

## CMPS 6100 Lab 03

In this lab, you will practice and build up an intuition around asymptotic analysis.

Some prompts will require you to edit `main.py` and others will require answers to go in `answers.md`.

Refer back to the README.md for instruction on git, how to test your code, and how to submit properly to get all the points you've earned.

### Asymptotic Analysis Problems (14 pts)

Conventions:

$$\lg n = \log_2 n$$

$$\ln n = \log_e n$$

$$\log n = \log_{10} n$$

$$\log^c n = (\log n)^c$$

$$\lg \lg n = \lg(\lg n)$$

Using the asymptotic definitions or the limit theorem, prove (or disprove) the following statements. Add all answers to `answers.md`. Each of the following problems are worth one point, except for 4 and 10 which are worth two points each.

1.  $32n \in O(n)$
2.  $\ln n \in \Omega(n)$
3.  $\lg n \in \Theta(\ln n)$
4.  $\log_c n \in \Theta(\ln n), \quad c > 1$
5.  $n^2 \in O(2^n)$
6.  $n^3 \in \Omega(n^2)$
7.  $4^{\lg n} \in \Theta(n)$
8.  $\ln^2 n \in O(n)$
9.  $\ln^2 n \in O(\sqrt{n})$
10.  $\ln^c n \in O(n^k), \quad \forall c, k > 0$
11.  $\ln \ln n \in O(\ln n)$
12.  $2^n \in \Omega(2^{n+1})$

### The Ghost Game, Ghost Busters Add-on (13 pts)

For this programming assignment, you will add a new feature to your Ghost Game from the previous lab.

To start, copy over your Ghost Game source file from the previous lab into this one.

Now, in this lab, you will add combat to your game! Previously, if the player encountered the ghost, they lost. Now you will give them a chance to defeat the ghost and still win.

If the player encounters the ghost, the game should enter a combat loop. Both the player and ghost should have hp (health points). The combat loop always starts with the player getting an opportunity to attack the ghost. The player should be presented with a set of at least three options for attacks with each dealing a different amount of damage and/or having other effects. What these attacks are, the damage they deal, and their potential effects are up to you.

13. Detail the attack options for the player in `answers.md`

After the player attacks, if the ghost has not been defeated, the ghost will then perform an attack that decreases the player's hp by a set amount plus a random value. For example, the ghost's base damage could be 8 with a random amount of additional damage up to 4 points. The ghost would thus deal between 8 to 12 damage on each attack.

The combat ends when either the ghost or player are defeated.

If the player is defeated, they lose the game.

If the ghost is defeated, exploration is resumed, and the player must still find the portkey to win the game.

Don't forget to include useful messages throughout combat. Well formatted, concise, and informative messages make all the difference in a text-based game. A player who knows nothing about your implementation should be able to play your game.

If the player gets to the portkey without encountering the ghost, the player must defeat the ghost in the portkey room in order to win.

### **Bonus: Ghost Attack Options (5 points)**

Rather than having the ghost perform a simple attack every round, give the ghost atleast two options for attacks and have the ghost automatically choose what to do.

Your automatic choice can be as simple as a random choice. You could also have the ghost choose its attack based on other information.

These attacks and how the choice is made is up to you.

14. If implemented, detail the ghost attack options and game logic for ghost attack selection in `answers.md`.

## **Epilogue**

In this lab, you have built up a facility in asymptotic analysis and an intuition around these common functions. I hope that you've noticed some common general patterns which you can broadly apply.

With experience and practice, you will be able to consider an algorithm, determine its runtime, and quickly rank it relative to other algorithms and runtimes. We will continue to work on this in the coming weeks.