1 Foundations of Computer Science (avsm2)

You need to write OCaml code to help a local park ranger count the different types of trees present in a region of Cambridgeshire woodland.

(a) Define an OCaml type tree that can distinguish between an oak, birch or maple tree, and also any other species with an arbitrary string name.

[1 mark]

(b) Define two OCaml values with the following signatures:

(i) val describe : tree -> string
    that accepts a tree parameter and returns a human-readable string.

(ii) val identify : string -> tree
    that accepts a lowercase string parameter and returns a tree.

Explain briefly how the OCaml compiler can statically check if you have handled all the input possibilities for the input parameters to describe and identify.

[4 marks]

(c) Define a type stree that only distinguishes between three species oak, birch or maple and no others. Implement functions for the following signatures with similar functionality to the earlier identify function:

val identify_exn : string -> stree
val identify_opt : string -> stree option

Briefly discuss the tradeoffs between your two approaches.

[5 marks]

(d) You now need to implement a simple simulator before starting real surveys. Trees will occur in the following fixed infinite sequence: oak, birch, oak, maple, maple, and then repeat from the beginning.

(i) Define a function val spotter : unit -> stree that will return the sequence of trees when called multiple times.

[5 marks]

(ii) Define a purely functional alternative spotter that calculates the next stree in sequence, using only the input arguments to the function to calculate the return value. Write down an example application of this function with the input arguments and the expected output result. (Hint: you may need to pass in the complete sequence as one of the arguments.)

[5 marks]