In [36]:
```
import numpy as np
import pandas as pd
import plotly
import plotly.figure_factory as ff
import plotly.graph_objs as go
from sklearn.linear_model import LogisticRegression
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import MinMaxScaler
from plotly.offline import download_plotlyjs, init_notebook_mode, plot, iplot
init_notebook_mode(connected=True)
```

In [37]:
```
data = pd.read_csv('task_b.csv')
data=data.iloc[:,1:]
```

In [38]:
```
data.head()
```

Out[38]:

	f1	f2	f3	y
0	-195.871045	-14843.084171	5.532140	1.0
1	-1217.183964	-4068.124621	4.416082	1.0
2	9.138451	4413.412028	0.425317	0.0
3	363.824242	15474.760647	1.094119	0.0
4	-768.812047	-7963.932192	1.870536	0.0

In [39]:
```
data.corr()['y']
```

Out[39]:
```
f1    0.067172
f2   -0.017944
f3    0.839060
y     1.000000
Name: y, dtype: float64
```

In [40]:
```
data.std()
```

Out[40]:
```
f1      488.195035
f2    10403.417325
f3        2.926662
y         0.501255
dtype: float64
```

In [41]:
```
X=data[['f1','f2','f3']].values
y=data['y'].values
print(X.shape)
print(y.shape)
```

```
(200, 3)
(200,)
```

What if our features are with different variance

*** As part of this task you will observe how linear models work in case of data having feautres with different variance**

*** from the output of the above cells you can observe that var(F2)>>var(F1)>>Var(F3)**

> **Task1:**

1. Apply Logistic regression(SGDClassifier with logloss) on 'data' and check the feature importance
2. Apply SVM(SGDClassifier with hinge) on 'data' and check the feature importance

> **Task2:**

1. Apply Logistic regression(SGDClassifier with logloss) on 'data' after standardization
   i.e standardization(data, column wise): (column-mean(column))/std(column) and check the feature importance
2. Apply SVM(SGDClassifier with hinge) on 'data' after standardization
   i.e standardization(data, column wise): (column-mean(column))/std(column) and check the feature importance

Make sure you write the observations for each task, why a particular feautre got more importance than others

Logistic Regression

In [42]:
```
from sklearn.linear_model import SGDClassifier
import matplotlib.pyplot as plt

clf = SGDClassifier(eta0=0.0001, learning_rate='constant', loss='log',
              random_state=15, verbose=2)
clf.fit(X, y)
```

```
-- Epoch 1
Norm: 1.08, NNZs: 3, Bias: -0.001751, T: 200, Avg. loss: 2516.147588
Total training time: 0.00 seconds.
-- Epoch 2
Norm: 0.61, NNZs: 3, Bias: -0.001551, T: 400, Avg. loss: 2621.694380
Total training time: 0.00 seconds.
-- Epoch 3
Norm: 0.35, NNZs: 3, Bias: -0.001850, T: 600, Avg. loss: 3285.222158
Total training time: 0.00 seconds.
-- Epoch 4
Norm: 0.64, NNZs: 3, Bias: -0.003527, T: 800, Avg. loss: 3142.216822
Total training time: 0.00 seconds.
-- Epoch 5
Norm: 0.48, NNZs: 3, Bias: -0.004027, T: 1000, Avg. loss: 3009.886714
Total training time: 0.00 seconds.
-- Epoch 6
Norm: 1.40, NNZs: 3, Bias: -0.003523, T: 1200, Avg. loss: 3032.001946
Total training time: 0.00 seconds.
Convergence after 6 epochs took 0.00 seconds
```

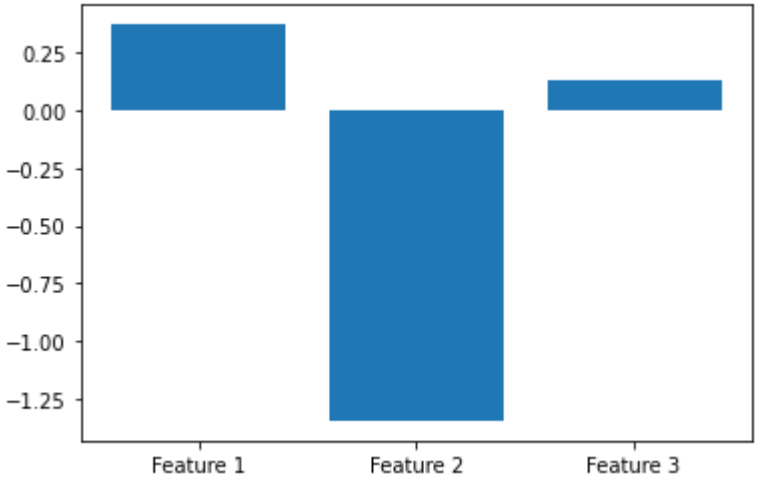
Out[42]:
```
SGDClassifier(eta0=0.0001, learning_rate='constant', loss='log',
              random_state=15, verbose=2)
```

In [43]:
```
importance = clf.coef_[0]
for i, j in enumerate(importance):
    print('Feature: %0d, Score: %.5f' % (i, j))

features = ['Feature 1', 'Feature 2', 'Feature 3']
plt.bar(features, clf.coef_[0])
```

```
Feature: 0, Score: 0.37170
Feature: 1, Score: -1.34464
Feature: 2, Score: 0.12669
```

Out[43]: <BarContainer object of 3 artists>



SVM

In [44]:
```
clf = SGDClassifier(eta0=0.0001, learning_rate='constant', loss='hinge',
                    random_state=15, verbose=2)
clf.fit(X, y)
```

```
-- Epoch 1
Norm: 0.61, NNZs: 3, Bias: -0.001600, T: 200, Avg. loss: 2634.084615
Total training time: 0.00 seconds.
-- Epoch 2
Norm: 0.68, NNZs: 3, Bias: -0.001100, T: 400, Avg. loss: 2593.136418
Total training time: 0.00 seconds.
-- Epoch 3
Norm: 0.76, NNZs: 3, Bias: -0.000900, T: 600, Avg. loss: 3308.216351
Total training time: 0.00 seconds.
-- Epoch 4
Norm: 0.77, NNZs: 3, Bias: -0.002700, T: 800, Avg. loss: 3155.085896
Total training time: 0.00 seconds.
-- Epoch 5
Norm: 0.93, NNZs: 3, Bias: -0.002800, T: 1000, Avg. loss: 3080.501847
Total training time: 0.00 seconds.
-- Epoch 6
Norm: 0.43, NNZs: 3, Bias: -0.002700, T: 1200, Avg. loss: 3011.887174
Total training time: 0.00 seconds.
-- Epoch 7
Norm: 0.69, NNZs: 3, Bias: -0.002200, T: 1400, Avg. loss: 3002.132514
Total training time: 0.00 seconds.
Convergence after 7 epochs took 0.00 seconds
```

