
The Matrix
1 2 3 4 5 6 7 8 8 1 1 2 3 4 5 6 7 8 8 1
A b a d e a a a a a A b a d e a a a a a
1 4 6 2 a a 3 2 5 1 1 4 6 2 a a 3 2 5 1
1 2 3 4 5 6 7 8 8 1 1 2 3 4 5 6 7 8 8 1
A b a d e a a a a a A b a d e a a a a a
1 4 6 2 a a 3 2 5 1 1 4 6 2 a a 3 2 5 1
1 2 3 4 5 6 7 8 8 1 1 2 3 4 5 6 7 8 8 1
A b a d e a a a a a A b a d e a a a a a
1 4 6 2 a a 3 2 5 1 1 4 6 2 a a 3 2 5 1
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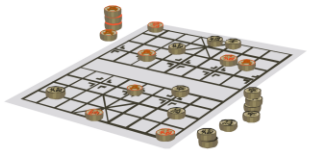
Two-D arrays
Matrices

A two-dimensional array is a one-dimensional array of one-dimensional arrays.

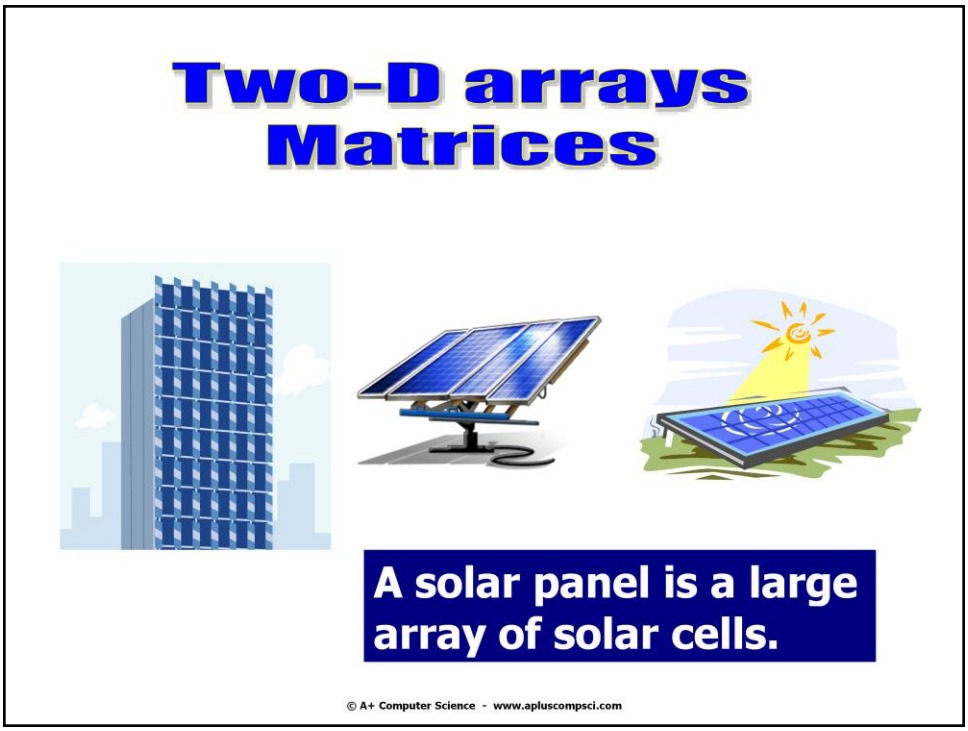
A spreadsheet is a matrix.

A matrix has rows and columns.



A matrix is an array of arrays.

Matrices have rows and columns.



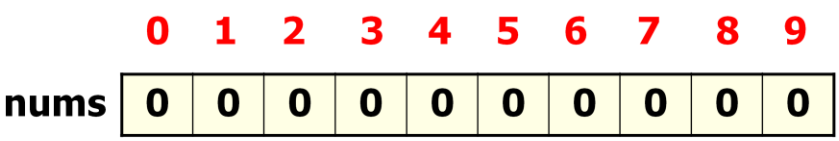
A matrix is an array of arrays.

Matrices have rows and columns.

What is an array?

An array is a group of items all of the same type which are accessed through a single identifier.

```
int[] nums = new int[10];
```

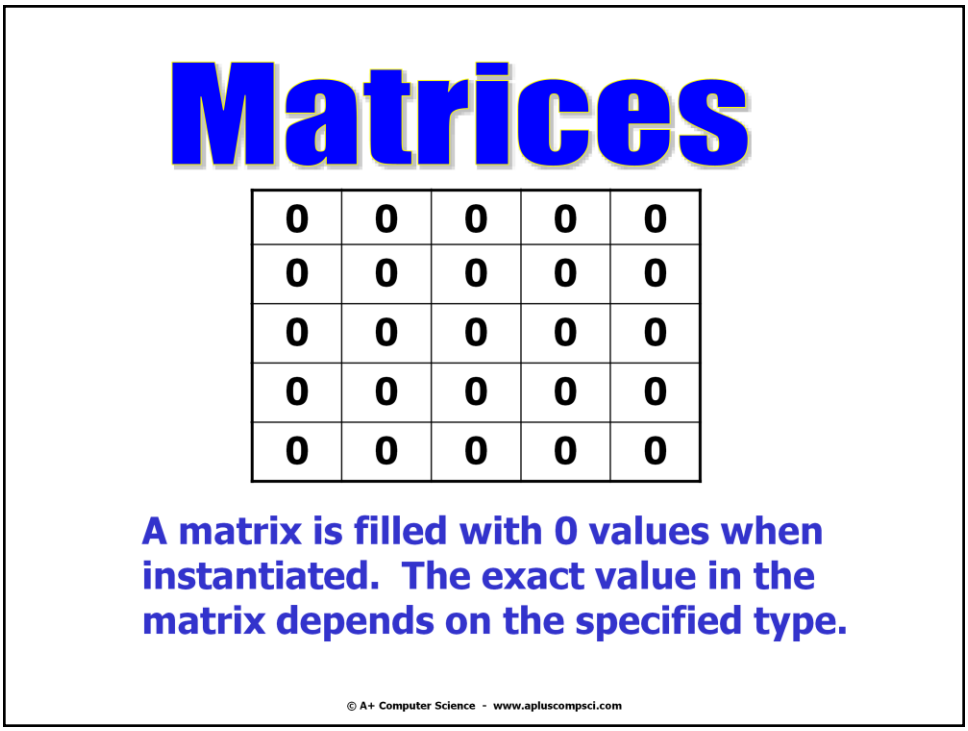


An array is a group of items all of the same type.

