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Introduction to Algorithms (CSC 3130-02)

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Stacks and Queues

1. Stacking

1. Push (8) - Stack: [8]
2. Push (2) - Stack: [8, 2]
3. Pop () - Removes 2, Stack: [8]
4. Push (Pop ()) * 2)

- Pop () removes 8, Stack: []
- 8 * 2 = 16
- Push (16) - Stack: [16]

5. Push (10) - Stack: [16, 10]
6. Push (Pop () / 2)
    - Pop () removes 10, Stack: [16]
    - 10 / 2 = 5
    - Push (5) - Stack: [16, 5]
7. Final Stack: [16,5] (5 is on the top of the stack)

2. Queuing

1. Push (4) - Queue: [4]
2. Push (Pop () + 4)

  - Pop () removes 4, Queue: []
  - 4 +4 = 8
  - Push (8) - Queue: [8]

3. Push (8) - Queue: [8, 8]
4. Push (Pop () / 2)
   - Pop () removes 8, Queue: [8]
   - 8 / 2 = 4
   - Push (4) - Queue: [8,4]
5. Pop () removes 8, Queue: [4]
6. Pop () removes 4, Queue: []
7. Final Queue: [] (empty)

7. Algorithm Analysis

4) The time complexity of this algorithm is O(n) because the loop runs n amount of times, where n is the length of the string that is the input. The space complexity of this algorithm is O(n) because the worst case is if the input is all open brackets, then we will need to store them in a stack, which means that the stack will hold n amount of elements.

5) The tine complexity of this algorithm is O(n) because since we have push/pop, at most, we should go through a string twice, which would be O(2n), but we can get rid of the slowest growing term, the 2, and it would simplify to O(n). The space complexity of this algorithm is O(n) because the countStack stores repetitive counts, while stringStack stores substrings. For the worst case, the input is an entirely nested bracket, which would push n, the number of elements, on the stack.

6) The time complexity of this algorithm is O(n) because we have to iterate through each character of the stack, which is the length of the array. At most, each character will be pushed/popped once. The space complexity of this algorithm is O(n) the StringBuilder stores the results, which is the length of the array, and if you have a full parenthesis input, then it would store operators, which is n amount of elements.