Lecture 23: Two-Dimensional Arrays

Last time:
1. Command Line Java
2. Code comments
3. Javadoc comments

Today:
1. 2-dimensional arrays
Recall Arrays

- **Arrays**: sequences of elements from the same base type
  
  ```java
  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 1\textsuperscript{st} level array:
  \begin{verbatim}
  char[][] a; // Array of char arrays
  a = new char[3][]; // Create array of 3 arrays
  \end{verbatim}

- Syntax for allocating space for the 2\textsuperscript{nd} level of arrays:
  \begin{verbatim}
  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
  \end{verbatim}
Example

```java
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
  ```java
  int[][] a = new int[2][4];   // 2 rows, 4 cols
  ```
  Equivalent to:
  ```java
  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

```java
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 Also Possible

- Of Strings:
  ```java
  String[][] s = new String[4][2];
  s[0][0] = "Fred";
  s[1][1] = "Jane";
  ```

- Of Cats:
  ```java
  Cat[][] c = new Cat[4][2];
  c[0][0] = new Cat("Fred");
  c[1][1] = new Cat("Jane");
  ```