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Lab 3 Comparison of MP Neuron and Perceptron

In [53]:
```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
from random import randint
from sklearn.metrics import accuracy_score
```

In [54]:
```
train_df = pd.read_csv("train.csv")
test_df = pd.read_csv("test.csv")
```

In [55]:
```
train_df.head(3)
```

Out[55]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S

In [56]:
```
train_df.shape
```

Out[56]:
```
(891, 12)
```

In [57]:
```
X = train_df.drop(columns=["Survived", "Name", "Sex", "Age", "Ticket", "Cabin", "Embarked"])
```

In [58]:
```
X.head()
```

Out[58]:

	PassengerId	Pclass	SibSp	Parch	Fare
0	1	3	1	0	7.2500
1	2	1	1	0	71.2833
2	3	3	0	0	7.9250
3	4	1	1	0	53.1000
4	5	3	0	0	8.0500

In [59]:
```
X.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 5 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   PassengerId  891 non-null    int64  
 1   Pclass       891 non-null    int64  
 2   SibSp        891 non-null    int64  
 3   Parch        891 non-null    int64  
 4   Fare         891 non-null    float64
dtypes: float64(1), int64(4)
memory usage: 34.9 KB
```

In [60]:
```
X.isnull().value_counts()
```

Out[60]:
```
PassengerId  Pclass  SibSp  Parch  Fare 
False        False   False  False  False    891
dtype: int64
```

In [61]:
```
y = train_df['Survived']
```

In [62]:
```
y.head()
```

Out[62]:
```
0    0
1    1
2    1
3    1
4    0
Name: Survived, dtype: int64
```

In [63]:
```
train_df.describe()
```

Out[63]:

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare
count	891.000000	891.000000	891.000000	714.000000	891.000000	891.000000	891.000000
mean	446.000000	0.383838	2.308642	29.699118	0.523008	0.381594	32.204208
std	257.353842	0.486592	0.836071	14.526497	1.102743	0.806057	49.693429
min	1.000000	0.000000	1.000000	0.420000	0.000000	0.000000	0.000000
25%	223.500000	0.000000	2.000000	20.125000	0.000000	0.000000	7.910400
50%	446.000000	0.000000	3.000000	28.000000	0.000000	0.000000	14.454200
75%	668.500000	1.000000	3.000000	38.000000	1.000000	0.000000	31.000000
max	891.000000	1.000000	3.000000	80.000000	8.000000	6.000000	512.329200

In [64]:
```
train_df['Survived'].value_counts()
```

Out[64]:
```
0    549
1    342
Name: Survived, dtype: int64
```

In [65]:
```
train_df.groupby('Survived').mean()
```

```
/var/folders/nd/q79n0hd51vqcq6swmwgkc95w0000gn/T/ipykernel_7680/2966032617.py:1: FutureWarning: The default val
ue of numeric_only in DataFrameGroupBy.mean is deprecated. In a future version, numeric_only will default to Fa
lse. Either specify numeric_only or select only columns which should be valid for the function.
  train_df.groupby('Survived').mean()
```

Out[65]:

Survived	PassengerId	Pclass	Age	SibSp	Parch	Fare
0	447.016393	2.531876	30.626179	0.553734	0.329690	22.117887
1	444.368421	1.950292	28.343690	0.473684	0.464912	48.395408

In [66]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.15, random_state=42)
```

In [67]:
```
print(X.shape, X_train.shape, X_test.shape)
```

```
(891, 5) (757, 5) (134, 5)
```

In [68]:
```
print(y.shape, y_train.shape, y_test.shape)
```

```
(891,) (757,) (134,)
```

In [69]:
```
print(y.mean(), y_train.mean(), y_test.mean())
```

```
0.3838383838383838 0.37780713342140027 0.417910447761194
```

In [70]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y,
                                                    test_size=0.15,
                                                    stratify = y,
                                                    random_state=42,
                                                    )
```

Stratify is used to return the equal proportions for the class labels of y

In [71]:
```
print(y.mean(), y_train.mean(), y_test.mean())
```

```
0.3838383838383838 0.3844121532364597 0.3805970149253731
```

In [72]:
```
print(X.mean(), X_train.mean(), X_test.mean())
```

```
PassengerId    446.000000
Pclass           2.308642
SibSp            0.523008
Parch            0.381594
Fare            32.204208
dtype: float64 PassengerId    444.726552
Pclass           2.305152
SibSp            0.505945
Parch            0.384412
Fare            31.612147
dtype: float64 PassengerId    453.194030
Pclass           2.328358
SibSp            0.619403
Parch            0.365672
Fare            35.548911
dtype: float64
```

