemp', 'windspeed']
                ('int', [])      : 22 | ['holiday', 'workingday', 'humidity', 'dayofwee
k', 'hour', ...]
        Types of features in processed data (raw dtype, special dtypes):
                ('float', [])                :  3 | ['temp', 'atemp', 'windspeed']
                ('int', [])                  :  5 | ['humidity', 'dayofweek', 'hour', 'd
ay', 'month']
                ('int', ['bool'])            : 17 | ['holiday', 'workingday', 'year', 's
eason_summer', 'season_fall', ...]
                ('int', ['datetime_as_int']) :  5 | ['datetime', 'datetime.year', 'datet
ime.month', 'datetime.day', 'datetime.dayofweek']
        0.3s = Fit runtime
        26 features in original data used to generate 30 features in processed data.
        Train Data (Processed) Memory Usage: 1.32 MB (0.1% of available memory)
Data preprocessing and feature engineering runtime = 0.38s ...
AutoGluon will gauge predictive performance using evaluation metric: 'root_mean_squared_
error'
        This metric's sign has been flipped to adhere to being higher_is_better. The met
ric score can be multiplied by -1 to get the metric value.
        To change this, specify the eval_metric parameter of Predictor()
AutoGluon will fit 2 stack levels (L1 to L2) ...
```

```
Fitting 11 L1 models ...
Fitting model: KNeighborsUnif_BAG_L1 ... Training model for up to 399.65s of the 599.62s
of remaining time.
        -101.5462        = Validation score   (-root_mean_squared_error)
        0.04s    = Training   runtime
        0.1s     = Validation runtime
Fitting model: KNeighborsDist_BAG_L1 ... Training model for up to 399.25s of the 599.22s
of remaining time.
        -84.1251         = Validation score   (-root_mean_squared_error)
        0.04s    = Training   runtime
        0.1s     = Validation runtime
Fitting model: LightGBMXT_BAG_L1 ... Training model for up to 398.86s of the 598.83s of
remaining time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -35.6713         = Validation score   (-root_mean_squared_error)
        65.02s   = Training   runtime
        5.03s    = Validation runtime
Fitting model: LightGBM_BAG_L1 ... Training model for up to 328.35s of the 528.32s of re
maining time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -33.8236         = Validation score   (-root_mean_squared_error)
        48.0s    = Training   runtime
        3.33s    = Validation runtime
Fitting model: RandomForestMSE_BAG_L1 ... Training model for up to 276.79s of the 476.76
s of remaining time.
        -38.5765         = Validation score   (-root_mean_squared_error)
        16.66s   = Training   runtime
        0.58s    = Validation runtime
Fitting model: CatBoost_BAG_L1 ... Training model for up to 257.07s of the 457.04s of re
maining time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -33.4308         = Validation score   (-root_mean_squared_error)
        215.53s  = Training   runtime
        0.14s    = Validation runtime
Fitting model: ExtraTreesMSE_BAG_L1 ... Training model for up to 38.62s of the 238.59s o
f remaining time.
        -38.3976         = Validation score   (-root_mean_squared_error)
        9.15s    = Training   runtime
        0.6s     = Validation runtime
Fitting model: NeuralNetFastAI_BAG_L1 ... Training model for up to 26.38s of the 226.35s
of remaining time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -76.8771         = Validation score   (-root_mean_squared_error)
        43.84s   = Training   runtime
        0.6s     = Validation runtime
Completed 1/20 k-fold bagging repeats ...
Fitting model: WeightedEnsemble_L2 ... Training model for up to 360.0s of the 179.51s of
remaining time.
        -32.2596         = Validation score   (-root_mean_squared_error)
        0.8s     = Training   runtime
        0.0s     = Validation runtime
Fitting 9 L2 models ...
Fitting model: LightGBMXT_BAG_L2 ... Training model for up to 178.61s of the 178.58s of
remaining time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
```

```
        -31.5987         = Validation score   (-root_mean_squared_error)
        26.73s   = Training   runtime
        0.56s    = Validation runtime
Fitting model: LightGBM_BAG_L2 ... Training model for up to 148.6s of the 148.58s of rem
aining time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -30.6887         = Validation score   (-root_mean_squared_error)
        25.11s   = Training   runtime
        0.28s    = Validation runtime
Fitting model: RandomForestMSE_BAG_L2 ... Training model for up to 120.27s of the 120.24
s of remaining time.
        -31.7191         = Validation score   (-root_mean_squared_error)
        36.03s   = Training   runtime
        0.66s    = Validation runtime
Fitting model: CatBoost_BAG_L2 ... Training model for up to 81.11s of the 81.08s of rema
ining time.
        Fitting 8 child models (S1F1 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -30.6542         = Validation score   (-root_mean_squared_error)
        72.63s   = Training   runtime
        0.09s    = Validation runtime
Fitting model: ExtraTreesMSE_BAG_L2 ... Training model for up to 5.5s of the 5.47s of re
maining time.
        -31.8265         = Validation score   (-root_mean_squared_error)
        13.91s   = Training   runtime
        0.67s    = Validation runtime
Completed 1/20 k-fold bagging repeats ...
Fitting model: WeightedEnsemble_L3 ... Training model for up to 360.0s of the -11.64s of
remaining time.
        -30.3202         = Validation score   (-root_mean_squared_error)
        0.44s    = Training   runtime
        0.0s     = Validation runtime
AutoGluon training complete, total runtime = 612.3s ... Best model: "WeightedEnsemble_L
3"
TabularPredictor saved. To load, use: predictor = TabularPredictor.load("AutogluonModel
s/ag-20221025_191659/")
```

In [76]:

```
predictor_new_features.fit_summary()
```

```
*** Summary of fit() ***
Estimated performance of each model:
                     model   score_val  pred_time_val    fit_time  pred_time_val_margina
l  fit_time_marginal  stack_level  can_infer  fit_order
0      WeightedEnsemble_L3  -30.320217      12.069630  559.226547                0.00092
4           0.442229            3       True         15
1          CatBoost_BAG_L2  -30.654188      10.567431  470.907141                0.08713
0          72.632449            2       True         13
2          LightGBM_BAG_L2  -30.688749      10.760023  423.384867                0.27972
2          25.110175            2       True         11
3        LightGBMXT_BAG_L2  -31.598705      11.040810  425.006845                0.56050
9          26.732152            2       True         10
4   RandomForestMSE_BAG_L2  -31.719050      11.141345  434.309542                0.66104
4          36.034850            2       True         12
5     ExtraTreesMSE_BAG_L2  -31.826471      11.147712  412.189656                0.66741
2          13.914964            2       True         14
6      WeightedEnsemble_L2  -32.259563       9.182379  346.049384                0.00136
6           0.802566            2       True          9
7          CatBoost_BAG_L1  -33.430821       0.135050  215.530286                0.13505
```

