Mudcard

- **The muddiest thing for me is that why we need a pd.dataframe. Why is it priority?**
  - Practicioners of the field use it so you should be familiar with it too.
- **When/would you ever turn strings or qualitative data from CSV files into numerical data?**
  - my advice is to leave the data untransformed during EDA
  - we will transform data to numerical values when we prepare it for ML
- **Why do we need double brackets for selecting columns in the dataframe but only single bracket for selecting rows?**
  - sometimes when you select rows or columns, you use a list of inidces or a list of column names
  - that's where the extra square bracket is coming from
- **Technically q3 asked to Merge the third data frame with df_append it should be right to join?**
  - df1.merge(df2,how='left') is the same as df2.merge(df1,how='right')
  - try it out
- **Is merge basically the same thing as join in pandas?**
  - similar, join takes two dataframes and combines them based on their indices
  - use the toy datasets from the previous lecture and try it out
- **what's the advantage of using pd.concat() over pd.merge()?**
  - concat is used to append dataframes
  - your goal determines which one is more appropriate/adventageous to use

Exploratory data analysis in python, part 2

Learning objectives

By the end of this lecture, you will be able to

- visualize one column (continuous or categorical data)
- visualize column pairs (all variations of continuous and categorical columns)
- visualize multiple columns simultaneously

Dataset of the day

Adult dataset, see here

Packages of the day

matplotlib and pandas

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Let's load the data first!

In [1]:

```
import pandas as pd
import numpy as np
import matplotlib
from matplotlib import pylab as plt
df = pd.read_csv('data/adult_data.csv')
print(df.dtypes)
```

```
age                int64
workclass         object
fnlwgt             int64
education         object
education-num      int64
marital-status    object
occupation        object
relationship      object
race              object
sex               object
capital-gain       int64
capital-loss       int64
hours-per-week     int64
native-country    object
gross-income      object
dtype: object
```

Column is categorical

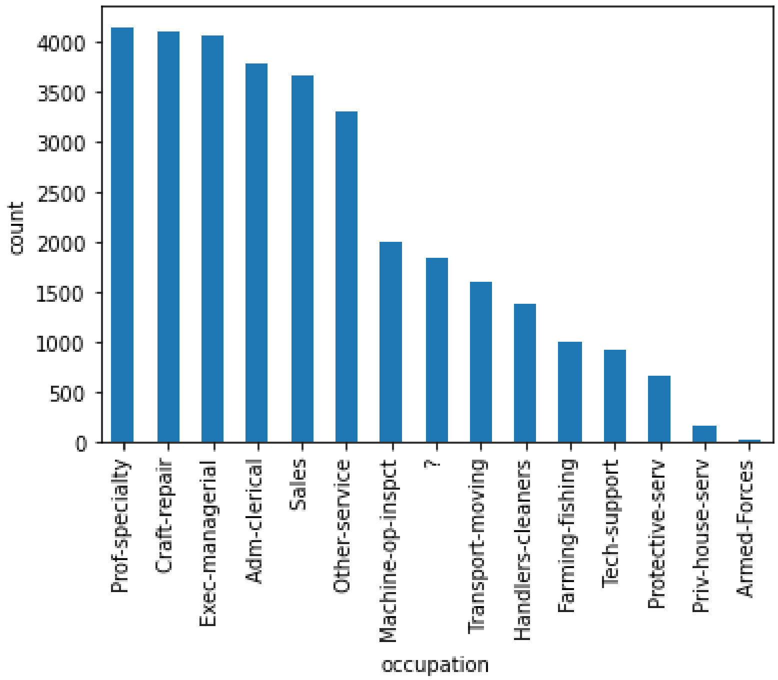
In [2]:

```
print(df['occupation'].value_counts())
```

```
 Prof-specialty       4140
 Craft-repair         4099
 Exec-managerial      4066
 Adm-clerical         3770
 Sales                3650
 Other-service        3295
 Machine-op-inspct    2002
 ?                    1843
 Transport-moving     1597
 Handlers-cleaners    1370
 Farming-fishing       994
 Tech-support          928
 Protective-serv       649
 Priv-house-serv       149
 Armed-Forces            9
Name: occupation, dtype: int64
```

