COL100M Minor 1

Pratyush Pandey

TOTAL POINTS

26.25 / 29

QUESTION 1

1 1 **1 / 1**

✓ **+ 1 pts** Correct

+ **0.5 pts** 'd' missing

+ **0.5 pts** 'rw' missing

+ **0.5 pts** Correct but 'x' extra

+ **0 pts** Incorrect/Unattempted

QUESTION 2

2 2 **0.5 / 1**

+ **1 pts** Correct

✓ **+ 0.5 pts** Only 2 parent directory links followed instead of 3

+ **0.5 pts** More than one cd command used.

+ **0.5 pts** Missed one directory change in between

+ **0.5 pts** Missing forward slashes

+ **0.25 pts** Only one parent directory link followed instead of 3

+ **0.25 pts** Missed one parent link pointer as well as one directory change

+ **0 pts** Incorrect/Not Attempted

💬 No need to put directory names in quotes

QUESTION 3

3 4 pts

3.1 3a **0.25 / 0.5**

+ **0.5 pts** Correct

✓ **+ 0.25 pts** Partially Correct

+ **0 pts** Incorrect/Unattempted

3.2 3b **1 / 1**

✓ **+ 1 pts** Correct

+ **0 pts** Incorrect/Unattempted

+ **0.5 pts** Partially Correct

3.3 3c **1 / 1**

✓ **+ 1 pts** Correct : 1, int

+ **0 pts** Incorrect. The correct answer is 1 of type int. $1 + (2 / 8) = 1 + 0 = 1$. (Uses integer division)

+ **0.5 pts** Value (= 1) is correct but the type (= int) is not mentioned.

+ **0.5 pts** Value (= 1) is incorrect but type (= int) is correct.

+ **0 pts** No Attempt.

3.4 3d **1.5 / 1.5**

✓ **+ 1.5 pts** Correct

+ **0 pts** Incorrect / Unattempted

+ **0.5 pts** Identified that error has occurred

+ **1 pts** Error identified but partially correct or incomplete

+ **0.5 pts** Grace marks for identifying a possible different error because of lack of knowledge of precedence of operators

QUESTION 4

4 4 **1 / 1**

✓ **+ 1 pts** Correct

+ **0 pts** Incorrect / Unattempted

QUESTION 5

5 11 pts

5.1 5a **3 / 3**

✓ **+ 1 pts** Signature correct.

✓ **+ 2 pts** Description correct.

+ **1 pts** Description partially correct.

+ **0 pts** Completely wrong

5.2 5b **4 / 4**

✓ **+ 2 pts** Completely correct; even if list instead of `a list

+ **1 pts** Structure correct but data type partially correct; structure almost correct, only type of x is

incorrect.

   + 1 pts Input , output correctly specified

✓ **+ 2 pts Description completely correct**

   + 1.5 pts Description correct, but doesn't specify what happens if n > len(l)

   + 1 pts Description says replaces the nth element

   + 0.5 pts Description makes some sense

   + 0 pts Completely wrong

5.3 5c **4 / 4**

✓ **+ 2 pts Signature, completely correct**

   + 1 pts Identifies that there are two function parameters.

   + 0 pts If functions have not been identified at all, then no marks can be given.

✓ **+ 2 pts Description, completely correct. h(g(x))**

   + 1 pts Description says finds h(g(x)), but either from g(h(x)) or equals f(g(h(x)), or some other roundabout way.

   + 0 pts Description incorrect.

QUESTION 6

6 6 **2 / 2**

✓ **+ 0.5 pts Correct for empty list**

✓ **+ 0.5 pts Correct for single element list**

✓ **+ 1 pts Correct for recursive case**

   + 0.5 pts Base cases correct but syntax incorrect

   + 0 pts incorrect

   + 0.5 pts recursive case partially handled

   + 2 pts Works, but is not a single, recursive function. Instead uses a helper recursive function.

QUESTION 7

7 **4 pts**

7.1 7a **2 / 2**

✓ **+ 2 pts Answer is 2**

   + 0 pts Incorrect,Answer is 2

7.2 7b **0 / 2**

✓ **+ 0 pts Answer is 22**

   + 2 pts Correct

QUESTION 8

8 **5 pts**

8.1 8a **3 / 3**

   - 3 pts Blank/Incorrect

   - 2 pts Recurrence written wrong/ Not written

   - 0.5 pts Mention what happens otherwise, like if n<0, then it is undefined

   - 0.5 pts Base Case should be fib(1) = 1 and fib(2) = 1. For negative numbers its not 1.

   - 0.5 pts Incorrect Base Case

   - 3 pts Mathematical formula was asked and not ocaml code

   - 0 pts Correct

+ 3 Point adjustment

8.2 8b **2 / 2**

✓ **+ 2 pts Correct**

   + 1.5 pts Wrong towards the end/start

   + 1 pts Half wrong

   + 0 pts Wrong sequence

   + 0 pts Blank

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COL100 – Minor exam 1

Feb. 3, 2018

NAME:

PRATYUSH PANDEY

STUDENT ID:

2017TT10938

1 Instructions

1. Write your answers *only in the space provided.* We are using software which automatically detects the answer region. If you write in the margins or in the wrong space, *your answer will not be graded.*

2. No calculators, phones, notes, or other resources are allowed. This is a closed book exam.

3. Time allocated for the exam: *1 hr.*

2 Exam begins here
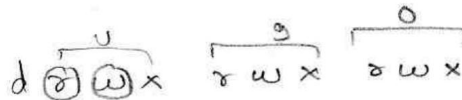
1. **(1 mark)** Suppose a directory personal has read and write access for users, but no access for groups and others, write the *permission string* that would be displayed on typing the command ls -l personal.

   d r w _ _ _ _ _ _ _ _

2. **(1 mark)** Suppose the directory structure is organised as in Figure 1 and your current working directory is as shown. Write a *single* cd command to go from your current directory to the directory indicated using a *relative path.*

   cd .. / "Calculator.app" / "Contents" / "MacOs"

   Ans: cd .. / .. / "Calculator.app" / "Contents" / "MacOs"

3. **(.5+1+1+1.5 marks)** For each expression below, write the value that is returned and its type. If there is an error, state what error is returned (in plain English).

   (a) "1" ^ string_of_int 1

   11 . Type → string .

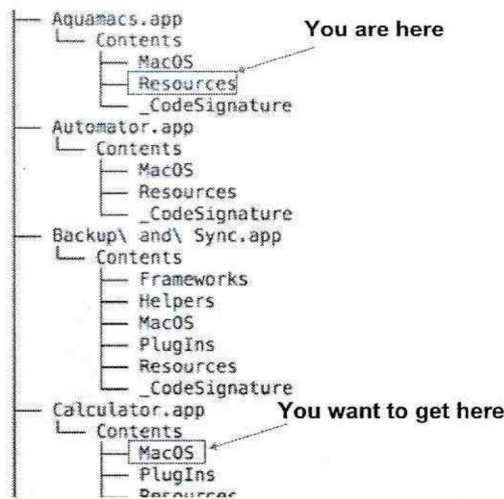   (b) (1 < 2) = false

   false . Type → Boolean .

1

Figure 1: Question 2: Directory structure

(c) `1 + 2 / 8`

> 1 . Type = int

(d) `string_of_int (float_of_int 2) ^ "2"`

> Error: string-of-int expected type integer but got float (2.0) instead

4. **(1 mark)** What is the value of x in the following code snippet?

```
let y = 5 in
let z = y+4 in
let x = z*5 in
let z = x+1 in
let x" = y*(z+1) in x"
```

(handwritten annotations:)

`z = 5 + 4 = 9`

`(x) = 9 * 5 = 45`

`(z) = (x) + 1 = 46`

`x" = 5 * (46 + 1) = 5 * 47`

```
  3
 4.7
x 5.
 235
```

> 235

5. **((1+2)+(2+2)+(2+2) marks)** For each function below (all named f), (i) Write the signature of the function (your notation should conform to that returned by the OCaml top level. That is, for function `let add a b = a+b`, write `int -> int -> int`), and, (ii) write a *one sentence* description of what the function does (for example, for function `add`, write "adds integers a and b").

