```
# To mount the drive in colab
from google.colab import drive
drive.mount('/content/drive/')
```

```
Drive already mounted at /content/drive/; to attempt to forcibly remount, call drive.mount("/content/drive/", force_remount=True).
```

Import Liberaries

```
import pandas as pd
import numpy as np
```

Loading Datasets

```
# Load and print trianing data
train_df = pd.read_csv('/content/drive/MyDrive/Seniors.csv')
train_df.head(5)
```

	Unnamed: 0	Temperature (°C)	Pressure (kPa)	Temperature x Pressure	Material Fusion Metric	Material Transformation Metric	Quality Rating
0	0	209.762701	8.050855	1688.769167	44522.217074	9.229576e+06	99.999971
1	1	243.037873	15.812068	3842.931469	63020.764997	1.435537e+07	99.985703
2	2	220.552675	7.843130	1729.823314	49125.950249	1.072839e+07	99.999758
3	3	208.976637	23.786089	4970.736918	57128.881547	9.125702e+06	99.999975
4	4	184.730960	15.797812	2918.345014	38068.201283	6.303792e+06	100.000000

Next steps: Generate code with train_df View recommended plots New interactive sheet

```
# Load and print testing data
test_df = pd.read_csv('/content/drive/MyDrive/Juniors.csv')
test_df.head(5)
```

	Unnamed: 0.1	Unnamed: 0	Temperature (°C)	Pressure (kPa)	Temperature x Pressure	Material Fusion Metric	Material Transformation Metric
0	0	2500	270.264688	11.023763	2979.333789	74382.645868	1.974082e+07
1	1	2501	147.113440	24.851899	3656.048303	36991.316027	3.183265e+06
2	2	2502	251.636694	19.861983	4998.003812	71156.545998	1.593350e+07
3	3	2503	226.765023	23.301227	5283.903266	64073.710961	1.166025e+07
4	4	2504	291.025207	16.896895	4917.422268	89519.819801	2.464829e+07

Next steps: Generate code with test_df View recommended plots New interactive sheet

Exploratory Data Analyss

```
train_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2500 entries, 0 to 2499
Data columns (total 7 columns):
 #   Column                          Non-Null Count  Dtype  
---  ------                          --------------  -----  
 0   Unnamed: 0                      2500 non-null   int64  
 1   Temperature (°C)                2500 non-null   float64
 2   Pressure (kPa)                  2500 non-null   float64
 3   Temperature x Pressure          2500 non-null   float64
 4   Material Fusion Metric          2500 non-null   float64
 5   Material Transformation Metric  2500 non-null   float64
 6   Quality Rating                  2500 non-null   float64
dtypes: float64(6), int64(1)
memory usage: 136.8 KB
```

```
test_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1457 entries, 0 to 1456
Data columns (total 7 columns):
 #   Column                          Non-Null Count  Dtype  
---  ------                          --------------  -----  
 0   Unnamed: 0.1                    1457 non-null   int64  
 1   Unnamed: 0                      1457 non-null   int64  
 2   Temperature (°C)                1457 non-null   float64
 3   Pressure (kPa)                  1457 non-null   float64
 4   Temperature x Pressure          1457 non-null   float64
 5   Material Fusion Metric          1457 non-null   float64
 6   Material Transformation Metric  1457 non-null   float64
dtypes: float64(5), int64(2)
memory usage: 79.8 KB
```

```
# To check nan values in train_df
train_df.isnull().sum()
```

	0
Unnamed: 0	0
Temperature (°C)	0
Pressure (kPa)	0
Temperature x Pressure	0
Material Fusion Metric	0
Material Transformation Metric	0
Quality Rating	0

dtype: int64

```
# To check nan values in test_df
test_df.isnull().sum()
```

	0
Unnamed: 0.1	0
Unnamed: 0	0
Temperature (°C)	0
Pressure (kPa)	0
Temperature x Pressure	0
Material Fusion Metric	0
Material Transformation Metric	0

dtype: int64

```
# To cehck statics of train_df
train_df.describe()
```

	Unnamed: 0	Temperature (°C)	Pressure (kPa)	Temperature x Pressure	Material Fusion Metric	Material Transformation Metric	Quality Rating
count	2500.00000	2500.000000	2500.000000	2500.000000	2500.000000	2.500000e+03	2500.000000
mean	1249.50000	200.653802	14.800937	2966.560892	48385.166770	1.014740e+07	96.039307
std	721.83216	58.615971	5.704845	1461.402337	24053.925674	7.678297e+06	13.306205
min	0.00000	100.014740	5.009819	513.706875	10156.971955	9.999462e+05	1.421653
25%	624.75000	150.875184	9.821192	1800.528733	27504.622582	3.434285e+06	99.936589
50%	1249.50000	200.291585	14.864597	2708.227080	44809.454736	8.034823e+06	99.999996
75%	1874.25000	251.811806	19.722411	3929.471504	68156.553776	1.596700e+07	100.000000
max	2499.00000	299.961716	24.999132	7365.018714	103756.181544	2.698960e+07	100.000000

```
# To check the correlation of features of train_df
train_df.corr()
```

