Assignment #2: Sorting algorithms in Prolog

cohen2jl 2025-10-03

A) 50 lists

Generated list 1:
[317,811,644,199,616,887,645,627,55,776,841,654,372,872,729,973,955,291,593,641,803
,776,346,500,236,820,32,600,697,891,484,487,56,770,160,216,87,409] Generated list 2:
[950,416,673,83,966,755,46] Generated list 3:
[481,983,677,999,342,88,954,679,434,917,406,227,987,143,582,50,960,966,200,393,41,4
48,219,647,740,735,714,559,632,955,588,166,468,558,406,183,908,160,69,309,863,847,8
53,913,380] Generated list 4:
[453,969,692,106,111,643,922,472,23,191,769,57,798,100,394,867,103,472,504,709,181,
709,892,82,693,61,469,224,6,839,882,564,125,971,375,873,405,384,503,792] Generated
list 5:
[759,918,533,89,235,817,709,17,745,62,950,916,229,557,399,186,346,242,504,443,338,2
50,719,275,778,899,802,227,263,338,954,721,678,666,25,950,570,718,266,288,278,856,4
64,298,271,65,647] Generated list 6:
[140,557,220,122,605,415,507,644,165,647,342,478,825,901,726,989,6,708] Generated
list 7:
[856,779,262,777,677,101,874,298,860,251,168,227,912,285,763,415,77,807,774,249,332
,360,265,787,611,458,177,155,657,272,227,938,696,487,970,950,129,54,547,540,805,338
] Generated list 8: [895,821,208,287,681,272,575,786,982,378,805,56,869,287,60]
Generated list 9:
[745,91,191,234,793,923,337,558,958,290,391,972,217,947,104,66,77,503,423,682,471,5
07,907] Generated list 10: [700,237,950,594,362,273,311] Generated list 11:
[189,654,16,552,273,509,474,540,579,268,635,124,209,960,866,326,792,716,651,950,682
,627,60,222,776,507,397,559,994,176,612,475,131,833,843,75,717,405,348,161]
Generated list 12: [780,452,772,261,642,813,407,130,246,733,635,626,487,477,101]
Generated list 13: [431,255,221,125,649,957,538,805,470,253] Generated list 14:
[765,924,255,187,536,103,236,96,386,425,630,457,763,308,724,456,295,161,442,450,324
,745,924,86,305,840,677,714,153,172,748,741,508,155,259,724] Generated list 15:
[594,439,592,510,149,944,469,118,268,8,309,829,346,303,361,401,705,562,53,38,997,44
9,854,469] Generated list 16:
[515,185,366,452,326,791,886,475,49,969,787,191,901,534,561,839,180,698,449,595,883
] Generated list 17:
[449,86,747,541,852,224,702,14,388,481,141,766,146,505,174,672,744,590,791,536,338,
52,778] Generated list 18: [639,847,900,21,508,592,688,161,396,364] Generated list 19:
[819,945,518,877,739,403,167,759,385,327,194,613,520,905,234,474,454,400,829,319,52
9,565,865,378,482,95,567,483,877,74,316,979,67,758,55,846,96,335,85,682,314,792,215,
504,860] Generated list 20: [649,801,293,372,969,403,747,172,139] Generated list 21:
[180,22,265,327,87,344,325,164,801,821,817,573,790,980,952,354,512,118,796,726,728,
578,661,992,438,234,687,238,732,846,428,893,438,788,953,947,937,898,764,104,619,47
3,118,171,667,818] Generated list 22:
[307,267,982,246,162,868,86,572,397,177,404,263,214,955,607,976,80,594,252,960,876,

