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CSC 320: Algoritms

Test Results: Note all times are in nano seconds:
I first did all arrays from 100 elements to 100,000 elements.
Note Quick sort fails/runs out of memory at 100,000 elements for arrays going
from LowtoHigh or HightoLow but random works for it.

Test#1

bubble100LH time: 2619684
bubble100HL time: 1234180
bubble100R time: 865363

insertion100LH time: 27700
insertion100HL time: 565282
insertion100R time: 326242

selection100LH time: 291874
selection100HL time: 392927
selection100R time: 302133

heap100LH time: 1005401
heap100HL time: 274946
heap100R time: 55399

quick100LH time: 928456
quick100HL time: 506804
quick100R time: 37959

merge100LH time: 450378
merge100HL time: 3895927
merge100R time: 502187

1000 elements

bubble1000LH time: 11213292
bubble1000HL time: 14361838
bubble1000R time: 2255995

insertion1000LH time: 160556
insertion1000HL time: 12046852
insertion1000R time: 2704322

selection1000LH time: 14077145
selection1000HL time: 4698708
selection1000R time: 5126003

heap1000LH time: 623758
heap1000HL time: 411906
heap1000R time: 438580

quick1000LH time: 7328651
quick1000HL time: 7063451
quick1000R time: 126188

merge1000LH time: 6978299

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merge1000HL time: 408315
merge1000R time: 479618

10,000 elements

bubble10000LH time: 87036387
bubble10000HL time: 112521750
bubble10000R time: 187675433

insertion100000LH time: 164660
insertion10000HL time: 156747058
insertion10000R time: 78152956

selection10000LH time: 268111571
selection10000HL time: 232774310
selection100R time: 255063935

heap10000LH time: 6796199
heap10000HL time: 6546901
heap10000R time: 7594364

quick10000LH time: 396197534
quick10000HL time: 248683746
quick10000R time: 2172896

merge10000LH time: 4279620
merge10000HL time: 4306294
merge10000R time: 5630756

100,000 elements

bubble100000LH time: 8789283970
bubble100000HL time: 11732640941
bubble100000R time: 20641016645

insertion100000LH time: 693521
insertion100000HL time: 6490857524
insertion100000R time: 3246605748

selection100000LH time: 11790043663
selection100000HL time: 14009339965
selection100000R time: 11134862670

heap100000LH time: 26210687
heap100000HL time: 24513817
heap100000R time: 23928017

merge100000LH time: 25798781
merge100000HL time: 26305072
merge100000R time: 35234668

quick100000R time: 13373364

Exception in thread "main" java.lang.StackOverflowError
        at Sorts.QuickSort(Sorts.java:198)
```

Test 2

```
bubble100LH time: 2289338
bubble100HL time: 915120
bubble100R time: 645815

insertion100LH time: 22570
insertion100HL time: 568872
insertion100R time: 232884

selection100LH time: 249812
selection100HL time: 322138
selection100R time: 250324

heap100LH time: 851512
heap100HL time: 259045
heap100R time: 61042

quick100LH time: 795087
quick100HL time: 533991
quick100R time: 116441

merge100LH time: 404212
merge100HL time: 3022870
merge100R time: 381642

1,000 elements

bubble1000LH time: 7892394
bubble1000HL time: 11926819
bubble1000R time: 2054916

insertion1000LH time: 120546
insertion1000HL time: 9885241
insertion1000R time: 2099030

selection1000LH time: 6263748
selection1000HL time: 4333994
selection1000R time: 4176003

heap1000LH time: 496032
heap1000HL time: 449353
heap1000R time: 559126

quick1000LH time: 5598439
quick1000HL time: 6804919
quick1000R time: 249299

merge1000LH time: 1152107
merge1000HL time: 379077
merge1000R time: 447301
```

```
10,000 elements

bubble10000LH time: 99550032
bubble10000HL time: 105212078
bubble10000R time: 173466457

insertion100000LH time: 706345
insertion10000HL time: 220874165
insertion10000R time: 36664799

selection10000LH time: 79024987
selection10000HL time: 204293778
selection100R time: 98382024

heap10000LH time: 7146037
heap10000HL time: 5897494
heap10000R time: 6690016

quick10000LH time: 329857008
quick10000HL time: 253017740
quick10000R time: 2375515

merge10000LH time: 4392984
merge10000HL time: 3795900
merge10000R time: 4839259

100,000 elements

bubble100000LH time: 10727512372
bubble100000HL time: 13527300725
bubble100000R time: 20830954741

insertion100000LH time: 676081
insertion100000HL time: 6487499179
insertion100000R time: 3236274232

selection100000LH time: 4613236815
selection100000HL time: 12013763214
selection100000R time: 8050041755

heap100000LH time: 24268109
heap100000HL time: 25324293
heap100000R time: 24395836

merge100000LH time: 25525373
merge100000HL time: 25917787
merge100000R time: 34076407

quick100000R time: 12597258

Exception in thread "main" java.lang.StackOverflowError
        at Sorts.QuickSort(Sorts.java:198)
```

Test #3

