संगणक विज्ञान एवं अभियांत्रिकी विभाग
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List of Laboratory Programs

Subject: Advanced Algorithms Laboratory (CS15202) **Semester: 5th Semester, B.Tech (CSE)**

Instructions:

- The programs should be written in C.
- Do not use built-in functions or APIs in the programs.
- Prepare a laboratory report including all executed programs throughout the semester. After each laboratory session, the respective program should be appended in the report and submitted at the beginning of the subsequent laboratory session.
- The report must be regularly verified by the instructor.

Programs:

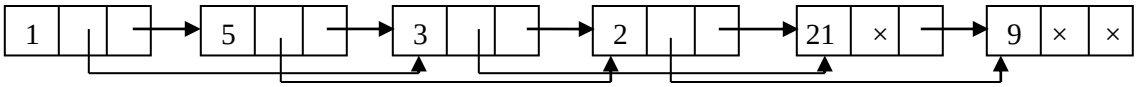
Prog 1. Write a program to build a (binary) min-heap for a given set of numbers, $A[0: n-1]$. Design the following functions:

(a) MIN-HEAPIFY(A, i): to maintaining the min-heap property on ith node.
(b) BUILD-MIN-HEAP(A): produces a min-heap from an unordered input array A.
(c) MIN-HEAP-INSERT(A, x): to insert x into the heap A.
(d) EXTRACT-MIN(A): to extract (return and delete) minimum number (i.e., root) from the heap A.

Prog 2. Let $A = \{1, 2, 3, 4, 5, 6, 8, 9, 10, 12, \ldots\}$ be a series of positive numbers whose prime factors only include 2, 3, 5. Note that 1 is typically treated as the first number of this series. See that the 10^{th} number of this series is 12. Write a program to find the n-th number of this series. In this program, input is the n as positive integer.

Hints: Use MinHeap. We will keep a min heap and initially insert 1 as the first number. The heap is {1}. Now, for next numbers, we ExtractMin from heap (i.e., root 1) and insert the multiples of 2, 3, and 5. Now, the heap becomes {2, 3, 5}. For next number, we extract min from heap which is 2. Now, we insert 2×2=4, 2×3=6, 2×5=10 into the heap and the heap becomes {3, 4, 5, 6, 10}. Next, we extract 3 and push 3×2=6, 3×3=9, and 3×5=15. Note that, we have already inserted 6, so we should not push another 6 into heap. Now heap becomes {4, 5, 6, 9, 10, 15}. We extract one element at each step until we extract the n-th element.

Prog 3. Assume a linked list as given in the following figure (consider the figure just as an example).



Write program with following methods

(a) A method to insert a new element after a given element in the linked list.
(b) A method to insert a new element at the end of the linked list.
(c) A method to print all the elements of the list.

Prog 4. (a) Write a program for NAIVE-STRING-MATCHER algorithm.
(b) Write a program for modified NAIVE-STRING-MATCHER algorithm with $O(n)$ complexity.

Prog 5. Write a program for the Rabin-Karp algorithm. Using the written program, find out number of spurious hits does the Rabin-Karp matcher encounter in the text $T = 3141592653589793$ when looking for the pattern $P = 26$. Consider working modulo $q = 11$.

Prog 6. Write a program for Knuth-Morris-Pratt (KMP) Algorithm for string matching.

Prog 7. (a) Write a program for 2-approximation algorithm of Travelling Salesperson Problem.
(b) Write a program for 2-approximation algorithm of Vertex-Cover Problem.

Prog 8. (a) Write the programs for 1.5 and 2-approximation algorithm of Tasks Scheduling Problem.
(b) Write a program for approximation algorithm of Set-Cover Problem.

Prog 9. Write a program to determine whether given two line-segments intersects or not.

Prog 10. Write a program for Grahan Scan Algorithm to build the smallest convex polygon (i.e., convex hall) containing all the given set of planar points.