486,607] Generated list 23: [292,229,194,757,374,417,182,886,604,167,928,294,277,307,348,384,570,751,148,614,977,122,456,719,631,661,857,499] Generated list 24: [410,656,15,55,769,24] Generated list 25: [905,73,528,619,56,813,270] Generated list 26: [646,968,590,436,942,373,560,420,379,702,886,986,14,222,266,183,21,119,177,126,71,47,62,787,423,976,804,303,836,436,385,248,624,448,66,823,953,579,119,888,973,172,273,113,382,337,279] Generated list 27: [54,866,107,75,292,415,997,784,49,723,419,265,513,126,636,106,940,176,974,458,657,493,577,298,682,609,818,359,735,389] Generated list 28: [807,61,987,624,192,946,321,872,380,897,760,97,896,438,860,837,472,708,32,298,394,156,106,8,290,621,58,876,456,14,580,206] Generated list 29: [111,197,377,250,687,227,58,881,913,169,269,513,527,53,599,150,122,796,86,258,200,34,995,427,52,304,952,375,141,506,700,950,611,939,234,879,797,275,282,316,170,70,868,749,102] Generated list 30: [514,219,710,776,170,672,55,825,903,153,206,265,274,624,507,247,191,473,511,260,662,961,986,950,340,496,735,712,54,493,365,886,198,655,151,794,136,245,52,376,62,418,175,480,193,730,460,905,598,976] Generated list 31: [399,266,866,613,31,774,269,326,746,707,503,582,447,628,492,865,716,641,981,565,381,65,696,957,417,67,976,989,485,68,938,773,273] Generated list 32: [874,989,914,132,995,731,422,911,673,984,412,90,865,86,67,622,816,933,548,711,93,687,693,780,868,681,244,990,184,142,7,469,182,623,128,236] Generated list 33: [605,230,407,989,635,20,478,487,60,680,549,685,594,699,99,621,41,875,534,847,103,916,651,894,134,438,249,292,877,199,411,654,591,575,77,342,275,797,115,716,458,553,582,80,421,90,606,837,114] Generated list 34: [683,857,708,389,397,858,523,226,304,243,957,504,414,891,932,732,696,997,266,375,163,314,417,206,543,367,995] Generated list 35: [544,480,242,16,893,959,165,278,5,13,496,699,197,202,390,698,151,88,756,744] Generated list 36: [912,352,632,905,28,161,361,116,338,699,162] Generated list 37: [636,909,594,55,740,635,871,62,954,562,857,853,22,843,611,500,829,776,463,581,433,138,244,277,654,554,382,785,918,642,144,707,869,323,617,591,604,231,684,472,12,161,154,135,168] Generated list 38: [983,961,856,397,338,456,937] Generated list 39: [758,566,214,532,749,279,68,922,699,493,936,677,774,194,503,813,701,495,799,313,714,673,4,676] Generated list 40: [885,524,404,863,735,174,726,612,181,987,354,376,842,457,660,266,679,692,570,495,306,522,968,443,889,578,708,532,610,159,330,847,834,560,620,928,405,328,97,628] Generated list 41: [540,125,42,690,868,91,543,723,669,58,456,649,793,298,335,485,418,794,406,852] Generated list 42: [64,251,670,571,891,849,206,595,640,722,702,491,464,898,756,318,906,970,745,500,381,661,329,386,817,996,597,974,822,894,115,925,903,462,747,565,296,155,401,754,254,217] Generated list 43: [33,96,650,388,76,547,337,314,287,27,972,255,512,831,771,857,119,461,763,742,728,565,886,39,370,257,228,459,855,661,629,729,275,441,107,935] Generated list 44: [162,704,857,670,937,627,602,983,29,5,331,199,163,876,255,173] Generated list 45: [403,128,631,885,522,679,626,390,499,82,533,429,162] Generated list 46: [757,244,119,744,969,473,339,487,41,116,132] Generated list 47:

[708,186,169,522,566,471,897,650,751,480,708,996,868,156,946,284,594,613,374,206,350,832,465,755,442,265,764,716,524,58,205,322,878,289,48,700,530,443,867,35,967,472,752] Generated list 48:
[403,381,641,50,365,59,38,99,916,729,642,151,439,506,418,163,390,392,553,939,438,663,773,482,782,993,239,265,647,921,257,165,659,341,379,424,480,564,400,114,644,752,271] Generated list 49:
[590,14,290,747,869,576,350,157,257,196,694,425,435,711,704,766,99,668,560,71,842,470,109,498,168,831,153,789,410,578,630,405,107,245,894,159,315,520,222,118,176,336,5,992] Generated list 50:
[552,374,838,450,650,937,622,252,829,942,759,208,379,916,587,133,668,827,648,936,386,984]

B) Save lists

Done.

