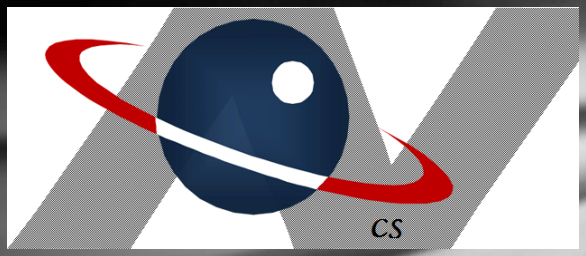
O(N) CS LESSONS

Lesson 6D – The "split" Process

Using Loops and Arrays



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Objectives

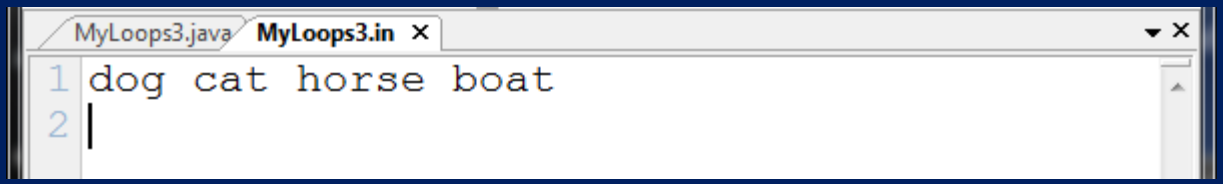
- In the previous lesson, you learned in detail about two different file input scenarios – the "unknown quantity" process, and the "initial N" process.
- A third file processing scenario is introduced in this lesson. It uses the String class "split" process, which takes in a multi-value horizontal line of data as a long string and "splits" the single String into an array of Strings.

Objectives

- An introduction to arrays is provided, enough to be successful with the "split" process.
- Also introduced is the transformation process required to take an array of Strings containing mathematical values and parsing them into a parallel array of actual values.
- Labs are provided to practice this new technique.

File input "split" scenario

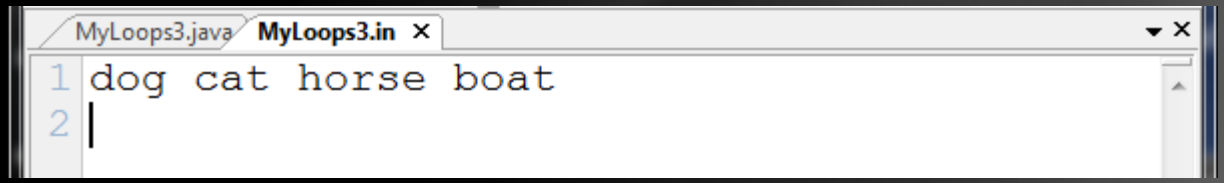
- This advanced technique will require some careful concentration and study, as well as learning a new and advanced data structure called an "array".
- First let's look at the data file and how it is organized
  - Here are several data items in a file, all on one line, separated by spaces.



- Although it is still possible to use the "***unknown quantity***" (File Scenario #1) technique in this situation, it's time to learn this new technique which will take us further and provide more flexibility for data processing.

File input "split" scenario

- The four steps of this process are:
  1. Read in the entire line as a String using the ***nextLine()*** command.
  2. Use the String "split" method to divide it into several parts.
  3. Store the resulting array of Strings into a String array object.
  4. Process the array of Strings in any number of ways.



File input "split" scenario

- Demonstrated below is the basic process as we just described:
  - The Scanner ***f*** object is constructed and linked
  - A String is read using the ***nextLine()*** command and assigned to ***s***
  - And then…something new and strange-looking…

MyLoops3.java | MyLoops3.in

```
22        public static void main (String [] args)
23          throws IOException
24        {
25          Scanner f = new Scanner(new File("MyLoops3.in"));
26          String s = f.nextLine();
27          args = s.split(" ");
28          out.printf("I love my %s.\n",args[0]);
29          out.printf("I love my %s.\n",args[1]);
30          out.printf("I love my %s.\n",args[2]);
31          out.printf("I love my %s.\n",args[3]);
32
33        }
34    }
```

MyLoops3.java | MyLoops3.in

```
1 dog cat horse boat
2
```

```
I love my dog.
I love my cat.
I love my horse.
I love my boat.
Press any key to continue...
```

args – an array of Strings

- So far you have been dutifully typing in the main method header with the ***(String [] args)*** portion included, not really knowing its purpose.
- We now will use this feature for the split process, although it is still not the original reason for it. *(Originally it was used for mainframe computer command line processing, but that is another lesson entirely.)*

MyLoops3.java | MyLoops3.in

```
22      public static void main (String [] args)
23        throws IOException
24      {
25        Scanner f = new Scanner(new File("MyLoops3.in"));
26        String s = f.nextLine();
27        args = s.split(" ");
28        out.printf("I love my %s.\n",args[0]);
29        out.printf("I love my %s.\n",args[1]);
30        out.printf("I love my %s.\n",args[2]);
31        out.printf("I love my %s.\n",args[3]);
32
33      }
34    }
```

MyLoops3.java | MyLoops3.in

```
1 dog cat horse boat
2
```

```
I love my dog.
I love my cat.
I love my horse.
I love my boat.
Press any key to continue...
```

args – an array of Strings

- Essentially ***args*** (short for "arguments") is a special data structure object called an array, which we will discuss in much more detail in Lesson 7.
- You can tell it is an array by the square brackets "[ ]" next to it.
- This simply means that it is capable of holding more than just one data element.

MyLoops3.java | MyLoops3.in

```
22        public static void main (String [] args)
23          throws IOException
24        {
25          Scanner f = new Scanner(new File("MyLoops3.in"));
26          String s = f.nextLine();
27          args = s.split(" ");
28          out.printf("I love my %s.\n",args[0]);
29          out.printf("I love my %s.\n",args[1]);
30          out.printf("I love my %s.\n",args[2]);
31          out.printf("I love my %s.\n",args[3]);
32
33        }
34    }
```

MyLoops3.java | MyLoops3.in

```
1 dog cat horse boat
2
```

```
I love my dog.
I love my cat.
I love my horse.
I love my boat.
Press any key to continue...
```

Analogy – variable vs array

- An analogy that might help your understanding is this:
  - A single element **variable** is like a normal bicycle…it has only one seat that can carry only one passenger.
  - A multi-element **array** is like a bus…it has many seats that can carry many passengers.

MyLoops3.java | MyLoops3.in

```
22        public static void main (String [] args)
23          throws IOException
24        {
25          Scanner f = new Scanner(new File("MyLoops3.in"));
26          String s = f.nextLine();
27          args = s.split(" ");
28          out.printf("I love my %s.\n",args[0]);
29          out.printf("I love my %s.\n",args[1]);
30          out.printf("I love my %s.\n",args[2]);
31          out.printf("I love my %s.\n",args[3]);
32
33        }
34    }
```

MyLoops3.java | MyLoops3.in

```
1 dog cat horse boat
2
```

```
I love my dog.
I love my cat.
I love my horse.
I love my boat.
Press any key to continue...
```

"split" process

- Here's what is happening with the "split" command you see below.
  - The String ***s*** has received an entire line from the data file, containing several pieces of data, each separated by a space.
  - The "split" method is told to use the space as the "splitter", or "delimiter". This is indicated in the parameter list. *(Actually, ANY character can be used as a "splitter". We'll explore that in more detail later on.)*

```
23          throws IOException
24        {
25          Scanner f = new Scanner(new File("MyLoops3.in"));
26          String s = f.nextLine();
27          args = s.split(" ");
28          out.printf("I love my %s.\n",args[0]);
29          out.printf("I love my %s.\n",args[1]);
30          out.printf("I love my %s.\n",args[2]);
31          out.printf("I love my %s.\n",args[3]);
32
33        }
34    }
```

MyLoops3.java | MyLoops3.in

```
1 dog cat horse boat
2
```

```
I love my dog.
I love my cat.
I love my horse.
I love my boat.
Press any key to continue...
```

