GroupBy_ed

July 15, 2023

1 Grouping Data

Sometimes we want to select data based on groups and understand aggregated data on a group level. We have seen that even though Pandas allows us to iterate over every row in a dataframe, it is generally very slow to do so. Fortunately Pandas has a groupby() function to speed up such task. The idea behind the groupby() function is that it takes some dataframe, splits it into chunks based on some key values, applies computation on those chunks, then combines the results back together into another dataframe. In pandas this is referred to as the split-apply-combine pattern.

1.1 Splitting

```
[1]: # Let's look at an example. First, we'll bring in our pandas and numpy libraries
     import pandas as pd
     import numpy as np
```

```
[2]: # Let's look at some US census data
     df = pd.read_csv('datasets/census.csv')
     # And exclude state level summarizations, which have sum level value of 40
     df = df[df['SUMLEV']==50]
     df.head()
```

```
[2]:    SUMLEV  REGION  DIVISION  STATE  COUNTY   STNAME          CTYNAME  \
    1      50       3         6      1       1  Alabama  Autauga County
    2      50       3         6      1       3  Alabama  Baldwin County
    3      50       3         6      1       5  Alabama  Barbour County
    4      50       3         6      1       7  Alabama      Bibb County
    5      50       3         6      1       9  Alabama    Blount County

       CENSUS2010POP  ESTIMATESBASE2010  POPESTIMATE2010  …  RDOMESTICMIG2011  \
    1          54571             54571            54660  …          7.242091
    2         182265            182265           183193  …         14.832960
    3          27457             27457            27341  …         -4.728132
    4          22915             22919            22861  …         -5.527043
    5          57322             57322            57373  …          1.807375

       RDOMESTICMIG2012  RDOMESTICMIG2013  RDOMESTICMIG2014  RDOMESTICMIG2015  \
    1         -2.915927         -3.012349          2.265971         -2.530799
    2         17.647293         21.845705         19.243287         17.197872
```

3	-2.500690	-7.056824	-3.904217	-10.543299
4	-5.068871	-6.201001	-0.177537	0.177258
5	-1.177622	-1.748766	-2.062535	-1.369970

	RNETMIG2011	RNETMIG2012	RNETMIG2013	RNETMIG2014	RNETMIG2015
1	7.606016	-2.626146	-2.722002	2.592270	-2.187333
2	15.844176	18.559627	22.727626	20.317142	18.293499
3	-4.874741	-2.758113	-7.167664	-3.978583	-10.543299
4	-5.088389	-4.363636	-5.403729	0.754533	1.107861
5	1.859511	-0.848580	-1.402476	-1.577232	-0.884411

[5 rows x 100 columns]

[3]:
```python
# In the first example for groupby() I want to use the census date. Let's get a
 list of the unique states,
# then we can iterate over all the states and for each state we reduce the data
 frame and calculate the
# average.

# Let's run such task for 3 times and time it. For this we'll use the cell
 magic function %%timeit
```

[4]:
```python
%%timeit -n 3

for state in df['STNAME'].unique():
    # We'll just calculate the average using numpy for this particular state
    avg = np.average(df.where(df['STNAME']==state).dropna()['CENSUS2010POP'])
    # And we'll print it to the screen
    print('Counties in state ' + state +
          ' have an average population of ' + str(avg))
```

```
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Counties in state Alaska have an average population of 24490.724137931036
Counties in state Arizona have an average population of 426134.4666666667
Counties in state Arkansas have an average population of 38878.90666666667
Counties in state California have an average population of 642309.5862068966
Counties in state Colorado have an average population of 78581.1875
Counties in state Connecticut have an average population of 446762.125
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Counties in state Illinois have an average population of 125790.50980392157
Counties in state Indiana have an average population of 70476.10869565218
Counties in state Iowa have an average population of 30771.262626262625
```

Counties in state Kansas have an average population of 27172.55238095238
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1.15 s ± 18.8 ms per loop (mean ± std. dev. of 7 runs, 3 loops each)
```

[5]:
```python
# If you scroll down to the bottom of that output you can see it takes a fair
 ↪bit of time to finish.
# Now let's try another approach using groupby()
```

[6]:
```python
%%timeit -n 3
# For this method, we start by telling pandas we're interested in grouping by
 ↪state name, this is the "split"
for group, frame in df.groupby('STNAME'):
    # You'll notice there are two values we set here. groupby() returns a
 ↪tuple, where the first value is the
    # value of the key we were trying to group by, in this case a specific
 ↪state name, and the second one is
    # projected dataframe that was found for that group