(a) ```
let rec f a b =
  if b = 0 then a else f b (a mod b)
```

> int → int → int

> Returns the gcd (greatest common divisor) of a, b.

2

$[$ f e 4 $[a,b,c]$ | a :: f e 3 $[b,c]$ | a :: f e 1 $[b,c]$ $(a,b,e,c)$

b :: f e 2 $[c]$ | b :: f e 0 $[c]$ $(b,e,c)$

c :: f e 1 $[ ]$ | e :: $[e]$ // $[e,c]$

$[e]$ | $(e,c)$

(b) 
```
let rec f x n l =
   match l with
   | [] -> [x]
   | h :: t -> if n = 0 then x :: l
   else h :: f x (n-1) t
```

$$'a \longrightarrow int \longrightarrow 'a\ list \longrightarrow 'a\ list$$

→ inserts 'x' at $n^{th}$ position in the list (indices starting from 0).
If $n >$ Length of the list then $x$ is inserted at the last position.

(c) let f g h x = let y = g x in h y

$$('a \rightarrow 'b) \rightarrow ('b \rightarrow 'c) \rightarrow 'a \rightarrow 'c$$

Returns value of h o g (x) or h(g(x)) i.e. g acts on function first, followed by h which acts on g output to give overall result.

6. **(2 marks)** Write a *single, recursive* function altrnt:'a list -> 'a list in OCaml, that takes in a list lst and returns a list containing every *alternate* element of lst starting from the first element (that is, the first element should be returned in the list). (*Note*: No partial marks will be awarded for this question.)

```
let rec altrnt li =
     match li with
     | a :: b :: tl → a :: altrnt tl
     | y :: [z] → [y]
     | [x] → [x]
     | [] → [];;
```

7. Define $h(n), n \geq 0$ as follows:
$h(0) = 0$
$h(n) = n - h(h(h(n-1))), n > 0$

Answer the following questions:

(a) **(2 marks)** What is $h(3)$?

2

(b) **(2 marks)** When translated into a recursive function in OCaml, which takes in n and returns the nth element in the sequence, h: int -> int and that follows the recursion above exactly, how many times is the function h called in h 3.

15

3

8. We learnt about the Fibonacci sequence and how it is recursively defined. Here is a variant on that sequence. The idea is as follows: Let $Q(1) = Q(2) = 1$. For computing $Q(n)$, $n > 2$, we would like to look at the two elements before it – that is, elements at the $(n-1)^{th}$ position and the $(n-2)^{th}$ position. Let the elements at these positions be x and y, then we calculate the $Q(n)$ as the sum of the elements at $(n-x)^{th}$ position and $(n-y)^{th}$ position. Example: Suppose we want to find $Q(5)$, then we look at elements at the 4th and 3rd positions. Let those elements be 3 and 2. We then add the numbers at the $(5-3)^{th}$ and $(5-2)^{th}$ position (that is, the second and third position) to get $Q(5)$.

Answer the following questions:

(a) **(3 marks)** Write a *recursive* mathematical formulation of the above.

$$Q_{(n)} = \begin{cases} 1 & \text{if } n = 1 \\ 1 & \text{if } n = 2 \\ Q(n - Q(n-1)) + Q(n - Q(n-2)) & \text{if } n > 2 \\ (\text{invalid input} & \text{if } n < 1) \end{cases}$$

(b) **(2 marks)** Write the first 10 elements in the sequence.

$$1, 1, 2, 3, 3, 4, 5, 5, 6, 6.$$

Use this space for rough work if required. Whatever you write here *will not be graded.*

$n = 1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9 \quad 10$

$1, 1, 2, 3, 3, 4, 5, 5, 6, 6$

$n = 4$

$Q \begin{cases} n \ 1 & \text{if } n = 1 \\ 1 & \text{if } n = 2 \\ Q(n - Q(n-1)) + Q(n - Q(n-2)) & \text{if } n > 2 \end{cases}$

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