```
0        215.530286           1       True          6
8          LightGBM_BAG_L1  -33.823642       3.333457   48.002054                3.33345
7          48.002054           1       True          4
9        LightGBMXT_BAG_L1  -35.671317       5.031229   65.015355                5.03122
9          65.015355           1       True          3
10    ExtraTreesMSE_BAG_L1  -38.397642       0.595315    9.149802                0.59531
5           9.149802           1       True          7
11  RandomForestMSE_BAG_L1  -38.576526       0.577486   16.662720                0.57748
6          16.662720           1       True          5
12  NeuralNetFastAI_BAG_L1  -76.877093       0.601048   43.838271                0.60104
8          43.838271           1       True          8
13   KNeighborsDist_BAG_L1  -84.125061       0.103791    0.036403                0.10379
1           0.036403           1       True          2
14   KNeighborsUnif_BAG_L1 -101.546199       0.102925    0.039801                0.10292
5           0.039801           1       True          1
Number of models trained: 15
Types of models trained:
{'StackerEnsembleModel_LGB', 'StackerEnsembleModel_NNFastAiTabular', 'WeightedEnsembleMo
del', 'StackerEnsembleModel_RF', 'StackerEnsembleModel_CatBoost', 'StackerEnsembleModel_
KNN', 'StackerEnsembleModel_XT'}
Bagging used: True  (with 8 folds)
Multi-layer stack-ensembling used: True  (with 3 levels)
Feature Metadata (Processed):
(raw dtype, special dtypes):
('float', [])               :  3 | ['temp', 'atemp', 'windspeed']
('int', [])                 :  5 | ['humidity', 'dayofweek', 'hour', 'day', 'month']
('int', ['bool'])           : 17 | ['holiday', 'workingday', 'year', 'season_summer',
'season_fall', ...]
('int', ['datetime_as_int']) :  5 | ['datetime', 'datetime.year', 'datetime.month', 'dat
etime.day', 'datetime.dayofweek']
Plot summary of models saved to file: AutogluonModels/ag-20221025_191659/SummaryOfModel
s.html
*** End of fit() summary ***
```

Out[76]:

```
{'model_types': {'KNeighborsUnif_BAG_L1': 'StackerEnsembleModel_KNN',
  'KNeighborsDist_BAG_L1': 'StackerEnsembleModel_KNN',
  'LightGBMXT_BAG_L1': 'StackerEnsembleModel_LGB',
  'LightGBM_BAG_L1': 'StackerEnsembleModel_LGB',
  'RandomForestMSE_BAG_L1': 'StackerEnsembleModel_RF',
  'CatBoost_BAG_L1': 'StackerEnsembleModel_CatBoost',
  'ExtraTreesMSE_BAG_L1': 'StackerEnsembleModel_XT',
  'NeuralNetFastAI_BAG_L1': 'StackerEnsembleModel_NNFastAiTabular',
  'WeightedEnsemble_L2': 'WeightedEnsembleModel',
  'LightGBMXT_BAG_L2': 'StackerEnsembleModel_LGB',
  'LightGBM_BAG_L2': 'StackerEnsembleModel_LGB',
  'RandomForestMSE_BAG_L2': 'StackerEnsembleModel_RF',
  'CatBoost_BAG_L2': 'StackerEnsembleModel_CatBoost',
  'ExtraTreesMSE_BAG_L2': 'StackerEnsembleModel_XT',
  'WeightedEnsemble_L3': 'WeightedEnsembleModel'},
 'model_performance': {'KNeighborsUnif_BAG_L1': -101.54619908446061,
  'KNeighborsDist_BAG_L1': -84.12506123181602,
  'LightGBMXT_BAG_L1': -35.6713173907652,
  'LightGBM_BAG_L1': -33.82364178358865,
  'RandomForestMSE_BAG_L1': -38.57652602897791,
  'CatBoost_BAG_L1': -33.430821043536625,
  'ExtraTreesMSE_BAG_L1': -38.39764183521017,
  'NeuralNetFastAI_BAG_L1': -76.87709282160169,
  'WeightedEnsemble_L2': -32.259563231741424,
  'LightGBMXT_BAG_L2': -31.59870488116331,
  'LightGBM_BAG_L2': -30.688749261328784,
  'RandomForestMSE_BAG_L2': -31.71905024369919,
  'CatBoost_BAG_L2': -30.654188304873,
  'ExtraTreesMSE_BAG_L2': -31.826470555872838,
  'WeightedEnsemble_L3': -30.320217137224716},
 'model_best': 'WeightedEnsemble_L3',
 'model_paths': {'KNeighborsUnif_BAG_L1': 'AutogluonModels/ag-20221025_191659/models/KNe
ighborsUnif_BAG_L1/',
  'KNeighborsDist_BAG_L1': 'AutogluonModels/ag-20221025_191659/models/KNeighborsDist_BAG
_L1/',
  'LightGBMXT_BAG_L1': 'AutogluonModels/ag-20221025_191659/models/LightGBMXT_BAG_L1/',
  'LightGBM_BAG_L1': 'AutogluonModels/ag-20221025_191659/models/LightGBM_BAG_L1/',
  'RandomForestMSE_BAG_L1': 'AutogluonModels/ag-20221025_191659/models/RandomForestMSE_B
AG_L1/',
  'CatBoost_BAG_L1': 'AutogluonModels/ag-20221025_191659/models/CatBoost_BAG_L1/',
  'ExtraTreesMSE_BAG_L1': 'AutogluonModels/ag-20221025_191659/models/ExtraTreesMSE_BAG_L
1/',
  'NeuralNetFastAI_BAG_L1': 'AutogluonModels/ag-20221025_191659/models/NeuralNetFastAI_B
AG_L1/',
  'WeightedEnsemble_L2': 'AutogluonModels/ag-20221025_191659/models/WeightedEnsemble_L
2/',
  'LightGBMXT_BAG_L2': 'AutogluonModels/ag-20221025_191659/models/LightGBMXT_BAG_L2/',
  'LightGBM_BAG_L2': 'AutogluonModels/ag-20221025_191659/models/LightGBM_BAG_L2/',
  'RandomForestMSE_BAG_L2': 'AutogluonModels/ag-20221025_191659/models/RandomForestMSE_B
AG_L2/',
  'CatBoost_BAG_L2': 'AutogluonModels/ag-20221025_191659/models/CatBoost_BAG_L2/',
  'ExtraTreesMSE_BAG_L2': 'AutogluonModels/ag-20221025_191659/models/ExtraTreesMSE_BAG_L
2/',
  'WeightedEnsemble_L3': 'AutogluonModels/ag-20221025_191659/models/WeightedEnsemble_L
3/'},
 'model_fit_times': {'KNeighborsUnif_BAG_L1': 0.03980088233947754,
  'KNeighborsDist_BAG_L1': 0.03640294075012207,
  'LightGBMXT_BAG_L1': 65.01535511016846,
  'LightGBM_BAG_L1': 48.00205421447754,
  'RandomForestMSE_BAG_L1': 16.66271996498108,
  'CatBoost_BAG_L1': 215.53028559684753,
  'ExtraTreesMSE_BAG_L1': 9.149802207946777,
  'NeuralNetFastAI_BAG_L1': 43.838271141052246,
  'WeightedEnsemble_L2': 0.8025660514831543,
  'LightGBMXT_BAG_L2': 26.732152462005615,
  'LightGBM_BAG_L2': 25.110174655914307,
  'RandomForestMSE_BAG_L2': 36.03485035896301,
  'CatBoost_BAG_L2': 72.63244867324829,
  'ExtraTreesMSE_BAG_L2': 13.914963960647583,
  'WeightedEnsemble_L3': 0.4422290325164795},
 'model_pred_times': {'KNeighborsUnif_BAG_L1': 0.10292506217956543,
  'KNeighborsDist_BAG_L1': 0.1037912368774414,
  'LightGBMXT_BAG_L1': 5.031228542327881,
  'LightGBM_BAG_L1': 3.3334567546844482,
  'RandomForestMSE_BAG_L1': 0.5774857997894287,
  'CatBoost_BAG_L1': 0.13505029678344727,
  'ExtraTreesMSE_BAG_L1': 0.5953152179718018,
  'NeuralNetFastAI_BAG_L1': 0.6010477542877197,
  'WeightedEnsemble_L2': 0.0013663768768310547,
  'LightGBMXT_BAG_L2': 0.560509443283081,
  'LightGBM_BAG_L2': 0.2797219753265381,
  'RandomForestMSE_BAG_L2': 0.6610438823699951,
  'CatBoost_BAG_L2': 0.08713030815124512,
  'ExtraTreesMSE_BAG_L2': 0.6674115657806396,
  'WeightedEnsemble_L3': 0.0009236335754394531},
 'num_bag_folds': 8,
 'max_stack_level': 3,
 'model_hyperparams': {'KNeighborsUnif_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True,
   'use_child_oof': True},
  'KNeighborsDist_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True,
   'use_child_oof': True},
  'LightGBMXT_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'LightGBM_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'RandomForestMSE_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True,
   'use_child_oof': True},
  'CatBoost_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'ExtraTreesMSE_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True,
   'use_child_oof': True},
  'NeuralNetFastAI_BAG_L1': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'WeightedEnsemble_L2': {'use_orig_features': False,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'LightGBMXT_BAG_L2': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'LightGBM_BAG_L2': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'RandomForestMSE_BAG_L2': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True,
   'use_child_oof': True},
  'CatBoost_BAG_L2': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True},
  'ExtraTreesMSE_BAG_L2': {'use_orig_features': True,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True,
   'use_child_oof': True},
  'WeightedEnsemble_L3': {'use_orig_features': False,
   'max_base_models': 25,
   'max_base_models_per_type': 5,
   'save_bag_folds': True}},
 'leaderboard':                      model   score_val  pred_time_val    fit_time  \
 0      WeightedEnsemble_L3  -30.320217      12.069630  559.226547
 1          CatBoost_BAG_L2  -30.654188      10.567431  470.907141
 2          LightGBM_BAG_L2  -30.688749      10.760023  423.384867
 3        LightGBMXT_BAG_L2  -31.598705      11.040810  425.006845
 4    RandomForestMSE_BAG_L2  -31.719050     11.141345  434.309542
 5      ExtraTreesMSE_BAG_L2  -31.826471     11.147712  412.189656
 6      WeightedEnsemble_L2  -32.259563       9.182379  346.049384
 7          CatBoost_BAG_L1  -33.430821       0.135050  215.530286
 8          LightGBM_BAG_L1  -33.823642       3.333457   48.002054
 9        LightGBMXT_BAG_L1  -35.671317       5.031229   65.015355
 10     ExtraTreesMSE_BAG_L1  -38.397642      0.595315    9.149802
 11  RandomForestMSE_BAG_L1  -38.576526       0.577486   16.662720
 12  NeuralNetFastAI_BAG_L1  -76.877093       0.601048   43.838271
 13    KNeighborsDist_BAG_L1  -84.125061      0.103791    0.036403
 14    KNeighborsUnif_BAG_L1 -101.546199      0.102925    0.039801