```
bubble100LH time: 2428863
bubble100HL time: 1118252
bubble100R time: 755076

insertion100LH time: 25135
insertion100HL time: 508343
insertion100R time: 238014

selection100LH time: 265713
selection100HL time: 358046
selection100R time: 271355

heap100LH time: 1300865
heap100HL time: 48732
heap100R time: 49244

quick100LH time: 856642
quick100HL time: 583748
quick100R time: 31291

merge100LH time: 407803
merge100HL time: 3440419
merge100R time: 455508


1,000 elements

bubble1000LH time: 8618744
bubble1000HL time: 13684731
bubble1000R time: 2032345

insertion1000LH time: 127214
insertion1000HL time: 11382569
insertion1000R time: 2354997

selection1000LH time: 7114234
selection1000HL time: 4931592
selection1000R time: 5085993

heap1000LH time: 559639
heap1000HL time: 498083
heap1000R time: 545276

quick1000LH time: 6180647
quick1000HL time: 5605620
quick1000R time: 250324

merge1000LH time: 1008478
merge1000HL time: 424730
merge1000R time: 502187
```

```
10,000 elements

bubble10000LH time: 107830223
bubble10000HL time: 127688933
bubble10000R time: 269424747

insertion100000LH time: 1517847
insertion10000HL time: 425749639
insertion10000R time: 67527515

selection10000LH time: 117726236
selection10000HL time: 272969296
selection100R time: 130892878

heap10000LH time: 6407888
heap10000HL time: 7102436
heap10000R time: 7925736

quick10000LH time: 329428686
quick10000HL time: 236078282
quick10000R time: 2203674

merge10000LH time: 4257563
merge10000HL time: 4385803
merge10000R time: 5647683

100,000 elements

bubble100000LH time: 12667252467
bubble100000HL time: 12621113819
bubble100000R time: 24399633849

insertion100000LH time: 808937
insertion100000HL time: 7655983774
insertion100000R time: 3820700682

selection100000LH time: 5748497029
selection100000HL time: 15445295957
selection100000R time: 6703856224

heap100000LH time: 28509258
heap100000HL time: 28681613
heap100000R time: 28547217

merge100000LH time: 31361825
merge100000HL time: 30718574
merge100000R time: 40986483

quick100000R time: 15867373

Exception in thread "main" java.lang.StackOverflowError
        at Sorts.QuickSort(Sorts.java:198)
```

Test#1 1,000,000 elements

```
bubble1000000LH time: 899121994058
bubble1000000HL time: 3224671112999
bubble1000000R time: 3488724787019

insertion10000000LH time: 14426984
insertion1000000HL time: 2342412652759
insertion1000000R time: 418931454261

selection1000000LH time: 493956716486
selection1000000HL time: 1071362117538
selection1000000R time: 580973753406

heap1000000LH time: 243438224
heap1000000HL time: 224072467
heap1000000R time: 578754145

merge1000000LH time: 682265249
merge1000000HL time: 530391819
merge1000000R time: 672312298

quick1000000R time: 315465931
```

Exception in thread "main" java.lang.StackOverflowError
        at Sorts.QuickSort(<u>Sorts.java:198</u>)

```
Test #2 1,000,000 elements

bubble1000000LH time: 841769912571
bubble1000000HL time: 1801519613516
bubble1000000R time: 3368501988231

insertion10000000LH time: 17214404
insertion1000000HL time: 3324303125154
insertion1000000R time: 535506754136

selection1000000LH time: 641194900465
selection1000000HL time: 1243235024150
selection1000000R time: 668274237845

heap1000000LH time: 264876336
heap1000000HL time: 242891409
heap1000000R time: 542904438

merge1000000LH time: 373107693
merge1000000HL time: 333761142
merge1000000R time: 388741670

quick1000000R time: 173650096
```

Exception in thread "main" java.lang.StackOverflowError
        at Sorts.QuickSort(<u>Sorts.java:198</u>)

```
Test #3 1,000,000 elements

bubble1000000LH time: 752640496504
bubble1000000HL time: 2415525667976
bubble1000000R time: 4790640286190

insertion10000000LH time: 26523079
insertion1000000HL time: 4603696789695
insertion1000000R time: 795919085783

selection1000000LH time: 881959160224
selection1000000HL time: 2096266172071
selection1000000R time: 1145232216723

heap1000000LH time: 591785879
heap1000000HL time: 517082574
heap1000000R time: 817642931

merge1000000LH time: 563844980
merge1000000HL time: 541813886
merge1000000R time: 702278361

quick1000000R time: 381149870

Exception in thread "main" java.lang.StackOverflowError
       at Sorts.QuickSort(Sorts.java:198)
```