Ryan Dougherty

CSE110 Lecture Notes

Version 1.0

To Jennifer

Table of Contents

1 Introduction

Authors wishing to code their contribution with LaTeX, as well as those who have already coded with LaTeX, will be provided with a document class that will give the text the desired layout. Authors are requested to adhere strictly to these instructions; *the class file must not be changed.*

The text output area is automatically set within an area of 12.2 cm horizontally and 19.3 cm vertically.

If you are already familiar with LaTeX, then the LLNCS class should not give you any major difficulties. It will change the layout to the required LLNCS style (it will for instance define the layout of `\section`). We had to invent some extra commands, which are not provided by LaTeX (e.g. `\institute`, see also Sect. **??**)

For the main body of the paper (the text) you should use the commands of the standard LaTeX "article" class. Even if you are familiar with those commands, we urge you to read this entire documentation thoroughly. It contains many suggestions on how to use our commands properly; thus your paper will be formatted exactly to LLNCS standard. For the input of the references at the end of your contribution, please follow our instructions given in Sect. **??** References.

The majority of these hints are not specific for LLNCS; they may improve your use of LaTeX in general. Furthermore, the documentation provides suggestions about the proper editing and use of the input files (capitalization, abbreviation etc.) (see Sect. **??** How to Edit Your Input File).

2 Computers

The package consists of the following files:

`history.txt`	the version history of the package
`llncs.cls`	class file for LaTeX
`llncs.dem`	an example showing how to code the text
`llncs.doc`	general instructions (source of this document), `llncs.doc` means *l*atex *doc*umentation for *L*ecture *N*otes in *C*omputer *S*cience
`llncsdoc.pdf`	the documentation of the class (PDF version),
`llncs.doc`	general instructions (source of this document),
`llncsdoc.sty`	class modifications to help for the instructions
`llncs.ind`	an external (faked) author index file
`subjidx.ind`	subject index demo from the Springer book package
`llncs.dvi`	the resultig DVI file (remember to use binary transfer!)
`sprmindx.sty`	supplementary style file for MakeIndex (usage: `makeindex -s sprmindx.sty <yourfile.idx>`)

2.1 Written Exercises

1. What does a compiler do?
2. Consider the following Java Program:

```
public class VendingMachine {
     public static void main(String[] args) {
          System.out.println("Please insert 25c");
     }
}
```

   By what name would you save this program on your hard disk?
3. Is Java a functional language, procedural language, object-oriented language, or logic language?
4. What is a plain text file?
5. How is a text file different than a .doc file?
6. What is a source program?
7. What is Java bytecode?
8. What is the program that translates Java bytecode instructions into machine-language instructions?
9. Is Java case-sensitive?

2.2 Programming Exercises

3 Data Types

3.1 Written Exercises

1. Give the output of the following program:

```java
public class Example {
     public static void main(String[] args) {
          int y = 2, z = 1;
          z = y * 2;
          System.out.print(y + z);
     }
}
```

2. Consider the following program:

```java
public class Example {
     public static void main(String[] args) {
          String str = new String("Arizona state university");
          char ch1 = str.toLowerCase().toUpperCase().charAt(0);
          char ch2 = str.toUpperCase().charAt(8);
          char ch3 = str.toUpperCase().charAt(str.length() - 1);
          System.out.println("character 1 is: " + ch1);
          System.out.println("character 2 is: " + ch2);
          System.out.println("character 3 is: " + ch3);
     }
}
```

What will be the output?

3. Consider the following program:

```java
public class Example {
     public static void main(String[] args) {
          int num1 = 4, num2 = 5;
          System.out.println("4" + "5");
          System.out.println(num1 + num2);
          System.out.println("num1" + "num2");
          System.out.println(4+5);
     }
}
```

What will be the output?

4. Which of the following invokes the method length() of the object str and stores the result in val of type int?

```java
a) int val = str.length();
b) int val = length.str();
c) int val = length().str;
d) int val = length(str);
```

5. Evaluate each of the following expressions.

```
String s = "Programming is Fun";
String t = "Workshop is cool";
a) System.out.println(s.charAt(0) + t.substring(3, 4));
b) System.out.println(t.substring(7));
```

6. Evaluate each of the following expressions.

```
int j = 11;
int k = 3;
String s = "Ford Rivers";
a) j / k
b) j % k
c) s.substring(1, 5)
d) s.length()
e) s.charAt(3)
```

