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MODULE: DATA STRUCTURE AND ALGORITHM.

ASSIGNMENT II

(A) Numbers = $\{29, 14, 32, 13, 105, 42, 7, 95, 22\}$

(B) Bubble sort

$$n = 9 \quad 3 - 1 = 8$$

$k = i \text{ TO } (i-1)$, Number of passes.

1st pass: $k = 1 \quad T = 0 \text{ TO } (8-1-1)$

0: $[29, 14, 32, 13, 105, 42, 7, 95, 22]$

$\Rightarrow [14, 29, 32, 13, 105, 42, 7, 95, 22]$

1: $[14, 29, 32, 13, 105, 42, 7, 95, 22]$

$\Rightarrow [14, 29, 32, 13, 105, 42, 7, 95, 22]$

2: $[14, 29, 32, 13, 105, 42, 7, 95, 22]$

$\Rightarrow [14, 29, 13, 32, 105, 42, 7, 95, 22]$

3: $\Rightarrow [14, 29, 13, 32, 105, 42, 7, 95, 22]$

4: $\Rightarrow [14, 29, 13, 32, 105, 42, 7, 95, 22]$

5: $\Rightarrow [14, 29, 13, 32, 42, 7, 105, 95, 22]$

6: $\Rightarrow [14, 29, 13, 32, 42, 7, 95, 105, 22]$

7: $\Rightarrow [14, 29, 13, 32, 42, 7, 95, 22, 105]$

2nd pass: $k = 2 \quad T = 0 \text{ TO } (8-2-1)$

0: $(14, 29, 13, 32, 42, 7, 95, 22, 105)$

NO SWAP

$\Rightarrow [14, 29, 13, 32, 42, 7, 95, 22, 105]$

1: $\Rightarrow [14, 13, 29, 32, 42, 7, 95, 22, 105]$

$\Rightarrow [14, 13, 29, 32, 42, 7, 95, 22, 105]$

3: $\Rightarrow [14, 13, 29, 32, 42, 7, 95, 22, 105]$

4: $\Rightarrow [14, 13, 29, 32, 42, 7, 95, 22, 105]$

5: $\Rightarrow [14, 13, 29, 32, 42, 7, 95, 22, 105]$

6: $\Rightarrow [14, 13, 29, 32, 42, 7, 95, 22, 105]$

3rd pass: $k = 3 \quad T = 0 \text{ TO } (8-3-1)$

3: $[14, 13, 29, 37, 42, 22, 95, 105]$
 Swap
 $\Rightarrow [13, 14, 29, 37, 42, 22, 95, 105]$
 1: $[13, 14, 29, 37, 42, 22, 95, 105]$
 2: $[13, 14, 29, 37, 42, 22, 95, 105]$
 3: $[13, 14, 29, 37, 42, 22, 95, 105]$
 4: $[13, 14, 29, 37, 42, 22, 95, 105]$
 5: $[13, 14, 29, 37, 42, 22, 95, 105]$

4th Pass: $k=4$ $i=0 \text{ to } (9-4-1)$

3: $[13, 14, 29, 37, 42, 22, 95, 105]$
 Swap
 $\Rightarrow [13, 14, 29, 37, 42, 22, 95, 105]$
 1: $[13, 14, 29, 37, 42, 22, 95, 105]$
 2: $[13, 14, 29, 37, 42, 22, 95, 105]$
 3: $[13, 14, 29, 37, 22, 42, 95, 105]$
 4: $[13, 14, 29, 22, 37, 42, 95, 105]$

5th Pass: $k=5$ $i=0 \text{ to } (9-5-1)$

3: $[13, 14, 29, 22, 37, 42, 95, 105]$
 Swap
 $\Rightarrow [13, 14, 29, 22, 37, 42, 95, 105]$
 1: $[13, 14, 29, 22, 37, 42, 95, 105]$
 2: $[13, 29, 14, 22, 37, 42, 95, 105]$
 3: $[13, 29, 14, 22, 29, 37, 42, 95, 105]$

6th Pass: $k=6$ $i=0 \text{ to } (9-6-1)$

3: $[13, 29, 14, 22, 29, 37, 42, 95, 105]$
 Swap
 $\Rightarrow [13, 29, 14, 22, 29, 37, 42, 95, 105]$
 1: $[13, 29, 14, 22, 29, 37, 42, 95, 105]$
 2: $[13, 29, 14, 22, 29, 37, 42, 95, 105]$

7th Pass: $k=7$ $i=0 \text{ to } (9-7-1)$

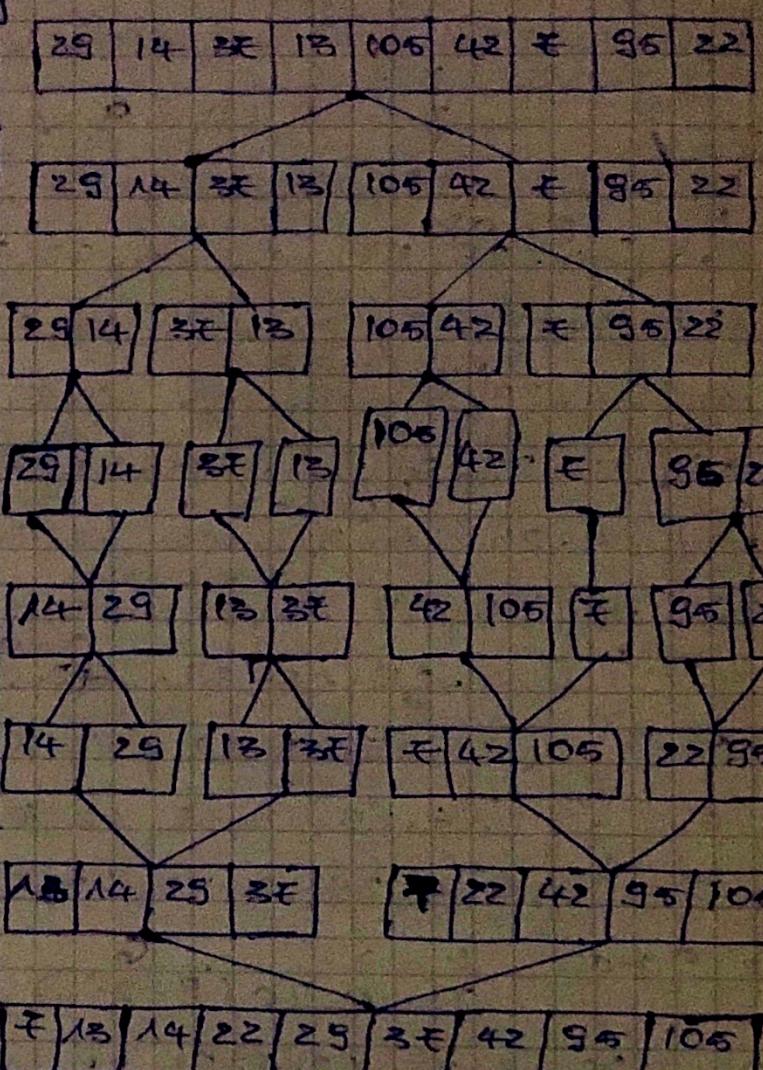
3: $[29, 14, 22, 29, 37, 42, 95, 105]$
 Swap
 $\Rightarrow [13, 14, 22, 29, 37, 42, 95, 105]$
 1: $[13, 14, 22, 29, 37, 42, 95, 105]$

8th Pass: $k=8$ $i=0 \text{ to } (9-8-1)$

3: $[13, 14, 22, 29, 37, 42, 95, 105]$
 Swap
 $\Rightarrow [13, 14, 22, 29, 37, 42, 95, 105]$

SORTED LIST

(b) Merge sort



SORTED LIST

(c) Selection sort

N [29 14 37 13 105 42 7 95 22]

$i = 9$

for $i = 0$ to 8

$i = i + 1$ to $n - 1$

* $i = 1$ to 8

$A[i] = 29$

$A[i]$

$A[small\ index] = 29$

$A[i] < A[small\ index]$, swap

$A[small\ index] = 29$

(*) ~~A[i] = 14~~

7	14
---	----

25	13	105	42	29	95	22
----	----	-----	----	----	----	----

* [small sub] = 13
 $A[i] > A[\text{small sub}]$, SWAP

7	13
---	----

25	14	105	42	29	95	22
----	----	-----	----	----	----	----

(*) $A[i] = 25$

7	13	14
---	----	----

$A[\text{small sub}] = 14$
 $A[i] > A[\text{small sub}]$, SWAP

7	13	14
---	----	----

(*) $A[i] = 25$

7	13	14	25
---	----	----	----

* [small sub] = 22
 $A[i] > A[\text{small sub}]$, SWAP

7	13	14	22
---	----	----	----

(*) $A[i] = 105$

7	13	14	22	105
---	----	----	----	-----

$A[\text{small sub}] = 29$
 $A[i] > A[\text{small sub}]$, SWAP

7	13	14	22	29
---	----	----	----	----

(*) $A[i] = 42$

7	13	14	22	29	42
---	----	----	----	----	----

* [small sub] = 35
 $A[i] > A[\text{small sub}]$, SWAP

7	13	14	22	29	35
---	----	----	----	----	----

(*) $A[i] = 105$

7	13	14	22	29	35	105
---	----	----	----	----	----	-----

* [small sub] = 42
 $A[i] > A[\text{small sub}]$, SWAP

7	13	14	22	29	35	42
---	----	----	----	----	----	----

7	13	14	22	29	35	42	95	105
---	----	----	----	----	----	----	----	-----

COSTAL 157

(a) Quick Sort

numbers = [25, 14, 35, 13, 105, 42, 7, 95, 22]
 \rightarrow PIVOT

25	14	35	13	105	42	7	95	22
----	----	----	----	-----	----	---	----	----

< 29

> 29

14	13	7	22	35	105	42	95
----	----	---	----	----	-----	----	----

14	13	7	22	35	105	42	95
----	----	---	----	----	-----	----	----

13	7	22	35	105	42	95
----	---	----	----	-----	----	----

13	7	22	35	105	42	95
----	---	----	----	-----	----	----

7	22	35	105	42	95
---	----	----	-----	----	----

7	22	35	105	42	95
---	----	----	-----	----	----

13	22	29	35	42	95	105
----	----	----	----	----	----	-----

13	22	29	35	42	95	105
----	----	----	----	----	----	-----

SORTED LIST

(b) Insertion Sort

numbers = [25, 14, 35, 13, 105, 42, 7, 95, 22]
 $\downarrow \downarrow \downarrow$

j = 1 to 8

25	14	35	13	105	42	7	95	22
----	----	----	----	-----	----	---	----	----

$25 > 14$, SWAP

14	25	35	13	105	42	7	95	22
----	----	----	----	-----	----	---	----	----

$25 < 35$, NO SWAP

14	25	35	13	105	42	7	95	22
----	----	----	----	-----	----	---	----	----

$35 > 13$, SWAP

14	25	13	35	105	42	7	95	22
----	----	----	----	-----	----	---	----	----

$13 > 14$, SWAP

14	13	25	35	105	42	7	95	22
----	----	----	----	-----	----	---	----	----

$25 < 105$, SWAP

14	13	25	35	105	42	7	95	22
----	----	----	----	-----	----	---	----	----

$35 < 105$, SWAP

14	13	25	35	105	42	7	95	22
----	----	----	----	-----	----	---	----	----

$105 > 42$, SWAP

13	14	29	37	42	105	7	55	22
----	----	----	----	----	-----	---	----	----

105>7, SWAP

13	14	29	37	42	7	105	55	22
----	----	----	----	----	---	-----	----	----

42>7, SWAP

13	14	29	37	7	42	105	55	22
----	----	----	----	---	----	-----	----	----

37>7, SWAP

13	14	29	7	37	42	105	55	22
----	----	----	---	----	----	-----	----	----

29>7, SWAP

13	14	7	29	37	42	105	55	22
----	----	---	----	----	----	-----	----	----

14>7, SWAP

13	7	14	29	37	42	105	55	22
----	---	----	----	----	----	-----	----	----

13>7, SWAP

7	13	14	29	37	42	105	55	22
---	----	----	----	----	----	-----	----	----

105>55, SWAP

7	13	14	29	37	42	55	105	22
---	----	----	----	----	----	----	-----	----

105>22, SWAP

7	13	14	29	37	42	95	22	105
---	----	----	----	----	----	----	----	-----

95>22, SWAP

7	13	14	29	37	42	22	95	105
---	----	----	----	----	----	----	----	-----

42>22, SWAP

7	13	14	29	37	22	42	95	105
---	----	----	----	----	----	----	----	-----

37>22, SWAP

7	13	14	29	22	37	42	95	105
---	----	----	----	----	----	----	----	-----

29>22, SWAP

7	13	14	22	29	37	42	95	105
---	----	----	----	----	----	----	----	-----

14<22, NO SWAP

7	13	14	22	29	37	42	95	105
---	----	----	----	----	----	----	----	-----

SORTED LIST

(c)

bubble sort:

- Best case: $O(n)$
- Average case: $O(n^2)$
- Worst case: $O(n^2)$
- Stable? YES
- Best use case: Small data sets

(d) merge sort:

- Best case: $O(n \log n)$
- Average case: $O(n \log n)$
- Worst case: $O(n \log n)$
- Stable? YES
- Best use case: Large data sets

(e) selection sort:

- Best case: $O(n^2)$
- Average case: $O(n^2)$
- Worst case: $O(n^2)$
- Stable? NO
- Best use case: Small data sets

(f) quick sort:

- Best case: $O(n \log n)$
- Average case: $O(n \log n)$
- Worst case: $O(n^2)$
- Stable? NO
- Best use case: Large data sets

(g) insertion sort:

- Best case: $O(n)$
- Average case: $O(n^2)$
- Worst case: $O(n^2)$
- Stable? YES
- Best use case: Large data sets