CSCI 3104: Algorithms **Instructor Buxton**
Problem Set 1 (45 points total) **Summer 2019, CU-Boulder**

Advice 1: For every problem in this class, you must justify your answer: show how you arrived at it and why it is correct. If there are assumptions you need to make along the way, state those clearly.

Advice 2: Verbal reasoning is typically insufficient for full credit. Instead, write a logical argument, in the style of a mathematical proof.

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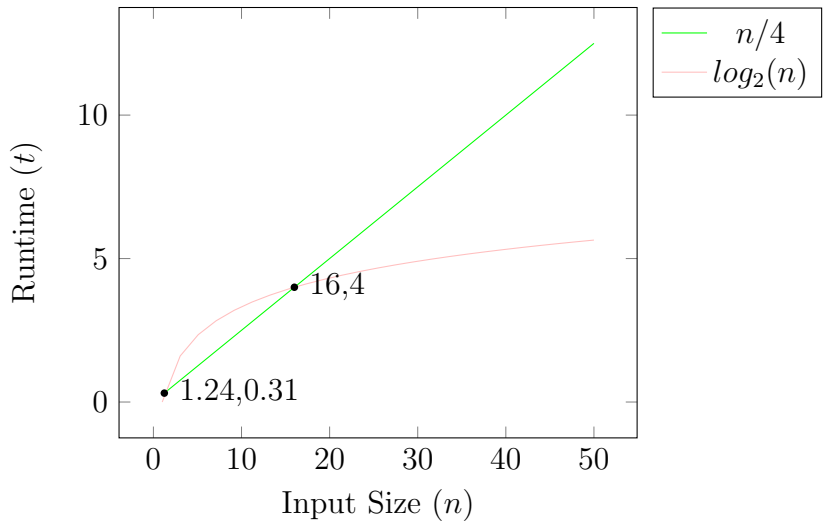
1. (5 points) Give an example of an application that uses a proprietary algorithm (i.e. Spotify's "Discover Weekly" playlist, Google's PageRank algorithm, etc.). Find an article that discusses this algorithm and give a summary of its content. Provide at least 4-5 sentences for full credit.

   O of all the most popular dating apps, Tinder is by far the most interesting (profitable) dating app, at it's core it's complied algorithms to match people based on their tinder profile elements. As of March 15, Tinder determined it's moving from the "elo" scoring system, which is derived from gaming and chess to match the best people with other best people, in this case the most desirable tinder profile with the other most desirable profiles. The Tinder algorithm has evolved to prioritize logistics on your profile instead, to provide more matches for its users. Tinder will now match you with people nearest to your location above all else, people using the app at the same time and how high your engagement rate between matched. This means, if a lot of guys use it at 8pm, then this would suggest only other girls using it at 8pm. This algorithm change stems from complaints that tinder algorithm is broken for the majority of people using the app. https://mashable.com/article/tinder-ends-elo-score/

2. (15 points) Consider two algorithms that perform the same function, that run in $n/4$ and $log_2(n)$, respectively, where $n \in \mathbb{N}$ (i.e. natural numbers). n represents the input size and $n/4$ and $log_2(n)$ represent runtimes with respect to the input size.

   (a) Plot these runtimes on the same graph with the values $n \in [1, 50]$ (don't forget labels). Provide the set of intervals over $\mathbb{N}$, where $n/4$ is the strictly better algorithm to use (think greater than, not greater than or equal).



   Since our n/4 is at a lower slope for runtime, then n/4 is the faster algorithm for the interval: $1.24 < n < 16$ However this changes after $n/4 = log_2(n)$ at n = 16. when our n/4 is intersected.

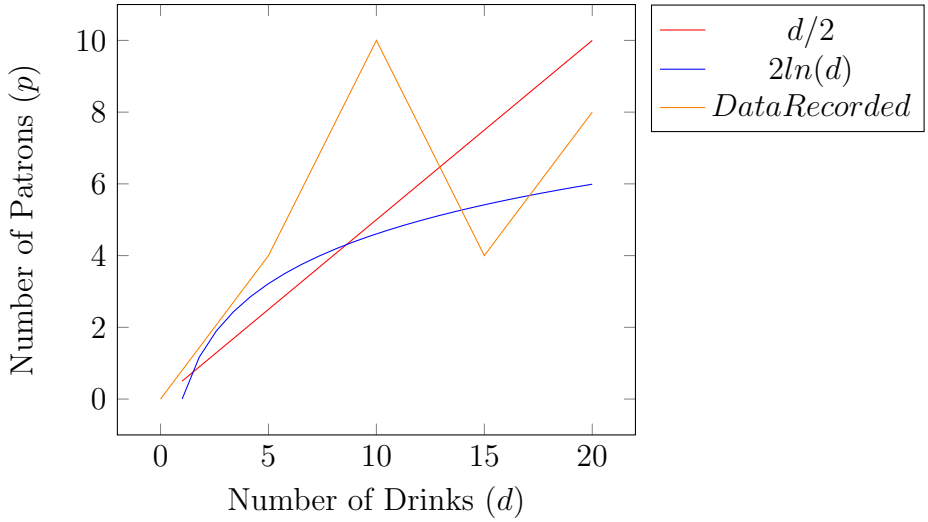
3. (15 points) Harry the Wizard needs your help solving a riddle deep in an abandoned dwarven mine. There are two doors marked A and B, respectively, and a stone pedestal in the middle of the room inscribed with the following text:

   "The dwarves who dwelled in this mine were fond of mathematical drinking games. Two dwarves, Arnold and Barry, are chosen as the participants for this game, and pick functions that they think will best predict the number of people who enter the pub in an hour (p) based on the number of drinks they consume in that hour (d). They choose $p(d) = d/2$ and $p(d) = 2ln(d)$, respectively. Below is a record of the number of drinks consumed and the corresponding number of patrons patrons who entered the bar over four hours.

Number Drinks (d)	Number Patrons (p)
5	4
10	10
15	4
20	8

   Which dwarf, Arnold or Barry, chose the most accurate function?"

   Due to an error in Harry's mental calculations in the last puzzle causing Grog the Barbian to lose his pinky finger, the party demands a written explanation of the solution to the puzzle. Additionally, since Grog doesn't know how to read, provide a relevant figure in your solution so Grog can believe he is part of the discussion.



   Below we plot our graph on a table to see which function is more accurate at each hour.

d (drinks)	p(d)	d/2	Data Difference (d/2)	2ln(d)	Data Difference (2ln(d))
5	5	2.5	1.5	3.21	0.78
10	6	5	5	4.60	5.39
15	5	7.5	3.5	5.41	1.31
20	8	10	2	5.99	2.00
			Average distance from Data for d/2 = 3		Average distance from Data for 2ln(d) = 2.40

The most accurate function is 2ln(d) because it is the shortest average distance from the bar data over 4 hours.

4. (10 points) Consider the following recurrence relation:

$$G_n = \begin{cases} 1 & \text{if } n = 0 \\ \text{-1} & \text{if } n = 1 \\ 2 & \text{if } n = 2 \\ (G_{n-1})(G_{n-2})+G_{n-3} & \text{otherwise} \end{cases}$$

   (a) Write pseudocode for this function that takes in a positive integer, n, and returns the nth number in the sequence.

   (b) What is the 10th number in the sequence?

article

Part A. pseudoode for recurrence relation about

```
def test(n):
n0 = 1
n1 = -1
n2 = 2
if n is 0:
then return n0
elif n is 1:
then return n1
elif n is 2:
then return n2
else:
index = 3
while index less than or equal too n:
q n3 = ((n2*n1)+n0) this represents our equation (Gn-1)(Gn-2)+(Gn-3)
n0 = n1
n1 = n2
n2 = n3
index += 1
return n3
```

b.

```
n=10
print(test(n))
= -147,503,198
```