     pred_time_val_marginal  fit_time_marginal  stack_level  can_infer  \
 0                 0.000924           0.442229            3       True
 1                 0.087130          72.632449            2       True
 2                 0.279722          25.110175            2       True
 3                 0.560509          26.732152            2       True
 4                 0.661044          36.034850            2       True
 5                 0.667412          13.914964            2       True
 6                 0.001366           0.802566            2       True
 7                 0.135050         215.530286            1       True
 8                 3.333457          48.002054            1       True
 9                 5.031229          65.015355            1       True
 10                0.595315           9.149802            1       True
 11                0.577486          16.662720            1       True
 12                0.601048          43.838271            1       True
 13                0.103791           0.036403            1       True
 14                0.102925           0.039801            1       True

     fit_order
 0          15
 1          13
 2          11
 3          10
 4          12
 5          14
 6           9
 7           6
 8           4
 9           3
 10          7
 11          5
 12          8
 13          2
 14          1  }
```

In [78]:

```
predictor_1 = predictor_new_features.predict(test)
predictor_1.head()
```

Out[78]:
```
0    17.402582
1    11.101305
2    10.093266
3     9.202630
4     8.157600
Name: count, dtype: float32
```

In [ ]:
```
# Remember to set all negative values to zero
predictor_1[predictor_1 < 0] = 0
```

In [ ]:
```
submission_new_features =  pd.read_csv("sampleSubmission.csv")
```

In [ ]:
```
submission_new_features.head()
```

Out[ ]:

	datetime	count
0	2011-01-20 00:00:00	0
1	2011-01-20 01:00:00	0
2	2011-01-20 02:00:00	0
3	2011-01-20 03:00:00	0
4	2011-01-20 04:00:00	0

In [ ]:
```
# Same submitting predictions
submission_new_features["count"] = predictor_1
submission_new_features.to_csv("submission_new_features.csv", index=False)
```

In [ ]:
```
submission_new_features.head()
```

Out[ ]:

	datetime	count
0	2011-01-20 00:00:00	17.402582
1	2011-01-20 01:00:00	11.101305
2	2011-01-20 02:00:00	10.093266
3	2011-01-20 03:00:00	9.202630
4	2011-01-20 04:00:00	8.157600

In [ ]:
```
!kaggle competitions submit -c bike-sharing-demand -f submission_new_features.csv -m "n
```

```
100%|████████████████████| 188k/188k [00:00<00:00, 514kB/s]
Successfully submitted to Bike Sharing Demand
```

In [ ]:
```
!kaggle competitions submissions -c bike-sharing-demand | tail -n +1 | head -n 6
```

```
fileName                       date                 description                            sta
tus    publicScore  privateScore
```

```
---------------------------  -------------------  ---------------------------------  ---
-----  -----------  ------------
submission_new_features.csv  2022-10-25 19:30:36  new features                       com
plete  0.78599      0.78599
submission.csv               2022-10-25 18:51:57  first raw submission               com
plete  1.80679      1.80679
submission_new_hpo.csv       2022-10-25 16:52:35  new features with hyperparameters  com
plete  0.51909      0.51909
submission_new_features.csv  2022-10-25 15:52:18  new features                       com
plete  0.84208      0.84208
```

New Score of ?

Step 6: Hyper parameter optimization

- There are many options for hyper parameter optimization.
- Options are to change the AutoGluon higher level parameters or the individual model hyperparameters.
- The hyperparameters of the models themselves that are in AutoGluon. Those need the `hyperparameter` and `hyperparameter_tune_kwargs` arguments.

In [137…

```
import autogluon.core as ag
from autogluon.core.space import Categorical, Int, Real

num_trials  = 10
search_strategy = 'auto'

nn_options = {
    'num_epochs': 50,
    'learning_rate': ag.space.Real(1e-4, 1e-2, default=5e-4, log=True),
    'activation': ag.space.Categorical('relu', 'softrelu', 'tanh'),
    'dropout_prob': ag.space.Real(0.0, 0.5, default=0.1),
}

gbm_options = {
    'num_boost_round': 100,
    'num_leaves': ag.space.Int(lower=26, upper=66, default=36),
}




hyperparameters = {
                   'GBM': gbm_options,
                   'NN_TORCH': nn_options,