	Unnamed: 0	Temperature (°C)	Pressure (kPa)	Temperature x Pressure	Material Fusion Metric	Material Transformation Metric	Quality Rating
Unnamed: 0	1.000000	0.012284	0.013340	0.009842	0.013677	0.010192	0.003135
Temperature (°C)	0.012284	1.000000	-0.009883	0.585975	0.975767	0.970969	-0.470129
Pressure (kPa)	0.013340	-0.009883	1.000000	0.771878	0.160815	-0.009420	0.016942
Temperature x Pressure	0.009842	0.585975	0.771878	1.000000	0.703844	0.568807	-0.259878
Material Fusion Metric	0.013677	0.975767	0.160815	0.703844	1.000000	0.977445	-0.519979
Material Transformation Metric	0.010192	0.970969	-0.009420	0.568807	0.977445	1.000000	-0.585221
Quality Rating	0.003135	-0.470129	0.016942	-0.259878	-0.519979	-0.585221	1.000000

Preprocessing

```
# To drop irrelevant columns
train_df = train_df.drop('Unnamed: 0', axis=1)
test_df = test_df.drop('Unnamed: 0.1', axis=1)
test_df = test_df.drop('Unnamed: 0', axis=1)
```

```
# To split the training data into training and validation
def train_val_split(train_df, val_ratio=0.2, random_seed=42):
    np.random.seed(random_seed)  # To reproducibility
    shuffle_indicies = np.random.permutation(len(train_df))  # To shuffle the data indices
    validation_size = int(len(train_df) * val_ratio)
    validation_indicies = shuffle_indicies[:validation_size]  # First part for validation
    train_indicies = shuffle_indicies[validation_size:]       # Remaining part for training
    return train_df.iloc[train_indicies], train_df.iloc[validation_indicies]

train_data, val_data = train_val_split(train_df, val_ratio=0.2)
```

```
# To Training
X_train = train_data.drop(columns=['Quality Rating']).values
y_train = train_data['Quality Rating'].values

# To validation
X_val = val_data.drop(columns=['Quality Rating']).values
y_val = val_data['Quality Rating'].values
```

```
# To check the shap of all data
print(X_train.shape)
print(y_train.shape)
print(X_val.shape)
print(y_val.shape)
```

```
(2000, 5)
(2000,)
(500, 5)
(500,)
```

Linear Regression model(scratch) training

```
class LinearRegression:
    def __init__(self, lr=0.01, n_iters=1000):
        self.lr = lr
        self.n_iters = n_iters
```

```
        self.n_iters = n_iters
        self.weights = None
        self.bias = None

    def fit(self, X_train, y_train, X_val=None, y_val=None):
        # To initialize weights and bias
        num_samples, num_features = X_train.shape
        self.weights = np.zeros(num_features)
        self.bias = 0

        # To store losses for later use in graph
        self.train_losses = []
        self.val_losses = []

        # Gradient Descent
        for epoch in range(1, self.n_iters + 1):
            # Predicted values for training set
            y_pred_train = np.dot(X_train, self.weights) + self.bias

            # To compute training loss (Mean Squared Error)
            train_loss = np.mean((y_train - y_pred_train) ** 2) # Cost function(mse) for training
            self.train_losses.append(train_loss)

            # To compute gradients
            dw = (1 / num_samples) * np.dot(X_train.T, (y_pred_train - y_train))
            db = (1 / num_samples) * np.sum(y_pred_train - y_train)

            # To update weights and bias
            self.weights -= self.lr * dw
            self.bias -= self.lr * db

            # Validation loss
            if X_val is not None and y_val is not None:
                y_pred_val = np.dot(X_val, self.weights) + self.bias
                val_loss = np.mean((y_val - y_pred_val) ** 2) # Cost function(mse) for validation
                self.val_losses.append(val_loss)

    def predict(self, X):
        return np.dot(X, self.weights) + self.bias

# To standardize data
def standardize_data(X):
    return (X - X.mean(axis=0)) / X.std(axis=0)

X_train = standardize_data(X_train)
X_val = standardize_data(X_val)
X_test = standardize_data(test_df.values)

# To train the model
model = LinearRegression(lr=0.01, n_iters=1000)
model.fit(X_train, y_train, X_val, y_val)

# To make predictions
predictions = model.predict(X_test)
print("Predictions:", predictions)
```

