whoop_train_v2

July 6, 2024

1 Setup

[131]:
```
import pandas as pd
import numpy as np
import seaborn as sns
from matplotlib import pyplot as plt
import os

import ast
from collections import OrderedDict

from IPython.display import display
```

[2]:
```
WHOOP_PROCESS_DIR = 'data/whoop/process/v1'
```

[3]:
```
def get_X_y(df:pd.DataFrame, label_col:str, drop_cols:list[str]) -> tuple[pd.
 ↪DataFrame, pd.Series]:
    drop_cols.append(label_col)
    X = df.copy().drop(columns=drop_cols)
    y = df.copy()[label_col]

    return X, y
```

2 Activity Classification

2.1 Import

[4]:
```
df_wo_full_18 = pd.read_csv(os.path.join(WHOOP_PROCESS_DIR, 'wo_full_18.csv'))
df_wo_full_18
```

[4]:

	duration_min	activity_name	activity_strain	calories	hr_max	hr_avg	\
0	89	Activity	11.7	705.0	159	127	
1	87	Jiu Jitsu	12.8	638.0	184	125	
2	76	Weightlifting	9.6	467.0	161	119	
3	80	Jiu Jitsu	10.1	511.0	167	121	
4	59	Martial Arts	11.8	534.0	177	134	
..	…	…	…	…	…	…	

```
444           77    Box Fitness            15.7     884.0     175     144
445           36   Powerlifting             7.4     247.0     153     122
446           61    Box Fitness            13.5     556.0     179     133
447           66    Box Fitness            15.9     779.0     180     147
448           86    Box Fitness            13.5     723.0     174     130

     hr_zone_1_p  hr_zone_2_p  hr_zone_3_p  hr_zone_4_p  hr_zone_5_p  \
0           0.04         0.78         0.18         0.00         0.00
1           0.28         0.47         0.11         0.09         0.04
2           0.36         0.45         0.19         0.00         0.00
3           0.30         0.48         0.17         0.02         0.00
4           0.04         0.51         0.29         0.15         0.01
..           …            …            …            …            …
444         0.00         0.15         0.33         0.49         0.03
445         0.08         0.70         0.20         0.02         0.00
446         0.08         0.44         0.19         0.19         0.10
447         0.02         0.14         0.24         0.35         0.25
448         0.08         0.41         0.30         0.19         0.02

     wo_date_ord  wo_day_of_week_sin  wo_day_of_week_cos  wo_start_min_sin  \
0         739052           -0.974928           -0.222521         -0.224951
1         739051           -0.433884           -0.900969         -0.991445
2         739050            0.433884           -0.900969         -0.999391
3         739048            0.781831            0.623490         -0.991445
4         739048            0.781831            0.623490         -0.923880
..           …                   …                   …                 …
444       738417            0.000000            1.000000         -0.988362
445       738415           -0.974928           -0.222521          0.342020
446       738415           -0.974928           -0.222521          0.619094
447       738414           -0.433884           -0.900969         -0.928810
448       738412            0.974928           -0.222521         -0.986286

     wo_start_min_cos  activity_code
0           -0.974370              0
1           -0.130526              5
2            0.034899             14
3           -0.130526              5
4           -0.382683              9
..                …              …
444         -0.152123              2
445         -0.939693             12
446         -0.785317              2
447         -0.370557              2
448         -0.165048              2

[449 rows x 17 columns]
```

[5]:
```
df_wo_full_18.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 449 entries, 0 to 448
Data columns (total 17 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   duration_min        449 non-null    int64
 1   activity_name       449 non-null    object
 2   activity_strain     449 non-null    float64
 3   calories            449 non-null    float64
 4   hr_max              449 non-null    int64
 5   hr_avg              449 non-null    int64
 6   hr_zone_1_p         449 non-null    float64
 7   hr_zone_2_p         449 non-null    float64
 8   hr_zone_3_p         449 non-null    float64
 9   hr_zone_4_p         449 non-null    float64
 10  hr_zone_5_p         449 non-null    float64
 11  wo_date_ord         449 non-null    int64
 12  wo_day_of_week_sin  449 non-null    float64
 13  wo_day_of_week_cos  449 non-null    float64
 14  wo_start_min_sin    449 non-null    float64
 15  wo_start_min_cos    449 non-null    float64
 16  activity_code       449 non-null    int64
dtypes: float64(11), int64(5), object(1)
memory usage: 59.8+ KB
```

[6]:
```
df_wo_full_3 = pd.read_csv(os.path.join(WHOOP_PROCESS_DIR, 'wo_full_3.csv'))
df_wo_full_3
```

[6]:

	duration_min	activity_name	activity_strain	calories	hr_max	hr_avg	\
0	89	Other	11.7	705.0	159	127	
1	87	Martial Arts	12.8	638.0	184	125	
2	76	Weightlifting	9.6	467.0	161	119	
3	80	Martial Arts	10.1	511.0	167	121	
4	59	Martial Arts	11.8	534.0	177	134	
..	…	…	…	…	…	…	
444	77	Other	15.7	884.0	175	144	
445	36	Weightlifting	7.4	247.0	153	122	
446	61	Other	13.5	556.0	179	133	
447	66	Other	15.9	779.0	180	147	
448	86	Other	13.5	723.0	174	130	

	hr_zone_1_p	hr_zone_2_p	hr_zone_3_p	hr_zone_4_p	hr_zone_5_p	\
0	0.04	0.78	0.18	0.00	0.00	
1	0.28	0.47	0.11	0.09	0.04	
2	0.36	0.45	0.19	0.00	0.00	
3	0.30	0.48	0.17	0.02	0.00	

```
4           0.04         0.51         0.29         0.15         0.01
..           …           …            …            …            …
444         0.00         0.15         0.33         0.49         0.03
445         0.08         0.70         0.20         0.02         0.00
446         0.08         0.44         0.19         0.19         0.10
447         0.02         0.14         0.24         0.35         0.25
448         0.08         0.41         0.30         0.19         0.02

     wo_date_ord  wo_day_of_week_sin  wo_day_of_week_cos  wo_start_min_sin  \
0         739052           -0.974928           -0.222521         -0.224951
1         739051           -0.433884           -0.900969         -0.991445
2         739050            0.433884           -0.900969         -0.999391
3         739048            0.781831            0.623490         -0.991445
4         739048            0.781831            0.623490         -0.923880
..           …                  …                   …                 …
444       738417            0.000000            1.000000         -0.988362
445       738415           -0.974928           -0.222521          0.342020
446       738415           -0.974928           -0.222521          0.619094
447       738414           -0.433884           -0.900969         -0.928810
448       738412            0.974928           -0.222521         -0.986286

     wo_start_min_cos  activity_code
0           -0.974370              1
1           -0.130526              0
2            0.034899              2
3           -0.130526              0
4           -0.382683              0
..                …              …
444         -0.152123              1
445         -0.939693              2
446         -0.785317              1
447         -0.370557              1
448         -0.165048              1

[449 rows x 17 columns]
```

[7]:
```
df_wo_full_3.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 449 entries, 0 to 448
Data columns (total 17 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   duration_min        449 non-null    int64
 1   activity_name       449 non-null    object
 2   activity_strain     449 non-null    float64
 3   calories            449 non-null    float64
 4   hr_max              449 non-null    int64
```

```
 5   hr_avg              449 non-null    int64
 6   hr_zone_1_p         449 non-null    float64
 7   hr_zone_2_p         449 non-null    float64
 8   hr_zone_3_p         449 non-null    float64
 9   hr_zone_4_p         449 non-null    float64
 10  hr_zone_5_p         449 non-null    float64
 11  wo_date_ord         449 non-null    int64
 12  wo_day_of_week_sin  449 non-null    float64
 13  wo_day_of_week_cos  449 non-null    float64
 14  wo_start_min_sin    449 non-null    float64
 15  wo_start_min_cos    449 non-null    float64
 16  activity_code       449 non-null    int64
dtypes: float64(11), int64(5), object(1)
memory usage: 59.8+ KB
```

[8]:
```
df_wo_lim_8 = pd.read_csv(os.path.join(WHOOP_PROCESS_DIR, 'wo_lim_8.csv'))
df_wo_lim_8
```

[8]:

	duration_min	activity_name	activity_strain	calories	hr_max	hr_avg	\
0	87	Jiu Jitsu	12.8	638.0	184	125	
1	76	Weightlifting	9.6	467.0	161	119	
2	80	Jiu Jitsu	10.1	511.0	167	121	
3	59	Martial Arts	11.8	534.0	177	134	
4	66	Weightlifting	8.8	410.0	154	120	
..	…	…	…	…	…	…	
381	77	Box Fitness	15.7	884.0	175	144	
382	36	Powerlifting	7.4	247.0	153	122	
383	61	Box Fitness	13.5	556.0	179	133	
384	66	Box Fitness	15.9	779.0	180	147	
385	86	Box Fitness	13.5	723.0	174	130	

	hr_zone_1_p	hr_zone_2_p	hr_zone_3_p	hr_zone_4_p	hr_zone_5_p	\
0	0.28	0.47	0.11	0.09	0.04	
1	0.36	0.45	0.19	0.00	0.00	
2	0.30	0.48	0.17	0.02	0.00	
3	0.04	0.51	0.29	0.15	0.01	
4	0.27	0.57	0.16	0.00	0.00	
..	…	…	…	…	…	
381	0.00	0.15	0.33	0.49	0.03	
382	0.08	0.70	0.20	0.02	0.00	
383	0.08	0.44	0.19	0.19	0.10	
384	0.02	0.14	0.24	0.35	0.25	
385	0.08	0.41	0.30	0.19	0.02	

	wo_date_ord	wo_day_of_week_sin	wo_day_of_week_cos	wo_start_min_sin	\
0	739051	-0.433884	-0.900969	-0.991445	
1	739050	0.433884	-0.900969	-0.999391	

```
2         739048            0.781831            0.623490         -0.991445
3         739048            0.781831            0.623490         -0.923880
4         739047            0.000000            1.000000         -0.999848
..           …                   …                   …                …
381       738417            0.000000            1.000000         -0.988362
382       738415           -0.974928           -0.222521          0.342020
383       738415           -0.974928           -0.222521          0.619094
384       738414           -0.433884           -0.900969         -0.928810
385       738412            0.974928           -0.222521         -0.986286

     wo_start_min_cos  activity_code
0           -0.130526              1
1            0.034899              5
2           -0.130526              1
3           -0.382683              3
4           -0.017452              5
..                …              …
381         -0.152123              0
382         -0.939693              4
383         -0.785317              0
384         -0.370557              0
385         -0.165048              0

[386 rows x 17 columns]
```

[9]:
```
df_wo_lim_8.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 386 entries, 0 to 385
Data columns (total 17 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   duration_min        386 non-null    int64
 1   activity_name       386 non-null    object
 2   activity_strain     386 non-null    float64
 3   calories            386 non-null    float64
 4   hr_max              386 non-null    int64
 5   hr_avg              386 non-null    int64
 6   hr_zone_1_p         386 non-null    float64
 7   hr_zone_2_p         386 non-null    float64
 8   hr_zone_3_p         386 non-null    float64
 9   hr_zone_4_p         386 non-null    float64
 10  hr_zone_5_p         386 non-null    float64
 11  wo_date_ord         386 non-null    int64
 12  wo_day_of_week_sin  386 non-null    float64
 13  wo_day_of_week_cos  386 non-null    float64
 14  wo_start_min_sin    386 non-null    float64
 15  wo_start_min_cos    386 non-null    float64
```

```
 16  activity_code       386 non-null    int64
dtypes: float64(11), int64(5), object(1)
memory usage: 51.4+ KB
```

2.2 Labels

[10]:
```
def get_label_dict(df, label_code_col, label_name_col):
    return OrderedDict(
        sorted(
            df.drop_duplicates(subset=[label_code_col])\
                .set_index(label_code_col)[label_name_col]\
                .to_dict()\
                .items()
        )
    )
```

[11]:
```
WO_LABEL_COL = 'activity_code'
WO_LABEL_NAME_COL = 'activity_name'
```

[12]:
```
wo_full_18_label_dict = get_label_dict(df_wo_full_18, WO_LABEL_COL,␣
 ↪WO_LABEL_NAME_COL)

wo_full_18_label_dict
```

[12]:
```
OrderedDict([(0, 'Activity'),
             (1, 'Assault Bike'),
             (2, 'Box Fitness'),
             (3, 'Boxing'),
             (4, 'Dance'),
             (5, 'Jiu Jitsu'),
             (6, 'Kickboxing'),
             (7, 'Lacrosse'),
             (8, 'Manual Labor'),
             (9, 'Martial Arts'),
             (10, 'Operations - Tactical'),
             (11, 'Paintball'),
             (12, 'Powerlifting'),
             (13, 'Spin'),
             (14, 'Weightlifting'),
             (15, 'Wrestling'),
             (16, 'Yard Work'),
             (17, 'Yoga')])
```

2.3 Feature Selection

[13]:
```
df_wo_full_18.info()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 449 entries, 0 to 448
Data columns (total 17 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   duration_min        449 non-null    int64
 1   activity_name       449 non-null    object
 2   activity_strain     449 non-null    float64
 3   calories            449 non-null    float64
 4   hr_max              449 non-null    int64
 5   hr_avg              449 non-null    int64
 6   hr_zone_1_p         449 non-null    float64
 7   hr_zone_2_p         449 non-null    float64
 8   hr_zone_3_p         449 non-null    float64
 9   hr_zone_4_p         449 non-null    float64
 10  hr_zone_5_p         449 non-null    float64
 11  wo_date_ord         449 non-null    int64
 12  wo_day_of_week_sin  449 non-null    float64
 13  wo_day_of_week_cos  449 non-null    float64
 14  wo_start_min_sin    449 non-null    float64
 15  wo_start_min_cos    449 non-null    float64
 16  activity_code       449 non-null    int64
dtypes: float64(11), int64(5), object(1)
memory usage: 59.8+ KB
```

2.3.1 v1 Features

[14]:
```
WO_DROP_COLS_V1 = [WO_LABEL_NAME_COL] # just drop extra label column for v1 --␣
↪keep all features
```

[15]:
```
X_wo_full_18_v1, y_wo_full_18_v1 = get_X_y(df_wo_full_18, WO_LABEL_COL,␣
↪WO_DROP_COLS_V1)
```

[16]:
```
X_wo_full_3_v1, y_wo_full_3_v1 = get_X_y(df_wo_full_3, WO_LABEL_COL,␣
↪WO_DROP_COLS_V1)
```

[17]:
```
X_wo_full_3_v1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 449 entries, 0 to 448
Data columns (total 15 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   duration_min        449 non-null    int64
 1   activity_strain     449 non-null    float64
 2   calories            449 non-null    float64
 3   hr_max              449 non-null    int64
 4   hr_avg              449 non-null    int64
 5   hr_zone_1_p         449 non-null    float64
```

```
 6   hr_zone_2_p          449 non-null    float64
 7   hr_zone_3_p          449 non-null    float64
 8   hr_zone_4_p          449 non-null    float64
 9   hr_zone_5_p          449 non-null    float64
 10  wo_date_ord          449 non-null    int64
 11  wo_day_of_week_sin   449 non-null    float64
 12  wo_day_of_week_cos   449 non-null    float64
 13  wo_start_min_sin     449 non-null    float64
 14  wo_start_min_cos     449 non-null    float64
dtypes: float64(11), int64(4)
memory usage: 52.7 KB
```

[18]:
```
X_wo_lim_8_v1, y_wo_lim_8_v1 = get_X_y(df_wo_lim_8, WO_LABEL_COL,␣
↪WO_DROP_COLS_V1)
```

2.3.2 v2 Features

[19]:
```
WO_DROP_COLS_V2 = [

    # ideally our model should be able to predict activities regardless of␣
↪their duration, date, or time of day
    'duration_min',
    'wo_date_ord',
    'wo_day_of_week_sin',
    'wo_day_of_week_cos',
    'wo_start_min_sin',
    'wo_start_min_cos',

    'activity_strain' # we should also drop this whoop proprietary metric

]
```

[20]:
```
X_wo_full_3_v2, y_wo_full_3_v2 = X_wo_full_3_v1.copy().
↪drop(columns=WO_DROP_COLS_V2), y_wo_full_3_v1.copy()
X_wo_lim_8_v2, y_wo_lim_8_v2 = X_wo_lim_8_v1.copy().
↪drop(columns=WO_DROP_COLS_V2), y_wo_lim_8_v1.copy()
```

2.4 Model Selection

2.4.1 ML Models

[21]:
```
from sklearn.model_selection import cross_val_score, StratifiedKFold,␣
↪cross_val_predict
from sklearn.ensemble import RandomForestClassifier
from sklearn.decomposition import PCA
from sklearn.base import BaseEstimator, ClassifierMixin
from sklearn.utils import check_random_state
from sklearn.preprocessing import StandardScaler
```

```
from sklearn.metrics import confusion_matrix, classification_report
from sklearn.model_selection import GridSearchCV

from xgboost import XGBClassifier

import torch.utils.tensorboard as tb
```

[22]:
```
class RotationForest(BaseEstimator, ClassifierMixin):
    def __init__(self, base_classifier=RandomForestClassifier(), n_splits=3,␣
 ↪n_classifiers=10, random_state=None):
        self.base_classifier = base_classifier
        self.n_splits = n_splits
        self.n_classifiers = n_classifiers
        self.random_state = random_state
        self.classifiers_ = []
        self.pcas_ = []

    def fit(self, X, y):

        X = X.values if isinstance(X, pd.DataFrame) else X

        random_state = check_random_state(self.random_state)
        self.classifiers_ = []
        self.pcas_ = []
        self.classes_ = np.unique(y)

        for _ in range(self.n_classifiers):
            # Randomly split the features into subsets
            features_indices = np.array_split(random_state.permutation(X.
 ↪shape[1]), self.n_splits)
            transformed_X = np.zeros_like(X)

            for indices in features_indices:
                pca = PCA()
                X_subset = X[:, indices]
                transformed_X[:, indices] = pca.fit_transform(X_subset)
                self.pcas_.append((pca, indices))

            clf = self.base_classifier.fit(transformed_X, y)
            self.classifiers_.append(clf)

        return self

    def predict(self, X):

        X = X.values if isinstance(X, pd.DataFrame) else X
```

```
        transformed_X = np.zeros_like(X)
        for pca, indices in self.pcas_:
            transformed_X[:, indices] = pca.transform(X[:, indices])

        predictions = np.array([clf.predict(transformed_X) for clf in self.
 ↪classifiers_]).T
        return np.apply_along_axis(lambda x: np.argmax(np.bincount(x.
 ↪astype(int))), axis=1, arr=predictions)

    def predict_proba(self, X):

        X = X.values if isinstance(X, pd.DataFrame) else X

        transformed_X = np.zeros_like(X)
        for pca, indices in self.pcas_:
            transformed_X[:, indices] = pca.transform(X[:, indices])

        probas = np.mean([clf.predict_proba(transformed_X) for clf in self.
 ↪classifiers_], axis=0)
        return probas
```

[23]:
```
classification_models_v1 = {
    'Random Forest': RandomForestClassifier(),
    'Rotation Forest': RotationForest(base_classifier=RandomForestClassifier(),␣
 ↪n_splits=3, random_state=42),
    'XGBoost': XGBClassifier(use_label_encoder=False, eval_metric='mlogloss')
}

class_kf_v1 = StratifiedKFold(n_splits=10, shuffle=True, random_state=42)
```

[90]:
```
classification_models_v3 = {
    'Random Forest': RandomForestClassifier(),
    'Rotation Forest': RotationForest(base_classifier=RandomForestClassifier(),␣
 ↪n_splits=3, random_state=42),
    'XGBoost': XGBClassifier(use_label_encoder=False, eval_metric='mlogloss')
}

class_param_grids_v3 = {
    'Random Forest': {
        'n_estimators': [50, 100, 200, 300],
        'max_depth': [None, 10, 20, 30, 40],
        'min_samples_split': [2, 3, 5, 10],
        'min_samples_leaf': [1, 2, 4, 6]
    },
    'Rotation Forest': {
        'n_classifiers': [10, 15, 20, 25],
        'n_splits': [5, 7, 9, 11],
```

```
        'base_classifier__n_estimators': [25, 50, 75, 100],
        'base_classifier__max_depth': [None, 10, 20],
        'base_classifier__min_samples_split': [2, 5, 10]
    },
    'XGBoost': {
        'n_estimators': [25, 50, 75, 100],
        'learning_rate': [0.001, 0.005, 0.01, 0.05, 0.1],
        'max_depth': [5, 7, 9, 11],
        'subsample': [0.8, 0.9, 1.0],
        'colsample_bytree': [0.8, 0.9, 1.0],
        'gamma': [0, 0.1, 0.2]
    }
}

class_kf_v3 = StratifiedKFold(n_splits=10, shuffle=True, random_state=42)
```

2.4.2 Neural Model

[25]:
```
import torch
import torch.nn as nn
import torch.optim as optim
from torch.utils.data import DataLoader, TensorDataset
from sklearn.model_selection import train_test_split

from ray import train, tune
from ray.tune import CLIReporter
from ray.tune.schedulers import ASHAScheduler
from ray.train import Checkpoint

import tempfile
```

```
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-packages/tqdm/auto.py:21:
TqdmWarning: IProgress not found. Please update jupyter and ipywidgets. See
https://ipywidgets.readthedocs.io/en/stable/user_install.html
  from .autonotebook import tqdm as notebook_tqdm
2024-06-26 13:11:23,031 INFO util.py:154 -- Missing packages: ['ipywidgets'].
Run `pip install -U ipywidgets`, then restart the notebook server for rich
notebook output.
2024-06-26 13:11:23,463 INFO util.py:154 -- Missing packages: ['ipywidgets'].
Run `pip install -U ipywidgets`, then restart the notebook server for rich
notebook output.
```

[26]:
```
class SimpleNN(nn.Module):
    def __init__(self, input_size, hidden_size, num_classes):
        # pass in num_classes=1 for regression
        super(SimpleNN, self).__init__()
        self.fc1 = nn.Linear(input_size, hidden_size)
        self.bn1 = nn.BatchNorm1d(hidden_size)
```

```
        self.fc2 = nn.Linear(hidden_size, hidden_size)
        self.bn2 = nn.BatchNorm1d(hidden_size)
        self.fc3 = nn.Linear(hidden_size, num_classes)
        self.relu = nn.ReLU()

    def forward(self, x):
        out = self.relu(self.bn1(self.fc1(x)))
        out = self.relu(self.bn2(self.fc2(out)))
        out = self.fc3(out)
        return out
```

2.5 Model Training

2.5.1 ML Models Methods

[27]:
```
def scale_X(X):
    scaler = StandardScaler()
    X = X.values if isinstance(X, pd.DataFrame) else X
    return scaler.fit_transform(X)

def train_eval_classification_model(model, X, y, kf, logger=None,␣
 ↪print_results=True, print_conf_matrix=False):
    X = scale_X(X)

    model.fit(X, y)
    y_pred = cross_val_predict(model, X, y, cv=kf)

    conf_matrix = confusion_matrix(y, y_pred)
    class_report = classification_report(y, y_pred)

    scores = cross_val_score(model, X, y, cv=kf, scoring='accuracy')

    if logger:
        logger.add_scalar('acc', np.mean(scores), 0)

    if print_results:
        print(f'Accuracy: {np.mean(scores):.4f} (+/- {np.std(scores):.4f})')
        if print_conf_matrix:
            print("Confusion Matrix:\n", conf_matrix)
        print("Classification Report:\n", class_report)
        print()

    return model

def train_classification_models(models, X, y, kf=None, log_dir=None,␣
 ↪print_results=True):
    trained_models = {}
```

```
    for name, model in models.items():
        print(f'Training {name}\n')

        from os import path
        logger = tb.SummaryWriter(path.join(log_dir, name)) if log_dir else None

        trained_models[name] = train_eval_classification_model(model, X, y, kf,␣
↪logger, print_results)

    return trained_models
```

[28]:
```
def classification_grid_search(model, X, y, param_grid, kf, print_results=True):
    X = scale_X(X)

    grid_search = GridSearchCV(estimator=model, param_grid=param_grid, cv=kf,␣
↪scoring='accuracy', n_jobs=-1)
    grid_search.fit(X, y)

    best_model = grid_search.best_estimator_

    if print_results:
        print(f'Best Parameters: {grid_search.best_params_}')
        print()

    return best_model

def grid_search_classification_models(models, param_grids, X, y, kf=None,␣
↪print_results=True):
    best_models = {}
    for name, model in models.items():
        print(f'Optimizing {name}')

        param_grid = param_grids.get(name, {})
        original_params = model.get_params()
        search_params = {key: original_params[key] for key in param_grid.keys()}
        print(f'Original Parameters: {search_params}')


        best_models[name] = classification_grid_search(model, X, y, param_grid,␣
↪kf, print_results)

    return best_models
```

2.5.2 Neural Model Methods

[29]:
```
def create_class_dataloaders(X, y, batch_size):
    torch.manual_seed(42)

    X = X.values if isinstance(X, pd.DataFrame) else X
    y = y.values if isinstance(y, pd.Series) else y

    batch_size = batch_size if batch_size else X.shape[0]

    X_train, X_val, y_train, y_val = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42, stratify=y)

    scaler = StandardScaler()
    X_train = scaler.fit_transform(X_train)
    X_val = scaler.transform(X_val)

    train_dataset = TensorDataset(torch.tensor(X_train, dtype=torch.float32),␣
 ↪torch.tensor(y_train, dtype=torch.long))
    val_dataset = TensorDataset(torch.tensor(X_val, dtype=torch.float32), torch.
 ↪tensor(y_val, dtype=torch.long))

    train_loader = DataLoader(train_dataset, batch_size=batch_size,␣
 ↪shuffle=True)
    val_loader = DataLoader(val_dataset, batch_size=batch_size, shuffle=False)

    return train_loader, val_loader
```

[59]:
```
def accuracy(outputs, labels):
        outputs_idx = torch.argmax(outputs, dim=1).type_as(labels)
        # print(f'Labels: {labels}')
        # print(f'Preds: {outputs_idx}')
        return outputs_idx.eq(labels).float().mean()

def train_classification_nn(config, X, y): #, lr=1e-3, hidden_size=100,␣
 ↪num_epochs=20, batch_size=32, log_dir=None, model_path='models/
 ↪classification_model.th'):
    lr = config['lr']
    hidden_size = config['hidden_size']
    num_epochs = config['num_epochs']
    batch_size = config['batch_size']
    model_name = f'h{hidden_size}_b{batch_size}_lr{lr}'

    from os import path

    if 'log_dir' in config:
```

```
        train_logger = tb.SummaryWriter(path.join(config['log_dir'],␣
↪model_name, 'nn', 'train'))
        valid_logger = tb.SummaryWriter(path.join(config['log_dir'],␣
↪model_name, 'nn', 'val'))
    else:
        train_logger, valid_logger = None, None

    device = torch.device('mps') if torch.backends.mps.is_available() else␣
↪torch.device('cuda') if torch.cuda.is_available() else torch.device('cpu') #␣
↪type: ignore
    print(f'Using device: {device}')

    train_loader, val_loader = create_class_dataloaders(X, y, batch_size)

    input_size = X.shape[1]
    num_classes = len(np.unique(y))

    model = SimpleNN(input_size, hidden_size, num_classes).to(device)

    class_weights = torch.tensor(1. / np.bincount(y), dtype=torch.float).
↪to(device)
    criterion = nn.CrossEntropyLoss(weight=class_weights)
    optimizer = optim.Adam(model.parameters(), lr=lr)

    if 'early_stop' in config:
        best_vacc = 0
        patience = config['early_stop']
        epochs_no_improve = 0

    global_step = 0
    for epoch in range(num_epochs):
        model.train()
        loss_vals, acc_vals, vacc_vals = [], [], []

        for batch_idx, (features, labels) in enumerate(train_loader):
            features, labels = features.to(device), labels.to(device)

            outputs = model(features)
            loss = criterion(outputs, labels)
            # print(f'Epoch {epoch} batch {batch_idx} loss: {loss:.4f}')

            acc = accuracy(outputs, labels)
            # print(f'Epoch {epoch} batch {batch_idx} acc: {acc:.4f}')
            loss_vals.append(loss.detach().cpu().numpy())
            acc_vals.append(acc.cpu().numpy())

            optimizer.zero_grad()
```

```
            loss.backward()
            optimizer.step()
            global_step += 1

        avg_loss = sum(loss_vals) / len(loss_vals)
        avg_acc = sum(acc_vals) / len(acc_vals)
        if train_logger:
            train_logger.add_scalar('loss', avg_loss, global_step)
            train_logger.add_scalar('acc', avg_acc, global_step)
            # if global_step % 100 == 0:
                # log(train_logger, features, labels, outputs, global_step) #␣
↪requries custom log() function

        if 'model_path' in config:
            torch.save(model.state_dict(), path.join(config['model_path'],␣
↪model_name+'.th'))

        model.eval()
        with torch.no_grad():
            for batch_idx, (features, labels) in enumerate(val_loader):
                features, labels = features.to(device), labels.to(device)

                outputs = model(features)
                val_acc = accuracy(outputs, labels)
                vacc_vals.append(val_acc.cpu().numpy())

                # print(f'Epoch {epoch} val_batch {batch_idx} val_acc: {val_acc:
↪.4f}')

            avg_vacc = sum(vacc_vals) / len(vacc_vals)
            if valid_logger:
                valid_logger.add_scalar('acc', avg_vacc, global_step)

        if 'early_stop' in config:
            if avg_vacc > best_vacc:
                best_vacc = avg_vacc
                epochs_no_improve = 0
            else:
                epochs_no_improve += 1

            if epochs_no_improve >= patience:
                if 'print' in config:
                    print(f"Early stopping at epoch {epoch}")
                    print(f"Best Validation Accuracy: {best_vacc} at epoch␣
↪{epoch - patience}")
                break
```

```
        if 'tune' in config:
            # with tempfile.TemporaryDirectory() as temp_checkpoint_dir:
            #     checkpoint = Checkpoint.from_directory(temp_checkpoint_dir)
            train.report(
                {
                    'loss':avg_loss,
                    'accuracy':avg_acc,
                    'val_accuracy':avg_vacc,
                    'model_name':model_name,
                    'epoch':epoch
                }
                # checkpoint=checkpoint
            )

        if 'print' in config:
            print(f'Epoch [{epoch}/{num_epochs}], Loss: {avg_loss:.4f},␣
↪Training Accuracy: {avg_acc:.4f}, Validation Accuracy: {avg_vacc:.4f}')
```

[31]:
```
def tune_classification_nn(search_space, X, y):
    search_space['tune'] = True

    reporter = CLIReporter(
        parameter_columns=['lr', 'hidden_size', 'batch_size', 'num_epochs'],
        metric_columns=['loss', 'accuracy', 'val_accuracy']
    )

    scheduler = ASHAScheduler(
        metric='val_accuracy',
        mode='max',
        grace_period=25,
        reduction_factor=1.5
    )

    analysis = tune.run(
        tune.with_parameters(train_classification_nn, X=X, y=y),
        # resources_per_trial={'cpu': 2, 'gpu': 0.5},
        config=search_space,
        # num_samples=n_trials,
        scheduler=scheduler,
        progress_reporter=reporter
    )

    best_trial = analysis.get_best_trial(metric='val_accuracy', mode='max')
    best_config = best_trial.config
    best_val_accuracy = best_trial.last_result['val_accuracy']
    best_epoch = best_trial.last_result['epoch']
```

```
    print("Best Hyperparameters Found: ", best_config)
    print("Best Validation Accuracy: ", best_val_accuracy)
    print("Best Number Epochs: ", best_epoch)

    if 'model_path' in search_space:
        best_model_path = f"{best_config['model_path']}/{best_trial.
↪last_result['model_name']}.th"
        print("Best Model Path: ", best_model_path)
```

2.5.3 v1 Training

Full 18 Immediately we run into problems here, as multiple classes have only one instance per class, which does not allow for cross validation or train_test splitting.

[32]:
```
# FULL_18_LOGS_V1 = 'logs/whoop-activity-class/full-18/v1'
# FULL_18_MODEL_V1 = 'models/whoop-activity-class/full_18_v1.th'
```

[33]:
```
# train_classification_models(classification_models_v1, X_wo_full_18_v1,␣
↪y_wo_full_18_v1, 1, FULL_18_LOGS_V1)
```

Full 3

[34]:
```
FULL_3_LOGS_V1 = os.path.join(os.getcwd(), 'logs/whoop-activity-class/v1/
↪full-3')
FULL_3_MODELPATH_V1 = os.path.join(os.getcwd(), 'models/whoop-activity-class/v1/
↪full-3')
```

[35]:
```
train_classification_models(classification_models_v1, X_wo_full_3_v1,␣
↪y_wo_full_3_v1, class_kf_v1, FULL_3_LOGS_V1)
```

```
Training Random Forest

Accuracy: 0.8844 (+/- 0.0463)
Classification Report:
              precision    recall  f1-score   support

           0       0.92      0.92      0.92       144
           1       0.90      0.72      0.80       109
           2       0.86      0.95      0.90       196

    accuracy                           0.89       449
   macro avg       0.89      0.87      0.88       449
weighted avg       0.89      0.89      0.88       449


Training Rotation Forest

Accuracy: 0.8666 (+/- 0.0420)
Classification Report:
```

```
                precision    recall  f1-score   support

           0       0.87      0.89      0.88       144
           1       0.83      0.71      0.76       109
           2       0.86      0.92      0.89       196

    accuracy                           0.86       449
   macro avg       0.85      0.84      0.84       449
weighted avg       0.86      0.86      0.86       449


Training XGBoost

Accuracy: 0.8843 (+/- 0.0406)
Classification Report:
                precision    recall  f1-score   support

           0       0.92      0.92      0.92       144
           1       0.83      0.77      0.80       109
           2       0.88      0.92      0.90       196

    accuracy                           0.88       449
   macro avg       0.88      0.87      0.87       449
weighted avg       0.88      0.88      0.88       449
```

[35]:
```
{'Random Forest': RandomForestClassifier(),
 'Rotation Forest': RotationForest(random_state=42),
 'XGBoost': XGBClassifier(base_score=None, booster=None, callbacks=None,
               colsample_bylevel=None, colsample_bynode=None,
               colsample_bytree=None, device=None, early_stopping_rounds=None,
               enable_categorical=False, eval_metric='mlogloss',
               feature_types=None, gamma=None, grow_policy=None,
               importance_type=None, interaction_constraints=None,
               learning_rate=None, max_bin=None, max_cat_threshold=None,
               max_cat_to_onehot=None, max_delta_step=None, max_depth=None,
               max_leaves=None, min_child_weight=None, missing=nan,
               monotone_constraints=None, multi_strategy=None,
               n_estimators=None,
               n_jobs=None, num_parallel_tree=None, objective='multi:softprob',
               …)}
```

[45]:
```
FULL_3_MODEL_V1_CONFIG = {
    'lr': 1e-2,
    'hidden_size': int(1e3),
    'batch_size': 32,
```

```
    'num_epochs': 200,
    'early_stop': 10,
    'log_dir': FULL_3_LOGS_V1,
    'model_path': FULL_3_MODELPATH_V1,
    'print': True
}
```

[60]:
```
train_classification_nn(
    FULL_3_MODEL_V1_CONFIG,
    X_wo_full_3_v1,
    y_wo_full_3_v1
)
```

```
Using device: mps
Epoch [0/200], Loss: 1.0636, Training Accuracy: 0.6663, Validation Accuracy:
0.6763
Epoch [1/200], Loss: 0.5518, Training Accuracy: 0.7939, Validation Accuracy:
0.7588
Epoch [2/200], Loss: 0.5804, Training Accuracy: 0.8211, Validation Accuracy:
0.8421
Epoch [3/200], Loss: 0.5486, Training Accuracy: 0.8434, Validation Accuracy:
0.6867
Epoch [4/200], Loss: 0.5124, Training Accuracy: 0.8590, Validation Accuracy:
0.8165
Epoch [5/200], Loss: 0.6863, Training Accuracy: 0.8564, Validation Accuracy:
0.8421
Epoch [6/200], Loss: 0.7941, Training Accuracy: 0.8251, Validation Accuracy:
0.8269
Epoch [7/200], Loss: 0.4629, Training Accuracy: 0.8828, Validation Accuracy:
0.7957
Epoch [8/200], Loss: 0.3972, Training Accuracy: 0.8605, Validation Accuracy:
0.8630
Epoch [9/200], Loss: 0.2885, Training Accuracy: 0.8969, Validation Accuracy:
0.8317
Epoch [10/200], Loss: 0.3586, Training Accuracy: 0.8683, Validation Accuracy:
0.8341
Epoch [11/200], Loss: 0.3622, Training Accuracy: 0.8996, Validation Accuracy:
0.8702
Epoch [12/200], Loss: 0.3256, Training Accuracy: 0.8891, Validation Accuracy:
0.8502
Epoch [13/200], Loss: 0.3316, Training Accuracy: 0.9033, Validation Accuracy:
0.8109
Epoch [14/200], Loss: 0.3329, Training Accuracy: 0.8798, Validation Accuracy:
0.8397
Epoch [15/200], Loss: 0.2321, Training Accuracy: 0.9141, Validation Accuracy:
0.8654
Epoch [16/200], Loss: 0.2279, Training Accuracy: 0.9178, Validation Accuracy:
0.8630
```

```
Epoch [17/200], Loss: 0.1597, Training Accuracy: 0.9412, Validation Accuracy:
0.8526
Epoch [18/200], Loss: 0.2104, Training Accuracy: 0.9252, Validation Accuracy:
0.8654
Epoch [19/200], Loss: 0.5525, Training Accuracy: 0.8925, Validation Accuracy:
0.8526
Epoch [20/200], Loss: 0.3327, Training Accuracy: 0.8761, Validation Accuracy:
0.8886
Epoch [21/200], Loss: 0.3958, Training Accuracy: 0.8735, Validation Accuracy:
0.8622
Epoch [22/200], Loss: 0.3419, Training Accuracy: 0.9074, Validation Accuracy:
0.8550
Epoch [23/200], Loss: 0.1944, Training Accuracy: 0.9215, Validation Accuracy:
0.8654
Epoch [24/200], Loss: 0.3484, Training Accuracy: 0.9137, Validation Accuracy:
0.7981
Epoch [25/200], Loss: 0.2992, Training Accuracy: 0.8876, Validation Accuracy:
0.8526
Epoch [26/200], Loss: 0.2516, Training Accuracy: 0.9219, Validation Accuracy:
0.7853
Epoch [27/200], Loss: 0.1550, Training Accuracy: 0.9453, Validation Accuracy:
0.8526
Epoch [28/200], Loss: 0.2292, Training Accuracy: 0.9200, Validation Accuracy:
0.8654
Epoch [29/200], Loss: 0.3496, Training Accuracy: 0.8694, Validation Accuracy:
0.7748
Early stopping at epoch 30
Best Validation Accuracy: 0.8886218070983887 at epoch 20
```

Limited 8

[47]:
```
LIM_8_LOGS_V1 = os.path.join(os.getcwd(), 'logs/whoop-activity-class/v1/lim-8')
LIM_8_MODELPATH_V1 = os.path.join(os.getcwd(), 'models/whoop-activity-class/v1/
↪lim-8')
```

[48]:
```
train_classification_models(classification_models_v1, X_wo_lim_8_v1,␣
↪y_wo_lim_8_v1, class_kf_v1, LIM_8_LOGS_V1)
```

```
Training Random Forest

Accuracy: 0.8650 (+/- 0.0353)
Classification Report:
              precision    recall  f1-score   support

           0       0.97      0.85      0.90        33
           1       0.79      0.84      0.81        96
           2       0.71      0.42      0.53        12
           3       0.75      0.50      0.60        12
           4       0.88      0.83      0.85        35
```

```
           5       0.90      0.96      0.92       161
           6       0.79      0.75      0.77        20
           7       1.00      0.88      0.94        17

    accuracy                           0.86       386
   macro avg       0.85      0.75      0.79       386
weighted avg       0.86      0.86      0.86       386


Training Rotation Forest

Accuracy: 0.8134 (+/- 0.0401)
Classification Report:
              precision    recall  f1-score   support

           0       0.87      0.79      0.83        33
           1       0.79      0.84      0.82        96
           2       0.67      0.50      0.57        12
           3       0.88      0.58      0.70        12
           4       0.83      0.54      0.66        35
           5       0.85      0.96      0.90       161
           6       0.94      0.75      0.83        20
           7       1.00      0.88      0.94        17

    accuracy                           0.84       386
   macro avg       0.85      0.73      0.78       386
weighted avg       0.84      0.84      0.83       386


Training XGBoost

Accuracy: 0.8706 (+/- 0.0433)
Classification Report:
              precision    recall  f1-score   support

           0       0.91      0.88      0.89        33
           1       0.84      0.88      0.86        96
           2       0.46      0.50      0.48        12
           3       0.67      0.50      0.57        12
           4       0.86      0.86      0.86        35
           5       0.92      0.94      0.93       161
           6       0.94      0.75      0.83        20
           7       0.93      0.82      0.87        17

    accuracy                           0.87       386
   macro avg       0.81      0.77      0.79       386
weighted avg       0.87      0.87      0.87       386
```

[48]:
```
{'Random Forest': RandomForestClassifier(),
 'Rotation Forest': RotationForest(random_state=42),
 'XGBoost': XGBClassifier(base_score=None, booster=None, callbacks=None,
                colsample_bylevel=None, colsample_bynode=None,
                colsample_bytree=None, device=None, early_stopping_rounds=None,
                enable_categorical=False, eval_metric='mlogloss',
                feature_types=None, gamma=None, grow_policy=None,
                importance_type=None, interaction_constraints=None,
                learning_rate=None, max_bin=None, max_cat_threshold=None,
                max_cat_to_onehot=None, max_delta_step=None, max_depth=None,
                max_leaves=None, min_child_weight=None, missing=nan,
                monotone_constraints=None, multi_strategy=None,
n_estimators=None,
                n_jobs=None, num_parallel_tree=None, objective='multi:softprob',
…)}
```

