Machine Learning is a subset of Artificial Intelligence which involves developing algorithms and models that allow computers to learn or make predictions.

Types of Machine Learning:

1. Supervised Learning : Labelled Data with a particular target
2. Unsupervised Learning : Unlabelled Data without any particular target
3. Reinforcement Learning : Trains using trial and error approach with feedbacks. 4.Deep Learning: Subset of ML. Used to create a neural network which can recogonize complex patterns.

In [1]:
```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.linear_model import Lasso
import matplotlib.pyplot as plt
import kagglehub
import os
from sklearn.metrics import r2_score
```

In [2]:
```
path = kagglehub.dataset_download("tylermorse/retail-business-sales-20172019")
print(os.listdir(path))
```

```
Downloading from https://www.kaggle.com/api/v1/datasets/download/tylermorse/ret
ail-business-sales-20172019?dataset_version_number=2...
100%|██████████| 10.7k/10.7k [00:00<00:00, 9.24MB/s]
Extracting files...
['business.retailsales2.csv', 'business.retailsales.csv']
```

In [3]:
```
csv_path = os.path.join(path, 'business.retailsales.csv')
df = pd.read_csv(csv_path)
df.head()
```

Out[3]:

	Product Type	Net Quantity	Gross Sales	Discounts	Returns	Total Net Sales
0	Art & Sculpture	34	14935.0	-594.00	-1609.0	12732.00
1	Basket	13	3744.0	-316.80	0.0	3427.20
2	Basket	12	3825.0	-201.60	-288.0	3335.40
3	Basket	17	3035.0	-63.25	0.0	2971.75
4	Art & Sculpture	47	2696.8	-44.16	0.0	2652.64

In [4]:
```
df.shape
```

Out[4]:
```
(1775, 6)
```

In [5]:
```
df.isnull().sum()
```

Out[5]:

	0
Product Type	8
Net Quantity	0
Gross Sales	0
Discounts	0
Returns	0
Total Net Sales	0

dtype: int64

In [6]:
```
df = df.drop('Product Type', axis=1)
```

In [7]:
```
x = df.iloc[:, :-1].values
y = df.iloc[:, -1].values
```

In [8]:
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3,random_state=
```

In [9]:
```
model=Lasso()
model.fit(x_train,y_train)
prediction=model.predict(x_test)
print(prediction)
print(y_test)
```