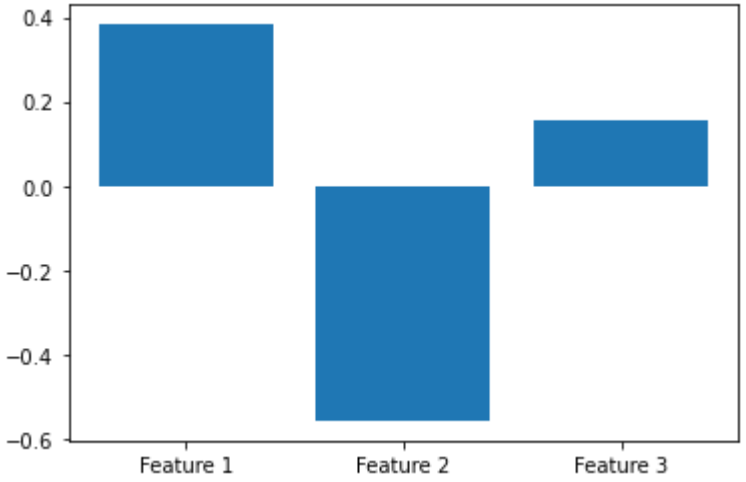
Out[44]:
```
SGDClassifier(eta0=0.0001, learning_rate='constant', random_state=15, verbose=2)
```

In [45]:
```
importance = clf.coef_[0]
for i, j in enumerate(importance):
    print('Feature: %0d, Score: %.5f' % (i, j))

features = ['Feature 1', 'Feature 2', 'Feature 3']
plt.bar(features, clf.coef_[0])
```

```
Feature: 0, Score: 0.38249
Feature: 1, Score: -0.55765
Feature: 2, Score: 0.15408
```

Out[45]: <BarContainer object of 3 artists>



Observation:

- Here, trying to manually observe, the first feature can be said to be the most imortant as it shows the highest amount of correlation with the other features. Moreover, it provides the most information.
- However, if we choose to let go of the SGD classifier, we can import methods like 'featureimportances' to predict the most imporant features.

Task 2

Logistic Regression

In [46]:
```
scaler = StandardScaler()
y = y.reshape(-1, 1)

scaled_X = scaler.fit_transform(X)
scaled_y = scaler.fit_transform(y)
```

