lab03_partA

September 16, 2024

[25]:

```
import pandas as pd
```

[26]:

```
housing = pd.read_csv('housing.csv')
housing.head()
```

[26]:

```
   longitude  latitude  housing_median_age  total_rooms  total_bedrooms  \
0    -122.23     37.88                41.0        880.0           129.0
1    -122.22     37.86                21.0       7099.0          1106.0
2    -122.24     37.85                52.0       1467.0           190.0
3    -122.25     37.85                52.0       1274.0           235.0
4    -122.25     37.85                52.0       1627.0           280.0

   population  households  median_income  median_house_value
0       322.0       126.0         8.3252            452600.0
1      2401.0      1138.0         8.3014            358500.0
2       496.0       177.0         7.2574            352100.0
3       558.0       219.0         5.6431            341300.0
4       565.0       259.0         3.8462            342200.0
```

[27]:

```
housing.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20640 entries, 0 to 20639
Data columns (total 9 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   longitude           20640 non-null  float64
 1   latitude            20640 non-null  float64
 2   housing_median_age  20640 non-null  float64
 3   total_rooms         20640 non-null  float64
 4   total_bedrooms      20433 non-null  float64
 5   population          20640 non-null  float64
 6   households          20640 non-null  float64
 7   median_income       20640 non-null  float64
 8   median_house_value  20640 non-null  float64
dtypes: float64(9)
memory usage: 1.4 MB
```

[28]:

```
housing.describe()
```

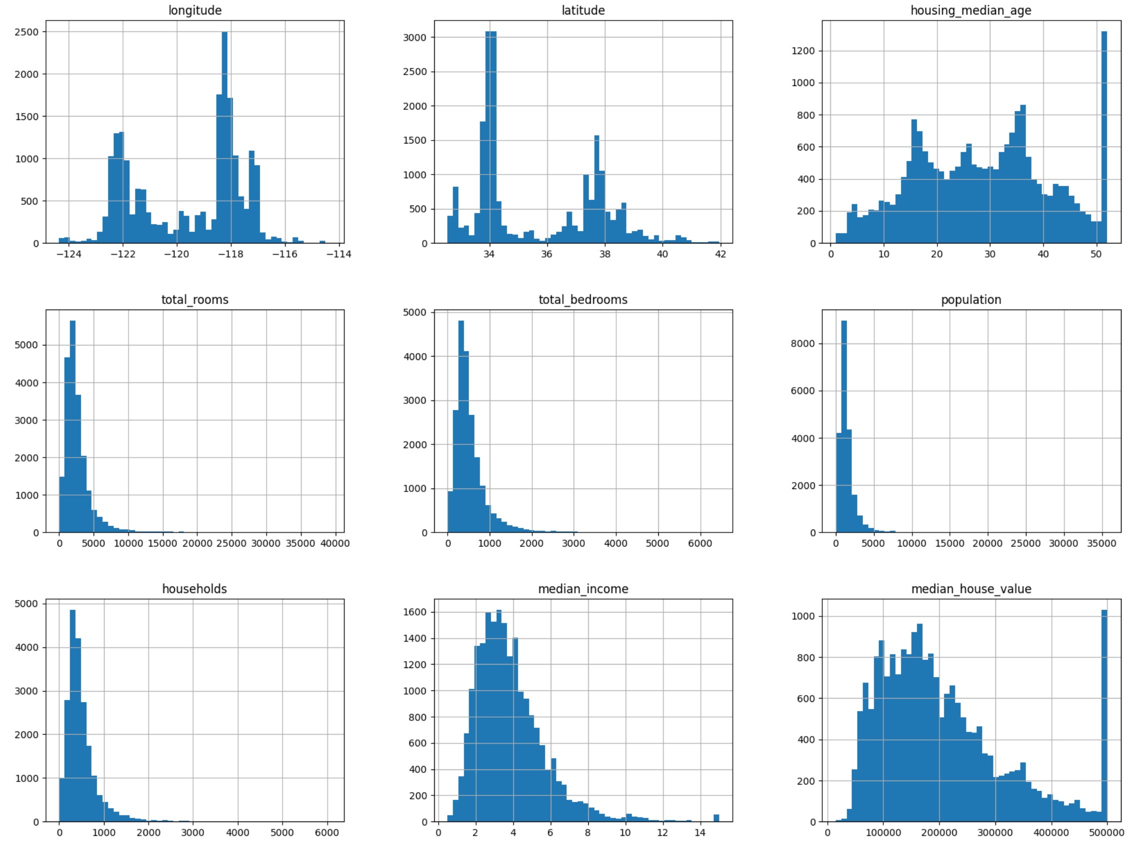
[28]:

```
          longitude      latitude  housing_median_age   total_rooms  \
count  20640.000000  20640.000000        20640.000000  20640.000000
mean    -119.569704     35.631861           28.639486   2635.763081
std        2.003532      2.135952           12.585558   2181.615252
min     -124.350000     32.540000            1.000000      2.000000
25%     -121.800000     33.930000           18.000000   1447.750000
50%     -118.490000     34.260000           29.000000   2127.000000
75%     -118.010000     37.710000           37.000000   3148.000000
max     -114.310000     41.950000           52.000000  39320.000000

       total_bedrooms    population    households  median_income  \
count    20433.000000  20640.000000  20640.000000   20640.000000
mean       537.870553   1425.476744    499.539680       3.870671
std        421.385070   1132.462122    382.329753       1.899822
min          1.000000      3.000000      1.000000       0.499900
25%        296.000000    787.000000    280.000000       2.563400
50%        435.000000   1166.000000    409.000000       3.534800
75%        647.000000   1725.000000    605.000000       4.743250
max       6445.000000  35682.000000   6082.000000      15.000100

       median_house_value
count        20640.000000
mean        206855.816909
std         115395.615874
min          14999.000000
25%         119600.000000
50%         179700.000000
75%         264725.000000
max         500001.000000
```

