Part B Question 3

In [ ]:
```
# Setting the seed here is sufficient.
# If you don't plan to use these starter code, make sure you add this cell.

SEED = 42

import os
os.environ['TF_CUDNN_DETERMINISTIC'] = '1'
os.environ["CUDA_VISIBLE_DEVICES"] = "-1"
import random
random.seed(SEED)

import numpy as np
np.random.seed(SEED)

import tensorflow as tf
tf.random.set_seed(SEED)
```

In [ ]:
```
import graphviz
import pydot_ng as pydot
from tensorflow import keras
from tensorflow.keras import layers
from tensorflow.keras.layers import Normalization, StringLookup, IntegerLookup
from math import floor
from math import sqrt
import matplotlib.pyplot as plt
```

In [ ]:
```
import pandas as pd
df = pd.read_csv('hdb_price_prediction.csv')
df
```

Out[ ]:

	month	year	full_address	nearest_stn	dist_to_nearest_stn	dist_to_dhoby	degree_centrality	e
0	1	2017	406 ANG MO KIO AVENUE 10	Ang Mo Kio	1.007264	7.006044	0.016807	
1	1	2017	108 ANG MO KIO AVENUE 4	Ang Mo Kio	1.271389	7.983837	0.016807	
2	1	2017	602 ANG MO KIO AVENUE 5	Yio Chu Kang	1.069743	9.090700	0.016807	
3	1	2017	465 ANG MO KIO AVENUE 10	Ang Mo Kio	0.946890	7.519889	0.016807	
4	1	2017	601 ANG MO KIO AVENUE 5	Yio Chu Kang	1.092551	9.130489	0.016807	
...	...	...	...	...	...	...	...	
133407	6	2022	877 YISHUN STREET 81	Khatib	0.475885	12.738721	0.016807	
133408	1	2022	633 YISHUN STREET 61	Khatib	0.774113	13.229106	0.016807	
133409	2	2022	633 YISHUN STREET 61	Khatib	0.774113	13.229106	0.016807	
133410	2	2022	632 YISHUN STREET 61	Khatib	0.700595	13.222912	0.016807	
133411	5	2022	605 YISHUN STREET 61	Khatib	0.603845	13.592586	0.016807	

133412 rows × 13 columns

In [ ]:

```
# The functions in this cell are adapted from https://keras.io/examples/structured_data/
# It is the same link as the one mentioned in the question paper (Q1b)

def dataframe_to_dataset(dataframe):
    dataframe = dataframe.copy()

    labels = dataframe.pop("resale_price")
    ds = tf.data.Dataset.from_tensor_slices((dict(dataframe), labels))
    ds = ds.shuffle(buffer_size=len(dataframe))
    return ds


def encode_numerical_feature(feature, name, dataset):
    # Create a Normalization layer for our feature
    normalizer = Normalization()

    # Prepare a Dataset that only yields our feature
```

```
    feature_ds = dataset.map(lambda x, y: x[name])
    feature_ds = feature_ds.map(lambda x: tf.expand_dims(x, -1))

    # Learn the statistics of the data
    normalizer.adapt(feature_ds)

    # Normalize the input feature
    encoded_feature = normalizer(feature)
    return encoded_feature


def encode_categorical_feature(feature, name, dataset, is_string):
    lookup_class = StringLookup if is_string else IntegerLookup
    # Create a lookup layer which will turn strings into integer indices
    lookup = lookup_class(output_mode="binary") # NOTE: as mentioned in the question pa

    # Prepare a Dataset that only yields our feature
    feature_ds = dataset.map(lambda x, y: x[name])
    feature_ds = feature_ds.map(lambda x: tf.expand_dims(x, -1))

    # Learn the set of possible string values and assign them a fixed integer index
    lookup.adapt(feature_ds)

    # Turn the string input into integer indices
    encoded_feature = lookup(feature)
    return encoded_feature
```

In [ ]:
```
from keras import backend as K
def r2(y_true, y_pred):
    '''
    # Obtained from https://jmlb.github.io/ml/2017/03/20/CoeffDetermination_CustomMetri
    # TODO: you have to find out how to use it in your code
    '''
    SS_res = K.sum(K.square( y_true - y_pred ))
    SS_tot = K.sum(K.square( y_true - K.mean(y_true) ) )
    return ( 1 - SS_res/(SS_tot + K.epsilon()) )
```

From Question 1

In [ ]:
```
# Split data

train_dataframe = df[df['year']<= 2020]
test_dataframe =  df[df['year']>2020]
```

In [ ]:
```
category_not_used = ["full_address", "nearest_stn"]
train_dataframe = train_dataframe.drop(category_not_used, axis = 1)
test_dataframe = test_dataframe.drop(category_not_used, axis = 1)

train_ds = dataframe_to_dataset(train_dataframe)
test_ds = dataframe_to_dataset(test_dataframe)

train_ds = train_ds.batch(256)
test_ds = test_ds.batch(256)
```

In [ ]:
```
#Categorical feature encoded as integer
month = keras.Input(shape=(1,), name="month", dtype="int64")
```

```
# Categorical feature encoded as string
flat_model_type = keras.Input(shape=(1,), name="flat_model_type", dtype="string")
storey_range = keras.Input(shape=(1,), name="storey_range", dtype="string")

# Numerical features
dist_to_nearest_stn = keras.Input(shape=(1,), name="dist_to_nearest_stn")
dist_to_dhoby = keras.Input(shape=(1,), name="dist_to_dhoby")
degree_centrality = keras.Input(shape=(1,), name="degree_centrality")
eigenvector_centrality = keras.Input(shape=(1,), name="eigenvector_centrality")
remaining_lease_years = keras.Input(shape=(1,), name="remaining_lease_years")
floor_area_sqm = keras.Input(shape=(1,), name="floor_area_sqm")
```

In [ ]:
```
all_inputs = [month,flat_model_type,storey_range,dist_to_nearest_stn,
              dist_to_dhoby,degree_centrality,eigenvector_centrality,remaining_lease_years
```

From Question 2

In [ ]:
```
def Q2_encode_categorical_feature(feature, name, dataset, is_string, num_categories, di
    lookup_class = StringLookup if is_string else IntegerLookup
    # Create a lookup layer which will turn strings into integer indices
    lookup = lookup_class(output_mode="int")

    # Prepare a Dataset that only yields our feature
    feature_ds = dataset.map(lambda x, y: x[name])
    feature_ds = feature_ds.map(lambda x: tf.expand_dims(x,-1))

    # Learn the set of possible string values and assign them a fixed integer index
    lookup.adapt(feature_ds)

    # Turn the string input into integer indices
    encoded_feature = lookup(feature)

    emb = layers.Embedding(input_dim=num_categories+1, output_dim=floor(num_categories/
    embedded = emb(encoded_feature)

    return layers.Flatten()(embedded)
```

In [ ]:
```
def square_roots(l):
    result = [sqrt(i) for i in l]
    return result
```

In [ ]:
```
callback = tf.keras.callbacks.EarlyStopping(monitor='val_loss', patience=10)
```

Best hyperparamters value : 'learning_rate': 0.046185127256095915, 'divisor': 2, 'hidden_units': 8

In [ ]:
```
learning_rate = 0.046185127256095915
divisor = 2
hidden_units = 8
```

Question 3

In [ ]:
```
# old test set
Q3_old_df = pd.read_csv('hdb_price_prediction_old.csv')
```

```
Q3_old_test_df = Q3_old_df[Q3_old_df["year"]>2020].copy()
Q3_old_test_df = Q3_old_test_df.drop(category_not_used, axis = 1)
Q3_old_test_ds = dataframe_to_dataset(Q3_old_test_df)
Q3_old_test_ds = Q3_old_test_ds.batch(128)

# new test set
Q3_new_test_2021_df = test_dataframe[test_dataframe["year"]==2021].copy()
Q3_new_test_2022_df = test_dataframe[test_dataframe["year"]==2022].copy()

Q3_new_test_2021_ds = dataframe_to_dataset(Q3_new_test_2021_df)
Q3_new_test_2022_ds = dataframe_to_dataset(Q3_new_test_2022_df)

Q3_new_test_2021_ds = Q3_new_test_2021_ds.batch(256)
Q3_new_test_2022_ds = Q3_new_test_2022_ds.batch(256)
```

Question 3A

Using 2E model from the best epoch for 3A according to the clarification on the discussion board

In [ ]:
```
Q2E_model = keras.models.load_model('PartB_best_model/', custom_objects={"r2":r2})
Q2E_model.load_weights('PartB_bestepoch/')
```

Out[ ]:
```
<tensorflow.python.training.tracking.util.CheckpointLoadStatus at 0x20eaeb66ec0>
```

In [ ]:
```
# old test set
Q3_old_df = pd.read_csv('hdb_price_prediction_old.csv')

Q3_old_test_df = Q3_old_df[Q3_old_df["year"]>2020].copy()
Q3_old_test_df = Q3_old_test_df.drop(category_not_used, axis = 1)
Q3_old_test_ds = dataframe_to_dataset(Q3_old_test_df)
Q3_old_test_ds = Q3_old_test_ds.batch(128)

# new test set
Q3_new_test_2021_df = test_dataframe[test_dataframe["year"]==2021].copy()
Q3_new_test_2022_df = test_dataframe[test_dataframe["year"]==2022].copy()

Q3_new_test_2021_ds = dataframe_to_dataset(Q3_new_test_2021_df)
Q3_new_test_2022_ds = dataframe_to_dataset(Q3_new_test_2022_df)

Q3_new_test_2021_ds = Q3_new_test_2021_ds.batch(256)
Q3_new_test_2022_ds = Q3_new_test_2022_ds.batch(256)
```

Question 3A

In [ ]:
```
old_test_loss, old_test_R2 = Q2E_model.evaluate(Q3_old_test_ds)
print('Old Test RMSE: %f' % sqrt(old_test_loss))
print('Old Test R^2: %f' % old_test_R2)

new_test_2021_loss, new_test_2021_R2 = Q2E_model.evaluate(Q3_new_test_2021_ds)
print('Test RMSE_2021: %f' % sqrt(new_test_2021_loss))
print('Test R^2_2021: %f' % (new_test_2021_R2))

new_test_2022_loss, new_test_2022_R2 = Q2E_model.evaluate(Q3_new_test_2022_ds)
```

```
print('Test RMSE_2022: %f' % sqrt(new_test_2022_loss))
print('Test R^2_2022: %f' % (new_test_2022_R2))

#Output in a table

data = {"Old Test RMSE": [sqrt(old_test_loss)],
        "Old Test R^2": [(old_test_R2)],
        "Test RMSE_2021": [sqrt(new_test_2021_loss)],
        "Test R^2_2021": [(new_test_2021_R2)],
        "Test RMSE_2022": [(new_test_2022_loss)],
        "Test R^2_2022": [(new_test_2022_R2)]}

data_df = pd.DataFrame.from_dict(data)
data_df
```

```
c:\Users\JoeTe\AppData\Local\Programs\Python\Python310\lib\site-packages\keras\engine\functional.py:566: UserWarning: Input dict contained keys ['year'] which did not match any model input. They will be ignored by the model.
  inputs = self._flatten_to_reference_inputs(inputs)
131/131 [==============================] - 1s 2ms/step - loss: 5597425152.0000 - r2: 0.7832
Old Test RMSE: 74815.941831
Old Test R^2: 0.783178
114/114 [==============================] - 0s 3ms/step - loss: 6625486336.0000 - r2: 0.7472
Test RMSE_2021: 81397.090464
Test R^2_2021: 0.747247
67/67 [==============================] - 0s 3ms/step - loss: 14154502144.0000 - r2: 0.5040
Test RMSE_2022: 118972.694951
Test R^2_2022: 0.504003
```

Out[ ]:

	Old Test RMSE	Old Test R^2	Test RMSE_2021	Test R^2_2021	Test RMSE_2022	Test R^2_2022
0	74815.941831	0.783178	81397.090464	0.747247	1.415450e+10	0.504003

Question 3B

Compare the extent to which model degradation has impacted your model to that of the team's linear regression model and explain why this has occured.

Linear Regression Model	R^2 value
Q1B Test > 2020	.627
Q3B Old Test > 2020	.760
Q3B Test == 2021	.715
Q3B Test == 2022	.464

--**Neural Network Model**--

NN model	R^2 value
Q3B Old Test > 2020	.783178
Q3B Test == 2021	.747247

NN model	R^2 value
Q3B Test == 2022	.504003

Model degradation has led to a more signiifcant drop in R^2 value in the linear regression model as compared to the neural network model. As the multi-layer neural network has the ability to capture non-linear relationships, even though there is a change in characteristics of the dataset, the neural network model still performs better.

Question 3C

Identifying Covariate shift

In [ ]:
```
# As we used train_ds for best_model, we are going to use train_dataframe

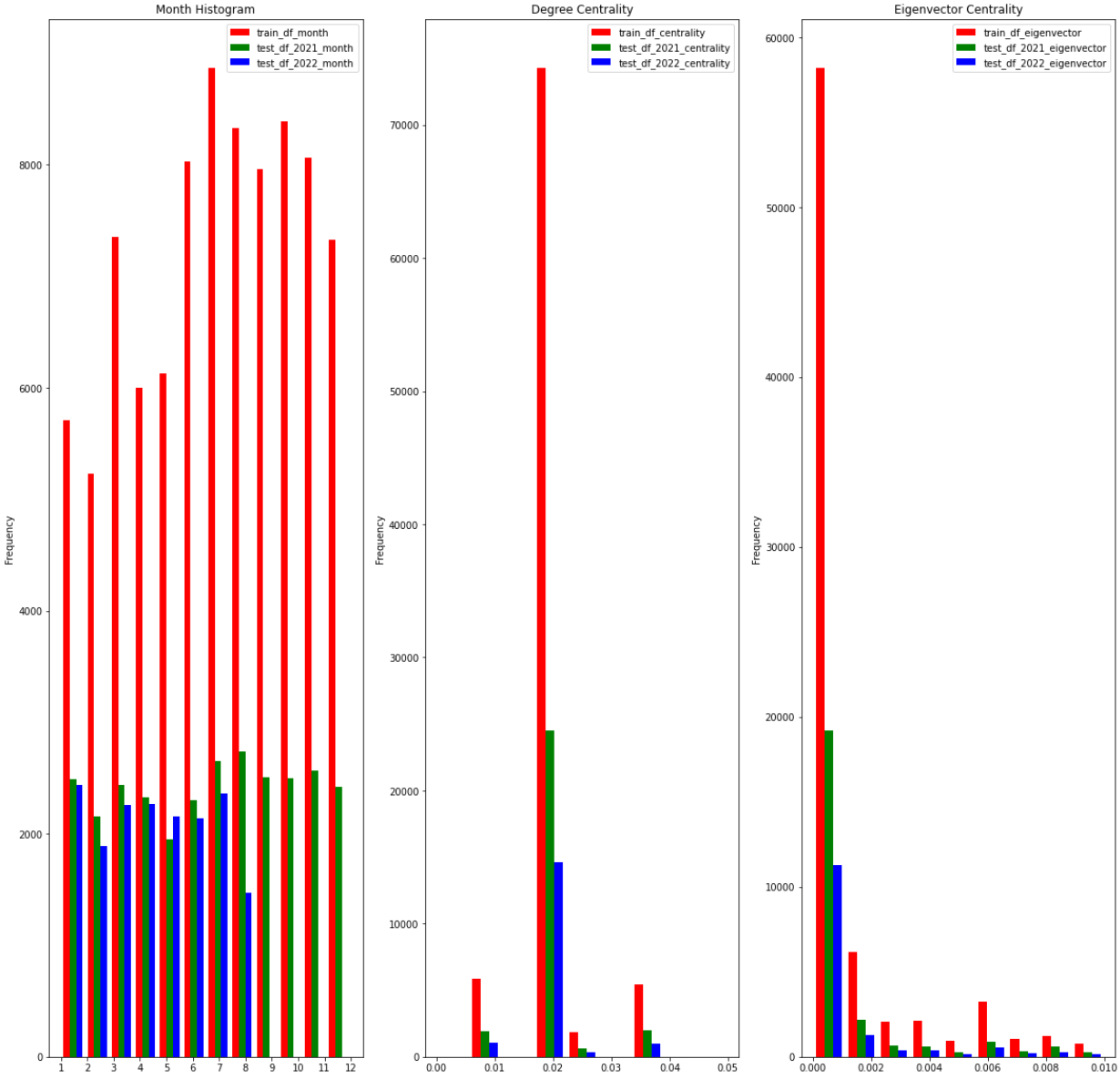
train_df_shift = train_dataframe.copy()
Q3_old_test_df_shift = Q3_old_test_df.copy()
test_df_2021_shift = Q3_new_test_2021_df.copy()
test_df_2022_shift = Q3_new_test_2022_df.copy()
```

In [ ]:
```
fig, axes =plt.subplots(1,3, figsize=(20,20))
axes[0].hist([train_df_shift["month"], test_df_2021_shift["month"],test_df_2022_shift["
axes[0].legend(loc='upper right')
axes[0].set_title('Month Histogram')
axes[0].set_xticks(range(1,13))
axes[0].set_ylabel('Frequency')

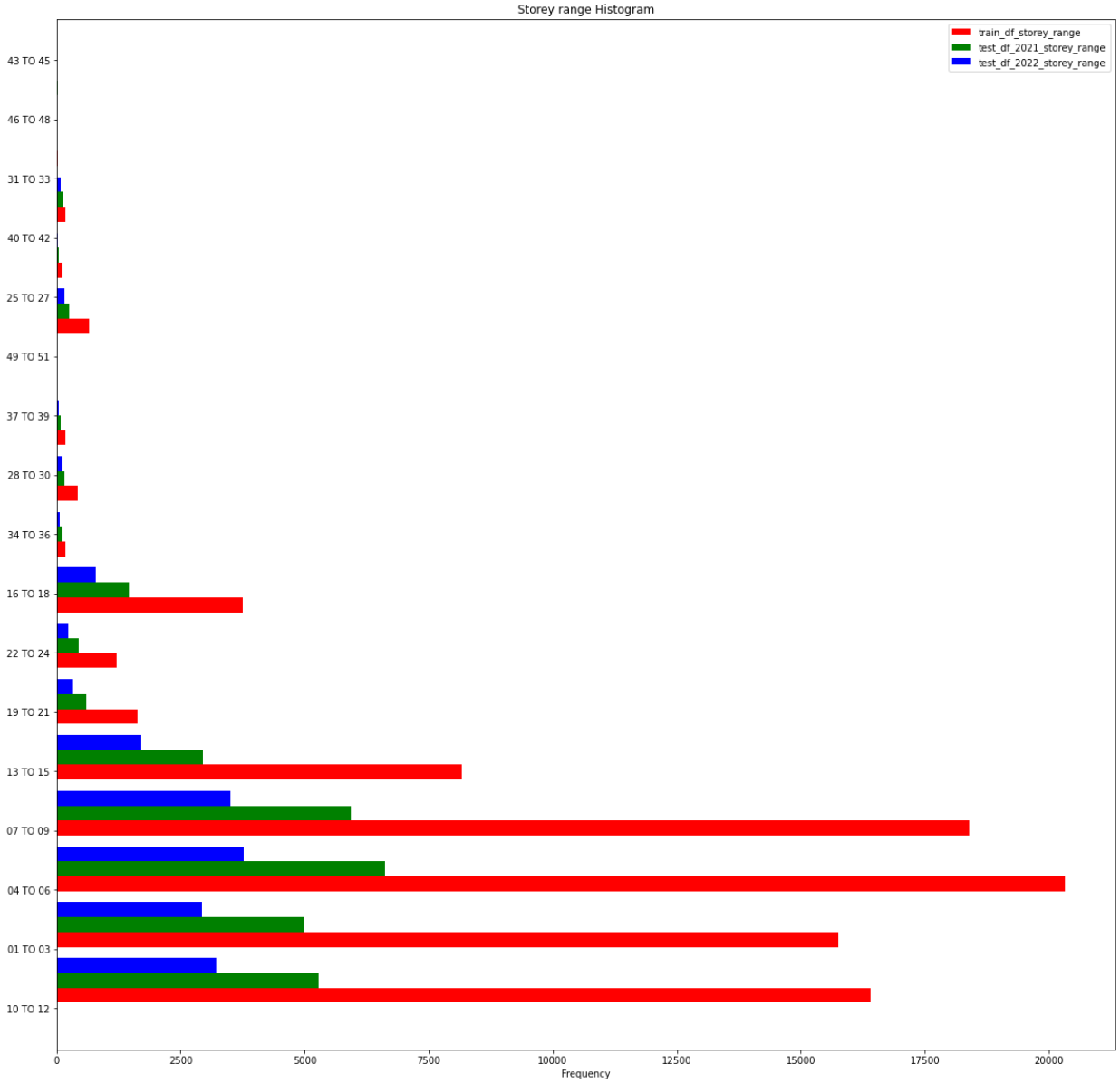
axes[1].hist([train_df_shift["degree_centrality"], test_df_2021_shift["degree_centrality
axes[1].legend(loc='upper right')
axes[1].set_title('Degree Centrality')
axes[1].set_ylabel('Frequency')

axes[2].hist([train_df_shift["eigenvector_centrality"], test_df_2021_shift["eigenvector_
axes[2].legend(loc='upper right')
axes[2].set_title('Eigenvector Centrality')
axes[2].set_ylabel('Frequency')

plt.show()
```



In [ ]:
```
fig, axes =plt.subplots(1, figsize=(20,20))
axes.hist([train_df_shift["storey_range"], test_df_2021_shift["storey_range"],test_df_2(
axes.legend(loc='upper right')
axes.set_title('Storey range Histogram')
axes.set_xlabel('Frequency')
plt.show()
```



Question 3C

Which variable showed the largest covariate/label shift that might have led to the drop in model performance as seen in 3b?

From the histogram plot, the Month has the largest distribution shift within the train and test dataset which could be the reason for the drop in R^2 values

The easiest way would be to drop the features which are being classifed as drifiting, however this might result in a loss of information. Alternatively, it would be to retrieve more updated dataset and integrate into training.