In [52]:
```
clf = SGDClassifier(eta0=0.0001, learning_rate='constant', loss='log',
                    random_state=15, verbose=2)
clf.fit(scaled_X, scaled_y)
```

```
-- Epoch 1
Norm: 0.01, NNZs: 3, Bias: 0.000001, T: 200, Avg. loss: 0.691431
Total training time: 0.00 seconds.
-- Epoch 2
Norm: 0.02, NNZs: 3, Bias: 0.000002, T: 400, Avg. loss: 0.687922
Total training time: 0.00 seconds.
-- Epoch 3
Norm: 0.03, NNZs: 3, Bias: 0.000002, T: 600, Avg. loss: 0.684449
Total training time: 0.00 seconds.
-- Epoch 4
Norm: 0.03, NNZs: 3, Bias: 0.000003, T: 800, Avg. loss: 0.681011
Total training time: 0.00 seconds.
-- Epoch 5
Norm: 0.04, NNZs: 3, Bias: 0.000003, T: 1000, Avg. loss: 0.677608
Total training time: 0.00 seconds.
-- Epoch 6
Norm: 0.05, NNZs: 3, Bias: 0.000003, T: 1200, Avg. loss: 0.674240
Total training time: 0.00 seconds.
-- Epoch 7
Norm: 0.06, NNZs: 3, Bias: 0.000003, T: 1400, Avg. loss: 0.670905
Total training time: 0.00 seconds.
-- Epoch 8
Norm: 0.07, NNZs: 3, Bias: 0.000003, T: 1600, Avg. loss: 0.667605
Total training time: 0.00 seconds.
-- Epoch 9
Norm: 0.07, NNZs: 3, Bias: 0.000002, T: 1800, Avg. loss: 0.664338
Total training time: 0.00 seconds.
-- Epoch 10
Norm: 0.08, NNZs: 3, Bias: 0.000002, T: 2000, Avg. loss: 0.661104
Total training time: 0.00 seconds.
-- Epoch 11
Norm: 0.09, NNZs: 3, Bias: 0.000002, T: 2200, Avg. loss: 0.657903
Total training time: 0.00 seconds.
-- Epoch 12
Norm: 0.10, NNZs: 3, Bias: 0.000001, T: 2400, Avg. loss: 0.654734
Total training time: 0.00 seconds.
-- Epoch 13
Norm: 0.11, NNZs: 3, Bias: 0.000001, T: 2600, Avg. loss: 0.651598
Total training time: 0.00 seconds.
-- Epoch 14
Norm: 0.11, NNZs: 3, Bias: 0.000001, T: 2800, Avg. loss: 0.648493
Total training time: 0.00 seconds.
-- Epoch 15
```

```
Norm: 0.12, NNZs: 3, Bias: 0.000001, T: 3000, Avg. loss: 0.645419
Total training time: 0.00 seconds.
-- Epoch 16
Norm: 0.13, NNZs: 3, Bias: 0.000002, T: 3200, Avg. loss: 0.642377
Total training time: 0.00 seconds.
-- Epoch 17
Norm: 0.14, NNZs: 3, Bias: 0.000002, T: 3400, Avg. loss: 0.639365
Total training time: 0.00 seconds.
-- Epoch 18
Norm: 0.14, NNZs: 3, Bias: 0.000001, T: 3600, Avg. loss: 0.636383
Total training time: 0.00 seconds.
-- Epoch 19
Norm: 0.15, NNZs: 3, Bias: 0.000001, T: 3800, Avg. loss: 0.633431
Total training time: 0.00 seconds.
-- Epoch 20
Norm: 0.16, NNZs: 3, Bias: 0.000001, T: 4000, Avg. loss: 0.630509
Total training time: 0.00 seconds.
-- Epoch 21
Norm: 0.17, NNZs: 3, Bias: 0.000001, T: 4200, Avg. loss: 0.627616
Total training time: 0.00 seconds.
-- Epoch 22
Norm: 0.18, NNZs: 3, Bias: 0.000001, T: 4400, Avg. loss: 0.624752
Total training time: 0.00 seconds.
-- Epoch 23
Norm: 0.18, NNZs: 3, Bias: 0.000001, T: 4600, Avg. loss: 0.621917
Total training time: 0.00 seconds.
-- Epoch 24
Norm: 0.19, NNZs: 3, Bias: 0.000000, T: 4800, Avg. loss: 0.619110
Total training time: 0.00 seconds.
-- Epoch 25
Norm: 0.20, NNZs: 3, Bias: -0.000000, T: 5000, Avg. loss: 0.616331
Total training time: 0.01 seconds.
-- Epoch 26
Norm: 0.21, NNZs: 3, Bias: -0.000001, T: 5200, Avg. loss: 0.613579
Total training time: 0.01 seconds.
-- Epoch 27
Norm: 0.21, NNZs: 3, Bias: -0.000001, T: 5400, Avg. loss: 0.610855
Total training time: 0.01 seconds.
-- Epoch 28
Norm: 0.22, NNZs: 3, Bias: -0.000001, T: 5600, Avg. loss: 0.608158
Total training time: 0.01 seconds.
-- Epoch 29
Norm: 0.23, NNZs: 3, Bias: -0.000002, T: 5800, Avg. loss: 0.605488
```

```
Total training time: 0.01 seconds.
-- Epoch 30
Norm: 0.23, NNZs: 3, Bias: -0.000003, T: 6000, Avg. loss: 0.602845
Total training time: 0.01 seconds.
-- Epoch 31
Norm: 0.24, NNZs: 3, Bias: -0.000002, T: 6200, Avg. loss: 0.600227
Total training time: 0.01 seconds.
-- Epoch 32
Norm: 0.25, NNZs: 3, Bias: -0.000002, T: 6400, Avg. loss: 0.597635
Total training time: 0.01 seconds.
-- Epoch 33
Norm: 0.26, NNZs: 3, Bias: -0.000003, T: 6600, Avg. loss: 0.595069
Total training time: 0.01 seconds.
-- Epoch 34
Norm: 0.26, NNZs: 3, Bias: -0.000003, T: 6800, Avg. loss: 0.592528
Total training time: 0.01 seconds.
-- Epoch 35
Norm: 0.27, NNZs: 3, Bias: -0.000003, T: 7000, Avg. loss: 0.590011
Total training time: 0.01 seconds.
-- Epoch 36
Norm: 0.28, NNZs: 3, Bias: -0.000004, T: 7200, Avg. loss: 0.587519
Total training time: 0.01 seconds.
-- Epoch 37
Norm: 0.28, NNZs: 3, Bias: -0.000004, T: 7400, Avg. loss: 0.585052
Total training time: 0.01 seconds.
-- Epoch 38
Norm: 0.29, NNZs: 3, Bias: -0.000004, T: 7600, Avg. loss: 0.582608
Total training time: 0.01 seconds.
-- Epoch 39
Norm: 0.30, NNZs: 3, Bias: -0.000005, T: 7800, Avg. loss: 0.580189
Total training time: 0.01 seconds.
-- Epoch 40
Norm: 0.30, NNZs: 3, Bias: -0.000005, T: 8000, Avg. loss: 0.577793
Total training time: 0.01 seconds.
-- Epoch 41
Norm: 0.31, NNZs: 3, Bias: -0.000007, T: 8200, Avg. loss: 0.575420
Total training time: 0.01 seconds.
-- Epoch 42
Norm: 0.32, NNZs: 3, Bias: -0.000008, T: 8400, Avg. loss: 0.573071
Total training time: 0.01 seconds.
-- Epoch 43
Norm: 0.33, NNZs: 3, Bias: -0.000009, T: 8600, Avg. loss: 0.570743
Total training time: 0.01 seconds.
```

```
-- Epoch 44
Norm: 0.33, NNZs: 3, Bias: -0.000010, T: 8800, Avg. loss: 0.568439
Total training time: 0.01 seconds.
-- Epoch 45
Norm: 0.34, NNZs: 3, Bias: -0.000010, T: 9000, Avg. loss: 0.566156
Total training time: 0.01 seconds.
-- Epoch 46
Norm: 0.35, NNZs: 3, Bias: -0.000010, T: 9200, Avg. loss: 0.563896
Total training time: 0.01 seconds.
-- Epoch 47
Norm: 0.35, NNZs: 3, Bias: -0.000012, T: 9400, Avg. loss: 0.561657
Total training time: 0.01 seconds.
-- Epoch 48
Norm: 0.36, NNZs: 3, Bias: -0.000012, T: 9600, Avg. loss: 0.559439
Total training time: 0.01 seconds.
-- Epoch 49
Norm: 0.37, NNZs: 3, Bias: -0.000013, T: 9800, Avg. loss: 0.557243
Total training time: 0.01 seconds.
-- Epoch 50
Norm: 0.37, NNZs: 3, Bias: -0.000015, T: 10000, Avg. loss: 0.555067
