

# Population.java

**Objective:** To implement different sorting methods and organize a large set of data.

## Background:

We have a list of over 30,000 USA cities and their populations. It would be helpful if the data could be sorted in different and helpful ways to answer important questions. Some sample queries: “What are the most populous cities in USA?” or “What are the most populous cities in a chosen state?” or “What states in the USA have a city named Springfield?”

In this project, you will create a database from the list of USA cities and sort the data. You will sort the data for population and city name using Selection Sort, Insertion Sort, and Merge Sort.

## Assignment:

Download the file **Population.zip** from Mr Greenstein’s web site. Unzip the file and it will create a **Population** directory containing three files: a starter **City.java** file, a starter **Population.java** file, and the city data file **usPopData2017.txt**. Do all of your work in the **Population** directory. You will need the **FileUtils** and **Prompt** classes for this project.

1. Enhance the **City** class to hold one city’s data. It should implement **Comparable<City>** and have **private** fields to hold the city name (**String**), the state name (**String**), city type (**String**), and the population (**int**). It should also have a constructor, and **compareTo()** and **equals()** methods. The **toString()** method is already provided. The **compareTo()** method will sort **City** populations. Use the following algorithm for **compareTo()**:
  - a. if populations are different, return **this.population - other.population**.
  - b. Else if state names are different, return **this.state compareTo other.state**.
  - c. Else return **this.name compareTo other.name**.
2. Write a **Comparator** class that compares city names. It should compare names and return an integer value of their difference. If the names are equal, then it should return the difference in populations. Remember that the **Comparator** interface is in the **java.util** package.

```
public class CityComparatorByName implements Comparator<City>
```

3. Write a method to read the **usPopData2017.txt** file and load the **List<City> cities** with data. Use **FileUtils openToRead** method and the delimiter “[\t\n]” (delimiting tabs and newlines, see **Scanner** API for **useDelimiter** method).
4. Modify your **SortMethods** class to handle **City** objects. Change each **Integer[]** to **List<City>**; change each **arr[x]** to **arr.get(x)**; change each **new Integer[y]** to **new ArrayList<City>()**.
5. Create sorts for the following orderings.
  - a. Cities in ascending population order (Selection Sort)
  - b. Cities in descending population order (Merge Sort)
  - c. Cities in ascending name order (Insertion Sort)
  - d. Cities in descending name order (Merge Sort)
6. Add code to measure the time taken for the sort.

```
long startMillisec = System.currentTimeMillis();  
<sort here>  
long endMillisec = System.currentTimeMillis();
```

7. Create methods to handle two more queries. Use any sort method.
  - a. Most populous cities in a chosen state.

b. List all cities in the USA of a chosen city name.

8. Use the sample run below as a model to format your output. The "Enter selection" prompt should forgive mistyped entries. Entering city and state names should be case-sensitive (should match case exactly). Algorithm elapsed time will change depending on processor speed and operating system conditions. In general, Selection Sort is noticeably the slowest, and Insertion Sort should take about half that time. Merge Sort should take significantly less time than the other sorts.

Here is a sample run output:

**% java Population**

```
Enter selection: 1
Enter selection: 2
Enter selection: 3
Enter selection: 4
Enter selection: 5
Enter selection: 6
Enter selection: 9
Enter selection: 1
```

31765 cities in database

1. Fifty least populous cities in USA (Selection Sort)
  2. Fifty most populous cities in USA (Merge Sort)
  3. First fifty cities sorted by name (Insertion Sort)
  4. Last fifty cities sorted by name descending (Merge Sort)
  5. Fifty most populous cities in named state
  6. All cities matching a name sorted by population
  9. Quit
- Enter selection -> 1

Fifty least populous cities

State	City	Type	Population
1: Illinois	Balance of Niles	township	0
2: Illinois	Balance of Stites	township	0
3: Illinois	Balance of West Peoria	township	0
4: Indiana	Balance of Pigeon	township	0
5: New Hampshire	Kilkenny	township	0
6: New Hampshire	Livermore	town	0
7: New Hampshire	Success	township	0
8: North Dakota	Rock Island	township	0
9: Oklahoma	Carlton Landing	town	0
10: South Dakota	Buffalo Chip	town	0
11: Vermont	Lewis	town	0
12: Illinois	Balance of Moraine	township	1
13: Nebraska	Monowi	village	1
14: Illinois	Balance of Moline	township	2
15: Illinois	Balance of Richwoods	township	2
16: Nebraska	Gross	village	2
17: Oklahoma	Lotsee	town	2
18: South Dakota	Butte	township	2
19: Idaho	Warm River	city	3
20: South Dakota	Hillsvew	town	3
21: South Dakota	White Rock	town	3
22: Vermont	Somerset	town	3
23: Kansas	Freeport	city	4
24: New Hampshire	Odell	township	4
25: North Dakota	Ashby	township	4
26: North Dakota	Harper	township	4
27: North Dakota	Lansing	township	4
28: North Dakota	Redmond	township	4

29: North Dakota	Rexine	township	4
30: North Dakota	Ruso	city	4
31: Oklahoma	Hoot Owl	town	4
32: South Dakota	Lily	town	4
33: South Dakota	New Surprise Valley	township	4
34: Wyoming	Lost Springs	town	4
35: Kansas	Lees	township	5
36: Maine	Frye Island	town	5
37: Minnesota	Funkley	city	5
38: Minnesota	Hangaard	township	5
39: Missouri	Cave	town	5
40: North Dakota	Richland Center	township	5
41: South Dakota	Prospect	township	5
42: South Dakota	Verdon	town	5
43: West Virginia	Thurmond	town	5
44: Florida	Westlake	city	6
45: Missouri	Three Creeks	village	6
46: Nebraska	Anoka	village	6
47: North Dakota	Evergreen	township	6
48: North Dakota	Fairview	township	6
49: North Dakota	Mauch	township	6
50: North Dakota	New Home	township	6

Elapsed Time 1435 milliseconds

1. Fifty least populous cities in USA (Selection Sort)
2. Fifty most populous cities in USA (Merge Sort)
3. First fifty cities sorted by name (Insertion Sort)
4. Last fifty cities sorted by name descending (Merge Sort)
5. Fifty most populous cities in named state
6. All cities matching a name sorted by population
9. Quit

Enter selection -> 2

Fifty most populous cities

State	City	Type	Population
1: New York	New York	city	8,622,698
2: California	Los Angeles	city	3,999,759
3: Illinois	Chicago	city	2,716,450
4: Texas	Houston	city	2,312,717
5: Arizona	Phoenix	city	1,626,078
6: Pennsylvania	Philadelphia	city	1,580,863
7: Texas	San Antonio	city	1,511,946
8: California	San Diego	city	1,419,516
9: Texas	Dallas	city	1,341,075
10: California	San Jose	city	1,035,317
11: Texas	Austin	city	950,715
12: Florida	Jacksonville	city	892,062
13: California	San Francisco	city	884,363
14: Ohio	Columbus	city	879,170
15: Texas	Fort Worth	city	874,168
16: Indiana	Indianapolis	city	872,680
17: North Carolina	Charlotte	city	859,035
18: Kentucky	Louisville	government	771,158
19: Washington	Seattle	city	724,745
20: Colorado	Denver	city	704,621
21: District of Columbia	Washington	city	693,972
22: Tennessee	Nashville	government	691,243
23: Massachusetts	Boston	city	685,094
24: Texas	El Paso	city	683,577

25: Michigan	Detroit	city	673,104
26: Tennessee	Memphis	city	652,236
27: Oregon	Portland	city	647,805
28: Oklahoma	Oklahoma City	city	643,648
29: Nevada	Las Vegas	city	641,676
30: Maryland	Baltimore	city	611,648
31: Wisconsin	Milwaukee	city	595,351
32: New Mexico	Albuquerque	city	558,545
33: Arizona	Tucson	city	535,677
34: California	Fresno	city	527,438
35: New York	Balance of Hempstead	town	506,066
36: California	Sacramento	city	501,901
37: Arizona	Mesa	city	496,401
38: Missouri	Kansas City	city	488,943
39: Georgia	Atlanta	city	486,290
40: New York	Brookhaven	town	486,170
41: California	Long Beach	city	469,450
42: Nebraska	Omaha	city	466,893
43: North Carolina	Raleigh	city	464,758
44: Colorado	Colorado Springs	city	464,474
45: Florida	Miami	city	463,347
46: Virginia	Virginia Beach	city	450,435
47: New York	Balance of Brookhaven	town	434,603
48: California	Oakland	city	425,195
49: Minnesota	Minneapolis	city	422,331
50: Oklahoma	Tulsa	city	401,800

Elapsed Time 33 milliseconds

1. Fifty least populous cities in USA (Selection Sort)
2. Fifty most populous cities in USA (Merge Sort)
3. First fifty cities sorted by name (Insertion Sort)
4. Last fifty cities sorted by name descending (Merge Sort)
5. Fifty most populous cities in named state
6. All cities matching a name sorted by population
9. Quit

Enter selection -> 3

Fifty cities sorted by name

	State	City	Type	Population
1:	Minnesota	Aastad	township	213
2:	Mississippi	Abbeville	town	436
3:	Alabama	Abbeville	city	2,567
4:	Georgia	Abbeville	city	2,789
5:	South Carolina	Abbeville	city	5,083
6:	Louisiana	Abbeville	city	12,272
7:	Maine	Abbot	town	676
8:	Wisconsin	Abbotsford	city	2,265
9:	Pennsylvania	Abbott	township	231
10:	Texas	Abbott	city	363
11:	Kansas	Abbyville	city	87
12:	North Dakota	Abercrombie	city	261
13:	Ohio	Aberdeen	village	1,602
14:	Idaho	Aberdeen	city	1,950
15:	Mississippi	Aberdeen	city	5,328
16:	North Carolina	Aberdeen	town	7,625
17:	Maryland	Aberdeen	city	16,049
18:	Washington	Aberdeen	city	16,462
19:	New Jersey	Aberdeen	township	18,355
20:	South Dakota	Aberdeen	city	28,388

21: Texas	Abernathy	city	2,753
22: Nebraska	Abie	village	66
23: Kansas	Abilene	city	6,380
24: Texas	Abilene	city	121,885
25: Illinois	Abingdon	city	3,125
26: Virginia	Abingdon	town	7,981
27: Illinois	Abington	township	364
28: Indiana	Abington	township	814
29: Massachusetts	Abington	town	16,396
30: Pennsylvania	Abington	township	55,604
31: Louisiana	Abita Springs	town	2,540
32: Indiana	Aboite	township	37,686
33: Wisconsin	Abrams	town	1,871
34: New Jersey	Absecon	city	8,283
35: Maryland	Accident	town	314
36: Virginia	Accomac	town	493
37: Idaho	Acequia	city	127
38: Oklahoma	Achille	town	526
39: Kansas	Achilles	township	46
40: Texas	Ackerly	city	227
41: Mississippi	Ackerman	town	1,455
42: Wisconsin	Ackley	town	507
43: Iowa	Ackley	city	1,525
44: Iowa	Ackworth	city	108
45: North Dakota	Acme	township	25
46: Michigan	Acme	township	4,694
47: Minnesota	Acoma	township	1,134
48: North Dakota	Acton	township	96
49: Minnesota	Acton	township	379
50: Maine	Acton	town	2,592

Elapsed Time 2015 milliseconds

1. Fifty least populous cities in USA (Selection Sort)
2. Fifty most populous cities in USA (Merge Sort)
3. First fifty cities sorted by name (Insertion Sort)
4. Last fifty cities sorted by name descending (Merge Sort)
5. Fifty most populous cities in named state
6. All cities matching a name sorted by population
9. Quit

Enter selection -> 3

Fifty cities sorted by name

	State	City	Type	Population
1:	Minnesota	Aastad	township	213
2:	Mississippi	Abbeville	town	436
3:	Alabama	Abbeville	city	2,567
4:	Georgia	Abbeville	city	2,789
5:	South Carolina	Abbeville	city	5,083
6:	Louisiana	Abbeville	city	12,272
7:	Maine	Abbot	town	676
8:	Wisconsin	Abbotsford	city	2,265
9:	Pennsylvania	Abbott	township	231
10:	Texas	Abbott	city	363
11:	Kansas	Abbyville	city	87
12:	North Dakota	Abercrombie	city	261
13:	Ohio	Aberdeen	village	1,602
14:	Idaho	Aberdeen	city	1,950
15:	Mississippi	Aberdeen	city	5,328
16:	North Carolina	Aberdeen	town	7,625

17: Maryland	Aberdeen	city	16,049
18: Washington	Aberdeen	city	16,462
19: New Jersey	Aberdeen	township	18,355
20: South Dakota	Aberdeen	city	28,388
21: Texas	Abernathy	city	2,753
22: Nebraska	Abie	village	66
23: Kansas	Abilene	city	6,380
24: Texas	Abilene	city	121,885
25: Illinois	Abingdon	city	3,125
26: Virginia	Abingdon	town	7,981
27: Illinois	Abington	township	364
28: Indiana	Abington	township	814
29: Massachusetts	Abington	town	16,396
30: Pennsylvania	Abington	township	55,604
31: Louisiana	Abita Springs	town	2,540
32: Indiana	Aboite	township	37,686
33: Wisconsin	Abrams	town	1,871
34: New Jersey	Absecon	city	8,283
35: Maryland	Accident	town	314
36: Virginia	Accomac	town	493
37: Idaho	Acequia	city	127
38: Oklahoma	Achille	town	526
39: Kansas	Achilles	township	46
40: Texas	Ackerly	city	227
41: Mississippi	Ackerman	town	1,455
42: Wisconsin	Ackley	town	507
43: Iowa	Ackley	city	1,525
44: Iowa	Ackworth	city	108
45: North Dakota	Acme	township	25
46: Michigan	Acme	township	4,694
47: Minnesota	Acoma	township	1,134
48: North Dakota	Acton	township	96
49: Minnesota	Acton	township	379
50: Maine	Acton	town	2,592

Elapsed Time 20 milliseconds

1. Fifty least populous cities in USA (Selection Sort)
  2. Fifty most populous cities in USA (Merge Sort)
  3. First fifty cities sorted by name (Insertion Sort)
  4. Last fifty cities sorted by name descending (Merge Sort)
  5. Fifty most populous cities in named state
  6. All cities matching a name sorted by population
  9. Quit
- Enter selection -> 4

Fifty cities sorted by name descending

State	City	Type	Population
1: Louisiana	Zwolle	town	1,929
2: Iowa	Zwingle	city	92
3: Kansas	Zurich	city	95
4: Minnesota	Zumbrota	city	3,409
5: Minnesota	Zumbro Falls	city	242
6: Minnesota	Zumbro	township	727
7: Illinois	Zuma	township	745
8: Florida	Zolfo Springs	town	1,816
9: Ohio	Zoar	village	177
10: Indiana	Zionsville	town	26,710
11: Illinois	Zion	city	23,952
12: Minnesota	Zion	township	350

13: North Dakota	Zion	township	53
14: Arkansas	Zinc	town	101
15: Minnesota	Zimmerman	city	5,654
16: Michigan	Zilwaukee	city	1,552
17: Washington	Zillah	city	3,125
18: Illinois	Zif	township	97
19: South Dakota	Zickrick	township	11
20: Nebraska	Zero	township	273
21: Pennsylvania	Zerbe	township	1,804
22: Florida	Zephyrhills	city	15,247
23: Kansas	Zenda	city	80
24: Minnesota	Zemple	city	91
25: South Dakota	Zell	township	62
26: Illinois	Zeigler	city	1,742
27: Michigan	Zeeland charter	township	11,077
28: Michigan	Zeeland	city	5,559
29: North Dakota	Zeeland	city	78
30: North Carolina	Zebulon	town	5,268
31: Georgia	Zebulon	city	1,173
32: Iowa	Zearing	city	530
33: Kansas	Zeandale	township	323
34: Texas	Zavalla	city	719
35: North Dakota	Zap	city	238
36: Ohio	Zanesville	city	25,388
37: Indiana	Zanesville	town	611
38: Illinois	Zanesville	township	467
39: Ohio	Zanesfield	village	193
40: Ohio	Zane	township	1,126
41: Ohio	Zaleski	village	270
42: Louisiana	Zachary	city	17,538
43: Nebraska	Yutan	city	1,261
44: Arizona	Yuma	city	95,502
45: Colorado	Yuma	city	3,511
46: Oklahoma	Yukon	city	26,830
47: California	Yucca Valley	town	21,748
48: Minnesota	Yucatan	township	321
49: California	Yucaipa	city	53,683
50: California	Yuba City	city	66,860

Elapsed Time 39 milliseconds

1. Fifty least populous cities in USA (Selection Sort)
2. Fifty most populous cities in USA (Merge Sort)
3. First fifty cities sorted by name (Insertion Sort)
4. Last fifty cities sorted by name descending (Merge Sort)
5. Fifty most populous cities in named state
6. All cities matching a name sorted by population
9. Quit

Enter selection -> 5

Enter state name (ie. Alabama) -> **Cali**

Enter state name (ie. Alabama) -> **California**

Fifty most populous cities in California

	State	City	Type	Population
1:	California	Los Angeles	city	3,999,759
2:	California	San Diego	city	1,419,516
3:	California	San Jose	city	1,035,317
4:	California	San Francisco	city	884,363
5:	California	Fresno	city	527,438

6: California	Sacramento	city	501,901
7: California	Long Beach	city	469,450
8: California	Oakland	city	425,195
9: California	Bakersfield	city	380,874
10: California	Anaheim	city	352,497
11: California	Santa Ana	city	334,136
12: California	Riverside	city	327,728
13: California	Stockton	city	310,496
14: California	Irvine	city	277,453
15: California	Chula Vista	city	270,471
16: California	Fremont	city	234,962
17: California	San Bernardino	city	216,995
18: California	Modesto	city	214,221
19: California	Fontana	city	211,815
20: California	Santa Clarita	city	210,888
21: California	Oxnard	city	210,037
22: California	Moreno Valley	city	207,226
23: California	Glendale	city	203,054
24: California	Huntington Beach	city	201,874
25: California	Rancho Cucamonga	city	177,452
26: California	Oceanside	city	176,193
27: California	Ontario	city	175,841
28: California	Santa Rosa	city	175,269
29: California	Garden Grove	city	174,226
30: California	Elk Grove	city	171,844
31: California	Corona	city	167,836
32: California	Hayward	city	160,500
33: California	Lancaster	city	160,316
34: California	Salinas	city	157,596
35: California	Palmdale	city	157,519
36: California	Sunnyvale	city	153,656
37: California	Pomona	city	152,939
38: California	Escondido	city	151,969
39: California	Torrance	city	146,758
40: California	Pasadena	city	142,647
41: California	Orange	city	140,560
42: California	Fullerton	city	140,392
43: California	Roseville	city	135,329
44: California	Visalia	city	133,010
45: California	Concord	city	129,783
46: California	Thousand Oaks	city	128,995
47: California	Santa Clara	city	127,134
48: California	Simi Valley	city	126,878
49: California	Victorville	city	122,441
50: California	Berkeley	city	122,324

1. Fifty least populous cities in USA (Selection Sort)
2. Fifty most populous cities in USA (Merge Sort)
3. First fifty cities sorted by name (Insertion Sort)
4. Last fifty cities sorted by name descending (Merge Sort)
5. Fifty most populous cities in named state
6. All cities matching a name sorted by population
9. Quit

Enter selection -> **6**

Enter city name -> **fremont**

City Fremont by population

State	City	Type	Population
1: California	Fremont	city	234,962



2: Illinois	Fremont	township	32,773
3: Nebraska	Fremont	city	26,457
4: Ohio	Fremont	city	16,193
5: New Hampshire	Fremont	town	4,721
6: Michigan	Fremont	city	4,015
7: Indiana	Fremont	town	2,162
8: North Carolina	Fremont	town	1,267
9: New York	Fremont	town	966
10: Kansas	Fremont	township	894
11: Iowa	Fremont	city	727
12: Wisconsin	Fremont	village	657
13: Minnesota	Fremont	township	355
14: South Dakota	Fremont	township	284
15: North Dakota	Fremont	township	55

1. Fifty least populous cities in USA (Selection Sort)
2. Fifty most populous cities in USA (Merge Sort)
3. First fifty cities sorted by name (Insertion Sort)
4. Last fifty cities sorted by name descending (Merge Sort)
5. Fifty most populous cities in named state
6. All cities matching a name sorted by population
9. Quit

Enter selection -> **q**

Enter selection -> **9**

Thanks for using Population!