main_advertising

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1 Advanced Java & Advanced Python Assignment

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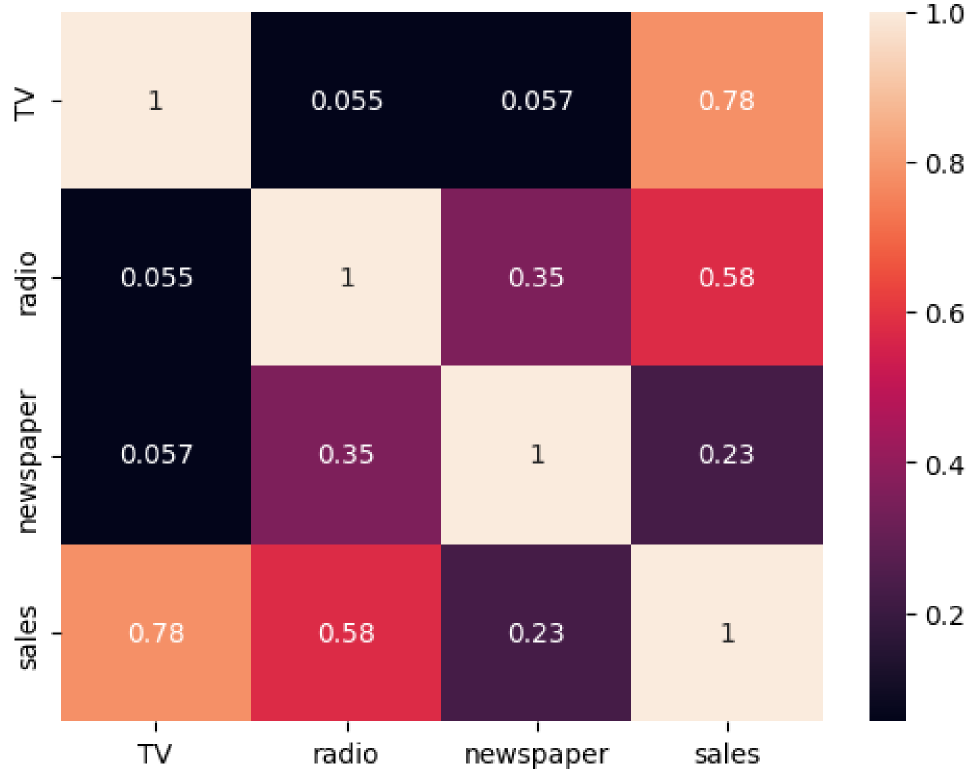
1.1.1 Advertising Dataset

[ ]:
```
import matplotlib.pyplot as plt


from  Class.ModelClass import *     # Importing the Model class from ModelClass.
 ↪py
from functions.utils import *   # Importing the utils functions from utils.py
```