Total training time: 0.01 seconds.
-- Epoch 51
Norm: 0.38, NNZs: 3, Bias: -0.000016, T: 10200, Avg. loss: 0.552912
Total training time: 0.01 seconds.
-- Epoch 52
Norm: 0.39, NNZs: 3, Bias: -0.000017, T: 10400, Avg. loss: 0.550777
Total training time: 0.02 seconds.
-- Epoch 53
Norm: 0.39, NNZs: 3, Bias: -0.000018, T: 10600, Avg. loss: 0.548663
Total training time: 0.02 seconds.
-- Epoch 54
Norm: 0.40, NNZs: 3, Bias: -0.000020, T: 10800, Avg. loss: 0.546568
Total training time: 0.02 seconds.
-- Epoch 55
Norm: 0.40, NNZs: 3, Bias: -0.000021, T: 11000, Avg. loss: 0.544493
Total training time: 0.02 seconds.
-- Epoch 56
Norm: 0.41, NNZs: 3, Bias: -0.000023, T: 11200, Avg. loss: 0.542438
Total training time: 0.02 seconds.
-- Epoch 57
Norm: 0.42, NNZs: 3, Bias: -0.000024, T: 11400, Avg. loss: 0.540402
Total training time: 0.02 seconds.
-- Epoch 58
```

```
Norm: 0.42, NNZs: 3, Bias: -0.000025, T: 11600, Avg. loss: 0.538384
Total training time: 0.02 seconds.
-- Epoch 59
Norm: 0.43, NNZs: 3, Bias: -0.000027, T: 11800, Avg. loss: 0.536386
Total training time: 0.02 seconds.
-- Epoch 60
Norm: 0.44, NNZs: 3, Bias: -0.000028, T: 12000, Avg. loss: 0.534406
Total training time: 0.02 seconds.
-- Epoch 61
Norm: 0.44, NNZs: 3, Bias: -0.000030, T: 12200, Avg. loss: 0.532444
Total training time: 0.02 seconds.
-- Epoch 62
Norm: 0.45, NNZs: 3, Bias: -0.000030, T: 12400, Avg. loss: 0.530501
Total training time: 0.02 seconds.
-- Epoch 63
Norm: 0.45, NNZs: 3, Bias: -0.000032, T: 12600, Avg. loss: 0.528575
Total training time: 0.02 seconds.
-- Epoch 64
Norm: 0.46, NNZs: 3, Bias: -0.000034, T: 12800, Avg. loss: 0.526668
Total training time: 0.02 seconds.
-- Epoch 65
Norm: 0.47, NNZs: 3, Bias: -0.000035, T: 13000, Avg. loss: 0.524777
Total training time: 0.02 seconds.
-- Epoch 66
Norm: 0.47, NNZs: 3, Bias: -0.000038, T: 13200, Avg. loss: 0.522904
Total training time: 0.02 seconds.
-- Epoch 67
Norm: 0.48, NNZs: 3, Bias: -0.000039, T: 13400, Avg. loss: 0.521048
Total training time: 0.02 seconds.
-- Epoch 68
Norm: 0.49, NNZs: 3, Bias: -0.000042, T: 13600, Avg. loss: 0.519209
Total training time: 0.02 seconds.
-- Epoch 69
Norm: 0.49, NNZs: 3, Bias: -0.000046, T: 13800, Avg. loss: 0.517387
Total training time: 0.02 seconds.
-- Epoch 70
Norm: 0.50, NNZs: 3, Bias: -0.000049, T: 14000, Avg. loss: 0.515581
Total training time: 0.02 seconds.
-- Epoch 71
Norm: 0.50, NNZs: 3, Bias: -0.000054, T: 14200, Avg. loss: 0.513791
Total training time: 0.02 seconds.
-- Epoch 72
Norm: 0.51, NNZs: 3, Bias: -0.000057, T: 14400, Avg. loss: 0.512018
```

```
Total training time: 0.02 seconds.
-- Epoch 73
Norm: 0.52, NNZs: 3, Bias: -0.000060, T: 14600, Avg. loss: 0.510260
Total training time: 0.02 seconds.
-- Epoch 74
Norm: 0.52, NNZs: 3, Bias: -0.000064, T: 14800, Avg. loss: 0.508518
Total training time: 0.02 seconds.
-- Epoch 75
Norm: 0.53, NNZs: 3, Bias: -0.000067, T: 15000, Avg. loss: 0.506792
Total training time: 0.02 seconds.
-- Epoch 76
Norm: 0.53, NNZs: 3, Bias: -0.000069, T: 15200, Avg. loss: 0.505081
Total training time: 0.02 seconds.
-- Epoch 77
Norm: 0.54, NNZs: 3, Bias: -0.000072, T: 15400, Avg. loss: 0.503385
Total training time: 0.02 seconds.
-- Epoch 78
Norm: 0.54, NNZs: 3, Bias: -0.000076, T: 15600, Avg. loss: 0.501705
Total training time: 0.02 seconds.
-- Epoch 79
Norm: 0.55, NNZs: 3, Bias: -0.000080, T: 15800, Avg. loss: 0.500039
Total training time: 0.02 seconds.
-- Epoch 80
Norm: 0.56, NNZs: 3, Bias: -0.000084, T: 16000, Avg. loss: 0.498387
Total training time: 0.02 seconds.
-- Epoch 81
Norm: 0.56, NNZs: 3, Bias: -0.000088, T: 16200, Avg. loss: 0.496751
Total training time: 0.02 seconds.
-- Epoch 82
Norm: 0.57, NNZs: 3, Bias: -0.000091, T: 16400, Avg. loss: 0.495128
Total training time: 0.02 seconds.
-- Epoch 83
Norm: 0.57, NNZs: 3, Bias: -0.000095, T: 16600, Avg. loss: 0.493520
Total training time: 0.02 seconds.
-- Epoch 84
Norm: 0.58, NNZs: 3, Bias: -0.000100, T: 16800, Avg. loss: 0.491925
Total training time: 0.02 seconds.
-- Epoch 85
Norm: 0.58, NNZs: 3, Bias: -0.000104, T: 17000, Avg. loss: 0.490345
Total training time: 0.02 seconds.
-- Epoch 86
Norm: 0.59, NNZs: 3, Bias: -0.000108, T: 17200, Avg. loss: 0.488778
Total training time: 0.02 seconds.
```

```
-- Epoch 87
Norm: 0.60, NNZs: 3, Bias: -0.000113, T: 17400, Avg. loss: 0.487225
Total training time: 0.02 seconds.
-- Epoch 88
Norm: 0.60, NNZs: 3, Bias: -0.000118, T: 17600, Avg. loss: 0.485685
Total training time: 0.02 seconds.
-- Epoch 89
Norm: 0.61, NNZs: 3, Bias: -0.000123, T: 17800, Avg. loss: 0.484158
Total training time: 0.02 seconds.
-- Epoch 90
Norm: 0.61, NNZs: 3, Bias: -0.000128, T: 18000, Avg. loss: 0.482644
Total training time: 0.02 seconds.
-- Epoch 91
Norm: 0.62, NNZs: 3, Bias: -0.000132, T: 18200, Avg. loss: 0.481144
Total training time: 0.02 seconds.
-- Epoch 92
Norm: 0.62, NNZs: 3, Bias: -0.000137, T: 18400, Avg. loss: 0.479656
Total training time: 0.02 seconds.
-- Epoch 93
Norm: 0.63, NNZs: 3, Bias: -0.000143, T: 18600, Avg. loss: 0.478180
Total training time: 0.02 seconds.
-- Epoch 94
Norm: 0.63, NNZs: 3, Bias: -0.000147, T: 18800, Avg. loss: 0.476718
Total training time: 0.02 seconds.
-- Epoch 95
Norm: 0.64, NNZs: 3, Bias: -0.000153, T: 19000, Avg. loss: 0.475267
Total training time: 0.02 seconds.
-- Epoch 96
Norm: 0.64, NNZs: 3, Bias: -0.000158, T: 19200, Avg. loss: 0.473829
Total training time: 0.02 seconds.
-- Epoch 97
Norm: 0.65, NNZs: 3, Bias: -0.000164, T: 19400, Avg. loss: 0.472402
Total training time: 0.02 seconds.
-- Epoch 98
Norm: 0.65, NNZs: 3, Bias: -0.000170, T: 19600, Avg. loss: 0.470988
Total training time: 0.02 seconds.
-- Epoch 99
Norm: 0.66, NNZs: 3, Bias: -0.000176, T: 19800, Avg. loss: 0.469585
Total training time: 0.02 seconds.
-- Epoch 100
Norm: 0.67, NNZs: 3, Bias: -0.000182, T: 20000, Avg. loss: 0.468194