C) Complete code

Attached in .pl format (assignment-2-cohen2jl.pl)

D) Run results

Testing list 1 (length:
length([317,811,644,199,616,887,645,627,55,776,841,654,372,872,729,973,955,291,593,641,803,776,346,500,236,820,32,600,697,891,484,487,56,770,160,216,87,409]))
bubbleSort: 0.000769 seconds insertionSort: 0.000047 seconds mergeSort: 0.000056 seconds quickSort: 0.000232 seconds hybrid_bubble_merge: 0.000070 seconds hybrid_bubble_quick: 0.000046 seconds hybrid_insertion_merge: 0.000040 seconds hybrid_insertion_quick: 0.000034 seconds Testing list 2 (length: length([950,416,673,83,966,755,46])) bubbleSort: 0.000007 seconds insertionSort: 0.000004 seconds mergeSort: 0.000010 seconds quickSort: 0.000005 seconds hybrid_bubble_merge: 0.000008 seconds hybrid_bubble_quick: 0.000007 seconds hybrid_insertion_merge: 0.000005 seconds hybrid_insertion_quick: 0.000006 seconds Testing list 3 (length:
length([481,983,677,999,342,88,954,679,434,917,406,227,987,143,582,50,960,966,200,393,41,448,219,647,740,735,714,559,632,955,588,166,468,558,406,183,908,160,69,309,863,847,853,913,380])) bubbleSort: 0.001160 seconds insertionSort: 0.000069 seconds mergeSort: 0.000062 seconds quickSort: 0.000034 seconds hybrid_bubble_merge: 0.000056 seconds hybrid_bubble_quick: 0.000049 seconds hybrid_insertion_merge: 0.000047 seconds hybrid_insertion_quick: 0.000362 seconds Testing list 4 (length: length([453,969,692,106,111,643,922,472,23,191,769,57,798,100,394,867,103,472,504,709,181,709,892,82,693,61,469,224,6,839,882,564,125,971,375,873,405,384,503,792]))
bubbleSort: 0.000663 seconds insertionSort: 0.000063 seconds mergeSort: 0.000056 seconds quickSort: 0.000031 seconds hybrid_bubble_merge: 0.000070 seconds hybrid_bubble_quick: 0.000357 seconds hybrid_insertion_merge: 0.000036 seconds hybrid_insertion_quick: 0.000032 seconds Testing list 5 (length:
length([759,918,533,89,235,817,709,17,745,62,950,916,229,557,399,186,346,242,504,443

,338,250,719,275,778,899,802,227,263,338,954,721,678,666,25,950,570,718,266,288,278,
856,464,298,271,65,647])) bubbleSort: 0.001240 seconds insertionSort: 0.000058 seconds
mergeSort: 0.000065 seconds quickSort: 0.000040 seconds hybrid_bubble_merge:
0.000061 seconds hybrid_bubble_quick: 0.000067 seconds hybrid_insertion_merge:
0.000058 seconds hybrid_insertion_quick: 0.000049 seconds Testing list 6 (length:
length([140,557,220,122,605,415,507,644,165,647,342,478,825,901,726,989,6,708]))
bubbleSort: 0.000041 seconds insertionSort: 0.000008 seconds mergeSort: 0.000022
seconds quickSort: 0.000013 seconds hybrid_bubble_merge: 0.000022 seconds
hybrid_bubble_quick: 0.000016 seconds hybrid_insertion_merge: 0.000012 seconds
hybrid_insertion_quick: 0.000012 seconds Testing list 7 (length:
length([856,779,262,777,677,101,874,298,860,251,168,227,912,285,763,415,77,807,774,2
49,332,360,265,787,611,458,177,155,657,272,227,938,696,487,970,950,129,54,547,540,8
05,338])) bubbleSort: 0.000800 seconds insertionSort: 0.000047 seconds mergeSort:
0.000057 seconds quickSort: 0.000193 seconds hybrid_bubble_merge: 0.000078 seconds
hybrid_bubble_quick: 0.000051 seconds hybrid_insertion_merge: 0.000036 seconds
hybrid_insertion_quick: 0.000036 seconds Testing list 8 (length:
length([895,821,208,287,681,272,575,786,982,378,805,56,869,287,60])) bubbleSort:
0.000043 seconds insertionSort: 0.000009 seconds mergeSort: 0.000023 seconds
quickSort: 0.000011 seconds hybrid_bubble_merge: 0.000021 seconds
hybrid_bubble_quick: 0.000017 seconds hybrid_insertion_merge: 0.000012 seconds
hybrid_insertion_quick: 0.000013 seconds Testing list 9 (length:
length([745,91,191,234,793,923,337,558,958,290,391,972,217,947,104,66,77,503,423,682
,471,507,907])) bubbleSort: 0.000141 seconds insertionSort: 0.000016 seconds mergeSort:
0.000030 seconds quickSort: 0.000040 seconds hybrid_bubble_merge: 0.000057 seconds
hybrid_bubble_quick: 0.000046 seconds hybrid_insertion_merge: 0.000037 seconds
hybrid_insertion_quick: 0.000033 seconds Testing list 10 (length:
length([700,237,950,594,362,273,311])) bubbleSort: 0.000013 seconds insertionSort:
0.000007 seconds mergeSort: 0.000017 seconds quickSort: 0.000008 seconds
hybrid_bubble_merge: 0.000016 seconds hybrid_bubble_quick: 0.000014 seconds
hybrid_insertion_merge: 0.000007 seconds hybrid_insertion_quick: 0.000006 seconds
Testing list 11 (length:
length([189,654,16,552,273,509,474,540,579,268,635,124,209,960,866,326,792,716,651,9
50,682,627,60,222,776,507,397,559,994,176,612,475,131,833,843,75,717,405,348,161]))
bubbleSort: 0.001191 seconds insertionSort: 0.000068 seconds mergeSort: 0.000089
seconds quickSort: 0.000045 seconds hybrid_bubble_merge: 0.000110 seconds
hybrid_bubble_quick: 0.000081 seconds hybrid_insertion_merge: 0.000065 seconds
hybrid_insertion_quick: 0.000048 seconds Testing list 12 (length:
length([780,452,772,261,642,813,407,130,246,733,635,626,487,477,101])) bubbleSort:
0.000077 seconds insertionSort: 0.000016 seconds mergeSort: 0.000031 seconds
quickSort: 0.000016 seconds hybrid_bubble_merge: 0.000030 seconds
hybrid_bubble_quick: 0.000028 seconds hybrid_insertion_merge: 0.000020 seconds
hybrid_insertion_quick: 0.000017 seconds Testing list 13 (length:
length([431,255,221,125,649,957,538,805,470,253])) bubbleSort: 0.000022 seconds
insertionSort: 0.000007 seconds mergeSort: 0.000020 seconds quickSort: 0.000010
seconds hybrid_bubble_merge: 0.000022 seconds hybrid_bubble_quick: 0.000020 seconds
hybrid_insertion_merge: 0.000009 seconds hybrid_insertion_quick: 0.000010 seconds