}


hyperparameter_tune_kwargs = { 'scheduler' : 'local',

    'searcher': search_strategy,
}
```

In [138…

```
predictor_new_hpo = TabularPredictor(label = 'count',eval_metric = "root_mean_squared_e
No path specified. Models will be saved in: "AutogluonModels/ag-20221025_194721/"
Presets specified: ['best_quality']
Warning: hyperparameter tuning is currently experimental and may cause the process to ha
ng.
Stack configuration (auto_stack=True): num_stack_levels=1, num_bag_folds=8, num_bag_sets
=20
Beginning AutoGluon training ... Time limit = 600s
AutoGluon will save models to "AutogluonModels/ag-20221025_194721/"
AutoGluon Version:  0.5.2
Python Version:     3.7.10
Operating System:   Linux
Train Data Rows:    10886
Train Data Columns: 26
Label Column: count
Preprocessing data ...
Using Feature Generators to preprocess the data ...
Fitting AutoMLPipelineFeatureGenerator...
        Available Memory:                    2205.48 MB
        Train Data (Original)  Memory Usage: 1.2 MB (0.1% of available memory)
        Inferring data type of each feature based on column values. Set feature_metadata
_in to manually specify special dtypes of the features.
        Stage 1 Generators:
                Fitting AsTypeFeatureGenerator...
                        Note: Converting 17 features to boolean dtype as they only conta
in 2 unique values.
        Stage 2 Generators:
                Fitting FillNaFeatureGenerator...
        Stage 3 Generators:
                Fitting IdentityFeatureGenerator...
                Fitting DatetimeFeatureGenerator...
        Stage 4 Generators:
                Fitting DropUniqueFeatureGenerator...
        Types of features in original data (raw dtype, special dtypes):
                ('datetime', []) :  1 | ['datetime']
                ('float', [])    :  3 | ['temp', 'atemp', 'windspeed']
                ('int', [])      : 22 | ['holiday', 'workingday', 'humidity', 'dayofwee
k', 'hour', ...]
        Types of features in processed data (raw dtype, special dtypes):
                ('float', [])                 :  3 | ['temp', 'atemp', 'windspeed']
                ('int', [])                   :  5 | ['humidity', 'dayofweek', 'hour', 'd
ay', 'month']
                ('int', ['bool'])             : 17 | ['holiday', 'workingday', 'year', 's
eason_summer', 'season_fall', ...]
                ('int', ['datetime_as_int']) :  5 | ['datetime', 'datetime.year', 'datet
ime.month', 'datetime.day', 'datetime.dayofweek']
        0.2s = Fit runtime
        26 features in original data used to generate 30 features in processed data.
        Train Data (Processed) Memory Usage: 1.32 MB (0.1% of available memory)
Data preprocessing and feature engineering runtime = 0.24s ...
AutoGluon will gauge predictive performance using evaluation metric: 'root_mean_squared_
error'
        This metric's sign has been flipped to adhere to being higher_is_better. The met
ric score can be multiplied by -1 to get the metric value.
        To change this, specify the eval_metric parameter of Predictor()
AutoGluon will fit 2 stack levels (L1 to L2) ...
Fitting 2 L1 models ...
Hyperparameter tuning model: LightGBM_BAG_L1 ... Tuning model for up to 22.49s of the 59
9.76s of remaining time.
        Stopping HPO to satisfy time limit...
```

```
Fitted model: LightGBM_BAG_L1/T1 ...
        -39.5336         = Validation score   (-root_mean_squared_error)
        0.4s     = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T2 ...
        -37.4208         = Validation score   (-root_mean_squared_error)
        0.37s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T3 ...
        -37.5748         = Validation score   (-root_mean_squared_error)
        0.45s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T4 ...
        -119.6744        = Validation score   (-root_mean_squared_error)
        0.36s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T5 ...
        -41.8718         = Validation score   (-root_mean_squared_error)
        0.41s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T6 ...
        -109.3032        = Validation score   (-root_mean_squared_error)
        0.44s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T7 ...
        -36.9386         = Validation score   (-root_mean_squared_error)
        0.35s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T8 ...
        -35.7561         = Validation score   (-root_mean_squared_error)
        0.43s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T9 ...
        -107.0444        = Validation score   (-root_mean_squared_error)
        0.36s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T10 ...
        -35.1671         = Validation score   (-root_mean_squared_error)
        0.37s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T11 ...
        -74.0444         = Validation score   (-root_mean_squared_error)
        0.43s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T12 ...
        -122.9626        = Validation score   (-root_mean_squared_error)
        0.37s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T13 ...
        -39.7222         = Validation score   (-root_mean_squared_error)
        0.37s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T14 ...
        -64.7804         = Validation score   (-root_mean_squared_error)
        0.37s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T15 ...
        -110.9282        = Validation score   (-root_mean_squared_error)
        0.46s    = Training   runtime
        0.01s    = Validation runtime
```

```
Fitted model: LightGBM_BAG_L1/T16 ...
        -91.727  = Validation score   (-root_mean_squared_error)
        0.36s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T17 ...
        -59.9896         = Validation score   (-root_mean_squared_error)
        0.43s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T18 ...
        -35.4015         = Validation score   (-root_mean_squared_error)
        0.36s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T19 ...
        -40.5293         = Validation score   (-root_mean_squared_error)
        0.41s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T20 ...
        -38.2612         = Validation score   (-root_mean_squared_error)
        0.4s     = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T21 ...
        -63.3289         = Validation score   (-root_mean_squared_error)
        0.46s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T22 ...
        -34.9728         = Validation score   (-root_mean_squared_error)
        0.43s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T23 ...
        -34.7979         = Validation score   (-root_mean_squared_error)
        0.37s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T24 ...
        -51.6029         = Validation score   (-root_mean_squared_error)
        0.39s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T25 ...
        -108.1451        = Validation score   (-root_mean_squared_error)
        0.37s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T26 ...
        -36.1957         = Validation score   (-root_mean_squared_error)
        0.36s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T27 ...
        -39.0647         = Validation score   (-root_mean_squared_error)
        0.43s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T28 ...
        -34.6904         = Validation score   (-root_mean_squared_error)
        0.38s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T29 ...
        -123.6912        = Validation score   (-root_mean_squared_error)
        0.41s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T30 ...
        -66.8498         = Validation score   (-root_mean_squared_error)
        0.47s    = Training   runtime
        0.01s    = Validation runtime
```

```
Fitted model: LightGBM_BAG_L1/T31 ...
        -103.0846        = Validation score   (-root_mean_squared_error)
        0.37s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T32 ...
        -67.9096         = Validation score   (-root_mean_squared_error)
        0.46s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T33 ...
        -57.9828         = Validation score   (-root_mean_squared_error)
        0.37s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T34 ...
        -33.8788         = Validation score   (-root_mean_squared_error)
        0.42s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T35 ...
        -37.325  = Validation score   (-root_mean_squared_error)
        0.4s     = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T36 ...
        -36.0906         = Validation score   (-root_mean_squared_error)
        0.45s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T37 ...
        -35.0006         = Validation score   (-root_mean_squared_error)
        0.38s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L1/T38 ...
        -53.807  = Validation score   (-root_mean_squared_error)
        0.4s     = Training   runtime
        0.01s    = Validation runtime
Hyperparameter tuning model: NeuralNetTorch_BAG_L1 ... Tuning model for up to 22.49s of
the 576.87s of remaining time.
2022-10-25 19:47:46,494 ERROR syncer.py:147 -- Log sync requires rsync to be installed.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
2022-10-25 19:48:04,491 INFO stopper.py:364 -- Reached timeout of 17.988396633215547 sec
onds. Stopping all trials.
Fitted model: NeuralNetTorch_BAG_L1/T1 ...
        -70.2039         = Validation score   (-root_mean_squared_error)
        12.75s   = Training   runtime
        0.04s    = Validation runtime
Fitted model: NeuralNetTorch_BAG_L1/T2 ...
        -57.5765         = Validation score   (-root_mean_squared_error)
        12.39s   = Training   runtime
        0.02s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T1 ... Training model for up to 356.43s of the 556.44s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -40.2053         = Validation score   (-root_mean_squared_error)
        15.93s   = Training   runtime
        0.13s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T2 ... Training model for up to 338.16s of the 538.18s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -38.7331         = Validation score   (-root_mean_squared_error)
        15.92s   = Training   runtime
        0.11s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T3 ... Training model for up to 319.57s of the 519.58s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -38.6493         = Validation score   (-root_mean_squared_error)
        16.06s   = Training   runtime
        0.13s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T4 ... Training model for up to 300.89s of the 500.9s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -120.5435        = Validation score   (-root_mean_squared_error)
        15.54s   = Training   runtime
        0.08s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T5 ... Training model for up to 282.46s of the 482.48s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -42.8305         = Validation score   (-root_mean_squared_error)
        16.08s   = Training   runtime
        0.11s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T6 ... Training model for up to 263.8s of the 463.82s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -109.7241        = Validation score   (-root_mean_squared_error)
        15.69s   = Training   runtime
        0.09s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T7 ... Training model for up to 245.69s of the 445.7s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -38.0605         = Validation score   (-root_mean_squared_error)
        16.42s   = Training   runtime
        0.11s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T8 ... Training model for up to 226.66s of the 426.68s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -36.6053         = Validation score   (-root_mean_squared_error)
        15.69s   = Training   runtime
        0.13s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T9 ... Training model for up to 208.43s of the 408.45s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -108.3192        = Validation score   (-root_mean_squared_error)
        15.1s    = Training   runtime
        0.08s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T10 ... Training model for up to 190.6s of the 390.61s of
remaining time.
```