Total training time: 0.02 seconds.
-- Epoch 101
```

```
Norm: 0.67, NNZs: 3, Bias: -0.000188, T: 20200, Avg. loss: 0.466815
Total training time: 0.03 seconds.
-- Epoch 102
Norm: 0.68, NNZs: 3, Bias: -0.000194, T: 20400, Avg. loss: 0.465447
Total training time: 0.03 seconds.
-- Epoch 103
Norm: 0.68, NNZs: 3, Bias: -0.000201, T: 20600, Avg. loss: 0.464090
Total training time: 0.03 seconds.
-- Epoch 104
Norm: 0.69, NNZs: 3, Bias: -0.000207, T: 20800, Avg. loss: 0.462744
Total training time: 0.03 seconds.
-- Epoch 105
Norm: 0.69, NNZs: 3, Bias: -0.000215, T: 21000, Avg. loss: 0.461410
Total training time: 0.03 seconds.
-- Epoch 106
Norm: 0.70, NNZs: 3, Bias: -0.000222, T: 21200, Avg. loss: 0.460086
Total training time: 0.03 seconds.
-- Epoch 107
Norm: 0.70, NNZs: 3, Bias: -0.000228, T: 21400, Avg. loss: 0.458773
Total training time: 0.03 seconds.
-- Epoch 108
Norm: 0.71, NNZs: 3, Bias: -0.000235, T: 21600, Avg. loss: 0.457471
Total training time: 0.03 seconds.
-- Epoch 109
Norm: 0.71, NNZs: 3, Bias: -0.000241, T: 21800, Avg. loss: 0.456179
Total training time: 0.03 seconds.
-- Epoch 110
Norm: 0.72, NNZs: 3, Bias: -0.000249, T: 22000, Avg. loss: 0.454898
Total training time: 0.03 seconds.
-- Epoch 111
Norm: 0.72, NNZs: 3, Bias: -0.000255, T: 22200, Avg. loss: 0.453627
Total training time: 0.03 seconds.
-- Epoch 112
Norm: 0.73, NNZs: 3, Bias: -0.000262, T: 22400, Avg. loss: 0.452366
Total training time: 0.03 seconds.
-- Epoch 113
Norm: 0.73, NNZs: 3, Bias: -0.000269, T: 22600, Avg. loss: 0.451115
Total training time: 0.03 seconds.
-- Epoch 114
Norm: 0.74, NNZs: 3, Bias: -0.000277, T: 22800, Avg. loss: 0.449874
Total training time: 0.03 seconds.
-- Epoch 115
Norm: 0.74, NNZs: 3, Bias: -0.000284, T: 23000, Avg. loss: 0.448643
```

```
Total training time: 0.03 seconds.
-- Epoch 116
Norm: 0.75, NNZs: 3, Bias: -0.000292, T: 23200, Avg. loss: 0.447422
Total training time: 0.03 seconds.
-- Epoch 117
Norm: 0.75, NNZs: 3, Bias: -0.000300, T: 23400, Avg. loss: 0.446210
Total training time: 0.03 seconds.
-- Epoch 118
Norm: 0.76, NNZs: 3, Bias: -0.000308, T: 23600, Avg. loss: 0.445008
Total training time: 0.03 seconds.
-- Epoch 119
Norm: 0.76, NNZs: 3, Bias: -0.000316, T: 23800, Avg. loss: 0.443816
Total training time: 0.03 seconds.
-- Epoch 120
Norm: 0.77, NNZs: 3, Bias: -0.000326, T: 24000, Avg. loss: 0.442632
Total training time: 0.03 seconds.
-- Epoch 121
Norm: 0.77, NNZs: 3, Bias: -0.000334, T: 24200, Avg. loss: 0.441458
Total training time: 0.03 seconds.
-- Epoch 122
Norm: 0.78, NNZs: 3, Bias: -0.000343, T: 24400, Avg. loss: 0.440293
Total training time: 0.03 seconds.
-- Epoch 123
Norm: 0.78, NNZs: 3, Bias: -0.000352, T: 24600, Avg. loss: 0.439138
Total training time: 0.03 seconds.
-- Epoch 124
Norm: 0.79, NNZs: 3, Bias: -0.000362, T: 24800, Avg. loss: 0.437991
Total training time: 0.03 seconds.
-- Epoch 125
Norm: 0.79, NNZs: 3, Bias: -0.000370, T: 25000, Avg. loss: 0.436852
Total training time: 0.03 seconds.
-- Epoch 126
Norm: 0.79, NNZs: 3, Bias: -0.000378, T: 25200, Avg. loss: 0.435723
Total training time: 0.03 seconds.
-- Epoch 127
Norm: 0.80, NNZs: 3, Bias: -0.000388, T: 25400, Avg. loss: 0.434602
Total training time: 0.03 seconds.
-- Epoch 128
Norm: 0.80, NNZs: 3, Bias: -0.000397, T: 25600, Avg. loss: 0.433490
Total training time: 0.03 seconds.
-- Epoch 129
Norm: 0.81, NNZs: 3, Bias: -0.000407, T: 25800, Avg. loss: 0.432387
Total training time: 0.03 seconds.
```

```
-- Epoch 130
Norm: 0.81, NNZs: 3, Bias: -0.000417, T: 26000, Avg. loss: 0.431291
Total training time: 0.03 seconds.
-- Epoch 131
Norm: 0.82, NNZs: 3, Bias: -0.000426, T: 26200, Avg. loss: 0.430204
Total training time: 0.03 seconds.
-- Epoch 132
Norm: 0.82, NNZs: 3, Bias: -0.000436, T: 26400, Avg. loss: 0.429125
Total training time: 0.03 seconds.
-- Epoch 133
Norm: 0.83, NNZs: 3, Bias: -0.000446, T: 26600, Avg. loss: 0.428055
Total training time: 0.03 seconds.
-- Epoch 134
Norm: 0.83, NNZs: 3, Bias: -0.000457, T: 26800, Avg. loss: 0.426992
Total training time: 0.03 seconds.
-- Epoch 135
Norm: 0.84, NNZs: 3, Bias: -0.000467, T: 27000, Avg. loss: 0.425937
Total training time: 0.03 seconds.
-- Epoch 136
Norm: 0.84, NNZs: 3, Bias: -0.000478, T: 27200, Avg. loss: 0.424891
Total training time: 0.03 seconds.
-- Epoch 137
Norm: 0.85, NNZs: 3, Bias: -0.000490, T: 27400, Avg. loss: 0.423851
Total training time: 0.03 seconds.
-- Epoch 138
Norm: 0.85, NNZs: 3, Bias: -0.000501, T: 27600, Avg. loss: 0.422820
Total training time: 0.03 seconds.
-- Epoch 139
Norm: 0.85, NNZs: 3, Bias: -0.000512, T: 27800, Avg. loss: 0.421796
Total training time: 0.03 seconds.
-- Epoch 140
Norm: 0.86, NNZs: 3, Bias: -0.000523, T: 28000, Avg. loss: 0.420780
Total training time: 0.03 seconds.
-- Epoch 141
Norm: 0.86, NNZs: 3, Bias: -0.000534, T: 28200, Avg. loss: 0.419771
Total training time: 0.03 seconds.
-- Epoch 142
Norm: 0.87, NNZs: 3, Bias: -0.000546, T: 28400, Avg. loss: 0.418770
Total training time: 0.03 seconds.
-- Epoch 143
Norm: 0.87, NNZs: 3, Bias: -0.000556, T: 28600, Avg. loss: 0.417776
Total training time: 0.03 seconds.
-- Epoch 144
```

```
Norm: 0.88, NNZs: 3, Bias: -0.000568, T: 28800, Avg. loss: 0.416789
Total training time: 0.03 seconds.
-- Epoch 145
Norm: 0.88, NNZs: 3, Bias: -0.000579, T: 29000, Avg. loss: 0.415809
Total training time: 0.03 seconds.
-- Epoch 146
Norm: 0.89, NNZs: 3, Bias: -0.000591, T: 29200, Avg. loss: 0.414836
Total training time: 0.03 seconds.
-- Epoch 147
Norm: 0.89, NNZs: 3, Bias: -0.000603, T: 29400, Avg. loss: 0.413871
Total training time: 0.03 seconds.
Convergence after 147 epochs took 0.03 seconds

C:\Users\Suresh\AppData\Roaming\Python\Python38\site-packages\sklearn\utils\validation.py:63: DataConversion
Warning:

A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), fo
r example using ravel().
```