[49]:
```
LIM_8_MODEL_V1_CONFIG = {
    'lr': 1e-2,
    'hidden_size': int(1e3),
    'batch_size': 32,
    'num_epochs': 200,
    'early_stop': 10,
    'log_dir': LIM_8_LOGS_V1,
    'model_path': LIM_8_MODELPATH_V1,
    'print': True
}
```

[61]:
```
train_classification_nn(
    LIM_8_MODEL_V1_CONFIG,
    X_wo_lim_8_v1,
    y_wo_lim_8_v1
)
```

```
Using device: mps
Epoch [0/200], Loss: 1.9636, Training Accuracy: 0.5344, Validation Accuracy:
0.5446
Epoch [1/200], Loss: 1.0983, Training Accuracy: 0.6594, Validation Accuracy:
0.6577
Epoch [2/200], Loss: 0.6951, Training Accuracy: 0.7781, Validation Accuracy:
0.6815
Epoch [3/200], Loss: 0.9360, Training Accuracy: 0.7994, Validation Accuracy:
0.7128
Epoch [4/200], Loss: 0.4278, Training Accuracy: 0.8556, Validation Accuracy:
0.7307
Epoch [5/200], Loss: 0.3488, Training Accuracy: 0.8637, Validation Accuracy:
0.7679
```

```
Epoch [6/200], Loss: 0.2574, Training Accuracy: 0.8831, Validation Accuracy:
0.7917
Epoch [7/200], Loss: 0.3573, Training Accuracy: 0.8713, Validation Accuracy:
0.7098
Epoch [8/200], Loss: 0.3570, Training Accuracy: 0.8406, Validation Accuracy:
0.7857
Epoch [9/200], Loss: 0.2017, Training Accuracy: 0.9163, Validation Accuracy:
0.7827
Epoch [10/200], Loss: 0.1471, Training Accuracy: 0.9119, Validation Accuracy:
0.8333
Epoch [11/200], Loss: 0.1381, Training Accuracy: 0.9525, Validation Accuracy:
0.8095
Epoch [12/200], Loss: 0.1888, Training Accuracy: 0.9081, Validation Accuracy:
0.8229
Epoch [13/200], Loss: 0.3958, Training Accuracy: 0.8775, Validation Accuracy:
0.7961
Epoch [14/200], Loss: 0.2168, Training Accuracy: 0.9413, Validation Accuracy:
0.7411
Epoch [15/200], Loss: 0.2701, Training Accuracy: 0.8788, Validation Accuracy:
0.8170
Epoch [16/200], Loss: 0.1879, Training Accuracy: 0.9256, Validation Accuracy:
0.8229
Epoch [17/200], Loss: 0.2038, Training Accuracy: 0.9306, Validation Accuracy:
0.7961
Epoch [18/200], Loss: 0.2448, Training Accuracy: 0.9169, Validation Accuracy:
0.8021
Epoch [19/200], Loss: 0.2104, Training Accuracy: 0.8938, Validation Accuracy:
0.8095
Early stopping at epoch 20
Best Validation Accuracy: 0.8333333333333334 at epoch 10
```

2.5.4 v2 Training

Using v2 features on v1 models

Full 3

[51]:
```
FULL_3_LOGS_V2 = os.path.join(os.getcwd(), 'logs/whoop-activity-class/v2/
↪full-3')
FULL_3_MODELPATH_V2 = os.path.join(os.getcwd(), 'models/whoop-activity-class/v2/
↪full-3')
```

[52]:
```
train_classification_models(classification_models_v1, X_wo_full_3_v2,␣
↪y_wo_full_3_v2, class_kf_v1, FULL_3_LOGS_V2)
```

```
Training Random Forest

Accuracy: 0.7619 (+/- 0.0521)
Classification Report:
```

```
                precision    recall  f1-score   support

           0       0.78      0.81      0.79       144
           1       0.70      0.52      0.60       109
           2       0.81      0.90      0.85       196

    accuracy                           0.78       449
   macro avg       0.76      0.74      0.75       449
weighted avg       0.77      0.78      0.77       449


Training Rotation Forest

Accuracy: 0.7441 (+/- 0.0699)
Classification Report:
                precision    recall  f1-score   support

           0       0.75      0.83      0.79       144
           1       0.70      0.45      0.55       109
           2       0.79      0.88      0.83       196

    accuracy                           0.76       449
   macro avg       0.75      0.72      0.72       449
weighted avg       0.75      0.76      0.75       449


Training XGBoost

Accuracy: 0.7486 (+/- 0.0582)
Classification Report:
                precision    recall  f1-score   support

           0       0.74      0.77      0.76       144
           1       0.61      0.52      0.56       109
           2       0.82      0.86      0.84       196

    accuracy                           0.75       449
   macro avg       0.72      0.72      0.72       449
weighted avg       0.74      0.75      0.74       449
```

[52]:
```
{'Random Forest': RandomForestClassifier(),
 'Rotation Forest': RotationForest(random_state=42),
 'XGBoost': XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=None, device=None, early_stopping_rounds=None,
```

```
                enable_categorical=False, eval_metric='mlogloss',
                feature_types=None, gamma=None, grow_policy=None,
                importance_type=None, interaction_constraints=None,
                learning_rate=None, max_bin=None, max_cat_threshold=None,
                max_cat_to_onehot=None, max_delta_step=None, max_depth=None,
                max_leaves=None, min_child_weight=None, missing=nan,
                monotone_constraints=None, multi_strategy=None,
n_estimators=None,
                n_jobs=None, num_parallel_tree=None, objective='multi:softprob',
…)}
```

[53]:
```
FULL_3_MODEL_V2_CONFIG = {
    'lr': 1e-2,
    'hidden_size': int(1e3),
    'batch_size': 32,
    'num_epochs': 200,
    'early_stop': 10,
    'log_dir': FULL_3_LOGS_V2,
    'model_path': FULL_3_MODELPATH_V2,
    'print': True
}
```

[62]:
```
train_classification_nn(
    FULL_3_MODEL_V2_CONFIG,
    X_wo_full_3_v2,
    y_wo_full_3_v2
)
```

```
Using device: mps
Epoch [0/200], Loss: 1.4897, Training Accuracy: 0.5956, Validation Accuracy:
0.5337
Epoch [1/200], Loss: 0.9266, Training Accuracy: 0.6793, Validation Accuracy:
0.7796
Epoch [2/200], Loss: 0.7319, Training Accuracy: 0.7210, Validation Accuracy:
0.6058
Epoch [3/200], Loss: 0.8453, Training Accuracy: 0.6685, Validation Accuracy:
0.7380
Epoch [4/200], Loss: 0.8353, Training Accuracy: 0.7392, Validation Accuracy:
0.7692
Epoch [5/200], Loss: 0.6706, Training Accuracy: 0.7664, Validation Accuracy:
0.6242
Epoch [6/200], Loss: 0.7537, Training Accuracy: 0.7258, Validation Accuracy:
0.6210
Epoch [7/200], Loss: 0.6408, Training Accuracy: 0.7656, Validation Accuracy:
0.7484
Epoch [8/200], Loss: 0.7060, Training Accuracy: 0.7325, Validation Accuracy:
0.5929
Epoch [9/200], Loss: 0.8712, Training Accuracy: 0.7481, Validation Accuracy:
```

```
0.7019
Epoch [10/200], Loss: 0.7770, Training Accuracy: 0.7467, Validation Accuracy:
0.6659
Early stopping at epoch 11
Best Validation Accuracy: 0.7796474496523539 at epoch 1
```

Limited 8

[55]:
```
LIM_8_LOGS_V2 = os.path.join(os.getcwd(), 'logs/whoop-activity-class/v2/lim-8')
LIM_8_MODELPATH_V2 = os.path.join(os.getcwd(), 'models/whoop-activity-class/v2/
↪lim-8')
```

[56]:
```
train_classification_models(classification_models_v1, X_wo_lim_8_v2,␣
↪y_wo_lim_8_v2, class_kf_v1, LIM_8_LOGS_V2)
```

```
Training Random Forest

Accuracy: 0.6711 (+/- 0.0511)
Classification Report:
              precision    recall  f1-score   support

           0       0.59      0.39      0.47        33
           1       0.63      0.75      0.69        96
           2       0.60      0.50      0.55        12
           3       0.50      0.33      0.40        12
           4       0.25      0.06      0.09        35
           5       0.74      0.91      0.82       161
           6       0.64      0.35      0.45        20
           7       0.93      0.76      0.84        17

    accuracy                           0.68       386
   macro avg       0.61      0.51      0.54       386
weighted avg       0.65      0.68      0.65       386


Training Rotation Forest

Accuracy: 0.6605 (+/- 0.0487)
Classification Report:
              precision    recall  f1-score   support

           0       0.44      0.33      0.38        33
           1       0.61      0.72      0.66        96
           2       0.55      0.50      0.52        12
           3       0.56      0.42      0.48        12
           4       0.11      0.03      0.05        35
           5       0.73      0.87      0.79       161
           6       0.33      0.20      0.25        20
           7       0.93      0.76      0.84        17
```

```
    accuracy                           0.65       386
   macro avg       0.53      0.48      0.50       386
weighted avg       0.59      0.65      0.61       386


Training XGBoost

Accuracy: 0.6479 (+/- 0.0415)
Classification Report:
              precision    recall  f1-score   support

           0       0.38      0.39      0.39        33
           1       0.65      0.67      0.66        96
           2       0.38      0.42      0.40        12
           3       0.56      0.42      0.48        12
           4       0.30      0.17      0.22        35
           5       0.77      0.85      0.81       161
           6       0.33      0.30      0.32        20
           7       0.88      0.82      0.85        17

    accuracy                           0.65       386
   macro avg       0.53      0.50      0.51       386
weighted avg       0.63      0.65      0.64       386
```

[56]:
```
{'Random Forest': RandomForestClassifier(),
 'Rotation Forest': RotationForest(random_state=42),
 'XGBoost': XGBClassifier(base_score=None, booster=None, callbacks=None,
               colsample_bylevel=None, colsample_bynode=None,
               colsample_bytree=None, device=None, early_stopping_rounds=None,
               enable_categorical=False, eval_metric='mlogloss',
               feature_types=None, gamma=None, grow_policy=None,
               importance_type=None, interaction_constraints=None,
               learning_rate=None, max_bin=None, max_cat_threshold=None,
               max_cat_to_onehot=None, max_delta_step=None, max_depth=None,
               max_leaves=None, min_child_weight=None, missing=nan,
               monotone_constraints=None, multi_strategy=None,
n_estimators=None,
               n_jobs=None, num_parallel_tree=None, objective='multi:softprob',
…)}
```

[57]:
```
LIM_8_MODEL_V2_CONFIG = {
    'lr': 1e-2,
    'hidden_size': int(1e3),
    'batch_size': 32,
```

```
    'num_epochs': 200,
    'early_stop': 10,
    'log_dir': LIM_8_LOGS_V2,
    'model_path': LIM_8_MODELPATH_V2,
    'print': True
}
```

[63]:
```
train_classification_nn(
    LIM_8_MODEL_V2_CONFIG,
    X_wo_lim_8_v2,
    y_wo_lim_8_v2
)
```

```
Using device: mps
Epoch [0/200], Loss: 2.4883, Training Accuracy: 0.3331, Validation Accuracy:
0.2723
Epoch [1/200], Loss: 1.8059, Training Accuracy: 0.4744, Validation Accuracy:
0.2098
Epoch [2/200], Loss: 1.7748, Training Accuracy: 0.5019, Validation Accuracy:
0.5134
Epoch [3/200], Loss: 1.1420, Training Accuracy: 0.5062, Validation Accuracy:
0.4762
Epoch [4/200], Loss: 1.2047, Training Accuracy: 0.5431, Validation Accuracy:
0.5179
Epoch [5/200], Loss: 0.9447, Training Accuracy: 0.5819, Validation Accuracy:
0.5342
Epoch [6/200], Loss: 1.0468, Training Accuracy: 0.6100, Validation Accuracy:
0.5655
Epoch [7/200], Loss: 1.0812, Training Accuracy: 0.5594, Validation Accuracy:
0.4271
Epoch [8/200], Loss: 0.8748, Training Accuracy: 0.5938, Validation Accuracy:
0.5134
Epoch [9/200], Loss: 0.7014, Training Accuracy: 0.6550, Validation Accuracy:
0.6384
Epoch [10/200], Loss: 0.8281, Training Accuracy: 0.6294, Validation Accuracy:
0.5580
Epoch [11/200], Loss: 0.5903, Training Accuracy: 0.7194, Validation Accuracy:
0.6890
Epoch [12/200], Loss: 0.5898, Training Accuracy: 0.7169, Validation Accuracy:
0.3899
Epoch [13/200], Loss: 0.6059, Training Accuracy: 0.6800, Validation Accuracy:
0.4970
Epoch [14/200], Loss: 0.4585, Training Accuracy: 0.7319, Validation Accuracy:
0.5625
Epoch [15/200], Loss: 0.5919, Training Accuracy: 0.7713, Validation Accuracy:
0.4479
Epoch [16/200], Loss: 0.5653, Training Accuracy: 0.6906, Validation Accuracy:
0.7232
```

```
Epoch [17/200], Loss: 0.6793, Training Accuracy: 0.7262, Validation Accuracy:
0.6131
Epoch [18/200], Loss: 0.5673, Training Accuracy: 0.7475, Validation Accuracy:
0.7098
Epoch [19/200], Loss: 0.5412, Training Accuracy: 0.7394, Validation Accuracy:
0.7158
Epoch [20/200], Loss: 0.5169, Training Accuracy: 0.7919, Validation Accuracy:
0.5759
Epoch [21/200], Loss: 0.5592, Training Accuracy: 0.7613, Validation Accuracy:
0.6205
Epoch [22/200], Loss: 0.5090, Training Accuracy: 0.7088, Validation Accuracy:
0.5967
Epoch [23/200], Loss: 0.6070, Training Accuracy: 0.7306, Validation Accuracy:
0.6890
Epoch [24/200], Loss: 0.5389, Training Accuracy: 0.7369, Validation Accuracy:
0.6518
Epoch [25/200], Loss: 0.5165, Training Accuracy: 0.8244, Validation Accuracy:
0.5164
Early stopping at epoch 26
Best Validation Accuracy: 0.723214308420817 at epoch 16
```

2.5.5 v3 Training

Using v2 features on v3 models. v3 models are optimized by using GridSearch

Full 3

[64]:
```
FULL_3_LOGS_V3 = os.path.join(os.getcwd(), 'logs/whoop-activity-class/v3/
↪full-3')
FULL_3_MODELPATH_V3 = os.path.join(os.getcwd(), 'models/whoop-activity-class/v3/
↪full-3')
```

[65]:
```
best_classification_models_full_3_v3 =␣
↪grid_search_classification_models(classification_models_v3,␣
↪class_param_grids_v3, X_wo_full_3_v2, y_wo_full_3_v2, class_kf_v3)
```

```
Optimizing Random Forest
Original Parameters: {'n_estimators': 100, 'max_depth': None,
'min_samples_split': 2, 'min_samples_leaf': 1}
Best Parameters: {'max_depth': 40, 'min_samples_leaf': 1, 'min_samples_split':
2, 'n_estimators': 50}

Optimizing Rotation Forest
Original Parameters: {'n_classifiers': 10, 'n_splits': 3,
'base_classifier__n_estimators': 100, 'base_classifier__max_depth': None,
'base_classifier__min_samples_split': 2}

/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/model_selection/_validation.py:425: FitFailedWarning:
2880 fits failed out of a total of 5760.
```

```
The score on these train-test partitions for these parameters will be set to
nan.
If these failures are not expected, you can try to debug them by setting
error_score='raise'.

Below are more details about the failures:
--------------------------------------------------------------------------------
2592 fits failed with the following error:
Traceback (most recent call last):
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/model_selection/_validation.py", line 729, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/var/folders/v2/f0f7cs8s1z1d9c0543w9ftcr0000gn/T/ipykernel_63198/1641602
099.py", line 27, in fit
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/utils/_set_output.py", line 157, in wrapped
    data_to_wrap = f(self, X, *args, **kwargs)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/base.py", line 1152, in wrapper
    return fit_method(estimator, *args, **kwargs)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/decomposition/_pca.py", line 460, in fit_transform
    U, S, Vt = self._fit(X)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/decomposition/_pca.py", line 483, in _fit
    X = self._validate_data(
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/base.py", line 605, in _validate_data
    out = check_array(X, input_name="X", **check_params)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/utils/validation.py", line 976, in check_array
    raise ValueError(
ValueError: Found array with 0 feature(s) (shape=(404, 0)) while a minimum of 1
is required by PCA.

--------------------------------------------------------------------------------
288 fits failed with the following error:
Traceback (most recent call last):
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/model_selection/_validation.py", line 729, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/var/folders/v2/f0f7cs8s1z1d9c0543w9ftcr0000gn/T/ipykernel_63198/1641602
099.py", line 27, in fit
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/utils/_set_output.py", line 157, in wrapped
    data_to_wrap = f(self, X, *args, **kwargs)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/base.py", line 1152, in wrapper
```

```
    return fit_method(estimator, *args, **kwargs)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/decomposition/_pca.py", line 460, in fit_transform
    U, S, Vt = self._fit(X)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/decomposition/_pca.py", line 483, in _fit
    X = self._validate_data(
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/base.py", line 605, in _validate_data
    out = check_array(X, input_name="X", **check_params)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/utils/validation.py", line 976, in check_array
    raise ValueError(
ValueError: Found array with 0 feature(s) (shape=(405, 0)) while a minimum of 1
is required by PCA.

  warnings.warn(some_fits_failed_message, FitFailedWarning)
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/model_selection/_search.py:979: UserWarning: One or more of the
test scores are non-finite: [0.74858586 0.7529798         nan        nan
0.74848485 0.73969697
        nan        nan 0.74409091 0.76409091        nan        nan
 0.74186869 0.73974747        nan        nan 0.74414141 0.77080808
        nan        nan 0.73060606 0.75070707        nan        nan
 0.73959596 0.78414141        nan        nan 0.73747475 0.74414141
        nan        nan 0.73964646 0.76863636        nan        nan
 0.73727273 0.74863636        nan        nan 0.75515152 0.78419192
        nan        nan 0.74636364 0.75974747        nan        nan
 0.73065657 0.77535354        nan        nan 0.75520202 0.75075758
        nan        nan 0.75075758 0.7729798         nan        nan
 0.77080808 0.7619697         nan        nan 0.74409091 0.75974747
        nan        nan 0.75742424 0.75530303        nan        nan
 0.73292929 0.77747475        nan        nan 0.73075758 0.75080808
        nan        nan 0.73752525 0.75525253        nan        nan
 0.73070707 0.75080808        nan        nan 0.74631313 0.78853535
        nan        nan 0.75080808 0.75530303        nan        nan
 0.74414141 0.77313131        nan        nan 0.75505051 0.76419192
        nan        nan 0.74621212 0.78631313        nan        nan
 0.74858586 0.76646465        nan        nan 0.74181818 0.76646465
        nan        nan 0.75065657 0.75520202        nan        nan
 0.75732323 0.75954545        nan        nan 0.75080808 0.75530303
        nan        nan 0.72848485 0.76186869        nan        nan
 0.74853535 0.73060606        nan        nan 0.74848485 0.77959596
        nan        nan 0.74848485 0.74636364        nan        nan
 0.73070707 0.75070707        nan        nan 0.75292929 0.76409091
        nan        nan 0.75070707 0.76409091        nan        nan
 0.74858586 0.7620202         nan        nan 0.74626263 0.75974747
        nan        nan 0.75070707 0.76853535        nan        nan
```

```
0.75737374 0.77959596        nan        nan 0.75752525 0.76419192
       nan        nan 0.75065657 0.75747475        nan        nan
0.75732323 0.7530303         nan        nan 0.76186869 0.77070707
       nan        nan 0.75969697 0.76424242        nan        nan
0.71515152 0.73737374        nan        nan 0.73954545 0.72843434
       nan        nan 0.74843434 0.7729798         nan        nan
0.74424242 0.73530303        nan        nan 0.73070707 0.75075758
       nan        nan 0.75515152 0.75308081        nan        nan
0.75292929 0.78414141        nan        nan 0.7530303  0.73742424
       nan        nan 0.73292929 0.76636364        nan        nan
0.74181818 0.75080808        nan        nan 0.76181818 0.77070707
       nan        nan 0.76191919 0.75752525        nan        nan
0.74181818 0.75525253        nan        nan 0.74621212 0.75510101
       nan        nan 0.76409091 0.77520202        nan        nan
0.76646465 0.74646465        nan        nan 0.73515152 0.75747475
       nan        nan 0.75055556 0.7529798         nan        nan
0.75737374 0.77530303        nan        nan 0.74858586 0.75070707
       nan        nan 0.73282828 0.76409091        nan        nan
0.73949495 0.73075758        nan        nan 0.75510101 0.77964646
       nan        nan 0.75742424 0.73964646        nan        nan
0.73070707 0.76631313        nan        nan 0.75065657 0.75075758
       nan        nan 0.75287879 0.77964646        nan        nan
0.75070707 0.75747475        nan        nan 0.7530303  0.76191919
       nan        nan 0.75959596 0.7440404         nan        nan
0.7440404  0.77075758        nan        nan 0.76191919 0.75090909
       nan        nan 0.74848485 0.7529798         nan        nan
0.74388889 0.75520202        nan        nan 0.75287879 0.76858586
       nan        nan 0.75742424 0.73959596        nan        nan
0.7439899  0.77085859        nan        nan 0.75510101 0.7440404
       nan        nan 0.75065657 0.76863636        nan        nan
0.75292929 0.76414141        nan        nan 0.7439899  0.75742424
       nan        nan 0.75510101 0.74631313        nan        nan
0.7729798  0.77520202        nan        nan 0.75520202 0.76419192
       nan        nan 0.74191919 0.75308081        nan        nan
0.75959596 0.74843434        nan        nan 0.75737374 0.77525253
       nan        nan 0.75308081 0.75540404        nan        nan
0.73080808 0.75979798        nan        nan 0.72843434 0.73292929
       nan        nan 0.74843434 0.76414141        nan        nan
0.74626263 0.74419192        nan        nan 0.75974747 0.77075758
       nan        nan 0.74191919 0.73742424        nan        nan
0.74858586 0.78636364        nan        nan 0.76858586 0.75979798
       nan        nan 0.74186869 0.76641414        nan        nan
0.7439899  0.76631313        nan        nan 0.74626263 0.77964646
       nan        nan 0.7529798  0.75540404        nan        nan
0.75080808 0.76414141        nan        nan 0.7530303  0.74631313
       nan        nan 0.74186869 0.77969697        nan        nan
0.75747475 0.75984848        nan        nan 0.76393939 0.75530303
       nan        nan 0.74409091 0.74848485        nan        nan
```

```
 0.75292929 0.77075758        nan        nan 0.7529798  0.76207071
        nan        nan 0.74414141 0.77530303        nan        nan
 0.74838384 0.74409091        nan        nan 0.74631313 0.77969697
        nan        nan 0.76186869 0.75530303        nan        nan
 0.75085859 0.76186869        nan        nan 0.73737374 0.75964646
        nan        nan 0.75070707 0.78186869        nan        nan
 0.7619697  0.7620202         nan        nan 0.75292929 0.75530303
        nan        nan 0.74409091 0.76414141        nan        nan
 0.75737374 0.78409091        nan        nan 0.76191919 0.76651515
        nan        nan 0.73292929 0.75964646        nan        nan
 0.73954545 0.73969697        nan        nan 0.7529798  0.75964646
        nan        nan 0.74409091 0.75757576        nan        nan
 0.73287879 0.76186869        nan        nan 0.75075758 0.75520202
        nan        nan 0.75070707 0.77075758        nan        nan
 0.76636364 0.76419192        nan        nan 0.74631313 0.77085859
        nan        nan 0.75075758 0.75075758        nan        nan
 0.75737374 0.76409091        nan        nan 0.76414141 0.75979798
        nan        nan 0.74176768 0.7619697         nan        nan
 0.75070707 0.74626263        nan        nan 0.75292929 0.77075758
        nan        nan 0.76409091 0.75979798        nan        nan]
  warnings.warn(
```

```
Best Parameters: {'base_classifier__max_depth': None,
'base_classifier__min_samples_split': 5, 'base_classifier__n_estimators': 50,
'n_classifiers': 20, 'n_splits': 7}

Optimizing XGBoost
Original Parameters: {'n_estimators': None, 'learning_rate': None, 'max_depth':
None, 'subsample': None, 'colsample_bytree': None, 'gamma': None}
Best Parameters: {'colsample_bytree': 0.9, 'gamma': 0, 'learning_rate': 0.005,
'max_depth': 11, 'n_estimators': 100, 'subsample': 0.9}
```

[68]:
```
train_classification_models(best_classification_models_full_3_v3,␣
↪X_wo_full_3_v2, y_wo_full_3_v2, class_kf_v3, FULL_3_LOGS_V3)
```

```
Training Random Forest

Accuracy: 0.7396 (+/- 0.0548)
Classification Report:
              precision    recall  f1-score   support

           0       0.76      0.81      0.78       144
           1       0.68      0.48      0.56       109
           2       0.79      0.89      0.84       196

    accuracy                           0.76       449
   macro avg       0.74      0.72      0.73       449
weighted avg       0.75      0.76      0.75       449
```

```
Training Rotation Forest

Accuracy: 0.7730 (+/- 0.0448)
Classification Report:
              precision    recall  f1-score   support

           0       0.75      0.82      0.78       144
           1       0.75      0.50      0.60       109
           2       0.81      0.90      0.86       196

    accuracy                           0.78       449
   macro avg       0.77      0.74      0.75       449
weighted avg       0.78      0.78      0.77       449


Training XGBoost

Accuracy: 0.7886 (+/- 0.0657)
Classification Report:
              precision    recall  f1-score   support

           0       0.79      0.81      0.80       144
           1       0.71      0.58      0.64       109
           2       0.82      0.89      0.85       196

    accuracy                           0.79       449
   macro avg       0.77      0.76      0.76       449
weighted avg       0.78      0.79      0.78       449
```

[68]:
```
{'Random Forest': RandomForestClassifier(max_depth=40, n_estimators=50),
 'Rotation Forest':
 RotationForest(base_classifier=RandomForestClassifier(min_samples_split=5,
                                                       n_estimators=50),
                n_classifiers=20, n_splits=7, random_state=42),
 'XGBoost': XGBClassifier(base_score=None, booster=None, callbacks=None,
               colsample_bylevel=None, colsample_bynode=None,
               colsample_bytree=0.9, device=None, early_stopping_rounds=None,
               enable_categorical=False, eval_metric='mlogloss',
               feature_types=None, gamma=0, grow_policy=None,
               importance_type=None, interaction_constraints=None,
               learning_rate=0.005, max_bin=None, max_cat_threshold=None,
               max_cat_to_onehot=None, max_delta_step=None, max_depth=11,
               max_leaves=None, min_child_weight=None, missing=nan,
```

```
                monotone_constraints=None, multi_strategy=None, n_estimators=100,
                n_jobs=None, num_parallel_tree=None, objective='multi:softprob',
…)}
```

[66]:
```
FULL_3_MODEL_V3_SEARCH = {
    'lr': tune.grid_search([1e-1, 5e-2, 1e-2, 5e-3, 1e-3]),
    'hidden_size': tune.grid_search([int(1e2), int(5e2), int(1e3), int(5e3)]),
    'batch_size': tune.grid_search([16, 32, 64]),
    'num_epochs': 200,
    'early_stop': 10,
    'log_dir': FULL_3_LOGS_V3,
    'model_path': FULL_3_MODELPATH_V3
}
```

