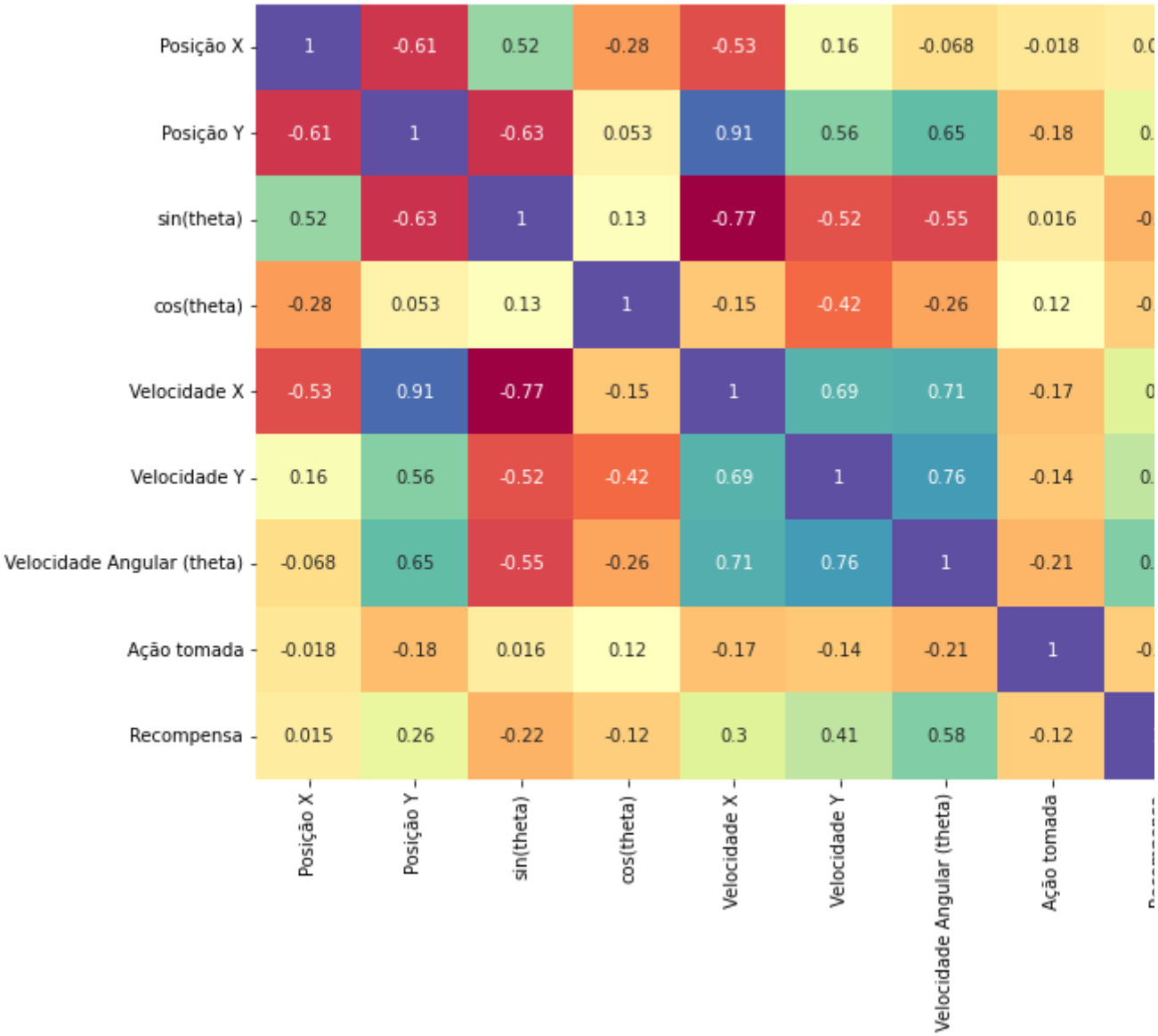
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras import layers
from sklearn.model_selection import train_test_split