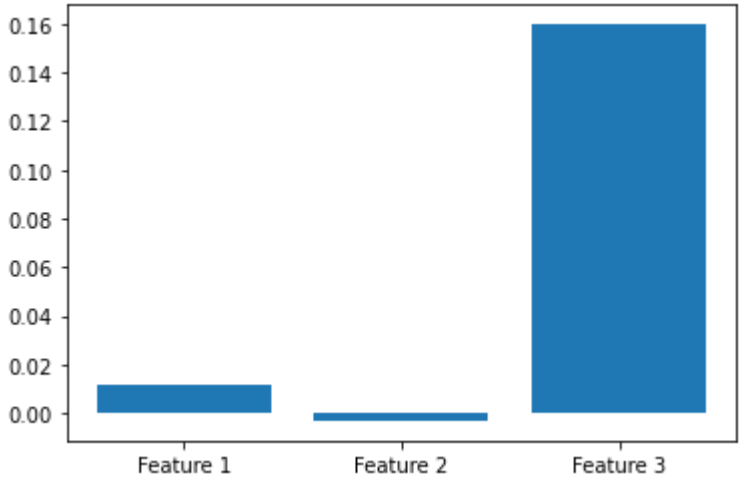
Out[52]:
```
SGDClassifier(eta0=0.0001, learning_rate='constant', loss='log',
              random_state=15, verbose=2)
```