[67]:
```
tune_classification_nn(
    FULL_3_MODEL_V3_SEARCH,
    X_wo_full_3_v2,
    y_wo_full_3_v2
)
```

```
2024-06-26 13:37:35,045 INFO worker.py:1770 -- Started a local Ray instance.
2024-06-26 13:37:35,640 INFO tune.py:253 -- Initializing Ray automatically. For
cluster usage or custom Ray initialization, call `ray.init(…)` before
`tune.run(…)`.
2024-06-26 13:37:35,643 INFO tune.py:616 -- [output] This uses the legacy output
and progress reporter, as Jupyter notebooks are not supported by the new engine,
yet. For more information, please see https://github.com/ray-
project/ray/issues/36949

== Status ==
Current time: 2024-06-26 13:37:36 (running for 00:00:00.45)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: None
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (60 PENDING)
+-----------------------------------+----------+-------+------+--------------
+-------------+--------------+
| Trial name                        | status   | loc   |   lr |   hidden_size
|   batch_size |   num_epochs |
|-----------------------------------+----------+-------+------+--------------
+-------------+--------------|
| train_classification_nn_28337_00000 | PENDING  |       | 0.1  |           100
|           16 |          200 |
| train_classification_nn_28337_00001 | PENDING  |       | 0.1  |           100
|           32 |          200 |
```

```
| train_classification_nn_28337_00002 | PENDING  |       | 0.1  |          100
|          64 |          200 |
| train_classification_nn_28337_00003 | PENDING  |       | 0.1  |          500
|          16 |          200 |
| train_classification_nn_28337_00004 | PENDING  |       | 0.1  |          500
|          32 |          200 |
| train_classification_nn_28337_00005 | PENDING  |       | 0.1  |          500
|          64 |          200 |
| train_classification_nn_28337_00006 | PENDING  |       | 0.1  |         1000
|          16 |          200 |
| train_classification_nn_28337_00007 | PENDING  |       | 0.1  |         1000
|          32 |          200 |
| train_classification_nn_28337_00008 | PENDING  |       | 0.1  |         1000
|          64 |          200 |
| train_classification_nn_28337_00009 | PENDING  |       | 0.1  |         5000
|          16 |          200 |
| train_classification_nn_28337_00010 | PENDING  |       | 0.1  |         5000
|          32 |          200 |
| train_classification_nn_28337_00011 | PENDING  |       | 0.1  |         5000
|          64 |          200 |
| train_classification_nn_28337_00012 | PENDING  |       | 0.05 |          100
|          16 |          200 |
| train_classification_nn_28337_00013 | PENDING  |       | 0.05 |          100
|          32 |          200 |
| train_classification_nn_28337_00014 | PENDING  |       | 0.05 |          100
|          64 |          200 |
| train_classification_nn_28337_00015 | PENDING  |       | 0.05 |          500
|          16 |          200 |
| train_classification_nn_28337_00016 | PENDING  |       | 0.05 |          500
|          32 |          200 |
| train_classification_nn_28337_00017 | PENDING  |       | 0.05 |          500
|          64 |          200 |
| train_classification_nn_28337_00018 | PENDING  |       | 0.05 |         1000
|          16 |          200 |
| train_classification_nn_28337_00019 | PENDING  |       | 0.05 |         1000
|          32 |          200 |
+-------------------------------------+----------+-------+------+--------------
+--------------+--------------+
… 40 more trials not shown (40 PENDING)


(train_classification_nn pid=78863) Using device: mps
== Status ==
Current time: 2024-06-26 13:37:41 (running for 00:00:05.49)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: None
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
```

```
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (50 PENDING, 10 RUNNING)
+-----------------------------------+----------+----------------+------+-----
----------+-------------+-------------+
| Trial name                        | status   | loc            |   lr |
hidden_size |   batch_size |   num_epochs |
|-----------------------------------+----------+----------------+------+-----
----------+-------------+-------------|
| train_classification_nn_28337_00000 | RUNNING  | 127.0.0.1:78859 | 0.1  |
100 |           16 |          200 |
| train_classification_nn_28337_00001 | RUNNING  | 127.0.0.1:78860 | 0.1  |
100 |           32 |          200 |
| train_classification_nn_28337_00002 | RUNNING  | 127.0.0.1:78861 | 0.1  |
100 |           64 |          200 |
| train_classification_nn_28337_00003 | RUNNING  | 127.0.0.1:78862 | 0.1  |
500 |           16 |          200 |
| train_classification_nn_28337_00004 | RUNNING  | 127.0.0.1:78863 | 0.1  |
500 |           32 |          200 |
| train_classification_nn_28337_00005 | RUNNING  | 127.0.0.1:78864 | 0.1  |
500 |           64 |          200 |
| train_classification_nn_28337_00006 | RUNNING  | 127.0.0.1:78865 | 0.1  |
1000 |           16 |          200 |
| train_classification_nn_28337_00007 | RUNNING  | 127.0.0.1:78867 | 0.1  |
1000 |           32 |          200 |
| train_classification_nn_28337_00008 | RUNNING  | 127.0.0.1:78868 | 0.1  |
1000 |           64 |          200 |
| train_classification_nn_28337_00009 | RUNNING  | 127.0.0.1:78869 | 0.1  |
5000 |           16 |          200 |
| train_classification_nn_28337_00010 | PENDING  |                 | 0.1  |
5000 |           32 |          200 |
| train_classification_nn_28337_00011 | PENDING  |                 | 0.1  |
5000 |           64 |          200 |
| train_classification_nn_28337_00012 | PENDING  |                 | 0.05 |
100 |           16 |          200 |
| train_classification_nn_28337_00013 | PENDING  |                 | 0.05 |
100 |           32 |          200 |
| train_classification_nn_28337_00014 | PENDING  |                 | 0.05 |
100 |           64 |          200 |
| train_classification_nn_28337_00015 | PENDING  |                 | 0.05 |
500 |           16 |          200 |
| train_classification_nn_28337_00016 | PENDING  |                 | 0.05 |
500 |           32 |          200 |
| train_classification_nn_28337_00017 | PENDING  |                 | 0.05 |
500 |           64 |          200 |
| train_classification_nn_28337_00018 | PENDING  |                 | 0.05 |
1000 |           16 |          200 |
| train_classification_nn_28337_00019 | PENDING  |                 | 0.05 |
```

```
1000 |           32 |          200 |
+-----------------------------------+----------+----------------+------+-----
----------+-------------+-------------+
… 40 more trials not shown (40 PENDING)



<IPython.core.display.HTML object>

== Status ==
Current time: 2024-06-26 13:37:46 (running for 00:00:10.51)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.728365401426951
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (50 PENDING, 8 RUNNING, 2 TERMINATED)
+-----------------------------------+-----------+----------------+------+---
-----------+-------------+-------------+----------+-----------+-------------
---+
| Trial name                        | status    | loc            |   lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-----------------------------------+-----------+----------------+------+---
-----------+-------------+-------------+----------+-----------+-------------
---|
| train_classification_nn_28337_00000 | RUNNING   | 127.0.0.1:78859 | 0.1  |
100 |           16 |          200 | 0.755288 |   0.718556 |       0.645833 |
| train_classification_nn_28337_00001 | RUNNING   | 127.0.0.1:78860 | 0.1  |
100 |           32 |          200 | 0.568453 |   0.755952 |       0.733173 |
| train_classification_nn_28337_00003 | RUNNING   | 127.0.0.1:78862 | 0.1  |
500 |           16 |          200 | 0.720297 |   0.71778  |       0.604167 |
| train_classification_nn_28337_00004 | RUNNING   | 127.0.0.1:78863 | 0.1  |
500 |           32 |          200 | 0.691133 |   0.710938 |       0.741186 |
| train_classification_nn_28337_00005 | RUNNING   | 127.0.0.1:78864 | 0.1  |
500 |           64 |          200 | 0.385664 |   0.841747 |       0.670673 |
| train_classification_nn_28337_00006 | RUNNING   | 127.0.0.1:78865 | 0.1  |
1000 |           16 |          200 | 0.747587 |   0.678571 |       0.779167 |
| train_classification_nn_28337_00007 | RUNNING   | 127.0.0.1:78867 | 0.1  |
1000 |           32 |          200 | 0.566316 |   0.747396 |       0.766827 |
| train_classification_nn_28337_00009 | RUNNING   | 127.0.0.1:78869 | 0.1  |
5000 |           16 |          200 | 0.890066 |   0.675078 |       0.695833 |
| train_classification_nn_28337_00010 | PENDING   |                 | 0.1  |
5000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00011 | PENDING   |                 | 0.1  |
5000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00012 | PENDING   |                 | 0.05 |
100 |           16 |          200 |          |            |                |
```

```
| train_classification_nn_28337_00013 | PENDING    |                 | 0.05 |
100 |           32 |          200 |          |            |                 |
| train_classification_nn_28337_00014 | PENDING    |                 | 0.05 |
100 |           64 |          200 |          |            |                 |
| train_classification_nn_28337_00015 | PENDING    |                 | 0.05 |
500 |           16 |          200 |          |            |                 |
| train_classification_nn_28337_00016 | PENDING    |                 | 0.05 |
500 |           32 |          200 |          |            |                 |
| train_classification_nn_28337_00017 | PENDING    |                 | 0.05 |
500 |           64 |          200 |          |            |                 |
| train_classification_nn_28337_00018 | PENDING    |                 | 0.05 |
1000 |           16 |          200 |          |            |                 |
| train_classification_nn_28337_00019 | PENDING    |                 | 0.05 |
1000 |           32 |          200 |          |            |                 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1  |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00008 | TERMINATED | 127.0.0.1:78868 | 0.1  |
1000 |           64 |          200 | 0.51141  |   0.802885 |       0.689303 |
+-------------------------------------+------------+-----------------+------+---
------------+-------------+-------------+----------+------------+-------------
---+
… 40 more trials not shown (40 PENDING)


(train_classification_nn pid=78968) Using device: mps [repeated
10x across cluster] (Ray deduplicates logs by default. Set RAY_DEDUP_LOGS=0 to
disable log deduplication, or see https://docs.ray.io/en/master/ray-
observability/user-guides/configure-logging.html#log-deduplication for more
options.)
== Status ==
Current time: 2024-06-26 13:37:51 (running for 00:00:15.53)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7380475534333123
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (47 PENDING, 7 RUNNING, 6 TERMINATED)
+-------------------------------------+------------+-----------------+------+---
------------+-------------+-------------+----------+------------+-------------
---+
| Trial name                          | status     | loc             |   lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-------------------------------------+------------+-----------------+------+---
```

```
------------+-------------+-------------+----------+------------+-------------
---|
| train_classification_nn_28337_00000 | RUNNING    | 127.0.0.1:78859 | 0.1  |
100 |           16 |          200 | 0.664618 |   0.720109 |       0.69375  |
| train_classification_nn_28337_00003 | RUNNING    | 127.0.0.1:78862 | 0.1  |
500 |           16 |          200 | 0.651741 |   0.753106 |       0.69375  |
| train_classification_nn_28337_00004 | RUNNING    | 127.0.0.1:78863 | 0.1  |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00009 | RUNNING    | 127.0.0.1:78869 | 0.1  |
5000 |           16 |          200 | 0.76212  |   0.677795 |       0.6625   |
| train_classification_nn_28337_00010 | RUNNING    | 127.0.0.1:78968 | 0.1  |
5000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00011 | RUNNING    | 127.0.0.1:78994 | 0.1  |
5000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00012 | RUNNING    | 127.0.0.1:78995 | 0.05 |
100 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00013 | PENDING    |                 | 0.05 |
100 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00014 | PENDING    |                 | 0.05 |
100 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00015 | PENDING    |                 | 0.05 |
500 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00016 | PENDING    |                 | 0.05 |
500 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00017 | PENDING    |                 | 0.05 |
500 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00018 | PENDING    |                 | 0.05 |
1000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00019 | PENDING    |                 | 0.05 |
1000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1  |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1  |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1  |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1  |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
| train_classification_nn_28337_00007 | TERMINATED | 127.0.0.1:78867 | 0.1  |
1000 |           32 |          200 | 0.592407 |   0.749256 |       0.779647 |
| train_classification_nn_28337_00008 | TERMINATED | 127.0.0.1:78868 | 0.1  |
1000 |           64 |          200 | 0.51141  |   0.802885 |       0.689303 |
+-------------------------------------+------------+-----------------+------+---
------------+-------------+-------------+----------+------------+-------------
---+
… 40 more trials not shown (40 PENDING)
```

```
(train_classification_nn pid=79037) Using device: mps [repeated 5x
across cluster]
== Status ==
Current time: 2024-06-26 13:37:56 (running for 00:00:20.54)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7380475534333123
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (44 PENDING, 7 RUNNING, 9 TERMINATED)
+-----------------------------------+-----------+----------------+------+---
-----------+-------------+-------------+----------+-----------+-------------
---+
| Trial name                        | status    | loc            |   lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-----------------------------------+-----------+----------------+------+---
-----------+-------------+-------------+----------+-----------+-------------
---|
| train_classification_nn_28337_00009 | RUNNING    | 127.0.0.1:78869 | 0.1  |
5000 |           16 |          200 | 0.718347 |   0.697593 |       0.76875  |
| train_classification_nn_28337_00010 | RUNNING    | 127.0.0.1:78968 | 0.1  |
5000 |           32 |          200 | 0.858963 |   0.715774 |       0.588141 |
| train_classification_nn_28337_00011 | RUNNING    | 127.0.0.1:78994 | 0.1  |
5000 |           64 |          200 | 0.759946 |   0.729567 |       0.585938 |
| train_classification_nn_28337_00012 | RUNNING    | 127.0.0.1:78995 | 0.05 |
100 |           16 |          200 | 0.675969 |   0.736801 |       0.74375  |
| train_classification_nn_28337_00013 | RUNNING    | 127.0.0.1:78996 | 0.05 |
100 |           32 |          200 | 0.611041 |   0.757068 |       0.697115 |
| train_classification_nn_28337_00014 | RUNNING    | 127.0.0.1:79008 | 0.05 |
100 |           64 |          200 | 0.502354 |   0.80008  |       0.674279 |
| train_classification_nn_28337_00015 | RUNNING    | 127.0.0.1:79037 | 0.05 |
500 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00016 | PENDING    |                 | 0.05 |
500 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00017 | PENDING    |                 | 0.05 |
500 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00018 | PENDING    |                 | 0.05 |
1000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00019 | PENDING    |                 | 0.05 |
1000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00020 | PENDING    |                 | 0.05 |
1000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00021 | PENDING    |                 | 0.05 |
5000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00022 | PENDING    |                 | 0.05 |
```

```
5000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1  |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1  |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1  |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1  |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1  |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1  |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1  |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
+-------------------------------------+------------+-----------------+------+---
------------+-------------+-------------+----------+------------+-------------
---+
… 40 more trials not shown (37 PENDING, 2 TERMINATED)


== Status ==
Current time: 2024-06-26 13:38:01 (running for 00:00:25.57)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.6832932829856873
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (41 PENDING, 6 RUNNING, 13 TERMINATED)
+-------------------------------------+------------+-----------------+------+---
------------+-------------+-------------+----------+------------+-------------
---+
| Trial name                          | status     | loc             |   lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-------------------------------------+------------+-----------------+------+---
------------+-------------+-------------+----------+------------+-------------
---|
| train_classification_nn_28337_00010 | RUNNING    | 127.0.0.1:78968 | 0.1  |
5000 |           32 |          200 | 0.740899 |   0.706473 |       0.764423 |
| train_classification_nn_28337_00012 | RUNNING    | 127.0.0.1:78995 | 0.05 |
100 |           16 |          200 | 0.623786 |   0.743789 |       0.716667 |
| train_classification_nn_28337_00015 | RUNNING    | 127.0.0.1:79037 | 0.05 |
500 |           16 |          200 | 0.699297 |   0.717391 |       0.747917 |
| train_classification_nn_28337_00016 | RUNNING    | 127.0.0.1:79050 | 0.05 |
500 |           32 |          200 | 0.666441 |   0.768229 |       0.637821 |
| train_classification_nn_28337_00017 | RUNNING    | 127.0.0.1:79051 | 0.05 |
```

```
500 |           64 |          200 | 0.480941 |   0.803819 |       0.801683 |
| train_classification_nn_28337_00018 | RUNNING    | 127.0.0.1:79053 | 0.05 |
1000 |           16 |          200 | 0.783529 |   0.694099 |       0.7      |
| train_classification_nn_28337_00019 | PENDING    |                 | 0.05 |
1000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00020 | PENDING    |                 | 0.05 |
1000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00021 | PENDING    |                 | 0.05 |
5000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00022 | PENDING    |                 | 0.05 |
5000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00023 | PENDING    |                 | 0.05 |
5000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00024 | PENDING    |                 | 0.01 |
100 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00025 | PENDING    |                 | 0.01 |
100 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1  |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1  |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1  |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1  |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1  |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1  |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1  |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
+-------------------------------------+------------+-----------------+------+---
------------+-------------+-------------+----------+------------+-------------
---+
… 40 more trials not shown (34 PENDING, 6 TERMINATED)


(train_classification_nn pid=79099) Using device: mps [repeated 4x
across cluster]
== Status ==
Current time: 2024-06-26 13:38:06 (running for 00:00:30.60)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7013221383094788
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
```

```
Number of trials: 60/60 (37 PENDING, 7 RUNNING, 16 TERMINATED)
+-----------------------------------+------------+-----------------+------+---
-----------+-------------+-------------+-----------+------------+-----------
----+
| Trial name                        | status     | loc             |   lr |
hidden_size |   batch_size |   num_epochs |      loss |   accuracy |
val_accuracy |
|-----------------------------------+------------+-----------------+------+---
-----------+-------------+-------------+-----------+------------+-----------
----|
| train_classification_nn_28337_00010 | RUNNING    | 127.0.0.1:78968 | 0.1  |
5000 |           32 |          200 |  0.616311 |   0.782366 |       0.720353 |
| train_classification_nn_28337_00016 | RUNNING    | 127.0.0.1:79050 | 0.05 |
500 |           32 |          200 |  0.616437 |   0.755952 |       0.727564 |
| train_classification_nn_28337_00018 | RUNNING    | 127.0.0.1:79053 | 0.05 |
1000 |           16 |          200 |  0.746982 |   0.701475 |       0.60625  |
| train_classification_nn_28337_00019 | RUNNING    | 127.0.0.1:79099 | 0.05 |
1000 |           32 |          200 |  0.614304 |   0.744792 |       0.75641  |
| train_classification_nn_28337_00020 | RUNNING    | 127.0.0.1:79111 | 0.05 |
1000 |           64 |          200 |  0.619931 |   0.775708 |       0.759014 |
| train_classification_nn_28337_00021 | RUNNING    | 127.0.0.1:79112 | 0.05 |
5000 |           16 |          200 | 23.8318   |   0.511258 |       0.535417 |
| train_classification_nn_28337_00022 | RUNNING    | 127.0.0.1:79143 | 0.05 |
5000 |           32 |          200 |           |            |                |
| train_classification_nn_28337_00023 | PENDING    |                 | 0.05 |
5000 |           64 |          200 |           |            |                |
| train_classification_nn_28337_00024 | PENDING    |                 | 0.01 |
100 |           16 |          200 |           |            |                |
| train_classification_nn_28337_00025 | PENDING    |                 | 0.01 |
100 |           32 |          200 |           |            |                |
| train_classification_nn_28337_00026 | PENDING    |                 | 0.01 |
100 |           64 |          200 |           |            |                |
| train_classification_nn_28337_00027 | PENDING    |                 | 0.01 |
500 |           16 |          200 |           |            |                |
| train_classification_nn_28337_00028 | PENDING    |                 | 0.01 |
500 |           32 |          200 |           |            |                |
| train_classification_nn_28337_00029 | PENDING    |                 | 0.01 |
500 |           64 |          200 |           |            |                |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1  |
100 |           16 |          200 |  0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1  |
100 |           32 |          200 |  0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1  |
100 |           64 |          200 |  0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1  |
500 |           16 |          200 |  0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1  |
500 |           32 |          200 |  0.596172 |   0.741815 |       0.624199 |
```

```
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1  |
500 |           64 |          200 |  0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1  |
1000 |           16 |          200 |  0.747713 |   0.726708 |       0.614583 |
+-------------------------------------+------------+-----------------+------+---
------------+-------------+-------------+----------+------------+------------
----+
… 40 more trials not shown (30 PENDING, 9 TERMINATED)


(train_classification_nn pid=79155) Using device: mps [repeated 4x
across cluster]
== Status ==
Current time: 2024-06-26 13:38:11 (running for 00:00:35.62)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7162126236491733
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (34 PENDING, 5 RUNNING, 21 TERMINATED)
+-------------------------------------+------------+-----------------+------+---
------------+-------------+-------------+----------+------------+------------
---+
| Trial name                          | status     | loc             |   lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-------------------------------------+------------+-----------------+------+---
------------+-------------+-------------+----------+------------+------------
---|
| train_classification_nn_28337_00021 | RUNNING    | 127.0.0.1:79112 | 0.05 |
5000 |           16 |          200 | 0.762965 |   0.685947 |       0.7625   |
| train_classification_nn_28337_00022 | RUNNING    | 127.0.0.1:79143 | 0.05 |
5000 |           32 |          200 | 0.785742 |   0.723214 |       0.689103 |
| train_classification_nn_28337_00023 | RUNNING    | 127.0.0.1:79155 | 0.05 |
5000 |           64 |          200 | 7.55561  |   0.58774  |       0.619591 |
| train_classification_nn_28337_00024 | RUNNING    | 127.0.0.1:79156 | 0.01 |
100 |           16 |          200 | 0.699511 |   0.714674 |       0.675    |
| train_classification_nn_28337_00025 | RUNNING    | 127.0.0.1:79183 | 0.01 |
100 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00026 | PENDING    |                 | 0.01 |
100 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00027 | PENDING    |                 | 0.01 |
500 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00028 | PENDING    |                 | 0.01 |
500 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00029 | PENDING    |                 | 0.01 |
```

```
500 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00030 | PENDING    |                | 0.01 |
1000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00031 | PENDING    |                | 0.01 |
1000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00032 | PENDING    |                | 0.01 |
1000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00033 | PENDING    |                | 0.01 |
5000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1  |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1  |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1  |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1  |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1  |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1  |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1  |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
| train_classification_nn_28337_00007 | TERMINATED | 127.0.0.1:78867 | 0.1  |
1000 |           32 |          200 | 0.592407 |   0.749256 |       0.779647 |
+-------------------------------------+------------+-----------------+------+---
------------+-------------+-------------+----------+------------+------------
---+
… 40 more trials not shown (26 PENDING, 13 TERMINATED)


(train_classification_nn pid=79226) Using device: mps [repeated 6x
across cluster]
== Status ==
Current time: 2024-06-26 13:38:16 (running for 00:00:40.65)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7162126236491733
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (29 PENDING, 10 RUNNING, 21 TERMINATED)
+-------------------------------------+------------+-----------------+-------+--
------------+-------------+-------------+----------+------------+------------
----+
| Trial name                          | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
```

```
val_accuracy |
|-----------------------------------+------------+-----------------+-------+--
------------+-------------+-------------+----------+------------+-----------
----|
| train_classification_nn_28337_00021 | RUNNING    | 127.0.0.1:79112 | 0.05  |
5000 |           16 |          200 | 0.776457 |   0.732143 |       0.654167 |
| train_classification_nn_28337_00022 | RUNNING    | 127.0.0.1:79143 | 0.05  |
5000 |           32 |          200 | 0.956888 |   0.629464 |       0.613782 |
| train_classification_nn_28337_00023 | RUNNING    | 127.0.0.1:79155 | 0.05  |
5000 |           64 |          200 | 0.613441 |   0.758413 |       0.64363  |
| train_classification_nn_28337_00024 | RUNNING    | 127.0.0.1:79156 | 0.01  |
100 |           16 |          200 | 0.604336 |   0.751165 |       0.725    |
| train_classification_nn_28337_00025 | RUNNING    | 127.0.0.1:79183 | 0.01  |
100 |           32 |          200 | 0.452747 |   0.834449 |       0.800481 |
| train_classification_nn_28337_00026 | RUNNING    | 127.0.0.1:79202 | 0.01  |
100 |           64 |          200 | 0.330795 |   0.87707  |       0.728966 |
| train_classification_nn_28337_00027 | RUNNING    | 127.0.0.1:79203 | 0.01  |
500 |           16 |          200 | 0.775235 |   0.725155 |       0.702083 |
| train_classification_nn_28337_00031 | PENDING    |                 | 0.01  |
1000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00032 | PENDING    |                 | 0.01  |
1000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00033 | PENDING    |                 | 0.01  |
5000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00034 | PENDING    |                 | 0.01  |
5000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00035 | PENDING    |                 | 0.01  |
5000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00036 | PENDING    |                 | 0.005 |
100 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00037 | PENDING    |                 | 0.005 |
100 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1   |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1   |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1   |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1   |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1   |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1   |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1   |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
+-----------------------------------+------------+-----------------+-------+--
------------+-------------+-------------+----------+------------+-----------
```

```
----+
… 40 more trials not shown (3 RUNNING, 22 PENDING, 14 TERMINATED)


== Status ==
Current time: 2024-06-26 13:38:21 (running for 00:00:45.71)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.700120210647583
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (29 PENDING, 4 RUNNING, 27 TERMINATED)
+-------------------------------------+------------+-----------------+-------+--
-------------+-------------+-------------+----------+------------+------------
----+
| Trial name                          | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-------------------------------------+------------+-----------------+-------+--
-------------+-------------+-------------+----------+------------+------------
----|
| train_classification_nn_28337_00021 | RUNNING    | 127.0.0.1:79112 | 0.05  |
5000 |           16 |          200 | 0.635365 |   0.735637 |       0.764583 |
| train_classification_nn_28337_00027 | RUNNING    | 127.0.0.1:79203 | 0.01  |
500 |           16 |          200 | 0.580377 |   0.789208 |       0.685417 |
| train_classification_nn_28337_00028 | RUNNING    | 127.0.0.1:79207 | 0.01  |
500 |           32 |          200 | 0.39021  |   0.854167 |       0.709936 |
| train_classification_nn_28337_00030 | RUNNING    | 127.0.0.1:79226 | 0.01  |
1000 |           16 |          200 | 0.847251 |   0.708075 |       0.610417 |
| train_classification_nn_28337_00031 | PENDING    |                 | 0.01  |
1000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00032 | PENDING    |                 | 0.01  |
1000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00033 | PENDING    |                 | 0.01  |
5000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00034 | PENDING    |                 | 0.01  |
5000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00035 | PENDING    |                 | 0.01  |
5000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00036 | PENDING    |                 | 0.005 |
100 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00037 | PENDING    |                 | 0.005 |
100 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00038 | PENDING    |                 | 0.005 |
100 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1   |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
```

```
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1   |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1   |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1   |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1   |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1   |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1   |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
| train_classification_nn_28337_00007 | TERMINATED | 127.0.0.1:78867 | 0.1   |
1000 |           32 |          200 | 0.592407 |   0.749256 |       0.779647 |
+-------------------------------------+------------+-----------------+-------+--
-------------+-------------+-------------+----------+------------+------------
----+
… 40 more trials not shown (21 PENDING, 19 TERMINATED)


(train_classification_nn pid=79376) Using device: mps [repeated 2x
across cluster]
== Status ==
Current time: 2024-06-26 13:38:26 (running for 00:00:50.72)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7057425379753113
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (23 PENDING, 6 RUNNING, 31 TERMINATED)
+-------------------------------------+------------+-----------------+-------+--
-------------+-------------+-------------+----------+------------+------------
----+
| Trial name                          | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-------------------------------------+------------+-----------------+-------+--
-------------+-------------+-------------+----------+------------+------------
----|
| train_classification_nn_28337_00027 | RUNNING    | 127.0.0.1:79203 | 0.01  |
500 |           16 |          200 | 0.475278 |   0.798525 |       0.704167 |
| train_classification_nn_28337_00032 | RUNNING    | 127.0.0.1:79402 | 0.01  |
1000 |           64 |          200 | 0.452466 |   0.859776 |       0.774639 |
| train_classification_nn_28337_00033 | RUNNING    | 127.0.0.1:79429 | 0.01  |
5000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00034 | RUNNING    | 127.0.0.1:79430 | 0.01  |
```

```
5000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00035 | RUNNING    | 127.0.0.1:79431 | 0.01  |
5000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00036 | RUNNING    | 127.0.0.1:79432 | 0.005 |
100 |           16 |          200 | 0.828075 |   0.663432 |       0.758333 |
| train_classification_nn_28337_00037 | PENDING    |                 | 0.005 |
100 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00038 | PENDING    |                 | 0.005 |
100 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00039 | PENDING    |                 | 0.005 |
500 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00040 | PENDING    |                 | 0.005 |
500 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00041 | PENDING    |                 | 0.005 |
500 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00042 | PENDING    |                 | 0.005 |
1000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00043 | PENDING    |                 | 0.005 |
1000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1   |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1   |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1   |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1   |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1   |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1   |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1   |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
+-------------------------------------+------------+-----------------+-------+--
------------+-------------+-------------+----------+------------+------------
----+
… 40 more trials not shown (16 PENDING, 24 TERMINATED)


(train_classification_nn pid=79445) Using device: mps [repeated 6x
across cluster]
== Status ==
Current time: 2024-06-26 13:38:31 (running for 00:00:55.76)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7101629376411438
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
```

```
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (18 PENDING, 10 RUNNING, 32 TERMINATED)
+-----------------------------------+------------+-----------------+-------+--
-----------+-------------+-------------+----------+------------+-----------
----+
| Trial name                        | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-----------------------------------+------------+-----------------+-------+--
-----------+-------------+-------------+----------+------------+-----------
----|
| train_classification_nn_28337_00027 | RUNNING    | 127.0.0.1:79203 | 0.01  |
500 |           16 |          200 | 0.484426 |   0.800854 |       0.73125  |
| train_classification_nn_28337_00033 | RUNNING    | 127.0.0.1:79429 | 0.01  |
5000 |           16 |          200 | 1.45509  |   0.62073  |       0.652083 |
| train_classification_nn_28337_00034 | RUNNING    | 127.0.0.1:79430 | 0.01  |
5000 |           32 |          200 | 0.856682 |   0.75744  |       0.691506 |
| train_classification_nn_28337_00035 | RUNNING    | 127.0.0.1:79431 | 0.01  |
5000 |           64 |          200 | 0.793841 |   0.769431 |       0.588942 |
| train_classification_nn_28337_00036 | RUNNING    | 127.0.0.1:79432 | 0.005 |
100 |           16 |          200 | 0.539885 |   0.803571 |       0.741667 |
| train_classification_nn_28337_00037 | RUNNING    | 127.0.0.1:79445 | 0.005 |
100 |           32 |          200 | 0.459948 |   0.827753 |       0.735577 |
| train_classification_nn_28337_00038 | RUNNING    | 127.0.0.1:79457 | 0.005 |
100 |           64 |          200 | 0.435008 |   0.83153  |       0.763221 |
| train_classification_nn_28337_00042 | PENDING    |                 | 0.005 |
1000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00043 | PENDING    |                 | 0.005 |
1000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00044 | PENDING    |                 | 0.005 |
1000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00045 | PENDING    |                 | 0.005 |
5000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00046 | PENDING    |                 | 0.005 |
5000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00047 | PENDING    |                 | 0.005 |
5000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00048 | PENDING    |                 | 0.001 |
100 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1   |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1   |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1   |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1   |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
```

```
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1   |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1   |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1   |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
+-------------------------------------+------------+-----------------+-------+--
------------+-------------+-------------+----------+------------+------------
----+
… 40 more trials not shown (3 RUNNING, 11 PENDING, 25 TERMINATED)


(train_classification_nn pid=79535) Using device: mps [repeated 5x
across cluster]
== Status ==
Current time: 2024-06-26 13:38:36 (running for 00:01:00.76)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7145833373069763
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (17 PENDING, 5 RUNNING, 38 TERMINATED)
+-------------------------------------+------------+-----------------+-------+--
------------+-------------+-------------+----------+------------+------------
----+
| Trial name                          | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-------------------------------------+------------+-----------------+-------+--
------------+-------------+-------------+----------+------------+------------
----|
| train_classification_nn_28337_00033 | RUNNING    | 127.0.0.1:79429 | 0.01  |
5000 |           16 |          200 | 0.814306 |   0.742236 |       0.579167 |
| train_classification_nn_28337_00039 | RUNNING    | 127.0.0.1:79484 | 0.005 |
500 |           16 |          200 | 0.68203  |   0.733696 |       0.716667 |
| train_classification_nn_28337_00040 | RUNNING    | 127.0.0.1:79485 | 0.005 |
500 |           32 |          200 | 0.518532 |   0.809152 |       0.750801 |
| train_classification_nn_28337_00041 | RUNNING    | 127.0.0.1:79486 | 0.005 |
500 |           64 |          200 | 0.337956 |   0.872997 |       0.763221 |
| train_classification_nn_28337_00042 | RUNNING    | 127.0.0.1:79535 | 0.005 |
1000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00043 | PENDING    |                 | 0.005 |
1000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00044 | PENDING    |                 | 0.005 |
1000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00045 | PENDING    |                 | 0.005 |
```

```
5000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00046 | PENDING    |                | 0.005 |
5000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00047 | PENDING    |                | 0.005 |
5000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00048 | PENDING    |                | 0.001 |
100 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00049 | PENDING    |                | 0.001 |
100 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00050 | PENDING    |                | 0.001 |
100 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1   |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1   |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1   |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1   |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1   |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1   |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1   |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
| train_classification_nn_28337_00007 | TERMINATED | 127.0.0.1:78867 | 0.1   |
1000 |           32 |          200 | 0.592407 |   0.749256 |       0.779647 |
+-------------------------------------+------------+-----------------+-------+--
-------------+-------------+-------------+----------+------------+------------
----+
… 40 more trials not shown (9 PENDING, 30 TERMINATED)


== Status ==
Current time: 2024-06-26 13:38:41 (running for 00:01:05.77)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7180555595291985
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (12 PENDING, 7 RUNNING, 41 TERMINATED)
+-------------------------------------+------------+-----------------+-------+--
-------------+-------------+-------------+----------+------------+------------
----+
| Trial name                          | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
```

```
|-----------------------------------+-----------+----------------+-------+--
------------+-------------+-------------+----------+-----------+-----------
----|
| train_classification_nn_28337_00039 | RUNNING    | 127.0.0.1:79484 | 0.005 |
500 |           16 |          200 | 0.424724 |   0.843556 |       0.741667 |
| train_classification_nn_28337_00042 | RUNNING    | 127.0.0.1:79535 | 0.005 |
1000 |           16 |          200 | 0.735275 |   0.753882 |       0.758333 |
| train_classification_nn_28337_00043 | RUNNING    | 127.0.0.1:79537 | 0.005 |
1000 |           32 |          200 | 0.439733 |   0.808408 |       0.737981 |
| train_classification_nn_28337_00044 | RUNNING    | 127.0.0.1:79538 | 0.005 |
1000 |           64 |          200 | 0.316041 |   0.87727  |       0.689904 |
| train_classification_nn_28337_00045 | RUNNING    | 127.0.0.1:79550 | 0.005 |
5000 |           16 |          200 | 2.42184  |   0.626941 |       0.589583 |
| train_classification_nn_28337_00046 | RUNNING    | 127.0.0.1:79551 | 0.005 |
5000 |           32 |          200 | 1.46069  |   0.700149 |       0.624199 |
| train_classification_nn_28337_00047 | RUNNING    | 127.0.0.1:79577 | 0.005 |
5000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00048 | PENDING    |                 | 0.001 |
100 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00049 | PENDING    |                 | 0.001 |
100 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00050 | PENDING    |                 | 0.001 |
100 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00051 | PENDING    |                 | 0.001 |
500 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00052 | PENDING    |                 | 0.001 |
500 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00053 | PENDING    |                 | 0.001 |
500 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00054 | PENDING    |                 | 0.001 |
1000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1   |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1   |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1   |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1   |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1   |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1   |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1   |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
+-----------------------------------+-----------+----------------+-------+--
------------+-------------+-------------+----------+-----------+-----------
----+
```

```
… 40 more trials not shown (5 PENDING, 34 TERMINATED)


(train_classification_nn pid=79590) Using device: mps [repeated 6x
across cluster]
== Status ==
Current time: 2024-06-26 13:38:46 (running for 00:01:10.85)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7169471383094788
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (9 PENDING, 6 RUNNING, 45 TERMINATED)
+-------------------------------------+------------+-----------------+-------+--
-----------+-------------+-------------+----------+------------+-----------
----+
| Trial name                          | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-------------------------------------+------------+-----------------+-------+--
-----------+-------------+-------------+----------+------------+-----------
----|
| train_classification_nn_28337_00045 | RUNNING    | 127.0.0.1:79550 | 0.005 |
5000 |           16 |          200 | 1.19222  |   0.713898 |       0.720833 |
| train_classification_nn_28337_00046 | RUNNING    | 127.0.0.1:79551 | 0.005 |
5000 |           32 |          200 | 2.14728  |   0.628348 |       0.686699 |
| train_classification_nn_28337_00047 | RUNNING    | 127.0.0.1:79577 | 0.005 |
5000 |           64 |          200 | 0.888406 |   0.759749 |       0.74399  |
| train_classification_nn_28337_00048 | RUNNING    | 127.0.0.1:79589 | 0.001 |
100 |           16 |          200 | 0.64998  |   0.762811 |       0.772917 |
| train_classification_nn_28337_00049 | RUNNING    | 127.0.0.1:79590 | 0.001 |
100 |           32 |          200 | 0.576301 |   0.800595 |       0.75641  |
| train_classification_nn_28337_00050 | RUNNING    | 127.0.0.1:79618 | 0.001 |
100 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00051 | PENDING    |                 | 0.001 |
500 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00052 | PENDING    |                 | 0.001 |
500 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00053 | PENDING    |                 | 0.001 |
500 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00054 | PENDING    |                 | 0.001 |
1000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00055 | PENDING    |                 | 0.001 |
1000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00056 | PENDING    |                 | 0.001 |
1000 |           64 |          200 |          |            |                |
```

```
| train_classification_nn_28337_00057 | PENDING    |                 | 0.001 |
5000 |           16 |          200 |          |            |                 |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1   |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1   |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1   |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1   |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1   |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1   |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1   |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
+-------------------------------------+------------+-----------------+-------+--
------------+-------------+-------------+----------+------------+------------
----+
… 40 more trials not shown (2 PENDING, 38 TERMINATED)


(train_classification_nn pid=79644) Using device: mps [repeated 5x
across cluster]
== Status ==
Current time: 2024-06-26 13:38:51 (running for 00:01:15.87)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7169471383094788
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (5 PENDING, 8 RUNNING, 47 TERMINATED)
+-------------------------------------+------------+-----------------+-------+--
------------+-------------+-------------+----------+------------+------------
----+
| Trial name                          | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-------------------------------------+------------+-----------------+-------+--
------------+-------------+-------------+----------+------------+------------
----|
| train_classification_nn_28337_00046 | RUNNING    | 127.0.0.1:79551 | 0.005 |
5000 |           32 |          200 | 1.23283  |   0.753348 |       0.652244 |
| train_classification_nn_28337_00047 | RUNNING    | 127.0.0.1:79577 | 0.005 |
5000 |           64 |          200 | 0.327875 |   0.883948 |       0.705529 |
| train_classification_nn_28337_00048 | RUNNING    | 127.0.0.1:79589 | 0.001 |
```

```
100 |           16 |          200 | 0.503483 |   0.806289 |       0.747917 |
| train_classification_nn_28337_00050 | RUNNING    | 127.0.0.1:79618 | 0.001 |
100 |           64 |          200 | 0.399938 |   0.858106 |       0.72476  |
| train_classification_nn_28337_00051 | RUNNING    | 127.0.0.1:79630 | 0.001 |
500 |           16 |          200 | 0.614959 |   0.74573  |       0.735417 |
| train_classification_nn_28337_00052 | RUNNING    | 127.0.0.1:79631 | 0.001 |
500 |           32 |          200 | 0.468966 |   0.822917 |       0.737981 |
| train_classification_nn_28337_00053 | RUNNING    | 127.0.0.1:79644 | 0.001 |
500 |           64 |          200 | 0.577953 |   0.78746  |       0.732572 |
| train_classification_nn_28337_00054 | RUNNING    | 127.0.0.1:79670 | 0.001 |
1000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00055 | PENDING    |                 | 0.001 |
1000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00056 | PENDING    |                 | 0.001 |
1000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00057 | PENDING    |                 | 0.001 |
5000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00058 | PENDING    |                 | 0.001 |
5000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00059 | PENDING    |                 | 0.001 |
5000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1   |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1   |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1   |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1   |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1   |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1   |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1   |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
| train_classification_nn_28337_00007 | TERMINATED | 127.0.0.1:78867 | 0.1   |
1000 |           32 |          200 | 0.592407 |   0.749256 |       0.779647 |
+-------------------------------------+------------+-----------------+-------+--
-------------+-------------+-------------+----------+------------+------------
----+
… 40 more trials not shown (39 TERMINATED)


(train_classification_nn pid=79712) Using device: mps [repeated 4x
across cluster]
== Status ==
Current time: 2024-06-26 13:38:56 (running for 00:01:20.90)
```

```
Using AsyncHyperBand: num_stopped=6
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7153712709744772
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (2 PENDING, 6 RUNNING, 52 TERMINATED)
+-----------------------------------+-----------+----------------+-------+--
-----------+-------------+-------------+----------+-----------+-----------
----+
| Trial name                        | status    | loc            |    lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-----------------------------------+-----------+----------------+-------+--
-----------+-------------+-------------+----------+-----------+-----------
----|
| train_classification_nn_28337_00051 | RUNNING    | 127.0.0.1:79630 | 0.001 |
500 |           16 |          200 | 0.424    |   0.855978 |       0.752083 |
| train_classification_nn_28337_00052 | RUNNING    | 127.0.0.1:79631 | 0.001 |
500 |           32 |          200 | 0.394913 |   0.837054 |       0.748397 |
| train_classification_nn_28337_00054 | RUNNING    | 127.0.0.1:79670 | 0.001 |
1000 |           16 |          200 | 0.609596 |   0.750388 |       0.745833 |
| train_classification_nn_28337_00055 | RUNNING    | 127.0.0.1:79685 | 0.001 |
1000 |           32 |          200 | 0.486999 |   0.817708 |       0.709936 |
| train_classification_nn_28337_00056 | RUNNING    | 127.0.0.1:79710 | 0.001 |
1000 |           64 |          200 | 0.370138 |   0.86051  |       0.759615 |
| train_classification_nn_28337_00057 | RUNNING    | 127.0.0.1:79712 | 0.001 |
5000 |           16 |          200 |          |            |                |
| train_classification_nn_28337_00058 | PENDING    |                 | 0.001 |
5000 |           32 |          200 |          |            |                |
| train_classification_nn_28337_00059 | PENDING    |                 | 0.001 |
5000 |           64 |          200 |          |            |                |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1   |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1   |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1   |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1   |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1   |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1   |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1   |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
| train_classification_nn_28337_00007 | TERMINATED | 127.0.0.1:78867 | 0.1   |
1000 |           32 |          200 | 0.592407 |   0.749256 |       0.779647 |
```

```
| train_classification_nn_28337_00008 | TERMINATED | 127.0.0.1:78868 | 0.1   |
1000 |           64 |          200 | 0.51141  |   0.802885 |       0.689303 |
| train_classification_nn_28337_00009 | TERMINATED | 127.0.0.1:78869 | 0.1   |
5000 |           16 |          200 | 0.713379 |   0.718556 |       0.666667 |
| train_classification_nn_28337_00010 | TERMINATED | 127.0.0.1:78968 | 0.1   |
5000 |           32 |          200 | 0.601506 |   0.764137 |       0.745994 |
| train_classification_nn_28337_00011 | TERMINATED | 127.0.0.1:78994 | 0.1   |
5000 |           64 |          200 | 0.711831 |   0.756744 |       0.682692 |
+-------------------------------------+------------+-----------------+-------+--
-------------+-------------+-------------+----------+------------+------------
----+
… 40 more trials not shown (40 TERMINATED)


== Status ==
Current time: 2024-06-26 13:39:01 (running for 00:01:25.97)
Using AsyncHyperBand: num_stopped=6
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7169471383094788
Logical resource usage: 4.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (4 RUNNING, 56 TERMINATED)
+-------------------------------------+------------+-----------------+-------+--
-------------+-------------+-------------+----------+------------+------------
----+
| Trial name                          | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-------------------------------------+------------+-----------------+-------+--
-------------+-------------+-------------+----------+------------+------------
----|
| train_classification_nn_28337_00051 | RUNNING    | 127.0.0.1:79630 | 0.001 |
500 |           16 |          200 | 0.485613 |   0.821817 |       0.7625   |
| train_classification_nn_28337_00057 | RUNNING    | 127.0.0.1:79712 | 0.001 |
5000 |           16 |          200 | 0.727314 |   0.736801 |       0.727083 |
| train_classification_nn_28337_00058 | RUNNING    | 127.0.0.1:79735 | 0.001 |
5000 |           32 |          200 | 0.635235 |   0.75372  |       0.709936 |
| train_classification_nn_28337_00059 | RUNNING    | 127.0.0.1:79736 | 0.001 |
5000 |           64 |          200 | 0.470477 |   0.812901 |       0.72476  |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1   |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1   |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1   |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1   |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
```

```
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1   |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1   |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1   |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
| train_classification_nn_28337_00007 | TERMINATED | 127.0.0.1:78867 | 0.1   |
1000 |           32 |          200 | 0.592407 |   0.749256 |       0.779647 |
| train_classification_nn_28337_00008 | TERMINATED | 127.0.0.1:78868 | 0.1   |
1000 |           64 |          200 | 0.51141  |   0.802885 |       0.689303 |
| train_classification_nn_28337_00009 | TERMINATED | 127.0.0.1:78869 | 0.1   |
5000 |           16 |          200 | 0.713379 |   0.718556 |       0.666667 |
| train_classification_nn_28337_00010 | TERMINATED | 127.0.0.1:78968 | 0.1   |
5000 |           32 |          200 | 0.601506 |   0.764137 |       0.745994 |
| train_classification_nn_28337_00011 | TERMINATED | 127.0.0.1:78994 | 0.1   |
5000 |           64 |          200 | 0.711831 |   0.756744 |       0.682692 |
| train_classification_nn_28337_00012 | TERMINATED | 127.0.0.1:78995 | 0.05  |
100 |           16 |          200 | 0.610523 |   0.754658 |       0.7      |
| train_classification_nn_28337_00013 | TERMINATED | 127.0.0.1:78996 | 0.05  |
100 |           32 |          200 | 0.633289 |   0.742932 |       0.668269 |
| train_classification_nn_28337_00014 | TERMINATED | 127.0.0.1:79008 | 0.05  |
100 |           64 |          200 | 0.421022 |   0.819778 |       0.674279 |
| train_classification_nn_28337_00015 | TERMINATED | 127.0.0.1:79037 | 0.05  |
500 |           16 |          200 | 0.730315 |   0.734084 |       0.720833 |
+-------------------------------------+------------+-----------------+-------+--
-------------+--------------+--------------+----------+------------+------------
----+
… 40 more trials not shown (40 TERMINATED)


== Status ==
Current time: 2024-06-26 13:39:06 (running for 00:01:30.99)
Using AsyncHyperBand: num_stopped=6
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7169471383094788
Logical resource usage: 1.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (1 RUNNING, 59 TERMINATED)
+-------------------------------------+------------+-----------------+-------+--
-------------+--------------+--------------+----------+------------+------------
----+
| Trial name                          | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-------------------------------------+------------+-----------------+-------+--
-------------+--------------+--------------+----------+------------+------------
----|
```

```
| train_classification_nn_28337_00057 | RUNNING    | 127.0.0.1:79712 | 0.001 |
5000 |           16 |          200 | 0.592764 |   0.755823 |       0.7625   |
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1   |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1   |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1   |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1   |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1   |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1   |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1   |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
| train_classification_nn_28337_00007 | TERMINATED | 127.0.0.1:78867 | 0.1   |
1000 |           32 |          200 | 0.592407 |   0.749256 |       0.779647 |
| train_classification_nn_28337_00008 | TERMINATED | 127.0.0.1:78868 | 0.1   |
1000 |           64 |          200 | 0.51141  |   0.802885 |       0.689303 |
| train_classification_nn_28337_00009 | TERMINATED | 127.0.0.1:78869 | 0.1   |
5000 |           16 |          200 | 0.713379 |   0.718556 |       0.666667 |
| train_classification_nn_28337_00010 | TERMINATED | 127.0.0.1:78968 | 0.1   |
5000 |           32 |          200 | 0.601506 |   0.764137 |       0.745994 |
| train_classification_nn_28337_00011 | TERMINATED | 127.0.0.1:78994 | 0.1   |
5000 |           64 |          200 | 0.711831 |   0.756744 |       0.682692 |
| train_classification_nn_28337_00012 | TERMINATED | 127.0.0.1:78995 | 0.05  |
100 |           16 |          200 | 0.610523 |   0.754658 |       0.7      |
| train_classification_nn_28337_00013 | TERMINATED | 127.0.0.1:78996 | 0.05  |
100 |           32 |          200 | 0.633289 |   0.742932 |       0.668269 |
| train_classification_nn_28337_00014 | TERMINATED | 127.0.0.1:79008 | 0.05  |
100 |           64 |          200 | 0.421022 |   0.819778 |       0.674279 |
| train_classification_nn_28337_00015 | TERMINATED | 127.0.0.1:79037 | 0.05  |
500 |           16 |          200 | 0.730315 |   0.734084 |       0.720833 |
| train_classification_nn_28337_00016 | TERMINATED | 127.0.0.1:79050 | 0.05  |
500 |           32 |          200 | 0.493676 |   0.792411 |       0.754006 |
| train_classification_nn_28337_00017 | TERMINATED | 127.0.0.1:79051 | 0.05  |
500 |           64 |          200 | 0.32327  |   0.882278 |       0.658654 |
| train_classification_nn_28337_00018 | TERMINATED | 127.0.0.1:79053 | 0.05  |
1000 |           16 |          200 | 0.711133 |   0.744953 |       0.73125  |
+-------------------------------------+------------+-----------------+-------+--
-------------+-------------+-------------+----------+------------+------------
----+
… 40 more trials not shown (40 TERMINATED)


2024-06-26 13:39:09,087 INFO tune.py:1009 -- Wrote the latest version of all
```

```
result files and experiment state to
'/Users/tyler/ray_results/train_classification_nn_2024-06-26_13-37-35' in
0.0274s.
2024-06-26 13:39:09,095 INFO tune.py:1041 -- Total run time: 93.45 seconds
(93.39 seconds for the tuning loop).

== Status ==
Current time: 2024-06-26 13:39:09 (running for 00:01:33.42)
Using AsyncHyperBand: num_stopped=6
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.7169471383094788
Logical resource usage: 1.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-37-35/train_classification_nn_2024-06-26_13-37-35/driver_artifacts
Number of trials: 60/60 (60 TERMINATED)
+-----------------------------------+------------+-----------------+-------+--
-----------+-------------+-------------+----------+------------+-----------
----+
| Trial name                        | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-----------------------------------+------------+-----------------+-------+--
-----------+-------------+-------------+----------+------------+-----------
----|
| train_classification_nn_28337_00000 | TERMINATED | 127.0.0.1:78859 | 0.1   |
100 |           16 |          200 | 0.682498 |   0.708463 |       0.683333 |
| train_classification_nn_28337_00001 | TERMINATED | 127.0.0.1:78860 | 0.1   |
100 |           32 |          200 | 0.630913 |   0.741443 |       0.694712 |
| train_classification_nn_28337_00002 | TERMINATED | 127.0.0.1:78861 | 0.1   |
100 |           64 |          200 | 0.386636 |   0.86238  |       0.755409 |
| train_classification_nn_28337_00003 | TERMINATED | 127.0.0.1:78862 | 0.1   |
500 |           16 |          200 | 0.649903 |   0.775621 |       0.747917 |
| train_classification_nn_28337_00004 | TERMINATED | 127.0.0.1:78863 | 0.1   |
500 |           32 |          200 | 0.596172 |   0.741815 |       0.624199 |
| train_classification_nn_28337_00005 | TERMINATED | 127.0.0.1:78864 | 0.1   |
500 |           64 |          200 | 0.461879 |   0.807893 |       0.732572 |
| train_classification_nn_28337_00006 | TERMINATED | 127.0.0.1:78865 | 0.1   |
1000 |           16 |          200 | 0.747713 |   0.726708 |       0.614583 |
| train_classification_nn_28337_00007 | TERMINATED | 127.0.0.1:78867 | 0.1   |
1000 |           32 |          200 | 0.592407 |   0.749256 |       0.779647 |
| train_classification_nn_28337_00008 | TERMINATED | 127.0.0.1:78868 | 0.1   |
1000 |           64 |          200 | 0.51141  |   0.802885 |       0.689303 |
| train_classification_nn_28337_00009 | TERMINATED | 127.0.0.1:78869 | 0.1   |
5000 |           16 |          200 | 0.713379 |   0.718556 |       0.666667 |
| train_classification_nn_28337_00010 | TERMINATED | 127.0.0.1:78968 | 0.1   |
5000 |           32 |          200 | 0.601506 |   0.764137 |       0.745994 |
| train_classification_nn_28337_00011 | TERMINATED | 127.0.0.1:78994 | 0.1   |
5000 |           64 |          200 | 0.711831 |   0.756744 |       0.682692 |
```

| train_classification_nn_28337_00012 | TERMINATED | 127.0.0.1:78995 | 0.05 |
100 | 16 | 200 | 0.610523 | 0.754658 | 0.7 |
| train_classification_nn_28337_00013 | TERMINATED | 127.0.0.1:78996 | 0.05 |
100 | 32 | 200 | 0.633289 | 0.742932 | 0.668269 |
| train_classification_nn_28337_00014 | TERMINATED | 127.0.0.1:79008 | 0.05 |
100 | 64 | 200 | 0.421022 | 0.819778 | 0.674279 |
| train_classification_nn_28337_00015 | TERMINATED | 127.0.0.1:79037 | 0.05 |
500 | 16 | 200 | 0.730315 | 0.734084 | 0.720833 |
| train_classification_nn_28337_00016 | TERMINATED | 127.0.0.1:79050 | 0.05 |
500 | 32 | 200 | 0.493676 | 0.792411 | 0.754006 |
| train_classification_nn_28337_00017 | TERMINATED | 127.0.0.1:79051 | 0.05 |
500 | 64 | 200 | 0.32327 | 0.882278 | 0.658654 |
| train_classification_nn_28337_00018 | TERMINATED | 127.0.0.1:79053 | 0.05 |
1000 | 16 | 200 | 0.711133 | 0.744953 | 0.73125 |
| train_classification_nn_28337_00019 | TERMINATED | 127.0.0.1:79099 | 0.05 |
1000 | 32 | 200 | 0.652203 | 0.762277 | 0.737981 |
| train_classification_nn_28337_00020 | TERMINATED | 127.0.0.1:79111 | 0.05 |
1000 | 64 | 200 | 0.389138 | 0.865919 | 0.774639 |
| train_classification_nn_28337_00021 | TERMINATED | 127.0.0.1:79112 | 0.05 |
5000 | 16 | 200 | 0.748078 | 0.715062 | 0.7375 |
| train_classification_nn_28337_00022 | TERMINATED | 127.0.0.1:79143 | 0.05 |
5000 | 32 | 200 | 0.689052 | 0.741815 | 0.707532 |
| train_classification_nn_28337_00023 | TERMINATED | 127.0.0.1:79155 | 0.05 |
5000 | 64 | 200 | 0.595864 | 0.81477 | 0.697716 |
| train_classification_nn_28337_00024 | TERMINATED | 127.0.0.1:79156 | 0.01 |
100 | 16 | 200 | 0.604336 | 0.751165 | 0.725 |
| train_classification_nn_28337_00025 | TERMINATED | 127.0.0.1:79183 | 0.01 |
100 | 32 | 200 | 0.4413 | 0.821057 | 0.766827 |
| train_classification_nn_28337_00026 | TERMINATED | 127.0.0.1:79202 | 0.01 |
100 | 64 | 200 | 0.336797 | 0.870927 | 0.678486 |
| train_classification_nn_28337_00027 | TERMINATED | 127.0.0.1:79203 | 0.01 |
500 | 16 | 200 | 0.484426 | 0.800854 | 0.73125 |
| train_classification_nn_28337_00028 | TERMINATED | 127.0.0.1:79207 | 0.01 |
500 | 32 | 200 | 0.457891 | 0.828869 | 0.761218 |
| train_classification_nn_28337_00029 | TERMINATED | 127.0.0.1:79225 | 0.01 |
500 | 64 | 200 | 0.259335 | 0.900307 | 0.685697 |
| train_classification_nn_28337_00030 | TERMINATED | 127.0.0.1:79226 | 0.01 |
1000 | 16 | 200 | 0.580584 | 0.786491 | 0.783333 |
| train_classification_nn_28337_00031 | TERMINATED | 127.0.0.1:79376 | 0.01 |
1000 | 32 | 200 | 0.776964 | 0.746652 | 0.665865 |
| train_classification_nn_28337_00032 | TERMINATED | 127.0.0.1:79402 | 0.01 |
1000 | 64 | 200 | 0.368016 | 0.859776 | 0.740385 |
| train_classification_nn_28337_00033 | TERMINATED | 127.0.0.1:79429 | 0.01 |
5000 | 16 | 200 | 0.559844 | 0.743012 | 0.727083 |
| train_classification_nn_28337_00034 | TERMINATED | 127.0.0.1:79430 | 0.01 |
5000 | 32 | 200 | 0.51323 | 0.825149 | 0.720353 |
| train_classification_nn_28337_00035 | TERMINATED | 127.0.0.1:79431 | 0.01 |
5000 | 64 | 200 | 0.867363 | 0.80008 | 0.561298 |