Question 3D & 3E

RFE.py

In [ ]:
```
"""
```

```
Implementation of recursive feature elimination algorithm for neural networks.

Recursive feature elimination (RFE) is a feature selection method that removes unnecessa
It can also shed some insights on how much each feature contributes to the prediction ta

The algorithm starts by removing one input feature whose removal leads to the minimum dr
- Given k features, to determine which of the k features will cause the minimum drop / r
    - In the case removing a feature leads to an improvement from the baseline (all feat
    - There will also be cases when all subsets with k-1 features do not do better than

This procedure is repeated recursively on the reduced input set until the optimal numbe
- The feature removal goes on until either 1 feature is left, or the model performance d
- The condition to stop the recursive process once all (k-1)-features models do worse th

Each model should use a different subset of features and they are trained independently


In the code below, a boolean mask `vec` is used to keep track of which features to selec

You need to place your model training code into the 'train_model' function and have it r

Look out for the comments labelled 'TODO'.

"""
import keras_tuner
import time
start = time.time()

num_features = 9

vec = [1 for i in range(num_features)]
best_loss = 1e15
new_best_loss = 1e14
which_iter = ''

all_losses = [] # should be len 9,8,7,...


def train_model(feature_mask):
    """
    Given a boolean mask (feature_mask), select the features accordingly, train the mode
    """

    feature_mask_string = ''.join([str(i) for i in feature_mask])

    # TODO: define the input layer here (your code from Q2)

    divisor = 2
    hidden_units = 8
    optimizer = tf.keras.optimizers.Adam(learning_rate=0.046185127256095915)

    month_num_categories = df["month"].nunique()
    flat_model_type_num_categories = df["flat_model_type"].nunique()
    storey_range_num_categories = df["storey_range"].nunique()


    #Integer categorical features
    month_embedded = Q2_encode_categorical_feature(month, "month",train_ds, False, montl
    #String categorical features
    flat_model_type_embedded = Q2_encode_categorical_feature(flat_model_type, "flat_mode
```

```
    storey_range_embedded = Q2_encode_categorical_feature(storey_range, "storey_range",

    #Numerical features
    dist_to_nearest_stn_encoded = encode_numerical_feature(dist_to_nearest_stn, "dist_t
    dist_to_dhoby_encoded = encode_numerical_feature(dist_to_dhoby, "dist_to_dhoby", tra
    degree_centrality_encoded = encode_numerical_feature(degree_centrality, "degree_cen
    eigenvector_centrality_encoded = encode_numerical_feature(eigenvector_centrality, "
    remaining_lease_year_encoded = encode_numerical_feature(remaining_lease_years, "rema
    floor_area_sqm_encoded = encode_numerical_feature(floor_area_sqm,"floor_area_sqm",

    all_features_input = [
                        month_embedded,
                        storey_range_embedded,
                        flat_model_type_embedded,
                        floor_area_sqm_encoded,
                        remaining_lease_year_encoded,
                        degree_centrality_encoded,
                        eigenvector_centrality_encoded,
                        dist_to_nearest_stn_encoded,
                        dist_to_dhoby_encoded
                    ]

    selected_inputs = []
    print('going through feature_mask', feature_mask)
    for i,j in zip(all_features_input, feature_mask):
        if j == 1:
            selected_inputs.append(i)
            print(i)
        else:
            print('Skipping', i)

    all_features = layers.concatenate(selected_inputs)


    # TODO: Complete the rest of the architecture + training code and retrieve the trai
    model_history = {}
    # Model trained using the best hyperparameters
    hidden_layer = layers.Dense(units=hidden_units, activation ="linear")(all_features)
    output = layers.Dense(1, activation="linear")(hidden_layer)
    model = keras.Model(all_inputs, output)
    model.compile(optimizer=optimizer, loss= "mse",metrics=[r2])

    model_history["model"] = model.fit(train_ds, epochs=50, validation_data = test_ds,

    val_loss_hx = square_roots(model_history["model"].history["val_loss"]) # NOTE: You
    val_loss_min = min(val_loss_hx)

    return val_loss_min


## RFE starts here

while sum(vec) > 0 and best_loss > new_best_loss:

    print('vec', vec)

    best_loss = new_best_loss
    new_min_loss_flag = False

    losses_from_same_vec = []
```

```
    for ix, i in enumerate(vec):

        print('ix', ix, 'i', i)

        if i == 0:
            continue # if the feature is off, no need to do anything, go to next positi
        else:
            temp_vec = vec[:]
            temp_vec[ix] = 0 # turn off the feature
            print('updated temp_vec', temp_vec)

            loss = train_model(temp_vec)
            losses_from_same_vec.append(loss)

            if loss < new_best_loss:
                new_best_loss = loss
                which_iter = 'len ' + str(sum(vec)) + ', ix ' + str(ix)
                print('new min loss:', which_iter)
                new_min_loss_flag = True
                min_loss_vec = temp_vec[:]

            tf.keras.backend.clear_session()
            print('session cleared!\n')


    all_losses.append(losses_from_same_vec)

    # After going through the vec once, update vec if new min loss
    if new_min_loss_flag:
        vec = min_loss_vec

    # else case means no new min loss, the latter while loop condition will cause it to
    print(time.time() - start, 'seconds elapsed')
    print()

print(all_losses)
```

```
vec [1, 1, 1, 1, 1, 1, 1, 1, 1]
ix 0 i 1
updated temp_vec [0, 1, 1, 1, 1, 1, 1, 1, 1]
going through feature_mask [0, 1, 1, 1, 1, 1, 1, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
```

```
c:\Users\JoeTe\AppData\Local\Programs\Python\Python310\lib\site-packages\keras\engine\f
unctional.py:566: UserWarning: Input dict contained keys ['year'] which did not match a
ny model input. They will be ignored by the model.
  inputs = self._flatten_to_reference_inputs(inputs)
```

```
342/342 [==============================] - 3s 5ms/step - loss: 84233969664.0000 - r2: -
2.5428 - val_loss: 17914851328.0000 - val_r2: 0.3487
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 9193890816.0000 - r2: 0.
6115 - val_loss: 15100820480.0000 - val_r2: 0.4486
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 7906354176.0000 - r2: 0.
6649 - val_loss: 14291372032.0000 - val_r2: 0.4771
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 7305051648.0000 - r2: 0.
6904 - val_loss: 13262029824.0000 - val_r2: 0.5147
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 6865902080.0000 - r2: 0.
7088 - val_loss: 12781097984.0000 - val_r2: 0.5317
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 6460293120.0000 - r2: 0.
7258 - val_loss: 12580141056.0000 - val_r2: 0.5400
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 6078106112.0000 - r2: 0.
7424 - val_loss: 12306676736.0000 - val_r2: 0.5500
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 5718280704.0000 - r2: 0.
7573 - val_loss: 11234048000.0000 - val_r2: 0.5888
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 5402378240.0000 - r2: 0.
7711 - val_loss: 11167117312.0000 - val_r2: 0.5907
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 5145071616.0000 - r2: 0.
7814 - val_loss: 10686197760.0000 - val_r2: 0.6088
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 4920711680.0000 - r2: 0.
7915 - val_loss: 10606539776.0000 - val_r2: 0.6117
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 4730554880.0000 - r2: 0.
7989 - val_loss: 10828210176.0000 - val_r2: 0.6032
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4558792704.0000 - r2: 0.
8062 - val_loss: 11062680576.0000 - val_r2: 0.5951
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 4407778304.0000 - r2: 0.
8131 - val_loss: 11093219328.0000 - val_r2: 0.5933
Epoch 15/50
342/342 [==============================] - 2s 5ms/step - loss: 4271872768.0000 - r2: 0.
8186 - val_loss: 10455182336.0000 - val_r2: 0.6170
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 4156879616.0000 - r2: 0.
8235 - val_loss: 10005659648.0000 - val_r2: 0.6335
Epoch 17/50
342/342 [==============================] - 2s 4ms/step - loss: 4060937728.0000 - r2: 0.
8275 - val_loss: 9786472448.0000 - val_r2: 0.6410
Epoch 18/50
342/342 [==============================] - 2s 4ms/step - loss: 3986707712.0000 - r2: 0.
8307 - val_loss: 9877778432.0000 - val_r2: 0.6387
Epoch 19/50
342/342 [==============================] - 2s 4ms/step - loss: 3925940736.0000 - r2: 0.
8330 - val_loss: 10563970048.0000 - val_r2: 0.6129
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 3880566784.0000 - r2: 0.
8351 - val_loss: 10277425152.0000 - val_r2: 0.6228
Epoch 21/50
```

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342/342 [==============================] - 2s 4ms/step - loss: 3836108032.0000 - r2: 0.
8374 - val_loss: 10462694400.0000 - val_r2: 0.6163
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 3812864512.0000 - r2: 0.
8383 - val_loss: 9357457408.0000 - val_r2: 0.6572
Epoch 23/50
342/342 [==============================] - 2s 5ms/step - loss: 3787199232.0000 - r2: 0.
8392 - val_loss: 10147275776.0000 - val_r2: 0.6284
Epoch 24/50
342/342 [==============================] - 2s 5ms/step - loss: 3777229312.0000 - r2: 0.
8393 - val_loss: 10972878848.0000 - val_r2: 0.5981
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 3758003456.0000 - r2: 0.
8401 - val_loss: 10113007616.0000 - val_r2: 0.6295
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 3748783616.0000 - r2: 0.
8407 - val_loss: 10314356736.0000 - val_r2: 0.6226
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 3736385792.0000 - r2: 0.
8411 - val_loss: 10037955584.0000 - val_r2: 0.6318
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 3729478912.0000 - r2: 0.
8416 - val_loss: 10081419264.0000 - val_r2: 0.6304
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 3723907584.0000 - r2: 0.
8417 - val_loss: 10166334464.0000 - val_r2: 0.6276
Epoch 30/50
342/342 [==============================] - 2s 4ms/step - loss: 3714027776.0000 - r2: 0.
8421 - val_loss: 10441419776.0000 - val_r2: 0.6170
Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 3712171008.0000 - r2: 0.
8422 - val_loss: 10423503872.0000 - val_r2: 0.6182
Epoch 32/50
342/342 [==============================] - 2s 4ms/step - loss: 3703762432.0000 - r2: 0.
8425 - val_loss: 10045666304.0000 - val_r2: 0.6320
new min loss: len 9, ix 0
session cleared!

ix 1 i 1
updated temp_vec [1, 0, 1, 1, 1, 1, 1, 1, 1]
going through feature_mask [1, 0, 1, 1, 1, 1, 1, 1, 1]
KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=None), name='f
latten/Reshape:0', description="created by layer 'flatten'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=Non
e), name='flatten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
```

```
342/342 [==============================] - 2s 5ms/step - loss: 85261770752.0000 - r2: -
2.6320 - val_loss: 19633022976.0000 - val_r2: 0.2867
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 10591634432.0000 - r2:
0.5526 - val_loss: 17218633728.0000 - val_r2: 0.3718
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 9515292672.0000 - r2: 0.
5981 - val_loss: 16059164672.0000 - val_r2: 0.4143
Epoch 4/50
342/342 [==============================] - 2s 5ms/step - loss: 8894954496.0000 - r2: 0.
6235 - val_loss: 16265158656.0000 - val_r2: 0.4066
Epoch 5/50
342/342 [==============================] - 2s 5ms/step - loss: 8360264192.0000 - r2: 0.
6459 - val_loss: 15291811840.0000 - val_r2: 0.4413
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 7840298496.0000 - r2: 0.
6683 - val_loss: 14026286080.0000 - val_r2: 0.4883
Epoch 7/50
342/342 [==============================] - 2s 5ms/step - loss: 7327800320.0000 - r2: 0.
6891 - val_loss: 13854793728.0000 - val_r2: 0.4937
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 6847192064.0000 - r2: 0.
7101 - val_loss: 13228857344.0000 - val_r2: 0.5170
Epoch 9/50
342/342 [==============================] - 2s 4ms/step - loss: 6420887040.0000 - r2: 0.
7286 - val_loss: 12891869184.0000 - val_r2: 0.5291
Epoch 10/50
342/342 [==============================] - 2s 4ms/step - loss: 6074100736.0000 - r2: 0.
7429 - val_loss: 13015591936.0000 - val_r2: 0.5240
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 5784262144.0000 - r2: 0.
7550 - val_loss: 13211977728.0000 - val_r2: 0.5170
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 5541690368.0000 - r2: 0.
7652 - val_loss: 12599604224.0000 - val_r2: 0.5399
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 5331721216.0000 - r2: 0.
7741 - val_loss: 12559361024.0000 - val_r2: 0.5400
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 5146573312.0000 - r2: 0.
7817 - val_loss: 12059112448.0000 - val_r2: 0.5588
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4984705536.0000 - r2: 0.
7884 - val_loss: 12525056000.0000 - val_r2: 0.5422
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 4856171008.0000 - r2: 0.
7937 - val_loss: 11924646912.0000 - val_r2: 0.5629
Epoch 17/50
342/342 [==============================] - 2s 4ms/step - loss: 4743585280.0000 - r2: 0.
7991 - val_loss: 11237491712.0000 - val_r2: 0.5886
Epoch 18/50
342/342 [==============================] - 2s 4ms/step - loss: 4660304896.0000 - r2: 0.
8025 - val_loss: 10346027008.0000 - val_r2: 0.6215
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 4588898304.0000 - r2: 0.
8056 - val_loss: 11660153856.0000 - val_r2: 0.5722
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 4534401024.0000 - r2: 0.
8079 - val_loss: 11552970752.0000 - val_r2: 0.5767
Epoch 21/50
```

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342/342 [==============================] - 2s 4ms/step - loss: 4497468928.0000 - r2: 0.
8089 - val_loss: 11117726720.0000 - val_r2: 0.5938
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 4458612736.0000 - r2: 0.
8107 - val_loss: 11480393728.0000 - val_r2: 0.5793
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 4441649152.0000 - r2: 0.
8118 - val_loss: 10385385472.0000 - val_r2: 0.6200
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 4420738048.0000 - r2: 0.
8122 - val_loss: 10623262720.0000 - val_r2: 0.6109
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 4403219968.0000 - r2: 0.
8133 - val_loss: 11046177792.0000 - val_r2: 0.5966
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 4393296384.0000 - r2: 0.
8134 - val_loss: 11356088320.0000 - val_r2: 0.5844
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 4385645568.0000 - r2: 0.
8141 - val_loss: 11382678528.0000 - val_r2: 0.5828
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 4378764800.0000 - r2: 0.
8143 - val_loss: 11153591296.0000 - val_r2: 0.5919
session cleared!

ix 2 i 1
updated temp_vec [1, 1, 0, 1, 1, 1, 1, 1, 1]
going through feature_mask [1, 1, 0, 1, 1, 1, 1, 1, 1]
KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=None), name='f
latten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=Non
e), name='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 4ms/step - loss: 102494937088.0000 - r2:
-3.3473 - val_loss: 30999971840.0000 - val_r2: -0.1290
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 19509213184.0000 - r2:
0.1767 - val_loss: 27977291776.0000 - val_r2: -0.0200
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 17737322496.0000 - r2:
0.2496 - val_loss: 25948788736.0000 - val_r2: 0.0535
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 16531158016.0000 - r2:
0.3001 - val_loss: 24883771392.0000 - val_r2: 0.0904
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 15369210880.0000 - r2:
```

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0.3493 - val_loss: 23583514624.0000 - val_r2: 0.1376
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 14087512064.0000 - r2:
0.4034 - val_loss: 22505607168.0000 - val_r2: 0.1770
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 12650244096.0000 - r2:
0.4642 - val_loss: 19992442880.0000 - val_r2: 0.2696
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 11077565440.0000 - r2:
0.5312 - val_loss: 19677661184.0000 - val_r2: 0.2805
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 9459326976.0000 - r2: 0.
5997 - val_loss: 16731126784.0000 - val_r2: 0.3877
Epoch 10/50
342/342 [==============================] - 2s 4ms/step - loss: 7930593792.0000 - r2: 0.
6641 - val_loss: 14500708352.0000 - val_r2: 0.4692
Epoch 11/50
342/342 [==============================] - 2s 5ms/step - loss: 6644866048.0000 - r2: 0.
7186 - val_loss: 14084695040.0000 - val_r2: 0.4852
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 5682263040.0000 - r2: 0.
7590 - val_loss: 13421562880.0000 - val_r2: 0.5088
Epoch 13/50
342/342 [==============================] - 2s 5ms/step - loss: 5034625536.0000 - r2: 0.
7866 - val_loss: 11725064192.0000 - val_r2: 0.5707
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 4647222272.0000 - r2: 0.
8026 - val_loss: 11764769792.0000 - val_r2: 0.5694
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4444011520.0000 - r2: 0.
8114 - val_loss: 11378088960.0000 - val_r2: 0.5827
Epoch 16/50
342/342 [==============================] - 2s 5ms/step - loss: 4345747968.0000 - r2: 0.
8154 - val_loss: 10819470336.0000 - val_r2: 0.6036
Epoch 17/50
342/342 [==============================] - 2s 5ms/step - loss: 4315298304.0000 - r2: 0.
8169 - val_loss: 11498280960.0000 - val_r2: 0.5787
Epoch 18/50
342/342 [==============================] - 2s 4ms/step - loss: 4300529152.0000 - r2: 0.
8172 - val_loss: 10470012928.0000 - val_r2: 0.6168
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 4301428224.0000 - r2: 0.
8175 - val_loss: 11587800064.0000 - val_r2: 0.5762
Epoch 20/50
342/342 [==============================] - 2s 5ms/step - loss: 4296964608.0000 - r2: 0.
8175 - val_loss: 11552980992.0000 - val_r2: 0.5768
Epoch 21/50
342/342 [==============================] - 2s 5ms/step - loss: 4295818240.0000 - r2: 0.
8177 - val_loss: 10809815040.0000 - val_r2: 0.6040
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 4294925312.0000 - r2: 0.
8178 - val_loss: 10960581632.0000 - val_r2: 0.5986
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 4294653184.0000 - r2: 0.
8173 - val_loss: 10847040512.0000 - val_r2: 0.6023
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 4297402880.0000 - r2: 0.
8174 - val_loss: 10962416640.0000 - val_r2: 0.5987
Epoch 25/50
342/342 [==============================] - 2s 5ms/step - loss: 4296814592.0000 - r2: 0.
```

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8172 - val_loss: 10995421184.0000 - val_r2: 0.5968
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 4294394624.0000 - r2: 0.
8175 - val_loss: 10424577024.0000 - val_r2: 0.6178
Epoch 27/50
342/342 [==============================] - 2s 5ms/step - loss: 4294155008.0000 - r2: 0.
8177 - val_loss: 11505511424.0000 - val_r2: 0.5791
Epoch 28/50
342/342 [==============================] - 2s 5ms/step - loss: 4292388352.0000 - r2: 0.
8178 - val_loss: 10658909184.0000 - val_r2: 0.6097
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 4296458752.0000 - r2: 0.
8175 - val_loss: 11015828480.0000 - val_r2: 0.5968
Epoch 30/50
342/342 [==============================] - 2s 4ms/step - loss: 4295876096.0000 - r2: 0.
8176 - val_loss: 11409266688.0000 - val_r2: 0.5813
Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 4298457600.0000 - r2: 0.
8176 - val_loss: 10404177920.0000 - val_r2: 0.6192
Epoch 32/50
342/342 [==============================] - 2s 5ms/step - loss: 4298015744.0000 - r2: 0.
8175 - val_loss: 10348520448.0000 - val_r2: 0.6215
Epoch 33/50
342/342 [==============================] - 2s 4ms/step - loss: 4295517696.0000 - r2: 0.
8174 - val_loss: 11412959232.0000 - val_r2: 0.5819
Epoch 34/50
342/342 [==============================] - 2s 4ms/step - loss: 4297567232.0000 - r2: 0.
8180 - val_loss: 11189014528.0000 - val_r2: 0.5895
Epoch 35/50
342/342 [==============================] - 2s 5ms/step - loss: 4293269760.0000 - r2: 0.
8177 - val_loss: 11925702656.0000 - val_r2: 0.5633
Epoch 36/50
342/342 [==============================] - 2s 4ms/step - loss: 4296138752.0000 - r2: 0.
8175 - val_loss: 11661296640.0000 - val_r2: 0.5733
Epoch 37/50
342/342 [==============================] - 2s 4ms/step - loss: 4295155712.0000 - r2: 0.
8177 - val_loss: 11001415680.0000 - val_r2: 0.5973
Epoch 38/50
342/342 [==============================] - 2s 4ms/step - loss: 4291897600.0000 - r2: 0.
8176 - val_loss: 11315067904.0000 - val_r2: 0.5858
Epoch 39/50
342/342 [==============================] - 2s 4ms/step - loss: 4296313344.0000 - r2: 0.
8176 - val_loss: 11400420352.0000 - val_r2: 0.5821
Epoch 40/50
342/342 [==============================] - 2s 4ms/step - loss: 4297419264.0000 - r2: 0.
8176 - val_loss: 11366893568.0000 - val_r2: 0.5836
Epoch 41/50
342/342 [==============================] - 2s 4ms/step - loss: 4295795712.0000 - r2: 0.
8175 - val_loss: 11170376704.0000 - val_r2: 0.5905
Epoch 42/50
342/342 [==============================] - 2s 4ms/step - loss: 4298819072.0000 - r2: 0.
8178 - val_loss: 11259379712.0000 - val_r2: 0.5872
session cleared!

ix 3 i 1
updated temp_vec [1, 1, 1, 0, 1, 1, 1, 1, 1]
going through feature_mask [1, 1, 1, 0, 1, 1, 1, 1, 1]
KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=None), name='f
latten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
```

```
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 5ms/step - loss: 80495673344.0000 - r2: -
2.4372 - val_loss: 17870663680.0000 - val_r2: 0.3501
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 9202412544.0000 - r2: 0.
6111 - val_loss: 15069891584.0000 - val_r2: 0.4502
Epoch 3/50
342/342 [==============================] - 2s 6ms/step - loss: 7963362816.0000 - r2: 0.
6625 - val_loss: 14381225984.0000 - val_r2: 0.4746
Epoch 4/50
342/342 [==============================] - 2s 5ms/step - loss: 7388098560.0000 - r2: 0.
6870 - val_loss: 13286060032.0000 - val_r2: 0.5141
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 6963076608.0000 - r2: 0.
7045 - val_loss: 13144882176.0000 - val_r2: 0.5195
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 6563250688.0000 - r2: 0.
7215 - val_loss: 12646665216.0000 - val_r2: 0.5368
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 6179361280.0000 - r2: 0.
7382 - val_loss: 12423191552.0000 - val_r2: 0.5458
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 5814233600.0000 - r2: 0.
7539 - val_loss: 11836732416.0000 - val_r2: 0.5669
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 5498119168.0000 - r2: 0.
7667 - val_loss: 11320582144.0000 - val_r2: 0.5858
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 5232248320.0000 - r2: 0.
7779 - val_loss: 11286522880.0000 - val_r2: 0.5872
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 5018023936.0000 - r2: 0.
7869 - val_loss: 11062874112.0000 - val_r2: 0.5940
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 4835913216.0000 - r2: 0.
7946 - val_loss: 10545971200.0000 - val_r2: 0.6140
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4686564864.0000 - r2: 0.
8014 - val_loss: 10428934144.0000 - val_r2: 0.6177
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 4550263296.0000 - r2: 0.
8066 - val_loss: 10919398400.0000 - val_r2: 0.5998
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4437322752.0000 - r2: 0.
8114 - val_loss: 11104902144.0000 - val_r2: 0.5940
```

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Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 4336629248.0000 - r2: 0.
8158 - val_loss: 11001410560.0000 - val_r2: 0.5972
Epoch 17/50
342/342 [==============================] - 2s 5ms/step - loss: 4264702720.0000 - r2: 0.
8186 - val_loss: 10870009856.0000 - val_r2: 0.6016
Epoch 18/50
342/342 [==============================] - 2s 4ms/step - loss: 4200787200.0000 - r2: 0.
8215 - val_loss: 10283597824.0000 - val_r2: 0.6233
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 4147219200.0000 - r2: 0.
8238 - val_loss: 9934967808.0000 - val_r2: 0.6359
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 4117580544.0000 - r2: 0.
8248 - val_loss: 10374819840.0000 - val_r2: 0.6199
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 4086652160.0000 - r2: 0.
8262 - val_loss: 11558983680.0000 - val_r2: 0.5767
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 4066028032.0000 - r2: 0.
8273 - val_loss: 10714385408.0000 - val_r2: 0.6076
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 4049172736.0000 - r2: 0.
8280 - val_loss: 10346795008.0000 - val_r2: 0.6208
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 4045679360.0000 - r2: 0.
8280 - val_loss: 10423843840.0000 - val_r2: 0.6178
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 4037679616.0000 - r2: 0.
8282 - val_loss: 9867473920.0000 - val_r2: 0.6386
Epoch 26/50
342/342 [==============================] - 2s 5ms/step - loss: 4034238208.0000 - r2: 0.
8285 - val_loss: 9957960704.0000 - val_r2: 0.6347
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 4028502016.0000 - r2: 0.
8283 - val_loss: 10889845760.0000 - val_r2: 0.6005
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 4030767616.0000 - r2: 0.
8287 - val_loss: 9982628864.0000 - val_r2: 0.6341
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 4034046464.0000 - r2: 0.
8284 - val_loss: 10357706752.0000 - val_r2: 0.6205
Epoch 30/50
342/342 [==============================] - 2s 4ms/step - loss: 4029967872.0000 - r2: 0.
8289 - val_loss: 9798505472.0000 - val_r2: 0.6400
Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 4026867968.0000 - r2: 0.
8288 - val_loss: 9882098688.0000 - val_r2: 0.6374
Epoch 32/50
342/342 [==============================] - 2s 5ms/step - loss: 4025907712.0000 - r2: 0.
8291 - val_loss: 9466027008.0000 - val_r2: 0.6532
Epoch 33/50
342/342 [==============================] - 2s 4ms/step - loss: 4026418176.0000 - r2: 0.
8289 - val_loss: 10748668928.0000 - val_r2: 0.6051
Epoch 34/50
342/342 [==============================] - 2s 4ms/step - loss: 4029605376.0000 - r2: 0.
8289 - val_loss: 9761126400.0000 - val_r2: 0.6421
Epoch 35/50
342/342 [==============================] - 2s 5ms/step - loss: 4031402752.0000 - r2: 0.
8288 - val_loss: 10250723328.0000 - val_r2: 0.6240
```

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Epoch 36/50
342/342 [==============================] - 2s 4ms/step - loss: 4031625984.0000 - r2: 0.
8288 - val_loss: 10609468416.0000 - val_r2: 0.6100
Epoch 37/50
342/342 [==============================] - 2s 4ms/step - loss: 4028155136.0000 - r2: 0.
8288 - val_loss: 10410066944.0000 - val_r2: 0.6185
Epoch 38/50
342/342 [==============================] - 2s 4ms/step - loss: 4025265152.0000 - r2: 0.
8287 - val_loss: 10252887040.0000 - val_r2: 0.6237
Epoch 39/50
342/342 [==============================] - 2s 4ms/step - loss: 4025591040.0000 - r2: 0.
8290 - val_loss: 10318706688.0000 - val_r2: 0.6209
Epoch 40/50
342/342 [==============================] - 2s 4ms/step - loss: 4033463552.0000 - r2: 0.
8282 - val_loss: 10539613184.0000 - val_r2: 0.6138
Epoch 41/50
342/342 [==============================] - 2s 4ms/step - loss: 4026807552.0000 - r2: 0.
8290 - val_loss: 10363836416.0000 - val_r2: 0.6203
Epoch 42/50
342/342 [==============================] - 2s 4ms/step - loss: 4025837056.0000 - r2: 0.
8290 - val_loss: 11176003584.0000 - val_r2: 0.5898
session cleared!

ix 4 i 1
updated temp_vec [1, 1, 1, 1, 0, 1, 1, 1, 1]
going through feature_mask [1, 1, 1, 1, 0, 1, 1, 1, 1]
KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=None), name='f
latten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 5ms/step - loss: 80711655424.0000 - r2: -
2.4033 - val_loss: 18232870912.0000 - val_r2: 0.3377
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 9234685952.0000 - r2: 0.
6101 - val_loss: 15131847680.0000 - val_r2: 0.4470
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 7977432064.0000 - r2: 0.
6619 - val_loss: 13883782144.0000 - val_r2: 0.4932
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 7412662272.0000 - r2: 0.
6846 - val_loss: 13950188544.0000 - val_r2: 0.4901
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 6997133312.0000 - r2: 0.
7035 - val_loss: 12539573248.0000 - val_r2: 0.5416
Epoch 6/50
```

