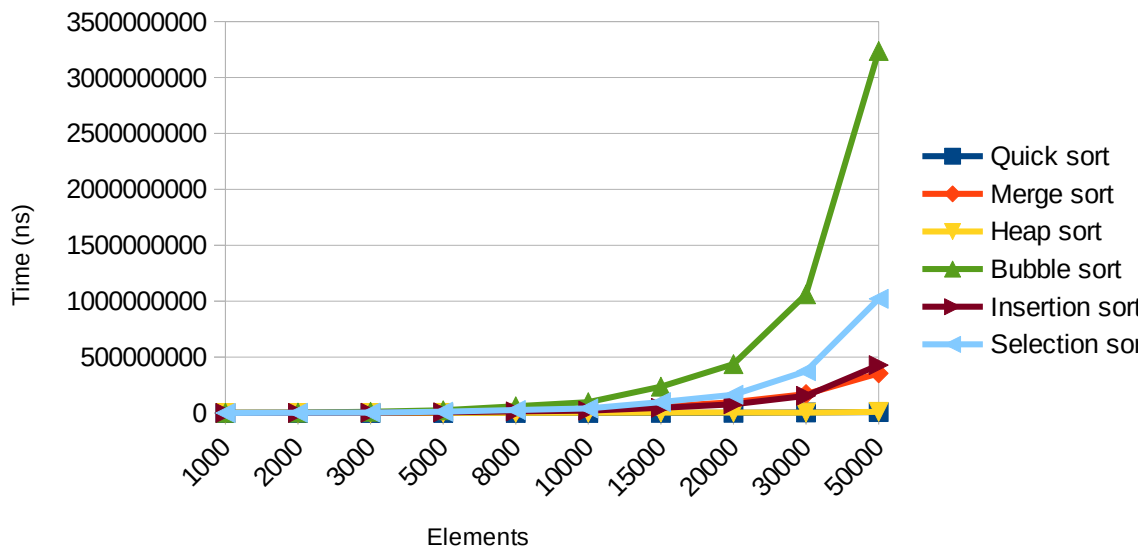


Random (time)

Size	Quick sort	Merge sort	Heap sort	Bubble sort	Insertion sort	Selection sort
1000	125192	1263246	202933	2051822	290856	584850
2000	124195	1663797	263512	3911460	1218630	2098154
3000	152714	1708510	488290	11057783	2367856	3837519
5000	267668	9747432	1160435	24845810	6639912	12088346
8000	524735	15418889	1764227	60579174	14699287	26372869
10000	569837	25571013	2278027	97209923	21028297	41027818
15000	997841	56641417	3835463	235567641	46026125	97410570
20000	1481443	96795242	4646873	437017311	78041518	162932063
30000	5140992	168957990	3048229	1061280897	153803756	373091387
50000	8309651	354571706	10418140	3236537002	428297672	1020439470

Size	Quick sort	Merge sort	Heap sort	Bubble sort	Insertion sort	Selection sort
1000	18245	10704	37823	751455	504909	500500
2000	42042	23414	83635	2999303	2002606	2001000
3000	65915	36915	132782	6737227	4480454	4501500
5000	117869	65225	235919	18759518	12529035	12502500
8000	196940	109621	398509	48036962	32089923	32004000
10000	253595	140452	511594	75024587	50069174	50005000
15000	397550	219291	802422	168662143	112354285	112507500
20000	536174	300872	1103458	299875593	199791186	200010000
30000	856157	468573	1724332	674782313	449624625	450015000
50000	1515873	818166	3024749	1875720944	1251541887	1250025000

Random



Random (time)

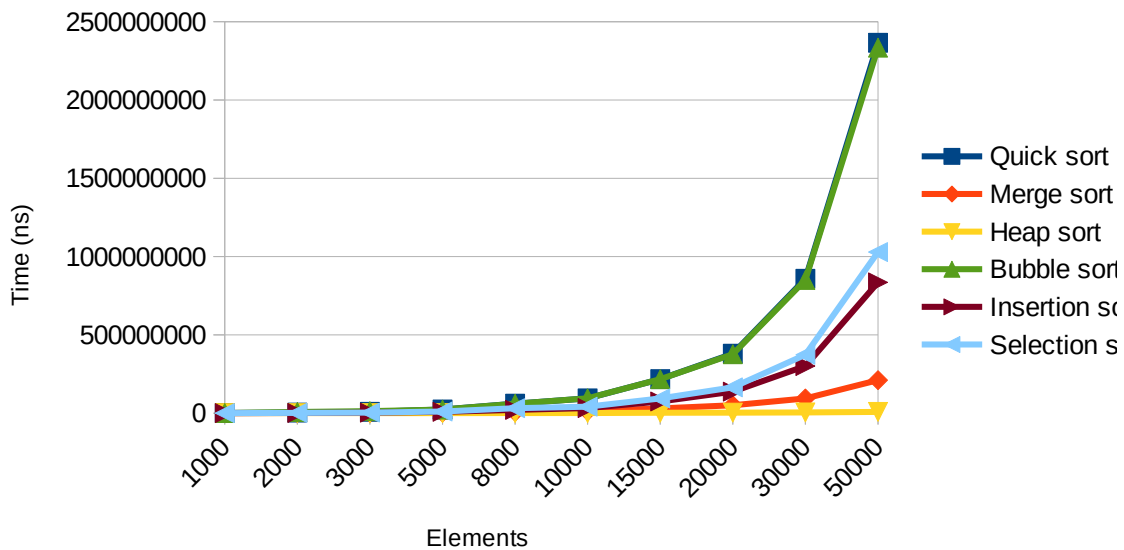
t
rt

Increasing (time)

Size	Quick sort	Merge sort	Heap sort	Bubble sort	Insertion sort	Selection sort
1000	966859	210211	47100	921851	369059	444155
2000	3798891	1024128	266570	7651574	1425114	1648835
3000	8506112	1633213	464675	12819850	2983022	3687961
5000	23604205	3895917	313973	23161632	8286772	10300892
8000	60503205	8284930	688561	59886063	20887012	31478922
10000	94434493	13251253	675110	94943232	32788507	41351905
15000	217273779	30290382	2507020	216960612	74406542	93647686
20000	379811846	50465456	3272318	376214706	137403889	164748546
30000	857961346	93858680	4733636	850443217	301054326	372729351
50000	2365035101	210555315	8021801	2334335595	835296700	1028649180