In [73]:
```
x_binarised_train = X_train.apply(pd.cut, bins=2, labels=[1,0])
```

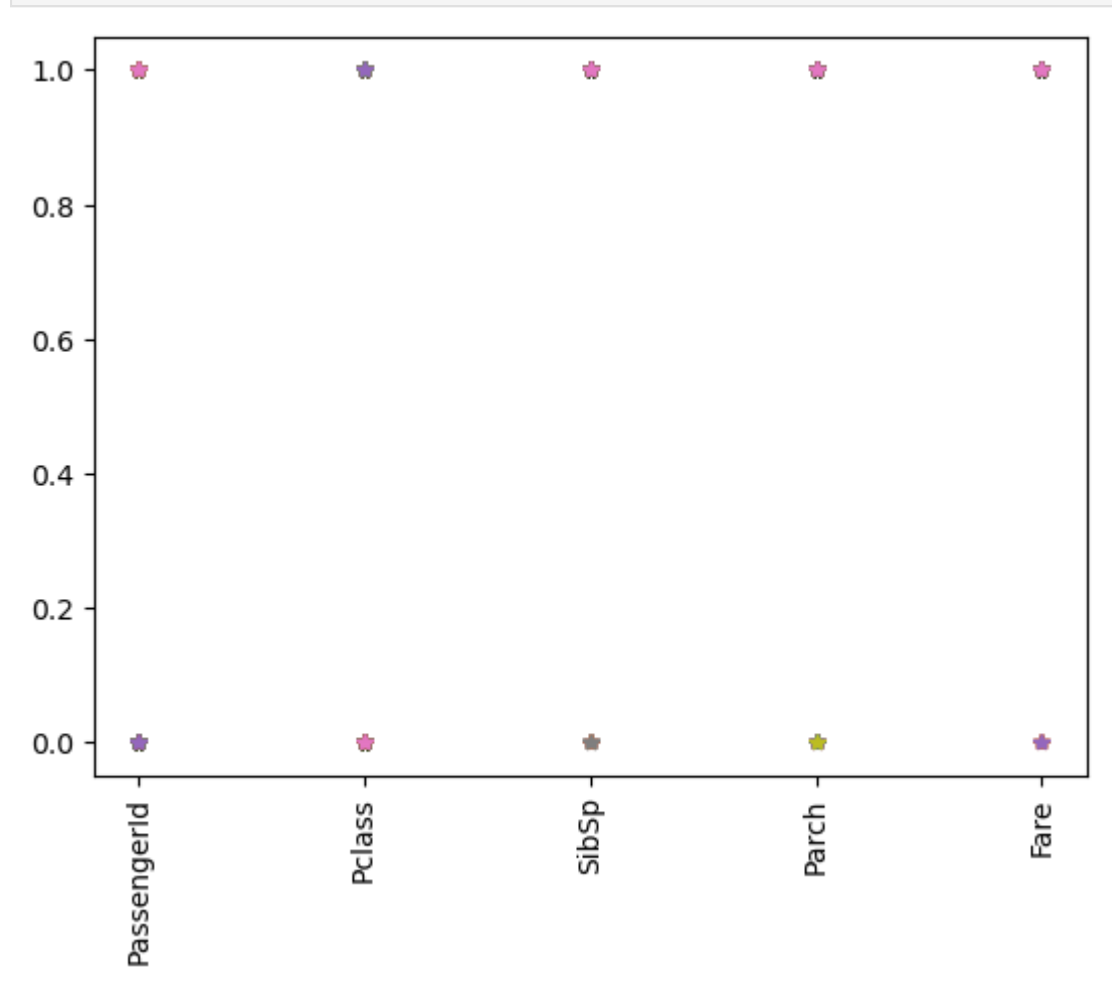
In [74]:
```
x_binarised_train
```

Out[74]:

	PassengerId	Pclass	SibSp	Parch	Fare
400	1	0	1	1	1
122	1	1	1	1	1
358	1	0	1	1	1
626	0	1	1	1	1
874	0	1	1	1	1
...	...	...	...	...	...
537	0	1	1	1	1
736	0	0	1	1	1
462	0	1	1	1	1
347	1	0	1	1	1
289	1	0	1	1	1

757 rows × 5 columns

In [75]:
```
plt.plot(x_binarised_train.T, '*')
plt.xticks(rotation='vertical')
plt.show()
```



In [76]:
```
x_binarised_test = X_test.apply(pd.cut, bins=2, labels=[1,0])
```

In [77]:
```
x_binarised_test = x_binarised_test.values
x_binarised_train = x_binarised_train.values
```