Before computing regression, let's do some data analysis

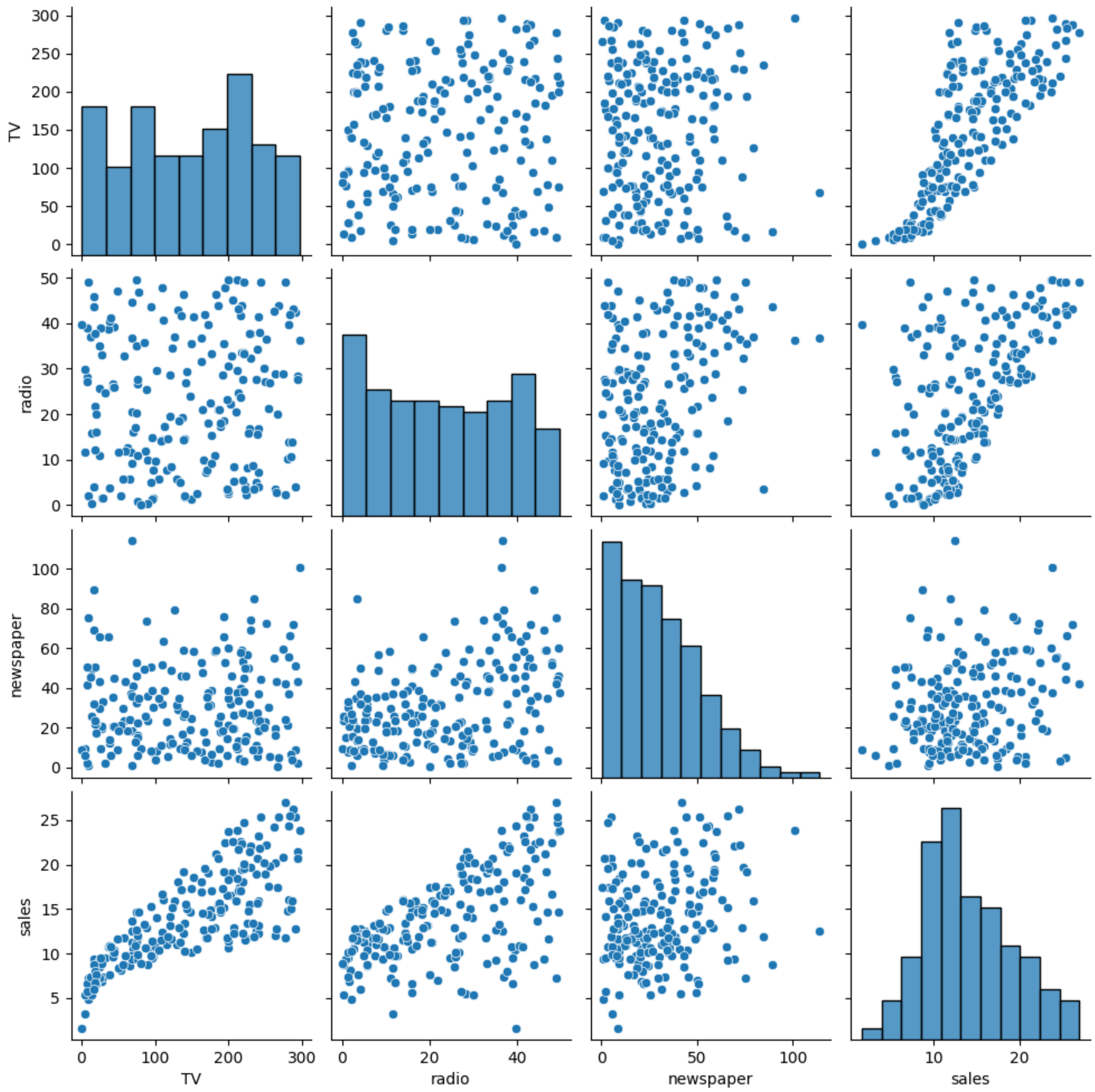
[ ]:
```
x, y, df = import_clean_data('./data/Advertising.csv', input_list=['TV',␣
 ↪'radio', 'newspaper'], output_list=['sales'])
df.head()

#heatmap for the correlation coefficient between the variables
import seaborn as sns
sns.heatmap(df.corr(), annot=True)
```

[ ]:
```
<AxesSubplot: >
```




```
[ ]: #plot correlation between all variables
     %matplotlib inline
     sns.pairplot(df)
```

```
[ ]: <seaborn.axisgrid.PairGrid at 0x19bd76b6bb0>
```



[ ]:
```
#spearman correlation for all combination of columns
from scipy.stats import spearmanr
for i in range(len(df.columns)):
    for j in range(i+1, len(df.columns)):
        corr, _ = spearmanr(df[df.columns[i]], df[df.columns[j]])
        print('Spearmans correlation between {} and {} is: {}'.format(df.
↪columns[i], df.columns[j], corr))
```