Size	Quick sort	Merge sort	Heap sort	Bubble sort	Insertion sort	Selection sort
1000	751998	7043	34767	999000	999999	500500
2000	3003998	15087	77835	3998000	3999999	2001000
3000	6755998	24075	123503	8997000	8999999	4501500
5000	18759998	42003	221247	24995000	24999999	12502500
8000	48015998	68351	375107	63992000	63999999	32004000
10000	75019998	89007	481787	99990000	99999999	50005000
15000	168779998	136363	759231	224985000	224999999	112507500
20000	300039998	188015	1047339	399980000	399999999	200010000
30000	675059998	287727	1641851	899970000	899999999	450015000
50000	1875099998	501951	2870571	2499950000	2499999999	1250025000

Increasing



Increasing (time)

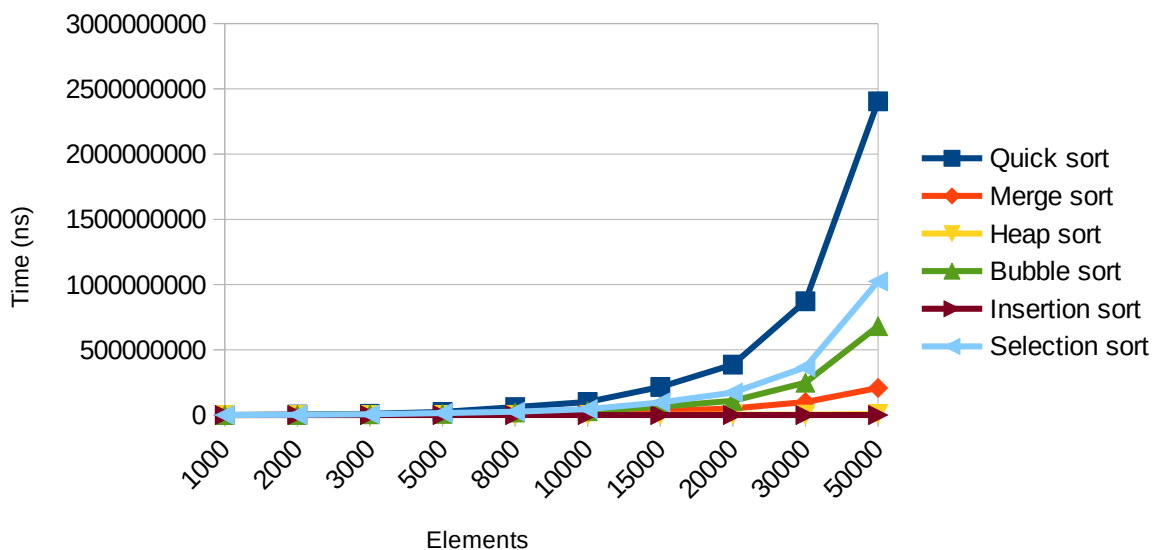
t
ort
ort

Decreasing (time)

Size	Quick sort	Merge sort	Heap sort	Bubble sort	Insertion sort	Selection sort
1000	979866	254380	48883	332319	1795	404175
2000	3830147	682745	167686	1640797	3238	2269167
3000	9545060	1917686	526290	6315885	19217	5844189
5000	24034671	5088333	890100	9628326	5327	15123438
8000	61221258	9804297	1277960	20146867	8476	25808641
10000	100625676	15151880	1631705	29403933	10591	45308445
15000	215338930	32006149	1558227	64569782	48643	96611647
20000	386439361	50678111	3656930	109281740	76613	172237342
30000	872013256	100117878	3092295	248021418	41359	366435374
50000	2404324696	207817161	8145845	681508857	106508	1024340005

Size	Quick sort	Merge sort	Heap sort	Bubble sort	Insertion sort	Selection sort
1000	1001998	6931	40335	499500	999	500500
2000	4003998	14863	88203	1999000	1999	2001000
3000	9005998	22827	141511	4498500	2999	4501500
5000	25009998	39803	251231	12497500	4999	12502500
8000	64015998	67455	422555	31996000	7999	32004000
10000	100019998	84607	542827	49995000	9999	50005000
15000	225029998	132251	845079	112492500	14999	112507500
20000	400039998	179215	1161515	199990000	19999	200010000
30000	900059998	279503	1805403	449985000	29999	450015000
50000	2500099998	482511	3168219	1249975000	49999	1250025000

Decreasing

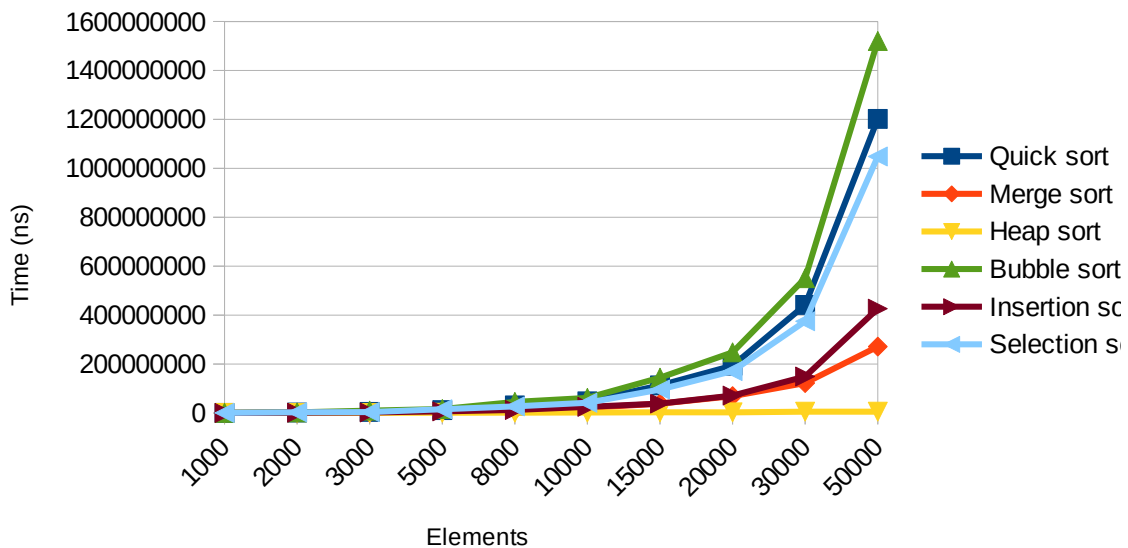


A-Shape (time)

Size	Quick sort	Merge sort	Heap sort	Bubble sort	Insertion sort	Selection sort
1000	519614	293027	49065	632798	264753	444854
2000	1908003	1019869	120490	2563677	1100328	2993106
3000	4327932	1546282	445729	9677845	2244599	3897073
5000	11942732	7812622	1080677	16109232	6524979	15439359
8000	30929712	13147250	1337093	45234645	12612216	27034252
10000	47845313	21185538	2023388	61639821	25101686	41846402
15000	112840415	38191864	2947701	144438669	38320014	95800421
20000	193488733	68968914	2607441	247944188	71292218	171156494
30000	441653506	122377695	5436482	550848087	149144909	374863898
50000	1201879210	271233950	5291555	1520423702	426269150	1048370314