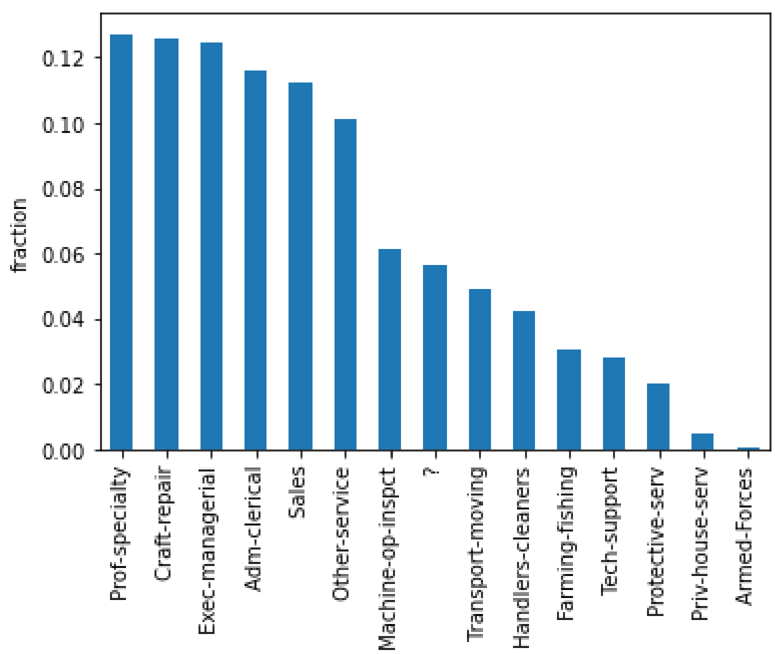
In [3]:

```
pd.value_counts(df['occupation']).plot.bar()
plt.ylabel('count')
plt.xlabel('occupation')
plt.show()
```



In [4]:

```
pd.value_counts(df['occupation'],normalize=True).plot.bar()
plt.ylabel('fraction')
plt.show()
```



Be very careful if the categories are ordered (e.g., months)!

https://st12.ning.com/topology/rest/1.0/file/get/8259702852?profile=original

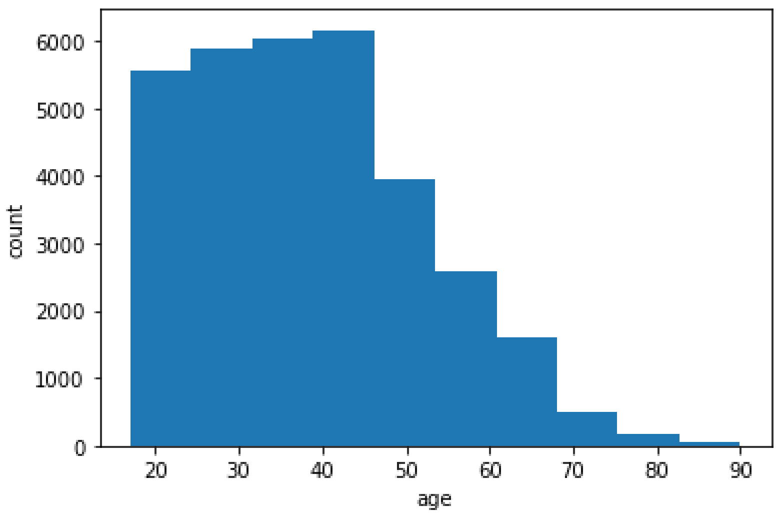
https://st12.ning.com/topology/rest/1.0/file/get/8259711099?profile=original