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342/342 [==============================] - 2s 4ms/step - loss: 6622203392.0000 - r2: 0.
7195 - val_loss: 12998205440.0000 - val_r2: 0.5242
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 6267579392.0000 - r2: 0.
7337 - val_loss: 12529460224.0000 - val_r2: 0.5414
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 5945974272.0000 - r2: 0.
7477 - val_loss: 12429953024.0000 - val_r2: 0.5447
Epoch 9/50
342/342 [==============================] - 2s 4ms/step - loss: 5664828416.0000 - r2: 0.
7599 - val_loss: 12277330944.0000 - val_r2: 0.5504
Epoch 10/50
342/342 [==============================] - 2s 4ms/step - loss: 5441388544.0000 - r2: 0.
7688 - val_loss: 11942919168.0000 - val_r2: 0.5624
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 5261246976.0000 - r2: 0.
7767 - val_loss: 11294402560.0000 - val_r2: 0.5867
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 5110703104.0000 - r2: 0.
7828 - val_loss: 11565496320.0000 - val_r2: 0.5763
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4979515392.0000 - r2: 0.
7887 - val_loss: 11568473088.0000 - val_r2: 0.5762
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 4864920064.0000 - r2: 0.
7936 - val_loss: 11210907648.0000 - val_r2: 0.5891
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4755517952.0000 - r2: 0.
7979 - val_loss: 10911067136.0000 - val_r2: 0.5998
Epoch 16/50
342/342 [==============================] - 2s 5ms/step - loss: 4661481984.0000 - r2: 0.
8020 - val_loss: 11462226944.0000 - val_r2: 0.5802
Epoch 17/50
342/342 [==============================] - 2s 4ms/step - loss: 4583750656.0000 - r2: 0.
8055 - val_loss: 10438235136.0000 - val_r2: 0.6174
Epoch 18/50
342/342 [==============================] - 2s 5ms/step - loss: 4522015232.0000 - r2: 0.
8078 - val_loss: 10574886912.0000 - val_r2: 0.6128
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 4469915136.0000 - r2: 0.
8098 - val_loss: 11054543872.0000 - val_r2: 0.5952
Epoch 20/50
342/342 [==============================] - 2s 5ms/step - loss: 4434426368.0000 - r2: 0.
8115 - val_loss: 10639208448.0000 - val_r2: 0.6094
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 4408077312.0000 - r2: 0.
8127 - val_loss: 11063087104.0000 - val_r2: 0.5946
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 4393796608.0000 - r2: 0.
8135 - val_loss: 10329194496.0000 - val_r2: 0.6217
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 4375490560.0000 - r2: 0.
8143 - val_loss: 10568276992.0000 - val_r2: 0.6130
Epoch 24/50
342/342 [==============================] - 2s 5ms/step - loss: 4365385728.0000 - r2: 0.
8147 - val_loss: 11027198976.0000 - val_r2: 0.5960
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 4355033600.0000 - r2: 0.
8147 - val_loss: 10241219584.0000 - val_r2: 0.6246
Epoch 26/50
```

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342/342 [==============================] - 2s 4ms/step - loss: 4350126592.0000 - r2: 0.
8154 - val_loss: 10446946304.0000 - val_r2: 0.6175
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 4354115072.0000 - r2: 0.
8151 - val_loss: 11587213312.0000 - val_r2: 0.5749
Epoch 28/50
342/342 [==============================] - 2s 5ms/step - loss: 4352003584.0000 - r2: 0.
8149 - val_loss: 11166474240.0000 - val_r2: 0.5909
Epoch 29/50
342/342 [==============================] - 2s 5ms/step - loss: 4347476992.0000 - r2: 0.
8154 - val_loss: 11686495232.0000 - val_r2: 0.5723
Epoch 30/50
342/342 [==============================] - 2s 4ms/step - loss: 4351278080.0000 - r2: 0.
8152 - val_loss: 11057091584.0000 - val_r2: 0.5950
Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 4349202944.0000 - r2: 0.
8150 - val_loss: 10264541184.0000 - val_r2: 0.6235
Epoch 32/50
342/342 [==============================] - 2s 4ms/step - loss: 4347315200.0000 - r2: 0.
8154 - val_loss: 11440153600.0000 - val_r2: 0.5808
Epoch 33/50
342/342 [==============================] - 2s 4ms/step - loss: 4345354752.0000 - r2: 0.
8153 - val_loss: 10376419328.0000 - val_r2: 0.6187
Epoch 34/50
342/342 [==============================] - 2s 4ms/step - loss: 4350939136.0000 - r2: 0.
8152 - val_loss: 10426923008.0000 - val_r2: 0.6171
Epoch 35/50
342/342 [==============================] - 2s 5ms/step - loss: 4349132288.0000 - r2: 0.
8151 - val_loss: 10596150272.0000 - val_r2: 0.6124
session cleared!

ix 5 i 1
updated temp_vec [1, 1, 1, 1, 1, 0, 1, 1, 1]
going through feature_mask [1, 1, 1, 1, 1, 0, 1, 1, 1]
KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=None), name='f
latten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 3s 5ms/step - loss: 80398843904.0000 - r2: -
2.3915 - val_loss: 17927591936.0000 - val_r2: 0.3481
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 9302264832.0000 - r2: 0.
6064 - val_loss: 14980526080.0000 - val_r2: 0.4540
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 8118947328.0000 - r2: 0.
```

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6559 - val_loss: 14407076864.0000 - val_r2: 0.4740
Epoch 4/50
342/342 [==============================] - 2s 5ms/step - loss: 7576016384.0000 - r2: 0.
6784 - val_loss: 13424757760.0000 - val_r2: 0.5094
Epoch 5/50
342/342 [==============================] - 2s 5ms/step - loss: 7180418560.0000 - r2: 0.
6951 - val_loss: 13202658304.0000 - val_r2: 0.5179
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 6808173056.0000 - r2: 0.
7114 - val_loss: 12264760320.0000 - val_r2: 0.5519
Epoch 7/50
342/342 [==============================] - 2s 5ms/step - loss: 6437244928.0000 - r2: 0.
7271 - val_loss: 12130525184.0000 - val_r2: 0.5567
Epoch 8/50
342/342 [==============================] - 2s 5ms/step - loss: 6059947008.0000 - r2: 0.
7427 - val_loss: 12054940672.0000 - val_r2: 0.5591
Epoch 9/50
342/342 [==============================] - 2s 4ms/step - loss: 5704654336.0000 - r2: 0.
7582 - val_loss: 12802484224.0000 - val_r2: 0.5313
Epoch 10/50
342/342 [==============================] - 2s 4ms/step - loss: 5395784704.0000 - r2: 0.
7713 - val_loss: 11700237312.0000 - val_r2: 0.5721
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 5126403072.0000 - r2: 0.
7829 - val_loss: 11407868928.0000 - val_r2: 0.5828
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 4907173376.0000 - r2: 0.
7916 - val_loss: 11656908800.0000 - val_r2: 0.5726
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4728506368.0000 - r2: 0.
7990 - val_loss: 10740834304.0000 - val_r2: 0.6066
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 4566230528.0000 - r2: 0.
8063 - val_loss: 11687936000.0000 - val_r2: 0.5721
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4422736896.0000 - r2: 0.
8121 - val_loss: 11053454336.0000 - val_r2: 0.5952
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 4302544384.0000 - r2: 0.
8173 - val_loss: 10791914496.0000 - val_r2: 0.6047
Epoch 17/50
342/342 [==============================] - 2s 4ms/step - loss: 4205160448.0000 - r2: 0.
8212 - val_loss: 10386314240.0000 - val_r2: 0.6197
Epoch 18/50
342/342 [==============================] - 2s 5ms/step - loss: 4119240704.0000 - r2: 0.
8253 - val_loss: 10105574400.0000 - val_r2: 0.6299
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 4053384704.0000 - r2: 0.
8278 - val_loss: 10690438144.0000 - val_r2: 0.6080
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 4001106688.0000 - r2: 0.
8298 - val_loss: 9948614656.0000 - val_r2: 0.6352
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 3962021120.0000 - r2: 0.
8315 - val_loss: 10594677760.0000 - val_r2: 0.6110
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 3933258752.0000 - r2: 0.
8328 - val_loss: 10798641152.0000 - val_r2: 0.6041
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 3910182400.0000 - r2: 0.
```

```
8339 - val_loss: 10988827648.0000 - val_r2: 0.5967
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 3885136896.0000 - r2: 0.
8352 - val_loss: 11367307264.0000 - val_r2: 0.5836
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 3876626432.0000 - r2: 0.
8351 - val_loss: 10585232384.0000 - val_r2: 0.6109
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 3864109056.0000 - r2: 0.
8355 - val_loss: 10306058240.0000 - val_r2: 0.6221
Epoch 27/50
342/342 [==============================] - 2s 5ms/step - loss: 3849888256.0000 - r2: 0.
8363 - val_loss: 10761812992.0000 - val_r2: 0.6046
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 3846124544.0000 - r2: 0.
8365 - val_loss: 9740153856.0000 - val_r2: 0.6426
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 3833835520.0000 - r2: 0.
8372 - val_loss: 10296077312.0000 - val_r2: 0.6228
Epoch 30/50
342/342 [==============================] - 2s 4ms/step - loss: 3827265792.0000 - r2: 0.
8373 - val_loss: 9998372864.0000 - val_r2: 0.6327
Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 3822737664.0000 - r2: 0.
8373 - val_loss: 10598210560.0000 - val_r2: 0.6111
Epoch 32/50
342/342 [==============================] - 2s 5ms/step - loss: 3812735232.0000 - r2: 0.
8382 - val_loss: 10312808448.0000 - val_r2: 0.6221
Epoch 33/50
342/342 [==============================] - 2s 4ms/step - loss: 3809062400.0000 - r2: 0.
8383 - val_loss: 9991796736.0000 - val_r2: 0.6339
Epoch 34/50
342/342 [==============================] - 2s 4ms/step - loss: 3804163584.0000 - r2: 0.
8383 - val_loss: 10487187456.0000 - val_r2: 0.6155
Epoch 35/50
342/342 [==============================] - 2s 4ms/step - loss: 3802187520.0000 - r2: 0.
8385 - val_loss: 9794363392.0000 - val_r2: 0.6412
Epoch 36/50
342/342 [==============================] - 2s 4ms/step - loss: 3806201600.0000 - r2: 0.
8381 - val_loss: 11287945216.0000 - val_r2: 0.5862
Epoch 37/50
342/342 [==============================] - 2s 5ms/step - loss: 3797568256.0000 - r2: 0.
8387 - val_loss: 10275117056.0000 - val_r2: 0.6231
Epoch 38/50
342/342 [==============================] - 2s 5ms/step - loss: 3790469888.0000 - r2: 0.
8389 - val_loss: 10649269248.0000 - val_r2: 0.6096
session cleared!

ix 6 i 1
updated temp_vec [1, 1, 1, 1, 1, 1, 0, 1, 1]
going through feature_mask [1, 1, 1, 1, 1, 1, 0, 1, 1]
KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=None), name='f
latten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
```

```
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 5ms/step - loss: 80080289792.0000 - r2: -
2.4051 - val_loss: 17803132928.0000 - val_r2: 0.3526
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 9334406144.0000 - r2: 0.
6051 - val_loss: 14682474496.0000 - val_r2: 0.4639
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 8150084608.0000 - r2: 0.
6547 - val_loss: 14057127936.0000 - val_r2: 0.4857
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 7612501504.0000 - r2: 0.
6776 - val_loss: 13795707904.0000 - val_r2: 0.4950
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 7222210560.0000 - r2: 0.
6940 - val_loss: 12871858176.0000 - val_r2: 0.5287
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 6849555968.0000 - r2: 0.
7094 - val_loss: 12853231616.0000 - val_r2: 0.5298
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 6470360576.0000 - r2: 0.
7253 - val_loss: 12347099136.0000 - val_r2: 0.5486
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 6069558784.0000 - r2: 0.
7427 - val_loss: 12301194240.0000 - val_r2: 0.5496
Epoch 9/50
342/342 [==============================] - 2s 4ms/step - loss: 5676581888.0000 - r2: 0.
7592 - val_loss: 11909481472.0000 - val_r2: 0.5641
Epoch 10/50
342/342 [==============================] - 2s 4ms/step - loss: 5305610752.0000 - r2: 0.
7747 - val_loss: 11855142912.0000 - val_r2: 0.5658
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 4977228800.0000 - r2: 0.
7890 - val_loss: 11507351552.0000 - val_r2: 0.5783
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 4692942848.0000 - r2: 0.
8008 - val_loss: 11045811200.0000 - val_r2: 0.5962
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4451047936.0000 - r2: 0.
8108 - val_loss: 10722797568.0000 - val_r2: 0.6071
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 4255181568.0000 - r2: 0.
8191 - val_loss: 10986463232.0000 - val_r2: 0.5972
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4096100608.0000 - r2: 0.
8265 - val_loss: 9943513088.0000 - val_r2: 0.6348
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 3991401984.0000 - r2: 0.
8304 - val_loss: 10077490176.0000 - val_r2: 0.6306
Epoch 17/50
342/342 [==============================] - 2s 4ms/step - loss: 3914690304.0000 - r2: 0.
8336 - val_loss: 10446841856.0000 - val_r2: 0.6171
```

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Epoch 18/50
342/342 [==============================] - 2s 4ms/step - loss: 3865083904.0000 - r2: 0.
8358 - val_loss: 10470786048.0000 - val_r2: 0.6162
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 3835939328.0000 - r2: 0.
8368 - val_loss: 11169783808.0000 - val_r2: 0.5901
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 3816835584.0000 - r2: 0.
8378 - val_loss: 11137601536.0000 - val_r2: 0.5914
Epoch 21/50
342/342 [==============================] - 2s 5ms/step - loss: 3802668800.0000 - r2: 0.
8384 - val_loss: 10131096576.0000 - val_r2: 0.6289
Epoch 22/50
342/342 [==============================] - 2s 5ms/step - loss: 3784996352.0000 - r2: 0.
8393 - val_loss: 10241388544.0000 - val_r2: 0.6242
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 3780587776.0000 - r2: 0.
8392 - val_loss: 9483613184.0000 - val_r2: 0.6521
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 3767889920.0000 - r2: 0.
8401 - val_loss: 9986979840.0000 - val_r2: 0.6336
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 3756922624.0000 - r2: 0.
8401 - val_loss: 9501573120.0000 - val_r2: 0.6516
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 3751091200.0000 - r2: 0.
8407 - val_loss: 10717040640.0000 - val_r2: 0.6077
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 3746099712.0000 - r2: 0.
8408 - val_loss: 10358139904.0000 - val_r2: 0.6197
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 3732866560.0000 - r2: 0.
8410 - val_loss: 9890068480.0000 - val_r2: 0.6374
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 3724982784.0000 - r2: 0.
8417 - val_loss: 10497672192.0000 - val_r2: 0.6151
Epoch 30/50
342/342 [==============================] - 2s 4ms/step - loss: 3718452736.0000 - r2: 0.
8419 - val_loss: 9602296832.0000 - val_r2: 0.6475
Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 3716409600.0000 - r2: 0.
8420 - val_loss: 10761810944.0000 - val_r2: 0.6051
Epoch 32/50
342/342 [==============================] - 2s 5ms/step - loss: 3707588864.0000 - r2: 0.
8427 - val_loss: 10352261120.0000 - val_r2: 0.6209
Epoch 33/50
342/342 [==============================] - 2s 5ms/step - loss: 3698672640.0000 - r2: 0.
8427 - val_loss: 10635817984.0000 - val_r2: 0.6098
session cleared!

ix 7 i 1
updated temp_vec [1, 1, 1, 1, 1, 1, 1, 0, 1]
going through feature_mask [1, 1, 1, 1, 1, 1, 1, 0, 1]
KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=None), name='f
latten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
```

```
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 5ms/step - loss: 80175898624.0000 - r2: -
2.4489 - val_loss: 17686804480.0000 - val_r2: 0.3576
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 9343433728.0000 - r2: 0.
6052 - val_loss: 15319055360.0000 - val_r2: 0.4409
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 8208274944.0000 - r2: 0.
6521 - val_loss: 13705702400.0000 - val_r2: 0.4997
Epoch 4/50
342/342 [==============================] - 2s 5ms/step - loss: 7718840320.0000 - r2: 0.
6728 - val_loss: 14526059520.0000 - val_r2: 0.4692
Epoch 5/50
342/342 [==============================] - 2s 5ms/step - loss: 7370313216.0000 - r2: 0.
6875 - val_loss: 13381168128.0000 - val_r2: 0.5105
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 7057735680.0000 - r2: 0.
7008 - val_loss: 13255412736.0000 - val_r2: 0.5152
Epoch 7/50
342/342 [==============================] - 2s 5ms/step - loss: 6746699776.0000 - r2: 0.
7139 - val_loss: 12857327616.0000 - val_r2: 0.5298
Epoch 8/50
342/342 [==============================] - 3s 7ms/step - loss: 6439802880.0000 - r2: 0.
7269 - val_loss: 12509320192.0000 - val_r2: 0.5424
Epoch 9/50
342/342 [==============================] - 2s 6ms/step - loss: 6150098944.0000 - r2: 0.
7392 - val_loss: 11966364672.0000 - val_r2: 0.5620
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 5886361600.0000 - r2: 0.
7502 - val_loss: 12451021824.0000 - val_r2: 0.5452
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 5653027840.0000 - r2: 0.
7601 - val_loss: 11882528768.0000 - val_r2: 0.5642
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 5446935040.0000 - r2: 0.
7687 - val_loss: 11150854144.0000 - val_r2: 0.5916
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 5261761024.0000 - r2: 0.
7766 - val_loss: 11284672512.0000 - val_r2: 0.5868
Epoch 14/50
342/342 [==============================] - 2s 5ms/step - loss: 5096023040.0000 - r2: 0.
7835 - val_loss: 11181058048.0000 - val_r2: 0.5902
Epoch 15/50
342/342 [==============================] - 2s 5ms/step - loss: 4948155904.0000 - r2: 0.
7898 - val_loss: 11170469888.0000 - val_r2: 0.5905
Epoch 16/50
342/342 [==============================] - 2s 5ms/step - loss: 4822238208.0000 - r2: 0.
7952 - val_loss: 10289341440.0000 - val_r2: 0.6230
Epoch 17/50
```

```
342/342 [==============================] - 2s 5ms/step - loss: 4719842304.0000 - r2: 0.
7999 - val_loss: 10911794176.0000 - val_r2: 0.5999
Epoch 18/50
342/342 [==============================] - 2s 5ms/step - loss: 4632202752.0000 - r2: 0.
8030 - val_loss: 10720440320.0000 - val_r2: 0.6076
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 4564213760.0000 - r2: 0.
8061 - val_loss: 10578983936.0000 - val_r2: 0.6126
Epoch 20/50
342/342 [==============================] - 3s 7ms/step - loss: 4511161856.0000 - r2: 0.
8080 - val_loss: 10754480128.0000 - val_r2: 0.6061
Epoch 21/50
342/342 [==============================] - 2s 6ms/step - loss: 4468314112.0000 - r2: 0.
8102 - val_loss: 10484645888.0000 - val_r2: 0.6163
Epoch 22/50
342/342 [==============================] - 2s 5ms/step - loss: 4433625088.0000 - r2: 0.
8117 - val_loss: 10072026112.0000 - val_r2: 0.6306
Epoch 23/50
342/342 [==============================] - 2s 5ms/step - loss: 4407047168.0000 - r2: 0.
8129 - val_loss: 10943974400.0000 - val_r2: 0.5989
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 4392254464.0000 - r2: 0.
8136 - val_loss: 9771290624.0000 - val_r2: 0.6421
Epoch 25/50
342/342 [==============================] - 2s 5ms/step - loss: 4374901248.0000 - r2: 0.
8139 - val_loss: 10695561216.0000 - val_r2: 0.6082
Epoch 26/50
342/342 [==============================] - 2s 5ms/step - loss: 4360040448.0000 - r2: 0.
8148 - val_loss: 10487298048.0000 - val_r2: 0.6151
Epoch 27/50
342/342 [==============================] - 2s 5ms/step - loss: 4348233216.0000 - r2: 0.
8150 - val_loss: 10487799808.0000 - val_r2: 0.6149
Epoch 28/50
342/342 [==============================] - 2s 5ms/step - loss: 4345607168.0000 - r2: 0.
8153 - val_loss: 10659180544.0000 - val_r2: 0.6095
Epoch 29/50
342/342 [==============================] - 2s 5ms/step - loss: 4334695424.0000 - r2: 0.
8160 - val_loss: 10673411072.0000 - val_r2: 0.6089
Epoch 30/50
342/342 [==============================] - 2s 4ms/step - loss: 4328178176.0000 - r2: 0.
8160 - val_loss: 10705417216.0000 - val_r2: 0.6070
Epoch 31/50
342/342 [==============================] - 2s 5ms/step - loss: 4330211328.0000 - r2: 0.
8156 - val_loss: 10670054400.0000 - val_r2: 0.6086
Epoch 32/50
342/342 [==============================] - 2s 4ms/step - loss: 4323808256.0000 - r2: 0.
8163 - val_loss: 10939929600.0000 - val_r2: 0.5997
Epoch 33/50
342/342 [==============================] - 2s 5ms/step - loss: 4312432128.0000 - r2: 0.
8170 - val_loss: 11187687424.0000 - val_r2: 0.5902
Epoch 34/50
342/342 [==============================] - 2s 5ms/step - loss: 4311614976.0000 - r2: 0.
8169 - val_loss: 10751865856.0000 - val_r2: 0.6061
session cleared!

ix 8 i 1
updated temp_vec [1, 1, 1, 1, 1, 1, 1, 1, 0]
going through feature_mask [1, 1, 1, 1, 1, 1, 1, 1, 0]
KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=None), name='f
latten/Reshape:0', description="created by layer 'flatten'")
```

```
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 3s 5ms/step - loss: 80158990336.0000 - r2: -
2.4264 - val_loss: 18186868736.0000 - val_r2: 0.3386
Epoch 2/50
342/342 [==============================] - 2s 5ms/step - loss: 9509337088.0000 - r2: 0.
5982 - val_loss: 15857568768.0000 - val_r2: 0.4209
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 8439908352.0000 - r2: 0.
6425 - val_loss: 14305497088.0000 - val_r2: 0.4767
Epoch 4/50
342/342 [==============================] - 2s 5ms/step - loss: 8023572480.0000 - r2: 0.
6601 - val_loss: 14619164672.0000 - val_r2: 0.4651
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 7759451648.0000 - r2: 0.
6710 - val_loss: 13963573248.0000 - val_r2: 0.4889
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 7541074432.0000 - r2: 0.
6799 - val_loss: 14192051200.0000 - val_r2: 0.4811
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 7342496256.0000 - r2: 0.
6885 - val_loss: 13567130624.0000 - val_r2: 0.5036
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 7158838272.0000 - r2: 0.
6968 - val_loss: 13145064448.0000 - val_r2: 0.5195
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 7000005120.0000 - r2: 0.
7028 - val_loss: 13536392192.0000 - val_r2: 0.5051
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 6871961600.0000 - r2: 0.
7081 - val_loss: 13212436480.0000 - val_r2: 0.5155
Epoch 11/50
342/342 [==============================] - 2s 5ms/step - loss: 6772603904.0000 - r2: 0.
7126 - val_loss: 13197639680.0000 - val_r2: 0.5166
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 6711330304.0000 - r2: 0.
7149 - val_loss: 12575580160.0000 - val_r2: 0.5401
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 6662393344.0000 - r2: 0.
7168 - val_loss: 13257688064.0000 - val_r2: 0.5150
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 6632907264.0000 - r2: 0.
7178 - val_loss: 12876764160.0000 - val_r2: 0.5290
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 6611277824.0000 - r2: 0.
```