0.1 Question 3

[29]:

```
%matplotlib inline
import matplotlib.pyplot as plt
housing.hist(bins=50, figsize=(20,15))
plt.show()
```



0.2 Question 4

[30]:
```
# to make this notebook's output identical and reproducible at every run, we␣
 ↪need set seed
import numpy as np
np.random.seed(10)
```

[31]:
```
# For illustration only. Sklearn has train_test_split()
def split_train_test(data, test_ratio):
    shuffled_indices = np.random.permutation(len(data))
    test_set_size = int(len(data) * test_ratio)
    test_indices = shuffled_indices[:test_set_size]
    train_indices = shuffled_indices[test_set_size:]
    return data.iloc[train_indices], data.iloc[test_indices]
```

[32]:
```
# run the function to get the train & test set
train_set, test_set = split_train_test(housing, 0.2)
```

[33]:
```
train_samples = train_set.shape[0]
test_samples = test_set.shape[0]
```

```
print(f"Number of samples in train_set: {train_samples}")
print(f"Number of samples in test_set: {test_samples}")
print(f"Total samples: {train_samples + test_samples}")

total_samples = housing.shape[0]
print(f"Total samples in the housing dataset: {total_samples}")

assert train_samples + test_samples == total_samples, "The total samples do not␣
 ↪match!"
```

```
Number of samples in train_set: 16512
Number of samples in test_set: 4128
Total samples: 20640
Total samples in the housing dataset: 20640
```