Column is continuous

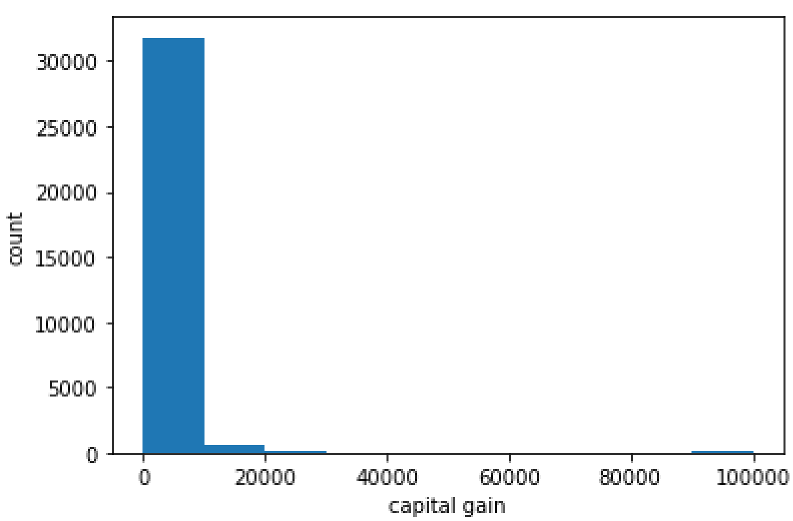
In [5]:
```python
print(df['age'].describe())
```

```
count    32561.000000
mean        38.581647
std         13.640433
min         17.000000
25%         28.000000
50%         37.000000
75%         48.000000
max         90.000000
Name: age, dtype: float64
```

In [6]:
```python
df['age'].plot.hist()    # bins = int(np.sqrt(df.shape[0]))
                         # bins = df['age'].nunique()
plt.xlabel('age')
plt.ylabel('count')
plt.show()
```



In [7]:
```python
df['capital-gain'].plot.hist() # log=True, bins = np.logspace(np.log10(1),np.log
#plt.semilogy()
#plt.semilogx()
plt.xlabel('capital gain')
plt.ylabel('count')
plt.show()
```



Quiz 1

What fraction of the people in the dataset have a Masters degree?

In [8]:
```
# add your code here:
```

By the end of this lecture, you will be able to

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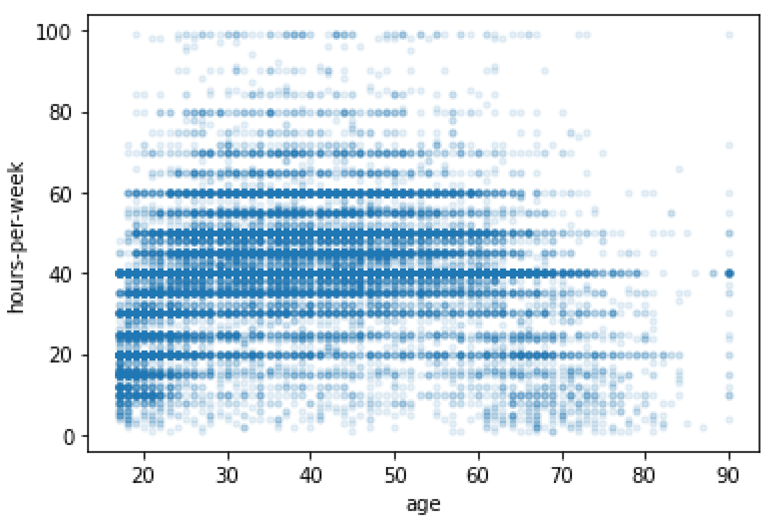
Overview

Visualization types	column continuous	column categorical
column continuous	scatter plot, heatmap	category-specific histograms, box plot, violin plot
column categorical	category-specific histograms, box plot, violin plot	stacked bar plot

Continuous vs. continuous columns

- scatter plot

In [9]:
```
df.plot.scatter('age','hours-per-week',s=10,alpha=0.1) # alpha=0.1,s=10
plt.show()
```



Continuous vs. continuous columns

- heatmap

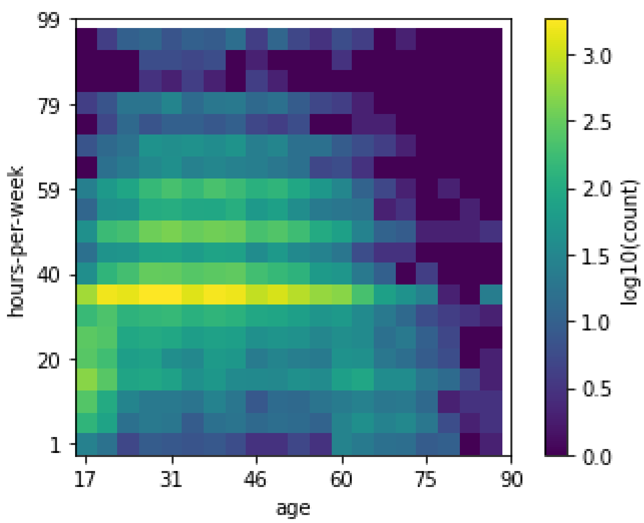
In [10]:
```
nbins = 20
```

```
heatmap, xedges, yedges = np.histogram2d(df['age'], df['hours-per-week'], bins=n
extent = [xedges[0], xedges[-1], yedges[0], yedges[-1]]
```