#1.1 Carregue o conjunto de dados, utilizando como nome para as colunas (column_nam


columns=['Posição X',
         'Posição Y',
         'sin(theta)',
         'cos(theta)',
         'Velocidade X',
         'Velocidade Y',
         'Velocidade Angular (theta)',
         'Posição da Perna Esquerda',
         'Posição da Perna Direita',
         'Ação tomada',
         'Recompensa']

dataset = pd.read_csv('Dataset_lunar_lander_msd_1.csv',
                header=0,
                names=columns)

dataset.describe()
```

	Posição X	Posição Y	sin(theta)	cos(theta)	Velocidade X	Velocidade Y	A
count	319.000000	319.000000	319.000000	319.000000	319.000000	319.000000	
mean	-0.261284	1.207487	-0.191235	0.848472	-0.423802	-0.536888	
std	0.355957	0.423591	0.483746	0.101391	0.676049	0.833081	
min	-0.998415	-0.021675	-0.775714	0.605497	-1.976554	-3.892494	
25%	-0.537009	1.033986	-0.605157	0.777747	-0.910821	-0.744606	
50%	-0.201242	1.359330	-0.381933	0.846116	-0.078000	-0.218413	
75%	-0.016972	1.424816	0.279503	0.939264	0.087120	0.033671	
max	0.620101	1.852696	0.795848	0.999661	0.396150	0.150921	

```
#1.2 Mostre a correlação entre a saída (Recompensa) e, pelo menos, quatro dados à s
corr = dataset.drop(columns=['Posição da Perna Esquerda', 'Posição da Perna Direita
```

```
plt.figure(figsize=(12,8))
sns.heatmap(corr, cmap="Spectral",annot=True)
plt.show()
```

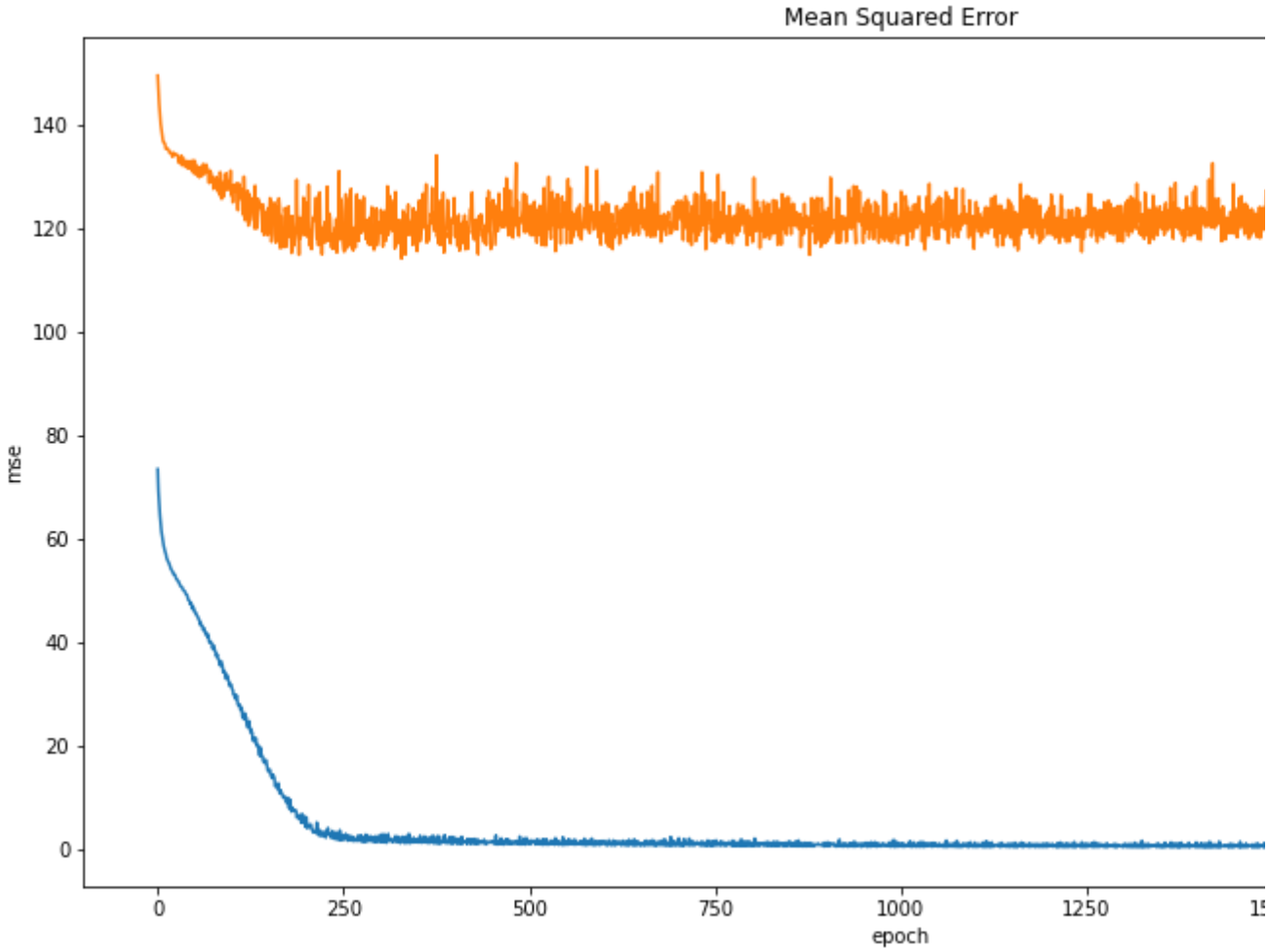



