NATIONAL UNIVERSITY OF SINGAPORE

CS1101S — PROGRAMMING METHODOLOGY

AY2022/2023 SEMESTER 1

READING ASSESSMENT 2

Time Allowed: 45 Minutes

ANSWERS

INSTRUCTIONS

- 1. This assessment contains 21 Multiple-Choice Questions in 3 Sections.
- 2. Each question has one correct answer. The **indicated marks** are awarded for each correct answer and there is **no penalty** for a wrong answer.
- 3. The full score of this assessment is **60 marks**.
- 4. Answer all questions.
- 5. This is a **Closed-Book** assessment, but you are allowed one double-sided **A4 / letter-sized sheet** of handwritten or printed **notes**.
- 6. You are allowed to use up to 4 sheets of blank A4 / letter-sized paper as scratch paper.
- 7. You are allowed access to these online reference pages:
 - Source §3 pre-declared constants and functions at https://docs.sourceacademy.org/source_3/global.html
 - **Specification of Source §3** at https://docs.sourceacademy.org/source_3.pdf
- 8. Follow the instructions of your invigilator or the module coordinator to submit your answers.

Pre-declared Functions

In this assessment, you are allowed access to these online reference pages:

- Source §3 pre-declared constants and functions at https://docs.sourceacademy.org/source_3/global.html
- **Specification of Source §3** at https://docs.sourceacademy.org/source_3.pdf

For this **entire assessment**, the following implementations for the pre-declared functions **map**, **filter**, **accumulate**, and **append supersede** the implementations given in the **Specification of Source §3** at https://docs.sourceacademy.org/source_3.pdf.

```
function map(f, xs) {
    return is null(xs)
           ? xs
           : pair(f(head(xs)), map(f, tail(xs)));
}
function filter(pred, xs) {
    return is null(xs)
           ? null
           : pred(head(xs))
           ? pair(head(xs), filter(pred, tail(xs)))
           : filter(pred, tail(xs));
}
function accumulate(f, initial, xs) {
    return is_null(xs)
           ? initial
           : f(head(xs), accumulate(f, initial, tail(xs)));
}
function append(xs, ys) {
    return is_null(xs)
           ? ys
           : pair(head(xs), append(tail(xs), ys));
}
```

Section A [16 marks]

For all the questions in this section, consider the following Source program:

Program X:

```
let w = 2;
function gee() {
          let w = 3;
        }
     let hoo = x => (y => 100 * w + 10 * x + y);
     w = 4;
     return hoo;
}
{
    let w = 5;
}
w = 6;
gee()(7)(8);
```

- (1) [4 marks] What is the result of evaluating Program X?
 - **A.** 278
 - **B.** 378
 - **C.** 478 (answer)
 - **D.** 578
 - **E.** 678
 - **F.** 587
 - **G.** 687
 - **H.** None of the other options is the correct answer
- (2) [3 marks] How many environment frames get created during the evaluation of Program X? (Do not count the global environment frame.)
 - **A.** 1
 - **B.** 2
 - **C.** 3
 - **D.** 4
 - **E.** 5
 - F. 6 (answer)
 - **G.** 7
 - **H.** None of the other options is the correct answer

(3)	[3 marks] Of the environment frames that get created during the evaluation of Program X, how many extend the program environment <i>directly</i> ?			
	A.	1		
	В.	2 (answer)		
		3		
	D.			
	E.	5		
	F.	6		
	G.	7		
	Н.	None of the other options is the correct answer		
(4)		[3 marks] How many function objects get created during the evaluation of Program X (Do not count function objects of primitive and pre-declared functions.)		
	A.	0		
	В.	1		
	C.	2		
	D.	3 (answer)		
	E.	4		
	F.	5		
	G.	6		
	H.	None of the other options is the correct answer		
(5)	of the A. B. C.	B. 3C. 4 (answer)		
	D.	5		
	E.	6		
	F.	7		
	G.	None of the other entires is the correct energy		
	Н.	None of the other options is the correct answer		

Section B [24 marks]

For all the questions in this section, consider the following Source program:

Program Y:

```
function something(xs, ys) {
    function swap pair(p, q) {
        let head p = head(p);
        let tail p = tail(p);
        set head(p, head(q));
        set tail(p, tail(q));
        set_head(q, head_p);
        set_tail(q, tail_p);
    }
    if (!is null(xs)) {
        swap pair(xs, ys);
        something(tail(xs), tail(ys));
    }
}
let AA = list(list(11), list(22), list(33), list(44));
let BB = list(list(55), list(66), list(77), list(88));
let AA0 = AA;
let AA0 head = head(AA0);
let AAO_tail = tail(AAO);
let AA1 = tail(AA);
let AA1 head = head(AA1);
let AA1 tail = tail(AA1);
something(AA, BB);
```

(6) [3 marks] What is the value of AA (in *list notation*) at the end of the evaluation of Program Y?

```
A. list(list(11), list(22), list(33), list(44))
B. list(list(55), list(66), list(77), list(88))
C. list(list(11), list(66), list(33), list(88))
D. list(list(55), list(22), list(77), list(44)) (answer)
E. list(list(11), list(66), list(77), list(88))
F. list(list(55), list(22), list(33), list(44))
```

(7) [3 marks] What is the result of the following statement if it is evaluated at the end of Program Y?

```
[ AA0 === AA, AA0_head === head(AA), AA0_tail === tail(AA) ];
A. [false, false, false]
B. [false, false, true ]
C. [false, true, false]
D. [false, true, true ]
E. [true, false, false] (answer)
F. [true, false, true ]
G. [true, true, true, true ]
```

(8) [3 marks] What is the result of the following statement if it is evaluated at the end of Program Y?

```
[ AA1 === tail(AA),
   AA1_head === head(tail(AA)),
   AA1_tail === tail(tail(AA)) ];

A. [false, false, false]
B. [false, false, true ]
C. [false, true, false]
D. [false, true, true ] (answer)
E. [true, false, false]
F. [true, false, true ]
G. [true, true, true ]
```

(9)	[2 n	narks] How many pairs get created during the evaluation of Program Y?
	A.	4
	В.	8
	C.	12
	D.	16 (answer)
	E.	20
	F.	24
	G.	32
	Н.	None of the other options is the correct answer
(10)		narks] How many bindings does the program environment frame contain during evaluation of Program Y?
	A.	Fewer than 8
	B.	8
	C.	9 (answer)
	D.	10
	E.	11
	F.	12
	G.	13
	Н.	More than 13
(11)	Pro of t	narks] How many environment frames get created during the evaluation of gram Y? (Do not count the global environment frame. We assume that the applications he primitive functions, such as is_null, head, tail, pair, list, set_head, and a_tail, do not create any frame.)
	A.	6
	B.	10
	C.	14
	D.	15
	E.	17
	F.	19 (answer)
	G.	20
	H.	None of the other options is the correct answer

(12)	Υ,	how	of the environment frames that get created during the evaluation of Program many extend the program environment <i>directly</i> ? (We assume that the ions of the primitive functions do not create any frame.)	
	A.	5	(answer)	
	В.	9		
		13		
		14		
	E.	16		
	F.	18		
		19		
	Н.	_	ne of the other options is the correct answer	
(13)	[3 n	ıarl	(xs] How many function objects get created during the evaluation of Program Y?	
(==)	(Do not count function objects of primitive and pre-declared functions such as array_length, math_floor, pair, head, tail, length, and map.)			
	A.			
	В.	1		
	C.			
	D.	_		
	E.	6	(answer)	
	F.	7		
	G.	9		
	Н.	No	ne of the other options is the correct answer	
(14) [2 marks] Of the function objects that get created during the evaluation of Program Y, how many have the program environment as their environment (i.e. their right circles point to the program frame)? (Do not count function objects of primitive and pre-declared functions.)				
	A.	0		
	B.	1	(answer)	
	C.	4		
	D.	5		
	E.	6		
	F.	7		
	G.	9		
	Н.		ne of the other options is the correct answer	

Section C [20 marks]

For all the questions in this section, consider the following Source program:

Program Z:

```
function what(rows) {
    let M = [];
    let rr = 0;
    while (rr < rows) {</pre>
        M[rr] = [];
        let cc = 0;
        while (cc <= rr ) {</pre>
             if ( cc % 2 === 0 ) {
                 M[rr][cc] = () => 10 * rr + cc;
             } else {
                 let temp = 10 * rr + cc;
                 M[rr][cc] = () \Rightarrow temp;
             cc = cc + 1;
        rr = rr + 1;
    }
    return M;
}
let AA = what(7);
```

(15) [3 marks] What is the result of the following statement if it is evaluated at the end of Program Z?

```
AA[4][1]();
```

- **A.** 41 (answer)
- **B.** 40
- **C.** 77
- **D.** 47
- E. 71
- **F.** 45
- **G.** 75
- **H.** None of the other options is the correct answer

	arks] What is the result of the following statement if it is evaluated at the end of ram Z?			
AA[4	1][2]();			
A.	42			
В.	41			
С.	77			
D.	47			
	71			
	45			
G.				
Н.	None of the other options is the correct answer			
(17) [3 marks] How many arrays get created during the evaluation of Program Z?				
A.				
	6			
	7			
	8 (answer)			
	9			
	28			
	29			
Н.	None of the other options is the correct answer			
	arks] How many environment frames get created during the evaluation of ram Z? (Do not count the global environment frame.)			
A.	3			
В.	10			
C.	15			
D.	17			
E.	22 (answer)			
F.	31			
G.	38			
Н.	None of the other options is the correct answer			

(19) [2 marks] Of the environment frames that get created during the evaluation of Program Z, how many have bindings for the variable cc ?				
A.	1			
	4			
C. (
D.				
	8			
	12			
	28			
Н.	None of the other options is the correct answer			
(20) [2 marks] Of the environment frames that get created during the evaluation of Program Z, how many have bindings for the variable temp?				
A. (
B. C.	1			
	7			
	8			
	12 (answer)			
	28			
	None of the other options is the correct answer			
(21) [4 marks] How many function objects get created during the evaluation of Program Z? (Do not count function objects of primitive and pre-declared functions.)				
A.				
	7			
	8			
	12 13			
	29 (answer) 50			
	None of the other options is the correct answer			
11.	None of the other options is the correct answer			
	—— END OF QUESTIONS ——			

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