HESHAN SANDARUWAN
200304512443

1. An array in Java is a data structure that stores a fixed-size sequentialcollection of elements of the same data type. Each element in the array is identified by an index or a key. Arrays are used to store and manipulate collections of values of the same type efficiently.

2. a. int[] xr; - Declaration of an integer array reference named xr.
b. xr = new int[4]; - Creation of an integer array with a size of 4 and assigning it to xr.
c. System.out.println(xr); - Prints the memory address/reference of the array, not the actual values.
d. System.out.println(xr[0]); - Prints the value at index 0 of the array xr. Output depends on the initialization; if not initialized, it prints 0.
e. xr[0] = 100; - Assigns the value 100 to the first element (index 0) of the array.
f. xr[1] = 200; - Assigns the value 200 to the second element (index 1) of the array.
g. xr[2] = 300; - Assigns the value 300 to the third element (index 2) of the array.
h. xr[3] = 400; - Assigns the value 400 to the fourth element (index 3) of the array.
i. System.out.println(xr[0] + " " + xr[1] + " " + xr[2] + " " + xr[3]); - Prints the values of all elements in the array: "100 200 300 400".
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3. d. A built-in Java class for defining key-value pairs.

4. d. Arrays offer fast and direct access to elements using an index.

5.

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a.final int ARRAY_SIZE = 10;
b. double[] fractions = new double[ARRAY_SIZE];
c. double element4 = fractions[4];
d. fractions[9] = 1.667;
e. fractions[6] = 3.333;
f. double sum = 0;
for (int x = 0; x < ARRAY_SIZE; x++) {
sum += fractions[x];
}

6.
- Classes
- Interfaces
- Arrays
Reference types store references to the memory location of the actual data, while primitive types store the actual data directly.

7.
-int: 0
- double: 0.0
- boolean: false
- char: \u0000
- Reference types (e.g:-String, arrays): null

8.
a.int[] numbers = new int[5];
B.
Scanner scanner = new Scanner(System.in);
for (int i = 0; i < 5; i++) {
numbers[i] = scanner.nextInt();
}
C.
for (int i = 0; i < 5; i++) {
numbers[i] = scanner.nextInt();
}

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d.System.out.println(Arrays.toString(numbers));
e.
for (int i = 0; i < 5; i++) {
Sysem.out.print(numbers[i] + " ");
}
System.out.println();
9.
a. System.out.println(f[6]);

b. Arrays.fill(g, 8);
c.
double total = 0;
for (double value : c) {
total += value;
}
d. System.arraycopy(a, 0, b, 0, 11);
e.
double min = Double.MAX_VALUE;
double max = Double.MIN_VALUE;
for (double value : w) {
if (value < min) {
min = value;
}
if (value > max) {
max = value;
}
}
System.out.println("Smallest: " + min);
System.out.println("Largest: " + max);
10.
a. int[] numbers = {65, 78, 43, 89, 34, 56, 90, 23, 64, 71, 94, 29};

b. System.out.println("Size of the array: " +

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```
numbers.length);
c. System.out.print("[");
for (int i = 0; i < numbers.length; i++) {
System.out.print(numbers[i]);
if (i < numbers.length - 1) {
System.out.print(", ");
}
}
System.out.println("]");
d.System.out.print("[");
for (int number : numbers) {
System.out.print(number);
if (number != numbers[numbers.length - 1]) {
System.out.print(", ");
}
}
System.out.println("]");
e. System.out.print("[");
for (int number : numbers) {
if (number % 2 != 0) {
System.out.print(number);
if (number != numbers[numbers.length - 1]) {
System.out.print(", ");
}
}



}
System.out.println("]");
f. System.out.print("[");
for (int number : numbers) {
if (number % 2 == 0) {
System.out.print(number);
if (number != numbers[numbers.length - 1]) {
System.out.print(", ");
}
```

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```
}
}
System.out.println("]");
```

11.a. int[] a;
b. int []b;
d. int c[];

12.
a. int[] a = new int[5];
d. int[] d = {10, 20, 30, 40, 50};
e. int[] e = new int[]{10, 20, 30, 40, 50};
g. int[] g = new int[0];

