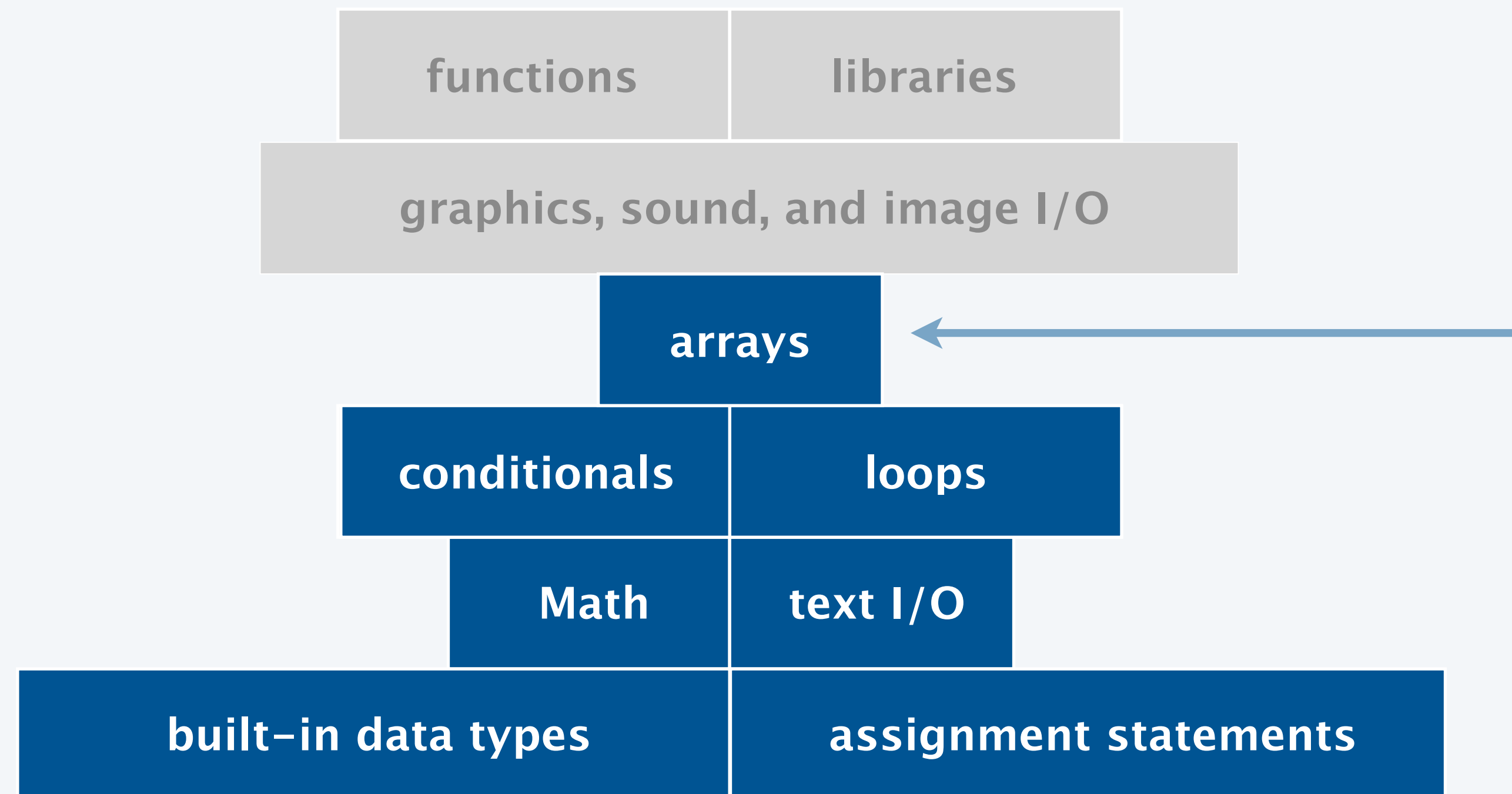


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1.4 ARRAYS

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

Basic building blocks for programming



we can start storing and processing larger volumes of data

```
public class AssignmentName {
    public static void main(String[] args) {
        int index = Integer.parseInt(args[0]);

        String name0 = "Hello, World";
        String name1 = "Conditionals";
        String name2 = "Loops";
        ...
        String name5 = "Functions";

        String name;
        if (index == 0) name = name0;
        else if (index == 1) name = name1;
        else if (index == 2) name = name2;
        ...
        else if (index == 5) name = name5;
        else name = "No assignment for this index.";

        System.out.println(name);
    }
}
```