    # Now we include our logic in the "apply" step, which is to calculate an
 ↪average of the census2010pop
    avg = np.average(frame['CENSUS2010POP'])
    # And print the results
    print('Counties in state ' + group +
          ' have an average population of ' + str(avg))
# And we don't have to worry about the combine step in this case, because all
 ↪of our data transformation is
# actually printing out results.
```

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Counties in state District of Columbia have an average population of 601723.0
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Counties in state Indiana have an average population of 70476.10869565218
Counties in state Iowa have an average population of 30771.262626262625
Counties in state Kansas have an average population of 27172.55238095238
Counties in state Kentucky have an average population of 36161.39166666667
Counties in state Louisiana have an average population of 70833.9375
Counties in state Maine have an average population of 83022.5625
Counties in state Maryland have an average population of 240564.66666666666
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Counties in state New Hampshire have an average population of 131647.0
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Counties in state South Carolina have an average population of
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100551.39130434782

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Counties in state New Mexico have an average population of 62399.36363636364
Counties in state New York have an average population of 312550.03225806454
Counties in state North Carolina have an average population of 95354.83
Counties in state North Dakota have an average population of 12690.396226415094
Counties in state Ohio have an average population of 131096.63636363635
Counties in state Oklahoma have an average population of 48718.844155844155
Counties in state Oregon have an average population of 106418.72222222222
Counties in state Pennsylvania have an average population of 189587.74626865672
Counties in state Rhode Island have an average population of 210513.4
Counties in state South Carolina have an average population of 100551.39130434782
Counties in state South Dakota have an average population of 12336.060606060606
Counties in state Tennessee have an average population of 66801.1052631579
Counties in state Texas have an average population of 98998.27165354331
Counties in state Utah have an average population of 95306.37931034483
Counties in state Vermont have an average population of 44695.78571428572
Counties in state Virginia have an average population of 60111.29323308271
Counties in state Washington have an average population of 172424.10256410256
Counties in state West Virginia have an average population of 33690.8
Counties in state Wisconsin have an average population of 78985.91666666667
Counties in state Wyoming have an average population of 24505.478260869564
Counties in state Alabama have an average population of 71339.34328358209
Counties in state Alaska have an average population of 24490.724137931036
Counties in state Arizona have an average population of 426134.4666666667
Counties in state Arkansas have an average population of 38878.90666666667
Counties in state California have an average population of 642309.5862068966
Counties in state Colorado have an average population of 78581.1875
Counties in state Connecticut have an average population of 446762.125
Counties in state Delaware have an average population of 299311.3333333333
Counties in state District of Columbia have an average population of 601723.0
Counties in state Florida have an average population of 280616.5671641791
Counties in state Georgia have an average population of 60928.63522012578
Counties in state Hawaii have an average population of 272060.2
Counties in state Idaho have an average population of 35626.86363636364
Counties in state Illinois have an average population of 125790.50980392157
Counties in state Indiana have an average population of 70476.10869565218
Counties in state Iowa have an average population of 30771.262626262625
Counties in state Kansas have an average population of 27172.55238095238
Counties in state Kentucky have an average population of 36161.39166666667
Counties in state Louisiana have an average population of 70833.9375
Counties in state Maine have an average population of 83022.5625
Counties in state Maryland have an average population of 240564.66666666666

Counties in state Massachusetts have an average population of 467687.78571428574
Counties in state Michigan have an average population of 119080.0
Counties in state Minnesota have an average population of 60964.65517241379
Counties in state Mississippi have an average population of 36186.54878048781
Counties in state Missouri have an average population of 52077.62608695652
Counties in state Montana have an average population of 17668.125
Counties in state Nebraska have an average population of 19638.075268817203
Counties in state Nevada have an average population of 158855.9411764706
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Counties in state Iowa have an average population of 30771.262626262625
Counties in state Kansas have an average population of 27172.55238095238

```
Counties in state Kentucky have an average population of 36161.39166666667
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Counties in state Wyoming have an average population of 24505.478260869564
5.72 ms ± 253 µs per loop (mean ± std. dev. of 7 runs, 3 loops each)
```

[7]: ```
Wow, what a huge difference in speed. An improve by roughly by two factors!
```

[8]: ```
# Now, 99% of the time, you'll use group by on one or more columns. But you can␣
 ↪also provide a function to
# group by and use that to segment your data.

# This is a bit of a fabricated example but lets say that you have a big batch␣
 ↪job with lots of processing and
# you want to work on only a third or so of the states at a given time. We␣
 ↪could create some function which
```

```
# returns a number between zero and two based on the first character of the␣
 ↪state name. Then we can tell group
# by to use this function to split up our data frame. It's important to note␣
 ↪that in order to do this you need
# to set the index of the data frame to be the column that you want to group by␣
 ↪first.

