session2_data_analysis_demo

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1 Data Analysis with Python

Kim Hee (Graduate research assistant) Universitätsmedizin Mannheim, Mannheim (UMM)

- This is prepared for `Data analysis tools (Datenanalysewerkzeuge)` at MIRACUM summer school 2019

1.1 Prerequisite: Access the MIMIC Dataset

The MIMIC (Medical Information Mart for Intensive Care) is a freely accessible database containing Intensive Care Unit (ICU) patients. The demo dataset is limited to 100 patients and publicly available as CSV files or as a single Postgres database backup file

> **Instruction to access the MIMIC demo dataset:** 1. Create an account on PhysioNet using the following link: https://physionet.org/pnw/login 2. Navigate to the project page: https://physionet.org/works/MIMICIIIClinicalDatabaseDemo/ 3. Read the Data Use Agreement and click "I agree" to access the data

- Database description: https://mimic.physionet.org/gettingstarted/overview/
- Table description: https://mimic.physionet.org/mimictables/admissions/
- ER-Diagram: https://mit-lcp.github.io/mimic-schema-spy/relationships.html

Agenda * Data Analysis and Visualization * Pandas * Pandas-Profiling * Missingno * Wordcloud

1.2 Pandas

http://pandas.pydata.org/pandas-docs/stable/reference/ Pandas is a Python library for exploring, processing, and model data

1.2.1 Import and load pandas and an ODBC drive called psycopg2 (1/9)

[2]:
```
import pandas as pd
pd.set_option('display.max_columns', 999)
import pandas.io.sql as psql
import psycopg2
```

1.2.2 Query the meta data (2/9)

[3]:
```
DB_IP = "129.206.5.27"
conn = psycopg2.connect(f"postgres://postgres:postgres@{DB_IP}:5432/mimic")
```

[4]:
```
sql = "SELECT * FROM pg_catalog.pg_tables \
       WHERE schemaname = 'public'"
temp = psql.read_sql(sql, conn)
temp.tail() # Print the last five tables
```

[4]:
```
   schemaname  tablename tableowner tablespace  hasindexes  hasrules  \
38     public   services   postgres       None        True     False
39     public  transfers   postgres       None        True     False
40     public   patients   postgres       None        True     False
41     public    d_items   postgres       None        True     False
42     public   icustays   postgres       None        True     False

    hastriggers  rowsecurity
38         True        False
39         True        False
40         True        False
41         True        False
42         True        False
```

1.2.3 Query the admissions table and the patients table (3/9)

[5]:
```
sql = "SELECT * FROM admissions"
a = psql.read_sql(sql, conn)
a.head(5)
```

[5]:
```
   row_id  subject_id  hadm_id           admittime           dischtime  \
0   12258       10006   142345 2164-10-23 21:09:00 2164-11-01 17:15:00
1   12263       10011   105331 2126-08-14 22:32:00 2126-08-28 18:59:00
2   12265       10013   165520 2125-10-04 23:36:00 2125-10-07 15:13:00
3   12269       10017   199207 2149-05-26 17:19:00 2149-06-03 18:42:00
4   12270       10019   177759 2163-05-14 20:43:00 2163-05-15 12:00:00

             deathtime admission_type         admission_location  \
0                  NaT      EMERGENCY       EMERGENCY ROOM ADMIT
1 2126-08-28 18:59:00      EMERGENCY  TRANSFER FROM HOSP/EXTRAM
2 2125-10-07 15:13:00      EMERGENCY  TRANSFER FROM HOSP/EXTRAM
3                  NaT      EMERGENCY       EMERGENCY ROOM ADMIT
4 2163-05-15 12:00:00      EMERGENCY  TRANSFER FROM HOSP/EXTRAM

  discharge_location insurance language  religion marital_status  \
```

```
0   HOME HEALTH CARE  Medicare     None  CATHOLIC      SEPARATED
1       DEAD/EXPIRED   Private     None  CATHOLIC         SINGLE
2       DEAD/EXPIRED  Medicare     None  CATHOLIC           None
3                SNF  Medicare     None  CATHOLIC       DIVORCED
4       DEAD/EXPIRED  Medicare     None  CATHOLIC       DIVORCED

                ethnicity           edregtime           edouttime  \
0  BLACK/AFRICAN AMERICAN 2164-10-23 16:43:00 2164-10-23 23:00:00
1   UNKNOWN/NOT SPECIFIED                 NaT                 NaT
2   UNKNOWN/NOT SPECIFIED                 NaT                 NaT
3                   WHITE 2149-05-26 12:08:00 2149-05-26 19:45:00
4                   WHITE                 NaT                 NaT

             diagnosis  hospital_expire_flag  has_chartevents_data
0               SEPSIS                     0                     1
1          HEPATITIS B                     1                     1
2               SEPSIS                     1                     1
3    HUMERAL FRACTURE                     0                     1
4  ALCOHOLIC HEPATITIS                     1                     1
```