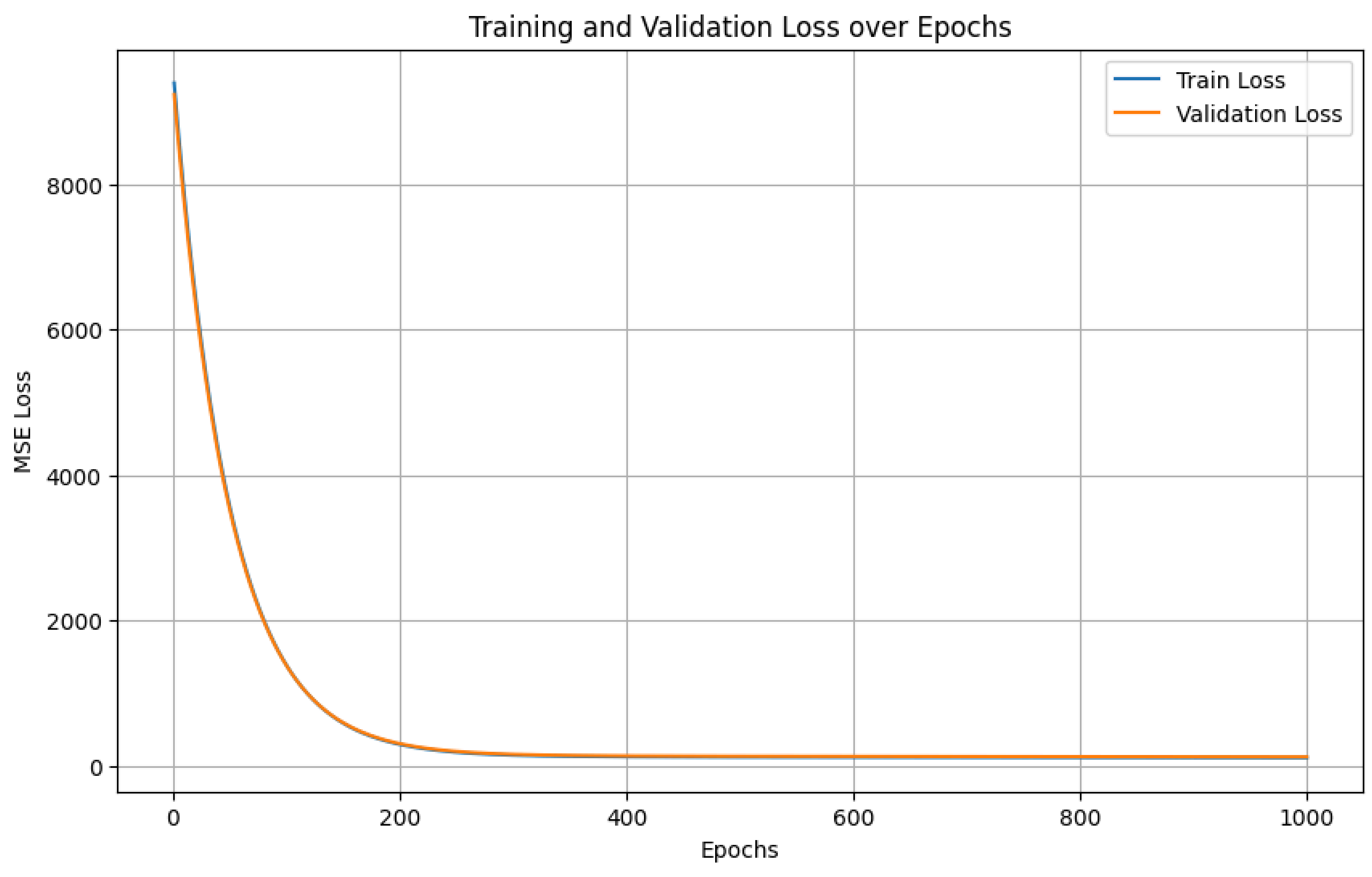
```
Predictions: [ 85.79718193 101.82484611  91.35291813 ...  93.01045507  98.10420562
 101.4638689 ]
```

Cost Function Visualization

```
import matplotlib.pyplot as plt

# To plot the loss curves
def plot_loss(train_losses, val_losses, n_iters):
    plt.figure(figsize=(10, 6))
    plt.plot(range(1, n_iters + 1), train_losses, label="Train Loss")
    if val_losses:
        plt.plot(range(1, n_iters + 1), val_losses, label="Validation Loss")
    plt.xlabel("Epochs")
    plt.ylabel("MSE Loss")
    plt.title("Training and Validation Loss over Epochs")
    plt.legend()
    plt.grid()
    plt.show()

# To call the function to plot the losses
plot_loss(model.train_losses, model.val_losses, model.n_iters)
```



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