# We'll create some new function called set_batch_number and if the first␣
 ↪letter of the parameter is a capital
# M we'll return a 0. If it's a capital Q we'll return a 1 and otherwise we'll␣
 ↪return a 2. Then we'll pass
# this function to the data frame

df = df.set_index('STNAME')

def set_batch_number(item):
    if item[0]<'M':
        return 0
    if item[0]<'Q':
        return 1
    return 2

# The dataframe is supposed to be grouped by according to the batch number And␣
 ↪we will loop through each batch
# group
for group, frame in df.groupby(set_batch_number):
    print('There are ' + str(len(frame)) + ' records in group ' + str(group) +␣
 ↪' for processing.')
```

```
There are 1177 records in group 0 for processing.
There are 1134 records in group 1 for processing.
There are 831 records in group 2 for processing.
```

```
[9]:  # Notice that this time I didn't pass in a column name to groupby(). Instead, I␣
       ↪set the index of the dataframe
      # to be STNAME, and if no column identifier is passed groupby() will␣
       ↪automatically use the index.
```

```
[10]:  # Let's take one more look at an example of how we might group data. In this␣
        ↪example, I want to use a dataset
       # of housing from airbnb. In this dataset there are two columns of interest,␣
        ↪one is the cancellation_policy
       # and the other is the review_scores_value.
       df=pd.read_csv("datasets/listings.csv")
       df.head()
```

```
[10]:            id                            listing_url        scrape_id  \
     0   12147973  https://www.airbnb.com/rooms/12147973  20160906204935
     1    3075044   https://www.airbnb.com/rooms/3075044  20160906204935
     2       6976      https://www.airbnb.com/rooms/6976  20160906204935
     3    1436513   https://www.airbnb.com/rooms/1436513  20160906204935
     4    7651065   https://www.airbnb.com/rooms/7651065  20160906204935

       last_scraped                                        name  \
     0   2016-09-07                   Sunny Bungalow in the City
     1   2016-09-07              Charming room in pet friendly apt
     2   2016-09-07                 Mexican Folk Art Haven in Boston
     3   2016-09-07   Spacious Sunny Bedroom Suite in Historic Home
     4   2016-09-07                           Come Home to Boston

                                          summary  \
     0  Cozy, sunny, family home.  Master bedroom high…
     1  Charming and quiet room in a second floor 1910…
     2  Come stay with a friendly, middle-aged guy in …
     3  Come experience the comforts of home away from…
     4  My comfy, clean and relaxing home is one block…

                                            space  \
     0  The house has an open and cozy feel at the sam…
     1  Small but cozy and quite room with a full size…
     2  Come stay with a friendly, middle-aged guy in …
     3  Most places you find in Boston are small howev…
     4  Clean, attractive, private room, one block fro…

                                      description experiences_offered  \
     0  Cozy, sunny, family home.  Master bedroom high…                none
     1  Charming and quiet room in a second floor 1910…                none
     2  Come stay with a friendly, middle-aged guy in …                none
     3  Come experience the comforts of home away from…                none
     4  My comfy, clean and relaxing home is one block…                none

                             neighborhood_overview  … review_scores_value  \
     0  Roslindale is quiet, convenient and friendly. …  …                  NaN
     1  The room is in Roslindale, a diverse and prima…  …                  9.0
     2  The LOCATION: Roslindale is a safe and diverse…  …                 10.0
     3  Roslindale is a lovely little neighborhood loc…  …                 10.0
     4  I love the proximity to downtown, the neighbor…  …                 10.0

       requires_license license jurisdiction_names instant_bookable  \
     0                f     NaN                NaN                f
     1                f     NaN                NaN                t
     2                f     NaN                NaN                f
     3                f     NaN                NaN                f
```

```
4                     f      NaN              NaN                     f

   cancellation_policy require_guest_profile_picture  \
0             moderate                             f
1             moderate                             f
2             moderate                             t
3             moderate                             f
4             flexible                             f

   require_guest_phone_verification calculated_host_listings_count  \
0                                f                              1
1                                f                              1
2                                f                              1
3                                f                              1
4                                f                              1

   reviews_per_month
0                NaN
1               1.30
2               0.47
3               1.00
4               2.25

[5 rows x 95 columns]
```

```
[11]:  # So, how would I group by both of these columns? A first approach might be to␣
       ↪promote them to a multiindex
       # and just call groupby()
       df=df.set_index(["cancellation_policy","review_scores_value"])