In [11]:

```
heatmap[heatmap == 0] = 0.1 # we will use log and log(0) is undefined

plt.imshow(np.log10(heatmap).T, origin='lower',vmin=0) # use log count
plt.xlabel('age')
plt.ylabel('hours-per-week')
plt.xticks(np.arange(nbins+1)[::4],xedges[::4].astype(int))
plt.yticks(np.arange(nbins+1)[::4],yedges[::4].astype(int))
plt.colorbar(label='log10(count)')
plt.show()
```



Categorical vs. categorical columns

- stacked bar plot

In [12]:

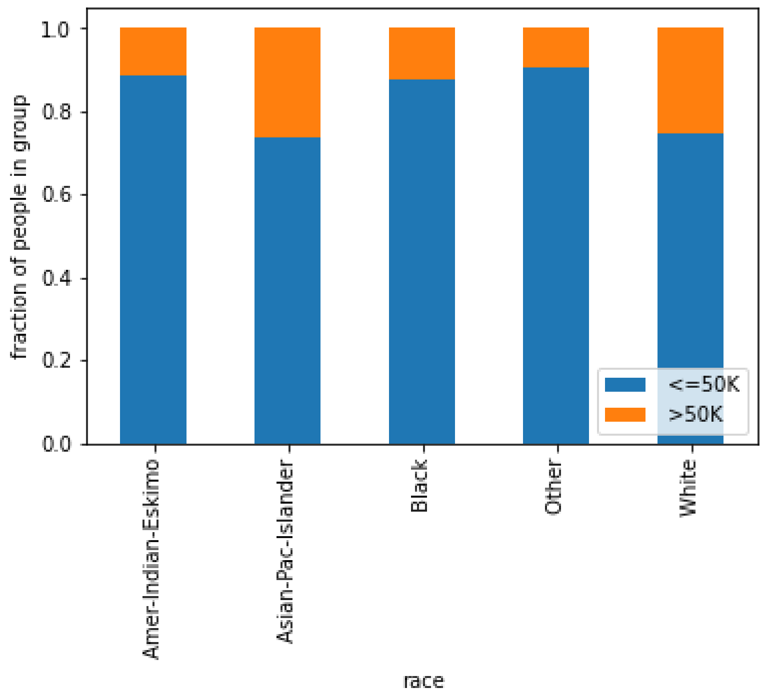
```
count_matrix = df.groupby(['race', 'gross-income']).size().unstack()
#print(count_matrix)

count_matrix_norm = count_matrix.div(count_matrix.sum(axis=1),axis=0)
print(count_matrix_norm)
```

```
gross-income              <=50K      >50K
race
 Amer-Indian-Eskimo   0.884244  0.115756
 Asian-Pac-Islander   0.734360  0.265640
 Black                0.876120  0.123880
 Other                0.907749  0.092251
 White                0.744140  0.255860
```

In [13]:

```
count_matrix_norm.plot(kind='bar', stacked=True)
plt.ylabel('fraction of people in group')
plt.legend(loc=4)
plt.show()
```