"split" process

- The split method searches through the entire String looking for instances of the "splitter".
- Each time it sees one, it creates a division of the String and places it into another slot in the array.
- Since this input String has three spaces, it is divided into four parts, each part assigned to a "slot" in the array.
- Each portion is placed into the array in a numbered position, starting with position zero.

```
25          Scanner f = new Scanner(new File("MyLoops3.in"));
26          String s = f.nextLine();
27          args = s.split(" ");
28          out.printf("I love my %s.\n",args[0]);
29          out.printf("I love my %s.\n",args[1]);
30          out.printf("I love my %s.\n",args[2]);
31          out.printf("I love my %s.\n",args[3]);
32      }
```

args

0	1	2	3
dog	cat	horse	boat

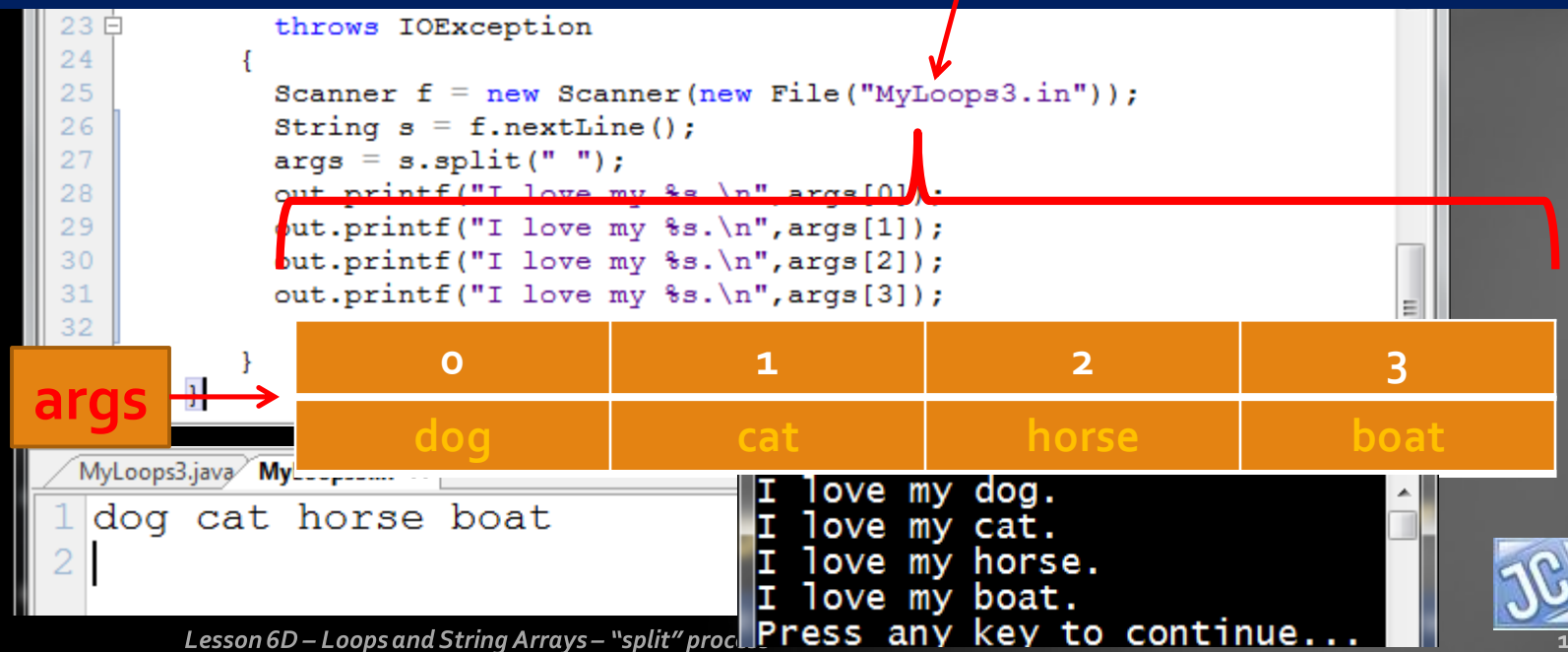
MyLoops3.java

```
1 dog cat horse boat
2
```

```
I love my dog.
I love my cat.
I love my horse.
I love my boat.
Press any key to continue...
```

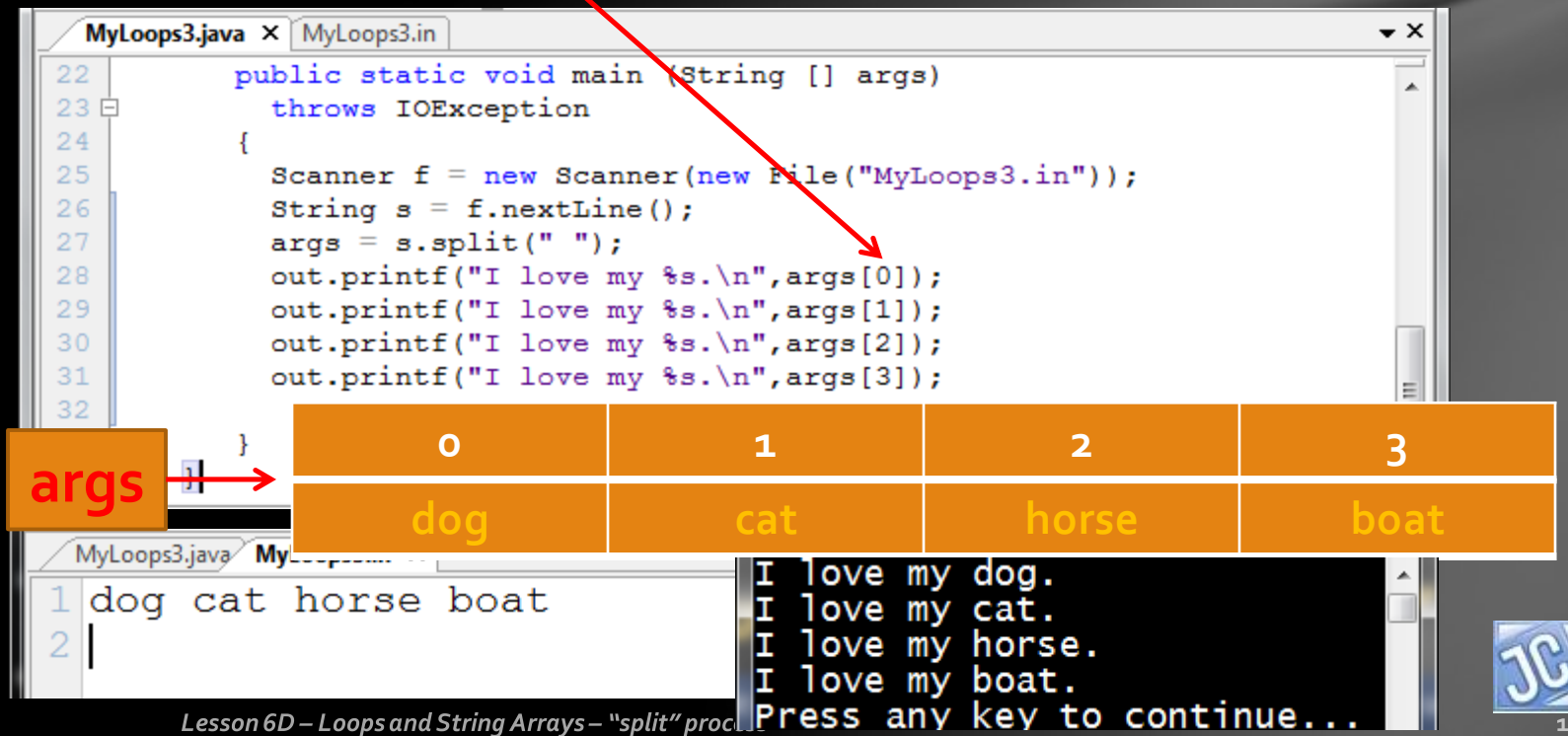
"split" process

- Once the "split" process is completed, the array now contains all of the data from the original String, separated into four separate slots that are numbered from zero to 3.
- This is another example of "zero-indexing", which we explored in an earlier lesson when we were processing the individual characters of a String.
- ***Get used to this…you'll see it a lot!!!***