       # When we have a multiindex we need to pass in the levels we are interested in␣
       ↪grouping by
       for group, frame in df.groupby(level=(0,1)):
           print(group)
```

```
('flexible', 2.0)
('flexible', 4.0)
('flexible', 5.0)
('flexible', 6.0)
('flexible', 7.0)
('flexible', 8.0)
('flexible', 9.0)
('flexible', 10.0)
('moderate', 2.0)
('moderate', 4.0)
('moderate', 6.0)
('moderate', 7.0)
```

```
('moderate', 8.0)
('moderate', 9.0)
('moderate', 10.0)
('strict', 2.0)
('strict', 3.0)
('strict', 4.0)
('strict', 5.0)
('strict', 6.0)
('strict', 7.0)
('strict', 8.0)
('strict', 9.0)
('strict', 10.0)
('super_strict_30', 6.0)
('super_strict_30', 7.0)
('super_strict_30', 8.0)
('super_strict_30', 9.0)
('super_strict_30', 10.0)
```

[12]:
```python
# This seems to work ok. But what if we wanted to group by the cancelation
 ↪policy and review scores, but
# separate out all the 10's from those under ten? In this case, we could use a
 ↪function to manage the
# groupings

def grouping_fun(item):
    # Check the "review_scores_value" portion of the index. item is in the
 ↪format of
    # (cancellation_policy,review_scores_value
    if item[1] == 10.0:
        return (item[0],"10.0")
    else:
        return (item[0],"not 10.0")

for group, frame in df.groupby(by=grouping_fun):
    print(group)
```

```
('flexible', '10.0')
('flexible', 'not 10.0')
('moderate', '10.0')
('moderate', 'not 10.0')
('strict', '10.0')
('strict', 'not 10.0')
('super_strict_30', '10.0')
('super_strict_30', 'not 10.0')
```

[13]:
```python
df.head()
```

```
[13]:                                                                      id  \
      cancellation_policy review_scores_value
      moderate            NaN                  12147973
                          9.0                   3075044
                          10.0                     6976
                          10.0                  1436513
      flexible            10.0                  7651065


                                                                   listing_url
    \
      cancellation_policy review_scores_value
      moderate            NaN                  https://www.airbnb.com/rooms/12147973
                          9.0                   https://www.airbnb.com/rooms/3075044
                          10.0                     https://www.airbnb.com/rooms/6976
                          10.0                  https://www.airbnb.com/rooms/1436513
      flexible            10.0                  https://www.airbnb.com/rooms/7651065


                                                      scrape_id last_scraped  \
      cancellation_policy review_scores_value
      moderate            NaN                  20160906204935   2016-09-07
                          9.0                  20160906204935   2016-09-07
                          10.0                 20160906204935   2016-09-07
                          10.0                 20160906204935   2016-09-07
      flexible            10.0                 20160906204935   2016-09-07


        name  \
      cancellation_policy review_scores_value
      moderate            NaN                                      Sunny Bungalow in
      the City
                          9.0                                  Charming room in pet
      friendly apt
                          10.0                           Mexican Folk Art Haven in
      Boston
                          10.0                 Spacious Sunny Bedroom Suite in
      Historic Home
      flexible            10.0                                         Come Home to
      Boston


        summary  \
      cancellation_policy review_scores_value
      moderate            NaN                  Cozy, sunny, family home.  Master
      bedroom high…
                          9.0                  Charming and quiet room in a second
      floor 1910…
                          10.0                 Come stay with a friendly, middle-aged
      guy in …
                          10.0                 Come experience the comforts of home
```

```
away from…
flexible            10.0                  My comfy, clean and relaxing home is
one block…


      space  \
cancellation_policy review_scores_value
moderate            NaN                   The house has an open and cozy feel at
the sam…
                    9.0                   Small but cozy and quite room with a
full size…
                    10.0                  Come stay with a friendly, middle-aged
guy in …
                    10.0                  Most places you find in Boston are
small howev…
flexible            10.0                  Clean, attractive, private room, one
block fro…


description  \
cancellation_policy review_scores_value
moderate            NaN                   Cozy, sunny, family home.  Master
bedroom high…
                    9.0                   Charming and quiet room in a second
floor 1910…
                    10.0                  Come stay with a friendly, middle-aged
guy in …
                    10.0                  Come experience the comforts of home
away from…
flexible            10.0                  My comfy, clean and relaxing home is
one block…