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7193 - val_loss: 13708978176.0000 - val_r2: 0.4981
Epoch 16/50
342/342 [==============================] - 2s 5ms/step - loss: 6593835520.0000 - r2: 0.
7201 - val_loss: 13261856768.0000 - val_r2: 0.5148
Epoch 17/50
342/342 [==============================] - 2s 5ms/step - loss: 6588242432.0000 - r2: 0.
7207 - val_loss: 13035227136.0000 - val_r2: 0.5234
Epoch 18/50
342/342 [==============================] - 3s 7ms/step - loss: 6570256384.0000 - r2: 0.
7209 - val_loss: 12478478336.0000 - val_r2: 0.5427
Epoch 19/50
342/342 [==============================] - 2s 6ms/step - loss: 6559140864.0000 - r2: 0.
7212 - val_loss: 13271840768.0000 - val_r2: 0.5146
Epoch 20/50
342/342 [==============================] - 2s 5ms/step - loss: 6547275776.0000 - r2: 0.
7215 - val_loss: 13454249984.0000 - val_r2: 0.5071
Epoch 21/50
342/342 [==============================] - 2s 5ms/step - loss: 6545554432.0000 - r2: 0.
7225 - val_loss: 13153554432.0000 - val_r2: 0.5190
Epoch 22/50
342/342 [==============================] - 2s 5ms/step - loss: 6538350592.0000 - r2: 0.
7226 - val_loss: 13555025920.0000 - val_r2: 0.5046
Epoch 23/50
342/342 [==============================] - 2s 5ms/step - loss: 6527509504.0000 - r2: 0.
7230 - val_loss: 12778303488.0000 - val_r2: 0.5325
Epoch 24/50
342/342 [==============================] - 2s 5ms/step - loss: 6525082112.0000 - r2: 0.
7230 - val_loss: 13613329408.0000 - val_r2: 0.5013
Epoch 25/50
342/342 [==============================] - 2s 5ms/step - loss: 6513960448.0000 - r2: 0.
7231 - val_loss: 13027079168.0000 - val_r2: 0.5234
Epoch 26/50
342/342 [==============================] - 2s 5ms/step - loss: 6505930752.0000 - r2: 0.
7233 - val_loss: 13163394048.0000 - val_r2: 0.5175
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 6498365440.0000 - r2: 0.
7240 - val_loss: 12059819008.0000 - val_r2: 0.5592
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 6486931456.0000 - r2: 0.
7248 - val_loss: 12951625728.0000 - val_r2: 0.5253
Epoch 29/50
342/342 [==============================] - 2s 5ms/step - loss: 6486639104.0000 - r2: 0.
7241 - val_loss: 12056755200.0000 - val_r2: 0.5589
Epoch 30/50
342/342 [==============================] - 2s 6ms/step - loss: 6483221504.0000 - r2: 0.
7244 - val_loss: 13351948288.0000 - val_r2: 0.5118
Epoch 31/50
342/342 [==============================] - 2s 5ms/step - loss: 6475042816.0000 - r2: 0.
7256 - val_loss: 14420697088.0000 - val_r2: 0.4729
Epoch 32/50
342/342 [==============================] - 2s 5ms/step - loss: 6466921984.0000 - r2: 0.
7252 - val_loss: 12679285760.0000 - val_r2: 0.5358
Epoch 33/50
342/342 [==============================] - 2s 4ms/step - loss: 6461721600.0000 - r2: 0.
7261 - val_loss: 13083009024.0000 - val_r2: 0.5209
Epoch 34/50
342/342 [==============================] - 2s 4ms/step - loss: 6455377920.0000 - r2: 0.
7261 - val_loss: 12688973824.0000 - val_r2: 0.5356
Epoch 35/50
342/342 [==============================] - 2s 4ms/step - loss: 6450290688.0000 - r2: 0.
```

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7256 - val_loss: 13568328704.0000 - val_r2: 0.5036
Epoch 36/50
342/342 [==============================] - 2s 4ms/step - loss: 6445832704.0000 - r2: 0.
7267 - val_loss: 13505464320.0000 - val_r2: 0.5055
Epoch 37/50
342/342 [==============================] - 2s 4ms/step - loss: 6437641728.0000 - r2: 0.
7269 - val_loss: 13232326656.0000 - val_r2: 0.5149
Epoch 38/50
342/342 [==============================] - 2s 4ms/step - loss: 6441622016.0000 - r2: 0.
7272 - val_loss: 13128293376.0000 - val_r2: 0.5193
Epoch 39/50
342/342 [==============================] - 2s 4ms/step - loss: 6431753728.0000 - r2: 0.
7268 - val_loss: 13192140800.0000 - val_r2: 0.5168
session cleared!

668.8013157844543 seconds elapsed

vec [0, 1, 1, 1, 1, 1, 1, 1, 1]
ix 0 i 0
ix 1 i 1
updated temp_vec [0, 0, 1, 1, 1, 1, 1, 1, 1]
going through feature_mask [0, 0, 1, 1, 1, 1, 1, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=Non
e), name='flatten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 5ms/step - loss: 90005692416.0000 - r2: -
2.8329 - val_loss: 19830272000.0000 - val_r2: 0.2789
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 10645669888.0000 - r2:
0.5503 - val_loss: 16980983808.0000 - val_r2: 0.3818
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 9456443392.0000 - r2: 0.
6001 - val_loss: 15808874496.0000 - val_r2: 0.4234
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 8786861056.0000 - r2: 0.
6282 - val_loss: 15212924928.0000 - val_r2: 0.4443
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 8235969536.0000 - r2: 0.
6511 - val_loss: 14868723712.0000 - val_r2: 0.4574
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 7713276416.0000 - r2: 0.
6736 - val_loss: 14186053632.0000 - val_r2: 0.4818
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 7206021632.0000 - r2: 0.
```

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6948 - val_loss: 14747133952.0000 - val_r2: 0.4616
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 6742014464.0000 - r2: 0.
7149 - val_loss: 13171303424.0000 - val_r2: 0.5188
Epoch 9/50
342/342 [==============================] - 2s 4ms/step - loss: 6348805632.0000 - r2: 0.
7311 - val_loss: 12585592832.0000 - val_r2: 0.5401
Epoch 10/50
342/342 [==============================] - 2s 4ms/step - loss: 6012047360.0000 - r2: 0.
7457 - val_loss: 12634760192.0000 - val_r2: 0.5385
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 5736128512.0000 - r2: 0.
7566 - val_loss: 11935260672.0000 - val_r2: 0.5642
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 5500752896.0000 - r2: 0.
7672 - val_loss: 12131320832.0000 - val_r2: 0.5564
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 5289134080.0000 - r2: 0.
7759 - val_loss: 12078824448.0000 - val_r2: 0.5578
Epoch 14/50
342/342 [==============================] - 3s 8ms/step - loss: 5111194112.0000 - r2: 0.
7834 - val_loss: 11510254592.0000 - val_r2: 0.5787
Epoch 15/50
342/342 [==============================] - 3s 7ms/step - loss: 4957054464.0000 - r2: 0.
7899 - val_loss: 11813090304.0000 - val_r2: 0.5675
Epoch 16/50
342/342 [==============================] - 3s 8ms/step - loss: 4831053312.0000 - r2: 0.
7953 - val_loss: 11820143616.0000 - val_r2: 0.5670
Epoch 17/50
342/342 [==============================] - 2s 5ms/step - loss: 4727578112.0000 - r2: 0.
7997 - val_loss: 11686343680.0000 - val_r2: 0.5720
Epoch 18/50
342/342 [==============================] - 2s 4ms/step - loss: 4644462592.0000 - r2: 0.
8026 - val_loss: 11796517888.0000 - val_r2: 0.5681
Epoch 19/50
342/342 [==============================] - 2s 4ms/step - loss: 4582528512.0000 - r2: 0.
8055 - val_loss: 11471808512.0000 - val_r2: 0.5799
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 4533689344.0000 - r2: 0.
8075 - val_loss: 10889774080.0000 - val_r2: 0.6016
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 4493766656.0000 - r2: 0.
8095 - val_loss: 11653874688.0000 - val_r2: 0.5736
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 4462586368.0000 - r2: 0.
8108 - val_loss: 11904147456.0000 - val_r2: 0.5639
Epoch 23/50
342/342 [==============================] - 2s 5ms/step - loss: 4438259712.0000 - r2: 0.
8115 - val_loss: 10838308864.0000 - val_r2: 0.6034
Epoch 24/50
342/342 [==============================] - 2s 5ms/step - loss: 4422277120.0000 - r2: 0.
8125 - val_loss: 10559202304.0000 - val_r2: 0.6137
Epoch 25/50
342/342 [==============================] - 2s 5ms/step - loss: 4409693184.0000 - r2: 0.
8129 - val_loss: 10907449344.0000 - val_r2: 0.6005
Epoch 26/50
342/342 [==============================] - 2s 5ms/step - loss: 4394734080.0000 - r2: 0.
8137 - val_loss: 11791185920.0000 - val_r2: 0.5685
Epoch 27/50
342/342 [==============================] - 2s 5ms/step - loss: 4388009984.0000 - r2: 0.
```

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8139 - val_loss: 12077436928.0000 - val_r2: 0.5580
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 4381473792.0000 - r2: 0.
8141 - val_loss: 10609126400.0000 - val_r2: 0.6119
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 4377974272.0000 - r2: 0.
8143 - val_loss: 11426770944.0000 - val_r2: 0.5809
Epoch 30/50
342/342 [==============================] - 2s 4ms/step - loss: 4369295360.0000 - r2: 0.
8143 - val_loss: 10923433984.0000 - val_r2: 0.5998
Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 4363771904.0000 - r2: 0.
8148 - val_loss: 10503582720.0000 - val_r2: 0.6155
Epoch 32/50
342/342 [==============================] - 2s 4ms/step - loss: 4361182208.0000 - r2: 0.
8146 - val_loss: 11285430272.0000 - val_r2: 0.5869
Epoch 33/50
342/342 [==============================] - 2s 4ms/step - loss: 4349387264.0000 - r2: 0.
8152 - val_loss: 10613336064.0000 - val_r2: 0.6121
Epoch 34/50
342/342 [==============================] - 2s 5ms/step - loss: 4352168960.0000 - r2: 0.
8154 - val_loss: 10952532992.0000 - val_r2: 0.5978
Epoch 35/50
342/342 [==============================] - 2s 4ms/step - loss: 4344773632.0000 - r2: 0.
8155 - val_loss: 10671338496.0000 - val_r2: 0.6091
Epoch 36/50
342/342 [==============================] - 2s 5ms/step - loss: 4346535424.0000 - r2: 0.
8156 - val_loss: 10471223296.0000 - val_r2: 0.6166
Epoch 37/50
342/342 [==============================] - 2s 4ms/step - loss: 4341458432.0000 - r2: 0.
8158 - val_loss: 11071927296.0000 - val_r2: 0.5945
Epoch 38/50
342/342 [==============================] - 2s 5ms/step - loss: 4340793856.0000 - r2: 0.
8155 - val_loss: 10328383488.0000 - val_r2: 0.6221
Epoch 39/50
342/342 [==============================] - 2s 4ms/step - loss: 4342792192.0000 - r2: 0.
8158 - val_loss: 10833520640.0000 - val_r2: 0.6036
Epoch 40/50
342/342 [==============================] - 2s 5ms/step - loss: 4330809344.0000 - r2: 0.
8162 - val_loss: 11316944896.0000 - val_r2: 0.5860
Epoch 41/50
342/342 [==============================] - 2s 4ms/step - loss: 4330205184.0000 - r2: 0.
8165 - val_loss: 11302493184.0000 - val_r2: 0.5867
Epoch 42/50
342/342 [==============================] - 2s 4ms/step - loss: 4331473920.0000 - r2: 0.
8160 - val_loss: 11888680960.0000 - val_r2: 0.5645
Epoch 43/50
342/342 [==============================] - 2s 5ms/step - loss: 4328078336.0000 - r2: 0.
8163 - val_loss: 10934825984.0000 - val_r2: 0.6002
Epoch 44/50
342/342 [==============================] - 2s 5ms/step - loss: 4328529408.0000 - r2: 0.
8165 - val_loss: 11404837888.0000 - val_r2: 0.5815
Epoch 45/50
342/342 [==============================] - 2s 5ms/step - loss: 4325100032.0000 - r2: 0.
8165 - val_loss: 11374733312.0000 - val_r2: 0.5834
Epoch 46/50
342/342 [==============================] - 2s 5ms/step - loss: 4325207552.0000 - r2: 0.
8167 - val_loss: 11079190528.0000 - val_r2: 0.5942
Epoch 47/50
342/342 [==============================] - 2s 5ms/step - loss: 4323763200.0000 - r2: 0.
```

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8161 - val_loss: 11451700224.0000 - val_r2: 0.5811
Epoch 48/50
342/342 [==============================] - 2s 5ms/step - loss: 4325681152.0000 - r2: 0.
8161 - val_loss: 11125625856.0000 - val_r2: 0.5930
session cleared!

ix 2 i 1
updated temp_vec [0, 1, 0, 1, 1, 1, 1, 1, 1]
going through feature_mask [0, 1, 0, 1, 1, 1, 1, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=Non
e), name='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 4ms/step - loss: 116803567616.0000 - r2:
 -3.8894 - val_loss: 32792778752.0000 - val_r2: -0.1930
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 19393314816.0000 - r2:
 0.1809 - val_loss: 27624755200.0000 - val_r2: -0.0074
Epoch 3/50
342/342 [==============================] - 2s 5ms/step - loss: 17267003392.0000 - r2:
 0.2699 - val_loss: 25910161408.0000 - val_r2: 0.0533
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 15947011072.0000 - r2:
 0.3255 - val_loss: 24429602816.0000 - val_r2: 0.1070
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 14702606336.0000 - r2:
 0.3771 - val_loss: 22537934848.0000 - val_r2: 0.1766
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 13371957248.0000 - r2:
 0.4340 - val_loss: 20977225728.0000 - val_r2: 0.2328
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 11929003008.0000 - r2:
 0.4947 - val_loss: 19830919168.0000 - val_r2: 0.2747
Epoch 8/50
342/342 [==============================] - 2s 5ms/step - loss: 10387715072.0000 - r2:
 0.5598 - val_loss: 18092353536.0000 - val_r2: 0.3380
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 8844957696.0000 - r2: 0.
6255 - val_loss: 16083867648.0000 - val_r2: 0.4116
Epoch 10/50
342/342 [==============================] - 2s 4ms/step - loss: 7434096640.0000 - r2: 0.
6852 - val_loss: 14625618944.0000 - val_r2: 0.4654
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 6271909376.0000 - r2: 0.
7343 - val_loss: 13743147008.0000 - val_r2: 0.4963
```

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Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 5434492928.0000 - r2: 0.
7703 - val_loss: 11707303936.0000 - val_r2: 0.5719
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4887925760.0000 - r2: 0.
7927 - val_loss: 12021276672.0000 - val_r2: 0.5603
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 4562963968.0000 - r2: 0.
8063 - val_loss: 11130519552.0000 - val_r2: 0.5921
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4398455808.0000 - r2: 0.
8135 - val_loss: 11286612992.0000 - val_r2: 0.5865
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 4334199296.0000 - r2: 0.
8163 - val_loss: 11304624128.0000 - val_r2: 0.5861
Epoch 17/50
342/342 [==============================] - 2s 4ms/step - loss: 4309671936.0000 - r2: 0.
8170 - val_loss: 11033714688.0000 - val_r2: 0.5968
Epoch 18/50
342/342 [==============================] - 2s 4ms/step - loss: 4300701696.0000 - r2: 0.
8173 - val_loss: 11010307072.0000 - val_r2: 0.5974
Epoch 19/50
342/342 [==============================] - 2s 4ms/step - loss: 4299910144.0000 - r2: 0.
8175 - val_loss: 11107769344.0000 - val_r2: 0.5934
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 4302593024.0000 - r2: 0.
8176 - val_loss: 11152720896.0000 - val_r2: 0.5911
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 4299191296.0000 - r2: 0.
8176 - val_loss: 11130767360.0000 - val_r2: 0.5920
Epoch 22/50
342/342 [==============================] - 2s 5ms/step - loss: 4299333632.0000 - r2: 0.
8171 - val_loss: 11135420416.0000 - val_r2: 0.5916
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 4302606336.0000 - r2: 0.
8175 - val_loss: 11209032704.0000 - val_r2: 0.5894
Epoch 24/50
342/342 [==============================] - 2s 5ms/step - loss: 4298905088.0000 - r2: 0.
8171 - val_loss: 10031071232.0000 - val_r2: 0.6327
Epoch 25/50
342/342 [==============================] - 2s 5ms/step - loss: 4302756864.0000 - r2: 0.
8169 - val_loss: 10651707392.0000 - val_r2: 0.6099
Epoch 26/50
342/342 [==============================] - 2s 5ms/step - loss: 4299097600.0000 - r2: 0.
8176 - val_loss: 10921047040.0000 - val_r2: 0.5998
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 4299481088.0000 - r2: 0.
8177 - val_loss: 10554843136.0000 - val_r2: 0.6136
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 4301577728.0000 - r2: 0.
8170 - val_loss: 10606294016.0000 - val_r2: 0.6117
Epoch 29/50
342/342 [==============================] - 2s 5ms/step - loss: 4301124608.0000 - r2: 0.
8174 - val_loss: 10266842112.0000 - val_r2: 0.6244
Epoch 30/50
342/342 [==============================] - 2s 4ms/step - loss: 4299602944.0000 - r2: 0.
8177 - val_loss: 11022340096.0000 - val_r2: 0.5967
Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 4301990912.0000 - r2: 0.
8170 - val_loss: 10816647168.0000 - val_r2: 0.6040
```

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Epoch 32/50
342/342 [==============================] - 2s 4ms/step - loss: 4300320256.0000 - r2: 0.
8173 - val_loss: 11427849216.0000 - val_r2: 0.5821
Epoch 33/50
342/342 [==============================] - 2s 4ms/step - loss: 4300383232.0000 - r2: 0.
8175 - val_loss: 10913975296.0000 - val_r2: 0.6008
Epoch 34/50
342/342 [==============================] - 2s 4ms/step - loss: 4301914624.0000 - r2: 0.
8173 - val_loss: 10776312832.0000 - val_r2: 0.6051
session cleared!

ix 3 i 1
updated temp_vec [0, 1, 1, 0, 1, 1, 1, 1, 1]
going through feature_mask [0, 1, 1, 0, 1, 1, 1, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 3s 6ms/step - loss: 83839279104.0000 - r2: -
2.5474 - val_loss: 18059087872.0000 - val_r2: 0.3430
Epoch 2/50
342/342 [==============================] - 2s 5ms/step - loss: 9215245312.0000 - r2: 0.
6107 - val_loss: 14565794816.0000 - val_r2: 0.4679
Epoch 3/50
342/342 [==============================] - 2s 5ms/step - loss: 7917755904.0000 - r2: 0.
6648 - val_loss: 13702408192.0000 - val_r2: 0.4997
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 7315540480.0000 - r2: 0.
6902 - val_loss: 13301528576.0000 - val_r2: 0.5133
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 6872672768.0000 - r2: 0.
7086 - val_loss: 12730893312.0000 - val_r2: 0.5343
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 6473196544.0000 - r2: 0.
7256 - val_loss: 12524326912.0000 - val_r2: 0.5419
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 6090057728.0000 - r2: 0.
7415 - val_loss: 11606441984.0000 - val_r2: 0.5754
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 5742655488.0000 - r2: 0.
7563 - val_loss: 11456474112.0000 - val_r2: 0.5813
Epoch 9/50
342/342 [==============================] - 2s 4ms/step - loss: 5437439488.0000 - r2: 0.
7691 - val_loss: 12078303232.0000 - val_r2: 0.5574
Epoch 10/50
```

```
342/342 [==============================] - 2s 4ms/step - loss: 5182807040.0000 - r2: 0.
7795 - val_loss: 11332683776.0000 - val_r2: 0.5849
Epoch 11/50
342/342 [==============================] - 2s 5ms/step - loss: 4981968896.0000 - r2: 0.
7883 - val_loss: 11260435456.0000 - val_r2: 0.5869
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 4804116480.0000 - r2: 0.
7961 - val_loss: 11685789696.0000 - val_r2: 0.5720
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4656887808.0000 - r2: 0.
8024 - val_loss: 11002479616.0000 - val_r2: 0.5977
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 4522317824.0000 - r2: 0.
8081 - val_loss: 10670326784.0000 - val_r2: 0.6092
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4413960704.0000 - r2: 0.
8129 - val_loss: 9852830720.0000 - val_r2: 0.6388
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 4317558784.0000 - r2: 0.
8168 - val_loss: 10492532736.0000 - val_r2: 0.6160
Epoch 17/50
342/342 [==============================] - 2s 6ms/step - loss: 4245321472.0000 - r2: 0.
8199 - val_loss: 10460804096.0000 - val_r2: 0.6159
Epoch 18/50
342/342 [==============================] - 3s 8ms/step - loss: 4185410048.0000 - r2: 0.
8224 - val_loss: 10313739264.0000 - val_r2: 0.6217
Epoch 19/50
342/342 [==============================] - 3s 6ms/step - loss: 4138877440.0000 - r2: 0.
8242 - val_loss: 10554099712.0000 - val_r2: 0.6125
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 4104815104.0000 - r2: 0.
8254 - val_loss: 11189902336.0000 - val_r2: 0.5895
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 4080284928.0000 - r2: 0.
8267 - val_loss: 10401379328.0000 - val_r2: 0.6185
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 4066540288.0000 - r2: 0.
8271 - val_loss: 10268734464.0000 - val_r2: 0.6234
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 4050216960.0000 - r2: 0.
8283 - val_loss: 10772934656.0000 - val_r2: 0.6048
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 4046470656.0000 - r2: 0.
8281 - val_loss: 9828080640.0000 - val_r2: 0.6398
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 4038330624.0000 - r2: 0.
8283 - val_loss: 9471824896.0000 - val_r2: 0.6529
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 4040138752.0000 - r2: 0.
8283 - val_loss: 10334856192.0000 - val_r2: 0.6211
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 4034928640.0000 - r2: 0.
8286 - val_loss: 9885783040.0000 - val_r2: 0.6379
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 4033774336.0000 - r2: 0.
8286 - val_loss: 10558016512.0000 - val_r2: 0.6136
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 4033547008.0000 - r2: 0.
8288 - val_loss: 9963298816.0000 - val_r2: 0.6345
Epoch 30/50
```

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342/342 [==============================] - 2s 4ms/step - loss: 4037455872.0000 - r2: 0.
8285 - val_loss: 10527281152.0000 - val_r2: 0.6132
Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 4030567936.0000 - r2: 0.
8283 - val_loss: 10201422848.0000 - val_r2: 0.6253
Epoch 32/50
342/342 [==============================] - 2s 4ms/step - loss: 4034401792.0000 - r2: 0.
8288 - val_loss: 10520246272.0000 - val_r2: 0.6146
Epoch 33/50
342/342 [==============================] - 2s 4ms/step - loss: 4033681664.0000 - r2: 0.
8287 - val_loss: 9845316608.0000 - val_r2: 0.6395
Epoch 34/50
342/342 [==============================] - 2s 4ms/step - loss: 4034972928.0000 - r2: 0.
8283 - val_loss: 10765573120.0000 - val_r2: 0.6061
Epoch 35/50
342/342 [==============================] - 2s 4ms/step - loss: 4037021696.0000 - r2: 0.
8284 - val_loss: 10487278592.0000 - val_r2: 0.6155
session cleared!

ix 4 i 1
updated temp_vec [0, 1, 1, 1, 0, 1, 1, 1, 1]
going through feature_mask [0, 1, 1, 1, 0, 1, 1, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 3s 5ms/step - loss: 83386630144.0000 - r2: -
2.5483 - val_loss: 18228957184.0000 - val_r2: 0.3373
Epoch 2/50
342/342 [==============================] - 2s 5ms/step - loss: 9244055552.0000 - r2: 0.
6092 - val_loss: 14702411776.0000 - val_r2: 0.4637
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 7956681216.0000 - r2: 0.
6625 - val_loss: 14026158080.0000 - val_r2: 0.4872
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 7359891456.0000 - r2: 0.
6881 - val_loss: 13720023040.0000 - val_r2: 0.4983
Epoch 5/50
342/342 [==============================] - 2s 5ms/step - loss: 6937421824.0000 - r2: 0.
7057 - val_loss: 13204143104.0000 - val_r2: 0.5166
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 6560001536.0000 - r2: 0.
7214 - val_loss: 12539025408.0000 - val_r2: 0.5411
Epoch 7/50
342/342 [==============================] - 2s 5ms/step - loss: 6207460352.0000 - r2: 0.
```