Size	Quick sort	Merge sort	Heap sort	Bubble sort	Insertion sort	Selection sort
1000	503001	7485	34879	748501	499001	500500
2000	2006001	15973	77479	2997001	1998001	2001000
3000	4509001	24949	126563	6745501	4497001	4501500
5000	12515001	43401	223371	18742501	12495001	12502500
8000	32024001	71901	372539	47988001	31992001	32004000
10000	50030001	91805	486315	74985001	49990001	50005000
15000	112545001	141805	751831	168727501	112485001	112507500
20000	200060001	193613	1051395	299970001	199980001	200010000
30000	450090001	298613	1623267	674955001	449970001	450015000
50000	1250150001	517229	2908595	1874925001	1249950001	1250025000

A-Shape



A-Shape (time)

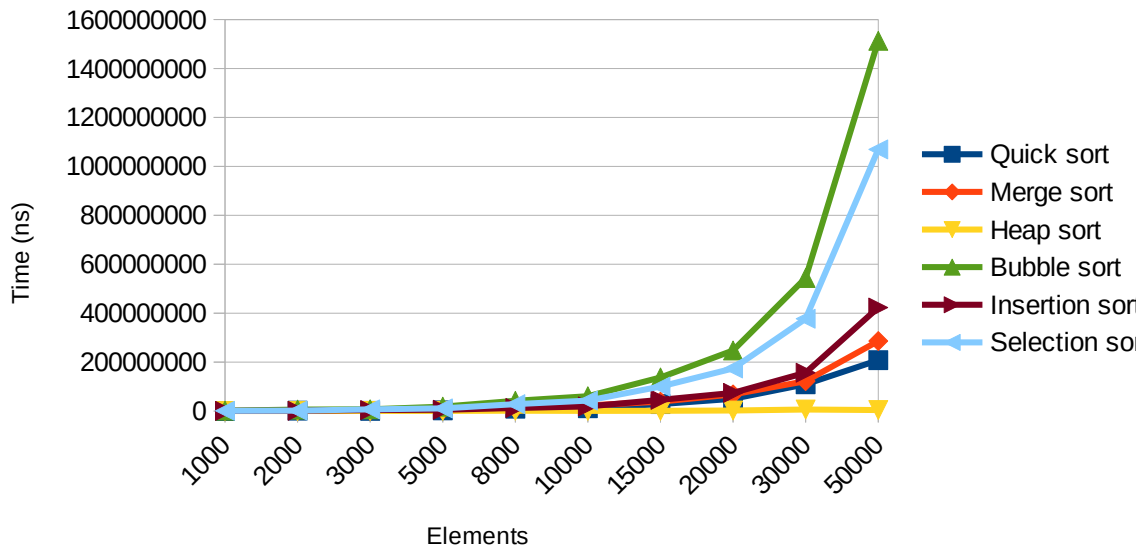
ort
ort

V-Shape (time)

Size	Quick sort	Merge sort	Heap sort	Bubble sort	Insertion sort	Selection sort
1000	171142	375753	164966	1728873	752272	1213441
2000	1619138	1829090	273533	6046143	1056492	1761156
3000	914289	1704474	342777	7343453	4026268	6805663
5000	2892989	4343990	857616	18068553	5422150	10928950
8000	9848512	10385584	1374594	41863093	12512764	28364266
10000	11480438	22908897	833162	60747725	19148562	42888199
15000	28549482	38428454	1179232	137396930	46008160	100298275
20000	50151286	68129158	2460443	247465865	74213465	174162170
30000	109525289	122015672	6244203	543788601	156882314	377276829
50000	208099939	286065082	4063636	1513435149	422995112	1069557233

Size	Quick sort	Merge sort	Heap sort	Bubble sort	Insertion sort	Selection sort
1000	164229	7486	38511	749500	500999	500500
2000	633291	15974	85007	2999000	2001999	2001000
3000	906089	24950	134279	6748500	4502999	4501500
5000	2998501	43402	237883	18747500	12504999	12502500
8000	9816455	71902	404051	47996000	32007999	32004000
10000	11892945	91806	515927	74995000	50009999	50005000
15000	26369887	141806	811987	168742500	112514999	112507500
20000	47347511	193614	1111255	299990000	200019999	200010000
30000	105007009	298614	1743847	674985000	450029999	450015000
50000	213740655	517230	3045939	1874975000	1250049999	1250025000

V-Shape



V-Shape (time)

t
rt

Quick sort

	Random	Increasing	Decreasing	A-Shape	V-Shape
1000	125192	966859	979866	519614	171142
2000	124195	3798891	3830147	1908003	1619138
3000	152714	8506112	9545060	4327932	914289
5000	267668	23604205	24034671	11942732	2892989
8000	524735	60503205	61221258	30929712	9848512
10000	569837	94434493	100625676	47845313	11480438
15000	997841	217273779	215338930	112840415	28549482
20000	1481443	379811846	386439361	193488733	50151286
30000	5140992	857961346	872013256	441653506	109525289
50000	8309651	2365035101	2404324696	1201879210	208099939

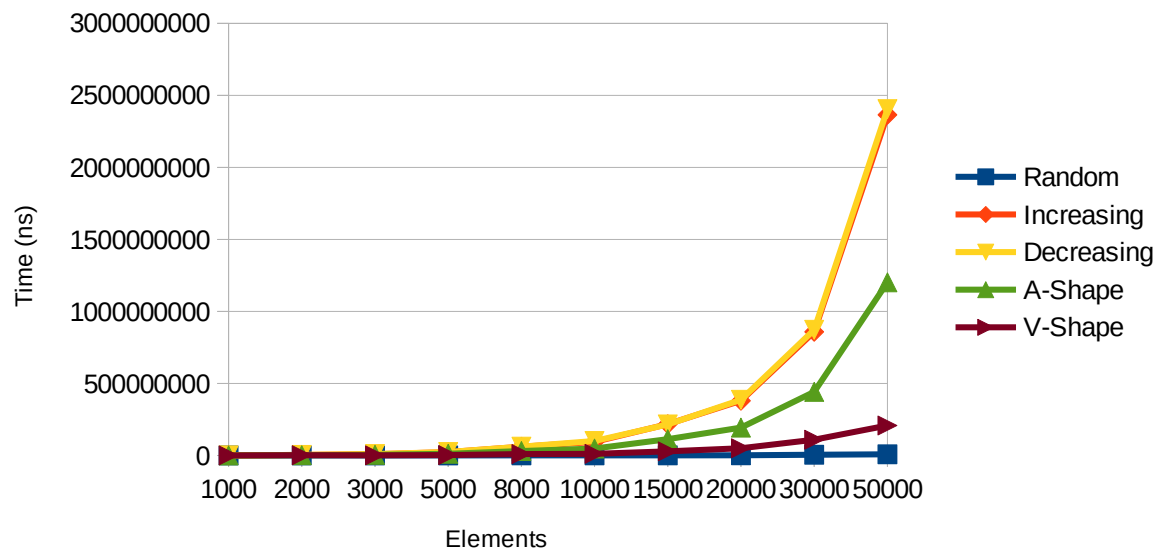
	Random	Increasing	Decreasing	A-Shape	V-Shape
1000	18245	751998	1001998	503001	164229
2000	42042	3003998	4003998	2006001	633291
3000	65915	6755998	9005998	4509001	906089
5000	117869	18759998	25009998	12515001	2998501
8000	196940	48015998	64015998	32024001	9816455
10000	253595	75019998	100019998	50030001	11892945
15000	397550	168779998	225029998	112545001	26369887
20000	536174	300039998	400039998	200060001	47347511
30000	856157	675059998	900059998	450090001	105007009
50000	1515873	1875099998	2500099998	1250150001	213740655