                                   experiences_offered  \
cancellation_policy review_scores_value
moderate            NaN                                    none
                    9.0                                    none
                    10.0                                   none
                    10.0                                   none
flexible            10.0                                   none


neighborhood_overview  \
cancellation_policy review_scores_value
moderate            NaN                   Roslindale is quiet, convenient and
friendly. …
                    9.0                   The room is in Roslindale, a diverse
and prima…
                    10.0                  The LOCATION: Roslindale is a safe and
diverse…
                    10.0                  Roslindale is a lovely little
```

```
neighborhood loc…
flexible            10.0                    I love the proximity to downtown, the
neighbor…


                                        …  review_scores_communication  \
cancellation_policy review_scores_value  …
moderate            NaN                  …                           NaN
                    9.0                  …                          10.0
                    10.0                 …                          10.0
                    10.0                 …                          10.0
flexible            10.0                 …                          10.0


                                        review_scores_location  \
cancellation_policy review_scores_value
moderate            NaN                                     NaN
                    9.0                                     9.0
                    10.0                                    9.0
                    10.0                                   10.0
flexible            10.0                                    9.0


                                        requires_license license  \
cancellation_policy review_scores_value
moderate            NaN                                 f     NaN
                    9.0                                 f     NaN
                    10.0                                f     NaN
                    10.0                                f     NaN
flexible            10.0                                f     NaN


                                        jurisdiction_names instant_bookable  \
cancellation_policy review_scores_value
moderate            NaN                                NaN                f
                    9.0                                NaN                t
                    10.0                               NaN                f
                    10.0                               NaN                f
flexible            10.0                               NaN                f


                                        require_guest_profile_picture  \
cancellation_policy review_scores_value
moderate            NaN                                             f
                    9.0                                             f
                    10.0                                            t
                    10.0                                            f
flexible            10.0                                            f


                                        require_guest_phone_verification  \
cancellation_policy review_scores_value
moderate            NaN                                                f
```

```
                      9.0                                                          f
                     10.0                                                          f
                     10.0                                                          f
flexible             10.0                                                          f

                                                  calculated_host_listings_count  \
cancellation_policy review_scores_value
moderate            NaN                                                          1
                    9.0                                                          1
                    10.0                                                         1
                    10.0                                                         1
flexible            10.0                                                         1

                                                  reviews_per_month
cancellation_policy review_scores_value
moderate            NaN                                          NaN
                    9.0                                         1.30
                    10.0                                        0.47
                    10.0                                        1.00
flexible            10.0                                        2.25

[5 rows x 93 columns]
```

1.2 Applying

To this point we have applied very simple processing to our data after splitting, really just outputting some print statements to demonstrate how the splitting works. The pandas developers have three broad categories of data processing to happen during the apply step, Aggregation of group data, Transformation of group data, and Filtration of group data

1.2.1 Aggregation

```
[14]:  # The most straight forward apply step is the aggregation of data, and uses the␣
       ↪method agg() on the groupby
       # object. Thus far we have only iterated through the groupby object, unpacking␣
       ↪it into a label (the group
       # name) and a dataframe. But with agg we can pass in a dictionary of the␣
       ↪columns we are interested in
       # aggregating along with the function we are looking to apply to aggregate.

       # Let's reset the index for our airbnb data
       df=df.reset_index()

       # Now lets group by the cancellation policy and find the average␣
       ↪review_scores_value by group
       df.groupby("cancellation_policy").agg({"review_scores_value":np.average})
```

```
[14]:                  review_scores_value
      cancellation_policy
      flexible                        NaN
      moderate                        NaN
      strict                          NaN
      super_strict_30                 NaN
```

```
[15]:  # Hrm. That didn't seem to work at all. Just a bunch of not a numbers. The␣
       ↪issue is actually in the function
       # that we sent to aggregate. np.average does not ignore nans! However, there is␣
       ↪a function we can use for this
       df.groupby("cancellation_policy").agg({"review_scores_value":np.nanmean})
```

```
[15]:                  review_scores_value
      cancellation_policy
      flexible                   9.237421
      moderate                   9.307398
      strict                     9.081441
      super_strict_30            8.537313
```

```
[16]:  # We can just extend this dictionary to aggregate by multiple functions or␣
       ↪multiple columns.
       df.groupby("cancellation_policy").agg({"review_scores_value":(np.nanmean,np.
       ↪nanstd),
                                             "reviews_per_month":np.nanmean})
```

```
[16]:                  review_scores_value              reviews_per_month
                            nanmean     nanstd                 nanmean
      cancellation_policy
      flexible              9.237421   1.096271                1.829210
      moderate              9.307398   0.859859                2.391922
      strict                9.081441   1.040531                1.873467
      super_strict_30       8.537313   0.840785                0.340143
```