```
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -36.2891         = Validation score   (-root_mean_squared_error)
        16.33s   = Training   runtime
        0.14s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T11 ... Training model for up to 171.66s of the 371.67s o
f remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -74.9174         = Validation score   (-root_mean_squared_error)
        16.08s   = Training   runtime
        0.1s     = Validation runtime
Fitting model: LightGBM_BAG_L1/T12 ... Training model for up to 153.15s of the 353.17s o
f remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -123.7461        = Validation score   (-root_mean_squared_error)
        15.67s   = Training   runtime
        0.08s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T13 ... Training model for up to 134.93s of the 334.95s o
f remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -41.0961         = Validation score   (-root_mean_squared_error)
        16.19s   = Training   runtime
        0.12s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T14 ... Training model for up to 116.06s of the 316.08s o
f remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -66.2488         = Validation score   (-root_mean_squared_error)
        15.47s   = Training   runtime
        0.09s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T15 ... Training model for up to 97.92s of the 297.94s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -111.1477        = Validation score   (-root_mean_squared_error)
        16.18s   = Training   runtime
        0.1s     = Validation runtime
Fitting model: LightGBM_BAG_L1/T16 ... Training model for up to 79.06s of the 279.08s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -93.0623         = Validation score   (-root_mean_squared_error)
        15.76s   = Training   runtime
        0.08s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T17 ... Training model for up to 60.66s of the 260.67s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -60.5335         = Validation score   (-root_mean_squared_error)
        15.63s   = Training   runtime
        0.11s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T18 ... Training model for up to 41.74s of the 241.75s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -37.0905         = Validation score   (-root_mean_squared_error)
        15.9s    = Training   runtime
        0.11s    = Validation runtime
Fitting model: LightGBM_BAG_L1/T19 ... Training model for up to 23.21s of the 223.22s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -41.0115         = Validation score   (-root_mean_squared_error)
        15.87s   = Training   runtime
        0.1s     = Validation runtime
Fitting model: LightGBM_BAG_L1/T20 ... Training model for up to 4.63s of the 204.65s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -39.4095         = Validation score   (-root_mean_squared_error)
        16.95s   = Training   runtime
        0.12s    = Validation runtime
Completed 1/20 k-fold bagging repeats ...
Fitting model: WeightedEnsemble_L2 ... Training model for up to 360.0s of the 184.76s of
remaining time.
        -35.6095         = Validation score   (-root_mean_squared_error)
        0.47s    = Training   runtime
        0.0s     = Validation runtime
Fitting 2 L2 models ...
Hyperparameter tuning model: LightGBM_BAG_L2 ... Tuning model for up to 10.36s of the 18
4.17s of remaining time.
        Stopping HPO to satisfy time limit...
Fitted model: LightGBM_BAG_L2/T1 ...
        -38.636  = Validation score   (-root_mean_squared_error)
        0.71s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L2/T2 ...
        -38.3145         = Validation score   (-root_mean_squared_error)
        0.6s     = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L2/T3 ...
        -38.3505         = Validation score   (-root_mean_squared_error)
        0.89s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L2/T4 ...
        -101.8381        = Validation score   (-root_mean_squared_error)
        0.67s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L2/T5 ...
        -38.5903         = Validation score   (-root_mean_squared_error)
        0.75s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L2/T6 ...
        -98.7234         = Validation score   (-root_mean_squared_error)
        0.84s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L2/T7 ...
        -38.0346         = Validation score   (-root_mean_squared_error)
        0.56s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L2/T8 ...
        -38.4349         = Validation score   (-root_mean_squared_error)
        0.84s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L2/T9 ...
        -89.149  = Validation score   (-root_mean_squared_error)
        0.66s    = Training   runtime
        0.01s    = Validation runtime
Fitted model: LightGBM_BAG_L2/T10 ...
        -38.585  = Validation score   (-root_mean_squared_error)
        0.66s    = Training   runtime
        0.0s     = Validation runtime
Hyperparameter tuning model: NeuralNetTorch_BAG_L2 ... Tuning model for up to 10.36s of
the 175.07s of remaining time.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
NaN or Inf found in input tensor.
2022-10-25 19:54:36,363 INFO stopper.py:364 -- Reached timeout of 8.28942954182625 secon
ds. Stopping all trials.
Fitted model: NeuralNetTorch_BAG_L2/T1 ...
        -47.9211         = Validation score   (-root_mean_squared_error)
        3.35s    = Training   runtime
        0.06s    = Validation runtime
Fitted model: NeuralNetTorch_BAG_L2/T2 ...
        -44.6948         = Validation score   (-root_mean_squared_error)
        3.0s     = Training   runtime
        0.04s    = Validation runtime
Fitting model: LightGBM_BAG_L2/T1 ... Training model for up to 164.56s of the 164.52s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -35.5407         = Validation score   (-root_mean_squared_error)
        17.88s   = Training   runtime
        0.09s    = Validation runtime
Fitting model: LightGBM_BAG_L2/T2 ... Training model for up to 144.51s of the 144.47s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -35.3995         = Validation score   (-root_mean_squared_error)
        18.12s   = Training   runtime
        0.1s     = Validation runtime
Fitting model: LightGBM_BAG_L2/T3 ... Training model for up to 123.85s of the 123.81s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -35.5108         = Validation score   (-root_mean_squared_error)
        19.14s   = Training   runtime
        0.12s    = Validation runtime
Fitting model: LightGBM_BAG_L2/T4 ... Training model for up to 102.52s of the 102.49s of
remaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -102.3511        = Validation score   (-root_mean_squared_error)
        17.63s   = Training   runtime
        0.1s     = Validation runtime
Fitting model: LightGBM_BAG_L2/T5 ... Training model for up to 82.55s of the 82.52s of r
emaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -35.8443         = Validation score   (-root_mean_squared_error)
        18.76s   = Training   runtime
        0.1s     = Validation runtime
Fitting model: LightGBM_BAG_L2/T6 ... Training model for up to 61.41s of the 61.37s of r
```

```
emaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -99.2444         = Validation score   (-root_mean_squared_error)
        19.24s   = Training   runtime
        0.11s    = Validation runtime
Fitting model: LightGBM_BAG_L2/T7 ... Training model for up to 40.06s of the 40.02s of r
emaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -35.429  = Validation score   (-root_mean_squared_error)
        17.16s   = Training   runtime
        0.09s    = Validation runtime
Fitting model: LightGBM_BAG_L2/T8 ... Training model for up to 20.51s of the 20.47s of r
emaining time.
        Fitting 7 child models (S1F2 - S1F8) | Fitting with ParallelLocalFoldFittingStra
tegy
        -35.4848         = Validation score   (-root_mean_squared_error)
        19.1s    = Training   runtime
        0.1s     = Validation runtime
Completed 1/20 k-fold bagging repeats ...
Fitting model: WeightedEnsemble_L3 ... Training model for up to 360.0s of the -1.21s of
remaining time.
        -35.1715         = Validation score   (-root_mean_squared_error)
        0.34s    = Training   runtime
        0.0s     = Validation runtime
AutoGluon training complete, total runtime = 601.76s ... Best model: "WeightedEnsemble_L
3"
TabularPredictor saved. To load, use: predictor = TabularPredictor.load("AutogluonModel
s/ag-20221025_194721/")
```

In [139…