| train_classification_nn_28337_00036 | TERMINATED | 127.0.0.1:79432 | 0.005 |
100 | 16 | 200 | 0.503135 | 0.817158 | 0.76875 |
| train_classification_nn_28337_00037 | TERMINATED | 127.0.0.1:79445 | 0.005 |
100 | 32 | 200 | 0.473207 | 0.80692 | 0.735577 |
| train_classification_nn_28337_00038 | TERMINATED | 127.0.0.1:79457 | 0.005 |
100 | 64 | 200 | 0.283411 | 0.881544 | 0.694111 |
| train_classification_nn_28337_00039 | TERMINATED | 127.0.0.1:79484 | 0.005 |
500 | 16 | 200 | 0.424724 | 0.843556 | 0.741667 |
| train_classification_nn_28337_00040 | TERMINATED | 127.0.0.1:79485 | 0.005 |
500 | 32 | 200 | 0.407174 | 0.846354 | 0.740385 |
| train_classification_nn_28337_00041 | TERMINATED | 127.0.0.1:79486 | 0.005 |
500 | 64 | 200 | 0.226802 | 0.909989 | 0.697716 |
| train_classification_nn_28337_00042 | TERMINATED | 127.0.0.1:79535 | 0.005 |
1000 | 16 | 200 | 0.574551 | 0.771351 | 0.7 |
| train_classification_nn_28337_00043 | TERMINATED | 127.0.0.1:79537 | 0.005 |
1000 | 32 | 200 | 0.566384 | 0.81436 | 0.722756 |
| train_classification_nn_28337_00044 | TERMINATED | 127.0.0.1:79538 | 0.005 |
1000 | 64 | 200 | 0.300159 | 0.871127 | 0.716947 |
| train_classification_nn_28337_00045 | TERMINATED | 127.0.0.1:79550 | 0.005 |
5000 | 16 | 200 | 0.706813 | 0.73486 | 0.73125 |
| train_classification_nn_28337_00046 | TERMINATED | 127.0.0.1:79551 | 0.005 |
5000 | 32 | 200 | 1.0879 | 0.75372 | 0.69391 |
| train_classification_nn_28337_00047 | TERMINATED | 127.0.0.1:79577 | 0.005 |
5000 | 64 | 200 | 0.638098 | 0.815171 | 0.701322 |
| train_classification_nn_28337_00048 | TERMINATED | 127.0.0.1:79589 | 0.001 |
100 | 16 | 200 | 0.513087 | 0.817158 | 0.789583 |
| train_classification_nn_28337_00049 | TERMINATED | 127.0.0.1:79590 | 0.001 |
100 | 32 | 200 | 0.482939 | 0.830357 | 0.737981 |
| train_classification_nn_28337_00050 | TERMINATED | 127.0.0.1:79618 | 0.001 |
100 | 64 | 200 | 0.3106 | 0.893429 | 0.74399 |
| train_classification_nn_28337_00051 | TERMINATED | 127.0.0.1:79630 | 0.001 |
500 | 16 | 200 | 0.428746 | 0.833463 | 0.760417 |
| train_classification_nn_28337_00052 | TERMINATED | 127.0.0.1:79631 | 0.001 |
500 | 32 | 200 | 0.443351 | 0.859003 | 0.75641 |
| train_classification_nn_28337_00053 | TERMINATED | 127.0.0.1:79644 | 0.001 |
500 | 64 | 200 | 0.332919 | 0.882278 | 0.771034 |
| train_classification_nn_28337_00054 | TERMINATED | 127.0.0.1:79670 | 0.001 |
1000 | 16 | 200 | 0.47188 | 0.809006 | 0.772917 |
| train_classification_nn_28337_00055 | TERMINATED | 127.0.0.1:79685 | 0.001 |
1000 | 32 | 200 | 0.403742 | 0.844866 | 0.745994 |
| train_classification_nn_28337_00056 | TERMINATED | 127.0.0.1:79710 | 0.001 |
1000 | 64 | 200 | 0.302768 | 0.880409 | 0.759615 |
| train_classification_nn_28337_00057 | TERMINATED | 127.0.0.1:79712 | 0.001 |
5000 | 16 | 200 | 0.506226 | 0.806677 | 0.745833 |
| train_classification_nn_28337_00058 | TERMINATED | 127.0.0.1:79735 | 0.001 |
5000 | 32 | 200 | 0.783217 | 0.702753 | 0.758814 |
| train_classification_nn_28337_00059 | TERMINATED | 127.0.0.1:79736 | 0.001 |
5000 | 64 | 200 | 0.369486 | 0.863315 | 0.739784 |

```
+-----------------------------------+-----------+----------------+-------+--
------------+-------------+-------------+----------+-----------+-----------
----+
```

```
Best Hyperparameters Found:  {'lr': 0.001, 'hidden_size': 100, 'batch_size': 16,
'num_epochs': 200, 'early_stop': 10, 'log_dir': '/Users/tyler/GitHub
Repositories/Apple Watch FitBit Project/Wearables-Activity-
Classification/logs/whoop-activity-class/v3/full-3', 'model_path':
'/Users/tyler/GitHub Repositories/Apple Watch FitBit Project/Wearables-Activity-
Classification/models/whoop-activity-class/v3/full-3', 'tune': True}
Best Validation Accuracy:  0.7895833353201548
Best Number Epochs:  13
Best Model Path:  /Users/tyler/GitHub Repositories/Apple Watch FitBit
Project/Wearables-Activity-Classification/models/whoop-activity-
class/v3/full-3/h100_b16_lr0.001.th
```

Limited 8

[69]:
```
LIM_8_LOGS_V3 = os.path.join(os.getcwd(), 'logs/whoop-activity-class/v3/lim-8')
LIM_8_MODELPATH_V3 = os.path.join(os.getcwd(), 'models/whoop-activity-class/v3/
  ↪lim-8')
```

[71]:
```
best_classification_models_lim_8_v3 =␣
  ↪grid_search_classification_models(classification_models_v3,␣
  ↪class_param_grids_v3, X_wo_lim_8_v2, y_wo_lim_8_v2, class_kf_v3)
```

```
Optimizing Random Forest
Original Parameters: {'n_estimators': 100, 'max_depth': None,
'min_samples_split': 2, 'min_samples_leaf': 1}
Best Parameters: {'max_depth': 20, 'min_samples_leaf': 2, 'min_samples_split':
2, 'n_estimators': 200}

Optimizing Rotation Forest
Original Parameters: {'n_classifiers': 10, 'n_splits': 3,
'base_classifier__n_estimators': 100, 'base_classifier__max_depth': None,
'base_classifier__min_samples_split': 2}

/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/model_selection/_validation.py:425: FitFailedWarning:
2880 fits failed out of a total of 5760.
The score on these train-test partitions for these parameters will be set to
nan.
If these failures are not expected, you can try to debug them by setting
error_score='raise'.

Below are more details about the failures:
--------------------------------------------------------------------------------
1728 fits failed with the following error:
```

```
Traceback (most recent call last):
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/model_selection/_validation.py", line 729, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/var/folders/v2/f0f7cs8s1z1d9c0543w9ftcr0000gn/T/ipykernel_63198/1641602
099.py", line 27, in fit
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/utils/_set_output.py", line 157, in wrapped
    data_to_wrap = f(self, X, *args, **kwargs)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/base.py", line 1152, in wrapper
    return fit_method(estimator, *args, **kwargs)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/decomposition/_pca.py", line 460, in fit_transform
    U, S, Vt = self._fit(X)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/decomposition/_pca.py", line 483, in _fit
    X = self._validate_data(
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/base.py", line 605, in _validate_data
    out = check_array(X, input_name="X", **check_params)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/utils/validation.py", line 976, in check_array
    raise ValueError(
ValueError: Found array with 0 feature(s) (shape=(347, 0)) while a minimum of 1
is required by PCA.

--------------------------------------------------------------------------------
1152 fits failed with the following error:
Traceback (most recent call last):
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/model_selection/_validation.py", line 729, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/var/folders/v2/f0f7cs8s1z1d9c0543w9ftcr0000gn/T/ipykernel_63198/1641602
099.py", line 27, in fit
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/utils/_set_output.py", line 157, in wrapped
    data_to_wrap = f(self, X, *args, **kwargs)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/base.py", line 1152, in wrapper
    return fit_method(estimator, *args, **kwargs)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/decomposition/_pca.py", line 460, in fit_transform
    U, S, Vt = self._fit(X)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/decomposition/_pca.py", line 483, in _fit
    X = self._validate_data(
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
```

```
packages/sklearn/base.py", line 605, in _validate_data
    out = check_array(X, input_name="X", **check_params)
  File "/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/utils/validation.py", line 976, in check_array
    raise ValueError(
ValueError: Found array with 0 feature(s) (shape=(348, 0)) while a minimum of 1
is required by PCA.

  warnings.warn(some_fits_failed_message, FitFailedWarning)
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/model_selection/_search.py:979: UserWarning: One or more of the
test scores are non-finite: [0.67618084 0.64777328        nan        nan
0.63205128 0.67887989
        nan        nan 0.65026991 0.67381916        nan        nan
 0.6477058  0.65816464        nan        nan 0.66079622 0.66052632
        nan        nan 0.63744939 0.66585695        nan        nan
 0.66585695 0.69696356        nan        nan 0.69190283 0.66578947
        nan        nan 0.67118758 0.68407557        nan        nan
 0.67098516 0.65802969        nan        nan 0.66835358 0.67624831
        nan        nan 0.68130904 0.6634278         nan        nan
 0.67375169 0.66612686        nan        nan 0.6451417  0.67881242
        nan        nan 0.67624831 0.68157895        nan        nan
 0.66862348 0.67118758        nan        nan 0.65013495 0.65303644
        nan        nan 0.67618084 0.65809717        nan        nan
 0.66329285 0.66612686        nan        nan 0.66329285 0.67132254
        nan        nan 0.67631579 0.68670715        nan        nan
 0.66578947 0.68137652        nan        nan 0.65566802 0.6917004
        nan        nan 0.67638327 0.65796221        nan        nan
 0.68670715 0.66605938        nan        nan 0.66315789 0.67388664
        nan        nan 0.68144399 0.69197031        nan        nan
 0.67112011 0.66848853        nan        nan 0.67624831 0.66875843
        nan        nan 0.66072874 0.68137652        nan        nan
 0.66848853 0.68663968        nan        nan 0.67887989 0.66848853
        nan        nan 0.64763833 0.66869096        nan        nan
 0.66835358 0.65573549        nan        nan 0.67395412 0.67388664
        nan        nan 0.67112011 0.67611336        nan        nan
 0.66349528 0.67139001        nan        nan 0.66578947 0.66336032
        nan        nan 0.65040486 0.66862348        nan        nan
 0.69176788 0.65053981        nan        nan 0.66855601 0.65836707
        nan        nan 0.65816464 0.66592443        nan        nan
 0.67894737 0.68407557        nan        nan 0.67381916 0.66842105
        nan        nan 0.67105263 0.66869096        nan        nan
 0.65796221 0.67112011        nan        nan 0.66855601 0.68441296
        nan        nan 0.6608637  0.65053981        nan        nan
 0.66066127 0.65809717        nan        nan 0.63744939 0.65020243
        nan        nan 0.68394062 0.66349528        nan        nan
 0.65566802 0.66322537        nan        nan 0.67368421 0.67112011
        nan        nan 0.66066127 0.64271255        nan        nan
```

```
0.66349528 0.68663968        nan        nan 0.6865722  0.67091768
       nan        nan 0.66066127 0.68394062        nan        nan
0.65006748 0.66336032        nan        nan 0.665722   0.68940621
       nan        nan 0.67881242 0.65020243        nan        nan
0.66592443 0.67118758        nan        nan 0.65546559 0.67105263
       nan        nan 0.68670715 0.6817139         nan        nan
0.68933873 0.67894737        nan        nan 0.6634278  0.67354926
       nan        nan 0.65020243 0.6682861         nan        nan
0.6608637  0.66875843        nan        nan 0.68414305 0.67368421
       nan        nan 0.67125506 0.67132254        nan        nan
0.65526316 0.67638327        nan        nan 0.66329285 0.68690958
       nan        nan 0.67381916 0.67887989        nan        nan
0.67368421 0.6634278         nan        nan 0.64251012 0.66862348
       nan        nan 0.66869096 0.67894737        nan        nan
0.68130904 0.66592443        nan        nan 0.66605938 0.67381916
       nan        nan 0.66066127 0.66099865        nan        nan
0.67368421 0.67118758        nan        nan 0.67381916 0.68151147
       nan        nan 0.65823212 0.66855601        nan        nan
0.67091768 0.64237517        nan        nan 0.66875843 0.65816464
       nan        nan 0.67375169 0.66585695        nan        nan
0.6659919  0.65850202        nan        nan 0.65276653 0.68414305
       nan        nan 0.66072874 0.67368421        nan        nan
0.66862348 0.65033738        nan        nan 0.6634278  0.66079622
       nan        nan 0.67112011 0.67354926        nan        nan
0.66079622 0.67894737        nan        nan 0.67132254 0.66072874
       nan        nan 0.6659919  0.65573549        nan        nan
0.65296896 0.67132254        nan        nan 0.66855601 0.66612686
       nan        nan 0.66605938 0.65317139        nan        nan
0.65047233 0.65290148        nan        nan 0.64784076 0.67354926
       nan        nan 0.66842105 0.67381916        nan        nan
0.68124157 0.6477058         nan        nan 0.65283401 0.67894737
       nan        nan 0.65816464 0.66848853        nan        nan
0.67368421 0.68920378        nan        nan 0.67881242 0.67368421
       nan        nan 0.67381916 0.67624831        nan        nan
0.6477058  0.67348178        nan        nan 0.67651822 0.68137652
       nan        nan 0.69176788 0.68394062        nan        nan
0.68394062 0.66072874        nan        nan 0.66066127 0.66072874
       nan        nan 0.67901484 0.69966262        nan        nan
0.67091768 0.66848853        nan        nan 0.65836707 0.67618084
       nan        nan 0.65276653 0.65560054        nan        nan
0.67638327 0.6608637         nan        nan 0.66072874 0.66605938
       nan        nan 0.6634278  0.67651822        nan        nan
0.65020243 0.67125506        nan        nan 0.67395412 0.67894737
       nan        nan 0.66356275 0.67105263        nan        nan
0.68373819 0.67651822        nan        nan 0.65539811 0.68144399
       nan        nan 0.66072874 0.68164642        nan        nan
0.69156545 0.67112011        nan        nan 0.67874494 0.67388664
       nan        nan 0.65796221 0.66869096        nan        nan
```

```
 0.68677463 0.68920378        nan        nan 0.67894737 0.65553306
        nan        nan 0.67118758 0.64797571        nan        nan
 0.65026991 0.66066127        nan        nan 0.65060729 0.67887989
        nan        nan 0.66612686 0.6634278         nan        nan
 0.68144399 0.65816464        nan        nan 0.67105263 0.66875843
        nan        nan 0.66862348 0.67125506        nan        nan
 0.67651822 0.6608637         nan        nan 0.67368421 0.67132254
        nan        nan 0.64500675 0.65047233        nan        nan
 0.67112011 0.68933873        nan        nan 0.66855601 0.67618084
        nan        nan 0.66072874 0.66079622        nan        nan
 0.65809717 0.67381916        nan        nan 0.67105263 0.67375169
        nan        nan 0.66848853 0.66066127        nan        nan]
  warnings.warn(
```

```
Best Parameters: {'base_classifier__max_depth': 20,
'base_classifier__min_samples_split': 2, 'base_classifier__n_estimators': 100,
'n_classifiers': 20, 'n_splits': 7}

Optimizing XGBoost
Original Parameters: {'n_estimators': None, 'learning_rate': None, 'max_depth':
None, 'subsample': None, 'colsample_bytree': None, 'gamma': None}
Best Parameters: {'colsample_bytree': 1.0, 'gamma': 0, 'learning_rate': 0.1,
'max_depth': 7, 'n_estimators': 100, 'subsample': 1.0}
```

[72]:
```
train_classification_models(best_classification_models_lim_8_v3, X_wo_lim_8_v2,␣
↪y_wo_lim_8_v2, class_kf_v3, LIM_8_LOGS_V3)
```

```
Training Random Forest

Accuracy: 0.6787 (+/- 0.0440)
Classification Report:
              precision    recall  f1-score   support

           0       0.46      0.18      0.26        33
           1       0.62      0.75      0.68        96
           2       0.56      0.42      0.48        12
           3       0.56      0.42      0.48        12
           4       0.50      0.06      0.10        35
           5       0.72      0.94      0.82       161
           6       0.50      0.25      0.33        20
           7       0.93      0.76      0.84        17

    accuracy                           0.67       386
   macro avg       0.61      0.47      0.50       386
weighted avg       0.64      0.67      0.63       386


Training Rotation Forest
```

```
Accuracy: 0.6945 (+/- 0.0490)
Classification Report:
              precision    recall  f1-score   support

           0       0.50      0.39      0.44        33
           1       0.65      0.75      0.70        96
           2       0.45      0.42      0.43        12
           3       0.56      0.42      0.48        12
           4       0.29      0.06      0.10        35
           5       0.76      0.94      0.84       161
           6       0.30      0.15      0.20        20
           7       1.00      0.76      0.87        17

    accuracy                           0.68       386
   macro avg       0.56      0.49      0.51       386
weighted avg       0.64      0.68      0.65       386


Training XGBoost

Accuracy: 0.6971 (+/- 0.0416)
Classification Report:
              precision    recall  f1-score   support

           0       0.54      0.45      0.49        33
           1       0.70      0.74      0.72        96
           2       0.42      0.42      0.42        12
           3       0.75      0.50      0.60        12
           4       0.44      0.23      0.30        35
           5       0.77      0.89      0.83       161
           6       0.42      0.40      0.41        20
           7       0.87      0.76      0.81        17

    accuracy                           0.70       386
   macro avg       0.61      0.55      0.57       386
weighted avg       0.68      0.70      0.68       386
```

[72]:
```
{'Random Forest': RandomForestClassifier(max_depth=20, min_samples_leaf=2,
n_estimators=200),
 'Rotation Forest':
RotationForest(base_classifier=RandomForestClassifier(max_depth=20),
               n_classifiers=20, n_splits=7, random_state=42),
 'XGBoost': XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
```

```
                colsample_bytree=1.0, device=None, early_stopping_rounds=None,
                enable_categorical=False, eval_metric='mlogloss',
                feature_types=None, gamma=0, grow_policy=None,
                importance_type=None, interaction_constraints=None,
                learning_rate=0.1, max_bin=None, max_cat_threshold=None,
                max_cat_to_onehot=None, max_delta_step=None, max_depth=7,
                max_leaves=None, min_child_weight=None, missing=nan,
                monotone_constraints=None, multi_strategy=None, n_estimators=100,
                n_jobs=None, num_parallel_tree=None, objective='multi:softprob',
…)}
```

[73]:
```
LIM_8_MODEL_V3_SEARCH = {
    'lr': tune.grid_search([1e-1, 5e-2, 1e-2, 5e-3, 1e-3]),
    'hidden_size': tune.grid_search([int(1e2), int(5e2), int(1e3), int(5e3)]),
    'batch_size': tune.grid_search([16, 32, 64]),
    'num_epochs': 200,
    'early_stop': 10,
    'log_dir': LIM_8_LOGS_V3,
    'model_path': LIM_8_MODELPATH_V3
}
```

[74]:
```
tune_classification_nn(
    LIM_8_MODEL_V3_SEARCH,
    X_wo_lim_8_v2,
    y_wo_lim_8_v2
)
```

```
2024-06-26 13:55:41,077 INFO tune.py:616 -- [output] This uses the legacy output
and progress reporter, as Jupyter notebooks are not supported by the new engine,
yet. For more information, please see https://github.com/ray-
project/ray/issues/36949

== Status ==
Current time: 2024-06-26 13:55:41 (running for 00:00:00.32)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: None
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (60 PENDING)


== Status ==
Current time: 2024-06-26 13:55:46 (running for 00:00:05.37)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: None
```

```
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (50 PENDING, 10 RUNNING)


(train_classification_nn pid=88764) Using device: mps
(train_classification_nn pid=88861) Using device: mps [repeated
10x across cluster]
(train_classification_nn pid=88959) Using device: mps [repeated 8x
across cluster]
(train_classification_nn pid=89019) Using device: mps [repeated 5x
across cluster]
(train_classification_nn pid=89079) Using device: mps [repeated 6x
across cluster]
(train_classification_nn pid=89123) Using device: mps [repeated 3x
across cluster]
(train_classification_nn pid=89219) Using device: mps [repeated 7x
across cluster]
(train_classification_nn pid=89288) Using device: mps [repeated 7x
across cluster]
(train_classification_nn pid=89356) Using device: mps [repeated 6x
across cluster]
(train_classification_nn pid=89413) Using device: mps [repeated 3x
across cluster]
(train_regression_nn pid=15825) Using device: mps
(train_regression_nn pid=15980) Using device: mps [repeated 10x
across cluster]
(train_regression_nn pid=16083) Using device: mps [repeated 10x
across cluster]
(train_regression_nn pid=16167) Using device: mps [repeated 10x
across cluster]
(train_regression_nn pid=16238) Using device: mps [repeated 10x
across cluster]
(train_regression_nn pid=16357) Using device: mps [repeated 10x
across cluster]
(train_regression_nn pid=18323) Using device: mps
(train_regression_nn pid=18395) Using device: mps [repeated 14x
across cluster]
```

```
(train_regression_nn pid=18464) Using device: mps [repeated 7x
across cluster]
(train_regression_nn pid=19849) Using device: mps
(train_regression_nn pid=19954) Using device: mps [repeated 10x
across cluster]
(train_regression_nn pid=20021) Using device: mps [repeated 6x
across cluster]
(train_regression_nn pid=20076) Using device: mps [repeated 4x
across cluster]
(train_regression_nn pid=20170) Using device: mps [repeated 7x
across cluster]
(train_regression_nn pid=20248) Using device: mps [repeated 4x
across cluster]
(train_regression_nn pid=20320) Using device: mps [repeated 4x
across cluster]
(train_regression_nn pid=20396) Using device: mps [repeated 2x
across cluster]
(train_regression_nn pid=20481) Using device: mps [repeated 5x
across cluster]
(train_regression_nn pid=20539) Using device: mps
(train_regression_nn pid=20538) Using device: mps
(train_regression_nn pid=20593) Using device: mps [repeated 5x
across cluster]
(train_regression_nn pid=20660) Using device: mps [repeated 3x
across cluster]
(train_regression_nn pid=20724) Using device: mps [repeated 4x
across cluster]
(train_regression_nn pid=25761) Using device: mps
(train_regression_nn pid=25879) Using device: mps [repeated 10x
across cluster]
(train_regression_nn pid=25946) Using device: mps [repeated 5x
across cluster]
(train_regression_nn pid=26003) Using device: mps [repeated 4x
across cluster]
(train_regression_nn pid=26068) Using device: mps [repeated 6x
across cluster]
(train_regression_nn pid=26140) Using device: mps [repeated 2x
across cluster]
```

```
(train_regression_nn pid=26195) Using device: mps [repeated 3x
across cluster]
(train_regression_nn pid=26247) Using device: mps [repeated 3x
across cluster]
(train_regression_nn pid=26302) Using device: mps [repeated 6x
across cluster]
(train_regression_nn pid=26370) Using device: mps [repeated 2x
across cluster]
(train_regression_nn pid=26425) Using device: mps [repeated 4x
across cluster]
(train_regression_nn pid=26467) Using device: mps [repeated 4x
across cluster]
(train_regression_nn pid=26561) Using device: mps [repeated 5x
across cluster]
(train_regression_nn pid=64650) Using device: mps
(train_regression_nn pid=64794) Using device: mps [repeated 10x
across cluster]
(train_regression_nn pid=64875) Using device: mps [repeated 6x
across cluster]
(train_regression_nn pid=64942) Using device: mps [repeated 3x
across cluster]
(train_regression_nn pid=65021) Using device: mps [repeated 3x
across cluster]
(train_regression_nn pid=65116) Using device: mps [repeated 6x
across cluster]
(train_regression_nn pid=65197) Using device: mps [repeated 2x
across cluster]
(train_regression_nn pid=65287) Using device: mps [repeated 3x
across cluster]
(train_regression_nn pid=65367) Using device: mps [repeated 2x
across cluster]
(train_regression_nn pid=65430) Using device: mps [repeated 2x
across cluster]
(train_regression_nn pid=65506) Using device: mps [repeated 3x
across cluster]
(train_regression_nn pid=65611) Using device: mps [repeated 4x
across cluster]
```

```
(train_regression_nn pid=65670) Using device: mps [repeated 8x
across cluster]
(train_regression_nn pid=65785) Using device: mps [repeated 3x
across cluster]
(train_regression_nn pid=77306) Using device: mps
(train_regression_nn pid=77413) Using device: mps [repeated 10x
across cluster]
(train_regression_nn pid=77502) Using device: mps [repeated 6x
across cluster]
(train_regression_nn pid=77570) Using device: mps [repeated 5x
across cluster]
(train_regression_nn pid=77626) Using device: mps [repeated 5x
across cluster]
(train_regression_nn pid=77682) Using device: mps [repeated 4x
across cluster]
(train_regression_nn pid=77750) Using device: mps [repeated 2x
across cluster]
(train_regression_nn pid=77877) Using device: mps [repeated 4x
across cluster]
(train_regression_nn pid=78020) Using device: mps [repeated 5x
across cluster]
(train_regression_nn pid=78047) Using device: mps
(train_regression_nn pid=78072) Using device: mps
(train_regression_nn pid=78155) Using device: mps [repeated 5x
across cluster]
(train_regression_nn pid=78208) Using device: mps [repeated 2x
across cluster]
(train_regression_nn pid=78260) Using device: mps [repeated 4x
across cluster]
(train_regression_nn pid=78313) Using device: mps [repeated 4x
across cluster]
<IPython.core.display.HTML object>
== Status ==
Current time: 2024-06-26 13:55:51 (running for 00:00:10.40)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.6696428656578064
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
```

```
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (50 PENDING, 7 RUNNING, 3 TERMINATED)


== Status ==
Current time: 2024-06-26 13:55:56 (running for 00:00:15.44)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: 0.5591517984867096
| Iter 25.000: 0.604166673289405
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (44 PENDING, 7 RUNNING, 9 TERMINATED)


== Status ==
Current time: 2024-06-26 13:56:01 (running for 00:00:20.44)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: 0.5591517984867096
| Iter 25.000: 0.6285714387893677
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (41 PENDING, 8 RUNNING, 11 TERMINATED)


== Status ==
Current time: 2024-06-26 13:56:06 (running for 00:00:25.48)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: 0.5591517984867096
| Iter 25.000: 0.5714285771052042
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (37 PENDING, 6 RUNNING, 17 TERMINATED)


== Status ==
Current time: 2024-06-26 13:56:11 (running for 00:00:30.48)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: 0.5591517984867096
| Iter 25.000: 0.5561755994955698
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (31 PENDING, 9 RUNNING, 20 TERMINATED)
```

```
== Status ==
Current time: 2024-06-26 13:56:16 (running for 00:00:35.50)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: 0.5591517984867096
| Iter 25.000: 0.5654761923684014
Logical resource usage: 7.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (29 PENDING, 5 RUNNING, 26 TERMINATED)


== Status ==
Current time: 2024-06-26 13:56:21 (running for 00:00:40.50)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: 0.5747767984867096
| Iter 25.000: 0.5684523847368028
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (21 PENDING, 10 RUNNING, 29 TERMINATED)


== Status ==
Current time: 2024-06-26 13:56:26 (running for 00:00:45.52)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: 0.5747767984867096
| Iter 25.000: 0.5766369236840142
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (19 PENDING, 5 RUNNING, 36 TERMINATED)


== Status ==
Current time: 2024-06-26 13:56:31 (running for 00:00:50.55)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: 0.5747767984867096
| Iter 25.000: 0.5792410969734192
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (14 PENDING, 8 RUNNING, 38 TERMINATED)


== Status ==
Current time: 2024-06-26 13:56:36 (running for 00:00:55.57)
Using AsyncHyperBand: num_stopped=4
```

```
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: 0.5747767984867096
| Iter 25.000: 0.5980654915173849
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (12 PENDING, 5 RUNNING, 43 TERMINATED)


== Status ==
Current time: 2024-06-26 13:56:41 (running for 00:01:00.57)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: 0.5747767984867096
| Iter 25.000: 0.5980654915173849
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (7 PENDING, 8 RUNNING, 45 TERMINATED)


== Status ==
Current time: 2024-06-26 13:56:46 (running for 00:01:05.62)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: 0.5747767984867096
| Iter 25.000: 0.6035714387893677
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (4 PENDING, 6 RUNNING, 50 TERMINATED)


== Status ==
Current time: 2024-06-26 13:56:51 (running for 00:01:10.62)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: 0.7924107313156128 | Iter 37.500:
0.6060267984867096 | Iter 25.000: 0.617559532324473
Logical resource usage: 6.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (6 RUNNING, 54 TERMINATED)


== Status ==
Current time: 2024-06-26 13:56:56 (running for 00:01:15.70)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: 0.7924107313156128 | Iter 37.500:
0.6060267984867096 | Iter 25.000: 0.6176587369706895
Logical resource usage: 2.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
```

```
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (2 RUNNING, 58 TERMINATED)



2024-06-26 13:57:00,154 INFO tune.py:1009 -- Wrote the latest version of all
result files and experiment state to
'/Users/tyler/ray_results/train_classification_nn_2024-06-26_13-55-41' in
0.0274s.
2024-06-26 13:57:00,162 INFO tune.py:1041 -- Total run time: 79.09 seconds
(79.04 seconds for the tuning loop).

== Status ==
Current time: 2024-06-26 13:57:00 (running for 00:01:19.07)
Using AsyncHyperBand: num_stopped=5
Bracket: Iter 84.375: None | Iter 56.250: 0.7924107313156128 | Iter 37.500:
0.6060267984867096 | Iter 25.000: 0.6128968344794379
Logical resource usage: 1.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-26_13-55-41/train_classification_nn_2024-06-26_13-55-41/driver_artifacts
Number of trials: 60/60 (60 TERMINATED)
+-----------------------------------+------------+-----------------+-------+--
-----------+-------------+-------------+----------+------------+-----------
----+
| Trial name                        | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |     loss |   accuracy |
val_accuracy |
|-----------------------------------+------------+-----------------+-------+--
-----------+-------------+-------------+----------+------------+-----------
----|
| train_classification_nn_af2ae_00000 | TERMINATED | 127.0.0.1:88760 | 0.1   |
100 |           16 |          200 | 1.39122  |   0.4875   |       0.564286 |
| train_classification_nn_af2ae_00001 | TERMINATED | 127.0.0.1:88761 | 0.1   |
100 |           32 |          200 | 0.814207 |   0.593125 |       0.571429 |
| train_classification_nn_af2ae_00002 | TERMINATED | 127.0.0.1:88762 | 0.1   |
100 |           64 |          200 | 0.487577 |   0.65024  |       0.69308  |
| train_classification_nn_af2ae_00003 | TERMINATED | 127.0.0.1:88763 | 0.1   |
500 |           16 |          200 | 1.1756   |   0.4      |       0.526786 |
| train_classification_nn_af2ae_00004 | TERMINATED | 127.0.0.1:88764 | 0.1   |
500 |           32 |          200 | 0.828042 |   0.57375  |       0.547619 |
| train_classification_nn_af2ae_00005 | TERMINATED | 127.0.0.1:88765 | 0.1   |
500 |           64 |          200 | 0.529203 |   0.703125 |       0.626116 |
| train_classification_nn_af2ae_00006 | TERMINATED | 127.0.0.1:88766 | 0.1   |
1000 |           16 |          200 | 1.18135  |   0.3875   |       0.510714 |
| train_classification_nn_af2ae_00007 | TERMINATED | 127.0.0.1:88767 | 0.1   |
1000 |           32 |          200 | 0.895604 |   0.5825   |       0.58631  |
| train_classification_nn_af2ae_00008 | TERMINATED | 127.0.0.1:88768 | 0.1   |
1000 |           64 |          200 | 0.641086 |   0.602163 |       0.535714 |
| train_classification_nn_af2ae_00009 | TERMINATED | 127.0.0.1:88769 | 0.1   |
```

```
5000 |           16 |          200 | 1.35618  |   0.45625  |       0.385714 |
| train_classification_nn_af2ae_00010 | TERMINATED | 127.0.0.1:88861 | 0.1   |
5000 |           32 |          200 | 1.03608  |   0.505    |       0.520833 |
| train_classification_nn_af2ae_00011 | TERMINATED | 127.0.0.1:88892 | 0.1   |
5000 |           64 |          200 | 0.598814 |   0.642548 |       0.543527 |
| train_classification_nn_af2ae_00012 | TERMINATED | 127.0.0.1:88893 | 0.05  |
100 |           16 |          200 | 1.08789  |   0.51875  |       0.514286 |
| train_classification_nn_af2ae_00013 | TERMINATED | 127.0.0.1:88894 | 0.05  |
100 |           32 |          200 | 0.884392 |   0.625625 |       0.547619 |
| train_classification_nn_af2ae_00014 | TERMINATED | 127.0.0.1:88895 | 0.05  |
100 |           64 |          200 | 0.369851 |   0.799038 |       0.657366 |
| train_classification_nn_af2ae_00015 | TERMINATED | 127.0.0.1:88896 | 0.05  |
500 |           16 |          200 | 0.991441 |   0.621875 |       0.557143 |
| train_classification_nn_af2ae_00016 | TERMINATED | 127.0.0.1:88911 | 0.05  |
500 |           32 |          200 | 0.687607 |   0.66625  |       0.575893 |
| train_classification_nn_af2ae_00017 | TERMINATED | 127.0.0.1:88912 | 0.05  |
500 |           64 |          200 | 0.457835 |   0.732212 |       0.495536 |
| train_classification_nn_af2ae_00018 | TERMINATED | 127.0.0.1:88959 | 0.05  |
1000 |           16 |          200 | 1.08598  |   0.546875 |       0.576786 |
| train_classification_nn_af2ae_00019 | TERMINATED | 127.0.0.1:88976 | 0.05  |
1000 |           32 |          200 | 0.871919 |   0.5825   |       0.596726 |
| train_classification_nn_af2ae_00020 | TERMINATED | 127.0.0.1:88977 | 0.05  |
1000 |           64 |          200 | 0.568837 |   0.714663 |       0.425223 |
| train_classification_nn_af2ae_00021 | TERMINATED | 127.0.0.1:89005 | 0.05  |
5000 |           16 |          200 | 1.11926  |   0.53125  |       0.267857 |
| train_classification_nn_af2ae_00022 | TERMINATED | 127.0.0.1:89006 | 0.05  |
5000 |           32 |          200 | 1.57499  |   0.545    |       0.428571 |
| train_classification_nn_af2ae_00023 | TERMINATED | 127.0.0.1:89019 | 0.05  |
5000 |           64 |          200 | 0.891621 |   0.65     |       0.520089 |
| train_classification_nn_af2ae_00024 | TERMINATED | 127.0.0.1:89022 | 0.01  |
100 |           16 |          200 | 0.873126 |   0.6125   |       0.528571 |
| train_classification_nn_af2ae_00025 | TERMINATED | 127.0.0.1:89036 | 0.01  |
100 |           32 |          200 | 0.420611 |   0.804375 |       0.651786 |
| train_classification_nn_af2ae_00026 | TERMINATED | 127.0.0.1:89064 | 0.01  |
100 |           64 |          200 | 0.192187 |   0.923798 |       0.736607 |
| train_classification_nn_af2ae_00027 | TERMINATED | 127.0.0.1:89065 | 0.01  |
500 |           16 |          200 | 0.541462 |   0.74375  |       0.591071 |
| train_classification_nn_af2ae_00028 | TERMINATED | 127.0.0.1:89066 | 0.01  |
500 |           32 |          200 | 0.616811 |   0.6675   |       0.517857 |
| train_classification_nn_af2ae_00029 | TERMINATED | 127.0.0.1:89079 | 0.01  |
500 |           64 |          200 | 0.38358  |   0.876442 |       0.677455 |
| train_classification_nn_af2ae_00030 | TERMINATED | 127.0.0.1:89108 | 0.01  |
1000 |           16 |          200 | 0.78758  |   0.684375 |       0.551786 |
| train_classification_nn_af2ae_00031 | TERMINATED | 127.0.0.1:89122 | 0.01  |
1000 |           32 |          200 | 0.516464 |   0.824375 |       0.516369 |
| train_classification_nn_af2ae_00032 | TERMINATED | 127.0.0.1:89123 | 0.01  |
1000 |           64 |          200 | 0.444074 |   0.837981 |       0.728795 |
| train_classification_nn_af2ae_00033 | TERMINATED | 127.0.0.1:89153 | 0.01  |
```

```
5000 |           16 |          200 | 0.755377 |   0.65     |       0.5125   |
| train_classification_nn_af2ae_00034 | TERMINATED | 127.0.0.1:89154 | 0.01  |
5000 |           32 |          200 | 1.10338  |   0.715    |       0.410714 |
| train_classification_nn_af2ae_00035 | TERMINATED | 127.0.0.1:89155 | 0.01  |
5000 |           64 |          200 | 1.82869  |   0.651202 |       0.366071 |
| train_classification_nn_af2ae_00036 | TERMINATED | 127.0.0.1:89156 | 0.005 |
100 |           16 |          200 | 0.570124 |   0.725    |       0.642857 |
| train_classification_nn_af2ae_00037 | TERMINATED | 127.0.0.1:89157 | 0.005 |
100 |           32 |          200 | 0.512    |   0.753125 |       0.558036 |
| train_classification_nn_af2ae_00038 | TERMINATED | 127.0.0.1:89158 | 0.005 |
100 |           64 |          200 | 0.457582 |   0.749519 |       0.551339 |
| train_classification_nn_af2ae_00039 | TERMINATED | 127.0.0.1:89218 | 0.005 |
500 |           16 |          200 | 0.657544 |   0.675    |       0.667857 |
| train_classification_nn_af2ae_00040 | TERMINATED | 127.0.0.1:89219 | 0.005 |
500 |           32 |          200 | 0.337054 |   0.803125 |       0.647321 |
| train_classification_nn_af2ae_00041 | TERMINATED | 127.0.0.1:89231 | 0.005 |
500 |           64 |          200 | 0.18849  |   0.918269 |       0.756696 |
| train_classification_nn_af2ae_00042 | TERMINATED | 127.0.0.1:89232 | 0.005 |
1000 |           16 |          200 | 0.728992 |   0.653125 |       0.657143 |
| train_classification_nn_af2ae_00043 | TERMINATED | 127.0.0.1:89233 | 0.005 |
1000 |           32 |          200 | 0.487765 |   0.821875 |       0.647321 |
| train_classification_nn_af2ae_00044 | TERMINATED | 127.0.0.1:89258 | 0.005 |
1000 |           64 |          200 | 0.216209 |   0.870192 |       0.71317  |
| train_classification_nn_af2ae_00045 | TERMINATED | 127.0.0.1:89259 | 0.005 |
5000 |           16 |          200 | 0.621719 |   0.725    |       0.4875   |
| train_classification_nn_af2ae_00046 | TERMINATED | 127.0.0.1:89288 | 0.005 |
5000 |           32 |          200 | 0.480115 |   0.785625 |       0.578869 |
| train_classification_nn_af2ae_00047 | TERMINATED | 127.0.0.1:89313 | 0.005 |
5000 |           64 |          200 | 0.774283 |   0.658894 |       0.492188 |
| train_classification_nn_af2ae_00048 | TERMINATED | 127.0.0.1:89326 | 0.001 |
100 |           16 |          200 | 0.805866 |   0.678125 |       0.526786 |
| train_classification_nn_af2ae_00049 | TERMINATED | 127.0.0.1:89327 | 0.001 |
100 |           32 |          200 | 0.36921  |   0.82     |       0.678571 |
| train_classification_nn_af2ae_00050 | TERMINATED | 127.0.0.1:89328 | 0.001 |
100 |           64 |          200 | 0.418793 |   0.804567 |       0.610491 |
| train_classification_nn_af2ae_00051 | TERMINATED | 127.0.0.1:89329 | 0.001 |
500 |           16 |          200 | 0.521804 |   0.740625 |       0.642857 |
| train_classification_nn_af2ae_00052 | TERMINATED | 127.0.0.1:89356 | 0.001 |
500 |           32 |          200 | 0.29013  |   0.83     |       0.712798 |
| train_classification_nn_af2ae_00053 | TERMINATED | 127.0.0.1:89371 | 0.001 |
500 |           64 |          200 | 0.131826 |   0.939183 |       0.780134 |
| train_classification_nn_af2ae_00054 | TERMINATED | 127.0.0.1:89372 | 0.001 |
1000 |           16 |          200 | 0.549748 |   0.684375 |       0.667857 |
| train_classification_nn_af2ae_00055 | TERMINATED | 127.0.0.1:89413 | 0.001 |
1000 |           32 |          200 | 0.347346 |   0.81875  |       0.688988 |
| train_classification_nn_af2ae_00056 | TERMINATED | 127.0.0.1:89425 | 0.001 |
1000 |           64 |          200 | 0.200364 |   0.888462 |       0.784598 |
| train_classification_nn_af2ae_00057 | TERMINATED | 127.0.0.1:89426 | 0.001 |
```

```
5000 |           16 |          200 | 0.738971 |   0.6625   |       0.460714 |
| train_classification_nn_af2ae_00058 | TERMINATED | 127.0.0.1:89427 | 0.001 |
5000 |           32 |          200 | 0.433437 |   0.80625  |       0.69494  |
| train_classification_nn_af2ae_00059 | TERMINATED | 127.0.0.1:89452 | 0.001 |
5000 |           64 |          200 | 0.528963 |   0.724279 |       0.582589 |
+-------------------------------------+------------+-----------------+-------+--
------------+-------------+-------------+----------+------------+------------
----+
```

```
Best Hyperparameters Found:  {'lr': 0.001, 'hidden_size': 1000, 'batch_size':
64, 'num_epochs': 200, 'early_stop': 10, 'log_dir': '/Users/tyler/GitHub
Repositories/Apple Watch FitBit Project/Wearables-Activity-
Classification/logs/whoop-activity-class/v3/lim-8', 'model_path':
'/Users/tyler/GitHub Repositories/Apple Watch FitBit Project/Wearables-Activity-
Classification/models/whoop-activity-class/v3/lim-8', 'tune': True}
Best Validation Accuracy:  0.7845982313156128
Best Number Epochs:  32
Best Model Path:  /Users/tyler/GitHub Repositories/Apple Watch FitBit
Project/Wearables-Activity-Classification/models/whoop-activity-
class/v3/lim-8/h1000_b64_lr0.001.th
```

