CSE505 – Spring 2018
Assignment 2 – Functional Programming
Due Date for **Problems 1 and 2**: **Fri, March 9** (11:59 pm, online)
Problem 3: To be assigned next week

Problem 1: In Lecture 10, we discussed the ML datatype for a simple binary tree

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

and the function cat shown below for concatenating all strings in a string tree, with blanks separating consecutive strings.

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

Write a tail-recursive equivalent of cat, called cat2, such that for all string trees t, cat(t) = cat2(t), i.e., they produce the same output given the same input.

Hint: Define cat2 in terms of a tail-recursive function cat_tail: string tree list * string -> string, where the first component of the input tuple is a list of trees and the second is the accumulator.

Place your code in a file called cat.sml and submit it using the submit_cse505 command. Starter code including test cases posted at Resources→Homeworks→cat.sml.

Problem 2: Towards the end of Lecture 10, we discussed a flatten function for a two-level list. Note that a two-level ML list of type 'a list list is homogeneous and hence a list such as [1, [2], 3] is not well-typed.

We can define a heterogeneous multi-level list in ML by a type 'a mixed list by defining a type called 'a mixed with two constructors, base and nest. The use of these two constructors is illustrated below for encoding the heterogeneous list [1, [2, [3, 4]], 5, [6]]:

    [base(1), nest([base(2), nest([base(3), base(4)])]), base(5), nest([base(6)])]

We refer to the above list as a mixed list. The constructor base encodes a basic value of any type, and the constructor nest encodes a nested mixed list of the same type of basic value.

   (i)   Write an ML datatype for the type 'a mixed in terms of constructors base and nest.

   (ii)   Write a function flatten: 'a mixed list -> 'a list which takes a mixed list as input and produces a single-level list as output. So, for the above example, the output would be [1,2,3,4,5,6].

Place your code for (i) and (ii) in a file called mixed.sml and submit it using the submit_cse505 command.   Starter code and test cases posted at Resources→Homeworks→mixed.sml.

End of Problems 1 and 2