[6]:
```
sql = "SELECT * FROM patients"
p = psql.read_sql(sql, conn)
p.head()
```

[6]:
```
   row_id  subject_id gender        dob        dod   dod_hosp    dod_ssn  \
0    9467       10006      F 2094-03-05 2165-08-12 2165-08-12 2165-08-12
1    9472       10011      F 2090-06-05 2126-08-28 2126-08-28        NaT
2    9474       10013      F 2038-09-03 2125-10-07 2125-10-07 2125-10-07
3    9478       10017      F 2075-09-21 2152-09-12        NaT 2152-09-12
4    9479       10019      M 2114-06-20 2163-05-15 2163-05-15 2163-05-15

   expire_flag
0            1
1            1
2            1
3            1
4            1
```

1.2.4 Order by admission time and print the first and the last five records (4/9)

[7]:
```
a.sort_values(by = 'admittime').head()
```

[7]:
```
     row_id  subject_id  hadm_id           admittime           dischtime  \
75    40496       42231   171878 2102-08-29 07:15:00 2102-09-06 16:20:00
113   40993       43881   172454 2104-09-24 17:31:00 2104-09-30 16:17:00
114   40994       43881   167021 2104-10-24 09:44:00 2104-11-01 11:59:00
```

```
40    12353       10102   164869 2105-05-29 18:18:00 2105-06-11 02:20:00
112   40992       43879   158100 2106-08-30 15:43:00 2106-08-31 15:15:00

              deathtime admission_type         admission_location  \
75                  NaT       ELECTIVE  PHYS REFERRAL/NORMAL DELI
113                 NaT      EMERGENCY       EMERGENCY ROOM ADMIT
114                 NaT      EMERGENCY       EMERGENCY ROOM ADMIT
40  2105-06-11 02:20:00      EMERGENCY  CLINIC REFERRAL/PREMATURE
112                 NaT      EMERGENCY  CLINIC REFERRAL/PREMATURE

    discharge_location insurance language           religion marital_status  \
75    HOME HEALTH CARE  Medicare     ENGL           CATHOLIC        MARRIED
113   HOME HEALTH CARE   Private     ENGL      NOT SPECIFIED        MARRIED
114               HOME   Private     ENGL      NOT SPECIFIED        MARRIED
40        DEAD/EXPIRED  Medicare     None           CATHOLIC        MARRIED
112               HOME  Medicare     ENGL  PROTESTANT QUAKER        MARRIED

                 ethnicity           edregtime           edouttime  \
75                   WHITE                 NaT                 NaT
113                  WHITE 2104-09-24 12:07:00 2104-09-24 18:50:00
114                  WHITE 2104-10-24 07:17:00 2104-10-24 11:10:00
40                   WHITE                 NaT                 NaT
112  BLACK/AFRICAN AMERICAN                 NaT                 NaT

                                          diagnosis  hospital_expire_flag  \
75                                  RENAL CANCER/SDA                     0
113                          ACUTE PULMONARY EMBOLISM                     0
114                                    UPPER GI BLEED                     0
40   CHRONIC MYELOGENOUS LEUKEMIA;TRANSFUSION REACTION                     1
112                                 PLEURAL EFFUSION                     0

     has_chartevents_data
75                      1
113                     1
114                     1
40                      1
112                     1
```