Testing list 14 (length: length([765,924,255,187,536,103,236,96,386,425,630,457,763,308,724,456,295,161,442,450,324,745,924,86,305,840,677,714,153,172,748,741,508,155,259,724])) bubbleSort: 0.000791 seconds insertionSort: 0.000054 seconds mergeSort: 0.000083 seconds quickSort: 0.000053 seconds hybrid_bubble_merge: 0.000092 seconds hybrid_bubble_quick: 0.000069 seconds hybrid_insertion_merge: 0.000046 seconds hybrid_insertion_quick: 0.000044 seconds Testing list 15 (length: length([594,439,592,510,149,944,469,118,268,8,309,829,346,303,361,401,705,562,53,38,997,449,854,469])) bubbleSort: 0.000220 seconds insertionSort: 0.000040 seconds mergeSort: 0.000052 seconds quickSort: 0.000024 seconds hybrid_bubble_merge: 0.000037 seconds hybrid_bubble_quick: 0.000031 seconds hybrid_insertion_merge: 0.000029 seconds hybrid_insertion_quick: 0.000027 seconds Testing list 16 (length: length([515,185,366,452,326,791,886,475,49,969,787,191,901,534,561,839,180,698,449,595,883])) bubbleSort: 0.000149 seconds insertionSort: 0.000019 seconds mergeSort: 0.000046 seconds quickSort: 0.000019 seconds hybrid_bubble_merge: 0.000038 seconds hybrid_bubble_quick: 0.000035 seconds hybrid_insertion_merge: 0.000024 seconds hybrid_insertion_quick: 0.000022 seconds Testing list 17 (length: length([449,86,747,541,852,224,702,14,388,481,141,766,146,505,174,672,744,590,791,536,338,52,778])) bubbleSort: 0.000199 seconds insertionSort: 0.000026 seconds mergeSort: 0.000047 seconds quickSort: 0.000023 seconds hybrid_bubble_merge: 0.000041 seconds hybrid_bubble_quick: 0.000038 seconds hybrid_insertion_merge: 0.000032 seconds hybrid_insertion_quick: 0.000022 seconds Testing list 18 (length: length([639,847,900,21,508,592,688,161,396,364])) bubbleSort: 0.000029 seconds insertionSort: 0.000009 seconds mergeSort: 0.000019 seconds quickSort: 0.000010 seconds hybrid_bubble_merge: 0.000029 seconds hybrid_bubble_quick: 0.000027 seconds hybrid_insertion_merge: 0.000011 seconds hybrid_insertion_quick: 0.000011 seconds Testing list 19 (length: length([819,945,518,877,739,403,167,759,385,327,194,613,520,905,234,474,454,400,829,319,529,565,865,378,482,95,567,483,877,74,316,979,67,758,55,846,96,335,85,682,314,792,215,504,860])) bubbleSort: 0.001792 seconds insertionSort: 0.000100 seconds mergeSort: 0.000097 seconds quickSort: 0.000053 seconds hybrid_bubble_merge: 0.000085 seconds hybrid_bubble_quick: 0.000083 seconds hybrid_insertion_merge: 0.000071 seconds hybrid_insertion_quick: 0.000050 seconds Testing list 20 (length: length([649,801,293,372,969,403,747,172,139])) bubbleSort: 0.000020 seconds insertionSort: 0.000007 seconds mergeSort: 0.000017 seconds quickSort: 0.000009 seconds hybrid_bubble_merge: 0.000022 seconds hybrid_bubble_quick: 0.000037 seconds hybrid_insertion_merge: 0.000016 seconds hybrid_insertion_quick: 0.000011 seconds Testing list 21 (length: length([180,22,265,327,87,344,325,164,801,821,817,573,790,980,952,354,512,118,796,726,728,578,661,992,438,234,687,238,732,846,428,893,438,788,953,947,937,898,764,104,619,473,118,171,667,818])) bubbleSort: 0.001383 seconds insertionSort: 0.000053 seconds mergeSort: 0.000073 seconds quickSort: 0.000062 seconds hybrid_bubble_merge: 0.000059 seconds hybrid_bubble_quick: 0.000071 seconds hybrid_insertion_merge: 0.000044 seconds hybrid_insertion_quick: 0.000047 seconds Testing list 22 (length: length([307,267,982,246,162,868,86,572,397,177,404,263,214,955,607,976,80,594,252,960,876,486,607])) bubbleSort: 0.000110 seconds insertionSort: 0.000015 seconds

