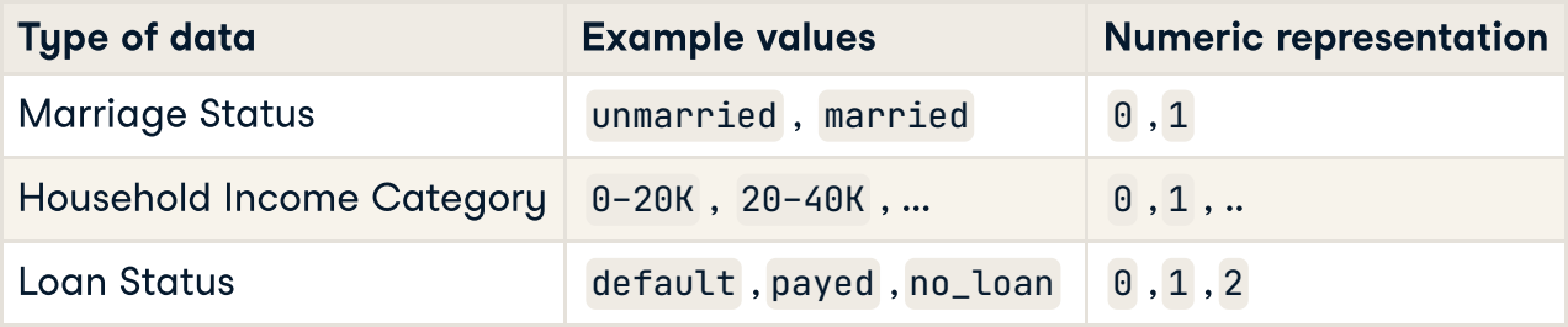
Text and categorical data problems

Membership constraints

Categories and membership constraints

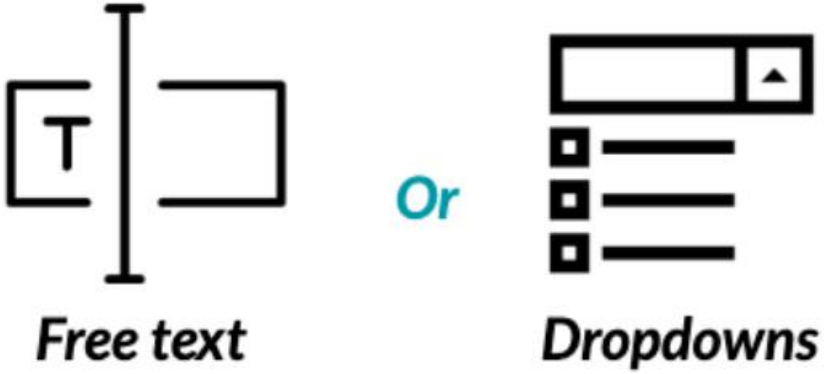
Predefined finite set of categories



Type of data	Example values	Numeric representation
Marriage Status	`unmarried` , `married`	`0` , `1`
Household Income Category	`0-20K` , `20-40K` , ...	`0` , `1` , ..
Loan Status	`default` , `payed` , `no_loan`	`0` , `1` , `2`

Marriage status can only be unmarried _or_ married

Why could we have these problems?



Data Entry Errors

Parsing Errors

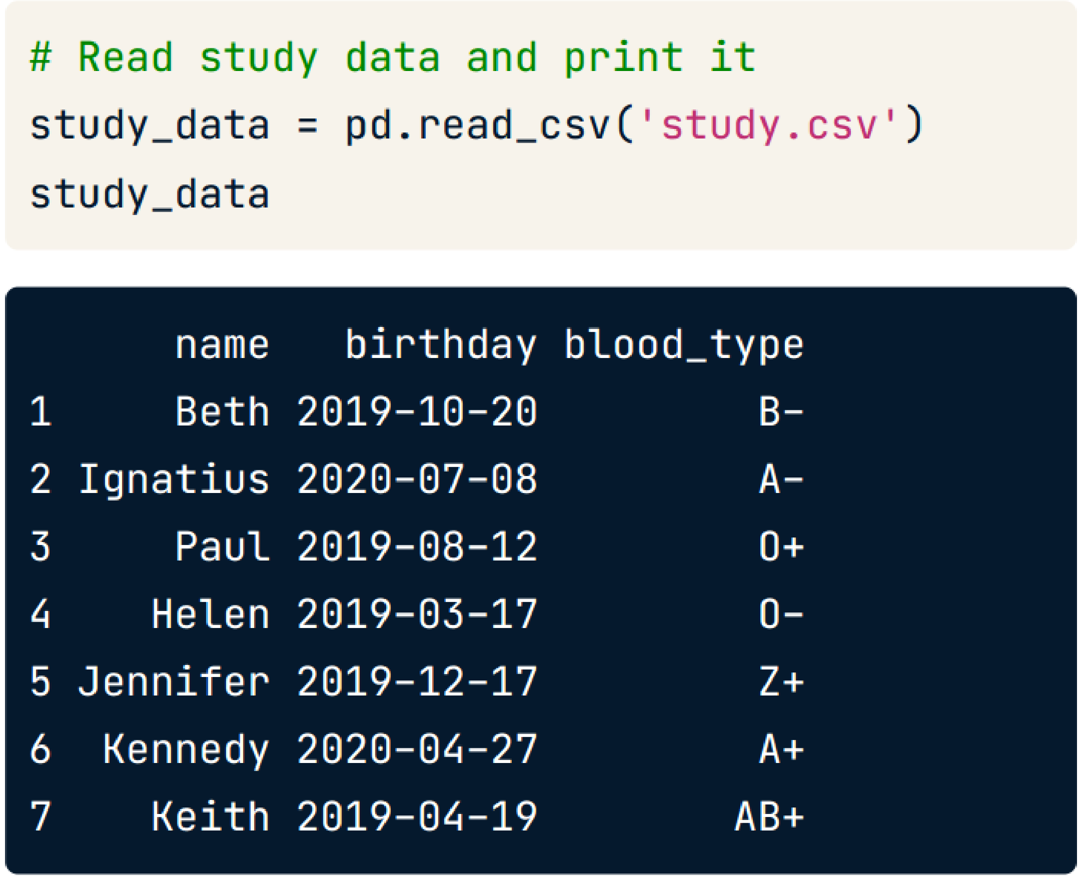
How do we treat these problems?

Dropping Data

Remapping Categories

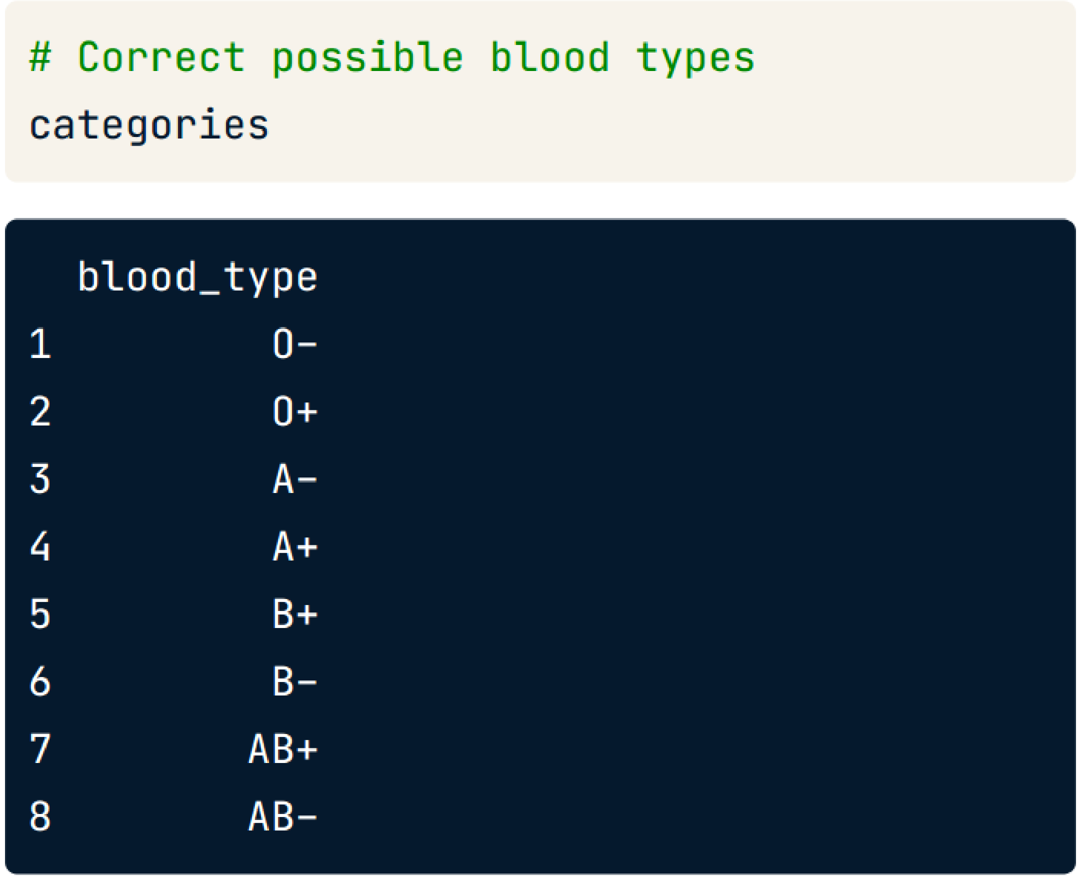
Inferring Categories

An example



```
# Read study data and print it
study_data = pd.read_csv('study.csv')
study_data
```

```
       name   birthday blood_type
1      Beth 2019-10-20         B-
2 Ignatius 2020-07-08         A-
3      Paul 2019-08-12         O+
4     Helen 2019-03-17         O-
5 Jennifer 2019-12-17         Z+
6  Kennedy 2020-04-27         A+
7     Keith 2019-04-19        AB+
```



```
# Correct possible blood types
categories
```

```
  blood_type
1         O-
2         O+
3         A-
4         A+
5         B+
6         B-
7        AB+
8        AB-
```

An example

```
# Read study data and print it
study_data = pd.read_csv('study.csv')
study_data
```

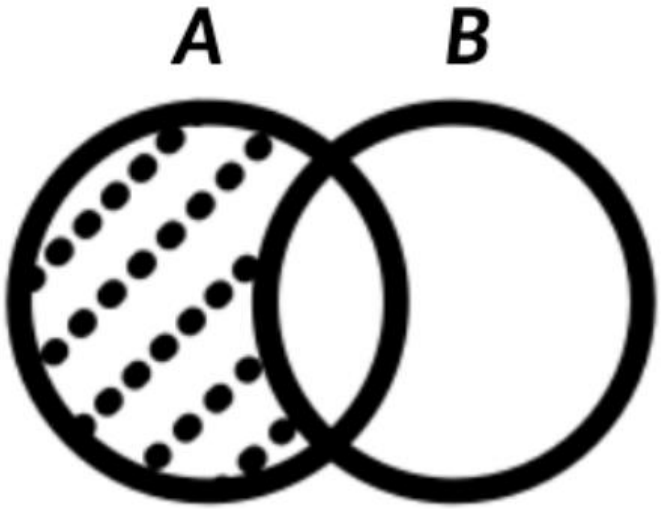
```
      name   birthday blood_type
1     Beth 2019-10-20         B-
2 Ignatius 2020-07-08         A-
3     Paul 2019-08-12         O+
4    Helen 2019-03-17         O-
5 Jennifer 2019-12-17         Z+  <--
6  Kennedy 2020-04-27         A+
7    Keith 2019-04-19        AB+
```

```
# Correct possible blood types
categories
```

```
  blood_type
1         O-
2         O+
3         A-
4         A+
5         B+
6         B-
7        AB+
8        AB-
```

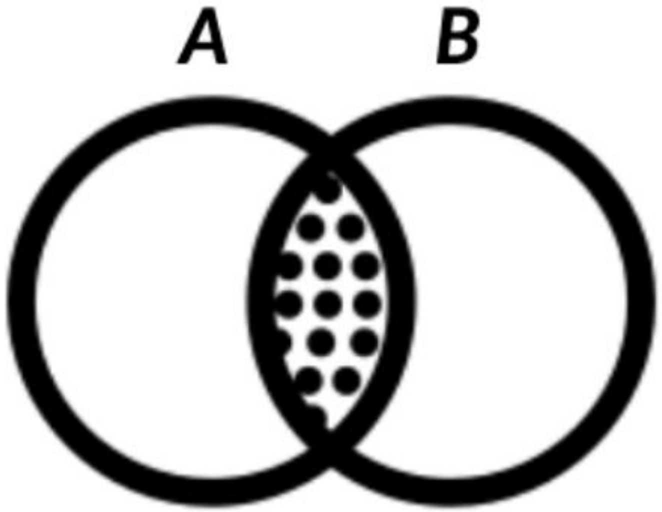
A note on joins

Anti Joins



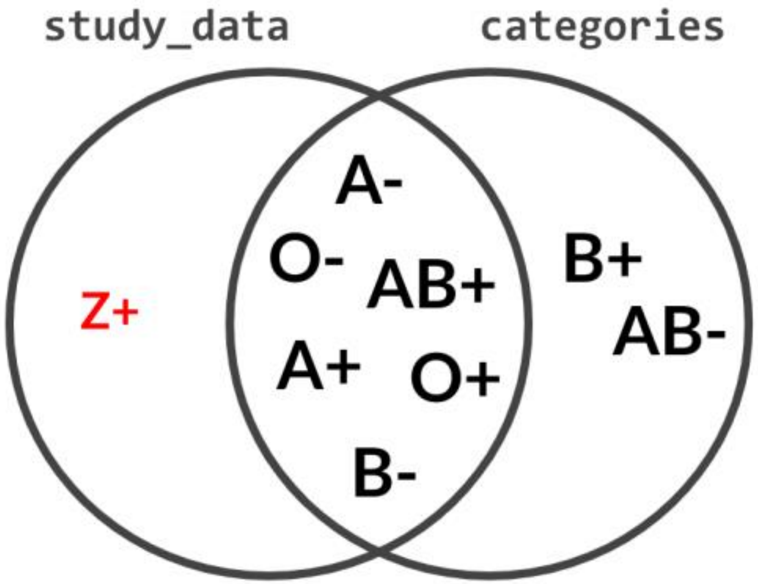
What is in A and not in B

Inner Joins



What is in both A and B

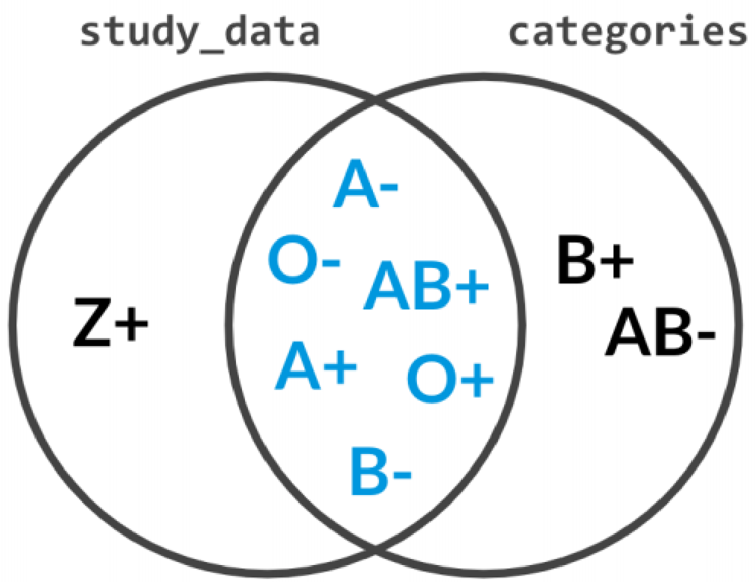
A left anti join on blood types



What is in study_data *only*

Returns only rows containing Z+

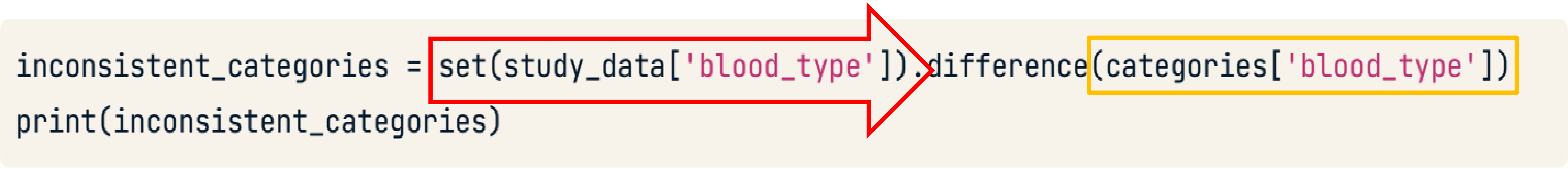
An inner join on blood types



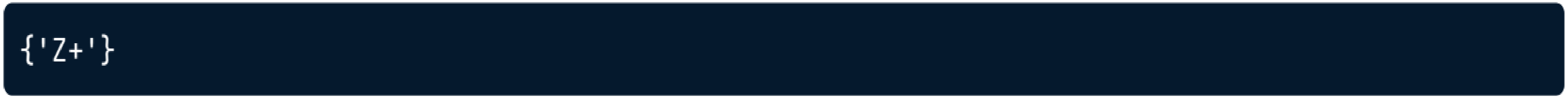
What is in study_data *and* categories *only*

Returns all the rows except those containing Z+ , B+ *and* AB-

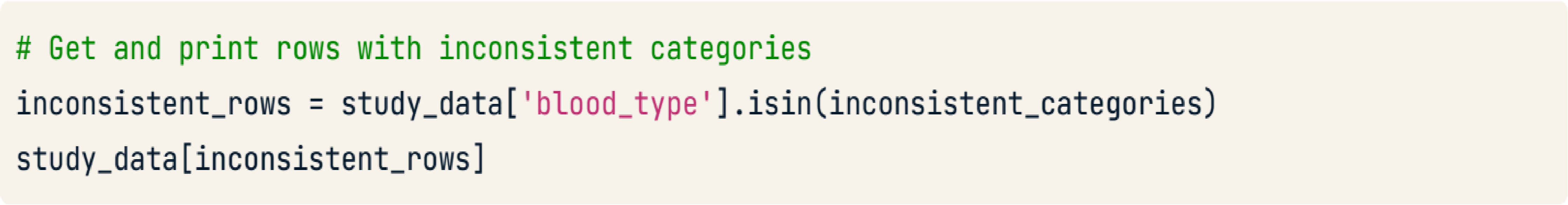
Finding inconsistent categories



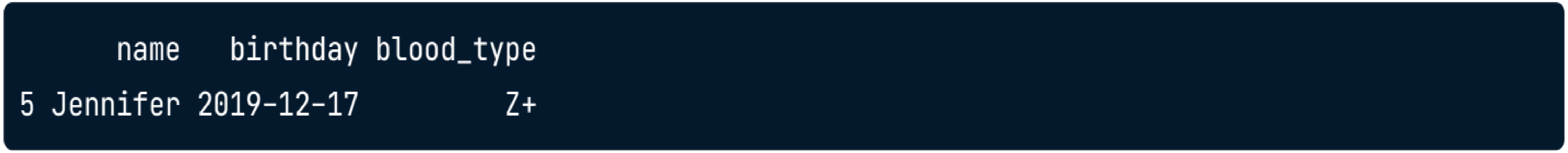
```
inconsistent_categories = set(study_data['blood_type']).difference(categories['blood_type'])
print(inconsistent_categories)
```



```
{'Z+'}
```

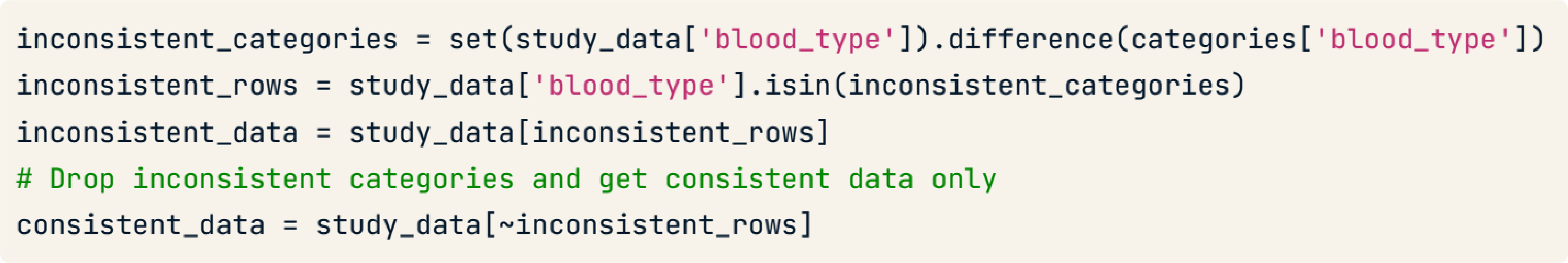


```
# Get and print rows with inconsistent categories
inconsistent_rows = study_data['blood_type'].isin(inconsistent_categories)
study_data[inconsistent_rows]
```

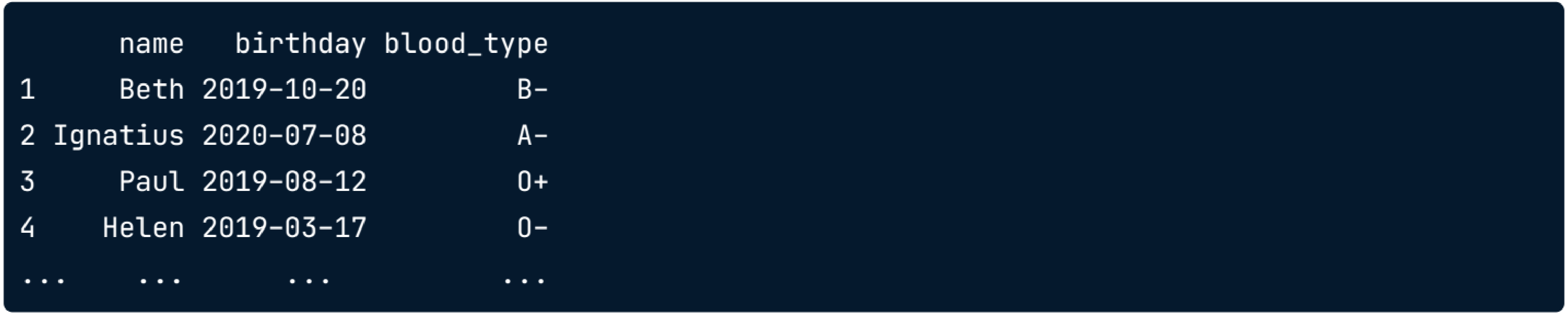


```
      name    birthday blood_type
5 Jennifer 2019-12-17         Z+
```

Dropping inconsistent categories



```
inconsistent_categories = set(study_data['blood_type']).difference(categories['blood_type'])
inconsistent_rows = study_data['blood_type'].isin(inconsistent_categories)
inconsistent_data = study_data[inconsistent_rows]
# Drop inconsistent categories and get consistent data only
consistent_data = study_data[~inconsistent_rows]
```



```
      name   birthday blood_type
1     Beth 2019-10-20         B-
2 Ignatius 2020-07-08         A-
3     Paul 2019-08-12         O+
4    Helen 2019-03-17         O-
...    ...        ...        ...
```

Categorical variables

What type of errors could we have?

I) Value inconsistency

- ✓ Inconsistent ,fields: 'married' , 'Maried' , 'UNMARRIED' , 'not married' ..
- ✓ _Trailing white spaces: _ 'married ' , ' married ' ..

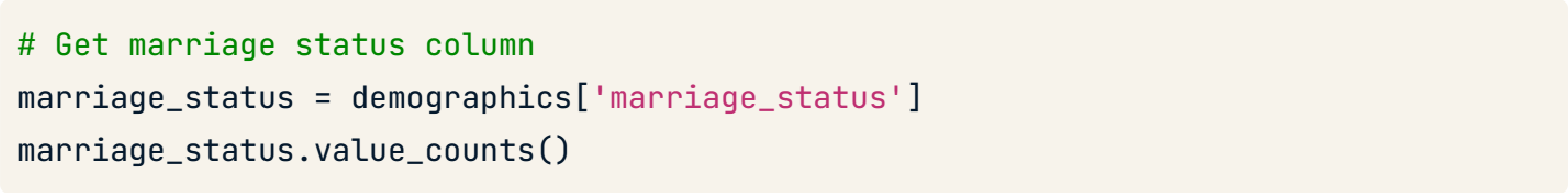
II) Collapsing too many categories to few

- ✓ Creating new groups: 0-20K , 20-40K categories ... from continuous household income data
- ✓ Mapping groups to new ones: Mapping household income categories to 2 'rich' , 'poor'

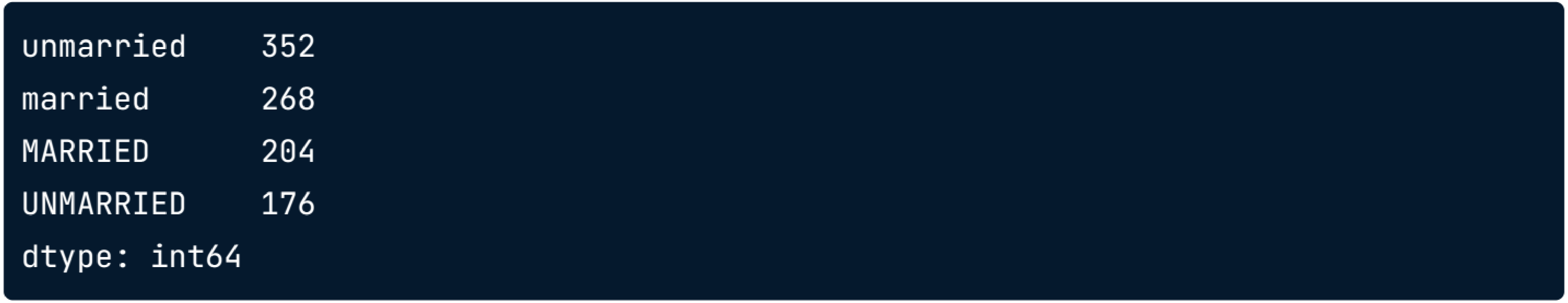
III) Making sure data is of type category

Value consistency

Capitalization: 'married' , 'Married' , 'UNMARRIED' , 'unmarried' ..

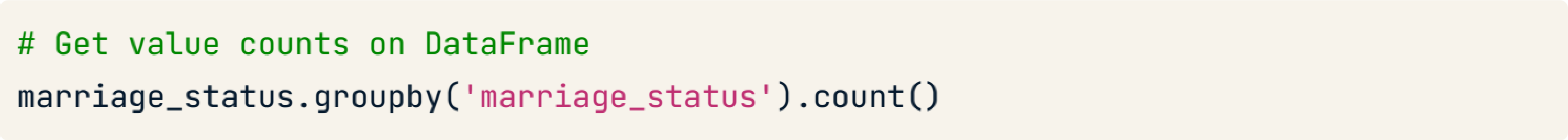


```python
# Get marriage status column
marriage_status = demographics['marriage_status']
marriage_status.value_counts()
```

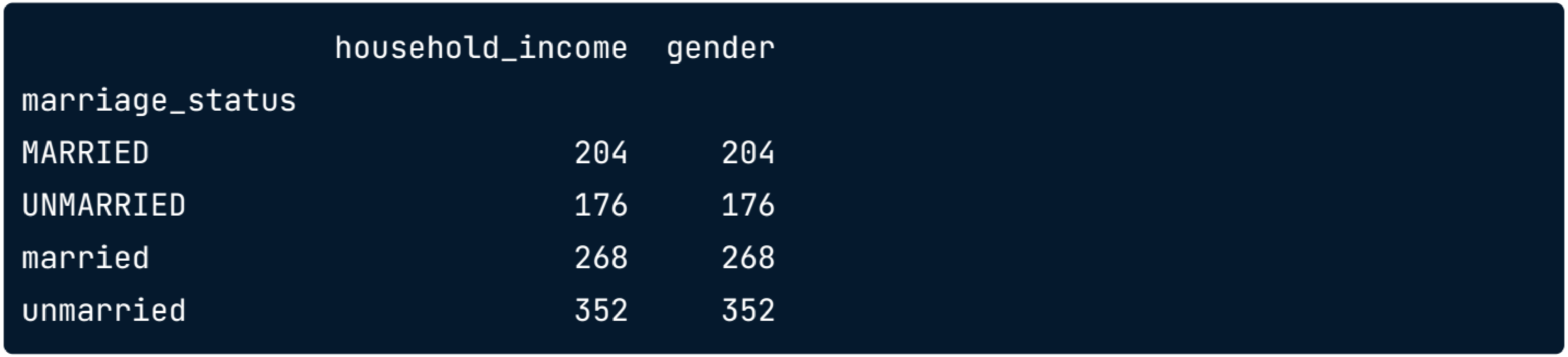


```
unmarried    352
married      268
MARRIED      204
UNMARRIED    176
dtype: int64
```

Value consistency

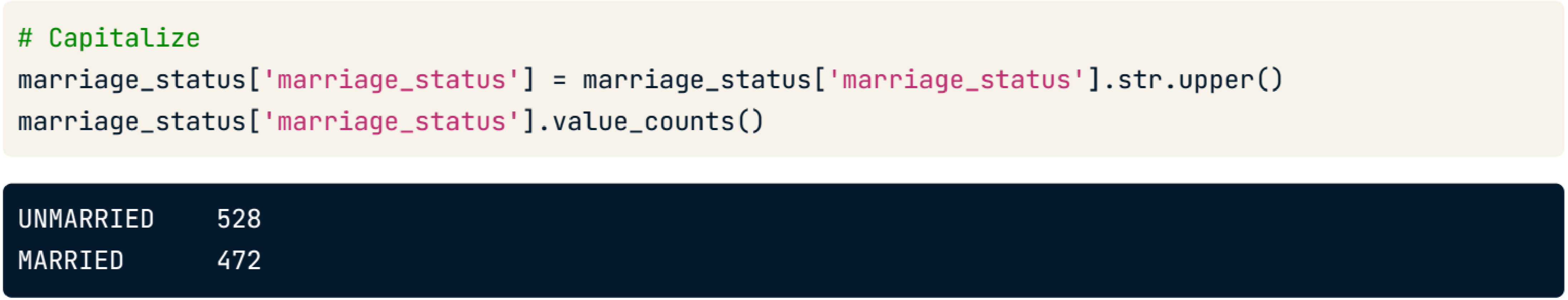


```
# Get value counts on DataFrame
marriage_status.groupby('marriage_status').count()
```



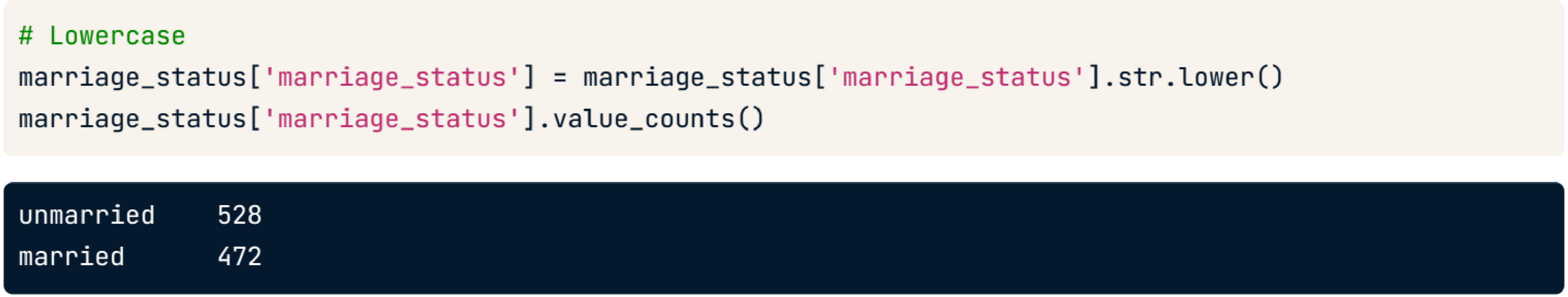
```
                 household_income  gender
marriage_status
MARRIED                       204     204
UNMARRIED                     176     176
married                       268     268
unmarried                     352     352
```

Value consistency



```python
# Capitalize
marriage_status['marriage_status'] = marriage_status['marriage_status'].str.upper()
marriage_status['marriage_status'].value_counts()
```

```
UNMARRIED    528
MARRIED      472
```

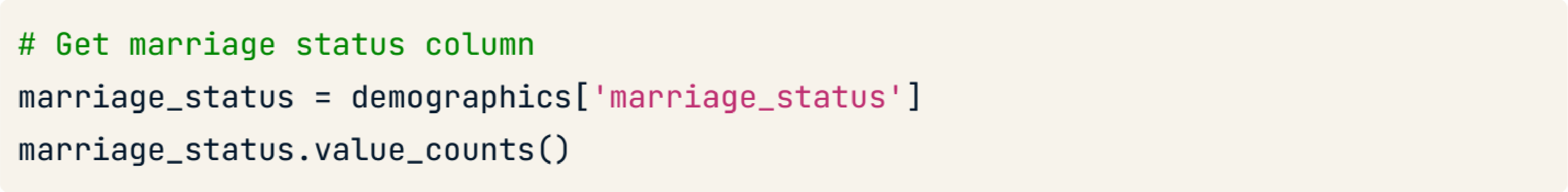


```python
# Lowercase
marriage_status['marriage_status'] = marriage_status['marriage_status'].str.lower()
marriage_status['marriage_status'].value_counts()
```

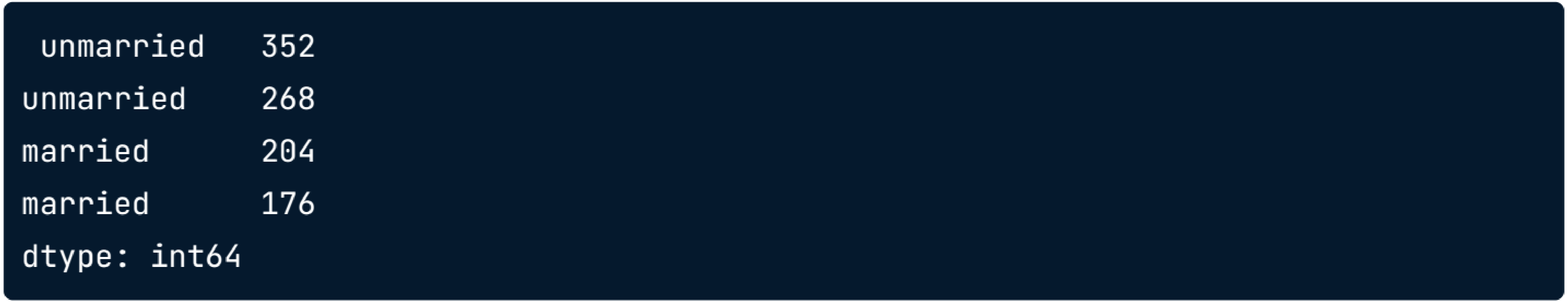
```
unmarried    528
married      472
```

Value consistency

Trailing spaces: 'married ' , 'married' , 'unmarried' , ' unmarried' ..

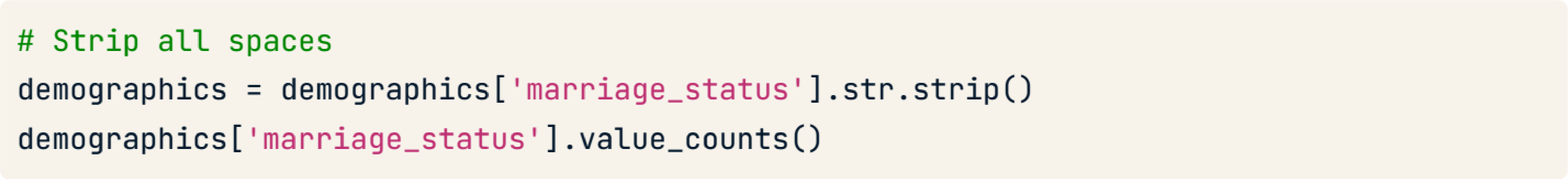


```
# Get marriage status column
marriage_status = demographics['marriage_status']
marriage_status.value_counts()
```

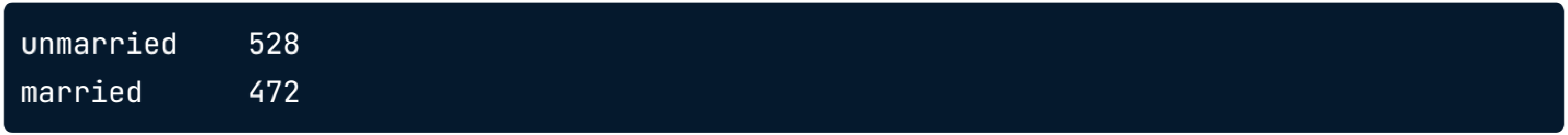


```
 unmarried   352
unmarried    268
married      204
married      176
dtype: int64
```

Value consistency



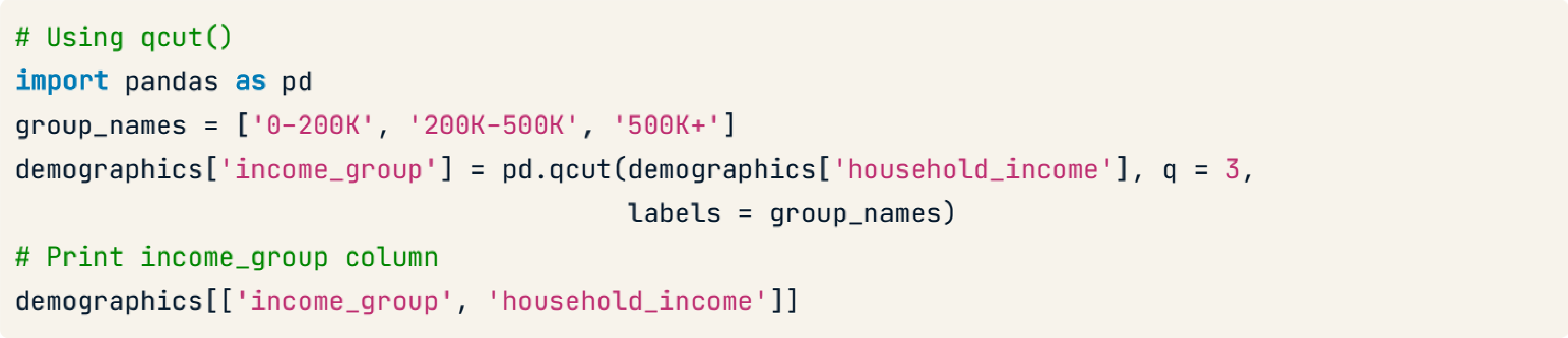
```python
# Strip all spaces
demographics = demographics['marriage_status'].str.strip()
demographics['marriage_status'].value_counts()
```



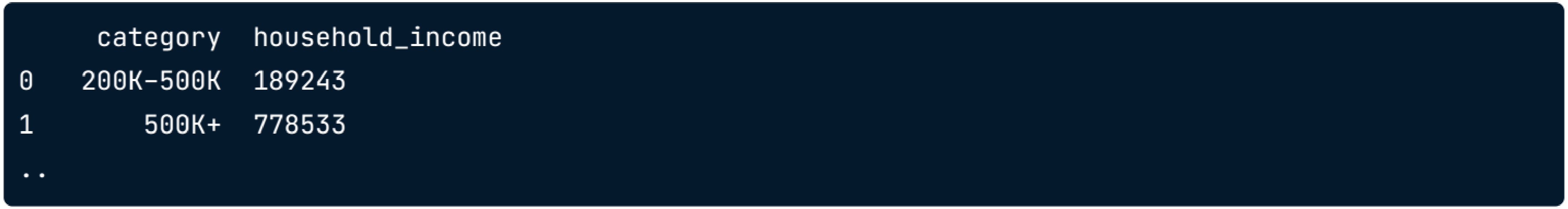
```
unmarried    528
married      472
```

Collapsing data into categories

Create categories out of data: income_group column from income column.



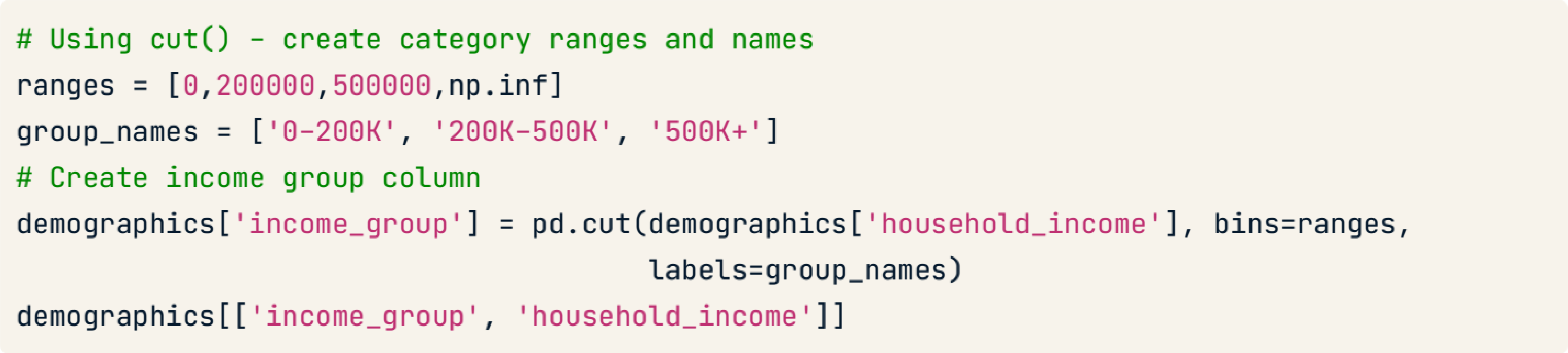
```python
# Using qcut()
import pandas as pd
group_names = ['0-200K', '200K-500K', '500K+']
demographics['income_group'] = pd.qcut(demographics['household_income'], q = 3,
                                       labels = group_names)
# Print income_group column
demographics[['income_group', 'household_income']]
```



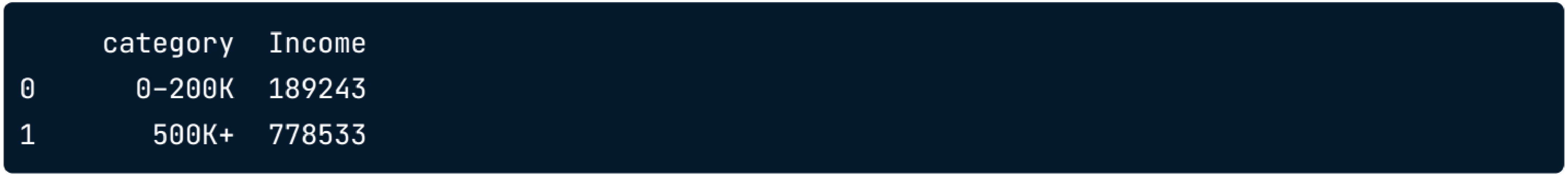
```
     category  household_income
0   200K-500K  189243
1       500K+  778533
..
```

Collapsing data into categories

Create categories out of data: income_group column from income column.



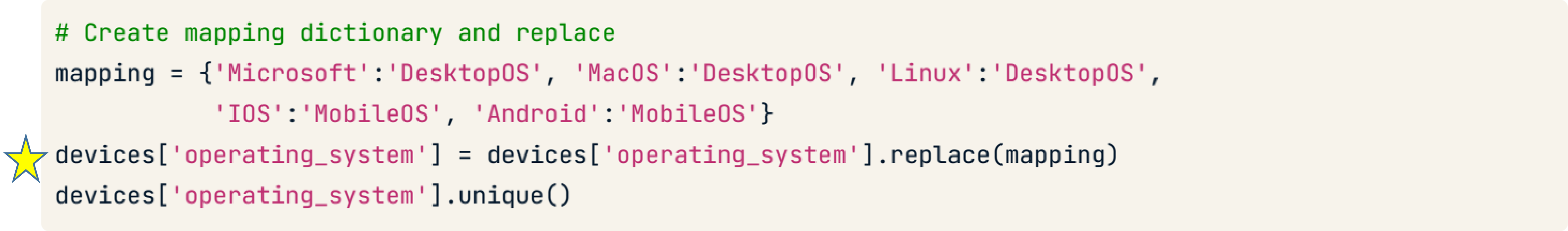
```
# Using cut() - create category ranges and names
ranges = [0,200000,500000,np.inf]
group_names = ['0-200K', '200K-500K', '500K+']
# Create income group column
demographics['income_group'] = pd.cut(demographics['household_income'], bins=ranges,
                                      labels=group_names)
demographics[['income_group', 'household_income']]
```



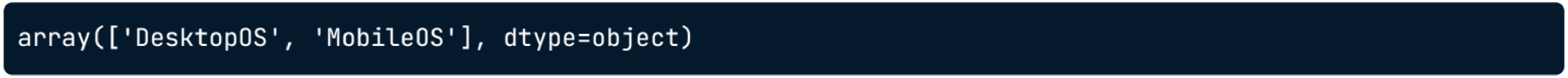
```
     category  Income
0      0-200K  189243
1       500K+  778533
```

Collapsing data into categories

- ✓ Map categories to fewer ones: reducing categories in categorical column.
- ✓ operating_system column is: 'Microsoft', 'MacOS', 'IOS', 'Android', 'Linux‘
- ✓ operating_system column should become: 'DesktopOS', 'MobileOS'



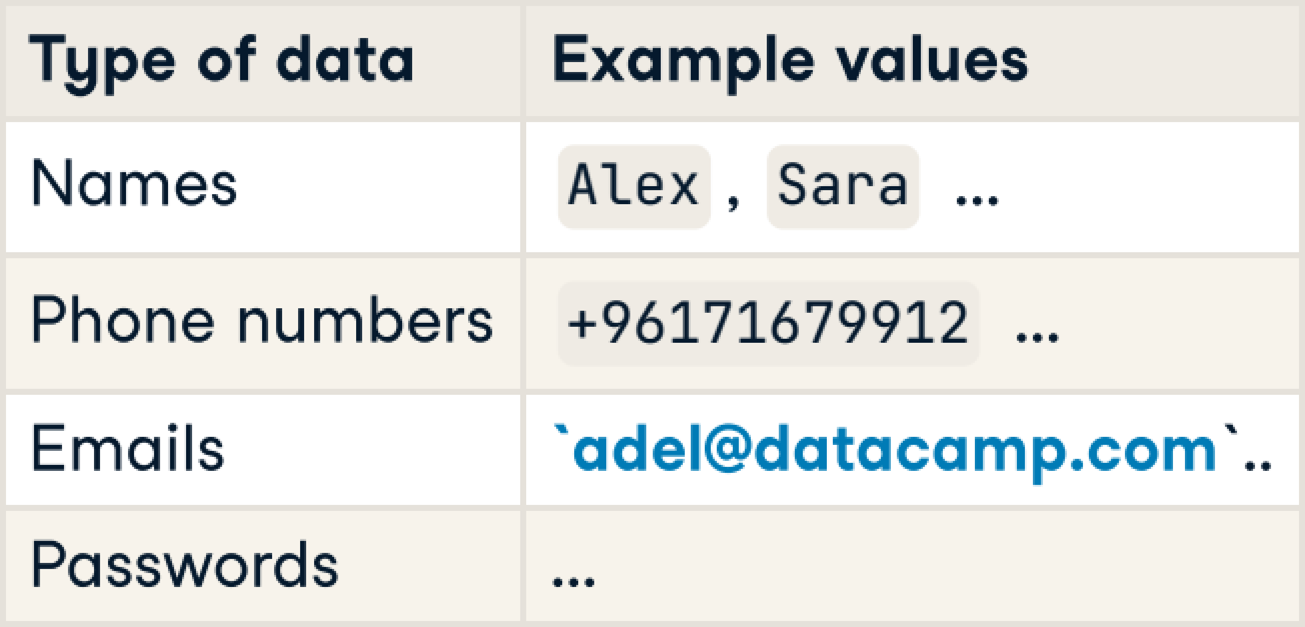
```python
# Create mapping dictionary and replace
mapping = {'Microsoft':'DesktopOS', 'MacOS':'DesktopOS', 'Linux':'DesktopOS',
           'IOS':'MobileOS', 'Android':'MobileOS'}
devices['operating_system'] = devices['operating_system'].replace(mapping)
devices['operating_system'].unique()
```



```
array(['DesktopOS', 'MobileOS'], dtype=object)
```

Cleaning text data

What is text data?



Type of data	Example values
Names	Alex , Sara ...
Phone numbers	+96171679912 ...
Emails	`adel@datacamp.com`..
Passwords	...

Common text data problems

1) Data inconsistency:

+96171679912 or 0096171679912 or ..?

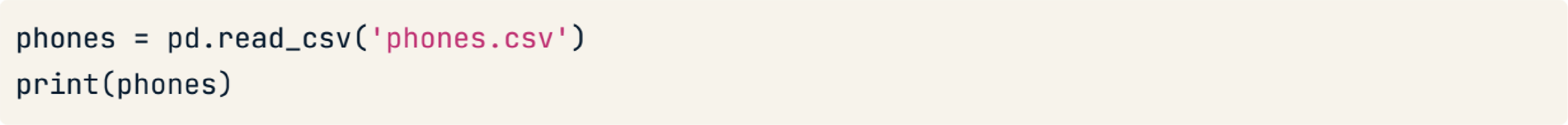
☆2) Fixed length violations:

Passwords needs to be at least 8 characters

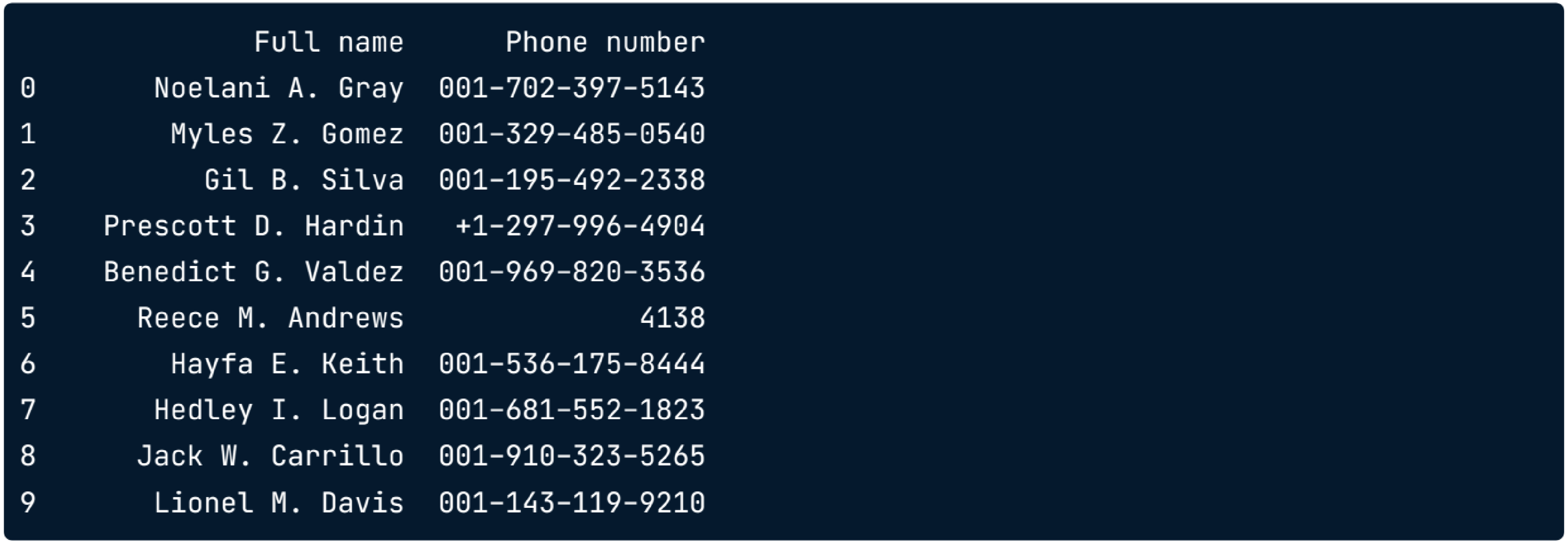
☆3) Typos:

+961.71.679912

Example

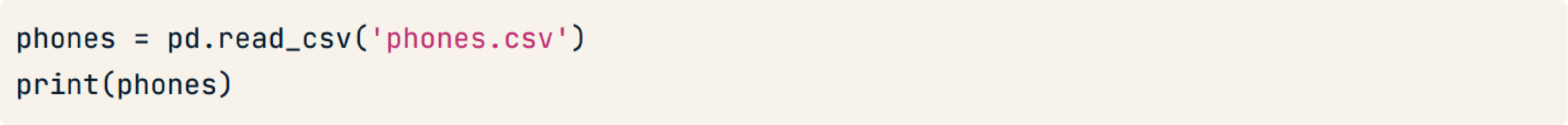


```
phones = pd.read_csv('phones.csv')
print(phones)
```

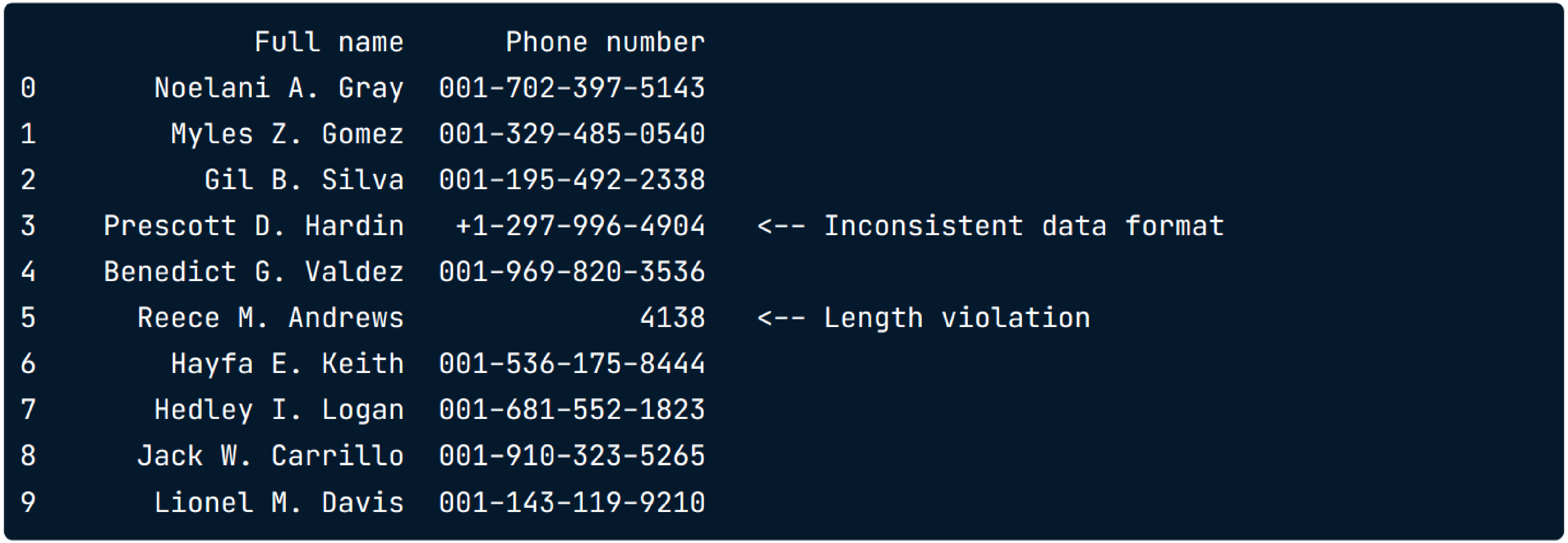


```
              Full name      Phone number
0       Noelani A. Gray  001-702-397-5143
1        Myles Z. Gomez  001-329-485-0540
2          Gil B. Silva  001-195-492-2338
3    Prescott D. Hardin   +1-297-996-4904
4    Benedict G. Valdez  001-969-820-3536
5      Reece M. Andrews              4138
6        Hayfa E. Keith  001-536-175-8444
7       Hedley I. Logan  001-681-552-1823
8      Jack W. Carrillo  001-910-323-5265
9       Lionel M. Davis  001-143-119-9210
```

Example



```
phones = pd.read_csv('phones.csv')
print(phones)
```



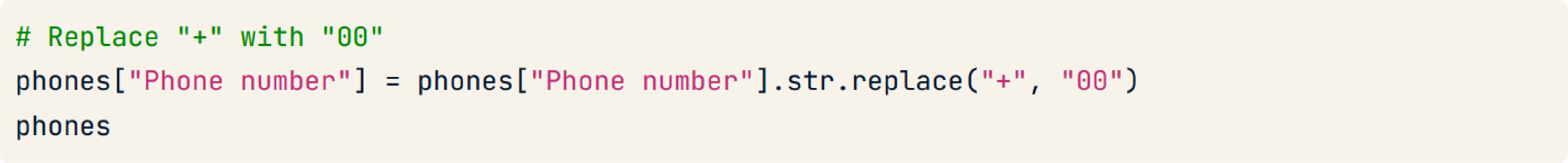
```
              Full name      Phone number
0       Noelani A. Gray  001-702-397-5143
1        Myles Z. Gomez  001-329-485-0540
2          Gil B. Silva  001-195-492-2338
3    Prescott D. Hardin   +1-297-996-4904   <-- Inconsistent data format
4    Benedict G. Valdez  001-969-820-3536
5      Reece M. Andrews              4138   <-- Length violation
6        Hayfa E. Keith  001-536-175-8444
7       Hedley I. Logan  001-681-552-1823
8      Jack W. Carrillo  001-910-323-5265
9       Lionel M. Davis  001-143-119-9210
```

Example

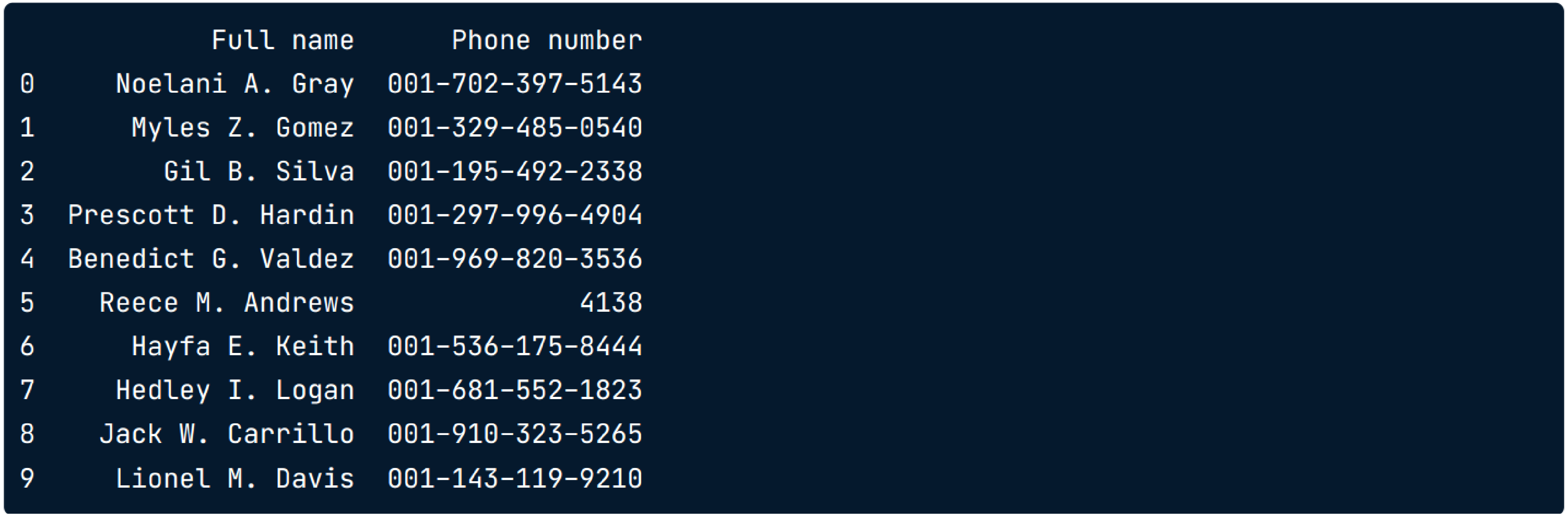
```python
phones = pd.read_csv('phones.csv')
print(phones)
```

```
              Full name   Phone number
0       Noelani A. Gray  0017023975143
1        Myles Z. Gomez  0013294850540
2          Gil B. Silva  0011954922338
3    Prescott D. Hardin  0012979964904
4    Benedict G. Valdez  0019698203536
5      Reece M. Andrews            NaN
6        Hayfa E. Keith  0015361758444
7       Hedley I. Logan  0016815521823
8      Jack W. Carrillo  0019103235265
9       Lionel M. Davis  0011431199210
```

Fixing the phone number column

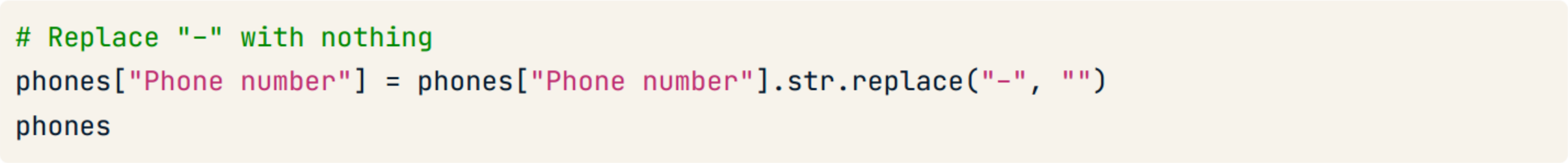


```python
# Replace "+" with "00"
phones["Phone number"] = phones["Phone number"].str.replace("+", "00")
phones
```

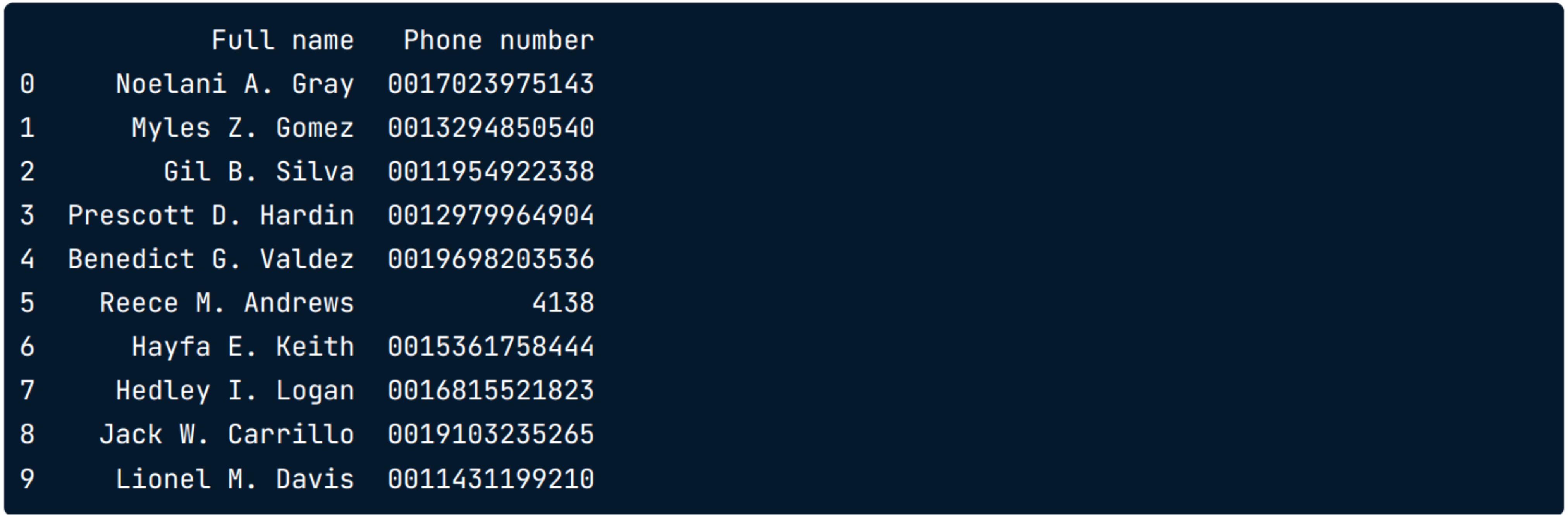


```
             Full name      Phone number
0      Noelani A. Gray  001-702-397-5143
1       Myles Z. Gomez  001-329-485-0540
2         Gil B. Silva  001-195-492-2338
3   Prescott D. Hardin  001-297-996-4904
4   Benedict G. Valdez  001-969-820-3536
5     Reece M. Andrews              4138
6       Hayfa E. Keith  001-536-175-8444
7      Hedley I. Logan  001-681-552-1823
8     Jack W. Carrillo  001-910-323-5265
9      Lionel M. Davis  001-143-119-9210
```

Fixing the phone number column

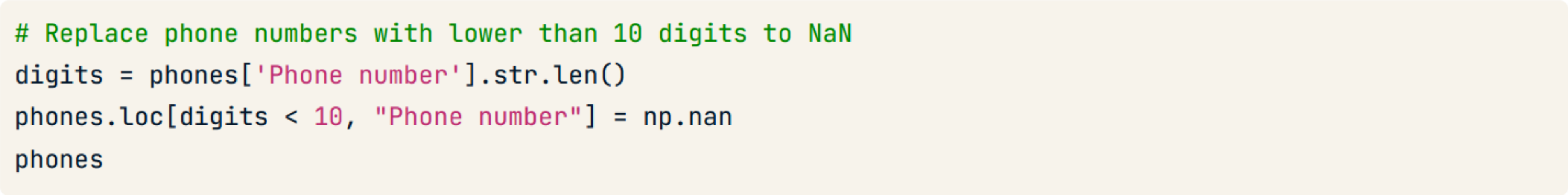


```
# Replace "-" with nothing
phones["Phone number"] = phones["Phone number"].str.replace("-", "")
phones
```

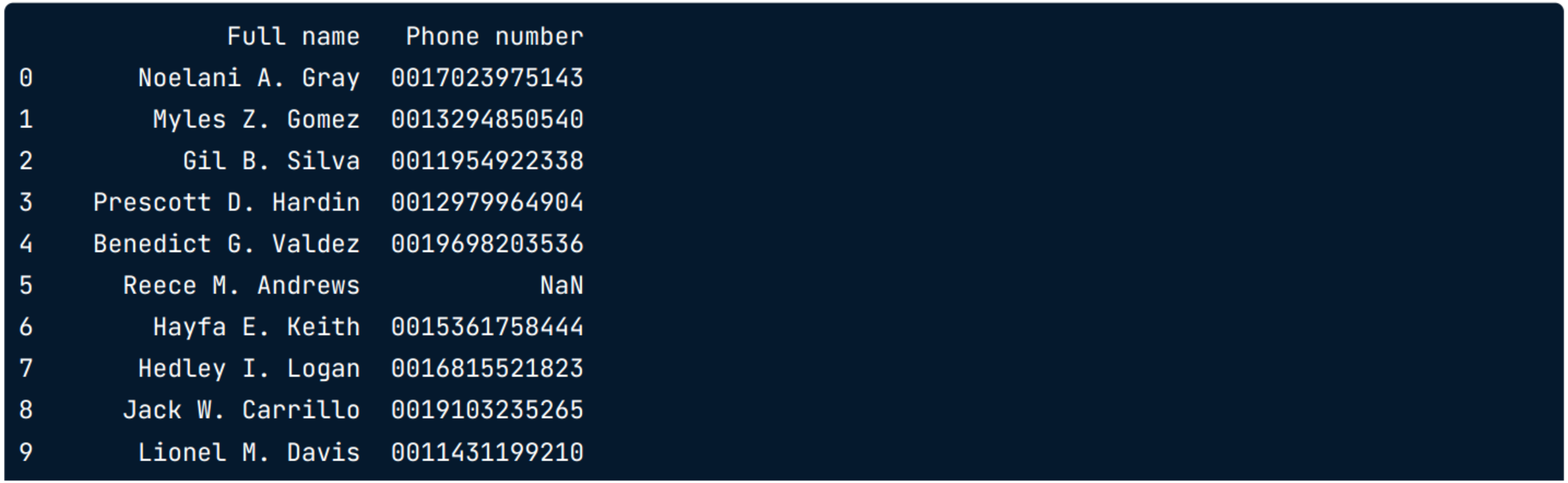


```
            Full name   Phone number
0      Noelani A. Gray  0017023975143
1       Myles Z. Gomez  0013294850540
2         Gil B. Silva  0011954922338
3   Prescott D. Hardin  0012979964904
4   Benedict G. Valdez  0019698203536
5     Reece M. Andrews           4138
6       Hayfa E. Keith  0015361758444
7      Hedley I. Logan  0016815521823
8    Jack W. Carrillo   0019103235265
9      Lionel M. Davis  0011431199210
```

Fixing the phone number column

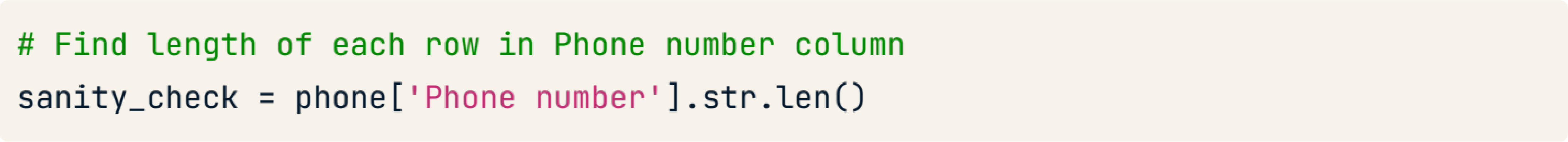


```
  # Replace phone numbers with lower than 10 digits to NaN
1 digits = phones['Phone number'].str.len()
2 phones.loc[digits < 10, "Phone number"] = np.nan
  phones
```



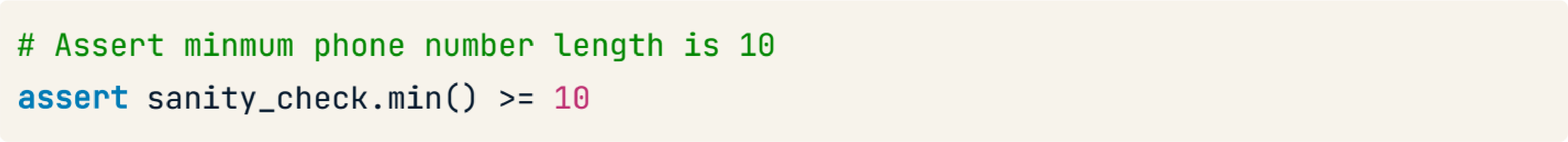
```
              Full name   Phone number
0        Noelani A. Gray  0017023975143
1         Myles Z. Gomez  0013294850540
2           Gil B. Silva  0011954922338
3    Prescott D. Hardin  0012979964904
4    Benedict G. Valdez  0019698203536
5      Reece M. Andrews            NaN
6        Hayfa E. Keith  0015361758444
7       Hedley I. Logan  0016815521823
8      Jack W. Carrillo  0019103235265
9       Lionel M. Davis  0011431199210
```

Fixing the phone number column



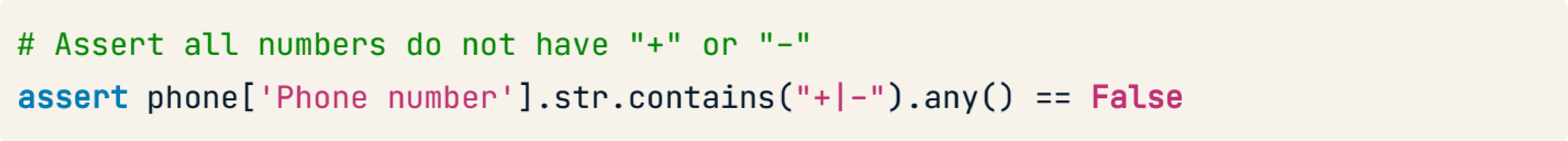
```
# Find length of each row in Phone number column
sanity_check = phone['Phone number'].str.len()
```

1



```
# Assert minmum phone number length is 10
assert sanity_check.min() >= 10
```

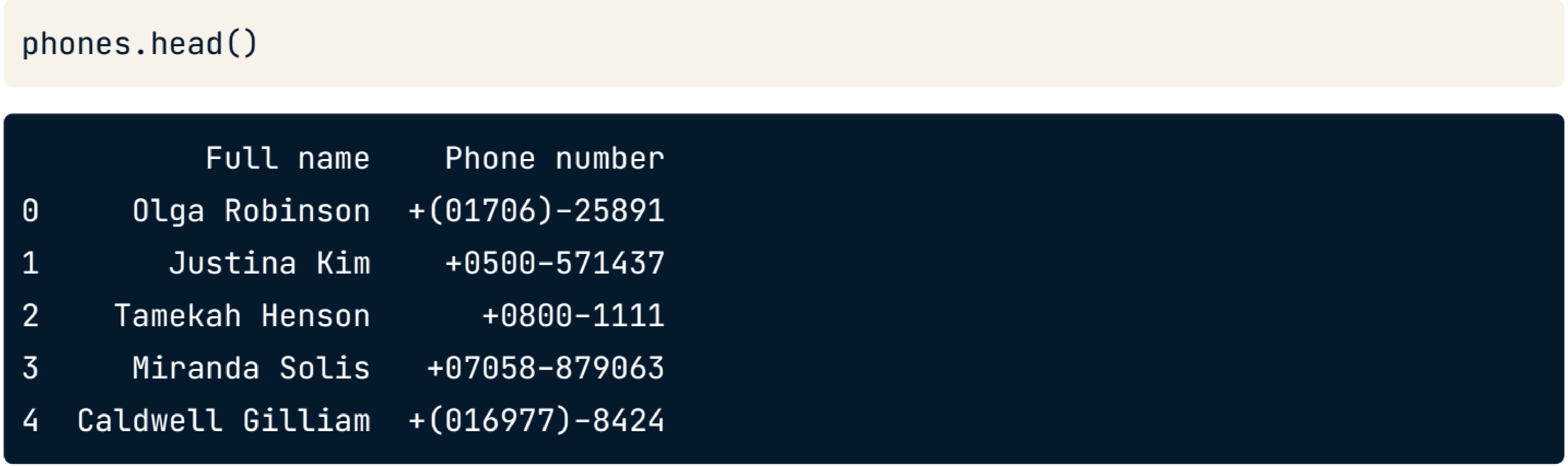
2



```
# Assert all numbers do not have "+" or "-"
assert phone['Phone number'].str.contains("+|-").any() == False
```

- Remember, assert returns nothing if the condition passes

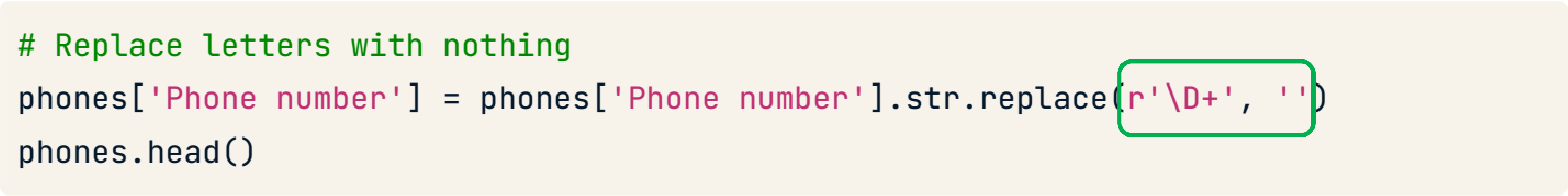
But what about more complicated examples?



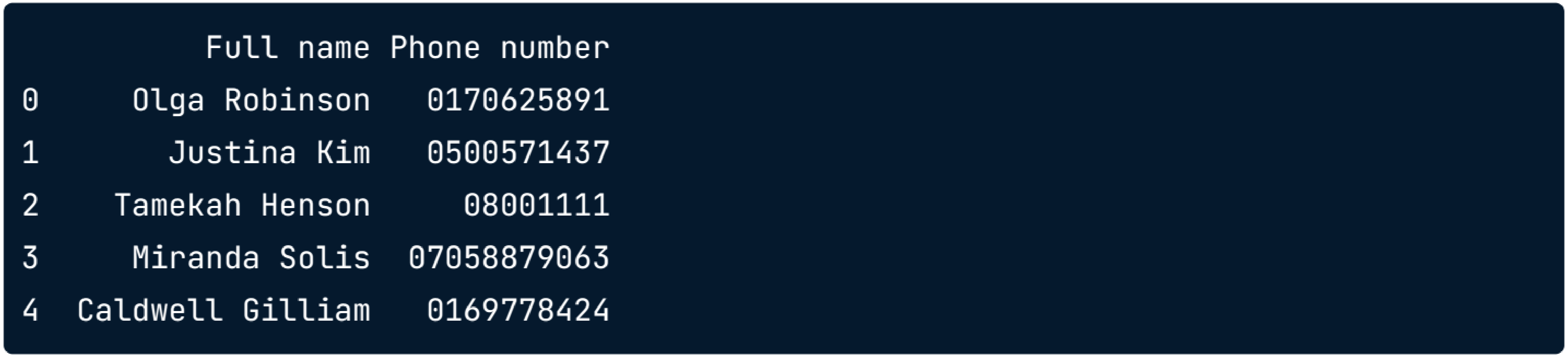
```
phones.head()
```

```
         Full name     Phone number
0     Olga Robinson  +(01706)-25891
1       Justina Kim    +0500-571437
2    Tamekah Henson      +0800-1111
3     Miranda Solis   +07058-879063
4  Caldwell Gilliam  +(016977)-8424
```

Regular expressions in action



```
# Replace letters with nothing
phones['Phone number'] = phones['Phone number'].str.replace(r'\D+', '')
phones.head()
```



```
           Full name Phone number
0      Olga Robinson   0170625891
1        Justina Kim   0500571437
2     Tamekah Henson     08001111
3      Miranda Solis  07058879063
4  Caldwell Gilliam   0169778424
```

Let's practice!