Continuous vs. categorical columns

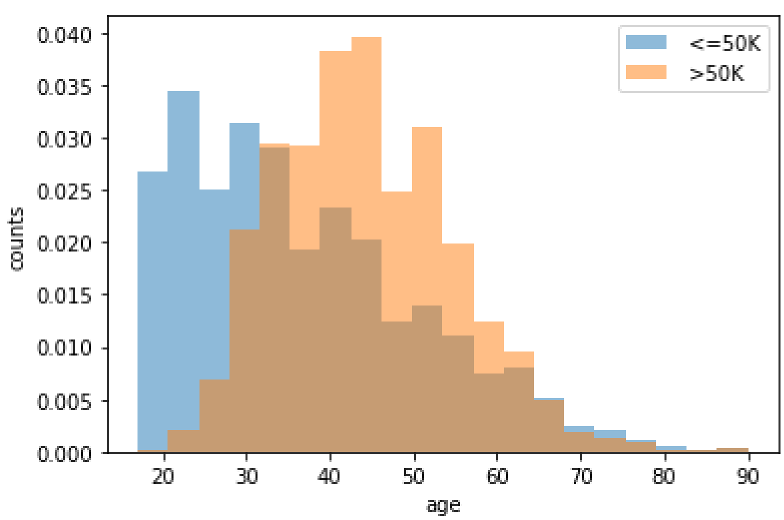
- category-specific histograms

In [14]:

```
import matplotlib
from matplotlib import pylab as plt

categories = df['gross-income'].unique()
bin_range = (df['age'].min(),df['age'].max())

for c in categories:
    plt.hist(df[df['gross-income']==c]['age'],alpha=0.5,label=c,range=bin_range,
plt.legend()
plt.ylabel('counts')
plt.xlabel('age')
plt.show()
```

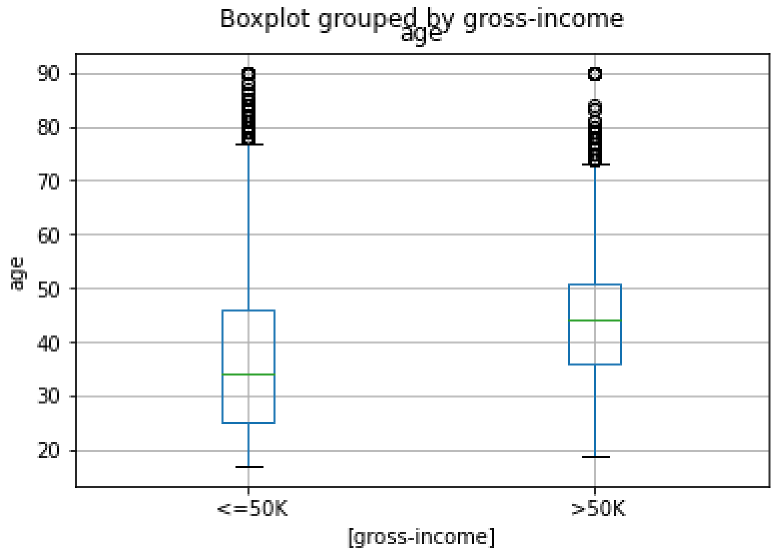


Continuous vs. categorical columns

- box plot

In [15]:

```
df[['age','gross-income']].boxplot(by='gross-income')
plt.ylabel('age')
plt.show()
```



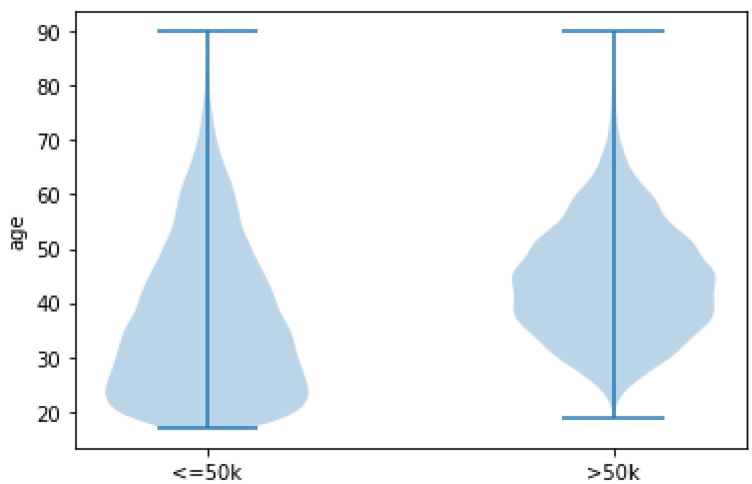
Continuous vs. categorical columns

- violin plot

In [16]:

```
dataset = [df[df['gross-income']==' <=50K']['age'].values,
           df[df['gross-income']==' >50K']['age'].values]

plt.violinplot(dataset = dataset)
plt.xticks([1,2],['<=50k','>50k'])
plt.ylabel('age')
plt.show()
```



Quiz 2

Pair the column name(s) with the appropriate visualization type!