[34]:

```
%pip install sklearn
```

```
Collecting sklearn
  Using cached sklearn-0.0.post12.tar.gz (2.6 kB)
  Preparing metadata (setup.py): started
  Preparing metadata (setup.py): finished with status 'error'
Note: you may need to restart the kernel to use updated packages.

  error: subprocess-exited-with-error

  × python setup.py egg_info did not run successfully.
    exit code: 1
   > [15 lines of output]
      The 'sklearn' PyPI package is deprecated, use 'scikit-learn'
      rather than 'sklearn' for pip commands.

      Here is how to fix this error in the main use cases:
      - use 'pip install scikit-learn' rather than 'pip install sklearn'
      - replace 'sklearn' by 'scikit-learn' in your pip requirements files
        (requirements.txt, setup.py, setup.cfg, Pipfile, etc …)
      - if the 'sklearn' package is used by one of your dependencies,
        it would be great if you take some time to track which package uses
        'sklearn' instead of 'scikit-learn' and report it to their issue tracker
      - as a last resort, set the environment variable
        SKLEARN_ALLOW_DEPRECATED_SKLEARN_PACKAGE_INSTALL=True to avoid this
error

      More information is available at
      https://github.com/scikit-learn/sklearn-pypi-package
      [end of output]

  note: This error originates from a subprocess, and is likely not a problem
with pip.
```

```
error: metadata-generation-failed

× Encountered error while generating package metadata.
 > See above for output.

note: This is an issue with the package mentioned above, not pip.
hint: See above for details.

[notice] A new release of pip is available: 24.1.2 -> 24.2
[notice] To update, run: python.exe -m pip install --upgrade pip
```

[35]:

```
from sklearn.model_selection import train_test_split
train_set, test_set = train_test_split(housing, test_size=0.2, random_state=10)
```

[36]:

```
train_set[train_set.isna().any(axis=1)]
```

[36]:

```
       longitude  latitude  housing_median_age  total_rooms  total_bedrooms  \
6814     -118.07     34.10                32.0       4275.0             NaN
4738     -118.38     34.05                49.0        702.0             NaN
290      -122.16     37.77                47.0       1256.0             NaN
19833    -119.38     36.53                38.0       1281.0             NaN
4852     -118.31     34.03                47.0       1315.0             NaN
…            …         …                  …          …              …
11512    -118.10     33.74                32.0       2035.0             NaN
13656    -117.30     34.05                 6.0       2155.0             NaN
13015    -121.19     38.71                11.0       4415.0             NaN
10236    -117.92     33.87                33.0       1597.0             NaN
14521    -117.14     32.90                16.0       3217.0             NaN

       population  households  median_income  median_house_value
6814       2812.0      1012.0         3.3512            214100.0
4738        458.0       187.0         4.8958            333600.0
290         570.0       218.0         4.3750            161900.0
19833      1423.0       293.0         1.9602             51400.0
4852        785.0       245.0         1.2300            138400.0
…             …         …             …                 …
11512       934.0       512.0         4.2287            500001.0
13656      1039.0       391.0         1.6675             95800.0
13015      1520.0       627.0         3.2321            390800.0
10236      1888.0       423.0         3.0550            157800.0
14521      2054.0       687.0         4.2234            162100.0

[166 rows x 9 columns]
```

[37]:

```
train_set_clean = train_set.dropna(subset=["total_bedrooms"])
train_set_clean
```

[37]:

```
       longitude  latitude  housing_median_age  total_rooms  total_bedrooms  \
12346    -116.52     33.82                21.0      10227.0          2315.0
19326    -122.94     38.50                46.0       2280.0           492.0
16824    -122.49     37.63                31.0       3109.0           621.0
6869     -118.11     34.06                16.0       2416.0           565.0
16677    -120.66     35.13                41.0       2666.0           751.0
…            …        …                  …           …              …
9372     -122.53     37.93                37.0       1722.0           352.0
7291     -118.22     33.98                18.0       1781.0           765.0
17728    -121.79     37.32                 6.0       2850.0           561.0
7293     -118.23     33.98                35.0       1366.0           496.0
17673    -121.88     37.30                16.0       2692.0           749.0

       population  households  median_income  median_house_value
12346      3623.0      1734.0         2.5212            145200.0
19326       807.0       366.0         2.6316            117000.0
16824      1472.0       618.0         5.1550            263900.0
6869       1750.0       514.0         2.8229            163700.0
16677       940.0       507.0         1.9653            236100.0
…             …          …             …                  …
9372        648.0       337.0         4.1250            310300.0
7291       1913.0       702.0         1.2059            255000.0
17728      2160.0       581.0         5.5336            241900.0
7293       2160.0       497.0         2.2059            150000.0
17673      1674.0       681.0         2.6763            191100.0

[16346 rows x 9 columns]
```