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7366 - val_loss: 12199351296.0000 - val_r2: 0.5538
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 5896666112.0000 - r2: 0.
7497 - val_loss: 11943270400.0000 - val_r2: 0.5620
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 5620384256.0000 - r2: 0.
7616 - val_loss: 11452865536.0000 - val_r2: 0.5801
Epoch 10/50
342/342 [==============================] - 2s 4ms/step - loss: 5415740416.0000 - r2: 0.
7703 - val_loss: 11272138752.0000 - val_r2: 0.5875
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 5234055168.0000 - r2: 0.
7780 - val_loss: 11854760960.0000 - val_r2: 0.5655
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 5088158208.0000 - r2: 0.
7841 - val_loss: 11008510976.0000 - val_r2: 0.5964
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4958414336.0000 - r2: 0.
7895 - val_loss: 11427966976.0000 - val_r2: 0.5811
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 4840226816.0000 - r2: 0.
7947 - val_loss: 11308126208.0000 - val_r2: 0.5859
Epoch 15/50
342/342 [==============================] - 2s 5ms/step - loss: 4735406080.0000 - r2: 0.
7987 - val_loss: 10650008576.0000 - val_r2: 0.6105
Epoch 16/50
342/342 [==============================] - 3s 7ms/step - loss: 4650805760.0000 - r2: 0.
8023 - val_loss: 10082204672.0000 - val_r2: 0.6305
Epoch 17/50
342/342 [==============================] - 3s 7ms/step - loss: 4571046912.0000 - r2: 0.
8060 - val_loss: 10719252480.0000 - val_r2: 0.6070
Epoch 18/50
342/342 [==============================] - 2s 6ms/step - loss: 4509652992.0000 - r2: 0.
8084 - val_loss: 11150828544.0000 - val_r2: 0.5917
Epoch 19/50
342/342 [==============================] - 3s 7ms/step - loss: 4468514304.0000 - r2: 0.
8104 - val_loss: 11979574272.0000 - val_r2: 0.5610
Epoch 20/50
342/342 [==============================] - 3s 8ms/step - loss: 4432396288.0000 - r2: 0.
8114 - val_loss: 10930905088.0000 - val_r2: 0.6001
Epoch 21/50
342/342 [==============================] - 4s 11ms/step - loss: 4406353920.0000 - r2:
 0.8130 - val_loss: 10471836672.0000 - val_r2: 0.6159
Epoch 22/50
342/342 [==============================] - 4s 8ms/step - loss: 4386549760.0000 - r2: 0.
8138 - val_loss: 10295397376.0000 - val_r2: 0.6228
Epoch 23/50
342/342 [==============================] - 2s 5ms/step - loss: 4373530624.0000 - r2: 0.
8143 - val_loss: 10845365248.0000 - val_r2: 0.6031
Epoch 24/50
342/342 [==============================] - 2s 6ms/step - loss: 4370723328.0000 - r2: 0.
8143 - val_loss: 11147707392.0000 - val_r2: 0.5918
Epoch 25/50
342/342 [==============================] - 2s 5ms/step - loss: 4364005376.0000 - r2: 0.
8146 - val_loss: 10876574720.0000 - val_r2: 0.6005
Epoch 26/50
342/342 [==============================] - 2s 6ms/step - loss: 4358935040.0000 - r2: 0.
8152 - val_loss: 10326127616.0000 - val_r2: 0.6212
session cleared!
```

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ix 5 i 1
updated temp_vec [0, 1, 1, 1, 1, 0, 1, 1, 1]
going through feature_mask [0, 1, 1, 1, 1, 0, 1, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 3s 5ms/step - loss: 83965829120.0000 - r2: -
2.5575 - val_loss: 18129956864.0000 - val_r2: 0.3411
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 9331533824.0000 - r2: 0.
6053 - val_loss: 14852483072.0000 - val_r2: 0.4578
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 8068550144.0000 - r2: 0.
6578 - val_loss: 14285746176.0000 - val_r2: 0.4782
Epoch 4/50
342/342 [==============================] - 2s 5ms/step - loss: 7510617088.0000 - r2: 0.
6816 - val_loss: 13828570112.0000 - val_r2: 0.4943
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 7106737152.0000 - r2: 0.
6986 - val_loss: 12747389952.0000 - val_r2: 0.5337
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 6732551168.0000 - r2: 0.
7144 - val_loss: 12686903296.0000 - val_r2: 0.5364
Epoch 7/50
342/342 [==============================] - 2s 5ms/step - loss: 6354995200.0000 - r2: 0.
7310 - val_loss: 11971852288.0000 - val_r2: 0.5625
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 5990754304.0000 - r2: 0.
7456 - val_loss: 11666651136.0000 - val_r2: 0.5733
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 5648307200.0000 - r2: 0.
7600 - val_loss: 11520303104.0000 - val_r2: 0.5790
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 5345218048.0000 - r2: 0.
7736 - val_loss: 11461672960.0000 - val_r2: 0.5808
Epoch 11/50
342/342 [==============================] - 2s 5ms/step - loss: 5090892288.0000 - r2: 0.
7841 - val_loss: 11498575872.0000 - val_r2: 0.5791
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 4879182336.0000 - r2: 0.
7926 - val_loss: 11792990208.0000 - val_r2: 0.5682
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4699447296.0000 - r2: 0.
8007 - val_loss: 11322973184.0000 - val_r2: 0.5849
```

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Epoch 14/50
342/342 [==============================] - 2s 5ms/step - loss: 4544199680.0000 - r2: 0.
8072 - val_loss: 10204312576.0000 - val_r2: 0.6266
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4405832704.0000 - r2: 0.
8130 - val_loss: 10222858240.0000 - val_r2: 0.6256
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 4294457600.0000 - r2: 0.
8178 - val_loss: 10494285824.0000 - val_r2: 0.6153
Epoch 17/50
342/342 [==============================] - 2s 4ms/step - loss: 4191257600.0000 - r2: 0.
8221 - val_loss: 9946973184.0000 - val_r2: 0.6358
Epoch 18/50
342/342 [==============================] - 2s 4ms/step - loss: 4110819328.0000 - r2: 0.
8250 - val_loss: 10996540416.0000 - val_r2: 0.5975
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 4048609024.0000 - r2: 0.
8277 - val_loss: 11035852800.0000 - val_r2: 0.5954
Epoch 20/50
342/342 [==============================] - 2s 5ms/step - loss: 3999833856.0000 - r2: 0.
8303 - val_loss: 9633631232.0000 - val_r2: 0.6475
Epoch 21/50
342/342 [==============================] - 2s 5ms/step - loss: 3962371328.0000 - r2: 0.
8315 - val_loss: 10580331520.0000 - val_r2: 0.6128
Epoch 22/50
342/342 [==============================] - 2s 5ms/step - loss: 3933795840.0000 - r2: 0.
8329 - val_loss: 10002265088.0000 - val_r2: 0.6335
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 3908149248.0000 - r2: 0.
8341 - val_loss: 10993312768.0000 - val_r2: 0.5971
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 3891889664.0000 - r2: 0.
8349 - val_loss: 10630715392.0000 - val_r2: 0.6096
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 3879041280.0000 - r2: 0.
8352 - val_loss: 10116176896.0000 - val_r2: 0.6290
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 3867250688.0000 - r2: 0.
8357 - val_loss: 9833509888.0000 - val_r2: 0.6392
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 3858376448.0000 - r2: 0.
8363 - val_loss: 10235920384.0000 - val_r2: 0.6246
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 3849780480.0000 - r2: 0.
8366 - val_loss: 9243064320.0000 - val_r2: 0.6607
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 3843236096.0000 - r2: 0.
8368 - val_loss: 10207884288.0000 - val_r2: 0.6261
Epoch 30/50
342/342 [==============================] - 2s 5ms/step - loss: 3836257024.0000 - r2: 0.
8370 - val_loss: 10488264704.0000 - val_r2: 0.6142
Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 3827999232.0000 - r2: 0.
8374 - val_loss: 10145711104.0000 - val_r2: 0.6281
Epoch 32/50
342/342 [==============================] - 2s 5ms/step - loss: 3825127680.0000 - r2: 0.
8377 - val_loss: 10550017024.0000 - val_r2: 0.6129
Epoch 33/50
342/342 [==============================] - 2s 4ms/step - loss: 3819906048.0000 - r2: 0.
8375 - val_loss: 9825393664.0000 - val_r2: 0.6388
```

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Epoch 34/50
342/342 [==============================] - 2s 4ms/step - loss: 3816203776.0000 - r2: 0.
8380 - val_loss: 11314226176.0000 - val_r2: 0.5848
Epoch 35/50
342/342 [==============================] - 2s 4ms/step - loss: 3814184448.0000 - r2: 0.
8378 - val_loss: 10099957760.0000 - val_r2: 0.6297
Epoch 36/50
342/342 [==============================] - 2s 4ms/step - loss: 3809821440.0000 - r2: 0.
8378 - val_loss: 9941312512.0000 - val_r2: 0.6360
Epoch 37/50
342/342 [==============================] - 2s 4ms/step - loss: 3802808320.0000 - r2: 0.
8382 - val_loss: 10479225856.0000 - val_r2: 0.6159
Epoch 38/50
342/342 [==============================] - 2s 4ms/step - loss: 3800049920.0000 - r2: 0.
8384 - val_loss: 10546983936.0000 - val_r2: 0.6136
new min loss: len 8, ix 5
session cleared!

ix 6 i 1
updated temp_vec [0, 1, 1, 1, 1, 1, 0, 1, 1]
going through feature_mask [0, 1, 1, 1, 1, 1, 0, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 3s 5ms/step - loss: 83593543680.0000 - r2: -
2.5541 - val_loss: 18029369344.0000 - val_r2: 0.3444
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 9345782784.0000 - r2: 0.
6053 - val_loss: 14858757120.0000 - val_r2: 0.4582
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 8115495424.0000 - r2: 0.
6558 - val_loss: 13958162432.0000 - val_r2: 0.4899
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 7563288064.0000 - r2: 0.
6796 - val_loss: 14024923136.0000 - val_r2: 0.4878
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 7156594688.0000 - r2: 0.
6967 - val_loss: 13018455040.0000 - val_r2: 0.5236
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 6780131328.0000 - r2: 0.
7125 - val_loss: 13190541312.0000 - val_r2: 0.5182
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 6389032448.0000 - r2: 0.
7292 - val_loss: 12234297344.0000 - val_r2: 0.5524
```

```
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 5998474752.0000 - r2: 0.
7455 - val_loss: 11957411840.0000 - val_r2: 0.5630
Epoch 9/50
342/342 [==============================] - 2s 4ms/step - loss: 5604696064.0000 - r2: 0.
7622 - val_loss: 11831913472.0000 - val_r2: 0.5671
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 5246516224.0000 - r2: 0.
7776 - val_loss: 11684023296.0000 - val_r2: 0.5715
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 4932328960.0000 - r2: 0.
7907 - val_loss: 10909723648.0000 - val_r2: 0.6010
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 4656014848.0000 - r2: 0.
8025 - val_loss: 10421347328.0000 - val_r2: 0.6185
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4422565888.0000 - r2: 0.
8124 - val_loss: 10325799936.0000 - val_r2: 0.6226
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 4231491840.0000 - r2: 0.
8206 - val_loss: 10099499008.0000 - val_r2: 0.6307
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4084504576.0000 - r2: 0.
8261 - val_loss: 10966948864.0000 - val_r2: 0.5984
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 3977910784.0000 - r2: 0.
8310 - val_loss: 10167856128.0000 - val_r2: 0.6278
Epoch 17/50
342/342 [==============================] - 2s 4ms/step - loss: 3910802176.0000 - r2: 0.
8339 - val_loss: 10716382208.0000 - val_r2: 0.6070
Epoch 18/50
342/342 [==============================] - 2s 4ms/step - loss: 3867871744.0000 - r2: 0.
8357 - val_loss: 10241861632.0000 - val_r2: 0.6249
Epoch 19/50
342/342 [==============================] - 2s 4ms/step - loss: 3842390016.0000 - r2: 0.
8371 - val_loss: 9173248000.0000 - val_r2: 0.6642
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 3818849280.0000 - r2: 0.
8377 - val_loss: 9983319040.0000 - val_r2: 0.6339
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 3805117440.0000 - r2: 0.
8385 - val_loss: 9759128576.0000 - val_r2: 0.6422
Epoch 22/50
342/342 [==============================] - 2s 5ms/step - loss: 3797113600.0000 - r2: 0.
8385 - val_loss: 10103607296.0000 - val_r2: 0.6294
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 3783937536.0000 - r2: 0.
8391 - val_loss: 9649896448.0000 - val_r2: 0.6462
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 3777030912.0000 - r2: 0.
8394 - val_loss: 11088484352.0000 - val_r2: 0.5935
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 3764782336.0000 - r2: 0.
8401 - val_loss: 10083856384.0000 - val_r2: 0.6310
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 3755526656.0000 - r2: 0.
8404 - val_loss: 10057212928.0000 - val_r2: 0.6310
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 3745123840.0000 - r2: 0.
8412 - val_loss: 9981505536.0000 - val_r2: 0.6345
```

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Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 3743236608.0000 - r2: 0.
8408 - val_loss: 9707754496.0000 - val_r2: 0.6442
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 3735941376.0000 - r2: 0.
8411 - val_loss: 10340207616.0000 - val_r2: 0.6211
new min loss: len 8, ix 6
session cleared!

ix 7 i 1
updated temp_vec [0, 1, 1, 1, 1, 1, 1, 0, 1]
going through feature_mask [0, 1, 1, 1, 1, 1, 1, 0, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 5ms/step - loss: 83564371968.0000 - r2: -
2.5378 - val_loss: 18459748352.0000 - val_r2: 0.3285
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 9405271040.0000 - r2: 0.
6025 - val_loss: 15149900800.0000 - val_r2: 0.4472
Epoch 3/50
342/342 [==============================] - 2s 5ms/step - loss: 8183810560.0000 - r2: 0.
6533 - val_loss: 14010522624.0000 - val_r2: 0.4882
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 7662575104.0000 - r2: 0.
6746 - val_loss: 14219698176.0000 - val_r2: 0.4796
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 7307174400.0000 - r2: 0.
6900 - val_loss: 13007501312.0000 - val_r2: 0.5238
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 6988192768.0000 - r2: 0.
7033 - val_loss: 12865484800.0000 - val_r2: 0.5293
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 6675596288.0000 - r2: 0.
7170 - val_loss: 12723016704.0000 - val_r2: 0.5338
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 6372205056.0000 - r2: 0.
7297 - val_loss: 12116942848.0000 - val_r2: 0.5565
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 6087164928.0000 - r2: 0.
7416 - val_loss: 11905811456.0000 - val_r2: 0.5647
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 5833146368.0000 - r2: 0.
7526 - val_loss: 12113833984.0000 - val_r2: 0.5567
```

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Epoch 11/50
342/342 [==============================] - 2s 5ms/step - loss: 5606953472.0000 - r2: 0.
7622 - val_loss: 11815682048.0000 - val_r2: 0.5676
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 5405927936.0000 - r2: 0.
7703 - val_loss: 11153462272.0000 - val_r2: 0.5916
Epoch 13/50
342/342 [==============================] - 2s 5ms/step - loss: 5224197120.0000 - r2: 0.
7780 - val_loss: 11240827904.0000 - val_r2: 0.5881
Epoch 14/50
342/342 [==============================] - 2s 5ms/step - loss: 5061809152.0000 - r2: 0.
7854 - val_loss: 10664211456.0000 - val_r2: 0.6092
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4926023168.0000 - r2: 0.
7905 - val_loss: 11253691392.0000 - val_r2: 0.5874
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 4803828224.0000 - r2: 0.
7957 - val_loss: 10995560448.0000 - val_r2: 0.5974
Epoch 17/50
342/342 [==============================] - 2s 5ms/step - loss: 4703695360.0000 - r2: 0.
8003 - val_loss: 11166728192.0000 - val_r2: 0.5907
Epoch 18/50
342/342 [==============================] - 2s 5ms/step - loss: 4618240000.0000 - r2: 0.
8041 - val_loss: 10789804032.0000 - val_r2: 0.6045
Epoch 19/50
342/342 [==============================] - 2s 4ms/step - loss: 4556971520.0000 - r2: 0.
8066 - val_loss: 10069328896.0000 - val_r2: 0.6309
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 4506068480.0000 - r2: 0.
8084 - val_loss: 10604805120.0000 - val_r2: 0.6123
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 4463435776.0000 - r2: 0.
8104 - val_loss: 10827491328.0000 - val_r2: 0.6030
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 4432708608.0000 - r2: 0.
8119 - val_loss: 9912639488.0000 - val_r2: 0.6376
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 4410599424.0000 - r2: 0.
8123 - val_loss: 10344053760.0000 - val_r2: 0.6207
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 4389508096.0000 - r2: 0.
8134 - val_loss: 10625531904.0000 - val_r2: 0.6104
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 4375076352.0000 - r2: 0.
8140 - val_loss: 10398173184.0000 - val_r2: 0.6185
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 4363612160.0000 - r2: 0.
8145 - val_loss: 10096433152.0000 - val_r2: 0.6303
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 4354134528.0000 - r2: 0.
8150 - val_loss: 10378398720.0000 - val_r2: 0.6202
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 4346710528.0000 - r2: 0.
8152 - val_loss: 9848462336.0000 - val_r2: 0.6390
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 4336858624.0000 - r2: 0.
8158 - val_loss: 11493597184.0000 - val_r2: 0.5787
Epoch 30/50
342/342 [==============================] - 2s 4ms/step - loss: 4333722624.0000 - r2: 0.
8158 - val_loss: 10486359040.0000 - val_r2: 0.6161
```

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Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 4334154752.0000 - r2: 0.
8156 - val_loss: 10557164544.0000 - val_r2: 0.6129
Epoch 32/50
342/342 [==============================] - 2s 4ms/step - loss: 4323890688.0000 - r2: 0.
8163 - val_loss: 10667595776.0000 - val_r2: 0.6091
Epoch 33/50
342/342 [==============================] - 2s 4ms/step - loss: 4325086720.0000 - r2: 0.
8162 - val_loss: 10104910848.0000 - val_r2: 0.6298
Epoch 34/50
342/342 [==============================] - 2s 4ms/step - loss: 4315066880.0000 - r2: 0.
8169 - val_loss: 10421852160.0000 - val_r2: 0.6182
Epoch 35/50
342/342 [==============================] - 2s 4ms/step - loss: 4310144000.0000 - r2: 0.
8167 - val_loss: 10259040256.0000 - val_r2: 0.6243
Epoch 36/50
342/342 [==============================] - 2s 4ms/step - loss: 4307928576.0000 - r2: 0.
8165 - val_loss: 10766547968.0000 - val_r2: 0.6056
Epoch 37/50
342/342 [==============================] - 2s 5ms/step - loss: 4311762432.0000 - r2: 0.
8168 - val_loss: 10457050112.0000 - val_r2: 0.6165
Epoch 38/50
342/342 [==============================] - 2s 4ms/step - loss: 4305048576.0000 - r2: 0.
8169 - val_loss: 10685855744.0000 - val_r2: 0.6084
session cleared!

ix 8 i 1
updated temp_vec [0, 1, 1, 1, 1, 1, 1, 1, 0]
going through feature_mask [0, 1, 1, 1, 1, 1, 1, 1, 0]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 4ms/step - loss: 84165976064.0000 - r2: -
2.5502 - val_loss: 18399973376.0000 - val_r2: 0.3308
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 9584312320.0000 - r2: 0.
5947 - val_loss: 14980865024.0000 - val_r2: 0.4531
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 8436067328.0000 - r2: 0.
6420 - val_loss: 14372782080.0000 - val_r2: 0.4752
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 8002133504.0000 - r2: 0.
6611 - val_loss: 14090211328.0000 - val_r2: 0.4847
Epoch 5/50
```

```
342/342 [==============================] - 2s 4ms/step - loss: 7735772672.0000 - r2: 0.
6719 - val_loss: 13578053632.0000 - val_r2: 0.5033
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 7512758784.0000 - r2: 0.
6812 - val_loss: 13132097536.0000 - val_r2: 0.5197
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 7315742720.0000 - r2: 0.
6898 - val_loss: 13815695360.0000 - val_r2: 0.4939
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 7135713792.0000 - r2: 0.
6976 - val_loss: 12684075008.0000 - val_r2: 0.5357
Epoch 9/50
342/342 [==============================] - 2s 4ms/step - loss: 6983661568.0000 - r2: 0.
7040 - val_loss: 12630836224.0000 - val_r2: 0.5382
Epoch 10/50
342/342 [==============================] - 2s 4ms/step - loss: 6862861824.0000 - r2: 0.
7091 - val_loss: 13249691648.0000 - val_r2: 0.5155
Epoch 11/50
342/342 [==============================] - 2s 5ms/step - loss: 6769325056.0000 - r2: 0.
7131 - val_loss: 13242088448.0000 - val_r2: 0.5142
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 6707618816.0000 - r2: 0.
7155 - val_loss: 12123368448.0000 - val_r2: 0.5558
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 6673852416.0000 - r2: 0.
7172 - val_loss: 12639850496.0000 - val_r2: 0.5369
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 6640315904.0000 - r2: 0.
7179 - val_loss: 12784731136.0000 - val_r2: 0.5322
Epoch 15/50
342/342 [==============================] - 2s 5ms/step - loss: 6618140160.0000 - r2: 0.
7189 - val_loss: 12194622464.0000 - val_r2: 0.5539
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 6602052096.0000 - r2: 0.
7196 - val_loss: 13485679616.0000 - val_r2: 0.5061
Epoch 17/50
342/342 [==============================] - 2s 5ms/step - loss: 6590389248.0000 - r2: 0.
7205 - val_loss: 12526616576.0000 - val_r2: 0.5410
Epoch 18/50
342/342 [==============================] - 2s 5ms/step - loss: 6577262592.0000 - r2: 0.
7208 - val_loss: 12338122752.0000 - val_r2: 0.5478
Epoch 19/50
342/342 [==============================] - 2s 4ms/step - loss: 6569065984.0000 - r2: 0.
7211 - val_loss: 13035734016.0000 - val_r2: 0.5235
Epoch 20/50
342/342 [==============================] - 2s 5ms/step - loss: 6555034624.0000 - r2: 0.
7216 - val_loss: 12353913856.0000 - val_r2: 0.5475
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 6552752128.0000 - r2: 0.
7222 - val_loss: 13201506304.0000 - val_r2: 0.5170
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 6543037952.0000 - r2: 0.
7218 - val_loss: 12778235904.0000 - val_r2: 0.5316
session cleared!