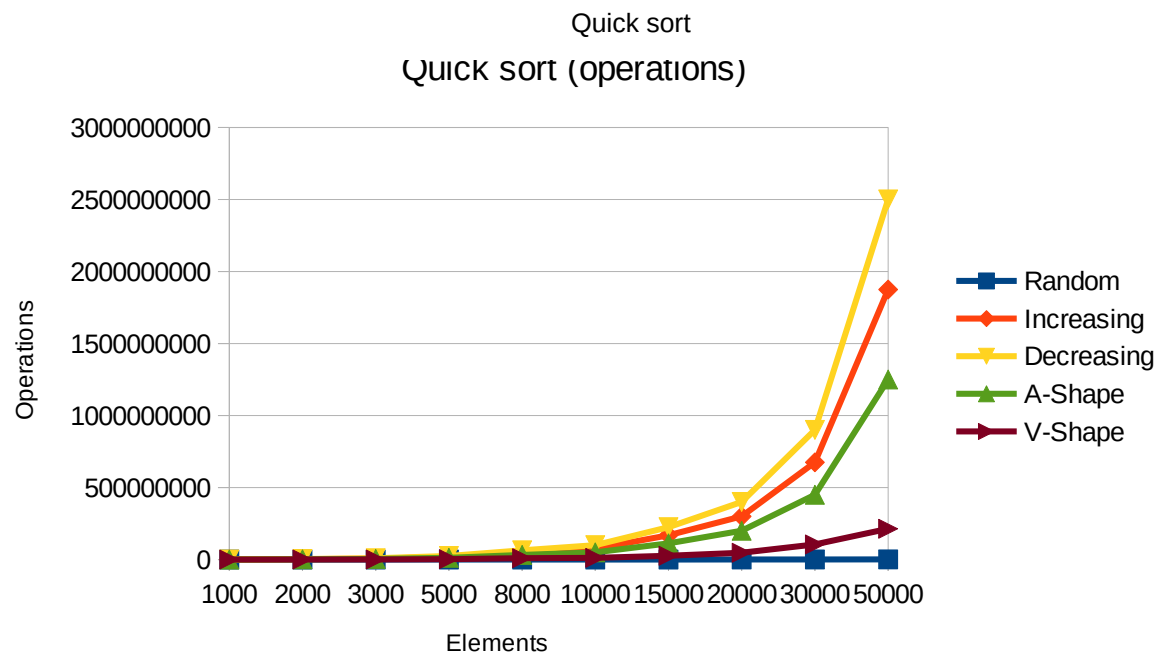
Best
n log(n)

Average
n log(n)

Worst
n²

Quick sort





Merge sort

	Random	Increasing	Decreasing	A-Shape	V-Shape
1000	1263246	210211	254380	293027	375753
2000	1663797	1024128	682745	1019869	1829090
3000	1708510	1633213	1917686	1546282	1704474
5000	9747432	3895917	5088333	7812622	4343990
8000	15418889	8284930	9804297	13147250	10385584
10000	25571013	13251253	15151880	21185538	22908897
15000	56641417	30290382	32006149	38191864	38428454
20000	96795242	50465456	50678111	68968914	68129158
30000	168957990	93858680	100117878	122377695	122015672
50000	354571706	210555315	207817161	271233950	286065082

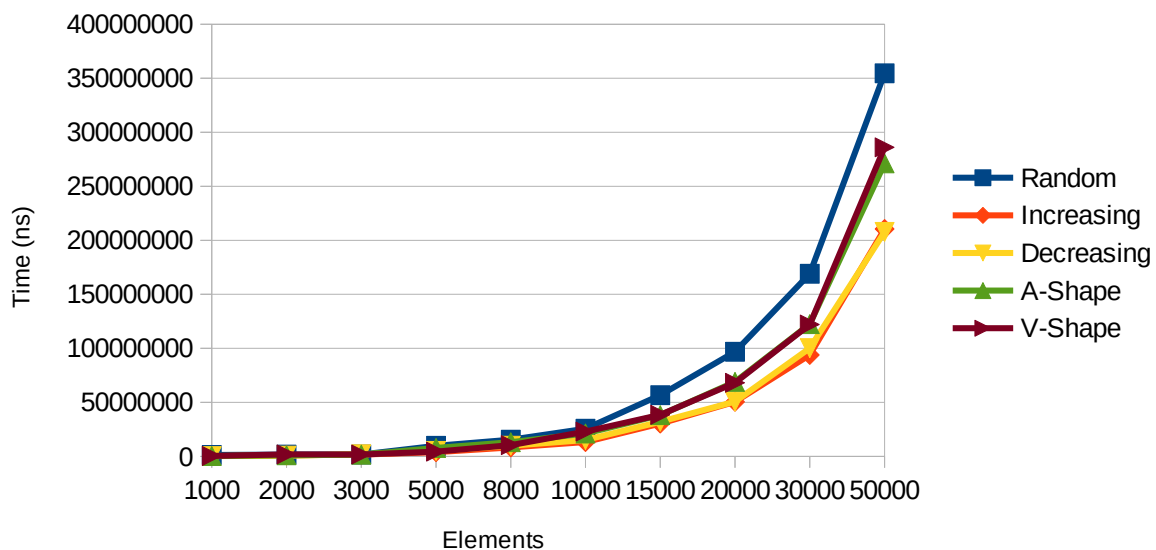
	Random	Increasing	Decreasing	A-Shape	V-Shape
1000	10704	7043	6931	7485	7486
2000	23414	15087	14863	15973	15974
3000	36915	24075	22827	24949	24950
5000	65225	42003	39803	43401	43402
8000	109621	68351	67455	71901	71902
10000	140452	89007	84607	91805	91806
15000	219291	136363	132251	141805	141806
20000	300872	188015	179215	193613	193614
30000	468573	287727	279503	298613	298614
50000	818166	501951	482511	517229	517230