[8]:
```
a.sort_values(by = 'admittime').tail()
```

[8]:
```
     row_id  subject_id  hadm_id           admittime           dischtime  \
108   40406       41976   179418 2201-12-31 19:19:00 2202-01-03 17:55:00
109   40407       41976   151798 2202-02-15 19:01:00 2202-02-19 16:42:00
110   40408       41976   145024 2202-05-01 22:00:00 2202-05-04 18:42:00
111   40409       41976   149469 2202-09-16 21:56:00 2202-09-23 16:20:00
124   40410       41976   153826 2202-10-03 01:45:00 2202-10-11 16:30:00
```

```
    deathtime admission_type         admission_location discharge_location  \
108       NaT      EMERGENCY  CLINIC REFERRAL/PREMATURE                SNF
109       NaT      EMERGENCY  CLINIC REFERRAL/PREMATURE                SNF
110       NaT      EMERGENCY  TRANSFER FROM SKILLED NUR                SNF
111       NaT      EMERGENCY  CLINIC REFERRAL/PREMATURE                ICF
124       NaT      EMERGENCY  CLINIC REFERRAL/PREMATURE                ICF

    insurance language  religion marital_status  \
108  Medicare     SPAN  CATHOLIC        MARRIED
109  Medicare     SPAN  CATHOLIC        MARRIED
110  Medicare     SPAN  CATHOLIC        MARRIED
111  Medicare     SPAN  CATHOLIC        MARRIED
124  Medicare     SPAN  CATHOLIC        MARRIED

                         ethnicity           edregtime           edouttime  \
108  HISPANIC/LATINO - PUERTO RICAN 2201-12-31 17:41:00 2201-12-31 23:05:00
109  HISPANIC/LATINO - PUERTO RICAN 2202-02-15 16:35:00 2202-02-15 21:00:00
110  HISPANIC/LATINO - PUERTO RICAN 2202-05-01 19:32:00 2202-05-01 23:30:00
111  HISPANIC/LATINO - PUERTO RICAN 2202-09-16 18:24:00 2202-09-16 23:35:00
124  HISPANIC/LATINO - PUERTO RICAN 2202-10-03 01:19:00 2202-10-03 03:40:00

               diagnosis  hospital_expire_flag  has_chartevents_data
108            PNEUMONIA                     0                     1
109   UTI/PYELONEPHRITIS                     0                     1
110  RESPIRATORY DISTRESS                    0                     1
111               SEPSIS                     0                     1
124               SEPSIS                     0                     1
```

1.2.5 GROUPBY function example (5/9)

[9]:
```
a.groupby(['admission_type']).count()['row_id']
```

[9]:
```
admission_type
ELECTIVE       8
EMERGENCY    119
URGENT         2
Name: row_id, dtype: int64
```

1.2.6 built-in function example (6/9)

[10]:
```
a['admission_type'].value_counts()
```

[10]:
```
EMERGENCY    119
ELECTIVE       8
```

```
URGENT         2
Name: admission_type, dtype: int64
```

1.2.7 JOIN function example (7/9)

[11]:
```
ap = pd.merge(a, p, on = 'subject_id' , how = 'inner')
ap.head()
```

[11]:

	row_id_x	subject_id	hadm_id	admittime	dischtime	deathtime	admission_type	admission_location	discharge_location	insurance	language	religion	marital_status	ethnicity	edregtime	edouttime	diagnosis	hospital_expire_flag	has_chartevents_data	row_id_y	gender	dob	dod	dod_hosp	dod_ssn	expire_flag
0	12258	10006	142345	2164-10-23 21:09:00	2164-11-01 17:15:00	NaT	EMERGENCY	EMERGENCY ROOM ADMIT	HOME HEALTH CARE	Medicare	None	CATHOLIC	SEPARATED	BLACK/AFRICAN AMERICAN	2164-10-23 16:43:00	2164-10-23 23:00:00	SEPSIS	0	1	9467	F	2094-03-05	2165-08-12	2165-08-12	2165-08-12	1
1	12263	10011	105331	2126-08-14 22:32:00	2126-08-28 18:59:00	2126-08-28 18:59:00	EMERGENCY	TRANSFER FROM HOSP/EXTRAM	DEAD/EXPIRED	Private	None	CATHOLIC	SINGLE	UNKNOWN/NOT SPECIFIED	NaT	NaT	HEPATITIS B	1	1	9472	F	2090-06-05	2126-08-28	2126-08-28	NaT	1
2	12265	10013	165520	2125-10-04 23:36:00	2125-10-07 15:13:00	2125-10-07 15:13:00	EMERGENCY	TRANSFER FROM HOSP/EXTRAM	DEAD/EXPIRED	Medicare	None	CATHOLIC	None	UNKNOWN/NOT SPECIFIED	NaT	NaT	SEPSIS	1	1	9474						
3	12269	10017	199207	2149-05-26 17:19:00	2149-06-03 18:42:00	NaT	EMERGENCY	EMERGENCY ROOM ADMIT	SNF	Medicare	None	CATHOLIC	DIVORCED	WHITE	2149-05-26 12:08:00	2149-05-26 19:45:00	HUMERAL FRACTURE	0	1	9478						
4	12270	10019	177759	2163-05-14 20:43:00	2163-05-15 12:00:00	2163-05-15 12:00:00	EMERGENCY	TRANSFER FROM HOSP/EXTRAM	DEAD/EXPIRED	Medicare	None	CATHOLIC	DIVORCED	WHITE	NaT	NaT	ALCOHOLIC HEPATITIS	1	1	9479						

```
2      F 2038-09-03 2125-10-07 2125-10-07 2125-10-07            1
3      F 2075-09-21 2152-09-12        NaT 2152-09-12            1
4      M 2114-06-20 2163-05-15 2163-05-15 2163-05-15            1
```