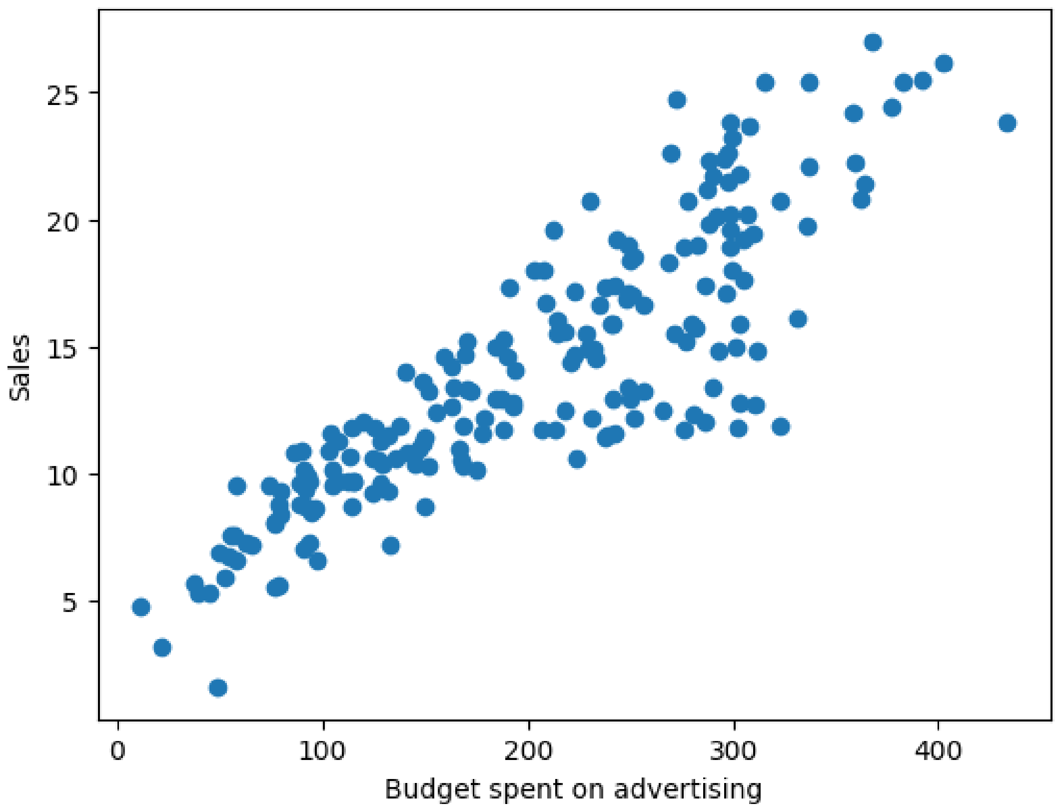
```
Spearmans correlation between TV and radio is: 0.05612339226247207
Spearmans correlation between TV and newspaper is: 0.05083973485105542
Spearmans correlation between TV and sales is: 0.8006143768505688
Spearmans correlation between radio and newspaper is: 0.3169794890663236
Spearmans correlation between radio and sales is: 0.5543037314053145
```

Spearmans correlation between newspaper and sales is: 0.19492188424873094

[ ]:
```python
# Create a new column of the sum of the budget spent on advertising
df['adv_budget'] = df['TV'] + df['radio'] + df['newspaper']

#spearman
corr, _ = spearmanr(df['adv_budget'], df['sales'])
print('Spearmans correlation between sum and sales is: {}'.format(corr))

#plot
plt.scatter(df['adv_budget'], df['sales'])
plt.xlabel('Budget spent on advertising')
plt.ylabel('Sales')
```

Spearmans correlation between sum and sales is: 0.8770508999294694

[ ]: Text(0, 0.5, 'Sales')



Let's compute the regression using TV and RADIO predictors only

[ ]:
```python
x, y, df = import_clean_data('./data/Advertising.csv', input_list=['TV',
    'radio'], output_list=['sales'])
```

```
X, y = prepare_vectors(x, y)
```

Let's find out what is the best combinaison of: - Test size - Number of iterations - Learning rate

[ ]:
```
test_size_list = [0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7]
iteration_list = [50, 100, 500, 1000, 3000, 5000, 7000, 10000]
rate_list = [0.1, 0.05, 0.01, 0.001, 0.0001]

model1_df, model1_dict = find_combination(X, y, test_size_list, iteration_list,␣
 ↪rate_list)
```

[ ]:
```
model1_df
#model1_df.to_csv('model_df.csv')   #to save in a csv file

model1_df.head()
```

[ ]:

