Feedback — Homework 5

You submitted this homework on **Wed 1 Jul 2015 10:57 PM PDT**. You got a
score of **80.00** out of **100.00**. You can attempt again, if you'd like.

*"I arise in the morning torn between a desire to improve the world and a desire to enjoy the
world. This makes it hard to plan the day."* E. B. White - author of *Charlotte's Web*

Analyzing the Greedy Boss Scenario

In this week's mini-project, we will investigate various strategies for the simple (but popular)
game "Cookie Clicker". (If you think Cookie Clicker is silly, just remember that "Farmville" made
the founders of Zynga rich.) As a warmup, this week's Practice Activity, The Case of the Greedy
Boss, considers a simple scenario that is very similar to Cookie Clicker in which you can
repeatedly bribe your boss to have him increase your salary.

This homework will analyze the behavior of the greedy boss simulator for several simple cases.
If you have not taken a look at this practice activity, you should work through it first before
attempting this homework.

Question 1

Use the function `run_simulations` in the greedy boss simulator to plot the graph of total salary

earned as a function of the number of days for `bribe_cost_increment = 0, 500, 1000, 2000` .

Which value for `bribe_cost_increment` generates the fastest growth in total salary earned in the

simulation?

Remember to compare the plots of the functions over roughly the same number of days.

Your Answer		Score	Explanation
○ 2000			
○ 1000			
● 0	✔	10.00	Correct. Lower cost for bribes leads to faster growth in total salary earned.

○ 500

Total	10.00 / 10.00	

Question 2

One scenario that the greedy boss simulator does not cover is the situation when you refuse to accept a bribe. Which of the following arithmetic sums evaluates to your total salary earned after d days?

Your Answer	Score	Explanation
○ $100 + 200 + \ldots + 100(d-1) + 100d$		
○ $1 + 1 + \ldots + 1 + 1$ (with d terms in sum)		
○ $1 + 2 + \ldots + (d-1) + d$		
◉ $100 + 100 + \ldots + 100 + 100$ (with d terms in sum)	✔ 10.00	Correct. You earn 100 dollars per day over d days.
Total	10.00 / 10.00	

Question 3

Reduce the arithmetic sum that you selected in Question 2 to a polynomial expression in the number of days d using the rules for arithmetic sums specified in the Math notes. This expression should evaluate to your total salary earned after d days.

Enter the answer as a math expression below

You entered:

```
100*d
```

Preview   Help

Your Answer	Score	Explanation
100*d	✔ 10.00	Correct. Your salary earned grows linearly.
Total	10.00 / 10.00	

Question 4

For the next three problems, we will consider the case when `bribe_cost_increment == 1000`. First, convert the output of `greedy_boss()` into Log/Log form by taking the logarithm of both `current_day` and the total salary earned using `math.log()` before they appended to the list `days_vs_earnings`.

The plot of the resulting graph approaches a straight line as the number of days increase. This observation signals that the function **might** be a polynomial function. Compute the slope of this line and round it to the nearest integer to estimate the degree of this polynomial.

You entered:

```
2
```

Your Answer	Score	Explanation
2	✔ 10.00	Correct. The graph corresponds to a quadratic function.
Total	10.00 / 10.00	

Question 5

Examine the output of the simulation `greedy_boss(50, 1000)`. Note you accumulate enough

savings to pay a bribe once every 10 days.

Which of the arithmetic sums below evaluates to the total salary earned after n bribes?

Your Answer		Score	Explanation
◯ $1000 + \frac{1000}{2} + \frac{1000}{3} + \ldots + \frac{1000}{n}$			
◯ $1000 + 1000 + 1000 + \ldots + 1000$			
◯ $1000 + \frac{1000}{2} + \frac{1000}{2^2} + \ldots + \frac{1000}{2^n}$			
◉ $1000 + 2000 + 3000 + \ldots + 1000n$	✔	10.00	Correct. The total salary earned grows at a quadratic rate.
Total		10.00 / 10.00	

Question 6

Reduce the arithmetic sum that you selected in Question 5 to a closed-form expression in n using the rules for arithmetic sums specified in the Math notes. This expression should relate total salary earned to the number of bribes.

Finally, use the fact that each bribe happens once every 10 days to derive a polynomial expression for total salary earned in terms of the number of days d. As a check, this expression in d should evaluate exactly to the total salary earned by the end of the day of each bribe.

Enter this expression in d as a math expression below.

You entered:

```
5000*d*(10*d+1)
```

Preview   Help

Your Answer		Score	Explanation
5000*d*(10*d+1)	✖	0.00	Match failed
Total		0.00 / 10.00	

Question 7

The next two questions will examine the case when the cost of a bribe does not increase, i.e; `bribe_cost_increment == 0`. Our first task is to check whether the total salary earned is a polynomial function of the number of days in this case. To this end, create a Log/Log plot of the output of `greedy_boss` and examine the resulting graph.

Does the graph approach a straight line as the number of days increases?

Your Answer		Score	Explanation
◉ No, the graph does not approach a straight line.	✔	10.00	Correct. This observation means the the function can not be a polynomial.
◯ Yes, the graph approaches a straight line.			
Total		10.00 / 10.00	

Question 8

To conclude our analysis of this case, we will do some manual experimentation to locate an expression in d that grows at a similar rate to total salary earned when `bribe_cost_increment == 0`.

Compare the growth rates of the expressions below to the growth rate of total salary earned using the plotting technique described in the Math notes. Which expression grows at approximately the same rate as total salary earned?

Your Answer	Score	Explanation
○ $9.5d^4$		
○ $95d^2$		
○ $e^{9.5d}$		
◉ $e^{0.095d}$	✔ 10.00	Correct. The ratio of the two quantities approaches a constant (approximately) as d increases.
Total	10.00 / 10.00	

Question 9

In the last two questions, we will consider a simple version of Cookie Clicker in which there is only one possible upgrade option. Instead of increasing the cost of an upgrade by some fixed amount after each upgrade as done in the greedy boss simulator, each upgrade in Cookie Clicker costs 15% more than the cost of the previous upgrade. (Note that this cost compounds in the same manner that interest does.)

If the first upgrade costs one unit, enter a math expression that models the cost of the nth upgrade.

You entered:

[   ]

[Preview]   Help

Your Answer	Score	Explanation
	✘ 0.00	Could not parse student submission
Total	0.00 / 10.00	

Question Explanation

The cost of each upgrade grows exponentially. Also, make sure that your answer evaluates to 1 when $n == 1$.

Question 10

For the case when `bribe_cost_increment == 1000`, the cost of the nth bribe was exactly $1000n$. Which expression in n grows faster (as defined in the Math notes), $1000n$ or your answer to question 9?

You may want to plot some examples using `SimplePlot` for large values of n to help in making this comparison.

Your Answer	Score	Explanation
⊙ The cost of an upgrade in Cookie Clicker grows faster than the cost of a bribe in the greedy boss scenario.	✔ 10.00	Correct. In this simplified version of Cooke Clicker, the cost of upgrades grows faster than in the greedy boss scenario. Therefore, the total cookies generated in this version grows at rate that is bounded by a quadratic function.
○ The cost of an upgrade in Cookie Clicker grows more slowly than the cost of a bribe in the greedy boss scenario.		
○ Both expressions grow at the same rate.		
Total	10.00 / 10.00	