1247.380729675293 seconds elapsed

vec [0, 1, 1, 1, 1, 1, 0, 1, 1]
ix 0 i 0
ix 1 i 1
```

```
updated temp_vec [0, 0, 1, 1, 1, 1, 0, 1, 1]
going through feature_mask [0, 0, 1, 1, 1, 1, 0, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=Non
e), name='flatten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 4ms/step - loss: 89987153920.0000 - r2: -
2.8522 - val_loss: 19506042880.0000 - val_r2: 0.2909
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 10884641792.0000 - r2:
 0.5405 - val_loss: 17683671040.0000 - val_r2: 0.3553
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 9763692544.0000 - r2: 0.
5875 - val_loss: 16492160000.0000 - val_r2: 0.3986
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 9143046144.0000 - r2: 0.
6133 - val_loss: 16088696832.0000 - val_r2: 0.4131
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 8640017408.0000 - r2: 0.
6341 - val_loss: 15720560640.0000 - val_r2: 0.4266
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 8154136576.0000 - r2: 0.
6545 - val_loss: 14086389760.0000 - val_r2: 0.4856
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 7650281472.0000 - r2: 0.
6765 - val_loss: 13691954176.0000 - val_r2: 0.5005
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 7137410560.0000 - r2: 0.
6980 - val_loss: 13684852736.0000 - val_r2: 0.5003
Epoch 9/50
342/342 [==============================] - 2s 4ms/step - loss: 6634145792.0000 - r2: 0.
7191 - val_loss: 13198139392.0000 - val_r2: 0.5180
Epoch 10/50
342/342 [==============================] - 2s 4ms/step - loss: 6163918336.0000 - r2: 0.
7390 - val_loss: 13091895296.0000 - val_r2: 0.5217
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 5758565888.0000 - r2: 0.
7563 - val_loss: 11897107456.0000 - val_r2: 0.5649
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 5398583808.0000 - r2: 0.
7712 - val_loss: 12058244096.0000 - val_r2: 0.5588
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 5104091136.0000 - r2: 0.
7842 - val_loss: 11964025856.0000 - val_r2: 0.5628
Epoch 14/50
```

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342/342 [==============================] - 2s 4ms/step - loss: 4876264960.0000 - r2: 0.
7935 - val_loss: 12084913152.0000 - val_r2: 0.5573
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4712729600.0000 - r2: 0.
8001 - val_loss: 11850822656.0000 - val_r2: 0.5669
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 4610267648.0000 - r2: 0.
8046 - val_loss: 10278489088.0000 - val_r2: 0.6233
Epoch 17/50
342/342 [==============================] - 2s 4ms/step - loss: 4546248192.0000 - r2: 0.
8071 - val_loss: 10905100288.0000 - val_r2: 0.6013
Epoch 18/50
342/342 [==============================] - 2s 4ms/step - loss: 4500249600.0000 - r2: 0.
8092 - val_loss: 11305452544.0000 - val_r2: 0.5855
Epoch 19/50
342/342 [==============================] - 2s 4ms/step - loss: 4478354944.0000 - r2: 0.
8098 - val_loss: 10851313664.0000 - val_r2: 0.6026
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 4464063488.0000 - r2: 0.
8103 - val_loss: 11783289856.0000 - val_r2: 0.5683
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 4447757824.0000 - r2: 0.
8113 - val_loss: 11100526592.0000 - val_r2: 0.5934
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 4441122816.0000 - r2: 0.
8118 - val_loss: 10469043200.0000 - val_r2: 0.6169
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 4435063808.0000 - r2: 0.
8120 - val_loss: 10524083200.0000 - val_r2: 0.6147
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 4427213824.0000 - r2: 0.
8119 - val_loss: 11046732800.0000 - val_r2: 0.5958
Epoch 25/50
342/342 [==============================] - 2s 5ms/step - loss: 4413429248.0000 - r2: 0.
8127 - val_loss: 11112513536.0000 - val_r2: 0.5935
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 4403909120.0000 - r2: 0.
8134 - val_loss: 11298569216.0000 - val_r2: 0.5865
session cleared!

ix 2 i 1
updated temp_vec [0, 1, 0, 1, 1, 1, 0, 1, 1]
going through feature_mask [0, 1, 0, 1, 1, 1, 0, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=Non
e), name='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
```

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ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 5ms/step - loss: 116594532352.0000 - r2:
 -3.9555 - val_loss: 32838334464.0000 - val_r2: -0.1952
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 19538227200.0000 - r2:
 0.1750 - val_loss: 27668328448.0000 - val_r2: -0.0096
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 17444386816.0000 - r2:
 0.2622 - val_loss: 25567787008.0000 - val_r2: 0.0678
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 16114204672.0000 - r2:
 0.3174 - val_loss: 24116148224.0000 - val_r2: 0.1186
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 14844802048.0000 - r2:
 0.3717 - val_loss: 22816520192.0000 - val_r2: 0.1667
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 13468339200.0000 - r2:
 0.4290 - val_loss: 21709289472.0000 - val_r2: 0.2065
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 11946966016.0000 - r2:
 0.4938 - val_loss: 19292381184.0000 - val_r2: 0.2949
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 10329523200.0000 - r2:
 0.5627 - val_loss: 17666799616.0000 - val_r2: 0.3541
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 8731555840.0000 - r2: 0.
6306 - val_loss: 15978203136.0000 - val_r2: 0.4161
Epoch 10/50
342/342 [==============================] - 2s 4ms/step - loss: 7287352832.0000 - r2: 0.
6918 - val_loss: 14004008960.0000 - val_r2: 0.4875
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 6139458048.0000 - r2: 0.
7401 - val_loss: 13113492480.0000 - val_r2: 0.5202
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 5328577024.0000 - r2: 0.
7738 - val_loss: 12270082048.0000 - val_r2: 0.5509
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4824365568.0000 - r2: 0.
7955 - val_loss: 11325787136.0000 - val_r2: 0.5860
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 4541285888.0000 - r2: 0.
8072 - val_loss: 11763961856.0000 - val_r2: 0.5690
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4400336384.0000 - r2: 0.
8131 - val_loss: 10813936640.0000 - val_r2: 0.6042
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 4339005440.0000 - r2: 0.
8156 - val_loss: 10986704896.0000 - val_r2: 0.5980
Epoch 17/50
342/342 [==============================] - 2s 5ms/step - loss: 4317920768.0000 - r2: 0.
8164 - val_loss: 10672699392.0000 - val_r2: 0.6092
Epoch 18/50
342/342 [==============================] - 2s 4ms/step - loss: 4310366208.0000 - r2: 0.
8171 - val_loss: 10789411840.0000 - val_r2: 0.6039
Epoch 19/50
342/342 [==============================] - 2s 4ms/step - loss: 4308696576.0000 - r2: 0.
8168 - val_loss: 11186969600.0000 - val_r2: 0.5905
Epoch 20/50
342/342 [==============================] - 2s 5ms/step - loss: 4308765696.0000 - r2: 0.
```

```
8169 - val_loss: 11530619904.0000 - val_r2: 0.5774
Epoch 21/50
342/342 [==============================] - 2s 5ms/step - loss: 4313685504.0000 - r2: 0.
8167 - val_loss: 11364387840.0000 - val_r2: 0.5837
Epoch 22/50
342/342 [==============================] - 2s 5ms/step - loss: 4310763520.0000 - r2: 0.
8167 - val_loss: 10629494784.0000 - val_r2: 0.6106
Epoch 23/50
342/342 [==============================] - 2s 5ms/step - loss: 4311959040.0000 - r2: 0.
8169 - val_loss: 11353272320.0000 - val_r2: 0.5840
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 4307700224.0000 - r2: 0.
8169 - val_loss: 10363502592.0000 - val_r2: 0.6207
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 4307980288.0000 - r2: 0.
8172 - val_loss: 11261588480.0000 - val_r2: 0.5871
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 4308119552.0000 - r2: 0.
8170 - val_loss: 11056994304.0000 - val_r2: 0.5944
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 4307963904.0000 - r2: 0.
8168 - val_loss: 10027071488.0000 - val_r2: 0.6333
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 4312203776.0000 - r2: 0.
8171 - val_loss: 11611829248.0000 - val_r2: 0.5748
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 4308875776.0000 - r2: 0.
8170 - val_loss: 10917797888.0000 - val_r2: 0.6002
Epoch 30/50
342/342 [==============================] - 2s 4ms/step - loss: 4311970304.0000 - r2: 0.
8172 - val_loss: 10618851328.0000 - val_r2: 0.6107
Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 4308805632.0000 - r2: 0.
8169 - val_loss: 11240960000.0000 - val_r2: 0.5884
Epoch 32/50
342/342 [==============================] - 2s 4ms/step - loss: 4313898496.0000 - r2: 0.
8168 - val_loss: 10276703232.0000 - val_r2: 0.6234
Epoch 33/50
342/342 [==============================] - 2s 4ms/step - loss: 4307119616.0000 - r2: 0.
8168 - val_loss: 11387730944.0000 - val_r2: 0.5829
Epoch 34/50
342/342 [==============================] - 2s 5ms/step - loss: 4308295168.0000 - r2: 0.
8172 - val_loss: 10637644800.0000 - val_r2: 0.6104
Epoch 35/50
342/342 [==============================] - 2s 4ms/step - loss: 4310036480.0000 - r2: 0.
8167 - val_loss: 10116751360.0000 - val_r2: 0.6300
Epoch 36/50
342/342 [==============================] - 2s 4ms/step - loss: 4308676096.0000 - r2: 0.
8169 - val_loss: 10670757888.0000 - val_r2: 0.6090
Epoch 37/50
342/342 [==============================] - 2s 4ms/step - loss: 4308533248.0000 - r2: 0.
8170 - val_loss: 10842461184.0000 - val_r2: 0.6028
session cleared!

ix 3 i 1
updated temp_vec [0, 1, 1, 0, 1, 1, 0, 1, 1]
going through feature_mask [0, 1, 1, 0, 1, 1, 0, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
```

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latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 5ms/step - loss: 83793453056.0000 - r2: -
2.5432 - val_loss: 18048194560.0000 - val_r2: 0.3434
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 9373725696.0000 - r2: 0.
6031 - val_loss: 15110559744.0000 - val_r2: 0.4486
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 8123372544.0000 - r2: 0.
6557 - val_loss: 14178332672.0000 - val_r2: 0.4818
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 7566222848.0000 - r2: 0.
6794 - val_loss: 13477303296.0000 - val_r2: 0.5072
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 7159742464.0000 - r2: 0.
6964 - val_loss: 12849199104.0000 - val_r2: 0.5302
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 6783286784.0000 - r2: 0.
7126 - val_loss: 12940408832.0000 - val_r2: 0.5269
Epoch 7/50
342/342 [==============================] - 2s 6ms/step - loss: 6401275904.0000 - r2: 0.
7285 - val_loss: 12239178752.0000 - val_r2: 0.5523
Epoch 8/50
342/342 [==============================] - 2s 5ms/step - loss: 6012796928.0000 - r2: 0.
7449 - val_loss: 11940146176.0000 - val_r2: 0.5632
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 5639873536.0000 - r2: 0.
7607 - val_loss: 11951199232.0000 - val_r2: 0.5622
Epoch 10/50
342/342 [==============================] - 2s 4ms/step - loss: 5293108224.0000 - r2: 0.
7755 - val_loss: 11446333440.0000 - val_r2: 0.5810
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 4992667136.0000 - r2: 0.
7878 - val_loss: 10794875904.0000 - val_r2: 0.6048
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 4740267008.0000 - r2: 0.
7988 - val_loss: 11057880064.0000 - val_r2: 0.5951
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4529575936.0000 - r2: 0.
8079 - val_loss: 10541399040.0000 - val_r2: 0.6136
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 4360370688.0000 - r2: 0.
8146 - val_loss: 10824603648.0000 - val_r2: 0.6033
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4234121472.0000 - r2: 0.
8200 - val_loss: 10053271552.0000 - val_r2: 0.6320
```

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Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 4156019968.0000 - r2: 0.
8235 - val_loss: 10532268032.0000 - val_r2: 0.6143
Epoch 17/50
342/342 [==============================] - 2s 4ms/step - loss: 4099003648.0000 - r2: 0.
8260 - val_loss: 10434284544.0000 - val_r2: 0.6178
Epoch 18/50
342/342 [==============================] - 2s 4ms/step - loss: 4069341440.0000 - r2: 0.
8270 - val_loss: 10520492032.0000 - val_r2: 0.6138
Epoch 19/50
342/342 [==============================] - 2s 4ms/step - loss: 4060891136.0000 - r2: 0.
8276 - val_loss: 9632365568.0000 - val_r2: 0.6473
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 4047939584.0000 - r2: 0.
8278 - val_loss: 10133447680.0000 - val_r2: 0.6287
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 4049009408.0000 - r2: 0.
8279 - val_loss: 10390014976.0000 - val_r2: 0.6202
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 4049967360.0000 - r2: 0.
8277 - val_loss: 9948754944.0000 - val_r2: 0.6352
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 4050358784.0000 - r2: 0.
8274 - val_loss: 10603695104.0000 - val_r2: 0.6116
Epoch 24/50
342/342 [==============================] - 2s 5ms/step - loss: 4048640512.0000 - r2: 0.
8279 - val_loss: 10257072128.0000 - val_r2: 0.6244
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 4049286912.0000 - r2: 0.
8279 - val_loss: 10626932736.0000 - val_r2: 0.6108
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 4051057664.0000 - r2: 0.
8279 - val_loss: 10358333440.0000 - val_r2: 0.6196
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 4049014016.0000 - r2: 0.
8279 - val_loss: 10292021248.0000 - val_r2: 0.6229
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 4052834304.0000 - r2: 0.
8277 - val_loss: 10523151360.0000 - val_r2: 0.6145
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 4049313792.0000 - r2: 0.
8276 - val_loss: 10045377536.0000 - val_r2: 0.6314
session cleared!

ix 4 i 1
updated temp_vec [0, 1, 1, 1, 0, 1, 0, 1, 1]
going through feature_mask [0, 1, 1, 1, 0, 1, 0, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
```

```
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 3s 6ms/step - loss: 83919863808.0000 - r2: -
2.5509 - val_loss: 17962620928.0000 - val_r2: 0.3475
Epoch 2/50
342/342 [==============================] - 2s 5ms/step - loss: 9392357376.0000 - r2: 0.
6029 - val_loss: 15246248960.0000 - val_r2: 0.4438
Epoch 3/50
342/342 [==============================] - 2s 5ms/step - loss: 8161935872.0000 - r2: 0.
6542 - val_loss: 13975411712.0000 - val_r2: 0.4902
Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 7620348416.0000 - r2: 0.
6764 - val_loss: 13411568640.0000 - val_r2: 0.5093
Epoch 5/50
342/342 [==============================] - 2s 4ms/step - loss: 7236435456.0000 - r2: 0.
6930 - val_loss: 12918425600.0000 - val_r2: 0.5273
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 6884269568.0000 - r2: 0.
7077 - val_loss: 13014245376.0000 - val_r2: 0.5238
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 6531901440.0000 - r2: 0.
7228 - val_loss: 12413325312.0000 - val_r2: 0.5461
Epoch 8/50
342/342 [==============================] - 2s 4ms/step - loss: 6184103936.0000 - r2: 0.
7380 - val_loss: 11856643072.0000 - val_r2: 0.5655
Epoch 9/50
342/342 [==============================] - 2s 4ms/step - loss: 5850116096.0000 - r2: 0.
7518 - val_loss: 11527526400.0000 - val_r2: 0.5778
Epoch 10/50
342/342 [==============================] - 2s 4ms/step - loss: 5545887744.0000 - r2: 0.
7648 - val_loss: 12403202048.0000 - val_r2: 0.5464
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 5289587200.0000 - r2: 0.
7755 - val_loss: 11307867136.0000 - val_r2: 0.5856
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 5061973504.0000 - r2: 0.
7854 - val_loss: 11025552384.0000 - val_r2: 0.5965
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4872112640.0000 - r2: 0.
7934 - val_loss: 10769132544.0000 - val_r2: 0.6051
Epoch 14/50
342/342 [==============================] - 2s 4ms/step - loss: 4711345152.0000 - r2: 0.
8002 - val_loss: 10935745536.0000 - val_r2: 0.5994
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4587463168.0000 - r2: 0.
8054 - val_loss: 10785999872.0000 - val_r2: 0.6052
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 4499338752.0000 - r2: 0.
8090 - val_loss: 10495132672.0000 - val_r2: 0.6158
Epoch 17/50
342/342 [==============================] - 2s 4ms/step - loss: 4436440576.0000 - r2: 0.
8115 - val_loss: 11531452416.0000 - val_r2: 0.5778
Epoch 18/50
342/342 [==============================] - 2s 4ms/step - loss: 4400982528.0000 - r2: 0.
8127 - val_loss: 10750526464.0000 - val_r2: 0.6056
Epoch 19/50
```

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342/342 [==============================] - 2s 4ms/step - loss: 4377972224.0000 - r2: 0.
8136 - val_loss: 10570318848.0000 - val_r2: 0.6126
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 4371724800.0000 - r2: 0.
8145 - val_loss: 9908303872.0000 - val_r2: 0.6371
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 4366943232.0000 - r2: 0.
8146 - val_loss: 10406959104.0000 - val_r2: 0.6180
Epoch 22/50
342/342 [==============================] - 2s 5ms/step - loss: 4368788480.0000 - r2: 0.
8142 - val_loss: 10707963904.0000 - val_r2: 0.6074
Epoch 23/50
342/342 [==============================] - 2s 5ms/step - loss: 4365166592.0000 - r2: 0.
8143 - val_loss: 9777769472.0000 - val_r2: 0.6414
Epoch 24/50
342/342 [==============================] - 2s 5ms/step - loss: 4360126976.0000 - r2: 0.
8149 - val_loss: 10321369088.0000 - val_r2: 0.6219
Epoch 25/50
342/342 [==============================] - 2s 5ms/step - loss: 4360343040.0000 - r2: 0.
8147 - val_loss: 10895797248.0000 - val_r2: 0.6005
Epoch 26/50
342/342 [==============================] - 2s 5ms/step - loss: 4365467136.0000 - r2: 0.
8143 - val_loss: 10714351616.0000 - val_r2: 0.6068
Epoch 27/50
342/342 [==============================] - 2s 5ms/step - loss: 4364457984.0000 - r2: 0.
8148 - val_loss: 10649474048.0000 - val_r2: 0.6092
Epoch 28/50
342/342 [==============================] - 2s 5ms/step - loss: 4361560576.0000 - r2: 0.
8144 - val_loss: 11120081920.0000 - val_r2: 0.5922
Epoch 29/50
342/342 [==============================] - 2s 5ms/step - loss: 4364187648.0000 - r2: 0.
8146 - val_loss: 11552462848.0000 - val_r2: 0.5762
Epoch 30/50
342/342 [==============================] - 2s 5ms/step - loss: 4362395136.0000 - r2: 0.
8148 - val_loss: 10441269248.0000 - val_r2: 0.6173
Epoch 31/50
342/342 [==============================] - 2s 5ms/step - loss: 4358671360.0000 - r2: 0.
8146 - val_loss: 10765799424.0000 - val_r2: 0.6049
Epoch 32/50
342/342 [==============================] - 2s 5ms/step - loss: 4365680128.0000 - r2: 0.
8147 - val_loss: 10708961280.0000 - val_r2: 0.6072
Epoch 33/50
342/342 [==============================] - 2s 5ms/step - loss: 4361576960.0000 - r2: 0.
8147 - val_loss: 10916336640.0000 - val_r2: 0.5998
session cleared!

ix 5 i 1
updated temp_vec [0, 1, 1, 1, 1, 0, 0, 1, 1]
going through feature_mask [0, 1, 1, 1, 1, 0, 0, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
```

```
e), name='normalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 5ms/step - loss: 84371333120.0000 - r2: -
2.5765 - val_loss: 18686388224.0000 - val_r2: 0.3210
Epoch 2/50
342/342 [==============================] - 2s 5ms/step - loss: 9524235264.0000 - r2: 0.
5978 - val_loss: 15614382080.0000 - val_r2: 0.4297
Epoch 3/50
342/342 [==============================] - 2s 5ms/step - loss: 8317708800.0000 - r2: 0.
6477 - val_loss: 14386483200.0000 - val_r2: 0.4747
Epoch 4/50
342/342 [==============================] - 2s 5ms/step - loss: 7794613760.0000 - r2: 0.
6702 - val_loss: 14286009344.0000 - val_r2: 0.4778
Epoch 5/50
342/342 [==============================] - 2s 5ms/step - loss: 7435457024.0000 - r2: 0.
6848 - val_loss: 13065964544.0000 - val_r2: 0.5215
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 7098687488.0000 - r2: 0.
6986 - val_loss: 13074604032.0000 - val_r2: 0.5221
Epoch 7/50
342/342 [==============================] - 2s 5ms/step - loss: 6747190784.0000 - r2: 0.
7136 - val_loss: 12387640320.0000 - val_r2: 0.5471
Epoch 8/50
342/342 [==============================] - 2s 5ms/step - loss: 6366137856.0000 - r2: 0.
7299 - val_loss: 12882551808.0000 - val_r2: 0.5285
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 5968778752.0000 - r2: 0.
7469 - val_loss: 11826561024.0000 - val_r2: 0.5670
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 5569426432.0000 - r2: 0.
7637 - val_loss: 10959800320.0000 - val_r2: 0.5992
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 5186244608.0000 - r2: 0.
7799 - val_loss: 11540880384.0000 - val_r2: 0.5779
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 4862503424.0000 - r2: 0.
7939 - val_loss: 10494723072.0000 - val_r2: 0.6166
Epoch 13/50
342/342 [==============================] - 2s 5ms/step - loss: 4591574528.0000 - r2: 0.
8051 - val_loss: 11321662464.0000 - val_r2: 0.5855
Epoch 14/50
342/342 [==============================] - 2s 5ms/step - loss: 4368728064.0000 - r2: 0.
8146 - val_loss: 10170118144.0000 - val_r2: 0.6278
Epoch 15/50
342/342 [==============================] - 2s 5ms/step - loss: 4213311488.0000 - r2: 0.
8207 - val_loss: 10602686464.0000 - val_r2: 0.6118
Epoch 16/50
342/342 [==============================] - 2s 5ms/step - loss: 4092627456.0000 - r2: 0.
8262 - val_loss: 9890996224.0000 - val_r2: 0.6384
Epoch 17/50
342/342 [==============================] - 2s 5ms/step - loss: 4022979328.0000 - r2: 0.
8293 - val_loss: 11168140288.0000 - val_r2: 0.5907
Epoch 18/50
342/342 [==============================] - 2s 6ms/step - loss: 3979743744.0000 - r2: 0.
```

```
8311 - val_loss: 10194356224.0000 - val_r2: 0.6265
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 3951117824.0000 - r2: 0.
8323 - val_loss: 9412401152.0000 - val_r2: 0.6554
Epoch 20/50
342/342 [==============================] - 2s 5ms/step - loss: 3937585408.0000 - r2: 0.
8323 - val_loss: 9096219648.0000 - val_r2: 0.6667
Epoch 21/50
342/342 [==============================] - 2s 5ms/step - loss: 3917091584.0000 - r2: 0.
8336 - val_loss: 10418855936.0000 - val_r2: 0.6179
Epoch 22/50
342/342 [==============================] - 2s 5ms/step - loss: 3904449024.0000 - r2: 0.
8340 - val_loss: 10801277952.0000 - val_r2: 0.6040
Epoch 23/50
342/342 [==============================] - 2s 5ms/step - loss: 3897027584.0000 - r2: 0.
8341 - val_loss: 9161884672.0000 - val_r2: 0.6650
Epoch 24/50
342/342 [==============================] - 2s 6ms/step - loss: 3889399552.0000 - r2: 0.
8350 - val_loss: 9837389824.0000 - val_r2: 0.6399
Epoch 25/50
342/342 [==============================] - 2s 5ms/step - loss: 3879763712.0000 - r2: 0.
8352 - val_loss: 10398830592.0000 - val_r2: 0.6179
Epoch 26/50
342/342 [==============================] - 2s 5ms/step - loss: 3868733952.0000 - r2: 0.
8353 - val_loss: 9509779456.0000 - val_r2: 0.6515
Epoch 27/50
342/342 [==============================] - 2s 5ms/step - loss: 3862706432.0000 - r2: 0.
8357 - val_loss: 10379034624.0000 - val_r2: 0.6195
Epoch 28/50
342/342 [==============================] - 2s 5ms/step - loss: 3851609344.0000 - r2: 0.
8367 - val_loss: 10123697152.0000 - val_r2: 0.6290
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 3848138752.0000 - r2: 0.
8363 - val_loss: 11512753152.0000 - val_r2: 0.5780
Epoch 30/50
342/342 [==============================] - 2s 5ms/step - loss: 3841390592.0000 - r2: 0.
8365 - val_loss: 10372819968.0000 - val_r2: 0.6208
new min loss: len 7, ix 5
session cleared!

ix 6 i 0
ix 7 i 1
updated temp_vec [0, 1, 1, 1, 1, 1, 0, 0, 1]
going through feature_mask [0, 1, 1, 1, 1, 1, 0, 0, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization/truediv:0', description="created by layer 'normalization'")
```

```
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 5ms/step - loss: 84016275456.0000 - r2: -
2.5252 - val_loss: 18391066624.0000 - val_r2: 0.3316
Epoch 2/50
342/342 [==============================] - 2s 5ms/step - loss: 9567910912.0000 - r2: 0.
5959 - val_loss: 15429454848.0000 - val_r2: 0.4366
Epoch 3/50
342/342 [==============================] - 2s 6ms/step - loss: 8401012224.0000 - r2: 0.
6440 - val_loss: 13935760384.0000 - val_r2: 0.4904
Epoch 4/50
342/342 [==============================] - 2s 5ms/step - loss: 7935512064.0000 - r2: 0.
6637 - val_loss: 13903556608.0000 - val_r2: 0.4920
Epoch 5/50
342/342 [==============================] - 3s 6ms/step - loss: 7624537600.0000 - r2: 0.
6767 - val_loss: 13741676544.0000 - val_r2: 0.4976
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 7341304832.0000 - r2: 0.
6884 - val_loss: 12416688128.0000 - val_r2: 0.5457
Epoch 7/50
342/342 [==============================] - 2s 5ms/step - loss: 7053516288.0000 - r2: 0.
7007 - val_loss: 12550067200.0000 - val_r2: 0.5412
Epoch 8/50
342/342 [==============================] - 2s 5ms/step - loss: 6744735232.0000 - r2: 0.
7141 - val_loss: 12455897088.0000 - val_r2: 0.5434
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 6420152832.0000 - r2: 0.
7280 - val_loss: 12641503232.0000 - val_r2: 0.5372
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 6093853696.0000 - r2: 0.
7412 - val_loss: 11775325184.0000 - val_r2: 0.5688
Epoch 11/50
342/342 [==============================] - 2s 5ms/step - loss: 5769456128.0000 - r2: 0.
7554 - val_loss: 11769500672.0000 - val_r2: 0.5693
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 5462257152.0000 - r2: 0.
7683 - val_loss: 11169593344.0000 - val_r2: 0.5913
Epoch 13/50
342/342 [==============================] - 2s 5ms/step - loss: 5171779072.0000 - r2: 0.
7807 - val_loss: 11499299840.0000 - val_r2: 0.5790
Epoch 14/50
342/342 [==============================] - 2s 5ms/step - loss: 4929242624.0000 - r2: 0.
7906 - val_loss: 10758926336.0000 - val_r2: 0.6058
Epoch 15/50
342/342 [==============================] - 2s 5ms/step - loss: 4728667648.0000 - r2: 0.
7993 - val_loss: 10297697280.0000 - val_r2: 0.6226
Epoch 16/50
342/342 [==============================] - 2s 6ms/step - loss: 4588178432.0000 - r2: 0.
8053 - val_loss: 10311399424.0000 - val_r2: 0.6227
Epoch 17/50
342/342 [==============================] - 2s 5ms/step - loss: 4504940544.0000 - r2: 0.
8086 - val_loss: 10261923840.0000 - val_r2: 0.6243
Epoch 18/50
342/342 [==============================] - 2s 5ms/step - loss: 4457596416.0000 - r2: 0.
8102 - val_loss: 11093683200.0000 - val_r2: 0.5934
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 4431859712.0000 - r2: 0.
8121 - val_loss: 10383995904.0000 - val_r2: 0.6192
Epoch 20/50
```

```
342/342 [==============================] - 2s 5ms/step - loss: 4411459072.0000 - r2: 0.
8128 - val_loss: 9869056000.0000 - val_r2: 0.6380
Epoch 21/50
342/342 [==============================] - 2s 5ms/step - loss: 4394965504.0000 - r2: 0.
8132 - val_loss: 11229720576.0000 - val_r2: 0.5885
Epoch 22/50
342/342 [==============================] - 2s 5ms/step - loss: 4385844736.0000 - r2: 0.
8136 - val_loss: 10411809792.0000 - val_r2: 0.6182
Epoch 23/50
342/342 [==============================] - 2s 5ms/step - loss: 4379905024.0000 - r2: 0.
8140 - val_loss: 9869601792.0000 - val_r2: 0.6379
Epoch 24/50
342/342 [==============================] - 2s 5ms/step - loss: 4369960960.0000 - r2: 0.
8144 - val_loss: 10893921280.0000 - val_r2: 0.6007
Epoch 25/50
342/342 [==============================] - 2s 5ms/step - loss: 4360532992.0000 - r2: 0.
8151 - val_loss: 9976648704.0000 - val_r2: 0.6343
Epoch 26/50
342/342 [==============================] - 2s 5ms/step - loss: 4356997120.0000 - r2: 0.
8144 - val_loss: 10621778944.0000 - val_r2: 0.6110
Epoch 27/50
342/342 [==============================] - 2s 5ms/step - loss: 4350898176.0000 - r2: 0.
8154 - val_loss: 10326710272.0000 - val_r2: 0.6211
Epoch 28/50
342/342 [==============================] - 2s 5ms/step - loss: 4344685056.0000 - r2: 0.
8153 - val_loss: 10631309312.0000 - val_r2: 0.6103
Epoch 29/50
342/342 [==============================] - 2s 5ms/step - loss: 4336909312.0000 - r2: 0.
8155 - val_loss: 10721864704.0000 - val_r2: 0.6074
Epoch 30/50
342/342 [==============================] - 2s 5ms/step - loss: 4333404672.0000 - r2: 0.
8159 - val_loss: 9289379840.0000 - val_r2: 0.6597
Epoch 31/50
342/342 [==============================] - 2s 5ms/step - loss: 4335321088.0000 - r2: 0.
8156 - val_loss: 10088204288.0000 - val_r2: 0.6301
Epoch 32/50
342/342 [==============================] - 2s 5ms/step - loss: 4319906816.0000 - r2: 0.
8162 - val_loss: 10440757248.0000 - val_r2: 0.6173
Epoch 33/50
342/342 [==============================] - 2s 5ms/step - loss: 4322811904.0000 - r2: 0.
8166 - val_loss: 9566310400.0000 - val_r2: 0.6494
Epoch 34/50
342/342 [==============================] - 2s 5ms/step - loss: 4320857088.0000 - r2: 0.
8166 - val_loss: 10573116416.0000 - val_r2: 0.6119
Epoch 35/50
342/342 [==============================] - 2s 5ms/step - loss: 4311997952.0000 - r2: 0.
8168 - val_loss: 10451291136.0000 - val_r2: 0.6169
Epoch 36/50
342/342 [==============================] - 2s 5ms/step - loss: 4311609344.0000 - r2: 0.
8166 - val_loss: 9960503296.0000 - val_r2: 0.6350
Epoch 37/50
342/342 [==============================] - 2s 5ms/step - loss: 4312603136.0000 - r2: 0.
8167 - val_loss: 10612739072.0000 - val_r2: 0.6116
Epoch 38/50
342/342 [==============================] - 2s 5ms/step - loss: 4306817536.0000 - r2: 0.
8171 - val_loss: 9664379904.0000 - val_r2: 0.6460
Epoch 39/50
342/342 [==============================] - 2s 5ms/step - loss: 4303596544.0000 - r2: 0.
8167 - val_loss: 10216649728.0000 - val_r2: 0.6261
Epoch 40/50
```

```
342/342 [==============================] - 2s 5ms/step - loss: 4298840064.0000 - r2: 0.
8172 - val_loss: 9636554752.0000 - val_r2: 0.6470
session cleared!

ix 8 i 1
updated temp_vec [0, 1, 1, 1, 1, 1, 0, 1, 0]
going through feature_mask [0, 1, 1, 1, 1, 1, 0, 1, 0]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 3s 5ms/step - loss: 83800211456.0000 - r2: -
2.5582 - val_loss: 18781927424.0000 - val_r2: 0.3168
Epoch 2/50
342/342 [==============================] - 2s 5ms/step - loss: 9752740864.0000 - r2: 0.
5877 - val_loss: 15927121920.0000 - val_r2: 0.4181
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 8676987904.0000 - r2: 0.
6324 - val_loss: 14758786048.0000 - val_r2: 0.4610
Epoch 4/50
342/342 [==============================] - 2s 6ms/step - loss: 8298673664.0000 - r2: 0.
6483 - val_loss: 14535880704.0000 - val_r2: 0.4688
Epoch 5/50
342/342 [==============================] - 2s 6ms/step - loss: 8087645696.0000 - r2: 0.
6570 - val_loss: 13815581696.0000 - val_r2: 0.4949
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 7928750080.0000 - r2: 0.
6639 - val_loss: 14223835136.0000 - val_r2: 0.4787
Epoch 7/50
342/342 [==============================] - 2s 6ms/step - loss: 7786971136.0000 - r2: 0.
6692 - val_loss: 14610836480.0000 - val_r2: 0.4661
Epoch 8/50
342/342 [==============================] - 2s 6ms/step - loss: 7657887744.0000 - r2: 0.
6754 - val_loss: 13649122304.0000 - val_r2: 0.5011
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 7539061248.0000 - r2: 0.
6801 - val_loss: 13514673152.0000 - val_r2: 0.5052
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 7442177024.0000 - r2: 0.
6838 - val_loss: 13937095680.0000 - val_r2: 0.4893
Epoch 11/50
342/342 [==============================] - 3s 7ms/step - loss: 7350930944.0000 - r2: 0.
6882 - val_loss: 13608912896.0000 - val_r2: 0.5015
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 7285389824.0000 - r2: 0.
```