```
[8.64720730e+02 6.79976628e+01 7.56465528e+01 2.19936332e+02
 1.57590465e+02 7.19960488e+01 1.15978295e+02 2.36444633e+02
 1.74954489e+02 2.03942788e+02 6.00008907e+01 6.49988733e+01
 1.80178373e+01 2.80138024e+01 2.80138024e+01 2.88370525e+01
 5.57010979e+02 9.69334935e+01 7.59944348e+01 9.59863650e+01
 2.14151932e+02 1.40194513e+01 1.80178373e+01 4.80057326e+01
 2.12861131e+02 4.80057326e+01 6.12504989e+01 1.95032262e+02
 6.79976628e+01 5.85014959e+01 1.48586730e+02 1.09980716e+02
 1.34412124e+02 4.14422817e+01 2.95538241e+02 8.36237811e+01
 5.31245472e+02 3.80097675e+01 1.07217205e+02 1.18914114e+03
 3.38888317e+02 1.51780057e+02 1.87949244e+02 1.29223062e+02
 5.22368415e+01 1.67663553e+02 2.10043498e+02 1.44966594e+02
 5.80016977e+01 2.24559522e+02 4.86452698e+01 8.34262277e+02
 6.66527400e+01 2.71915351e+02 1.02667680e+02 4.28933034e+02
 4.91385706e+02 9.88972065e+01 2.29932297e+02 1.57590465e+02
 3.57875361e+01 1.31971839e+02 5.80016977e+01 7.79936279e+01
 1.44966594e+02 2.40154164e+01 1.34621775e+03 1.69405368e+02
 4.80057326e+01 5.40033117e+01 2.76002135e+02 4.80057326e+01
 3.06377996e+01 6.79976628e+01 5.49803180e+02 1.43966997e+02
 3.60105745e+01 1.17073657e+02 1.66594200e+02 1.51963770e+02
 4.18244406e+01 1.44966594e+02 3.32519854e+02 4.80057326e+01
 1.80178373e+01 1.84950454e+02 2.03647599e+02 6.96146969e+01
 1.80178373e+01 3.09900018e+02 7.49948383e+01 1.48237945e+02
 1.59960542e+02 1.84950454e+02 6.79976628e+01 3.41887106e+02
 1.64958524e+02 1.75954086e+02 2.50150129e+01 1.44966594e+02
 1.24974664e+02 6.79976628e+01 2.98608695e+02 3.48399442e+02
 1.48586730e+02 8.99887860e+01 9.79855580e+01 1.80178373e+01
 2.20162234e+01 8.75082110e+01 1.09980716e+02 1.74954489e+02
 1.74954489e+02 1.58446639e+02 1.49964576e+02 5.94497519e+01
 1.84950454e+02 3.69875808e+02 5.40033117e+01 3.08062889e+02
 2.35289229e+01 4.56407230e-02 1.74954489e+02 9.86103622e+01
 2.11204708e+02 2.43926648e+02 1.86232084e+02 2.80138024e+01
 3.14898000e+02 2.19936332e+02 9.89625644e+02 6.12504989e+01
 1.54962559e+02 3.00129955e+01 4.80057326e+01 4.40073466e+01
 4.80057326e+01 1.76360599e+02 1.60186443e+01 1.74954489e+02
 7.36970823e+02 1.11505894e+02 1.80178373e+01 7.82060705e+02
 8.51722967e+02 1.74954489e+02 1.59960542e+02 1.18205400e+02
 1.91947630e+02 1.97195624e+02 1.34970629e+02 1.27606027e+02
 2.40154164e+01 2.27933104e+02 4.40073466e+01 7.66261452e+02
 1.05208635e+01 3.97560870e+02 1.40194513e+01 5.45033351e+01
 5.60025047e+01 1.39968611e+02 3.60105745e+01 9.12236611e+01
 2.16340645e+01 1.35970225e+02 1.18304824e+03 6.46240809e+01
 6.74978645e+01 2.40154164e+01 1.80178373e+01 7.83934665e+01
 3.80097675e+01 6.04722506e+02 8.79895930e+01 1.84950454e+02
 7.19960488e+01 6.38155638e+01 6.59984698e+01 4.10330226e+02
 5.60025047e+01 1.97945209e+02 1.66594200e+02 1.29223062e+02
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 8.82617043e+01 1.10741822e+03 6.12504989e+01 1.21613259e+02
 5.22172977e+01 4.32430287e+01 9.19879790e+01 6.25182983e+01
 3.72494995e+02 8.99887860e+01 2.20162234e+01 8.99887860e+01
 1.02960950e+03 1.24974664e+02 5.80016977e+01 1.84950454e+02
 3.51883071e+02 6.79976628e+01 8.19920139e+01 8.99887860e+01
 8.90313347e+02 5.60025047e+01 1.48193296e+02 3.60105745e+01
 1.14033224e+02 6.39992767e+01 1.80178373e+01 5.60025047e+01
```

3.80097675e+01 3.20121885e+01 5.21814478e+02 2.91194592e+02
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2.80138024e+01 6.59984698e+01 1.86212240e+02 1.95946016e+02
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1.03568054e+02 2.84910105e+02 5.80016977e+01 3.07820243e+02
4.40073466e+01 1.44966594e+02 8.99887860e+01 1.09980716e+02
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1.03223741e+03 6.03009321e+02 2.72415374e+02 5.40033117e+01
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3.60105745e+01 3.60105745e+01 3.20121885e+01 1.48435941e+02
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 5.80016977e+01 9.18042661e+01 2.78685064e+02 4.57774453e+02
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 4.05319859e+01 2.40104481e+02 3.56573011e+02 3.40113815e+01
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 5.62304168e+01 2.60146094e+01 3.60105745e+01 4.32430287e+01
 3.06377996e+01 6.79976628e+01 1.24974664e+02 2.40154164e+01
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 8.39912069e+01 3.13178285e+02 8.12129630e+01 1.10067618e+02
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 1.44966594e+02 1.66594200e+02 1.67957314e+02 7.34376292e+02
 1.49964576e+02 1.98107273e+02 3.40113815e+01 6.99742656e+02
 3.40113815e+01]
[ 864.8    68.     75.59  220.    157.5    72.    116.    236.4   175.
