

CSE 121 Lesson 15: 2D Arrays

Matt Wang & Brett Wortzman
Autumn 2024



TAs:

Abby	Afifah	Ailsa	Alice	Aliyan	Arohan
Chloë	Christopher	Dalton	Derek	Elizabeth	Ethan
Hanna	Hannah	Heather	Hibbah	Janvi	Jasmine
Judy	Julia	Kelsey	Lucas	Luke	Mahima
Maitreyi	Maria	Merav	Minh	Neha	Ronald
Ruslana	Sahej	Sam	Samrutha	Sushma	Vivian
Yijia	Zachary				

[sli.do #cse121](https://sli.do/#cse121)

Today's playlist:
[121 24au lecture tunes](#)

Announcements, Reminders

- C3 released Wednesday, due Tuesday, November 19th
- R5 released yesterday, due Thursday, November 21st
 - last chance for P1
- Quiz 2 next Thursday, November 21st
 - topics: everything up until Wednesday (i.e. not today's material)
 - next Wednesday's PCM + class is *secretly* quiz prep :)
 - practice quizzes :)
- Ed post on post-section work's extra resub today!
- more logistics on final next Friday (after Quiz 2)!

(PCM) 2D Arrays (1/3)

```
int[][]
```

type

```
a
```

name

```
= new int[4][3];
```

array creation code

An array of arrays!

- The *ElementType* of the array is another array itself!
 - Your first example of “nested data structures”
 - There will be more in CSE 122!

```
int[][]
```

```
double[][]
```

```
String[][]
```

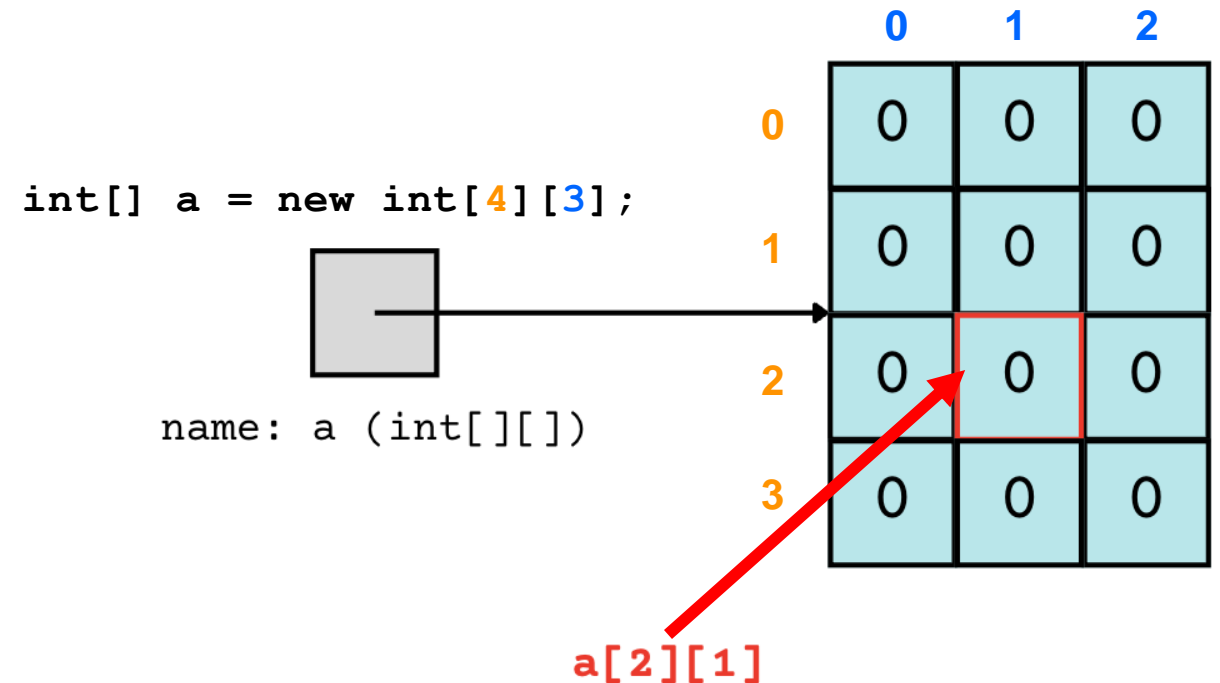
```
boolean[][]
```

```
char[][]
```

(PCM) 2D Arrays (2/3)

An array of arrays!

The two dimensions are
“rows” and “columns”

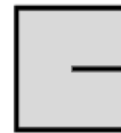


(PCM) 2D Arrays (3/3)

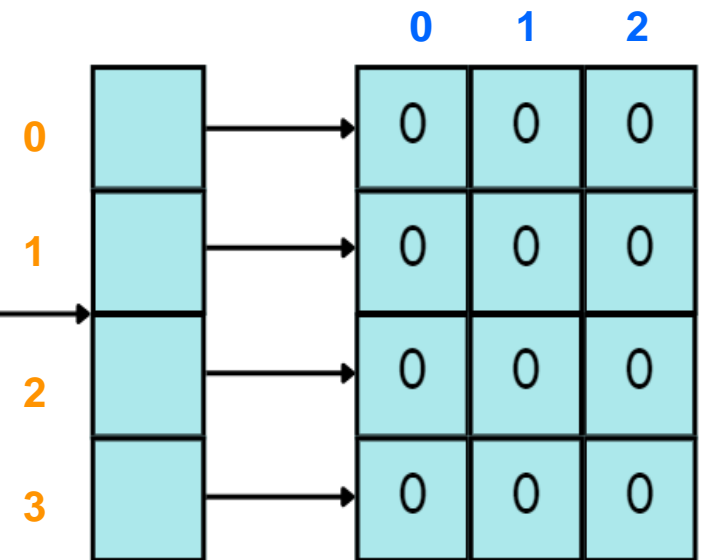
A slightly more accurate view...

reference semantics

```
int[] a = new int[4][3];
```



name: a (int[][])



(PCM) 2D Array Traversals

for each row...

```
for (int i = 0; i < list.length; i++) {  
    for (int j = 0; j < list[i].length; j++) {  
        // do something with list[i][j]  
    }  
}
```

for each element within a row...

Arrays Utility Class

Method	Description
<code>Arrays.toString(array);</code>	Returns a <code>String</code> representing the array, such as <code>"[10, 30, -25, 17]"</code>
<code>Arrays.equals(array1, array2);</code>	Returns <code>true</code> if the two arrays contain the same elements in the same order
<code>Arrays.deepToString(array);</code>	Returns a <code>String</code> representing the array; if the array contains other arrays as elements, the <code>String</code> represents their contents, and so on. For example, <code>"[[99, 151], [30, 5]]"</code>
<code>Arrays.deepEquals(array1, array2);</code>	Returns <code>true</code> if the two arrays contain the same elements in the same order; if the array(s) contain other arrays as elements, their contents are tested for equality, and so on.

Applications of 2D Arrays

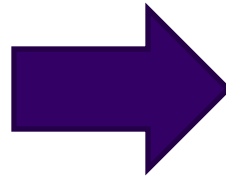
- **Matrices**
 - Useful in various applications requiring complex math!
 - Fundamental to machine learning & AI
 - P3 is a real-life application of this!
- Board games
 - e.g., chess/checkerboard, tic tac toe, sudoku
- Representing information in a grid or table
 - e.g., scorekeeping, gradebook, census data
- Image processing

matrixAdd

23	96	18	4	64
45	40	18	44	34
92	13	77	71	12



70	73	66	79	39
91	75	73	99	47
27	64	21	34	1



matrixAdd

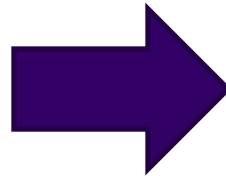
23	96	18	4	64
45	40	18	44	34
92	13	77	71	12



70	73	66	79	39
91	75	73	99	47
27	64	21	34	1

i: 0

j: 0



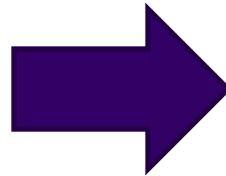
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i: 0
j: 0



93				

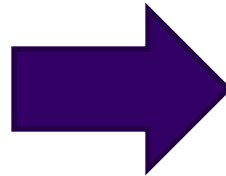
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70	73	66	79	39
91	75	73	99	47
27	64	21	34	1

i: 0
j: 1



93	169			

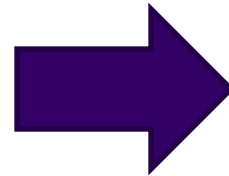
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23	96	18	4	64
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70	73	66	79	39
91	75	73	99	47
27	64	21	34	1

i: 0
j: 2



93	169	84		

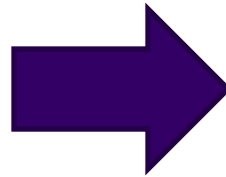
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i: 0
j: 3



93	169	84	83	

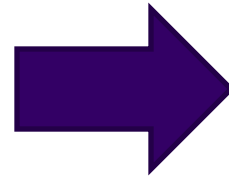
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i: 0
j: 4



93	169	84	83	103

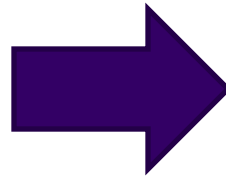
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91	75	73	99	47
27	64	21	34	1

i: 1
j: 0



93	169	84	83	103
136				

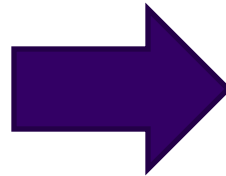
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27	64	21	34	1

i: 1
j: 1



93	169	84	83	103
136	115			

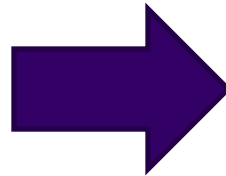
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i: 1
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93	169	84	83	103
136	115	91		

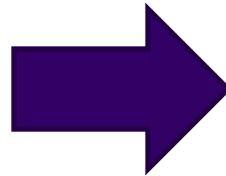
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i: 1
j: 3



93	169	84	83	103
136	115	91	143	

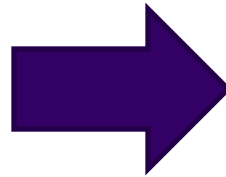
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i: 1
j: 4



93	169	84	83	103
136	115	91	143	81

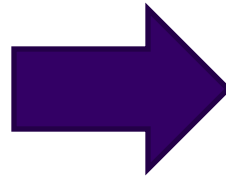
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27	64	21	34	1

i: 2
j: 0



93	169	84	83	103
136	115	91	143	81
119				

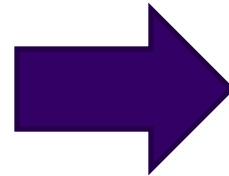
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136	115	91	143	81
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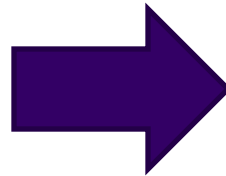
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27	64	21	34	1

i: 2

j: 2



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119	77	98		

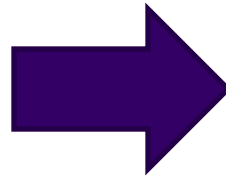
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i: 2
j: 3



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136	115	91	143	81
119	77	98	105	

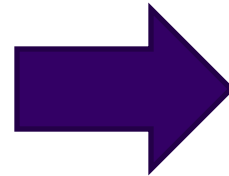
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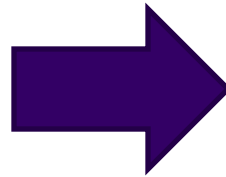
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27	64	21	34	1



93	169	84	83	103
136	115	91	143	81
119	77	98	105	13

(2D)ays Above Average: `readData()`

How many days' data would you like to input? 3

Next day's data:

Temperature in Seattle? 44

Temperature in Tacoma? 40

Temperature in Bothell? 43

Next day's data:

Temperature in Seattle? 42

Temperature in Tacoma? 40

Temperature in Bothell? 44

Next day's data:

Temperature in Seattle? 42

Temperature in Tacoma? 41

Temperature in Bothell? 43

...



	Seattle	Tacoma	Bothell
1	44	40	43
2	42	40	44
3	42	41	43

(2D)ays Above Average: `readData()`

How many days' data would you like to input? 3

Next day's data:

Temperature in Seattle? 44

Temperature in Tacoma? 40

Temperature in Bothell? 43

Next day's data:

Temperature in Seattle? 42

Temperature in Tacoma? 40

Temperature in Bothell? 44

Next day's data:

Temperature in Seattle? 42

Temperature in Tacoma? 41

Temperature in Bothell? 43

...



	Seattle	Tacoma	Bothell
1	44		
2			
3			

(2D)ays Above Average: `readData()`

How many days' data would you like to input? 3

Next day's data:

Temperature in Seattle? 44

Temperature in Tacoma? 40

Temperature in Bothell? 43

Next day's data:

Temperature in Seattle? 42

Temperature in Tacoma? 40

Temperature in Bothell? 44

Next day's data:

Temperature in Seattle? 42

Temperature in Tacoma? 41

Temperature in Bothell? 43

...



	Seattle	Tacoma	Bothell
1	44	40	
2			
3			

(2D)ays Above Average: `readData()`

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Next day's data:

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Next day's data:

Temperature in Seattle? 42

Temperature in Tacoma? 41

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...



	Seattle	Tacoma	Bothell
1	44	40	43
2			
3			

(2D)ays Above Average: `readData()`

How many days' data would you like to input? 3

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Next day's data:

Temperature in Seattle? 42

Temperature in Tacoma? 41

Temperature in Bothell? 43

...



	Seattle	Tacoma	Bothell
1	44	40	43
2	42		
3			

(2D)ays Above Average: `readData()`

How many days' data would you like to input? 3

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Temperature in Bothell? 43

...



	Seattle	Tacoma	Bothell
1	44	40	43
2	42	40	
3			

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How many days' data would you like to input? 3

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	Seattle	Tacoma	Bothell
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3			

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3	42		

(2D)ays Above Average: `readData()`

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(2D)ays Above Average: `readData()`

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...



	Seattle	Tacoma	Bothell
1	44	40	43
2	42	40	44
3	42	41	43

(2D)ays Above Average: `computeAverages()`

How many days' data would you like to input? 3

...

The average values for each location were

```
[42.666666666666664, 40.333333333333336,  
43.333333333333336]
```

	Seattle	Tacoma	Bothell
1	44	40	43
2	42	40	44
3	42	41	43



42.667	40.333	43.333
--------	--------	--------

Average of Seattle
temperatures
 $(44 + 42 + 42) / 3$