mergeSort: 0.000032 seconds quickSort: 0.000017 seconds hybrid_bubble_merge: 0.000028 seconds hybrid_bubble_quick: 0.000026 seconds hybrid_insertion_merge: 0.000021 seconds hybrid_insertion_quick: 0.000017 seconds Testing list 23 (length: length([292,229,194,757,374,417,182,886,604,167,928,294,277,307,348,384,570,751,148, 614,977,122,456,719,631,661,857,499])) bubbleSort: 0.000186 seconds insertionSort: 0.000018 seconds mergeSort: 0.000037 seconds quickSort: 0.000021 seconds hybrid_bubble_merge: 0.000032 seconds hybrid_bubble_quick: 0.000032 seconds hybrid_insertion_merge: 0.000023 seconds hybrid_insertion_quick: 0.000022 seconds Testing list 24 (length: length([410,656,15,55,769,24])) bubbleSort: 0.000005 seconds insertionSort: 0.000003 seconds mergeSort: 0.000009 seconds quickSort: 0.000005 seconds hybrid_bubble_merge: 0.000006 seconds hybrid_bubble_quick: 0.000005 seconds hybrid_insertion_merge: 0.000004 seconds hybrid_insertion_quick: 0.000004 seconds Testing list 25 (length: length([905,73,528,619,56,813,270])) bubbleSort: 0.000007 seconds insertionSort: 0.000004 seconds mergeSort: 0.000010 seconds quickSort: 0.000005 seconds hybrid_bubble_merge: 0.000008 seconds hybrid_bubble_quick: 0.000007 seconds hybrid_insertion_merge: 0.000004 seconds hybrid_insertion_quick: 0.000004 seconds Testing list 26 (length: length([646,968,590,436,942,373,560,420,379,702,886,986,14,222,266,183,21,119,177,12 6,71,47,62,787,423,976,804,303,836,436,385,248,624,448,66,823,953,579,119,888,973,17 2,273,113,382,337,279])) bubbleSort: 0.001231 seconds insertionSort: 0.000061 seconds mergeSort: 0.000065 seconds quickSort: 0.000041 seconds hybrid_bubble_merge: 0.000054 seconds hybrid_bubble_quick: 0.000063 seconds hybrid_insertion_merge: 0.000044 seconds hybrid_insertion_quick: 0.000073 seconds Testing list 27 (length: length([54,866,107,75,292,415,997,784,49,723,419,265,513,126,636,106,940,176,974,458 ,657,493,577,298,682,609,818,359,735,389])) bubbleSort: 0.000284 seconds insertionSort: 0.000022 seconds mergeSort: 0.000039 seconds quickSort: 0.000028 seconds hybrid_bubble_merge: 0.000036 seconds hybrid_bubble_quick: 0.000035 seconds hybrid_insertion_merge: 0.000024 seconds hybrid_insertion_quick: 0.000030 seconds Testing list 28 (length: length([807,61,987,624,192,946,321,872,380,897,760,97,896,438,860,837,472,708,32,298 ,394,156,106,8,290,621,58,876,456,14,580,206])) bubbleSort: 0.000446 seconds insertionSort: 0.000035 seconds mergeSort: 0.000043 seconds quickSort: 0.000025 seconds hybrid_bubble_merge: 0.000046 seconds hybrid_bubble_quick: 0.000034 seconds hybrid_insertion_merge: 0.000026 seconds hybrid_insertion_quick: 0.000025 seconds Testing list 29 (length: length([111,197,377,250,687,227,58,881,913,169,269,513,527,53,599,150,122,796,86,258 ,200,34,995,427,52,304,952,375,141,506,700,950,611,939,234,879,797,275,282,316,170,7 0,868,749,102])) bubbleSort: 0.000927 seconds insertionSort: 0.000121 seconds mergeSort: 0.000061 seconds quickSort: 0.000037 seconds hybrid_bubble_merge: 0.000052 seconds hybrid_bubble_quick: 0.000042 seconds hybrid_insertion_merge: 0.000041 seconds hybrid_insertion_quick: 0.000036 seconds Testing list 30 (length: length([514,219,710,776,170,672,55,825,903,153,206,265,274,624,507,247,191,473,511,2 60,662,961,986,950,340,496,735,712,54,493,365,886,198,655,151,794,136,245,52,376,62, 418,175,480,193,730,460,905,598,976])) bubbleSort: 0.001419 seconds insertionSort: 0.000076 seconds mergeSort: 0.000066 seconds quickSort: 0.000038 seconds hybrid_bubble_merge: 0.000059 seconds hybrid_bubble_quick: 0.000060 seconds