3 Recovery Score Regression

3.1 Daily strain metrics setup

3.1.1 Import

[75]:
```
df_phys = pd.read_csv(os.path.join(WHOOP_PROCESS_DIR, 'phys.csv'))
df_phys
```

[75]:

	recovery_score_p	hr_rest	hr_var	skin_temp_c	blood_ox_p	\
0	0.84	52.0	92.0	33.30	0.9614	
1	0.94	48.0	95.0	34.30	0.9889	
2	0.83	50.0	87.0	34.00	0.9782	
3	0.73	49.0	80.0	33.20	0.9900	
4	0.74	50.0	78.0	33.90	0.9840	
..	…	…	…	…	…	
620	0.57	48.0	74.0	33.13	0.9581	
621	0.49	46.0	68.0	31.83	0.9661	
622	0.48	47.0	65.0	32.80	0.9669	
623	0.45	49.0	67.0	32.44	0.9584	
624	0.55	49.0	68.0	33.30	0.9733	

	sleep_performance_p	resp_rate	asleep_min	in_bed_min	light_sleep_min	\
0	0.98	14.8	533.0	570.0	231.0	
1	0.87	14.0	433.0	484.0	298.0	
2	1.00	14.4	535.0	571.0	273.0	

```
3                  1.00       14.8       488.0       562.0            221.0
4                  1.00       14.3       568.0       623.0            355.0
..                  …          …          …           …                …
620                0.93       13.7       453.0       494.0            271.0
621                1.00       14.2       490.0       557.0            254.0
622                0.93       13.7       481.0       564.0            258.0
623                0.78       13.7       410.0       487.0            230.0
624                0.95       14.0       482.0       549.0            182.0

     …  calories  hr_max  hr_avg  cycle_date_ord  cycle_day_of_week_sin  \
0    …    3689.0   159.0    82.0          739052              -0.974928
1    …    2700.0   184.0    73.0          739051              -0.433884
2    …    2505.0   161.0    72.0          739050               0.433884
3    …    2202.0   145.0    72.0          739049               0.974928
4    …    3029.0   177.0    73.0          739048               0.781831
..   …       …      …      …              …                      …
620  …    2753.0   179.0    64.0          738420               0.433884
621  …    1794.0   119.0    57.0          738419               0.974928
622  …    1871.0   153.0    58.0          738418               0.781831
623  …    2863.0   175.0    69.0          738417               0.000000
624  …    2104.0   154.0    66.0          738416              -0.781831

     cycle_day_of_week_cos  sleep_onset_min_sin  sleep_onset_min_cos  \
0                -0.222521            -0.207912             0.978148
1                -0.900969            -0.091502             0.995805
2                -0.900969             0.030539             0.999534
3                -0.222521             0.052336             0.998630
4                 0.623490            -0.212178             0.977231
..                     …                    …                    …
620              -0.900969            -0.160743             0.986996
621              -0.222521            -0.496217             0.868199
622               0.623490            -0.422618             0.906308
623               1.000000            -0.337917             0.941176
624               0.623490            -0.422618             0.906308

     prev_sleep_onset_min_sin  prev_sleep_onset_min_cos
0                   -0.091502                  0.995805
1                    0.030539                  0.999534
2                    0.052336                  0.998630
3                   -0.212178                  0.977231
4                   -0.195090                  0.980785
..                        …                         …
620                 -0.496217                  0.868199
621                 -0.422618                  0.906308
622                 -0.337917                  0.941176
623                 -0.422618                  0.906308
624                 -0.358368                  0.933580
```

```
[625 rows x 34 columns]
```

[76]:
```
df_phys.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 625 entries, 0 to 624
Data columns (total 34 columns):
 #   Column                    Non-Null Count  Dtype
---  ------                    --------------  -----
 0   recovery_score_p          625 non-null    float64
 1   hr_rest                   625 non-null    float64
 2   hr_var                    625 non-null    float64
 3   skin_temp_c               625 non-null    float64
 4   blood_ox_p                625 non-null    float64
 5   sleep_performance_p       625 non-null    float64
 6   resp_rate                 625 non-null    float64
 7   asleep_min                625 non-null    float64
 8   in_bed_min                625 non-null    float64
 9   light_sleep_min           625 non-null    float64
 10  light_sleep_p             625 non-null    float64
 11  deep_sleep_min            625 non-null    float64
 12  deep_sleep_p              625 non-null    float64
 13  rem_sleep_min             625 non-null    float64
 14  rem_sleep_p               625 non-null    float64
 15  awake_min                 625 non-null    float64
 16  awake_p                   625 non-null    float64
 17  restorative_sleep_min     625 non-null    float64
 18  restorative_sleep_p       625 non-null    float64
 19  sleep_need_min            625 non-null    float64
 20  sleep_debt_min            625 non-null    float64
 21  sleep_efficiency_p        625 non-null    float64
 22  sleep_consistency_p       625 non-null    float64
 23  day_strain                625 non-null    float64
 24  calories                  625 non-null    float64
 25  hr_max                    625 non-null    float64
 26  hr_avg                    625 non-null    float64
 27  cycle_date_ord            625 non-null    int64
 28  cycle_day_of_week_sin     625 non-null    float64
 29  cycle_day_of_week_cos     625 non-null    float64
 30  sleep_onset_min_sin       625 non-null    float64
 31  sleep_onset_min_cos       625 non-null    float64
 32  prev_sleep_onset_min_sin  625 non-null    float64
 33  prev_sleep_onset_min_cos  625 non-null    float64
dtypes: float64(33), int64(1)
memory usage: 166.1 KB
```

3.1.2 Label

[77]:
```
PHYS_LABEL = 'recovery_score_p'
```

3.1.3 Feature Selection

Methods

[218]:
```
def get_feature_importances(models, features):
    feature_names = pd.Series(features.columns)

    feature_importance_dict = {}

    for name, model in regression_models_v1.items():
        if name in ['Lasso', 'Ridge']:
            importances = np.abs(model.coef_)
        elif name == 'Random Forest':
            importances = model.feature_importances_
        elif name == 'XGBoost':
            importances = model.feature_importances_

        # print(f'{name} feature importances:')
        importances_series = pd.Series(importances)
        feature_importance_df = pd.DataFrame(
            {
                'feature': feature_names,
                'importance': importances_series
            }
        )\
        .sort_values(by='importance', ascending=False)\
        .reset_index(drop=True)\
        .reset_index(names=['rank'])\
        .set_index('feature')

        feature_importance_dict[name] = feature_importance_df

        # display(feature_importance_df)

    compare_df = pd.concat(feature_importance_dict, axis=1)

    feature_ranks = compare_df.xs('rank', level=1, axis=1)
    # display(feature_ranks)

    compare_df['avg_rank'] = feature_ranks.mean(axis=1)
    compare_df.sort_values(by='avg_rank', ascending=True, inplace=True)

    # display(compare_df)

    return compare_df
```

v1 Features Focusing on removing clearly redundant features for v1

[78]:
```
PHYS_DROP_COLS_V1 = [

    # calculated by in_bed_min * respective percentage
    'asleep_min',
    'light_sleep_min',
    'deep_sleep_min',
    'rem_sleep_min',
    'awake_min',
    'restorative_sleep_min', # can probably drop restorative_sleep_p =␣
 ↪(deep_sleep_p + rem_sleep_p) too, but might as well leave it for v1

    'day_strain' # proprietary whoop metric -- not available from raw data
]

X_phys_v1, y_phys_v1 = get_X_y(df_phys, PHYS_LABEL, PHYS_DROP_COLS_V1)
```

v2 Features For v2, we'll first drop just the features that we would like to be independent from our model, like date, day of week, etc.

[227]:
```
PHYS_DROP_COLS_V2 = [
    'cycle_date_ord',
    'cycle_day_of_week_sin',
    'cycle_day_of_week_cos'
]

X_phys_v2, y_phys_v2 = X_phys_v1.copy().drop(columns=PHYS_DROP_COLS_V2),␣
 ↪y_phys_v1.copy()
```

[229]:
```
X_phys_v2.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 625 entries, 0 to 624
Data columns (total 23 columns):
 #   Column                   Non-Null Count  Dtype
---  ------                   --------------  -----
 0   hr_rest                  625 non-null    float64
 1   hr_var                   625 non-null    float64
 2   skin_temp_c              625 non-null    float64
 3   blood_ox_p               625 non-null    float64
 4   sleep_performance_p      625 non-null    float64
 5   resp_rate                625 non-null    float64
 6   in_bed_min               625 non-null    float64
 7   light_sleep_p            625 non-null    float64
 8   deep_sleep_p             625 non-null    float64
 9   rem_sleep_p              625 non-null    float64
 10  awake_p                  625 non-null    float64
```

```
 11  restorative_sleep_p       625 non-null    float64
 12  sleep_need_min            625 non-null    float64
 13  sleep_debt_min            625 non-null    float64
 14  sleep_efficiency_p        625 non-null    float64
 15  sleep_consistency_p       625 non-null    float64
 16  calories                  625 non-null    float64
 17  hr_max                    625 non-null    float64
 18  hr_avg                    625 non-null    float64
 19  sleep_onset_min_sin       625 non-null    float64
 20  sleep_onset_min_cos       625 non-null    float64
 21  prev_sleep_onset_min_sin  625 non-null    float64
 22  prev_sleep_onset_min_cos  625 non-null    float64
dtypes: float64(23)
memory usage: 112.4 KB
```

v4 Features For v4 we'll use the average feature importance ranks to keep only the most important half of features from each tuned model, hopefully without losing too much performance. Ideally, we can even boost performance on the neural regressor.

[261]:
```
# need to train v3 below before running

reg_feature_importances_v3 =␣
 ↪get_feature_importances(trained_regression_models_phys_v3, X_phys_v2)
reg_feature_importances_v3
```

[261]:

	Lasso		Ridge		Random Forest	\
	rank	importance	rank	importance	rank	
feature						
hr_var	0	0.159438	0	0.162212	0	
calories	1	0.036645	1	0.040572	2	
resp_rate	2	0.030769	2	0.033042	4	
hr_rest	5	0.017090	5	0.019649	1	
sleep_onset_min_sin	4	0.020220	4	0.023148	6	
sleep_consistency_p	11	0.003009	12	0.007480	8	
in_bed_min	9	0.004389	6	0.016548	12	
hr_avg	3	0.024217	3	0.028753	16	
skin_temp_c	7	0.015596	7	0.016504	10	
awake_p	18	0.000000	14	0.006534	3	
restorative_sleep_p	6	0.016106	16	0.005006	11	
hr_max	8	0.005851	10	0.007920	15	
rem_sleep_p	12	0.001982	15	0.005709	9	
sleep_efficiency_p	13	0.001923	9	0.007965	20	
deep_sleep_p	17	0.000000	19	0.001492	5	
sleep_performance_p	14	0.000826	8	0.013329	19	
light_sleep_p	16	0.000000	11	0.007711	17	
prev_sleep_onset_min_sin	10	0.003862	13	0.006879	21	
blood_ox_p	20	0.000000	20	0.000931	7	

```
prev_sleep_onset_min_cos    22    0.000000    18    0.002524           14
sleep_need_min              19    0.000000    21    0.000890           13
sleep_debt_min              15    0.000305    17    0.004509           22
sleep_onset_min_cos         21    0.000000    22    0.000152           18
```

		XGBoost		avg_rank
	importance	rank	importance	
feature				
hr_var	0.689356	0	0.546038	0.00
calories	0.026204	2	0.033836	1.50
resp_rate	0.018923	4	0.030279	3.00
hr_rest	0.030128	6	0.027413	4.25
sleep_onset_min_sin	0.016012	3	0.031679	4.25
sleep_consistency_p	0.015395	1	0.035723	8.00
in_bed_min	0.011717	10	0.021297	9.25
hr_avg	0.011036	16	0.015193	9.50
skin_temp_c	0.013832	15	0.016425	9.75
awake_p	0.019619	5	0.030176	10.00
restorative_sleep_p	0.013779	8	0.022700	10.25
hr_max	0.011045	11	0.020492	11.00
rem_sleep_p	0.015087	9	0.021704	11.25
sleep_efficiency_p	0.008451	7	0.025535	12.25
deep_sleep_p	0.017303	13	0.017924	13.50
sleep_performance_p	0.008821	14	0.017185	13.75
light_sleep_p	0.010584	19	0.013042	15.75
prev_sleep_onset_min_sin	0.008238	21	0.009802	16.25
blood_ox_p	0.015860	18	0.013973	16.25
prev_sleep_onset_min_cos	0.011106	12	0.019662	16.50
sleep_need_min	0.011457	17	0.015017	17.50
sleep_debt_min	0.005885	20	0.012705	18.50
sleep_onset_min_cos	0.010163	22	0.002202	20.75

[264]:
```
PHYS_DROP_COLS_V4 = reg_feature_importances_v3[
        reg_feature_importances_v3['avg_rank']\
        >\
        (reg_feature_importances_v3.shape[0] // 2)
    ].index.tolist()
PHYS_DROP_COLS_V4
```

[264]:
```
['rem_sleep_p',
 'sleep_efficiency_p',
 'deep_sleep_p',
 'sleep_performance_p',
 'light_sleep_p',
 'prev_sleep_onset_min_sin',
 'blood_ox_p',
 'prev_sleep_onset_min_cos',
```

```
 'sleep_need_min',
 'sleep_debt_min',
 'sleep_onset_min_cos']
```

[265]:
```
X_phys_v4, y_phys_v4 = X_phys_v2.copy().drop(columns=PHYS_DROP_COLS_V4),␣
↪y_phys_v2.copy()
```

[266]:
```
X_phys_v4.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 625 entries, 0 to 624
Data columns (total 12 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   hr_rest              625 non-null    float64
 1   hr_var               625 non-null    float64
 2   skin_temp_c          625 non-null    float64
 3   resp_rate            625 non-null    float64
 4   in_bed_min           625 non-null    float64
 5   awake_p              625 non-null    float64
 6   restorative_sleep_p  625 non-null    float64
 7   sleep_consistency_p  625 non-null    float64
 8   calories             625 non-null    float64
 9   hr_max               625 non-null    float64
 10  hr_avg               625 non-null    float64
 11  sleep_onset_min_sin  625 non-null    float64
dtypes: float64(12)
memory usage: 58.7 KB
```

3.2 Merged strain, workouts, journal entries setup

3.2.1 Import

[277]:
```
df_merge = pd.read_csv(os.path.join(WHOOP_PROCESS_DIR, 'merge.csv'))
df_merge['activity_names'] = df_merge['activity_names'].apply(ast.literal_eval)
df_merge['activity_codes'] = df_merge['activity_codes'].apply(ast.literal_eval)
df_merge
```

[277]:

	cycle_date_ord	recovery_score_p	hr_rest	hr_var	skin_temp_c	\
0	739052	0.84	52.0	92.0	33.30	
1	739051	0.94	48.0	95.0	34.30	
2	739050	0.83	50.0	87.0	34.00	
3	739049	0.73	49.0	80.0	33.20	
4	739048	0.74	50.0	78.0	33.90	
..	…	…	…	…	…	
620	738420	0.57	48.0	74.0	33.13	
621	738419	0.49	46.0	68.0	31.83	
622	738418	0.48	47.0	65.0	32.80	

```
623          738417              0.45     49.0    67.0        32.44
624          738416              0.55     49.0    68.0        33.30

     blood_ox_p  sleep_performance_p  resp_rate  asleep_min  in_bed_min  …  \
0        0.9614                 0.98       14.8       533.0       570.0  …
1        0.9889                 0.87       14.0       433.0       484.0  …
2        0.9782                 1.00       14.4       535.0       571.0  …
3        0.9900                 1.00       14.8       488.0       562.0  …
4        0.9840                 1.00       14.3       568.0       623.0  …
..          …                    …          …          …          …  …
620      0.9581                 0.93       13.7       453.0       494.0  …
621      0.9661                 1.00       14.2       490.0       557.0  …
622      0.9669                 0.93       13.7       481.0       564.0  …
623      0.9584                 0.78       13.7       410.0       487.0  …
624      0.9733                 0.95       14.0       482.0       549.0  …

     Masturbate?  See direct sunlight upon waking up?  Spend time outdoors?  \
0            NaN                                 NaN                   True
1            NaN                                 NaN                  False
2            NaN                                 NaN                  False
3            NaN                                 NaN                    NaN
4            NaN                                 NaN                  False
..           …                                   …                    …
620          NaN                                True                    NaN
621          NaN                                True                    NaN
622          NaN                                True                    NaN
623          NaN                                True                    NaN
624          NaN                                True                    NaN

     Spend time stretching?  Take an ice bath?  \
0                     False              False
1                     False              False
2                     False              False
3                       NaN                NaN
4                     False              False
..                      …                  …
620                     NaN                NaN
621                     NaN                NaN
622                     NaN                NaN
623                     NaN                NaN
624                     NaN                NaN

     Take prescription sleep medication?  Use CBD oil in any form?  \
0                                    NaN                       True
1                                    NaN                       True
2                                    NaN                       True
3                                    NaN                        NaN
```

```
4                                    NaN                        True
..                                   …                          …
620                                 True                       False
621                                 True                        True
622                                 True                       False
623                                 True                       False
624                                 True                       False

     Use a sauna?  Use tobacco in any form?  activity_codes_comb
0           False                      True                    1
1           False                      True                   13
2           False                      True                   31
3             NaN                       NaN                    0
4           False                     False                   15
..            …                         …                     …
620           NaN                       NaN                    9
621           NaN                       NaN                    0
622           NaN                       NaN                    0
623           NaN                       NaN                    9
624           NaN                       NaN                    0

[625 rows x 62 columns]
```

[278]:
```
df_merge.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 625 entries, 0 to 624
Data columns (total 62 columns):
 #   Column                                Non-Null Count  Dtype
---  ------                                --------------  -----
 0   cycle_date_ord                        625 non-null    int64
 1   recovery_score_p                      625 non-null    float64
 2   hr_rest                               625 non-null    float64
 3   hr_var                                625 non-null    float64
 4   skin_temp_c                           625 non-null    float64
 5   blood_ox_p                            625 non-null    float64
 6   sleep_performance_p                   625 non-null    float64
 7   resp_rate                             625 non-null    float64
 8   asleep_min                            625 non-null    float64
 9   in_bed_min                            625 non-null    float64
 10  light_sleep_min                       625 non-null    float64
 11  light_sleep_p                         625 non-null    float64
 12  deep_sleep_min                        625 non-null    float64
 13  deep_sleep_p                          625 non-null    float64
 14  rem_sleep_min                         625 non-null    float64
 15  rem_sleep_p                           625 non-null    float64
 16  awake_min                             625 non-null    float64
 17  awake_p                               625 non-null    float64
```

```
 18  restorative_sleep_min               625 non-null    float64
 19  restorative_sleep_p                 625 non-null    float64
 20  sleep_need_min                      625 non-null    float64
 21  sleep_debt_min                      625 non-null    float64
 22  sleep_efficiency_p                  625 non-null    float64
 23  sleep_consistency_p                 625 non-null    float64
 24  day_strain                          625 non-null    float64
 25  calories                            625 non-null    float64
 26  hr_max                              625 non-null    float64
 27  hr_avg                              625 non-null    float64
 28  cycle_day_of_week_sin               625 non-null    float64
 29  cycle_day_of_week_cos               625 non-null    float64
 30  sleep_onset_min_sin                 625 non-null    float64
 31  sleep_onset_min_cos                 625 non-null    float64
 32  prev_sleep_onset_min_sin            625 non-null    float64
 33  prev_sleep_onset_min_cos            625 non-null    float64
 34  activity_duration_min               374 non-null    float64
 35  activity_strain_sum                 374 non-null    float64
 36  activity_strain_max                 374 non-null    float64
 37  activity_calories                   374 non-null    float64
 38  activity_hr_max                     374 non-null    float64
 39  activity_hr_avg                     374 non-null    float64
 40  activity_hr_zone_1_min              374 non-null    float64
 41  activity_hr_zone_2_min              374 non-null    float64
 42  activity_hr_zone_3_min              374 non-null    float64
 43  activity_hr_zone_4_min              374 non-null    float64
 44  activity_hr_zone_5_min              374 non-null    float64
 45  activity_names                      625 non-null    object
 46  activity_codes                      625 non-null    object
 47  activity_count                      374 non-null    float64
 48  Avoid consuming processed foods?    238 non-null    object
 49  Eat any food close to bedtime?      539 non-null    object
 50  Have an injury or wound             375 non-null    object
 51  Have any alcoholic drinks?          526 non-null    object
 52  Masturbate?                         237 non-null    object
 53  See direct sunlight upon waking up? 164 non-null    object
 54  Spend time outdoors?                375 non-null    object
 55  Spend time stretching?              375 non-null    object
 56  Take an ice bath?                   299 non-null    object
 57  Take prescription sleep medication? 432 non-null    object
 58  Use CBD oil in any form?            157 non-null    object
 59  Use a sauna?                        361 non-null    object
 60  Use tobacco in any form?            323 non-null    object
 61  activity_codes_comb                 625 non-null    int64
dtypes: float64(45), int64(2), object(15)
memory usage: 302.9+ KB
```

3.2.2 Label

[279]:
```
MERGE_LABEL = 'recovery_score_p'
```

3.2.3 Feature Selection

I wanted to use the journal entries here, but I forgot that null entries will break most of our models. As a result, we'll remove any questions with null entries in v1, along with any other clearly redundant or unwanted (see PHYS) features. I'll also need to fill the null activity entries with 0 values.

Drop nulls

[290]:
```
df_merge_fill = df_merge.copy()
df_merge_fill.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 625 entries, 0 to 624
Data columns (total 62 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   cycle_date_ord                  625 non-null    int64
 1   recovery_score_p                625 non-null    float64
 2   hr_rest                         625 non-null    float64
 3   hr_var                          625 non-null    float64
 4   skin_temp_c                     625 non-null    float64
 5   blood_ox_p                      625 non-null    float64
 6   sleep_performance_p             625 non-null    float64
 7   resp_rate                       625 non-null    float64
 8   asleep_min                      625 non-null    float64
 9   in_bed_min                      625 non-null    float64
 10  light_sleep_min                 625 non-null    float64
 11  light_sleep_p                   625 non-null    float64
 12  deep_sleep_min                  625 non-null    float64
 13  deep_sleep_p                    625 non-null    float64
 14  rem_sleep_min                   625 non-null    float64
 15  rem_sleep_p                     625 non-null    float64
 16  awake_min                       625 non-null    float64
 17  awake_p                         625 non-null    float64
 18  restorative_sleep_min           625 non-null    float64
 19  restorative_sleep_p             625 non-null    float64
 20  sleep_need_min                  625 non-null    float64
 21  sleep_debt_min                  625 non-null    float64
 22  sleep_efficiency_p              625 non-null    float64
 23  sleep_consistency_p             625 non-null    float64
 24  day_strain                      625 non-null    float64
 25  calories                        625 non-null    float64
 26  hr_max                          625 non-null    float64
 27  hr_avg                          625 non-null    float64
```

```
 28  cycle_day_of_week_sin                625 non-null    float64
 29  cycle_day_of_week_cos                625 non-null    float64
 30  sleep_onset_min_sin                  625 non-null    float64
 31  sleep_onset_min_cos                  625 non-null    float64
 32  prev_sleep_onset_min_sin             625 non-null    float64
 33  prev_sleep_onset_min_cos             625 non-null    float64
 34  activity_duration_min                374 non-null    float64
 35  activity_strain_sum                  374 non-null    float64
 36  activity_strain_max                  374 non-null    float64
 37  activity_calories                    374 non-null    float64
 38  activity_hr_max                      374 non-null    float64
 39  activity_hr_avg                      374 non-null    float64
 40  activity_hr_zone_1_min               374 non-null    float64
 41  activity_hr_zone_2_min               374 non-null    float64
 42  activity_hr_zone_3_min               374 non-null    float64
 43  activity_hr_zone_4_min               374 non-null    float64
 44  activity_hr_zone_5_min               374 non-null    float64
 45  activity_names                       625 non-null    object
 46  activity_codes                       625 non-null    object
 47  activity_count                       374 non-null    float64
 48  Avoid consuming processed foods?     238 non-null    object
 49  Eat any food close to bedtime?       539 non-null    object
 50  Have an injury or wound              375 non-null    object
 51  Have any alcoholic drinks?           526 non-null    object
 52  Masturbate?                          237 non-null    object
 53  See direct sunlight upon waking up?  164 non-null    object
 54  Spend time outdoors?                 375 non-null    object
 55  Spend time stretching?               375 non-null    object
 56  Take an ice bath?                    299 non-null    object
 57  Take prescription sleep medication?  432 non-null    object
 58  Use CBD oil in any form?             157 non-null    object
 59  Use a sauna?                         361 non-null    object
 60  Use tobacco in any form?             323 non-null    object
 61  activity_codes_comb                  625 non-null    int64
dtypes: float64(45), int64(2), object(15)
memory usage: 302.9+ KB
```

[291]:
```
MERGE_ACTIVITY_COLS = [col for col in df_merge_fill.columns if col.
 ↪startswith('activity_')]
MERGE_ACTIVITY_COLS
```

[291]:
```
['activity_duration_min',
 'activity_strain_sum',
 'activity_strain_max',
 'activity_calories',
 'activity_hr_max',
 'activity_hr_avg',
```

```
 'activity_hr_zone_1_min',
 'activity_hr_zone_2_min',
 'activity_hr_zone_3_min',
 'activity_hr_zone_4_min',
 'activity_hr_zone_5_min',
 'activity_names',
 'activity_codes',
 'activity_count',
 'activity_codes_comb']
```

[292]:
```
df_merge_fill[MERGE_ACTIVITY_COLS] = df_merge_fill[MERGE_ACTIVITY_COLS].
 ↪fillna(0)
df_merge_fill.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 625 entries, 0 to 624
Data columns (total 62 columns):
 #   Column                                Non-Null Count  Dtype
---  ------                                --------------  -----
 0   cycle_date_ord                        625 non-null    int64
 1   recovery_score_p                      625 non-null    float64
 2   hr_rest                               625 non-null    float64
 3   hr_var                                625 non-null    float64
 4   skin_temp_c                           625 non-null    float64
 5   blood_ox_p                            625 non-null    float64
 6   sleep_performance_p                   625 non-null    float64
 7   resp_rate                             625 non-null    float64
 8   asleep_min                            625 non-null    float64
 9   in_bed_min                            625 non-null    float64
 10  light_sleep_min                       625 non-null    float64
 11  light_sleep_p                         625 non-null    float64
 12  deep_sleep_min                        625 non-null    float64
 13  deep_sleep_p                          625 non-null    float64
 14  rem_sleep_min                         625 non-null    float64
 15  rem_sleep_p                           625 non-null    float64
 16  awake_min                             625 non-null    float64
 17  awake_p                               625 non-null    float64
 18  restorative_sleep_min                 625 non-null    float64
 19  restorative_sleep_p                   625 non-null    float64
 20  sleep_need_min                        625 non-null    float64
 21  sleep_debt_min                        625 non-null    float64
 22  sleep_efficiency_p                    625 non-null    float64
 23  sleep_consistency_p                   625 non-null    float64
 24  day_strain                            625 non-null    float64
 25  calories                              625 non-null    float64
 26  hr_max                                625 non-null    float64
 27  hr_avg                                625 non-null    float64
 28  cycle_day_of_week_sin                 625 non-null    float64
```

```
 29  cycle_day_of_week_cos                625 non-null    float64
 30  sleep_onset_min_sin                  625 non-null    float64
 31  sleep_onset_min_cos                  625 non-null    float64
 32  prev_sleep_onset_min_sin             625 non-null    float64
 33  prev_sleep_onset_min_cos             625 non-null    float64
 34  activity_duration_min                625 non-null    float64
 35  activity_strain_sum                  625 non-null    float64
 36  activity_strain_max                  625 non-null    float64
 37  activity_calories                    625 non-null    float64
 38  activity_hr_max                      625 non-null    float64
 39  activity_hr_avg                      625 non-null    float64
 40  activity_hr_zone_1_min               625 non-null    float64
 41  activity_hr_zone_2_min               625 non-null    float64
 42  activity_hr_zone_3_min               625 non-null    float64
 43  activity_hr_zone_4_min               625 non-null    float64
 44  activity_hr_zone_5_min               625 non-null    float64
 45  activity_names                       625 non-null    object
 46  activity_codes                       625 non-null    object
 47  activity_count                       625 non-null    float64
 48  Avoid consuming processed foods?     238 non-null    object
 49  Eat any food close to bedtime?       539 non-null    object
 50  Have an injury or wound              375 non-null    object
 51  Have any alcoholic drinks?           526 non-null    object
 52  Masturbate?                          237 non-null    object
 53  See direct sunlight upon waking up?  164 non-null    object
 54  Spend time outdoors?                 375 non-null    object
 55  Spend time stretching?               375 non-null    object
 56  Take an ice bath?                    299 non-null    object
 57  Take prescription sleep medication?  432 non-null    object
 58  Use CBD oil in any form?             157 non-null    object
 59  Use a sauna?                         361 non-null    object
 60  Use tobacco in any form?             323 non-null    object
 61  activity_codes_comb                  625 non-null    int64
dtypes: float64(45), int64(2), object(15)
memory usage: 302.9+ KB
```

[293]:
```
df_merge_fill.dropna(axis=1, how='any', inplace=True)
df_merge_fill.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 625 entries, 0 to 624
Data columns (total 49 columns):
 #   Column                   Non-Null Count  Dtype
---  ------                   --------------  -----
 0   cycle_date_ord           625 non-null    int64
 1   recovery_score_p         625 non-null    float64
 2   hr_rest                  625 non-null    float64
 3   hr_var                   625 non-null    float64
```

```
 4   skin_temp_c               625 non-null    float64
 5   blood_ox_p                625 non-null    float64
 6   sleep_performance_p       625 non-null    float64
 7   resp_rate                 625 non-null    float64
 8   asleep_min                625 non-null    float64
 9   in_bed_min                625 non-null    float64
 10  light_sleep_min           625 non-null    float64
 11  light_sleep_p             625 non-null    float64
 12  deep_sleep_min            625 non-null    float64
 13  deep_sleep_p              625 non-null    float64
 14  rem_sleep_min             625 non-null    float64
 15  rem_sleep_p               625 non-null    float64
 16  awake_min                 625 non-null    float64
 17  awake_p                   625 non-null    float64
 18  restorative_sleep_min     625 non-null    float64
 19  restorative_sleep_p       625 non-null    float64
 20  sleep_need_min            625 non-null    float64
 21  sleep_debt_min            625 non-null    float64
 22  sleep_efficiency_p        625 non-null    float64
 23  sleep_consistency_p       625 non-null    float64
 24  day_strain                625 non-null    float64
 25  calories                  625 non-null    float64
 26  hr_max                    625 non-null    float64
 27  hr_avg                    625 non-null    float64
 28  cycle_day_of_week_sin     625 non-null    float64
 29  cycle_day_of_week_cos     625 non-null    float64
 30  sleep_onset_min_sin       625 non-null    float64
 31  sleep_onset_min_cos       625 non-null    float64
 32  prev_sleep_onset_min_sin  625 non-null    float64
 33  prev_sleep_onset_min_cos  625 non-null    float64
 34  activity_duration_min     625 non-null    float64
 35  activity_strain_sum       625 non-null    float64
 36  activity_strain_max       625 non-null    float64
 37  activity_calories         625 non-null    float64
 38  activity_hr_max           625 non-null    float64
 39  activity_hr_avg           625 non-null    float64
 40  activity_hr_zone_1_min    625 non-null    float64
 41  activity_hr_zone_2_min    625 non-null    float64
 42  activity_hr_zone_3_min    625 non-null    float64
 43  activity_hr_zone_4_min    625 non-null    float64
 44  activity_hr_zone_5_min    625 non-null    float64
 45  activity_names            625 non-null    object
 46  activity_codes            625 non-null    object
 47  activity_count            625 non-null    float64
 48  activity_codes_comb       625 non-null    int64
dtypes: float64(45), int64(2), object(2)
memory usage: 239.4+ KB
```

v1 Features

[294]:
```
df_merge_fill.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 625 entries, 0 to 624
Data columns (total 49 columns):
 #   Column                    Non-Null Count  Dtype
---  ------                    --------------  -----
 0   cycle_date_ord            625 non-null    int64
 1   recovery_score_p          625 non-null    float64
 2   hr_rest                   625 non-null    float64
 3   hr_var                    625 non-null    float64
 4   skin_temp_c               625 non-null    float64
 5   blood_ox_p                625 non-null    float64
 6   sleep_performance_p       625 non-null    float64
 7   resp_rate                 625 non-null    float64
 8   asleep_min                625 non-null    float64
 9   in_bed_min                625 non-null    float64
 10  light_sleep_min           625 non-null    float64
 11  light_sleep_p             625 non-null    float64
 12  deep_sleep_min            625 non-null    float64
 13  deep_sleep_p              625 non-null    float64
 14  rem_sleep_min             625 non-null    float64
 15  rem_sleep_p               625 non-null    float64
 16  awake_min                 625 non-null    float64
 17  awake_p                   625 non-null    float64
 18  restorative_sleep_min     625 non-null    float64
 19  restorative_sleep_p       625 non-null    float64
 20  sleep_need_min            625 non-null    float64
 21  sleep_debt_min            625 non-null    float64
 22  sleep_efficiency_p        625 non-null    float64
 23  sleep_consistency_p       625 non-null    float64
 24  day_strain                625 non-null    float64
 25  calories                  625 non-null    float64
 26  hr_max                    625 non-null    float64
 27  hr_avg                    625 non-null    float64
 28  cycle_day_of_week_sin     625 non-null    float64
 29  cycle_day_of_week_cos     625 non-null    float64
 30  sleep_onset_min_sin       625 non-null    float64
 31  sleep_onset_min_cos       625 non-null    float64
 32  prev_sleep_onset_min_sin  625 non-null    float64
 33  prev_sleep_onset_min_cos  625 non-null    float64
 34  activity_duration_min     625 non-null    float64
 35  activity_strain_sum       625 non-null    float64
 36  activity_strain_max       625 non-null    float64
 37  activity_calories         625 non-null    float64
 38  activity_hr_max           625 non-null    float64
 39  activity_hr_avg           625 non-null    float64
```

```
 40  activity_hr_zone_1_min    625 non-null    float64
 41  activity_hr_zone_2_min    625 non-null    float64
 42  activity_hr_zone_3_min    625 non-null    float64
 43  activity_hr_zone_4_min    625 non-null    float64
 44  activity_hr_zone_5_min    625 non-null    float64
 45  activity_names            625 non-null    object
 46  activity_codes            625 non-null    object
 47  activity_count            625 non-null    float64
 48  activity_codes_comb       625 non-null    int64
dtypes: float64(45), int64(2), object(2)
memory usage: 239.4+ KB
```

[295]:
```
# focusing on removing clearly redundant or unwanted features for v1

MERGE_DROP_COLS_V1 = [

    # models shouldn't be dependent on date
    'cycle_date_ord',
    'cycle_day_of_week_sin',
    'cycle_day_of_week_cos',

    # calculated by in_bed_min * respective percentage
    'asleep_min',
    'light_sleep_min',
    'deep_sleep_min',
    'rem_sleep_min',
    'awake_min',
    'restorative_sleep_min', # can probably drop restorative_sleep_p =␣
 ↪(deep_sleep_p + rem_sleep_p) too, but might as well leave it for v1

    # proprietary whoop metrics -- not available from raw data
    'day_strain',
    'activity_strain_sum',
    'activity_strain_max',

    # activity list objects invalid features
    'activity_names',
    'activity_codes'
    # activity_count might also be redundant after encoding the activity lists
]

X_merge_v1, y_merge_v1 = get_X_y(df_merge_fill, MERGE_LABEL, MERGE_DROP_COLS_V1)
```

v3 Features Here we'll use the average feature importance ranks from our tuned v2 models to keep only the most important features.