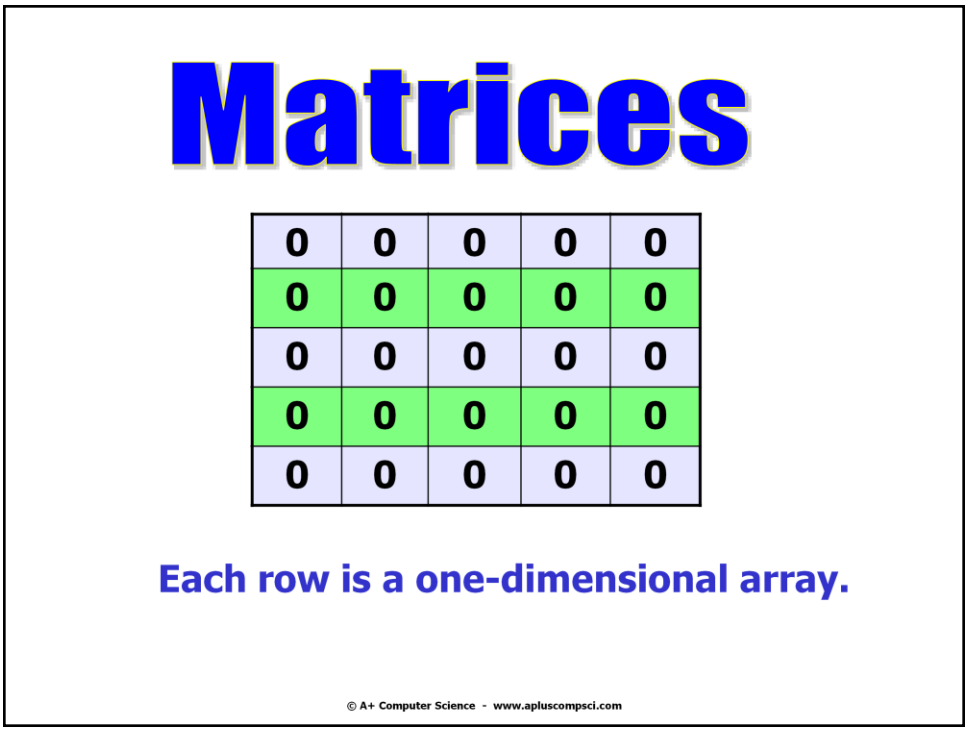
An array of int can only store ints.

An array of double can only store doubles.

An array of String can only store String references.



Just like an array, a matrix is loaded with zero values when instantiated.



A single row in an matrix is an array.

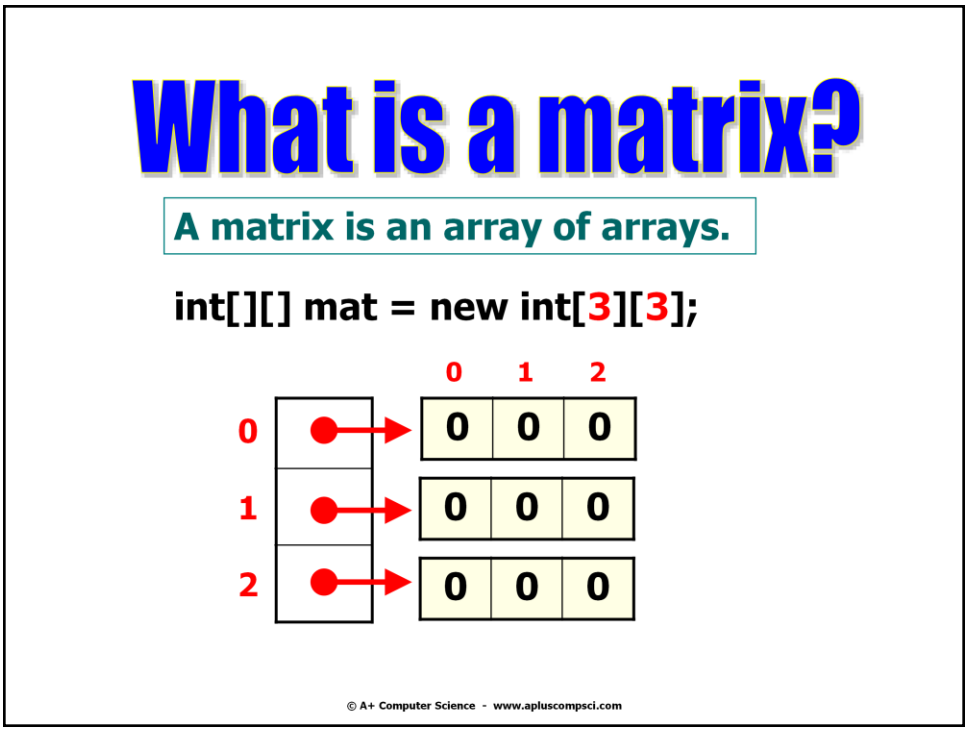
`mat[0]` stores the location / address of a one-dimensional array. Each spot in matrix refers to a one-dimensional array.

Matrices

	0	1	2	3	4
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0

```
int[][] mat = new int[5][5];
```

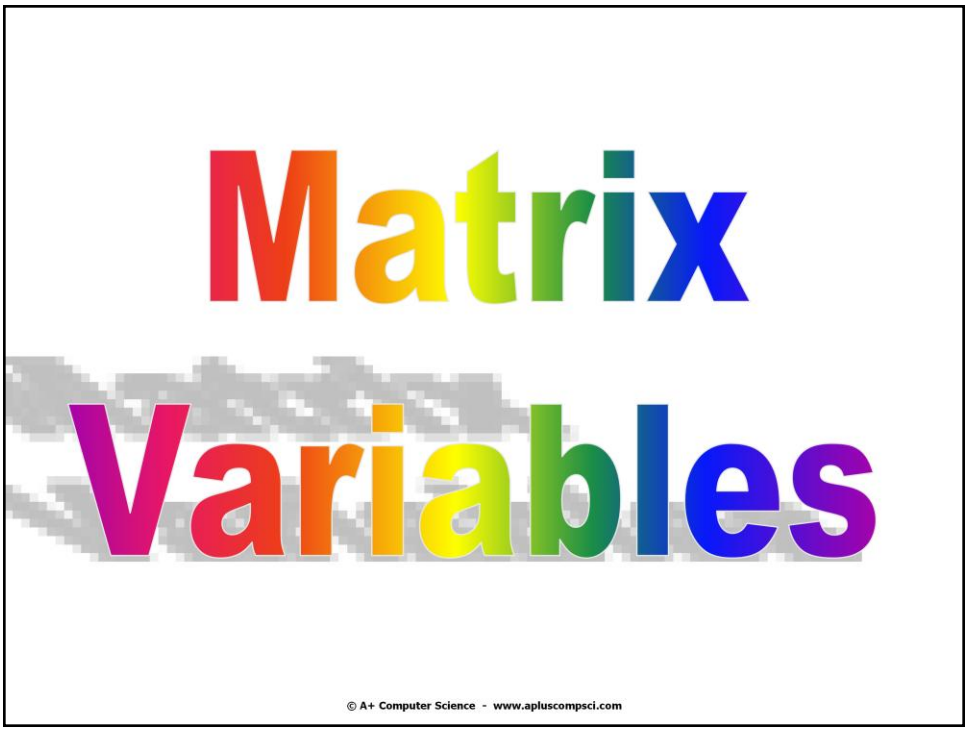

mat contains 5 rows of 5 ints. Each row is a one-dimensional array(int[]).



Each spot in an matrix stores the location/address of an array.

`mat[0]` stores the location / address of a one-dimensional array.

open matrixone.java


Matrix
Variables
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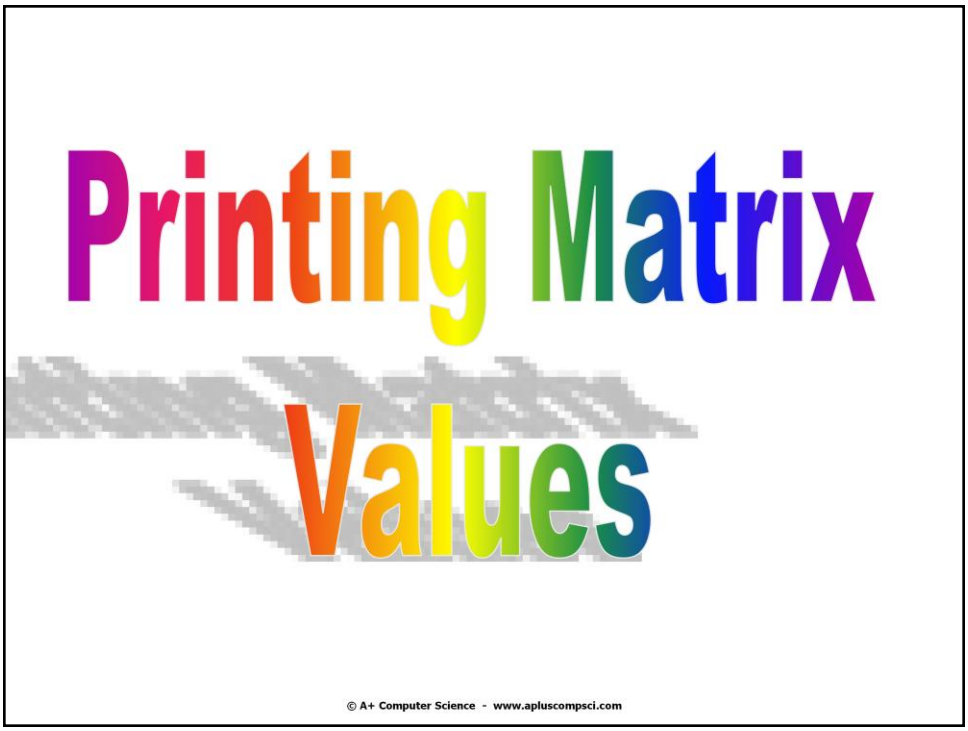
Matrix Variables

```
int[][] mat = {{6, 5,7,9,2},
               {5,3,4,6},
               {7,0,8}};


final int SIZE = 40;
int[][] intMat = new int[SIZE][SIZE];
      //intMat is filled with zeros - 0s
```

Matrix Variables

```
String[][] words = new String[4][4];
      //words is filled with 16 nulls

double[][] dMat = new double[3][3];
      //dMat is filled with 9 0.0s

int[][] mat = new int[5][5];
      //mat is filled with 25 0s
```


Printing Matrix
Values
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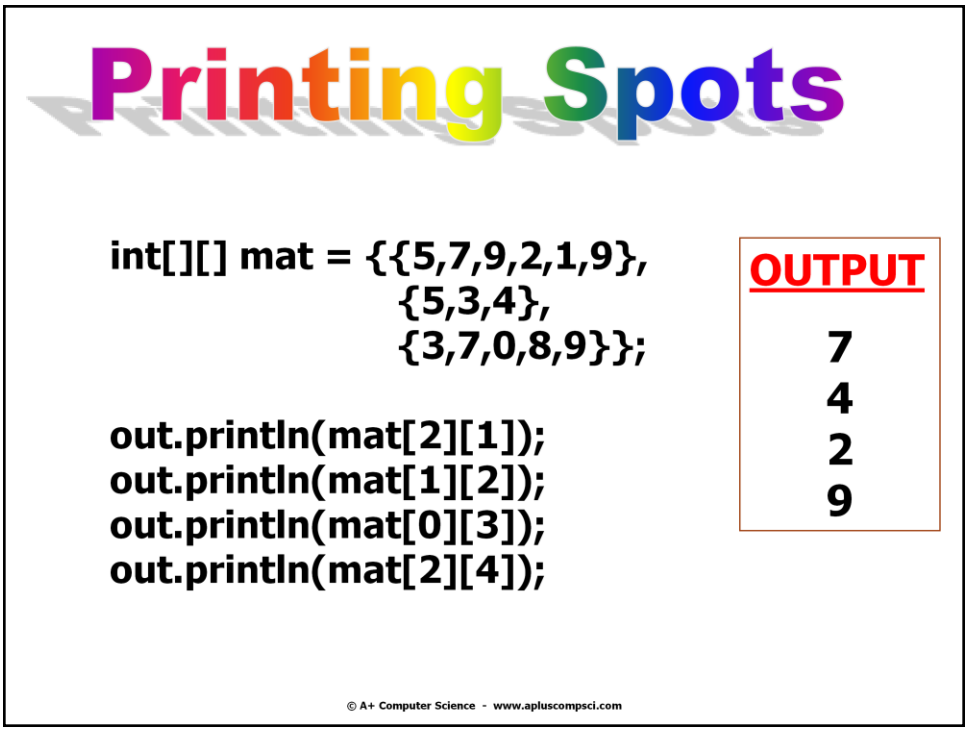
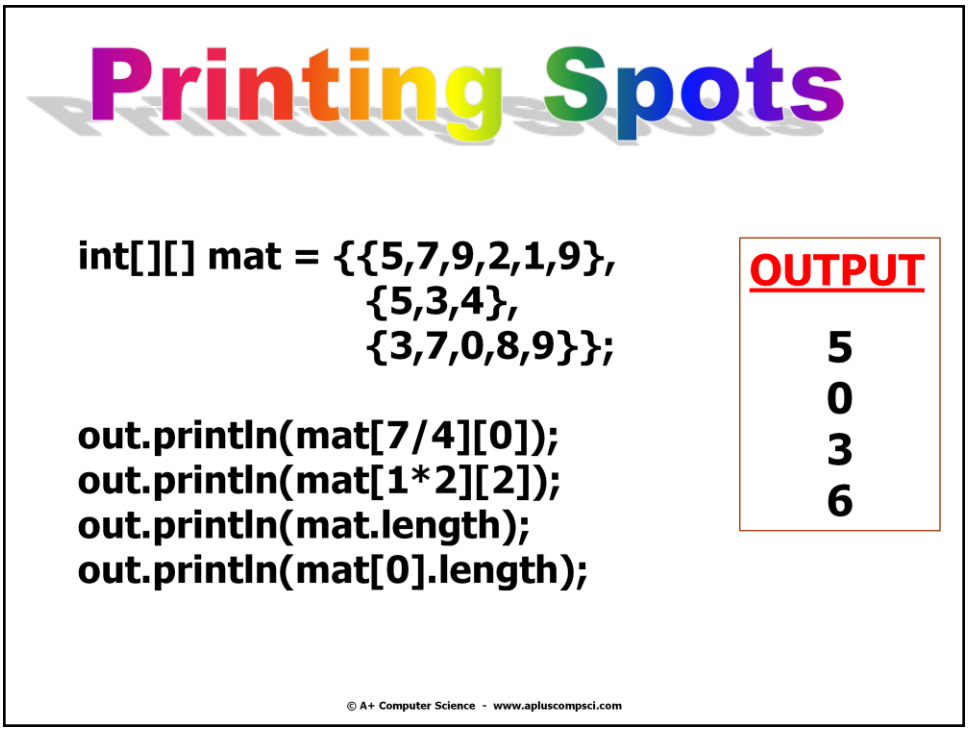


When printing out a spot in a matrix, the row and column must be provided.

```
out.println(mat[2][1]);
```

This line prints spot 1 of the array referred to by `mat[2]`. `mat[2]` stores the location/address of an array.