[38]:

```
train_labels = train_set_clean["median_house_value"].copy() # get labels for␣
↪output label Y
train_features = train_set_clean.drop("median_house_value", axis=1) # drop␣
↪labels to get features X for training set
```

0.3 Question 8

Task 1

[39]:

```
train_features.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 16346 entries, 12346 to 17673
Data columns (total 8 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   longitude           16346 non-null  float64
 1   latitude            16346 non-null  float64
 2   housing_median_age  16346 non-null  float64
 3   total_rooms         16346 non-null  float64
 4   total_bedrooms      16346 non-null  float64
 5   population          16346 non-null  float64
 6   households          16346 non-null  float64
 7   median_income       16346 non-null  float64
dtypes: float64(8)
memory usage: 1.1 MB
```

Task 2

[40]:

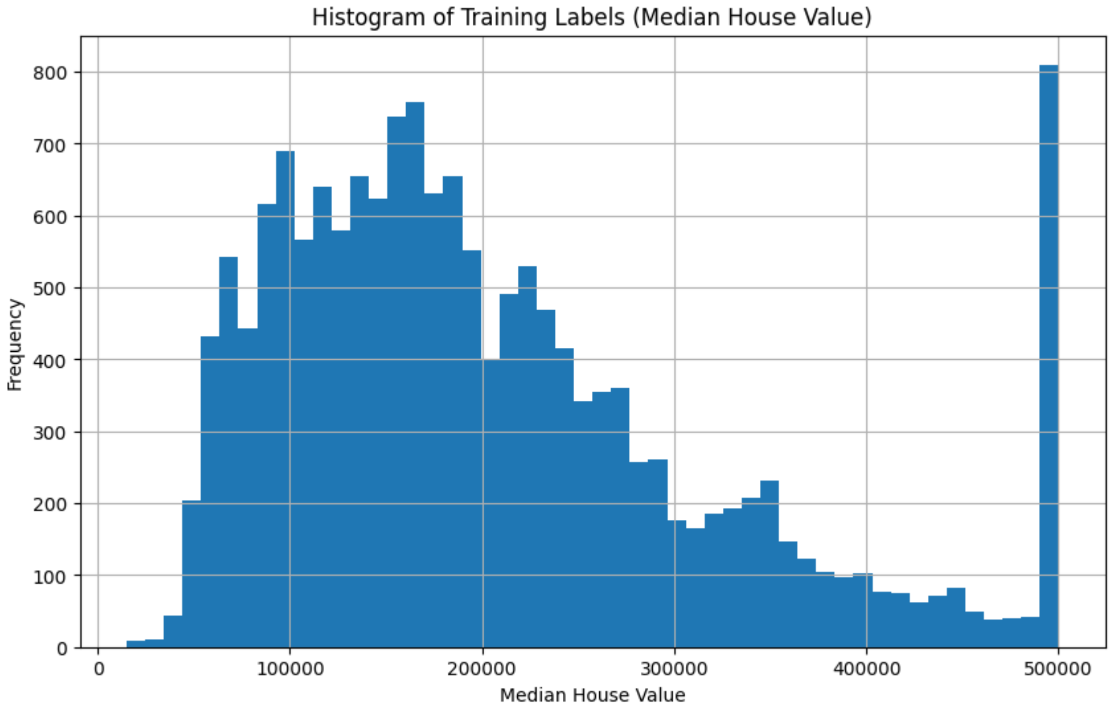
```
print(f"Shape of train_features: {train_features.shape}")

print("Missing values in train_features:")
print(train_features.isnull().sum())

print("Statistics summary of train_features:")
print(train_features.describe())
```

```
Shape of train_features: (16346, 8)
Missing values in train_features:
longitude             0
latitude              0
housing_median_age    0
total_rooms           0
total_bedrooms        0
population            0
households            0
median_income         0
dtype: int64
Statistics summary of train_features:
          longitude      latitude  housing_median_age   total_rooms  \
count  16346.000000  16346.000000        16346.000000  16346.000000
mean    -119.576731     35.639888           28.606265   2630.196745
std        2.006389      2.139648           12.632219   2158.731496
min     -124.350000     32.540000            1.000000      2.000000
25%     -121.800000     33.930000           18.000000   1451.000000
50%     -118.500000     34.260000           29.000000   2125.500000
75%     -118.010000     37.720000           37.000000   3137.000000
max     -114.310000     41.950000           52.000000  39320.000000

       total_bedrooms    population    households  median_income
count    16346.000000  16346.000000  16346.000000   16346.000000
mean       537.625413   1425.149456    498.992659       3.864135
std        418.511077   1136.460782    378.999712       1.892231
min          1.000000      3.000000      1.000000       0.499900
25%        296.000000    785.000000    279.000000       2.559275
50%        435.000000   1165.500000    409.000000       3.533800
75%        647.000000   1728.000000    605.000000       4.739900
max       6445.000000  35682.000000   6082.000000      15.000100
```