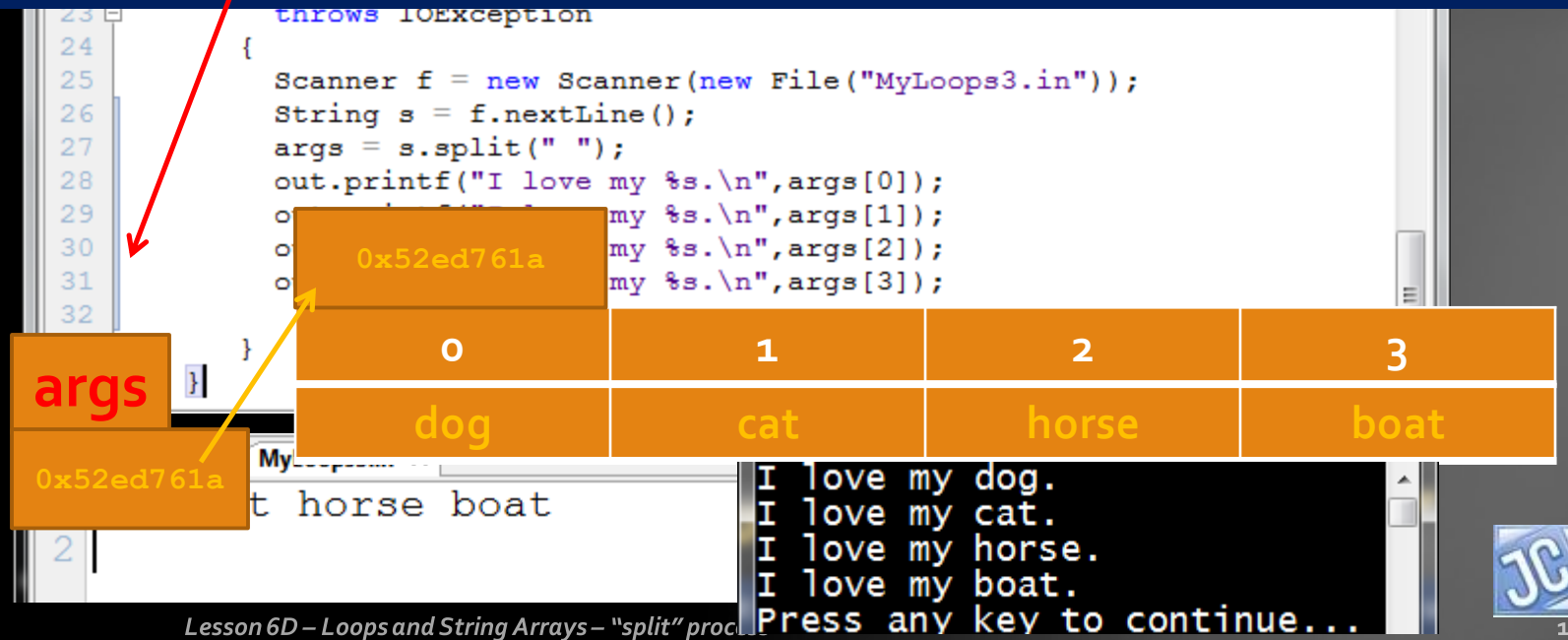
Indexing

- The output statements access the ***args*** array variable, with an additional feature…an ***index*** *(number inside square brackets)*.
- This is required when accessing the elements of an array.
- It is not possible to retrieve the data elements of an array (for now) without this indexing feature.



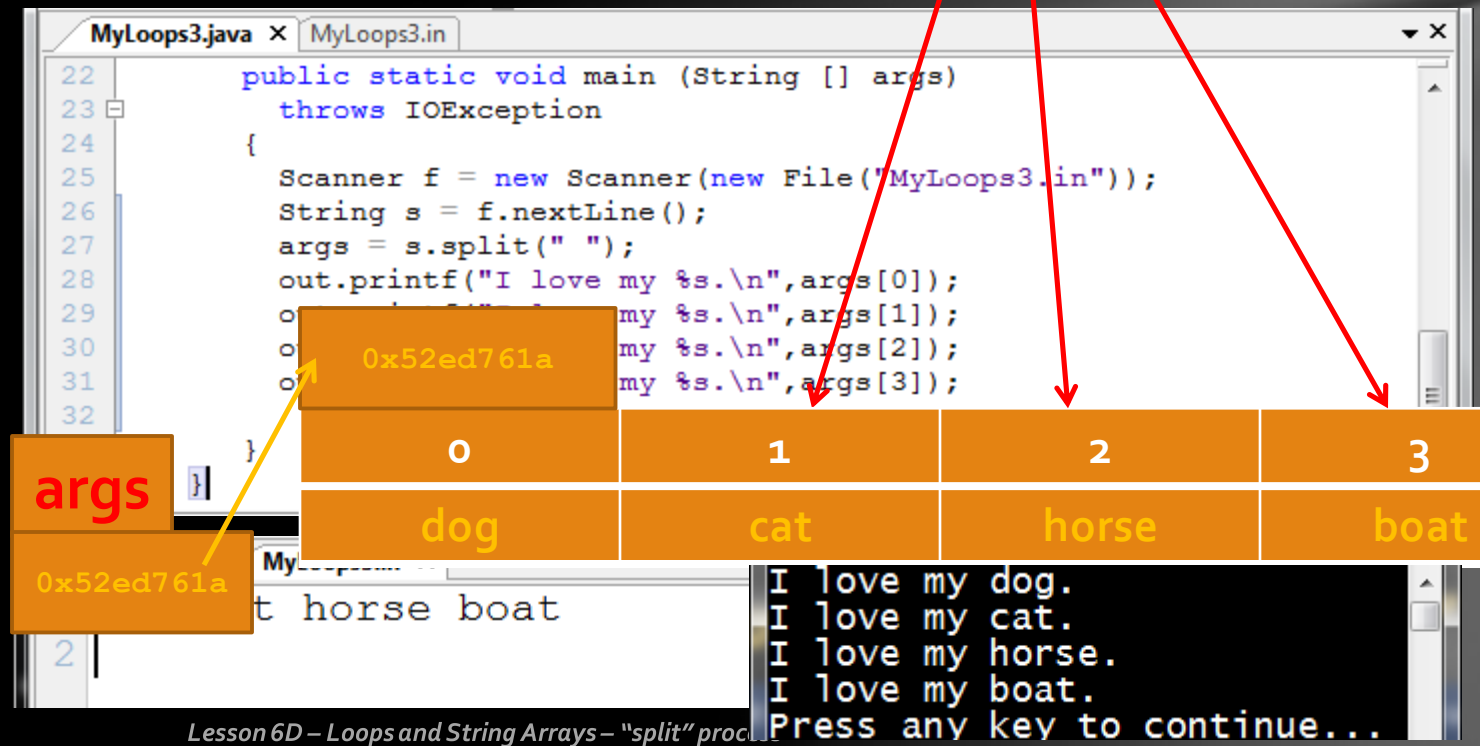
args - clarifications

- Here are two more clarifications about the array variable ***args***
  - Like the String variable we discussed in an earlier lesson, it is actually an ***object reference***, which means it stores in memory the **address** of the first element in the array, not the value of the element itself.
  - Also, you can call it anything you like…args, cow, monkey,…it is not a "magic" word and it doesn't matter what it is named.



