Problem 3

Problem 3 - Using Bisection Search to Make the Program Faster

0.0/20.0 points (graded)

You'll notice that in Problem 2, your monthly payment had to be a multiple of $10. Why did we make it that way? You can try running your code locally so that the payment can be any dollar and cent amount (in other words, the monthly payment is a multiple of $0.01). Does your code still work? It should, but you may notice that your code runs more slowly, especially in cases with very large balances and interest rates. (Note: when your code is running on our servers, there are limits on the amount of computing time each submission is allowed, so your observations from running this experiment on the grading system might be limited to an error message complaining about too much time taken.)

Well then, how can we calculate a more accurate fixed monthly payment than we did in Problem 2 without running into the problem of slow code? We can make this program run faster using a technique introduced in lecture - bisection search!

The following variables contain values as described below:

1. `balance` - the outstanding balance on the credit card
2. `annualInterestRate` - annual interest rate as a decimal

To recap the problem: we are searching for the smallest monthly payment such that we can pay off the entire balance within a year. What is a reasonable **lower bound** for this payment value? $0 is the obvious anwer, but you can do better than that. If there was no interest, the debt can be paid off by monthly payments of one-twelfth of the original balance, so we must pay at least this much every month. One-twelfth of the original balance is a good lower bound.

What is a good **upper bound**? Imagine that instead of paying monthly, we paid off the entire balance at the end of the year. What we ultimately pay must be greater than what we would've paid in monthly installments, because the interest was compounded on the balance we didn't pay off each month. So a good upper bound for the monthly payment would be one-twelfth of the balance, *after* having its interest compounded monthly for an entire year.

In short:

> **Monthly interest rate** = (Annual interest rate) / 12.0
> **Monthly payment lower bound** = Balance / 12
> **Monthly payment upper bound** = (Balance x (1 + Monthly interest rate)^{12}) / 12.0

Write a program that uses these bounds and bisection search (for more info check out the Wikipedia page on bisection search) to find the smallest monthly payment *to the cent* (no more multiples of $10) such that we can pay off the debt within a year. Try it out with large inputs, and notice how fast it is (try the same large inputs in your solution to Problem 2 to compare!). Produce the same return value as you did in Problem 2.

Note that if you do not use bisection search, your code will not run - your code only has 30 seconds to run on our servers.

Test Cases to Test Your Code With. Be sure to test these on your own machine - and that you get the same output! - before running your code on this webpage!

Click to See Problem 3 Test Cases

```
1 # Paste your code into this box
2
```

Press ESC then TAB or click outside of the code editor to exit

Unanswered

Note:
Depending on where, and how frequently, you round during this function, your answers may be off a few cents in either direction. Try rounding as few times as possible in order to increase the accuracy of your result.

Important
Only hit "Check" once per submission. You only get 30 checks per problem.
If you believe you have correct code but it is marked incorrect after clicking "Check"...
"Staff Debug: L397 Error" means your code has an infinite loop...
Do not define your own values

Submit You have used 0 of 30 attempts

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recursion error because I was rounding too soon My code kept timing out with a recursion error. What I found is that I was rounding my mid_p...	4
I'm pretty stuck here. Did you guys use some code from the first exercise ?	4
? How to structure a test function? Hello! I've been trying to solve this for several hours and came to the structure of two parts: t...	2
? infinite loop	1
? (SPOILERS) My code works, but my values are way off. As said in the title, my code is not returning the expected values. I am using a while loop to ru...	5
? Says it has an infinite loop but my IDE runs it just fine? When I define the variables "balance" and "annualInterestRate" in my IDE and it worked fine. ...	3
Cannot find the infinite loop in my code I cannot find my where my infinite loop is. The code works in python tutor (but long>999 step...	2
? Almost there - now stuck and confused. [RESOLVED - potentially useful post] I have what I believe to be pretty decent code. For the second test case given (999999, 0.18) ...	5

Here's tips for how to solve the problem. NO SPOILER.	First of all, if you are doing MITx exercise and completed the previous test (just to increment ...	2
SPOILER. I'm off by around 4-5 dollars for each. Why?	((Snip: please do not post PSET code)) ((Instead, describe the problem and the error messag...	2
Finally got it! (hardest part is concept)	OMG, i finally figured it out after frigging low. I feel extremely proud of myself ... and super th...	3
Are pointers a thing in Python?	So, I set a temp variable as balance and use it to reset the value of balance in my while loop. ...	2
Please help!	I'm struggling this problem for long time. I cannot generate the correct result as test cases. A...	1
20 lines including definition of variables, is there a better way to do this?	Has anyone done it with fewer lines? The actual body of my code was about 14 lines, and the...	2
Correct but no Check Mark?	So I got it right, "Correct (20/20 points)", but when I click the next button it doesn't get the gre...	8
If you can believe it, it took me less time to solve this than the first problem.	I spent an hour on this. I spent 4 on the first one.	1
I took 6 hours on this question and was tempted to give up. Whoever is struggling out there, do not copy and paste the code from a repository in github. Painstakingly go through your code on pythontutor and you will find out where you mes	I took 4 hours on this problem and was tempted to give up. Whoever is struggling out there, ...	3
It was a torture but was worth it, 17 lines :)	This was a really abstract problem and spent three days trying to solve it (not the whole day t...	2
My program terminates for no reason		1
To the cent ?	Hi ! I´m chilean :D, so i don´t understand pretty well how the cents works, so can you explain...	7