hybrid_insertion_merge: 0.000044 seconds hybrid_insertion_quick: 0.000040 seconds Testing list 31 (length: length([399,266,866,613,31,774,269,326,746,707,503,582,447,628,492,865,716,641,981,565,381,65,696,957,417,67,976,989,485,68,938,773,273])) bubbleSort: 0.000352 seconds insertionSort: 0.000028 seconds mergeSort: 0.000042 seconds quickSort: 0.000023 seconds hybrid_bubble_merge: 0.000046 seconds hybrid_bubble_quick: 0.000040 seconds hybrid_insertion_merge: 0.000026 seconds hybrid_insertion_quick: 0.000051 seconds Testing list 32 (length: length([874,989,914,132,995,731,422,911,673,984,412,90,865,86,67,622,816,933,548,711,93,687,693,780,868,681,244,990,184,142,7,469,182,623,128,236])) bubbleSort: 0.000964 seconds insertionSort: 0.000076 seconds mergeSort: 0.000073 seconds quickSort: 0.000037 seconds hybrid_bubble_merge: 0.000059 seconds hybrid_bubble_quick: 0.000041 seconds hybrid_insertion_merge: 0.000285 seconds hybrid_insertion_quick: 0.000029 seconds Testing list 33 (length: length([605,230,407,989,635,20,478,487,60,680,549,685,594,699,99,621,41,875,534,847,103,916,651,894,134,438,249,292,877,199,411,654,591,575,77,342,275,797,115,716,458,553,582,80,421,90,606,837,114])) bubbleSort: 0.001464 seconds insertionSort: 0.000065 seconds mergeSort: 0.000069 seconds quickSort: 0.000043 seconds hybrid_bubble_merge: 0.000057 seconds hybrid_bubble_quick: 0.000064 seconds hybrid_insertion_merge: 0.000046 seconds hybrid_insertion_quick: 0.000043 seconds Testing list 34 (length: length([683,857,708,389,397,858,523,226,304,243,957,504,414,891,932,732,696,997,266,375,163,314,417,206,543,367,995])) bubbleSort: 0.000229 seconds insertionSort: 0.000023 seconds mergeSort: 0.000036 seconds quickSort: 0.000018 seconds hybrid_bubble_merge: 0.000030 seconds hybrid_bubble_quick: 0.000028 seconds hybrid_insertion_merge: 0.000023 seconds hybrid_insertion_quick: 0.000016 seconds Testing list 35 (length: length([544,480,242,16,893,959,165,278,5,13,496,699,197,202,390,698,151,88,756,744])) bubbleSort: 0.000085 seconds insertionSort: 0.000013 seconds mergeSort: 0.000026 seconds quickSort: 0.000013 seconds hybrid_bubble_merge: 0.000033 seconds hybrid_bubble_quick: 0.000021 seconds hybrid_insertion_merge: 0.000015 seconds hybrid_insertion_quick: 0.000014 seconds Testing list 36 (length: length([912,352,632,905,28,161,361,116,338,699,162])) bubbleSort: 0.000024 seconds insertionSort: 0.000006 seconds mergeSort: 0.000015 seconds quickSort: 0.000008 seconds hybrid_bubble_merge: 0.000012 seconds hybrid_bubble_quick: 0.000018 seconds hybrid_insertion_merge: 0.000009 seconds hybrid_insertion_quick: 0.000008 seconds Testing list 37 (length: length([636,909,594,55,740,635,871,62,954,562,857,853,22,843,611,500,829,776,463,581,433,138,244,277,654,554,382,785,918,642,144,707,869,323,617,591,604,231,684,472,12,161,154,135,168])) bubbleSort: 0.001297 seconds insertionSort: 0.000065 seconds mergeSort: 0.000062 seconds quickSort: 0.000039 seconds hybrid_bubble_merge: 0.000053 seconds hybrid_bubble_quick: 0.000060 seconds hybrid_insertion_merge: 0.000042 seconds hybrid_insertion_quick: 0.000045 seconds Testing list 38 (length: length([983,961,856,397,338,456,937])) bubbleSort: 0.000008 seconds insertionSort: 0.000004 seconds mergeSort: 0.000010 seconds quickSort: 0.000005 seconds hybrid_bubble_merge: 0.000008 seconds hybrid_bubble_quick: 0.000008 seconds hybrid_insertion_merge: 0.000004 seconds hybrid_insertion_quick: 0.000004 seconds