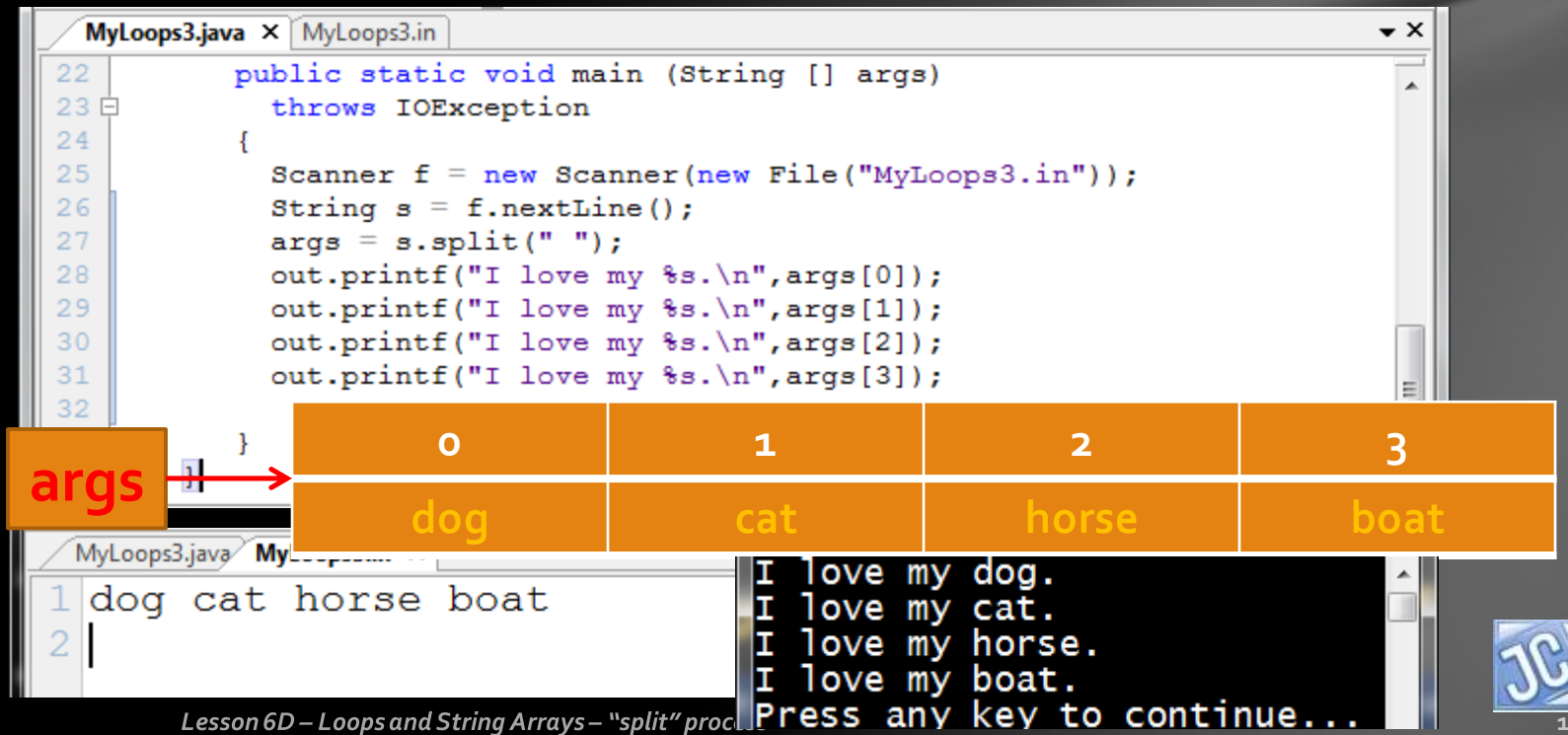
Indexing – offsets from zero

- The index of zero indicates the position of the element in the first memory slot referenced by the array variable.
- An index value of 1 essentially means "1 slot offset from" the original location, 2 means "2 slots offset", and so on.



String array processing

- And now, after all of that, we have successfully used the "split" process to harvest one line of data containing multiple elements and assign it to an array of Strings.
- Now let's talk about different ways to process it.



String array processing

- In the example shown so far, all four elements are accessed directly using integers for the indexing process: 0, 1, 2, and 3.
- This is really no different than simply outputting the values using a while loop to read each one from the file and output it immediately.

```
MyLoops3.java | MyLoops3.in

22      public static void main (String [] args)
23        throws IOException
24      {
25        Scanner f = new Scanner(new File("MyLoops3.in"));
26        String s = f.nextLine();
27        args = s.split(" ");
28        out.printf("I love my %s.\n",args[0]);
29        out.printf("I love my %s.\n",args[1]);
30        out.printf("I love my %s.\n",args[2]);
31        out.printf("I love my %s.\n",args[3]);
32
        }
```

args

0	1	2	3
dog	cat	horse	boat

```
MyLoops3.java
1 dog cat horse boat
2
```

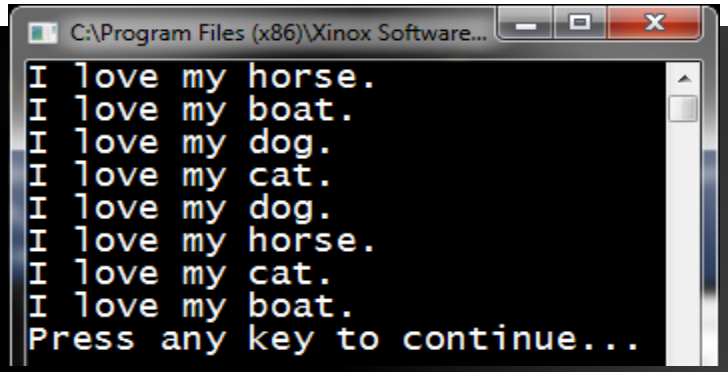
```
I love my dog.
I love my cat.
I love my horse.
I love my boat.
Press any key to continue...
```

String array processing

- The difference is that now you can access the data elements in any order you wish, as many times as you want.
- See the examples below:

3.java × MyLoops3.in

```
{
  Scanner f = new Scanner(new File("MyLoops3.in"));
  String s = f.nextLine();
  args = s.split(" ");
  out.printf("I love my %s.\n",args[2]);
  out.printf("I love my %s.\n",args[3]);
  out.printf("I love my %s.\n",args[0]);
  out.printf("I love my %s.\n",args[1]);
  out.printf("I love my %s.\n",args[0]);
  out.printf("I love my %s.\n",args[2]);
  out.printf("I love my %s.\n",args[1]);
  out.printf("I love my %s.\n",args[3]);
```



Forwards and backwards

- The real power in having the data in an array is that you can use a loop to process the array.
- Below are two loops:
  - One processes the array in forwards order
  - The second outputs the array elements in reverse order

ops3.java × MyLoops3.in

```
    public static void main (String [] args)
      throws IOException
    {
      Scanner f = new Scanner(new File("MyLoops3.in"));
      String s = f.nextLine();
      args = s.split(" ");
      for(int x = 0;x<args.length;x++)
          out.printf("I love my %s.\n",args[x]);
      for(int x = args.length-1;x>=0;x--)
          out.printf("I love my %s.\n",args[x]);
    }
}
```

C:\Program Files (x86)\Xinox Softw

```
I love my dog.
I love my cat.
I love my horse.
I love my boat.
I love my boat.
I love my horse.
I love my cat.
I love my dog.
Press any key to cc
```

length vs length()

- The two loops are fairly easy to understand, but there is one new feature we haven't used before.
- It looks familiar because we used a similar method with Strings, but there is one significant difference.
- ***args.length*** is a value that represents the total number of elements in the array, much like the ***String.length()*** method counts the number of characters in a String.

```
public static void main (String [] args)
  throws IOException
{
  Scanner f = new Scanner(new File("MyLoops3.in"));
  String s = f.nextLine();
  args = s.split(" ");
  for(int x = 0;x<args.length;x++)
      out.printf("I love my %s.\n",args[x]);
  for(int x = args.length-1;x>=0;x--)
      out.printf("I love my %s.\n",args[x]);
}
}
```

```
I love my dog.
I love my cat.
I love my horse.
I love my boat.
I love my boat.
I love my horse.
I love my cat.
I love my dog.
Press any key to cc
```

Uses of args.length

- The difference is that ***args.length*** does not use parentheses, and the ***String.length()*** method does.
- ***You must*** keep this difference clear in your mind.
- ***args.length*** is used in the **check** portion of the first loop, and is used in the **start** portion of the second loop.

ops3.java × MyLoops3.in

```
    public static void main (String [] args)
      throws IOException
    {
      Scanner f = new Scanner(new File("MyLoops3.in"));
      String s = f.nextLine();
      args = s.split(" ");
      for(int x = 0;x<args.length;x++)
          out.printf("I love my %s.\n",args[x]);
      for(int x = args.length-1;x>=0;x--)
          out.printf("I love my %s.\n",args[x]);
    }
}
```