Best
n log(n)

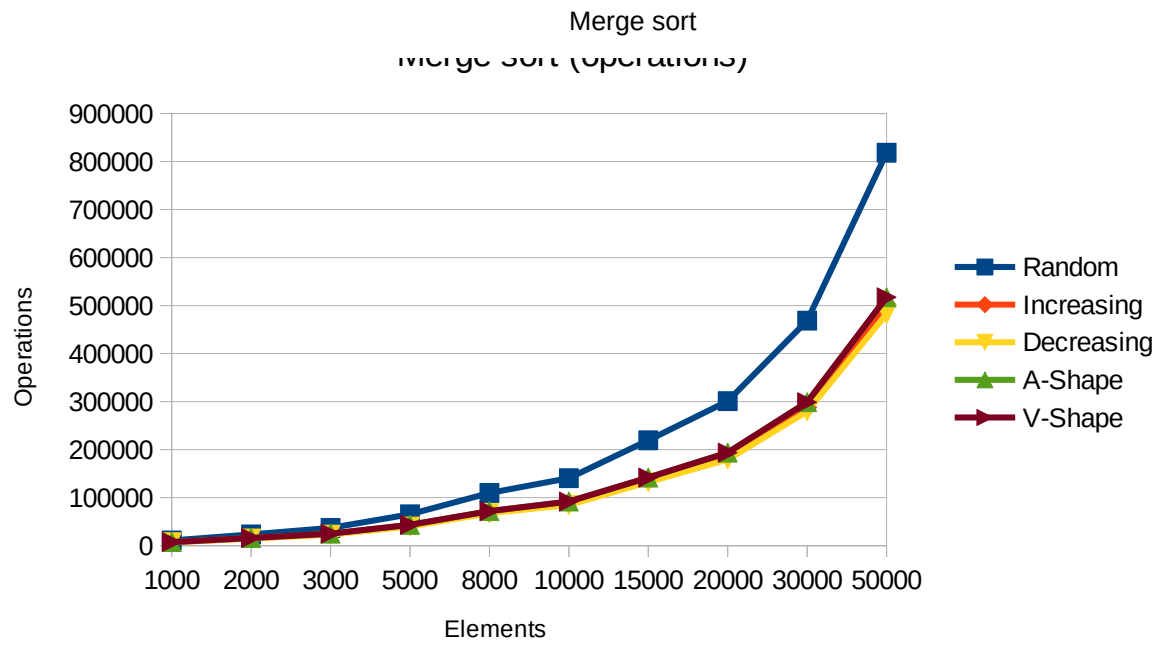
Average
n log(n)

Worst
n log(n)

Merge sort



Merge sort (operations)



Merge sort

Heap sort

	Random	Increasing	Decreasing	A-Shape	V-Shape
1000	202933	47100	48883	49065	164966
2000	263512	266570	167686	120490	273533
3000	488290	464675	526290	445729	342777
5000	1160435	313973	890100	1080677	857616
8000	1764227	688561	1277960	1337093	1374594
10000	2278027	675110	1631705	2023388	833162
15000	3835463	2507020	1558227	2947701	1179232
20000	4646873	3272318	3656930	2607441	2460443
30000	3048229	4733636	3092295	5436482	6244203
50000	10418140	8021801	8145845	5291555	4063636

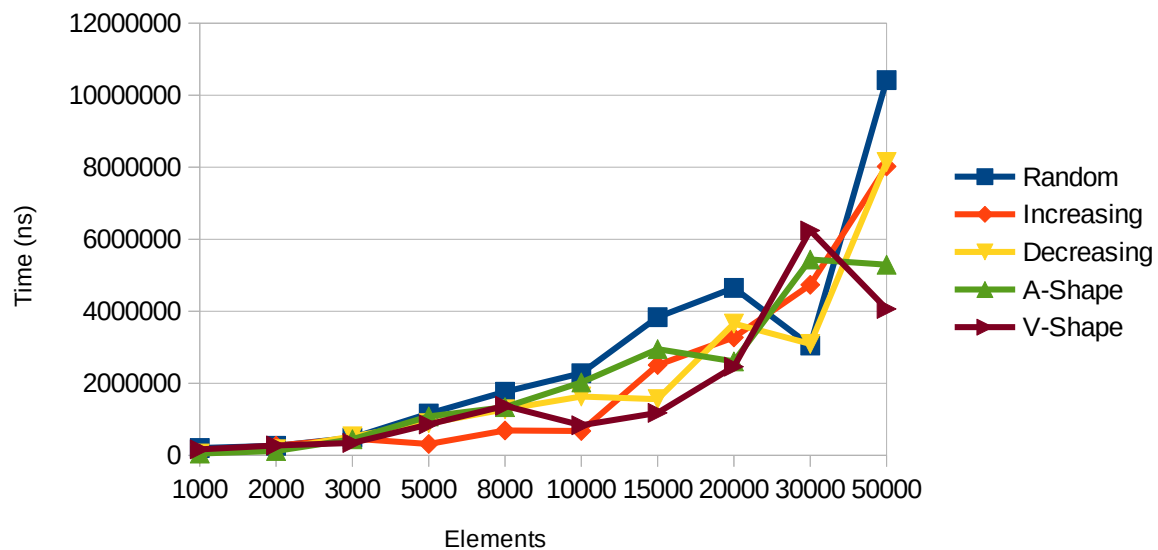
	Random	Increasing	Decreasing	A-Shape	V-Shape
1000	37823	34767	40335	34879	38511
2000	83635	77835	88203	77479	85007
3000	132782	123503	141511	126563	134279
5000	235919	221247	251231	223371	237883
8000	398509	375107	422555	372539	404051
10000	511594	481787	542827	486315	515927
15000	802422	759231	845079	751831	811987
20000	1103458	1047339	1161515	1051395	1111255
30000	1724332	1641851	1805403	1623267	1743847
50000	3024749	2870571	3168219	2908595	3045939

Best
n log(n)