```
#1.3 Prepare o conjunto de dados, separando os dados de treinamento e de teste. Par

X = dataset.drop(columns=['Recompensa'])
y = dataset['Recompensa']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.30, random_st



#1.4 Realize o treinamento por 2000 épocas e apresente o resultado.

EPOCHS = 2000

def build_model(dataset):
  model = keras.Sequential([
    layers.Dense(64, activation='relu', input_shape=[len(dataset.keys())]),
    layers.Dense(64, activation='relu'),
    layers.Dense(1)
  ])
```

```
  optimizer = tf.keras.optimizers.RMSprop(0.001)

  model.compile(loss='mse',
                optimizer=optimizer,
                metrics=['mae', 'mse'])
  return model

model = build_model(X_train)

history = model.fit(
  X_train, y_train,
  epochs=EPOCHS, validation_split = 0.3, verbose=0)




hist = pd.DataFrame(history.history)
hist['epoch'] = history.epoch
plt.figure(figsize=(15,8))

sns.lineplot(data=hist,
             x='epoch',
             y='mae',
             label='Train Error');
sns.lineplot(data=hist,
             x='epoch',
             y='val_mae',
             label = 'Val Error').set_title("Mean Abs Error");
```

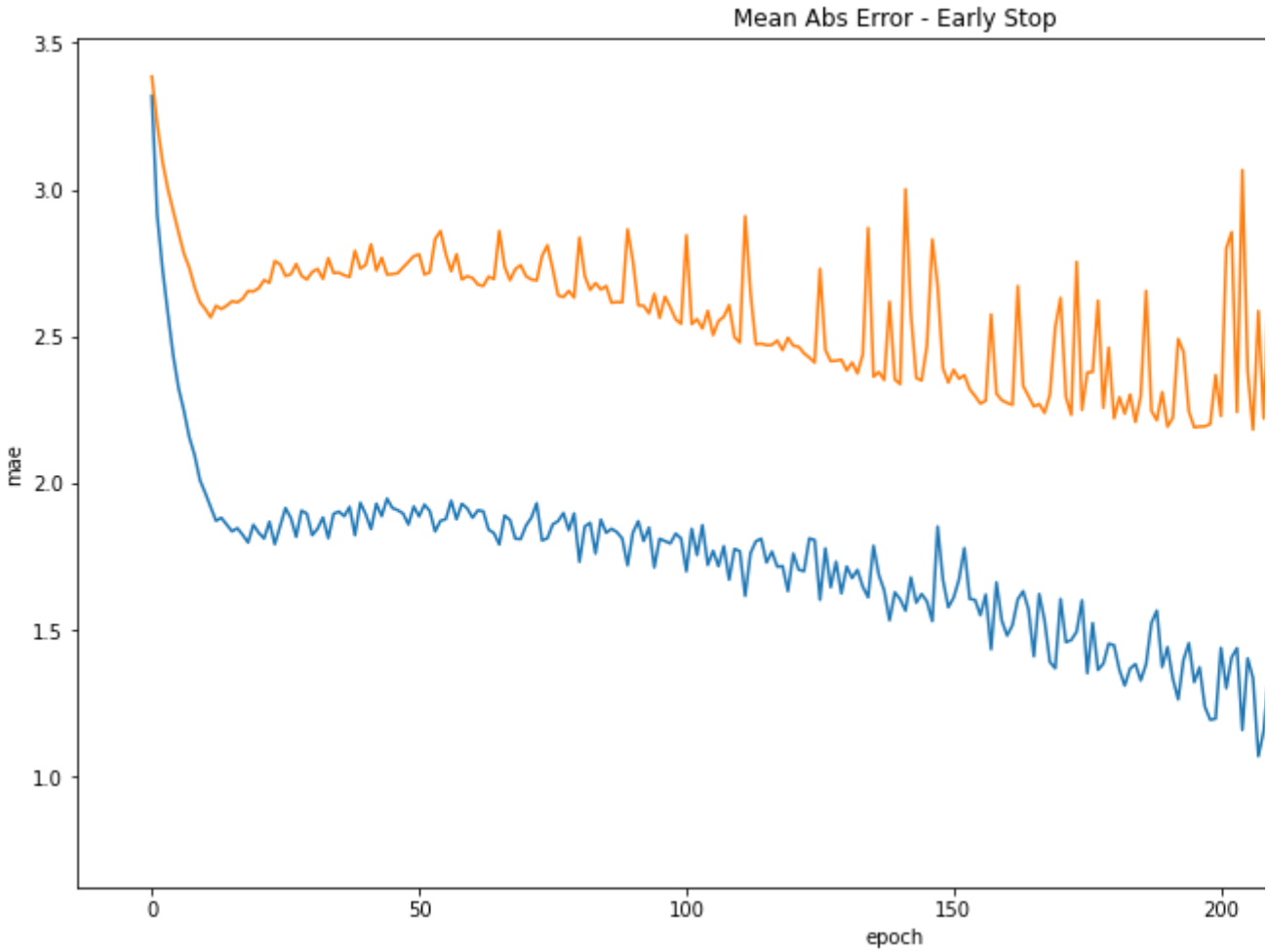
Mean Abs Error

```
plt.figure(figsize=(15,8))

sns.lineplot(data=hist,
             x='epoch',
             y='mse',
             label='Train Error');
