1. Breath alcohol tests in Ames, Iowa, USA

Ames, Iowa, USA is the home of Iowa State University, a land grant university with over 36,000 students. By comparison, the city of Ames, Iowa, itself only has about 65,000 residents. As with any other college town, Ames has had its fair share of alcohol-related incidents. (For example, Google 'VEISHEA riots 2014'.) We will take a look at some breath alcohol test data from Ames that is published by the State of Iowa.

Ames, Iowa
CANADA
MEXICO
North Pacific Ocean
North Atlantic Ocean
Gulf of Mexico
THE BAHAMAS
Nassau
Washington, D.C.
Ottawa
Edmonton
Regina
Winnipeg
Vancouver
Québec
Montréal
Toronto
Hermosillo
Chihuahua
Monterrey
Mexicali
Washington
Oregon
California
Nevada
Idaho
Montana
Wyoming
Utah
Colorado
Arizona
New Mexico
North Dakota
South Dakota
Nebraska
Kansas
Oklahoma
Texas
Minnesota
Iowa
Missouri
Arkansas
Louisiana
Wisconsin
Illinois
Michigan
Indiana
Ohio
Kentucky
Tennessee
Mississippi
Alabama
Georgia
Florida
South Carolina
North Carolina
Virginia
West Virginia
Pennsylvania
New York
New Jersey
Maine
Seattle
Olympia
Salem
Helena
Boise
Sacramento
Carson City
San Francisco
Las Vegas
Los Angeles
Salt Lake City
Phoenix
Cheyenne
Denver
Santa Fe
Bismarck
Pierre
Lincoln
Topeka
Oklahoma City
Dallas
Austin
Houston
St. Paul
Des Moines
Jefferson City
St. Louis
Little Rock
Baton Rouge
New Orleans
Jackson
Memphis
Madison
Chicago
Springfield
Indianapolis
Lansing
Detroit
Columbus
Frankfort
Nashville
Montgomery
Atlanta
Tallahassee
Miami
Columbia
Raleigh
Richmond
Charleston
Annapolis
Dover
Harrisburg
Philadelphia
Trenton
New York
Hartford
Providence
Boston
Concord
Albany
Montpelier
Augusta
State capital
Scale 1:27,000,000
Albers Equal-Area Projection
standard parallels 28°30'N and 45°30'N
500 Kilometers
500 Miles
130
120
110
100
90
80
70
50
40
30

The data file 'breath_alcohol_ames.csv' contains 1,556 readings from breath alcohol tests administered by the Ames and Iowa State University Police Departments from January 2013 to December 2017. The columns in this data set are year, month, day, hour, location, gender, Res1, Res2.

In [2]:

```
# import pandas
import pandas as pd

# read the data into your workspace
ba_data = pd.read_csv('datasets/breath_alcohol_ames.csv')

# quickly inspect the data
print(ba_data.head())

# obtain counts for each year
ba_year = ba_data['year'].value_counts()
ba_year
```

```
   year  month  day  hour location gender   Res1   Res2
0  2017     12   17     1  Ames PD      M  0.046  0.046
1  2017     12   14     3   ISU PD      F  0.121  0.120
2  2017     12   10     5   ISU PD      F  0.068  0.067
3  2017     12   10     3   ISU PD      F  0.077  0.077
4  2017     12    9     2   ISU PD      M  0.085  0.084
```

Out[2]:

```
2013    397
2014    344
2015    286
2016    269
2017    260
Name: year, dtype: int64
```

In [3]:

```
%%nose

import pandas as pd

# # check read file
# def test_breath_alcohol_ames():
#     correct_pulls = pd.read_csv("datasets/breath_alcohol_ames.csv")
#     assert correct_pulls.equals(breath_alcohol_ames), \
#     'Read in "datasets/breath_alcohol_ames.csv" using read_csv().'

# # check head

# # check value counts
# def test_value_counts():
#     assert len(ba_year) == 5, \
#     'The rows are not arraged by year. Did you select the correct value to count?'

def test_task_1a():
    correct_ba_data = pd.read_csv("datasets/breath_alcohol_ames.csv")
    assert correct_ba_data.equals(ba_data), "The variable `ba_data` should contain the data in `breath_alcoho
l_ames.csv`"

def test_task_1b():
    correct_ba_year = ba_data['year'].value_counts()
    assert correct_ba_year.equals(ba_year), "The variable `ba_year` should contain the counts of years in `ba
_data`. Did you use the `value_counts` method?"
```

