Activity 8: Arrays

Programs often need to store multiple values of the same type, such as a list of 1000 phone numbers or the names of your top 20 favorite songs. Rather than create a separate variable for each one, we can store them together using an array.

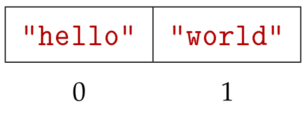
Model 1 Array Syntax

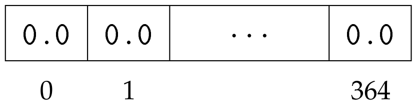
Each value in an array is known as an *element*. The programmer must specify the *length* of the array (the number of array elements). Once the array is created, its length cannot be changed.

```
String[] wordArray = {"hello", "world"};
System.out.println(wordArray[0]);            // outputs hello
System.out.println(wordArray.length);        // outputs 2

double[] numberArray = new double[365];
System.out.println(numberArray[0]);          // outputs 0.0
System.out.println(numberArray.length);      // outputs 365
```

Array elements are accessed by *index* number, starting at zero:





Questions (15 min) **Start time:** ________

1. Examine the results of the above code.

   a) What is the index for the element `"world"`?

   b) What is the length of the `wordArray`?

   c) What is the length of the `numberArray`?

   d) How would you access the last element of `numberArray`?

2. Now examine the syntax of the code.

   a) What are three ways that square brackets [] are used?

   b) In contrast, how are curly braces used for an array?

Array variables can be initialized without the `new` keyword:

```
int[] picks = {3, 5, 7, 2, 1};
String[] names = {"Grace", "Alan", "Tim"};
```

However, if the variable is already declared, `new` is required:

```
picks = new int[] {3, 5, 7, 2, 1};
names = new String[] {"Grace", "Alan", "Tim"};
```

3. Write *expressions* that create the following `new` arrays. (Do not declare variables.)

a)

0	14	1024	127	3	5521

b)

3.23	1.52	4.23	32.5	2.45	5.23	3.33

4. Write *statements* that both declare and initialize variables for these `new` arrays.

a)

0	14	1024	127	3	5521

b)

3.23	1.52	4.23	32.5	2.45	5.23	3.33

5. What are the type and value for each of the four *expressions* below?

```
int[] a = {3, 6, 15, 22, 100, 0};
double[] b = {3.5, 4.5, 2.0, 2.0, 2.0};
String[] c = {"alpha", "beta", "gamma"};
```

a) `a[3] + a[2]`

b) `b[2] - b[0] + a[4]`

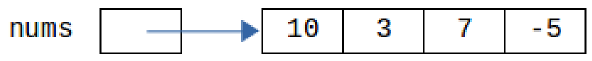
c) `c[1].charAt(a[0])`

d) `a[4] * b[1] <= a[5] * a[0]`

Model 2   Array Diagrams

Array elements are stored together in one contiguous block of memory. To show arrays in memory diagrams, we simply draw adjacent boxes.

```
int[] nums = {10, 3, 7, -5};
```



Questions (10 min)   Start time: ________

6. Draw a memory diagram for the following array declarations.

   a)
   ```
   int[] sizes = new int[5];
   sizes[2] = 7;
   ```

   b)
   ```
   char[] codes = new char[3];
   codes[2] = 'X';
   ```

   c)
   ```
   double[] costs = new double[4];
   costs[0] = 0.99;
   ```

7. What is the *default* value for uninitialized array elements? (Hint: You should have no empty boxes in your memory diagrams above.)

8. Like strings, arrays are reference types. What is the *value* of an array variable?

9. Draw a memory diagram of the following array. (Hint: You should have four arrows.)

```
String[] greek = {"alpha", "beta", "gamma"};
```

Model 3 Arrays and Loops

The real power of arrays is the ability to process them using loops, i.e., performing the same task for multiple elements.

```
for (int i = 0; i < array.length; i++) {
   // ... process array[i] ...
}
```

Here are two specific examples:

```
// set all of the elements of x to -1.0
double[] x = new double[100];
for (int i = 0; i < x.length; i++) {
    x[i] = -1.0;
}
// sum the elements of scores
int sum = 0;
for (int i = 0; i < scores.length; i++) {
    sum += scores[i];
}
```

Questions (20 min) Start time: ________

10. What is the value of `array` and `accumulator` at the end of the following code? Trace the loop by hand in the space below.

```
int[] array = {5, 26, 13, 12, 37, 15, 16, 4, 1, 3};
int accumulator = 0;
for (int i = 0; i < array.length; i++) {
    if (array[i] % 2 == 1 && i + 1 < array.length) {
        array[i] *= -1;
        accumulator += array[i+1];
    }
}
```

11. Implement the following method that creates and returns a new array.

```java
/**
 * Return a new array containing the pairwise maximum value of
 * the arguments. For each subscript i, the return value at [i]
 * will be the larger of x[i] and y[i].
 *
 * @param x an array of double values
 * @param y an array of double values
 * @return pairwise max of x and y
 */
public static double[] pairwiseMax(double[] x, double[] y) {








}
```

12. Implement the following method that reads through two integer arrays.

```java
/**
 * Computes the final average grade for a student. The labs are
 * worth 40% and the exams are worth 60%. All scores range from
 * 0 to 100, inclusive.
 *
 * @param labs the student's lab scores
 * @param exams the student's exam scores
 * @return weighted average of all scores
 */
public static double finalGrade(int[] labs, int[] exams) {








}
```