C:\Program Files (x86)\Xinox Softw

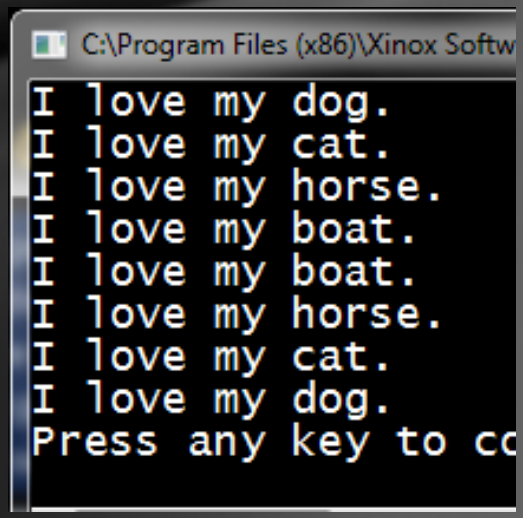
```
I love my dog.
I love my cat.
I love my horse.
I love my boat.
I love my boat.
I love my horse.
I love my cat.
I love my dog.
Press any key to cc
```

Off by one

- Also notice that each time, the **actual** ***args.length*** value is never reached…x<args.length, and x=args.length-1, again because of "zero-indexing".
- Just as in our previous study of Strings, the last element of an array is in the "length-1" position, since the first element is in the "zero" position.
- Therefore the value of args.length is always one step out of bounds, NOT a place you want to go, EVER!

ops3.java × MyLoops3.in

```
public static void main (String [] args)
  throws IOException
{
  Scanner f = new Scanner(new File("MyLoops3.in"));
  String s = f.nextLine();
  args = s.split(" ");
  for(int x = 0;x<args.length;x++)
      out.printf("I love my %s.\n",args[x]);
  for(int x = args.length-1;x>=0;x--)
      out.printf("I love my %s.\n",args[x]);
}
}
```



Elegance and flexibility of "split" process

- And now…the TRUE power in using this "split", array processing technique…observe!!!
- With absolutely ***no change*** in the source code below, but with an expansion to the data file, look at the results.

ops3.java × MyLoops3.in

```
public static void main (String [] args)
  throws IOException
{
  Scanner f = new Scanner(new File("MyLoops3.in"));
  String s = f.nextLine();
  args = s.split(" ");
  for(int x = 0;x<args.length;x++)
      out.printf("I love my %s.\n",args[x]);
  for(int x = args.length-1;x>=0;x--)
      out.printf("I love my %s.\n",args[x]);
}
}
```

C:\Program Files (x86)\Xin...

```
I love my dog.
I love my cat.
I love my horse.
I love my boat.
I love my job.
I love my spouse.
I love my school.
I love my programming.
I love my programming.
I love my school.
I love my spouse.
I love my job.
I love my boat.
I love my horse.
I love my cat.
I love my dog.
Press any key to contin
```

MyLoops3.java | MyLoops3.in ×

```
1 dog cat horse boat job spouse school programming
2
```

Elegance and flexibility of "split" process

- The number of elements in the data file increased, and the program adjusted accordingly, using the flexibility of the "split" and "length" commands.
- ***Herein lies the elegance and true power of this process!!!!***

ops3.java × MyLoops3.in

```
    public static void main (String [] args)
      throws IOException
    {
      Scanner f = new Scanner(new File("MyLoops3.in"));
      String s = f.nextLine();
      args = s.split(" ");
      for(int x = 0;x<args.length;x++)
          out.printf("I love my %s.\n",args[x]);
      for(int x = args.length-1;x>=0;x--)
          out.printf("I love my %s.\n",args[x]);
    }
}
```

```
I love my dog.
I love my cat.
I love my horse.
I love my boat.
I love my job.
I love my spouse.
I love my school.
I love my programming.
I love my programming.
I love my school.
I love my spouse.
I love my job.
I love my boat.
I love my horse.
I love my cat.
I love my dog.
Press any key to contin
```

MyLoops3.java | MyLoops3.in ×

```
1 dog cat horse boat job spouse school programming
2
```

Arrays.sort

- And now, one more really cool feature about arrays…
- ***You can very easily sort them in alphabetical order….LOOK!!!***

```
.java ✕ | MyLoops3.in

public static void main (String [] args)
  throws IOException
{
  Scanner f = new Scanner(new File("MyLoops3.in"));
  String s = f.nextLine();
  args = s.split(" ");
  Arrays.sort(args);
  for(int x = 0;x<args.length;x++)
      out.printf("I love my %s.\n",args[x]);
  for(int x = args.length-1;x>=0;x--)
      out.printf("I love my %s.\n",args[x]);
}
```

```
C:\Program Files (x86)\Xinox S...
I love my boat.
I love my cat.
I love my dog.
I love my horse.
I love my job.
I love my programming.
I love my school.
I love my spouse.
I love my spouse.
I love my school.
I love my programming.
I love my job.
I love my horse.
I love my dog.
I love my cat.
I love my boat.
Press any key to continue
```

MyLoops3.java | **MyLoops3.in** ✕

```
1 dog cat horse boat job spouse school programming
2
```

Integer array processing

- Now let's further explore this new process using an array of integers.
- Below is a new data file, a program to process it using the split method, and a simple vertical output of the data.

split.java | intSplit.in

```
1 33 45 82 18 4 921 -38 -55 356
2
```

C:\Program Files (x86)\Xinox Software...

```
33
45
82
18
4
921
-38
-55
356
Press any key to continue...
```

split.java | intSplit.in

```
6       */
7     public class split
8     {
9        public static void main (String [] args)
10         throws IOException
11       {
12         Scanner f = new Scanner(new File("intSplit.in"));
13         String s = f.nextLine();
14         args = s.split(" ");
15         for(int x = 0;x<args.length;x++)
16             out.println(args[x]);
17       }
18    }
```

Integer array processing

- It looks simple enough, but there is a problem…
- Can you see it!!!
- This is not an array of integers!
- If you add the first two values, the result is a ***concatenation***, not a mathematical addition!

split.java | intSplit.in

```
1 33 45 82 18 4 921 -38 -55 356
2
```

intSplit.in

```
{
   public static void main (String [] args)
     throws IOException
   {
     Scanner f = new Scanner(new File("intSplit.in"));
     String s = f.nextLine();
     args = s.split(" ");
     for(int x = 0;x<args.length;x++)
         out.println(args[x]);
     out.printf("%s + %s = %s\n",args[0],args[1],args[0]+args[1]);

   }
}
```

C:\Program Files (x86)\Xinox Software\J...

```
33
45
82
18
4
921
-38
-55
356
33 + 45 = 3345
Press any key to continue...
```

Integer array processing

- The values look like integers, but are still indeed Strings in a String array.
- What must be done is a ***transformation*** from a String array to an int array, which is what we will do next.

split.java | intSplit.in

```
1 33 45 82 18 4 921 -38 -55 356
2
```

intSplit.in

```
{
   public static void main (String [] args)
     throws IOException
   {
     Scanner f = new Scanner(new File("intSplit.in"));
     String s = f.nextLine();
     args = s.split(" ");
     for(int x = 0;x<args.length;x++)
         out.println(args[x]);
     out.printf("%s + %s = %s\n",args[0],args[1],args[0]+args[1]);

   }
}
```

C:\Program Files (x86)\Xinox Software\J...

```
33
45
82
18
4
921
-38
-55
356
33 + 45 = 3345
Press any key to continue...
```

Integer array processing

- First, a ***clarification***....there is no direct way for the "split" process to take a line of mathematical values – integers or decimals – and put them into an array of their own type.
- ***"split" only creates String arrays....***

split.java | intSplit.in

```
1 33 45 82 18 4 921 -38 -55 356
2
```

intSplit.in

```
{
   public static void main (String [] args)
     throws IOException
   {
     Scanner f = new Scanner(new File("intSplit.in"));
     String s = f.nextLine();
     args = s.split(" ");
     for(int x = 0;x<args.length;x++)
         out.println(args[x]);
     out.printf("%s + %s = %s\n",args[0],args[1],args[0]+args[1]);

   }
}
```

C:\Program Files (x86)\Xinox Software\J...

```
33
45
82
18
4
921
-38
-55
356
33 + 45 = 3345
Press any key to continue...
```

Integer array processing

- However, the "split" process is the first of a three-step process required to create an array of integers.
- The second and third steps are to create and fill a new array of integers exactly the same length as the array of Strings created by the "split" process.
- That is shown here…***STUDY THIS EXAMPLE CAREFULLY!!!***

split.java | intSplit.in

```
1 33 45 82 18 4 921 -38 -55 356
2
```

split.java | intSplit.in

```
11      {
12        Scanner f = new Scanner(new File("intSplit.in"));
13        String s = f.nextLine();
14        args = s.split(" ");
15        int [] ints = new int[args.length];
16        for(int x = 0;x<args.length;x++)
17            ints[x]=Integer.parseInt(args[x]);
18        for(int x = 0;x<ints.length;x++)
19            out.println(ints[x]);
20        out.printf("%d + %d = %d\n",ints[0],ints[1],ints[0]+ints[1]);
21
```

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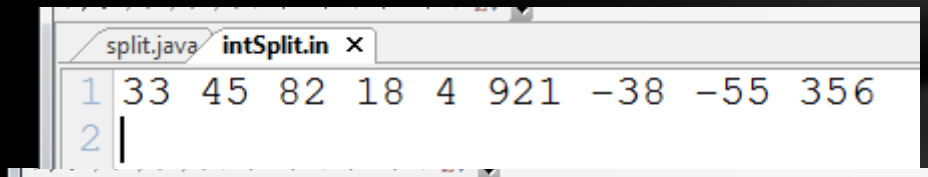
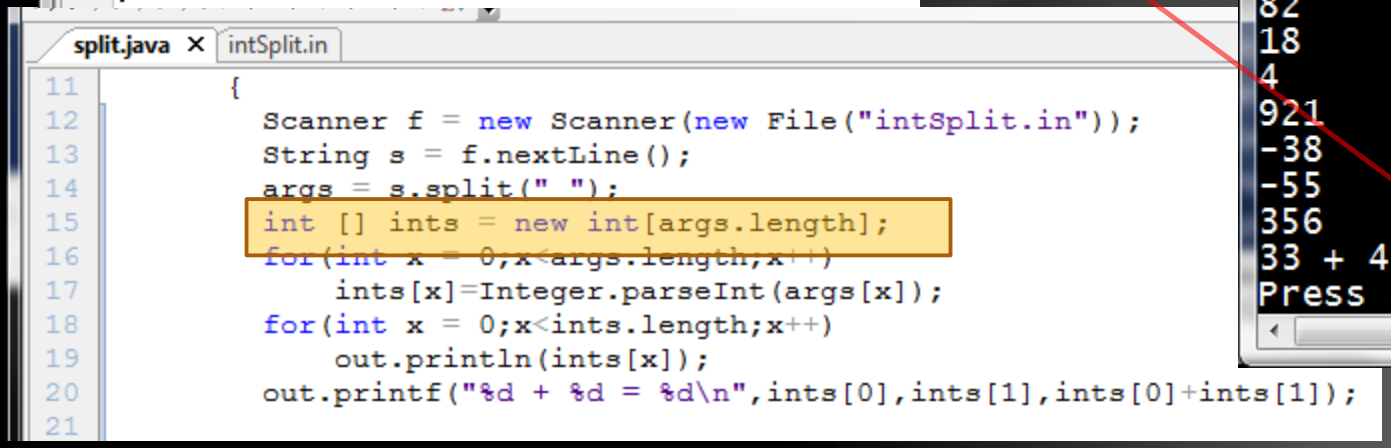
```
33
45
82
18
4
921
-38
-55
356
33 + 45 = 78
Press any key to cont
```

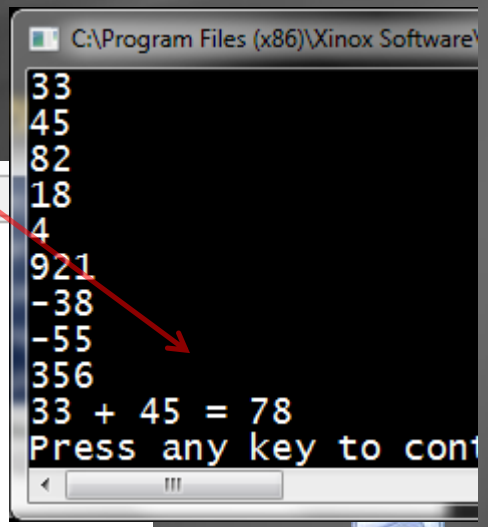
Integer array processing

- As you can see by the output, the values are indeed integers now because an array of integers is being processed, as evidenced by the final math statement.

- Let's notice several key parts of this "transformation" process as shown below.







Integer array processing

- After the "split" process creates the array of Strings, a new array of ***integers*** is created using the magic word ***new***. This second step involves several new concepts we must understand
  - `int [] ints = new int[args.length];`

split.java | intSplit.in

```
1 33 45 82 18 4 921 -38 -55 356
2
```

split.java | intSplit.in

```
11      {
12        Scanner f = new Scanner(new File("intSplit.in"));
13        String s = f.nextLine();
14        args = s.split(" ");
15        int [] ints = new int[args.length];
16        for(int x = 0;x<args.length;x++)
17            ints[x]=Integer.parseInt(args[x]);
18        for(int x = 0;x<ints.length;x++)
19            out.println(ints[x]);
20        out.printf("%d + %d = %d\n",ints[0],ints[1],ints[0]+ints[1]);
21
```

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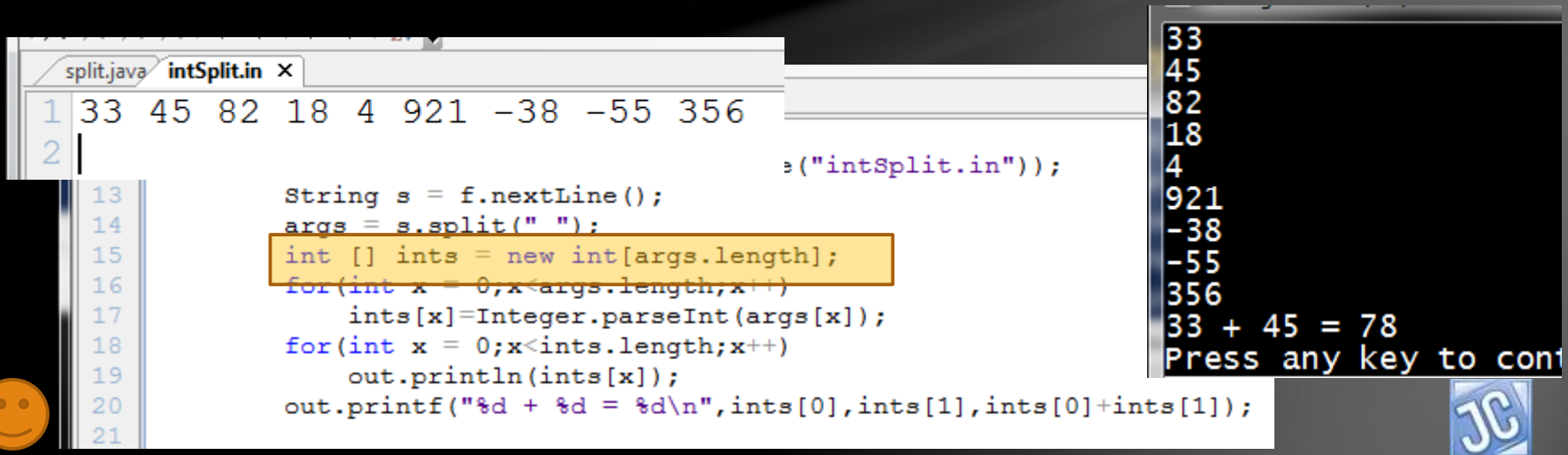
```
33
45
82
18
4
921
-38
-55
356
33 + 45 = 78
Press any key to cont
```

Integer array processing

- `int [] ints = new int[args.length];`

- This command first creates an ***int array object reference*** ***(int [] ints)***, similar to ***String [] args***. However, instead of an array of Strings, an array of integers is what we want. The name ***ints*** is NOT "magic" and can be anything you want.

