# Quiz 01

*COSC 211: Data Structures*, Fall 2021

**Instructions.** This quiz is open book and open note—you may freely use your notes, lecture notes, or textbook while working on it. You may *not* consult any living resources such as other students or web forums. The quiz must be submitted by the beginning of class on Thursday, *September 9th, 2021*. If you do not attend class in person, you may email your scanned or typeset solution to the professor using the subject line `[COSC 211] Quiz 01`.
**Affirmation.** I attest that that work presented here is mine and mine alone. I have not consulted any disallowed resources while taking this quiz.

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**Question 1.** Suppose you are given two `Stack` instances with states $S_1 = (x_0, x_1, \ldots, x_{n-1})$ and $S_2 = \varepsilon$ (empty), respectively. Suppose that $i$ is an index satisfying $0 \leq i \leq n$. In the space below, describe how you can use the two `Stacks` to simulate the `List` operation $\text{add}(i, y)$. That is, you should describe a sequence of `Stack` operations applied to $S_1$ and $S_2$ such that after executing these operations, the state of $S_1$ is the same as if you had applied $\text{add}(i, y)$.

⇒ situation at start

*Hint:* What is the effect of performing the the following three operations: (1) $S_2.\text{push}(S_1.\text{pop}())$, (2) $S_1.\text{push}(y)$, (3) $S_1.\text{push}(S_2.\text{pop}())$?

Solution

step 1 $S_2 \cdot \text{push}(S_1 \cdot \text{pop}())$ ⇒ do this $(n-i)$ times

$$\Downarrow$$

$$\begin{cases} S_1 = (x_0, x_1, x_2, \ldots, x_{i-1}) \\ S_2 = (x_{n-1}, x_{n-2}, \ldots, x_i) \end{cases}$$

step 2 $S_1 \cdot \text{push}(y)$ ⇒ $\begin{cases} S_1 = (x_0, x_1, x_2, \ldots, x_{i-1}, y) \\ S_2 = (x_{n-1}, x_{n-2}, \ldots, x_i) \end{cases}$ only one time

step 3 $S_1 \cdot \text{push}(S_2 \cdot \text{pop}())$ ⇒ do this $(n-i)$ times

$$\Downarrow$$

$$\begin{cases} S_1 = (x_0, x_1, x_2, \ldots, x_{i-1}, y, x_i, \ldots x_{n-2}, x_{n-1}) \\ S_2 = \varepsilon \end{cases}$$

↳ final situation after a series of operations

$$\Downarrow$$

looks like $\text{add}(i, y)$ is implemented !!