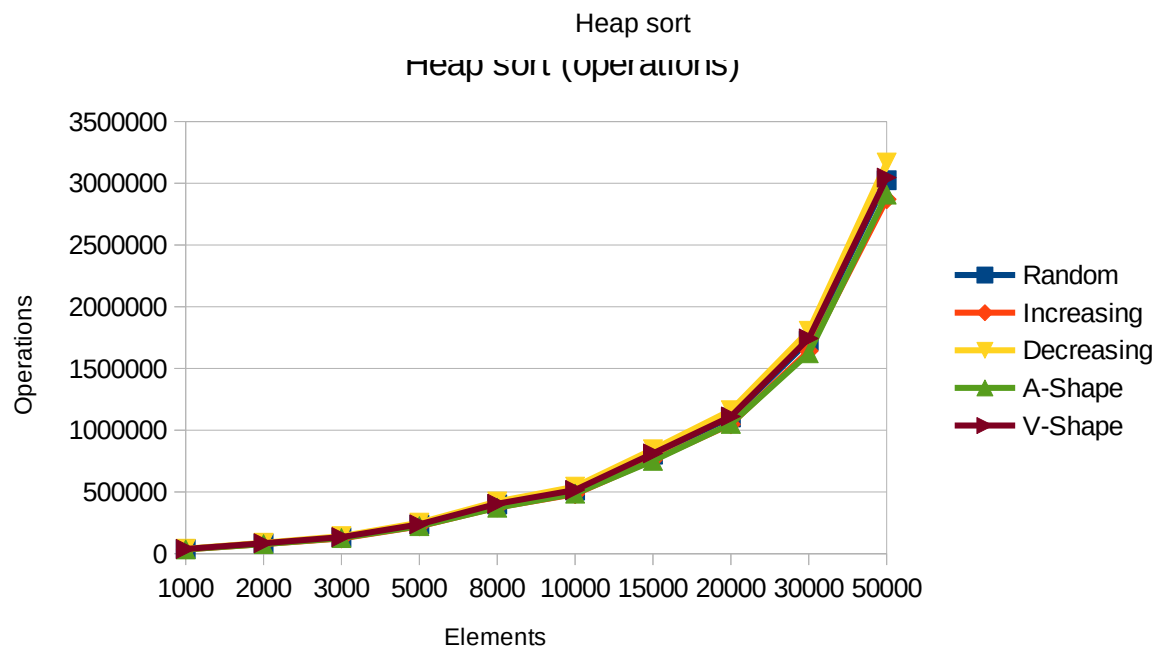
Average
n log(n)

Worst
n log(n)

Heap sort



Heap sort (operations)



Heap sort

Bubble sort

	Random	Increasing	Decreasing	A-Shape	V-Shape
1000	2051822	921851	332319	632798	1728873
2000	3911460	7651574	1640797	2563677	6046143
3000	11057783	12819850	6315885	9677845	7343453
5000	24845810	23161632	9628326	16109232	18068553
8000	60579174	59886063	20146867	45234645	41863093
10000	97209923	94943232	29403933	61639821	60747725
15000	235567641	216960612	64569782	144438669	137396930
20000	437017311	376214706	109281740	247944188	247465865
30000	1061280897	850443217	248021418	550848087	543788601
50000	3236537002	2334335595	681508857	1520423702	1513435149

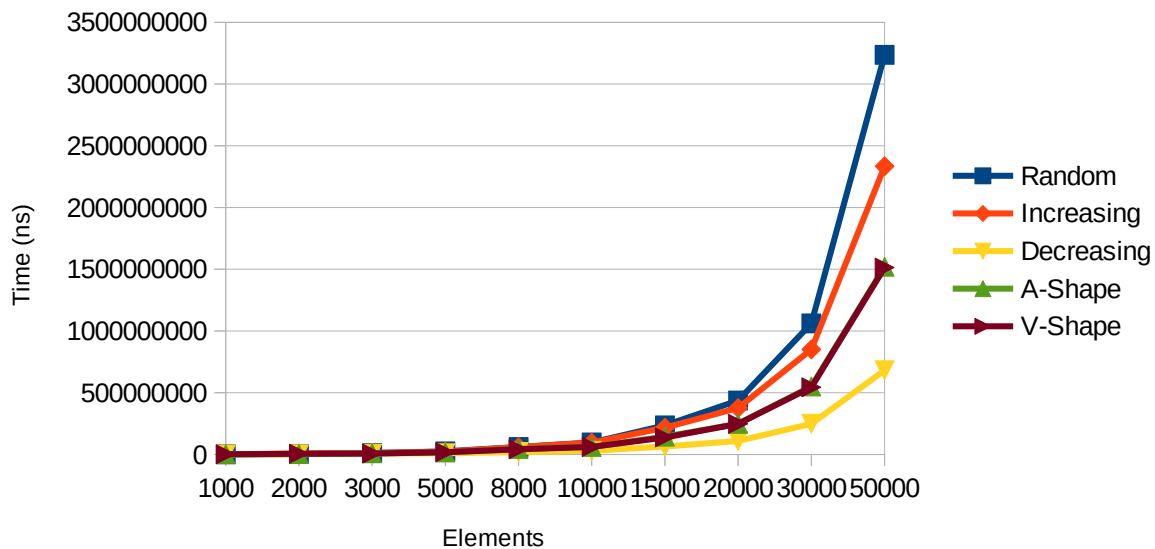
	Random	Increasing	Decreasing	A-Shape	V-Shape
1000	751455	999000	499500	748501	749500
2000	2999303	3998000	1999000	2997001	2999000
3000	6737227	8997000	4498500	6745501	6748500
5000	18759518	24995000	12497500	18742501	18747500
8000	48036962	63992000	31996000	47988001	47996000
10000	75024587	99990000	49995000	74985001	74995000
15000	168662143	224985000	112492500	168727501	168742500
20000	299875593	399980000	199990000	299970001	299990000
30000	674782313	899970000	449985000	674955001	674985000
50000	1875720944	2499950000	1249975000	1874925001	1874975000