13. b. Array.length;

```
for (int number : numbers) {
if (number % 2 == 0) {
System.out.print(number);
if (number != numbers[numbers.length - 1]) {
System.out.print(", ");
}
}
}
System.out.println("]");
```

11.a. int[] a;
b. int []b;
d. int c[];

12.
a. int[] a = new int[5];
d. int[] d = {10, 20, 30, 40, 50};
e. int[] e = new int[]{10, 20, 30, 40, 50};
g. int[] g = new int[0];

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13. b. Array.length;

14.

```
import java.util.Random;
public class Main{
public static void main(String[] args) {
int[] numbers = new int[12];
Random random = new Random();
for (int i = 0; i < numbers.length; i++) {
numbers[i] = random.nextInt(101);between 0 and 100
}
System.out.print("Original Array: [");
for (int i = 0; i < numbers.length; i++) {
System.out.print(numbers[i]);
if (i < numbers.length - 1) {
System.out.print(", ");
}
}
System.out.println("]");
System.out.print("Reverse Array: [");
for (int i = numbers.length - 1; i >= 0; i--) {
System.out.print(numbers[i]);
if (i > 0) {
System.out.print(", ");
}
}
System.out.println("]");
int sum = 0;
for (int number : numbers) {
sum += number;
}
System.out.println("Sum: " + sum);
int max = Integer.MIN_VALUE;
for (int number : numbers) {
```

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```
if (number > max) {
max = number;
}
}
System.out.println("Maximum: " + max);
int min = Integer.MAX_VALUE;
for (int number : numbers) {
if (number < min) {
min = number;
}
}
System.out.println("Minimum: " + min);
int evenCount = 0;
for (int number : numbers) {
if (number % 2 == 0) {
evenCount++;
}
}
System.out.println("Number of even numbers: " +
evenCount);
array
int oddCount = 0;
for (int number : numbers) {
if (number % 2 != 0) {
oddCount++;

}
}
System.out.println("Number of odd numbers: " +
oddCount);
System.out.print("Integers at even indexes: (");
for (int i = 0; i < numbers.length; i += 2) {
System.out.print(numbers[i]);
if (i < numbers.length - 2) {
System.out.print(", ");
```

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```
}
}
System.out.println(")");
System.out.print("Integers at odd indexes: (");
for (int i = 1; i < numbers.length; i += 2) {
System.out.print(numbers[i]);
if (i < numbers.length - 1) {
System.out.print(", ");
}
}
System.out.println(")");
}
}
```

15.

```
import java.util.Arrays;
public class Main {

public static void main(String[] args) {
int[] ar = {1, 2, 3, 4, 5};
int[] br = new int[]{10, 20, 30, 40, 50};
System.out.print("a. ");
System.out.println(Arrays.toString(ar));
System.out.print("b. ");
for (int i = 0; i < ar.length; i++) {
ar[i]++;
}
System.out.println(Arrays.toString(ar));
System.out.print("c. ");
System.out.println(Arrays.toString(ar));
System.out.print("d. ");
if (ar.length == br.length) {
System.out.println("Both arrays are the same size.");
} else {
System.out.println("Arrays are not the same size.");
}
System.out.print("e. ");
```

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```
for (int i = 0; i < ar.length; i++) {
ar[i] += br[i];
}
System.out.println(Arrays.toString(ar));
System.out.print("f. ");
System.arraycopy(br, 0, ar, 0, br.length);
System.out.println(Arrays.toString(ar));

}
}
```

```
16.import java.util.*;
class Main {
public static void main(String args[]) {
Scanner input = new Scanner(System.in);
System.out.print("Input no of students: ");
final int N = input.nextInt();
int[] marks = new int[N];
System.out.println("Enter marks for each student:");
for (int i = 0; i < N; i++) {
System.out.print("Enter marks for student " + (i + 1) + ": ");
marks[i] = input.nextInt();
}
int total = 0;
for (int mark : marks) {
total += mark;
}
int max = marks[0];
for (int i = 1; i < N; i++) {
if (marks[i] > max) {
max = marks[i];
}
}
int min = marks[0];
for (int i = 1; i < N; i++) {
```

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```
if (marks[i] < min) {
min = marks[i];
}
}
System.out.print("Marks: [");
for (int i = 0; i < N; i++) {
System.out.print(marks[i]);
if (i < N - 1) {
System.out.print(", ");
}
}
System.out.println("]");
System.out.println("Total: " + total);
System.out.println("Maximum: " + max);
System.out.println("Minimum: " + min);
}
}
Input no of students: 4
Enter marks for each student:
Enter marks for student 1: 32
Enter marks for student 2: 45
Enter marks for student 3: 54
Enter marks for student 4: 76
Marks: [32, 45, 54, 76]
Total: 207
Maximum: 76

Minimum:32

17.import java.util.*;
class Main {
public static void main(String args[]) {
Scanner input = new Scanner(System.in);
System.out.print("Input no of students: ");
final int N = input.nextInt();
```

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```
int[] marks = createAnArray(N);
readMarks(marks);
int total = total(marks);
int max = max(marks);
int min = min(marks);
printMarks(marks);
System.out.println("Total: " + total);
System.out.println("Maximum: " + max);
System.out.println("Minimum: " + min);
}
static int[] createAnArray(int size) {
return new int[size];
}
static void readMarks(int[] marks) {
Scanner input = new Scanner(System.in);
System.out.println("Enter marks for each student:");
for (int i = 0; i < marks.length; i++) {
System.out.print("Enter marks for student " + (i + 1) + ": ");

marks[i] = input.nextInt();
}
}
static int total(int[] marks) {
int total = 0;
for (int mark : marks) {
total += mark;
}
return total;
}
static int max(int[] marks) {
int max = marks[0];
for (int i = 1; i < marks.length; i++) {
if (marks[i] > max) {
max = marks[i];
}
}
```

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```
return max;
}
static int min(int[] marks) {
int min = marks[0];
for (int i = 1; i < marks.length; i++) {
if (marks[i] < min) {
min = marks[i];
}
}

return min;
}
static void printMarks(int[] marks) {
System.out.print("Marks: [");
for (int i = 0; i < marks.length; i++) {
System.out.print(marks[i]);
if (i < marks.length - 1) {
System.out.print(", ");
}
}
System.out.println("]");
}
}
```

18.

```
class Main {
public static void main(String[] args) {
int a = 10;
int[] arr = {1, 2, 3};
System.out.println("Before method call:");
System.out.println("a: " + a);
System.out.println("arr[0]: " + arr[0]);
modifyValues(a, arr);
System.out.println("After method call:");
System.out.println("a: " + a);
System.out.println("arr[0]: " + arr[0]); }
```

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```
static void modifyValues(int x, int[] array) {
x = 20;
array[0] = 100;
}
}
```

19.
a. int[] arrayA = new int[20];
b. int[] arrayB = {1, 2, 3, 4, 5};
double[] arrayC = new double[arrayB.length];
c. boolean[] arrayD = {true, true, true, false, false};
d. char[] vowelArray = {'A', 'E', 'I', 'O', 'U'};

20.
e. array={10, 20, 30, 40, 50};
f. array=new int[]{10, 20, 30, 40, 50};

21.
a. int a = new int[10];
Explanation: This is not legal. You can't initialize a primitive int variable with an array.
b. int b = new int[10].length;
Explanation: This is legal. It initializes an array and then retrieves its length.
c. int c = {10, 20, 30, 40}.length;
Explanation: This is not legal. You can't use array initializer without specifying the variable type.
d. int d = new int[]{10, 20, 30, 40}.length;
Explanation: This is legal. It initializes an array and then retrieves its length.

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e. int e = new double[]{1.1, 1, 2, 1, 5, 1, 4}.length;
Explanation: This is legal. It initializes a double array and then retrieves its
length.
f. int f = new int[]{10, 20, 30, 40}[2];
Explanation: This is legal. It initializes an array and retrieves the value at
index 2.
g. int[] g = new int[]{10, 20, 30, 40}[2];
Explanation: This is not legal. It tries to initialize an array with a single
element (value at index 2).
h. int h = new double[]{1.1, 1, 2, 1, 5, 1, 4}.[2];
Explanation: This is not legal. The dot notation [2] is incorrect for arrays.
It should be used for array access.
i. int i = new double[]{1.1, 1, 2, 1, 5, 1, 4}[2];

Explanation: This is legal. It initializes a double array and retrieves the
value at index 2.
j. double j = new double[]{1.1, 1, 2, 1, 5, 1, 4}.[2];
Explanation: This is not legal. The dot notation [2] is incorrect for arrays.
It should be used for array access.

22.

```
public class Main{
public static void main(String[] args) {
double[] z = new double[20];
double sum = 0;
int countNonZero = 0;
for (double value : z) {
if (value != 0) {
sum += value;
countNonZero++;
```

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```
}
}
if (countNonZero > 0) {
double average = sum / countNonZero;
System.out.println("Average of non-zero numbers: " +
average);
} else {

System.out.println("No non-zero numbers to calculate
average.");
}
}
}
```

23. c. int a=10;

24.100 200
100 201

25.

```
import java.util.*;
class Main {
public static void main(String args[]) {
char[] vowels1 = {'a', 'e', 'i', 'o', 'u'};
char[] vowels2 = {'A', 'E', 'I', 'O', 'U'};
System.out.println(Arrays.toString(vowels1)); // [a, e, i, o,
u]
System.out.println(Arrays.toString(vowels2)); // [A, E, I, O,
U]
char[] vowelsAll = merge(vowels1, vowels2);
System.out.println(Arrays.toString(vowelsAll));
}
static char[] merge(char[] arr1, char[] arr2) {
char[] result = new char[arr1.length + arr2.length];

System.arraycopy(arr1, 0, result, 0, arr1.length);
```

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```
System.arraycopy(arr2, 0, result, arr1.length, arr2.length);
return result;
}
}
```

26.
g. printArray(new int[]{10,20,30,40});
k. printArray(new int[]{10,20,30,40});

27.
b. xr[0] = x;

28.
c. Titi nic

29.
c. The command-line arguments passed to the program when it is executed.

30.
b. It contains an empty array of length zero.
31.
a. one two three

32.

```
public class Main {
public static void main(String[] args) {
int[] array = {12, 5, 3, 8, 7, 9, 10};
int secondSmallest = findSecondSmallest(array);
System.out.println("The second smallest element is: " +
secondSmallest);
}
static int findSecondSmallest(int[] arr) {
if (arr.length < 2) {
System.out.println("Array should have at least two
elements");
return -1;
```

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```
}
int smallest = Integer.MAX_VALUE;
int secondSmallest = Integer.MAX_VALUE;
for (int value : arr) {
if (value < smallest) {
secondSmallest = smallest;
smallest = value;
} else if (value < secondSmallest && value != smallest) {
secondSmallest = value;
}
}
return secondSmallest;
}
}
```

```
33.public class Main{
public static void main(String[] args) {
int[] array = {1, 2, 3, 4, 5, 6, 7, 8, 9};
System.out.println("Original Array: ");
printArray(array);
reverseArray(array);
System.out.println("\nReversed Array: ");
printArray(array);
}
static void reverseArray(int[] arr) {
int start = 0;
int end = arr.length - 1;
while (start < end) {
int temp = arr[start];
arr[start] = arr[end];
arr[end] = temp;
start++;
end--;
}
}
```

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```
static void printArray(int[] arr) {
for (int value : arr) {
System.out.print(value + " ");
}
System.out.println();

}
```

34.
b. The code will compile but will result in a runtime error "ArrayIndexOutOfBoundsException" because it attempts to access an element outside the array bounds.

35.
[100, 200, 300]
[100, 200, 300]
[101, 201, 301]

36.

```
public class Main {
public static void main(String[] args) {
int[] ascendingArray = {1, 2, 4, 7, 9};
int[] descendingArray = {10, 8, 6, 3, 1};
int[] randomArray = {5, 2, 8, 3, 6};
System.out.println(isOrdered(ascendingArray));
System.out.println(isOrdered(descendingArray));
System.out.println(isOrdered(randomArray));
}
static boolean isOrdered(int[] array) {
boolean ascending = true;

boolean descending = true;
for (int i = 1; i < array.length; i++) {
if (array[i - 1] > array[i]) {
ascending = false;
break;
```

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```
}
}
for (int i = 1; i < array.length; i++) {
if (array[i - 1] < array[i]) {
descending = false;
break;
}
}
return ascending || descending;
}
}
```

37.

```
public class Main {
public static void main(String[] args) {
int[] array = {5, 2, 9, 3, 7};
System.out.println("Original Array: ");
printArray(array);
rotateClockwise(array);
System.out.println("\nArray after Cyclic Rotation: ");
printArray(array);

}
static void rotateClockwise(int[] arr) {
if (arr.length <= 1) {
return;
}
int lastElement = arr[arr.length - 1];
for (int i = arr.length - 1; i > 0; i--) {
arr[i] = arr[i - 1];
}
arr[0] = lastElement;
}
static void printArray(int[] arr) {
for (int value : arr) {
System.out.print(value + " ");
```

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```
}
}
}
```

```
38.import java.util.*;
public class Main{
public static void main(String[] args) {
int[] arr1 = {1, 2, 3, 4, 5};
int[] arr2 = {3, 4, 5, 6, 7};
int[] union = findUnion(arr1, arr2);
System.out.println("Union of arr1 and arr2: " +
Arrays.toString(union));

int[] intersection = findIntersection(arr1, arr2);
System.out.println("Intersection of arr1 and arr2: " +
Arrays.toString(intersection));
boolean areEqual = areArraysEqual(arr1, arr2);
System.out.println("arr1 and arr2 are equal: " + areEqual);
}
static int[] findUnion(int[] arr1, int[] arr2) {
int[] result = new int[arr1.length + arr2.length];
System.arraycopy(arr1, 0, result, 0, arr1.length);
System.arraycopy(arr2, 0, result, arr1.length, arr2.length);
result = Arrays.stream(result).distinct().toArray();
return result;
}
static int[] findIntersection(int[] arr1, int[] arr2) {
return Arrays.stream(arr1)
.distinct()
.filter(element -> Arrays.stream(arr2).anyMatch(e -> e ==
element))
.toArray();
}
static boolean areArraysEqual(int[] arr1, int[] arr2) {
return Arrays.equals(arr1, arr2);
}
```

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}

39.
c. When trying to access an index beyond the length of the args array

40.

```
import java.util.*;
public class Main {
public static void main(String[] args) {
Scanner scanner = new Scanner(System.in);
int[] uniqueNumbers = new int[5];
int currentIndex = 0;
System.out.println("Enter five numbers between 10 and
100 (inclusive):");
while (currentIndex < uniqueNumbers.length) {
int number = scanner.nextInt();
if (number >= 10 && number <= 100) {
if (!contains(uniqueNumbers, currentIndex, number)) {
uniqueNumbers[currentIndex] = number;
currentIndex++;
displayUniqueNumbers(uniqueNumbers, currentIndex);
} else {
System.out.println("Duplicate number! Enter a different
number.");
}
} else {
System.out.println("Number must be between 10 and 100
```



```
(inclusive). Enter a valid number.");
}
}
}
static void displayUniqueNumbers(int[] array, int size) {
```

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```
System.out.print("Unique numbers: ");
for (int i = 0; i < size; i++) {
System.out.print(array[i] + " ");
}
System.out.println();
}
static boolean contains(int[] array, int size, int number) {
for (int i = 0; i < size; i++) {
if (array[i] == number) {
return true;
}
}
return false;
}
}
```

41.

```
public class Main {
public static void main(String[] args) {
int[] sourceArray = {1, 2, 3, 4, 5};
int[] destinationArray = new int[7];
copyRange(sourceArray, 1, destinationArray, 2, 3);
for (int value : destinationArray) {
System.out.print(value + " ");
}
}
static void copyRange(int[] source, int startIndexSource,
int[] destination,
int startIndexDestination, int length) {
for (int i = 0; i < length; i++) {
destination[startIndexDestination + i] =
source[startIndexSource + i];
}
}
}
```

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```
42.import java.util.*;
public class Main {
public static void main(String[] args) {
int[] array = {0, 0, 1, 0, 3, 0, 5, 0, 6};
System.out.println("Original Array: " +
Arrays.toString(array));
rearrangeArray(array);
System.out.println("Rearranged Array: " +
Arrays.toString(array));

}
static void rearrangeArray(int[] arr) {
int nonZeroIndex = 0;
for (int i = 0; i < arr.length; i++) {
if (arr[i] != 0) {
int temp = arr[i];
arr[i] = arr[nonZeroIndex];
arr[nonZeroIndex] = temp;
nonZeroIndex++;
}
}
}
}
```

```
43.
import java.util.*;
public class NumberListApplication {
public static void main(String[] args) {
int[] numberList = new int[5];
insert(numberList, 23);
insert(numberList, 54);
insert(numberList, 46);
printList(numberList);

remove(numberList);
insert(numberList, 72, 1);
```

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```
printList(numberList);
remove(numberList, 2);
printList(numberList);
System.out.println("Is list empty? " +
isEmpty(numberList));
System.out.println("Is list full? " + isFull(numberList));
clear(numberList);
printList(numberList);
insert(numberList, 92);
printList(numberList);
removeDuplicates(numberList);
printList(numberList);
int searchResult = searchElement(numberList, 54);
System.out.println("Location of 54: " + searchResult);
boolean isExistResult = isExist(numberList, 72);
System.out.println("Does 72 exist in the list? " +
isExistResult);
}
static void insert(int[] array, int number) {
if (number > 0) {
if (array.length == size(array)) {
array = Arrays.copyOf(array, array.length * 2);
}
array[size(array)] = number;

}
}
static void printList(int[] array) {
System.out.println("List: " + Arrays.toString(array));
}
static void remove(int[] array) {
if (size(array) > 0) {
array[size(array) - 1] = 0;
}
}
static void remove(int[] array, int index) {
```

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```
if (index >= 0 && index < size(array)) {
for (int i = index; i < size(array) - 1; i++) {
array[i] = array[i + 1];
}
array[size(array) - 1] = 0;
}
}
static void insert(int[] array, int number, int index) {
if (index >= 0 && index <= size(array) && number > 0) {
if (array.length == size(array)) {
array = Arrays.copyOf(array, array.length * 2);
}
for (int i = size(array) - 1; i >= index; i--) {
array[i + 1] = array[i];
}

array[index] = number;
}
}
static int size(int[] array) {
int count = 0;
for (int value : array) {
if (value > 0) {
count++;
} else {
break; }
}
return count;
}
static boolean isEmpty(int[] array) {
return size(array) == 0;
}
static boolean isFull(int[] array) {
return size(array) == array.length;
}
static void clear(int[] array) {
```

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```
Arrays.fill(array, 0);
}
static void removeDuplicates(int[] array) {
for (int i = 0; i < size(array) - 1; i++) {
for (int j = i + 1; j < size(array); j++) {
if (array[i] == array[j]) {

remove(array, j);
j--; }
}
}
}
static int searchElement(int[] array, int number) {
for (int i = 0; i < size(array); i++) {
if (array[i] == number) {
return i;
}
}
return -1;
}
static boolean isExist(int[] array, int number) {
return searchElement(array, number) != -1;
}
}
44.public class Main{
public static void main(String[] args) {
int[] fraction1 = {25, 15};
if (reduce(fraction1))
System.out.println("" + fraction1[0] + '/' + fraction1[1]);
else
System.out.println("fraction error");
int[] fraction2 = {25, 0};

if (reduce(fraction2))
System.out.println("" + fraction2[0] + '/' + fraction2[1]);
else
```

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```
System.out.println("fraction error");
}
static boolean reduce(int[] fraction) {
int numerator = fraction[0];
int denominator = fraction[1];
if (numerator <= 0 || denominator <= 0) {
return false;
}
int gcd = findGCD(numerator, denominator);
fraction[0] /= gcd;
fraction[1] /= gcd;
return true;
}
static int findGCD(int a, int b) {
while (b != 0) {
int temp = b;
b = a % b;
a = temp;
}
return a;
}
}
```

```
45.public class Main {
public static void main(String[] args) {
double[] xValues = {1.0, 2.0, 3.0};
double[] coefficients = {2.0, -1.0, 3.0};
double[] results = p(xValues, coefficients);
for (int i = 0; i < results.length; i++) {
System.out.println("p(" + xValues[i] + ") = " + results[i]);
}
}
public static double[] p(double[] x, double[] coeff) {
int n = coeff.length;
int m = x.length;
double[] results = new double[m];
```

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```
for (int i = 0; i < m; i++) {
double value = 0.0;
for (int j = 0; j < n; j++) {
value += coeff[j] * Math.pow(x[i], n - j - 1);
}
results[i] = value;
}
return results;
}
}
```