```
predictor_new_hpo.fit_summary()
```

```
*** Summary of fit() ***
Estimated performance of each model:
                       model   score_val  pred_time_val    fit_time  pred_time_val_margi
nal  fit_time_marginal  stack_level  can_infer  fit_order
0        LightGBM_BAG_L1/T34  -33.878791       0.008692    0.424173                0.008
692          0.424173            1       True         34
1        LightGBM_BAG_L1/T28  -34.690409       0.008248    0.377011                0.008
248          0.377011            1       True         28
2        LightGBM_BAG_L1/T23  -34.797872       0.008775    0.373073                0.008
775          0.373073            1       True         23
3        LightGBM_BAG_L1/T22  -34.972811       0.009275    0.432362                0.009
275          0.432362            1       True         22
4        LightGBM_BAG_L1/T37  -35.000593       0.008118    0.384975                0.008
118          0.384975            1       True         37
5        WeightedEnsemble_L3  -35.171529       2.547833  392.323947                0.000
909          0.342697            3       True         54
6         LightGBM_BAG_L2/T2  -35.399461       2.234326  336.587533                0.104
946         18.119448            2       True         43
7         LightGBM_BAG_L2/T7  -35.429021       2.215829  335.623304                0.086
450         17.155219            2       True         48
8         LightGBM_BAG_L2/T8  -35.484768       2.232730  337.566505                0.103
350         19.098420            2       True         49
9         LightGBM_BAG_L2/T3  -35.510800       2.252179  337.608163                0.122
799         19.140078            2       True         44
10        LightGBM_BAG_L2/T1  -35.540708       2.220080  336.346057                0.090
700         17.877973            2       True         42
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11       WeightedEnsemble_L2  -35.609541       0.387346   48.389525                0.000
874          0.467424          2        True          41
12        LightGBM_BAG_L2/T5  -35.844344       2.228659  337.227089                0.099
279          18.759004          2        True          46
13       LightGBM_BAG_L1/T36  -36.090639       0.008912    0.450410                0.008
912           0.450410          1        True          36
14       LightGBM_BAG_L1/T26  -36.195730       0.008180    0.360917                0.008
180           0.360917          1        True          26
15       LightGBM_BAG_L1/T10  -36.289065       0.143575   16.329736                0.143
575          16.329736          1        True          10
16        LightGBM_BAG_L1/T8  -36.605302       0.132714   15.689579                0.132
714          15.689579          1        True           8
17       LightGBM_BAG_L1/T18  -37.090486       0.110183   15.902786                0.110
183          15.902786          1        True          18
18       LightGBM_BAG_L1/T35  -37.324954       0.009536    0.401186                0.009
536           0.401186          1        True          35
19        LightGBM_BAG_L1/T7  -38.060526       0.110815   16.421547                0.110
815          16.421547          1        True           7
20       LightGBM_BAG_L2/T10  -38.585027       2.133451  319.123313                0.004
071           0.655228          2        True          51
21        LightGBM_BAG_L1/T3  -38.649296       0.133552   16.061681                0.133
552          16.061681          1        True           3
22        LightGBM_BAG_L1/T2  -38.733066       0.114028   15.921004                0.114
028          15.921004          1        True           2
23       LightGBM_BAG_L1/T27  -39.064736       0.008544    0.434031                0.008
544           0.434031          1        True          27
24       LightGBM_BAG_L1/T20  -39.409530       0.116236   16.949297                0.116
236          16.949297          1        True          20
25        LightGBM_BAG_L1/T1  -40.205337       0.127324   15.930247                0.127
324          15.930247          1        True           1
26       LightGBM_BAG_L1/T19  -41.011463       0.102638   15.871809                0.102
638          15.871809          1        True          19
27       LightGBM_BAG_L1/T13  -41.096138       0.118339   16.193982                0.118
339          16.193982          1        True          13
28        LightGBM_BAG_L1/T5  -42.830508       0.106793   16.075041                0.106
793          16.075041          1        True           5
29  NeuralNetTorch_BAG_L2/T2  -44.694824       2.164808  321.470202                0.035
429           3.002118          2        True          53
30  NeuralNetTorch_BAG_L2/T1  -47.921056       2.188482  321.816810                0.059
102           3.348725          2        True          52
31       LightGBM_BAG_L1/T24  -51.602943       0.007765    0.389119                0.007
765           0.389119          1        True          24
32       LightGBM_BAG_L1/T38  -53.807036       0.007567    0.396710                0.007
567           0.396710          1        True          38
33  NeuralNetTorch_BAG_L1/T2  -57.576498       0.020421   12.391123                0.020
421          12.391123          1        True          40
34       LightGBM_BAG_L1/T33  -57.982771       0.007185    0.370799                0.007
185           0.370799          1        True          33
35       LightGBM_BAG_L1/T17  -60.533497       0.113262   15.625375                0.113
262          15.625375          1        True          17
36       LightGBM_BAG_L1/T21  -63.328924       0.010431    0.461207                0.010
431           0.461207          1        True          21
37       LightGBM_BAG_L1/T14  -66.248758       0.086177   15.469664                0.086
177          15.469664          1        True          14
38       LightGBM_BAG_L1/T30  -66.849753       0.007901    0.467024                0.007
901           0.467024          1        True          30
39       LightGBM_BAG_L1/T32  -67.909555       0.008497    0.457404                0.008
497           0.457404          1        True          32
40  NeuralNetTorch_BAG_L1/T1  -70.203931       0.044611   12.753078                0.044
611          12.753078          1        True          39
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41       LightGBM_BAG_L1/T11  -74.917394       0.104947   16.081815                0.104
947          16.081815           1       True         11
42        LightGBM_BAG_L2/T9  -89.149034       2.137581  319.128025                0.008
201           0.659940           2       True         50
43       LightGBM_BAG_L1/T16  -93.062319       0.081938   15.759909                0.081
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44        LightGBM_BAG_L2/T6  -99.244379       2.238601  337.712905                0.109
221          19.244821           2       True         47
45        LightGBM_BAG_L2/T4 -102.351122       2.226577  336.102807                0.097
197          17.634722           2       True         45
46       LightGBM_BAG_L1/T31 -103.084566       0.006850    0.373883                0.006
850           0.373883           1       True         31
47       LightGBM_BAG_L1/T25 -108.145119       0.006622    0.369180                0.006
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48        LightGBM_BAG_L1/T9 -108.319186       0.080380   15.101957                0.080
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49        LightGBM_BAG_L1/T6 -109.724132       0.085504   15.694554                0.085
504          15.694554           1       True          6
50       LightGBM_BAG_L1/T15 -111.147686       0.098771   16.183651                0.098
771          16.183651           1       True         15
51        LightGBM_BAG_L1/T4 -120.543532       0.081074   15.537647                0.081
074          15.537647           1       True          4
52       LightGBM_BAG_L1/T29 -123.691217       0.007169    0.409614                0.007
169           0.409614           1       True         29
53       LightGBM_BAG_L1/T12 -123.746113       0.081130   15.666805                0.081
130          15.666805           1       True         12
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Bagging used: True  (with 8 folds)
Multi-layer stack-ensembling used: True  (with 3 levels)
Feature Metadata (Processed):
(raw dtype, special dtypes):
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('int', [])                  :  5 | ['humidity', 'dayofweek', 'hour', 'day', 'month']
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('int', ['datetime_as_int']) :  5 | ['datetime', 'datetime.year', 'datetime.month', 'dat
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Plot summary of models saved to file: AutogluonModels/ag-20221025_194721/SummaryOfModel
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*** End of fit() summary ***
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Out[139…

