# ExampleManipulatingDataFrames

July 21, 2021

In this lecture I'm going to walk through a basic data cleaning process with you and introduce you to a few more pandas API functions.

```python
# Let's start by bringing in pandas
import pandas as pd
# And load our dataset. We're going to be cleaning the list of presidents in
 ↪the US from wikipedia
df=pd.read_csv("datasets/presidents.csv")
# And lets just take a look at some of the data
df.head()
```

[1]:

| | # | President | Born | Age atstart of presidency | \ |
|---|---|---|---|---|---|
| 0 | 1 | George Washington | Feb 22, 1732[a] | 57ãyears, 67ãdaysApr 30, 1789 | |
| 1 | 2 | John Adams | Oct 30, 1735[a] | 61ãyears, 125ãdaysMar 4, 1797 | |
| 2 | 3 | Thomas Jefferson | Apr 13, 1743[a] | 57ãyears, 325ãdaysMar 4, 1801 | |
| 3 | 4 | James Madison | Mar 16, 1751[a] | 57ãyears, 353ãdaysMar 4, 1809 | |
| 4 | 5 | James Monroe | Apr 28, 1758 | 58ãyears, 310ãdaysMar 4, 1817 | |

| | Age atend of presidency | Post-presidencytimespan | Died | \ |
|---|---|---|---|---|
| 0 | 65ãyears, 10ãdaysMar 4, 1797 | 2ãyears, 285ãdays | Dec 14, 1799 | |
| 1 | 65ãyears, 125ãdaysMar 4, 1801 | 25ãyears, 122ãdays | Jul 4, 1826 | |
| 2 | 65ãyears, 325ãdaysMar 4, 1809 | 17ãyears, 122ãdays | Jul 4, 1826 | |
| 3 | 65ãyears, 353ãdaysMar 4, 1817 | 19ãyears, 116ãdays | Jun 28, 1836 | |
| 4 | 66ãyears, 310ãdaysMar 4, 1825 | 6ãyears, 122ãdays | Jul 4, 1831 | |

| | Age |
|---|---|
| 0 | 67ãyears, 295ãdays |
| 1 | 90ãyears, 247ãdays |
| 2 | 83ãyears, 82ãdays |
| 3 | 85ãyears, 104ãdays |
| 4 | 73ãyears, 67ãdays |

```python
# Ok, we have some presidents, some dates, I see a bunch of footnotes in the
 ↪"Born" column which might cause
# issues. Let's start with cleaning up that name into firstname and lastname.
 ↪I'm going to tackle this with
# a regex. So I want to create two new columns and apply a regex to the
 ↪projection of the "President" column.
```

```python
# Here's one solution, we could make a copy of the President column
df["First"]=df['President']
# Then we can call replace() and just have a pattern that matches the last name
 →and set it to an empty string
df["First"]=df["First"].replace("[ ].*", "", regex=True)
# Now let's take a look
df.head()
```

[2]:
| | # | President | Born | Age atstart of presidency | \ |
|---|---|---|---|---|---|
| 0 | 1 | George Washington | Feb 22, 1732[a] | 57ãyears, 67ãdaysApr 30, 1789 | |
| 1 | 2 | John Adams | Oct 30, 1735[a] | 61ãyears, 125ãdaysMar 4, 1797 | |
| 2 | 3 | Thomas Jefferson | Apr 13, 1743[a] | 57ãyears, 325ãdaysMar 4, 1801 | |
| 3 | 4 | James Madison | Mar 16, 1751[a] | 57ãyears, 353ãdaysMar 4, 1809 | |
| 4 | 5 | James Monroe | Apr 28, 1758 | 58ãyears, 310ãdaysMar 4, 1817 | |

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| 3 | 65ãyears, 353ãdaysMar 4, 1817 | 19ãyears, 116ãdays | Jun 28, 1836 | |
| 4 | 66ãyears, 310ãdaysMar 4, 1825 | 6ãyears, 122ãdays | Jul 4, 1831 | |

| | Age | First |
|---|---|---|
| 0 | 67ãyears, 295ãdays | George |
| 1 | 90ãyears, 247ãdays | John |
| 2 | 83ãyears, 82ãdays | Thomas |
| 3 | 85ãyears, 104ãdays | James |
| 4 | 73ãyears, 67ãdays | James |

