

Introduction to Flat Files

STREAMLINED DATA INGESTION WITH PANDAS



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pandas



pandas

Data Frames

- `pandas` -specific structure for two-dimensional data

	Country	Population	Area (sq. mi.)
0	Afghanistan	31056997	647500
1	Albania	3581655	28748
2	Algeria	32930091	2381740
3	American Samoa	57794	199
4	Andorra	71201	468
5	Angola	12127071	1246700
6	Anguilla	13477	102
7	Antigua & Barbuda	69108	443
8	Argentina	39921833	2766890
9	Armenia	2976372	29800
10	Aruba	71891	193

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Column Labels

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Column Labels

Row Labels (Index)

Flat Files

- Simple, easy-to-produce format
- Data stored as plain text (no formatting)
- One row per line
- Values for different fields are separated by a delimiter
- Most common flat file type: comma-separated values
- One `pandas` function to load them all: `read_csv()`

Loading CSVs

- Sample of `us_tax_data_2016.csv`

```
STATEFIPS,STATE,zipcode,agi_stub,...,N11901,A11901,N11902,A11902  
1,AL,0,1,...,63420,51444,711580,1831661
```

```
import pandas as pd  
  
tax_data = pd.read_csv("us_tax_data_2016.csv")  
tax_data.head(4)
```

	STATEFIPS	STATE	zipcode	agi_stub	...	N11901	A11901	N11902	A11902
0	1	AL	0	1	...	63420	51444	711580	1831661
1	1	AL	0	2	...	74090	110889	416090	1173463
2	1	AL	0	3	...	64000	143060	195130	543284
3	1	AL	0	4	...	45020	128920	117410	381329

```
[4 rows x 147 columns]
```

Loading Other Flat Files

- Specify a different delimiter with `sep`
- Sample of `us_tax_data_2016.tsv`

```
STATEFIPS  STATE  zipcode  agi_stub  ...  N11901  A11901  N11902  A11902
1         AL    0      1      ...    63420   51444   711580   1831661
```

```
import pandas as pd
tax_data = pd.read_csv("us_tax_data_2016.tsv", sep="\t")
tax_data.head(3)
```

```
STATEFIPS  STATE  zipcode  agi_stub  ...  N11901  A11901  N11902  A11902
0          1    AL        0      1      ...    63420   51444   711580   1831661
1          1    AL        0      2      ...    74090   110889   416090   1173463
2          1    AL        0      3      ...    64000   143060   195130   543284
```

```
[3 rows x 147 columns]
```


Let's practice!

STREAMLINED DATA INGESTION WITH PANDAS

Modifying flat file imports

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U.S. Tax Data

```
tax_data = pd.read_csv('us_tax_data_2016.csv')  
  
print(tax_data.shape)
```

```
(179796, 147)
```

Limiting Columns

- Choose columns to load with the `usecols` keyword argument
- Accepts a list of column numbers or names, or a function to filter column names

```
col_names = ['STATEFIPS', 'STATE', 'zipcode', 'agi_stub', 'N1']
col_nums = [0, 1, 2, 3, 4]
# Choose columns to load by name
tax_data_v1 = pd.read_csv('us_tax_data_2016.csv',
                          usecols=col_names)
# Choose columns to load by number
tax_data_v2 = pd.read_csv('us_tax_data_2016.csv',
                          usecols=col_nums)
print(tax_data_v1.equals(tax_data_v2))
```

True

Limiting Rows

- Limit the number of rows loaded with the `nrows` keyword argument

```
tax_data_first1000 = pd.read_csv('us_tax_data_2016.csv', nrows=1000)
print(tax_data_first1000.shape)
```

```
(1000, 147)
```

Limiting Rows

- Use `nrows` and `skiprows` together to process a file in chunks
- `skiprows` accepts a list of row numbers, a number of rows, or a function to filter rows
- Set `header=None` so `pandas` knows there are no column names

```
tax_data_next500 = pd.read_csv('us_tax_data_2016.csv',  
                                nrows=500,  
                                skiprows=1000,  
                                header=None)
```

Limiting Rows

```
print(tax_data_next500.head(1))
```

```
   0    1    2    3    4    5    6    7    8    9   10  ...   136  137  138  139  140  141  142  143
0    1  AL  35565    4  270    0  250    0  210  790  280  ...  1854  260  1978    0    0    0    0  50

[1 rows x 147 columns]
```

Assigning Column Names

- Supply column names by passing a list to the `names` argument
- The list **MUST** have a name for every column in your data
- **If you only need to rename a few columns, do it after the import!**

Assigning Column Names

```
col_names = list(tax_data_first1000)
tax_data_next500 = pd.read_csv('us_tax_data_2016.csv',
                                nrows=500,
                                skiprows=1000,
                                header=None,
                                names=col_names)

print(tax_data_next500.head(1))
```

```
  STATEFIPS  STATE  zipcode  agi_stub  ...  N11901  A11901  N11902  A11902
0          1    AL    35565         4  ...      50     222     210     794

[1 rows x 147 columns]
```

Let's practice!

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Handling errors and missing data

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Common Flat File Import Issues

- Column data types are wrong
- Values are missing
- Records that cannot be read by `pandas`

Specifying Data Types

- `pandas` automatically infers column data types

```
print(tax_data.dtypes)
```

```
STATEFIPS    int64  
STATE        object  
zipcode      int64  
agi_stub     int64  
N1           int64  
            ...  
N11902       int64  
A11902       int64  
Length: 147, dtype: object
```

Specifying Data Types

- Use the `dtype` keyword argument to specify column data types
- `dtype` takes a dictionary of column names and data types

```
tax_data = pd.read_csv("us_tax_data_2016.csv", dtype={"zipcode": str})  
print(tax_data.dtypes)
```

```
STATEFIPS    int64  
STATE        object  
zipcode      object  
agi_stub     int64  
N1           int64  
            ...  
N11902       int64  
A11902       int64  
Length: 147, dtype: object
```

Customizing Missing Data Values

- `pandas` automatically interprets some values as missing or NA

```
print(tax_data.head())
```

```
   STATEFIPS STATE  zipcode  agi_stub      N1  ...  A85300  N11901  A11901  N11902  A11902
0          1    AL         0         1  815440  ...        0   63420   51444   711580  1831661
1          1    AL         0         2  495830  ...        0   74090  110889   416090  1173463
2          1    AL         0         3  263390  ...        0   64000  143060   195130   543284
3          1    AL         0         4  167190  ...        0   45020  128920   117410   381329
4          1    AL         0         5  217440  ...       19   82940  423629   126130   506526
```

```
[5 rows x 147 columns]
```

Customizing Missing Data Values

- Use the `na_values` keyword argument to set custom missing values
- Can pass a single value, list, or dictionary of columns and values

```
tax_data = pd.read_csv("us_tax_data_2016.csv",  
                       na_values={"zipcode" : 0})  
  
print(tax_data[tax_data.zipcode.isna()])
```

	STATEFIPS	STATE	zipcode	agi_stub	N1	...	A85300	N11901	A11901	N11902	A11902
0	1	AL	NaN	1	815440	...	0	63420	51444	711580	1831661
1	1	AL	NaN	2	495830	...	0	74090	110889	416090	1173463
2	1	AL	NaN	3	263390	...	0	64000	143060	195130	543284
...
179034	56	WY	NaN	5	38030	...	121	13230	73326	22250	99589
179035	56	WY	NaN	6	8480	...	53835	3630	128149	2250	125557

[306 rows x 147 columns]

Lines with Errors

Sample of `us_tax_data_2016_corrupt.csv`

```
STATEFIPS,STATE,zipcode,agi_stub,...,N11901,A11901,N11902,A11902  
1,AL,0,1,...,63420,51444,711580,1831661  
1,AL,0, ,2,...,74090,110889,416090,1173463
```

```
tax_data = pd.read_csv("us_tax_data_2016_corrupt.csv")
```

```
Traceback (most recent call last):
  File "<stdin>", line 2, in <module>
    data = pd.read_csv('us_tax_data_2016_corrupt.csv')
  File "<stdin>", line 697, in parser_f
    return _read(filepath_or_buffer, kwds)
  File "<stdin>", line 430, in _read
    data = parser.read(nrows)
  File "<stdin>", line 1134, in read
    ret = self._engine.read(nrows)
  File "<stdin>", line 1990, in read
    data = self._reader.read(nrows)
  File "<stdin>", line 899, in pandas._libs.parsers.TextReader.read
  File "<stdin>", line 914, in pandas._libs.parsers.TextReader._read_low_memory
  File "<stdin>", line 968, in pandas._libs.parsers.TextReader._read_rows
  File "<stdin>", line 955, in pandas._libs.parsers.TextReader._tokenize_rows
  File "<stdin>", line 2172, in pandas._libs.parsers.raise_parser_error
pandas.errors.ParserError: Error tokenizing data. C error: Expected 147 fields in line 3, saw 148
```

Lines with Errors

- Set `error_bad_lines=False` to skip unparseable records
- Set `warn_bad_lines=True` to see messages when records are skipped

```
tax_data = pd.read_csv("us_tax_data_2016_corrupt.csv",  
                       error_bad_lines=False,  
                       warn_bad_lines=True)
```

```
b'Skipping line 3: expected 147 fields, saw 148\n'
```

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