

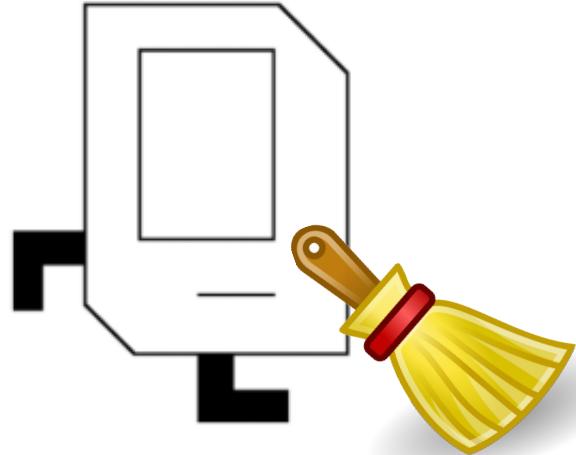
Nested 2

Chris Gregg

Based on Slides by Chris Piech + Mehran Sahami

CS106A, Stanford University

Housekeeping



- If you downloaded the starter code for Assignment 5 before 8am on Wednesday, July 22nd, either re-download it, or check [this Ed post](#) to see how to modify the text files to include a newline at the end of each file.
- See [this Ed post](#) to see how to read all the lines from a file all at once (instead of with a loop).



Learned about Collections



List
index -> value

Dictionary
key -> value

List

```
my_list = ['a', 'b', 'c']

print(my_list[1])

for i in range(len(my_list)):
    value = my_list[i]
    print(i, value)
```

my_list

a	b	c
0	1	2

indices

Dictionary

```
my_dict = {
    'x': 'a',
    'y': 'b',
    'z': 'c'
}

print(my_list['y'])

for key in my_dict:
    value = my_dict[key]
    print(key, value)
```

my_dict

a	b	c
'x'	'y'	'z'

keys



List

```
my_list = [  
    'a',  
    'b',  
    'c'  
]  
  
print(my_list[1])  
  
for i in range(len(my_list)):  
    value = my_list[i]  
    print(i, value)
```

my_list

a	b	c
0	1	2

indices

Dictionary

```
my_dict = {  
    'x': 'a',  
    'y': 'b',  
    'z': 'c'  
}  
  
print(my_list['y'])  
  
for key in my_dict:  
    value = my_dict[key]  
    print(key, value)
```

my_dict

a	b	c
'x'	'y'	'z'

keys



List

```
my_list = ['a', 'b', 'c']

print(my_list[1])

for i in range(len(my_list)):
    value = my_list[i]
    print(i, value)
```

my_list

a	b	c
0	1	2

indices

Dictionary

```
my_dict = {
    'x': 'a',
    'y': 'b',
    'z': 'c'
}

print(my_list['y'])

for key in my_dict:
    value = my_dict[key]
    print(key, value)
```

my_dict

a	b	c
'x'	'y'	'z'

keys



List

```
my_list = ['a', 'b', 'c']

print(my_list[1])

for i in range(len(my_list)):
    value = my_list[i]
    print(i, value)
```

my_list

a	b	c
0	1	2

indices

Dictionary

```
my_dict = {
    'x': 'a',
    'y': 'b',
    'z': 'c'
}

print(my_list['y'])

for key in my_dict:
    value = my_dict[key]
    print(key, value)
```

my_dict

a	b	c
'x'	'y'	'z'

keys



List

```
my_list = ['a', 'b', 'c']

print(my_list[1])

for i in range(len(my_list)):
    value = my_list[i]
    print(i, value)
```

my_list

a	b	c
0	1	2

indices

Dictionary

```
my_dict = {
    'x': 'a',
    'y': 'b',
    'z': 'c'
}

print(my_list['y'])

for key in my_dict:
    value = my_dict[key]
    print(key, value)
```

my_dict

a	b	c
'x'	'y'	'z'

keys



Ultimate CS106A: Reverse a Dict



Normal Dict:

Key -> Value



Reversed Dict:

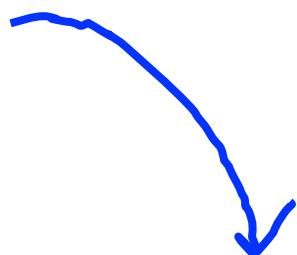
Value -> Keys

Claim: understanding this single example is most indicative of mastery in CS106A



Ultimate CS106A: Reverse a Dict

```
ages = {  
    'Mehran':50,  
    'Gary':70,  
    'Chris':32,  
    'Wil':23,  
    'Adele':32,  
    'Lionel':32,  
    'Rihanna':32,  
    'Stephen':32  
}
```



```
reversed = {  
    50:[ "Mehran" ],  
    70:[ "Gary" ],  
    32:[ "Chris", "Adele", "Lionel", "Rihanna", "Stephen" ],  
    23:[ "Wil" ]  
}
```



End Review

Learning Goals

1. Mix and match lists and dictionaries



File Types

.txt

Once upon a time there was a rabbit named George. George was a wonderful animal whose goal in life was to learn to code. So George signed up for CS106A. Everything was great until one day...

.py

```
import json

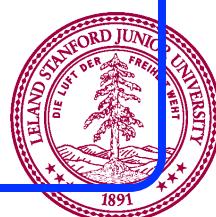
def main():
    file = open('ages.json')
    data = json.load(file)
    for name in data:
        age = data[name]
        print(name, age)
```

.CSV

pastel blue,72,100,175
baby blue,182,226,245
purple,130,64,234
blue,75,49,234
light blue,76,215,249
olive green,111,145,122
brown,88,70,1

.json

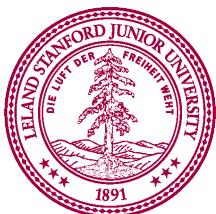
mystery



How would you store this dictionary in a file?

ages

```
{  
    "Chris":48,  
    "Gary":70,  
    "Snoopy":52,  
    "Wil":23,  
    "Rihanna":32,  
    "Adele":32  
}
```



JSON: A way to teach Nested Structures

JSON: file which stores a nested datastructure in
human readable text

ages.json

```
{  
    "Chris":48,  
    "Gary":70,  
    "Snoopy":52,  
    "Wil":23,  
    "Rihanna":32,  
    "Adele":32  
}
```

print_ages.py

```
import json  
  
def main():  
    file = open('ages.json')  
    data = json.load(file)  
    for name in data:  
        age = data[name]  
        print(name, age)
```



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ages.json

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{  
    "Chris":48,  
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    "Wil":23,  
    "Rihanna":32,  
    "Adele":32  
}
```

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    "Adele":32  
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```

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import json  
  
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    file = open('ages.json')  
    data = json.load(file)  
    for name in data:  
        age = data[name]  
        print(name, age)
```



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```
{  
    "Chris":48,  
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    "Snoopy":52,  
    "Wil":23,  
    "Rihanna":32,  
    "Adele":32  
}
```

print_ages.py

```
import json  
  
def main():  
    file = open('ages.json')  
    data = json.load(file)  
    for name in data:  
        age = data[name]  
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JSON: A way to teach Nested Structures

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ages.json

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    "Chris":48,  
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    "Snoopy":52,  
    "Wil":23,  
    "Rihanna":32,  
    "Adele":32  
}
```

print_ages.py

```
import json  
  
def main():  
    file = open('ages.json')  
    data = json.load(file)  
    for name in data:  
        age = data[name]  
        print(name, age)
```



Lets give it a whirl!

`type` is a function which tells you a variable's type!

```
Chris@ndoto Lecture18 % python
Python 3.8.1 (v3.8.1:1b293b6006, Dec 18 2019, 14:08:53)
[Clang 6.0 (clang-600.0.57)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> import json
>>> data = json.load(open('example_1.json'))
>>> data
['a', 25, {'test': 'woot'}, False]
>>> type(dat)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'dat' is not defined
>>> type(data)
<class 'list'>
>>> type(data[0])
<class 'str'>
>>> data[0]
'a'
>>> data[1]
25
>>> data[2]
{'test': 'woot'}
>>> data[3]
False
>>> data[4]
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
IndexError: list index out of range
>>>
```



JSON: A way to teach Nested Structures

ages.json

```
{  
    "Chris":48,  
    "Gary":70,  
    "Snoopy":52,  
    "Wil":23,  
    "Rihanna":32,  
    "Adele":32  
}
```

```
import json  
  
# load data  
data = json.load(open('ages.json'))  
  
# save data  
json.dump(data, open('ages.json'))
```



Weekly Weather

Next 7 Days

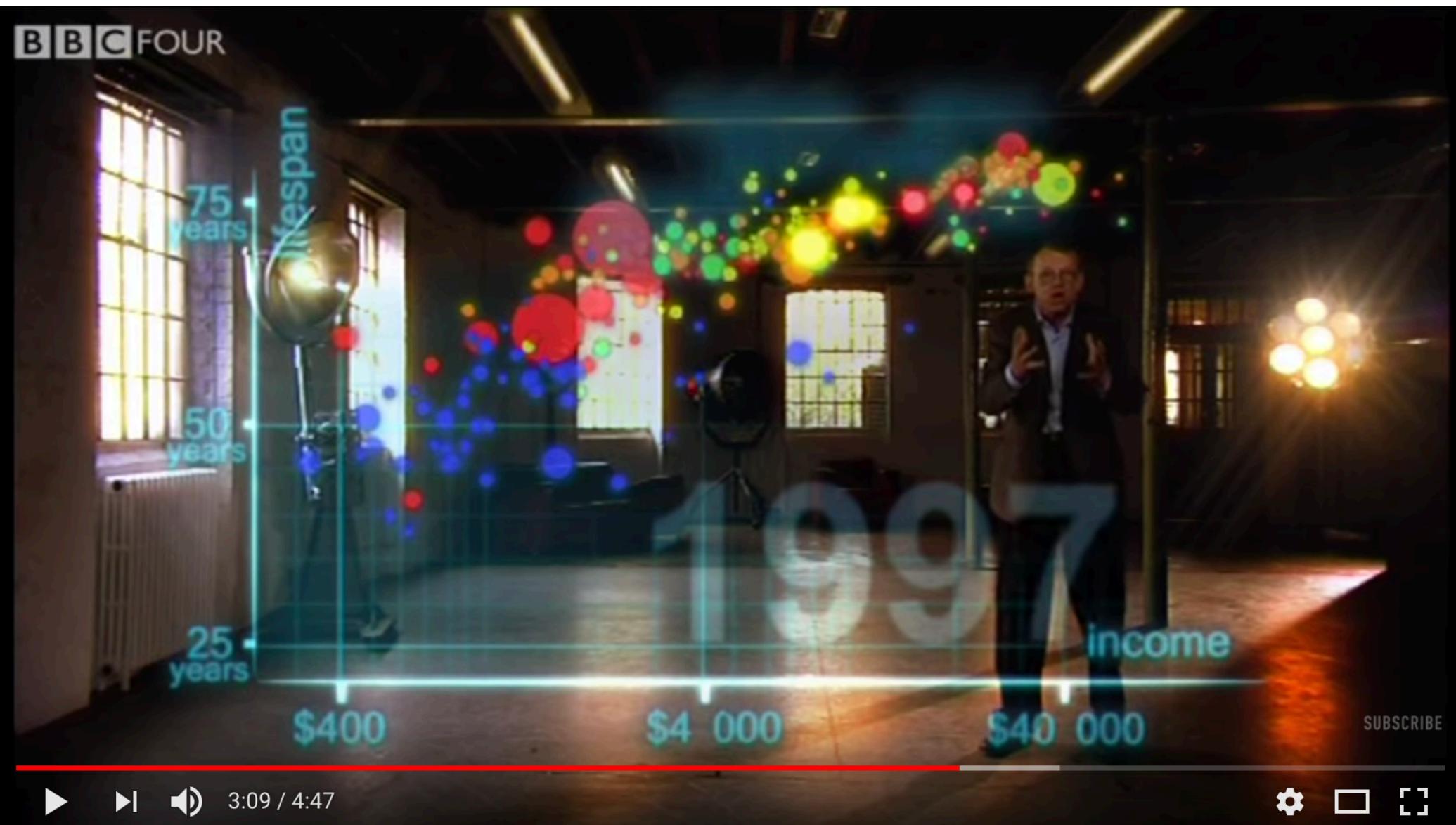


Tue 05/19	Wed 05/20	Thu 05/21	Fri 05/22	Sat 05/23	Sun 05/24	Mon 05/25
Chance of a shower	Mainly sunny					
20°	22°	23°	22°	24°	24°	25°
Feels like	20	21	22	21	23	23
Night	12°	11°	11°	11°	11°	12°
POP	40 %	30 %	10 %	10 %	10 %	0 %
Wind (km/h)	26 w	23 w	25 w	26 w	24 w	23 N
Wind gust (km/h)	39	35	38	39	36	34
Hrs Of Sun	11 h	9 h	12 h	11 h	12 h	11 h



Mindset Population Data

<https://www.youtube.com/watch?v=jbkSRLYSoho>



Mindset Raw Data

Population

Screenshot of an Excel spreadsheet titled "pop". The data consists of 21 rows of population figures for various countries, starting with Afghanistan at 32,800,000 and ending with Bhutan at 629,000. The columns are labeled A through K.

	A	B	C	D	E	F	G	H	I	J	K
1	Afghanistan	3280000	3280000	3280000	3280000	3280000	3280000	3280000	3280000	3280000	3280000
2	Albania	410445	411759	413074	414388	415703	417018	418332	419647	420961	422276
3	Algeria	2503218	2512401	2521585	2530769	2539953	2549137	2558320	2567504	2576688	2585872
4	Angola	1567028	1567028	1567028	1567028	1567028	1567028	1567028	1567028	1567028	1567028
5	Antigua and	37000	37000	37000	37000	37000	37000	37000	37000	37000	37000
6	Argentina	5340000	5340000	5340000	5340000	5340000	5340000	5340000	5340000	5340000	5340000
7	Armenia	413326	413326	413326	413326	413326	413326	413326	413326	413326	413326
8	Aruba	19286	19286	19286	19286	19286	19286	19286	19286	19286	19286
9	Australia	351014	350156	349299	348441	347584	346727	345869	345012	344154	343292
10	Austria	3205587	3213693	3221799	3229903	3238012	3246118	3254224	3262331	3270437	3278545
11	Azerbaijan	879960	879960	879960	879960	879960	879960	879960	879960	879960	879960
12	Bahamas	27350	27350	27350	27350	27350	27350	27350	27350	27350	27350
13	Bahrain	64474	64474	64474	64474	64474	64474	64474	64474	64474	64474
14	Bangladesh	19227358	19265749	19304140	19342531	19380922	19419313	19457704	19496095	19534486	19572871
15	Barbados	81729	81729	81729	81729	81729	81729	81729	81729	81729	81729
16	Belarus	2355081	2355081	2355081	2355081	2355081	2355081	2355081	2355081	2355081	2355081
17	Belgium	3138137	3152719	3167301	3181883	3196465	3211048	3225630	3240212	3254794	3269374
18	Belize	25526	25526	25526	25526	25526	25526	25526	25526	25526	25526
19	Benin	636559	636559	636559	636559	636559	636559	636559	636559	636559	636559
20	Bhutan	89989	89989	89989	89989	89989	89989	89989	89989	89989	89989
21	Bolivia	1100000	1100000	1100000	1100000	1100000	1100000	1100000	1100000	1100000	1100000

Screenshot of an Excel spreadsheet titled "gdp". The data consists of 20 rows of GDP figures for various countries, starting with Afghanistan at \$603 and ending with Bhutan at \$629. The columns are labeled A through K.

	A	B	C	D	E	F	G	H	I	J	K
1	Afghanistan	603	603	603	603	603	603	603	603	603	603
2	Albania	667	667	668	668	668	668	668	668	668	668
3	Algeria	716	716	717	718	719	720	721	722	723	724
4	Angola	618	620	623	626	628	631	634	637	640	642
5	Antigua and	757	757	757	757	757	757	757	758	758	758
6	Argentina	1507	1508	1508	1508	1508	1508	1508	1509	1509	1509
7	Armenia	514	514	514	514	514	514	514	514	514	514
8	Aruba	833	833	833	833	833	833	833	834	834	834
9	Australia	815	816	818	820	822	824	826	828	830	832
10	Austria	1848	1855	1863	1870	1878	1885	1893	1901	1908	1916
11	Azerbaijan	775	775	775	775	775	776	776	776	776	776
12	Bahamas	1445	1445	1445	1446	1446	1446	1446	1447	1447	1447
13	Bahrain	1235	1240	1246	1251	1256	1262	1267	1273	1278	1284
14	Bangladesh	876	876	876	876	876	876	876	876	876	875
15	Barbados	913	914	914	914	914	914	914	914	915	915
16	Belarus	608	608	608	609	609	609	610	610	610	611
17	Belgium	2412	2413	2413	2413	2414	2414	2414	2415	2415	2416
18	Belize	579	579	579	579	579	579	579	579	579	579
19	Benin	597	597	597	597	597	597	597	597	597	597
20	Bhutan	629	629	630	630	630	630	630	630	630	630

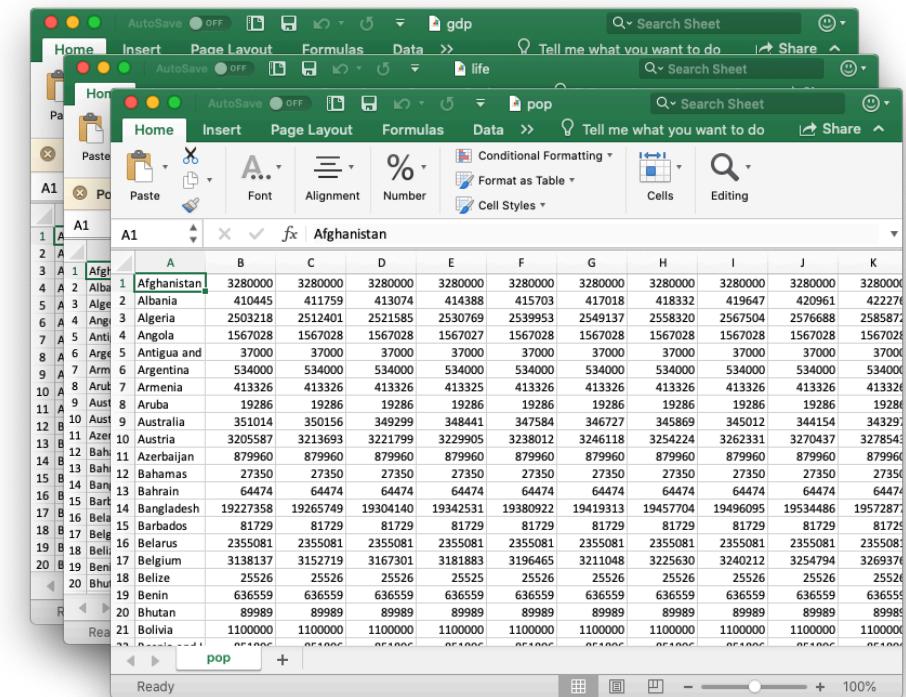
Life Expectancy

Screenshot of an Excel spreadsheet titled "life". The data consists of 20 rows of life expectancy figures for various countries, starting with Afghanistan at 28.21 and ending with Bhutan at 28.8. The columns are labeled A through L.

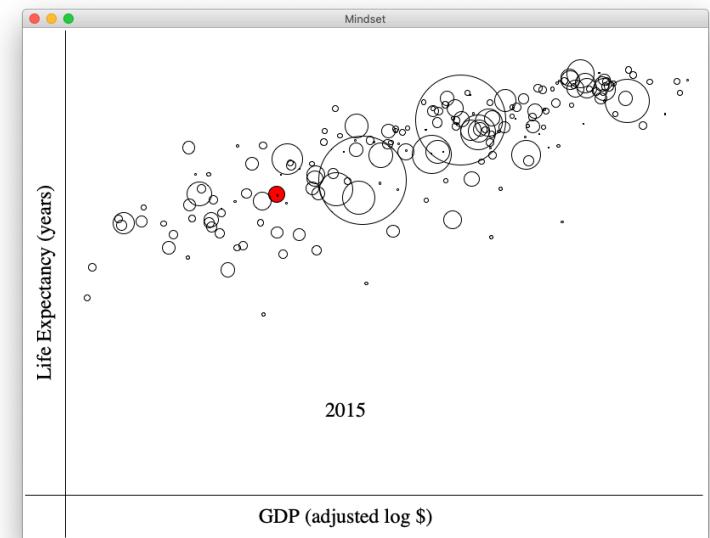
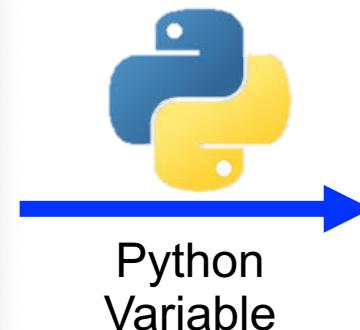
	A	B	C	D	E	F	G	H	I	J	K	L
1	Afghanistan	28.21	28.2	28.19	28.18	28.17	28.16	28.15	28.14	28.13	28.12	28.1
2	Albania	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.
3	Algeria	28.82	28.82	28.82	28.82	28.82	28.82	28.82	28.82	28.82	28.82	28.8
4	Angola	26.98	26.98	26.98	26.98	26.98	26.98	26.98	26.98	26.98	26.98	26.9
5	Antigua and	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.5
6	Argentina	33.2	33.2	33.2	33.2	33.2	33.2	33.2	33.2	33.2	33.2	33.
7	Armenia	34	34	34	34	34	34	34	34	34	34	3
8	Aruba	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.4
9	Australia	34.05	34.05	34.05	34.05	34.05	34.05	34.05	34.05	34.05	34.05	34.0
10	Austria	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.
11	Azerbaijan	29.17	29.17	29.17	29.17	29.17	29.17	29.17	29.17	29.17	29.17	29.1
12	Bahamas	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.1
13	Bahrain	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.
14	Bangladesh	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25
15	Barbados	32.12	32.12	32.12	32.12	32.12	32.12	32.12	32.12	32.12	32.12	32.1
16	Belarus	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.
17	Belgium	40	40.01	40.02	40.02	40.03	40.04	40.05	40.06	40.06	40.07	40.0
18	Belize	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.
19	Benin	31	31	31	31	31	31	31	31	31	31	3
20	Bhutan	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.



Mindset Data Visualization

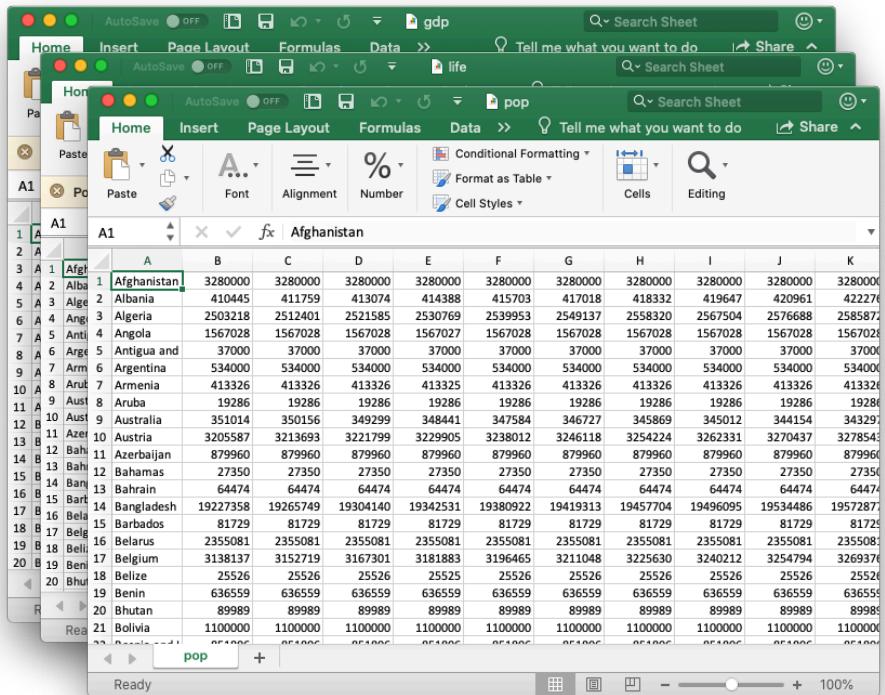


	A	B	C	D	E	F	G	H	I	J	K	
3	A 1	Afgh	3280000	3280000	3280000	3280000	3280000	3280000	3280000	3280000	3280000	
4	A 2	Alba	410445	411759	413074	414388	415703	417018	418332	419647	420961	
5	A 3	Alge	2503218	2512401	2512585	2530769	2539953	2549137	2558320	2567504	2576688	
6	A 4	Angi	1567028	1567028	1567028	1567028	1567028	1567028	1567028	1567028	1567028	
7	A 5	Anti	37000	37000	37000	37000	37000	37000	37000	37000	37000	
8	A 6	Arge	534000	534000	534000	534000	534000	534000	534000	534000	534000	
9	A 7	Arm	413326	413326	413326	413325	413326	413326	413326	413326	413326	
10	A 8	Arut	413326	413326	413326	413325	413326	413326	413326	413326	413326	
11	A 9	Aust	19286	19286	19286	19286	19286	19286	19286	19286	19286	
12	A 10	Aust	351014	350156	349299	348441	347584	346727	345869	345012	344154	
13	A 11	Azer	10	Austria	3205857	3213693	3221799	3229905	3238012	3246118	3254224	3262331
14	A 12	Bahi	879960	879960	879960	879960	879960	879960	879960	879960	879960	
15	A 13	Bahia	27350	27350	27350	27350	27350	27350	27350	27350	27350	
16	A 14	Ban	64474	64474	64474	64474	64474	64474	64474	64474	64474	
17	A 15	Barh	19227358	19265749	19304140	19342531	19380922	19419313	19457704	19496095	19534486	19572877
18	A 16	Bela	81729	81729	81729	81729	81729	81729	81729	81729	81729	
19	A 17	Belg	2355081	2355081	2355081	2355081	2355081	2355081	2355081	2355081	2355081	
20	A 18	Beli	3138137	3152719	3167301	3181883	3196465	3211048	3225630	3240212	3254794	3269376
21	A 19	Beni	25526	25526	25526	25525	25526	25526	25526	25526	25526	
22	A 20	Bhutan	636559	636559	636559	636559	636559	636559	636559	636559	636559	
23	A 21	Bolivia	1100000	1100000	1100000	1100000	1100000	1100000	1100000	1100000	1100000	
24	A 22	Rea										



Mindset Data Visualization

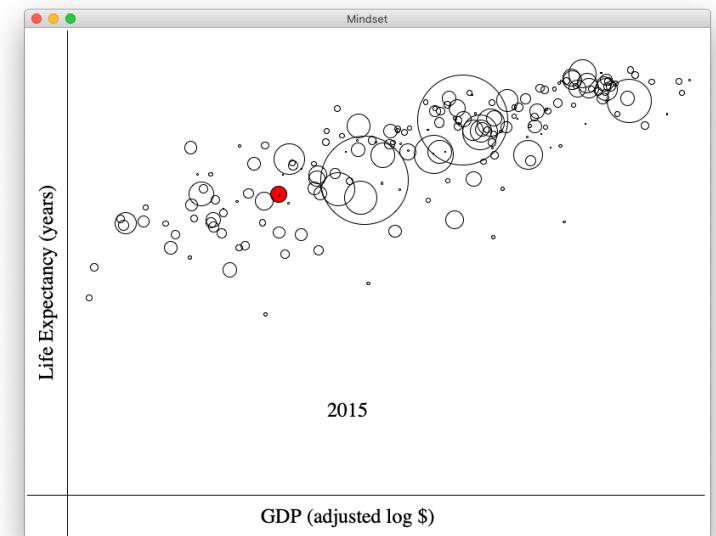
Step 1: load the data into a python variable



	A	B	C	D	E	F	G	H	I	J	K	
3	A 1	Afgh	3280000	3280000	3280000	3280000	3280000	3280000	3280000	3280000	3280000	
4	A 2	Alba	1 3280000	3280000	3280000	3280000	3280000	3280000	3280000	3280000	3280000	
5	A 3	Alge	2 410445	411759	413074	414388	415703	417018	418332	419647	420961	422276
6	A 4	Ang	3 2503218	2512401	2521585	2530769	2539953	2549137	2558320	2567504	2576688	2585872
7	A 5	Ant	4 1567028	1567028	1567028	1567027	1567028	1567028	1567028	1567028	1567028	1567028
8	A 6	Arg	5 37000	37000	37000	37000	37000	37000	37000	37000	37000	37000
9	A 7	Arm	6 534000	534000	534000	534000	534000	534000	534000	534000	534000	534000
10	A 8	Arub	7 413326	413326	413326	413325	413326	413326	413326	413326	413326	413326
11	A 9	Aust	8 19286	19286	19286	19286	19286	19286	19286	19286	19286	19286
12	A 10	Aust	9 350104	350156	349299	348441	347627	346727	345869	345012	344154	343297
13	B 11	Azer	10 3205587	3213693	3221799	3229905	3238012	3246118	3254224	3262331	3270437	327854
14	B 12	Bahi	11 879960	879960	879960	879960	879960	879960	879960	879960	879960	879960
15	B 13	Bahia	12 27350	27350	27350	27350	27350	27350	27350	27350	27350	27350
16	B 14	Ban	13 64474	64474	64474	64474	64474	64474	64474	64474	64474	64474
17	B 15	Barh	14 19227358	19265749	19304140	19342531	19380922	19419313	19457704	19496095	19534486	19572877
18	B 16	Bela	15 81729	81729	81729	81729	81729	81729	81729	81729	81729	81729
19	B 17	Belg	16 2355081	2355081	2355081	2355081	2355081	2355081	2355081	2355081	2355081	2355081
20	B 18	Beli	17 3138137	3152719	3167301	3181883	3196465	3211048	3225630	3240212	3254794	3269376
21	B 19	Beri	18 25526	25526	25526	25525	25526	25526	25526	25526	25526	25526
22	B 20	Bhut	19 636559	636559	636559	636559	636559	636559	636559	636559	636559	636559
23	R	20 Bhutan	89989	89989	89989	89989	89989	89989	89989	89989	89989	
24	Ready	1100000	1100000	1100000	1100000	1100000	1100000	1100000	1100000	1100000	1100000	

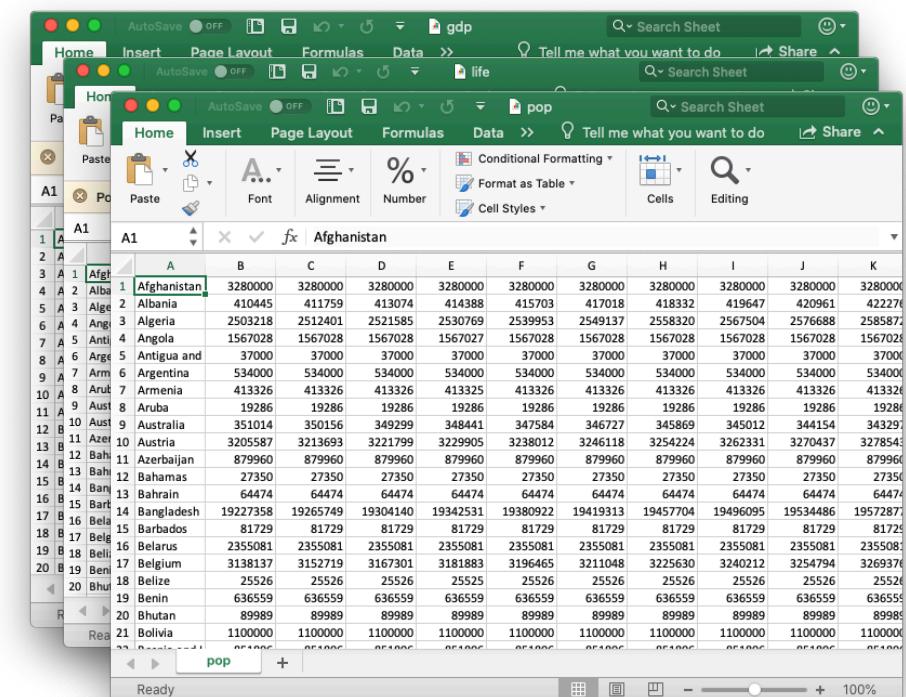


Python
Variable

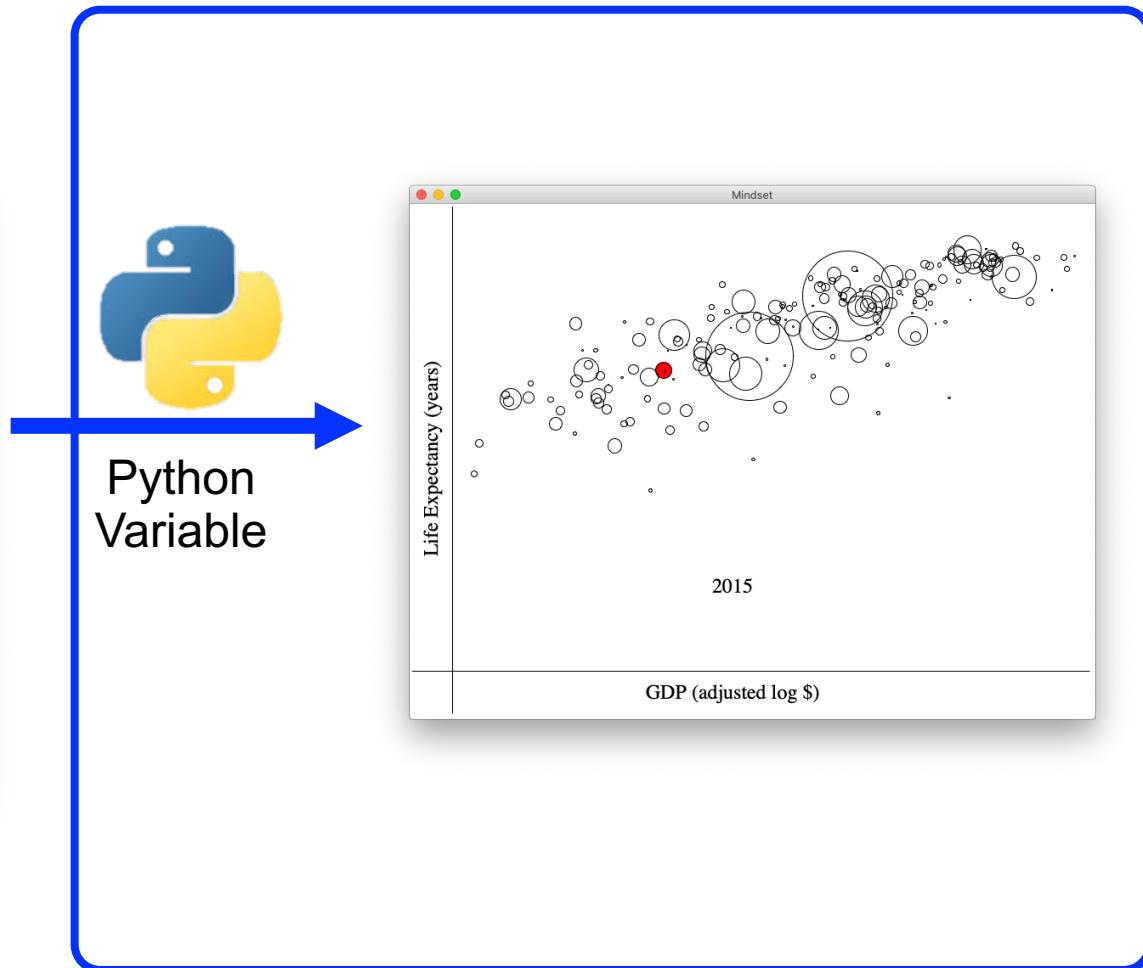


Mindset Data Visualization

Step 2: visualize the python variable



A	B	C	D	E	F	G	H	I	J	K
A 1	Afghanistan	3280000	3280000	3280000	3280000	3280000	3280000	3280000	3280000	3280000
A 2	Alba	410445	411759	413074	414388	415703	417018	418332	419647	420961
A 3	Alge	2503218	2512401	2521585	2530769	2539953	2549137	2558320	2567504	2576688
A 4	Ang	4 Algeria	1567028	1567028	1567027	1567028	1567028	1567028	1567028	1567028
A 5	Ant	4 Angola	37000	37000	37000	37000	37000	37000	37000	37000
A 6	Arg	5 Antigua and	534000	534000	534000	534000	534000	534000	534000	534000
A 7	Arm	6 Argentina	413326	413326	413326	413326	413326	413326	413326	413326
A 8	Arut	7 Armenia	19286	19286	19286	19286	19286	19286	19286	19286
A 9	Aust	8 Aruba	351014	350156	349299	348441	347584	346727	345869	345012
A 10	Aust	9 Australia	3205857	3213693	3221799	3229905	3238012	3246118	3254224	3262331
A 11	Azer	10 Austria	879960	879960	879960	879960	879960	879960	879960	879960
A 12	Bahi	11 Azerbaijan	27350	27350	27350	27350	27350	27350	27350	27350
A 13	Bahi	12 Bahamas	64474	64474	64474	64474	64474	64474	64474	64474
A 14	Ban	13 Bahrain	3138137	3152719	3167301	3181883	3196465	3211048	3225630	3240212
A 15	Bar	14 Bangladesh	19227358	19265749	19304140	19342531	19380922	19419313	19457704	19496095
A 16	Bela	15 Barbados	81729	81729	81729	81729	81729	81729	81729	81729
A 17	Bel	16 Belarus	2355081	2355081	2355081	2355081	2355081	2355081	2355081	2355081
A 18	Beli	17 Belgium	25526	25526	25526	25526	25526	25526	25526	25526
A 19	Beni	18 Belize	636559	636559	636559	636559	636559	636559	636559	636559
A 20	Bhu	19 Benin	89898	89898	89898	89898	89898	89898	89898	89898
R		20 Bhutan	1100000	1100000	1100000	1100000	1100000	1100000	1100000	1100000
		21 Bolivia	1100000	1100000	1100000	1100000	1100000	1100000	1100000	1100000



Mindset Data

```
{  
  "Afghanistan": {  
    "life": [28.21, 28.2, 28.19, ... , 53.8],  
    "pop": [3280000, 3284351, ... , 32526562],  
    "gdp": [603.0, 604.0, ... , 1925.0]  
  },  
  
  "Albania": {  
    "life": [...],  
    "pop": [...],  
    "gdp": [...]  
  }  
  ...  
}
```

A

```
{  
  "1800": {  
    "Afghanistan": {"life": 28.21, "pop": 3280000, "gdp": 603.0},  
    "Albania": {"life": 28.2, "pop": 3284351, "gdp": 604.0},  
    ...  
    "Zimbabwe": {"life": 20.8, "pop": 12226542, "gdp": 98.0}  
  },  
  
  "1801": {  
    "Afghanistan": {...}  
    "Albania": {...}  
    ...  
    "Zimbabwe": {...}  
  }  
  ...  
}
```

B



Python Variable



Lets do it!

