

# COMPUTER SCIENCE TRIPOS Part IA – 2022 – Paper 1

## 1 Foundations of Computer Science (avsm2)

A single-player game requires you to guess the letters of a *target* word within a limited number of tries. Each try the player guesses a single letter  $c$  and integer position  $i$  (starting from 0). The game responds: **Green** if  $c$  appears in the position  $i$  in the target, **Amber** if  $c$  is present elsewhere within the target, or **Black** if  $c$  is not present in the target. For simplicity, repeated letters are not allowed in the target.

```
type word = char list
type guess = char * int
type guesses = guess list
val prune_guesses : guesses -> guesses
```

The `word` type is used to list the correct letters in order, `guess` is a single guess (the letter and its position within the target `word`) and `guesses` is used to list the guesses in order with the most recent first. You may assume that a `prune_guesses` function is available that removes all but the most recent guess for each character.

(a) Define two functions `mapi` and `lookfor` with the following types:

```
val mapi : (int -> 'a -> 'b) -> 'a list -> 'b list
val lookfor : 'a -> ('b * 'a) list -> 'b option
```

The call `mapi f l` maps over every element of `l` using a function `f` that accepts the position of the current list element along with the element. For example, `mapi f ["a";"b";"c"] = [ f 0 "a"; f 1 "b"; f 2 "c" ]`.

The call `lookfor y l` searches `l` for a pair where the second component is equal to `y`, and returns the first component in the pair if found. [4 marks]

(b) Using the earlier definitions, or otherwise, write a function

```
val respond : word -> guesses -> responses
```

that takes a target word and a list of guesses and returns feedback about the game progress to the player. You should define a `responses` type by referring to the game rules. [8 marks]

(c) (i) Define a function `create_game: word -> (guess -> responses)` that returns a function `g` which can be used to imperatively play an independent game: any such `g` can be called for at most six tries after which it raises an `Out_of_turns` exception. [6 marks]

(ii) Illustrate with a brief example how you would use such a function `g` to make some tries, showing the three possible response types. [2 marks]