



Introduction to Computing for the Social Sciences  
Theory Exercise Sheet 3

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### Exercise 1: Hash tables

When building a hash table, you are given the following sequence of inputs:

6, 0, 2, 12, 3, 11, 10, 1, 9

Your hash function is  $f(x) = (2 \cdot x + 3) \bmod m$ , where  $m$  is the size of the hash table.  
Consider a hash table with  $m=8$  and separate chaining.

- Show the final state of the table after filling it with the above sequence.
- Now assuming with  $m=16$ , fill the table resolving conflicts with linear probing.
- Propose a hash function with fewer collisions and explain why it does so.

### Exercise 2: Binary Search Trees

a) based on the below list, show the steps of the execution of binary search to find the element with key=33.

10 33 19 26 27 31 34 35 42 44

- Construct a Binary Search Tree (BST) by adding the numbers in the indicated order: 4, 6, 2, 1, 3, 10, 12. You only need to draw the final BST after all the numbers have been added.
- Show how the resulting BST of the previous step can be changed to have lower depth on its nodes.
- Show how to remove element 10 from the resulting BST of the previous step.

### Exercise 3: Linked lists

- Write the pseudocode of a procedure to find all the instances of an element containing number 31 in a doubly linked list. Return those instances as a single-linked list.
- Write the list of 2.a as a doubly linked list. Show how your pseudocode finds 31 in that list.