COMP 302 winter 2020

Quiz 2 Solutions

1. Consider the following function

```
# let comp = fun f -> fun g -> fun x -> g (f x);;
val comp : (’a -> ’b) -> (’b -> ’c) -> ’a -> ’c = <fun>
```

You can see what the OCaml type checker assigned to this higher-order function.

The following questions pertain to this fragment.

Q 1 The `(’a -> ’b)` appearing as part of the type is the type assigned to:
(a) *f* (b) *g* (c) *x* (d) comp.
Answer (a)

Q 2 The type of the subexpression `(f x)` is: (a) `’b` (b) `’c` (c) `’a` (d) `’a -> ’b`.
Answer (a)

Q 3 The type of `g` is (a) `’a` (b) `’a -> ’b` (c) `’b -> ’c` (d) `’b`
Answer (c).

Q 4 The type of `comp (fun u:int -> u + 1) (fun v -> v = 0)` is (a) `int -> int` (b) `bool -> bool` (c) `bool -> int` (d) `int -> bool`
Answer (d).

Q 5 We say two types are isomorphic if there is a one-to-one and onto mapping between the terms that matches pairs of terms with essentially equivalent behaviour. Thus, for example, we have said that the types `’a -> ’b -> ’c` and `(’a * ’b) -> ’c` are isomorphic as currying and uncurrying move us back and forth between these two types. Which of the following pairs are isomorphic? There is only one correct answer. (a) `’a * ’b` and `’a -> ’b` (b) `’a * ’b` and `’b * ’a` (c) `’a -> ’b` and `’b -> ’a` (d) `int` and `int -> bool`. Answer: (b)

Q 6 Recall the Church numerals: **zero**= `fun f -> fun x -> x`, **one**= `fun f -> fun x -> f x`, **two**= `fun f -> fun x -> f (f x)`, **three**= `fun f -> fun x -> f (f (f x))`. Which one of the following statements about the most general polymorphic types of the Church numerals is true? There is only one correct answer. Whenever I use the word “type” below I mean the most general polymorphic type.

(a) The type of **zero** is different from all the others, the type of **one** is different from all the others, and all the remaining ones have the same type.

(b) The type of **zero** is different from all the others, and all the remaining ones have the same type.

(c) They all have the same type.

(d) They all have different types.

Answer: (a)