*this program is storing
information*

*this program is processing
information*

```
public class PatientName {
    public static void main(String[] args) {
        int id = Integer.parseInt(args[0]);

        String name0 = "Sebastian Caldas";
        String name1 = "Marcel Dall'Agno1";
        ...
        String name1259 = "Kevin Wayne";

        String name;
        if (id == 0) name = name0;
        else if (id == 1) name = name1;
        ...
        else if (id == 1259) name = name1259;
        else name = "No patient with this id.";

        System.out.println(name);
    }
}
```

← *error-prone code!*

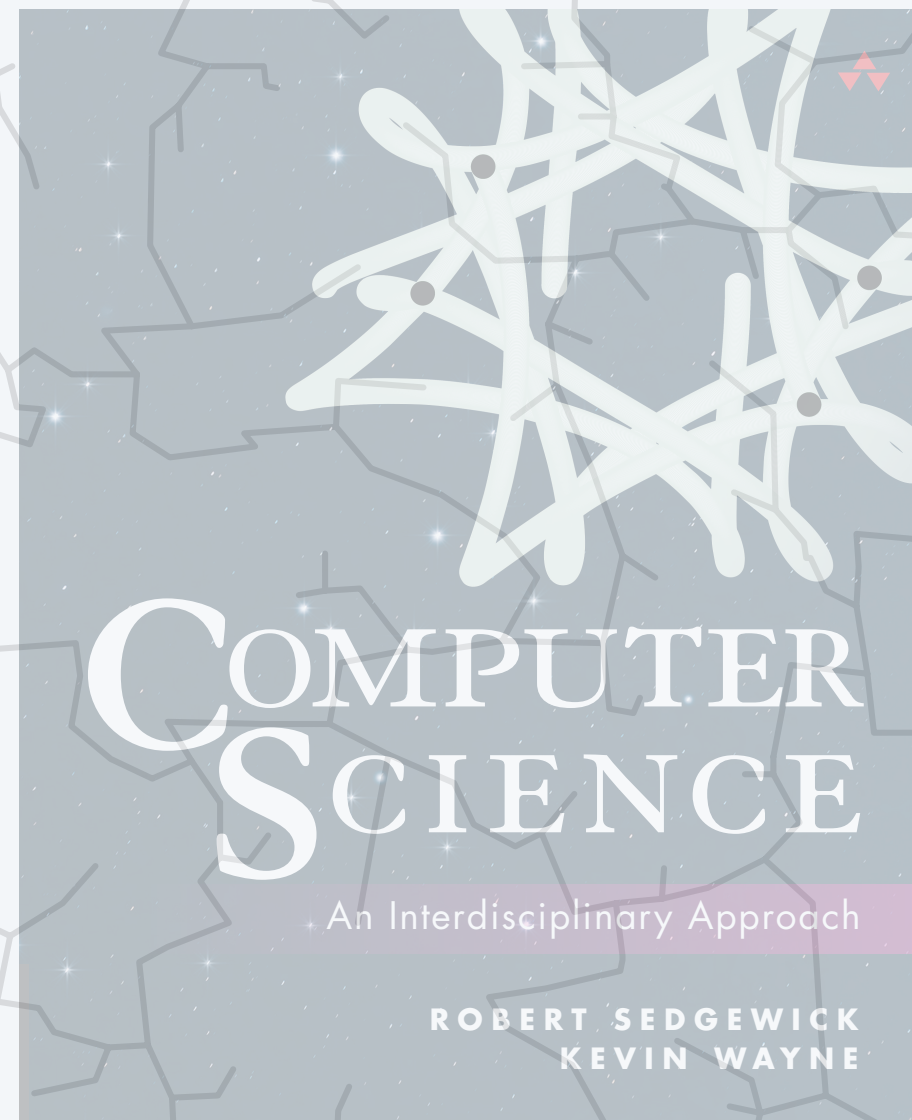
```
public class PatientName {
    public static void main(String[] args) {
        int id = Integer.parseInt(args[0]);

        String first0 = "Sebastian";
        String last0 = "Caldas";
        ...
        String first1259 = "Kevin";
        String last1259 = "Wayne";

        String name;
        if (id == 0) name = first0 + " " + last0;
        ...
        else if (id == 1259) name = first1259 + " " + last1259;
        else name = "No patient with this id.";

        System.out.println(name);
    }
}
```

← *error-prone code!*



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1.4 ARRAYS

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

Your first data structure

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

Examples.

- ▶ 6 assignments in this course.
- ▶ 300 students in COS126.
- ▶ 10 million audio samples in a song.
- ▶ 4 billion nucleotides in a DNA strand.
- ▶ 1 trillion parameters in a large language model.

Main purpose. Facilitate storage and manipulation of data.

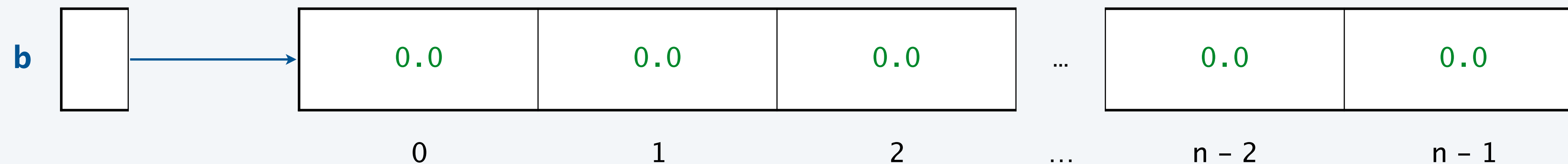
value	"Hello, World"	"Conditionals"	"Loops"	"Arrays"	"IO"	"Functions"
index	0	1	2	3	4	5

Arrays in Java

Create an array. Specify its type and length.

operation	typical code
declare an array	<code>double[] a;</code>
create an array of length n	<code>a = new double[n];</code>
declare, create and initialize an array	<code>double[] b = new double[n];</code>

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



Arrays in Java

Create an array. Specify its type and length.

operation	typical code
declare an array	<code>double[] a;</code>
create an array of length n	<code>a = new double[n];</code>
declare, create and initialize an array	<code>double[] b = new double[n];</code>
array initializer	<code>double[] c = { 0.3, 0.6, 0.1 };</code>



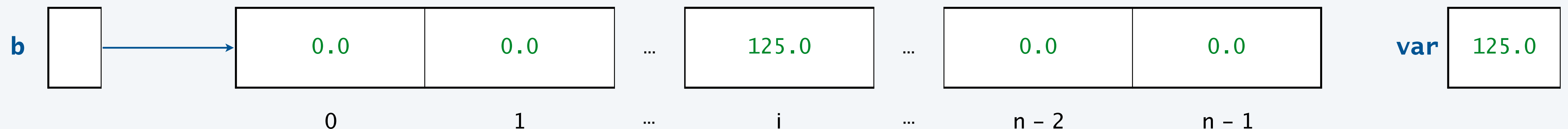
Arrays in Java

Access an array element. Use name of array, square brackets, and index.

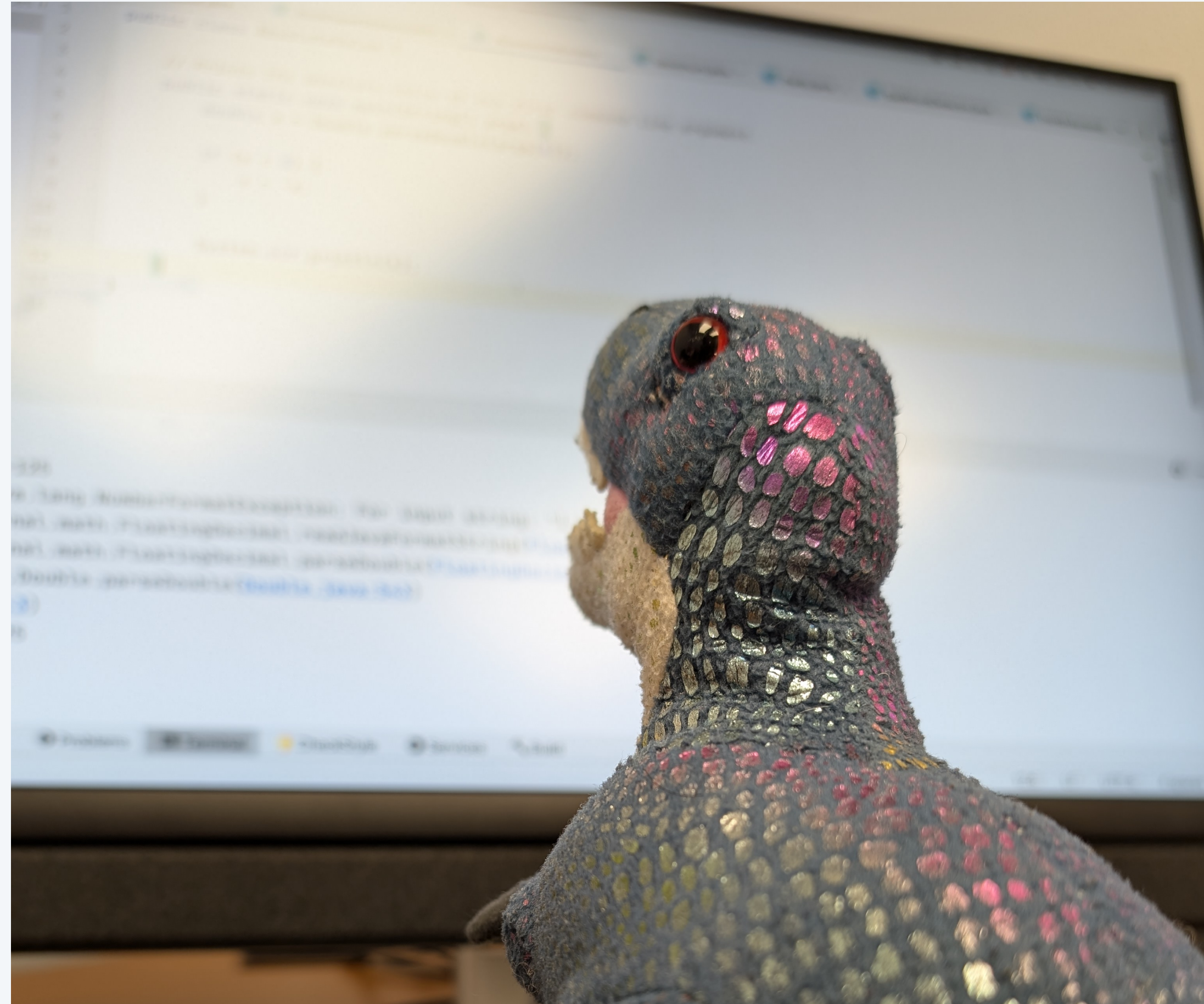
operation	typical code
declare, create and initialize an array	<code>double[] b = new double[n];</code>
assign 125.0 to i-th element	<code>b[i] = 125.0;</code>
get array length	<code>b.length</code>
assign value of i-th element to variable	<code>double var = b[i];</code>

← *index can be any expression of type int*

← *array elements are variables (can be used in expressions)*



Examples of array code





What are the contents of array `a[]` after the loop terminates?

- A. A B C D E
- B. A B C B A
- C. E D C B A
- D. E D C D E
- E. This code produces an error.

```
String[] a = { "A", "B", "C", "D", "E" };
int n = a.length;

for (int i = 0; i < n / 2; i++) {
    String temp = a[i];
    a[i] = a[n - i - 1];
    a[n - i - 1] = temp;
}
```



What are the contents of array `a[]` after the loop terminates?

- A. A B C D E
- B. A B C B A
- C. E D C B A
- D. E D C D E
- E. This code produces an error.

```
String[] a = { "A", "B", "C", "D", "E" };  
int n = a.length;  
  
for (int i = 0; i < n; i++) {  
    String temp = a[i];  
    a[i] = a[n - i - 1];  
    a[n - i - 1] = temp;  
}
```

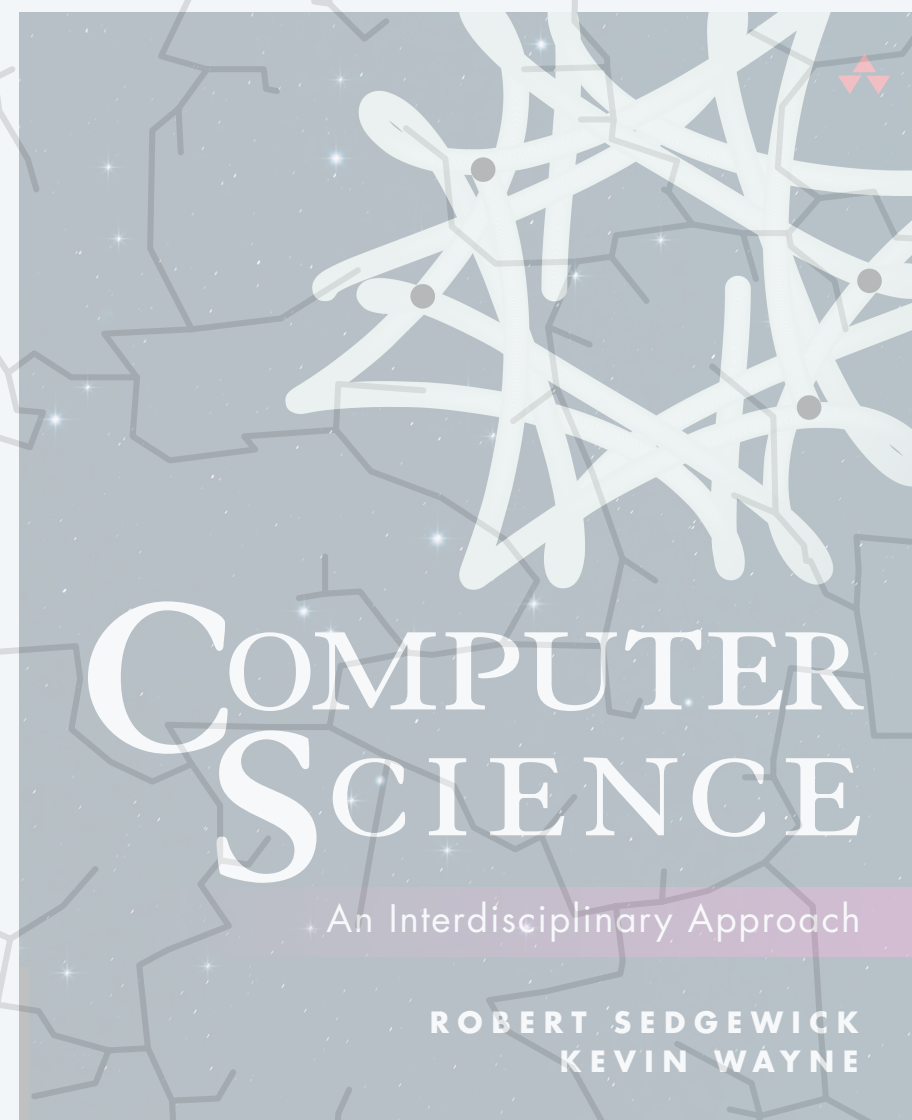


What are the contents of array `a[]` after the loop terminates?

- A. A B C D E
- B. A B C B A
- C. E D C B A
- D. E D C D E
- E. This code produces an error.

```
String[] a = { "A", "B", "C", "D", "E" };  
int n = a.length;  
  
for (int i = 0; i <= n; i++) {  
    String temp = a[i];  
    a[i] = a[n - i - 1];  
    a[n - i - 1] = temp;  
}
```





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1.4 ARRAYS

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

Sound

Sound. The perceptible vibration of air by the ear.



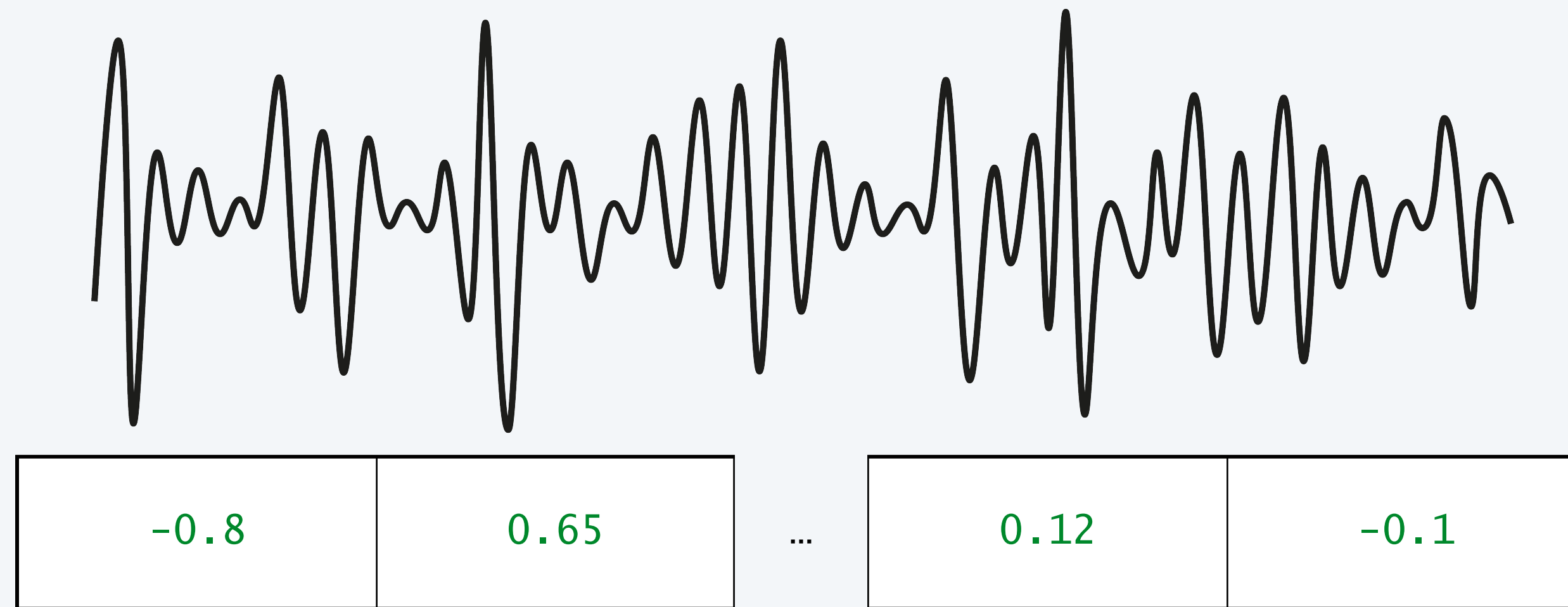
Digital Audio

Audio. An analog or digital encoding of sound.

Audio formats. Vinyl, cassette tapes, CD, .wav, .mp3, etc.

Audio signal. Real-valued (between -1 and $+1$) function of time.

- ▶ Value (amplitude) relates to change in sound pressure.



StdAudio library

StdAudio. Our library for playing, reading and saving digital audio.  *available with javac-introcs and java-introcs commands*

```
public class StdAudio
```

```
    int SAMPLE_RATE           44,100 Hz
```

```
    void play(String filename) play the given .wav file
```

```
    void playInBackground(String filename) play the given .wav file in a background thread
```

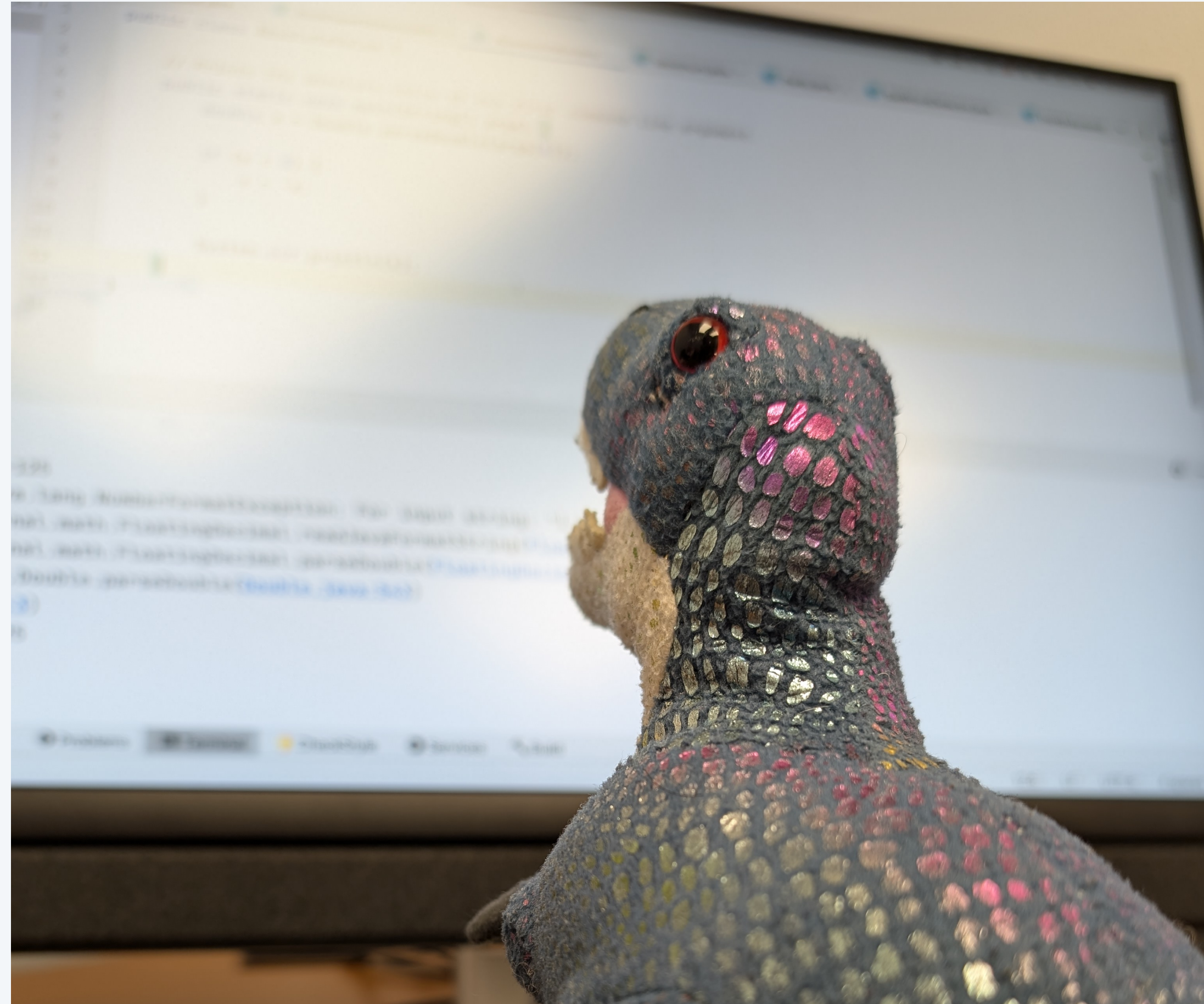
```
    void play(double[] samples) play the given samples
```

```
    void play(double sample) play sample
```

```
    void save(String filename, double[] a) save to a .wav file
```

```
    double[] read(String filename) read from a .wav file
```

Examples of manipulating digital audio



Credits

media	source	License
<i>Datacenter</i>	<u>Adobe Stock</u>	<u>education license</u>
<i>Cartoon dinosaur</i>	<u>Adobe Stock</u>	<u>education license</u>
<i>Sound wave</i>	<u>Adobe Stock</u>	<u>education license</u>
<i>Ear</i>	<u>Adobe Stock</u>	<u>education license</u>
<i>Pause</i>	<u>Adobe Stock</u>	<u>education license</u>