Testing list 39 (length: length([758,566,214,532,749,279,68,922,699,493,936,677,774,194,503,813,701,495,799,313,714,673,4,676])) bubbleSort: 0.000212 seconds insertionSort: 0.000024 seconds mergeSort: 0.000032 seconds quickSort: 0.000017 seconds hybrid_bubble_merge: 0.000028 seconds hybrid_bubble_quick: 0.000044 seconds hybrid_insertion_merge: 0.000021 seconds hybrid_insertion_quick: 0.000017 seconds Testing list 40 (length: length([885,524,404,863,735,174,726,612,181,987,354,376,842,457,660,266,679,692,570,495,306,522,968,443,889,578,708,532,610,159,330,847,834,560,620,928,405,328,97,628])) bubbleSort: 0.000724 seconds insertionSort: 0.000055 seconds mergeSort: 0.000055 seconds quickSort: 0.000032 seconds hybrid_bubble_merge: 0.000249 seconds hybrid_bubble_quick: 0.000049 seconds hybrid_insertion_merge: 0.000033 seconds hybrid_insertion_quick: 0.000034 seconds Testing list 41 (length: length([540,125,42,690,868,91,543,723,669,58,456,649,793,298,335,485,418,794,406,852])) bubbleSort: 0.000080 seconds insertionSort: 0.000012 seconds mergeSort: 0.000025 seconds quickSort: 0.000020 seconds hybrid_bubble_merge: 0.000030 seconds hybrid_bubble_quick: 0.000020 seconds hybrid_insertion_merge: 0.000014 seconds hybrid_insertion_quick: 0.000011 seconds Testing list 42 (length: length([64,251,670,571,891,849,206,595,640,722,702,491,464,898,756,318,906,970,745,500,381,661,329,386,817,996,597,974,822,894,115,925,903,462,747,565,296,155,401,754,254,217])) bubbleSort: 0.000902 seconds insertionSort: 0.000049 seconds mergeSort: 0.000181 seconds quickSort: 0.000039 seconds hybrid_bubble_merge: 0.000057 seconds hybrid_bubble_quick: 0.000057 seconds hybrid_insertion_merge: 0.000036 seconds hybrid_insertion_quick: 0.000037 seconds Testing list 43 (length: length([33,96,650,388,76,547,337,314,287,27,972,255,512,831,771,857,119,461,763,742,728,565,886,39,370,257,228,459,855,661,629,729,275,441,107,935])) bubbleSort: 0.000617 seconds insertionSort: 0.000045 seconds mergeSort: 0.000070 seconds quickSort: 0.000042 seconds hybrid_bubble_merge: 0.000088 seconds hybrid_bubble_quick: 0.000064 seconds hybrid_insertion_merge: 0.000038 seconds hybrid_insertion_quick: 0.000037 seconds Testing list 44 (length: length([162,704,857,670,937,627,602,983,29,5,331,199,163,876,255,173])) bubbleSort: 0.000055 seconds insertionSort: 0.000011 seconds mergeSort: 0.000021 seconds quickSort: 0.000012 seconds hybrid_bubble_merge: 0.000018 seconds hybrid_bubble_quick: 0.000019 seconds hybrid_insertion_merge: 0.000012 seconds hybrid_insertion_quick: 0.000012 seconds Testing list 45 (length: length([403,128,631,885,522,679,626,390,499,82,533,429,162])) bubbleSort: 0.000033 seconds insertionSort: 0.000008 seconds mergeSort: 0.000017 seconds quickSort: 0.000008 seconds hybrid_bubble_merge: 0.000015 seconds hybrid_bubble_quick: 0.000016 seconds hybrid_insertion_merge: 0.000010 seconds hybrid_insertion_quick: 0.000009 seconds Testing list 46 (length: length([757,244,119,744,969,473,339,487,41,116,132])) bubbleSort: 0.000022 seconds insertionSort: 0.000007 seconds mergeSort: 0.000013 seconds quickSort: 0.000007 seconds hybrid_bubble_merge: 0.000011 seconds hybrid_bubble_quick: 0.000016 seconds hybrid_insertion_merge: 0.000009 seconds hybrid_insertion_quick: 0.000008 seconds Testing list 47 (length: length([708,186,169,522,566,471,897,650,751,480,708,996,868,156,946,284,594,613,374,206,350,832,465,755,442,265,764,716,524,58,205,322,878,289,48,700,530,443,867,35,96

7,472,752])) bubbleSort: 0.000880 seconds insertionSort: 0.000050 seconds mergeSort: 0.000218 seconds quickSort: 0.000032 seconds hybrid_bubble_merge: 0.000055 seconds hybrid_bubble_quick: 0.000049 seconds hybrid_insertion_merge: 0.000039 seconds hybrid_insertion_quick: 0.000034 seconds Testing list 48 (length: length([403,381,641,50,365,59,38,99,916,729,642,151,439,506,418,163,390,392,553,939, 438,663,773,482,782,993,239,265,647,921,257,165,659,341,379,424,480,564,400,114,64 4,752,271])) bubbleSort: 0.000842 seconds insertionSort: 0.000043 seconds mergeSort: 0.000058 seconds quickSort: 0.000034 seconds hybrid_bubble_merge: 0.000051 seconds hybrid_bubble_quick: 0.000065 seconds hybrid_insertion_merge: 0.000039 seconds hybrid_insertion_quick: 0.000033 seconds Testing list 49 (length: length([590,14,290,747,869,576,350,157,257,196,694,425,435,711,704,766,99,668,560,71 ,842,470,109,498,168,831,153,789,410,578,630,405,107,245,894,159,315,520,222,118,17 6,336,5,992])) bubbleSort: 0.001085 seconds insertionSort: 0.000055 seconds mergeSort: 0.000060 seconds quickSort: 0.000034 seconds hybrid_bubble_merge: 0.000048 seconds hybrid_bubble_quick: 0.000046 seconds hybrid_insertion_merge: 0.000041 seconds hybrid_insertion_quick: 0.000053 seconds Testing list 50 (length: length([552,374,838,450,650,937,622,252,829,942,759,208,379,916,587,133,668,827,648, 936,386,984])) bubbleSort: 0.000101 seconds insertionSort: 0.000014 seconds mergeSort: 0.000029 seconds quickSort: 0.000014 seconds hybrid_bubble_merge: 0.000023 seconds hybrid_bubble_quick: 0.000022 seconds hybrid_insertion_merge: 0.000018 seconds hybrid_insertion_quick: 0.000014 seconds

E/F) Performance

Algorithm bubbleSort: Average time = 0.000507 seconds over 50 tests Algorithm hybrid_bubble_merge: Average time = 0.000046 seconds over 50 tests Algorithm hybrid_bubble_quick: Average time = 0.000045 seconds over 50 tests Algorithm hybrid_insertion_merge: Average time = 0.000033 seconds over 50 tests Algorithm hybrid_insertion_quick: Average time = 0.000033 seconds over 50 tests Algorithm insertionSort: Average time = 0.000035 seconds over 50 tests Algorithm mergeSort: Average time = 0.000049 seconds over 50 tests Algorithm quickSort: Average time = 0.000033 seconds over 50 tests