1.2.8 Create a new column (8/9)

[12]:
```
ap['age'] = ap['admittime'].dt.year - ap['dob'].dt.year
ap.head()
```

[12]:
```
   row_id_x  subject_id  hadm_id           admittime           dischtime  \
0     12258       10006   142345 2164-10-23 21:09:00 2164-11-01 17:15:00
1     12263       10011   105331 2126-08-14 22:32:00 2126-08-28 18:59:00
2     12265       10013   165520 2125-10-04 23:36:00 2125-10-07 15:13:00
3     12269       10017   199207 2149-05-26 17:19:00 2149-06-03 18:42:00
4     12270       10019   177759 2163-05-14 20:43:00 2163-05-15 12:00:00

            deathtime admission_type         admission_location  \
0                 NaT      EMERGENCY       EMERGENCY ROOM ADMIT
1 2126-08-28 18:59:00      EMERGENCY  TRANSFER FROM HOSP/EXTRAM
2 2125-10-07 15:13:00      EMERGENCY  TRANSFER FROM HOSP/EXTRAM
3                 NaT      EMERGENCY       EMERGENCY ROOM ADMIT
4 2163-05-15 12:00:00      EMERGENCY  TRANSFER FROM HOSP/EXTRAM

  discharge_location insurance language  religion marital_status  \
0   HOME HEALTH CARE  Medicare     None  CATHOLIC      SEPARATED
1       DEAD/EXPIRED   Private     None  CATHOLIC         SINGLE
2       DEAD/EXPIRED  Medicare     None  CATHOLIC           None
3                SNF  Medicare     None  CATHOLIC       DIVORCED
4       DEAD/EXPIRED  Medicare     None  CATHOLIC       DIVORCED

               ethnicity           edregtime           edouttime  \
0  BLACK/AFRICAN AMERICAN 2164-10-23 16:43:00 2164-10-23 23:00:00
1   UNKNOWN/NOT SPECIFIED                 NaT                 NaT
2   UNKNOWN/NOT SPECIFIED                 NaT                 NaT
3                   WHITE 2149-05-26 12:08:00 2149-05-26 19:45:00
4                   WHITE                 NaT                 NaT

             diagnosis  hospital_expire_flag  has_chartevents_data  row_id_y  \
0               SEPSIS                     0                     1      9467
1         HEPATITIS B                      1                     1      9472
2               SEPSIS                     1                     1      9474
3    HUMERAL FRACTURE                      0                     1      9478
4  ALCOHOLIC HEPATITIS                     1                     1      9479

  gender        dob        dod   dod_hosp    dod_ssn  expire_flag  age
0      F 2094-03-05 2165-08-12 2165-08-12 2165-08-12            1   70
```

```
1      F 2090-06-05 2126-08-28 2126-08-28        NaT            1   36
2      F 2038-09-03 2125-10-07 2125-10-07 2125-10-07            1   87
3      F 2075-09-21 2152-09-12        NaT 2152-09-12            1   74
4      M 2114-06-20 2163-05-15 2163-05-15 2163-05-15            1   49
```

1.2.9 WHERE function example (9/9)

[13]:
```
ap[ ap['diagnosis'] == 'ASTHMA' ]
```

[13]:
```
Empty DataFrame
Columns: [row_id_x, subject_id, hadm_id, admittime, dischtime, deathtime,
admission_type, admission_location, discharge_location, insurance, language,
religion, marital_status, ethnicity, edregtime, edouttime, diagnosis,
hospital_expire_flag, has_chartevents_data, row_id_y, gender, dob, dod,
dod_hosp, dod_ssn, expire_flag, age]
Index: []
```

[14]:
```
ap[ap['diagnosis'].str.contains('ASTHMA')]
```

[14]:
```
    row_id_x  subject_id  hadm_id           admittime           dischtime  \
79     40514       42302   167754 2160-05-04 14:10:00 2160-05-08 11:55:00
83     40349       41795   138132 2145-07-07 01:19:00 2145-07-20 19:15:00
84     40350       41795   118192 2145-09-06 08:52:00 2145-09-09 16:25:00

   deathtime admission_type    admission_location discharge_location  \
79       NaT      EMERGENCY  EMERGENCY ROOM ADMIT                SNF
83       NaT      EMERGENCY  EMERGENCY ROOM ADMIT                SNF
84       NaT      EMERGENCY  EMERGENCY ROOM ADMIT                SNF

   insurance language       religion marital_status ethnicity  \
79  Medicare     ENGL  NOT SPECIFIED         SINGLE     WHITE
83  Medicare     ENGL  NOT SPECIFIED        MARRIED     WHITE
84  Medicare     ENGL  NOT SPECIFIED        MARRIED     WHITE

             edregtime           edouttime                         diagnosis  \
79 2160-05-04 11:05:00 2160-05-04 15:48:00                 ASTHMA/COPD FLARE
83 2145-07-06 22:59:00 2145-07-07 02:16:00  ASTHMA;CHRONIC OBST PULM DISEASE
84 2145-09-05 22:24:00 2145-09-06 10:14:00  ASTHMA;CHRONIC OBST PULM DISEASE

    hospital_expire_flag  has_chartevents_data  row_id_y gender        dob  \
79                     0                     1     31397      F 2074-09-29
83                     0                     1     31277      M 2096-07-25
84                     0                     1     31277      M 2096-07-25

          dod dod_hosp    dod_ssn  expire_flag  age
79 2160-06-08      NaT 2160-06-08            1   86
```

```
83 2145-12-06       NaT 2145-12-06             1   49
84 2145-12-06       NaT 2145-12-06             1   49
```