```
[17]:  # Take a moment to make sure you understand the previous cell, since it's␣
       ↪somewhat complex. First we're doing
       # a group by on the dataframe object by the column "cancellation_policy". This␣
       ↪creates a new GroupBy object.
       # Then we are invoking the agg() function on that object. The agg function is␣
       ↪going to apply one or more
       # functions we specify to the group dataframes and return a single row per␣
       ↪dataframe/group. When we called
       # this function we sent it two dictionary entries, each with the key indicating␣
       ↪which column we wanted
       # functions applied to. For the first column we actually supplied a tuple of␣
       ↪two functions. Note that these
```

```
# are not function invocations, like np.nanmean(), or function names, like␣
 ↪"nanmean" they are references to
# functions which will return single values. The groupby object will recognize␣
 ↪the tuple and call each
# function in order on the same column. The results will be in a heirarchical␣
 ↪index, but since they are
# columns they don't show as an index per se. Then we indicated another column␣
 ↪and a single function we wanted
# to run.
```

1.2.2 Transformation

```
[18]: # Transformation is different from aggregation. Where agg() returns a single␣
       ↪value per column, so one row per
      # group, tranform() returns an object that is the same size as the group.␣
       ↪Essentially, it broadcasts the
      # function you supply over the grouped dataframe, returning a new dataframe.␣
       ↪This makes combining data later
      # easy.
```

```
[19]: # For instance, suppose we want to include the average rating values in a given␣
       ↪group by cancellation policy,
      # but preserve the dataframe shape so that we could generate a difference␣
       ↪between an individual observation
      # and the sum.

      # First, lets define just some subset of columns we are interested in
      cols=['cancellation_policy','review_scores_value']
      # Now lets transform it, I'll store this in its own dataframe
      transform_df=df[cols].groupby('cancellation_policy').transform(np.nanmean)
      transform_df.head()
```

```
[19]:    review_scores_value
      0             9.307398
      1             9.307398
      2             9.307398
      3             9.307398
      4             9.237421
```

```
[20]: # So we can see that the index here is actually the same as the original␣
       ↪dataframe. So lets just join this
      # in. Before we do that, lets rename the column in the transformed version
      transform_df.rename({'review_scores_value':'mean_review_scores'},␣
       ↪axis='columns', inplace=True)
      df=df.merge(transform_df, left_index=True, right_index=True)
      df.head()
```

```
[20]:    cancellation_policy  review_scores_value         id  \
      0             moderate                  NaN   12147973
      1             moderate                  9.0    3075044
      2             moderate                 10.0       6976
      3             moderate                 10.0    1436513
      4             flexible                 10.0    7651065

                               listing_url        scrape_id last_scraped  \
      0  https://www.airbnb.com/rooms/12147973  20160906204935   2016-09-07
      1   https://www.airbnb.com/rooms/3075044  20160906204935   2016-09-07
      2      https://www.airbnb.com/rooms/6976  20160906204935   2016-09-07
      3   https://www.airbnb.com/rooms/1436513  20160906204935   2016-09-07
      4   https://www.airbnb.com/rooms/7651065  20160906204935   2016-09-07

                                              name  \
      0                   Sunny Bungalow in the City
      1             Charming room in pet friendly apt
      2               Mexican Folk Art Haven in Boston
      3  Spacious Sunny Bedroom Suite in Historic Home
      4                           Come Home to Boston

                                           summary  \
      0  Cozy, sunny, family home.  Master bedroom high…
      1  Charming and quiet room in a second floor 1910…
      2  Come stay with a friendly, middle-aged guy in …
      3  Come experience the comforts of home away from…
      4  My comfy, clean and relaxing home is one block…

                                             space  \
      0  The house has an open and cozy feel at the sam…
      1  Small but cozy and quite room with a full size…
      2  Come stay with a friendly, middle-aged guy in …
      3  Most places you find in Boston are small howev…
      4  Clean, attractive, private room, one block fro…

                                       description  … \
      0  Cozy, sunny, family home.  Master bedroom high…  …
      1  Charming and quiet room in a second floor 1910…  …
      2  Come stay with a friendly, middle-aged guy in …  …
      3  Come experience the comforts of home away from…  …
      4  My comfy, clean and relaxing home is one block…  …

        review_scores_location requires_license license jurisdiction_names  \
      0                    NaN                f     NaN                NaN
      1                    9.0                f     NaN                NaN
      2                    9.0                f     NaN                NaN
      3                   10.0                f     NaN                NaN
```

