

P2: Lists in Prolog (2)

1. (a) Define a predicate that determines the sum of two numbers written in list representation.
 (b) Starting from a list consisting of integers and lists of digits, compute the sum of all numbers represented as sublists. E.g.: $[1, [2, 3], 4, 5, [6, 7, 9], 10, 11, [1, 2, 0], 6] \Rightarrow [8, 2, 2]$.
2. (a) Sort a list while keeping duplicates. E.g.: $[4\ 2\ 6\ 2\ 3\ 4] \Rightarrow [2\ 2\ 3\ 4\ 4\ 6]$
 (b) Starting from a list of integers and sublists on integers, sort each sublist while keeping duplicates. E.g.: $[1, 2, [4, 1, 4], 3, 6, [7, 10, 1, 3, 9], 5, [1, 1, 1], 7] \Rightarrow [1, 2, [1, 4, 4], 3, 6, [1, 3, 7, 9, 10], 5, [1, 1, 1], 7]$.
3. (a) Sort a list while eliminating duplicates. E.g.: $[4\ 2\ 6\ 2\ 3\ 4] \Rightarrow [2\ 3\ 4\ 6]$
 (b) Starting from a list of integers and sublists on integers, sort each sublist while eliminating duplicates. E.g.: $[1, 2, [4, 1, 4], 3, 6, [7, 10, 1, 3, 9], 5, [1, 1, 1], 7] \Rightarrow [1, 2, [1, 4], 3, 6, [1, 3, 7, 9, 10], 5, [1], 7]$.
4. (a) Interleave two sorted lists while eliminating duplicates
 (b) Starting from a list of integers and sorted sublists on integers, interleave all sublists without keeping duplicates. E.g.: $[1, [2, 3], 4, 5, [1, 4, 6], 3, [1, 3, 7, 9, 10], 5, [1, 1, 11], 8] \Rightarrow [1, 2, 3, 4, 6, 7, 9, 10, 11]$.
5. (a) Find the indices of the maximum value of a list. E.g.: $\text{argsmax}([10,14,12,13,14], L) \Rightarrow L = [2,5]$
 (b) Starting from a list of integers and sublists on integers, replace all sublists with the indices where the maximum value was found. E.g.: $[1, [2, 3], [4, 1, 4], 3, 6, [7, 10, 1, 3, 9], 5, [1, 1, 1], 7] \Rightarrow [1, [2], [1, 3], 3, 6, [2], 5, [1, 2, 3], 7]$
6. (a) In a list L, replace all instances of an element E with the elements of a list L1. E.g. $\text{swap}([1,2,1,3,1,4],1,[10,11],X) \Rightarrow X=[10,11,2,10,11,3,10,11,4]$.
 (b) Starting from a list of integers and sublists on integers, in each sublist replace all instances of the first element with a given list. E.g.: $[1, [4, 1, 4], 3, 6, [7, 10, 1, 3, 9], 5, [1, 1, 1], 7]$ si $[11, 11] \Rightarrow [1, [11, 11, 1, 11, 11], 3, 6, [11, 11, 10, 1, 3, 9], 5, [11\ 11\ 11\ 11\ 11], 7]$
7. (a) Define a predicate that multiplies an integer represented as a list of digits with another digit. E.g.: $[1\ 9\ 3\ 5\ 9\ 9] * 2 \Rightarrow [3\ 8\ 7\ 1\ 9\ 8]$
 (b) Starting from a list of integers and at most nine sublists on digits, replace every sublist with a product of the number represented by the sublist and its sequence number, i.e., the first list with 1, the second list with 2 and so on. E.g.: $[1, [2, 3], [4, 1, 4], 3, 6, [7, 5, 1, 3, 9], 5, [1, 1, 1], 7] \Rightarrow [1, [2, 3], [8, 2, 8], 3, 6, [2, 2, 5, 4, 1, 7], 5, [4, 4, 4], 7]$
8. (a) Define a predicate that determines the successor of a number represented as a list of digits. E.g.: $[1\ 9\ 3\ 5\ 9\ 9] \Rightarrow [1\ 9\ 3\ 6\ 0\ 0]$
 (b) Starting from a list of integers and sublists on digits, replace each sublist with its successor. E.g.: $[1, [2, 3], 4, 5, [6, 7, 9], 10, 11, [1, 2, 0], 6] \Rightarrow [1, [2, 4], 4, 5, [6, 8, 0], 10, 11, [1, 2, 1], 6]$

9. (a) given a list of numbers, eliminate all sequences of consecutive elements. E.g.: $\text{delete}([1, 2, 4, 6, 7, 8, 10], L) \Rightarrow L=[4, 10]$.
 (b) Given a list of numbers and lists of numbers, eliminate from each sublist all consecutive sequences. E.g.: $[1, [2, 3, 5], 9, [1, 2, 4, 3, 4, 5, 7, 9], 11, [5, 8, 2], 7] \Rightarrow [1, [5], 9, [4, 7, 9], 11, [5, 8, 2], 7]$
10. (a) Given a list of numbers, insert after the 1st, 3rd, 7th, 15th, and so on elements a given value.
 (b) Given a list of numbers and lists of numbers that starts with a number and no two consecutive elements are lists, for each sublist, insert the preceding number in the after the 1st, 3rd, 7th, 15th, and so on elements of the sublist. E.g.: $[1, [2, 3], 7, [4, 1, 4], 3, 6, [7, 5, 1, 3, 9, 8, 2, 7], 5] \Rightarrow [1, [2, 1, 3], 7, [4, 7, 1, 4, 7], 3, 6, [7, 6, 5, 1, 6, 3, 9, 8, 2, 6, 7], 5]$
11. (a) Given a list of numbers, duplicate each prime number.
 (b) Given a list of numbers and lists of numbers, duplicate each prime number in each sublist. E.g.: $[1, [2, 3], 4, 5, [1, 4, 6], 3, [1, 3, 7, 9, 10], 5] \Rightarrow [1, [2, 2, 3, 3], 4, 5, [1, 4, 6], 3, [1, 3, 3, 7, 7, 9, 10], 5]$
12. (a) Replace all instances of a given value in a list with another given value.
 (b) Given a list of numbers and lists of numbers, replace the maximum integer of the heterogeneous list in each sublist with the maximum element of that sublist. E.g.: $[1, [2, 5, 7], 4, 5, [1, 4], 3, [1, 3, 5, 8, 5, 4], 5, [5, 9, 1], 2] \Rightarrow [1, [2, 7, 7], 4, 5, [1, 4], 3, [1, 3, 8, 8, 8, 4], 5, [9, 9, 1], 2]$
13. (a) Insert after each element of a list the list of its divisors, excluding 1 and itself.
 (b) Given a list of numbers and lists of numbers, in each sublist insert after each element the list of divisors of that element. E.g.: $[1, [2, 5, 7], 4, 5, [1, 4], 3, 2, [6, 2, 1], 4, [7, 2, 8, 1], 2] \Rightarrow [1, [2, 5, 7], 4, 5, [1, 4, 2], 3, 2, [6, 2, 3, 2, 1], 4, [7, 2, 8, 2, 4, 1], 2]$
14. (a) Define a predicate that determines the predecessor of a number represented as a list of digits. E.g.: $[1\ 9\ 3\ 6\ 0\ 0] \Rightarrow [1\ 9\ 3\ 5\ 9\ 9]$
 (b) Given a list of numbers and lists of digits, replace each sublist with the predecessor of the number represented by the sublist. E.g.: $[1, [2, 3], 4, 5, [6, 7, 9], 10, 11, [1, 2, 0], 6] \Rightarrow [1, [2, 2], 4, 5, [6, 7, 8], 10, 11, [1, 1, 9], 6]$
15. (a) Find the longest sequence of consecutive even numbers in a list. If there are multiple find one of them.
 (b) Given a list of numbers and lists of numbers, replace each sublist with its longest sequence of consecutive even numbers. E.g.: $[1, [2, 1, 4, 6, 7], 5, [1, 2, 3, 4], 2, [1, 4, 6, 8, 3], 2, [1, 5], 3] \Rightarrow [1, [4, 6], 5, [2], 2, [4, 6, 8], 2, [], 3]$