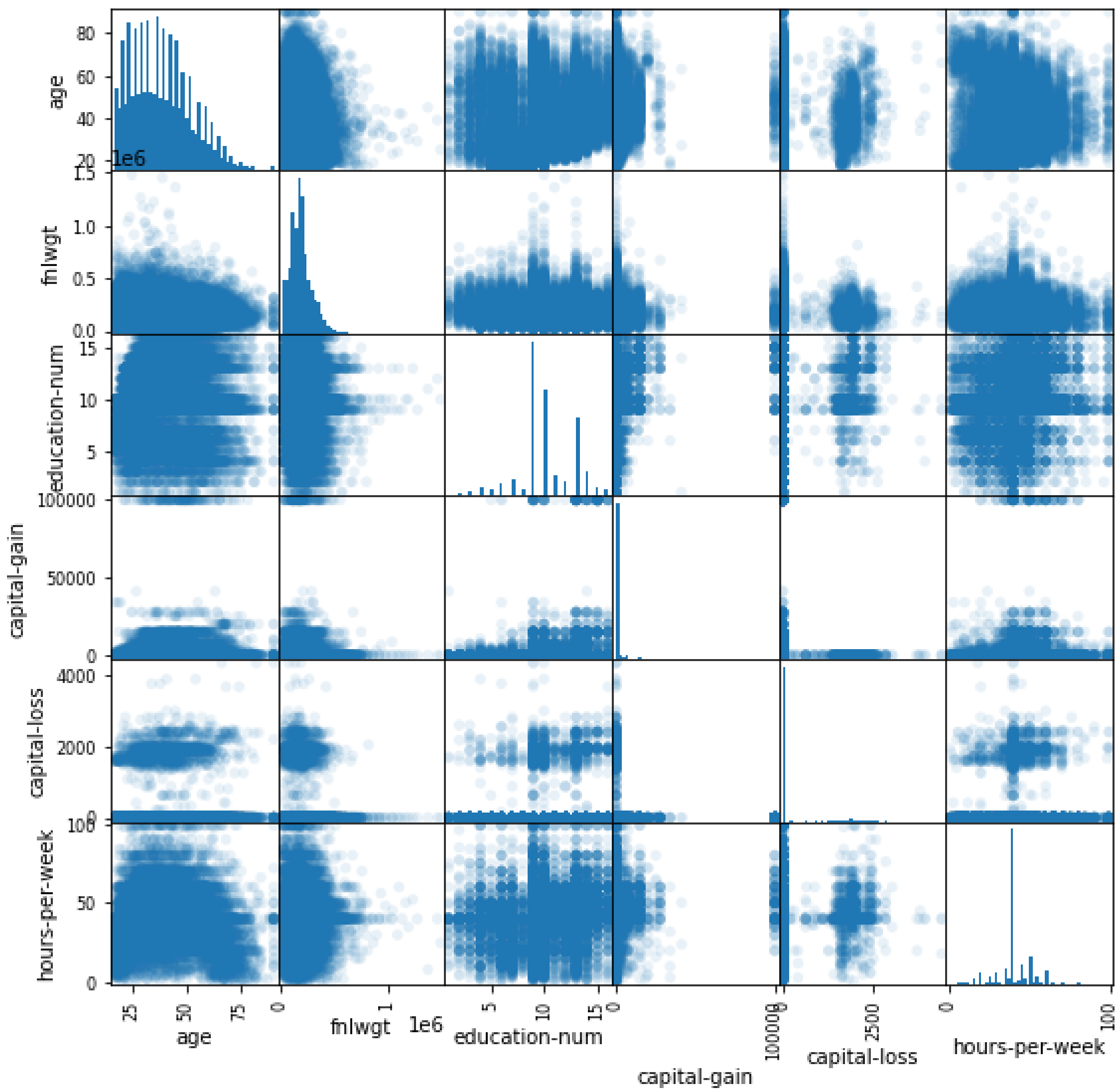
By the end of this lecture, you will be able to

- visualize one column (categorical or continuous data)
- visualize column pairs (all variations of continuous and categorical columns)
- **visualize multiple columns simultaneously**