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6906 - val_loss: 13576272896.0000 - val_r2: 0.5034
Epoch 13/50
342/342 [==============================] - 2s 5ms/step - loss: 7239026176.0000 - r2: 0.
6932 - val_loss: 14308842496.0000 - val_r2: 0.4764
Epoch 14/50
342/342 [==============================] - 2s 5ms/step - loss: 7205018112.0000 - r2: 0.
6946 - val_loss: 14327917568.0000 - val_r2: 0.4761
Epoch 15/50
342/342 [==============================] - 2s 6ms/step - loss: 7181932032.0000 - r2: 0.
6949 - val_loss: 14551773184.0000 - val_r2: 0.4672
Epoch 16/50
342/342 [==============================] - 2s 5ms/step - loss: 7172540928.0000 - r2: 0.
6952 - val_loss: 13801374720.0000 - val_r2: 0.4958
Epoch 17/50
342/342 [==============================] - 2s 6ms/step - loss: 7149157888.0000 - r2: 0.
6964 - val_loss: 13594110976.0000 - val_r2: 0.5031
Epoch 18/50
342/342 [==============================] - 2s 5ms/step - loss: 7138147328.0000 - r2: 0.
6974 - val_loss: 13849418752.0000 - val_r2: 0.4925
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 7135113728.0000 - r2: 0.
6974 - val_loss: 13969518592.0000 - val_r2: 0.4891
session cleared!

1705.7301578521729 seconds elapsed

vec [0, 1, 1, 1, 1, 0, 0, 1, 1]
ix 0 i 0
ix 1 i 1
updated temp_vec [0, 0, 1, 1, 1, 0, 0, 1, 1]
going through feature_mask [0, 0, 1, 1, 1, 0, 0, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=Non
e), name='flatten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 3s 5ms/step - loss: 90146463744.0000 - r2: -
2.8009 - val_loss: 20036366336.0000 - val_r2: 0.2712
Epoch 2/50
342/342 [==============================] - 2s 5ms/step - loss: 11000699904.0000 - r2:
 0.5355 - val_loss: 17413464064.0000 - val_r2: 0.3650
Epoch 3/50
342/342 [==============================] - 2s 5ms/step - loss: 9935208448.0000 - r2: 0.
5796 - val_loss: 16553443328.0000 - val_r2: 0.3966
Epoch 4/50
342/342 [==============================] - 2s 5ms/step - loss: 9372958720.0000 - r2: 0.
```

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6031 - val_loss: 15904566272.0000 - val_r2: 0.4199
Epoch 5/50
342/342 [==============================] - 2s 5ms/step - loss: 8921380864.0000 - r2: 0.
6220 - val_loss: 15549448192.0000 - val_r2: 0.4328
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 8473747456.0000 - r2: 0.
6412 - val_loss: 14399237120.0000 - val_r2: 0.4739
Epoch 7/50
342/342 [==============================] - 2s 5ms/step - loss: 7999761408.0000 - r2: 0.
6612 - val_loss: 14878332928.0000 - val_r2: 0.4573
Epoch 8/50
342/342 [==============================] - 2s 5ms/step - loss: 7486894592.0000 - r2: 0.
6836 - val_loss: 13758944256.0000 - val_r2: 0.4974
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 6955338752.0000 - r2: 0.
7059 - val_loss: 13637035008.0000 - val_r2: 0.5016
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 6426324480.0000 - r2: 0.
7285 - val_loss: 12661112832.0000 - val_r2: 0.5379
Epoch 11/50
342/342 [==============================] - 2s 5ms/step - loss: 5946855424.0000 - r2: 0.
7485 - val_loss: 12123574272.0000 - val_r2: 0.5566
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 5550158336.0000 - r2: 0.
7649 - val_loss: 12754508800.0000 - val_r2: 0.5340
Epoch 13/50
342/342 [==============================] - 2s 5ms/step - loss: 5214307840.0000 - r2: 0.
7790 - val_loss: 11275670528.0000 - val_r2: 0.5879
Epoch 14/50
342/342 [==============================] - 2s 5ms/step - loss: 4978152960.0000 - r2: 0.
7890 - val_loss: 11300332544.0000 - val_r2: 0.5869
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4810417152.0000 - r2: 0.
7957 - val_loss: 11100369920.0000 - val_r2: 0.5934
Epoch 16/50
342/342 [==============================] - 2s 5ms/step - loss: 4700152320.0000 - r2: 0.
8005 - val_loss: 11470564352.0000 - val_r2: 0.5804
Epoch 17/50
342/342 [==============================] - 2s 5ms/step - loss: 4636758016.0000 - r2: 0.
8032 - val_loss: 12163402752.0000 - val_r2: 0.5546
Epoch 18/50
342/342 [==============================] - 2s 5ms/step - loss: 4604421632.0000 - r2: 0.
8049 - val_loss: 10722771968.0000 - val_r2: 0.6077
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 4575416832.0000 - r2: 0.
8057 - val_loss: 11141793792.0000 - val_r2: 0.5921
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 4564972544.0000 - r2: 0.
8063 - val_loss: 10309777408.0000 - val_r2: 0.6235
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 4556046848.0000 - r2: 0.
8063 - val_loss: 10971065344.0000 - val_r2: 0.5985
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 4538958848.0000 - r2: 0.
8076 - val_loss: 11589285888.0000 - val_r2: 0.5760
Epoch 23/50
342/342 [==============================] - 2s 5ms/step - loss: 4531006976.0000 - r2: 0.
8077 - val_loss: 10089864192.0000 - val_r2: 0.6310
Epoch 24/50
342/342 [==============================] - 2s 5ms/step - loss: 4520794624.0000 - r2: 0.
```

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8081 - val_loss: 11050857472.0000 - val_r2: 0.5953
Epoch 25/50
342/342 [==============================] - 2s 5ms/step - loss: 4514453504.0000 - r2: 0.
8081 - val_loss: 11638915072.0000 - val_r2: 0.5733
Epoch 26/50
342/342 [==============================] - 2s 5ms/step - loss: 4506048512.0000 - r2: 0.
8087 - val_loss: 11347329024.0000 - val_r2: 0.5848
Epoch 27/50
342/342 [==============================] - 2s 5ms/step - loss: 4500792320.0000 - r2: 0.
8091 - val_loss: 11465971712.0000 - val_r2: 0.5801
Epoch 28/50
342/342 [==============================] - 2s 5ms/step - loss: 4491407872.0000 - r2: 0.
8096 - val_loss: 11180872704.0000 - val_r2: 0.5904
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 4486199296.0000 - r2: 0.
8098 - val_loss: 11863561216.0000 - val_r2: 0.5658
Epoch 30/50
342/342 [==============================] - 2s 5ms/step - loss: 4481029120.0000 - r2: 0.
8100 - val_loss: 11731342336.0000 - val_r2: 0.5699
Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 4476551168.0000 - r2: 0.
8099 - val_loss: 11745348608.0000 - val_r2: 0.5699
Epoch 32/50
342/342 [==============================] - 2s 4ms/step - loss: 4472165376.0000 - r2: 0.
8100 - val_loss: 10989080576.0000 - val_r2: 0.5980
Epoch 33/50
342/342 [==============================] - 2s 5ms/step - loss: 4464374272.0000 - r2: 0.
8102 - val_loss: 11147214848.0000 - val_r2: 0.5922
session cleared!

ix 2 i 1
updated temp_vec [0, 1, 0, 1, 1, 0, 0, 1, 1]
going through feature_mask [0, 1, 0, 1, 1, 0, 0, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=Non
e), name='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 2s 5ms/step - loss: 116891172864.0000 - r2:
 -3.9633 - val_loss: 32765126656.0000 - val_r2: -0.1921
Epoch 2/50
342/342 [==============================] - 2s 4ms/step - loss: 19675162624.0000 - r2:
 0.1695 - val_loss: 27499612160.0000 - val_r2: -0.0028
Epoch 3/50
342/342 [==============================] - 2s 4ms/step - loss: 17648375808.0000 - r2:
 0.2538 - val_loss: 25799665664.0000 - val_r2: 0.0590
```

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Epoch 4/50
342/342 [==============================] - 2s 4ms/step - loss: 16380920832.0000 - r2:
 0.3075 - val_loss: 24357488640.0000 - val_r2: 0.1116
Epoch 5/50
342/342 [==============================] - 2s 5ms/step - loss: 15166766080.0000 - r2:
 0.3579 - val_loss: 23280254976.0000 - val_r2: 0.1500
Epoch 6/50
342/342 [==============================] - 2s 4ms/step - loss: 13816082432.0000 - r2:
 0.4144 - val_loss: 21267165184.0000 - val_r2: 0.2228
Epoch 7/50
342/342 [==============================] - 2s 4ms/step - loss: 12301122560.0000 - r2:
 0.4795 - val_loss: 20389742592.0000 - val_r2: 0.2554
Epoch 8/50
342/342 [==============================] - 2s 5ms/step - loss: 10646465536.0000 - r2:
 0.5491 - val_loss: 17506809856.0000 - val_r2: 0.3603
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 8990558208.0000 - r2: 0.
6199 - val_loss: 15683751936.0000 - val_r2: 0.4267
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 7500900864.0000 - r2: 0.
6825 - val_loss: 14253642752.0000 - val_r2: 0.4791
Epoch 11/50
342/342 [==============================] - 2s 4ms/step - loss: 6317470208.0000 - r2: 0.
7323 - val_loss: 13308520448.0000 - val_r2: 0.5132
Epoch 12/50
342/342 [==============================] - 2s 4ms/step - loss: 5493986304.0000 - r2: 0.
7673 - val_loss: 12276319232.0000 - val_r2: 0.5518
Epoch 13/50
342/342 [==============================] - 2s 4ms/step - loss: 4986436096.0000 - r2: 0.
7890 - val_loss: 12116660224.0000 - val_r2: 0.5561
Epoch 14/50
342/342 [==============================] - 2s 5ms/step - loss: 4706762240.0000 - r2: 0.
8002 - val_loss: 11563707392.0000 - val_r2: 0.5766
Epoch 15/50
342/342 [==============================] - 2s 4ms/step - loss: 4568224768.0000 - r2: 0.
8065 - val_loss: 11201124352.0000 - val_r2: 0.5899
Epoch 16/50
342/342 [==============================] - 2s 4ms/step - loss: 4510497792.0000 - r2: 0.
8085 - val_loss: 10960939008.0000 - val_r2: 0.5989
Epoch 17/50
342/342 [==============================] - 2s 4ms/step - loss: 4488552960.0000 - r2: 0.
8097 - val_loss: 10769509376.0000 - val_r2: 0.6062
Epoch 18/50
342/342 [==============================] - 2s 5ms/step - loss: 4481922048.0000 - r2: 0.
8096 - val_loss: 11254085632.0000 - val_r2: 0.5882
Epoch 19/50
342/342 [==============================] - 2s 4ms/step - loss: 4481205248.0000 - r2: 0.
8098 - val_loss: 11321387008.0000 - val_r2: 0.5853
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 4480237056.0000 - r2: 0.
8100 - val_loss: 10931162112.0000 - val_r2: 0.5999
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 4480791552.0000 - r2: 0.
8102 - val_loss: 11112827904.0000 - val_r2: 0.5938
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 4479964160.0000 - r2: 0.
8097 - val_loss: 10833495040.0000 - val_r2: 0.6031
Epoch 23/50
342/342 [==============================] - 2s 4ms/step - loss: 4481840640.0000 - r2: 0.
8098 - val_loss: 10573914112.0000 - val_r2: 0.6132
```

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Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 4478342656.0000 - r2: 0.
8103 - val_loss: 11080835072.0000 - val_r2: 0.5948
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 4480696320.0000 - r2: 0.
8097 - val_loss: 10818692096.0000 - val_r2: 0.6041
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 4478482944.0000 - r2: 0.
8099 - val_loss: 11298949120.0000 - val_r2: 0.5862
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 4478995968.0000 - r2: 0.
8096 - val_loss: 10809484288.0000 - val_r2: 0.6042
Epoch 28/50
342/342 [==============================] - 2s 4ms/step - loss: 4481423360.0000 - r2: 0.
8099 - val_loss: 11683550208.0000 - val_r2: 0.5723
Epoch 29/50
342/342 [==============================] - 2s 4ms/step - loss: 4483410944.0000 - r2: 0.
8096 - val_loss: 10924393472.0000 - val_r2: 0.5997
Epoch 30/50
342/342 [==============================] - 2s 4ms/step - loss: 4481402880.0000 - r2: 0.
8098 - val_loss: 10651063296.0000 - val_r2: 0.6093
Epoch 31/50
342/342 [==============================] - 2s 4ms/step - loss: 4477922816.0000 - r2: 0.
8100 - val_loss: 11272416256.0000 - val_r2: 0.5873
Epoch 32/50
342/342 [==============================] - 2s 4ms/step - loss: 4485638656.0000 - r2: 0.
8097 - val_loss: 11604481024.0000 - val_r2: 0.5754
Epoch 33/50
342/342 [==============================] - 2s 4ms/step - loss: 4481234432.0000 - r2: 0.
8098 - val_loss: 10767513600.0000 - val_r2: 0.6055
session cleared!

ix 3 i 1
updated temp_vec [0, 1, 1, 0, 1, 0, 0, 1, 1]
going through feature_mask [0, 1, 1, 0, 1, 0, 0, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 3s 5ms/step - loss: 83445964800.0000 - r2: -
2.5651 - val_loss: 18529486848.0000 - val_r2: 0.3260
Epoch 2/50
342/342 [==============================] - 2s 5ms/step - loss: 9511372800.0000 - r2: 0.
5978 - val_loss: 14915290112.0000 - val_r2: 0.4562
Epoch 3/50
```

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342/342 [==============================] - 2s 6ms/step - loss: 8310459904.0000 - r2: 0.
6474 - val_loss: 14332730368.0000 - val_r2: 0.4755
Epoch 4/50
342/342 [==============================] - 2s 5ms/step - loss: 7789040128.0000 - r2: 0.
6697 - val_loss: 13660909568.0000 - val_r2: 0.5000
Epoch 5/50
342/342 [==============================] - 2s 5ms/step - loss: 7425052160.0000 - r2: 0.
6853 - val_loss: 13460405248.0000 - val_r2: 0.5072
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 7089691648.0000 - r2: 0.
6991 - val_loss: 13135621120.0000 - val_r2: 0.5200
Epoch 7/50
342/342 [==============================] - 2s 5ms/step - loss: 6739990528.0000 - r2: 0.
7139 - val_loss: 12851323904.0000 - val_r2: 0.5303
Epoch 8/50
342/342 [==============================] - 2s 5ms/step - loss: 6361536000.0000 - r2: 0.
7298 - val_loss: 12379035648.0000 - val_r2: 0.5482
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 5976451584.0000 - r2: 0.
7461 - val_loss: 11680228352.0000 - val_r2: 0.5730
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 5585273856.0000 - r2: 0.
7629 - val_loss: 11845128192.0000 - val_r2: 0.5663
Epoch 11/50
342/342 [==============================] - 2s 5ms/step - loss: 5224573440.0000 - r2: 0.
7786 - val_loss: 10919817216.0000 - val_r2: 0.6003
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 4918484992.0000 - r2: 0.
7913 - val_loss: 11347997696.0000 - val_r2: 0.5845
Epoch 13/50
342/342 [==============================] - 2s 5ms/step - loss: 4678230528.0000 - r2: 0.
8017 - val_loss: 10301498368.0000 - val_r2: 0.6227
Epoch 14/50
342/342 [==============================] - 2s 6ms/step - loss: 4489434624.0000 - r2: 0.
8095 - val_loss: 10686199808.0000 - val_r2: 0.6095
Epoch 15/50
342/342 [==============================] - 2s 5ms/step - loss: 4354114048.0000 - r2: 0.
8152 - val_loss: 9950290944.0000 - val_r2: 0.6351
Epoch 16/50
342/342 [==============================] - 2s 5ms/step - loss: 4265401600.0000 - r2: 0.
8191 - val_loss: 10603156480.0000 - val_r2: 0.6118
Epoch 17/50
342/342 [==============================] - 2s 6ms/step - loss: 4211734016.0000 - r2: 0.
8213 - val_loss: 11062308864.0000 - val_r2: 0.5945
Epoch 18/50
342/342 [==============================] - 2s 5ms/step - loss: 4190034432.0000 - r2: 0.
8219 - val_loss: 9842793472.0000 - val_r2: 0.6387
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 4172589312.0000 - r2: 0.
8228 - val_loss: 10065457152.0000 - val_r2: 0.6303
Epoch 20/50
342/342 [==============================] - 2s 5ms/step - loss: 4169281280.0000 - r2: 0.
8227 - val_loss: 9880274944.0000 - val_r2: 0.6385
Epoch 21/50
342/342 [==============================] - 2s 5ms/step - loss: 4167497216.0000 - r2: 0.
8231 - val_loss: 9671333888.0000 - val_r2: 0.6463
Epoch 22/50
342/342 [==============================] - 2s 5ms/step - loss: 4162997504.0000 - r2: 0.
8231 - val_loss: 10075699200.0000 - val_r2: 0.6304
Epoch 23/50
```

```
342/342 [==============================] - 2s 5ms/step - loss: 4170805504.0000 - r2: 0.
8229 - val_loss: 11176513536.0000 - val_r2: 0.5903
Epoch 24/50
342/342 [==============================] - 2s 5ms/step - loss: 4167296512.0000 - r2: 0.
8230 - val_loss: 10819113984.0000 - val_r2: 0.6037
Epoch 25/50
342/342 [==============================] - 2s 5ms/step - loss: 4167415552.0000 - r2: 0.
8229 - val_loss: 10736569344.0000 - val_r2: 0.6068
Epoch 26/50
342/342 [==============================] - 2s 5ms/step - loss: 4163687168.0000 - r2: 0.
8227 - val_loss: 9845033984.0000 - val_r2: 0.6390
Epoch 27/50
342/342 [==============================] - 2s 5ms/step - loss: 4168500480.0000 - r2: 0.
8230 - val_loss: 9951373312.0000 - val_r2: 0.6354
Epoch 28/50
342/342 [==============================] - 2s 5ms/step - loss: 4162771200.0000 - r2: 0.
8231 - val_loss: 10022846464.0000 - val_r2: 0.6329
Epoch 29/50
342/342 [==============================] - 2s 5ms/step - loss: 4168816896.0000 - r2: 0.
8227 - val_loss: 10115510272.0000 - val_r2: 0.6296
Epoch 30/50
342/342 [==============================] - 2s 5ms/step - loss: 4167518720.0000 - r2: 0.
8232 - val_loss: 10195566592.0000 - val_r2: 0.6265
Epoch 31/50
342/342 [==============================] - 2s 5ms/step - loss: 4164757504.0000 - r2: 0.
8231 - val_loss: 10151695360.0000 - val_r2: 0.6281
session cleared!

ix 4 i 1
updated temp_vec [0, 1, 1, 1, 0, 0, 0, 1, 1]
going through feature_mask [0, 1, 1, 1, 0, 0, 0, 1, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_4/truediv:0', description="created by layer 'normalization_4'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 3s 6ms/step - loss: 83587432448.0000 - r2: -
2.5682 - val_loss: 18024263680.0000 - val_r2: 0.3447
Epoch 2/50
342/342 [==============================] - 2s 5ms/step - loss: 9521430528.0000 - r2: 0.
5979 - val_loss: 15256175616.0000 - val_r2: 0.4436
Epoch 3/50
342/342 [==============================] - 2s 5ms/step - loss: 8330320896.0000 - r2: 0.
6462 - val_loss: 13929097216.0000 - val_r2: 0.4921
Epoch 4/50
342/342 [==============================] - 2s 5ms/step - loss: 7829370880.0000 - r2: 0.
```

