

Name: _____

J#: _____

Jackson State University
CSC 323 Algorithm Design and Analysis, Spring 2017
Instructor: Dr. Natarajan Meghanathan
Exam 1 (Take Home Exam)

Maximum Points: 100

Due on: February 21, 2017: 1 PM

Use additional sheets, if necessary.

Print this Exam and answer in the space provided. You should staple your exam.

Submit on-time at 1 PM. LATE submissions WILL NOT be accepted.

1) (20 points) Draw a binary search tree for the following sorted array, and determine the average number of comparisons for a successful search and an unsuccessful search.

Student Name	Array
Alexander Arrington	[4, 8, 16, 26, 30, 33, 46, 64, 74, 95, 99]
Jaylen Boykin	[16, 22, 40, 58, 60, 65, 68, 70, 75, 79, 89, 95]
Jason Bruno	[22, 32, 41, 52, 56, 59, 69, 74, 79, 83, 89, 92, 99]
Elbert Buchanan	[3, 22, 30, 36, 49, 52, 64, 75, 89, 93, 96, 99]
Daniel Epps	[20, 23, 26, 29, 36, 40, 49, 54, 62, 69, 79, 88, 92]
Jordan Hubbard	[5, 9, 12, 15, 19, 22, 30, 50, 54, 57, 78, 84, 94]
Kayla Johnson	[8, 14, 19, 34, 37, 40, 43, 46, 49, 54, 77, 87, 95]
Bria McCutcheon	[3, 20, 28, 34, 41, 48, 54, 63, 84, 89, 97]
Darren McGee	[20, 26, 30, 42, 60, 66, 69, 73, 81, 87, 91]
Justin McGuffee	[5, 19, 23, 29, 33, 39, 51, 65, 70, 77, 83, 89, 95]
Kayshaunna Williams	[27, 38, 47, 56, 60, 64, 68, 72, 78, 84, 89, 97]
Michael Wilson	[4, 10, 16, 19, 25, 36, 45, 52, 55, 61, 69, 97]

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2) (16 points) Use the hashing technique to determine sub sequences of length 2 or more in the following array assigned to you. Show all the work (including the contents of the hash table as well as the different keys you are searching for) .

Student Name	Array
Alexander Arrington	[31, 8, 29, 90, 4, 9, 32, 7, 5, 33, 30, 89, 10]
Jaylen Boykin	[94, 97, 99, 98, 91, 67, 101, 21, 92, 96, 100, 93, 32]
Jason Bruno	[13, 10, 55, 89, 86, 81, 11, 90, 9, 93, 12, 98, 87]
Elbert Buchanan	[88, 40, 93, 43, 95, 39, 24, 26, 68, 94, 25, 42, 41]
Daniel Epps	[61, 21, 3, 99, 94, 22, 41, 73, 25, 71, 24, 95, 72]
Jordan Hubbard	[26, 1, 6, 90, 7, 25, 8, 24, 0, 42, 43, 91, 44]
Kayla Johnson	[17, 40, 80, 81, 34, 70, 3, 19, 83, 18, 33, 2, 15]
Bria McCutcheon	[41, 17, 6, 35, 60, 32, 31, 40, 7, 79, 33, 78, 34]
Darren McGee	[92, 60, 73, 81, 13, 14, 2, 12, 71, 80, 11, 1, 72]
Justin McGuffee	[81, 80, 17, 33, 68, 69, 34, 72, 77, 37, 32, 76, 73]
Kayshaunna Williams	[12, 91, 45, 90, 11, 55, 1, 92, 89, 94, 93, 26, 10]
Michael Wilson	[71, 43, 38, 37, 72, 82, 73, 34, 85, 83, 6, 7, 84]

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3) (16 points) Let the hash function be $H(K) = K \bmod 5$. Given two sets A and B, the Jaccard Index of A and B, $J(A, B)$ is defined as follows.

$$J(A, B) = \frac{|A \cap B|}{|A \cup B|}$$

- (a) Design a hash table based algorithm to determine the intersection of two sets A and B. Write the pseudo code.
- (b) Show the execution of the algorithm in (a) on the sets A and B assigned to you and determine the intersection of the two sets. Determine the total number of comparisons encountered.
- (c) Design a hash table based algorithm to determine the union of two sets A and B. Write the pseudo code.
- (d) Show the execution of the algorithm in (c) on the sets A and B assigned to you and determine the union of the two sets. Determine the total number of comparisons encountered.
- (e) Use the formula shown above to determine the Jaccard Index of the two sets A and B assigned to you.

Student Name	Set A	Set B
Alexander Arrington	[20, 21, 18, 13, 14, 19]	[11, 20, 15, 21, 19, 18]
Jaylen Boykin	[17, 16, 18, 13, 15, 14]	[13, 15, 20, 21, 10, 14]
Jason Bruno	[19, 21, 23, 22, 20, 18]	[20, 10, 14, 21, 17, 19]
Elbert Buchanan	[14, 15, 12, 20, 18, 16]	[19, 18, 14, 10, 15, 17]
Daniel Epps	[19, 13, 10, 14, 18, 17]	[14, 19, 15, 18, 20, 17]
Jordan Hubbard	[16, 15, 20, 17, 18, 19]	[14, 15, 16, 17, 21, 20]
Kayla Johnson	[13, 14, 16, 12, 18, 17]	[11, 10, 18, 12, 15, 17]
Bria McCutcheon	[18, 14, 16, 13, 17, 15]	[12, 21, 10, 18, 11, 20]
Darren McGee	[14, 11, 16, 12, 20, 13]	[21, 20, 16, 19, 15, 18]
Justin McGuffee	[15, 11, 10, 14, 16, 19]	[15, 11, 16, 20, 18, 19]
Kayshaunna Williams	[19, 20, 15, 17, 16, 18]	[17, 20, 15, 19, 21, 16]
Michael Wilson	[15, 13, 16, 17, 10, 20]	[16, 17, 18, 12, 20, 11]

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4) (16 pts) Consider an array A comprising of the characters that form your first name and last name, with no blank space in between. For example, if your first name is "JOHN" and last name is "PETER", then the array A is JOHNPETER. The sorted version of array A would be: EEHJNOPRT.

Sort the array A formed with your first name and last name using "Merge Sort". Show all the steps of the divide and conquer strategy (i.e., the splits and the merging). Also, count the total number of comparisons during the merging step.

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5) (32 pts) Implement the iterative and recursive algorithms to find the factorial of an integer. Compare their execution times (in milliseconds) for integer values ranging from 1 to 20. Plot the execution times incurred in logarithmic scale (as the y-axis for the iterative and recursive algorithms) and the integers ranging from 1 to 20 (as the x-axis). Use *long* as the data type of the variable to store the factorial of an integer.

Submission

Along with your answers for the other questions of this exam, submit a hardcopy of your programming codes for the iterative and recursive algorithms, the Excel plots of the execution times vs. integer values as well as your interpretation of the results. If you ran out of memory while running the recursive algorithm, report your results until the largest integer value for which you were able to compute the factorial without running out of memory. Also, explain why your program ran out of memory during execution.