Out[3]:

```
2/2 tests passed
```

2. What is the busiest police department in Ames?

There are two police departments in the data set: the Iowa State University Police Department and the Ames Police Department. Which one administers more breathalyzer tests?

In [4]:

```
# use value_counts to tally up the totals for each department
pds = ba_data['location'].value_counts()
pds
```

Out[4]:

```
ISU PD     940
Ames PD    616
Name: location, dtype: int64
```

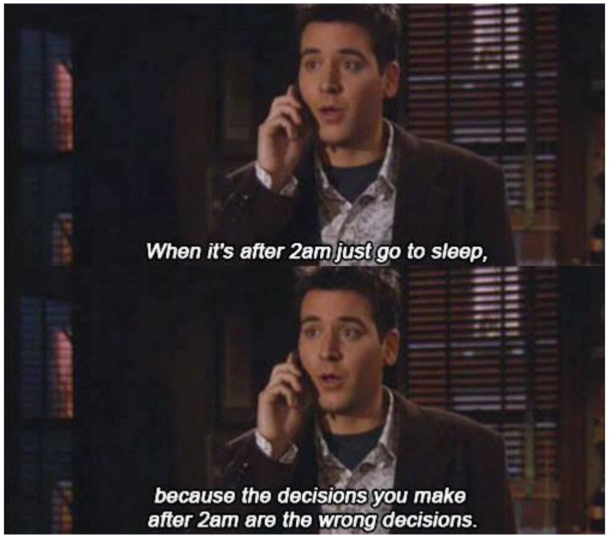
In [5]:

```
%%nose

# # check value counts
# def test_value_counts():
#     assert len(ba_year) == 2, \
#     'The rows are not arraged by location. Did you select the correct value to count?'

def test_task_2():
    correct_pds = ba_data['location'].value_counts()
    assert correct_pds.equals(pds), "The variable `pds` should contain the counts of locations in `ba_data`.
 Did you use the `value_counts` method?"
```

Out[5]:

```
1/1 tests passed
```

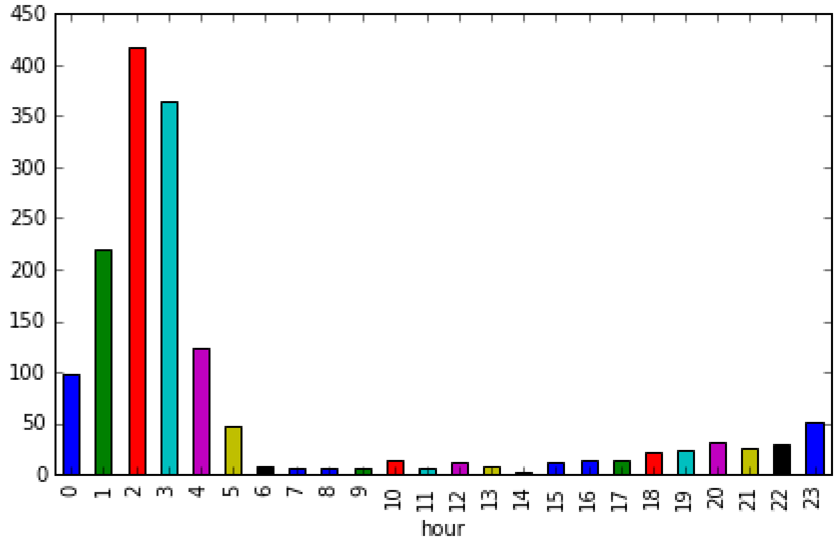
3. Nothing Good Happens after 2am


When it's after 2am just go to sleep,
because the decisions you make after 2am are the wrong decisions.