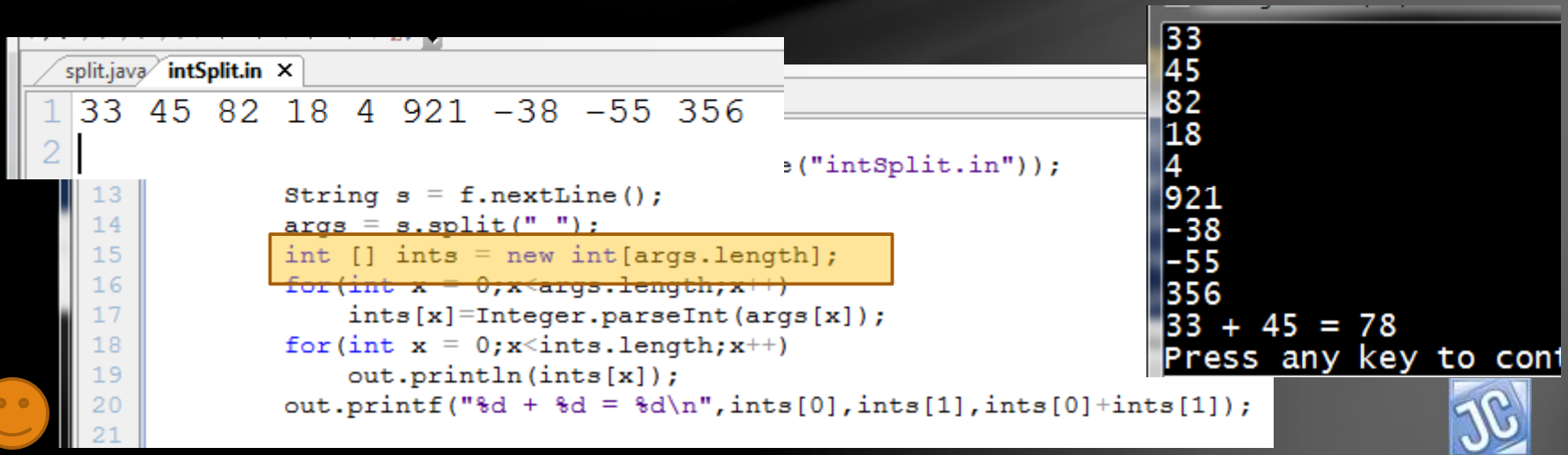


Integer array processing

- `int [] ints = new int[args.length];`

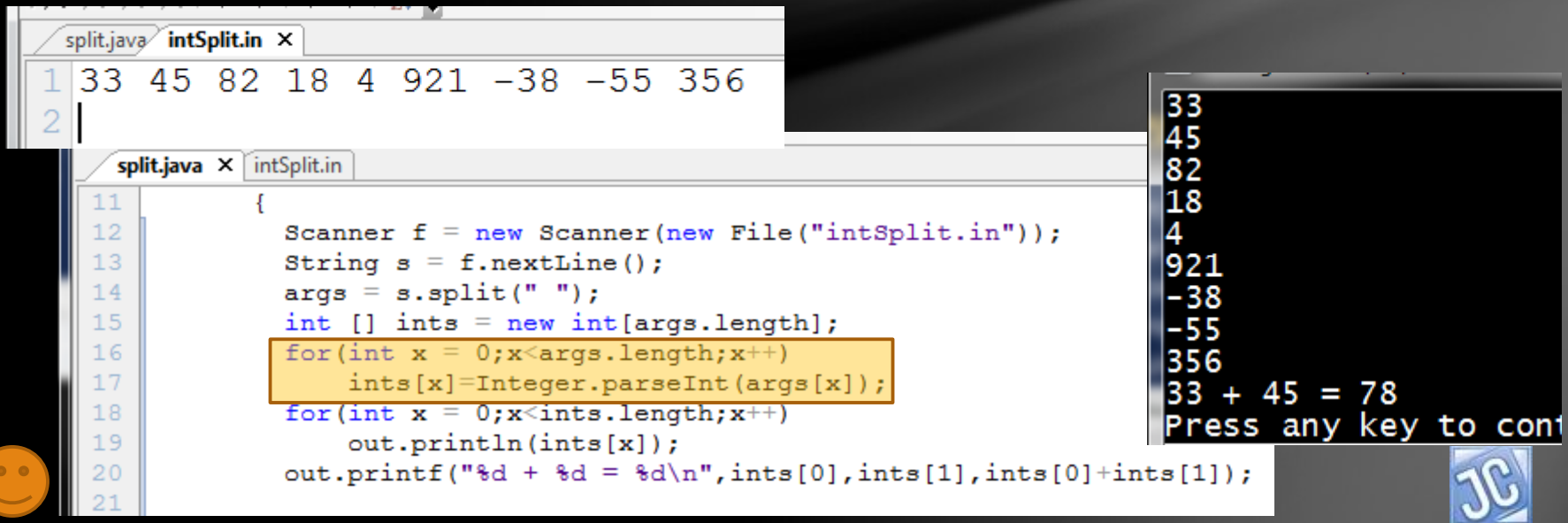
- Then the word **new** is used, a reserved word in Java used to construct new memory for an object.

- **int[args.length]** tells the compiler what type of memory and how much is required…an array of integers the same length as the ***args*** array that was just created.



Integer array processing

- The final step in the transformation process is the use of a loop to take ***each element*** in the String array args, which "looks" like an integer, but is still a String, and ***"parse"*** it into an actual integer value, using the Integer.parseInt() process introduced in an earlier lesson (3A) on the input process.



Integer array processing

- When this loop process is completed, the new int array is now filled with integer values that do indeed behave like integers, as you can see in the correct ***mathematical calculation*** below.

split.java | intSplit.in

```
1 33 45 82 18 4 921 -38 -55 356
2
```

split.java | intSplit.in

```
11        {
12          Scanner f = new Scanner(new File("intSplit.in"));
13          String s = f.nextLine();
14          args = s.split(" ");
15          int [] ints = new int[args.length];
16          for(int x = 0;x<args.length;x++)
17              ints[x]=Integer.parseInt(args[x]);
18          for(int x = 0;x<ints.length;x++)
19              out.println(ints[x]);
20          out.printf("%d + %d = %d\n",ints[0],ints[1],ints[0]+ints[1]);
21
```

```
33
45
82
18
4
921
-38
-55
356
33 + 45 = 78
Press any key to cont
```

Example 1: average of ints

- The beauty of this process is that you can now process the data numerous times because it is stored in memory as an array of integers.
- Below is a program that will calculate the average of the integers and output the results, a classic programming technique using arrays.

split.java | intSplit.in

```
1 33 45 82 18 4 921 -38 -55 356
2
```

split.java | intSplit.in

```
14          args = s.split(" ");
15          int [] ints = new int[args.length];
16          for(int x = 0;x<args.length;x++)
17              ints[x]=Integer.parseInt(args[x]);
18          int sum = 0;
19          out.println("The average of:");
20          for(int x = 0;x<ints.length;x++)
21          {
22              sum+=ints[x];
23              out.println(ints[x]);
24          }
25          double avg = (double)sum/ints.length;
26          out.printf("is %.1f\n",avg);
```

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```
The average of:
33
45
82
18
4
921
-38
-55
356
is 151.8
Press any key to continue...
```

Example 2: sorted ints

- You can also apply the ***Arrays.sort*** process we used earlier, only this time the sorting process is by numerical value, not alpha order.

split.java | intSplit.in

```
1 33 45 82 18 4 921 -38 -55 356
2
```

split.java | intSplit.in

```
13          String s = f.nextLine();
14          args = s.split(" ");
15          int [] ints = new int[args.length];
16          for(int x = 0;x<args.length;x++)
17              ints[x]=Integer.parseInt(args[x]);
18          Arrays.sort(ints);
19          out.println("Ascending...");
20          for(int x = 0;x<ints.length;x++)
21              out.println(ints[x]);
22          out.println("Descending...");
23          for(int x = ints.length-1;x>=0;x--)
24              out.println(ints[x]);
25      }
```

C:\Program Files (x86)\Xinox Software\J...

```
Ascending...
-55
-38
4
18
33
45
82
356
921
Descending...
921
356
82
45
33
18
4
-38
-55
Press any key to continue...
```

Example 3: method to transform

- In this example we will define a ***method*** to do the transformation process shown earlier , one that receives a String of integers as a parameter, and then returns an array of integers.

split.java | intSplit.in

```
33 45 82 18 4 921 -38 -55 356
```

```
Ascending...
-55
-38
4
18
33
45
82
356
921
Descending...
921
356
82
45
33
18
4
-38
-55
Press any key to continue..
```

```
/**Method to receive a String containing
 *integers and return an integer array.
*/
 public static int [] intArr (String arr)
 {
   String [] arrs = arr.split(" ");
   int [] ints = new int[arrs.length];
   for(int x = 0;x<arrs.length;x++)
       ints[x]=Integer.parseInt(arrs[x]);
   return ints;
 }
  public static void main (String [] args)
    throws IOException
  {
    Scanner f = new Scanner(new File("intSplit.in"));
    String s = f.nextLine();
    int [] ints = intArr(s);
    Arrays.sort(ints);
    out.println("Ascending...");
    for(int x = 0;x<ints.length;x++)
        out.println(ints[x]);
    out.println("Descending...");
    for(int x = ints.length-1;x>=0;x--)
        out.println(ints[x]);
  }
}
```

Example 4: method to average

- Here we will use a method to calculate the average of a received array of integers, like example 1 did. We will call the Example 3 method ***intArr*** to first transform the input String, then ***avgArr*** to calculate and return the average.

split.java | intSplit.in

```
1 33 45 82 18 4 921 -38 -55 356
2
```

```
C:\Program Files (x86)\Xinox Software...
33
45
82
18
4
921
-38
-55
356
Average = 151.8
Press any key to continu
```

split.java | splitLab6D_4.in

```
44      }
45     /**Method to receive an integer array
46      *and return the average of all the integers
47      *in the array.
48     */
49      public static double avgArr (int [] ints)
50      {
51        int sum = 0;
52        for(int x = 0;x<ints.length;x++)
53            sum+=ints[x];
54        double avg = (double)sum/ints.length;
55        return avg;
56      }
57      public static void main (String [] args)
58        throws IOException
59      {
60        Scanner f = new Scanner(new File("intSplit.in"));
61        String s = f.nextLine();
62        int [] ints = intArr(s);
63        for(int x = 0;x<ints.length;x++)
64            out.printf("%d\n",ints[x]);
65        out.printf("Average = %.1f\n",avgArr(ints));
66      }
67    }
```

Lesson Summary

- In this lesson, you learned a new and powerful process called "split", in which a line of data can be placed into an array of Strings and transformed into a numerical array as well.
- Now it is time to practice with several examples.

Labs

- Split will be the name of this series of labs. As you did before, create a separate folder and file called Split and do your work there.

Lab 1 – *AlphaOmega*

- WAP that reads a line of words from a data file and outputs the following elements:
  - The first word in the original array
  - The last word in the original array
  - The entire array in original order
  - The first word in alphabetical order
  - The last word in alphabetical order
  - The entire array in REVERSE alphabetical order.

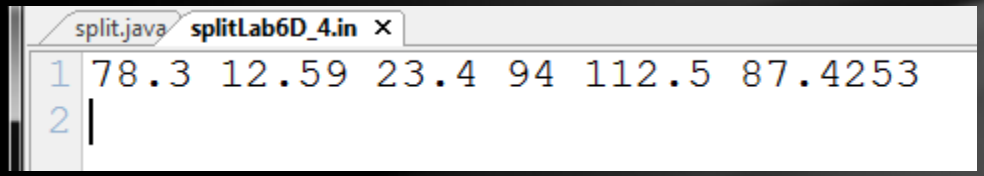
```
First = carrots
Last  = okra
Original order:
carrots
peas
apples
watermelon
celery
squash
okra
Alpha = apples
Omega = watermelon
Descending alpha order:
watermelon
squash
peas
okra
celery
carrots
apples
Press any key to continue
```

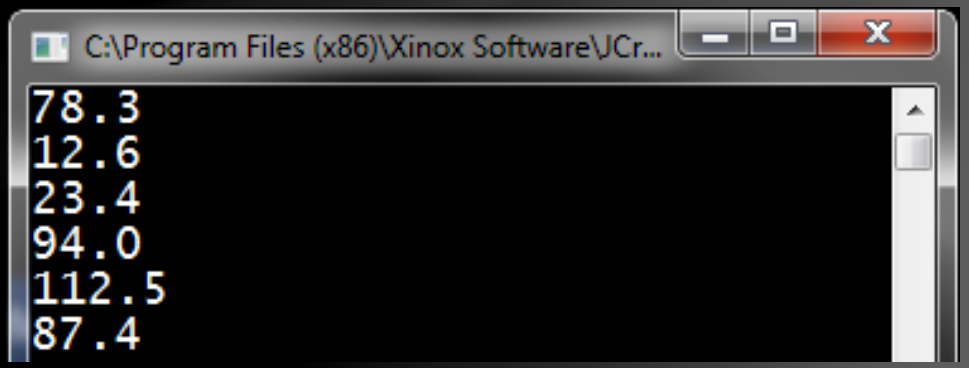
splitLab6D_1.java | splitLab6D_1.in

```
1 carrots peas apples watermelon celery squash okra
```

Lab 2 – ***dblArr***

- WAM called ***dblArr*** that receives a String containing a line of decimal values and returns an array of doubles. For help, refer to example 3 shown earlier in the lesson. Also, you'll need to remember how to parse double values, covered in a previous lesson.





Lab 3 – *avgArr* *(overloaded)*

- WAM called ***avgArr*** that receives an array of doubles and returns the average. This method will be ***almost identical*** to the one shown in example 4 shown earlier. It is actually an example of "overloading", where a method name is the same, but the parameter signature is different.
- Below is the method header and the method call from main.

```
 }
/**Method to receive a double array
 *and return the average of all the values
 *in the array.
*/
 public static double avgArr (double [] dubs)
 {
```

```
   }
   public static void main (String [] args)
     throws IOException
   {
     Scanner f = new Scanner(new File("splitLab6D_4.in"));
     String s = f.nextLine();
     double [] dubs = dblArr(s);
     for(int x = 0;x<dubs.length;x++)
         out.printf("%.1f\n",dubs[x]);
     out.printf("Average = %.1f\n",avgArr(dubs));
   }
```

Split.java | **splitLab6D_4.in** | splitLab6D_

```
78.3 12.59 23.4 94 112.5 88.4253
```

```
78.3
12.6
23.4
94.0
112.5
88.4
Average = 68.2
Press any key to c
```

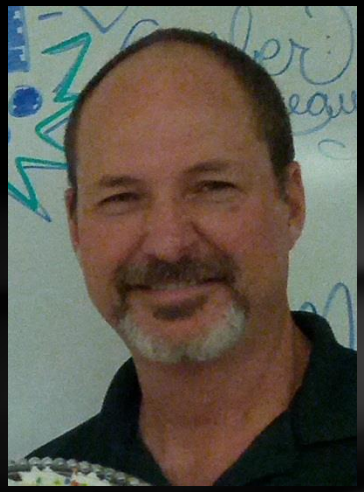
JavaDoc

- Complete the documentation for all of the methods, and then run the JavaDoc utility.

CONGRATULATIONS!

- You now know how to use the String class split method to transform String data into String arrays and value arrays.
- *Lesson 6E will explore nested loops, a key process necessary for processing matrix arrays (2D, 3D, etc), as well as outputting various patterns.*

Thank you, and have fun!



To order supplementary materials for all the lessons in this package, such as lab solutions, quizzes, tests, and unit reviews, visit the O(N)CS Lessons website, or contact me at

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