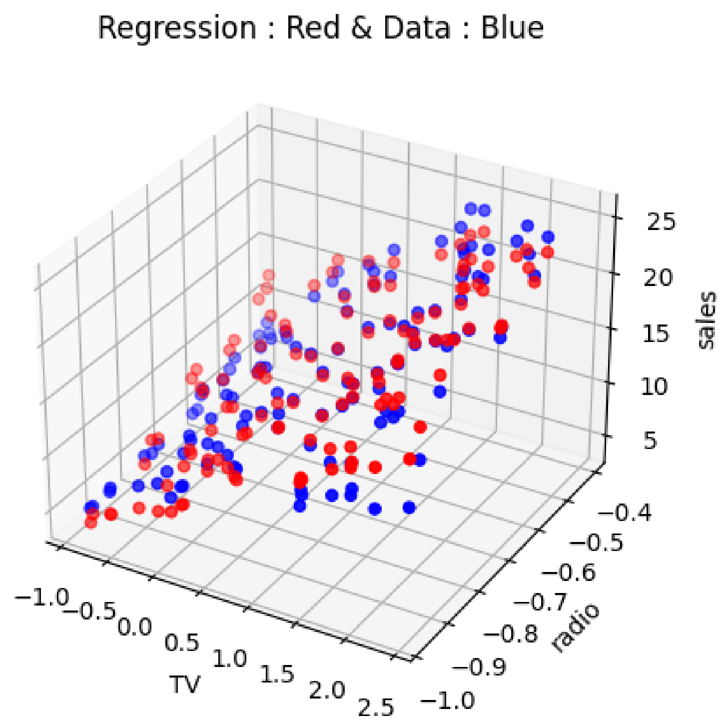
	test_size	iteration	rate	r_square	mse
0	0.4	10000.0	0.10	0.914199	2.232220
1	0.4	7000.0	0.10	0.914199	2.232220
2	0.4	5000.0	0.10	0.914199	2.232220
3	0.4	10000.0	0.05	0.914199	2.232220
4	0.4	7000.0	0.05	0.914197	2.232258

In this case, the best model the 3rd one. Because the other computes more iterations without improving significativly the model : Best : - Test size = 0.4 - Number of iterations = 5000 - Learning rate = 0.1 Warning : because of the randomness of the split, the best model can change from one execution to another

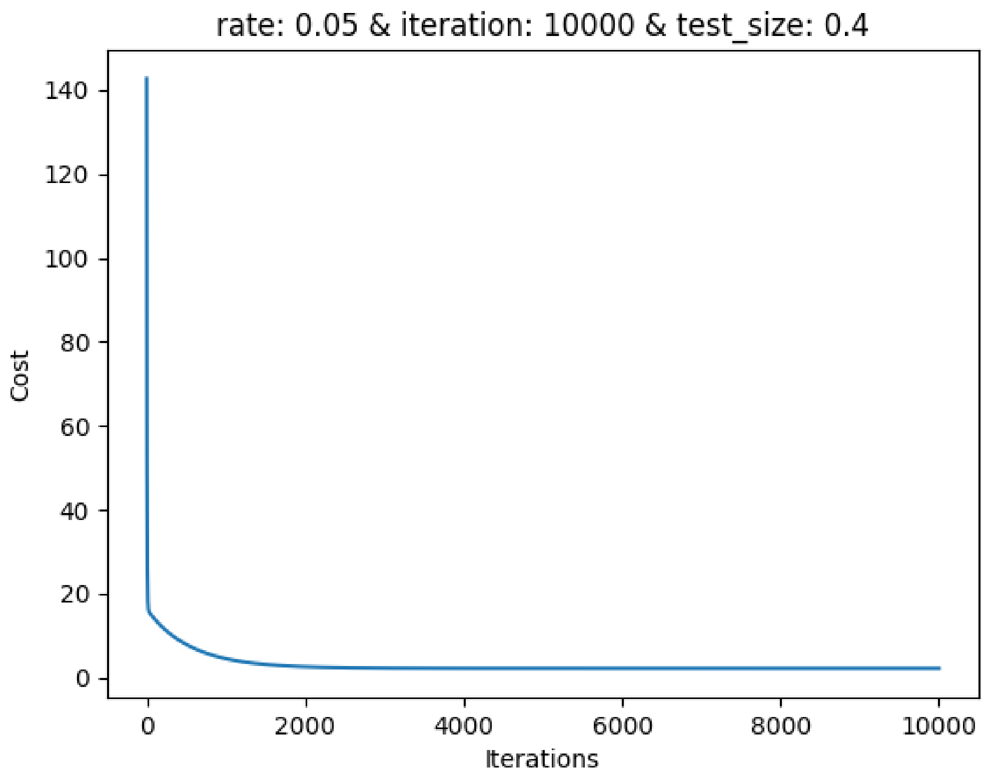
Let's visualize the regression line and the cost function

[ ]:
```
best_model = model1_dict[2][1] #get best model (the 4th one)
#make sure ipympl is installed (pip intall ipympl)
%matplotlib widget
best_model.plot_regression_3D('TV', 'radio', 'sales')
best_model.theta
```