Best
n

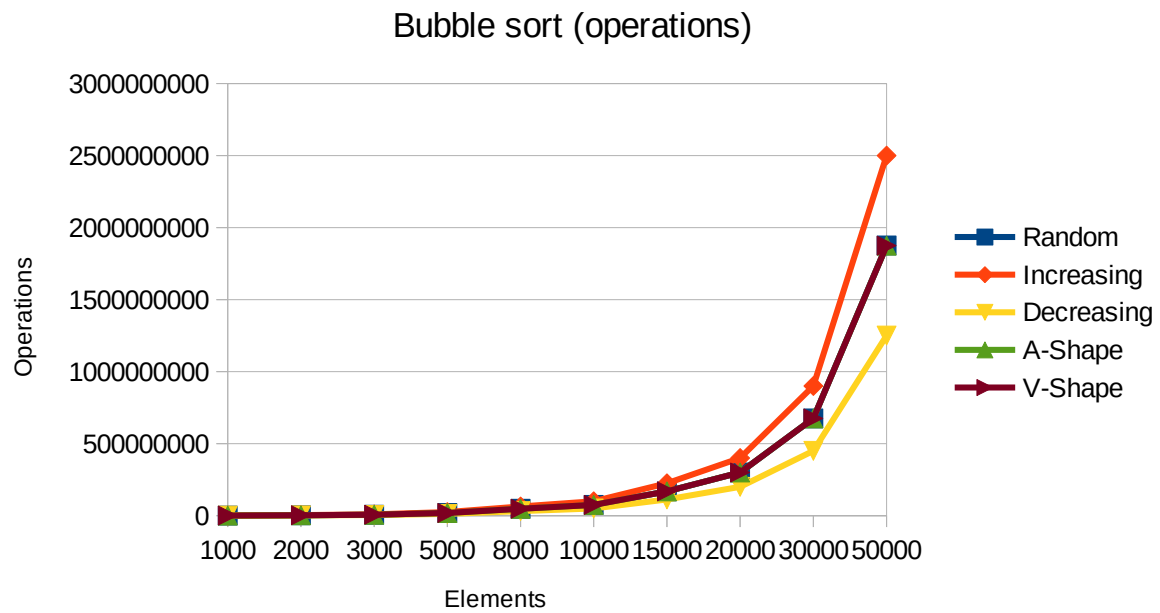
Average
n²

Worst
n²

Bubble sort



Bubble sort



Bubble sort

Insertion sort

	Random	Increasing	Decreasing	A-Shape	V-Shape
1000	290856	369059	1795	264753	752272
2000	1218630	1425114	3238	1100328	1056492
3000	2367856	2983022	19217	2244599	4026268
5000	6639912	8286772	5327	6524979	5422150
8000	14699287	20887012	8476	12612216	12512764
10000	21028297	32788507	10591	25101686	19148562
15000	46026125	74406542	48643	38320014	46008160
20000	78041518	137403889	76613	71292218	74213465
30000	153803756	301054326	41359	149144909	156882314
50000	428297672	835296700	106508	426269150	422995112

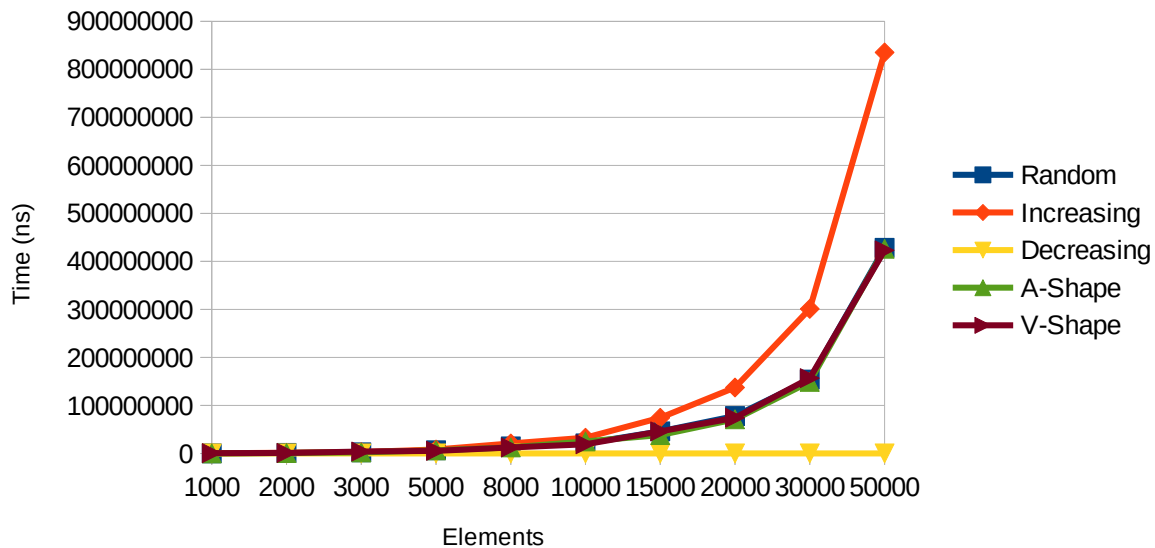
	Random	Increasing	Decreasing	A-Shape	V-Shape
1000	504909	999999	999	499001	500999
2000	2002606	3999999	1999	1998001	2001999
3000	4480454	8999999	2999	4497001	4502999
5000	12529035	24999999	4999	12495001	12504999
8000	32089923	63999999	7999	31992001	32007999
10000	50069174	99999999	9999	49990001	50009999
15000	112354285	224999999	14999	112485001	112514999
20000	199791186	399999999	19999	199980001	200019999
30000	449624625	899999999	29999	449970001	450029999
50000	1251541887	2499999999	49999	1249950001	1250049999