We all know that "nothing good happens after 2am." Thus, there are inevitably some times of the day when breath alcohol tests, especially in a college town like Ames, are most and least common. Which hours of the day have the most and least breathalyzer tests?

In [6]:
```
%matplotlib inline

# count by hour
hourly = ba_data.groupby(['hour']).size()

# create a vertical bar graph of the arrest count by hour
hourly.plot.bar(x=hourly)
```

Out[6]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f48fcef6ac8>
```



In [7]:
```
%%nose

# groupby, count, and sort values
# check counts
def test_sort_values():
    assert len(hourly) == 24, \
    'The rows are not arranged by hour. Did you select "hour" to group by?'

# no test for plots
```

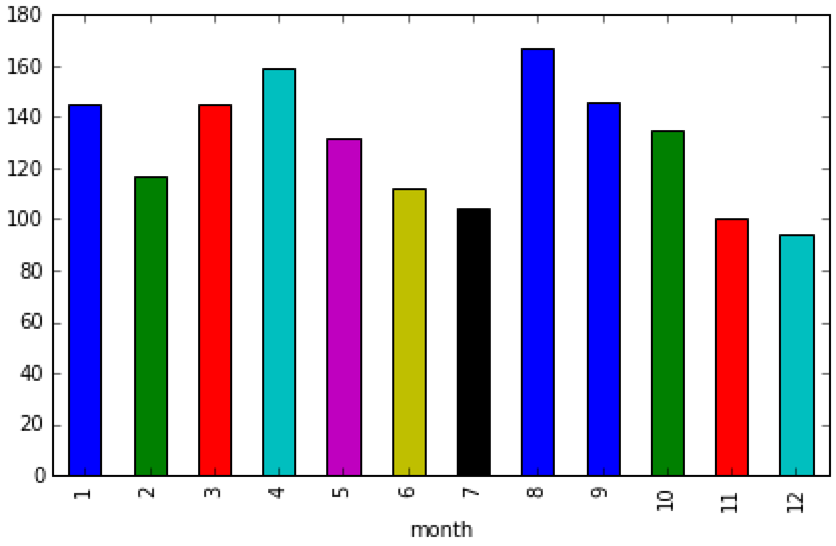
Out[7]:
```
1/1 tests passed
```

4. Breathalyzer tests by month

Now that we have discovered which time of day is most common for breath alcohol tests, we will determine which time of the year has the most breathalyzer tests. Which month will have the most recorded tests?

In [8]:
```
# count by month and arrange by descending frequency
monthly = ba_data.groupby(['month']).size()

# use plot.bar to make the appropriate bar chart
monthly.plot.bar(x='monthly')
```

Out[8]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f48fcde6a58>
```



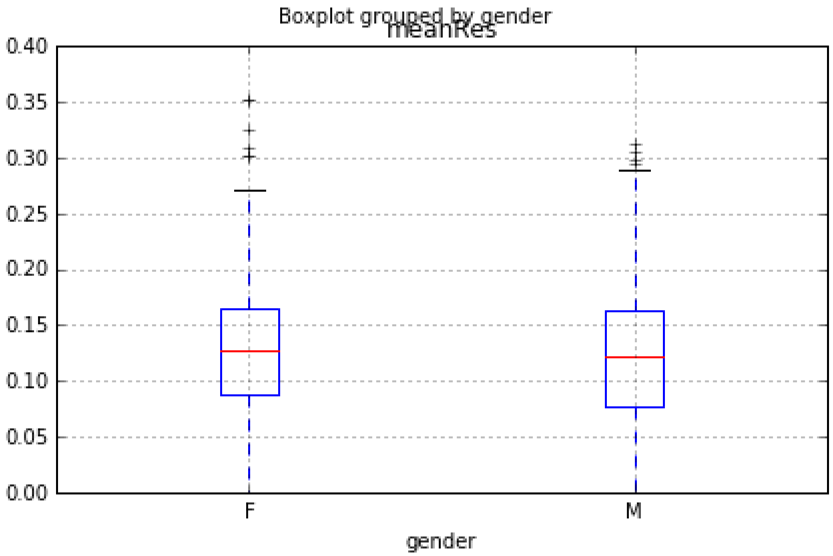
```
In [9]: %%nose

        # groupby, count, and sort values
        # check counts
        def test_sort_values():
            assert len(monthly) == 12, \
            'The rows are not arranged by month. Did you select "month" to group by?'

Out[9]: 1/1 tests passed
```

