COMPSCI 1JC3 Midterm Test 2
McMaster University

Answer Key: Large arrow ($\Longleftarrow$) for correct, small ($\leftarrow$) for partially correct

Day Class 01, 02, **Version 1** Dr. W. M. Farmer

DURATION: 2 hours November 17, 2017

Please CLEARLY print:

NAME:

Student ID: | | | | | | | | | |

In an addition to this examination paper, you will be given two answer sheets for this test. This examination paper includes 13 pages and 30 questions. You are responsible for ensuring that your copy of the examination paper is complete. Bring any discrepancy to the attention of your invigilator.

The examination will be conducted in two stages:

First Stage: You have 90 minutes to answer the questions in the examination paper on the first answer sheet working **by yourself**. Getting any help in any form from your fellow students and anyone else will be treated as academic dishonesty. You must submit your first answer sheet to your invigilator by the end of the 90-minute period. Your performance on the answer sheet counts for 85% of the Midterm Test 1 mark. You may want to fill out the second answer sheet as you fill out the first leaving blank those questions that you want to work on during the second stage.

Second Stage: You have 30 minutes to answer the questions in the examination paper on the second answer sheet working **with the other students in the test room**. You may walk around the test room, but you may not leave the test room. You must submit your second answer sheet and your examination paper to your invigilator by the end of the 30-minute period. Your performance on the answer sheet counts for 15% of the Midterm Test 1 mark.

Special Instructions:

(1) It is your responsibility to ensure that the two answer sheets are properly completed. Your examination result depends upon proper attention to these instructions:

- A heavy mark must be made, completely filling the circular bubble, with an HB pencil.
- Print your name, student number, course name, course number and the date in the space provided on the top of Side 1 and fill in the corresponding bubbles underneath.
- **Fill in the bubble corresponding to your version number.**
- Mark only **ONE** choice from the alternatives (1, 2, 3, 4, 5 or A, B, C, D, E) provided for each question. If there is a True/False question, mark 1 (or A) for True, and 2 (or B) for False. The question number is to the left of the bubbles. Make sure that the number of the question on the scan sheet is the same as the number on the examination paper.

- Pay particular attention to the "Marking Directions" given on the scan sheet.
- Begin answering the questions using the first set of bubbles, marked "1." Answer all questions.

(2) The use of notes and textbooks is **not** permitted in both stages of the test.

(3) Calculators, computers, cell phones, and all other electronic devices are **not** to be utilized in both stages of the test.

(4) Read each question carefully.

(5) Try to allocate your time sensibly and divide it appropriately between the questions.

(6) Select the **best** answer for each question.

Question 1 [1 mark]
Public key encryption has largely replaced conventional encryption in network communication. Is this statement true or false?

A. True.

B. False. ⟸

ANSWER:
Public key and conventional encryption are equally used in network communication today.

Question 2 [1 mark]
`QuickCheck` can be used to prove that a Haskell function satisfies a given property? Is this statement true or false?

A. True.

B. False. ⟸

ANSWER:
QuickCheck can be used to check whether a function satisfies a given property for a finite number of randomly generated instances, but it cannot, in general, be used to check all instances. Thus it cannot be used to prove that the function satisfies the property.

Question 3 [1 mark]
In Haskell, an enumeration type is a special case of a sum type. Is this statement true or false?

A. True. ⟸

B. False.

ANSWER:
An enumeration type is the simplest kind of sum type.

Question 4 [1 mark]
Public key encryption is used to exchange secret keys for conventional encryption. Is this statement true or false?

A. True. ⟸

B. False.

ANSWER:
Secret key exchange is one of the principal applications of public key encryption.

Question 5 [1 mark]
Unlike a server, a client usually listens at a fixed UDP or TCP protocol port. Is this statement true or false?

A. True.

B. False. ⟸

ANSWER:
Servers usually listen at fixed protocol ports, while clients are assigned temporary protocol ports on a random basis.

Question 6 [1 mark]
An operating systems manages running programs as *processes*. Is this statement true or false?

A. True. ⟸

B. False.

ANSWER:
A process consists of a program's code and its current activity.

Question 7 [1 mark]
The TCP/IP protocol suite can run on a computer that is not connected to any physical network. Is this statement true or false?

A. True. ⟸

B. False.

ANSWER:
TCP/IP can run on a computer without any physical network interfaces by using the virtual loopback network interface.

Question 8 [1 mark]
Every Haskell function must be defined on all possible inputs. Is this statement true or false?

A. True.

B. False. ⟸

ANSWER:
A Haskell function can be left undefined on a subset of its possible inputs.

Question 9 [1 mark]
Public key encryption can be used to protect

A. Confidentiality.

B. Integrity.

C. Confidentiality and integrity. ⟸

D. Availability, confidentiality, and integrity.

ANSWER:
Public key encryption can be used to protect both confidentiality and integrity, but not availability.

Question 10 [1 mark]
A hash table is

A. Used for efficiently storing and retrieving hash functions.

B. Used for efficiently storing and retrieving values. ⟸

C. Used to store encrypted passwords.

D. Produced by the application of a hash function.

ANSWER:
A hash table uses a hash function to store values that can be later quickly retrieved.

Question 11 [1 mark]
The Internet has the structure of a bipartite graph. The edges of the graph are

A. Hosts.

B. Network interfaces. ⟸

C. Physical networks.

D. Routers.

ANSWER:
The nodes are hosts and physical networks; the edges are network interfaces.

Question 12 [1 mark]
A(n) _____ normally would be transported in the data area of a(n) _____. Which answer fills in the blanks in order correctly?

A. IP datagram, TCP segment.

B. Network frame, IP datagram.

C. Network frame, TCP segment.

D. TCP segment, IP datagram. ⟸

ANSWER:
Only D makes sense.

Question 13 [1 mark]
Which communication protocol provides a reliable communication service between processes?

A. FTP.

B. HTTP.

C. IP

D. TCP. ⟸

ANSWER:
TCP is protocol for reliably transporting data between processes.

Question 14 [1 mark]
Tim Berners-Lee invented

A. HTML.

B. HTTP.

C. URLs.

D. All of the above. $\Longleftarrow$

ANSWER:
Yes, he invented all of these.

Question 15 [1 mark]
Which number can be represented exactly as a member of the type `Float`?

A. 0.375. $\Longleftarrow$

B. 0.575.

C. 0.610.

D. 0.800

ANSWER:
$0.375 = 0.25 + 0.125 = 1/4 + 1/8 = 1/2^2 + 1/2^3$.

Question 16 [1 mark]
A shell script is a program that executes commands for a

A. Command-line interface . $\Longleftarrow$

B. Graphical user interface.

C. Web browser.

D. Web server.

ANSWER:
A shell script is a program that executes commands for a command-line interface to an operating system called a shell.

Question 17 [1 mark]
The technology underlying the Internet was developed by researchers funded by

A. AT&T (before its breakup in 1982).

B. IBM.

C. The United Nations.

D. The U.S. Department of Defense. $\Longleftarrow$

ANSWER:
The research was funded by the U.S. Department of Defense's ARPA agency.

Question 18 [1 mark]
What is the hexadecimal number 3ABC in binary?

A. 10101110111100.

B. 11101010100100.

C. 11101010111100. $\Longleftarrow$

D. 11101111101100.

ANSWER:
$(3ABC)_{16} = 3*16^3 + 10*16^2 + 11*16^1 + 12*16^0 = (0011)_2*2^{12} + (1010)_2*2^8 + (1011)_2*2^4 + (1100)_2*2^0$.

Question 19 [1 mark]
The IP protocol routes IP datagrams using

A. The destination IP address. $\Longleftarrow$

B. The destination DNS name.

C. The destination IP address and DNS name.

D. The destination IP address, DNS name, and protocol port.

ANSWER:
Addressing is done in the IP protocol using IP addresses that are assigned to network interfaces.

Question 20 [**1 mark**]
A web browser includes a(n)

A. HTTP client. ⟸

B. HTTP server.

C. HTML WYSIWYG editor.

D. All of the above.

ANSWER:
A browser includes an HTTP client as well as possibly other clients.

Question 21 [**1 mark**]
What is the usual type of a sorting algorithm in Haskell?

A. `Ord a => [a] -> a`.

B. `Ord a => [a] -> [a]`. ⟸

C. `Ord a => [a] -> [a] -> [a]`.

D. `Ord a => ([a] -> [a]) -> [a]`.

ANSWER:
A sorting algorithm in Haskell takes a list as input and returns a list as output that is a sorted permutation of the input list.

Question 22 [**1 mark**]
The expressions of an algebraic type serve as _____ for the values of the type.

A. Constructors.

B. Formulas.

C. Literals. ⟸

D. Properties.

ANSWER:
An expression of an algebraic type indicates its value by its construction, as a literal does.

Question 23 [**1 mark**]
Suppose that we would like to prove a property about a function of type `Poly -> Poly` (where `Poly` is the type defined in Assignment 3) using structural induction. How many base cases would there be?

A. 0.

B. 1.

C. 2. $\Longleftarrow$

D. 3.

ANSWER:
Poly has two base cases, one for the indeterminant X and one for coefficients.

Question 24 [**1 mark**]
Consider the following Haskell code. What is the value `kilkenny 3 [1,2,3,4,5,6,7]`?

```
kilkenny :: Integer -> [a] -> [a]

kilkenny 0  x = []
kilkenny n [] = []
kilkenny n  x = (head x) : kilkenny (n - 1) (tail x)
```

A. `[4]`.

B. `[1,2,3]`. $\Longleftarrow$

C. `[3,4,5]`.

D. `[4,5,6,7]`.

ANSWER:
`kilkenny` is the "take" function on lists.

Question 25 [1 mark]
A *palindrome* is a string that reads the same both from left to right and right to left. For example, `"eye"` and `"racecar"` are palindromes. What expressions E_1 and E_2 will make the following function return `True` if the input `x` of type `String` is a palindrome and return `False` if the input `x` of type `String` is not a palindrome?

```
isPalindrome :: String -> Bool

isPalindrome []     = True
isPalindrome [c]    = True
isPalindrome (c:cs) =
  let ds = E1
  in if c == head ds
     then isPalindrome E2
     else False
```

A. E_1 is `(tail cs)` and E_2 is `ds`.

B. E_1 is `(reverse cs)` and E_2 is `reverse ds`.

C. E_1 is `(reverse cs)` and E_2 is `head ds`.

D. E_1 is `(reverse cs)` and E_2 is `(tail ds)`. $\Longleftarrow$

ANSWER:
Only D correctly makes `isPalindrome` into a palindrome checker.

Question 26 [1 mark]
Consider the following Haskell code. If `x` is the name of a text file, what does the file `"out.txt"` contain after `limerick x` is evaluated?

```
limerick x = do y <- readFile x
                writeFile "out.txt" (rathberry y)

rathberry a =
  let b = lines a
      c = map length b
      d = map show c
      e = unlines d
  in e
```

A. It contains a copy of the contents of the file named `x`.

B. It contains the lines of text in the file named `x` in reverse order.

C. It contains the length of each line of text in the file named `x`. ⟸

D. It contains the number of characters in the file named `x`.

ANSWER:
`rathberry` breaks its input string into lines, replaces each line with the line's length, replaces each length with a string representation, and finally reassembles the resulting list of strings into a single string with end of line characters.

Question 27 [**1 mark**]
Consider the following code where `Tree` is an algebraic type of multiple branching trees whose nodes are labeled by integers. What expression E will make the function `sumTree` return the sum of the integer labels in a member of type `Tree`?

```
data Tree = Branches [Tree] Integer

sumTree :: Tree -> Integer

sumTree (Branches [] x) = x
sumTree (Branches (t:ts) x) = E
```

A. `x + sumTree t + sumTree ts`.

B. `x + sumTree t + sumTree (Branches ts)`.

C. `x + sumTree t + sumTree (Branches ts x)`.

D. `sumTree t + sumTree (Branches ts x)`. $\Longleftarrow$

ANSWER:
The sum of a nonempty tree is the sum of the first branch of the tree plus the sum of the tree without its first branch.

Question 28 [**1 mark**]
Consider the following code. What is the type of `skibbereen`?

```
skibbereen = do x <- getLine
                y <- getLine
                print (bandon x y)

bandon a b =
  let a' = read a :: Float
      b' = read b :: Float
  in a' * b'
```

A. `IO ()`. $\Longleftarrow$

B. `IO Float`.

C. `IO String`.

D. `Float -> Float -> IO ()`.

ANSWER:
`skibbereen` does not return a value, so its type is `IO ()`.

Question 29 [1 mark]
Which of the following is true about the function `print`?

A. `print` is side-effect free.

B. `print` can print any value whose type is an instance of the `Show` type class. ⟸

C. `print` can print only strings.

D. `print` has type `a -> IO ()`.

ANSWER:
B is true, so A, C, and D must be false.

Question 30 [1 mark]
Consider the following Haskell function. What is the value of

`macroom [1,3,4,6,4,-3,4,-5,2,8,2,3,3,3]`?

```
macroom :: Ord a => [a] -> [a]

macroom     [] = []
macroom (x:xs) =
  let kinsale     [] y z = [y,z]
      kinsale (x:xs) y z
        | x < y     = kinsale xs x z
        | x > z     = kinsale xs y x
        | otherwise = kinsale xs y z
  in kinsale xs x x
```

A. `[-3,-5,1,2,2,3,3,3,3,3,4,4,6,8]`.

B. `[-3,8]`. ⟸

C. `[1,5]`.

D. `[2,12]`.

ANSWER:
`macroom x` returns a pair consisting of the minimum and maximum of the input list x. It returns [] if the input list is []. Unfortunately, none of the answers are correct.

Please make sure your **version number** is clearly marked on your scan sheet!

THE END.