Best
n

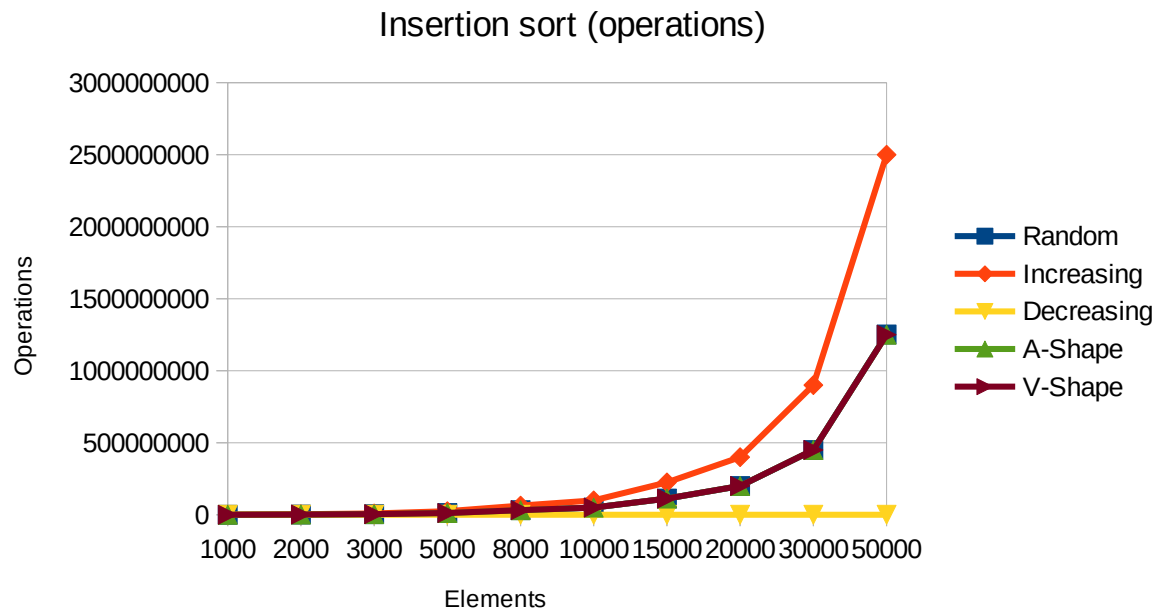
Average
n^2

Worst
n^2

Insertion sort



Insertion sort



Insertion sort

Selection sort

	Random	Increasing	Decreasing	A-Shape	V-Shape
1000	584850	444155	404175	444854	1213441
2000	2098154	1648835	2269167	2993106	1761156
3000	3837519	3687961	5844189	3897073	6805663
5000	12088346	10300892	15123438	15439359	10928950
8000	26372869	31478922	25808641	27034252	28364266
10000	41027818	41351905	45308445	41846402	42888199
15000	97410570	93647686	96611647	95800421	100298275
20000	162932063	164748546	172237342	171156494	174162170
30000	373091387	372729351	366435374	374863898	377276829
50000	1020439470	1028649180	1024340005	1048370314	1069557233

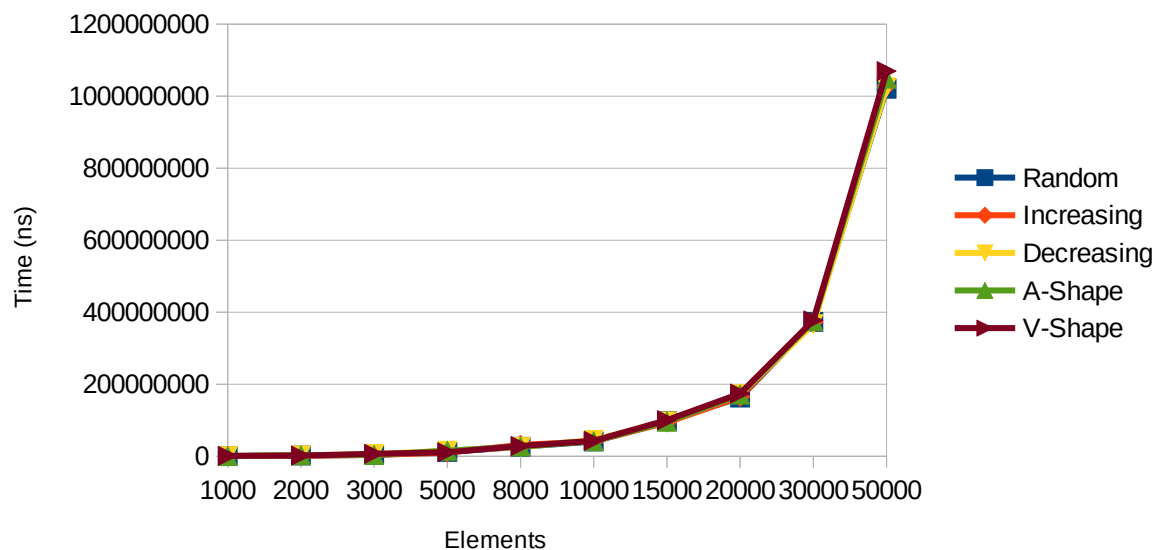
	Random	Increasing	Decreasing	A-Shape	V-Shape
1000	500500	500500	500500	500500	500500
2000	2001000	2001000	2001000	2001000	2001000
3000	4501500	4501500	4501500	4501500	4501500
5000	12502500	12502500	12502500	12502500	12502500
8000	32004000	32004000	32004000	32004000	32004000
10000	50005000	50005000	50005000	50005000	50005000
15000	112507500	112507500	112507500	112507500	112507500
20000	200010000	200010000	200010000	200010000	200010000
30000	450015000	450015000	450015000	450015000	450015000
50000	1250025000	1250025000	1250025000	1250025000	1250025000

Best
n²

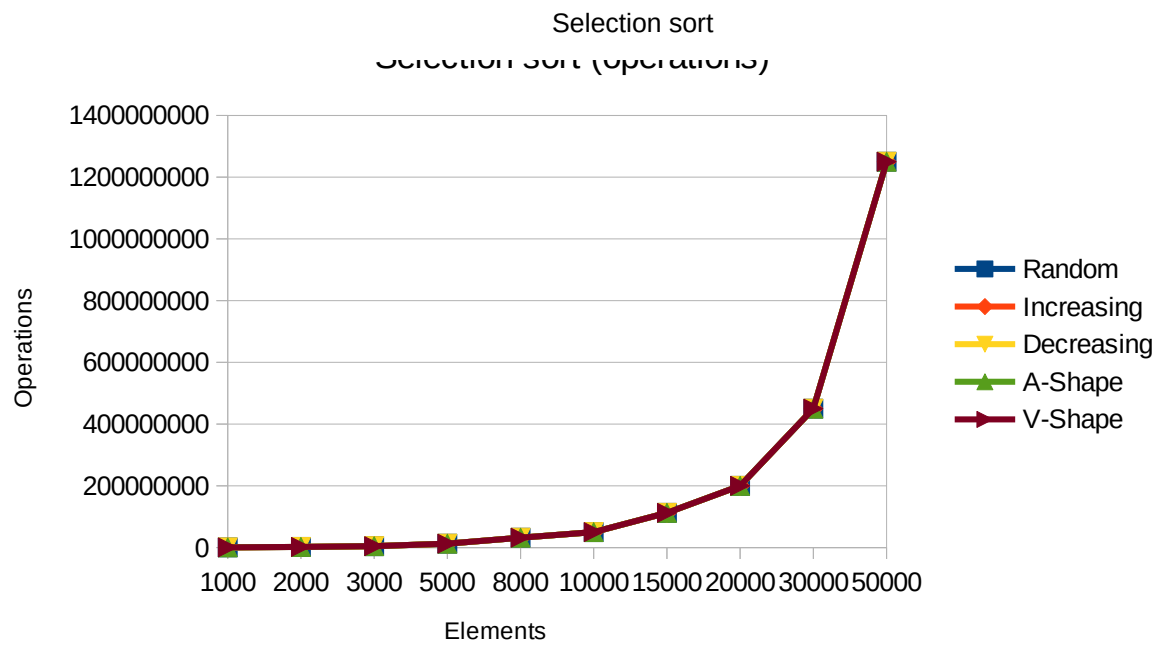
Average
n²

Worst
n²

Selection sort



Selection sort (operations)



Selection sort