[ ]:
```
array([[ 3.88722663],
       [16.15336096],
       [22.87367079]])
```




```
[ ]: %matplotlib widget
     best_model.plot_cost()
```



Now we can test our model

[ ]:
```
mse, r_square, predictions = best_model.test_model()
print('mse: ', mse)
print('r_square: ', r_square)
```

```
mse:  3.6984672078776635
r_square:  0.8685643402626058
```

1.1.2 Let's import the data Adversiting.csv to process TV and RADIO and NEWSPAPERS predictors with the same methodology

Let's find out what is the best combinaison of: - Test size - Number of iterations - Learning rate

[ ]:
```
#import data
x, y, df = import_clean_data('./data/Advertising.csv', input_list=['TV',␣
↪'radio', 'newspaper'], output_list=['sales'])
X, y = prepare_vectors(x, y)
```

[ ]:
```
#compute all models
model2_df, model2_dict = find_combination(X, y, test_size_list, iteration_list,␣
↪rate_list)
```

[ ]:
```
model2_df.head()
```

[ ]:

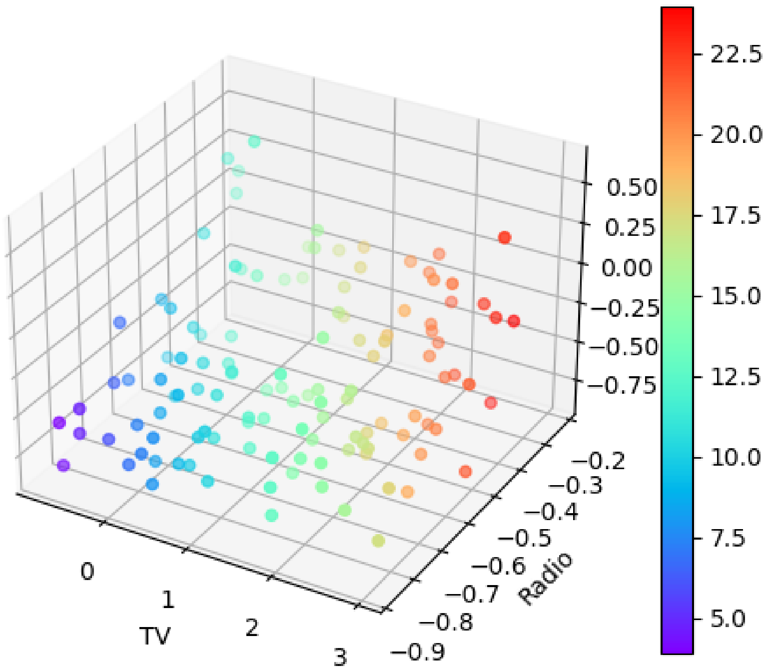
	test_size	iteration	rate	r_square	mse
0	0.4	10000.0	0.10	0.915685	2.193546
1	0.4	7000.0	0.10	0.915685	2.193546
2	0.4	5000.0	0.10	0.915685	2.193546
3	0.4	10000.0	0.05	0.915685	2.193546
4	0.4	7000.0	0.05	0.915685	2.193549

[ ]:
```
#Test of the model
model2_best = model2_dict[2][1] #get best model (the 3st one)
mse, r_square, predictions =model2_best.test_model()
print('mse: ', mse)
print('r_square: ', r_square)
```

```
mse:  3.862022758723319
r_square:  0.8627519237882015
```

Create a 3D plot and add a colorbar which maps values to colors to represent the sales

[ ]:
```
#Create a 3D plot and add a colorbar which maps values to colors to represent␣
↪the sales
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')

# Utiliser la couleur pour représenter les ventes
scatter = ax.scatter(model2_best.X_train[:,0], model2_best.X_train[:,1],␣
↪model2_best.X_train[:,2], c=model2_best.X_train.dot(model2_best.theta),␣
↪cmap='rainbow')

# Ajouter une barre de couleur
plt.colorbar(scatter)

# Ajouter des étiquettes d'axes
ax.set_xlabel('TV')
ax.set_ylabel('Radio')
ax.set_zlabel('Newspaper')

# Afficher le graphique
plt.show()
```



Suppose that spending money on radio advertising actually increases the effectiveness of TV advertising

sales = 0 + 1 *TV + 2 *radio + 3 *(radio *TV)