```
4                           9.0                    f      NaN                     NaN

   instant_bookable require_guest_profile_picture  \
0                 f                              f
1                 t                              f
2                 f                              t
3                 f                              f
4                 f                              f

   require_guest_phone_verification calculated_host_listings_count  \
0                                 f                              1
1                                 f                              1
2                                 f                              1
3                                 f                              1
4                                 f                              1

   reviews_per_month mean_review_scores
0                NaN           9.307398
1               1.30           9.307398
2               0.47           9.307398
3               1.00           9.307398
4               2.25           9.237421

[5 rows x 96 columns]
```

[21]:
```python
# Great, we can see that our new column is in place, the mean_review_scores. So␣
 ↪now we could create, for
# instance, the difference between a given row and it's group (the cancellation␣
 ↪policy) means.
df['mean_diff']=np.absolute(df['review_scores_value']-df['mean_review_scores'])
df['mean_diff'].head()
```

[21]:
```
0         NaN
1    0.307398
2    0.692602
3    0.692602
4    0.762579
Name: mean_diff, dtype: float64
```

1.2.3 Filtering

[22]:
```python
# The GroupBy object has build in support for filtering groups as well. It's␣
 ↪often that you'll want to group
# by some feature, then make some transformation to the groups, then drop␣
 ↪certain groups as part of your
```

```
# cleaning routines. The filter() function takes in a function which it applies⎵
 ↪to each group dataframe and
# returns either a True or a False, depending upon whether that group should be⎵
 ↪included in the results.
```

[23]:
```
# For instance, if we only want those groups which have a mean rating above 9⎵
 ↪included in our results
df.groupby('cancellation_policy').filter(lambda x: np.
 ↪nanmean(x['review_scores_value'])>9.2)
```

[23]:

	cancellation_policy	review_scores_value	id	\
0	moderate	NaN	12147973	
1	moderate	9.0	3075044	
2	moderate	10.0	6976	
3	moderate	10.0	1436513	
4	flexible	10.0	7651065	
…	…	…	…	
3576	flexible	NaN	14689681	
3577	flexible	NaN	13750763	
3579	flexible	NaN	14852179	
3582	flexible	NaN	14585486	
3584	flexible	NaN	14504422	

	listing_url	scrape_id	last_scraped	\
0	https://www.airbnb.com/rooms/12147973	20160906204935	2016-09-07	
1	https://www.airbnb.com/rooms/3075044	20160906204935	2016-09-07	
2	https://www.airbnb.com/rooms/6976	20160906204935	2016-09-07	
3	https://www.airbnb.com/rooms/1436513	20160906204935	2016-09-07	
4	https://www.airbnb.com/rooms/7651065	20160906204935	2016-09-07	
…	…	…	…	
3576	https://www.airbnb.com/rooms/14689681	20160906204935	2016-09-07	
3577	https://www.airbnb.com/rooms/13750763	20160906204935	2016-09-07	
3579	https://www.airbnb.com/rooms/14852179	20160906204935	2016-09-07	
3582	https://www.airbnb.com/rooms/14585486	20160906204935	2016-09-07	
3584	https://www.airbnb.com/rooms/14504422	20160906204935	2016-09-07	

	name	\
0	Sunny Bungalow in the City	
1	Charming room in pet friendly apt	
2	Mexican Folk Art Haven in Boston	
3	Spacious Sunny Bedroom Suite in Historic Home	
4	Come Home to Boston	
…	…	
3576	Beautiful loft style bedroom with large bathroom	
3577	Comfortable Space in the Heart of Brookline	
3579	Spacious Queen Bed Room Close to Boston Univer…	
3582	Gorgeous funky apartment	

```

```
3584   (K1) Private Room near Harvard/MIT

                                                        summary \
0   Cozy, sunny, family home. Master bedroom high…
1   Charming and quiet room in a second floor 1910…
2   Come stay with a friendly, middle-aged guy in …
3   Come experience the comforts of home away from…
4   My comfy, clean and relaxing home is one block…
…   …
3576   You'd be living on the top floor of a four sto…
3577   Our place is close to Coolidge Corner, Allston…
3579   - Grocery: A full-size Star market is 2 minute…
3582   Funky little apartment close to public transpo…
3584   My place is close to My home is a warm and fri…

                                                          space \
0   The house has an open and cozy feel at the sam…
1   Small but cozy and quite room with a full size…
2   Come stay with a friendly, middle-aged guy in …
3   Most places you find in Boston are small howev…
4   Clean, attractive, private room, one block fro…
…   …
3576   NaN
3577   This space consists of 2 Rooms and a private b…
3579   NaN
3582   Modern and relaxed space with many facilities …
3584   To ensure a smooth check in: 1. You MUST have …

                                                    description … requires_license \
0   Cozy, sunny, family home. Master bedroom high… …   f
1   Charming and quiet room in a second floor 1910… …   f
2   Come stay with a friendly, middle-aged guy in … …   f
3   Come experience the comforts of home away from… …   f
4   My comfy, clean and relaxing home is one block… …   f
…   … …   …
3576   You'd be living on the top floor of a four sto… …   f
3577   Our place is close to Coolidge Corner, Allston… …   f
3579   - Grocery: A full-size Star market is 2 minute… …   f
3582   Funky little apartment close to public transpo… …   f
3584   My place is close to My home is a warm and fri… …   f

      license jurisdiction_names instant_bookable \
0   NaN   NaN   f
1   NaN   NaN   t
2   NaN   NaN   f
3   NaN   NaN   f
4   NaN   NaN   f
```

```
...          ...                      ...                     ...
3576         NaN                      NaN                       f
3577         NaN                      NaN                       f
3579         NaN                      NaN                       f
3582         NaN                      NaN                       f
3584         NaN                      NaN                       t

      require_guest_profile_picture require_guest_phone_verification  \
0                                 f                                f
1                                 f                                f
2                                 t                                f
3                                 f                                f
4                                 f                                f
...                             ...                              ...
3576                              f                                f
3577                              f                                f
3579                              f                                f
3582                              f                                f
3584                              f                                f

      calculated_host_listings_count reviews_per_month mean_review_scores  \
0                                  1               NaN           9.307398
1                                  1              1.30           9.307398
2                                  1              0.47           9.307398
3                                  1              1.00           9.307398
4                                  1              2.25           9.237421
...                              ...               ...                ...
3576                               1               NaN           9.237421
3577                               1               NaN           9.237421
3579                               1               NaN           9.237421
3582                               1               NaN           9.237421
3584                               3               NaN           9.237421

      mean_diff
0           NaN
1      0.307398
2      0.692602
3      0.692602
4      0.762579
...         ...
3576        NaN
3577        NaN
3579        NaN
3582        NaN
3584        NaN

[1918 rows x 97 columns]
```

```
[24]: # Notice that the results are still indexed, but that any of the results which␣
      ↪were in a group with a mean
      # review score of less than or equal to 9.2 were not copied over.
```

1.2.4 Applying

```
[25]: # By far the most common operation I invoke on groupby objects is the apply()␣
      ↪function. This allows you to
      # apply an arbitrary function to each group, and stitch the results back for␣
      ↪each apply() into a single
      # dataframe where the index is preserved.

      # Lets look at an example using our airbnb data, I'm going to get a clean copy␣
      ↪of the dataframe
      df=pd.read_csv("datasets/listings.csv")
      # And lets just include some of the columns we were interested in previously
      df=df[['cancellation_policy','review_scores_value']]
      df.head()
```

```
[25]:   cancellation_policy  review_scores_value
      0            moderate                  NaN
      1            moderate                  9.0
      2            moderate                 10.0
      3            moderate                 10.0
      4            flexible                 10.0
```

```
[26]: # In previous work we wanted to find the average review score of a listing and␣
      ↪its deviation from the group
      # mean. This was a two step process, first we used transform() on the groupby␣
      ↪object and then we had to
      # broadcast to create a new column. With apply() we could wrap this logic in␣
      ↪one place
      def calc_mean_review_scores(group):
          # group is a dataframe just of whatever we have grouped by, e.g.␣
      ↪cancellation policy, so we can treat
          # this as the complete dataframe
          avg=np.nanmean(group["review_scores_value"])
          # now broadcast our formula and create a new column
          group["review_scores_mean"]=np.abs(avg-group["review_scores_value"])
          return group

      # Now just apply this to the groups
      df.groupby('cancellation_policy').apply(calc_mean_review_scores).head()
```

```
[26]:   cancellation_policy  review_scores_value  review_scores_mean
      0            moderate                  NaN                 NaN
```

```
1              moderate                    9.0              0.307398
2              moderate                   10.0              0.692602
3              moderate                   10.0              0.692602
4              flexible                   10.0              0.762579
```

[27]: # Using apply can be slower than using some of the specialized functions,␣
      ↪especially agg(). But, if your
      # dataframes are not huge, it's a solid general purpose approach

Groupby is a powerful and commonly used tool for data cleaning and data analysis. Once you have grouped the data by some category you have a dataframe of just those values and you can conduct aggregated analysis on the segments that you are interested. The groupby() function follows a split-apply-combine approach - first the data is split into subgroups, then you can apply some transformation, filtering, or aggregation, then the results are combined automatically by pandas for us.