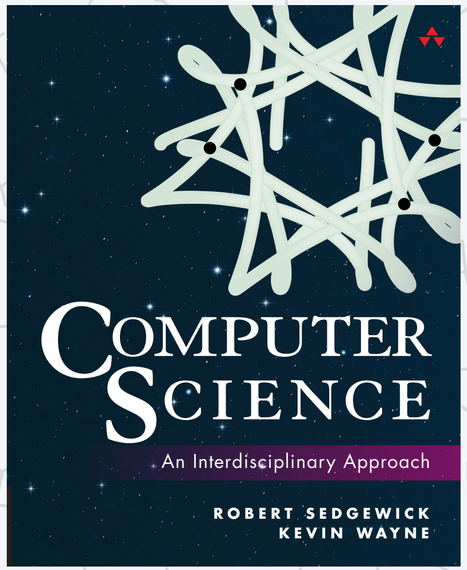

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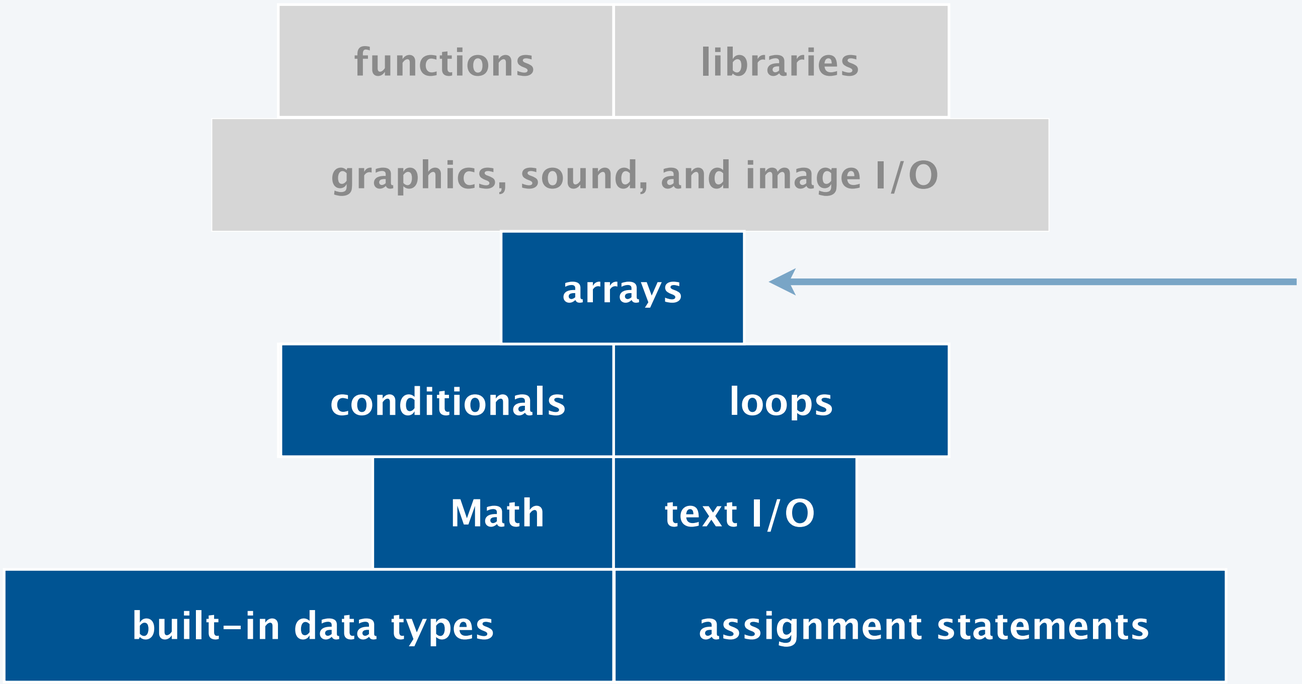
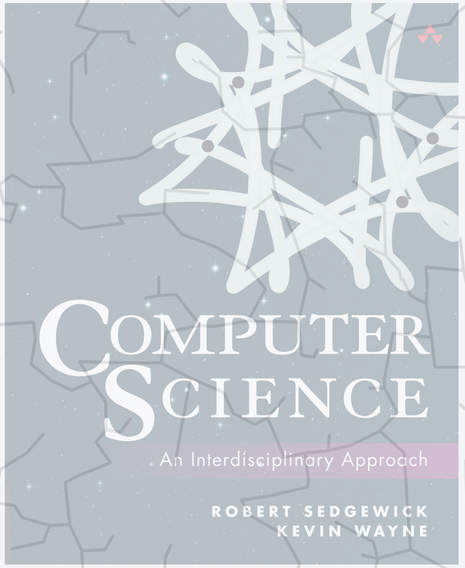
1.4 Arrays

- *basic concepts*
- *digital audio*
- *memory representation*
- *two-dimensional arrays*

Basic building blocks for programming



we can start storing and processing larger volumes of data



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1.4 ARRAYS

- *basic concepts*
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- *two-dimensional arrays*

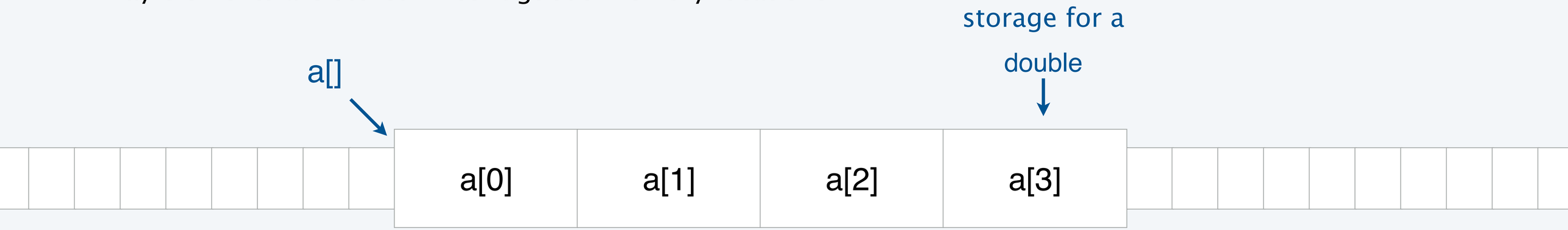

F11
Pause

Memory representation of an array

Java array. An array is an indexed sequence of values of the same type.

Computer memory. Computer memory is an indexed sequence of memory locations.

- Each int, double, boolean occupies a fixed number of memory locations.
- Array elements are stored in contiguous memory locations.



Key properties.

- Given index i accessing a[i] is extremely efficient.
- Once you create an array, you cannot change its type or length.
- Arrays are reference types, not primitive types.

think of the variables with a[] as storing the memory address of the first element

Arrays 2: quiz 1

What does the following code fragment print?

A. 0 1 2 0 1 2

B. 0 1 2 1 2 6

C. 1 2 6 0 1 2

D. 1 2 6 0 1 2

E. 1 2 6 1 2 6

```
int[] a = { 1, 2, 6 };
int[] b = new int[a.length];

b = a;
for (int i = 0; i < b.length; i++) {
    b[i] = i;
}

for (int i = 0; i < a.length; i++) {
    System.out.print(a[i] + " ");
}

for (int i = 0; i < b.length; i++) {
    System.out.print(b[i] + " ");
}
```

Arrays 2: quiz 2

What does the following code fragment print?

A. 0 1 2 0 1 2

B. 0 1 2 1 2 6

C. 1 2 6 0 1 2

D. 1 2 6 0 1 2

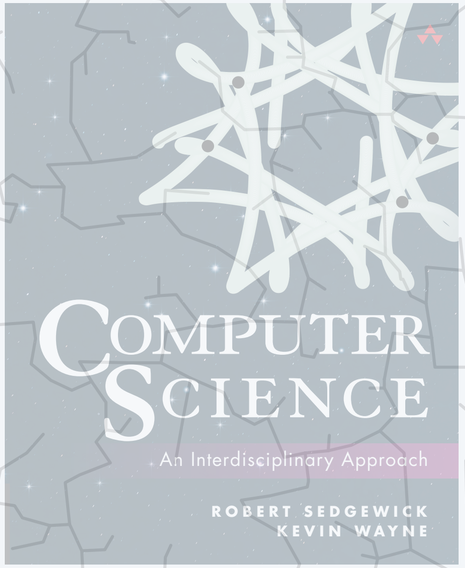
E. 1 2 6 1 2 6

```
int[] a = { 1, 2, 6 };
int[] b = new int[a.length];

for (int i = 0; i < b.length; i++) {
    b[i] = i;
}

b = a;
for (int i = 0; i < a.length; i++) {
    System.out.print(a[i] + " ");
}

for (int i = 0; i < b.length; i++) {
    System.out.print(b[i] + " ");
}
```



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1.4 ARRAYS

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F11
Pause

Your first data structure

A two-dimensional array is a *doubly indexed table* of values of the same type.

Examples.

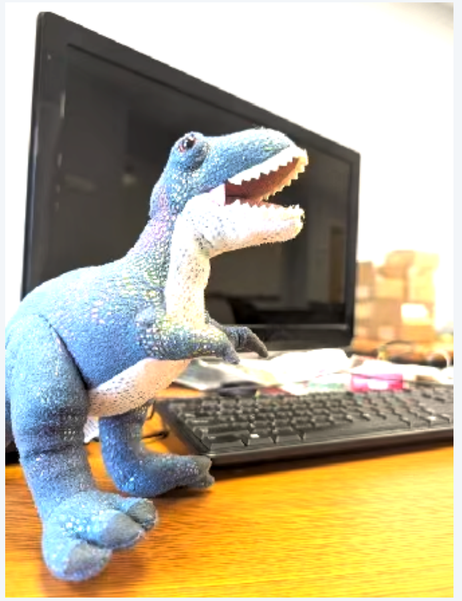
- Grades of students in an online class
- Customer transactions in a bank
- Entries in a matrix
- Pixels in a digital image
- Cells in a spreadsheet

grade

student	0	1	2
0	A	A	A–
1	B	B–	A
2	B	B+	B
3	C	C–	C–

column

row



Arrays in Java

Create an array. Specify its type and length.

operation	typical code
declare a two-dimensional array	double[][] a;
create an m-by-n array	a = new double[m][n];
declare, create and initialize	double[][] a = new double[m][n];
refer to an array element by index	a[i][j] = b[i][j] + c[j][k]
number of rows	a.length
number of columns	a[i].length

all elements are initialized to the default value (zero for numeric values, false for boolean)

can be different for each row ("ragged" array)

	0	1	2	3	4
0	a[0][0]	a[0][1]	a[0][2]	a[0][3]	a[0][4]
1	a[1][0]	a[1][1]	a[1][2]	a[1][3]	a[1][4]
2	a[2][0]	a[2][1]	a[2][2]	a[2][3]	a[2][4]

Arrays 2: quiz 3

How many elements are in these two arrays respectively?

A. 5, 20

B. 9, 10

C. 45, 23221

D. 20, 24

E. 4, 3

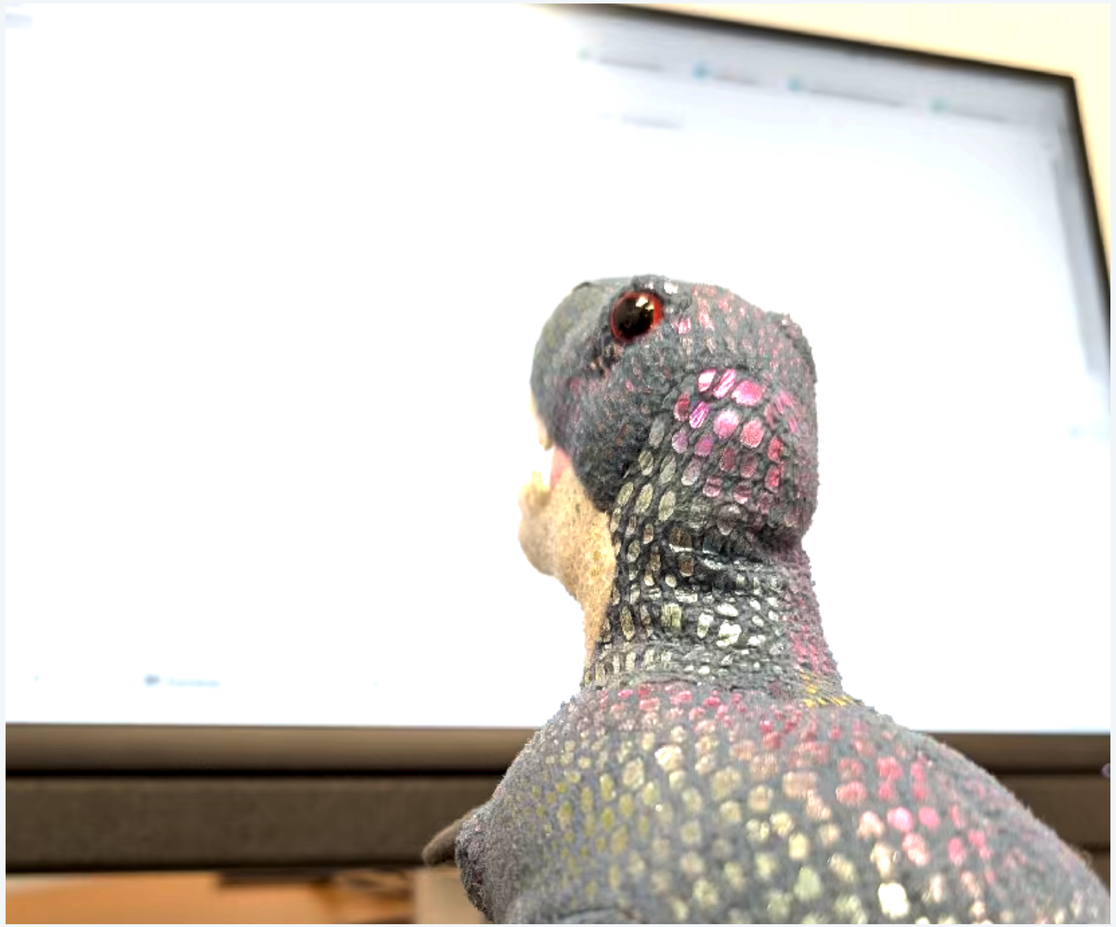
```
int [][] a = new int[4][5];

int [][][][][] a = new int[2][3][2][2][1];
```

How many elements in an array?

```
for (int i = 0; i < n; i++){
    for (int j = 0; j < m; j++){
        // How many times does this run?
        System.out.println(“Hello”);
    }
}
```

```
int [][] num = new int[n][m];
for (int i = 0; i < n; i++){
    for (int j = 0; j < m; j++){
        // How many times does this run?
        System.out.println(num[n][m]);
    }
}
```

Examples of two-dimensional arrays



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