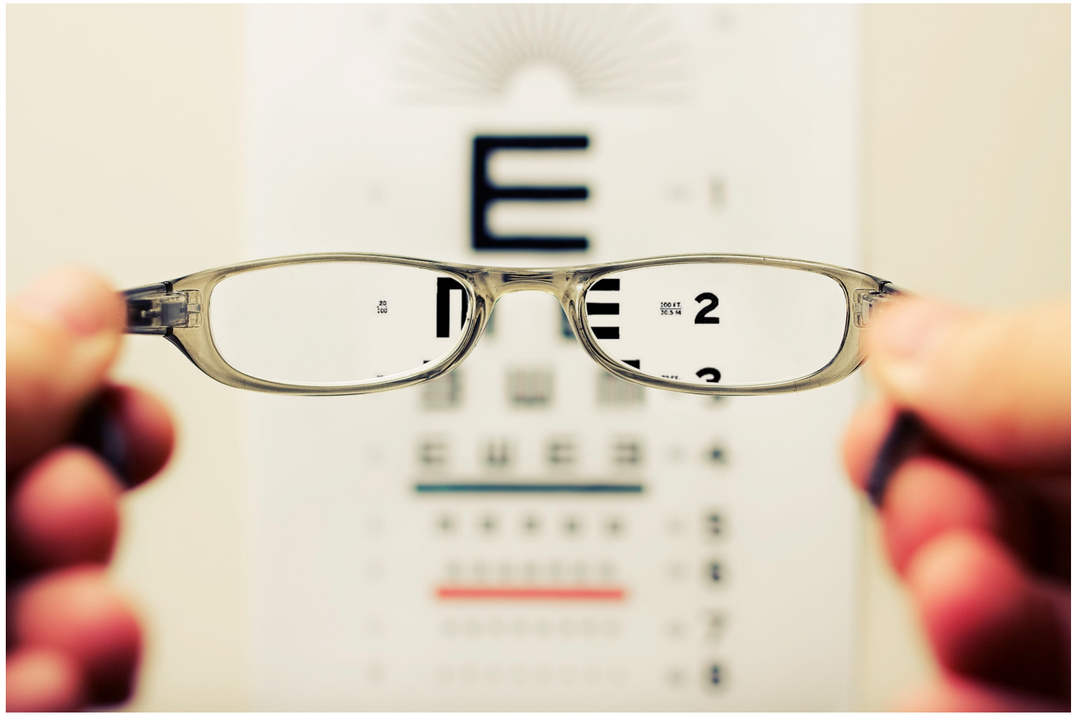
Inner join

JOINING DATA WITH PANDAS

Aaren Stubberfield
Instructor

datacamp

For clarity



Tables = DataFrames

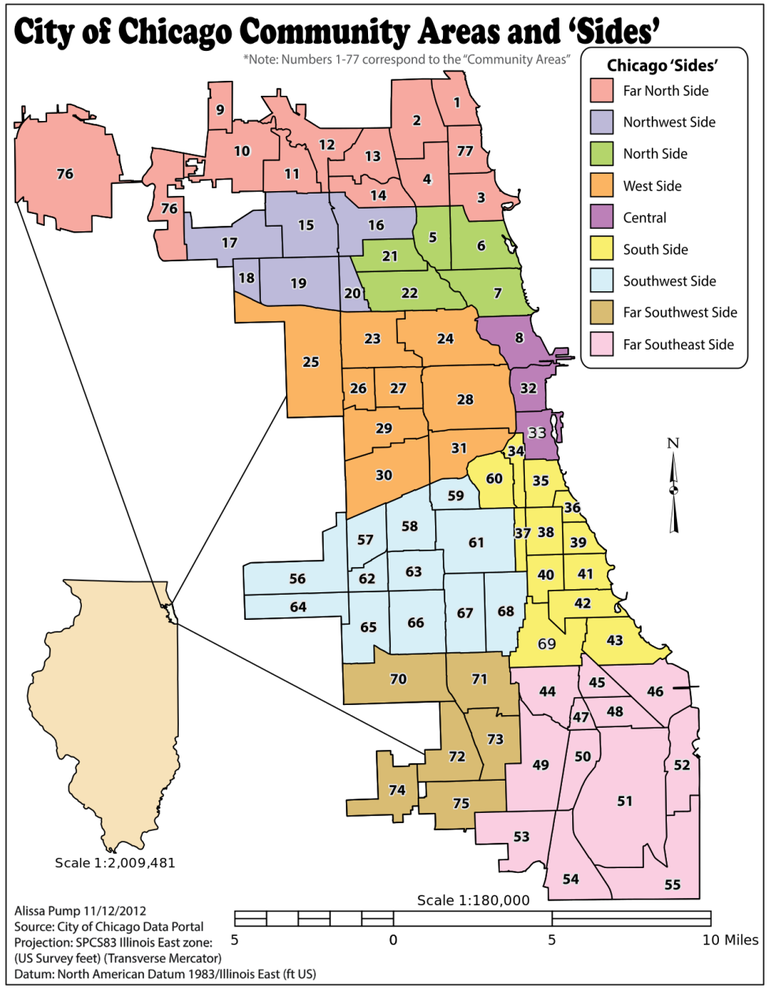
Merging = Joining

[1] Photo by David Travis on Unsplash

Chicago data portal dataset

[1] Photo by Pedro Lastra on Unsplash

Datasets for example



United States® Census Bureau

[1] Ward image By Alissapump, Own work, CC BY-SA 3.0

The ward data

```
wards = pd.read_csv('Ward_Offices.csv')
print(wards.head())
print(wards.shape)
```

```
  ward  alderman          address           zip
0 1     Proco "Joe" ...   2058 NORTH W...   60647
1 2     Brian Hopkins     1400 NORTH  ...   60622
2 3     Pat Dowell        5046 SOUTH S...   60609
3 4     William D. B...   435 EAST 35T...   60616
4 5     Leslie A. Ha...   2325 EAST 71...   60649
(50, 4)
```

Census data

```
census = pd.read_csv('Ward_Census.csv')
print(census.head())
print(census.shape)
```

```
  ward  pop_2000  pop_2010  change  address          zip
0 1     52951     56149     6%      2765 WEST SA...  60647
1 2     54361     55805     3%      WM WASTE MAN...  60622
2 3     40385     53039     31%     17 EAST 38TH...  60653
3 4     51953     54589     5%      31ST ST HARB...  60653
4 5     55302     51455     -7%     JACKSON PARK...  60637
(50, 6)
```

Merging tables

```
  ward  alderman          address          zip
0 1     Proco "Joe" ...   2058 NORTH W...  60647
1 2     Brian Hopkins     1400 NORTH  ...  60622
2 3     Pat Dowell        5046 SOUTH S...  60609
3 4     William D. B...   435 EAST 35T...  60616
4 5     Leslie A. Ha...   2325 EAST 71...  60649
```

```
  ward  pop_2000  pop_2010  change  address          zip
0 1     52951     56149     6%      2765 WEST SA...  60647
1 2     54361     55805     3%      WM WASTE MAN...  60622
2 3     40385     53039     31%     17 EAST 38TH...  60653
3 4     51953     54589     5%      31ST ST HARB...  60653
4 5     55302     51455     -7%     JACKSON PARK...  60637
```

Inner join

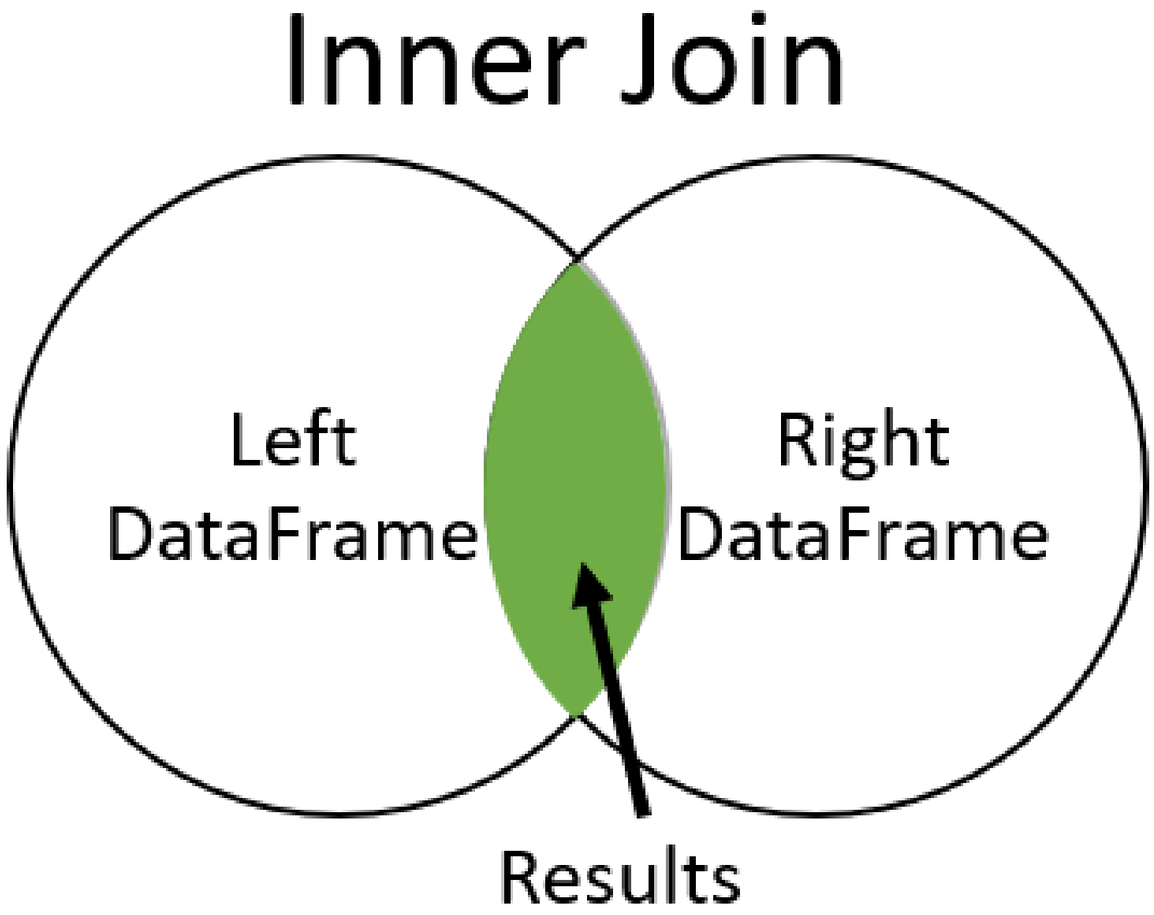
```
wards_census = wards.merge(census, on='ward')
print(wards_census.head(4))
```

```
  ward  alderman          address_x         zip_x  pop_2000  pop_2010  change  address_y         zip_y
0 1     Proco "Joe" ...   2058 NORTH W...   60647  52951     56149     6%      2765 WEST SA...   60647
1 2     Brian Hopkins     1400 NORTH  ...   60622  54361     55805     3%      WM WASTE MAN...   60622
2 3     Pat Dowell        5046 SOUTH S...   60609  40385     53039     31%     17 EAST 38TH...   60653
3 4     William D. B...   435 EAST 35T...   60616  51953     54589     5%      31ST ST HARB...   60653
```

```
print(wards_census.shape)
```

```
(50, 9)
```

Inner join



Suffixes

```
print(wards_census.columns)
```

```
Index(['ward', 'alderman', 'address_x', 'zip_x', 'pop_2000', 'pop_2010', 'change',
       'address_y', 'zip_y'],
      dtype='object')
```

Suffixes

```
wards_census = wards.merge(census, on='ward', suffixes=('_ward','_cen'))
print(wards_census.head())
print(wards_census.shape)
```

```
  ward  alderman          address_ward     zip_ward  pop_2000  pop_2010  change  address_cen      zi
0 1     Proco "Joe" ...   2058 NORTH W...  60647     52951     56149     6%      2765 WEST SA...  60
1 2     Brian Hopkins     1400 NORTH  ...  60622     54361     55805     3%      WM WASTE MAN...  60
2 3     Pat Dowell        5046 SOUTH S...  60609     40385     53039     31%     17 EAST 38TH...  60
3 4     William D. B...   435 EAST 35T...  60616     51953     54589     5%      31ST ST HARB...  60
4 5     Leslie A. Ha...   2325 EAST 71...  60649     55302     51455     -7%     JACKSON PARK...  60
(50, 9)
```

Let's practice!