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1.3 Pandas supports charting a tabular dataset

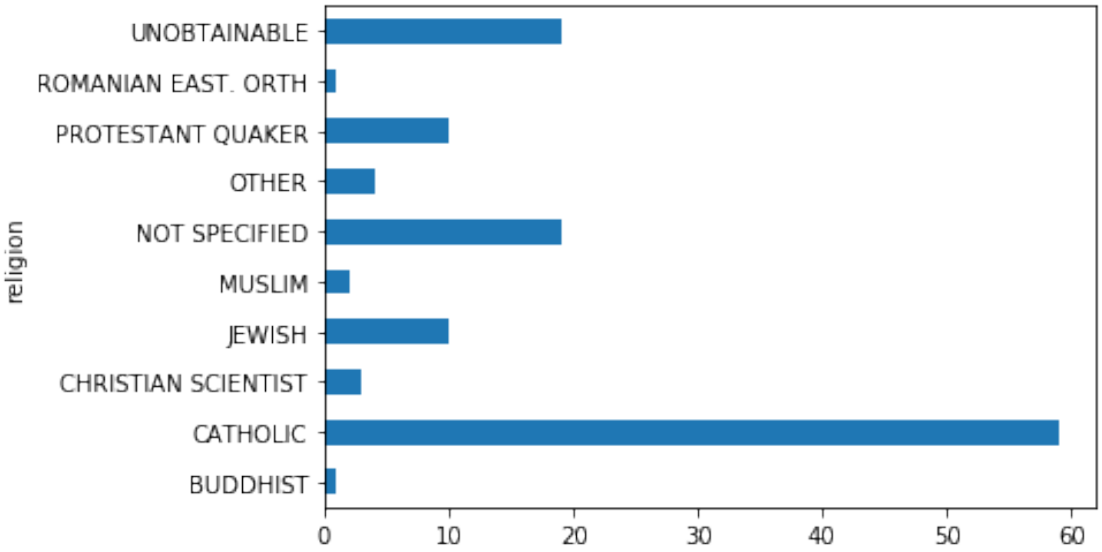
DataFrame.plot([x, y], **kind**) > **kind** : * 'line': line plot (default) * 'bar': vertical bar plot * 'barh': horizontal bar plot * 'hist': histogram * 'box': boxplot * 'kde': Kernel Density Estimation plot * 'density': same as 'kde' * 'area': stacked area plot * 'pie': pie plot * 'scatter': scatter plot * 'hexbin': Hexagonal binning plot

1.3.1 Visualize the admission table

[15]:
```
# plot a figure directly on Notebook
import matplotlib.pyplot as plt
%matplotlib inline
```

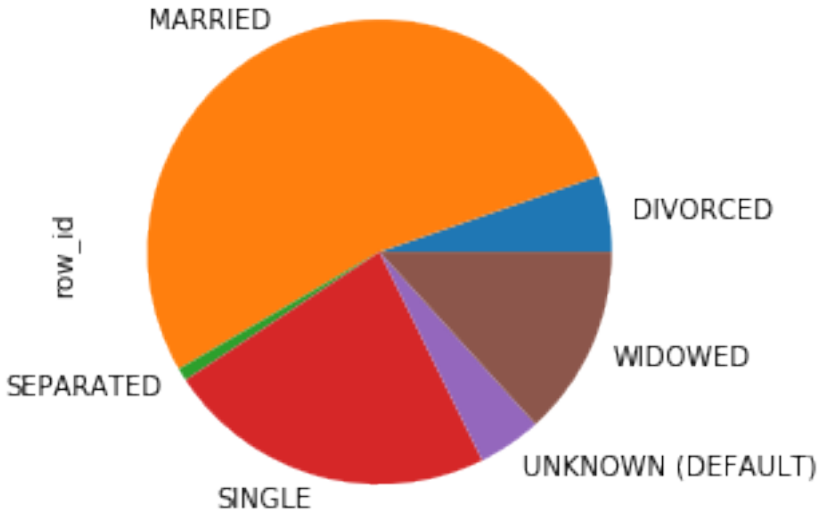
[16]:
```
a.groupby(['religion']).count()['row_id'].plot(kind = 'barh')
```

