CSCI 3104 Fall 2022
Instructors: Prof. Grochow and Chandra Kanth Nagesh

Quiz 6 S16

Due Date ..... Thursday Oct 27, 2022 8pm MT
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Quiz Code (enter in Canvas to get access to the LaTeX template) ..... **KJRTY**

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Instructions

- You may either type your work using this template, or you may handwrite your work and embed it as an image in this template. **If you choose to handwrite your work, the image must be legible, and oriented so that we do not have to rotate our screens to grade your work.** We have included some helpful LaTeX commands for including and rotating images commented out near the end of the LaTeX template.
- You should submit your work through the **class Gradescope page** only. Please submit one PDF file, compiled using this LaTeX template.
- You may not need a full page for your solutions; pagebreaks are there to help Gradescope automatically find where each problem is. Even if you do not attempt every problem, please submit this document with no fewer pages than the blank template (or Gradescope has issues with it).
- You **may not collaborate with other students**. **Copying from any source is an Honor Code violation. Furthermore, all submissions must be in your own words and reflect your understanding of the material.** If there is any confusion about this policy, it is your responsibility to clarify before the due date.
- Posting to **any** service including, but not limited to Chegg, Discord, Reddit, StackExchange, etc., for help on an assignment is a violation of the Honor Code.
- You **must** virtually sign the Honor Code (see Section). Failure to do so will result in your assignment not being graded.

Honor Code (Make Sure to Virtually Sign)

Problem HC.

- My submission is in my own words and reflects my understanding of the material.
- Any collaborations and external sources have been clearly cited in this document.
- I have not posted to external services including, but not limited to Chegg, Reddit, StackExchange, etc.
- I have neither copied nor provided others solutions they can copy.

I agree to the above, Tyler Huynh. □

16 Standard 16: Analyzing Recursive Code

Problem 16. Write down a recurrence for the **number of times this algorithm prints "hello".** Clearly justify your answer. You are **not** being asked to solve the recurrence.

Hint: Don't be distracted by what you think the algorithm is trying to do. Focus on the print statement (you're counting calls to print, not runtime!) and the recursive calls.

Algorithm 1 Recursive Algorithm

```
1:  procedure SQUARE(List L)
2:      print("hello");
3:      n ← len(L);
4:      if n ≤ 1 then return L;
5:      L_1 ← L[0 : ⌊n/2⌋];
6:      L_2 ← L[⌊n/2⌋ : n];
7:      L_1 ← SQUARE(L_1);
8:      L_2 ← SQUARE(L_2);
9:      L_1 ← L_1 append L_2;
10:     return L_1;
```

Tyler Huynh

Answer.

Q6 S16

Lines of code:

line 2 = 1 step to print ("hello")

3 = 2 steps for the assignment of n and calling the function len.

4 = 1 step for $n \leq 1$, 1 step for returning L (Base Case)

5 = 1 step for assignment, 1 step to split list

6 = same as line 5, 2 steps

7 = This line is calling recursively the list that has $n/2$, such that $T(\frac{n}{2})$.

8 = This line is calling recursively the list that has $n/2$, such that $T(\frac{n}{2})$.

9 = This line has 2 steps as 1 is for the assignment, and another is for the appending of L_1 and L_2.

10 = 1 step to return L_1

Total runtime complexity of T(n):

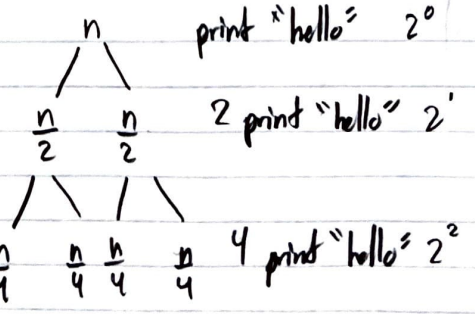
Base Case = $\Theta(1)$

Recursive Case = $2T(\frac{n}{2}) + \Theta(1)$

$$T(n) \begin{cases} \Theta(1) & n \leq 1 \\ 2T(\frac{n}{2}) + \Theta(1) & n > 1 \end{cases}$$

* The other steps result in being $\Theta(1)$, because it is a constant that is not determined by the size of the list.

Finding how many times "hello" will be printed:



k will represent the number of levels.

$\frac{n}{2^k} \leq 1$

$n \leq 2^k$

$\log_2 n \leq k$

For each level of k, hello will be printed 2^k times.

$\sum_{i=0}^{\log_2 n} 2^i$ Geometric series

$= \frac{1-2^{\log_2 n + 1}}{1-2}$

$= \frac{1-(2^{\log_2 n})(2)}{-1}$

$= \frac{1-(2n)}{-1}$

$= -1+2n$

$= 2n-1$

"hello" will be printed $2n-1$ times.

□