[41]:

```
print(train_labels.head())

import matplotlib.pyplot as plt

train_labels.hist(bins=50, figsize=(10, 6))
plt.xlabel("Median House Value")
plt.ylabel("Frequency")
plt.title("Histogram of Training Labels (Median House Value)")
plt.show()
```

```
12346    145200.0
19326    117000.0
16824    263900.0
6869     163700.0
16677    236100.0
Name: median_house_value, dtype: float64
```

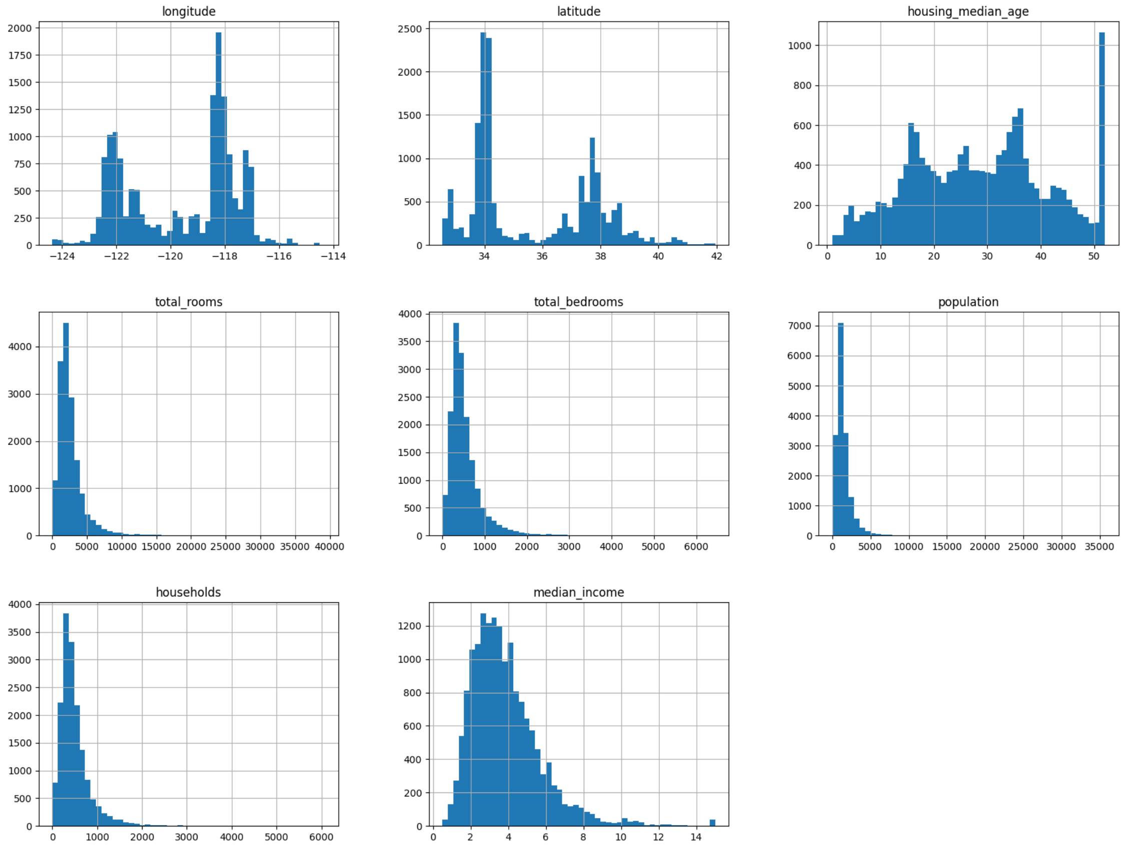


[42]:

```
train_features.hist(bins=50, figsize=(20,15))
```

[42]:

```
array([[<Axes: title={'center': 'longitude'}>,
        <Axes: title={'center': 'latitude'}>,
        <Axes: title={'center': 'housing_median_age'}>],
       [<Axes: title={'center': 'total_rooms'}>,
        <Axes: title={'center': 'total_bedrooms'}>,
        <Axes: title={'center': 'population'}>],
       [<Axes: title={'center': 'households'}>,
        <Axes: title={'center': 'median_income'}>, <Axes: >]],
      dtype=object)
```



[43]:
```
train_features.describe()
```

[43]:
```
          longitude      latitude  housing_median_age   total_rooms  \
count  16346.000000  16346.000000        16346.000000  16346.000000
mean    -119.576731     35.639888           28.606265   2630.196745
std        2.006389      2.139648           12.632219   2158.731496
min     -124.350000     32.540000            1.000000      2.000000
25%     -121.800000     33.930000           18.000000   1451.000000
50%     -118.500000     34.260000           29.000000   2125.500000