5. COLLEGE

When we think of (binge) drinking in college towns in America, we usually think of something like this image at the left. And so, one might suspect that breath alcohol tests are given to men more often than women and that men drink more than women.

```
In [10]: # count by gender
         counts_gender = ba_data['gender'].value_counts()

         # create a dataset with no NAs in gender
         gen = ba_data.dropna(subset=['gender'])

         # create a mean test result variable
         mean_bas = gen.assign(meanRes=(gen.Res1+gen.Res2)/2)

         # # create side-by-side boxplots to compare the mean blood alcohol levels of men and women
         mean_bas.boxplot(['meanRes'], by = 'gender')
```

```
Out[10]: <matplotlib.axes._subplots.AxesSubplot at 0x7f48f7fcaf28>
```



In [11]:

```
%%nose

# gender value_counts
def test_task_5b():
    correct_counts_gender = ba_data['gender'].value_counts()
    assert correct_counts_gender.equals(counts_gender), \
    "The variable `counts_gender` should contain the counts of gender in `ba_data`. Did you use the `value_counts` method?"

# dropna
def test_dropna():
    assert len(gen) == 1527, \
    'Did you use dropna() on `gender`?'

# create meanRes in mean_bas
def test_month_year_column():
    assert 'meanRes' in mean_bas, \
    "Did you create the `meanRes` column."

# no test for plots
```

Out[11]:

```
3/3 tests passed
```

6. Above the legal limit

In the USA, it is illegal to drive with a blood alcohol concentration (BAC) above 0.08%. This is the case for all 50 states (https://www.dmv.org/automotive-law/dui.php). Assuming everyone tested in our data was driving (though we have no way of knowing this from the data), if either of the results (`Res1`, `Res2`) are above 0.08, the person would be charged with DUI (driving under the influence).

In [12]:

```
# Filter the data
duis = ba_data[(ba_data.Res1 > 0.08) | (ba_data.Res2 > 0.08)]

# proportion of tests that would have resulted in a DUI
p_dui = duis.shape[0] / ba_data.shape[0]
p_dui
```

Out[12]:

```
0.7448586118251928
```

In [13]:

```
%%nose

# check filter
def test_duis():
    assert len(duis) == 1159, \
    'Did you use the logical OR operator (|) to filter ba_data?'

# check p_dui
def test_p_dui():
    correct_p_dui = duis.shape[0] / ba_data.shape[0]
    assert correct_p_dui == p_dui
```

Out[13]:

```
2/2 tests passed
```

7. Breathalyzer tests: is there a pattern over time?

We previously saw that 2am is the most common time of day for breathalyzer tests to be administered, and August is the most common month of the year for breathalyzer tests. Now, we look at the weeks in the year over time.

In [14]:

```
# Create date variable
ba_data['date'] = pd.to_datetime(ba_data[['year', 'month', 'day']])

# Create a week variable
ba_data['week'] = ba_data['date'].dt.week
# Check your work
ba_data.head()
```

Out[14]:

	year	month	day	hour	location	gender	Res1	Res2	date	week
0	2017	12	17	1	Ames PD	M	0.046	0.046	2017-12-17	50
1	2017	12	14	3	ISU PD	F	0.121	0.120	2017-12-14	50
2	2017	12	10	5	ISU PD	F	0.068	0.067	2017-12-10	49
3	2017	12	10	3	ISU PD	F	0.077	0.077	2017-12-10	49
4	2017	12	9	2	ISU PD	M	0.085	0.084	2017-12-09	49

In [15]:

```
%%nose

# create date var
def test_date():
    assert 'date' in ba_data, \
    "You did not create the variable for date."

# create week var
def test_week():
    assert 'week' in ba_data, \
    "You did not create the variable for week."
```

