CSE505 – Spring 2021
Assignment 3 – Functional & Logic Programming
(may be done by a team of two students)

Problem 1 is given below. A problem on logic programming to be posted later.

Problem 1: Due Date: April 12 (11:59 pm)

4a. The ML type definition below is for a polymorphic tree, called `ntree`, where each internal node has **a list of zero of more subtrees** and each leaf node holds a single value:

    datatype 'a ntree = leaf of 'a | node of 'a ntree list;

Using the `map(f,l)` higher-order function, define a function `subst(tr,v1,v2)` which returns a new ntree in which all occurrences of `v1` in the input ntree `tr` are replaced by v2 in the output tree. For example,

    subst(node([leaf("x"), node([leaf("y"), leaf("x"), leaf("z")])]), "x", "a")

       = node([leaf("a"), node([leaf("y"), leaf("a"), leaf("z")])])

Save your answer in a file `subst.sml`.

4b. Express the 'cat' function of A2 Problem 3(c) in tail-recursive form using ***continuation-passing*** style.

        datatype 'a tree = leaf of 'a | node of 'a tree * 'a tree;

        fun cat(leaf(s)) = s
           | cat(node(t1, t2)) = cat(t1) ^ " " ^ cat(t2);

Define the tail-recursive 'cat2' as follows:

        fun cat2(tr) = cat_cps(tr, (fn x => x))

The function `cat_cps` can be defined with two rules, one when `tr` is a 'leaf' and the other when `tr` is a 'node'. A nested lambda-expression is needed to translate the two recursive calls on 'cat' in the original definition. Use the same test case as in A2 Problem 3(c). Save your answer in a file `cat.sml`.

WHAT TO SUBMIT:

Prepare a top-level directory named *A3_Problem1_UBITId1_UBITId2* if the assignment is done by two students; otherwise, name it as *A3_Problem1_UBITId* if the assignment is done solo. (Order the *UBITId*'s in alphabetic order, in the former case.) In this directory, place `subst.sml` and `cat.sml`.

Compress the directory and submit the compressed file using the online submission procedure – instructions posted at Resources → Assignments → Online_Submission.pdf. Only one submission per team is required.

End of Assignment 3 Problem 1