FINAL PROJECT

Programming Languages

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Context of the problem

It is common that many of us grow up without having a financial background or making assumptions about how it works only by what we hear or what we read every day.

Normally, we reach adulthood without knowing how the finances work or how to have a good management of our money.

One of the many issues whose terms we usually do not know are loans and their interests.

For example, in Mexico different surveys are carried out by public entities, which allow to know the figures regarding the financial education that is lived in the country.

Within these results, it is stated that within the percentage of the population that has a departmental or self-service credit card 6% does not know if they charge interest, of those who have a bank credit card, 3.4% do not know if they charge interest, personal credit 1.2% do not know if they charge interest, mortgage credit 5.9% do not know if they charge interest and a group loan 2.8% do not know if they charge interest (Gómez, 2018).

The way in which a loan works will depend on the institution to which it goes or whether it is personal loans, for home or for car. Keeping the situation to its simplest form, a loan will allow you to access a certain amount of money that you need at that moment and then you pay back that money in installments (Hawlk, 2016).

The process of spreading out the loan into a series of fixed payments over time is called amortization (Pritchard, 2019).

Usually, these payments are made monthly and each payment stays the same each month. However, the payment is made up of two parts that change over time:

1. Interests. That is, what the borrower gets for making the loan.

2. Principal. That is, the amount that is paid from the principal loan (Pritchard, 2019).

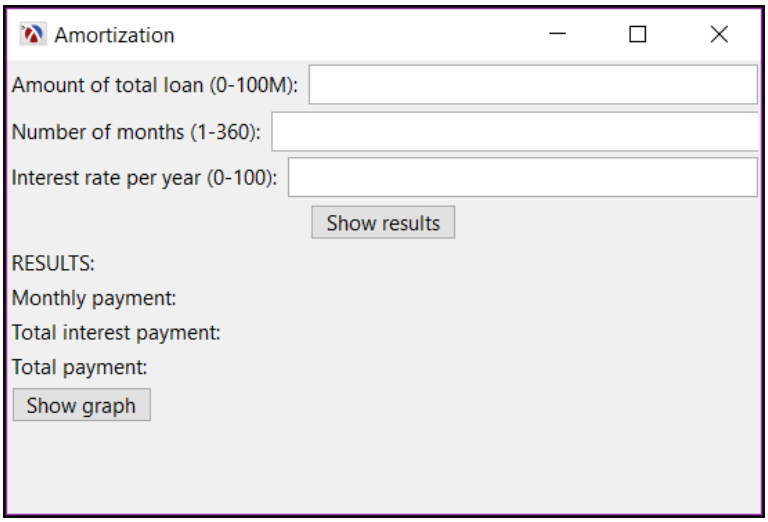
Interest are calculated based on the payment period and the interest rates given. There are two types of loans, long-term and short-terms loans. Long-term loans usually have a repayment period that could be of 1 to 25 years. While short-term loans could be of 3 to 18 months.

Although interest rate on long-term loans is usually lower than on short-term loans, that does not mean that they are less expensive. As interest will be paying over a longer time, the total amount paid at the end will be usually higher on long-term loans (Fundera, 2019).

However, this is where certain confusions may arise. If you have no knowledge of how to calculate these monthly payments and what percentage of them goes to interest and which to the principal payment, you could end up paying up to twice the principal loan.

Solution

A proposed solution for the previous problem it is a simple program that ask the user three inputs: the amount of the loan, the number of months to pay the loan and the interest rate per year.



Picture 1. Screenshot of the program user interface

Based on that data, the program calculates the amount of the monthly payment, the total amount of interests and the total payment for the loan (including interests).

To calculate the monthly payments the program uses a formula that there is already defined in the financial area (Massey University, 2018):

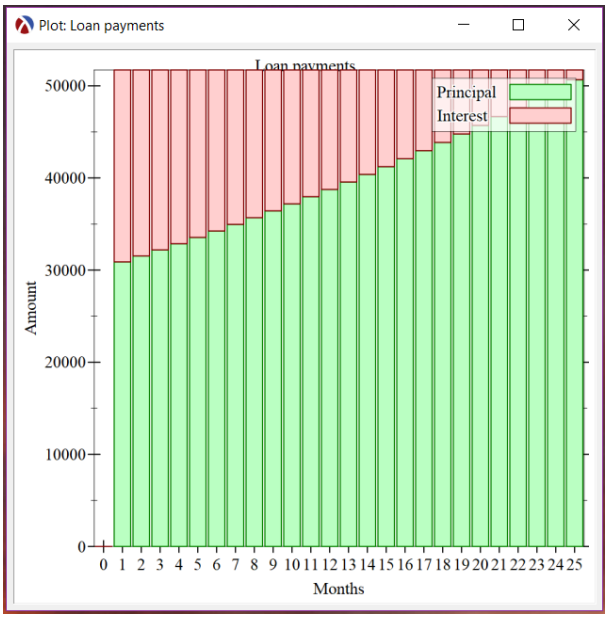
$$PMT = PV\left[\frac{i(1-i)^n}{((1+i)^n - 1)}\right]$$

$where$:

$PMT = payment\ per\ period$
$PV = present\ value\ of\ the\ loan$
$i = interest\ rate$
$n = number\ of\ periods$

Also, as it is known that graphs help to have a better understanding, the program includes a feature to show a stacked histogram. A stacked graph is useful for looking at changes in, and it can be used when the sum of the values is as important as the individual items (Salm, 2014).

In this case, the stacked graph plotted by the program shows how the monthly payments change over time, making easy to see the percentage of interests that are paid at the total amount of the payment, including the interest and the principal.



Picture 2. Example of a stacked graph

Programming paradigm

For the development of the solution it was used Racket as the programming language for the source code, this language is based on Scheme, which is a dialect of Lisp. Racket is multi-paradigm, including the functional paradigm.

The functional paradigm was chosen because it treats computation as calculation of stateless mathematical functions, which minimize side effects (Progopedia, n.d.). This means that the result depends only on the inputs, and as the results for the amortizations computation is just defined by the input that the user gives, functional paradigm it is perfect to achieve the solution.

It is known that less efficiency is a possible disadvantage of functional programming (University of Central Florida, n.d.), but as the computation required is not that complex and the program is

just developed for loans of maximum 30 years (360 months), efficiency is not a problem for the purpose of this problem's solution.

Results

To test that the calculated results were correct on the program, many tests were made using examples already calculated on the Internet.

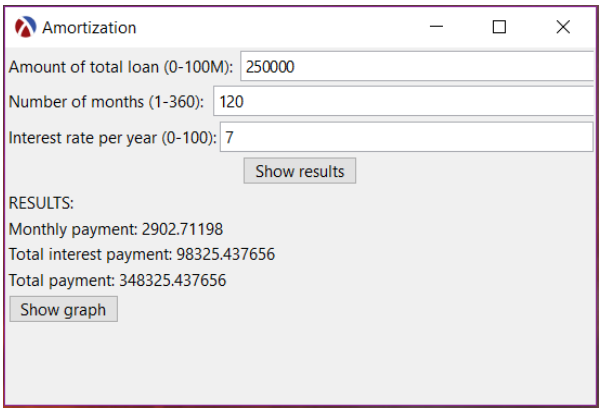
As evidence, there is an example explained on Fundera website (2019) that says as follows:

"If you pay 7% interest on a $250,000 10-year loan, you will pay a total of $98,325 in interest over the life of the loan. In contrast, if you pay 40% interest on a $250,000 9-month loan, you would only pay $43,486 in interest."

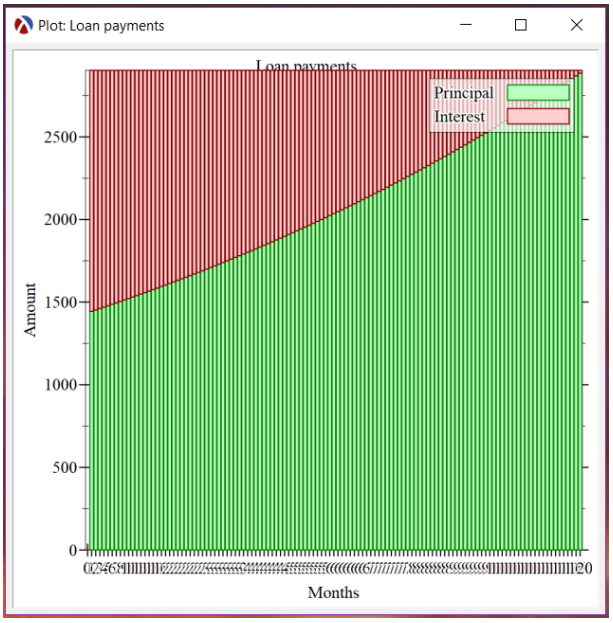
This example involves a problem with two parts. Both with the same amount of money for the loan but with different repayment period and different interest rate.

The first part is the example for a long-term loan of 10 years (or 120 months). While the second part is for a short-term loan of 9 months.

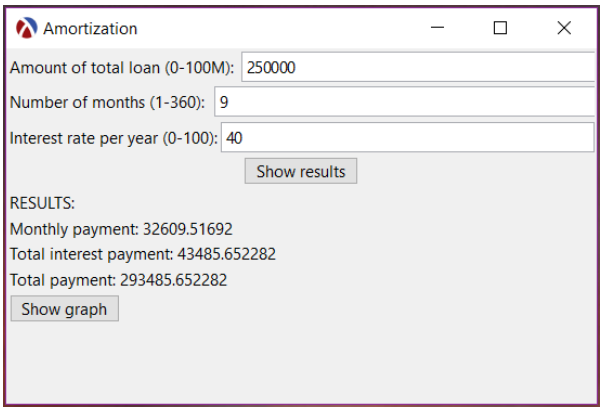
To prove if the results showed in the written example are the same as the ones computed by the program, the following pictures show the computation and the graphs.



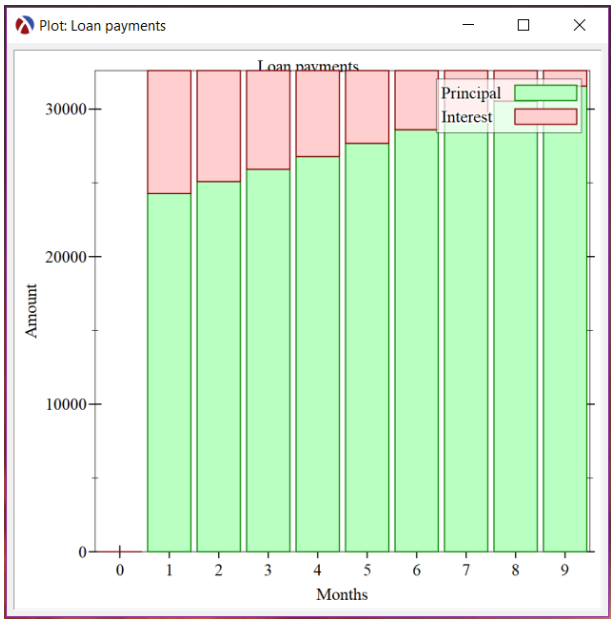
Picture 3. Results for long-term loan



Picture 4. Stacked graph for long-term loan



Picture 5. Results for short-term loan



Picture 6. Stacked graph for short-term loan

As shown in figures 3 and 5, the results of the total interest are the same that the ones in the described example.

As previously mentioned in the context of the problem, it is common for a long-term loan to pay more interest than a short- term loan and this it is easy to see in the graphs of pictures 4 and 6, where the amount of interest (red zone) is bigger in the picture 4 referred to the long-term loan, this is because of the difference in the percentages of the interest rate and the number of months.

Conclusions

This project was developed to aware people on how important is to know the way that loans works. However, this does not mean that the program could be used as financial advisor, it is only a tool to see how the interest rates and the payment periods affects the results on the total amount of the payment for a loan. And in this way, it may be easier to have a clearer idea of whether a loan is convenient or not.

To verify the results of the program, tests were also performed using excel sheets with complete amortization tables for the verification of the results of the monthly payments and the interest obtained. One of these files is included as evidence in the GitHub folder of the project.

Even though this program is a simple tool, its development and previous research allowed me to understand why financial education is so important in a country and how programs of this type could help people to have a clearer idea of how credits work and how they work. loans and have a way to compare them to decide which is best suited to their situation.

Setup instructions

1. Download the project folder from: https://github.com/karyrs15/programming_lang
   Or clone the repository from GitHub with the following command:

   ```
   git clone https://github.com/karyrs15/programming_lang.git
   ```

2. Extract files from the amortization_exe.zip file.
3. Open the amortization_exe folder.
4. Open the executable amortization_exe.exe to use the program.

References

Fundera. (2019). *Where to Find the Best Long-Term Small Business Loans*. From: https://www.fundera.com/business-loans/guides/long-term-loans

Gómez, C. (2018). *La educación financiera en México*. Instituto Belisario Domínguez. From: http://bibliodigitalibd.senado.gob.mx/bitstream/handle/123456789/4190/CI_53.pdf?sequence=1&isAllowed=y

Hawlk, K. (2016). *How Do Personal Loans Work?* From Student Loan Hero website: https://studentloanhero.com/featured/how-do-personal-loans-work/

Massey University. (2018). *Finance formulas*. From: http://owll.massey.ac.nz/maths-and-statistics/finance-formulas.php

Miller, M. (2019). *Learn Racket by Example: GUI Programming.* From: https://dev.to/goober99/learn-racket-by-example-gui-programming-3epm

Pritchard, J. (2019). *How Amortization Works.* From the balance website: https://www.thebalance.com/how-amortization-works-315522

Progopedia. (n.d.). *Paradigm: Functional*. From: http://progopedia.com/paradigm/functional/

Racket Documentation. From Racket website: https://docs.racket-lang.org

Salm, M. (2014). *Stacked Graph*. From BetterEvaluation website: https://www.betterevaluation.org/en/evaluation-options/stacked_graph

University of Central Florida. (n.d.). *Major Programming Paradigms*. From: http://www.eecs.ucf.edu/~leavens/ComS541Fall97/hw-pages/paradigms/major.html#functional