In [51]:
```
importance = clf.coef_[0]
for i, j in enumerate(importance):
    print('Feature: %0d, Score: %.5f' % (i, j))


features = ['Feature 1', 'Feature 2', 'Feature 3']
plt.bar(features, clf.coef_[0])
```

```
Feature: 0, Score: 0.01183
Feature: 1, Score: -0.00302
Feature: 2, Score: 0.15963
```

Out[51]: <BarContainer object of 3 artists>



SVM

In [53]:
```
clf = SGDClassifier(eta0=0.0001, learning_rate='constant', loss='hinge',
                    random_state=15, verbose=2)
clf.fit(scaled_X, scaled_y)
```

```
-- Epoch 1
Norm: 0.02, NNZs: 3, Bias: 0.000000, T: 200, Avg. loss: 0.993111
Total training time: 0.00 seconds.
-- Epoch 2
Norm: 0.03, NNZs: 3, Bias: -0.000000, T: 400, Avg. loss: 0.978934
Total training time: 0.00 seconds.
-- Epoch 3
Norm: 0.05, NNZs: 3, Bias: 0.000000, T: 600, Avg. loss: 0.964757
Total training time: 0.00 seconds.
-- Epoch 4
Norm: 0.07, NNZs: 3, Bias: 0.000000, T: 800, Avg. loss: 0.950580
Total training time: 0.00 seconds.
-- Epoch 5
Norm: 0.08, NNZs: 3, Bias: -0.000000, T: 1000, Avg. loss: 0.936403
Total training time: 0.00 seconds.
-- Epoch 6
Norm: 0.10, NNZs: 3, Bias: 0.000000, T: 1200, Avg. loss: 0.922226
Total training time: 0.00 seconds.
-- Epoch 7
Norm: 0.12, NNZs: 3, Bias: 0.000000, T: 1400, Avg. loss: 0.908049
Total training time: 0.00 seconds.
-- Epoch 8
Norm: 0.13, NNZs: 3, Bias: 0.000000, T: 1600, Avg. loss: 0.893873
Total training time: 0.00 seconds.
-- Epoch 9
Norm: 0.15, NNZs: 3, Bias: 0.000000, T: 1800, Avg. loss: 0.879696
Total training time: 0.00 seconds.
-- Epoch 10
Norm: 0.17, NNZs: 3, Bias: 0.000000, T: 2000, Avg. loss: 0.865519
Total training time: 0.00 seconds.
-- Epoch 11
Norm: 0.19, NNZs: 3, Bias: -0.000000, T: 2200, Avg. loss: 0.851342
Total training time: 0.00 seconds.
-- Epoch 12
Norm: 0.20, NNZs: 3, Bias: -0.000000, T: 2400, Avg. loss: 0.837165
Total training time: 0.00 seconds.
-- Epoch 13
Norm: 0.22, NNZs: 3, Bias: -0.000000, T: 2600, Avg. loss: 0.822988
Total training time: 0.00 seconds.
-- Epoch 14
Norm: 0.24, NNZs: 3, Bias: -0.000000, T: 2800, Avg. loss: 0.808812
Total training time: 0.00 seconds.
-- Epoch 15
```

```
Norm: 0.25, NNZs: 3, Bias: 0.000000, T: 3000, Avg. loss: 0.794635
Total training time: 0.00 seconds.
-- Epoch 16
Norm: 0.27, NNZs: 3, Bias: 0.000000, T: 3200, Avg. loss: 0.780458
Total training time: 0.00 seconds.
-- Epoch 17
Norm: 0.29, NNZs: 3, Bias: -0.000000, T: 3400, Avg. loss: 0.766282
Total training time: 0.00 seconds.
-- Epoch 18
Norm: 0.30, NNZs: 3, Bias: 0.000000, T: 3600, Avg. loss: 0.752105
Total training time: 0.00 seconds.
-- Epoch 19
Norm: 0.32, NNZs: 3, Bias: 0.000000, T: 3800, Avg. loss: 0.737929
Total training time: 0.00 seconds.
-- Epoch 20
Norm: 0.34, NNZs: 3, Bias: -0.000000, T: 4000, Avg. loss: 0.723752
Total training time: 0.00 seconds.
-- Epoch 21
Norm: 0.35, NNZs: 3, Bias: 0.000000, T: 4200, Avg. loss: 0.709575
Total training time: 0.00 seconds.
-- Epoch 22
Norm: 0.37, NNZs: 3, Bias: 0.000000, T: 4400, Avg. loss: 0.695399
Total training time: 0.00 seconds.
-- Epoch 23
Norm: 0.39, NNZs: 3, Bias: -0.000000, T: 4600, Avg. loss: 0.681222
Total training time: 0.00 seconds.
-- Epoch 24
Norm: 0.40, NNZs: 3, Bias: 0.000000, T: 4800, Avg. loss: 0.667046
Total training time: 0.00 seconds.
-- Epoch 25
Norm: 0.42, NNZs: 3, Bias: 0.000000, T: 5000, Avg. loss: 0.652870
Total training time: 0.00 seconds.
-- Epoch 26
Norm: 0.44, NNZs: 3, Bias: 0.000000, T: 5200, Avg. loss: 0.638693
Total training time: 0.00 seconds.
-- Epoch 27
Norm: 0.45, NNZs: 3, Bias: 0.000000, T: 5400, Avg. loss: 0.624517
Total training time: 0.00 seconds.
-- Epoch 28
Norm: 0.47, NNZs: 3, Bias: -0.000000, T: 5600, Avg. loss: 0.610341
Total training time: 0.00 seconds.
-- Epoch 29
Norm: 0.49, NNZs: 3, Bias: -0.000000, T: 5800, Avg. loss: 0.596164
```

```
Total training time: 0.00 seconds.
-- Epoch 30
Norm: 0.51, NNZs: 3, Bias: -0.000000, T: 6000, Avg. loss: 0.581988
Total training time: 0.00 seconds.
-- Epoch 31
Norm: 0.52, NNZs: 3, Bias: -0.000000, T: 6200, Avg. loss: 0.567812
Total training time: 0.00 seconds.
-- Epoch 32
Norm: 0.54, NNZs: 3, Bias: -0.000000, T: 6400, Avg. loss: 0.553635
Total training time: 0.00 seconds.
-- Epoch 33
Norm: 0.56, NNZs: 3, Bias: -0.000100, T: 6600, Avg. loss: 0.539559
Total training time: 0.00 seconds.
-- Epoch 34
Norm: 0.57, NNZs: 3, Bias: -0.000400, T: 6800, Avg. loss: 0.525831
Total training time: 0.00 seconds.
-- Epoch 35
Norm: 0.59, NNZs: 3, Bias: -0.000400, T: 7000, Avg. loss: 0.512822
Total training time: 0.00 seconds.
-- Epoch 36
Norm: 0.60, NNZs: 3, Bias: -0.000300, T: 7200, Avg. loss: 0.500814
Total training time: 0.00 seconds.
-- Epoch 37
Norm: 0.62, NNZs: 3, Bias: 0.000100, T: 7400, Avg. loss: 0.489867
Total training time: 0.00 seconds.
-- Epoch 38
Norm: 0.63, NNZs: 3, Bias: 0.000500, T: 7600, Avg. loss: 0.479843
Total training time: 0.00 seconds.
-- Epoch 39
Norm: 0.64, NNZs: 3, Bias: 0.000900, T: 7800, Avg. loss: 0.470023
Total training time: 0.00 seconds.
-- Epoch 40
Norm: 0.66, NNZs: 3, Bias: 0.001200, T: 8000, Avg. loss: 0.460939
Total training time: 0.00 seconds.
-- Epoch 41
Norm: 0.67, NNZs: 3, Bias: 0.001100, T: 8200, Avg. loss: 0.453123
Total training time: 0.00 seconds.
-- Epoch 42
Norm: 0.68, NNZs: 3, Bias: 0.001000, T: 8400, Avg. loss: 0.446506
Total training time: 0.00 seconds.
-- Epoch 43
Norm: 0.69, NNZs: 3, Bias: 0.001000, T: 8600, Avg. loss: 0.440244
Total training time: 0.00 seconds.
```

```
-- Epoch 44
Norm: 0.70, NNZs: 3, Bias: 0.001000, T: 8800, Avg. loss: 0.434183
Total training time: 0.00 seconds.
-- Epoch 45
Norm: 0.71, NNZs: 3, Bias: 0.001200, T: 9000, Avg. loss: 0.428457
Total training time: 0.00 seconds.
-- Epoch 46
Norm: 0.72, NNZs: 3, Bias: 0.001400, T: 9200, Avg. loss: 0.422915
Total training time: 0.00 seconds.
-- Epoch 47
Norm: 0.73, NNZs: 3, Bias: 0.001500, T: 9400, Avg. loss: 0.417423
Total training time: 0.00 seconds.
-- Epoch 48
Norm: 0.74, NNZs: 3, Bias: 0.001800, T: 9600, Avg. loss: 0.412336
Total training time: 0.00 seconds.
-- Epoch 49
Norm: 0.75, NNZs: 3, Bias: 0.001900, T: 9800, Avg. loss: 0.407610
Total training time: 0.00 seconds.
-- Epoch 50
Norm: 0.76, NNZs: 3, Bias: 0.002200, T: 10000, Avg. loss: 0.403083
Total training time: 0.00 seconds.
-- Epoch 51
Norm: 0.77, NNZs: 3, Bias: 0.002500, T: 10200, Avg. loss: 0.398796
Total training time: 0.00 seconds.
-- Epoch 52
Norm: 0.78, NNZs: 3, Bias: 0.002900, T: 10400, Avg. loss: 0.394692
Total training time: 0.00 seconds.
-- Epoch 53
Norm: 0.79, NNZs: 3, Bias: 0.003400, T: 10600, Avg. loss: 0.390702
Total training time: 0.00 seconds.
-- Epoch 54
Norm: 0.80, NNZs: 3, Bias: 0.004000, T: 10800, Avg. loss: 0.386766
Total training time: 0.00 seconds.
-- Epoch 55
Norm: 0.81, NNZs: 3, Bias: 0.004800, T: 11000, Avg. loss: 0.383045
Total training time: 0.01 seconds.
-- Epoch 56
Norm: 0.81, NNZs: 3, Bias: 0.005600, T: 11200, Avg. loss: 0.379523
Total training time: 0.01 seconds.
-- Epoch 57
Norm: 0.82, NNZs: 3, Bias: 0.006400, T: 11400, Avg. loss: 0.376092
Total training time: 0.01 seconds.
-- Epoch 58
```

```
Norm: 0.83, NNZs: 3, Bias: 0.006900, T: 11600, Avg. loss: 0.372853
Total training time: 0.01 seconds.
-- Epoch 59
Norm: 0.84, NNZs: 3, Bias: 0.007400, T: 11800, Avg. loss: 0.369757
Total training time: 0.01 seconds.
-- Epoch 60
Norm: 0.85, NNZs: 3, Bias: 0.007900, T: 12000, Avg. loss: 0.366660
Total training time: 0.01 seconds.
-- Epoch 61
Norm: 0.85, NNZs: 3, Bias: 0.008500, T: 12200, Avg. loss: 0.363659
Total training time: 0.01 seconds.
-- Epoch 62
Norm: 0.86, NNZs: 3, Bias: 0.008900, T: 12400, Avg. loss: 0.360918
Total training time: 0.01 seconds.
-- Epoch 63
Norm: 0.87, NNZs: 3, Bias: 0.009300, T: 12600, Avg. loss: 0.358293
Total training time: 0.01 seconds.
-- Epoch 64
Norm: 0.87, NNZs: 3, Bias: 0.009700, T: 12800, Avg. loss: 0.355741
Total training time: 0.01 seconds.
-- Epoch 65
Norm: 0.88, NNZs: 3, Bias: 0.010200, T: 13000, Avg. loss: 0.353291
Total training time: 0.01 seconds.
-- Epoch 66
Norm: 0.89, NNZs: 3, Bias: 0.010500, T: 13200, Avg. loss: 0.350947
Total training time: 0.01 seconds.
-- Epoch 67
Norm: 0.89, NNZs: 3, Bias: 0.010800, T: 13400, Avg. loss: 0.348714
Total training time: 0.01 seconds.
-- Epoch 68
Norm: 0.90, NNZs: 3, Bias: 0.011000, T: 13600, Avg. loss: 0.346524
Total training time: 0.01 seconds.
-- Epoch 69
Norm: 0.91, NNZs: 3, Bias: 0.011000, T: 13800, Avg. loss: 0.344410
Total training time: 0.01 seconds.
-- Epoch 70
Norm: 0.91, NNZs: 3, Bias: 0.011000, T: 14000, Avg. loss: 0.342392
Total training time: 0.01 seconds.
-- Epoch 71
Norm: 0.92, NNZs: 3, Bias: 0.010900, T: 14200, Avg. loss: 0.340372
Total training time: 0.01 seconds.
-- Epoch 72
Norm: 0.93, NNZs: 3, Bias: 0.010800, T: 14400, Avg. loss: 0.338400
```

```
Total training time: 0.01 seconds.
-- Epoch 73
Norm: 0.93, NNZs: 3, Bias: 0.010600, T: 14600, Avg. loss: 0.336501
Total training time: 0.01 seconds.
-- Epoch 74
Norm: 0.94, NNZs: 3, Bias: 0.010400, T: 14800, Avg. loss: 0.334604
Total training time: 0.01 seconds.
-- Epoch 75
Norm: 0.94, NNZs: 3, Bias: 0.010400, T: 15000, Avg. loss: 0.332782
Total training time: 0.01 seconds.
-- Epoch 76
Norm: 0.95, NNZs: 3, Bias: 0.010300, T: 15200, Avg. loss: 0.331037
Total training time: 0.01 seconds.
-- Epoch 77
Norm: 0.96, NNZs: 3, Bias: 0.010200, T: 15400, Avg. loss: 0.329317
Total training time: 0.01 seconds.
-- Epoch 78
Norm: 0.96, NNZs: 3, Bias: 0.010100, T: 15600, Avg. loss: 0.327597
Total training time: 0.01 seconds.
-- Epoch 79
Norm: 0.97, NNZs: 3, Bias: 0.009900, T: 15800, Avg. loss: 0.325932
Total training time: 0.01 seconds.
-- Epoch 80
Norm: 0.97, NNZs: 3, Bias: 0.009900, T: 16000, Avg. loss: 0.324369
Total training time: 0.01 seconds.
-- Epoch 81
Norm: 0.98, NNZs: 3, Bias: 0.009900, T: 16200, Avg. loss: 0.322840
Total training time: 0.01 seconds.
-- Epoch 82
Norm: 0.98, NNZs: 3, Bias: 0.009900, T: 16400, Avg. loss: 0.321310
Total training time: 0.01 seconds.
-- Epoch 83
Norm: 0.99, NNZs: 3, Bias: 0.010000, T: 16600, Avg. loss: 0.319872
Total training time: 0.01 seconds.
-- Epoch 84
Norm: 0.99, NNZs: 3, Bias: 0.010100, T: 16800, Avg. loss: 0.318513
Total training time: 0.01 seconds.
-- Epoch 85
Norm: 1.00, NNZs: 3, Bias: 0.010300, T: 17000, Avg. loss: 0.317175
Total training time: 0.01 seconds.
-- Epoch 86
Norm: 1.00, NNZs: 3, Bias: 0.010500, T: 17200, Avg. loss: 0.315862
Total training time: 0.01 seconds.
```

```
-- Epoch 87
Norm: 1.01, NNZs: 3, Bias: 0.010700, T: 17400, Avg. loss: 0.314549
Total training time: 0.01 seconds.
-- Epoch 88
Norm: 1.01, NNZs: 3, Bias: 0.010900, T: 17600, Avg. loss: 0.313237
Total training time: 0.01 seconds.
-- Epoch 89
Norm: 1.02, NNZs: 3, Bias: 0.011100, T: 17800, Avg. loss: 0.311924
Total training time: 0.01 seconds.
-- Epoch 90
Norm: 1.02, NNZs: 3, Bias: 0.011300, T: 18000, Avg. loss: 0.310612
Total training time: 0.01 seconds.
-- Epoch 91
Norm: 1.03, NNZs: 3, Bias: 0.011500, T: 18200, Avg. loss: 0.309337
Total training time: 0.01 seconds.
-- Epoch 92
Norm: 1.03, NNZs: 3, Bias: 0.011700, T: 18400, Avg. loss: 0.308166
Total training time: 0.01 seconds.
-- Epoch 93
Norm: 1.04, NNZs: 3, Bias: 0.011900, T: 18600, Avg. loss: 0.307057
Total training time: 0.01 seconds.
-- Epoch 94
Norm: 1.04, NNZs: 3, Bias: 0.012200, T: 18800, Avg. loss: 0.305980
Total training time: 0.01 seconds.
-- Epoch 95
Norm: 1.05, NNZs: 3, Bias: 0.012500, T: 19000, Avg. loss: 0.304914
Total training time: 0.01 seconds.
-- Epoch 96
Norm: 1.05, NNZs: 3, Bias: 0.012800, T: 19200, Avg. loss: 0.303880
Total training time: 0.01 seconds.
-- Epoch 97
Norm: 1.06, NNZs: 3, Bias: 0.013100, T: 19400, Avg. loss: 0.302892
Total training time: 0.01 seconds.
-- Epoch 98
Norm: 1.06, NNZs: 3, Bias: 0.013500, T: 19600, Avg. loss: 0.301927
Total training time: 0.01 seconds.
-- Epoch 99
Norm: 1.07, NNZs: 3, Bias: 0.013900, T: 19800, Avg. loss: 0.300979
Total training time: 0.01 seconds.
-- Epoch 100
Norm: 1.07, NNZs: 3, Bias: 0.014100, T: 20000, Avg. loss: 0.300054
Total training time: 0.01 seconds.
-- Epoch 101
```

```
Norm: 1.07, NNZs: 3, Bias: 0.014300, T: 20200, Avg. loss: 0.299188
Total training time: 0.01 seconds.
Convergence after 101 epochs took 0.01 seconds

C:\Users\Suresh\AppData\Roaming\Python\Python38\site-packages\sklearn\utils\validation.py:63: DataConversion
Warning:

A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), fo
r example using ravel().
```

