CS135 Fall 2024 - Assignment 1

Calculating Monthly Mortgage Payments.

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1 Description

The goal of this assignment is to familiarize you with basic input and output operations in C++, as well as performing fundamental arithmetic operations to solve a real-world problem. Specifically, you will calculate monthly mortgage payments using a standard formula. Through this task, you will practice:

1. **Input/Output Operations:** Reading data from the user and displaying results.
2. **Arithmetic Operations:** Implementing and applying mathematical formulas in code.
3. **Real-World Application:** Understanding how programming can solve everyday financial problems.

Skills Practiced:

- Handling user input and output
- Performing arithmetic calculations
- Implementing mathematical formulas in C++
- Debugging and validating user inputs

Knowledge Gained:

- Proficiency in basic C++ programming constructs
- Understanding the practical application of programming in finance
- Ability to translate mathematical formulas into executable code

Long-Term Relevance:

- These skills will be fundamental in any programming-related career. Understanding how to work with user input and perform calculations is crucial for developing applications in fields ranging from finance to engineering. Mastery of these basics will provide a strong foundation for more advanced topics.

2 Collaboration

Students are encouraged to collaborate within the guidelines specified in the syllabus. However, it is important to emphasize that the primary objective of these assignments is to acquire the essential skills required for success in the field of computer science. Accordingly, students are expected to independently write their own code, ensuring that it is free from any form of plagiarism, whether from peers, past students, or current ones. **To maintain academic integrity, all assignments will undergo cross-referencing across all sections of CS135 using the Measure Of Software Similarity (Moss) tool, which automatically assesses program similarities. You may study together and discuss the assignments, but what you turn in must be your individual work. Assignment submissions will be checked for plagiarism using Moss. Copying another student's program or sharing your program is a violation of academic integrity. Moss is not fooled by renaming variables, reformatting source code, or re-ordering functions.**

3 Task

1. Understand the Problem:
   (a) You need to calculate the monthly mortgage payment based on the principal loan amount, annual interest rate, and the term of the loan in years.
2. Formula:
$$M = \frac{P \times r \times (1+r)^n}{(1+r)^n - 1}$$
   where:
   - M = montly payment
   - P = principal loan ammount
   - r = montly interest rate (annual rate divided by 12)
   - n = number of payments (loan term in years multiple by 12)
3. Write the Program:
   (a) Prompt the user to enter the principal loan amount, annual interest rate, and loan term.
   (b) Use the formula to calculate the monthly mortgage payment.
   (c) Display the result in a user-friendly format.
4. Test and Debug:
   - Test your program with different sets of input values to ensure it works correctly.

Actions to Take if Uncertain:

- **Review Basic Syntax:** Ensure you understand how to use input/output functions (`cin`, `cout`) and perform arithmetic operations.
- **Consult Documentation:** Look up the `pow` function in C++ for calculating powers, as it will be useful for the formula.
- **Interest Rate Conversion:** Converts the annual interest rate percentage to a decimal and then to a monthly rate.

- **Mortgage Calculation:** Uses the formula for calculating the monthly mortgage payment. If the interest rate is zero, the calculation simplifies to just dividing the principal by the number of payments.
- **Output:** Displays the principal, annual interest rate, loan term, and the calculated monthly payment, formatted to two decimal places.

What to Avoid:

- **Hardcoding Values:** Allow the user to input all necessary values rather than hardcoding them in the program.
- **Neglecting User Experience:** Provide clear instructions and format the output neatly for better readability.

Criteria for Success

- **Correct Calculation:** The program must correctly calculate the monthly mortgage payment using the formula.
- **Code Organization:** The code should be well-organized and commented to explain its functionality.
- **User-Friendly Output:** The results should be presented in a clear and formatted manner.
- **Compilation:** Compile the program using the `g++` compiler to ensure it runs without errors. Make sure that your output matches the expected resul when executed.
- **Submission:** Save the program as `main.cpp` and submit it to CodeGrade before the deadline. Use the feedback provided by CodeGrade to identify and correct any errors, then resubmit if necessary.

Checklist/Rubric

By following these guidelines and criteria, you will develop a solid understanding of basic programming concepts and their application in solving real-world problems.

- ☐ Input/Output Operations:
  - ☐ Program prompts user for all required inputs.
  - ☐ Program outputs the result correctly.
- ☐ Correct Implementation of Formula:
  - ☐ Formula is correctly translated into C++ code.
  - ☐ Calculations are accurate and verified with sample inputs.
- ☐ Code Quality:
  - ☐ Code is well-structured and readable.
  - ☐ Comments are used to explain key sections of the code.
- ☐ Output Formatting:
  - ☐ Output is clear and easy to understand.
  - ☐ Results are formatted correctly (e.g., two decimal places for monetary values).

4 Sample Outpus with Correct Values

Explanation:

- Principal Loan Amount: The amount borrowed.
- Annual Interest Rate: The yearly interest rate, entered as a percentage.

- Loan Term: The length of the loan in years.
- Monthly Payment: The amount to be paid each month, calculated using the provided formula.

These outputs illustrate how different inputs affect the monthly mortgage payment, providing students with practical examples of how their code will perform in various scenarios.

Case 1: Standard Case

Input:

- Principal Loan Amount: $200,000
- Annual Interest Rate: 5%
- Loan Term: 30 years

Output:

```
Welcome to the CS135 Mortgage Calculator
Enter the principal loan amount: 200000
Enter the annual interest rate (as a percentage): 5
Enter the loan term in years: 30

Calculating the monthly mortgage payment...
Principal Loan Amount: $200000.00
Annual Interest Rate: 5.00%
Loan Term: 30 years
Monthly Payment: $1073.64
```

Case 2: Lower Interest Rate

Input:

- Principal Loan Amount: $150,000
- Annual Interest Rate: 3%
- Loan Term: 15 years

Output:

```
Welcome to the CS135 Mortgage Calculator
Enter the principal loan amount: 150000
Enter the annual interest rate (as a percentage): 3
Enter the loan term in years: 15

Calculating the monthly mortgage payment...
Principal Loan Amount: $150000.00
Annual Interest Rate: 3.00%
Loan Term: 15 years
Monthly Payment: $1035.87
```

Case 3: Higher Loan Term

Input:

- Principal Loan Amount: $300,000
- Annual Interest Rate: 4%
- Loan Term: 40 years

Output:

```
Welcome to the CS135 Mortgage Calculator
Enter the principal loan amount: 300000
Enter the annual interest rate (as a percentage): 4
Enter the loan term in years: 40

Calculating the monthly mortgage payment...
Principal Loan Amount: $300000.00
Annual Interest Rate: 4.00%
Loan Term: 40 years
Monthly Payment: $1432.25
```