CS 602 Data Driven Programming with Python, Summer 2021

Programming Assignment 2. Loan Calculator

在这个项目中，您将使用numpy\财务包中的方法来计算贷款的每月付款，以及每个月付款的利息和本金部分。有关将此软件包安装到pythonide中的说明在本文档末尾。

In this project you will use methods from the numpy_financial package to calculate monthly payments on a loan, as well as the interest and principal portions of each monthly payment. Instructions for installing this package into your Python IDE are at the end of this document.

Python topics included in this assignment are:

- Installing packages
- Data type conversion functions (str, float, int, etc.) 数据类型转换函数（str、float、int等）
- Formatting data (justifying values, integer, float, character and other formats)
- Control structures (if, if else, etc.) and loops (for, while) 控制结构（if、if else等）和循环（for、while）
- Conditions with comparison operators, and, and or 具有比较运算符的条件，和，和或
- Basic string functions (upper/lower case), zfill, 基本字符串函数（大写/小写），zfill,
- Symbolic constants 符号常数

The program runs in sample mode (using pre-set loan information) or custom mode (with loan information that the user specifies), and displays either a monthly report summarizing payment information for each month of the loan, or an annual report, summarizing payment information for each year of the loan. 该程序以示例模式（使用预先设置的贷款信息）或自定义模式（使用用户指定的贷款信息）运行，并显示汇总贷款每个月付款信息的月报或汇总贷款每个年付款信息的年报。

You should be able to write the solution to this assignment in about 100 lines of code, depending on how much white space you include and how many comments you provide. If you find yourself writing 20 or 30 lines, probably you forgot something (or your code is very brief), and if you find yourself writing more than 150-200 lines of code, you might see check again to see what you can do to structure your solution more efficiently. 您应该能够用大约100行代码来编写此任务的解决方案，这取决于您包含了多少空白和提供了多少注释。如果您发现自己编写了20或30行代码，那么您可能忘记了什么（或者您的代码非常简短），如果您发现自己编写了150-200行以上的代码，那么您可能会再次看到check，看看您可以做些什么来更有效地构建解决方案。

Sample Runs

Sample Mode, Monthly Report

This report shows a monthly report using the sample data values.

```
Welcome to the CS 602 Loan Calculator.
[S]ample or [C]ustom Report: S
[M]onthly or [A]nnual Report: M
============================================================
Loan amount:                $  100,000.00
Loan duration in months:             180
Annual Interest Rate:              0.0625%
Monthly Payment:            $      857.42
============================================================
Month     Principal         Interest          Payment
============================================================
-------------------------Year: 1-----------------------------
Month     Principal         Interest          Payment
    001  $       336.59  $       520.83  $       857.42
    002  $       338.34  $       519.08  $       857.42
    003  $       340.10  $       517.32  $       857.42
    004  $       341.88  $       515.55  $       857.42
    005  $       343.66  $       513.77  $       857.42
    006  $       345.45  $       511.98  $       857.42
    007  $       347.25  $       510.18  $       857.42
    008  $       349.05  $       508.37  $       857.42
    009  $       350.87  $       506.55  $       857.42
    010  $       352.70  $       504.72  $       857.42
    011  $       354.54  $       502.89  $       857.42
    012  $       356.38  $       501.04  $       857.42
-------------------------Year: 2-----------------------------
Month     Principal         Interest          Payment
    013  $       358.24  $       499.18  $       857.42
    014  $       360.11  $       497.32  $       857.42
    015  $       361.98  $       495.44  $       857.42
    016  $       363.87  $       493.56  $       857.42
    017  $       365.76  $       491.66  $       857.42
(several intermediate rows omitted)
    166  $       793.15  $        64.28  $       857.42
    167  $       797.28  $        60.14  $       857.42
    168  $       801.43  $        55.99  $       857.42
-------------------------Year: 15----------------------------
Month     Principal         Interest          Payment
    169  $       805.60  $        51.82  $       857.42
    170  $       809.80  $        47.62  $       857.42
    171  $       814.02  $        43.40  $       857.42
    172  $       818.26  $        39.16  $       857.42
    173  $       822.52  $        34.90  $       857.42
    174  $       826.80  $        30.62  $       857.42
    175  $       831.11  $        26.31  $       857.42
    176  $       835.44  $        21.98  $       857.42
    177  $       839.79  $        17.63  $       857.42
    178  $       844.16  $        13.26  $       857.42
    179  $       848.56  $         8.86  $       857.42
    180  $       852.98  $         4.44  $       857.42
============================================================
Total:  $  100,000.00  $   54,336.12  $  154,336.12

Principal payment exceeds interest payment starting in month 48.
```

从第48个月开始，本金支付超过利息支付。

用户首选项。
User Preferences.

Separator lines, Summarize loan values (12 space field width)

分隔线，汇总贷款值（12空格字段宽度）

Monthly report column headings

月报列标题

Field width of 6 for the month and 12 for each calculated value

月份字段宽度为6，每个计算值字段宽度为12

Year indicator at the start of each new year followed column headers and month, principal, interest, and payment values

在每一个新年开始时，年份指标跟随列标题和月份、本金、利息和付款值

End-of-report summary information and month when principal exceeds interest payment

期末汇总信息及本息超付月份

Custom Mode, Annual Report (with data validation)

This report shows a custom report using the values that the user enters. The output also shows data validation to check that the user types the correct report mode and type, as well as data validation on the number of years.

```
Welcome to the CS 602 Loan Calculator.
[S]ample or [C]ustom Report: j
Error. Enter [S]ample or [C]ustom.
[S]ample or [C]ustom Report: C
Enter annual interest rate: 0.075
Enter loan amount: 250000
Enter number of years (between 3 and 30): 1
Error. Enter number of years (between 3 and 30): 31
Error. Enter number of years (between 3 and 30): 20
[M]onthly or [A]nnual Report: j
Error. Enter [M] or [A]
[M]onthly or [A]nnual Report: a
============================================================
Loan amount:              $  250,000.00
Loan duration in months:          240
Annual Interest Rate:           0.0750%
Monthly Payment:          $    2,013.98
============================================================
Year     Principal       Interest        Payment
============================================================
  001   $    5,607.97  $   18,559.83  $   24,167.80
  002   $    6,043.33  $   18,124.47  $   24,167.80
  003   $    6,512.49  $   17,655.31  $   24,167.80
  004   $    7,018.07  $   17,149.73  $   24,167.80
  005   $    7,562.90  $   16,604.90  $   24,167.80
  006   $    8,150.03  $   16,017.77  $   24,167.80
  007   $    8,782.74  $   15,385.06  $   24,167.80
  008   $    9,464.56  $   14,703.23  $   24,167.80
  009   $   10,199.32  $   13,968.47  $   24,167.80
  010   $   10,991.12  $   13,176.68  $   24,167.80

  011   $   11,844.39  $   12,323.41  $   24,167.80
  012   $   12,763.90  $   11,403.90  $   24,167.80
  013   $   13,754.80  $   10,413.00  $   24,167.80
  014   $   14,822.62  $    9,345.18  $   24,167.80
  015   $   15,973.33  $    8,194.46  $   24,167.80
  016   $   17,213.39  $    6,954.41  $   24,167.80
  017   $   18,549.71  $    5,618.09  $   24,167.80
  018   $   19,989.77  $    4,178.03  $   24,167.80
  019   $   21,541.63  $    2,626.17  $   24,167.80
  020   $   23,213.96  $      953.84  $   24,167.80
============================================================
Total:  $  250,000.00  $  233,355.92  $  483,355.92

Principal payment exceeds interest payment starting in month 130.
```

从第130个月开始，本金支付超过利息支付。

User Preferences.

Data validation on report mode, number of years, and meeting type

用户首选项。

报表模式、年数、会议类型数据验证

Separator lines, Summarize loan values (12 space field width)

分隔线，汇总贷款值（12空格字段宽度）

Annual report column headings

年度报告列标题

Leading zeros on year numbers. Values aligned with column headings.

年份数字的前导零。与列标题对齐的值。

Blank lines at ten-year intervals

每隔十年填写一次空行

Field width of 6 for the year and 12 for each calculated value

年度字段宽度为6，每个计算值为12

End-of-report summary information and month when principal exceeds interest payment

期末汇总信息及本息超付月份

The next sections give specific requirements for your code and for the program to run.

Report Modes

Prompt the user to select a report mode. The user may type C or S in either upper or lower case. If the user enters any other values, issue an error message and prompt the user to try again until they enter a valid option.

Sample Mode

Creates a report using this sample data: annual interest rate is 0.0625 (6.25%); loan amount is $100,000; loan term is 15 years.

Custom Mode

The user can enter custom values for the annual interest rate, loan amount and loan term. In custom mode, the program validates the value entered for years to be sure it is between 3 and 30 (including 3 and 30). If the user enters an invalid value, issue an error message and prompt the user to try again until they enter a valid value.

Report Types

Prompt the user to select a report type. The user may type M for monthly report or A for annual report in either upper or lower case. If the user enters any other values, issue an error message and prompt the user to try again until they enter a valid option.

Monthly Report

Display column headings for Month, Principal, Interest and Payment. The first month's number is 1.

Each line representing one month of the loan displays this information in nicely (right-aligned) columns:

- the month number
- the principal amount paid that month
- the interest amount paid that month.
- the amount (principal + interest) paid that month

Before the start of each new year (i.e., before months 1, 13, 25, etc.) display a line showing the year number, centered in a field width of 60 characters and filled with "-". Hint: Look at the documentation for the Python .center() method.

Annual Report

Display column headings for Year, Principal, Interest and Payment. The first year's number is 1.

Each line representing one year of the loan displays this information in nicely (right-aligned) columns:

- the year number
- the total principal amount paid that year
- the total interest amount paid that year
- the total amount (principal + interest) paid that year

Every ten years (i.e., between years 10 and 11, 20 and 21, etc.) display a blank line.

Additional Information

Before the monthly or annual report, display this information with appropriate labels, in two columns that line up:

- the loan amount,
- the loan duration, in months
- the annual interest rate as a percent
- the monthly payment

Place a separator line containing 60 ='s above and below this information. Then display the report's column headings followed by another separator.

After the monthly or annual report, display the total of the payment, interest payment, and total payment columns (lined up with the values above). Then display the first month number when the monthly principal payment amount exceeded the interest amount for that month.

Formatting Notes

- Use a 6-space field width for the year number, and 12-space field width for the annual principal, annual interest, and total annual payment for that year. Separate each column with a \t (tab).
- Format the column headings for the monthly and annual reports so they line up with the values.
- Format the year or month number with at most two leading zeroes (so that the value will take up 3 spaces) all the time.
- Format all currency values right aligned, with 2 decimal places and a field width that's appropriate so values line up in each column.
- Format the interest rates to four decimal places.
- Separate the rows of the payment table from the summary information with a separator line containing 60 ='s.
- Format the table header row so that the column headings are roughly center aligned over the values of each column.
- Use Python f-strings for all formatting. Please do not use the str.format() method.
- When calling the ppmt, ipmt, and pmt functions, use a minus sign in front of the expression so that values appear as positive.

Coding Notes

- Use symbolic constants where appropriate, especially for string or numeric values that are referenced in the code.
- Be sure your program has a doc string at the top, and comments to guide the reader trying to understand your code.

Grading

General	
Data validation on report type, mode, and loan term in years	4
User input (Sample data used for sample report, user data for custom report)	2
Clear Code, Comments, Constants	2
Correct formulas for monthly principal, interest, payments	4
Report Format (columns line up, values formatted with leading 0's, commas, decimals)	4
Pre-Report Information	
Summarize loan values with separators	1
Monthly Report	
Monthly Report Column Headings	1
Year indicators at 12 month intervals	2
Annual Report	
Annual Report Column Headings	1
Correct formulas for each year's total annual principal, interest, and payment amounts	4
Blank lines at 10 year intervals	1
Summary Information	
End of Report Summary Calculations (total principal, interest, payment)	2
End of Report Principal Exceeds Interest Month Calculation	2
Total	30

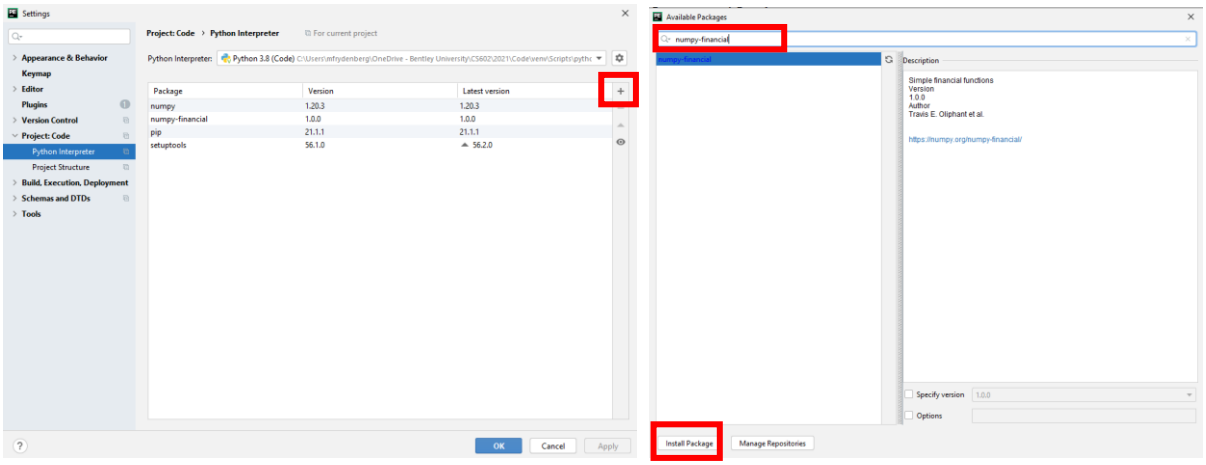
Submit your completed Python code file to Blackboard before the due date. This is an individual assignment, so please don't ask for help from other students or anyone else except for your instructor or CIS Sandbox tutors.

Install the numpy_financial package.

Using PyCharm.

To install the numpy_financial package in PyCharm, click on File → Settings → Project Interpreter.

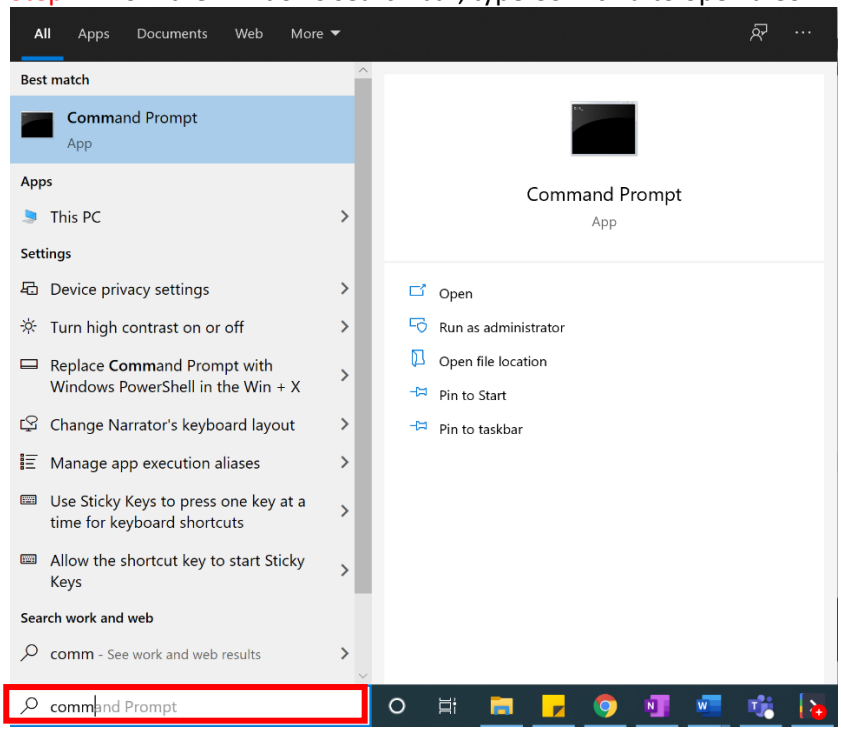
(1) Click the + sign to install a package
(2) Type numpy-financial in the search box
(3) Click Install Package to install the package.



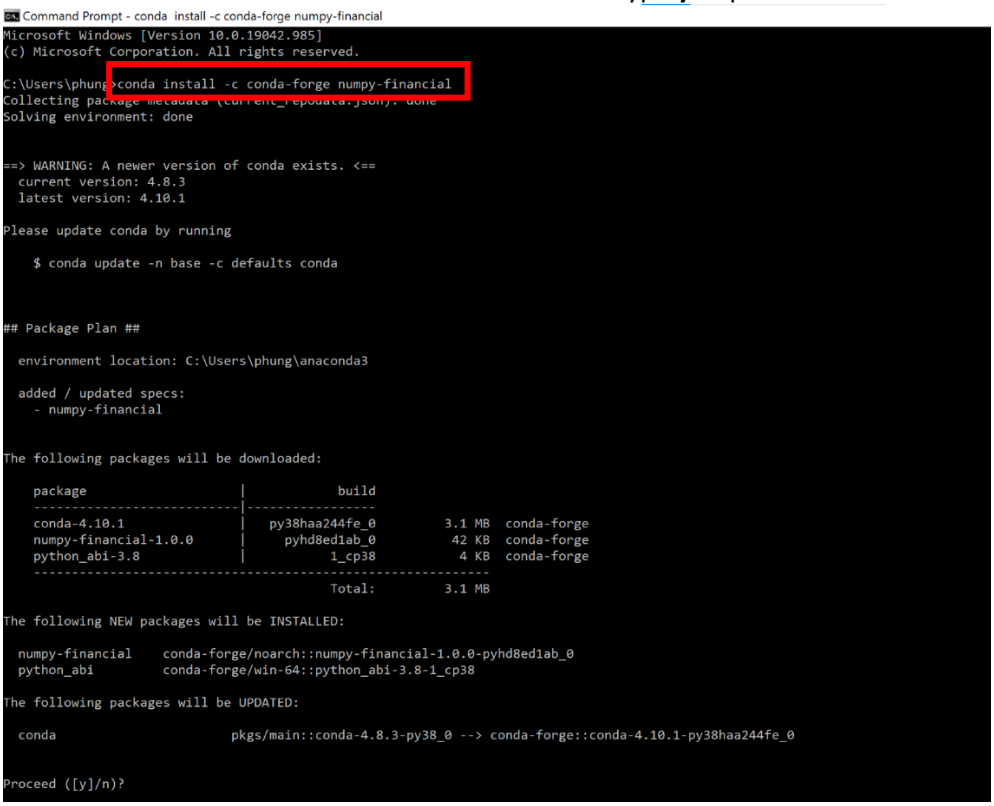
Create or open a Python file containing the sample program below and make sure it runs correctly.

Using Eclipse.

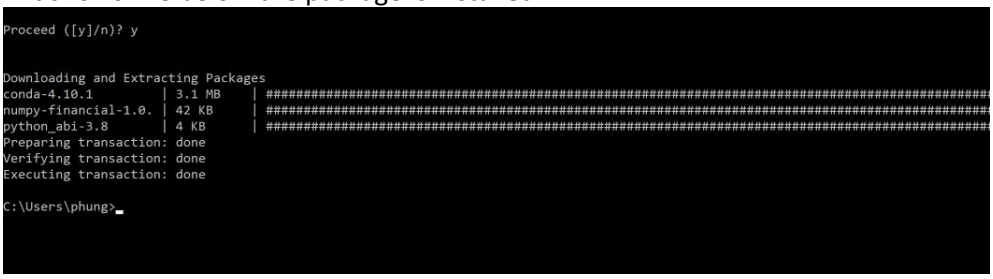
Step 1: From the Windows search bar, type command to open a Command Prompt window



Step 2: In the Command Prompt window, type the command
`install -c conda-forge numpy-financial`
Wait for it to run then it will ask to Proceed or not. Type **y** to proceed.



If it shows like below the package is installed.



Step 3: Run the sample program below to make sure your package is installed correctly.

Using Pip

To install numpy_financial using pip, in a terminal window, type `pip install numpy_financial .`

Run a Sample Program to Test Your Installation

To test that the numpy_financial package is installed properly, run this sample program. Note the minus sign before the loan amount so that the program calculates the monthly payment as a positive number.

```
"""
Test numpy_financial functions
"""
import numpy_financial as npf

int_rate = 0.08  # annual interest rate
years = 10
loan_amt = 100000
month_number = 1

monthly_pmt = npf.pmt(int_rate/12, years*12, -1* loan_amt)
int_part = npf.ipmt(int_rate/12, month_number, years*12,-1*loan_amt)
prin_part = npf.ppmt(int_rate/12, month_number, years*12,-1*loan_amt)

print()
print(f"The monthly payment on ${loan_amt:0.2f} at {int_rate*100:0.2f}%", end=" ")
print(f"for {years} years is ${monthly_pmt:0,.2f}.")
print(f"In month number {month_number} of the loan,")
print(f"${int_part:0.2f} is interest and ${prin_part:0.2f} is applied toward the
principal.")
```

```
The monthly payment on $100000.00 at 8.00% for 10 years is $1,213.28.
In month number 1 of the loan,
$666.67 is interest and $546.61 is applied toward the principal.
```

The statement `import numpy_financial as npf` gives your program access to the functions in that package. To call a function, use the package abbreviation name (npf) followed by a dot followed by the name of the function and any arguments in parentheses, as shown. You will need to use the pmt (monthly payment), ppmt (principal part of a monthly payment), and ipmt (interest part of a monthly payment) financial functions from the numpy_financial package. Read the documentation at https://numpy.org/numpy-financial/latest/ to learn about these functions.