Out[15]:

```
2/2 tests passed
```

8. Looking at timelines

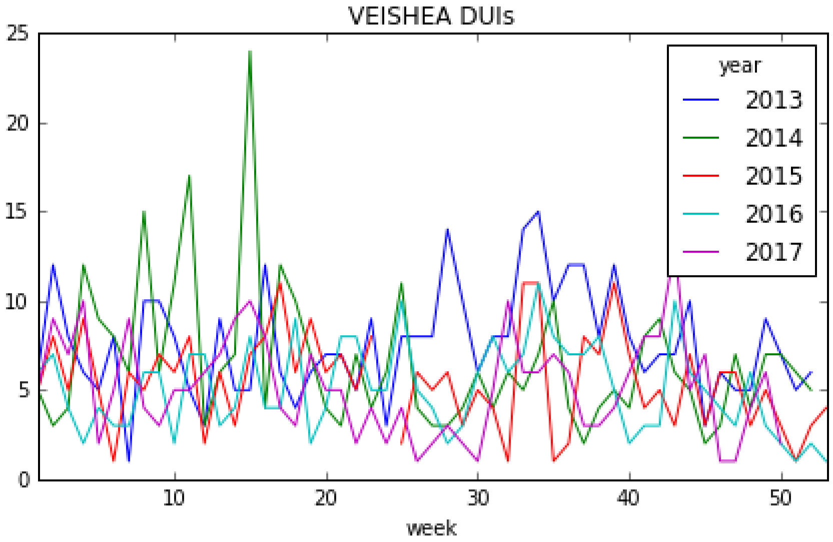
How do the weeks differ over time? One of the most common data visualizations is the time series, a line tracking the changes in a variable over time. We will use the new `week` variable to look at test frequency over time. We end with a time series plot showing the frequency of breathalyzer tests by week in year, with one line for each year.

In [16]:

```
# choose and count the variables of interest
timeline = ba_data.groupby(['week','year']).count()['Res1']

# unstack and plot
timeline.unstack().plot(title='VEISHEA DUIs', legend=True)
```

Out[16]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f48f7f2cba8>
```



In [17]:

```
%%nose

# check timeline
def test_timeline():
    assert len(timeline) == 259, \
    'Did you group by week and year?'

# plot
```

Out[17]:

```
1/1 tests passed
```

9. The end of VEISHEA

From Wikipedia (https://en.wikipedia.org/wiki/VEISHEA): "VEISHEA was an annual week-long celebration held each spring on the campus of Iowa State University in Ames, Iowa. The celebration featured an annual parade and many open-house demonstrations of the university facilities and departments. Campus organizations exhibited products, technologies, and held fundraisers for various charity groups. In addition, VEISHEA brought speakers, lecturers, and entertainers to Iowa State. [...] VEISHEA was the largest student-run festival in the nation, bringing in tens of thousands of visitors to the campus each year."

This over 90-year tradition in Ames was terminated permanently (https://www.news.iastate.edu/news/2014/08/07/veisheaend) after riots in 2014 (https://www.desmoinesregister.com/story/news/crime-and-courts/2014/04/09/veishea-ames-car-tipping/7495935/), where drunk celebrators flipped over multiple vehicles and tore light poles down. This was not the first incidence of violence and severe property damage in VEISHEA's history. Did former President Leath make the right decision by canceling VEISHEA?

In [18]:

```
## Was it right to permanently cancel VEISHEA? TRUE or FALSE?
canceling_VEISHEA_was_right = False
```

In [19]:

```
%%nose

def test_bool():
    assert isinstance(canceling_VEISHEA_was_right, bool), "Did you assign `True` or `False` to `canceling_VEI
SHEA_was_right`?"

## The original R version did not have a test regarding opinion.
# def test_opinion():
#     assert canceling_VEISHEA_was_right == 'False', \
#     'The previous year, 2013, had peak DUIs around week 30, and August has the highest amounts of DUIs per
 month. VEISHEA was held in April.'
```

Out[19]:

```
1/1 tests passed
```