  204.     60.     65.     18.     28.     28.     28.8   557.19   96.91
   76.     96.    214.2    14.     18.     48.    212.81   48.     61.2
  194.99   68.     58.5   148.5   110.    134.4    41.4   295.6    83.6
  531.     38.    107.2  1189.4   339.    151.8   188.    129.2    52.19
  167.6   210.    145.     58.    224.6    48.6   834.4    66.6   272.
  102.6   429.    491.4    98.8   230.    157.5    35.75  132.     58.
   78.    145.     24.   1346.4   169.4    48.     54.    276.     48.
   30.6    68.    550.    144.     36.    117.    166.5   152.     41.8
  145.    332.5    48.     18.    185.    203.58   69.6    18.    310.
   75.    148.    160.    185.     68.    342.    165.    176.     25.
  145.    125.     68.    298.59  348.4   148.5    90.     98.     18.
   22.     87.5   110.    175.    175.    158.4   150.     59.4   185.
  370.     54.    308.     23.48    0.    175.     98.6   211.2   244.
  186.21   28.    315.    220.    990.     61.2   155.     30.     48.
   44.     48.    176.38   16.    175.    737.    111.5    18.    782.
  851.5   175.    160.    118.2   192.    197.2   135.    127.6    24.
  228.     44.    766.52   10.5   397.59   14.     54.4    56.    140.
   36.     91.2    21.6   136.   1183.2    64.6    67.5    24.     18.
   78.4    38.    604.8    88.    185.     72.     63.8    66.    410.4
   56.    198.    166.5   129.2    18.     83.6   120.    166.     88.2
 1107.49   61.2   121.59   52.2    43.2    92.     62.5   372.61   90.
   22.     90.   1030.    125.     58.    185.    352.     68.     82.
   90.    890.4    56.    148.2    36.    114.01   64.     18.     56.
   38.     32.    522.    291.2   264.    115.     18.    204.     42.
   28.     34.    121.51  165.     44.     38.     38.     28.     58.
   32.     32.     48.     81.     69.6    34.     62.     98.    251.69
  857.5   185.    204.    123.2   520.     28.     34.84   38.     28.
```

```
 52.2   251.6   200.     72.     28.     66.    186.19  196.     43.2
 39.6    54.4    39.    216.    116.    158.     23.41  103.5   285.
 58.    307.8    44.    145.     90.    110.    148.2    56.    818.4
 14.    288.    957.     49.35   30.4   166.5    56.    185.     28.
 44.    185.     34.    144.    127.4    88.    225.     79.2    54.
472.71   58.    145.     23.4   173.6   187.2    34.    273.68  372.8
120.    305.5    44.     19.8    50.4   116.     46.8    58.     96.
 48.     48.    296.     27.2    36.54  187.2    79.8   182.     66.39
139.2   145.     28.    132.     18.     28.8   406.8   175.    180.
102.    248.     22.    111.59   48.    130.5   153.6    96.     63.8
110.    166.5     0.     88.    157.51  396.     60.    165.      0.
 79.2   122.4   186.2    34.     72.83  350.   1516.83  279.8   110.
134.     44.     18.     68.     72.     34.     56.    350.    126.
 36.     80.    136.32   64.8    32.    130.6    64.8   149.6    18.
 91.79  240.    925.     88.     31.    106.   1032.5   603.    272.4
 54.    210.    585.     14.    565.     84.     13.5   104.4   125.
 70.     36.    125.     28.8    48.    507.5    34.    185.     43.2
 89.1    28.    174.     18.     90.    145.    185.     66.6    18.
 43.2    56.     87.2    95.2    68.    189.     36.     36.     32.
148.4    16.2    44.    328.5   319.     54.     34.     44.    421.2
 58.     91.8   278.6   457.8    72.    103.5   124.    128.     40.49
240.    356.4    34.    240.    115.2   879.     88.      0.     64.
 58.     78.     28.     98.8    42.    172.4    74.    175.    116.
332.8   104.4   264.59  157.5    38.    148.    207.6   145.    156.6
 56.2    26.     36.     43.2    30.6    68.    125.     24.     28.88
124.8    18.     18.     99.    112.5   136.8   259.     18.     24.
 77.2    34.     30.     72.2   110.2    58.    271.2    42.     24.
209.     84.    313.2    81.2   110.     34.6    18.     48.     55.1
 48.    347.6    68.4    28.8    36.    174.    891.     34.2    38.1
 39.6   204.     46.    164.     81.6    38.     68.     14.4    48.
528.     66.    145.    166.5   168.    734.4   150.    198.     34.
700.     34.  ]
```

In [10]:
```
r2 = r2_score(y_test, prediction)
print("R² Score:", r2)
```

```
R² Score: 0.9999998935727327
```

In [11]:
```
plt.scatter(y_test, prediction, color='blue')
plt.plot([y_test.min(), y_test.max()], [y_test.min(), y_test.max()], 'r--')
plt.xlabel('Gross Sales')
plt.ylabel('Total Net Sales')
plt.title('Gross Sales vs Net Sales (Training Data)')
plt.show()
```


Gross Sales vs Net Sales (Training Data)
Total Net Sales
Gross Sales
0
200
400
600
800
1000
1200
1400