[ ]:
```
x, y, df = import_clean_data('./data/Advertising.csv', input_list=['TV', 'radio', 'newspaper'], output_list=['sales'])
X, y = prepare_vectors(x, y)

X[:,2] = X[:,0] * X[:,1] #add interaction between TV and radio and rewrite it in the 3rd column





model3_df, model3_dict = find_combination(X, y, test_size_list, iteration_list, rate_list)
```

[ ]:
```
model3_df.head(5)
#model3_df.to_csv('model3_df.csv')   #to save in a csv file
```

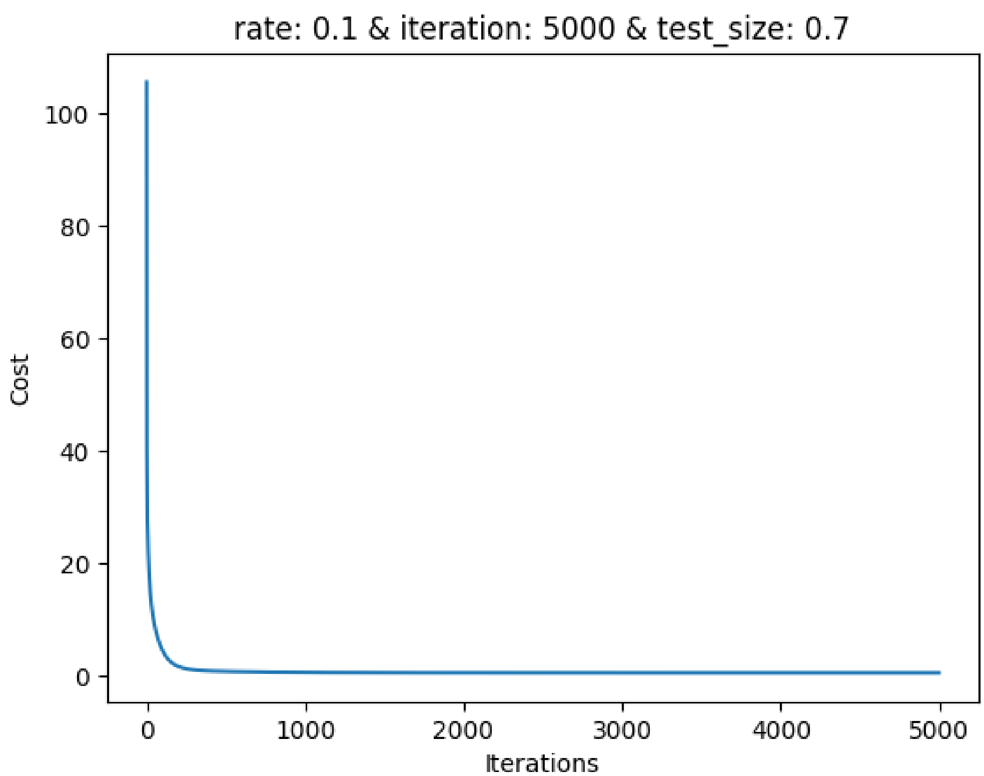
[ ]:

	test_size	iteration	rate	r_square	mse
0	0.7	10000.0	0.10	0.978194	0.611915
1	0.7	7000.0	0.10	0.978194	0.611915
2	0.7	10000.0	0.05	0.978194	0.611922
3	0.7	5000.0	0.10	0.978194	0.611924
4	0.7	7000.0	0.05	0.978187	0.612110

In this case, the best one is the 4th one. Because the other computes more iterations without improving the model.

Best : - Test size = 0.7 - Number of iterations = 5000 - Learning rate = 0.1

[ ]:
```
best_model3 = model3_dict[3][1] #get best model (the 1st one)
%matplotlib widget

best_model3.plot_cost()
```



[ ]:
```
#test the model with the test set
mse, r_square, predictions = best_model3.test_model()
print('mse: ', mse)
print('r_square: ', r_square)
```

```
mse:  1.0150663307880718
r_square:  0.9616161673015073
```

[ ]:
```python
# 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')

# Color to represent sales
scatter = ax.scatter(best_model3.X_train[:,0], best_model3.X_train[:,1],␣
 ↪best_model3.X_train[:,2], c=best_model3.X_train.dot(best_model3.theta),␣
 ↪cmap='rainbow')
plt.colorbar(scatter)

ax.set_xlabel('TV')
ax.set_ylabel('Radio')
ax.set_zlabel('Advertising Budget')

plt.show()
```