In [78]:
```
type(x_binarised_train), type(x_binarised_test)
```

Out[78]:
```
(numpy.ndarray, numpy.ndarray)
```

In [79]:
```
b = 3

i = randint(0, x_binarised_train.shape[0])

print("For row", i)

if (np.sum(x_binarised_train[100, :]) >= b):
    print("MP Neuron inference is Survived")
else:
    print("MP Neuron inference is Not Survived")

if (y_train[i] == 1):
    print("Ground Truth is Survived")
else:
    print("Ground truth is Not Survived")
```

```
For row 536
MP Neuron inference is Survived
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
File ~/enter/envs/dlenv/lib/python3.10/site-packages/pandas/core/indexes/base.py:3800, in Index.get_loc(self, k
ey, method, tolerance)
   3799 try:
-> 3800     return self._engine.get_loc(casted_key)
   3801 except KeyError as err:

File ~/enter/envs/dlenv/lib/python3.10/site-packages/pandas/_libs/index.pyx:138, in pandas._libs.index.IndexEng
ine.get_loc()

File ~/enter/envs/dlenv/lib/python3.10/site-packages/pandas/_libs/index.pyx:165, in pandas._libs.index.IndexEng
ine.get_loc()

File pandas/_libs/hashtable_class_helper.pxi:2263, in pandas._libs.hashtable.Int64HashTable.get_item()

File pandas/_libs/hashtable_class_helper.pxi:2273, in pandas._libs.hashtable.Int64HashTable.get_item()

KeyError: 536

The above exception was the direct cause of the following exception:

KeyError                                  Traceback (most recent call last)
/Users/selva/Documents/SEM-2/DL/lab/Lab2/main.ipynb Cell 28 in 1
      <a href='vscode-notebook-cell:/Users/selva/Documents/SEM-2/DL/lab/Lab2/main.ipynb#X36sZmlsZQ%3D%3D?line=
8'>9</a> else:
     <a href='vscode-notebook-cell:/Users/selva/Documents/SEM-2/DL/lab/Lab2/main.ipynb#X36sZmlsZQ%3D%3D?line=
9'>10</a>     print("MP Neuron inference is Not Survived")
---> <a href='vscode-notebook-cell:/Users/selva/Documents/SEM-2/DL/lab/Lab2/main.ipynb#X36sZmlsZQ%3D%3D?line=1
1'>12</a> if (y_train[i] == 1):
     <a href='vscode-notebook-cell:/Users/selva/Documents/SEM-2/DL/lab/Lab2/main.ipynb#X36sZmlsZQ%3D%3D?line=1
2'>13</a>     print("Ground Truth is Survived")
     <a href='vscode-notebook-cell:/Users/selva/Documents/SEM-2/DL/lab/Lab2/main.ipynb#X36sZmlsZQ%3D%3D?line=1
3'>14</a> else:

File ~/enter/envs/dlenv/lib/python3.10/site-packages/pandas/core/series.py:982, in Series.__getitem__(self, ke
y)
    979     return self._values[key]
    981 elif key_is_scalar:
--> 982     return self._get_value(key)
    984 if is_hashable(key):
    985     # Otherwise index.get_value will raise InvalidIndexError
    986     try:
    987         # For labels that don't resolve as scalars like tuples and frozensets

File ~/enter/envs/dlenv/lib/python3.10/site-packages/pandas/core/series.py:1092, in Series._get_value(self, lab
el, takeable)
   1089     return self._values[label]
   1091 # Similar to Index.get_value, but we do not fall back to positional
-> 1092 loc = self.index.get_loc(label)
   1093 return self.index._get_values_for_loc(self, loc, label)

File ~/enter/envs/dlenv/lib/python3.10/site-packages/pandas/core/indexes/base.py:3802, in Index.get_loc(self, k
ey, method, tolerance)
   3800     return self._engine.get_loc(casted_key)
   3801 except KeyError as err:
-> 3802     raise KeyError(key) from err
   3803 except TypeError:
   3804     # If we have a listlike key, _check_indexing_error will raise
   3805     #  InvalidIndexError. Otherwise we fall through and re-raise
   3806     #  the TypeError.
   3807     self._check_indexing_error(key)

KeyError: 536
```

In [80]:
```
b = 3

y_pred_train = []
accurate_rows = 0

for x, y in zip(x_binarised_train, y_train):
    y_pred = (np.sum(x) >= b)
    y_pred_train.append(y_pred)
    accurate_rows += (y == y_pred)

print(accurate_rows, accurate_rows/x_binarised_train.shape[0])
```

```
301 0.39762219286657857
```