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 2        LightGBM_BAG_L1/T23  -34.797872       0.008775    0.373073   
 3        LightGBM_BAG_L1/T22  -34.972811       0.009275    0.432362   
 4        LightGBM_BAG_L1/T37  -35.000593       0.008118    0.384975   
 5        WeightedEnsemble_L3  -35.171529       2.547833  392.323947   
 6         LightGBM_BAG_L2/T2  -35.399461       2.234326  336.587533   
 7         LightGBM_BAG_L2/T7  -35.429021       2.215829  335.623304   
 8         LightGBM_BAG_L2/T8  -35.484768       2.232730  337.566505   
 9         LightGBM_BAG_L2/T3  -35.510800       2.252179  337.608163   
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 11       WeightedEnsemble_L2  -35.609541       0.387346   48.389525   
 12        LightGBM_BAG_L2/T5  -35.844344       2.228659  337.227089   
 13       LightGBM_BAG_L1/T36  -36.090639       0.008912    0.450410   
 14       LightGBM_BAG_L1/T26  -36.195730       0.008180    0.360917   
 15       LightGBM_BAG_L1/T10  -36.289065       0.143575   16.329736   
 16        LightGBM_BAG_L1/T8  -36.605302       0.132714   15.689579   
 17       LightGBM_BAG_L1/T18  -37.090486       0.110183   15.902786   
 18       LightGBM_BAG_L1/T35  -37.324954       0.009536    0.401186   
 19        LightGBM_BAG_L1/T7  -38.060526       0.110815   16.421547   
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 21        LightGBM_BAG_L1/T3  -38.649296       0.133552   16.061681   
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 23       LightGBM_BAG_L1/T27  -39.064736       0.008544    0.434031   
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 25        LightGBM_BAG_L1/T1  -40.205337       0.127324   15.930247   
 26       LightGBM_BAG_L1/T19  -41.011463       0.102638   15.871809   
 27       LightGBM_BAG_L1/T13  -41.096138       0.118339   16.193982   
 28        LightGBM_BAG_L1/T5  -42.830508       0.106793   16.075041   
 29  NeuralNetTorch_BAG_L2/T2  -44.694824       2.164808  321.470202   
```

```
30  NeuralNetTorch_BAG_L2/T1  -47.921056       2.188482  321.816810
31       LightGBM_BAG_L1/T24  -51.602943       0.007765    0.389119
32       LightGBM_BAG_L1/T38  -53.807036       0.007567    0.396710
33  NeuralNetTorch_BAG_L1/T2  -57.576498       0.020421   12.391123
34       LightGBM_BAG_L1/T33  -57.982771       0.007185    0.370799
35       LightGBM_BAG_L1/T17  -60.533497       0.113262   15.625375
36       LightGBM_BAG_L1/T21  -63.328924       0.010431    0.461207
37       LightGBM_BAG_L1/T14  -66.248758       0.086177   15.469664
38       LightGBM_BAG_L1/T30  -66.849753       0.007901    0.467024
39       LightGBM_BAG_L1/T32  -67.909555       0.008497    0.457404
40  NeuralNetTorch_BAG_L1/T1  -70.203931       0.044611   12.753078
41       LightGBM_BAG_L1/T11  -74.917394       0.104947   16.081815
42        LightGBM_BAG_L2/T9  -89.149034       2.137581  319.128025
43       LightGBM_BAG_L1/T16  -93.062319       0.081938   15.759909
44        LightGBM_BAG_L2/T6  -99.244379       2.238601  337.712905
45        LightGBM_BAG_L2/T4 -102.351122       2.226577  336.102807
46       LightGBM_BAG_L1/T31 -103.084566       0.006850    0.373883
47       LightGBM_BAG_L1/T25 -108.145119       0.006622    0.369180
48        LightGBM_BAG_L1/T9 -108.319186       0.080380   15.101957
49        LightGBM_BAG_L1/T6 -109.724132       0.085504   15.694554
50       LightGBM_BAG_L1/T15 -111.147686       0.098771   16.183651
51        LightGBM_BAG_L1/T4 -120.543532       0.081074   15.537647
52       LightGBM_BAG_L1/T29 -123.691217       0.007169    0.409614
53       LightGBM_BAG_L1/T12 -123.746113       0.081130   15.666805

    pred_time_val_marginal  fit_time_marginal  stack_level  can_infer  \
0                 0.008692           0.424173            1       True
1                 0.008248           0.377011            1       True
2                 0.008775           0.373073            1       True
3                 0.009275           0.432362            1       True
4                 0.008118           0.384975            1       True
5                 0.000909           0.342697            3       True
6                 0.104946          18.119448            2       True
7                 0.086450          17.155219            2       True
8                 0.103350          19.098420            2       True
9                 0.122799          19.140078            2       True
10                0.090700          17.877973            2       True
11                0.000874           0.467424            2       True
12                0.099279          18.759004            2       True
13                0.008912           0.450410            1       True
14                0.008180           0.360917            1       True
15                0.143575          16.329736            1       True
16                0.132714          15.689579            1       True
17                0.110183          15.902786            1       True
18                0.009536           0.401186            1       True
19                0.110815          16.421547            1       True
20                0.004071           0.655228            2       True
21                0.133552          16.061681            1       True
22                0.114028          15.921004            1       True
23                0.008544           0.434031            1       True
24                0.116236          16.949297            1       True
25                0.127324          15.930247            1       True
26                0.102638          15.871809            1       True
27                0.118339          16.193982            1       True
28                0.106793          16.075041            1       True
29                0.035429           3.002118            2       True
30                0.059102           3.348725            2       True
31                0.007765           0.389119            1       True
32                0.007567           0.396710            1       True
33                0.020421          12.391123            1       True
```

```
34             0.007185         0.370799          1       True
35             0.113262        15.625375          1       True
36             0.010431         0.461207          1       True
37             0.086177        15.469664          1       True
38             0.007901         0.467024          1       True
39             0.008497         0.457404          1       True
40             0.044611        12.753078          1       True
41             0.104947        16.081815          1       True
42             0.008201         0.659940          2       True
43             0.081938        15.759909          1       True
44             0.109221        19.244821          2       True
45             0.097197        17.634722          2       True
46             0.006850         0.373883          1       True
47             0.006622         0.369180          1       True
48             0.080380        15.101957          1       True
49             0.085504        15.694554          1       True
50             0.098771        16.183651          1       True
51             0.081074        15.537647          1       True
52             0.007169         0.409614          1       True
53             0.081130        15.666805          1       True

    fit_order
0          34
1          28
2          23
3          22
4          37
5          54
6          43
7          48
8          49
9          44
10         42
11         41
12         46
13         36
14         26
15         10
16          8
17         18
18         35
19          7
20         51
21          3
22          2
23         27
24         20
25          1
26         19
27         13
28          5
29         53
30         52
31         24
32         38
33         40
34         33
35         17
36         21
37         14
```

```
38          30
39          32
40          39
41          11
42          50
43          16
44          47
45          45
46          31
47          25
48           9
49           6
50          15
51           4
52          29
53          12  }
```

In [140…

```
predictor_2 = predictor_new_hpo.predict(test)
predictor_2.head()
```

Out[140…

```
0    11.354465
1     6.781651
2     6.781651
3     6.773360
4     6.773360
Name: count, dtype: float32
```

In [141…

```
# Remember to set all negative values to zero
predictor_2[predictor_2 < 0 ] = 0
```

In [142…

```
submission_new_hpo =  pd.read_csv("sampleSubmission.csv")
submission_new_hpo.head()
```

Out[142…

	datetime	count
0	2011-01-20 00:00:00	0
1	2011-01-20 01:00:00	0
2	2011-01-20 02:00:00	0
3	2011-01-20 03:00:00	0
4	2011-01-20 04:00:00	0

In [143…

