Grade: /100

Instructions: You are not allowed to use any notes or books. YOU MAY NOT USE THE INTERNET NOR ANYONE ELSE. If I suspect cheating, I have the right to challenge your work and be able to show you know the material. There are 11 problems, the 11th is extra credit.

## Make sure you show all your work and be as detailed as possible.

- 1. (10 points) Determine the big-O for each of the following functions.
  - a. f(n) = 1 **(1)**
  - b. f(n) = 100n + 2n!, O(n!)

  - c.  $f(n) = n^2 \log(n) + n^3$  (n3) d.  $f(n) = 2^n + 3^n$  (13") e.  $f(n) = 9n^3 + n^3 \log(n)$  (n3 log ?)
  - f.  $f(n) = n^4 \log(n) + 9n^n + 4n + 70(n!)$
- g.  $f(n) = (n \log(n) + n^2)(3^n + 2^n)$  (10 points) Determine 1(n) relationship between processing time and n. Then determine a big-O estimate for the number of operations (a Simple Statement takes one unit of time) used in this segment of an algorithm. SHOW YOUR WORK.

1=0, (=1, i=2 ... i=n-1 for(int i = 0; i < n; i++){ for(int j = 0; j < n; j + +){ 5=0,7=1, J=2... J=n-1 Simple Statement Simple Statement Simple Statement \$ Simple Statement Simple Statement }

for(int k = 0; k < n; k++){ Simple Statement 1 Simple Statement 🖊 }

K=0, K=1, K=2... k=n-1

Simple Statement Simple Statement H Simple Statement Simple Statement

 $T(n) = 5n^2 + 2n + 4 = 0(n^2)$ 

(10 points) Determine T(n) relationship between processing time and n. Then determine a big-O
estimate for the number of operations (a Simple Statement takes one unit of time) used in this
segment of an algorithm. SHOW YOUR WORK.

4. (10 points) Find C,  $n_0$ , f(n) such that  $|T(n)| \leq C|f(n)|$  whenever  $n > n_0$ . SHOW YOUR WORK.

a. 
$$T(n) = 3n^5 - 2n^3 + 4n - 7$$
  $f(n) = n^3$ ,  $C = -2$ ,  $n = 1$ 

$$3n^{5}-2n^{3}+4n-7 \leq Cn^{3}$$
  
 $3\cdot 1^{5}-2\cdot 1^{3}+4\cdot 1-7 \leq C\cdot 1^{3}$   
 $3-2+4-7 \leq C$   
 $1-3 \leq C$   
 $-2 \leq C$ 

5. (10 points) Update the Array with the given commands. Draw a new picture for each part.

0	1 2		3	4	5	6	7	8	9

- a. Add the following Strings to the array: "John", "Jonas", "Hans", "Jani", "Juan", "Gio", "Joao", "Jana", "Johnny", "Jon" in that order.
- b. Replace index 6, with "Ivan."
- c. What happens if we add "Jane" at the end of the array?

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6 1 2 3 4 5 6 7 8 9

John Jonas Hans Jani Juan Gio Ivan Jana Johnny Jon

Can't Add Elements to aful Array. Will crash program.

6. (10 points) Update the ArrayList with the given commands. Draw a new picture for each part.

0	1	2	3	4	5	6	7	8	9

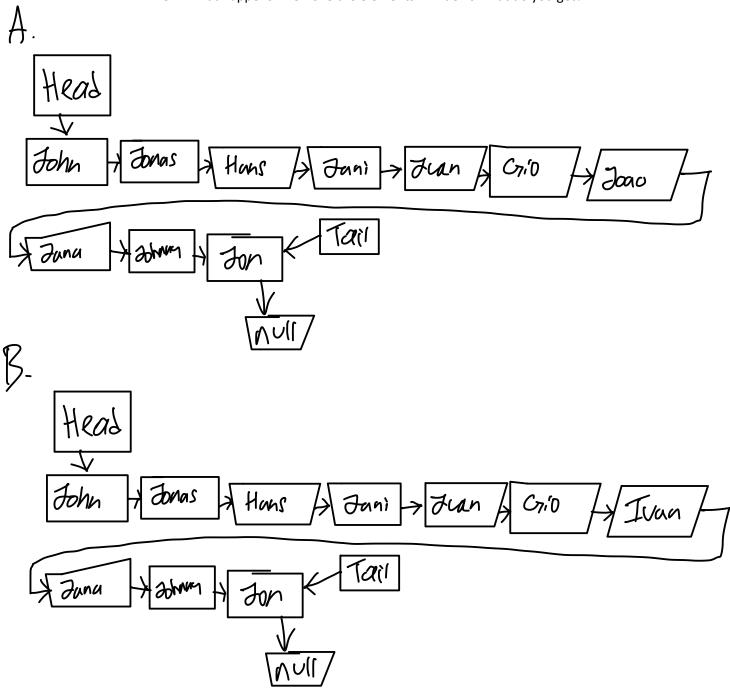
- a. Add the following Strings to the ArrayList: "John", "Jonas", "Hans", "Jani", "Juan", "Gio", "Joao", "Jana", "Johnny", "Jon" in that order.
- b. Replace index 6, with "Ivan"

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A.	e. What happens if remove the elements in index 6 what do you get?												
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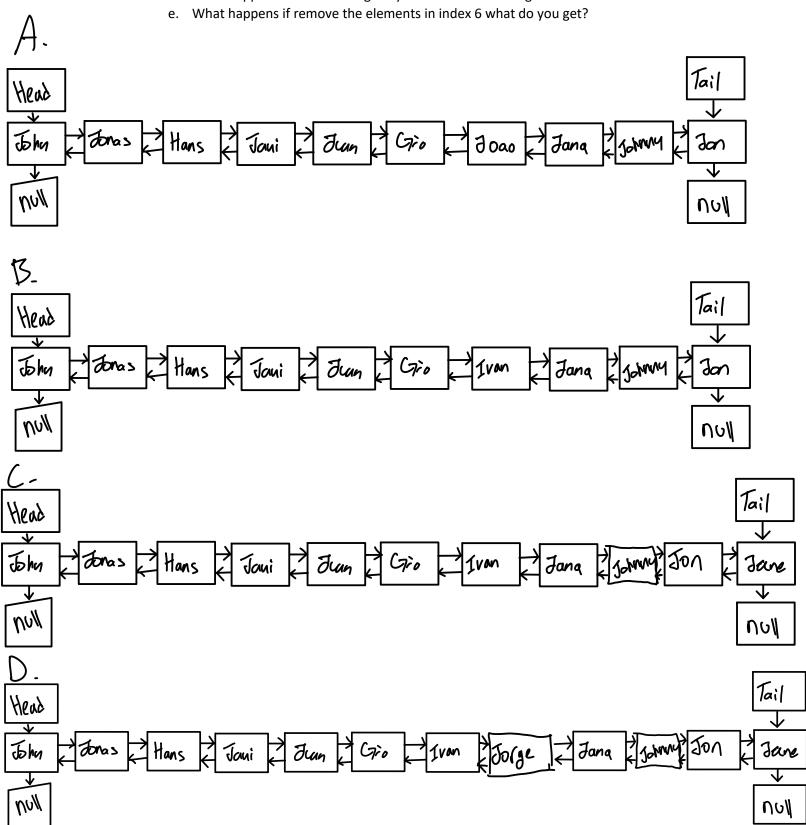
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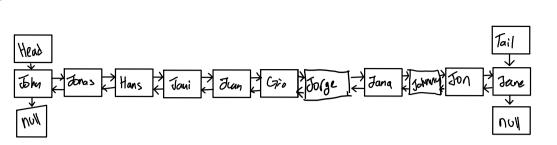
- 7. (10 points) Update the Single-Linked List with the given commands. **Draw a new picture for each part.** 
  - a. Add the following Strings to the Single-Linked List: "John", "Jonas", "Hans", "Jani", "Juan", "Gio", "Joao", "Jana", "Johnny", "Jon" in that order.
  - b. Replace index 6, with "Ivan".
  - c. What happens if we add "Jane" at the end of the list?
  - d. What happens if we add "Jorge" by index 7 what do we get?
  - e. What happens if remove the elements in index 6 what do you get?



Head Hons Fran C7,'0 Jani Jaao Tail > Jane Null Head Hons Jani C7,'0 Jaao Tail Junu Null Head > Juan Jani | Tail 1 Jana

- 8. (10 points) Update the Double-Linked List with the given commands. **Draw a new picture for each part.** 
  - a. Add the following Strings to the Double-Linked List: "John", "Jonas", "Hans", "Jani", "Juan", "Gio", "Joao", "Jana", "Johnny", "Jon" in that order.
  - b. Replace index 6, with "Ivan".
  - c. What happens if we add "Jane" at the end of the list?
  - d. What happens if we add "Jorge" by index 7 what do we get?



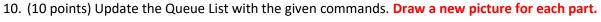


- 9. (10 points) Update the Stack List with the given commands. Draw a new picture for each part.
  - a. Add the following Strings to the Stack using an arrayList: "John", "Jonas", "Hans", "Jani", "Juan", "Gio", "Joao", "Jana", "Johnny", "Jon" in that order.
  - b. Push "Ivan".
  - c. Push "Jane".
  - d. Peek the list.

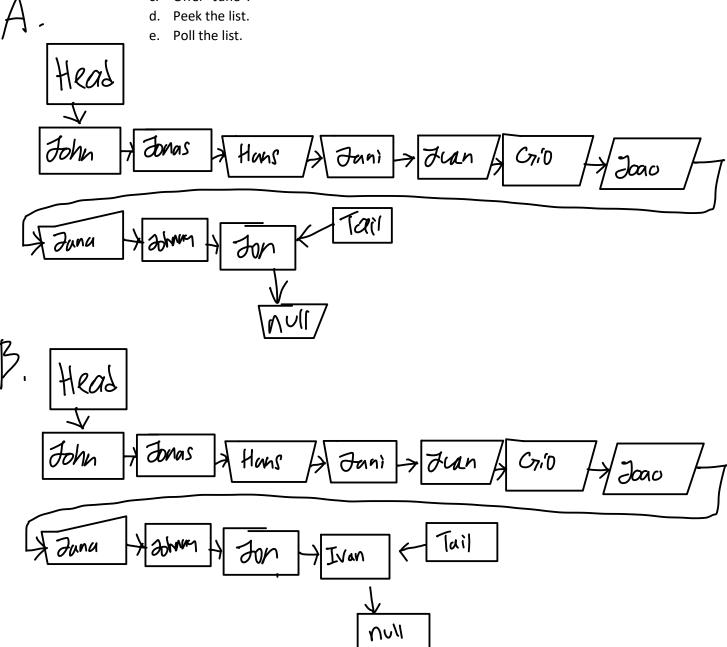
A.		e. Pop the	list.						TOP		
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01	//	17	13	14	15	16	17	18	19		
Ivan	Jane										

N Top

Returns Element At Top of Stack, Doesnot Jane 3 J Ч 5 6 Huns Jani Juan Giol Jood Jana Johnny Jon John Jonas  $\overline{\underline{\mathcal{O}}}$ 3 // 14 15 *γ*/ 18 19 19 Twan

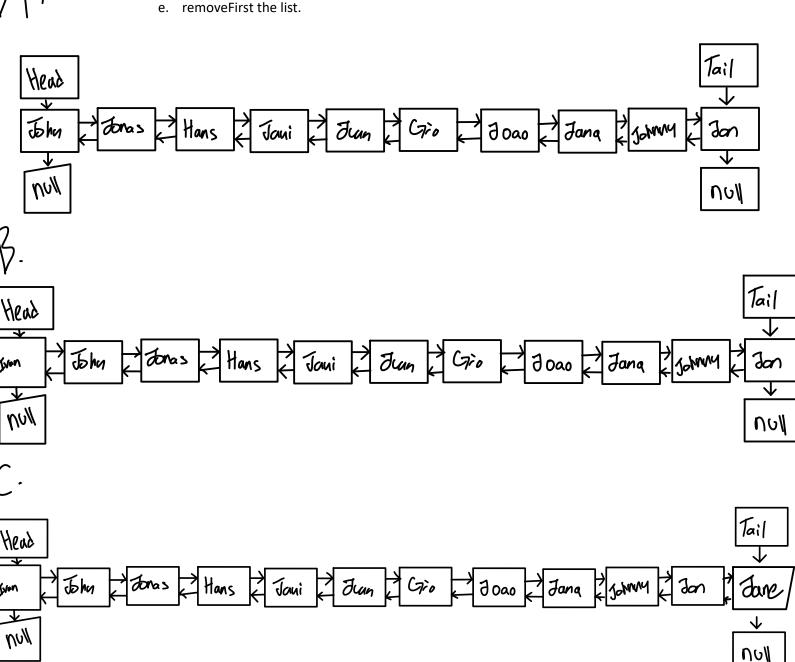


- a. Add the following Strings to the Single-LinkedList: "John", "Jonas", "Hans", "Jani", "Juan", "Gio", "Joao", "Jana", "Johnny", "Jon" in that order.
- b. Add "Ivan".
- c. Offer "Jane".



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- 11. Extra Credit (10 points): Update the Deque List with the given commands. Draw a new picture for each part.
  - a. Add the following Strings to the Double-LinkedList: "John", "Jonas", "Hans", "Jani", "Juan", "Gio", "Joao", "Jana", "Johnny", "Jon" in that order.
  - b. addFirst "Ivan".
  - addLast "Jane".
  - pollLast the list.



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