75%     -118.010000     37.720000           37.000000   3137.000000
max     -114.310000     41.950000           52.000000  39320.000000

       total_bedrooms    population    households  median_income
count    16346.000000  16346.000000  16346.000000   16346.000000
mean       537.625413   1425.149456    498.992659       3.864135
```

```
std        418.511077   1136.460782    378.999712       1.892231
min          1.000000      3.000000      1.000000       0.499900
25%        296.000000    785.000000    279.000000       2.559275
50%        435.000000   1165.500000    409.000000       3.533800
75%        647.000000   1728.000000    605.000000       4.739900
max       6445.000000  35682.000000   6082.000000      15.000100
```

[44]:
```python
from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler() ## define the transformer
scaler.fit(train_features) ## call .fit() method to calculate the min and max value for each column in datas
```

[44]:
```
MinMaxScaler()
```

[45]:
```python
print("Min of each column: ",scaler.data_min_)
print("Max of each column: ",scaler.data_max_)
```

```
Min of each column:  [-124.35     32.54      1.         2.         1.         3.
1.
    0.4999]
Max of each column:  [-1.14310e+02  4.19500e+01  5.20000e+01  3.93200e+04
6.44500e+03
  3.56820e+04  6.08200e+03  1.50001e+01]
```

[46]:
```python
train_features_normalized = scaler.transform(train_features)
train_features_normalized
```