[307]:
```
# need to train v2 below before running

reg_feature_importances_merge_v2 =␣
 ↪get_feature_importances(trained_regression_models_merge_v2, X_merge_v1)
reg_feature_importances_merge_v2
```

[307]:

	Lasso		Ridge		Random Forest	\
	rank	importance	rank	importance	rank	
feature						
hr_var	0	0.158367	1	0.160974	0	
resp_rate	2	0.029609	8	0.031038	3	
calories	1	0.044642	6	0.047973	2	
sleep_onset_min_sin	4	0.018527	12	0.019765	5	
hr_rest	7	0.014143	16	0.013144	1	
activity_hr_max	9	0.013461	4	0.055382	29	
sleep_consistency_p	15	0.003505	20	0.007448	8	
hr_avg	3	0.024777	11	0.026789	18	
activity_codes_comb	8	0.013657	13	0.017037	26	
skin_temp_c	6	0.015135	14	0.016533	10	
activity_duration_min	25	0.000000	3	0.063767	22	
activity_hr_zone_3_min	12	0.007802	2	0.063788	28	
awake_p	23	0.000000	26	0.004392	4	
activity_hr_zone_2_min	11	0.008220	5	0.050513	23	
restorative_sleep_p	5	0.016831	25	0.004671	11	
hr_max	10	0.008835	17	0.013078	17	
rem_sleep_p	18	0.000911	24	0.005011	7	
in_bed_min	14	0.004283	15	0.014793	12	
activity_calories	33	0.000000	0	0.172661	30	
activity_hr_zone_1_min	16	0.003411	28	0.003574	25	
blood_ox_p	21	0.000000	33	0.000252	9	
prev_sleep_onset_min_cos	24	0.000000	29	0.002324	16	
light_sleep_p	28	0.000000	21	0.006504	14	
prev_sleep_onset_min_sin	13	0.004759	22	0.006384	21	
sleep_performance_p	26	0.000000	18	0.012998	19	
deep_sleep_p	30	0.000000	30	0.001950	6	
sleep_efficiency_p	17	0.001997	23	0.005100	20	
activity_hr_zone_4_min	20	0.000403	7	0.035216	31	
sleep_need_min	29	0.000000	19	0.009286	15	
sleep_onset_min_cos	22	0.000000	31	0.001619	13	
activity_hr_avg	27	0.000000	10	0.027775	27	
sleep_debt_min	19	0.000666	32	0.001310	24	
activity_hr_zone_5_min	31	0.000000	9	0.027832	32	
activity_count	32	0.000000	27	0.003590	33	

	XGBoost		avg_rank
	importance	rank	importance
feature			

```
hr_var                     0.683340      0   0.477036     0.25
resp_rate                  0.018231      4   0.026879     4.25
calories                   0.021060     10   0.018758     4.75
sleep_onset_min_sin        0.014861      2   0.027380     5.75
hr_rest                    0.029944     12   0.017480     9.00
activity_hr_max            0.004237      1   0.046016    10.75
sleep_consistency_p        0.014175      7   0.021128    12.50
hr_avg                     0.008515     20   0.013233    13.00
activity_codes_comb        0.004912      6   0.021378    13.25
skin_temp_c                0.012010     25   0.010352    13.75
activity_duration_min      0.006377      5   0.023489    13.75
activity_hr_zone_3_min     0.004590     14   0.017452    14.00
awake_p                    0.016150      3   0.026978    14.00
activity_hr_zone_2_min     0.005298     18   0.015291    14.25
restorative_sleep_p        0.011302     17   0.016003    14.50
hr_max                     0.008737     16   0.016020    15.00
rem_sleep_p                0.014383     13   0.017476    15.50
in_bed_min                 0.010722     28   0.008259    17.25
activity_calories          0.003312      9   0.018846    18.00
activity_hr_zone_1_min     0.005097      8   0.019141    19.25
blood_ox_p                 0.013110     15   0.016496    19.50
prev_sleep_onset_min_cos   0.009093     11   0.018212    20.00
light_sleep_p              0.009990     19   0.013745    20.50
prev_sleep_onset_min_sin   0.006931     30   0.007809    21.50
sleep_performance_p        0.007664     24   0.010355    21.75
deep_sleep_p               0.014455     21   0.012401    21.75
sleep_efficiency_p         0.007560     27   0.008628    21.75
activity_hr_zone_4_min     0.002323     31   0.005825    22.25
sleep_need_min             0.009907     26   0.009860    22.25
sleep_onset_min_cos        0.010292     29   0.008142    23.75
activity_hr_avg            0.004638     32   0.004757    24.00
sleep_debt_min             0.005163     22   0.011014    24.25
activity_hr_zone_5_min     0.000950     33   0.003523    26.25
activity_count             0.000670     23   0.010638    28.75
```

[310]:
```
MERGE_DROP_COLS_V2 = reg_feature_importances_merge_v2[
        reg_feature_importances_merge_v2['avg_rank']\
        >\
        (reg_feature_importances_merge_v2.shape[0] // 2)
    ].index.tolist()
MERGE_DROP_COLS_V2
```

[310]:
```
['in_bed_min',
 'activity_calories',
 'activity_hr_zone_1_min',
 'blood_ox_p',
 'prev_sleep_onset_min_cos',
```

```
 'light_sleep_p',
 'prev_sleep_onset_min_sin',
 'sleep_performance_p',
 'deep_sleep_p',
 'sleep_efficiency_p',
 'activity_hr_zone_4_min',
 'sleep_need_min',
 'sleep_onset_min_cos',
 'activity_hr_avg',
 'sleep_debt_min',
 'activity_hr_zone_5_min',
 'activity_count']
```

[311]:
```
X_merge_v3, y_merge_v3 = X_merge_v1.copy().drop(columns=MERGE_DROP_COLS_V2),␣
↪y_merge_v1.copy()
```

[312]:
```
X_merge_v3.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 625 entries, 0 to 624
Data columns (total 17 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   hr_rest                 625 non-null    float64
 1   hr_var                  625 non-null    float64
 2   skin_temp_c             625 non-null    float64
 3   resp_rate               625 non-null    float64
 4   rem_sleep_p             625 non-null    float64
 5   awake_p                 625 non-null    float64
 6   restorative_sleep_p     625 non-null    float64
 7   sleep_consistency_p     625 non-null    float64
 8   calories                625 non-null    float64
 9   hr_max                  625 non-null    float64
 10  hr_avg                  625 non-null    float64
 11  sleep_onset_min_sin     625 non-null    float64
 12  activity_duration_min   625 non-null    float64
 13  activity_hr_max         625 non-null    float64
 14  activity_hr_zone_2_min  625 non-null    float64
 15  activity_hr_zone_3_min  625 non-null    float64
 16  activity_codes_comb     625 non-null    int64
dtypes: float64(16), int64(1)
memory usage: 83.1 KB
```

[313]:
```
[col for col in X_merge_v3.columns if col not in X_phys_v4.columns]
```

[313]:
```
['rem_sleep_p',
 'activity_duration_min',
 'activity_hr_max',
```

```
 'activity_hr_zone_2_min',
 'activity_hr_zone_3_min',
 'activity_codes_comb']
```

3.3 Model Selection

[83]:
```
from sklearn.model_selection import KFold
from sklearn.linear_model import Ridge, Lasso
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score

from xgboost import XGBRegressor
```

[141]:
```
regression_models_v1 = {
    'Lasso': Lasso(alpha=1e-3),
    'Ridge': Ridge(),
    'Random Forest': RandomForestRegressor(),
    'XGBoost': XGBRegressor(objective='reg:squarederror')
}

reg_kf_v1 = KFold(n_splits=10, shuffle=True, random_state=42)
```

[252]:
```
regression_models_v3 = {
    'Lasso': Lasso(),
    'Ridge': Ridge(),
    'Random Forest': RandomForestRegressor(),
    'XGBoost': XGBRegressor(objective='reg:squarederror')
}

reg_param_grids_v3 = {
    'Lasso': {
        'alpha': [1e-4, 5e-3, 1e-3, 5e-2, 1e-2, 5e-1],
        'max_iter': [int(5e2), int(1e2), int(5e2), int(1e3)],
        'tol': [1e-6, 1e-5, 1e-4, 1e-3]
    },
    'Ridge': {
        'alpha': [1e-3, 1e-2, 1e-1, 1, 1e1, 1e2],
        'max_iter': [int(1e2), int(5e2), int(1e3), int(5e3)],
        'tol': [1e-3, 1e-2, 5e-2, 1e-1],
        'solver': ['auto', 'svd', 'cholesky', 'lsqr', 'sparse_cg', 'sag',␣
 ↪'saga']
    },
    'Random Forest': {
        'n_estimators': [10, 20, 30, 40, 50],
        'max_depth': [None, 5, 10, 15, 20],
        'min_samples_split': [2, 3, 5, 10],
        'min_samples_leaf': [1, 2, 4, 6]
```

```
    },
    'XGBoost': {
        'n_estimators': [50, 75, 100, 125, 150],
        'learning_rate': [1e-2, 5e-2, 1e-1, 5e-1],
        'max_depth': [2, 3, 4, 5],
        'subsample': [0.6, 0.8, 1.0],
        'colsample_bytree': [0.6, 0.8, 1.0],
        'gamma': [0, 0.1, 0.2]
    }
}

reg_kf_v3 = KFold(n_splits=10, shuffle=True, random_state=42)
```

3.4 Model Training

3.4.1 ML Model Methods

[88]:
```
def train_eval_regression_model(model, X, y, kf, logger=None,␣
 ↪print_results=True):
    X = scale_X(X)

    model.fit(X, y)
    y_pred = cross_val_predict(model, X, y, cv=kf)

    mse = mean_squared_error(y, y_pred)
    mae = mean_absolute_error(y, y_pred)
    r2 = r2_score(y, y_pred)

    if logger:
        logger.add_scalar('mse', mse, 0)
        logger.add_scalar('mae', mae, 0)
        logger.add_scalar('r2', r2, 0)

    if print_results:
        print(f'Mean Squared Error: {mse:.4f}')
        print(f'Mean Absolute Error: {mae:.4f}')
        print(f'R² Score: {r2:.4f}')
        print()

    return model

def train_regression_models(models, X, y, kf=None, log_dir=None,␣
 ↪print_results=True):
    trained_models = {}
    for name, model in models.items():
        print(f'Training {name}\n')
```

```
        from os import path
        logger = tb.SummaryWriter(path.join(log_dir, name)) if log_dir else None

        trained_models[name] = train_eval_regression_model(model, X, y, kf,␣
 ↪logger, print_results)

    return trained_models
```

[89]:
```
def regression_grid_search(model, X, y, param_grid, kf, print_results=True):
    X = scale_X(X)

    grid_search = GridSearchCV(estimator=model, param_grid=param_grid, cv=kf,␣
 ↪scoring='neg_mean_squared_error', n_jobs=-1)
    grid_search.fit(X, y)

    best_model = grid_search.best_estimator_

    if print_results:
        print(f'Best Parameters: {grid_search.best_params_}')
        print()

    return best_model

def grid_search_regression_models(models, param_grids, X, y, kf=None,␣
 ↪print_results=True):
    best_models = {}
    for name, model in models.items():
        print(f'Optimizing {name}')

        param_grid = param_grids.get(name, {})
        original_params = model.get_params()
        search_params = {key: original_params[key] for key in param_grid.keys()}
        print(f'Original Parameters: {search_params}')


        best_models[name] = regression_grid_search(model, X, y, param_grid, kf,␣
 ↪print_results)

    return best_models
```

3.4.2 Neural Model Methods

[86]:
```
def create_reg_dataloaders(X, y, batch_size):
    torch.manual_seed(42)

    X = X.values if isinstance(X, pd.DataFrame) else X
    y = y.values if isinstance(y, pd.Series) else y
```

```
    batch_size = batch_size if batch_size else X.shape[0]

    X_train, X_val, y_train, y_val = train_test_split(X, y, test_size=0.2,␣
↪random_state=42)

    scaler = StandardScaler()
    X_train = scaler.fit_transform(X_train)
    X_val = scaler.transform(X_val)

    train_dataset = TensorDataset(torch.tensor(X_train, dtype=torch.float32),␣
↪torch.tensor(y_train, dtype=torch.float32))
    val_dataset = TensorDataset(torch.tensor(X_val, dtype=torch.float32), torch.
↪tensor(y_val, dtype=torch.float32))

    train_loader = DataLoader(train_dataset, batch_size=batch_size,␣
↪shuffle=True)
    val_loader = DataLoader(val_dataset, batch_size=batch_size, shuffle=False)

    return train_loader, val_loader
```

[259]:
```
def train_regression_nn(config, X, y): # , lr=1e-3, hidden_size=100,␣
↪num_epochs=20, batch_size=32, log_dir=None, model_path='models/
↪regression_model.th'):
    lr = config['lr']
    hidden_size = config['hidden_size']
    num_epochs = config['num_epochs']
    batch_size = config['batch_size']
    model_name = f'h{hidden_size}_b{batch_size}_lr{lr}'

    from os import path

    if 'log_dir' in config:
        train_logger = tb.SummaryWriter(path.join(config['log_dir'],␣
↪model_name, 'nn', 'train'))
        valid_logger = tb.SummaryWriter(path.join(config['log_dir'],␣
↪model_name, 'nn', 'val'))
    else:
        train_logger, valid_logger = None, None

    device = torch.device('mps') if torch.backends.mps.is_available() else␣
↪torch.device('cuda') if torch.cuda.is_available() else torch.device('cpu') #␣
↪type: ignore
    print(f'Using device: {device}')

    train_loader, val_loader = create_reg_dataloaders(X, y, batch_size)
```

```
    input_size = X.shape[1]
    num_classes = 1 # output size 1 for regression

    model = SimpleNN(input_size, hidden_size, num_classes).to(device)

    criterion = nn.MSELoss()
    optimizer = optim.Adam(model.parameters(), lr=lr)

    if 'early_stop' in config:
        best_val_mse = np.inf
        patience = config['early_stop']
        epochs_no_improve = 0

    global_step = 0
    for epoch in range(num_epochs):
        model.train()
        loss_vals, mse_vals, val_mse_vals = [], [], []

        for batch_idx, (features, labels) in enumerate(train_loader):
            features, labels = features.to(device), labels.to(device)

            outputs = model(features)
            loss = criterion(outputs, labels.view(-1, 1))  # Reshape labels for␣
↪compatibility ??
            # print(f'Epoch {epoch} batch {batch_idx} loss: {loss:.4f}')

            mse = torch.mean((outputs - labels) ** 2).item()
            # print(f'Epoch {epoch} batch {batch_idx} mse: {mse:.4f}')
            loss_vals.append(loss.detach().cpu().numpy())
            mse_vals.append(mse)

            optimizer.zero_grad()
            loss.backward()
            optimizer.step()
            global_step += 1

        avg_loss = sum(loss_vals) / len(loss_vals)
        avg_mse = sum(mse_vals) / len(mse_vals)
        if train_logger:
            train_logger.add_scalar('loss', avg_loss, global_step)
            train_logger.add_scalar('mse', avg_mse, global_step)
            # if global_step % 100 == 0:
                # log(train_logger, features, labels, outputs, global_step) #␣
↪requries custom log() function

        if 'model_path' in config:
```

```
            torch.save(model.state_dict(), path.join(config['model_path'],␣
↪model_name+'.th'))

        model.eval()
        with torch.no_grad():
            for batch_idx, (features, labels) in enumerate(val_loader):
                features, labels = features.to(device), labels.to(device)

                outputs = model(features)
                val_mse = torch.mean((outputs - labels) ** 2).item()
                val_mse_vals.append(val_mse)

                # print(f'Epoch {epoch} val_batch {batch_idx} val_mse: {val_mse:
↪.4f}')

            avg_val_mse = sum(val_mse_vals) / len(val_mse_vals)
            if valid_logger:
                valid_logger.add_scalar('mse', avg_val_mse, global_step)

        if 'early_stop' in config:
            if avg_val_mse < best_val_mse:
                best_val_mse = avg_val_mse
                epochs_no_improve = 0
            else:
                epochs_no_improve += 1

            if epochs_no_improve >= patience:
                if 'print' in config:
                    print(f"Early stopping at epoch {epoch}")
                    print(f"Best Validation MSE: {best_val_mse} at epoch {epoch␣
↪- patience}")
                break

        if 'tune' in config:
            train.report(
                {
                    'loss':avg_loss,
                    'mse':avg_mse,
                    'val_mse':avg_val_mse,
                    'model_name':model_name,
                    'epoch':epoch
                }
            )

        if 'print' in config:
            print(f'Epoch [{epoch}/{num_epochs}], Loss: {avg_loss:.4f},␣
↪Training MSE: {avg_mse:.4f}, Validation MSE: {avg_val_mse:.4f}')
```

[99]:
```
def tune_regression_nn(search_space, X, y):
    search_space['tune'] = True

    reporter = CLIReporter(
        parameter_columns=['lr', 'hidden_size', 'batch_size', 'num_epochs'],
        metric_columns=['loss', 'mse', 'val_mse']
    )

    scheduler = ASHAScheduler(
        metric='val_mse',
        mode='max',
        grace_period=25,
        reduction_factor=1.5
    )

    analysis = tune.run(
        tune.with_parameters(train_regression_nn, X=X, y=y),
        config=search_space,
        scheduler=scheduler,
        progress_reporter=reporter
    )

    best_trial = analysis.get_best_trial(metric='val_mse', mode='min')
    best_config = best_trial.config
    best_val_mse = best_trial.last_result['val_mse']
    best_epoch = best_trial.last_result['epoch']

    print("Best Hyperparameters Found: ", best_config)
    print("Best Validation MSE: ", best_val_mse)
    print("Best Number Epochs: ", best_epoch)

    if 'model_path' in search_space:
        best_model_path = f"{best_config['model_path']}/{best_trial.
↪last_result['model_name']}.th"
        print("Best Model Path: ", best_model_path)
```

3.4.3 Phys

v1 Training

[94]:
```
PHYS_LOGS_V1 = os.path.join(os.getcwd(), 'logs/whoop-recovery-reg/v1/phys')
PHYS_MODELPATH_V1 = os.path.join(os.getcwd(), 'models/whoop-recovery-reg/v1/
↪phys')
```

[142]:
```
trained_regression_models_phys_v1 =␣
↪train_regression_models(regression_models_v1, X_phys_v1, y_phys_v1,␣
↪reg_kf_v1, PHYS_LOGS_V1)
```

```
Training Lasso
```

```
Mean Squared Error: 0.0090
Mean Absolute Error: 0.0759
R² Score: 0.7332

Training Ridge

Mean Squared Error: 0.0092
Mean Absolute Error: 0.0761
R² Score: 0.7288

Training Random Forest

Mean Squared Error: 0.0072
Mean Absolute Error: 0.0677
R² Score: 0.7874

Training XGBoost

Mean Squared Error: 0.0060
Mean Absolute Error: 0.0608
R² Score: 0.8222
```

[96]:
```python
PHYS_MODEL_V1_CONFIG = {
    'lr': 1e-2,
    'hidden_size': int(1e3),
    'batch_size': 32,
    'num_epochs': 200,
    'early_stop': 10,
    'log_dir': PHYS_LOGS_V1,
    'model_path': PHYS_MODELPATH_V1,
    'print': True
}
```

[102]:
```python
train_regression_nn(
    PHYS_MODEL_V1_CONFIG,
    X_phys_v1,
    y_phys_v1
)
```

```
Using device: mps
Epoch [0/200], Loss: 3.6854, Training MSE: 3.6940, Validation MSE: 1.4247
Epoch [1/200], Loss: 0.3335, Training MSE: 0.3635, Validation MSE: 0.2324
Epoch [2/200], Loss: 0.1259, Training MSE: 0.1525, Validation MSE: 0.0865
Epoch [3/200], Loss: 0.0366, Training MSE: 0.0846, Validation MSE: 0.0549
Epoch [4/200], Loss: 0.0237, Training MSE: 0.0744, Validation MSE: 0.0782
Epoch [5/200], Loss: 0.0229, Training MSE: 0.0752, Validation MSE: 0.0540
```

```
Epoch [6/200], Loss: 0.0327, Training MSE: 0.0829, Validation MSE: 0.0999
Epoch [7/200], Loss: 0.0280, Training MSE: 0.0788, Validation MSE: 0.0775
Epoch [8/200], Loss: 0.0345, Training MSE: 0.0858, Validation MSE: 0.1146
Epoch [9/200], Loss: 0.0228, Training MSE: 0.0778, Validation MSE: 0.0683
Epoch [10/200], Loss: 0.0272, Training MSE: 0.0802, Validation MSE: 0.1318
Epoch [11/200], Loss: 0.0326, Training MSE: 0.0899, Validation MSE: 0.0513
Epoch [12/200], Loss: 0.0203, Training MSE: 0.0745, Validation MSE: 0.0552
Epoch [13/200], Loss: 0.0193, Training MSE: 0.0779, Validation MSE: 0.0760
Epoch [14/200], Loss: 0.0222, Training MSE: 0.0779, Validation MSE: 0.0747
Epoch [15/200], Loss: 0.0158, Training MSE: 0.0734, Validation MSE: 0.0865
Epoch [16/200], Loss: 0.0181, Training MSE: 0.0731, Validation MSE: 0.0640
Epoch [17/200], Loss: 0.0189, Training MSE: 0.0772, Validation MSE: 0.0608
Epoch [18/200], Loss: 0.0321, Training MSE: 0.0885, Validation MSE: 0.0664
Epoch [19/200], Loss: 0.0290, Training MSE: 0.0858, Validation MSE: 0.0615
Epoch [20/200], Loss: 0.0226, Training MSE: 0.0796, Validation MSE: 0.0644
Early stopping at epoch 21
Best Validation MSE: 0.051280426792800426 at epoch 11
```

v2 Training Using v2 features (with dates excluded) on v1 models (no hyperparameter tuning)

[230]:
```
PHYS_LOGS_V2 = os.path.join(os.getcwd(), 'logs/whoop-recovery-reg/v2/phys')
PHYS_MODELPATH_V2 = os.path.join(os.getcwd(), 'models/whoop-recovery-reg/v2/
↪phys')
```

[231]:
```
trained_regression_models_phys_v2 =␣
↪train_regression_models(regression_models_v1, X_phys_v2, y_phys_v2,␣
↪reg_kf_v1, PHYS_LOGS_V2)
```

```
Training Lasso

Mean Squared Error: 0.0101
Mean Absolute Error: 0.0793
R² Score: 0.7012

Training Ridge

Mean Squared Error: 0.0103
Mean Absolute Error: 0.0799
R² Score: 0.6965

Training Random Forest

Mean Squared Error: 0.0101
Mean Absolute Error: 0.0805
R² Score: 0.7018

Training XGBoost
```

```
Mean Squared Error: 0.0113
Mean Absolute Error: 0.0842
R² Score: 0.6658
```

[232]:
```
PHYS_MODEL_V2_CONFIG = {
    'lr': 1e-2,
    'hidden_size': int(1e3),
    'batch_size': 32,
    'num_epochs': 200,
    'early_stop': 10,
    'log_dir': PHYS_LOGS_V2,
    'model_path': PHYS_MODELPATH_V2,
    'print': True
}
```

[233]:
```
train_regression_nn(
    PHYS_MODEL_V2_CONFIG,
    X_phys_v2,
    y_phys_v2
)
```

```
Using device: mps
Epoch [0/200], Loss: 3.5496, Training MSE: 3.5630, Validation MSE: 1.5390
Epoch [1/200], Loss: 0.3372, Training MSE: 0.3557, Validation MSE: 0.2198
Epoch [2/200], Loss: 0.0729, Training MSE: 0.1107, Validation MSE: 0.0667
Epoch [3/200], Loss: 0.0311, Training MSE: 0.0787, Validation MSE: 0.0591
Epoch [4/200], Loss: 0.0337, Training MSE: 0.0830, Validation MSE: 0.0699
Epoch [5/200], Loss: 0.0351, Training MSE: 0.0799, Validation MSE: 0.0573
Epoch [6/200], Loss: 0.0233, Training MSE: 0.0729, Validation MSE: 0.0620
Epoch [7/200], Loss: 0.0177, Training MSE: 0.0735, Validation MSE: 0.0523
Epoch [8/200], Loss: 0.0171, Training MSE: 0.0657, Validation MSE: 0.0581
Epoch [9/200], Loss: 0.0160, Training MSE: 0.0709, Validation MSE: 0.0663
Epoch [10/200], Loss: 0.0138, Training MSE: 0.0683, Validation MSE: 0.0557
Epoch [11/200], Loss: 0.0133, Training MSE: 0.0659, Validation MSE: 0.0539
Epoch [12/200], Loss: 0.0179, Training MSE: 0.0718, Validation MSE: 0.0556
Epoch [13/200], Loss: 0.0211, Training MSE: 0.0758, Validation MSE: 0.0753
Epoch [14/200], Loss: 0.0253, Training MSE: 0.0802, Validation MSE: 0.0648
Epoch [15/200], Loss: 0.0256, Training MSE: 0.0835, Validation MSE: 0.1060
Epoch [16/200], Loss: 0.0205, Training MSE: 0.0744, Validation MSE: 0.0625
Early stopping at epoch 17
Best Validation MSE: 0.0523431608453393 at epoch 7
```

v3 Training Using v2 features (with dates excluded) on v3 models with hyperparameter tuning

[234]:
```
PHYS_LOGS_V3 = os.path.join(os.getcwd(), 'logs/whoop-recovery-reg/v3/phys')
PHYS_MODELPATH_V3 = os.path.join(os.getcwd(), 'models/whoop-recovery-reg/v3/
  ↪phys')
```

[253]:
```
best_regression_models_phys_v3 =␣
↪grid_search_regression_models(regression_models_v3, reg_param_grids_v3,␣
↪X_phys_v2, y_phys_v2, reg_kf_v3)
```

```
Optimizing Lasso
Original Parameters: {'alpha': 1.0, 'max_iter': 1000, 'tol': 0.0001}

/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.139e-04, tolerance: 1.936e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.928e-05, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.188e-04, tolerance: 1.906e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.502e-03, tolerance: 1.867e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 9.881e-03, tolerance: 1.903e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.833e-04, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.537e-04, tolerance: 1.910e-05
```

```
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.507e-04, tolerance: 1.936e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.319e-04, tolerance: 1.938e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.923e-04, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.502e-03, tolerance: 1.867e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.001e-02, tolerance: 1.895e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 9.881e-03, tolerance: 1.903e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.537e-04, tolerance: 1.910e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.507e-04, tolerance: 1.936e-04
```

```
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.833e-04, tolerance: 1.875e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.001e-02, tolerance: 1.895e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.923e-04, tolerance: 1.875e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 9.881e-03, tolerance: 1.903e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.001e-02, tolerance: 1.895e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.502e-03, tolerance: 1.867e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.139e-04, tolerance: 1.936e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.928e-05, tolerance: 1.875e-05
```

```
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.253e-05, tolerance: 1.927e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.760e-05, tolerance: 1.936e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.068e-03, tolerance: 1.903e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.086e-04, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.429e-03, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.590e-04, tolerance: 1.938e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.068e-03, tolerance: 1.903e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.349e-03, tolerance: 1.910e-04
```

```
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.068e-03, tolerance: 1.903e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.644e-05, tolerance: 1.867e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.349e-03, tolerance: 1.910e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.429e-03, tolerance: 1.875e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.590e-04, tolerance: 1.938e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.277e-05, tolerance: 2.115e-05
  model = cd_fast.enet_coordinate_descent(
```

```
Best Parameters: {'alpha': 0.001, 'max_iter': 100, 'tol': 1e-06}

Optimizing Ridge
Original Parameters: {'alpha': 1.0, 'max_iter': None, 'tol': 0.0001, 'solver':
'auto'}
Best Parameters: {'alpha': 0.001, 'max_iter': 1000, 'solver': 'saga', 'tol':
0.05}

Optimizing Random Forest
Original Parameters: {'n_estimators': 100, 'max_depth': None,
```

```
'min_samples_split': 2, 'min_samples_leaf': 1}
Best Parameters: {'max_depth': 15, 'min_samples_leaf': 2, 'min_samples_split':
3, 'n_estimators': 50}

Optimizing XGBoost
Original Parameters: {'n_estimators': None, 'learning_rate': None, 'max_depth':
None, 'subsample': None, 'colsample_bytree': None, 'gamma': None}
Best Parameters: {'colsample_bytree': 0.8, 'gamma': 0, 'learning_rate': 0.1,
'max_depth': 3, 'n_estimators': 100, 'subsample': 0.8}
```

[254]:
```
trained_regression_models_phys_v3 =␣
↪train_regression_models(best_regression_models_phys_v3, X_phys_v2,␣
↪y_phys_v2, reg_kf_v3, PHYS_LOGS_V3)
```

```
Training Lasso

Mean Squared Error: 0.0101
Mean Absolute Error: 0.0793
R² Score: 0.7012

Training Ridge

Mean Squared Error: 0.0102
Mean Absolute Error: 0.0801
R² Score: 0.6985

Training Random Forest


/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.277e-05, tolerance: 2.115e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.068e-03, tolerance: 1.903e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.644e-05, tolerance: 1.867e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
```

```
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.349e-03, tolerance: 1.910e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.253e-05, tolerance: 1.927e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.760e-05, tolerance: 1.936e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.086e-04, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.429e-03, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.590e-04, tolerance: 1.938e-05
  model = cd_fast.enet_coordinate_descent(

Mean Squared Error: 0.0101
Mean Absolute Error: 0.0801
R² Score: 0.7006

Training XGBoost

Mean Squared Error: 0.0092
Mean Absolute Error: 0.0760
R² Score: 0.7292
```

[255]:
```
PHYS_MODEL_V3_SEARCH = {
    'lr': tune.grid_search([1e-1, 5e-2, 1e-2, 5e-3, 1e-3]),
    'hidden_size': tune.grid_search([int(1e2), int(5e2), int(1e3), int(5e3)]),
    'batch_size': tune.grid_search([16, 32, 64]),
    'num_epochs': 200,
    'early_stop': 10,
    'log_dir': PHYS_LOGS_V3,
    'model_path': PHYS_MODELPATH_V3
}
```

[260]:
```
tune_regression_nn(
    PHYS_MODEL_V3_SEARCH,
    X_phys_v2,
    y_phys_v2
)
```

```
2024-06-29 15:31:31,410 INFO tune.py:616 -- [output] This uses the legacy output
and progress reporter, as Jupyter notebooks are not supported by the new engine,
yet. For more information, please see https://github.com/ray-
project/ray/issues/36949

== Status ==
Current time: 2024-06-29 15:31:32 (running for 00:00:00.65)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: None
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (60 PENDING)


== Status ==
Current time: 2024-06-29 15:31:37 (running for 00:00:05.68)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: None
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (50 PENDING, 10 RUNNING)



<IPython.core.display.HTML object>

== Status ==
Current time: 2024-06-29 15:31:42 (running for 00:00:10.69)
Using AsyncHyperBand: num_stopped=0
```

```
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.03366080857813358
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (50 PENDING, 6 RUNNING, 4 TERMINATED)


== Status ==
Current time: 2024-06-29 15:31:47 (running for 00:00:15.72)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.03366080857813358
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (46 PENDING, 5 RUNNING, 9 TERMINATED)


== Status ==
Current time: 2024-06-29 15:31:52 (running for 00:00:20.73)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.03366080857813358
Logical resource usage: 6.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (41 PENDING, 5 RUNNING, 14 TERMINATED)


== Status ==
Current time: 2024-06-29 15:31:57 (running for 00:00:25.77)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.03366080857813358
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (36 PENDING, 7 RUNNING, 17 TERMINATED)


== Status ==
Current time: 2024-06-29 15:32:02 (running for 00:00:30.79)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.038598463560144104
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
```

```
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (33 PENDING, 10 RUNNING, 17 TERMINATED)


== Status ==
Current time: 2024-06-29 15:32:07 (running for 00:00:35.88)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.048560360446572304 | Iter 25.000: 0.048213207706188164
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (33 PENDING, 6 RUNNING, 21 TERMINATED)


== Status ==
Current time: 2024-06-29 15:32:12 (running for 00:00:40.95)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.048560360446572304 | Iter 25.000: 0.048213207706188164
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (29 PENDING, 8 RUNNING, 23 TERMINATED)


== Status ==
Current time: 2024-06-29 15:32:17 (running for 00:00:46.01)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.048173402125636734 | Iter 25.000: 0.04837938894828161
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (26 PENDING, 7 RUNNING, 27 TERMINATED)


== Status ==
Current time: 2024-06-29 15:32:22 (running for 00:00:51.06)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04836688128610452 | Iter 25.000: 0.04842658123622338
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (23 PENDING, 10 RUNNING, 27 TERMINATED)
```

```
== Status ==
Current time: 2024-06-29 15:32:27 (running for 00:00:56.13)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04836688128610452 | Iter 25.000: 0.048473773524165154
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (20 PENDING, 8 RUNNING, 32 TERMINATED)


== Status ==
Current time: 2024-06-29 15:32:32 (running for 00:01:01.15)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04836688128610452 | Iter 25.000: 0.048473773524165154
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (18 PENDING, 9 RUNNING, 33 TERMINATED)


== Status ==
Current time: 2024-06-29 15:32:37 (running for 00:01:06.18)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.048560360446572304 | Iter 25.000: 0.050694579258561134
Logical resource usage: 7.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (17 PENDING, 7 RUNNING, 36 TERMINATED)


== Status ==
Current time: 2024-06-29 15:32:42 (running for 00:01:11.21)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.048560360446572304 | Iter 25.000: 0.05300228592629234
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (14 PENDING, 7 RUNNING, 39 TERMINATED)


== Status ==
Current time: 2024-06-29 15:32:47 (running for 00:01:16.22)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
```

```
0.048560360446572304 | Iter 25.000: 0.05300228592629234
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (11 PENDING, 8 RUNNING, 41 TERMINATED)


== Status ==
Current time: 2024-06-29 15:32:52 (running for 00:01:21.24)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04870831058360636 | Iter 25.000: 0.05360918235965073
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (8 PENDING, 8 RUNNING, 44 TERMINATED)


== Status ==
Current time: 2024-06-29 15:32:57 (running for 00:01:26.31)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04870831058360636 | Iter 25.000: 0.053617426892742515
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (5 PENDING, 9 RUNNING, 46 TERMINATED)


== Status ==
Current time: 2024-06-29 15:33:02 (running for 00:01:31.37)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04885626072064042 | Iter 25.000: 0.05507510815126201
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (3 PENDING, 7 RUNNING, 50 TERMINATED)


== Status ==
Current time: 2024-06-29 15:33:07 (running for 00:01:36.40)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: 0.05362042039632797 | Iter 37.500:
0.04885626072064042 | Iter 25.000: 0.05507510815126201
Logical resource usage: 6.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
```

```
Number of trials: 60/60 (6 RUNNING, 54 TERMINATED)


== Status ==
Current time: 2024-06-29 15:33:12 (running for 00:01:41.41)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: 0.05362042039632797 | Iter 37.500:
0.04885626072064042 | Iter 25.000: 0.05507510815126201
Logical resource usage: 2.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (2 RUNNING, 58 TERMINATED)


== Status ==
Current time: 2024-06-29 15:33:17 (running for 00:01:46.45)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: 0.05362042039632797 | Iter 37.500:
0.04885626072064042 | Iter 25.000: 0.05579982651397586
Logical resource usage: 1.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (1 RUNNING, 59 TERMINATED)



2024-06-29 15:33:18,444 INFO tune.py:1009 -- Wrote the latest version of all
result files and experiment state to
'/Users/tyler/ray_results/train_regression_nn_2024-06-29_15-31-31' in 0.0446s.
2024-06-29 15:33:18,452 INFO tune.py:1041 -- Total run time: 107.04 seconds
(106.98 seconds for the tuning loop).

== Status ==
Current time: 2024-06-29 15:33:18 (running for 00:01:47.02)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: 0.05362042039632797 | Iter 37.500:
0.04885626072064042 | Iter 25.000: 0.05579982651397586
Logical resource usage: 1.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-31-31/train_regression_nn_2024-06-29_15-31-31/driver_artifacts
Number of trials: 60/60 (60 TERMINATED)
+---------------------------------+------------+-----------------+-------+------
---------+-------------+-------------+------------+-----------+-------------+
| Trial name                      | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |       loss |       mse |     val_mse
|
|---------------------------------+------------+-----------------+-------+------
---------+-------------+-------------+------------+-----------+-------------|
| train_regression_nn_91dfb_00000 | TERMINATED | 127.0.0.1:19840 | 0.1   |
```

```
100 |           16 |          200 | 0.0138249  | 0.056404  |   0.0600403 |
| train_regression_nn_91dfb_00001 | TERMINATED | 127.0.0.1:19841 | 0.1   |
100 |           32 |          200 | 0.0143786  | 0.0548039 |   0.0508642 |
| train_regression_nn_91dfb_00002 | TERMINATED | 127.0.0.1:19842 | 0.1   |
100 |           64 |          200 | 0.0213037  | 0.0450125 |   0.047546  |
| train_regression_nn_91dfb_00003 | TERMINATED | 127.0.0.1:19843 | 0.1   |
500 |           16 |          200 | 0.0271134  | 0.0425659 |   0.723834  |
| train_regression_nn_91dfb_00004 | TERMINATED | 127.0.0.1:19844 | 0.1   |
500 |           32 |          200 | 0.0266381  | 0.039356  |   0.0381197 |
| train_regression_nn_91dfb_00005 | TERMINATED | 127.0.0.1:19845 | 0.1   |
500 |           64 |          200 | 0.0312997  | 0.0359783 |   0.0351303 |
| train_regression_nn_91dfb_00006 | TERMINATED | 127.0.0.1:19846 | 0.1   |
1000 |           16 |          200 | 0.0312283  | 0.0369348 |   0.517755  |
| train_regression_nn_91dfb_00007 | TERMINATED | 127.0.0.1:19847 | 0.1   |
1000 |           32 |          200 | 0.0287501  | 0.0378183 |   0.0429037 |
| train_regression_nn_91dfb_00008 | TERMINATED | 127.0.0.1:19848 | 0.1   |
1000 |           64 |          200 | 0.0324278  | 0.0352147 |   0.0337641 |
| train_regression_nn_91dfb_00009 | TERMINATED | 127.0.0.1:19849 | 0.1   |
5000 |           16 |          200 | 0.0331592  | 0.0338914 |  67.4872    |
| train_regression_nn_91dfb_00010 | TERMINATED | 127.0.0.1:19953 | 0.1   |
5000 |           32 |          200 | 0.0474289  | 0.054891  | 161.422     |
| train_regression_nn_91dfb_00011 | TERMINATED | 127.0.0.1:19954 | 0.1   |
5000 |           64 |          200 | 0.133985   | 0.140232  |  42.7806    |
| train_regression_nn_91dfb_00012 | TERMINATED | 127.0.0.1:19968 | 0.05  |
100 |           16 |          200 | 0.0115092  | 0.0603632 |   0.0640702 |
| train_regression_nn_91dfb_00013 | TERMINATED | 127.0.0.1:19969 | 0.05  |
100 |           32 |          200 | 0.00843935 | 0.0618573 |   0.053178  |
| train_regression_nn_91dfb_00014 | TERMINATED | 127.0.0.1:19987 | 0.05  |
100 |           64 |          200 | 0.00801027 | 0.0620598 |   0.0555777 |
| train_regression_nn_91dfb_00015 | TERMINATED | 127.0.0.1:19988 | 0.05  |
500 |           16 |          200 | 0.00965962 | 0.0607237 |   0.0539083 |
| train_regression_nn_91dfb_00016 | TERMINATED | 127.0.0.1:20021 | 0.05  |
500 |           32 |          200 | 0.0122591  | 0.0576968 |   0.0511129 |
| train_regression_nn_91dfb_00017 | TERMINATED | 127.0.0.1:20022 | 0.05  |
500 |           64 |          200 | 0.0181416  | 0.0512528 |   0.0464223 |
| train_regression_nn_91dfb_00018 | TERMINATED | 127.0.0.1:20023 | 0.05  |
1000 |           16 |          200 | 0.00971999 | 0.0584784 |   0.051938  |
| train_regression_nn_91dfb_00019 | TERMINATED | 127.0.0.1:20061 | 0.05  |
1000 |           32 |          200 | 0.0125243  | 0.0547891 |   0.0476995 |
| train_regression_nn_91dfb_00020 | TERMINATED | 127.0.0.1:20073 | 0.05  |
1000 |           64 |          200 | 0.0130967  | 0.058606  |   0.0481619 |
| train_regression_nn_91dfb_00021 | TERMINATED | 127.0.0.1:20074 | 0.05  |
5000 |           16 |          200 | 0.0122082  | 0.0562188 |   0.052048  |
| train_regression_nn_91dfb_00022 | TERMINATED | 127.0.0.1:20075 | 0.05  |
5000 |           32 |          200 | 0.0173735  | 0.0632031 |   0.0725326 |
| train_regression_nn_91dfb_00023 | TERMINATED | 127.0.0.1:20076 | 0.05  |
5000 |           64 |          200 | 0.0191868  | 0.0572277 |   0.0479799 |
| train_regression_nn_91dfb_00024 | TERMINATED | 127.0.0.1:20089 | 0.01  |
```

```
100 |           16 |          200 | 0.0136502  | 0.0629668 |   0.0535017 |
| train_regression_nn_91dfb_00025 | TERMINATED | 127.0.0.1:20090 | 0.01  |
100 |           32 |          200 | 0.00842276 | 0.0665183 |   0.0606904 |
| train_regression_nn_91dfb_00026 | TERMINATED | 127.0.0.1:20118 | 0.01  |
100 |           64 |          200 | 0.0052702  | 0.0683765 |   0.0597588 |
| train_regression_nn_91dfb_00027 | TERMINATED | 127.0.0.1:20170 | 0.01  |
500 |           16 |          200 | 0.0396004  | 0.0900059 |   0.0617711 |
| train_regression_nn_91dfb_00028 | TERMINATED | 127.0.0.1:20182 | 0.01  |
500 |           32 |          200 | 0.00838807 | 0.0651286 |   0.0585976 |
| train_regression_nn_91dfb_00029 | TERMINATED | 127.0.0.1:20183 | 0.01  |
500 |           64 |          200 | 0.00854653 | 0.0654407 |   0.072821  |
| train_regression_nn_91dfb_00030 | TERMINATED | 127.0.0.1:20184 | 0.01  |
1000 |           16 |          200 | 0.0494682  | 0.0998256 |   0.0783516 |
| train_regression_nn_91dfb_00031 | TERMINATED | 127.0.0.1:20248 | 0.01  |
1000 |           32 |          200 | 0.0204596  | 0.0744354 |   0.0625482 |
| train_regression_nn_91dfb_00032 | TERMINATED | 127.0.0.1:20271 | 0.01  |
1000 |           64 |          200 | 0.0067047  | 0.0656851 |   0.0605966 |
| train_regression_nn_91dfb_00033 | TERMINATED | 127.0.0.1:20272 | 0.01  |
5000 |           16 |          200 | 0.0469669  | 0.0959863 |   0.08221   |
| train_regression_nn_91dfb_00034 | TERMINATED | 127.0.0.1:20305 | 0.01  |
5000 |           32 |          200 | 0.0903459  | 0.148586  |   0.0823623 |
| train_regression_nn_91dfb_00035 | TERMINATED | 127.0.0.1:20320 | 0.01  |
5000 |           64 |          200 | 0.0216362  | 0.0818886 |   0.151405  |
| train_regression_nn_91dfb_00036 | TERMINATED | 127.0.0.1:20321 | 0.005 |
100 |           16 |          200 | 0.00737755 | 0.0619975 |   0.0554678 |
| train_regression_nn_91dfb_00037 | TERMINATED | 127.0.0.1:20396 | 0.005 |
100 |           32 |          200 | 0.00667389 | 0.0633931 |   0.0589365 |
| train_regression_nn_91dfb_00038 | TERMINATED | 127.0.0.1:20397 | 0.005 |
100 |           64 |          200 | 0.00495747 | 0.064868  |   0.067174  |
| train_regression_nn_91dfb_00039 | TERMINATED | 127.0.0.1:20398 | 0.005 |
500 |           16 |          200 | 0.0200558  | 0.0726684 |   0.0583948 |
| train_regression_nn_91dfb_00040 | TERMINATED | 127.0.0.1:20413 | 0.005 |
500 |           32 |          200 | 0.0088003  | 0.0665591 |   0.0605055 |
| train_regression_nn_91dfb_00041 | TERMINATED | 127.0.0.1:20427 | 0.005 |
500 |           64 |          200 | 0.00626317 | 0.0673912 |   0.0602682 |
| train_regression_nn_91dfb_00042 | TERMINATED | 127.0.0.1:20481 | 0.005 |
1000 |           16 |          200 | 0.035154   | 0.0830986 |   0.0657098 |
| train_regression_nn_91dfb_00043 | TERMINATED | 127.0.0.1:20537 | 0.005 |
1000 |           32 |          200 | 0.006926   | 0.0653386 |   0.0614611 |
| train_regression_nn_91dfb_00044 | TERMINATED | 127.0.0.1:20538 | 0.005 |
1000 |           64 |          200 | 0.00444246 | 0.064179  |   0.0683252 |
| train_regression_nn_91dfb_00045 | TERMINATED | 127.0.0.1:20539 | 0.005 |
5000 |           16 |          200 | 0.0358389  | 0.0942462 |   0.0832607 |
| train_regression_nn_91dfb_00046 | TERMINATED | 127.0.0.1:20540 | 0.005 |
5000 |           32 |          200 | 0.0163608  | 0.0740223 |   0.0620981 |
| train_regression_nn_91dfb_00047 | TERMINATED | 127.0.0.1:20565 | 0.005 |
5000 |           64 |          200 | 0.0179375  | 0.0797721 |   0.0843142 |
| train_regression_nn_91dfb_00048 | TERMINATED | 127.0.0.1:20566 | 0.001 |
```

```
100 |           16 |          200 | 0.00872903 | 0.0626244 |   0.0595248 |
| train_regression_nn_91dfb_00049 | TERMINATED | 127.0.0.1:20593 | 0.001 |
100 |           32 |          200 | 0.00439434 | 0.0664746 |   0.056322  |
| train_regression_nn_91dfb_00050 | TERMINATED | 127.0.0.1:20619 | 0.001 |
100 |           64 |          200 | 0.00500331 | 0.0670667 |   0.0625776 |
| train_regression_nn_91dfb_00051 | TERMINATED | 127.0.0.1:20633 | 0.001 |
500 |           16 |          200 | 0.0122545  | 0.0690771 |   0.0508018 |
| train_regression_nn_91dfb_00052 | TERMINATED | 127.0.0.1:20660 | 0.001 |
500 |           32 |          200 | 0.00401171 | 0.0667939 |   0.0571978 |
| train_regression_nn_91dfb_00053 | TERMINATED | 127.0.0.1:20661 | 0.001 |
500 |           64 |          200 | 0.00482642 | 0.070752  |   0.066221  |
| train_regression_nn_91dfb_00054 | TERMINATED | 127.0.0.1:20674 | 0.001 |
1000 |           16 |          200 | 0.0169293  | 0.0706017 |   0.0542929 |
| train_regression_nn_91dfb_00055 | TERMINATED | 127.0.0.1:20700 | 0.001 |
1000 |           32 |          200 | 0.00675562 | 0.0682082 |   0.064235  |
| train_regression_nn_91dfb_00056 | TERMINATED | 127.0.0.1:20724 | 0.001 |
1000 |           64 |          200 | 0.00512513 | 0.067264  |   0.0594947 |
| train_regression_nn_91dfb_00057 | TERMINATED | 127.0.0.1:20750 | 0.001 |
5000 |           16 |          200 | 0.0247937  | 0.0791694 |   0.0576804 |
| train_regression_nn_91dfb_00058 | TERMINATED | 127.0.0.1:20751 | 0.001 |
5000 |           32 |          200 | 0.0111193  | 0.0654073 |   0.0614277 |
| train_regression_nn_91dfb_00059 | TERMINATED | 127.0.0.1:20764 | 0.001 |
5000 |           64 |          200 | 0.00789091 | 0.0609493 |   0.0641119 |
+---------------------------------+------------+-----------------+-------+------
---------+-------------+-------------+------------+-----------+-------------+


Best Hyperparameters Found:  {'lr': 0.1, 'hidden_size': 1000, 'batch_size': 64,
'num_epochs': 200, 'early_stop': 10, 'log_dir': '/Users/tyler/GitHub
Repositories/Apple Watch FitBit Project/Wearables-Activity-
Classification/logs/whoop-recovery-reg/v3/phys', 'model_path':
'/Users/tyler/GitHub Repositories/Apple Watch FitBit Project/Wearables-Activity-
Classification/models/whoop-recovery-reg/v3/phys', 'tune': True}
Best Validation MSE:  0.03376410901546478
Best Number Epochs:  27
Best Model Path:  /Users/tyler/GitHub Repositories/Apple Watch FitBit
Project/Wearables-Activity-Classification/models/whoop-recovery-
reg/v3/phys/h1000_b64_lr0.1.th
```

v4 Training Using v4 features (most important from best v3 models), optimize a new set of v3 models with GridSearch