In [82]:
```
for b in range(x_binarised_train.shape[1] + 1):
    y_pred_train = []
    accurate_rows = 0

    for x, y in zip(x_binarised_train, y_train):
        y_pred = (np.sum(x) >= b)
        y_pred_train.append(y_pred)
        accurate_rows += (y == y_pred)

    print(b, accurate_rows, accurate_rows/x_binarised_train.shape[0])
```

```
0 291 0.3844121532364597
1 291 0.3844121532364597
2 291 0.3844121532364597
3 301 0.39762219286657857
4 418 0.5521796565389696
5 477 0.6301188903566711
```

In [83]:
```
b = 6

y_pred_test = []

for x in x_binarised_test:
    y_pred = (np.sum(x) >= b)
    y_pred_test.append(y_pred)

accuracy = accuracy_score(y_pred_test, y_test)
print(b,accuracy)
```

```
6 0.6194029850746269
```

MP Neuron Model

In [84]:
```
class MPNeuron:

    def __init__(self):
        self.b = None

    def model(self, x):
        return(sum(x) >= self.b)

    def predict(self, X):
        Y = []
        for x in X:
            result = self.model(x)
            Y.append(result)
        return np.array(Y)

    def fit(self, X, Y):
        accuracy = {}

        for b in range(X.shape[1] + 1):
            self.b = b
            Y_pred = self.predict(X)
            accuracy[b] = accuracy_score(Y_pred, Y)

        best_b = max(accuracy,key = accuracy.get)
        self.b = best_b

        print('Optimal Value of  is', best_b)
        print('Highest accuracy is',accuracy[best_b])
```

In [85]:
```
mp_neuron = MPNeuron()
mp_neuron.fit(x_binarised_train, y_train)
```

```
Optimal Value of  is 5
Highest accuracy is 0.6301188903566711
```

In [86]:
```
Y_test_pred = mp_neuron.predict(x_binarised_test)
accuracy_test = accuracy_score(Y_test_pred, y_test)
```

In [87]:
```
print(accuracy_test)
```

```
0.6044776119402985
```

Perceptron Model

In [88]:
```
from sklearn.linear_model import Perceptron
```

In [89]:
```
perceptron = Perceptron()
perceptron.fit(x_binarised_train, y_train)
```

Out[89]:
```
▾ Perceptron
Perceptron()
```

In [90]:
```
y_prec_pred = perceptron.predict(x_binarised_test)
```

In [92]:
```
accuracy_test1 = accuracy_score(y_prec_pred, y_test)
accuracy_test1
```

Out[92]:
```
0.417910447761194
```

In [93]:
```
import numpy as np
#
# Perceptron implementation
#
class CustomPerceptron(object):

    def __init__(self, n_iterations=100, random_state=1, learning_rate=0.01):
        self.n_iterations = n_iterations
        self.random_state = random_state
        self.learning_rate = learning_rate

    def fit(self, X, y):
        rgen = np.random.RandomState(self.random_state)
        self.coef_ = rgen.normal(loc=0.0, scale=0.01, size=1 + X.shape[1])
        self.errors_ = []
        for _ in range(self.n_iterations):
            errors = 0
            for xi, expected_value in zip(X, y):
                predicted_value = self.predict(xi)
                self.coef_[1:] = self.coef_[1:] + self.learning_rate * (expected_value - predicted_value) * xi
                self.coef_[0] = self.coef_[0] + self.learning_rate * (expected_value - predicted_value) * 1
                update = self.learning_rate * (expected_value - predicted_value)
                errors += int(update != 0.0)
            self.errors_.append(errors)
    '''
    Net Input is sum of weighted input signals
    '''
    def net_input(self, X):
            weighted_sum = np.dot(X, self.coef_[1:]) + self.coef_[0]
            return weighted_sum

    '''
    Activation function is fed the net input and the unit step function
    is executed to determine the output.
    '''
    def activation_function(self, X):
            weighted_sum = self.net_input(X)
            return np.where(weighted_sum >= 0.0, 1, 0)

    '''
    Prediction is made on the basis of output of activation function
    '''
    def predict(self, X):
        return self.activation_function(X)

    '''
    Model score is calculated based on comparison of
    expected value and predicted value
    '''
    def score(self, X, y):
        misclassified_data_count = 0
        for xi, target in zip(X, y):
            output = self.predict(xi)
            if(target != output):
                misclassified_data_count += 1
        total_data_count = len(X)
        self.score_ = (total_data_count - misclassified_data_count)/total_data_count
        return self.score_
```