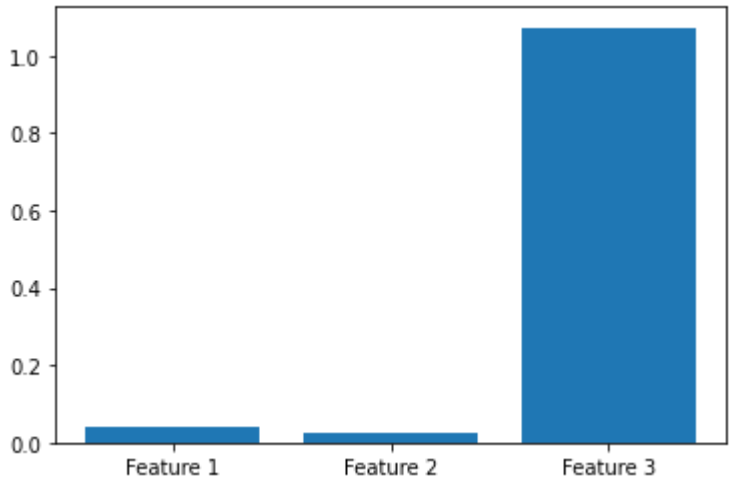
Out[53]:
```
SGDClassifier(eta0=0.0001, learning_rate='constant', random_state=15, verbose=2)
```

In [54]:
```
importance = clf.coef_[0]
for i, j in enumerate(importance):
    print('Feature: %0d, Score: %.5f' % (i, j))


features = ['Feature 1', 'Feature 2', 'Feature 3']
plt.bar(features, clf.coef_[0])
```

```
Feature: 0, Score: 0.04249
Feature: 1, Score: 0.02585
Feature: 2, Score: 1.07273
```

Out[54]:
```
<BarContainer object of 3 artists>
```



Observations:

- Here, after standardizing our data, feature number 3 clearly has the highest correlation with other features and also variance. Hence, it is the most important feature for this task