[267]:
```
PHYS_LOGS_V4 = os.path.join(os.getcwd(), 'logs/whoop-recovery-reg/v4/phys')
PHYS_MODELPATH_V4 = os.path.join(os.getcwd(), 'models/whoop-recovery-reg/v4/
  ↪phys')
```

[268]:
```
best_regression_models_phys_v4 =␣
↪grid_search_regression_models(regression_models_v3, reg_param_grids_v3,␣
↪X_phys_v4, y_phys_v4, reg_kf_v3)
```

```
Optimizing Lasso
Original Parameters: {'alpha': 1.0, 'max_iter': 1000, 'tol': 0.0001}
Best Parameters: {'alpha': 0.0001, 'max_iter': 500, 'tol': 0.001}

Optimizing Ridge
Original Parameters: {'alpha': 1.0, 'max_iter': None, 'tol': 0.0001, 'solver':
'auto'}
Best Parameters: {'alpha': 0.001, 'max_iter': 1000, 'solver': 'saga', 'tol':
0.05}

Optimizing Random Forest
Original Parameters: {'n_estimators': 100, 'max_depth': None,
'min_samples_split': 2, 'min_samples_leaf': 1}
Best Parameters: {'max_depth': 10, 'min_samples_leaf': 1, 'min_samples_split':
2, 'n_estimators': 40}

Optimizing XGBoost
Original Parameters: {'n_estimators': None, 'learning_rate': None, 'max_depth':
None, 'subsample': None, 'colsample_bytree': None, 'gamma': None}
Best Parameters: {'colsample_bytree': 0.8, 'gamma': 0, 'learning_rate': 0.1,
'max_depth': 3, 'n_estimators': 125, 'subsample': 0.8}
```

[269]:
```
trained_regression_models_phys_v4 =␣
↪train_regression_models(best_regression_models_phys_v4, X_phys_v4,␣
↪y_phys_v4, reg_kf_v3, PHYS_LOGS_V4)
```

```
Training Lasso

Mean Squared Error: 0.0099
Mean Absolute Error: 0.0782
R² Score: 0.7074

Training Ridge

Mean Squared Error: 0.0099
Mean Absolute Error: 0.0786
R² Score: 0.7064

Training Random Forest

Mean Squared Error: 0.0098
Mean Absolute Error: 0.0779
R² Score: 0.7116
```

```
Training XGBoost

Mean Squared Error: 0.0090
Mean Absolute Error: 0.0740
R² Score: 0.7352
```

[270]:
```
PHYS_MODEL_V4_SEARCH = {
    'lr': tune.grid_search([1e-1, 5e-2, 1e-2, 5e-3, 1e-3]),
    'hidden_size': tune.grid_search([int(1e2), int(5e2), int(1e3), int(5e3)]),
    'batch_size': tune.grid_search([16, 32, 64]),
    'num_epochs': 200,
    'early_stop': 10,
    'log_dir': PHYS_LOGS_V4,
    'model_path': PHYS_MODELPATH_V4
}
```

[271]:
```
tune_regression_nn(
    PHYS_MODEL_V4_SEARCH,
    X_phys_v4,
    y_phys_v4
)
```

```
2024-06-29 15:41:41,735 INFO tune.py:616 -- [output] This uses the legacy output
and progress reporter, as Jupyter notebooks are not supported by the new engine,
yet. For more information, please see https://github.com/ray-
project/ray/issues/36949

== Status ==
Current time: 2024-06-29 15:41:42 (running for 00:00:00.32)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: None
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (60 PENDING)


== Status ==
Current time: 2024-06-29 15:41:47 (running for 00:00:05.39)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: None
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (50 PENDING, 10 RUNNING)
```

```
<IPython.core.display.HTML object>
```

```
== Status ==
Current time: 2024-06-29 15:41:52 (running for 00:00:10.41)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.04457775875926018
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (50 PENDING, 6 RUNNING, 4 TERMINATED)


== Status ==
Current time: 2024-06-29 15:41:57 (running for 00:00:15.43)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.040047863498330116 | Iter 25.000: 0.04457775875926018
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (46 PENDING, 5 RUNNING, 9 TERMINATED)


== Status ==
Current time: 2024-06-29 15:42:02 (running for 00:00:20.45)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.040047863498330116 | Iter 25.000: 0.04457775875926018
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (41 PENDING, 10 RUNNING, 9 TERMINATED)


== Status ==
Current time: 2024-06-29 15:42:07 (running for 00:00:25.47)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.040047863498330116 | Iter 25.000: 0.04589600736896197
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (40 PENDING, 5 RUNNING, 15 TERMINATED)
```

```
== Status ==
Current time: 2024-06-29 15:42:12 (running for 00:00:30.52)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.040047863498330116 | Iter 25.000: 0.046555131673812866
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (35 PENDING, 8 RUNNING, 17 TERMINATED)


== Status ==
Current time: 2024-06-29 15:42:17 (running for 00:00:35.55)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.040047863498330116 | Iter 25.000: 0.04821204332013925
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (33 PENDING, 7 RUNNING, 20 TERMINATED)


== Status ==
Current time: 2024-06-29 15:42:22 (running for 00:00:40.55)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.045552282594144344 | Iter 25.000: 0.04821204332013925
Logical resource usage: 7.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (30 PENDING, 7 RUNNING, 23 TERMINATED)


== Status ==
Current time: 2024-06-29 15:42:27 (running for 00:00:45.56)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.045552282594144344 | Iter 25.000: 0.051525866612792015
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (27 PENDING, 10 RUNNING, 23 TERMINATED)


== Status ==
Current time: 2024-06-29 15:42:32 (running for 00:00:50.58)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
```

```
0.05030553850034873 | Iter 25.000: 0.054992421219746276
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (26 PENDING, 5 RUNNING, 29 TERMINATED)


== Status ==
Current time: 2024-06-29 15:42:37 (running for 00:00:55.60)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.05030553850034873 | Iter 25.000: 0.054992421219746276
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (21 PENDING, 8 RUNNING, 31 TERMINATED)


== Status ==
Current time: 2024-06-29 15:42:42 (running for 00:01:00.60)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: 0.04936145804822445 | Iter 37.500:
0.05030553850034873 | Iter 25.000: 0.0567256985232234
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (19 PENDING, 7 RUNNING, 34 TERMINATED)


== Status ==
Current time: 2024-06-29 15:42:47 (running for 00:01:05.60)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: 0.04936145804822445 | Iter 37.500:
0.05030553850034873 | Iter 25.000: 0.057307045285900436
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (15 PENDING, 8 RUNNING, 37 TERMINATED)


== Status ==
Current time: 2024-06-29 15:42:52 (running for 00:01:10.65)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: 0.04936145804822445 | Iter 37.500:
0.05030553850034873 | Iter 25.000: 0.0567256985232234
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
```

```
Number of trials: 60/60 (12 PENDING, 7 RUNNING, 41 TERMINATED)


== Status ==
Current time: 2024-06-29 15:42:57 (running for 00:01:15.70)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: 0.04936145804822445 | Iter 37.500:
0.05030553850034873 | Iter 25.000: 0.0567256985232234
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (9 PENDING, 7 RUNNING, 44 TERMINATED)


== Status ==
Current time: 2024-06-29 15:43:02 (running for 00:01:20.70)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: 0.04936145804822445 | Iter 37.500:
0.05030553850034873 | Iter 25.000: 0.057692443020641804
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (6 PENDING, 8 RUNNING, 46 TERMINATED)


== Status ==
Current time: 2024-06-29 15:43:07 (running for 00:01:25.72)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: 0.04936145804822445 | Iter 37.500:
0.05030553850034873 | Iter 25.000: 0.05827378978331884
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (4 PENDING, 6 RUNNING, 50 TERMINATED)


== Status ==
Current time: 2024-06-29 15:43:12 (running for 00:01:30.80)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: 0.04936145804822445 | Iter 37.500:
0.05543437600135803 | Iter 25.000: 0.057692443020641804
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (8 RUNNING, 52 TERMINATED)


== Status ==
```

```
Current time: 2024-06-29 15:43:17 (running for 00:01:35.89)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: 0.04936145804822445 | Iter 37.500:
0.05543437600135803 | Iter 25.000: 0.0572090707719326
Logical resource usage: 4.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (4 RUNNING, 56 TERMINATED)


== Status ==
Current time: 2024-06-29 15:43:22 (running for 00:01:40.90)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: 0.04936145804822445 | Iter 37.500:
0.05543437600135803 | Iter 25.000: 0.057692443020641804
Logical resource usage: 1.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (1 RUNNING, 59 TERMINATED)



2024-06-29 15:43:25,263 INFO tune.py:1009 -- Wrote the latest version of all
result files and experiment state to
'/Users/tyler/ray_results/train_regression_nn_2024-06-29_15-41-41' in 0.0793s.
2024-06-29 15:43:25,273 INFO tune.py:1041 -- Total run time: 103.54 seconds
(103.44 seconds for the tuning loop).

== Status ==
Current time: 2024-06-29 15:43:25 (running for 00:01:43.52)
Using AsyncHyperBand: num_stopped=4
Bracket: Iter 84.375: None | Iter 56.250: 0.04936145804822445 | Iter 37.500:
0.05543437600135803 | Iter 25.000: 0.057692443020641804
Logical resource usage: 1.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_15-41-41/train_regression_nn_2024-06-29_15-41-41/driver_artifacts
Number of trials: 60/60 (60 TERMINATED)
+---------------------------------+------------+-----------------+-------+------
---------+-------------+-------------+------------+-----------+------------+
| Trial name                      | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |       loss |       mse |    val_mse
|
|---------------------------------+------------+-----------------+-------+------
---------+-------------+-------------+------------+-----------+------------|
| train_regression_nn_fda7a_00000 | TERMINATED | 127.0.0.1:25761 | 0.1   |
100 |           16 |          200 | 0.0138131  | 0.0551077 |  0.0620503 |
| train_regression_nn_fda7a_00001 | TERMINATED | 127.0.0.1:25762 | 0.1   |
100 |           32 |          200 | 0.0114057  | 0.0592741 |  0.0545957 |
| train_regression_nn_fda7a_00002 | TERMINATED | 127.0.0.1:25763 | 0.1   |
```

```
100 |           64 |          200 | 0.0280861  | 0.0410663 |  0.0408314 |
| train_regression_nn_fda7a_00003 | TERMINATED | 127.0.0.1:25764 | 0.1   |
500 |           16 |          200 | 0.0190058  | 0.04696   |  3.12268   |
| train_regression_nn_fda7a_00004 | TERMINATED | 127.0.0.1:25765 | 0.1   |
500 |           32 |          200 | 0.030361   | 0.0378817 |  0.0375317 |
| train_regression_nn_fda7a_00005 | TERMINATED | 127.0.0.1:25766 | 0.1   |
500 |           64 |          200 | 0.0308655  | 0.0366306 |  0.0362957 |
| train_regression_nn_fda7a_00006 | TERMINATED | 127.0.0.1:25767 | 0.1   |
1000 |           16 |          200 | 0.0270346  | 0.0401071 | 17.4665    |
| train_regression_nn_fda7a_00007 | TERMINATED | 127.0.0.1:25768 | 0.1   |
1000 |           32 |          200 | 0.028794   | 0.0394222 |  0.0744042 |
| train_regression_nn_fda7a_00008 | TERMINATED | 127.0.0.1:25769 | 0.1   |
1000 |           64 |          200 | 0.0323691  | 0.0394759 |  0.0447844 |
| train_regression_nn_fda7a_00009 | TERMINATED | 127.0.0.1:25770 | 0.1   |
5000 |           16 |          200 | 0.029385   | 0.0617074 |  0.0548027 |
| train_regression_nn_fda7a_00010 | TERMINATED | 127.0.0.1:25879 | 0.1   |
5000 |           32 |          200 | 0.0277271  | 0.0600923 |  0.0624701 |
| train_regression_nn_fda7a_00011 | TERMINATED | 127.0.0.1:25880 | 0.1   |
5000 |           64 |          200 | 0.0521652  | 0.0530312 |  0.0465551 |
| train_regression_nn_fda7a_00012 | TERMINATED | 127.0.0.1:25893 | 0.05  |
100 |           16 |          200 | 0.0113767  | 0.0591814 |  0.0502253 |
| train_regression_nn_fda7a_00013 | TERMINATED | 127.0.0.1:25894 | 0.05  |
100 |           32 |          200 | 0.00898737 | 0.059292  |  0.0605848 |
| train_regression_nn_fda7a_00014 | TERMINATED | 127.0.0.1:25916 | 0.05  |
100 |           64 |          200 | 0.00795215 | 0.0595646 |  0.0539703 |
| train_regression_nn_fda7a_00015 | TERMINATED | 127.0.0.1:25946 | 0.05  |
500 |           16 |          200 | 0.0106877  | 0.058027  |  0.056265  |
| train_regression_nn_fda7a_00016 | TERMINATED | 127.0.0.1:25947 | 0.05  |
500 |           32 |          200 | 0.0115939  | 0.0613483 |  0.0522841 |
| train_regression_nn_fda7a_00017 | TERMINATED | 127.0.0.1:25948 | 0.05  |
500 |           64 |          200 | 0.0108878  | 0.0564419 |  0.0584697 |
| train_regression_nn_fda7a_00018 | TERMINATED | 127.0.0.1:25949 | 0.05  |
1000 |           16 |          200 | 0.0110424  | 0.0595533 |  0.0584104 |
| train_regression_nn_fda7a_00019 | TERMINATED | 127.0.0.1:26003 | 0.05  |
1000 |           32 |          200 | 0.0096331  | 0.0590967 |  0.053448  |
| train_regression_nn_fda7a_00020 | TERMINATED | 127.0.0.1:26024 | 0.05  |
1000 |           64 |          200 | 0.00950704 | 0.05847   |  0.0549165 |
| train_regression_nn_fda7a_00021 | TERMINATED | 127.0.0.1:26052 | 0.05  |
5000 |           16 |          200 | 0.0519429  | 0.101222  |  0.0735462 |
| train_regression_nn_fda7a_00022 | TERMINATED | 127.0.0.1:26053 | 0.05  |
5000 |           32 |          200 | 0.0332529  | 0.0823877 |  0.05774   |
| train_regression_nn_fda7a_00023 | TERMINATED | 127.0.0.1:26054 | 0.05  |
5000 |           64 |          200 | 0.0575701  | 0.103085  |  0.0600099 |
| train_regression_nn_fda7a_00024 | TERMINATED | 127.0.0.1:26055 | 0.01  |
100 |           16 |          200 | 0.0161965  | 0.0667611 |  0.057666  |
| train_regression_nn_fda7a_00025 | TERMINATED | 127.0.0.1:26068 | 0.01  |
100 |           32 |          200 | 0.00661119 | 0.0659381 |  0.0563623 |
| train_regression_nn_fda7a_00026 | TERMINATED | 127.0.0.1:26099 | 0.01  |
```

```
100 |           64 |          200 | 0.0051655  | 0.0622142 |  0.0628521 |
| train_regression_nn_fda7a_00027 | TERMINATED | 127.0.0.1:26140 | 0.01  |
500 |           16 |          200 | 0.0220901  | 0.0721302 |  0.0715014 |
| train_regression_nn_fda7a_00028 | TERMINATED | 127.0.0.1:26155 | 0.01  |
500 |           32 |          200 | 0.0120992  | 0.0704272 |  0.0656394 |
| train_regression_nn_fda7a_00029 | TERMINATED | 127.0.0.1:26156 | 0.01  |
500 |           64 |          200 | 0.00535663 | 0.066489  |  0.0624731 |
| train_regression_nn_fda7a_00030 | TERMINATED | 127.0.0.1:26195 | 0.01  |
1000 |           16 |          200 | 0.0185833  | 0.0703214 |  0.0739796 |
| train_regression_nn_fda7a_00031 | TERMINATED | 127.0.0.1:26196 | 0.01  |
1000 |           32 |          200 | 0.0085568  | 0.0662172 |  0.0554225 |
| train_regression_nn_fda7a_00032 | TERMINATED | 127.0.0.1:26197 | 0.01  |
1000 |           64 |          200 | 0.00705559 | 0.0645413 |  0.0589028 |
| train_regression_nn_fda7a_00033 | TERMINATED | 127.0.0.1:26247 | 0.01  |
5000 |           16 |          200 | 0.0426395  | 0.0917708 |  0.0782605 |
| train_regression_nn_fda7a_00034 | TERMINATED | 127.0.0.1:26259 | 0.01  |
5000 |           32 |          200 | 0.354914   | 0.410084  |  0.659096  |
| train_regression_nn_fda7a_00035 | TERMINATED | 127.0.0.1:26260 | 0.01  |
5000 |           64 |          200 | 0.0211283  | 0.082509  |  0.0683449 |
| train_regression_nn_fda7a_00036 | TERMINATED | 127.0.0.1:26285 | 0.005 |
100 |           16 |          200 | 0.00919356 | 0.0645596 |  0.0561326 |
| train_regression_nn_fda7a_00037 | TERMINATED | 127.0.0.1:26286 | 0.005 |
100 |           32 |          200 | 0.00818885 | 0.0654597 |  0.0629806 |
| train_regression_nn_fda7a_00038 | TERMINATED | 127.0.0.1:26287 | 0.005 |
100 |           64 |          200 | 0.00461668 | 0.0639251 |  0.0661992 |
| train_regression_nn_fda7a_00039 | TERMINATED | 127.0.0.1:26302 | 0.005 |
500 |           16 |          200 | 0.0149887  | 0.066275  |  0.0665899 |
| train_regression_nn_fda7a_00040 | TERMINATED | 127.0.0.1:26329 | 0.005 |
500 |           32 |          200 | 0.0106004  | 0.0661716 |  0.0588311 |
| train_regression_nn_fda7a_00041 | TERMINATED | 127.0.0.1:26370 | 0.005 |
500 |           64 |          200 | 0.00914204 | 0.064078  |  0.0613577 |
| train_regression_nn_fda7a_00042 | TERMINATED | 127.0.0.1:26383 | 0.005 |
1000 |           16 |          200 | 0.0198961  | 0.073004  |  0.0607526 |
| train_regression_nn_fda7a_00043 | TERMINATED | 127.0.0.1:26384 | 0.005 |
1000 |           32 |          200 | 0.00986489 | 0.0663119 |  0.0623534 |
| train_regression_nn_fda7a_00044 | TERMINATED | 127.0.0.1:26385 | 0.005 |
1000 |           64 |          200 | 0.00560605 | 0.0611246 |  0.0590985 |
| train_regression_nn_fda7a_00045 | TERMINATED | 127.0.0.1:26425 | 0.005 |
5000 |           16 |          200 | 0.145875   | 0.195843  |  0.174091  |
| train_regression_nn_fda7a_00046 | TERMINATED | 127.0.0.1:26429 | 0.005 |
5000 |           32 |          200 | 0.0164895  | 0.0721421 |  0.0744381 |
| train_regression_nn_fda7a_00047 | TERMINATED | 127.0.0.1:26441 | 0.005 |
5000 |           64 |          200 | 0.0129358  | 0.0734163 |  0.0612304 |
| train_regression_nn_fda7a_00048 | TERMINATED | 127.0.0.1:26442 | 0.001 |
100 |           16 |          200 | 0.0106714  | 0.0679786 |  0.0556412 |
| train_regression_nn_fda7a_00049 | TERMINATED | 127.0.0.1:26467 | 0.001 |
100 |           32 |          200 | 0.00604072 | 0.066446  |  0.0612434 |
| train_regression_nn_fda7a_00050 | TERMINATED | 127.0.0.1:26468 | 0.001 |
```

```
100 |           64 |          200 | 0.00506559 | 0.0672086 |  0.0716518 |
| train_regression_nn_fda7a_00051 | TERMINATED | 127.0.0.1:26494 | 0.001 |
500 |           16 |          200 | 0.0106639  | 0.0631909 |  0.0586324 |
| train_regression_nn_fda7a_00052 | TERMINATED | 127.0.0.1:26495 | 0.001 |
500 |           32 |          200 | 0.00621743 | 0.0665192 |  0.0632285 |
| train_regression_nn_fda7a_00053 | TERMINATED | 127.0.0.1:26496 | 0.001 |
500 |           64 |          200 | 0.00512172 | 0.0666447 |  0.0654064 |
| train_regression_nn_fda7a_00054 | TERMINATED | 127.0.0.1:26561 | 0.001 |
1000 |           16 |          200 | 0.0139665  | 0.0693021 |  0.0582546 |
| train_regression_nn_fda7a_00055 | TERMINATED | 127.0.0.1:26562 | 0.001 |
1000 |           32 |          200 | 0.00781053 | 0.067064  |  0.0567125 |
| train_regression_nn_fda7a_00056 | TERMINATED | 127.0.0.1:26576 | 0.001 |
1000 |           64 |          200 | 0.00370823 | 0.0644016 |  0.0591493 |
| train_regression_nn_fda7a_00057 | TERMINATED | 127.0.0.1:26601 | 0.001 |
5000 |           16 |          200 | 0.0184134  | 0.0711221 |  0.057183  |
| train_regression_nn_fda7a_00058 | TERMINATED | 127.0.0.1:26602 | 0.001 |
5000 |           32 |          200 | 0.00999552 | 0.0632295 |  0.0605941 |
| train_regression_nn_fda7a_00059 | TERMINATED | 127.0.0.1:26603 | 0.001 |
5000 |           64 |          200 | 0.00950598 | 0.0660013 |  0.0686538 |
+---------------------------------+------------+-----------------+-------+------
---------+--------------+--------------+------------+-----------+------------+
```

```
Best Hyperparameters Found:  {'lr': 0.1, 'hidden_size': 500, 'batch_size': 64,
'num_epochs': 200, 'early_stop': 10, 'log_dir': '/Users/tyler/GitHub
Repositories/Apple Watch FitBit Project/Wearables-Activity-
Classification/logs/whoop-recovery-reg/v4/phys', 'model_path':
'/Users/tyler/GitHub Repositories/Apple Watch FitBit Project/Wearables-Activity-
Classification/models/whoop-recovery-reg/v4/phys', 'tune': True}
Best Validation MSE:  0.03629567101597786
Best Number Epochs:  19
Best Model Path:  /Users/tyler/GitHub Repositories/Apple Watch FitBit
Project/Wearables-Activity-Classification/models/whoop-recovery-
reg/v4/phys/h500_b64_lr0.1.th
```

3.4.4 Merged

v1 Training

[288]:
```
MERGE_LOGS_V1 = os.path.join(os.getcwd(), 'logs/whoop-recovery-reg/v1/merge')
MERGE_MODELPATH_V1 = os.path.join(os.getcwd(), 'models/whoop-recovery-reg/v1/
  ↪merge')
```

[297]:
```
trained_regression_models_merge_v1 =␣
  ↪train_regression_models(regression_models_v1, X_merge_v1, y_merge_v1,␣
  ↪reg_kf_v1, MERGE_LOGS_V1)
```

```
Training Lasso
```

```
Mean Squared Error: 0.0101
Mean Absolute Error: 0.0788
R² Score: 0.7026

Training Ridge

Mean Squared Error: 0.0102
Mean Absolute Error: 0.0793
R² Score: 0.6994

Training Random Forest

Mean Squared Error: 0.0102
Mean Absolute Error: 0.0809
R² Score: 0.6990

Training XGBoost

Mean Squared Error: 0.0114
Mean Absolute Error: 0.0847
R² Score: 0.6642
```

[298]:
```
MERGE_MODEL_V1_CONFIG = {
    'lr': 1e-2,
    'hidden_size': int(1e3),
    'batch_size': 32,
    'num_epochs': 200,
    'early_stop': 10,
    'log_dir': MERGE_LOGS_V1,
    'model_path': MERGE_MODELPATH_V1,
    'print': True
}
```

[299]:
```
train_regression_nn(
    MERGE_MODEL_V1_CONFIG,
    X_merge_v1,
    y_merge_v1
)
```

```
Using device: mps
Epoch [0/200], Loss: 3.8330, Training MSE: 3.8568, Validation MSE: 0.8074
Epoch [1/200], Loss: 0.3347, Training MSE: 0.3684, Validation MSE: 0.1984
Epoch [2/200], Loss: 0.0828, Training MSE: 0.1275, Validation MSE: 0.0797
Epoch [3/200], Loss: 0.0350, Training MSE: 0.0757, Validation MSE: 0.0602
Epoch [4/200], Loss: 0.0280, Training MSE: 0.0696, Validation MSE: 0.0696
Epoch [5/200], Loss: 0.0293, Training MSE: 0.0753, Validation MSE: 0.0558
Epoch [6/200], Loss: 0.0212, Training MSE: 0.0686, Validation MSE: 0.0578
```

```
Epoch [7/200], Loss: 0.0181, Training MSE: 0.0670, Validation MSE: 0.0604
Epoch [8/200], Loss: 0.0155, Training MSE: 0.0670, Validation MSE: 0.0576
Epoch [9/200], Loss: 0.0170, Training MSE: 0.0693, Validation MSE: 0.0513
Epoch [10/200], Loss: 0.0168, Training MSE: 0.0699, Validation MSE: 0.0536
Epoch [11/200], Loss: 0.0159, Training MSE: 0.0688, Validation MSE: 0.0681
Epoch [12/200], Loss: 0.0278, Training MSE: 0.0829, Validation MSE: 0.0744
Epoch [13/200], Loss: 0.0182, Training MSE: 0.0706, Validation MSE: 0.0596
Epoch [14/200], Loss: 0.0162, Training MSE: 0.0720, Validation MSE: 0.0515
Epoch [15/200], Loss: 0.0163, Training MSE: 0.0696, Validation MSE: 0.0657
Epoch [16/200], Loss: 0.0303, Training MSE: 0.0857, Validation MSE: 0.0762
Epoch [17/200], Loss: 0.0253, Training MSE: 0.0769, Validation MSE: 0.0656
Epoch [18/200], Loss: 0.0167, Training MSE: 0.0722, Validation MSE: 0.0546
Early stopping at epoch 19
Best Validation MSE: 0.05128912627696991 at epoch 9
```

v2 Training Using v1 features to optimize v3 models with GridSearch hyperparameter tuning

[300]:
```
MERGE_LOGS_V2 = os.path.join(os.getcwd(), 'logs/whoop-recovery-reg/v2/merge')
MERGE_MODELPATH_V2 = os.path.join(os.getcwd(), 'models/whoop-recovery-reg/v2/
↪merge')
```

[301]:
```
best_regression_models_merge_v2 =␣
↪grid_search_regression_models(regression_models_v3, reg_param_grids_v3,␣
↪X_merge_v1, y_merge_v1, reg_kf_v3)
```

```
Optimizing Lasso
Original Parameters: {'alpha': 1.0, 'max_iter': 1000, 'tol': 0.0001}

/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.645e-01, tolerance: 1.936e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.285e-01, tolerance: 1.906e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.568e-01, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
```

```
check the scale of the features or consider increasing regularisation. Duality
gap: 5.525e-01, tolerance: 1.938e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.944e-01, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.286e-01, tolerance: 1.927e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.731e-01, tolerance: 1.910e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.365e-01, tolerance: 1.867e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.134e-01, tolerance: 1.895e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.568e-01, tolerance: 1.903e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.285e-01, tolerance: 1.906e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
```

```
check the scale of the features or consider increasing regularisation. Duality
gap: 2.568e-01, tolerance: 1.903e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.365e-01, tolerance: 1.867e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.286e-01, tolerance: 1.927e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.731e-01, tolerance: 1.910e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.645e-01, tolerance: 1.936e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.568e-01, tolerance: 1.875e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.944e-01, tolerance: 1.875e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.525e-01, tolerance: 1.938e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
```

```
check the scale of the features or consider increasing regularisation. Duality
gap: 6.134e-01, tolerance: 1.895e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.285e-01, tolerance: 1.906e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.568e-01, tolerance: 1.903e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.365e-01, tolerance: 1.867e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.731e-01, tolerance: 1.910e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.286e-01, tolerance: 1.927e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.944e-01, tolerance: 1.875e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.645e-01, tolerance: 1.936e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
```

```
check the scale of the features or consider increasing regularisation. Duality
gap: 3.568e-01, tolerance: 1.875e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.525e-01, tolerance: 1.938e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.134e-01, tolerance: 1.895e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.568e-01, tolerance: 1.903e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.285e-01, tolerance: 1.906e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.365e-01, tolerance: 1.867e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.731e-01, tolerance: 1.910e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.286e-01, tolerance: 1.927e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
```

```
check the scale of the features or consider increasing regularisation. Duality
gap: 2.944e-01, tolerance: 1.875e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.645e-01, tolerance: 1.936e-02
  model = cd_fast.enet_coordinate_descent(
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gap: 3.568e-01, tolerance: 1.875e-02
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gap: 2.012e+00, tolerance: 1.895e-05
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packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
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gap: 6.285e-01, tolerance: 1.906e-05
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Objective did not converge. You might want to increase the number of iterations,
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gap: 6.286e-01, tolerance: 1.927e-05
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gap: 2.944e-01, tolerance: 1.875e-05
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gap: 4.645e-01, tolerance: 1.936e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.568e-01, tolerance: 1.903e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.568e-01, tolerance: 1.875e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.944e-01, tolerance: 1.875e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.134e-01, tolerance: 1.895e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
```

```
check the scale of the features or consider increasing regularisation. Duality
gap: 4.645e-01, tolerance: 1.936e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.365e-01, tolerance: 1.867e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.731e-01, tolerance: 1.910e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.285e-01, tolerance: 1.906e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.322e-02, tolerance: 1.927e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.944e-01, tolerance: 1.875e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.746e-04, tolerance: 1.906e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.568e-01, tolerance: 1.903e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
```

```
check the scale of the features or consider increasing regularisation. Duality
gap: 6.362e-02, tolerance: 1.867e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.447e-03, tolerance: 1.938e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.694e-02, tolerance: 1.875e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.568e-01, tolerance: 1.875e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.641e-02, tolerance: 1.936e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.731e-01, tolerance: 1.910e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.069e-03, tolerance: 1.903e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.069e-03, tolerance: 1.903e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
```

```
check the scale of the features or consider increasing regularisation. Duality
gap: 7.387e-02, tolerance: 1.895e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.568e-01, tolerance: 1.875e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.525e-01, tolerance: 1.938e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.396e-02, tolerance: 1.910e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.881e-03, tolerance: 1.875e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.322e-02, tolerance: 1.927e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.694e-02, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.362e-02, tolerance: 1.867e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
```

```
check the scale of the features or consider increasing regularisation. Duality
gap: 6.286e-01, tolerance: 1.927e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.746e-04, tolerance: 1.906e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.134e-01, tolerance: 1.895e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.447e-03, tolerance: 1.938e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.322e-02, tolerance: 1.927e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.447e-03, tolerance: 1.938e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.645e-01, tolerance: 1.936e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.396e-02, tolerance: 1.910e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
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check the scale of the features or consider increasing regularisation. Duality
gap: 6.362e-02, tolerance: 1.867e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.069e-03, tolerance: 1.903e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.387e-02, tolerance: 1.895e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.641e-02, tolerance: 1.936e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.387e-02, tolerance: 1.895e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.641e-02, tolerance: 1.936e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.881e-03, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.362e-02, tolerance: 1.867e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
```

```
check the scale of the features or consider increasing regularisation. Duality
gap: 5.396e-02, tolerance: 1.910e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.694e-02, tolerance: 1.875e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.396e-02, tolerance: 1.910e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.881e-03, tolerance: 1.875e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.322e-02, tolerance: 1.927e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.387e-02, tolerance: 1.895e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.641e-02, tolerance: 1.936e-02
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.255e-05, tolerance: 1.906e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
```

```
check the scale of the features or consider increasing regularisation. Duality
gap: 2.188e-03, tolerance: 1.903e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.351e-04, tolerance: 1.875e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.407e-04, tolerance: 1.867e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.189e-04, tolerance: 1.875e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.835e-04, tolerance: 1.927e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.838e-03, tolerance: 1.938e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.646e-05, tolerance: 1.936e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.351e-04, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
```

```
check the scale of the features or consider increasing regularisation. Duality
gap: 8.189e-04, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.188e-03, tolerance: 1.903e-03
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.838e-03, tolerance: 1.938e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.188e-03, tolerance: 1.903e-04
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.351e-04, tolerance: 2.115e-05
  model = cd_fast.enet_coordinate_descent(
```

```
Best Parameters: {'alpha': 0.001, 'max_iter': 100, 'tol': 1e-06}

Optimizing Ridge
Original Parameters: {'alpha': 1.0, 'max_iter': None, 'tol': 0.0001, 'solver':
'auto'}
```

```
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:350: ConvergenceWarning: The max_iter was
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```
Best Parameters: {'alpha': 1, 'max_iter': 500, 'solver': 'sag', 'tol': 0.05}

Optimizing Random Forest
Original Parameters: {'n_estimators': 100, 'max_depth': None,
'min_samples_split': 2, 'min_samples_leaf': 1}
Best Parameters: {'max_depth': 20, 'min_samples_leaf': 2, 'min_samples_split':
3, 'n_estimators': 40}

Optimizing XGBoost
Original Parameters: {'n_estimators': None, 'learning_rate': None, 'max_depth':
None, 'subsample': None, 'colsample_bytree': None, 'gamma': None}
Best Parameters: {'colsample_bytree': 1.0, 'gamma': 0, 'learning_rate': 0.05,
'max_depth': 4, 'n_estimators': 150, 'subsample': 0.6}
```

[302]:
```python
trained_regression_models_merge_v2 = 
 ↪train_regression_models(best_regression_models_merge_v2, X_merge_v1, 
 ↪y_merge_v1, reg_kf_v3, MERGE_LOGS_V2)
```

```
Training Lasso

Mean Squared Error: 0.0101
Mean Absolute Error: 0.0788
R² Score: 0.7026

Training Ridge
```

```
Mean Squared Error: 0.0105
Mean Absolute Error: 0.0799
R² Score: 0.6894

Training Random Forest


/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.351e-04, tolerance: 2.115e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.255e-05, tolerance: 1.906e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.188e-03, tolerance: 1.903e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.407e-04, tolerance: 1.867e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.835e-04, tolerance: 1.927e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.646e-05, tolerance: 1.936e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.351e-04, tolerance: 1.875e-05
```

```
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.189e-04, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.838e-03, tolerance: 1.938e-05
  model = cd_fast.enet_coordinate_descent(

Mean Squared Error: 0.0100
Mean Absolute Error: 0.0806
R² Score: 0.7040

Training XGBoost

Mean Squared Error: 0.0091
Mean Absolute Error: 0.0751
R² Score: 0.7325
```

[305]:
```
MERGE_MODEL_V2_SEARCH = {
    'lr': tune.grid_search([1e-1, 5e-2, 1e-2, 5e-3, 1e-3]),
    'hidden_size': tune.grid_search([int(1e2), int(5e2), int(1e3), int(5e3)]),
    'batch_size': tune.grid_search([16, 32, 64]),
    'num_epochs': 200,
    'early_stop': 10,
    'log_dir': MERGE_LOGS_V2,
    'model_path': MERGE_MODELPATH_V2
}
```