Scatter matrix

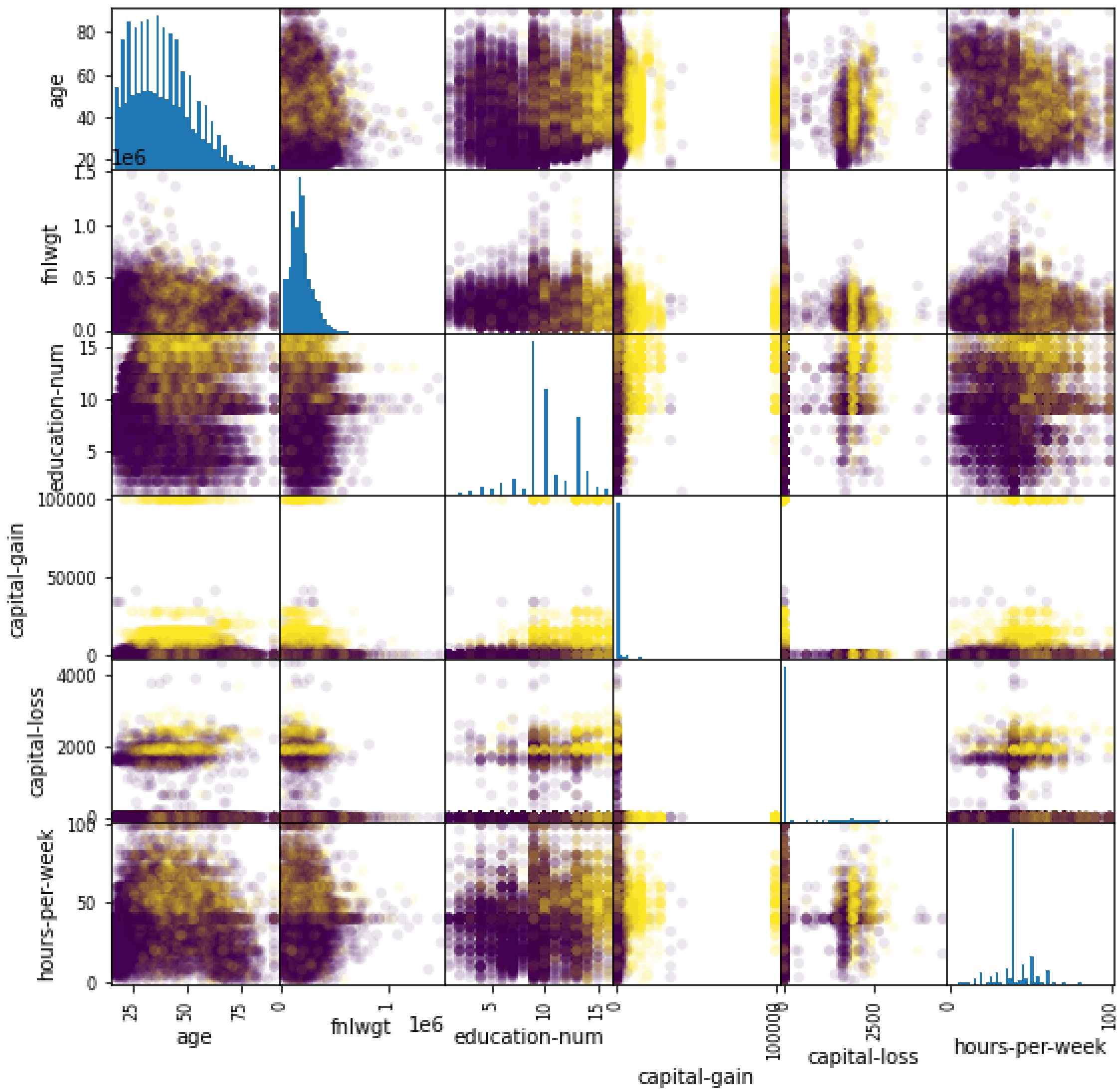
In [17]:

```
pd.plotting.scatter_matrix(df.select_dtypes(int), figsize=(9, 9), marker='o',his
                           s=30, alpha=.1)
plt.show()
```



In [18]:

```
pd.plotting.scatter_matrix(df.select_dtypes(int), figsize=(9, 9),c = pd.get_dumm
                           marker='o',hist_kwds={'bins': 50}, s=30, alpha=.1)
plt.show()
```



By now, you can

- visualize one column (continuous or categorical data)
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Matplotlib cheatsheets!

The cheatsheets in this repo are excellent. Feel free to use them any time!

Other great resources for visualization

https://www.data-to-viz.com/

https://pyviz.org/

Mud card

In [ ]: