National University of Computer and Emerging Sciences

Fast School of Computing Fall 2024

CS1002-Programming Fundamentals (CS-A,B,C,D,E,F,G)
Assignment 01

Instructions for submission:

Dear students we will be using auto-grading tools, so failure to submit according to the below format would result in zero marks in the relevant evaluation instrument.

i. For each question in your assignment, make a separate cpp file e.g. for question 1, make ROLL-NUM_SECTION_Q#.cpp (23i-0001_A_Q1.cpp) and so on. Each file that you submit must contain your name, student-id, and assignment # on top of the file in comments.
ii. Combine all your work in one folder. The folder must contain only .cpp files (no binaries, no exe files etc.).
iii. Run and test your program on a lab machine before submission.
iv. Rename the folder as ROLL-NUM_SECTION (e.g. 23i-0001_A) and compress the folder as a zip file. (e.g. 23i-0001_A.zip). do not submit .rar file.
v. Submit the .zip file on Google Classroom within the deadline.
vi. Submission other than Google classroom (e.g. email etc.) will not be accepted.
vii. The student is solely responsible to check the final zip files for issues like corrupt file, virus in the file, mistakenly exe sent. If we cannot download the file from Google classroom due to any reason it will lead to zero marks in the assignment.
viii. Displayed output should be well mannered and well presented. Use appropriate comment and indentation in your source code.
ix. Total Marks: 50.
x. The AIM of this assignment is to give you practice with cout, cin and arithmetic operator's (chapters 2 and 3 of textbook). Zero marks will be awarded if advance topics that are not discussed in class till now are used.
xi. If there is a syntax error in code, zero marks will be awarded in that part of assignment.
xii. Your code must be generic.

Deadline:

Deadline to submit assignment is 20th September 2024 11:59 PM. You are supposed to submit your assignment on GOOGLE CLASSROOM (CLASSROOM TAB not lab). Only ".ZIP" files are acceptable. Other formats should be directly given ZERO. Correct and timely submission of the assignment is the responsibility of every student, hence no relaxation will be given to anyone. **Late Submission policy will be applied as described in course outline**.

Tip: For timely completion of the assignment, start as early as possible.

Plagiarism: Plagiarism is not allowed. If found plagiarized, you will be awarded zero marks in the assignment (copying from the internet is the easiest way to get caught).

Note: Follow the given instruction to the letter, failing to do so will result in a zero.

General Instructions for the assignment:

1. **Variable and Function Naming:** Use variables and function names that reflect the context of the problem. Avoid generic names like `x`, `y`, or `z`.

2. **Logical Thinking:** In your code comments, explain why you chose specific variable names and why a particular operation (like `+` or `%`) is necessary for the problem's solution. These comments will be checked for correctness.

3. **Code Structure:** Your program should contain a clear `main()` function that primarily calls other functions where appropriate. Break down your program into smaller functions where necessary.

4. **Comments and Documentation:** Add a comment at the top of your code that includes your name, roll number, and a brief description of the program. Each function should have a comment explaining its purpose and parameters. Use comments to explain any non-obvious parts of your code.

5. **Input/Output Handling:** Provide clear instructions when taking input from the user. Format your output clearly, ensuring it's easy to understand and follows the requirements of the scenario in the assignment.

Question 1 [10 Marks]

Researchers at the KDD Lab at FAST are studying the complex relationship between global warming and sea level rise. They have developed a sophisticated model that considers various factors including time, global average temperature anomalies, and atmospheric CO_2 concentrations. Their goal is to predict future sea level changes and inform policymakers about potential coastal impacts.

Using our latest model, your task is to calculate the predicted sea level rise given the following equation:

$$\Delta S(t, T, C) = A \cdot \log\left(1 + \frac{t}{\tau}\right) \cdot \left[\frac{\sin(\omega T) + 1}{2}\right] \cdot \left(\frac{C}{C_0}\right)^{\alpha} + B \cdot \left[\frac{\arctan\left(\frac{t - t_0}{\beta}\right)}{\pi} + \frac{1}{2}\right] \cdot \left(\frac{\tan^{-1}\left(\frac{T - T_0}{\gamma}\right) + \frac{\pi}{2}}{\pi}\right) \cdot \exp\left(\frac{C - C_0}{\delta}\right)$$

Where:

ΔS: Sea level rise (in meters)

t: Time (in years since 2000)

T: Global average temperature anomaly (in °C)

C: Atmospheric CO_2 concentration (in ppm)

Constants:

A = 0.1, B = 0.05

τ = 50, ω = 0.5, α = 1.5

β = 20, γ = 1, δ = 100

t_o = 30, T_o = 1, C_o = 400

Use the cmath library in C++ for the trigonometric and logarithmic functions.

Question 2 [5 Marks]

You have started working at a cyber security company where your job is to make sure that all communication in the company's new software is fully encrypted. Communication is happening between 2 devices via the internet. For this task, your company asks you to come up with an encryption and decryption algorithm that makes sure that no one can understand the information sent even if the data is intercepted.

You are working only with numerical numbers.

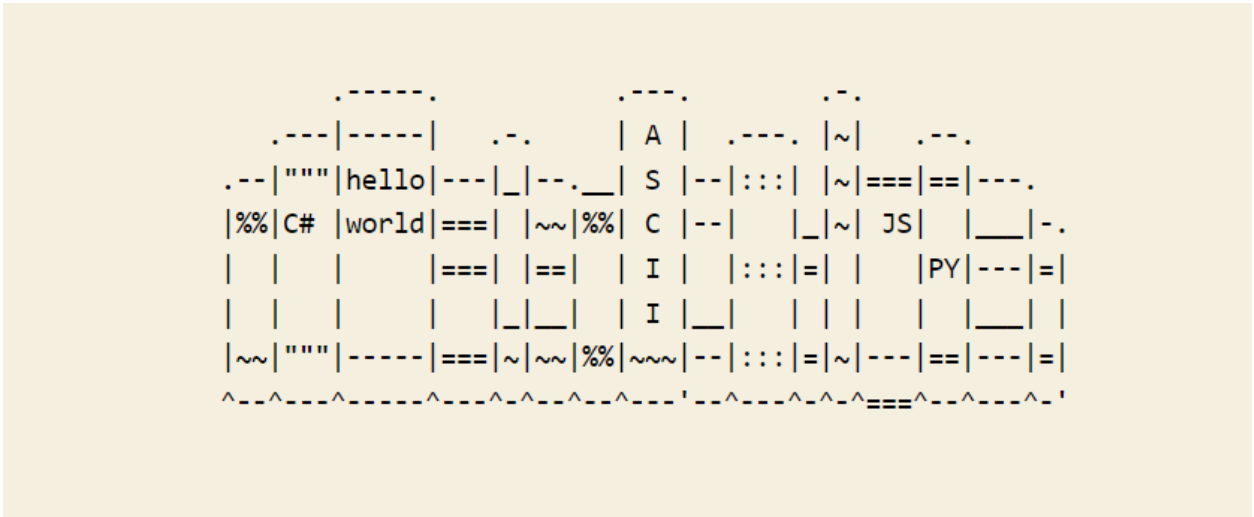
Part A: Convert the number into an encrypted form using the following steps:

1. Let the original number be n.
2. Use the last 4 digits of your roll number i.e. 24I-1234 and take its mod with 11.
3. Add 200 to the number.
4. Multiply the number you just generated with n.
5. Take the div of the new number with the number generated in step 2.
6. Multiply it by 17.
7. Subtract 5 from it.
8. Divide the number by taking the mod of the last 4 digits of your roll number with 9.
9. Add 3 to it.

Part B: By using the information provided in Part A, come up with a suitable decryption algorithm that can decrypt the encrypted number when it arrives from the host to destination.

Question 3 [10 Marks]

Write a C++ program that outputs the following using only one cout statement. Use setw() and setfill() for spaces and repeated characters. (Note: You cannot use any string literals containing spaces in cout. And use single cout statement)



Question 4 [10 Marks]

You are part of the Finance Department of FAST University where you want to simplify the procedure for parents and students alike to see how much the fee challan would be. You are tasked with creating a system where you take in the following inputs:

1. Number of Credit Hours
2. Price per Credit Hour

Additionally, there are extra charges on top of the tuition fee including:

1. 2000 rupees sports fund
2. 3000 rupees university fund

Furthermore there are taxes to be paid to the government and the bank. These taxes are separate from the fee to be paid to the university and are addition on top of the university fee.

1. Government tax on the entire fee.
    a. If the total fee to be paid to the university is less than 150k rupees then government tax is 18 percent.
    b. If the total fee to be paid to the university exceeds 150k rupees then charge 18 percent tax on the 150k and 25 percent on the remaining. Additionally charge a 10 percent wealth tax on the entire fee.
2. 2 percent charge on the entire fee to be paid to the bank.

After taking input from the user, show them the following:

1. Tuition fee
2. Additional charges to the university
3. Total university fee
4. Tax to be paid to the government
5. Wealth tax if any
6. Tax to be paid to the bank
7. Total additional tax
8. Total money to be paid

Question 5 [10 Marks]

Write a C++ program that takes the following inputs and comes up with a dynamic pattern using setw and setfill:

1. Number of Spaces between vertical bar and multiplication symbol
2. Number of Spaces between vertical bar and full stop symbol.
3. Number of Multiplication Symbol
4. Number of vertical bar symbol
5. Number of dots

For the '----------' line, come up with a formulae to calculate a number for the total length of this line. In the setw and setfill statement, you should only have variables, no numbers.

Pattern to make:

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|||         ***         |||         .         |||         ***         |||
|||         ***         |||         .         |||         ***         |||
|||         ***         |||         .         |||         ***         |||

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|||         ***         |||         .         |||         ***         |||
|||         ***         |||         .         |||         ***         |||
|||         ***         |||         .         |||         ***         |||

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```

Question 6 [5 Marks]

Part A: Write a C++ program which accepts an Uppercase alphabet as input and converts it to lower case alphabet.

Example 01: Input: A Output: a

Example 02: Input: Z Output: z

Part B: Write a C++ program which accepts a number between 1 and 9 and returns its polar opposite.

Example 01: Input: 1 Output: 9

Example 02: Input: 3 Output: 7