Student ID: 1133336 Student Name: 劉繡慈

Course: Data Structures (CSE CS203A)

Assignment III: Linked List Selection Sort

Student Worksheet Companion

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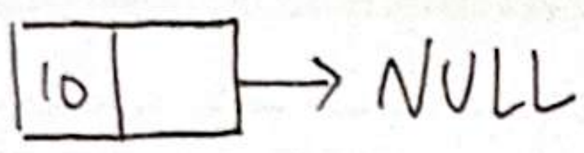
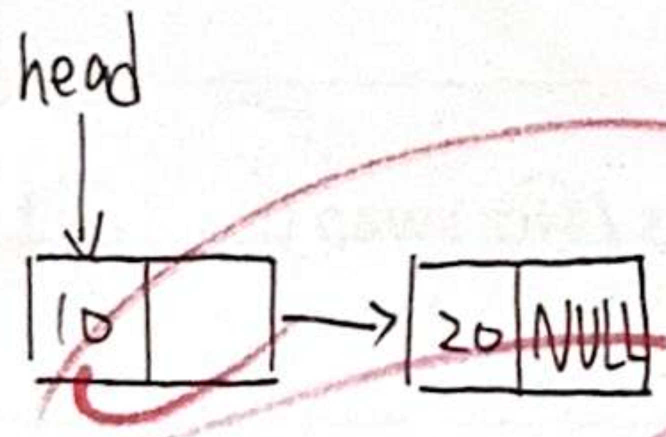
A1. Linked List Representation Drawing (5 pts)

a. (2 pts) Instructions: Draw a visual representation of a single node with next pointer that contains the initialized integer 10



b. (3 pts) Linked list representation with the given integers (Hint: For safety and clarity, include identifiable head and tail nodes)

Example: the input integers are (10, 20) and linked list representation will be [10 | •] → [20 | •] →



^ tail /2

A2. Populate with Integers (32 pts; 2 pts for each)

Fill the given integers (60, 24, 15, 42, 20, 11, 90, 8) into the above structures.

Annotate:

Node #	Value	Next Pointer
1	[60]	→ Node [2]
2	[24]	→ Node [3]
3	[15]	→ Node [4]
4	[42]	→ Node [5]
5	[20]	→ Node [6]
6	[11]	→ Node [7]
7	[90]	→ Node [8]

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8 [8] → [NULL]

A3. Selection Sort – First Three Steps (45 pts; 15 pts for each step)

Step Trace Table (Linked list):

Step 1 is the example to help you complete step 2 to 4.

Step 1 (i = head = 60): Traverse list to find minimum value 8 → call swap function Yes; swap (60, 8).

head → [8|•] → [24|•] → [15|•] → [42|•] → [20|•] → [11|•] → [90|•] → [60|NULL]

Step 2 (i = 24): Minimum value [11] → call swap function Yes / No; swap ([24], [11]).

head → [8|•] → [11 |•] → [15 |•] → [42 |•] → [20 |•] → [24 |•] → [90 |•] → [60 |NULL]

Step 3 (i = 15): Minimum value [15] → call swap function Yes / No; swap ([____], [____]).

head → [8|•] → [11 |•] → [15 |•] → [42 |•] → [20 |•] → [24 |•] → [90 |•] → [60 |NULL]

Step 4 (i = 42): Minimum value [20] → call swap function Yes / No; swap ([42], [20]).

head → [8|•] → [11 |•] → [15 |•] → [20 |•] → [42 |•] → [24 |•] → [90 |•] → [60 |NULL]

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A4. Discussion (68 pts)

Guiding Questions:

- How many swaps/exchanges are performed? Ans: 5 step ①②④⑤⑦
- How expensive is traversal for arrays vs. linked lists? Ans: O(1) / O(n)
- What memory/overhead differences do you see?
- Which representation is easier to visualize? Ans: arrays
- Which would you choose for implementing selection sort and why? Ans: arrays, more easier

Time complexity comparison (14 pts, 1pt for each)

Aspect / Operation	Array	Linked List	Explanation
Access Element	(1)	(2)	Array allows direct indexing; linked list needs traversal.
Find Minimum	(3)	(4)	Both must scan all remaining elements/nodes.
Swap Operation	(5)	(6)	In array, swap by indices; in linked list, swap node values.
Traversal Between Elements	(7)	(8)	Linked list traversal requires pointer navigation.
Overall Time Complexity (Selection Sort)	(9)	(10)	Both involve nested traversal to find minima; linked list adds traversal overhead.
Space Complexity	(11)	(12)	Both sorts are in-place if swapping values, not nodes.
Implementation Overhead	(13) Low or Moderate	(14) Low or Moderate	Linked list needs pointer operations and careful null checks.

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(1)	O(1)	(2)	O(n)
(3)	O(n)	(4)	O(n)
(5)	O(1)	(6)	O(1)
(7)	~~fast~~	(8)	~~slow~~
(9)	$O(n^2)$	(10)	$O(n^2)$
(11)	O(1)	(12)	O(1)
(13)	Low	(14)	Moderate

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Characteristics (54 pts, 3 pts for each)

Aspect	Array	Linked List
Storage	(1)	(2)
Access	(3)	(4)
Extra Variables	(5)	(6)
Traversal	(7)	(8)
Overhead	(9)	(10)
Visualization	(11)	(12)
Swaps	(13)	(14)
Flexibility	(15)	(16)
Overall	(17)	(18)

(1) contiguous memory 連續

(2) non-contiguous memory 不連續

(3) O(1) +1

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(4) O(n)

(5) index variables

(6) pointer variables

(7) fast

(8) slow

(9) low

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(10) high

(11) simple

(12) complex

(13) indices

(14) values

(15) fixed size

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(16) dynamic size

(17) Better for sorting

(18) Better for insert or delete.

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