[16]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f44fd7d8b70>
```



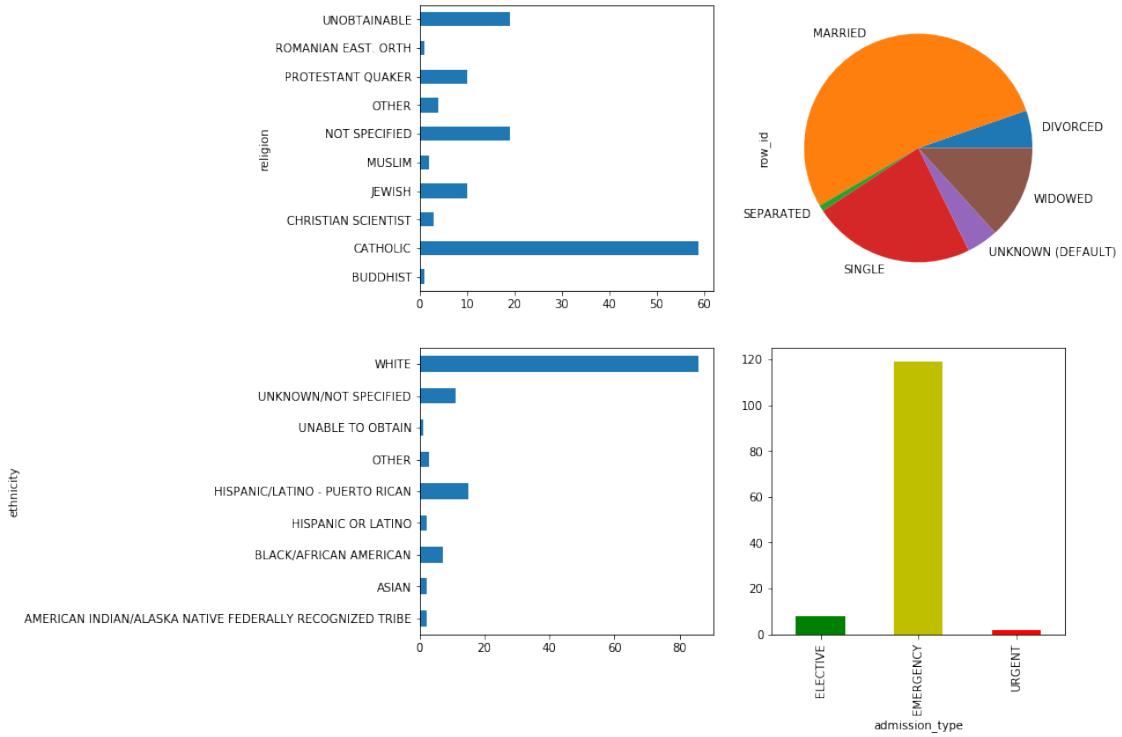
[17]:
```
a.groupby(['marital_status']).count()['row_id'].plot(kind='pie')
```

[17]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f44f6fd1358>
```



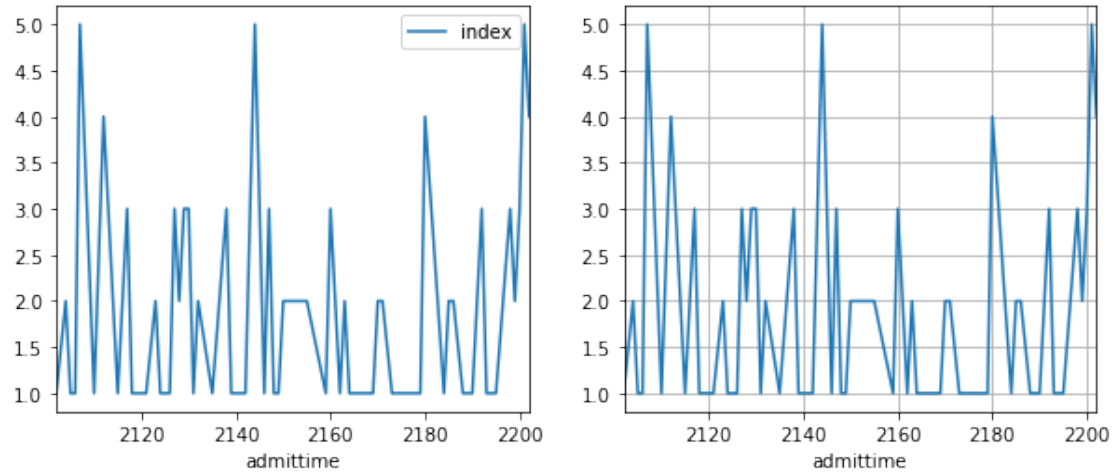
[18]:
```
fig, axes = plt.subplots(nrows = 2, ncols = 2, figsize = (10,10))
a.groupby(['religion']).count()['row_id'].plot(ax = axes[0,0], kind = 'barh')
a.groupby(['marital_status']).count()['row_id'].plot(ax = axes[0,1], kind =␣
↪'pie')
a.groupby(['ethnicity']).count()['row_id'].plot(ax = axes[1,0], kind = 'barh')
a.groupby(['admission_type']).count()['row_id'].plot(ax = axes[1,1], kind =␣
↪'bar', color = ['g','y','r'])
```

