

# Programming Assignment #4: Buying a Home

Due Date: March 16, 1998

## 1 The Problem

Many of us will buy at least one home over the course of our lives. As you probably know, most people purchase houses by securing a mortgage from a bank, mortgage company or other lending institution. A mortgage is essentially a loan that is paid back over a number of years. In the United States, mortgages are typically 15 or 30 years in duration, and a fixed payment is made each month. Therefore, 180 payments are needed to pay off a 15 year mortgage and 360 payments are needed to pay off a 30 year mortgage. When you qualify for a mortgage, the bank or mortgage company will provide you with what is called an amortization schedule for the mortgage. An amortization schedule shows how much you must pay each month (fixed), how much interest is being charged for each month and finally how much more you have to pay on the loan to pay off the mortgage.

Your task in this program is to generate an amortization schedule for a given mortgage amount to be paid off over  $n$  years. To explain how an amortization schedule is generated, suppose a certain couple plan on buying their first home. The purchase price of the house is \$120,000.00, and they have saved \$20,000.00 in cash for a down payment. Therefore, to pay the remainder of the purchase price, the couple secures a 15 year mortgage in the amount of \$100,000.00. They obtain an interest rate of 7.3% from the lender. Their monthly payment  $M$  is given by the formula

$$M = P \frac{r}{1 - (1 + r)^{-12N}}$$

The variable  $P$  (called the principal) is the initial loan amount,  $r$  is the monthly interest rate expressed in decimal form and  $N$  is the length of the

mortgage in years. For our couple,

$$M = 100,000.00 \times \frac{0.006083}{1 - (1.006083)^{-180}} = 915.68.$$

(To compute the monthly interest rate, take the quoted interest rate the 7.3% and divide by 1200. For our couple,  $r = 7.3/1200 = 0.006083$ .) So the monthly payment is \$915.68, and this amount remains fixed throughout the life of the loan.

As the loan is paid off, the interest you pay is also reduced. To compute the interest for a particular month, suppose that  $B$  denotes the principal that is left to pay. In other words,  $B$  stands for the balance of the loan. It is how much money you still owe the lender. The interest you will pay for that month is given by  $r \times B$ . Consequently, what you are actually paying back on the loan is  $M + r \times B$ . Therefore, after you make this month's payment, the updated value of  $B$ , call it  $B_{\text{new}}$ , is given by the formula

$$B_{\text{new}} = B - (M + r \times B) = B - M - r \times B = B \times (1 - r) - M.$$

So the new balance (or, if you will, the updated principal) is  $B \times (1 - r) - M$ , and this is the balance of the loan that is used to compute next month's interest and balance, etc.

## 2 The Program

Write a C++ program to generate a complete amortization schedule given the following initial data:

- 2 The amount of the loan
- 2 The interest rate
- 2 The length of the loan in years

After printing the complete schedule, the program should report the total interest you paid to finance your loan. It should also print the monthly payment you must make to the lender. A sample user/computer dialog follows.

```
Input the initial principal: 100000.0
Input the interest rate: 7.3
Input the length of the loan in years: 15
```

YEARS	YEARLY INTEREST	REMAINING PRINCIPAL
1	7174.06	96185.86
2	6886.12	92083.78
3	6576.45	87672.02
4	etc.	etc.
5	*	*
6	*	*
7	*	*
8	*	*
9	*	*
10	*	*
11	*	*
12	*	*
13	*	*
14	1164.08	10565.77
15	422.43	0.00

The total interest payed is: \$64823.05

The monthly payment is: \$915.86

Your should use the following functions in your program.

1. void getLoanData (float& principal , float& rate, int& length)

<sup>2</sup> PURPOSE: The purpose of this function is to input the initial mortgage data.

<sup>2</sup> The parameter principal should return the starting principal to the main program.

<sup>2</sup> The interest rate will be passed back to the main program in the parameter rate.

<sup>2</sup> The length of the loan will be passed back in the parameter length.

2. void computeSchedule (float principal , float rate, int length, float& totalInterest, float& monthlyPayment)

- <sup>2</sup> **PURPOSE:** The purpose of this function is to print out the amortization schedule as well as to compute the total interest payed on loan and the monthly mortgage payment.
- <sup>2</sup> The values of the parameters `principal`, `rate` and `length` will be passed from the main program.
- <sup>2</sup> The total interest payed over the life of the loan will be returned in the reference parameter `totalInterest`.
- <sup>2</sup> The monthly payment will be returned to the main program in the parameter `monthlyPayment`.

To check your answers, there are numerous mortgage calculators available out on the web. One of the best is at <http://www.interest.com/hugh/cal c/mort.html>.

### 3 What To Turn In

You should turn in two files on a 3" floppy disk. The first one should be the source code for your program. This file will contain the C++ program that you write. This file must be named `prog4.cpp`. Always use the extension `.cpp` to indicate C++ source files. The other file on your disk should be the executable file produced by the compiler. This file contains the machine level instructions that the computer can actually run. (The computer cannot run the source file directly.) Depending on the compiler, the executable file may have different names. In Visual C++ (the official programming environment for the course), the executable file has the extension `.exe`. For example, if the source file is `prog4.cpp`, the executable file will be called `prog4.exe`. In addition to the disk, you should turn in a printout (called a "hard copy" in computerese) of your program, that is, a printout of the file `prog4.cpp`. The disk and printout should be placed in a two-pocket folder. On the front of the folder, the following information must appear.

Your Name Comp 170 Fall Semester 1998 Section 611 Instructor: Dr. John Del Greco
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## 4 Extra Credit Embellishment

Rewrite the program so that it computes a sequence of amortization tables. The program should ask for an initial principal, interest rate and duration in years the first time it is run. Thereafter however, the program should display the following menu from which the user can make several choices.

- 1: Display current data
- 2: Change initial principal
- 3: Change interest rate
- 4: Change number of years
- 5: Generate amortization table
- 6: Exit the mortgage calculator

Please input a choice: 1

Current initial principal is: \$100000.00

Current interest rate is: 7.3%

Current length of loan is: 15 years

Please input a choice:

Doing the embellishment will require that some (or all) of the functions be rewritten.

## 5 Late Program Policy

A program will lose 10% of its value each day it is late (excluding weekends). Starting early on your programs will maximize your chances of earning full credit on your work!