COMP108 Data Structures and Algorithms

Data structures - Arrays (Part III 2D Arrays)

Professor Prudence Wong

pwong@liverpool.ac.uk

2022-23

- Input: Suppose we have data of daily rainfall for a year.
- Output: Find the maximum monthly average rainfall over a year.

- Input: Suppose we have data of daily rainfall for a year.
- Output: Find the maximum monthly average rainfall over a year.
- Solutions:
 - For simplicity, let's assume there are d days in a month and m months in a year.

- Input: Suppose we have data of daily rainfall for a year.
- Output: Find the maximum monthly average rainfall over a year.
- Solutions:
 - For simplicity, let's assume there are *d* days in a month and *m* months in a year.
 - Store rainfall data in a 2D array of size $m \times d$.

	1	2	3	 d	1 01000
1					E average
2					
3					C /
:					. /
m					

rainfall[i][j] stores rainfall of month i and day j

- Input: Suppose we have data of daily rainfall for a year.
- Output: Find the maximum monthly average rainfall over a year.
- Solutions:
 - For simplicity, let's assume there are *d* days in a month and *m* months in a year.
 - Store rainfall data in a 2D array of size $m \times d$.

	1	2	3	 d
1				
2				
3				
:				
m				

- rainfall[i][j] stores rainfall of month i and day j
- Sub-problem (i): what is average rainfall of month i?
- Sub-problem (ii): what is the maximum average?

$$j \leftarrow 1$$

 $sum \leftarrow 0$

 $average \leftarrow sum/d$

```
j \leftarrow 1 sum \leftarrow 0 while j \leq d do begin j \leftarrow j + 1 end average \leftarrow sum/d
```

```
\begin{split} j \leftarrow 1 \\ sum \leftarrow 0 \\ \text{while } j \leq d \text{ do} \\ \text{begin} \\ sum \leftarrow sum + rainfall[i][j] \\ j \leftarrow j + 1 \\ \text{end} \\ average \leftarrow sum/d \end{split}
```

Sub-problem (ii) Maximum of the averages

```
j \leftarrow 1
sum \leftarrow 0
while j \leq d do
begin
sum \leftarrow sum + rainfall[i][j]
j \leftarrow j + 1
end
average \leftarrow sum/d
```

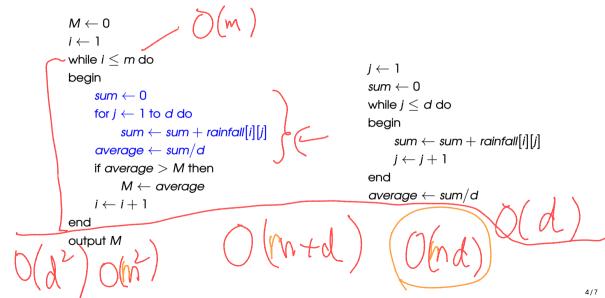
Sub-problem (ii) Maximum of the averages

```
M \leftarrow 0
i \leftarrow 1
while i \leq m do
                                                                   j \leftarrow 1
begin
                                                                    sum \leftarrow 0
                                                                    while i < d do
                                                                    begin
                                                                          sum \leftarrow sum + rainfall[i][j]
                                                                         i \leftarrow i + 1
      if average > M then
                                                                    end
            M ← average
                                                                    average \leftarrow sum/d
      i \leftarrow i + 1
end
output M
```

Sub-problem (ii) Maximum of the averages

```
M \leftarrow 0
i \leftarrow 1
while i < m do
                                                                     i \leftarrow 1
begin
                                                                     sum \leftarrow 0
      sum \leftarrow 0
                                                                     while i < d do
      for j \leftarrow 1 to d do
                                                                     begin
            sum \leftarrow sum + rainfall[i][j]
                                                                           sum \leftarrow sum + rainfall[i][j]
      average \leftarrow sum/d
                                                                           i \leftarrow i + 1
      if average > M then
                                                                     end
            M ← average
                                                                     average \leftarrow sum/d
      i \leftarrow i + 1
end
output M
```

Sub-problem (ii) Maximum of the averages (Time Complexity?)



Sub-problem (ii) Maximum of the averages (Time Complexity?) O(md)

```
M \leftarrow 0
i \leftarrow 1
while i < m do
                                                                     i \leftarrow 1
begin
                                                                     sum \leftarrow 0
      sum \leftarrow 0
                                                                     while i < d do
      for j \leftarrow 1 to d do
                                                                     begin
            sum \leftarrow sum + rainfall[i][j]
                                                                           sum \leftarrow sum + rainfall[i][j]
      average \leftarrow sum/d
                                                                           i \leftarrow i + 1
      if average > M then
                                                                     end
            M ← average
                                                                     average \leftarrow sum/d
      i \leftarrow i + 1
end
output M
```

COMP108-04-Arrays-03

Summary: 2D Arrays

Next: Stacks/Queues

For note taking