[18]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f44f6e5a240>
```



[19]:
```
fig, axes = plt.subplots(nrows = 1, ncols = 2, figsize = (10,4))
a['admittime'].dt.year.reset_index().groupby(['admittime']).count().plot(ax =␣
↪axes[0])
a['admittime'].dt.year.reset_index().groupby(['admittime']).count().plot(ax =␣
↪axes[1], grid = True, legend = False)
```

[19]: <matplotlib.axes._subplots.AxesSubplot at 0x7f44f6b92630>



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1.4 Missingno

https://github.com/ResidentMario/missingno Missingno offers a visual summary of the completeness of a dataset

1.4.1 Import missingno (1/2)

[23]:
```
import missingno as msno
```

1.4.2 Depict the missing values (2/2)

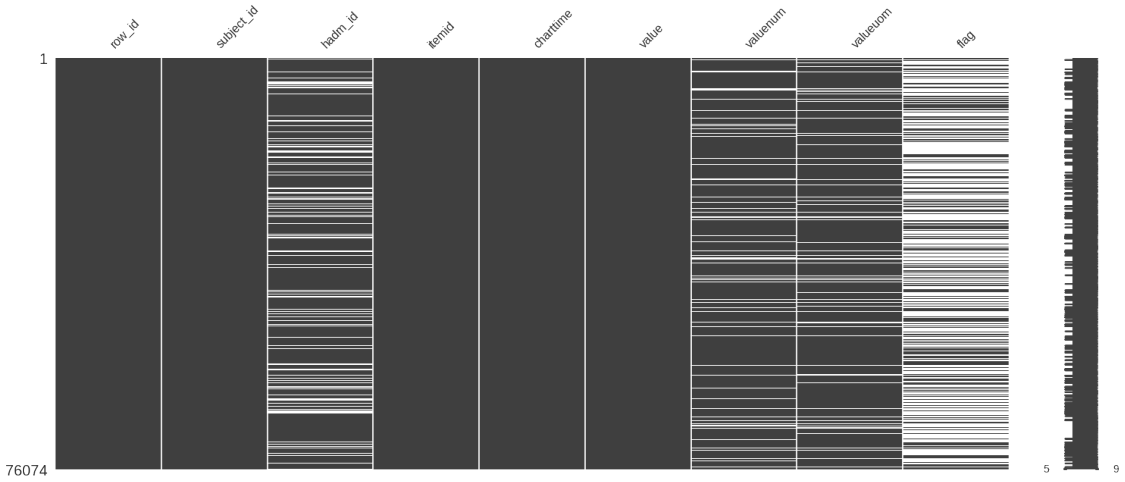
[24]:
```
sql = "SELECT * FROM labevents"
lab = psql.read_sql(sql, conn)
lab.head(1)
```

[24]:
```
    row_id  subject_id   hadm_id  itemid           charttime value  valuenum  \
0  6294375       10120  193924.0   51214 2115-05-13 14:53:00   226     226.0

  valueuom  flag
0    mg/dL  None
```

[25]:
```
%matplotlib inline
msno.matrix(lab)
```

[25]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f44bf3b9ef0>
```



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1.5 Pandas-Profiling

https://github.com/pandas-profiling/pandas-profiling Pandas-Profiling is a Python library for speed up an exploratory data analysis

1.5.1 Import pandas-profiling (1/3)

[20]:
```
import pandas_profiling
```

1.5.2 Query the admissions table (2/3)

[21]:
```
sql = "SELECT * FROM admissions"
a = psql.read_sql(sql, conn)
a.head(1)
```

