Concordia University
COMP 248 – Winter 2023
Assignment 2

Due Date:	By 11:59pm, February 17, 2023
Evaluation:	3% of final mark (see marking rubric at the end of booklet)
Late Submission:	None accepted
Purpose:	Illustrate and evaluate your understanding of the following concepts, viz: Java Identifiers, Arithmetic Operators & Operations, Input/Output Operations, String Operations, and Flow of Control statements: `if`, `if/else`, `switch`, `etc`.
CEAB/CIPS Attributes:	Design/Problem Analysis/Communication Skills

NOTE 1: *You are NOT allowed to post any assignment and/or its solution anywhere on the World Wide Web (WWW) and/or the Internet.* ***Intellectual Property Rights*** *are reserved. If any case is discovered via your account or IP address; your submission will NOT be considered and will be reported immediately to the appropriate authority.*

NOTE 2:

(i) Neither use nor import any other library/package aside from: `java.util.Scanner`;
(ii) Neither implement nor use any custom/user-defined function(s) for any task herein.
(iii) With respect to every task herein, do NOT implement or use the following constructs, viz: **iterations/loops**, **arrays, lists**, etc.

General Guidelines When Writing Programs:

- Include the following comments at the top of your source codes

```
// -----------------------------------------------------
// Assignment {include number}
// Written by: {include your name and student ID}
// For COMP 248 Section {your section} – Winter 2023
// -----------------------------------------------------
```

- In a comment, give a general explanation of what your program does. As the programming questions get more complex, the explanations will get lengthier.
- Include comments in your program describing the main steps of your program. Focus on your comments should be on the "why" rather than the "how".
- Display a welcome message.
- Display clear prompts for users when you are expecting the user to enter data from the keyboard.
- All output should be displayed with clear messages and in an easy-to-read format.
- End your program with a closing message so that the user knows the program has terminated.

Introduction

With reference to the domain of Computer Science, employ the following definitions toward completing the assigned tasks herein.

Bandwidth: A measure of the quantity of data that can travel through a given communication channel/link in one second. This is measured in bits per second (bps).

Latency: A measure of the delay incurred with respect to the transfer of data, from source to destination, via a given communication channel/link. It is measured in milliseconds (ms).

Byte: The equivalence of one byte (1 B) is eight bits (8 b).

Prefixes of Quantifiers: `1 Kilo (1 K) = 2^10; 1 Mega (1 M) = 2^20; 1 Giga (1 G) = 2^30; 1 Tera (1 T) = 2^40; 1 Peta (1 P) = 2^50; 1 Exa (1 E) = 2^60; 1 Zetta (1 Z) = 2^70; 1 Yotta (1 Y) = 2^80.`

Question 1 (*7pts*): Static Latency-Computer Program

Summer internships are fast approaching, and companies/firms have already begun recruiting capable candidates to fill up some Summer (Student) Intern positions. **Project-S** is a Space-Exploration program handled and managed by a globally reputable company in the Science and Technology sector of our global economy. Thus, **Project-S** is comprised of a mix of Astronomers, Scientists, Engineers, Research Assistants, and Summer Interns. Additionally, it is important to note that **Project-S** is essentially a program being designed and developed over a Metropolitan Area Network (MAN) comprising remote servers and computing nodes interconnected via the following media, viz: fibre optics, microwave, coaxial and twisted-pair cables. To this end, you have been recruited to be part of **Project-S** in the capacity of a Summer Intern, and you shall be reporting directly to your superiors comprising the Unit Head, Departmental Head, and Chief Networking Officer (CNO). Primarily, your job description involves monitoring point-to-point connections between computing nodes, so as to ensure that every communication/network link is alive with reference to its defined bandwidth on a given communication medium.

Therefore, design an algorithm; and thereafter, develop a program (using Java) based on your predesigned algorithm such that your algorithm and source code will accomplish the following:

1. Title/Name of your algorithm = `Algorithm 1: Static Latency Computer`
2. Name of your Java program/class = `A2_Q1`.
3. Display a welcome/salutation message to the user of the program.
4. Display a prompt message for the user to enter the bandwidth of a given communication channel/link, in {`n`}{`x`}bps format where `n` is a number and `x` is a prefix quantifier, as a single group of user input.
5. Validate the user's input in (4.) above in a bid to ensure that ONLY valid bandwidth data is entered based on the aforementioned format. In the event where the user enters an invalid input for the bandwidth data, display the appropriate error message and terminate the program with a message to the user to retry later.
6. Display prompt messages, one after the other, for the user to enter the source IP address and the destination IP address, respectively, with regard to any two (2) given nodes interconnected within the **Project-S** MAN.

7. Validate the user's input in (6.) above to ensure that ONLY a valid IP address, based on the Internet Protocol version 4 (IPv4) addressing standard/scheme, is entered by the user. In this regard, a valid IPv4 address possesses the following syntax based on decimal (base-10) number system: {0 to 255}.{0 to 255}.{0 to 255}.{0 to 255}. Hence, if the user enters an invalid IPv4 address for either source address or destination address in (6.) above; display the respective error message and terminate the program with a message to the user to retry later.
8. Upon successful validation in (7.) above, prompt the user to enter the amount of data, in {n}{y}B format where n is a number and y is a prefix quantifier, as a single group of user input. Thus, this data is assumed to be transmitted from the source IP address to the destination IP address using the communication channel defined in (4.) above.
9. Validate the user's input in (8.) above, so as to ensure that ONLY a valid data amount is entered based on the aforementioned format. If the user enters an invalid quantity of data, display an appropriate error message and terminate the program with a note to the user to try again.
10. Preprocess all the user's inputs above, and compute the latency in milliseconds (ms) that is incurred from transmitting the predefined quantity of data from the source IP address to the destination IP address over the defined network (communication) channel.
11. Finally, display a complimentary-close message as follows:
    `Thank you for your contribution to Project-S.`

The following are sample screenshots to illustrate the expected behavior of your program. Your program must display the same information, using the same format, depicted in the screenshots:

```
Welcome to the Static Latency-Computer Program:
++++++++++++++++++++++++++++++++++++++++++++++++

Please enter the bandwidth, in {n}{x}bps format, for the network link: 10Tbps
Please enter the source IP address: 10 100 222 254
Please enter the destination IP address: 254 200 100 5
Please enter data amount, in {n}{y}B format, for transmission over the network link: 10GB
Latency (10.100.222.254 --> 254.200.100.5) = 7.8125ms

Thank you for your contribution to Project-S.
```

Figure 1. Sample-1 output of Question 1

```
Welcome to the Static Latency-Computer Program:
++++++++++++++++++++++++++++++++++++++++++++++++

Please enter the bandwidth, in {n}{x}bps format, for the network link: 100Gbps
Please enter the source IP address: 1 5 10 111
Please enter the destination IP address: 2 255 1 9
Please enter data amount, in {n}{y}B format, for transmission over the network link: 10EB
Latency (1.5.10.111 --> 2.255.1.9) = 8.589934592E11ms

Thank you for your contribution to Project-S.
```

Figure 2. Sample-2 output of Question 1

```
Welcome to the Static Latency-Computer Program:
+++++++++++++++++++++++++++++++++++++++++++++++

Please enter the bandwidth, in {n}{x}bps format, for the network link: 50KBPS
Invalid input for bandwidth; please re-run and enter the bandwidth in {n}{x}bps format.

Thank you for your contribution to Project-S.
```

Figure 3. Sample-3 output of Question 1

```
Welcome to the Static Latency-Computer Program:
+++++++++++++++++++++++++++++++++++++++++++++++

Please enter the bandwidth, in {n}{x}bps format, for the network link: 100gbps
Invalid input for bandwidth; please re-run and enter the bandwidth in {n}{x}bps format.

Thank you for your contribution to Project-S.
```

Figure 4. Sample-4 output of Question 1

```
Welcome to the Static Latency-Computer Program:
+++++++++++++++++++++++++++++++++++++++++++++++

Please enter the bandwidth, in {n}{x}bps format, for the network link: 10Ybps
Please enter the source IP address: 256 10 114 200
Error: Your entry for source IP address is incorrect. Kindly retry with valid inputs.

Thank you for your contribution to Project-S.
```

Figure 5. Sample-5 output of Question 1

```
Welcome to the Static Latency-Computer Program:
+++++++++++++++++++++++++++++++++++++++++++++++

Please enter the bandwidth, in {n}{x}bps format, for the network link: 10Ybps
Please enter the source IP address: 255 114 121 30
Please enter the destination IP address: 12 155 256 10
Error: Your entry for destination IP address is incorrect. Kindly retry with valid inputs.

Thank you for your contribution to Project-S.
```

Figure 6. Sample-6 output of Question 1

```
Welcome to the Static Latency-Computer Program:
+++++++++++++++++++++++++++++++++++++++++++++++

Please enter the bandwidth, in {n}{x}bps format, for the network link: 10Ybps
Please enter the source IP address: o 10 155 142
Error: Your entry for source IP address is incorrect. Kindly retry with valid inputs.

Thank you for your contribution to Project-S.
```

Figure 7. Sample-7 output of Question 1

```
Welcome to the Static Latency-Computer Program:
++++++++++++++++++++++++++++++++++++++++++++++++

Please enter the bandwidth, in {n}{x}bps format, for the network link: 15Zbps
Please enter the source IP address: 152 178 255 100
Please enter the destination IP address: 10 255 42 131
Please enter data amount, in {n}{y}B format, for transmission over the network link: 100gb
Invalid input for the amount of data; please retry with the data amount in {n}{y}B format.

Thank you for your contribution to Project-S.
```

Figure 8. Sample-8 output of Question 1

```
Welcome to the Static Latency-Computer Program:
++++++++++++++++++++++++++++++++++++++++++++++++

Please enter the bandwidth, in {n}{x}bps format, for the network link: 10000Kbps
Please enter the source IP address: 100 151 242 111
Please enter the destination IP address: 111 253 146 26
Please enter data amount, in {n}{y}B format, for transmission over the network link: 100Gb
Invalid input for the amount of data; please retry with the data amount in {n}{y}B format.

Thank you for your contribution to Project-S.
```

Figure 9. Sample-9 output of Question 1

Question 2 (*7pts*): Dynamic Latency-Computer Program

Consequently, as a Summer (Student) Intern in the **Project-S** Space-Exploration program, part of your job description involves you evaluating point-to-point connections between computing nodes on a daily basis. To this end, on daily basis, you shall be computing the latency incurred in transferring a given quantity of data between any two (2) given nodes within the **Project-S** MAN. With regard to a microwave communication link on the **Project-S** network, the tabular data below defines the daily standard bandwidth and the daily (10 Gigabytes of data) latency.

Weekday/Mode	**Bandwidth**	**Latency**
Monday	999Mbps	$8.0 * 10^{-6}$ms
Tuesday	0.9Ybps	$8.8 * 10^{-21}$ms
Wednesday	10Gbps	$8.0 * 10^{-7}$ms
Thursday	2.5Tbps	$3.2 * 10^{-10}$ms
Friday	0.9Pbps	$8.8 * 10^{-12}$ms
Saturday	1.1Ebps	$7.2 * 10^{-15}$ms
Sunday	1.5Zbps	$5.3 * 10^{-18}$ms

Therefore, design an algorithm; and thereafter, develop a Java program based on your predesigned algorithm such that your algorithm and source code will accomplish the following:

1. Title/Name of your algorithm = `Algorithm 2: Dynamic Latency Computer`
2. Name of the Java program/class = `A2_Q2`
3. Display a prompt message for the user to enter the `Weekday`, the `Mode`, and a given data quantity as a single group of input separated via space characters. The data quantity value MUST be in {n}{y}B format where `n` is a number and `y` is a prefix quantifier. Also,

the data quantity MUST be either of the following: `10GB`, `20PB`, or `30ZB`. Hence, valid inputs for the `Weekday` (`Monday` – `Sunday`), the `Mode` (`Bandwidth` or `Latency`), and the data quantity (`10GB`, `20PB`, or `30ZB`) variables MUST be case-insensitive.

4. Validate the user's inputs to ensure that only valid values were entered for the `Weekday`, the `Mode`, and the data quantity inputs. If an invalid input was received; display the respective error message, and end the program with a note for the user to try again.
5. If the user has entered a valid input with respect to the `Weekday`, the `Mode`, and the data quantity; process the user's inputs to determine the corresponding real value in either `Bandwidth` mode or `Latency` mode.
6. Thereafter, compute the resultant value for the latency, in milliseconds (ms), incurred with respect to the transmission of the given data quantity over **Project-S** microwave communication link.
7. You MUST use the `switch()` statement to implement all your decision/selection logic with respect to the real values for the `Bandwidth`, the `Latency`, and the data quantity variables herein. In this regard, using an `if()` statement in lieu of `switch()` statement will be assumed as a logical failure; and this will attract zero (0) point.
8. After processing, display a confirmation message to the user in the form below:
   `Latency incurred in transmitting {n}{y}B of data, over` **`Project-S`** `microwave network link, is: {value}ms`
9. Finally, display a complimentary-close message as follows:
   `Once again, thanks for your contribution to Project-S.`

The following are sample screen shots to illustrate the expected behavior of your program. Your program must display the same information, using the same format, as depicted below:

```
Welcome to the Dynamic Latency-Computer Program:
++++++++++++++++++++++++++++++++++++++++++++++++++

Please enter a Weekday, Mode, and Data Quantity, respectively: SATURDAY bandwidth 20PB
Latency incurred in transmitting 20PB of data, over Project-S microwave network link, is: 142.045455ms

Once again, thanks for your contribution to Project-S.
```

Figure 10. Sample-1 output of Question 2

```
Welcome to the Dynamic Latency-Computer Program:
++++++++++++++++++++++++++++++++++++++++++++++++++

Please enter a Weekday, Mode, and Data Quantity, respectively: monday latency 30zb
Latency incurred in transmitting 30ZB of data, over Project-S microwave network link, is: 26388279.066624ms

Once again, thanks for your contribution to Project-S.
```

Figure 11. Sample-2 output of Question 2

```
Welcome to the Dynamic Latency-Computer Program:
++++++++++++++++++++++++++++++++++++++++++++++++

Please enter a Weekday, Mode, and Data Quantity, respectively: sUnDaY BAndWIdTh 20pB
Latency incurred in transmitting 20PB of data, over Project-S microwave network link, is: 0.101725ms

Once again, thanks for your contribution to Project-S.
```

Figure 12. Sample-3 output of Question 2

```
Welcome to the Dynamic Latency-Computer Program:
++++++++++++++++++++++++++++++++++++++++++++++++

Please enter a Weekday, Mode, and Data Quantity, respectively: WeDnEsDy lAtEnCy 10gB
Error: Invalid value entered for the 'Weekday' variable. Kindly retry with a valid input.

Once again, thanks for your contribution to Project-S.
```

Figure 13. Sample-4 output of Question 2

```
Welcome to the Dynamic Latency-Computer Program:
++++++++++++++++++++++++++++++++++++++++++++++++

Please enter a Weekday, Mode, and Data Quantity, respectively: THURSDAY BANDWDTH 20PB
Error: Invalid value entered for the 'Mode' variable. Kindly retry with a valid input.

Once again, thanks for your contribution to Project-S.
```

Figure 14. Sample-5 output of Question 2

```
Welcome to the Dynamic Latency-Computer Program:
++++++++++++++++++++++++++++++++++++++++++++++++

Please enter a Weekday, Mode, and Data Quantity, respectively: BandWidth MonDAY 30Zb
Error: Invalid value entered for the 'Mode' variable. Kindly retry with a valid input.

Once again, thanks for your contribution to Project-S.
```

Figure 15. Sample-6 output of Question 2

```
Welcome to the Dynamic Latency-Computer Program:
++++++++++++++++++++++++++++++++++++++++++++++++

Please enter a Weekday, Mode, and Data Quantity, respectively: MonDAY BandWidth 30Gb
Error: Invalid value entered for the 'Data Quantity' variable. Kindly retry with a valid input.

Once again, thanks for your contribution to Project-S.
```

Figure 16. Sample-7 output of Question 2

```
Welcome to the Dynamic Latency-Computer Program:
++++++++++++++++++++++++++++++++++++++++++++++++

Please enter a Weekday, Mode, and Data Quantity, respectively:   fRiDaY     BaNDwIdTH  20pB
Latency incurred in transmitting 20PB of data, over Project-S microwave network link, is: 177777.777778ms

Once again, thanks for your contribution to Project-S.
```

Figure 17. Sample-8 output of Question 2

Submitting Assignment 2

- Zip the source codes (`A#_Q1.java` and `A#_Q2.java` files ONLY) of this assignment.
- Naming convention for the `.zip` file: Create one `.zip` file, containing the source files for your assignment using the following naming syntax:
  - The `.zip` file should be called *a#_studentID*, where # is the number of the assignment and *studentID* is your student ID/Number.
    For example: With regard to this assignment, student `123456` would submit a `.zip` file named `a2_123456.zip`
- Submit your zipped file via Moodle or e-Concordia webpage.

Evaluation Criteria for Assignment 2 (20 points)

Source Code		
Comments for both questions (3 pts.)		
Description of the program (authors, date, purpose)	1	pt.
Description of variables and constants	1	pt.
Description of the programming logic/semantics	1	pt.
Programming style for both questions (3 pts.)		
Use of significant names for identifiers	1	pt.
Indentation and readability	1	pt.
Welcome Banner/Closing message	1	pt.
Question 1 (7 pts.)		
Definition of algorithm 1	1	pt.
Prompt user, read-in data, and validate bandwidth input	1	pt.
Prompt user, read-in data, and validate IP addresses input	1	pt.
Prompt user, read-in data, and validate data amount input	1	pt.
Logic towards computing latency in exact milliseconds (ms)	2	pts.
Display output (latency) accordingly and appropriately	1	pt.
Question 2 (7 pts.)		
Definition of algorithm 2	1	pt.
Process user's inputs in a case-insensitive format	1	pt.
Validate user's inputs for appropriateness	1	pt.
Data processing for `Weekday/Mode` table using only `switch()` statement	2	pts.
Logic towards computing latency in exact milliseconds (ms)	1	pt.
Display output (latency) accordingly and appropriately	1	pts.
TOTAL	**20**	**pts.**