[306]:
```
tune_regression_nn(
    MERGE_MODEL_V2_SEARCH,
    X_merge_v1,
    y_merge_v1
)
```

```
2024-06-29 16:50:16,795 INFO tune.py:616 -- [output] This uses the legacy output
and progress reporter, as Jupyter notebooks are not supported by the new engine,
yet. For more information, please see https://github.com/ray-
project/ray/issues/36949

== Status ==
Current time: 2024-06-29 16:50:17 (running for 00:00:00.54)
Using AsyncHyperBand: num_stopped=0
```

```
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: None
Logical resource usage: 0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (60 PENDING)


== Status ==
Current time: 2024-06-29 16:50:22 (running for 00:00:05.64)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: None
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (50 PENDING, 10 RUNNING)



<IPython.core.display.HTML object>

== Status ==
Current time: 2024-06-29 16:50:27 (running for 00:00:10.69)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.03729347139596939
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (50 PENDING, 6 RUNNING, 4 TERMINATED)


== Status ==
Current time: 2024-06-29 16:50:32 (running for 00:00:15.70)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.03729347139596939
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (48 PENDING, 4 RUNNING, 8 TERMINATED)


== Status ==
Current time: 2024-06-29 16:50:37 (running for 00:00:20.70)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.03729347139596939
```

```
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (42 PENDING, 9 RUNNING, 9 TERMINATED)


== Status ==
Current time: 2024-06-29 16:50:42 (running for 00:00:25.72)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.04224017138282458
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (39 PENDING, 7 RUNNING, 14 TERMINATED)


== Status ==
Current time: 2024-06-29 16:50:47 (running for 00:00:30.81)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.038758158683776855 | Iter 25.000: 0.04224017138282458
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (36 PENDING, 6 RUNNING, 18 TERMINATED)


== Status ==
Current time: 2024-06-29 16:50:52 (running for 00:00:35.85)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.038758158683776855 | Iter 25.000: 0.04224017138282458
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (32 PENDING, 8 RUNNING, 20 TERMINATED)


== Status ==
Current time: 2024-06-29 16:50:57 (running for 00:00:40.86)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.038758158683776855 | Iter 25.000: 0.04718687136967977
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (30 PENDING, 7 RUNNING, 23 TERMINATED)
```

```
== Status ==
Current time: 2024-06-29 16:51:02 (running for 00:00:45.96)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.038758158683776855 | Iter 25.000: 0.05213357135653496
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (27 PENDING, 8 RUNNING, 25 TERMINATED)


== Status ==
Current time: 2024-06-29 16:51:07 (running for 00:00:51.05)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04292271907130877 | Iter 25.000: 0.053074318915605545
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (25 PENDING, 9 RUNNING, 26 TERMINATED)


== Status ==
Current time: 2024-06-29 16:51:12 (running for 00:00:56.14)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04708727945884069 | Iter 25.000: 0.054304997281481825
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (24 PENDING, 8 RUNNING, 28 TERMINATED)


== Status ==
Current time: 2024-06-29 16:51:17 (running for 00:01:01.15)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: 0.051533810794353485 | Iter 37.500:
0.051251839846372604 | Iter 25.000: 0.054304997281481825
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (22 PENDING, 8 RUNNING, 30 TERMINATED)


== Status ==
Current time: 2024-06-29 16:51:23 (running for 00:01:06.20)
```

```
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: 0.051533810794353485 | Iter 37.500:
0.051251839846372604 | Iter 25.000: 0.054304997281481825
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (20 PENDING, 7 RUNNING, 33 TERMINATED)


== Status ==
Current time: 2024-06-29 16:51:28 (running for 00:01:11.26)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: 0.051533810794353485 | Iter 37.500:
0.051251839846372604 | Iter 25.000: 0.05582560645416379
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (17 PENDING, 9 RUNNING, 34 TERMINATED)


== Status ==
Current time: 2024-06-29 16:51:33 (running for 00:01:16.27)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: 0.051533810794353485 | Iter 37.500:
0.04955106934842964 | Iter 25.000: 0.05582560645416379
Logical resource usage: 5.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (15 PENDING, 3 RUNNING, 42 TERMINATED)


== Status ==
Current time: 2024-06-29 16:51:38 (running for 00:01:21.27)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: 0.051533810794353485 | Iter 37.500:
0.04955106934842964 | Iter 25.000: 0.05582560645416379
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (8 PENDING, 7 RUNNING, 45 TERMINATED)


== Status ==
Current time: 2024-06-29 16:51:43 (running for 00:01:26.29)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: 0.051533810794353485 | Iter 37.500:
0.04955106934842964 | Iter 25.000: 0.0570990436244756
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
```

```
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (5 PENDING, 10 RUNNING, 45 TERMINATED)


== Status ==
Current time: 2024-06-29 16:51:48 (running for 00:01:31.32)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: 0.051533810794353485 | Iter 37.500:
0.051251839846372604 | Iter 25.000: 0.05670665390789509
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (5 PENDING, 6 RUNNING, 49 TERMINATED)


== Status ==
Current time: 2024-06-29 16:51:53 (running for 00:01:36.34)
Using AsyncHyperBand: num_stopped=2
Bracket: Iter 84.375: None | Iter 56.250: 0.051533810794353485 | Iter 37.500:
0.05238541277746359 | Iter 25.000: 0.0576864085936298
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (1 PENDING, 7 RUNNING, 52 TERMINATED)


== Status ==
Current time: 2024-06-29 16:51:58 (running for 00:01:41.42)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: 0.05380032894512018 | Iter 37.500:
0.05238541277746359 | Iter 25.000: 0.05641297142331799
Logical resource usage: 3.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (3 RUNNING, 57 TERMINATED)


== Status ==
Current time: 2024-06-29 16:52:03 (running for 00:01:46.45)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: 0.05380032894512018 | Iter 37.500:
0.05238541277746359 | Iter 25.000: 0.05641297142331799
Logical resource usage: 2.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (2 RUNNING, 58 TERMINATED)
```

```
== Status ==
Current time: 2024-06-29 16:52:08 (running for 00:01:51.50)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: 0.05380032894512018 | Iter 37.500:
0.05238541277746359 | Iter 25.000: 0.05641297142331799
Logical resource usage: 1.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (1 RUNNING, 59 TERMINATED)



2024-06-29 16:52:09,149 INFO tune.py:1009 -- Wrote the latest version of all
result files and experiment state to
'/Users/tyler/ray_results/train_regression_nn_2024-06-29_16-50-16' in 0.0430s.
2024-06-29 16:52:09,158 INFO tune.py:1041 -- Total run time: 112.36 seconds
(112.30 seconds for the tuning loop).

== Status ==
Current time: 2024-06-29 16:52:09 (running for 00:01:52.34)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: 0.05380032894512018 | Iter 37.500:
0.05238541277746359 | Iter 25.000: 0.05641297142331799
Logical resource usage: 1.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_16-50-16/train_regression_nn_2024-06-29_16-50-16/driver_artifacts
Number of trials: 60/60 (60 TERMINATED)
+---------------------------------+------------+-----------------+-------+------
---------+-------------+-------------+------------+-----------+-----------+
| Trial name                      | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |       loss |       mse |   val_mse |
|---------------------------------+------------+-----------------+-------+------
---------+-------------+-------------+------------+-----------+-----------|
| train_regression_nn_926c0_00000 | TERMINATED | 127.0.0.1:64642 | 0.1   |
100 |           16 |          200 | 0.0160591  | 0.0547033 | 0.0545151 |
| train_regression_nn_926c0_00001 | TERMINATED | 127.0.0.1:64643 | 0.1   |
100 |           32 |          200 | 0.0239815  | 0.0431357 | 0.0507037 |
| train_regression_nn_926c0_00002 | TERMINATED | 127.0.0.1:64644 | 0.1   |
100 |           64 |          200 | 0.018094   | 0.0474175 | 0.0475477 |
| train_regression_nn_926c0_00003 | TERMINATED | 127.0.0.1:64645 | 0.1   |
500 |           16 |          200 | 0.0300297  | 0.036817  | 0.381484  |
| train_regression_nn_926c0_00004 | TERMINATED | 127.0.0.1:64646 | 0.1   |
500 |           32 |          200 | 0.0333625  | 0.0353384 | 0.0377637 |
| train_regression_nn_926c0_00005 | TERMINATED | 127.0.0.1:64647 | 0.1   |
500 |           64 |          200 | 0.0322798  | 0.0351928 | 0.0343491 |
| train_regression_nn_926c0_00006 | TERMINATED | 127.0.0.1:64649 | 0.1   |
1000 |           16 |          200 | 0.0329847  | 0.0354205 | 0.67697   |
| train_regression_nn_926c0_00007 | TERMINATED | 127.0.0.1:64650 | 0.1   |
```

```
1000 |           32 |          200 | 0.0332882  | 0.0345899 | 0.0337564 |
| train_regression_nn_926c0_00008 | TERMINATED | 127.0.0.1:64652 | 0.1   |
1000 |           64 |          200 | 0.0324982  | 0.036462  | 0.0370821 |
| train_regression_nn_926c0_00009 | TERMINATED | 127.0.0.1:64653 | 0.1   |
5000 |           16 |          200 | 0.0336942  | 0.035189  | 1.22584   |
| train_regression_nn_926c0_00010 | TERMINATED | 127.0.0.1:64794 | 0.1   |
5000 |           32 |          200 | 0.0352454  | 0.0421436 | 3.97655   |
| train_regression_nn_926c0_00011 | TERMINATED | 127.0.0.1:64806 | 0.1   |
5000 |           64 |          200 | 0.0351592  | 0.0388087 | 0.0410136 |
| train_regression_nn_926c0_00012 | TERMINATED | 127.0.0.1:64838 | 0.05  |
100 |           16 |          200 | 0.0161379  | 0.0591479 | 0.0578363 |
| train_regression_nn_926c0_00013 | TERMINATED | 127.0.0.1:64840 | 0.05  |
100 |           32 |          200 | 0.012508   | 0.0608314 | 0.0533799 |
| train_regression_nn_926c0_00014 | TERMINATED | 127.0.0.1:64858 | 0.05  |
100 |           64 |          200 | 0.0124569  | 0.0583444 | 0.0499835 |
| train_regression_nn_926c0_00015 | TERMINATED | 127.0.0.1:64859 | 0.05  |
500 |           16 |          200 | 0.0145793  | 0.0567863 | 0.0470883 |
| train_regression_nn_926c0_00016 | TERMINATED | 127.0.0.1:64875 | 0.05  |
500 |           32 |          200 | 0.0136793  | 0.0582654 | 0.0486771 |
| train_regression_nn_926c0_00017 | TERMINATED | 127.0.0.1:64892 | 0.05  |
500 |           64 |          200 | 0.0138216  | 0.0532833 | 0.0495539 |
| train_regression_nn_926c0_00018 | TERMINATED | 127.0.0.1:64923 | 0.05  |
1000 |           16 |          200 | 0.0134542  | 0.0562593 | 0.0461194 |
| train_regression_nn_926c0_00019 | TERMINATED | 127.0.0.1:64942 | 0.05  |
1000 |           32 |          200 | 0.0164418  | 0.0573669 | 0.0502496 |
| train_regression_nn_926c0_00020 | TERMINATED | 127.0.0.1:64944 | 0.05  |
1000 |           64 |          200 | 0.0167525  | 0.0537854 | 0.0529556 |
| train_regression_nn_926c0_00021 | TERMINATED | 127.0.0.1:64985 | 0.05  |
5000 |           16 |          200 | 0.0184917  | 0.0511932 | 0.0461495 |
| train_regression_nn_926c0_00022 | TERMINATED | 127.0.0.1:65021 | 0.05  |
5000 |           32 |          200 | 0.0173752  | 0.0510949 | 0.0685409 |
| train_regression_nn_926c0_00023 | TERMINATED | 127.0.0.1:65022 | 0.05  |
5000 |           64 |          200 | 0.0169192  | 0.0541863 | 0.0515338 |
| train_regression_nn_926c0_00024 | TERMINATED | 127.0.0.1:65045 | 0.01  |
100 |           16 |          200 | 0.00869927 | 0.0618844 | 0.0510711 |
| train_regression_nn_926c0_00025 | TERMINATED | 127.0.0.1:65046 | 0.01  |
100 |           32 |          200 | 0.0112665  | 0.0658093 | 0.0564246 |
| train_regression_nn_926c0_00026 | TERMINATED | 127.0.0.1:65066 | 0.01  |
100 |           64 |          200 | 0.00672431 | 0.0693241 | 0.0712778 |
| train_regression_nn_926c0_00027 | TERMINATED | 127.0.0.1:65081 | 0.01  |
500 |           16 |          200 | 0.018042   | 0.0709777 | 0.0543418 |
| train_regression_nn_926c0_00028 | TERMINATED | 127.0.0.1:65116 | 0.01  |
500 |           32 |          200 | 0.0181705  | 0.0730254 | 0.0581671 |
| train_regression_nn_926c0_00029 | TERMINATED | 127.0.0.1:65134 | 0.01  |
500 |           64 |          200 | 0.00918354 | 0.0673732 | 0.0552276 |
| train_regression_nn_926c0_00030 | TERMINATED | 127.0.0.1:65197 | 0.01  |
1000 |           16 |          200 | 0.068605   | 0.112106  | 0.0804798 |
| train_regression_nn_926c0_00031 | TERMINATED | 127.0.0.1:65222 | 0.01  |
```

```
1000 |           32 |          200 | 0.0167167  | 0.0721606 | 0.0545965 |
| train_regression_nn_926c0_00032 | TERMINATED | 127.0.0.1:65228 | 0.01  |
1000 |           64 |          200 | 0.0166145  | 0.0684153 | 0.0692381 |
| train_regression_nn_926c0_00033 | TERMINATED | 127.0.0.1:65285 | 0.01  |
5000 |           16 |          200 | 0.0297426  | 0.0832563 | 0.079177  |
| train_regression_nn_926c0_00034 | TERMINATED | 127.0.0.1:65287 | 0.01  |
5000 |           32 |          200 | 0.0181093  | 0.0626788 | 0.0536552 |
| train_regression_nn_926c0_00035 | TERMINATED | 127.0.0.1:65367 | 0.01  |
5000 |           64 |          200 | 0.0130477  | 0.0670905 | 0.0618651 |
| train_regression_nn_926c0_00036 | TERMINATED | 127.0.0.1:65418 | 0.005 |
100 |           16 |          200 | 0.0143556  | 0.066218  | 0.0607511 |
| train_regression_nn_926c0_00037 | TERMINATED | 127.0.0.1:65430 | 0.005 |
100 |           32 |          200 | 0.00824823 | 0.0653817 | 0.0635738 |
| train_regression_nn_926c0_00038 | TERMINATED | 127.0.0.1:65457 | 0.005 |
100 |           64 |          200 | 0.00571424 | 0.064965  | 0.0618437 |
| train_regression_nn_926c0_00039 | TERMINATED | 127.0.0.1:65469 | 0.005 |
500 |           16 |          200 | 0.0224084  | 0.0702857 | 0.0782387 |
| train_regression_nn_926c0_00040 | TERMINATED | 127.0.0.1:65506 | 0.005 |
500 |           32 |          200 | 0.012669   | 0.0692142 | 0.0554251 |
| train_regression_nn_926c0_00041 | TERMINATED | 127.0.0.1:65519 | 0.005 |
500 |           64 |          200 | 0.00803943 | 0.0701995 | 0.0579062 |
| train_regression_nn_926c0_00042 | TERMINATED | 127.0.0.1:65523 | 0.005 |
1000 |           16 |          200 | 0.0525662  | 0.101994  | 0.0838281 |
| train_regression_nn_926c0_00043 | TERMINATED | 127.0.0.1:65563 | 0.005 |
1000 |           32 |          200 | 0.0241996  | 0.0789236 | 0.101283  |
| train_regression_nn_926c0_00044 | TERMINATED | 127.0.0.1:65611 | 0.005 |
1000 |           64 |          200 | 0.00941062 | 0.0653414 | 0.0569706 |
| train_regression_nn_926c0_00045 | TERMINATED | 127.0.0.1:65624 | 0.005 |
5000 |           16 |          200 | 0.0446668  | 0.0979724 | 0.0749009 |
| train_regression_nn_926c0_00046 | TERMINATED | 127.0.0.1:65625 | 0.005 |
5000 |           32 |          200 | 0.0226527  | 0.0760786 | 0.093341  |
| train_regression_nn_926c0_00047 | TERMINATED | 127.0.0.1:65638 | 0.005 |
5000 |           64 |          200 | 0.015735   | 0.0684687 | 0.0723924 |
| train_regression_nn_926c0_00048 | TERMINATED | 127.0.0.1:65639 | 0.001 |
100 |           16 |          200 | 0.0149413  | 0.067345  | 0.0556362 |
| train_regression_nn_926c0_00049 | TERMINATED | 127.0.0.1:65640 | 0.001 |
100 |           32 |          200 | 0.00911641 | 0.0689656 | 0.0567067 |
| train_regression_nn_926c0_00050 | TERMINATED | 127.0.0.1:65641 | 0.001 |
100 |           64 |          200 | 0.00293304 | 0.0682637 | 0.0600189 |
| train_regression_nn_926c0_00051 | TERMINATED | 127.0.0.1:65642 | 0.001 |
500 |           16 |          200 | 0.00983991 | 0.0634923 | 0.0551158 |
| train_regression_nn_926c0_00052 | TERMINATED | 127.0.0.1:65670 | 0.001 |
500 |           32 |          200 | 0.00617166 | 0.0663483 | 0.060547  |
| train_regression_nn_926c0_00053 | TERMINATED | 127.0.0.1:65684 | 0.001 |
500 |           64 |          200 | 0.00339571 | 0.0682208 | 0.0607327 |
| train_regression_nn_926c0_00054 | TERMINATED | 127.0.0.1:65685 | 0.001 |
1000 |           16 |          200 | 0.0115395  | 0.0684792 | 0.0637268 |
| train_regression_nn_926c0_00055 | TERMINATED | 127.0.0.1:65784 | 0.001 |
```

```
1000 |           32 |          200 | 0.00891402 | 0.0670784 | 0.065684  |
| train_regression_nn_926c0_00056 | TERMINATED | 127.0.0.1:65785 | 0.001 |
1000 |           64 |          200 | 0.00665981 | 0.0654708 | 0.0564573 |
| train_regression_nn_926c0_00057 | TERMINATED | 127.0.0.1:65786 | 0.001 |
5000 |           16 |          200 | 0.023152   | 0.0772101 | 0.0743486 |
| train_regression_nn_926c0_00058 | TERMINATED | 127.0.0.1:65799 | 0.001 |
5000 |           32 |          200 | 0.00880943 | 0.0665889 | 0.058348  |
| train_regression_nn_926c0_00059 | TERMINATED | 127.0.0.1:65824 | 0.001 |
5000 |           64 |          200 | 0.00957717 | 0.0644542 | 0.0600244 |
+---------------------------------+------------+-----------------+-------+------
---------+-------------+-------------+------------+-----------+-----------+
```

```
Best Hyperparameters Found:  {'lr': 0.1, 'hidden_size': 1000, 'batch_size': 32,
'num_epochs': 200, 'early_stop': 10, 'log_dir': '/Users/tyler/GitHub
Repositories/Apple Watch FitBit Project/Wearables-Activity-
Classification/logs/whoop-recovery-reg/v2/merge', 'model_path':
'/Users/tyler/GitHub Repositories/Apple Watch FitBit Project/Wearables-Activity-
Classification/models/whoop-recovery-reg/v2/merge', 'tune': True}
Best Validation MSE:  0.03375638648867607
Best Number Epochs:  18
Best Model Path:  /Users/tyler/GitHub Repositories/Apple Watch FitBit
Project/Wearables-Activity-Classification/models/whoop-recovery-
reg/v2/merge/h1000_b32_lr0.1.th
```

v3 Training Using v3 features (most important features from best v2 models) to optimize a new set of v3 models with GridSearch hyperparameter tuning

[314]:
```
MERGE_LOGS_V3 = os.path.join(os.getcwd(), 'logs/whoop-recovery-reg/v3/merge')
MERGE_MODELPATH_V3 = os.path.join(os.getcwd(), 'models/whoop-recovery-reg/v3/
↪merge')
```

[315]:
```
best_regression_models_merge_v3 =␣
↪grid_search_regression_models(regression_models_v3, reg_param_grids_v3,␣
↪X_merge_v3, y_merge_v3, reg_kf_v3)
```

```
Optimizing Lasso
Original Parameters: {'alpha': 1.0, 'max_iter': 1000, 'tol': 0.0001}

/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 9.016e-05, tolerance: 1.910e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
```

```
gap: 6.088e-05, tolerance: 1.936e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.066e-05, tolerance: 1.906e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.029e-04, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.519e-05, tolerance: 1.927e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.648e-05, tolerance: 1.903e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.349e-05, tolerance: 1.875e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.331e-04, tolerance: 1.938e-05
  model = cd_fast.enet_coordinate_descent(
/Users/tyler/miniconda3/envs/ds310/lib/python3.10/site-
packages/sklearn/linear_model/_coordinate_descent.py:628: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.025e-04, tolerance: 1.895e-05
  model = cd_fast.enet_coordinate_descent(

Best Parameters: {'alpha': 0.0001, 'max_iter': 500, 'tol': 1e-05}

Optimizing Ridge
```

```
Original Parameters: {'alpha': 1.0, 'max_iter': None, 'tol': 0.0001, 'solver':
'auto'}
Best Parameters: {'alpha': 0.1, 'max_iter': 1000, 'solver': 'sag', 'tol': 0.05}

Optimizing Random Forest
Original Parameters: {'n_estimators': 100, 'max_depth': None,
'min_samples_split': 2, 'min_samples_leaf': 1}
Best Parameters: {'max_depth': None, 'min_samples_leaf': 2, 'min_samples_split':
2, 'n_estimators': 30}

Optimizing XGBoost
Original Parameters: {'n_estimators': None, 'learning_rate': None, 'max_depth':
None, 'subsample': None, 'colsample_bytree': None, 'gamma': None}
Best Parameters: {'colsample_bytree': 0.8, 'gamma': 0, 'learning_rate': 0.1,
'max_depth': 2, 'n_estimators': 150, 'subsample': 0.8}
```

[316]:
```
trained_regression_models_merge_v3 =␣
↪train_regression_models(best_regression_models_merge_v3, X_merge_v3,␣
↪y_merge_v3, reg_kf_v3, MERGE_LOGS_V3)
```

```
Training Lasso

Mean Squared Error: 0.0099
Mean Absolute Error: 0.0774
R² Score: 0.7082

Training Ridge

Mean Squared Error: 0.0100
Mean Absolute Error: 0.0773
R² Score: 0.7050

Training Random Forest

Mean Squared Error: 0.0100
Mean Absolute Error: 0.0799
R² Score: 0.7044

Training XGBoost

Mean Squared Error: 0.0088
Mean Absolute Error: 0.0736
R² Score: 0.7385
```

[317]:
```
MERGE_MODEL_V3_SEARCH = {
    'lr': tune.grid_search([1e-1, 5e-2, 1e-2, 5e-3, 1e-3]),
```

```
    'hidden_size': tune.grid_search([int(1e2), int(5e2), int(1e3), int(5e3)]),
    'batch_size': tune.grid_search([16, 32, 64]),
    'num_epochs': 200,
    'early_stop': 10,
    'log_dir': MERGE_LOGS_V3,
    'model_path': MERGE_MODELPATH_V3
}
```

[318]:
```
tune_regression_nn(
    MERGE_MODEL_V3_SEARCH,
    X_merge_v3,
    y_merge_v3
)
```

```
2024-06-29 17:12:17,759 INFO tune.py:616 -- [output] This uses the legacy output
and progress reporter, as Jupyter notebooks are not supported by the new engine,
yet. For more information, please see https://github.com/ray-
project/ray/issues/36949

== Status ==
Current time: 2024-06-29 17:12:18 (running for 00:00:00.34)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: None
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (60 PENDING)


== Status ==
Current time: 2024-06-29 17:12:23 (running for 00:00:05.39)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: None
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (50 PENDING, 10 RUNNING)


<IPython.core.display.HTML object>

== Status ==
Current time: 2024-06-29 17:12:28 (running for 00:00:10.41)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500: None | Iter
25.000: 0.05223072941104571
```

```
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (50 PENDING, 6 RUNNING, 4 TERMINATED)


== Status ==
Current time: 2024-06-29 17:12:33 (running for 00:00:15.46)
Using AsyncHyperBand: num_stopped=0
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.05919748544692993 | Iter 25.000: 0.0574006624519825
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (45 PENDING, 9 RUNNING, 6 TERMINATED)


== Status ==
Current time: 2024-06-29 17:12:38 (running for 00:00:20.52)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.059859064097205796 | Iter 25.000: 0.05729852057993412
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (43 PENDING, 8 RUNNING, 9 TERMINATED)


== Status ==
Current time: 2024-06-29 17:12:43 (running for 00:00:25.53)
Using AsyncHyperBand: num_stopped=1
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.059859064097205796 | Iter 25.000: 0.060088301077485085
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (39 PENDING, 9 RUNNING, 12 TERMINATED)


== Status ==
Current time: 2024-06-29 17:12:48 (running for 00:00:30.62)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.05295689714451631 | Iter 25.000: 0.05729852057993412
Logical resource usage: 8.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (38 PENDING, 4 RUNNING, 18 TERMINATED)
```

```
== Status ==
Current time: 2024-06-29 17:12:53 (running for 00:00:35.72)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.05295689714451631 | Iter 25.000: 0.05768355540931225
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (34 PENDING, 6 RUNNING, 20 TERMINATED)


== Status ==
Current time: 2024-06-29 17:12:58 (running for 00:00:40.78)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.05295689714451631 | Iter 25.000: 0.05768355540931225
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (30 PENDING, 9 RUNNING, 21 TERMINATED)


== Status ==
Current time: 2024-06-29 17:13:03 (running for 00:00:45.83)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.05295689714451631 | Iter 25.000: 0.059270963072776794
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (29 PENDING, 8 RUNNING, 23 TERMINATED)


== Status ==
Current time: 2024-06-29 17:13:08 (running for 00:00:50.90)
Using AsyncHyperBand: num_stopped=3
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.05295689714451631 | Iter 25.000: 0.06047333590686321
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (25 PENDING, 9 RUNNING, 26 TERMINATED)


== Status ==
Current time: 2024-06-29 17:13:13 (running for 00:00:55.96)
```

```
Using AsyncHyperBand: num_stopped=5
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04689461924135685 | Iter 25.000: 0.05768355540931225
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (24 PENDING, 8 RUNNING, 28 TERMINATED)


== Status ==
Current time: 2024-06-29 17:13:18 (running for 00:01:01.20)
Using AsyncHyperBand: num_stopped=6
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04689461924135685 | Iter 25.000: 0.0560961477458477
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (24 PENDING, 5 RUNNING, 31 TERMINATED)


== Status ==
Current time: 2024-06-29 17:13:24 (running for 00:01:06.27)
Using AsyncHyperBand: num_stopped=6
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04689461924135685 | Iter 25.000: 0.05768355540931225
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (23 PENDING, 6 RUNNING, 31 TERMINATED)


== Status ==
Current time: 2024-06-29 17:13:29 (running for 00:01:11.35)
Using AsyncHyperBand: num_stopped=6
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04689461924135685 | Iter 25.000: 0.059270963072776794
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (19 PENDING, 9 RUNNING, 32 TERMINATED)


== Status ==
Current time: 2024-06-29 17:13:34 (running for 00:01:16.39)
Using AsyncHyperBand: num_stopped=7
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04689461924135685 | Iter 25.000: 0.058670218413074814
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
```

```
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (18 PENDING, 6 RUNNING, 36 TERMINATED)


== Status ==
Current time: 2024-06-29 17:13:39 (running for 00:01:21.40)
Using AsyncHyperBand: num_stopped=7
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.04689461924135685 | Iter 25.000: 0.058670218413074814
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (17 PENDING, 6 RUNNING, 37 TERMINATED)


== Status ==
Current time: 2024-06-29 17:13:44 (running for 00:01:26.51)
Using AsyncHyperBand: num_stopped=7
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.050995574643214546 | Iter 25.000: 0.058670218413074814
Logical resource usage: 10.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (12 PENDING, 9 RUNNING, 39 TERMINATED)


== Status ==
Current time: 2024-06-29 17:13:49 (running for 00:01:31.57)
Using AsyncHyperBand: num_stopped=8
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.050995574643214546 | Iter 25.000: 0.057468729093670845
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (10 PENDING, 6 RUNNING, 44 TERMINATED)


== Status ==
Current time: 2024-06-29 17:13:54 (running for 00:01:36.59)
Using AsyncHyperBand: num_stopped=8
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.050995574643214546 | Iter 25.000: 0.057468729093670845
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (6 PENDING, 9 RUNNING, 45 TERMINATED)
```

```
== Status ==
Current time: 2024-06-29 17:13:59 (running for 00:01:41.66)
Using AsyncHyperBand: num_stopped=10
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.050995574643214546 | Iter 25.000: 0.05490003898739815
Logical resource usage: 9.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (4 PENDING, 7 RUNNING, 49 TERMINATED)


== Status ==
Current time: 2024-06-29 17:14:04 (running for 00:01:46.74)
Using AsyncHyperBand: num_stopped=11
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.050995574643214546 | Iter 25.000: 0.05490003898739815
Logical resource usage: 7.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (1 PENDING, 6 RUNNING, 53 TERMINATED)


== Status ==
Current time: 2024-06-29 17:14:09 (running for 00:01:51.82)
Using AsyncHyperBand: num_stopped=12
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.050995574643214546 | Iter 25.000: 0.05463917305072149
Logical resource usage: 3.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (3 RUNNING, 57 TERMINATED)


== Status ==
Current time: 2024-06-29 17:14:14 (running for 00:01:56.87)
Using AsyncHyperBand: num_stopped=12
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.050995574643214546 | Iter 25.000: 0.054769606019059815
Logical resource usage: 3.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (3 RUNNING, 57 TERMINATED)


== Status ==
Current time: 2024-06-29 17:14:19 (running for 00:02:01.94)
Using AsyncHyperBand: num_stopped=12
```

```
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.050995574643214546 | Iter 25.000: 0.054900038987398155
Logical resource usage: 1.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (1 RUNNING, 59 TERMINATED)



2024-06-29 17:14:19,918 INFO tune.py:1009 -- Wrote the latest version of all
result files and experiment state to
'/Users/tyler/ray_results/train_regression_nn_2024-06-29_17-12-17' in 0.0281s.
2024-06-29 17:14:19,926 INFO tune.py:1041 -- Total run time: 122.17 seconds
(122.12 seconds for the tuning loop).

== Status ==
Current time: 2024-06-29 17:14:19 (running for 00:02:02.14)
Using AsyncHyperBand: num_stopped=12
Bracket: Iter 84.375: None | Iter 56.250: None | Iter 37.500:
0.050995574643214546 | Iter 25.000: 0.054900038987398155
Logical resource usage: 1.0/10 CPUs, 0/0 GPUs
Result logdir: /tmp/ray/session_2024-06-26_13-37-32_661431_63198/artifacts/2024-
06-29_17-12-17/train_regression_nn_2024-06-29_17-12-17/driver_artifacts
Number of trials: 60/60 (60 TERMINATED)
+---------------------------------+------------+-----------------+-------+------
---------+-------------+-------------+------------+-----------+-----------+
| Trial name                      | status     | loc             |    lr |
hidden_size |   batch_size |   num_epochs |       loss |       mse |   val_mse |
|---------------------------------+------------+-----------------+-------+------
---------+-------------+-------------+------------+-----------+-----------|
| train_regression_nn_a5c7a_00000 | TERMINATED | 127.0.0.1:77301 | 0.1   |
100 |           16 |          200 | 0.0113746  | 0.0594848 | 0.0855351 |
| train_regression_nn_a5c7a_00001 | TERMINATED | 127.0.0.1:77302 | 0.1   |
100 |           32 |          200 | 0.0161785  | 0.0554679 | 0.0446101 |
| train_regression_nn_a5c7a_00002 | TERMINATED | 127.0.0.1:77303 | 0.1   |
100 |           64 |          200 | 0.0185166  | 0.0483685 | 0.050463  |
| train_regression_nn_a5c7a_00003 | TERMINATED | 127.0.0.1:77304 | 0.1   |
500 |           16 |          200 | 0.0301148  | 0.0372107 | 0.0592899 |
| train_regression_nn_a5c7a_00004 | TERMINATED | 127.0.0.1:77305 | 0.1   |
500 |           32 |          200 | 0.0288844  | 0.0372562 | 0.0472121 |
| train_regression_nn_a5c7a_00005 | TERMINATED | 127.0.0.1:77306 | 0.1   |
500 |           64 |          200 | 0.0306563  | 0.0370822 | 0.0576986 |
| train_regression_nn_a5c7a_00006 | TERMINATED | 127.0.0.1:77307 | 0.1   |
1000 |           16 |          200 | 0.017112   | 0.0581485 | 0.0545087 |
| train_regression_nn_a5c7a_00007 | TERMINATED | 127.0.0.1:77308 | 0.1   |
1000 |           32 |          200 | 0.0148133  | 0.0579104 | 0.0611822 |
| train_regression_nn_a5c7a_00008 | TERMINATED | 127.0.0.1:77309 | 0.1   |
1000 |           64 |          200 | 0.0258717  | 0.0432899 | 0.0472095 |
| train_regression_nn_a5c7a_00009 | TERMINATED | 127.0.0.1:77310 | 0.1   |
```

```
5000 |           16 |          200 | 0.0304389  | 0.0398499 | 0.72773   |
| train_regression_nn_a5c7a_00010 | TERMINATED | 127.0.0.1:77413 | 0.1   |
5000 |           32 |          200 | 0.0344151  | 0.0365696 | 0.198234  |
| train_regression_nn_a5c7a_00011 | TERMINATED | 127.0.0.1:77414 | 0.1   |
5000 |           64 |          200 | 0.0421175  | 0.0455216 | 0.0404757 |
| train_regression_nn_a5c7a_00012 | TERMINATED | 127.0.0.1:77428 | 0.05  |
100 |           16 |          200 | 0.017421   | 0.0559752 | 0.0621303 |
| train_regression_nn_a5c7a_00013 | TERMINATED | 127.0.0.1:77429 | 0.05  |
100 |           32 |          200 | 0.00884603 | 0.0581266 | 0.0646087 |
| train_regression_nn_a5c7a_00014 | TERMINATED | 127.0.0.1:77430 | 0.05  |
100 |           64 |          200 | 0.00742247 | 0.0602569 | 0.0575143 |
| train_regression_nn_a5c7a_00015 | TERMINATED | 127.0.0.1:77456 | 0.05  |
500 |           16 |          200 | 0.013945   | 0.0593138 | 0.0472992 |
| train_regression_nn_a5c7a_00016 | TERMINATED | 127.0.0.1:77502 | 0.05  |
500 |           32 |          200 | 0.0104341  | 0.059592  | 0.0520249 |
| train_regression_nn_a5c7a_00017 | TERMINATED | 127.0.0.1:77518 | 0.05  |
500 |           64 |          200 | 0.012045   | 0.0566878 | 0.0522312 |
| train_regression_nn_a5c7a_00018 | TERMINATED | 127.0.0.1:77519 | 0.05  |
1000 |           16 |          200 | 0.020427   | 0.0665627 | 0.0543904 |
| train_regression_nn_a5c7a_00019 | TERMINATED | 127.0.0.1:77531 | 0.05  |
1000 |           32 |          200 | 0.0191229  | 0.0638417 | 0.0581298 |
| train_regression_nn_a5c7a_00020 | TERMINATED | 127.0.0.1:77532 | 0.05  |
1000 |           64 |          200 | 0.0146438  | 0.0607869 | 0.0588785 |
| train_regression_nn_a5c7a_00021 | TERMINATED | 127.0.0.1:77570 | 0.05  |
5000 |           16 |          200 | 0.0123161  | 0.0529771 | 0.0859972 |
| train_regression_nn_a5c7a_00022 | TERMINATED | 127.0.0.1:77611 | 0.05  |
5000 |           32 |          200 | 0.0286801  | 0.0567515 | 0.0529229 |
| train_regression_nn_a5c7a_00023 | TERMINATED | 127.0.0.1:77612 | 0.05  |
5000 |           64 |          200 | 0.0308256  | 0.0487672 | 0.0468946 |
| train_regression_nn_a5c7a_00024 | TERMINATED | 127.0.0.1:77613 | 0.01  |
100 |           16 |          200 | 0.0142363  | 0.0648247 | 0.0599238 |
| train_regression_nn_a5c7a_00025 | TERMINATED | 127.0.0.1:77614 | 0.01  |
100 |           32 |          200 | 0.0135526  | 0.0652007 | 0.063039  |
| train_regression_nn_a5c7a_00026 | TERMINATED | 127.0.0.1:77626 | 0.01  |
100 |           64 |          200 | 0.00454491 | 0.0649987 | 0.0617479 |
| train_regression_nn_a5c7a_00027 | TERMINATED | 127.0.0.1:77627 | 0.01  |
500 |           16 |          200 | 0.0236121  | 0.0762414 | 0.0516163 |
| train_regression_nn_a5c7a_00028 | TERMINATED | 127.0.0.1:77653 | 0.01  |
500 |           32 |          200 | 0.00989368 | 0.065412  | 0.0596228 |
| train_regression_nn_a5c7a_00029 | TERMINATED | 127.0.0.1:77654 | 0.01  |
500 |           64 |          200 | 0.00597981 | 0.0640613 | 0.0609617 |
| train_regression_nn_a5c7a_00030 | TERMINATED | 127.0.0.1:77682 | 0.01  |
1000 |           16 |          200 | 0.0188686  | 0.0697189 | 0.0667077 |
| train_regression_nn_a5c7a_00031 | TERMINATED | 127.0.0.1:77734 | 0.01  |
1000 |           32 |          200 | 0.0152937  | 0.0700091 | 0.0567638 |
| train_regression_nn_a5c7a_00032 | TERMINATED | 127.0.0.1:77750 | 0.01  |
1000 |           64 |          200 | 0.0113755  | 0.0707568 | 0.0646574 |
| train_regression_nn_a5c7a_00033 | TERMINATED | 127.0.0.1:77765 | 0.01  |
```

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5000 |           16 |          200 | 0.0431508  | 0.0987493 | 0.0939748 |
| train_regression_nn_a5c7a_00034 | TERMINATED | 127.0.0.1:77779 | 0.01  |
5000 |           32 |          200 | 0.0405688  | 0.0950878 | 0.0674347 |
| train_regression_nn_a5c7a_00035 | TERMINATED | 127.0.0.1:77791 | 0.01  |
5000 |           64 |          200 | 0.0274454  | 0.0854893 | 0.0779838 |
| train_regression_nn_a5c7a_00036 | TERMINATED | 127.0.0.1:77877 | 0.005 |
100 |           16 |          200 | 0.00774891 | 0.0632282 | 0.0540824 |
| train_regression_nn_a5c7a_00037 | TERMINATED | 127.0.0.1:77888 | 0.005 |
100 |           32 |          200 | 0.00764413 | 0.063551  | 0.0611419 |
| train_regression_nn_a5c7a_00038 | TERMINATED | 127.0.0.1:77890 | 0.005 |
100 |           64 |          200 | 0.00731283 | 0.0712596 | 0.0574687 |
| train_regression_nn_a5c7a_00039 | TERMINATED | 127.0.0.1:77915 | 0.005 |
500 |           16 |          200 | 0.0242397  | 0.0711682 | 0.06523   |
| train_regression_nn_a5c7a_00040 | TERMINATED | 127.0.0.1:77927 | 0.005 |
500 |           32 |          200 | 0.0155717  | 0.0653386 | 0.0665976 |
| train_regression_nn_a5c7a_00041 | TERMINATED | 127.0.0.1:78020 | 0.005 |
500 |           64 |          200 | 0.00926101 | 0.062435  | 0.0583321 |
| train_regression_nn_a5c7a_00042 | TERMINATED | 127.0.0.1:78047 | 0.005 |
1000 |           16 |          200 | 0.0347673  | 0.0841441 | 0.0706762 |
| train_regression_nn_a5c7a_00043 | TERMINATED | 127.0.0.1:78071 | 0.005 |
1000 |           32 |          200 | 0.0154333  | 0.0700982 | 0.0577408 |
| train_regression_nn_a5c7a_00044 | TERMINATED | 127.0.0.1:78072 | 0.005 |
1000 |           64 |          200 | 0.00983961 | 0.0679622 | 0.0709492 |
| train_regression_nn_a5c7a_00045 | TERMINATED | 127.0.0.1:78099 | 0.005 |
5000 |           16 |          200 | 0.085442   | 0.135199  | 0.145734  |
| train_regression_nn_a5c7a_00046 | TERMINATED | 127.0.0.1:78153 | 0.005 |
5000 |           32 |          200 | 0.02011    | 0.0773292 | 0.0701589 |
| train_regression_nn_a5c7a_00047 | TERMINATED | 127.0.0.1:78154 | 0.005 |
5000 |           64 |          200 | 0.0138653  | 0.0679908 | 0.0549    |
| train_regression_nn_a5c7a_00048 | TERMINATED | 127.0.0.1:78155 | 0.001 |
100 |           16 |          200 | 0.0100774  | 0.0639661 | 0.053429  |
| train_regression_nn_a5c7a_00049 | TERMINATED | 127.0.0.1:78195 | 0.001 |
100 |           32 |          200 | 0.00688729 | 0.0678984 | 0.0541851 |
| train_regression_nn_a5c7a_00050 | TERMINATED | 127.0.0.1:78208 | 0.001 |
100 |           64 |          200 | 0.00450636 | 0.0646622 | 0.0615006 |
| train_regression_nn_a5c7a_00051 | TERMINATED | 127.0.0.1:78209 | 0.001 |
500 |           16 |          200 | 0.0116204  | 0.0670333 | 0.0506353 |
| train_regression_nn_a5c7a_00052 | TERMINATED | 127.0.0.1:78222 | 0.001 |
500 |           32 |          200 | 0.00932527 | 0.0683924 | 0.0625659 |
| train_regression_nn_a5c7a_00053 | TERMINATED | 127.0.0.1:78223 | 0.001 |
500 |           64 |          200 | 0.00472212 | 0.0650224 | 0.0687691 |
| train_regression_nn_a5c7a_00054 | TERMINATED | 127.0.0.1:78260 | 0.001 |
1000 |           16 |          200 | 0.0157807  | 0.0691634 | 0.0599643 |
| train_regression_nn_a5c7a_00055 | TERMINATED | 127.0.0.1:78286 | 0.001 |
1000 |           32 |          200 | 0.00836444 | 0.069367  | 0.0648727 |
| train_regression_nn_a5c7a_00056 | TERMINATED | 127.0.0.1:78300 | 0.001 |
1000 |           64 |          200 | 0.00624262 | 0.0631795 | 0.0646013 |
| train_regression_nn_a5c7a_00057 | TERMINATED | 127.0.0.1:78301 | 0.001 |
```

```
5000 |           16 |          200 | 0.0322541  | 0.0857145 | 0.064692  |
| train_regression_nn_a5c7a_00058 | TERMINATED | 127.0.0.1:78313 | 0.001 |
5000 |           32 |          200 | 0.0112105  | 0.0671175 | 0.0661384 |
| train_regression_nn_a5c7a_00059 | TERMINATED | 127.0.0.1:78338 | 0.001 |
5000 |           64 |          200 | 0.00811915 | 0.0608828 | 0.0617411 |
+---------------------------------+------------+-----------------+-------+------
---------+--------------+--------------+------------+-----------+-----------+
```

```
Best Hyperparameters Found:  {'lr': 0.1, 'hidden_size': 5000, 'batch_size': 64,
'num_epochs': 200, 'early_stop': 10, 'log_dir': '/Users/tyler/GitHub
Repositories/Apple Watch FitBit Project/Wearables-Activity-
Classification/logs/whoop-recovery-reg/v3/merge', 'model_path':
'/Users/tyler/GitHub Repositories/Apple Watch FitBit Project/Wearables-Activity-
Classification/models/whoop-recovery-reg/v3/merge', 'tune': True}
Best Validation MSE:  0.040475720539689064
Best Number Epochs:  37
Best Model Path:  /Users/tyler/GitHub Repositories/Apple Watch FitBit
Project/Wearables-Activity-Classification/models/whoop-recovery-
reg/v3/merge/h5000_b64_lr0.1.th
```

[ ]: