CAML
MCQ #5
Thursday, September the 14th 2023

1. What is the type of the function g defined below?

```
let g = function
    ((0,_),_) | (_,(0,_))        -> (0, false)
  | ((x,sx),(y,sy)) when sx=sy   -> (x+y, false)
  | ((x,true),(y,sy))            -> (x+y, not sy)
  | ((x,_),(y,sy))               -> (x+y, sy) ;;
```

(a) (int * bool) * (int * bool) * (int * bool)
(b) int * int -> int * bool
(c) (int * bool) -> (int * bool) -> int * bool
(d) (int * bool) * (int * bool) -> int * bool
(e) The function is incorrect.

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2. What will be the last result after successive evaluations of the following phrases?

```
let a = let b = (1,true) in (b,"one") ;;
let (x,y) = a in y ;;
```

(a) - : int * bool = (1, true)
(b) - : int * string = (1, "one")
(c) - : string = "one"
(d) - : bool * string = (true, "one")
(e) An error.

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3. Let f: int -> float -> bool defined in the current environment and print_me the function defined below:

```
let print_me x y =
    if f x y then
      ( print_int x;
        print_float y;; )
```

Which statements are true?

(a) If f x y is true the function print_me prints the value of x.
(b) If f x y is true the function print_me prints the value of y.
(c) If f x y is false the function print_me prints the value of x.
(d) If f x y is false the function print_me prints the value of y.
(e) This function is incorrect.

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4. What does the following function calculate when called with f x ($x \geq 0$)?

```
let rec f = function
      0  -> 1
    | x  -> f (x-1) + 1 ;;
```

(a) x
(b) $x+1$
(c) $\sum_{i=0}^{x} i$
(d) Nothing, it does not terminate!

5. What does the following function calculate when called with f x ($x > 0$)?

```
let rec f = function
   0  -> 0
 | x when x mod 3 = 0 -> f (x+1) + x
 | x  -> f (x+1) + x ;;
```

(a) The sum of the x first integers.
(b) The sum of the x first integers divisible by 3.
(c) The sum of the integers divisibles by 3 $\leq$ to x.
(d) x^3
(e) Nothing, it does not terminate!

6. For which values of x the following function does not stop for sure in theory?

```
let rec f = function
   0                     ->  1
 | x when x < 0          -> f(3*x)
 | x when x mod 2 = 0    -> f(x-2)+1
 | x                     -> f x ;;
```

(a) $x < 0$.
(b) $x > 0$ and even.
(c) x odd.
(d) It stops for any value of x.
(e) It never stops.

7. What is the type of the function f defined below

```
let rec f =
    let g = function x -> x=0 in
        function
              (x,y) when g y  -> x
            | (x,y)           -> f (x,y-1) ;;
```

(a) `int -> int -> int`
(b) `int * int -> int`
(c) `'a * int -> 'a`
(d) The function is incorrect.

8. What does the following function calculate when called with f (a,b) ($b \geq 0$)?

```
let rec f = function
     (a,0) -> 1
   | (a,b) -> f (a,b-1) * a ;;
```

(a) $a + b$
(b) $a * b$
(c) a^b
(d) Nothing, it does not terminate!

9. What does the following function calculate when called with f n ($n \geq 0$)?

```
let rec f x =
    if x < 10 then
        x mod 2
    else
        f (x / 10) + x mod 2 ;;
```

(a) The number of digits of n.
(b) The number of even digits of n.
(c) The number of odd digits of n.
(d) Nothing, it does not terminate!
(e) Nothing, it is incorrect.

10. What does the following function calculate when called with f (a,b) ($b \geq 0$)?

```
let rec f = function
    (a, 0) -> a
  | (a, b) -> f (a+1, b-1) ;;
```
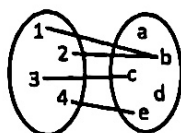
(a) $a + b$

(b) $a * b$

(c) $2a + b$

(d) Nothing, it does not terminate!

MCQ 5

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Question 11

Consider the function $f : \{1, 2, 3, 4\} \longrightarrow \{a, b, c, d, e\}$ defined by the following figure:

Then:

K   a. $f(\{1, 2, 3\}) = \{b, c\}$

    b. $f(\{1, 2, 3, 4\}) = \{a, c, e\}$

    c. $f^{-1}(\{b, c\}) = \{2, 3\}$

X   d. $f^{-1}(\{a, d\}) = \emptyset$

    e. None of the others

Question 12

Consider the function $f : \mathbb{R} \longrightarrow \mathbb{R}$ defined for all $x \in \mathbb{R}$ by $f(x) = x^2$.

    a. $f([0, 1]) = [-1, 1]$

X   b. $f([-1, 1]) = [0, 1]$

    c. $f^{-1}([0, 4]) = [-16, 16]$

    d. $f^{-1}([-1, 0]) = \emptyset$

    e. None of the others

Question 13

Let I and J be two subsets of $\mathbb{R}$ and $f : \begin{cases} I & \longrightarrow & J \\ x & \longmapsto & x^2 \end{cases}$

    a. If $I = J = \mathbb{R}$, then f is surjective.

X   b. If $I = \mathbb{R}$ and $J = \mathbb{R}^+$, then f is surjective.

    c. If $I = \mathbb{N}$ and $J = \mathbb{N}$, then f is surjective.

    d. If $I = \{-2, -1, 0, 2\}$ and $J = \{0, 1, 4, 8\}$, then f is surjective.
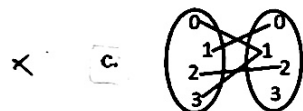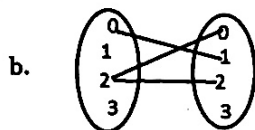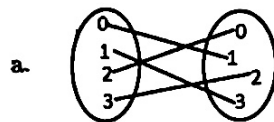
    e. None of the others

Question 14

Let E and F be two sets and $f : E \longrightarrow F$. The function f is surjective if and only if:

    a. $\forall y \in F, \exists x \in E, x = f(y)$

    b. $\forall x \in F, \exists y \in F, y = f(x)$

    c. $\forall y \in F, \forall x \in E, y = f(x)$

    d. $\forall y \in F, \exists x \in E, y = f(x)$

    e. None of the others

Question 15

Which of these figures represent(s) a function $f : \{0, 1, 2, 3\} \longrightarrow \{0, 1, 2, 3\}$ such that $f^{-1}(\{0, 2\}) = \{1, 2\}$?

    a.

    b.

    c.

    d. None of these figures

Question 16

Consider a set E and a relation $\mathscr{R}$ defined over E. Select the correct definitions(s):

    a. $\mathscr{R}$ is reflexive if: $\forall x \in E, x \mathscr{R} x$

    b. $\mathscr{R}$ is symmetric if: $\forall (x, y) \in E^2, x \mathscr{R} y$ and $y \mathscr{R} x$

    c. $\mathscr{R}$ is antisymmetric if: $\forall (x, y) \in E^2, x \mathscr{R} y, y \mathscr{R} x$ and $x = y$

    d. $\mathscr{R}$ is transitive if: $\forall (x, y, z) \in E^3, x \mathscr{R} y$ and $y \mathscr{R} z \Longrightarrow x \mathscr{R} z$
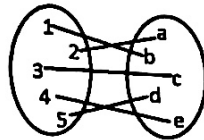
    e. None of the others

Question 17

In $E = \mathbb{N}$, consider the relation $\mathscr{R}$ defined by: $\forall (a, b) \in E^2, a \mathscr{R} b \iff \exists n \in \mathbb{N}$ such that $b = a^n$. Then:

   a. $2 \mathscr{R} 8$

   b. $8 \mathscr{R} 2$

   c. $\mathscr{R}$ is reflexive.

   d. $\mathscr{R}$ is symmetric.

   e. None of the others

Question 18

Consider the function $f : \{1, 2, 3, 4, 5\} \longrightarrow \{a, b, c, d, e\}$ defined by the following figure:

   a. f is injective, not surjective.

   b. f is surjective, not injective.

   c. f is neither injective nor surjective.

   d. f is injective and surjective.

Question 19

Let E and F be two sets and $f : E \longrightarrow F$. The function f is injective if and only if:

   a. $\forall (x, x') \in E^2, f(x) = f(x') \implies x = x'$

   b. $\forall (x, x') \in E^2, x \neq x' \implies f(x) \neq f(x')$

   c. $\forall (x, x') \in E^2, x = x'$ and $f(x) \neq f(x')$

   d. $\forall (x, x') \in E^2, x \neq x'$ and $f(x) = f(x')$

   e. None of the others

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Question 20

Let $E = \{0, 1, 2\}$ and $\mathscr{P}(E)$ the set of all the subsets of E. Then:

✗ a. $\{0, 1\} \in \mathscr{P}(E)$

b. $(0, 1) \in \mathscr{P}(E)$

c. $\mathrm{Card}\big(\mathscr{P}(E)\big) = 9$

✗ d. $\mathrm{Card}\big(\mathscr{P}(E)\big) = 8$

e. None of the others