```
# Same submitting predictions
submission_new_hpo["count"] = predictor_2
submission_new_hpo.to_csv("submission_new_hpo.csv", index=False)
```

In [144…

```
submission_new_hpo.head()
```

Out[144…

	datetime	count
0	2011-01-20 00:00:00	11.354465

	datetime	count
1	2011-01-20 01:00:00	6.781651
2	2011-01-20 02:00:00	6.781651
3	2011-01-20 03:00:00	6.773360
4	2011-01-20 04:00:00	6.773360

In [145…

```
!kaggle competitions submit -c bike-sharing-demand -f submission_new_hpo.csv -m "new fe
```

```
100%|█████████████████████| 188k/188k [00:00<00:00, 405kB/s]
Successfully submitted to Bike Sharing Demand
```

In [146…

```
!kaggle competitions submissions -c bike-sharing-demand | tail -n +1 | head -n 6
```

```
fileName                     date                 description                        sta
tus     publicScore  privateScore
---------------------------  -------------------  ---------------------------------  ---
-----  -----------  ------------
submission_new_hpo.csv       2022-10-25 19:58:18  new features with hyperparameters  com
plete  0.49516      0.49516
submission_new_features.csv  2022-10-25 19:30:36  new features                       com
plete  0.78599      0.78599
submission.csv               2022-10-25 18:51:57  first raw submission               com
plete  1.80679      1.80679
submission_new_hpo.csv       2022-10-25 16:52:35  new features with hyperparameters  com
plete  0.51909      0.51909
```

New Score of ?

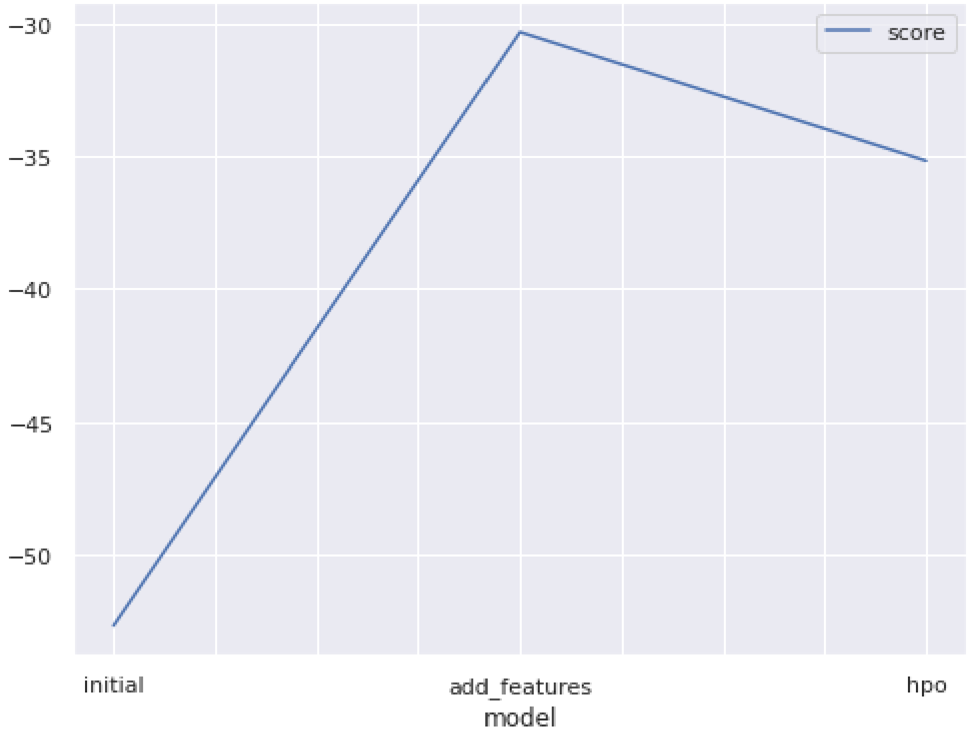
Step 7: Write a Report

Refer to the markdown file for the full report

Creating plots and table for report

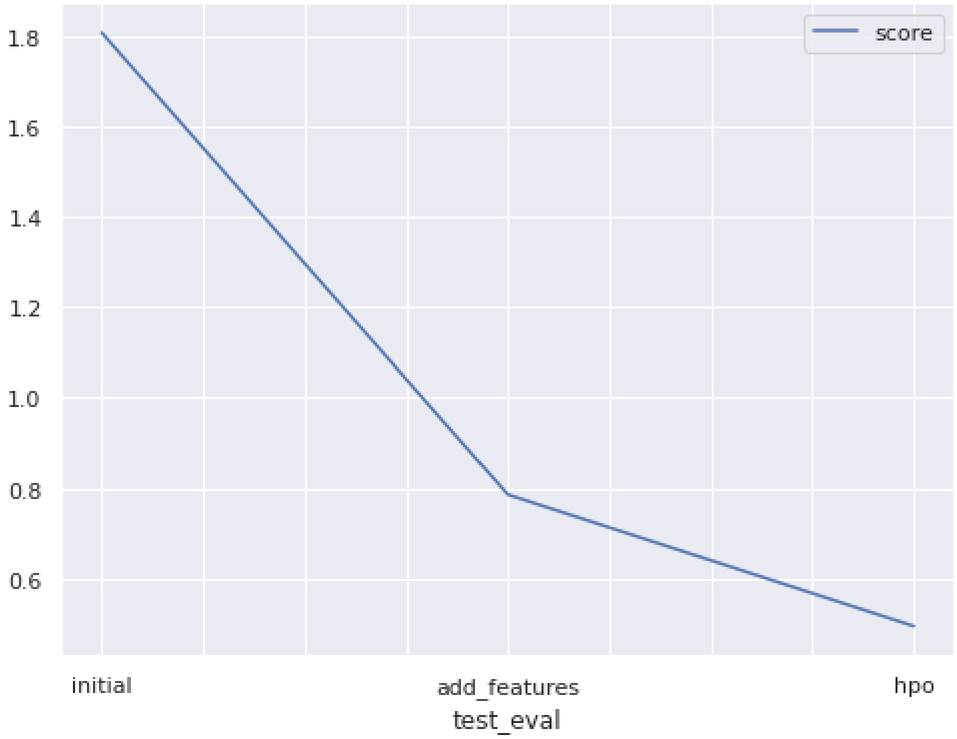
In [147…

```
# Taking the top model score from each training run and creating a line plot to show im
# You can create these in the notebook and save them to PNG or use some other tool (e.g
fig = pd.DataFrame(
    {
        "model": ["initial", "add_features", "hpo"],
        "score": [-52.683737, -30.320217, -35.171529]
    }
).plot(x="model", y="score", figsize=(8, 6)).get_figure()
fig.savefig('model_train_score.png')
```



In [148…

```
# Take the 3 kaggle scores and creating a line plot to show improvement
fig = pd.DataFrame(
    {
        "test_eval": ["initial", "add_features", "hpo"],
        "score": [1.80679, 0.78599, 0.49516]
    }
).plot(x="test_eval", y="score", figsize=(8, 6)).get_figure()
fig.savefig('model_test_score.png')
```



Hyperparameter table

In [150…

```
# The 3 hyperparameters we tuned with the kaggle score as the result
pd.DataFrame({
    "model": ["initial", "add_features", "hpo"],
    "names": ["first_model", "second_model", "third_model"],
    "time": ["time = 600", "time = 600", "time = 600"],
    "presets": ["best_quality", "best_quality", "best_quality"],
    "score": [1.80679, 0.78599, 0.49516]
})
```

Out[150…

	model	names	time	presets	score
0	initial	first_model	time = 600	best_quality	1.80679
1	add_features	second_model	time = 600	best_quality	0.78599
2	hpo	third_model	time = 600	best_quality	0.49516

In [ ]: