# Membership constraints

DATA CLEANING IN PYTHON

**Adel Nehme**
Content Developer @DataCamp

# Chapter 2 - Text and categorical data problems

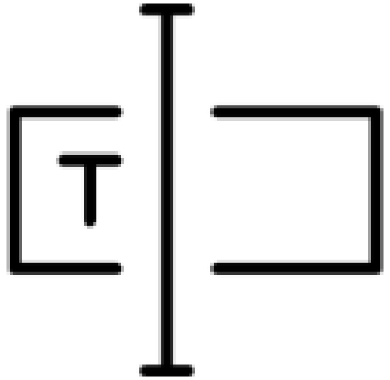
# Categories and membership constraints

## 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` |

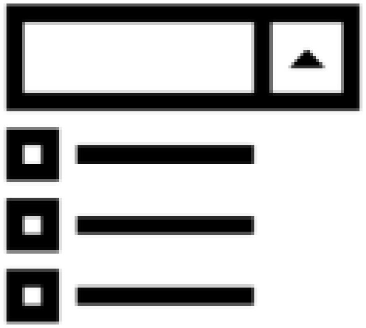
*Marriage status can **only** be* `unmarried` _or_ `married`

# Why could we have these problems?




Free text

*Or*

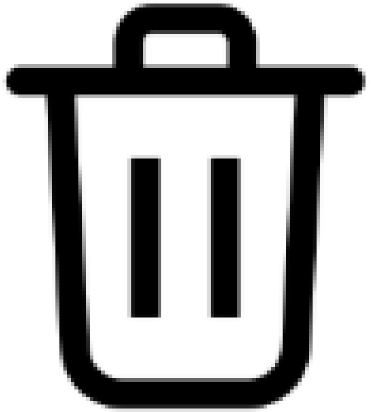


Dropdowns

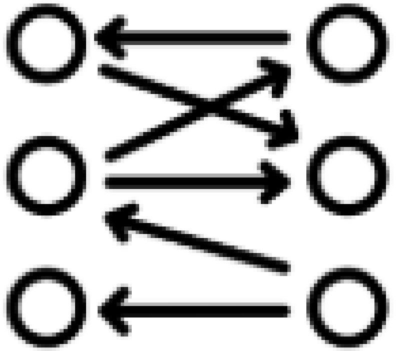
***Data Entry Errors***

***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
```

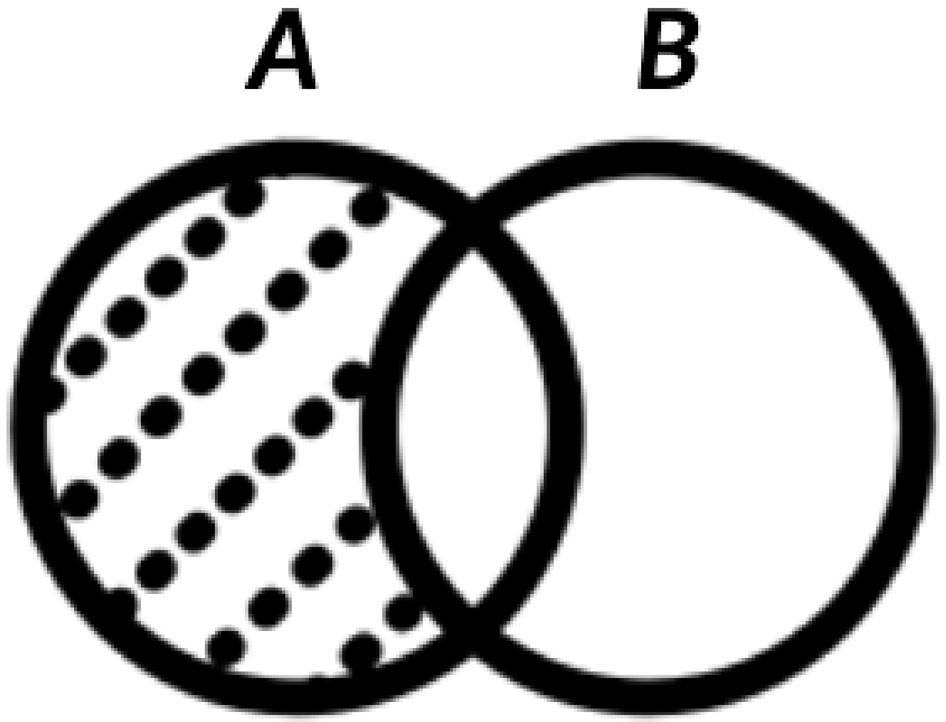
```
       name    birthday blood_type
1      Beth  2019-10-20         B-
2  Ignatius  2020-07-08         A-
3      Paul  2019-08-12         O+
4     Helen  2019-03-17         O-
5  Jennifer  2019-12-17         Z+
6   Kennedy  2020-04-27         A+
7     Keith  2019-04-19        AB+
```

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

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

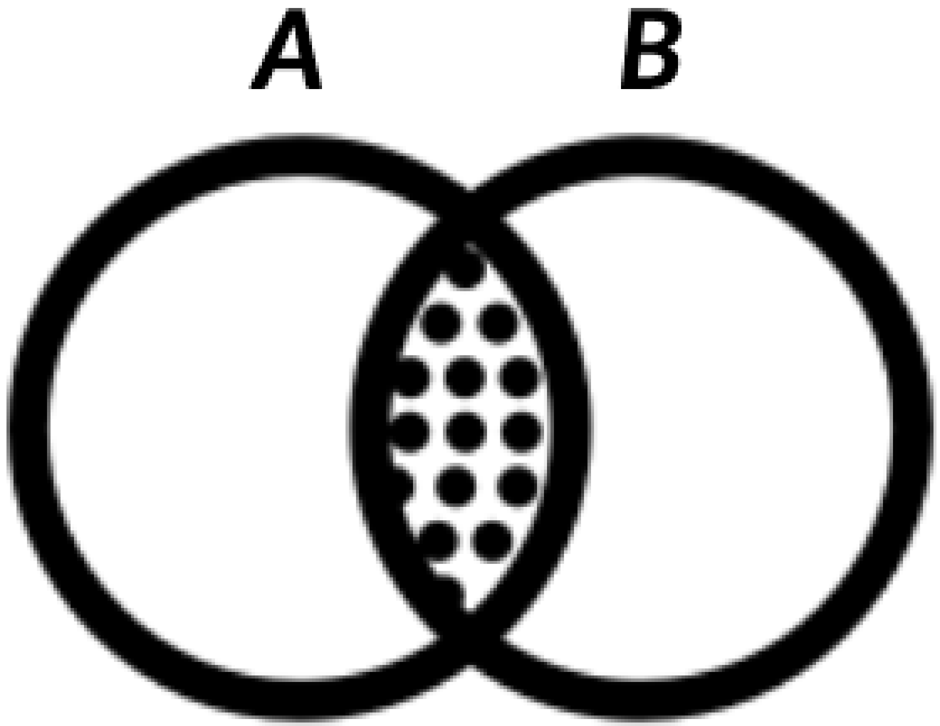
# A note on joins

*Anti Joins*



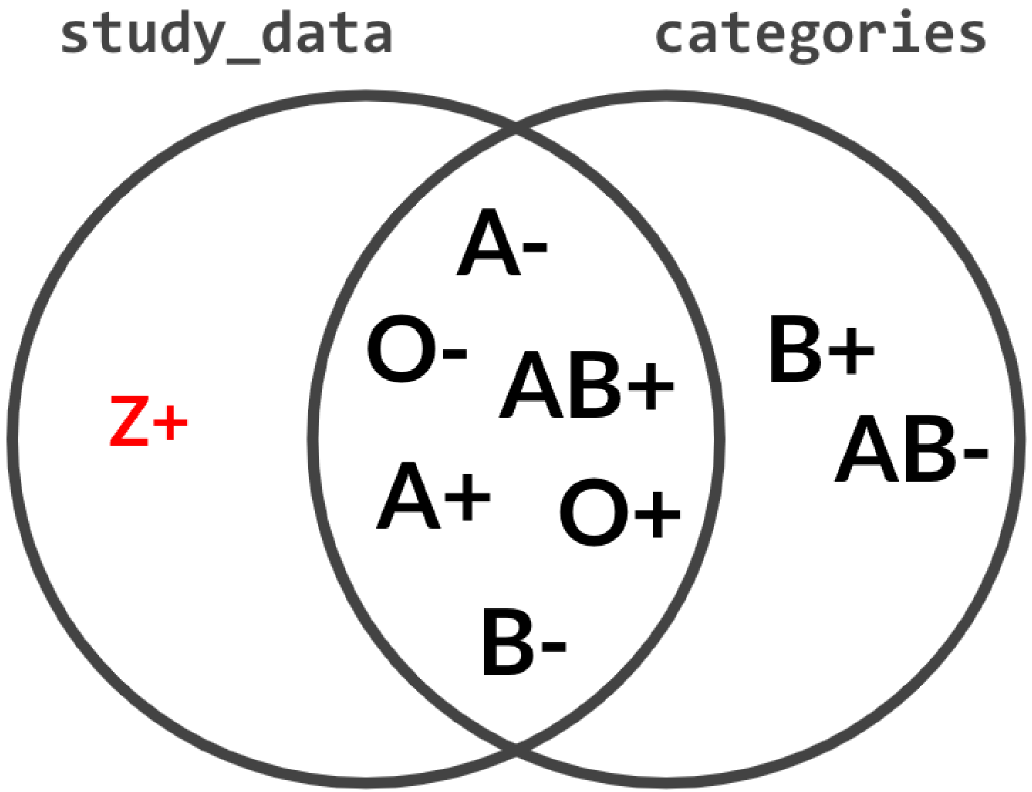

*What is in A and not in B*

*Inner Joins*




*What is in <u>both</u> A and B*

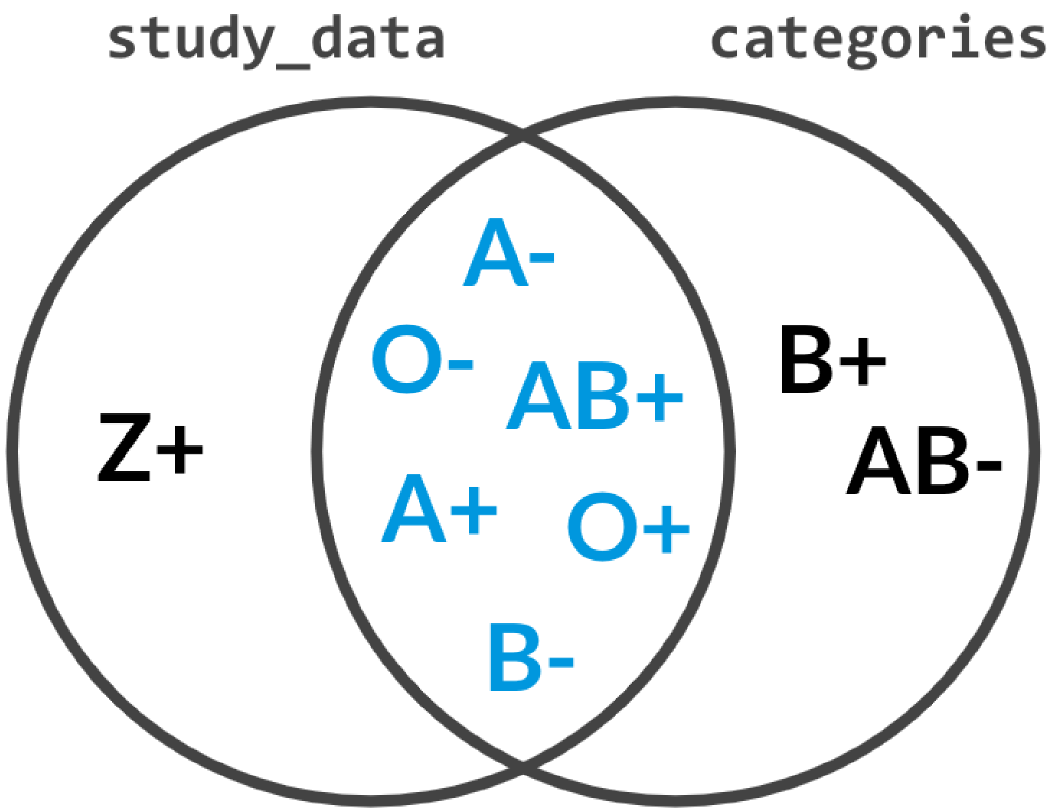
# A left anti join on blood types




*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_typ
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-
...     ...        ...        ...
```

# Let's practice!

DATA CLEANING IN PYTHON

# Categorical variables

DATA CLEANING IN PYTHON

**Adel Nehme**
Content Developer @DataCamp

# 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` (seen in Chapter 1)

# Value consistency

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

```
# 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

```
# 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'`

```
# 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)
```

# Let's practice!

# Cleaning text data

DATA CLEANING IN PYTHON

**Adel Nehme**
Content Developer @ DataCamp

# 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
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
```

Inconsistent data format

Length violation

# Example

```
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

```
# 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
digits = phones['Phone number'].str.len()
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
```

# Fixing the phone number column

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

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

```python
# 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
```

*Supercharged control + F*

# 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!

DATA CLEANING IN PYTHON