[3]:
```python
# That works, but it's kind of gross. And it's slow, since we had to make a
 →full copy of a column then go
# through and update strings. There are a few other ways we can deal with this.
 →Let me show you the most
# general one first, and that's called the apply() function. Let's drop the
 →column we made first
del(df["First"])

# The apply() function on a dataframe will take some arbitrary function you
 →have written and apply it to
# either a Series (a single column) or DataFrame across all rows or columns.
 →Lets write a function which
# just splits a string into two pieces using a single row of data
def splitname(row):
    # The row is a single Series object which is a single row indexed by column
 →values
    # Let's extract the firstname and create a new entry in the series
```

```
    row['First']=row['President'].split(" ")[0]
    # Let's do the same with the last word in the string
    row['Last']=row['President'].split(" ")[-1]
    # Now we just return the row and the pandas .apply() will take of merging␣
 ↪them back into a DataFrame
    return row

# Now if we apply this to the dataframe indicating we want to apply it across␣
 ↪columns
df=df.apply(splitname, axis='columns')
df.head()
```

[3]:
```
   #             President             Born      Age atstart of presidency  \
0  1  George Washington  Feb 22, 1732[a]  57ãyears, 67ãdaysApr 30, 1789
1  2        John Adams  Oct 30, 1735[a]  61ãyears, 125ãdaysMar 4, 1797
2  3   Thomas Jefferson  Apr 13, 1743[a]  57ãyears, 325ãdaysMar 4, 1801
3  4      James Madison  Mar 16, 1751[a]  57ãyears, 353ãdaysMar 4, 1809
4  5       James Monroe      Apr 28, 1758  58ãyears, 310ãdaysMar 4, 1817

          Age atend of presidency Post-presidencytimespan          Died  \
0  65ãyears, 10ãdaysMar 4, 1797        2ãyears, 285ãdays  Dec 14, 1799
1  65ãyears, 125ãdaysMar 4, 1801       25ãyears, 122ãdays   Jul 4, 1826
2  65ãyears, 325ãdaysMar 4, 1809       17ãyears, 122ãdays   Jul 4, 1826
3  65ãyears, 353ãdaysMar 4, 1817       19ãyears, 116ãdays  Jun 28, 1836
4  66ãyears, 310ãdaysMar 4, 1825        6ãyears, 122ãdays   Jul 4, 1831

                 Age    First        Last
0  67ãyears, 295ãdays  George  Washington
1  90ãyears, 247ãdays    John       Adams
2   83ãyears, 82ãdays  Thomas   Jefferson
3  85ãyears, 104ãdays   James     Madison
4   73ãyears, 67ãdays   James      Monroe
```

[4]:
```
# Pretty questionable as to whether that is less gross, but it achieves the␣
 ↪result and I find that I use the
# apply() function regularly in my work. The pandas series has a couple of␣
 ↪other nice convenience functions
# though, and the next I would like to touch on is called .extract(). Lets drop␣
 ↪our firstname and lastname.
del(df['First'])
del(df['Last'])

# Extract takes a regular expression as input and specifically requires you to␣
 ↪set capture groups that
# correspond to the output columns you are interested in. And, this is a great␣
 ↪place for you to pause the
```

```
# video and reflect - if you were going to write a regular expression that␣
 ↪returned groups and just had the
# firstname and lastname in it, what would that look like?

# Here's my solution, where we match three groups but only return two, the␣
 ↪first and the last name
pattern="(^[\w]*)(?:.* )([\w]*$)"

# Now the extract function is built into the str attribute of the Series␣
 ↪object, so we can call it
# using Series.str.extract(pattern)
df["President"].str.extract(pattern).head()
```

[4]:
```
         0           1
0   George  Washington
1     John      Adams
2   Thomas   Jefferson
3    James     Madison
4    James      Monroe
```

[5]:
```
# So that looks pretty nice, other than the column names. But if we name the␣
 ↪groups we get named columns out
pattern="(?P<First>^[\w]*)(?:.* )(?P<Last>[\w]*$)"

# Now call extract
names=df["President"].str.extract(pattern).head()
names
```

[5]:
```
     First        Last
0   George  Washington
1     John      Adams
2   Thomas   Jefferson
3    James     Madison
4    James      Monroe
```

[6]:
```
# And we can just copy these into our main dataframe if we want to
df["First"]=names["First"]
df["Last"]=names["Last"]
df.head()
```

[6]:
```
   #          President            Born    Age atstart of presidency  \
0  1  George Washington  Feb 22, 1732[a]   57ãyears, 67ãdaysApr 30, 1789
1  2         John Adams  Oct 30, 1735[a]   61ãyears, 125ãdaysMar 4, 1797
2  3   Thomas Jefferson  Apr 13, 1743[a]   57ãyears, 325ãdaysMar 4, 1801
3  4     James Madison  Mar 16, 1751[a]   57ãyears, 353ãdaysMar 4, 1809
4  5       James Monroe    Apr 28, 1758   58ãyears, 310ãdaysMar 4, 1817

      Age atend of presidency Post-presidencytimespan        Died  \
0   65ãyears, 10ãdaysMar 4, 1797      2ãyears, 285ãdays  Dec 14, 1799
```

```
1    65ãyears, 125ãdaysMar 4, 1801        25ãyears, 122ãdays    Jul 4, 1826
2    65ãyears, 325ãdaysMar 4, 1809        17ãyears, 122ãdays    Jul 4, 1826
3    65ãyears, 353ãdaysMar 4, 1817        19ãyears, 116ãdays   Jun 28, 1836
4    66ãyears, 310ãdaysMar 4, 1825         6ãyears, 122ãdays    Jul 4, 1831


                       Age    First         Last
0  67ãyears, 295ãdays  George   Washington
1  90ãyears, 247ãdays    John       Adams
2   83ãyears, 82ãdays  Thomas    Jefferson
3  85ãyears, 104ãdays   James      Madison
4   73ãyears, 67ãdays   James       Monroe
```

[7]:
```python
# It's worth looking at the pandas str module for other functions which have
#  been written specifically
# to clean up strings in DataFrames, and you can find that in the docs in the
#  Working with Text
# section: https://pandas.pydata.org/pandas-docs/stable/user_guide/text.html
```

[8]:
```python
# Now lets move on to clean up that Born column. First, let's get rid of
#  anything that isn't in the
# pattern of Month Day and Year.
df["Born"]=df["Born"].str.extract("([\w]{3} [\w]{1,2}, [\w]{4})")
df["Born"].head()
```

[8]:
```
0    Feb 22, 1732
1    Oct 30, 1735
2    Apr 13, 1743
3    Mar 16, 1751
4    Apr 28, 1758
Name: Born, dtype: object
```

[9]:
```python
# So, that cleans up the date format. But I'm going to foreshadow something
#  else here - the type of this
# column is object, and we know that's what pandas uses when it is dealing with
#  string. But pandas actually
# has really interesting date/time features - in fact, that's one of the
#  reasons Wes McKinney put his efforts
# into the library, to deal with financial transactions. So if I were building
#  this out, I would actually
# update this column to the write data type as well
df["Born"]=pd.to_datetime(df["Born"])
df["Born"].head()
```

[9]:
```
0    1732-02-22
1    1735-10-30
2    1743-04-13
3    1751-03-16
4    1758-04-28
Name: Born, dtype: datetime64[ns]
```

[10]: 
```
# This would make subsequent processing on the dataframe around dates, such as␣
 ↪getting every President who
# was born in a given time span, much easier.
```

Now, most of the other columns in this dataset I would clean in a similar fashion. And this would be a good practice activity for you, so I would recommend that you pause the video, open up the notebook for the lecture if you don't already have it opened, and then finish cleaning up this dataframe. In this lecture I introduced you to the str module which has a number of important functions for cleaning pandas dataframes. You don't have to use these - I actually use apply() quite a bit myself, especially if I don't need high performance data cleaning because my dataset is small. But the str functions are incredibly useful and build on your existing knowledge of regular expressions, and because they are vectorized they are efficient to use as well.