[21]:

	row_id	subject_id	hadm_id	admittime	dischtime	deathtime	admission_type	admission_location	discharge_location	insurance	language	religion	marital_status	ethnicity	edregtime	edouttime	diagnosis	hospital_expire_flag	has_chartevents_data
0	12258	10006	142345	2164-10-23 21:09:00	2164-11-01 17:15:00	NaT	EMERGENCY	EMERGENCY ROOM ADMIT	HOME HEALTH CARE	Medicare	None	CATHOLIC	SEPARATED	BLACK/AFRICAN AMERICAN	2164-10-23 16:43:00	2164-10-23 23:00:00	SEPSIS	0	1

1.5.3 Profile the table (3/3)

[22]:
```
pandas_profiling.ProfileReport(a)
```

```
/opt/conda/lib/python3.7/site-
packages/pandas_profiling/model/correlations.py:124: UserWarning: There was an
attempt to calculate the cramers correlation, but this failed.
To hide this warning, disable the calculation
(using `df.profile_report(correlations={"cramers": False}`)
If this is problematic for your use case, please report this as an issue:
https://github.com/pandas-profiling/pandas-profiling/issues
```

```
(include the error message: 'The internally computed table of expected
frequencies has a zero element at (0, 2).')
  correlation_name=correlation_name, error=error
```

```
<IPython.core.display.HTML object>
```

[22]:

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1.6 Wordcloud

https://github.com/amueller/word_cloud Wordcloud visualizes a given text in a word-cloud format

1.6.1 Import the Wordcloud package (1/4)

[26]:
```
from wordcloud import WordCloud
```

1.6.2 Prepare an input text in string (2/4)

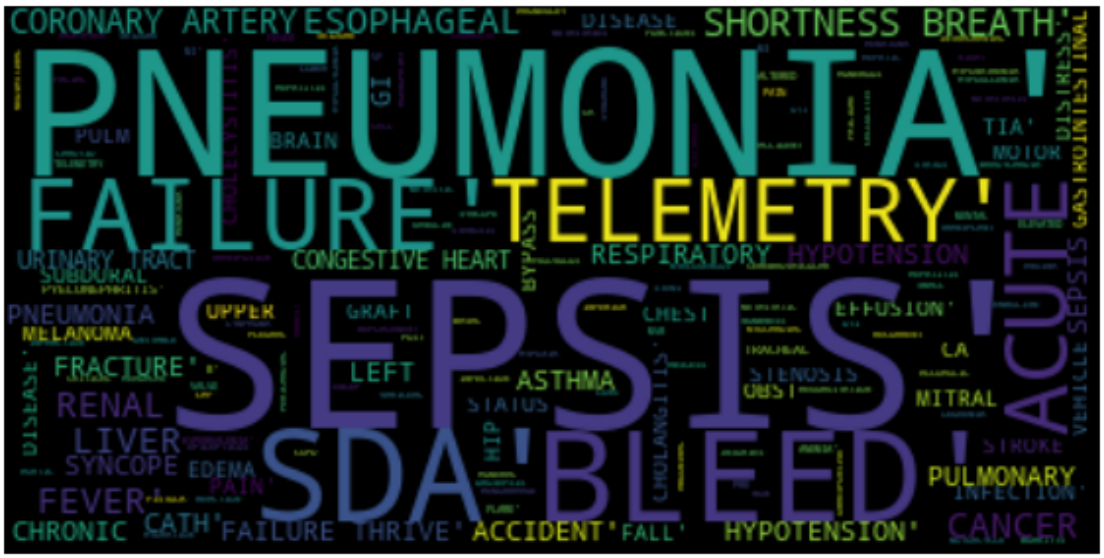
[27]:
```
text = str(a['diagnosis'].values)
```

1.6.3 Generate a word-cloud from the input text (3/4)

[28]:
```
wordcloud = WordCloud().generate(text)
```

1.6.4 Plot the word-cloud (4/4)

[29]:
```
import matplotlib.pyplot as plt
plt.figure(figsize = (10,10))
plt.imshow(wordcloud, interpolation = 'bilinear')
plt.axis("off")
plt.show()
```



1.7 Bonus Slide - Automate entity relationship diagrams

[30]:
```
from sqlalchemy import MetaData
from sqlalchemy_schemadisplay import create_schema_graph
```

[31]:
```
graph = create_schema_graph(
            metadata = MetaData(f'postgres://postgres:postgres@{DB_IP}:5432/
 ↪mimic'),
            show_datatypes = False, # The image would get nasty big if we'd␣
 ↪show the datatypes
            show_indexes = False, # ditto for indexes
            rankdir = 'LR', # From left to right (instead of top to bottom)
            concentrate = False # Don't try to join the relation lines together
)
```

[32]:
```
graph.write_png('images/er_mimic_auto.png')
```

[33]:
```
%%html
<img src = 'images/er_mimic_auto.png' style = 'width:1000px;'>
```

```
<IPython.core.display.HTML object>
```