In [94]:
```
ppn = CustomPerceptron()
```

In [95]:
```
ppn.fit(x_binarised_train, y_train)
```

In [96]:
```
y_ppn_pred = perceptron.predict(x_binarised_test)
```

In [97]:
```
accuracy_test2 = accuracy_score(y_ppn_pred, y_test)
accuracy_test2
```

Out[97]:
```
0.417910447761194
```

Accuracy Comparison

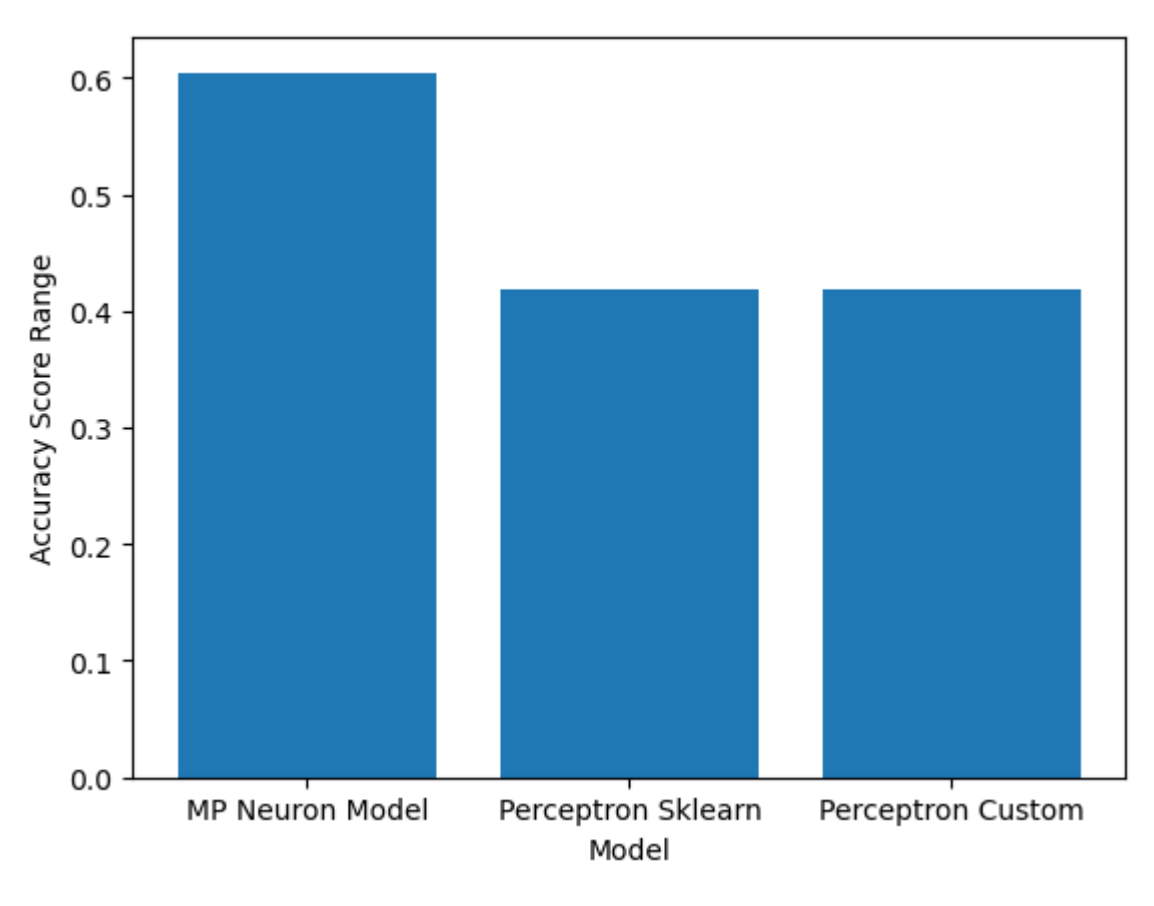
In [98]:
```
scores = [accuracy_test, accuracy_test1, accuracy_test2]
```

In [99]:
```
labels = ['MP Neuron Model', 'Perceptron Sklearn', 'Perceptron Custom']
```

In [101…
```
import matplotlib.pyplot as plt
```

In [108…
```
plt.bar(labels, scores)
plt.xlabel("Model")
plt.ylabel("Accuracy Score Range")
```

Out[108]:
```
Text(0, 0.5, 'Accuracy Score Range')
```



In [ ]: