Lecture Set #13: Two-Dimensional Arrays

1. 2-dimensional arrays
   1. Ragged Arrays
   2. Rectangular Arrays

Recall Arrays

- Arrays: sequences of elements from the same base type

```
int[] a;       // array of ints
Date[] d;      // array of references to Dates
```

- Base type may be:
  - Primitive (i.e. `int`)
  - Reference (i.e. `Date`, other objects)
- Arrays are also objects.
- Notice the similarities:
  - Arrays created using `new`
  - Array elements stored on heap
  - Array variables store references to space on the heap

Allocation of Space

- Syntax for allocating space for the 1st level array:

```
char[][] a;            // Array of char arrays
a = new char[3][];     // Create array of 3 arrays
```

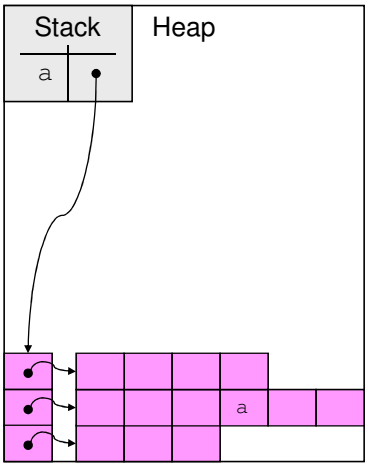
- Syntax for allocating space for the 2nd level of arrays:

```
a[0] = new char[4];    // Create array of 4 char
a[1] = new char[6];    // Create array of 6 char
a[2] = new char[3];    // Create array of 3 char
```


Example

```
char[][] a;
a = new char[3][];
a[0] = new char[4];
a[1] = new char[6];
a[2] = new char[3];
a[1][3] = 'a';
```

- This array has two dimensions: rows, columns
- This kind of array is called ragged because the rows are of unequal length



Questions

```
char[][] a;
a = new char[3][];
a[0] = new char[4];
a[1] = new char[6];
a[2] = new char[3];
```

- What does `a[1][2] = 'x';` do?
  Set element in row 2, column 3 to `'x'`
- What does `a.length` return?
  3
- What does `a[1].length` return?
  6

What type is a?
  a reference to an array of array references
What Type is a[0]?
  a reference to an array of characters
What type is a[0][0]?
  a character

Initializers

- **In one dimension:**

```
char[][] a;
a = new char[3][];
a[0] = {'a','b','c','d'};
a[1] = {'x','y','z'};
a[2] = {'m','n'};
```

- **In two dimensions:**

```
char[][] a = {{'a','b','c','d'},
              {'x','y','z'},
              {'m','n'}};
```

Rectangular Arrays

- Often we want 2-dimensional arrays in which rows have the same length
  - Tables
  - Matrices
- Java has a special short-hand syntax for creating rectangular arrays

```
int[][] a = new int[2][4];   // 2 rows, 4 cols
```

Equivalent to:

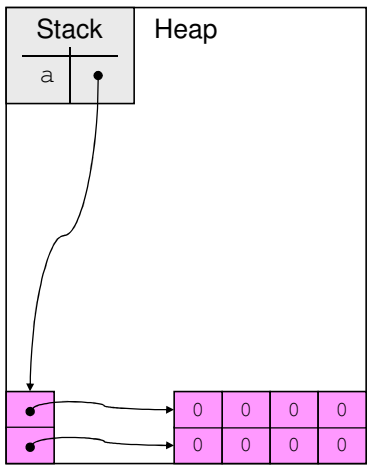
```
int[][] a = new int[2][];
a[0] = new int[4];
a[1] = new int[4];
```

- The short-hand takes care of allocating each row, initializing each cell in each row

Example

```
int[][] a = new int[2][4];
```

- Note each cell is initialized to default value (0)
- Each row is a 1-dim array



2-D Arrays of Objects

- The array name when indexed with two indexes is of that indicated type
- Of Strings:

```
String[][] s = new String[4][2];
s[0][0] = "Fred";
s[1][1] = "Jane";
```

- Of Cats:

```
Cat[][] c = new Cat[4][2];
c[0][0] = new Cat("Fred");
c[1][1] = new Cat("Jane");
```