sns.lineplot(data=hist,
             x='epoch',
             y='val_mse',
             label = 'Val Error').set_title("Mean Squared Error");
```




```
#1.5 Realizar o treinamento utilizando o método early stop e apresente o resultado:

model_es = build_model(X_train)
early_stop = keras.callbacks.EarlyStopping(monitor='val_mse',
                                           mode='min',
                                           patience=30,
                                           min_delta=0.01)
history_es = model_es.fit(X_train, y_train, epochs=EPOCHS,
                    validation_split = 0.3, verbose=0, callbacks=[early_stop])
hist_es = pd.DataFrame(history_es.history)
hist_es['epoch'] = history_es.epoch


plt.figure(figsize=(15,8))
```

```
sns.lineplot(data=hist_es,
             x='epoch',
             y='mae',
             label='Train Error');
sns.lineplot(data=hist_es,
             x='epoch',
             y='val_mae',
             label = 'Val Error').set_title("Mean Abs Error - Early Stop");
```




```
plt.figure(figsize=(15,8))

sns.lineplot(data=hist_es,
             x='epoch',
             y='mse',
             label='Train Error');
sns.lineplot(data=hist_es,
             x='epoch',
             y='val_mse',
             label = 'Val Error').set_title("Mean Squared Error - Early Stop");
```