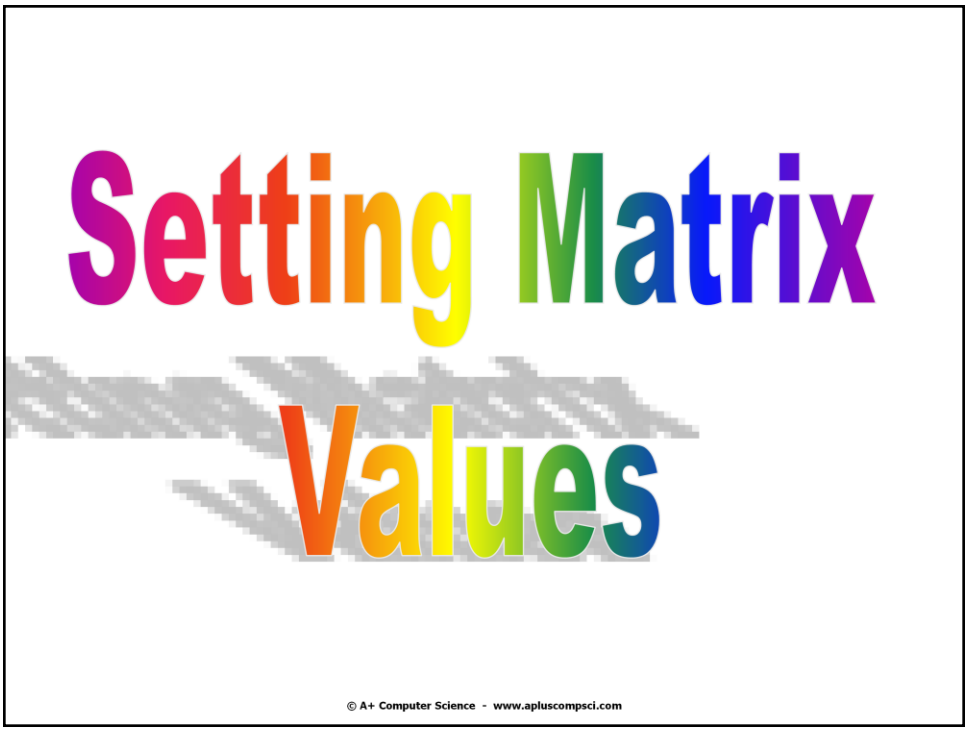


When printing out a spot in a matrix, the row and column must be provided.

```
out.println(mat[2][1]);
```

This line prints spot 1 of the array referred to by `mat[2]`. `mat[2]` stores the location/address of an array.

open matrixtwo.java


Setting Matrix
Values
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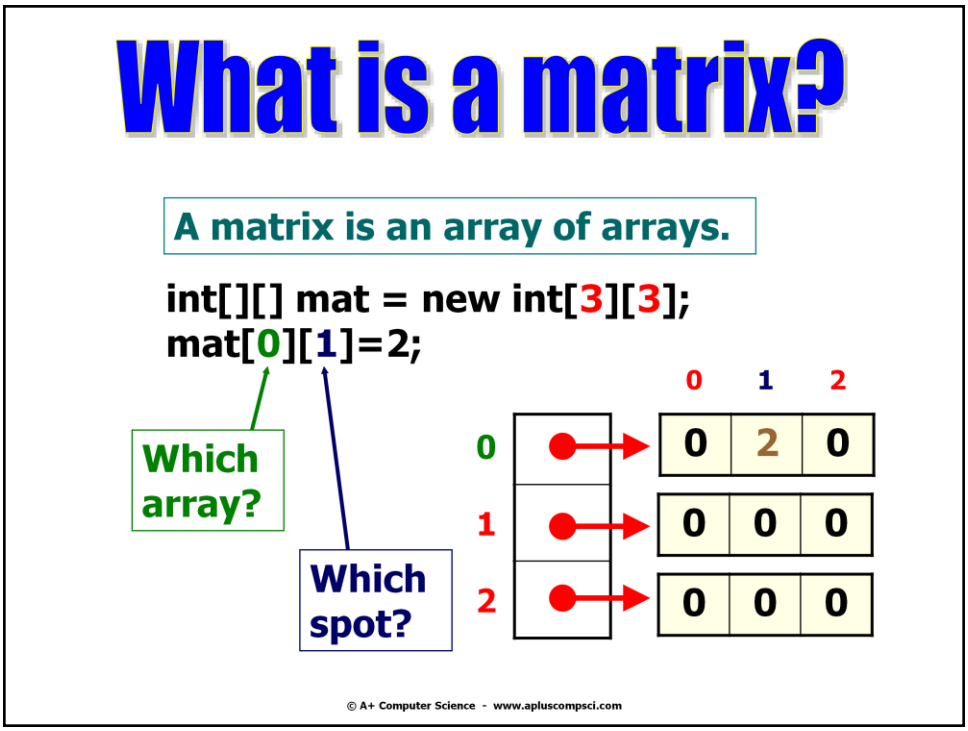
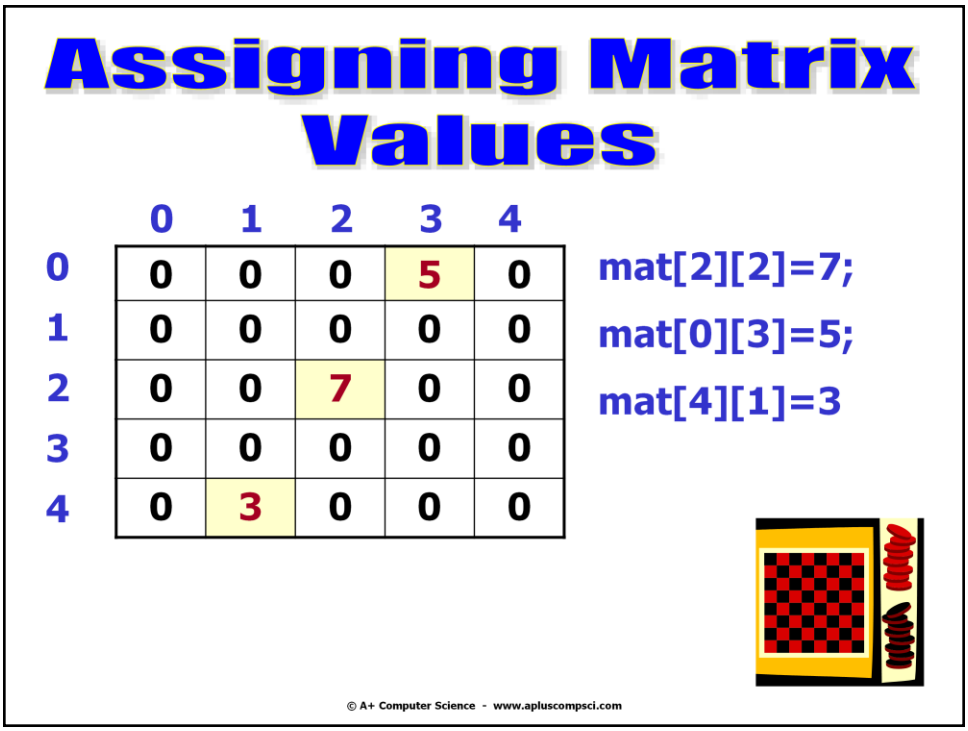


Each spot in an matrix stores the location/address of an array.

`mat[0]` stores the location / address of a one-dimensional array.

```
mat[0][1]=2;
```

This line sets `mat[0]` spot 1 to 2.



`mat[2]` stores the location / address of a one-dimensional array.

```
mat[2][2]=7;
```

This line sets `mat[2]` spot 2 to 7.

Assigning Matrix Values

```
for( int r = 0; r < mat.length; r++)
{
  for( int c = 0; c < mat[r].length; c++)
  {
       mat[r][c] = r*c;
  }
}
```

if mat was 3x3

0	0	0
0	1	2
0	2	4

open
matrixsetone.java
matrixsettwo.java


Nested Loop
Review
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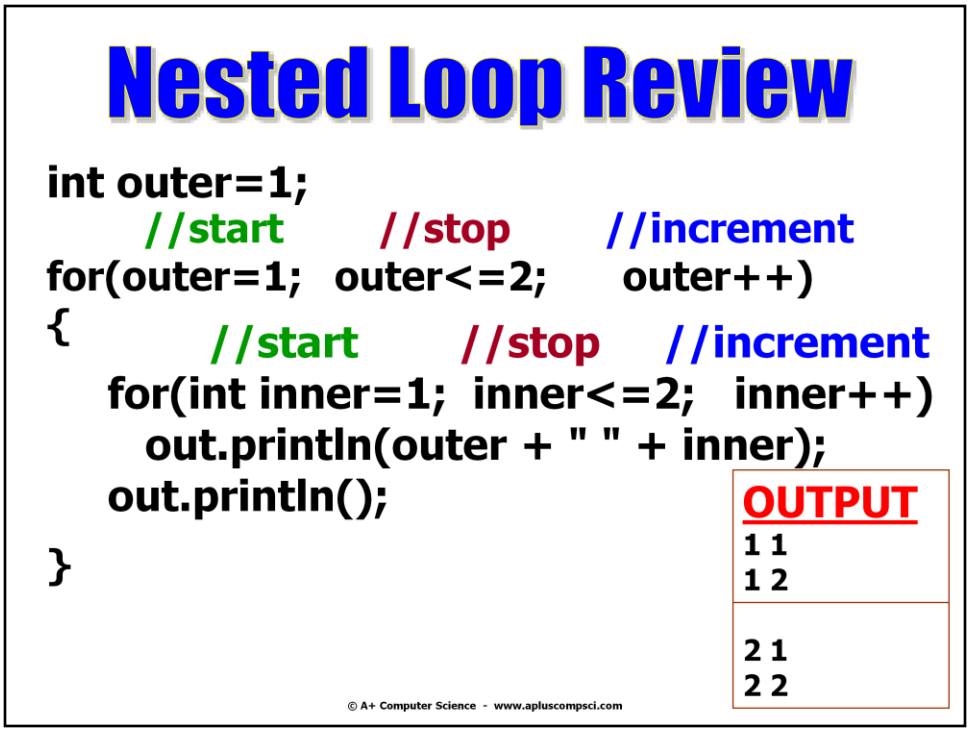
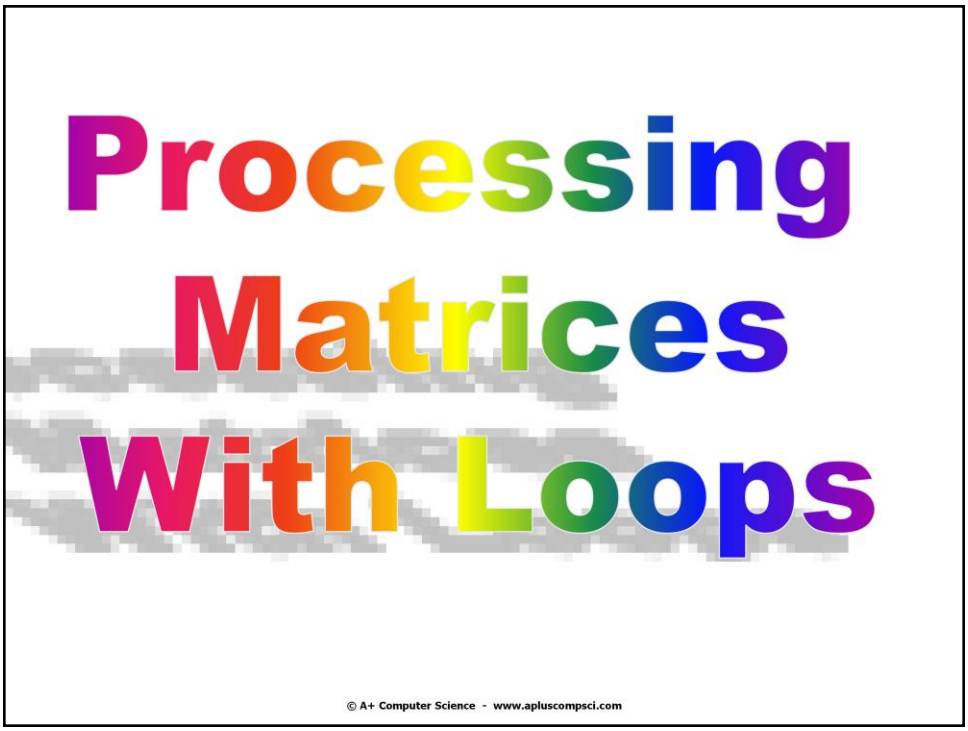


Nested loops are very important when accessing all spots in a matrix.

The outer loop is used to access each array. The inner loop is used to move from column to column across each array.

open nestedfor.java


Processing
Matrices
With Loops
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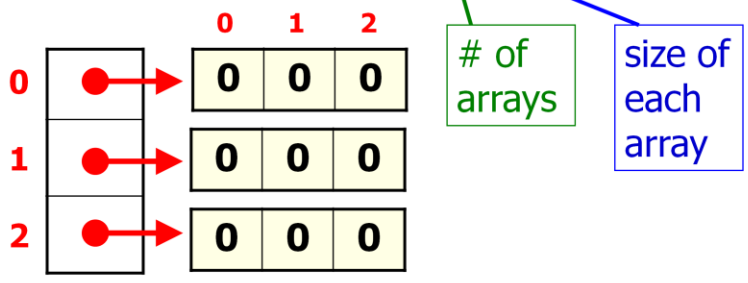
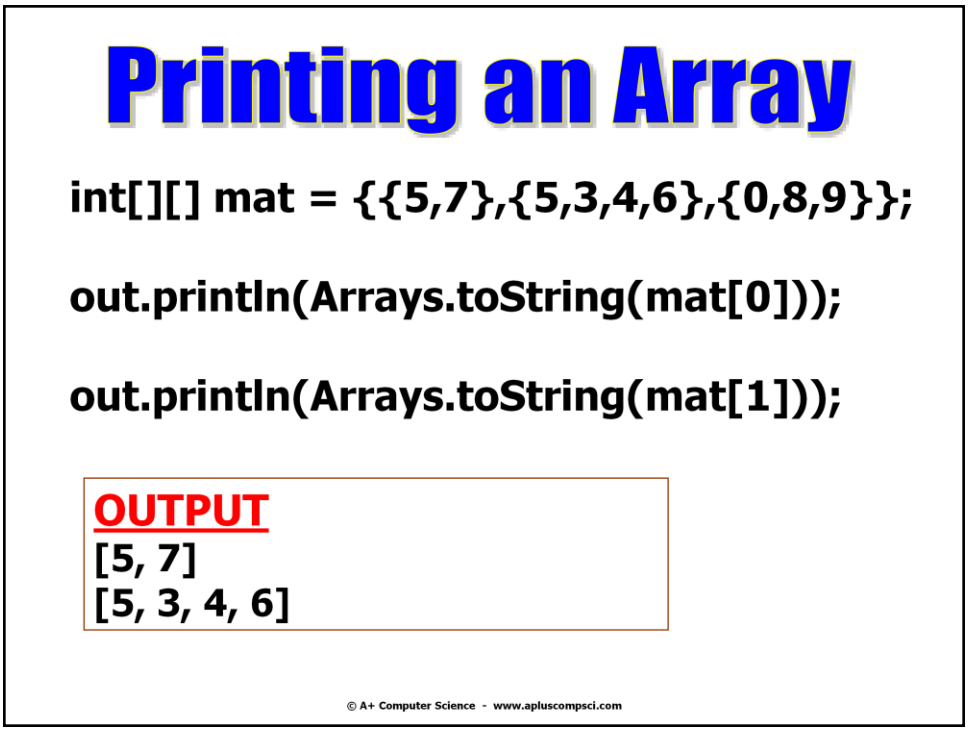
What is a matrix?

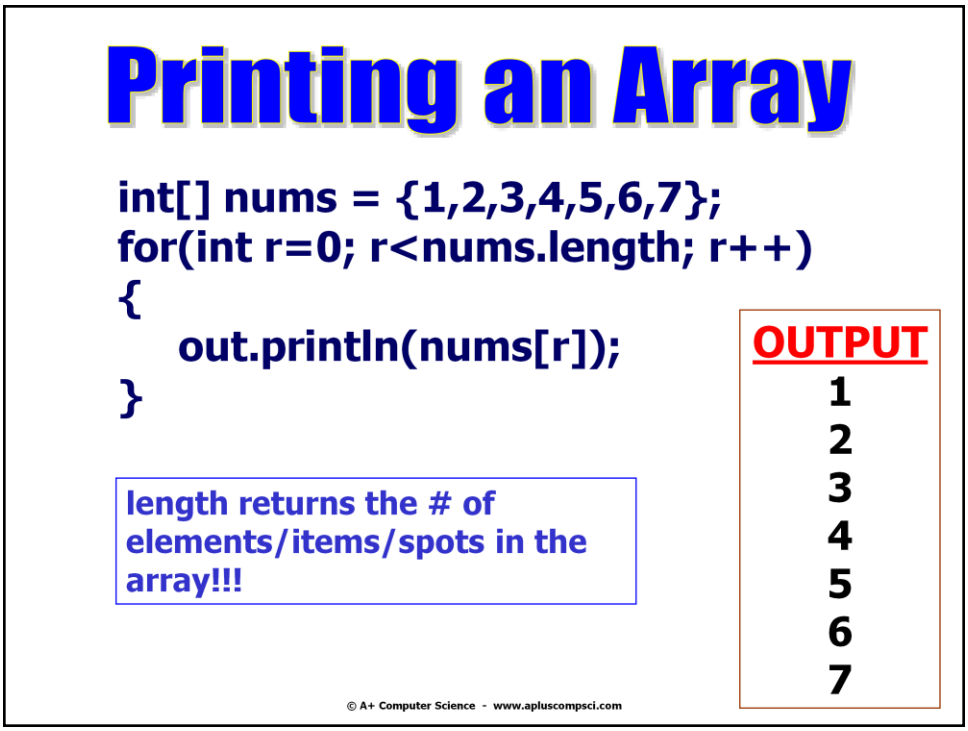
A matrix is an array of arrays.

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





Arrays.toString() can be used to print out each array in a matrix.



To print all spots in an array, some type of loop must be used that contains a variable that increases or decreases so that each spot in the array may be visited.

Printing a Matrix

```
int[][] mat = {{5,7},{5,3,4,6},{0,8,9}};

for(int r=0; r<mat.length; r++)
{
   for(int c=0; c<mat[r].length; c++)
   {
      out.print(mat[r][c]);
   }
   out.println();
}
```

OUTPUT

```
5 7
5 3 4 6
0 8 9
```


When printing a matrix, the inner loop is used to move across the columns.

The outer loop is used to move from row to row.

Each row is an array.

Printing a Matrix

```
int[][] mat = {{5,7},{5,3,4,6},{0,8,9}};

for( int[] row : mat )
{
  for( int num : row )
  {
    System.out.print( num + " ");
  }
  System.out.println();
}
```

OUTPUT

```
5 7
5 3 4 6
0 8 9
```


The for each loop works quite well as tool to print a matrix.

open matrixoutone.java matrixouttwo.java

open
matrixoutthree.java
matrixoutfour.java


Searching for
Values
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Searching a Matrix

```
int[][] mat = {{5,7},{5,3,4,6},{0,8,9}};
int count = 0;
for( int r = 0; r < mat.length; r++ )
{
  for( int  c = 0; c < mat[r].length;  c++)
  {
    if( mat[r][c] == 5 )
      count++;
  }
}
System.out.println("5 count = "  + count);
```

OUTPUT
5 count = 2

Searching for values in an array or matrix is a common process often tested on the AP exam.

Searching a Matrix

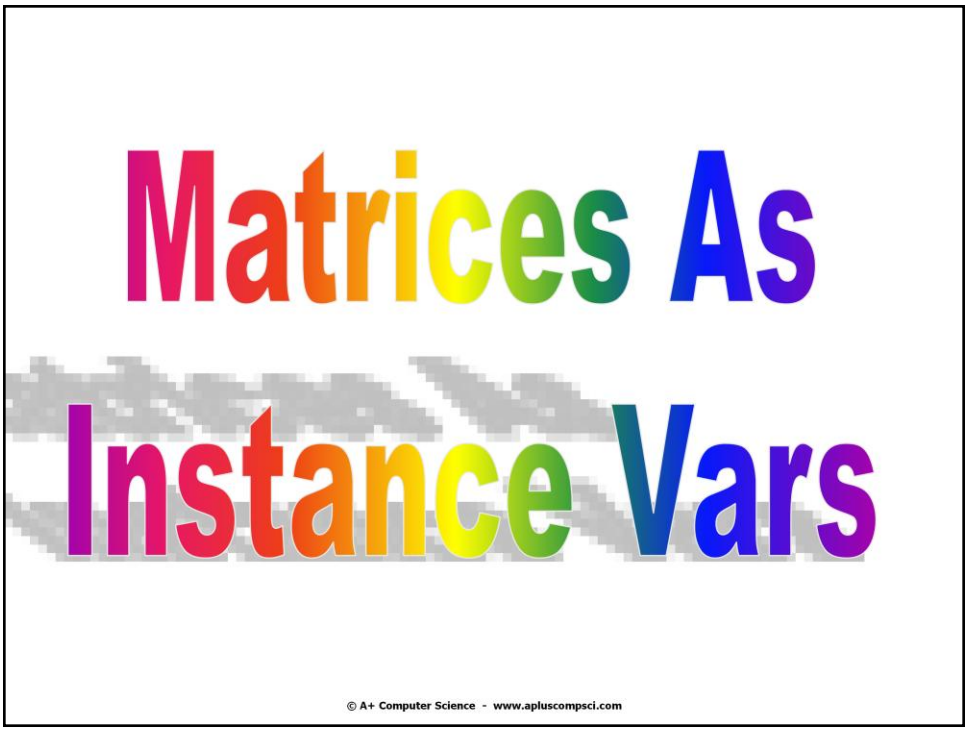
```
int[][] mat = {{5,7},{5,3,4,6},{0,8,9}};
int count = 0;
for( int[] row : mat )
{
  for( int num : row )
  {
    if( num == 5 )
      count++;
  }
}
System.out.println("5 count = "  + count);
```

OUTPUT

```
5 count = 2
```


Searching for values in an array or matrix is a common process often tested on the AP exam.

open matrixsearch.java


Matrices As
Instance Vars
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Matrix Instance Vars

```
public class MatrixFun
{
  private int[][] mat;     //instance variable

  public MatrixFun(int numRows, int numCols)
  {
    mat=new int[numRows][numCols];
  }

  //other methods not shown
}
```


When using an array/matrix as an instance variable, the type should only appear in front of the name once.

```
int[][] mat;  //instance variable
```

This line is the only line that should contain `int[][]` in front of the word mat.

The constructor instantiates mat, but does not redefine mat.

open matrixinstancevars.java

Matrix Extras

matrixinout.java

A complete matrix program.

matrixtotal.java

A matrix program that totals a matrix.

matrixfilereaderfor.java

A matrix program that reads a matrix from a file.

Helpful Hint

2D Matrices like RC.

Rows first - - Columns second


Start work
on the labs
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