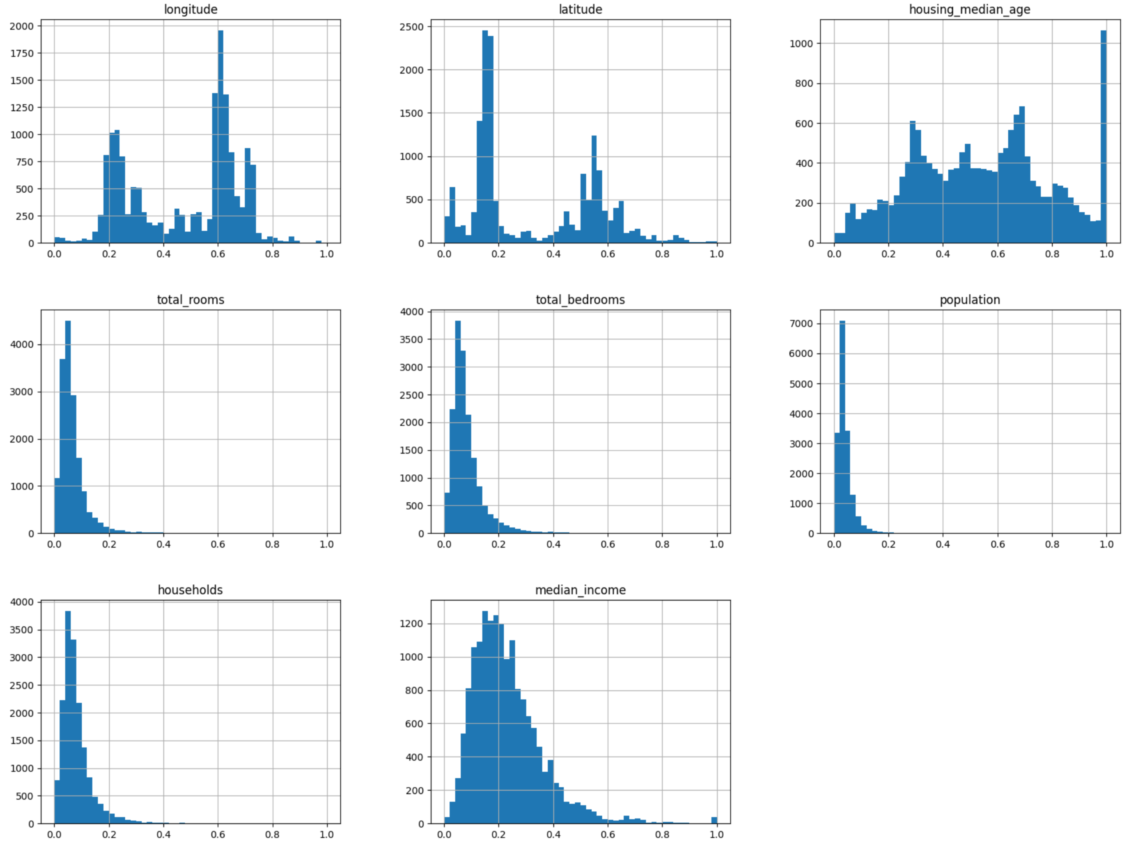
[46]:
```
array([[0.77988048, 0.1360255 , 0.39215686, …, 0.10146024, 0.28498602,
        0.13939808],
       [0.14043825, 0.63336876, 0.88235294, …, 0.02253426, 0.06002302,
        0.14701177],
       [0.18525896, 0.54091392, 0.58823529, …, 0.04117268, 0.10146358,
        0.32103695],
       …,
       [0.25498008, 0.50797024, 0.09803922, …, 0.06045573, 0.09537905,
        0.34714694],
       [0.60956175, 0.15302869, 0.66666667, …, 0.06045573, 0.08156553,
        0.11765355],
       [0.24601594, 0.50584485, 0.29411765, …, 0.04683427, 0.11182371,
        0.15009448]])
```

0.4 Question 9

Task 1

[48]:
```python
# Assuming train_features_normalized is your normalized dataset

import matplotlib.pyplot as plt
import pandas as pd
```

```
# Convert the normalized NumPy array back to a DataFrame for plotting
normalized_df = pd.DataFrame(train_features_normalized, columns=train_features.
 ↪columns)

# Plot histograms for each normalized feature
normalized_df.hist(bins=50, figsize=(20, 15))
plt.show()
```


longitude
latitude
housing_median_age
total_rooms
total_bedrooms
population
households
median_income