In [1]:

```
from __future__ import division, print_function, unicode_literals

# Common imports
import numpy as np
import os

# to make this notebook's output stable across runs
np.random.seed(42)

# To plot pretty figures
%matplotlib inline
import matplotlib as mpl
import matplotlib.pyplot as plt
mpl.rc('axes', labelsize=14)
mpl.rc('xtick', labelsize=12)
mpl.rc('ytick', labelsize=12)

# Where to save the figures
PROJECT_ROOT_DIR = "."
CHAPTER_ID = "end_to_end_project"
IMAGES_PATH = os.path.join(PROJECT_ROOT_DIR, "images", CHAPTER_ID)

def save_fig(fig_id, tight_layout=True, fig_extension="png", resolution=300):
    path = os.path.join(IMAGES_PATH, fig_id + "." + fig_extension)
    print("Saving figure", fig_id)
    if tight_layout:
        plt.tight_layout()
    plt.savefig(path, format=fig_extension, dpi=resolution)

# Ignore useless warnings (see SciPy issue #5998)
import warnings
warnings.filterwarnings(action="ignore", message="^internal gelsd")
```

In [2]:

```
import os
import tarfile
from six.moves import urllib

DOWNLOAD_ROOT = "https://raw.githubusercontent.com/ageron/handson-ml/master/"
HOUSING_PATH = os.path.join("datasets", "housing")
HOUSING_URL = DOWNLOAD_ROOT + "datasets/housing/housing.tgz"

def fetch_housing_data(housing_url=HOUSING_URL, housing_path=HOUSING_PATH):
    os.makedirs(housing_path, exist_ok=True)
    tgz_path = os.path.join(housing_path, "housing.tgz")
    urllib.request.urlretrieve(housing_url, tgz_path)
    housing_tgz = tarfile.open(tgz_path)
    housing_tgz.extractall(path=housing_path)
    housing_tgz.close()
```

In [3]:

```
fetch_housing_data()
```

In [4]:

```
import pandas as pd

def load_housing_data(housing_path=HOUSING_PATH):
    csv_path = os.path.join(housing_path, "housing.csv")
    return pd.read_csv(csv_path)
```

In [5]:
```
housing = load_housing_data()
housing.head()
```

Out[5]:

	longitude	latitude	housing_median_age	total_rooms	total_bedrooms	population	households	median_in
0	-122.23	37.88	41.0	880.0	129.0	322.0	126.0	8
1	-122.22	37.86	21.0	7099.0	1106.0	2401.0	1138.0	8
2	-122.24	37.85	52.0	1467.0	190.0	496.0	177.0	7
3	-122.25	37.85	52.0	1274.0	235.0	558.0	219.0	5
4	-122.25	37.85	52.0	1627.0	280.0	565.0	259.0	3

In [6]:

```
housing.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20640 entries, 0 to 20639
Data columns (total 10 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
 9   ocean_proximity     20640 non-null  object 
dtypes: float64(9), object(1)
memory usage: 1.6+ MB
```

In [7]:

```
housing["ocean_proximity"].value_counts()
```

Out[7]:

```
<1H OCEAN     9136
INLAND        6551
NEAR OCEAN    2658
NEAR BAY      2290
ISLAND           5
Name: ocean_proximity, dtype: int64
```

In [8]:
```
housing.describe()
```

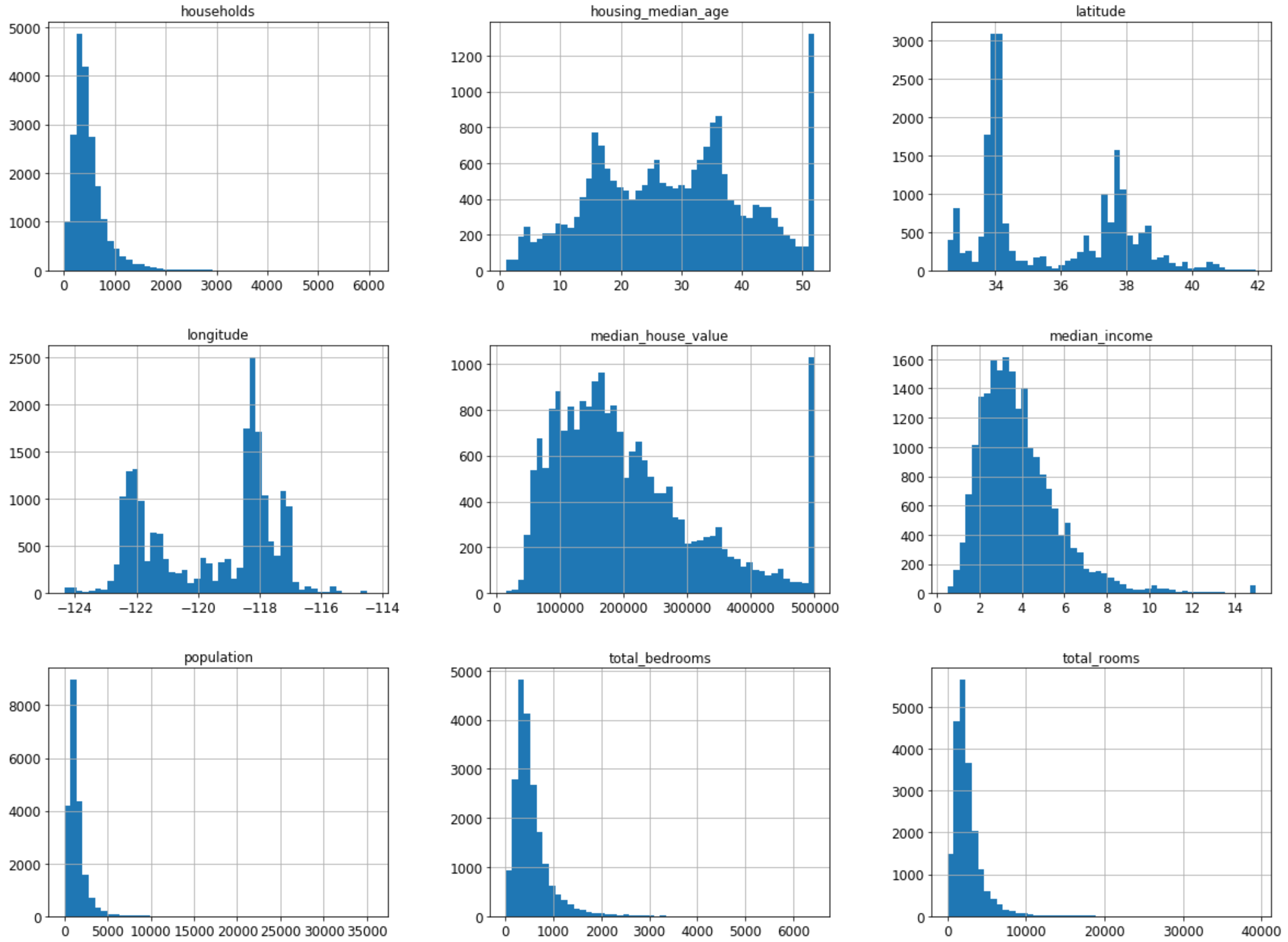
Out[8]:

	longitude	latitude	housing_median_age	total_rooms	total_bedrooms	population	hou
count	20640.000000	20640.000000	20640.000000	20640.000000	20433.000000	20640.000000	2064
mean	-119.569704	35.631861	28.639486	2635.763081	537.870553	1425.476744	49
std	2.003532	2.135952	12.585558	2181.615252	421.385070	1132.462122	382
min	-124.350000	32.540000	1.000000	2.000000	1.000000	3.000000	1
25%	-121.800000	33.930000	18.000000	1447.750000	296.000000	787.000000	28
50%	-118.490000	34.260000	29.000000	2127.000000	435.000000	1166.000000	40
75%	-118.010000	37.710000	37.000000	3148.000000	647.000000	1725.000000	60
max	-114.310000	41.950000	52.000000	39320.000000	6445.000000	35682.000000	608

In [9]:

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

plt.show()
```



In [10]:

```
# to make this notebook's output identical at every run
np.random.seed(42)
```

In [11]:

```
import numpy as np

# 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]
```

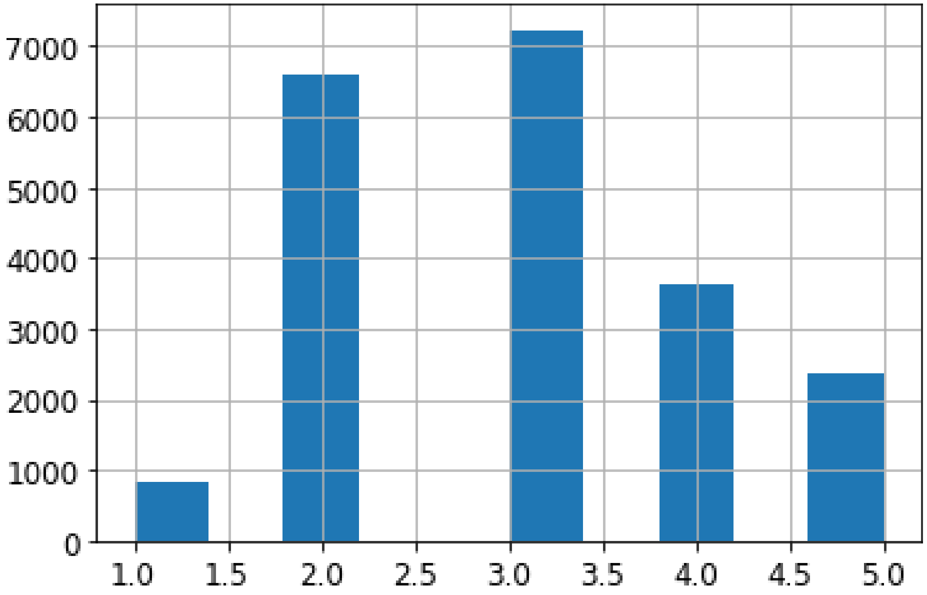
In [12]:

```
train_set, test_set = split_train_test(housing, 0.2)
print(len(train_set), "train +", len(test_set), "test")
```

```
16512 train + 4128 test
```

In [13]:

```
import numpy as np
housing['income_cat'] = pd.cut(housing['median_income'], bins=[0., 1.5, 3.0, 4.5, 6., np
housing['income_cat'].hist()
plt.show()
```



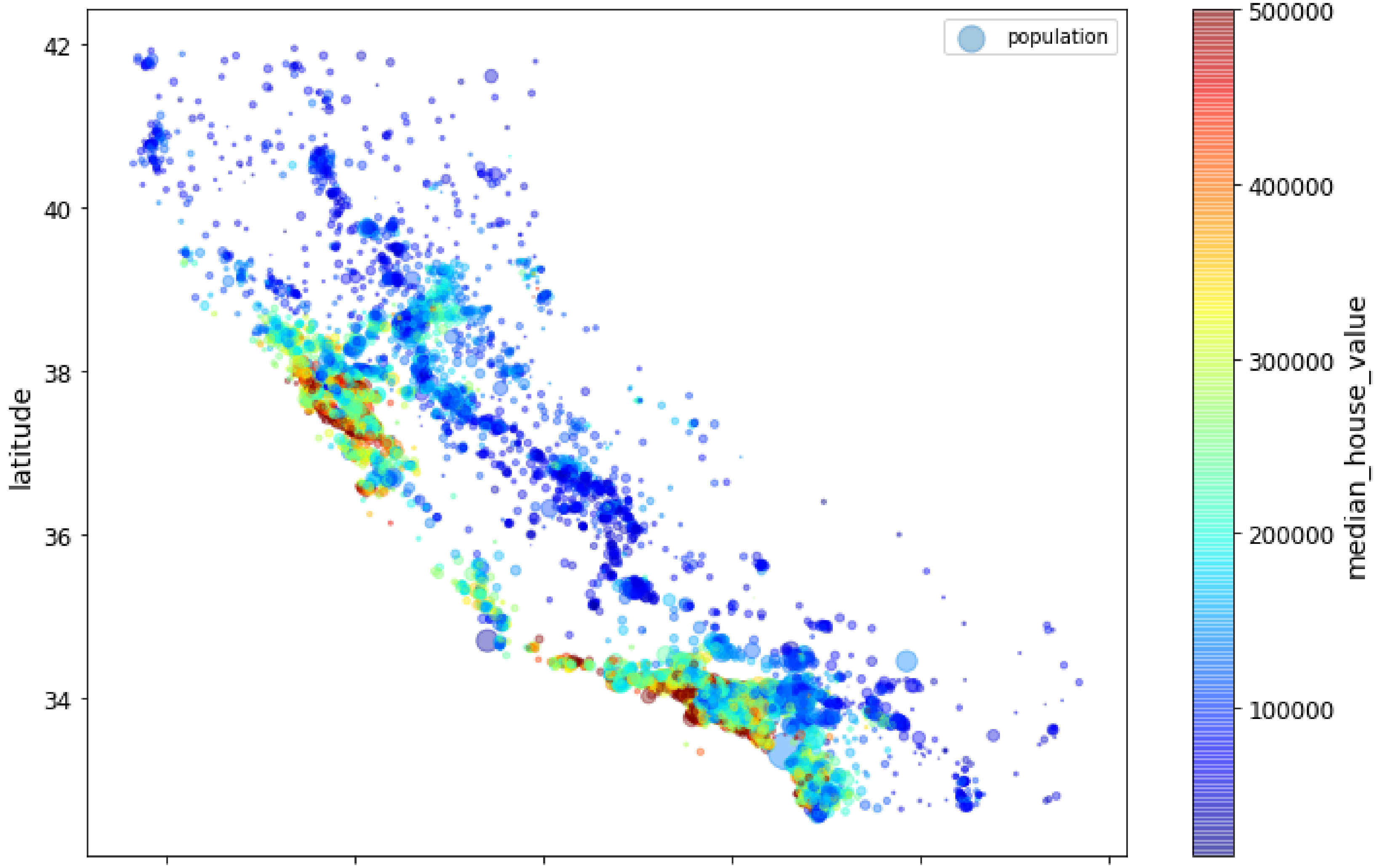
In [14]:

```
#Stratified Sampling on Dataset
from sklearn.model_selection import StratifiedShuffleSplit
split = StratifiedShuffleSplit(n_splits=1, test_size=0.2, random_state=42)
for train_index, test_index in split.split(housing, housing["income_cat"]):
    strat_train_set = housing.loc[train_index]
    strat_test_set = housing.loc[test_index]
print(strat_test_set['income_cat'].value_counts() / len(strat_test_set))
```

```
3    0.350533
2    0.318798
4    0.176357
5    0.114583
1    0.039729
Name: income_cat, dtype: float64
```

In [31]:

```
for set_ in (strat_train_set, strat_test_set):
    set_.drop('income_cat', axis=1, inplace=True)
housing = strat_train_set.copy()
housing.plot(kind='scatter', x='longitude', y='latitude', alpha=0.4, s=housing['populati
figsize=(12, 8), c='median_house_value', cmap=plt.get_cmap('jet'), colorbar=True)
plt.legend()
plt.show()
```



In [15]:

```
corr_matrix = housing.corr()
print(corr_matrix.median_house_value.sort_values(ascending=False))
```

```
median_house_value    1.000000
median_income         0.688075
total_rooms           0.134153
housing_median_age    0.105623
households            0.065843
total_bedrooms        0.049686
population           -0.024650
longitude            -0.045967
latitude             -0.144160
Name: median_house_value, dtype: float64
```

In [16]:

```
housing["rooms_per_household"] = housing["total_rooms"]/housing["households"]
housing["bedrooms_per_room"] = housing["total_bedrooms"]/housing["total_rooms"]
housing["population_per_household"] = housing["population"]/housing["households"]

corr_matrix = housing.corr()
print(corr_matrix["median_house_value"].sort_values(ascending=False))
```

```
median_house_value           1.000000
median_income                0.688075
rooms_per_household          0.151948
total_rooms                  0.134153
housing_median_age           0.105623
households                   0.065843
total_bedrooms               0.049686
population_per_household    -0.023737
population                  -0.024650
longitude                   -0.045967
latitude                    -0.144160
bedrooms_per_room           -0.255880
Name: median_house_value, dtype: float64
```

In [17]:

```
# Data Preparation
housing = strat_train_set.drop("median_house_value", axis=1)
housing_labels = strat_train_set["median_house_value"].copy()

median = housing["total_bedrooms"].median()
housing["total_bedrooms"].fillna(median, inplace=True)

housing_num = housing.drop("ocean_proximity", axis=1)

from sklearn.base import BaseEstimator, TransformerMixin

# column index
rooms_ix, bedrooms_ix, population_ix, households_ix = 3, 4, 5, 6

class CombinedAttributesAdder(BaseEstimator, TransformerMixin):
    def __init__(self, add_bedrooms_per_room=True): # no *args or **kargs
        self.add_bedrooms_per_room = add_bedrooms_per_room
    def fit(self, X, y=None):
        return self  # nothing else to do
    def transform(self, X):
        rooms_per_household = X[:, rooms_ix] / X[:, households_ix]
        population_per_household = X[:, population_ix] / X[:, households_ix]
        if self.add_bedrooms_per_room:
            bedrooms_per_room = X[:, bedrooms_ix] / X[:, rooms_ix]
            return np.c_[X, rooms_per_household, population_per_household,
                         bedrooms_per_room]
        else:
            return np.c_[X, rooms_per_household, population_per_household]
```

In [18]:

```
from sklearn.preprocessing import OneHotEncoder
from sklearn.pipeline import Pipeline
from sklearn.preprocessing import StandardScaler
from sklearn.impute import SimpleImputer
num_pipeline = Pipeline([
    ('imputer',SimpleImputer(strategy="median")),
    ('attribs_adder', CombinedAttributesAdder()),
    ('std_scaler', StandardScaler()),
])
housing_num_tr = num_pipeline.fit_transform(housing_num)

from sklearn.compose import ColumnTransformer
num_attribs = list(housing_num)
cat_attribs = ["ocean_proximity"]
full_pipeline = ColumnTransformer([
    ("num", num_pipeline, num_attribs),
    ("cat", OneHotEncoder(), cat_attribs),
])
housing_prepared = full_pipeline.fit_transform(housing)
```

In [19]:

```
from sklearn.linear_model import LinearRegression
lin_reg = LinearRegression()
lin_reg.fit(housing_prepared, housing_labels)

data = housing.iloc[:5]
labels = housing_labels.iloc[:5]
data_preparation = full_pipeline.transform(data)
print("Predictions: ", lin_reg.predict(data_preparation))
```

```
Predictions:  [203682.37379543 326371.39370781 204218.64588245  58685.4770482
 194213.06443039]
```

In [ ]: