

# OutOfSorts.java

## Background:

You know that, of the quadratic sorting algorithms, the bubble sort is the least efficient, and the insertion sort is the most efficient. You also know that the merge sort is more efficient than all three of the quadratic sorting algorithms that we covered. How do you know this, though? Wouldn't it be nice to prove to yourself the order of efficiency of these 4 sorting algorithms (YES!). Here's your chance to do just that!

## Assignment:

1. Use the code on the course web site to get started. Start filling in the code for the 4 sorts. We did the bubble sort together, but you'll need to translate the other 3 sorts from array of int to ArrayList of Integer.
2. Once you get the sorts working, add in the steps taken to accomplish each sort. We did the bubble sort together, but you'll need to add in the steps for the other 3 sorts. Be sure to count every variable declaration, method call, boolean expression (a compound expression would count as two steps), java statement, etc.
3. See the sample run output below to help guide you in this process.

```
C:\Java>java OutOfSorts
```

```
Are you feeling OUT OF SORTS?
```

```
Welcome to the SORTING PROGRAM, a program that will take an Integer ArrayList that is initially unordered, and then order the array using one of 3 quadratic sorting algorithms, or an n log n sort. These include a Bubble Sort, a Selection Sort, an Insertion Sort, and a Merge Sort. HAPPY SORTING!
```

```
Please enter the number of random integers you would like to generate (5 - 10000) -> 400
```

```
Please enter the maximum value that you would like to possibly generate (5 - 10000) -> 1000
```

```
280  984  393  642  772  453  738  222  219  637  463  776  664  627  293
846  843  805  725  631   97  640  750  738  240  915  332  358  438  654
955  584  700  472  729  746  522  141  532  908  634  943  653  154  515
749  211  868  563  853  413  993  362  280  345  159  494  689  582  670
726  979  360  532  223  441  446  135  612  592  112  711  382  857  833
416   84  905  403  719  252  749  188  808  769  711  138  890  678  932
995  582   54  430  861   74  606  623  922  384  171  812  658  820   63
393  301  706  585  458  675  547  620  988  790   68  357   98  717  969
646  615  359  827  423  841  694  309  897  518  937  730  946  847  882
```

54	243	930	344	628	183	137	243	282	590	727	373	982	533	496
294	824	290	376	134	64	694	664	267	784	587	995	21	989	110
291	538	189	913	621	916	984	118	353	568	781	74	10	494	522
501	977	854	227	630	554	744	237	331	908	610	263	15	142	64
743	322	42	181	545	209	60	551	767	79	762	423	222	3	242
342	233	952	13	531	505	159	472	124	194	399	334	73	749	23
362	172	758	36	302	189	818	377	188	533	393	818	89	224	748
602	911	218	274	996	102	256	994	430	978	514	547	810	897	280
753	855	723	775	667	64	836	16	162	988	455	316	200	31	192
604	368	924	564	269	732	344	652	639	750	899	228	500	789	822
435	327	814	314	555	981	894	380	476	711	526	405	232	195	177
476	377	234	96	622	28	466	164	749	107	106	507	13	724	311
657	785	618	232	273	163	301	184	832	182	874	677	230	497	472
217	961	345	972	904	352	984	886	839	402	685	330	290	884	556
599	361	746	140	133	638	289	781	616	920	266	203	510	685	806
607	621	361	72	887	138	846	605	205	200	956	607	284	231	668
843	234	151	44	374	661	132	758	113	64	711	973	55	271	946
139	74	767	780	949	406	279	938	306	266					

1. ArrayList of Integer Bubble Sort
2. ArrayList of Integer Selection Sort
3. ArrayList of Integer Insertion Sort
4. ArrayList of Integer Merge Sort

Enter a choice (1-4) from the menu above -> 3

3	10	13	13	15	16	21	23	28	31	36	42	44	54	54
55	60	63	64	64	64	64	68	72	73	74	74	74	79	84
89	96	97	98	102	106	107	110	112	113	118	124	132	133	134
135	137	138	138	139	140	141	142	151	154	159	159	162	163	164
171	172	177	181	182	183	184	188	188	189	189	192	194	195	200
200	203	205	209	211	217	218	219	222	222	223	224	227	228	230
231	232	232	233	234	234	237	240	242	243	243	252	256	263	266
266	267	269	271	273	274	279	280	280	280	282	284	289	290	290
291	293	294	301	301	302	306	309	311	314	316	322	327	330	331
332	334	342	344	344	345	345	352	353	357	358	359	360	361	361
362	362	368	373	374	376	377	377	380	382	384	393	393	393	399
402	403	405	406	413	416	423	423	430	430	435	438	441	446	453
455	458	463	466	472	472	472	476	476	494	494	496	497	500	501
505	507	510	514	515	518	522	522	526	531	532	532	533	533	538
545	547	547	551	554	555	556	563	564	568	582	582	584	585	587
590	592	599	602	604	605	606	607	607	610	612	615	616	618	620
621	621	622	623	627	628	630	631	634	637	638	639	640	642	646
652	653	654	657	658	661	664	664	667	668	670	675	677	678	685
685	689	694	694	700	706	711	711	711	711	717	719	723	724	725
726	727	729	730	732	738	738	743	744	746	746	748	749	749	749
749	750	750	753	758	758	762	767	767	769	772	775	776	780	781
781	784	785	789	790	805	806	808	810	812	814	818	818	820	822
824	827	832	833	836	839	841	843	843	846	846	847	853	854	855
857	861	868	874	882	884	886	887	890	894	897	897	899	904	905
908	908	911	913	915	916	920	922	924	930	932	937	938	943	946
946	949	952	955	956	961	969	972	973	977	978	979	981	982	984
984	984	988	988	989	993	994	995	995	996					

165,931 steps taken in this sort.

Enter the letter 'c' to continue with another sort, any other character to exit -> c

Please enter the number of random integers you would like to generate (5 - 10000) -> 400

Please enter the maximum value that you would like to possibly generate (5 - 10000) -> 1000

919	484	658	568	518	648	448	397	520	636	778	696	960	921	581
606	578	957	733	57	114	327	585	480	162	115	316	970	750	658
376	839	976	926	34	254	638	475	704	570	742	295	296	71	224
905	316	12	963	731	799	305	424	142	475	676	850	517	732	872
950	369	62	313	471	866	659	617	855	45	769	602	427	648	197
669	223	778	100	976	589	516	841	431	166	226	180	354	722	516
569	565	575	749	614	806	23	517	72	643	277	758	870	407	888
25	730	344	548	966	940	815	455	246	700	350	136	11	255	331
724	441	720	330	238	147	100	467	300	936	508	654	90	959	15
286	67	356	849	741	112	321	919	42	345	911	750	181	770	40
946	878	319	829	268	19	591	901	229	612	801	254	880	859	997
71	131	878	627	202	497	665	900	61	644	130	230	399	500	423
208	712	957	305	203	89	405	44	696	909	429	129	884	144	9
158	900	976	453	372	289	47	155	693	959	965	945	540	923	599
456	386	597	295	464	795	272	414	600	612	651	441	173	117	41
547	108	189	833	639	160	966	429	831	638	40	651	813	829	984
979	747	220	867	657	176	373	487	837	936	22	224	456	209	550
784	432	646	511	637	152	993	265	572	910	735	132	672	148	80
675	952	854	29	852	73	484	366	835	807	92	145	201	401	139
686	94	592	656	89	656	779	962	70	749	776	183	220	496	668
178	876	689	478	301	423	477	802	618	257	11	52	825	546	957
686	129	669	856	654	787	460	316	288	810	373	954	45	618	313
799	839	24	141	602	163	30	803	136	868	344	627	80	223	390
568	560	874	876	102	734	377	645	9	79	287	613	516	215	186
103	139	118	590	770	88	620	445	608	286	897	775	256	893	507
110	916	732	155	507	721	139	42	358	330	620	83	648	843	96
751	52	880	712	582	33	799	892	623	118					

1. ArrayList of Integer Bubble Sort
2. ArrayList of Integer Selection Sort
3. ArrayList of Integer Insertion Sort
4. ArrayList of Integer Merge Sort

Enter a choice (1-4) from the menu above -> 2

9	9	11	11	12	15	19	22	23	24	25	29	30	33	34
40	40	41	42	42	44	45	45	47	52	52	57	61	62	67
70	71	71	72	73	79	80	80	83	88	89	89	90	92	94
96	100	100	102	103	108	110	112	114	115	117	118	118	129	129
130	131	132	136	136	139	139	139	141	142	144	145	147	148	152
155	155	158	160	162	163	166	173	176	178	180	181	183	186	189
197	201	202	203	208	209	215	220	220	223	223	224	224	226	229
230	238	246	254	254	255	256	257	265	268	272	277	286	286	287
288	289	295	295	296	300	301	305	305	313	313	316	316	316	319
321	327	330	330	331	344	344	345	350	354	356	358	366	369	372
373	373	376	377	386	390	397	399	401	405	407	414	423	423	424
427	429	429	431	432	441	441	445	448	453	455	456	456	460	464
467	471	475	475	477	478	480	484	484	487	496	497	500	507	507
508	511	516	516	516	517	517	518	520	540	546	547	548	550	560
565	568	568	569	570	572	575	578	581	582	585	589	590	591	592
597	599	600	602	602	606	608	612	612	613	614	617	618	618	620
620	623	627	627	636	637	638	638	639	643	644	645	646	648	648
648	651	651	654	654	656	656	657	658	658	659	665	665	669	669
672	675	676	686	686	689	693	696	696	700	704	712	712	720	721
722	724	730	731	732	732	733	734	735	741	742	747	749	749	750
750	751	758	769	770	770	775	776	778	778	779	784	787	795	799
799	799	801	802	803	806	807	810	813	815	825	829	829	831	833
835	837	839	839	841	843	849	850	852	854	855	856	859	866	867
868	870	872	874	876	876	878	878	880	880	884	888	892	893	897
900	900	901	905	909	910	911	916	919	919	921	923	926	936	936
940	945	946	950	952	954	957	957	957	959	959	960	962	963	965
966	966	970	976	976	976	979	984	993	997					

244,335 steps taken in this sort.

Enter the letter 'c' to continue with another sort, any other character to exit -> c

Please enter the number of random integers you would like to generate (5 - 10000) -> 400

Please enter the maximum value that you would like to possibly generate (5 - 10000) -> 1000

611	828	212	651	68	617	549	620	781	53	426	610	24	462	340
532	999	35	992	544	968	829	802	502	635	968	664	353	537	635
619	106	32	78	518	417	667	260	27	366	319	710	521	680	531
850	509	565	891	333	233	253	128	923	17	610	846	54	725	422
456	496	442	478	930	473	100	219	432	188	328	495	793	952	215
930	998	996	72	500	611	646	476	207	76	715	92	120	364	862
810	663	316	199	700	724	333	586	195	101	786	927	676	776	606
259	333	771	62	573	774	652	652	139	361	295	358	546	656	156
261	815	691	162	661	697	980	273	396	727	345	936	8	666	641
928	770	756	415	558	365	553	405	758	179	228	487	416	752	892
411	178	917	903	158	39	572	122	293	264	801	790	10	597	294
15	902	206	620	872	641	575	924	774	873	363	54	61	636	277
948	747	516	193	364	971	569	52	661	971	778	566	409	353	417
391	64	5	261	232	781	252	993	276	755	756	535	476	114	232
260	451	486	247	230	212	873	254	638	473	314	554	651	47	167
26	674	728	523	350	904	80	382	916	680	774	744	770	767	458
702	765	210	670	941	555	795	955	799	164	484	191	196	684	405
99	258	48	121	55	472	945	915	610	525	675	802	579	768	155
791	172	444	329	717	387	352	988	578	815	668	323	920	85	991
617	261	405	506	138	938	28	364	624	38	46	996	787	271	590
70	885	750	377	276	718	625	569	914	400	453	58	521	852	1000
633	404	250	865	959	29	594	2	939	617	165	689	815	237	871
983	331	877	387	35	371	723	568	870	753	909	807	444	290	501
909	813	779	406	557	244	340	143	637	995	396	172	545	220	626
555	66	231	444	275	608	855	890	430	338	216	348	887	271	611
158	698	470	526	45	728	286	1	228	515	17	754	245	301	443
434	803	595	446	379	423	333	333	70	254					

1. ArrayList of Integer Bubble Sort
2. ArrayList of Integer Selection Sort
3. ArrayList of Integer Insertion Sort
4. ArrayList of Integer Merge Sort

Enter a choice (1-4) from the menu above -> 1

1	2	5	8	10	15	17	17	24	26	27	28	29	32	35
35	38	39	45	46	47	48	52	53	54	54	55	58	61	62
64	66	68	70	70	72	76	78	80	85	92	99	100	101	106
114	120	121	122	128	138	139	143	155	156	158	158	162	164	165
167	172	172	178	179	188	191	193	195	196	199	206	207	210	212
212	215	216	219	220	228	228	230	231	232	232	233	237	244	245
247	250	252	253	254	254	258	259	260	260	261	261	261	264	271
271	273	275	276	276	277	286	290	293	294	295	301	314	316	319
323	328	329	331	333	333	333	333	333	338	340	340	345	348	350
352	353	353	358	361	363	364	364	364	365	366	371	377	379	382
387	387	391	396	396	400	404	405	405	405	406	409	411	415	416
417	417	422	423	426	430	432	434	442	443	444	444	444	446	451

453	456	458	462	470	472	473	473	476	476	478	484	486	487	495
496	500	501	502	506	509	515	516	518	521	521	523	525	526	531
532	535	537	544	545	546	549	553	554	555	555	557	558	565	566
568	569	569	572	573	575	578	579	586	590	594	595	597	606	608
610	610	610	611	611	611	617	617	617	619	620	620	624	625	626
633	635	635	636	637	638	641	641	646	651	651	652	652	656	661
661	663	664	666	667	668	670	674	675	676	680	680	684	689	691
697	698	700	702	710	715	717	718	723	724	725	727	728	728	744
747	750	752	753	754	755	756	756	758	765	767	768	770	770	771
774	774	774	776	778	779	781	781	786	787	790	791	793	795	799
801	802	802	803	807	810	813	815	815	815	828	829	846	850	852
855	862	865	870	871	872	873	873	877	885	887	890	891	892	902
903	904	909	909	914	915	916	917	920	923	924	927	928	930	930
936	938	939	941	945	948	952	955	959	968	968	971	971	980	983
988	991	992	993	995	996	996	998	999	1000					

362,618 steps taken in this sort.

Enter the letter 'c' to continue with another sort, any other character to exit -> q

Thanks for working with the SORTING PROGRAM.  
Hopefully, you were able to put your affairs in order(!). Please run the program again  
if you're interested in seeing quadratic sorting algorithms at work.

C:\Java>