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6678 - val_loss: 13819139072.0000 - val_r2: 0.4949
Epoch 5/50
342/342 [==============================] - 2s 5ms/step - loss: 7484909056.0000 - r2: 0.
6829 - val_loss: 13214672896.0000 - val_r2: 0.5165
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 7168050176.0000 - r2: 0.
6963 - val_loss: 13183775744.0000 - val_r2: 0.5172
Epoch 7/50
342/342 [==============================] - 2s 5ms/step - loss: 6842338816.0000 - r2: 0.
7098 - val_loss: 12878156800.0000 - val_r2: 0.5294
Epoch 8/50
342/342 [==============================] - 2s 5ms/step - loss: 6502573056.0000 - r2: 0.
7242 - val_loss: 12244828160.0000 - val_r2: 0.5520
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 6152259584.0000 - r2: 0.
7395 - val_loss: 11994029056.0000 - val_r2: 0.5611
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 5812240384.0000 - r2: 0.
7536 - val_loss: 11319104512.0000 - val_r2: 0.5859
Epoch 11/50
342/342 [==============================] - 2s 5ms/step - loss: 5496240640.0000 - r2: 0.
7671 - val_loss: 11269211136.0000 - val_r2: 0.5869
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 5228764672.0000 - r2: 0.
7783 - val_loss: 11119448064.0000 - val_r2: 0.5929
Epoch 13/50
342/342 [==============================] - 2s 5ms/step - loss: 5000799232.0000 - r2: 0.
7880 - val_loss: 10971732992.0000 - val_r2: 0.5983
Epoch 14/50
342/342 [==============================] - 2s 5ms/step - loss: 4822924288.0000 - r2: 0.
7950 - val_loss: 10320931840.0000 - val_r2: 0.6218
Epoch 15/50
342/342 [==============================] - 2s 5ms/step - loss: 4694510592.0000 - r2: 0.
8009 - val_loss: 11742513152.0000 - val_r2: 0.5698
Epoch 16/50
342/342 [==============================] - 2s 5ms/step - loss: 4594268672.0000 - r2: 0.
8046 - val_loss: 10429423616.0000 - val_r2: 0.6180
Epoch 17/50
342/342 [==============================] - 2s 5ms/step - loss: 4533710848.0000 - r2: 0.
8079 - val_loss: 10166188032.0000 - val_r2: 0.6273
Epoch 18/50
342/342 [==============================] - 2s 5ms/step - loss: 4498118656.0000 - r2: 0.
8084 - val_loss: 10186775552.0000 - val_r2: 0.6266
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 4484977152.0000 - r2: 0.
8097 - val_loss: 11187607552.0000 - val_r2: 0.5899
Epoch 20/50
342/342 [==============================] - 2s 5ms/step - loss: 4480609280.0000 - r2: 0.
8098 - val_loss: 11362035712.0000 - val_r2: 0.5840
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 4477442560.0000 - r2: 0.
8098 - val_loss: 9844955136.0000 - val_r2: 0.6396
Epoch 22/50
342/342 [==============================] - 2s 5ms/step - loss: 4471868928.0000 - r2: 0.
8102 - val_loss: 10477588480.0000 - val_r2: 0.6152
Epoch 23/50
342/342 [==============================] - 2s 5ms/step - loss: 4476249088.0000 - r2: 0.
8096 - val_loss: 10794662912.0000 - val_r2: 0.6040
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 4468043776.0000 - r2: 0.
```

```
8103 - val_loss: 10645787648.0000 - val_r2: 0.6103
Epoch 25/50
342/342 [==============================] - 2s 5ms/step - loss: 4470034432.0000 - r2: 0.
8099 - val_loss: 10652855296.0000 - val_r2: 0.6097
Epoch 26/50
342/342 [==============================] - 2s 5ms/step - loss: 4470352896.0000 - r2: 0.
8101 - val_loss: 11590002688.0000 - val_r2: 0.5757
Epoch 27/50
342/342 [==============================] - 2s 5ms/step - loss: 4473199616.0000 - r2: 0.
8097 - val_loss: 10759284736.0000 - val_r2: 0.6054
Epoch 28/50
342/342 [==============================] - 2s 5ms/step - loss: 4470908416.0000 - r2: 0.
8103 - val_loss: 10779720704.0000 - val_r2: 0.6055
Epoch 29/50
342/342 [==============================] - 2s 5ms/step - loss: 4465952256.0000 - r2: 0.
8101 - val_loss: 11333297152.0000 - val_r2: 0.5846
Epoch 30/50
342/342 [==============================] - 2s 5ms/step - loss: 4464293888.0000 - r2: 0.
8102 - val_loss: 11791102976.0000 - val_r2: 0.5680
Epoch 31/50
342/342 [==============================] - 2s 5ms/step - loss: 4467483136.0000 - r2: 0.
8103 - val_loss: 10976492544.0000 - val_r2: 0.5978
session cleared!

ix 5 i 0
ix 6 i 0
ix 7 i 1
updated temp_vec [0, 1, 1, 1, 1, 0, 0, 0, 1]
going through feature_mask [0, 1, 1, 1, 1, 0, 0, 0, 1]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization/truediv:0', description="created by layer 'normalization'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 3s 5ms/step - loss: 83919060992.0000 - r2: -
2.5849 - val_loss: 18284072960.0000 - val_r2: 0.3356
Epoch 2/50
342/342 [==============================] - 2s 5ms/step - loss: 9662164992.0000 - r2: 0.
5910 - val_loss: 15442074624.0000 - val_r2: 0.4365
Epoch 3/50
342/342 [==============================] - 2s 5ms/step - loss: 8576373248.0000 - r2: 0.
6368 - val_loss: 14692812800.0000 - val_r2: 0.4634
Epoch 4/50
342/342 [==============================] - 2s 5ms/step - loss: 8166273024.0000 - r2: 0.
6538 - val_loss: 13890241536.0000 - val_r2: 0.4925
Epoch 5/50
```

```
342/342 [==============================] - 2s 6ms/step - loss: 7902879232.0000 - r2: 0.
6645 - val_loss: 13521978368.0000 - val_r2: 0.5055
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 7667283968.0000 - r2: 0.
6742 - val_loss: 13762298880.0000 - val_r2: 0.4969
Epoch 7/50
342/342 [==============================] - 2s 5ms/step - loss: 7423485440.0000 - r2: 0.
6851 - val_loss: 12987173888.0000 - val_r2: 0.5248
Epoch 8/50
342/342 [==============================] - 2s 6ms/step - loss: 7156075520.0000 - r2: 0.
6966 - val_loss: 12902815744.0000 - val_r2: 0.5278
Epoch 9/50
342/342 [==============================] - 2s 5ms/step - loss: 6850831872.0000 - r2: 0.
7095 - val_loss: 12137872384.0000 - val_r2: 0.5556
Epoch 10/50
342/342 [==============================] - 2s 5ms/step - loss: 6521731072.0000 - r2: 0.
7237 - val_loss: 12192129024.0000 - val_r2: 0.5549
Epoch 11/50
342/342 [==============================] - 2s 5ms/step - loss: 6154714112.0000 - r2: 0.
7388 - val_loss: 11567261696.0000 - val_r2: 0.5768
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 5780594176.0000 - r2: 0.
7545 - val_loss: 11381020672.0000 - val_r2: 0.5837
Epoch 13/50
342/342 [==============================] - 2s 5ms/step - loss: 5430535168.0000 - r2: 0.
7696 - val_loss: 11271649280.0000 - val_r2: 0.5874
Epoch 14/50
342/342 [==============================] - 2s 5ms/step - loss: 5118891520.0000 - r2: 0.
7827 - val_loss: 10581846016.0000 - val_r2: 0.6122
Epoch 15/50
342/342 [==============================] - 2s 5ms/step - loss: 4883044864.0000 - r2: 0.
7929 - val_loss: 10912841728.0000 - val_r2: 0.6005
Epoch 16/50
342/342 [==============================] - 2s 5ms/step - loss: 4728729600.0000 - r2: 0.
7993 - val_loss: 10773249024.0000 - val_r2: 0.6058
Epoch 17/50
342/342 [==============================] - 2s 5ms/step - loss: 4640606208.0000 - r2: 0.
8031 - val_loss: 10141966336.0000 - val_r2: 0.6288
Epoch 18/50
342/342 [==============================] - 2s 5ms/step - loss: 4593913344.0000 - r2: 0.
8049 - val_loss: 10069346304.0000 - val_r2: 0.6310
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 4569959424.0000 - r2: 0.
8058 - val_loss: 10964557824.0000 - val_r2: 0.5976
Epoch 20/50
342/342 [==============================] - 2s 5ms/step - loss: 4556332032.0000 - r2: 0.
8064 - val_loss: 10632665088.0000 - val_r2: 0.6112
Epoch 21/50
342/342 [==============================] - 2s 5ms/step - loss: 4549309440.0000 - r2: 0.
8065 - val_loss: 10354870272.0000 - val_r2: 0.6205
Epoch 22/50
342/342 [==============================] - 2s 5ms/step - loss: 4538954240.0000 - r2: 0.
8070 - val_loss: 10774494208.0000 - val_r2: 0.6051
Epoch 23/50
342/342 [==============================] - 2s 5ms/step - loss: 4526308352.0000 - r2: 0.
8077 - val_loss: 10070721536.0000 - val_r2: 0.6311
Epoch 24/50
342/342 [==============================] - 2s 5ms/step - loss: 4521906688.0000 - r2: 0.
8081 - val_loss: 10349940736.0000 - val_r2: 0.6205
Epoch 25/50
```

```
342/342 [==============================] - 2s 5ms/step - loss: 4516073472.0000 - r2: 0.
8079 - val_loss: 10316310528.0000 - val_r2: 0.6222
Epoch 26/50
342/342 [==============================] - 2s 5ms/step - loss: 4507717632.0000 - r2: 0.
8083 - val_loss: 10518024192.0000 - val_r2: 0.6145
Epoch 27/50
342/342 [==============================] - 2s 5ms/step - loss: 4508352512.0000 - r2: 0.
8085 - val_loss: 10909988864.0000 - val_r2: 0.5998
Epoch 28/50
342/342 [==============================] - 2s 5ms/step - loss: 4495156224.0000 - r2: 0.
8089 - val_loss: 9977421824.0000 - val_r2: 0.6344
Epoch 29/50
342/342 [==============================] - 2s 5ms/step - loss: 4485533696.0000 - r2: 0.
8096 - val_loss: 10453157888.0000 - val_r2: 0.6172
Epoch 30/50
342/342 [==============================] - 2s 5ms/step - loss: 4483357184.0000 - r2: 0.
8093 - val_loss: 9841751040.0000 - val_r2: 0.6398
Epoch 31/50
342/342 [==============================] - 2s 5ms/step - loss: 4482566144.0000 - r2: 0.
8098 - val_loss: 10003645440.0000 - val_r2: 0.6339
Epoch 32/50
342/342 [==============================] - 2s 5ms/step - loss: 4477719552.0000 - r2: 0.
8099 - val_loss: 11017398272.0000 - val_r2: 0.5969
Epoch 33/50
342/342 [==============================] - 2s 5ms/step - loss: 4471456256.0000 - r2: 0.
8099 - val_loss: 10240193536.0000 - val_r2: 0.6246
Epoch 34/50
342/342 [==============================] - 2s 5ms/step - loss: 4466287104.0000 - r2: 0.
8103 - val_loss: 11026427904.0000 - val_r2: 0.5965
Epoch 35/50
342/342 [==============================] - 2s 5ms/step - loss: 4472948736.0000 - r2: 0.
8100 - val_loss: 10700758016.0000 - val_r2: 0.6082
Epoch 36/50
342/342 [==============================] - 2s 5ms/step - loss: 4461091328.0000 - r2: 0.
8104 - val_loss: 11285548032.0000 - val_r2: 0.5863
Epoch 37/50
342/342 [==============================] - 2s 5ms/step - loss: 4460231680.0000 - r2: 0.
8104 - val_loss: 10695395328.0000 - val_r2: 0.6083
Epoch 38/50
342/342 [==============================] - 2s 5ms/step - loss: 4455735296.0000 - r2: 0.
8106 - val_loss: 11162105856.0000 - val_r2: 0.5907
Epoch 39/50
342/342 [==============================] - 2s 5ms/step - loss: 4453740544.0000 - r2: 0.
8111 - val_loss: 10038929408.0000 - val_r2: 0.6321
Epoch 40/50
342/342 [==============================] - 2s 5ms/step - loss: 4456326656.0000 - r2: 0.
8107 - val_loss: 10178365440.0000 - val_r2: 0.6269
session cleared!

ix 8 i 1
updated temp_vec [0, 1, 1, 1, 1, 0, 0, 1, 0]
going through feature_mask [0, 1, 1, 1, 1, 0, 0, 1, 0]
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 6), dtype=tf.float32, name=Non
e), name='flatten/Reshape:0', description="created by layer 'flatten'")
KerasTensor(type_spec=TensorSpec(shape=(None, 8), dtype=tf.float32, name=None), name='f
latten_2/Reshape:0', description="created by layer 'flatten_2'")
KerasTensor(type_spec=TensorSpec(shape=(None, 22), dtype=tf.float32, name=None), name
='flatten_1/Reshape:0', description="created by layer 'flatten_1'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_5/truediv:0', description="created by layer 'normalization_5'")
```

```
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization_4/truediv:0', description="created by layer 'normalization_4'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_2/truediv:0', description="created by layer 'normalization_2'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_3/truediv:0', description="created by layer 'normalization_3'")
KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=None), name='n
ormalization/truediv:0', description="created by layer 'normalization'")
Skipping KerasTensor(type_spec=TensorSpec(shape=(None, 1), dtype=tf.float32, name=Non
e), name='normalization_1/truediv:0', description="created by layer 'normalization_1'")
Epoch 1/50
342/342 [==============================] - 3s 5ms/step - loss: 84101398528.0000 - r2: -
2.5705 - val_loss: 18293598208.0000 - val_r2: 0.3354
Epoch 2/50
342/342 [==============================] - 2s 5ms/step - loss: 9882494976.0000 - r2: 0.
5823 - val_loss: 16022545408.0000 - val_r2: 0.4157
Epoch 3/50
342/342 [==============================] - 2s 5ms/step - loss: 8856056832.0000 - r2: 0.
6249 - val_loss: 14693538816.0000 - val_r2: 0.4627
Epoch 4/50
342/342 [==============================] - 2s 5ms/step - loss: 8520021504.0000 - r2: 0.
6389 - val_loss: 14630214656.0000 - val_r2: 0.4650
Epoch 5/50
342/342 [==============================] - 2s 5ms/step - loss: 8358569984.0000 - r2: 0.
6454 - val_loss: 14767358976.0000 - val_r2: 0.4604
Epoch 6/50
342/342 [==============================] - 2s 5ms/step - loss: 8247223296.0000 - r2: 0.
6504 - val_loss: 14168797184.0000 - val_r2: 0.4815
Epoch 7/50
342/342 [==============================] - 2s 5ms/step - loss: 8146710528.0000 - r2: 0.
6546 - val_loss: 14409947136.0000 - val_r2: 0.4737
Epoch 8/50
342/342 [==============================] - 2s 5ms/step - loss: 8055885824.0000 - r2: 0.
6584 - val_loss: 14793948160.0000 - val_r2: 0.4597
Epoch 9/50
342/342 [==============================] - 4s 9ms/step - loss: 7961962496.0000 - r2: 0.
6619 - val_loss: 13875165184.0000 - val_r2: 0.4926
Epoch 10/50
342/342 [==============================] - 3s 8ms/step - loss: 7880573952.0000 - r2: 0.
6657 - val_loss: 14354641920.0000 - val_r2: 0.4750
Epoch 11/50
342/342 [==============================] - 4s 9ms/step - loss: 7801496576.0000 - r2: 0.
6692 - val_loss: 13507847168.0000 - val_r2: 0.5059
Epoch 12/50
342/342 [==============================] - 2s 5ms/step - loss: 7738386944.0000 - r2: 0.
6719 - val_loss: 13805546496.0000 - val_r2: 0.4949
Epoch 13/50
342/342 [==============================] - 2s 5ms/step - loss: 7684825088.0000 - r2: 0.
6741 - val_loss: 14179750912.0000 - val_r2: 0.4817
Epoch 14/50
342/342 [==============================] - 2s 5ms/step - loss: 7643566080.0000 - r2: 0.
6752 - val_loss: 14339392512.0000 - val_r2: 0.4750
Epoch 15/50
342/342 [==============================] - 2s 5ms/step - loss: 7611014144.0000 - r2: 0.
6770 - val_loss: 13233200128.0000 - val_r2: 0.5150
Epoch 16/50
342/342 [==============================] - 2s 5ms/step - loss: 7590297600.0000 - r2: 0.
6772 - val_loss: 13288505344.0000 - val_r2: 0.5133
Epoch 17/50
342/342 [==============================] - 2s 5ms/step - loss: 7564120064.0000 - r2: 0.
```

```
6789 - val_loss: 14236790784.0000 - val_r2: 0.4790
Epoch 18/50
342/342 [==============================] - 2s 5ms/step - loss: 7560748544.0000 - r2: 0.
6796 - val_loss: 12738248704.0000 - val_r2: 0.5339
Epoch 19/50
342/342 [==============================] - 2s 5ms/step - loss: 7542912000.0000 - r2: 0.
6796 - val_loss: 13042865152.0000 - val_r2: 0.5227
Epoch 20/50
342/342 [==============================] - 2s 4ms/step - loss: 7535606272.0000 - r2: 0.
6804 - val_loss: 13319192576.0000 - val_r2: 0.5128
Epoch 21/50
342/342 [==============================] - 2s 4ms/step - loss: 7529489920.0000 - r2: 0.
6807 - val_loss: 12842728448.0000 - val_r2: 0.5300
Epoch 22/50
342/342 [==============================] - 2s 4ms/step - loss: 7520656896.0000 - r2: 0.
6810 - val_loss: 13797950464.0000 - val_r2: 0.4957
Epoch 23/50
342/342 [==============================] - 2s 5ms/step - loss: 7519001600.0000 - r2: 0.
6807 - val_loss: 14456489984.0000 - val_r2: 0.4709
Epoch 24/50
342/342 [==============================] - 2s 4ms/step - loss: 7505835520.0000 - r2: 0.
6816 - val_loss: 13557935104.0000 - val_r2: 0.5031
Epoch 25/50
342/342 [==============================] - 2s 4ms/step - loss: 7506881024.0000 - r2: 0.
6817 - val_loss: 13660411904.0000 - val_r2: 0.4997
Epoch 26/50
342/342 [==============================] - 2s 4ms/step - loss: 7498037760.0000 - r2: 0.
6810 - val_loss: 13664574464.0000 - val_r2: 0.4996
Epoch 27/50
342/342 [==============================] - 2s 4ms/step - loss: 7496159744.0000 - r2: 0.
6815 - val_loss: 13964638208.0000 - val_r2: 0.4878
Epoch 28/50
342/342 [==============================] - 2s 5ms/step - loss: 7479407616.0000 - r2: 0.
6828 - val_loss: 13562232832.0000 - val_r2: 0.5032
session cleared!

2141.5850541591644 seconds elapsed

[[96733.95168191983, 101715.42168226016, 101727.67788561774, 97293.50958825568, 101198.
9109822828, 98692.2178087006, 97383.84457393331, 98849.83876567529, 109803.2567823013
2], [101628.65485678731, 100155.23566943468, 97323.30088935538, 100410.18211317017, 961
40.85666354341, 95777.07450115606, 99239.41926472564, 110106.16898248708], [101382.8836
0467955, 100135.26595560627, 98144.61558333192, 98882.60449644315, 95374.10365502787, 9
6381.42891657085, 116252.62643054564], [100448.3160237144, 102829.5391023416, 98342.940
20416513, 99221.7472936251, 99205.59984194441, 112863.85029760415]]
```

In [ ]:

```
best_feature_subset = []
input = [
                    "month",
                    "storey_range",
                    "flat_model_type",
                    "floor_area_sqm",
                    "remaining_lease_year",
                    "degree_centrality",
                    "eigenvector_centrality",
                    "dist_to_nearest_stn",
                    "dist_to_dhoby"
                    ]

for i in range(len(vec)):
```

```
    if vec[i] == 1:
        best_feature_subset.append(input[i])

print(best_feature_subset)
```

```
['storey_range', 'flat_model_type', 'floor_area_sqm', 'remaining_lease_year', 'dist_to_
nearest_stn', 'dist_to_dhoby']
```

Best features

Best feature subset is storey_range, flat_model_type, floor_area_sqm, remaining_lease_year, dist_to_nearest_stn and dist_to_dhoby

Compare these features and discuss if there is any concept shift

From the best feature subset on the new test set, it is similar to the best feature subset of the old test set. In this case, I do not think that there is sufficient evidence just looking at the best features to determine if there is a concept shift.

However, through observations, in fact, I believe it is due to the pandemic, rising inflation and interest rates, it has led to a change in consumers' behaviour. People are more prudent about buying high-value assets and such behaviour are not reflected sufficiently by the inputted features. Therefore, when the model runs its prediction on the recent datasets, it performs poorly.

CONCLUSION

Question 1

1. Neural Networks vs Traditional machine learning models

Neural network models are capabale of learning from unlabeled or unstructured data whereas traditional machine learning models generally learn to process structured data. In the machine learning pipeline. feature engineering comes right after data cleaning and visualization where the expertise of data scientists is required. However, in the neural network pipeline, there is no need for explict feature engineering in the deep learning pipepine. The neural network learns features from the data by itself and captures all non-linear relationships.

Neural networks provide flexibility in the structure of inputs and outputs which machine learning lacks. They are capabale of capturing spatial and temporal relationships between features.

2. Improvements to traditional machine learning models

Feature selection and feature engineering would be the best bet to improve the accuracy of traditional machine learning models. Feature engineering helps to extracts

more information from existing data and these features may allow the model to have a higher ability to explain the variance in training data.

Feature selection finds out the best subset of attributes which better explains the relationship of independent variables with target variable.

Question 2

1. Bayesian and Hyperband optimization

Bayesian Optimization builds a probability model of the objective function and uses it to select hyperparameters to evaluate in the true objective function.

Hyperband is essentially just a grid search over the optimal allocation strategy. So at each individual trial the set of hyperparameters is chosen randomly. Hyperband is the extension of the Successive Halving algorithm.

Random search tests hyperparameter sets at random, hence it runs the risk of missing the ideal set of hyperparameters and forgoing peak model performance. However, with Bayesian optimization method,the user do not have to incorporate randomness and risk missing the optimal solution. Although, Bayesian optimization does has its drawbacks as additional time is required to determine the next hyperparameters to evaluate based on the results of the previous iterations.

2. Random search vs Grid search

Depending on the size of the hyperparameter search space and use case, the benefits of using grid search against random search varies.

Using the brute force grid search method is simple and straightforward but an increase in the size of hyperparameter search space will result in an exponential rise in run time and computation.

Random search method would reduce the computation time significantly but user might run the risk of missing the optimal case.

Question 3

Concept shift may have been the lead cause of model degradation, due to the pandemic, rising tensions between superpowers and high inflation rate, the consumers' behaviours has changed significantly over the past few years.

Since the model is trained on past data, the model do not have the information on the current economical factors that have led to changes in housing prices.