INTRODUCTION TO DATABASES IN PYTHON

Filtering and Targeting Data

Where Clauses

```
In [1]: stmt = select([census])

In [2]: stmt = stmt.where(census.columns.state ==
            'California')

In [3]: results = connection.execute(stmt).fetchall()

In [4]: for result in results:
   ...:     print(result.state, result.age)
Out[4]:
California 0
California 1
California 2
California 3
California 4
California 5
...
```

Where Clauses

- Restrict data returned by a query based on boolean conditions
- Compare a column against a value or another column
- Often used comparisons: '==', '<=', '>=', or '!='

Expressions

- Provide more complex conditions than simple operators
- Eg. `in_()`, `like()`, `between()`
- Many more in documentation
- Available as method on a Column

Expressions

```
In [1]: stmt = select([census])

In [2]: stmt = stmt.where(
            census.columns.state.startswith('New'))

In [3]: for result in connection.execute(stmt):
   ...:     print(result.state, result.pop2000)
Out[3]:
New Jersey 56983
New Jersey 56686
New Jersey 57011
...
```

Conjunctions

- Allow us to have multiple criteria in a where clause
- Eg. `and_()`, `not_()`, `or_()`

Conjunctions

```
In [1]: from sqlalchemy import or_

In [2]: stmt = select([census])

In [3]: stmt = stmt.where(
   ...:     or_(census.columns.state == 'California',
   ...:         census.columns.state == 'New York'
   ...:     )
   ...: )

In [4]: for result in connection.execute(stmt):
   ...:     print(result.state, result.sex)
Out[4]:
New York M
…
California F
```

Let’s practice!

Ordering Query Results

Order by Clauses

- Allows us to control the order in which records are returned in the query results
- Available as a method on statements `order_by()`

Order by Ascending

```
In [1]: print(results[:10])
Out[1]: [('Illinois',), …]

In [3]: stmt = select([census.columns.state])

In [4]: stmt = stmt.order_by(census.columns.state)

In [5]: results = connection.execute(stmt).fetchall()

In [6]: print(results[:10])
Out[6]: [('Alabama',), …]
```

Order by Descending

- Wrap the column with `desc()` in the `order_by()` clause

Order by Multiple

- Just separate multiple columns with a comma
- Orders completely by the first column
- Then if there are duplicates in the first column, orders by the second column
- repeat until all columns are ordered

Order by Multiple

```
In [6]: print(results)
Out[6]: ('Alabama', 'M')

In [7]: stmt = select([census.columns.state,
   ...:     census.columns.sex])

In [8]: stmt = stmt.order_by(census.columns.state,
   ...:     census.columns.sex)

In [9]: results = connection.execute(stmt).first()

In [10]: print(results)
Out[10]:('Alabama', 'F')
('Alabama', 'F')
…
('Alabama', 'M')
```

INTRODUCTION TO DATABASES IN PYTHON

Let’s practice!

Counting, Summing and Grouping Data

SQL Functions

- E.g. Count, Sum
- from sqlalchemy import func
- More efficient than processing in Python
- Aggregate data

Sum Example

```
In [1]: from sqlalchemy import func

In [2]: stmt = select([func.sum(census.columns.pop2008)])

In [3]: results = connection.execute(stmt).scalar()

In [4]: print(results)
Out[4]: 302876613
```

Group by

- Allows us to group row by common values

Group by

```
In [1]: stmt = select([census.columns.sex,
   ...:      func.sum(census.columns.pop2008)
   ...: ])

In [2]: stmt = stmt.group_by(census.columns.sex)

In [3]: results = connection.execute(stmt).fetchall()

In [4]: print(results)
Out[4]: [('F', 153959198), ('M', 148917415)]
```

Group by

- Supports multiple columns to group by with a pattern similar to `order_by()`
- Requires all selected columns to be grouped or aggregated by a function

Group by Multiple

```
In [1]: stmt = select([census.columns.sex,
   ...:     census.columns.age,
   ...:     func.sum(census.columns.pop2008)
   ...: ])

In [2]: stmt = stmt.group_by(census.columns.sex,
   ...:     census.columns.age)

In [2]: results = connection.execute(stmt).fetchall()

In [3]: print(results)
Out[3]:
[('F', 0, 2105442), ('F', 1, 2087705), ('F', 2, 2037280), ('F', 3,
2012742), ('F', 4, 2014825), ('F', 5, 1991082), ('F', 6, 1977923),
('F', 7, 2005470), ('F', 8, 1925725), …
```

Handling ResultSets from Functions

- SQLAlchemy auto generates “column names” for functions in the ResultSet
- The column names are often `func_#` such as `count_1`
- Replace them with the `label()` method

Using label()

```
In [1]: print(results[0].keys())
Out[1]: ['sex', u'sum_1']

In [2]: stmt = select([census.columns.sex,
   ...:     func.sum(census.columns.pop2008).label(
   ...:         'pop2008_sum')
   ...: ])

In [3]: stmt = stmt.group_by(census.columns.sex)

In [4]: results = connection.execute(stmt).fetchall()

In [5]: print(results[0].keys())
Out[5]: ['sex', 'pop2008_sum']
```

Let’s practice!

INTRODUCTION TO DATABASES IN PYTHON

SQLAlchemy and Pandas for Visualization

SQLAlchemy and Pandas

- DataFrame can take a SQLAlchemy ResultSet
- Make sure to set the DataFrame columns to the ResultSet keys

DataFrame Example

```
In [1]: import pandas as pd

In [2]: df = pd.DataFrame(results)

In [3]: df.columns = results[0].keys()

In [4]: print(df)
Out[4]:
    sex  pop2008_sum
0     F      2105442
1     F      2087705
2     F      2037280
3     F      2012742
4     F      2014825
5     F      1991082
```

Graphing

- We can graph just like we would normally

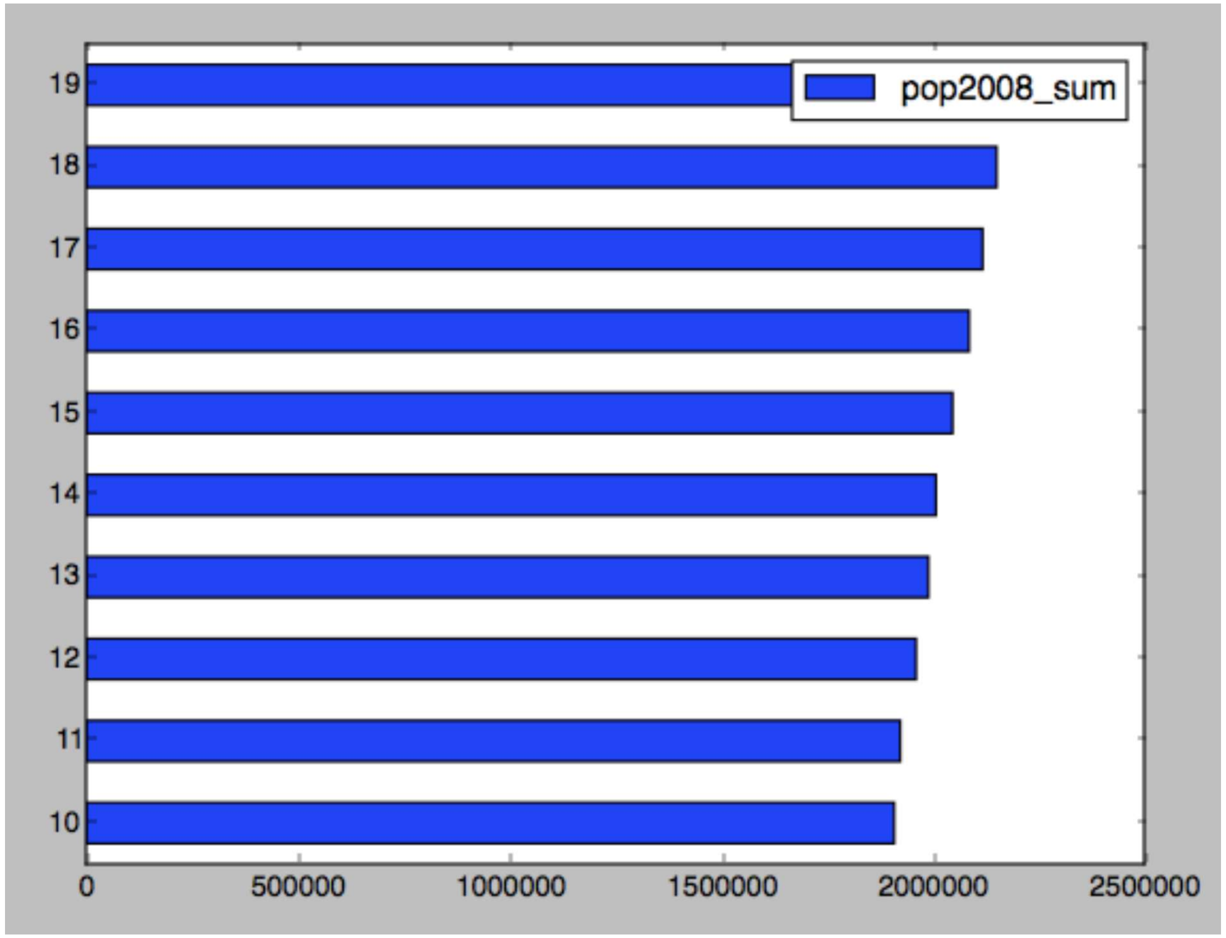
Graphing Example

```
In [1]: import matplotlib.pyplot as plt

In [2]: df[10:20].plot.barh()

In [3]: plt.show()
```

Graphing Output



Let’s practice!