JOINING DATA WITH PANDAS

One to many relationships

JOINING DATA WITH PANDAS

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One-to-one

A	B	C
A1	B1	C1
A2	B2	C2
A3	B3	C3

C	D
C1	D1
C2	D2
C3	D3

One-To-One = Every row in the left table is related to only one row in the right table

One-to-one example

```
   ward  alderman          address          zip
0  1     Proco "Joe" ...   2058 NORTH W...  60647
1  2     Brian Hopkins     1400 NORTH  ...  60622
2  3     Pat Dowell        5046 SOUTH S...  60609
3  4     William D. B...   435 EAST 35T...  60616
4  5     Leslie A. Ha...   2325 EAST 71...  60649
```

```
   ward  pop_2000  pop_2010  change  address          zip
0  1     52951     56149     6%      2765 WEST SA...  60647
1  2     54361     55805     3%      WM WASTE MAN...  60622
2  3     40385     53039     31%     17 EAST 38TH...  60653
3  4     51953     54589     5%      31ST ST HARB...  60653
4  5     55302     51455     -7%     JACKSON PARK...  60637
```

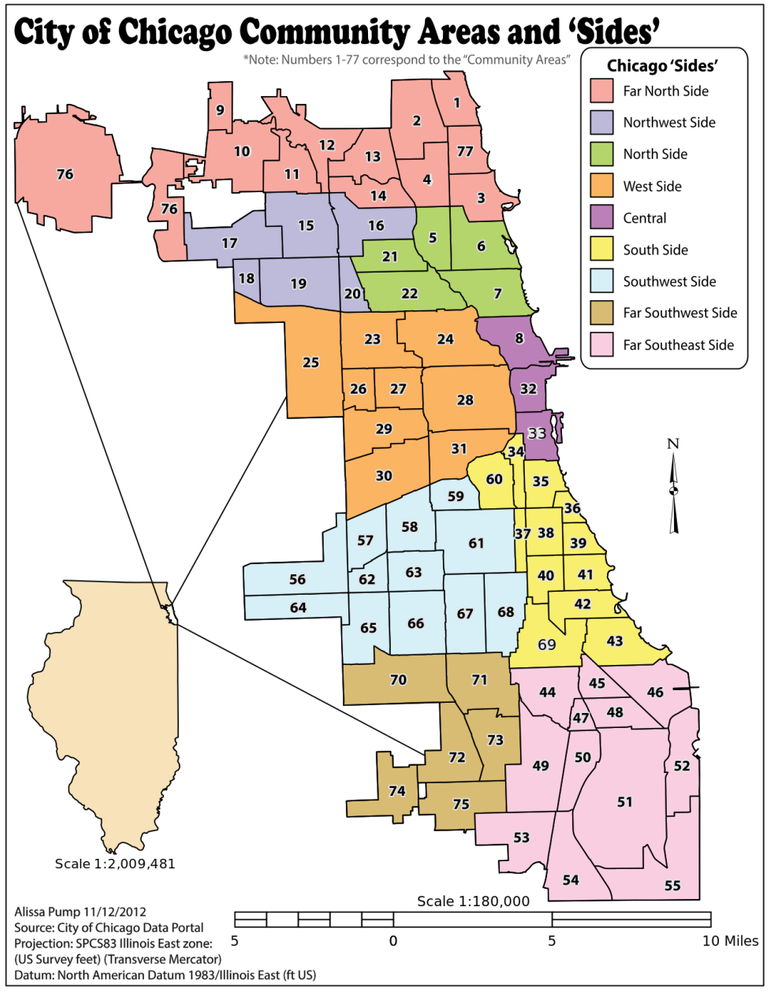
One-to-many

A	B	C
A1	B1	C1
A2	B2	C2
A3	B3	C3

C	D
C1	D1
C1	D2
C1	D3
C2	D4

One-To-Many = Every row in left table is related to one or more rows in the right table

One-to-many example



One-to-many example

```
licenses = pd.read_csv('Business_Licenses.csv')
print(licenses.head())
print(licenses.shape)
```

```
  account  ward  aid  business          address           zip
0 307071   3     743  REGGIE'S BAR...   2105 S STATE ST   60616
1 10       10    829  HONEYBEERS        13200 S HOUS...   60633
2 10002    14    775  CELINA DELI       5089 S ARCHE...   60632
3 10005    12    nan  KRAFT FOODS ...   2005 W 43RD ST    60609
4 10044    44    638  NEYBOUR'S TA...   3651 N SOUTH...   60613
(10000, 6)
```

One-to-many example

```
   ward  alderman          address          zip
0  1     Proco "Joe" ...   2058 NORTH W...  60647
1  2     Brian Hopkins     1400 NORTH  ...  60622
2  3     Pat Dowell        5046 SOUTH S...  60609
3  4     William D. B...   435 EAST 35T...  60616
4  5     Leslie A. Ha...   2325 EAST 71...  60649
```

```
   account  ward  aid  business          address          zip
0  307071   3     743  REGGIE'S BAR...   2105 S STATE ST  60616
1  10       10    829  HONEYBEERS        13200 S HOUS...  60633
2  10002    14    775  CELINA DELI       5089 S ARCHE...  60632
3  10005    12    nan  KRAFT FOODS ...   2005 W 43RD ST   60609
4  10044    44    638  NEYBOUR'S TA...   3651 N SOUTH...  60613
```

One-to-many example

```
ward_licenses = wards.merge(licenses, on='ward', suffixes=('_ward','_lic'))
print(ward_licenses.head())
```

```
  ward  alderman          address_ward     zip_ward  account  aid  business          address_lic
0 1     Proco "Joe" ...   2058 NORTH W...  60647     12024    nan  DIGILOG ELEC...   1038 N ASHLA...
1 1     Proco "Joe" ...   2058 NORTH W...  60647     14446    743  EMPTY BOTTLE...   1035 N WESTE...
2 1     Proco "Joe" ...   2058 NORTH W...  60647     14624    775  LITTLE MEL'S...   2205 N CALIF...
3 1     Proco "Joe" ...   2058 NORTH W...  60647     14987    nan  MR. BROWN'S ...   2301 W CHICA...
4 1     Proco "Joe" ...   2058 NORTH W...  60647     15642    814  Beat Kitchen      2000-2100 W ...
```

One-to-many example

```
print(wards.shape)
```

```
(50, 4)
```

```
print(ward_licenses.shape)
```

```
(10000, 9)
```

Let's practice!

JOINING DATA WITH PANDAS

Merging multiple DataFrames

JOINING DATA WITH PANDAS

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Merging multiple tables

A	B	C
A1	B1	C1
A2	B2	C2
A3	B3	C3

C	D
C1	D1
C2	D2
C3	D3

A	B	C
A1	B1	C1
A2	B2	C2
A3	B3	C3

C	E
C1	E1
C2	E2
C3	E3

E	F	G
E1	F1	G1
E2	F2	G2
E3	F3	G3

Remembering the licenses table

```
print(licenses.head())
```

```
   account  ward  aid  business          address           zip
0 307071    3     743  REGGIE'S BAR...   2105 S STATE ST   60616
1 10        10    829  HONEYBEERS        13200 S HOUS...   60633
2 10002     14    775  CELINA DELI       5089 S ARCHE...   60632
3 10005     12    nan  KRAFT FOODS ...   2005 W 43RD ST    60609
4 10044     44    638  NEYBOUR'S TA...   3651 N SOUTH...   60613
```

Remembering the wards table

```
print(wards.head())
```

```
   ward  alderman          address           zip
0  1     Proco "Joe" ...   2058 NORTH W...   60647
1  2     Brian Hopkins     1400 NORTH  ...   60622
2  3     Pat Dowell        5046 SOUTH S...   60609
3  4     William D. B...   435 EAST 35T...   60616
4  5     Leslie A. Ha...   2325 EAST 71...   60649
```

Review new data

```
grants = pd.read_csv('Small_Business_Grant_Agreements.csv')
print(grants.head())
```

```
  address           zip    grant       company
0 1000 S KOSTN...   60624  148914.50   NATIONWIDE F...
1 1000 W 35TH ST    60609  100000.00   SMALL BATCH,...
2 1000 W FULTO...   60612  34412.50    FULTON MARKE...
3 10008 S WEST...   60643  12285.32    LAW OFFICES ...
4 1002 W ARGYL...   60640  28998.75    MASALA'S IND...
```

Tables to merge

	address	zip	grant	company
0	1031 N CICER...	60651	150000.00	1031 HANS LLC
1	1375 W LAKE ST	60612	150000.00	1375 W LAKE ...
2	1800 W LAKE ST	60612	47700.00	1800 W LAKE LLC
3	4311 S HALST...	60609	87350.63	4311 S. HALS...
4	1747 W CARRO...	60612	50000.00	ACE STYLINE ...

	account	ward	aid	business	address	zip
0	307071	3	743	REGGIE'S BAR...	2105 S STATE ST	60616
1	10	10	829	HONEYBEERS	13200 S HOUS...	60633
2	10002	14	775	CELINA DELI	5089 S ARCHE...	60632
3	10005	12	nan	KRAFT FOODS ...	2005 W 43RD ST	60609
4	10044	44	638	NEYBOUR'S TA...	3651 N SOUTH...	60613

Theoretical merge

```
grants_licenses = grants.merge(licenses, on='zip')
print(grants_licenses.loc[grants_licenses['business']=="REGGIE'S BAR & GRILL",
                          ['grant','company','account','ward','business']])
```

```
   grant      company          account  ward  business
0  136443.07  CEDARS MEDIT...  307071   3     REGGIE'S BAR...
1  39943.15   DARRYL & FYL...  307071   3     REGGIE'S BAR...
2  31250.0    JGF MANAGEMENT   307071   3     REGGIE'S BAR...
3  143427.79  HYDE PARK AN...  307071   3     REGGIE'S BAR...
4  69500.0    ZBERRY INC       307071   3     REGGIE'S BAR...
```

Single merge

```
grants.merge(licenses, on=['address','zip'])
```

	address	zip	grant	company	account	ward	aid	business
0	1020 N KOLMA...	60651	68309.8	TRITON INDUS...	7689	37	929	TRITON INDUS...
1	10241 S COMM...	60617	33275.5	SOUTH CHICAG...	246598	10	nan	SOUTH CHICAG...
2	11612 S WEST...	60643	30487.5	BEVERLY RECO...	3705	19	nan	BEVERLY RECO...
3	1600 S KOSTN...	60623	128513.7	CHARTER STEE...	293825	24	nan	LEELO STEEL,...
4	1647 W FULTO...	60612	5634.0	SN PECK BUIL...	85595	27	673	S.N. PECK BU...

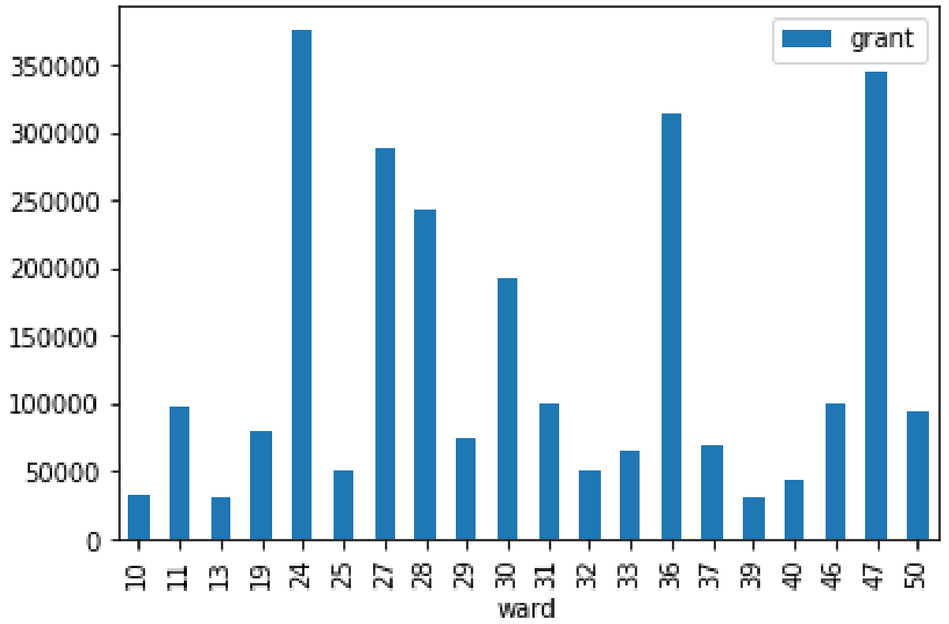
Merging multiple tables

```
grants_licenses_ward = grants.merge(licenses, on=['address','zip']) \
                             .merge(wards, on='ward', suffixes=('_bus','_ward'))
grants_licenses_ward.head()
```

	address_bus	zip_bus	grant	company	account	ward	aid	business	alderma
0	1020 N KOLMA...	60651	68309.8	TRITON INDUS...	7689	37	929	TRITON INDUS...	Emma M.
1	10241 S COMM...	60617	33275.5	SOUTH CHICAG...	246598	10	nan	SOUTH CHICAG...	Susan S
2	11612 S WEST...	60643	30487.5	BEVERLY RECO...	3705	19	nan	BEVERLY RECO...	Matthew
3	3502 W 111TH ST	60655	50000.0	FACE TO FACE...	263274	19	704	FACE TO FACE	Matthew
4	1600 S KOSTN...	60623	128513.7	CHARTER STEE...	293825	24	nan	LEELO STEEL,...	Michael

Results

```
import matplotlib.pyplot as plt
grant_licenses_ward.groupby('ward').agg('sum').plot(kind='bar', y='grant')
plt.show()
```



Merging even more...

Three tables:

```
df1.merge(df2, on='col') \
    .merge(df3, on='col')
```

Four tables:

```
df1.merge(df2, on='col') \
    .merge(df3, on='col') \
    .merge(df4, on='col')
```

Let's practice!

JOINING DATA WITH PANDAS

Left join

JOINING DATA WITH PANDAS

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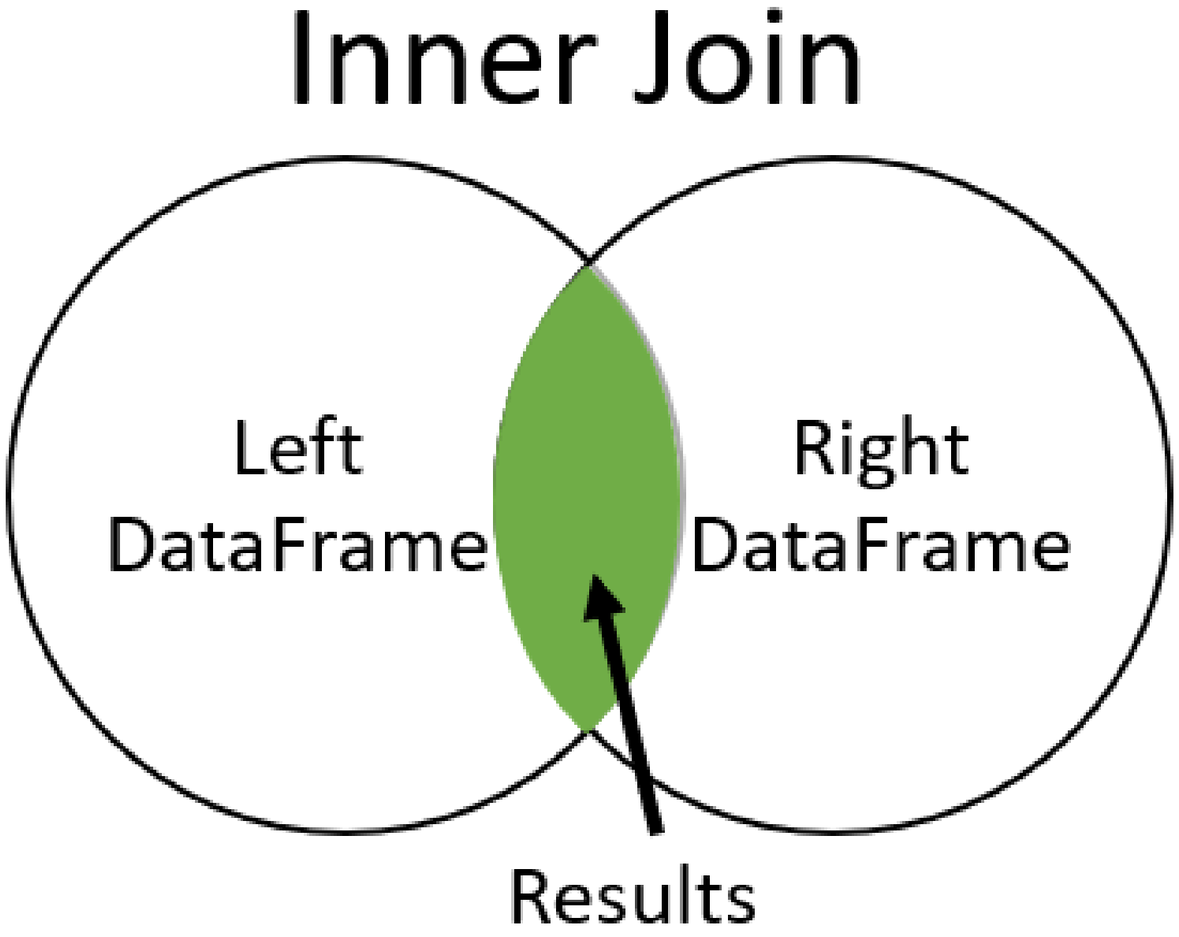
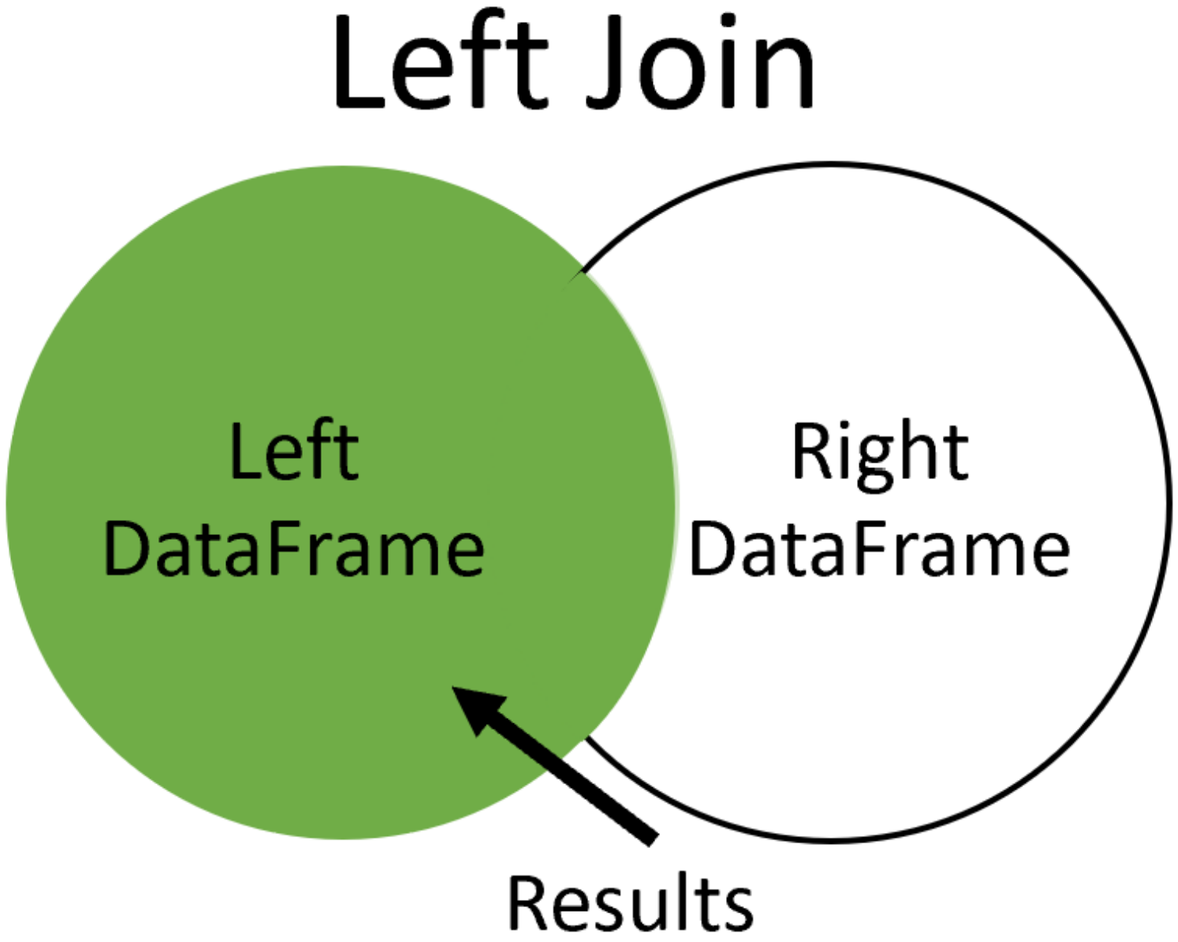
Quick review



Left join



Left join

Left Table

A	B	C
A2	B2	C2
A3	B3	C3
A4	B4	C4

Right Table

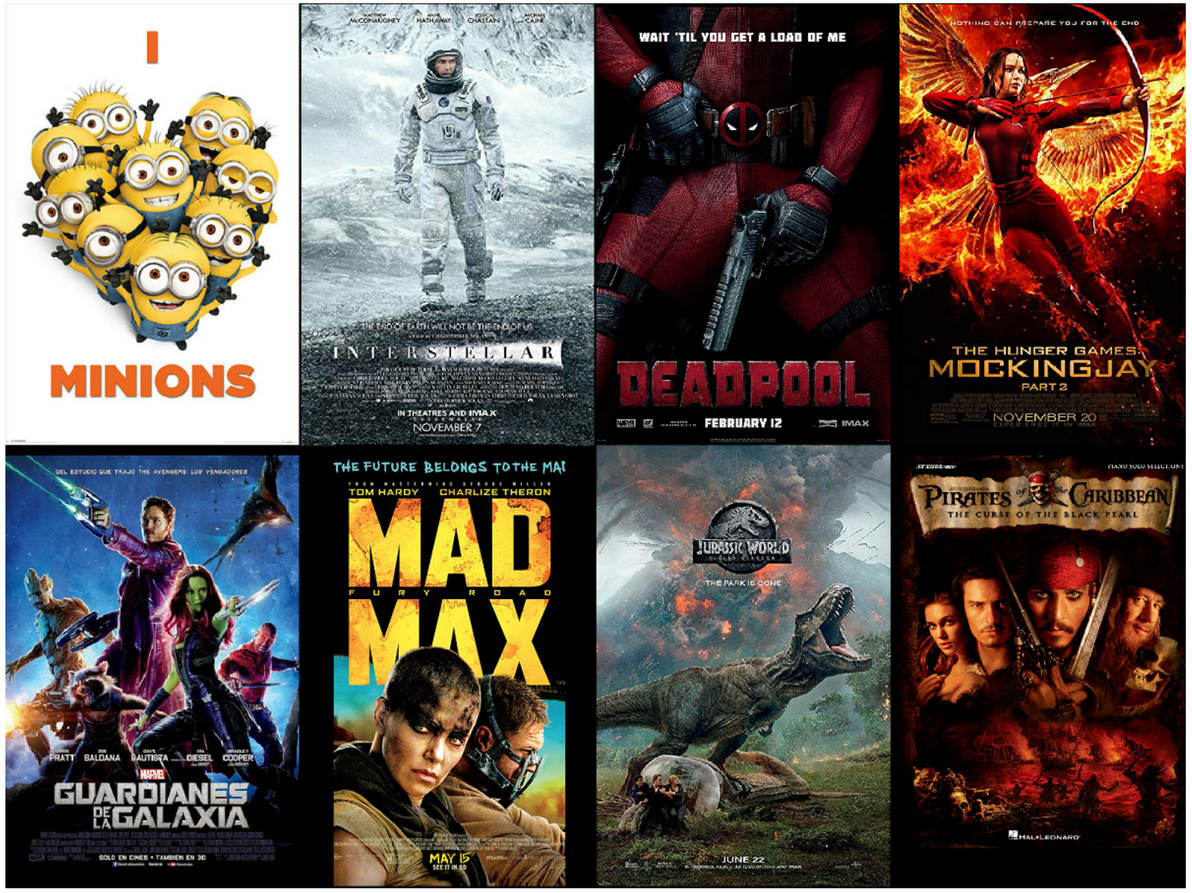
C	D
C1	D1
C2	D2
C4	D4
C5	D5

Result Table

A	B	C	D
A2	B2	C2	D2
A3	B3	C3	
A4	B4	C4	D4

New dataset

THE MOVIE DB



Movies table

```
movies = pd.read_csv('tmdb_movies.csv')
print(movies.head())
print(movies.shape)
```

```
   id     original_title   popularity       release_date
0  257    Oliver Twist     20.415572        2005-09-23
1  14290  Better Luck ...  3.877036         2002-01-12
2  38365  Grown Ups        38.864027        2010-06-24
3  9672   Infamous         3.6808959999...  2006-11-16
4  12819  Alpha and Omega  12.300789        2010-09-17
(4803, 4)
```

Tagline table

```
taglines = pd.read_csv('tmdb_taglines.csv')
print(taglines.head())
print(taglines.shape)
```

```
   id       tagline
0 19995   Enter the World of Pandora.
1 285     At the end of the world, the adventure begins.
2 206647  A Plan No One Escapes
3 49026   The Legend Ends
4 49529   Lost in our world, found in another.
(3955, 2)
```

Merge with left join

```
movies_taglines = movies.merge(taglines, on='id', how='left')
print(movies_taglines.head())
```

```
   id     original_title   popularity       release_date  tagline
0  257    Oliver Twist     20.415572        2005-09-23    NaN
1  14290  Better Luck ...  3.877036         2002-01-12    Never undere...
2  38365  Grown Ups        38.864027        2010-06-24    Boys will be...
3  9672   Infamous         3.6808959999...  2006-11-16    There's more...
4  12819  Alpha and Omega  12.300789        2010-09-17    A Pawsome 3D...
```

Number of rows returned

```
print(movies_taglines.shape)
```

```
(4805, 5)
```

Let's practice!

JOINING DATA WITH PANDAS

Other joins

JOINING DATA WITH PANDAS

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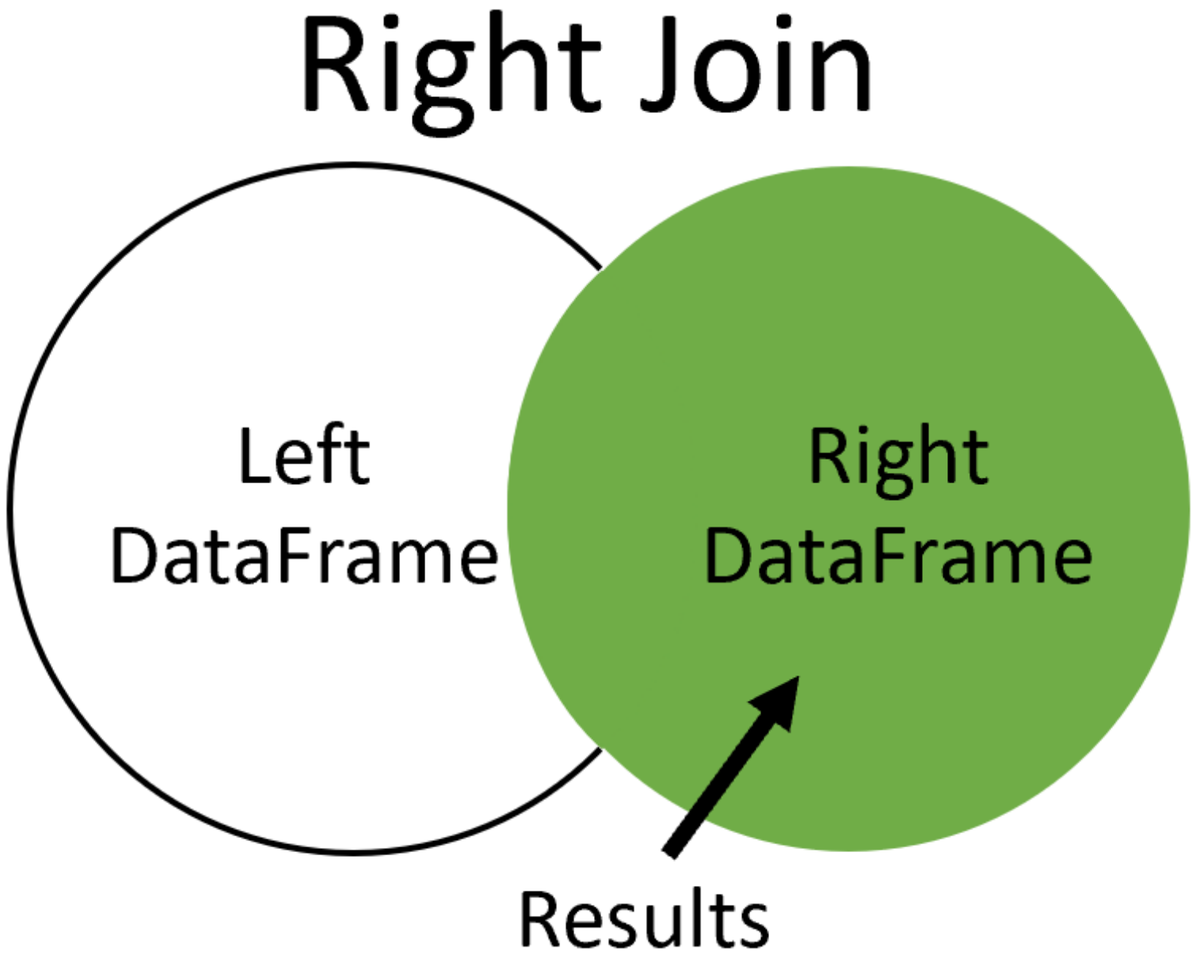
Right join



Right join

Left Table

A	B	C
A2	B2	C2
A3	B3	C3
A4	B4	C4

Right Table

C	D
C1	D1
C2	D2
C4	D4
C5	D5

Result Table

A	B	C	D
		C1	D1
A2	B2	C2	D2
A4	B4	C4	D4
		C5	D5

Looking at data

```
movie_to_genres = pd.read_csv('tmdb_movie_to_genres.csv')
tv_genre = movie_to_genres[movie_to_genres['genre'] == 'TV Movie']
print(tv_genre)
```

```
       movie_id  genre
4998   10947     TV Movie
5994   13187     TV Movie
7443   22488     TV Movie
10061  78814     TV Movie
10790  153397    TV Movie
10835  158150    TV Movie
11096  205321    TV Movie
11282  231617    TV Movie
```

Filtering the data

```
m = movie_to_genres['genre'] == 'TV Movie'
tv_genre = movie_to_genres[m]
print(tv_genre)
```

```
       movie_id  genre
4998   10947     TV Movie
5994   13187     TV Movie
7443   22488     TV Movie
10061  78814     TV Movie
10790  153397    TV Movie
10835  158150    TV Movie
11096  205321    TV Movie
11282  231617    TV Movie
```

Data to merge

```
   id      title             popularity       release_date
0  257     Oliver Twist      20.415572        2005-09-23
1  14290   Better Luck ...   3.877036         2002-01-12
2  38365   Grown Ups         38.864027        2010-06-24
3  9672    Infamous          3.6808959999...  2006-11-16
4  12819   Alpha and Omega   12.300789        2010-09-17
```

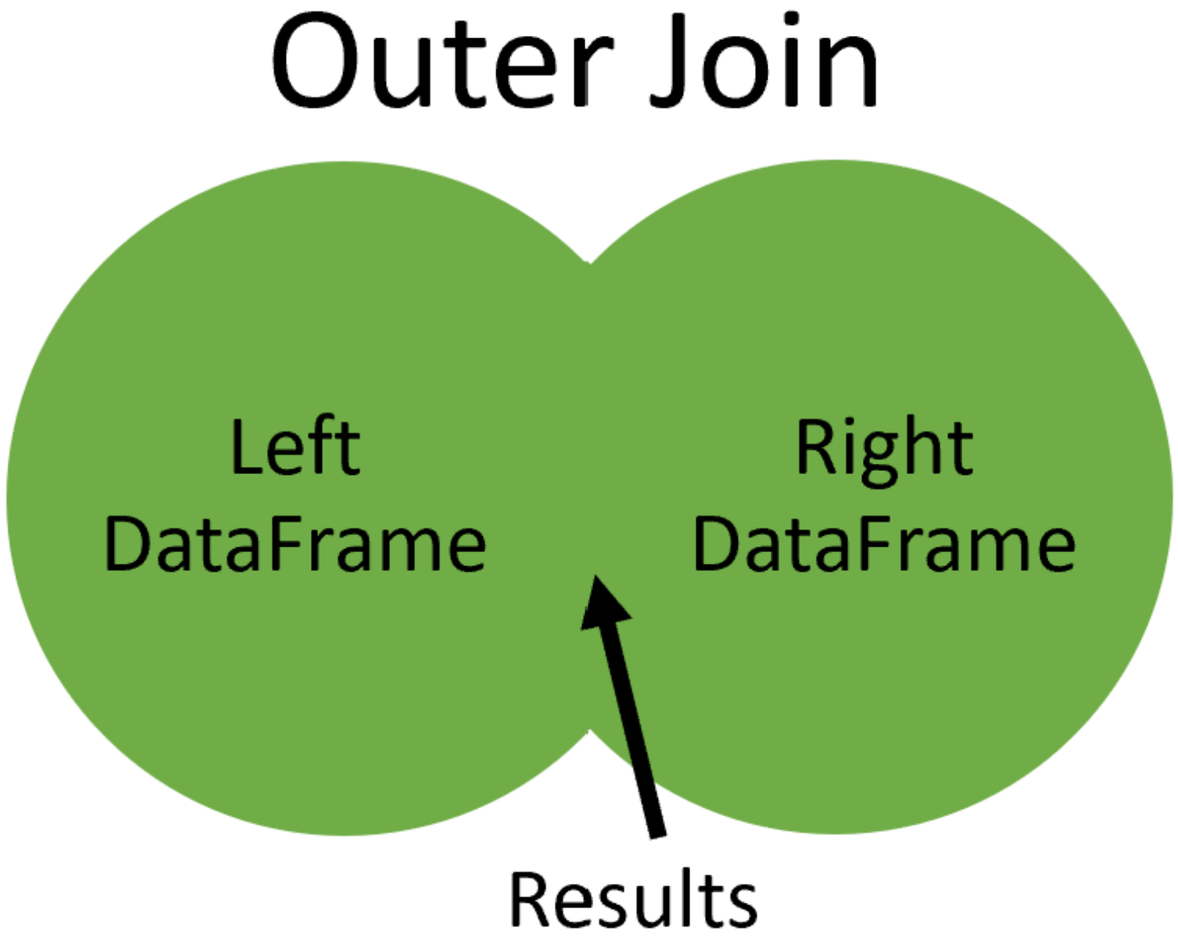
```
       movie_id  genre
4998   10947     TV Movie
5994   13187     TV Movie
7443   22488     TV Movie
10061  78814     TV Movie
10790  153397    TV Movie
```

Merge with right join

```
tv_movies = movies.merge(tv_genre, how='right',
                         left_on='id', right_on='movie_id')
print(tv_movies.head())
```

```
   id      title            popularity  release_date  movie_id  genre
0 153397  Restless         0.812776    2012-12-07    153397    TV Movie
1 10947   High School ...  16.536374   2006-01-20    10947     TV Movie
2 231617  Signed, Seal...  1.444476    2013-10-13    231617    TV Movie
3 78814   We Have Your...  0.102003    2011-11-12    78814     TV Movie
4 158150  How to Fall ...  1.923514    2012-07-21    158150    TV Movie
```

Outer join



Outer join

Left Table

A	B	C
A2	B2	C2
A3	B3	C3
A4	B4	C4

Right Table

C	D
C1	D1
C2	D2
C4	D4
C5	D5

Result Table

A	B	C	D
		C1	D1
A2	B2	C2	D2
A3	B3	C3	
A4	B4	C4	D4
		C5	D5

Datasets for outer join

```
m = movie_to_genres['genre'] == 'Family'
family = movie_to_genres[m].head(3)
```

```
   movie_id  genre
0  12        Family
1  35        Family
2  105       Family
```

```
m = movie_to_genres['genre'] == 'Comedy'
comedy = movie_to_genres[m].head(3)
```

```
   movie_id  genre
0  5         Comedy
1  13        Comedy
2  35        Comedy
```

Merge with outer join

```
family_comedy = family.merge(comedy, on='movie_id', how='outer',
                             suffixes=('_fam', '_com'))
print(family_comedy)
```

```
   movie_id  genre_fam  genre_com
0  12        Family     NaN
1  35        Family     Comedy
2  105       Family     NaN
3  5         NaN        Comedy
4  13        NaN        Comedy
```

Let's practice!

JOINING DATA WITH PANDAS

Merging a table to itself

JOINING DATA WITH PANDAS

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Instructor

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Sequel movie data

```
print(sequel.head())
```

```
   id      title          sequel
0 19995   Avatar         NaN
1 862     Toy Story      863
2 863     Toy Story 2    10193
3 597     Titanic        NaN
4 24428   The Avengers   NaN
```

Merging a table to itself

Left Table

id	title	sequel
19995	Avatar	
862	Toy Story	863
863	Toy Story 2	10193
597	Titanic	
24428	The Ave...	

Right Table

id	title	sequel
19995	Avatar	
862	Toy Story	863
863	Toy Story 2	10193
597	Titanic	
24428	The Ave...	

Merge Columns

Result Table

id_x	title_x	sequel_x	id_y	title_y	sequel_y
862	Toy Story	863	863	Toy Story 2	10193
863	Toy Story 2	10193	10193	Toy Story 3	

Merging a table to itself

```
original_sequels = sequels.merge(sequels, left_on='sequel', right_on='id',
                                 suffixes=('_org','_seq'))
print(original_sequels.head())
```

```
   id_org  title_org         sequel_org  id_seq  title_seq         sequel_seq
0  862     Toy Story         863         863     Toy Story 2       10193
1  863     Toy Story 2       10193       10193   Toy Story 3       NaN
2  675     Harry Potter...   767         767     Harry Potter...   NaN
3  121     The Lord of ...   122         122     The Lord of ...   NaN
4  120     The Lord of ...   121         121     The Lord of ...   122
```

Continue format results

```
print(original_sequels[,['title_org','title_seq']].head())
```

```
  title_org         title_seq
0 Toy Story         Toy Story 2
1 Toy Story 2       Toy Story 3
2 Harry Potter...   Harry Potter...
3 The Lord of ...   The Lord of ...
4 The Lord of ...   The Lord of ...
```

Merging a table to itself with left join

```
original_sequels = sequels.merge(sequels, left_on='sequel', right_on='id',
                                 how='left', suffixes=('_org','_seq'))
print(original_sequels.head())
```

```
   id_org  title_org      sequel_org  id_seq  title_seq     sequel_seq
0  19995   Avatar         NaN         NaN     NaN           NaN
1  862     Toy Story      863         863     Toy Story 2   10193
2  863     Toy Story 2    10193       10193   Toy Story 3   NaN
3  597     Titanic        NaN         NaN     NaN           NaN
4  24428   The Avengers   NaN         NaN     NaN           NaN
```

When to merge at table to itself

Common situations:

- Hierarchical relationships
- Sequential relationships
- Graph data

Let's practice!

JOINING DATA WITH PANDAS

Merging on indexes

JOINING DATA WITH PANDAS

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Table with an index

```
   id     title             popularity  release_date
0  257    Oliver Twist      20.415572   2005-09-23
1  14290  Better Luck ...   3.877036    2002-01-12
2  38365  Grown Ups         38.864027   2010-06-24
3  9672   Infamous          3.680896    2006-11-16
4  12819  Alpha and Omega   12.300789   2010-09-17
```

```
        title             popularity  release_date
id
257     Oliver Twist      20.415572   2005-09-23
14290   Better Luck ...   3.877036    2002-01-12
38365   Grown Ups         38.864027   2010-06-24
9672    Infamous          3.680896    2006-11-16
12819   Alpha and Omega   12.300789   2010-09-17
```

Setting an index

```
movies = pd.read_csv('tmdb_movies.csv', index_col=['id'])
print(movies.head())
```

```
       title             popularity  release_date
id
257    Oliver Twist      20.415572   2005-09-23
14290  Better Luck ...   3.877036    2002-01-12
38365  Grown Ups         38.864027   2010-06-24
9672   Infamous          3.680896    2006-11-16
12819  Alpha and Omega   12.300789   2010-09-17
```

Merge index datasets

```
       title             popularity  release_date
id
257    Oliver Twist      20.415572   2005-09-23
14290  Better Luck ...   3.877036    2002-01-12
38365  Grown Ups         38.864027   2010-06-24
9672   Infamous          3.680896    2006-11-16
```

```
        tagline
id
19995   Enter the Wo...
285     At the end o...
206647  A Plan No On...
49026   The Legend Ends
```

Merging on index

```
movies_taglines = movies.merge(taglines, on='id', how='left')
print(movies_taglines.head())
```

```
       title            popularity  release_date  tagline
id
257    Oliver Twist     20.415572   2005-09-23    NaN
14290  Better Luck ...  3.877036    2002-01-12    Never undere...
38365  Grown Ups        38.864027   2010-06-24    Boys will be...
9672   Infamous         3.680896    2006-11-16    There's more...
12819  Alpha and Omega  12.300789   2010-09-17    A Pawsome 3D...
```

MultiIndex datasets

```
samuel = pd.read_csv('samuel.csv',
                     index_col=['movie_id',
                                'cast_id'])
print(samuel.head())
```

```
                    name
movie_id  cast_id
184       3         Samuel L. Jackson
319       13        Samuel L. Jackson
326       2         Samuel L. Jackson
329       138       Samuel L. Jackson
393       21        Samuel L. Jackson
```

```
casts = pd.read_csv('casts.csv',
                    index_col=['movie_id',
                               'cast_id'])
print(casts.head())
```

```
                    character
movie_id  cast_id
5         22        Jezebel
          23        Diana
          24        Athena
          25        Elspeth
          26        Eva
```

MultiIndex merge

```
samuel_casts = samuel.merge(casts, on=['movie_id','cast_id'])
print(samuel_casts.head())
print(samuel_casts.shape)
```

```
                    name                character
movie_id  cast_id
184       3         Samuel L. Jackson   Ordell Robbie
319       13        Samuel L. Jackson   Big Don
326       2         Samuel L. Jackson   Neville Flynn
329       138       Samuel L. Jackson   Arnold
393       21        Samuel L. Jackson   Rufus
(67, 2)
```

Index merge with left_on and right_on

```
       title             popularity  release_date
id
257    Oliver Twist      20.415572   2005-09-23
14290  Better Luck ...   3.877036    2002-01-12
38365  Grown Ups         38.864027   2010-06-24
9672   Infamous          3.680896    2006-11-16
```

```
           genre
movie_id
5          Crime
5          Comedy
11         Science Fiction
11         Action
```

Index merge with left_on and right_on

```
movies_genres = movies.merge(movie_to_genres, left_on='id', left_index=True,
                             right_on='movie_id', right_index=True)
print(movies_genres.head())
```

```
    id  title       popularity  release_date  genre
5    5  Four Rooms  22.876230   1995-12-09    Crime
5    5  Four Rooms  22.876230   1995-12-09    Comedy
11  11  Star Wars   126.393695  1977-05-25    Science Fiction
11  11  Star Wars   126.393695  1977-05-25    Action
11  11  Star Wars   126.393695  1977-05-25    Adventure
```

Let's practice!

JOINING DATA WITH PANDAS

Filtering joins

JOINING DATA WITH PANDAS

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Mutating versus filtering joins

Mutating joins:

- Combines data from two tables based on matching observations in both tables

Filtering joins:

- Filter observations from table based on whether or not they match an observation in another table

What is a semi join?

Left Table

A	B	C
A2	B2	C2
A3	B3	C3
A4	B4	C4

Right Table

C	D
C1	D1
C2	D2
C4	D4
C5	D5

Result Table

A	B	C
A2	B2	C2
A4	B4	C4

Semi joins

- Returns the intersection, similar to an inner join
- Returns only columns from the left table and ***not*** the right
- No duplicates

Musical dataset

SQLITE TUTORIAL

[1] Photo by Vlad Bagacian from Pexels

Example datasets

```
  gid  name
0 1    Rock
1 2    Jazz
2 3    Metal
3 4    Alternative ...
4 5    Rock And Roll
```

```
  tid  name             aid  mtid  gid  composer         u_price
0 1    For Those Ab...  1    1     1    Angus Young,...  0.99
1 2    Balls to the...  2    2     1    nan              0.99
2 3    Fast As a Shark  3    2     1    F. Baltes, S...  0.99
3 4    Restless and...  3    2     1    F. Baltes, R...  0.99
4 5    Princess of ...  3    2     1    Deaffy & R.A...  0.99
```

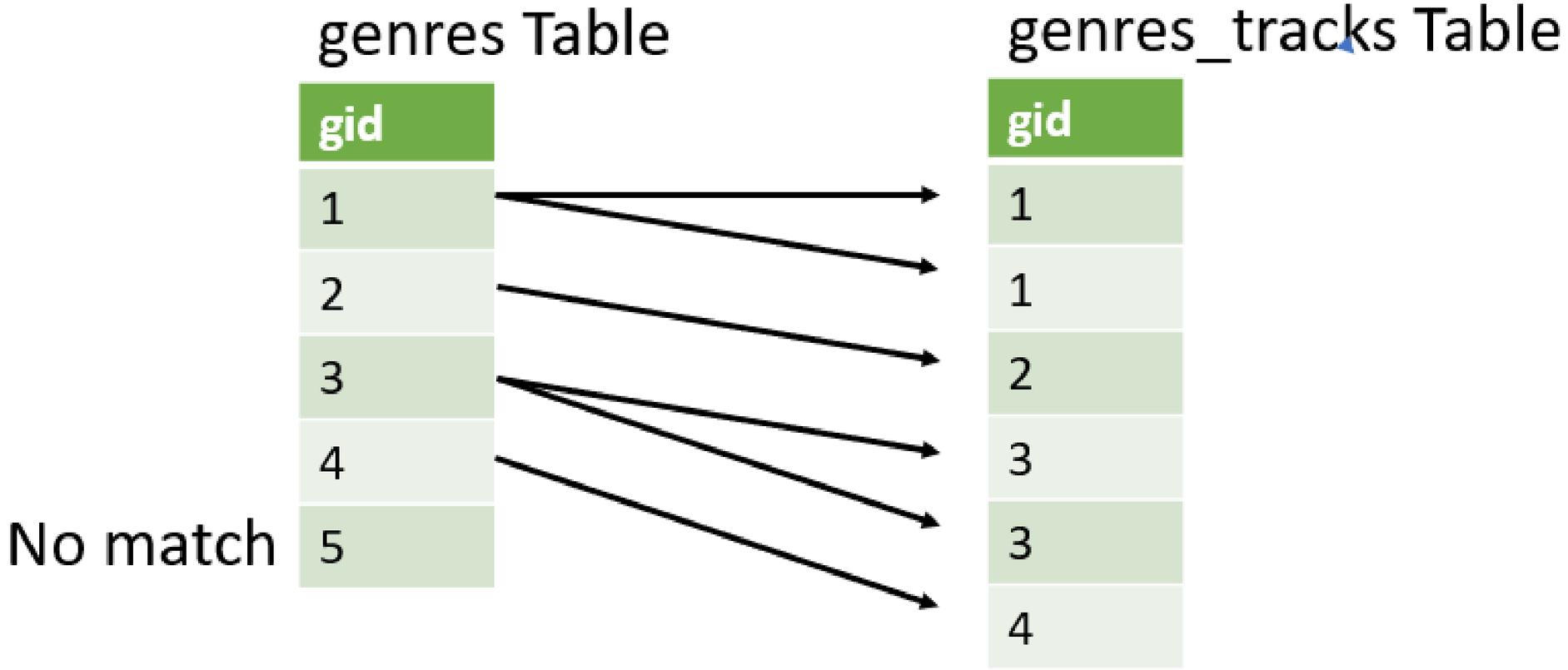
Step 1 - semi join

```
genres_tracks = genres.merge(top_tracks, on='gid')
print(genres_tracks.head())
```

```
  gid  name_x  tid   name_y           aid  mtid  composer         u_price
0 1    Rock    2260  Don't Stop M...  185  1     Mercury, Fre...  0.99
1 1    Rock    2933  Mysterious Ways  232  1     U2               0.99
2 1    Rock    2618  Speed Of Light   212  1     Billy Duffy/...  0.99
3 1    Rock    2998  When Love Co...  237  1     Bono/Clayton...  0.99
4 1    Rock    685   Who'll Stop ...  54   1     J. C. Fogerty    0.99
```

Step 2 - semi join

```
genres['gid'].isin(genres_tracks['gid'])
```



Step 2 - semi join

```
genres['gid'].isin(genres_tracks['gid'])
```

```
0     True
1     True
2     True
3     True
4    False
Name: gid, dtype: bool
```

Step 3 - semi join

```
genres_tracks = genres.merge(top_tracks, on='gid')
top_genres = genres[genres['gid'].isin(genres_tracks['gid'])]
print(top_genres.head())
```

```
  gid  name
0 1    Rock
1 2    Jazz
2 3    Metal
3 4    Alternative & Punk
4 6    Blues
```

What is an anti join?

Left Table

A	B	C
A2	B2	C2
A3	B3	C3
A4	B4	C4

Right Table

C	D
C1	D1
C2	D2
C4	D4
C5	D5

Result Table

A	B	C
A3	B3	C3

Anti join:

- Returns the left table, excluding the intersection
- Returns only columns from the left table and ***not*** the right

Step 1 - anti join

```
genres_tracks = genres.merge(top_tracks, on='gid', how='left', indicator=True)
print(genres_tracks.head())
```

```
   gid  name_x           tid     name_y           aid    mtid  composer         u_price  _merge
0  1    Rock             2260.0  Don't Stop M...  185.0  1.0   Mercury, Fre...  0.99     both
1  1    Rock             2933.0  Mysterious Ways  232.0  1.0   U2               0.99     both
2  1    Rock             2618.0  Speed Of Light   212.0  1.0   Billy Duffy/...  0.99     both
3  1    Rock             2998.0  When Love Co...  237.0  1.0   Bono/Clayton...  0.99     both
4  5    Rock And Roll    NaN     NaN              NaN    NaN   NaN              NaN      left_only
```

Step 2 - anti join

```
gid_list = genres_tracks.loc[genres_tracks['_merge'] == 'left_only', 'gid']
print(gid_list.head())
```

```
23     5
34     9
36    11
37    12
38    13
Name: gid, dtype: int64
```

Step 3 - anti join

```
genres_tracks = genres.merge(top_tracks, on='gid', how='left', indicator=True)
gid_list = genres_tracks.loc[genres_tracks['_merge'] == 'left_only','gid']
non_top_genres = genres[genres['gid'].isin(gid_list)]
print(non_top_genres.head())
```

```
  gid  name
0 5    Rock And Roll
1 9    Pop
2 11   Bossa Nova
3 12   Easy Listening
4 13   Heavy Metal
```

Let's practice!

JOINING DATA WITH PANDAS

Concatenate DataFrames together vertically

JOINING DATA WITH PANDAS

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Concatenate two tables vertically

A	B	C
A1	B1	C1
A2	B2	C2
A3	B3	C3

A	B	C
A4	B4	C4
A5	B5	C5
A6	B6	C6

- pandas `.concat()` method can concatenate both vertical and horizontal.
  - `axis=0`, vertical

Basic concatenation

- 3 different tables
- Same column names
- Table variable names:
  - `inv_jan` *(top)*
  - `inv_feb` *(middle)*
  - `inv_mar` *(bottom)*

```
   iid  cid  invoice_date  total
0  1    2    2009-01-01    1.98
1  2    4    2009-01-02    3.96
2  3    8    2009-01-03    5.94
```

```
   iid  cid  invoice_date  total
0  7    38   2009-02-01    1.98
1  8    40   2009-02-01    1.98
2  9    42   2009-02-02    3.96
```

```
   iid  cid  invoice_date  total
0  14   17   2009-03-04    1.98
1  15   19   2009-03-04    1.98
2  16   21   2009-03-05    3.96
```

Basic concatenation

```
pd.concat([inv_jan, inv_feb, inv_mar])
```

```
   iid  cid  invoice_date  total
0  1    2    2009-01-01    1.98
1  2    4    2009-01-02    3.96
2  3    8    2009-01-03    5.94
0  7    38   2009-02-01    1.98
1  8    40   2009-02-01    1.98
2  9    42   2009-02-02    3.96
0  14   17   2009-03-04    1.98
1  15   19   2009-03-04    1.98
2  16   21   2009-03-05    3.96
```

Ignoring the index

```
pd.concat([inv_jan, inv_feb, inv_mar],
          ignore_index=True)
```

	iid	cid	invoice_date	total
0	1	2	2009-01-01	1.98
1	2	4	2009-01-02	3.96
2	3	8	2009-01-03	5.94
3	7	38	2009-02-01	1.98
4	8	40	2009-02-01	1.98
5	9	42	2009-02-02	3.96
6	14	17	2009-03-04	1.98
7	15	19	2009-03-04	1.98
8	16	21	2009-03-05	3.96

Setting labels to original tables

```
pd.concat([inv_jan, inv_feb, inv_mar],
          ignore_index=False,
          keys=['jan','feb','mar'])
```

		iid	cid	invoice_date	total
jan	0	1	2	2009-01-01	1.98
	1	2	4	2009-01-02	3.96
	2	3	8	2009-01-03	5.94
feb	0	7	38	2009-02-01	1.98
	1	8	40	2009-02-01	1.98
	2	9	42	2009-02-02	3.96
mar	0	14	17	2009-03-04	1.98
	1	15	19	2009-03-04	1.98
	2	16	21	2009-03-05	3.96

Concatenate tables with different column names

Table: `inv_jan`

```
   iid  cid  invoice_date  total
0  1    2    2009-01-01    1.98
1  2    4    2009-01-02    3.96
2  3    8    2009-01-03    5.94
```

Table: `inv_feb`

```
   iid  cid  invoice_date  total  bill_ctry
0  7    38   2009-02-01    1.98   Germany
1  8    40   2009-02-01    1.98   France
2  9    42   2009-02-02    3.96   France
```

Concatenate tables with different column names

```
pd.concat([inv_jan, inv_feb],
          sort=True)
```

	bill_ctry	cid	iid	invoice_date	total
0	NaN	2	1	2009-01-01	1.98
1	NaN	4	2	2009-01-02	3.96
2	NaN	8	3	2009-01-03	5.94
0	Germany	38	7	2009-02-01	1.98
1	France	40	8	2009-02-01	1.98
2	France	42	9	2009-02-02	3.96

Concatenate tables with different column names

```
pd.concat([inv_jan, inv_feb],
          join='inner')
```

iid	cid	invoice_date	total
1	2	2009-01-01	1.98
2	4	2009-01-02	3.96
3	8	2009-01-03	5.94
7	38	2009-02-01	1.98
8	40	2009-02-01	1.98
9	42	2009-02-02	3.96

Let's practice!

JOINING DATA WITH PANDAS

Verifying integrity

JOINING DATA WITH PANDAS

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Let's check our data

Possible merging issue:

A	B	C
A1	B1	C1
A2	B2	C2
A3	B3	C3

C	D
C1	D1
C1	D2
C1	D3
C2	D4

- Unintentional one-to-many relationship
- Unintentional many-to-many relationship

Possible concatenating issue:

A	B	C
A1	B1	C1
A2	B2	C2
A3	B3	C3

A	B	C
A3 (duplicate)	B3 (duplicate)	C3 (duplicate)
A4	B4	C4
A5	B5	C5

- Duplicate records possibly unintentionally introduced

Validating merges

`.merge(validate=None)`:

- Checks if merge is of specified type
- `'one_to_one'`
- `'one_to_many'`
- `'many_to_one'`
- `'many_to_many'`

Merge dataset for example

Table Name: `tracks`

```
   tid  name              aid  mtid  gid  u_price
0  2    Balls to the...   2    2     1    0.99
1  3    Fast As a Shark   3    2     1    0.99
2  4    Restless and...   3    2     1    0.99
```

Table Name: `specs`

```
   tid  milliseconds  bytes
0  2    342562        5510424
1  3    230619        3990994
2  2    252051        4331779
```

Merge validate: one_to_one

```
tracks.merge(specs, on='tid',
             validate='one_to_one')
```

```
Traceback (most recent call last):
MergeError: Merge keys are not unique in right dataset; not a one-to-one merge
```

Merge validate: one_to_many

```
albums.merge(tracks, on='aid',
             validate='one_to_many')
```

```
  aid  title            artid  tid  name             mtid  gid  u_price
0 2    Balls to the...  2      2    Balls to the...  2     1    0.99
1 3    Restless and...  2      3    Fast As a Shark  2     1    0.99
2 3    Restless and...  2      4    Restless and...  2     1    0.99
```

Verifying concatenations

`.concat(verify_integrity=False)`:

- Check whether the new concatenated index contains duplicates
- Default value is `False`

Dataset for .concat() example

Table Name: `inv_feb`

iid	cid	invoice_date	total
7	38	2009-02-01	1.98
8	40	2009-02-01	1.98
9	42	2009-02-02	3.96

Table Name: `inv_mar`

iid	cid	invoice_date	total
9	17	2009-03-04	1.98
15	19	2009-03-04	1.98
16	21	2009-03-05	3.96

Verifying concatenation: example

```
pd.concat([inv_feb, inv_mar],
          verify_integrity=True)
```

```
Traceback (most recent call last):
ValueError: Indexes have overlapping
values: Int64Index([9], dtype='int64',
name='iid')
```

```
pd.concat([inv_feb, inv_mar],
          verify_integrity=False)
```

```
      cid  invoice_date  total
iid
7     38   2009-02-01    1.98
8     40   2009-02-01    1.98
9     42   2009-02-02    3.96
9     17   2009-03-04    1.98
15    19   2009-03-04    1.98
16    21   2009-03-05    3.96
```

Why verify integrity and what to do

Why:

- Real world data is often ***NOT*** clean

What to do:

- Fix incorrect data
- Drop duplicate rows

Let's practice!

JOINING DATA WITH PANDAS

Using merge_ordered()

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merge_ordered()

Left Table

A	B	C
A3	B3	C3
A2	B2	C2
A1	B1	C1

Right Table

C	D
C4	D4
C2	D2
C1	D1

Result Table

A	B	C	D
A1	B1	C1	D1
A2	B2	C2	D2
A3	B3	C3	
		C4	D4

Method comparison

`.merge()` **method:**

- Column(s) to join on
  - `on` , `left_on` , and `right_on`
- Type of join
  - `how` *(left, right, inner, outer)* {{@}}
  - **default** inner
- Overlapping column names
  - `suffixes`
- Calling the method
  - `df1.merge(df2)`

`merge_ordered()` **method:**

- Column(s) to join on
  - `on` , `left_on` , and `right_on`
- Type of join
  - `how` *(left, right, inner, outer)*
  - **default** outer
- Overlapping column names
  - `suffixes`
- Calling the function
  - `pd.merge_ordered(df1, df2)`

Financial dataset

[1] Photo by Markus Spiske on Unsplash

Stock data

Table Name: `appl`

	date	close
0	2007-02-01	12.087143
1	2007-03-01	13.272857
2	2007-04-01	14.257143
3	2007-05-01	17.312857
4	2007-06-01	17.434286

Table Name: `mcd`

	date	close
0	2007-01-01	44.349998
1	2007-02-01	43.689999
2	2007-03-01	45.049999
3	2007-04-01	48.279999
4	2007-05-01	50.549999

Merging stock data

```
import pandas as pd
pd.merge_ordered(appl, mcd, on='date', suffixes=('_aapl','_mcd'))
```

```
   date         close_aapl  close_mcd
0  2007-01-01   NaN         44.349998
1  2007-02-01   12.087143   43.689999
2  2007-03-01   13.272857   45.049999
3  2007-04-01   14.257143   48.279999
4  2007-05-01   17.312857   50.549999
5  2007-06-01   17.434286   NaN
```

Forward fill

Before

A	B
A1	B1
A2	
A3	B3
A4	
A5	B5

After

A	B
A1	B1
A2	**B1**
A3	B3
A4	**B3**
A5	B5

Fills missing with previous value

Forward fill example

```
pd.merge_ordered(appl, mcd, on='date',
                 suffixes=('_aapl','_mcd'),
                 fill_method='ffill')
```

	date	close_aapl	close_mcd
0	2007-01-01	NaN	44.349998
1	2007-02-01	12.087143	43.689999
2	2007-03-01	13.272857	45.049999
3	2007-04-01	14.257143	48.279999
4	2007-05-01	17.312857	50.549999
5	2007-06-01	17.434286	50.549999

```
pd.merge_ordered(appl, mcd, on='date',
                 suffixes=('_aapl','_mcd'))
```

	date	close_AAPL	close_mcd
0	2007-01-01	NaN	44.349998
1	2007-02-01	12.087143	43.689999
2	2007-03-01	13.272857	45.049999
3	2007-04-01	14.257143	48.279999
4	2007-05-01	17.312857	50.549999
5	2007-06-01	17.434286	NaN

When to use merge_ordered()?

- Ordered data / time series
- Filling in missing values

Let's practice!

JOINING DATA WITH PANDAS

Using merge_asof()

JOINING DATA WITH PANDAS

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Using merge_asof()

Left Table

B	C
B2	1
B3	5
B4	10

Right Table

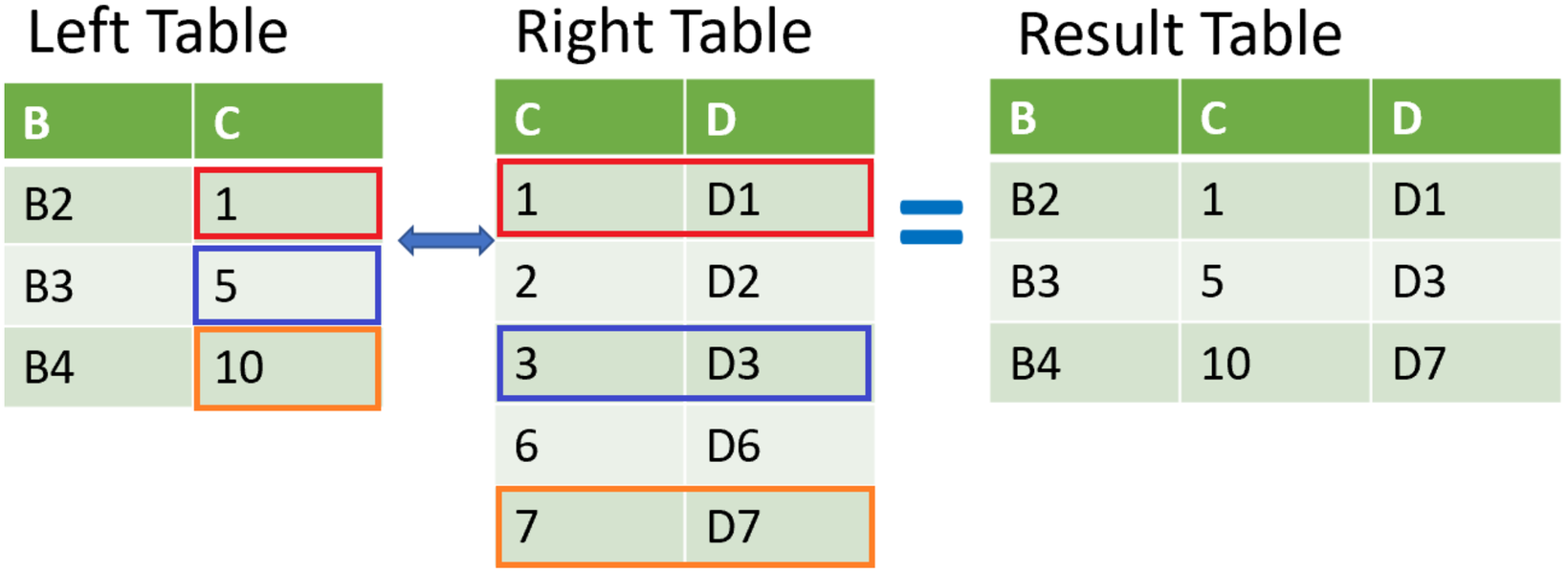
C	D
1	D1
2	D2
3	D3
6	D6
7	D7

Result Table

B	C	D
B2	1	D1
B3	5	D3
B4	10	D7

- Similar to a `merge_ordered()` left join
  - Similar features as `merge_ordered()`
- Match on the nearest key column and not exact matches.
  - Merged "on" columns must be sorted.

Using merge_asof()



- Similar to a `merge_ordered()` left join
  - Similar features as `merge_ordered()`
- Match on the nearest key column and not exact matches.
  - Merged "on" columns must be sorted.

Datasets

Table Name: `visa`

	date_time	close
0	2017-11-17 16:00:00	110.32
1	2017-11-17 17:00:00	110.24
2	2017-11-17 18:00:00	110.065
3	2017-11-17 19:00:00	110.04
4	2017-11-17 20:00:00	110.0
5	2017-11-17 21:00:00	109.9966
6	2017-11-17 22:00:00	109.82

Table Name: `ibm`

	date_time	close
0	2017-11-17 15:35:12	149.3
1	2017-11-17 15:40:34	149.13
2	2017-11-17 15:45:50	148.98
3	2017-11-17 15:50:20	148.99
4	2017-11-17 15:55:10	149.11
5	2017-11-17 16:00:03	149.25
6	2017-11-17 16:05:06	149.5175
7	2017-11-17 16:10:12	149.57
8	2017-11-17 16:15:30	149.59
9	2017-11-17 16:20:32	149.82
10	2017-11-17 16:25:47	149.96

merge_asof() example

```
pd.merge_asof(visa, ibm, on='date_time',
              suffixes=('_visa','_ibm'))
```

	date_time	close_visa	close_ibm
0	2017-11-17 16:00:00	110.32	149.11
1	2017-11-17 17:00:00	110.24	149.83
2	2017-11-17 18:00:00	110.065	149.59
3	2017-11-17 19:00:00	110.04	149.505
4	2017-11-17 20:00:00	110.0	149.42
5	2017-11-17 21:00:00	109.9966	149.26
6	2017-11-17 22:00:00	109.82	148.97

Table Name: `ibm`

	date_time	close
0	2017-11-17 15:35:12	149.3
1	2017-11-17 15:40:34	149.13
2	2017-11-17 15:45:50	148.98
3	2017-11-17 15:50:20	148.99
4	2017-11-17 15:55:10	149.11
5	2017-11-17 16:00:03	149.25
6	2017-11-17 16:05:06	149.5175
7	2017-11-17 16:10:12	149.57
8	2017-11-17 16:15:30	149.59
9	2017-11-17 16:20:32	149.82
10	2017-11-17 16:25:47	149.96

merge_asof() example with direction

```
pd.merge_asof(visa, ibm, on=['date_time'],
              suffixes=('_visa','_ibm'),
              direction='forward')
```

	date_time	close_visa	close_ibm
0	2017-11-17 16:00:00	110.32	149.25
1	2017-11-17 17:00:00	110.24	149.6184
2	2017-11-17 18:00:00	110.065	149.59
3	2017-11-17 19:00:00	110.04	149.505
4	2017-11-17 20:00:00	110.0	149.42
5	2017-11-17 21:00:00	109.9966	149.26
6	2017-11-17 22:00:00	109.82	148.97

Table Name: `ibm`

	date_time	close
0	2017-11-17 15:35:12	149.3
1	2017-11-17 15:40:34	149.13
2	2017-11-17 15:45:50	148.98
3	2017-11-17 15:50:20	148.99
4	2017-11-17 15:55:10	149.11
5	2017-11-17 16:00:03	149.25
6	2017-11-17 16:05:06	149.5175
7	2017-11-17 16:10:12	149.57
8	2017-11-17 16:15:30	149.59
9	2017-11-17 16:20:32	149.82
10	2017-11-17 16:25:47	149.96

When to use merge_asof()

- Data sampled from a process
- Developing a training set (no data leakage)

Let's practice!

JOINING DATA WITH PANDAS

Selecting data with .query()

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The .query() method

```
.query('SOME SELECTION STATEMENT')
```

- Accepts an input string
  - Input string used to determine what rows are returned
  - Input string similar to statement after **WHERE** clause in **SQL** statement
    - **Prior knowledge of SQL is not necessary**

Querying on a single condition

This table is `stocks`

	date	disney	nike
0	2019-07-01	143.009995	86.029999
1	2019-08-01	137.259995	84.5
2	2019-09-01	130.320007	93.919998
3	2019-10-01	129.919998	89.550003
4	2019-11-01	151.580002	93.489998
5	2019-12-01	144.630005	101.309998
6	2020-01-01	138.309998	96.300003
7	2020-02-01	117.650002	89.379997
8	2020-03-01	96.599998	82.739998
9	2020-04-01	99.580002	84.629997

```
stocks.query('nike >= 90')
```

	date	disney	nike
2	2019-09-01	130.320007	93.919998
4	2019-11-01	151.580002	93.489998
5	2019-12-01	144.630005	101.309998
6	2020-01-01	138.309998	96.300003

Querying on a multiple conditions, "and", "or"

This table is `stocks`

	date	disney	nike
0	2019-07-01	143.009995	86.029999
1	2019-08-01	137.259995	84.5
2	2019-09-01	130.320007	93.919998
3	2019-10-01	129.919998	89.550003
4	2019-11-01	151.580002	93.489998
5	2019-12-01	144.630005	101.309998
6	2020-01-01	138.309998	96.300003
7	2020-02-01	117.650002	89.379997
8	2020-03-01	96.599998	82.739998
9	2020-04-01	99.580002	84.629997

```
stocks.query('nike > 90 and disney < 140')
```

	date	disney	nike
2	2019-09-01	130.320007	93.919998
6	2020-01-01	138.309998	96.300003

```
stocks.query('nike > 96 or disney < 98')
```

	date	disney	nike
5	2019-12-01	144.630005	101.309998
6	2020-01-01	138.309998	96.300003
28	020-03-01	96.599998	82.739998

Updated dataset

This table is `stocks_long`

```
  date        stock   close
0 2019-07-01  disney  143.009995
1 2019-08-01  disney  137.259995
2 2019-09-01  disney  130.320007
3 2019-10-01  disney  129.919998
4 2019-11-01  disney  151.580002
5 2019-07-01  nike    86.029999
6 2019-08-01  nike    84.5
7 2019-09-01  nike    93.919998
8 2019-10-01  nike    89.550003
9 2019-11-01  nike    93.489998
```

Using .query() to select text

```
stocks_long.query('stock=="disney" or (stock=="nike" and close < 90)')
```

```
   date         stock   close
0  2019-07-01   disney  143.009995
1  2019-08-01   disney  137.259995
2  2019-09-01   disney  130.320007
3  2019-10-01   disney  129.919998
4  2019-11-01   disney  151.580002
5  2019-07-01   nike    86.029999
6  2019-08-01   nike    84.5
8  2019-10-01   nike    89.550003
```

Let's practice!

JOINING DATA WITH PANDAS

Reshaping data with .melt()

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Wide versus long data

Wide Format

	first	last	height	weight
0	John	Doe	5.5	130
1	Mary	Bo	6.0	150

Long Format

	first	last	variable	value
0	John	Doe	height	5.5
1	Mary	Bo	height	6.0
2	John	Doe	weight	130
3	Mary	Bo	weight	150

What does the .melt() method do?

- The melt method will allow us to unpivot our dataset

	first	last	height	weight
0	John	Doe	5.5	130
1	Mary	Bo	6.0	150

	first	last	variable	value
0	John	Doe	height	5.5
1	Mary	Bo	height	6.0
2	John	Doe	weight	130
3	Mary	Bo	weight	150

Dataset in wide format

This table is called `social_fin`

	financial	company	2019	2018	2017	2016
0	total_revenue	twitter	3459329	3042359	2443299	2529619
1	gross_profit	twitter	2322288	2077362	1582057	1597379
2	net_income	twitter	1465659	1205596	-108063	-456873
3	total_revenue	facebook	70697000	55838000	40653000	27638000
4	gross_profit	facebook	57927000	46483000	35199000	23849000
5	net_income	facebook	18485000	22112000	15934000	10217000

Example of .melt()

```
social_fin_tall = social_fin.melt(id_vars=['financial','company'])
print(social_fin_tall.head(10))
```

```
  financial      company   variable  value
0 total_revenue  twitter   2019      3459329
1 gross_profit   twitter   2019      2322288
2 net_income     twitter   2019      1465659
3 total_revenue  facebook  2019      70697000
4 gross_profit   facebook  2019      57927000
5 net_income     facebook  2019      18485000
6 total_revenue  twitter   2018      3042359
7 gross_profit   twitter   2018      2077362
8 net_income     twitter   2018      1205596
9 total_revenue  facebook  2018      55838000
```

Melting with value_vars

```
social_fin_tall = social_fin.melt(id_vars=['financial','company'],
                                  value_vars=['2018','2017'])
print(social_fin_tall.head(9))
```

```
  financial      company   variable  value
0 total_revenue  twitter   2018      3042359
1 gross_profit   twitter   2018      2077362
2 net_income     twitter   2018      1205596
3 total_revenue  facebook  2018      55838000
4 gross_profit   facebook  2018      46483000
5 net_income     facebook  2018      22112000
6 total_revenue  twitter   2017      2443299
7 gross_profit   twitter   2017      1582057
8 net_income     twitter   2017      -108063
```

Melting with column names

```
social_fin_tall = social_fin.melt(id_vars=['financial','company'],
                                  value_vars=['2018','2017'],
                                  var_name=['year'], value_name='dollars')
print(social_fin_tall.head(8))
```

```
  financial      company   year  dollars
0 total_revenue  twitter   2018  3042359
1 gross_profit   twitter   2018  2077362
2 net_income     twitter   2018  1205596
3 total_revenue  facebook  2018  55838000
4 gross_profit   facebook  2018  46483000
5 net_income     facebook  2018  22112000
6 total_revenue  twitter   2017  2443299
7 gross_profit   twitter   2017  1582057
```

Let's practice!

JOINING DATA WITH PANDAS

Course wrap-up

JOINING DATA WITH PANDAS

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You're this high performance race car now

[1] Photo by jae park from Pexels

Data merging basics

- Inner join using `.merge()`
- One-to-one and one-to-many relationships
- Merging multiple tables

Merging tables with different join types

- Inner join using `.merge()`
- One-to-one and one-to-one relationships
- Merging multiple tables
- **Left, right, and outer joins**
- **Merging a table to itself and merging on indexes**

Advanced merging and concatenating

- Inner join using `.merge()`
- One-to-one and one-to-one relationships
- Merging multiple tables
- Left, right, and outer joins
- Merging a table to itself and merging on indexes
- **Filtering joins**
  - **semi and anti joins**
- **Combining data vertically with `.concat()`**
- **Verify data integrity**

Merging ordered and time-series data

- Inner join using `.merge()`
- One-to-one and one-to-one relationships
- Merging multiple tables
- Left, right, and outer joins
- Merging a table to itself and merging on indexes
- Filtering joins
  - semi and anti joins
- Combining data vertically with `.concat()`
- Verify data integrity

- **Ordered data**
  - **`merge_ordered()` and `merge_asof()`**
- **Manipulating data with `.melt()`**

Thank you!

JOINING DATA WITH PANDAS