7. True or False? The type String is a primitive data type.
8. True or False? The type String is a primitive data type.
9. Write the output of the following program:

```
public class Question {
     public static void main(String[] args) {
          String str = "hello";
          System.out.println("abcdef".substring(1, 3));
          System.out.println("pizza".length());
          System.out.println(str.replace('h', 'm'));
          System.out.println("hamburger".substring(0, 3));
          System.out.println(str.charAt(1));
          System.out.println(str.equals("hello"));
          System.out.println("pizza".toUpperCase());
          System.out.println(Math.pow(2, 4));
          double num4 = Math.sqrt(16);
          System.out.println(num4);
     }
}
```

10. Write the output of the following program:

```
public class Question {
     public static void main(String[] args) {
          String s1 = new String("Clinton, Hillary");
          String s2 = new String("Obama, Barack");
          System.out.println(s1.charAt(2));
          System.out.println(s1.charAt(s1.length() - 1));
          System.out.println(s2.toUpperCase());
          System.out.println(s2.substring(
               s2.indexOf(",") + 2, s2.length());
```

```
      }
}
```

11. What value is contained in the integer variable length after the following statements are executed?

    ```
    length = 5;
    length += 3;
    length = length * 2;
    ```

12. What is the result of 2/4 when evaluated in Java? Why?

3.2 Programming Exercises

1. Write a Java program that asks the user for the radius of a circle and finds the area of the circle.
2. Write a Java program that prompts the user to enter 2 integers. Print the smaller of the 2 integers.

4 Decisions

4.1 Written Exercises

1. What is the output of the following code?

```
int depth = 8;
if (depth >= 8) {
     System.out.print("Danger: ");
     System.out.print("deep water. ");
}
System.out.println("No swimming allowed.");
```

2. What is the output of the following code?

```
int depth = 12;
int temp = 42;
System.out.print("The water is: ");
if (depth >= 8)
     System.out.print("deep ");
if (temp <= 50 && depth <= 12)
     System.out.print("cold ");
System.out.println(" wet.");
```

3. If k holds a value of the type int, then the value of the expression:

```
k <= 10 || k > 10
```

   a) must be true
   b) must be false
   c) could be either true or false
   d) is a value of type int

4. Consider the following code:

```
String str1 = "Java is fun";
String str2 = "Java is fun";
if ( /* */ )
     System.out.println("String1 and String2 are the same");
else
     System.out.println("String1 and String2 are different");
```

   Fill in the missing condition to check if str1 and str2 are the same.

5. Evaluate the following expressions, assuming that x = -2 and y = 3.

```
a) x <= y
b) (x < 0) || (y < 0)
c) (x <= y) && (x < 0)
d) ((x + y) > 0) && !(y > 0)
```

6. Write the output of the following code:

```
int grade = 45;
if (grade >= 70)
     System.out.println("passing");
if (grade < 70)
     System.out.println("dubious");
if (grade < 60)
     System.out.println("failing");
```

7. Write the output of the following code:

```
String option = "A";
if (option.equals("A"))
     System.out.println("addRecord");
if (option.compareTo("A") == 0)
     System.out.println("deleteRecord");
```

8. Write the output of the following code:

```
double x = -1.5;
if (x < -1.0)
     System.out.println("true");
else
     System.out.println("false");
     System.out.println("after if...else");
```

9. Write the output of the following code:

```
int j = 8;
double x = -1.5;
if (x >= j)
     System.out.println("x is high");
else
     System.out.println("x is low");
```

10. Write the output of the following code:

```
double x = -1.5;
if (x <= 0.0) {
     if (x < 0.0)
          System.out.println("neg");
     else
          System.out.println("zero");
}
else
     System.out.println("pos");
```

4.2 Programming Exercises

1. Write a program that asks for 3 integers and prints the median value of the three integers.
2. Write code that ensures that an int variable called number is an odd integer.

5 Loops

5.1 Written Exercises

1. What are the 3 kinds of loops in Java?
2. What is the output of the following loop? How many times does the loop execute?

   ```
   int n = 979;
   for (int j = 0; j <= n; j++) {
         System.out.println("Hello");
   }
   ```

3. What is the output of the following loop? How many times does the loop execute?

   ```
   int j = 1;
   int n = 5;
   while (j <= n) {
         System.out.println("Hello");
         n--;
   }
   ```

4. What is the output of the following loop? How many times does the loop execute?

   ```
   int n = 5;
   for (int j = 1; j <= n; j += 3) {
         System.out.print("Hello ");
         int k = j;
         while (k < n) {
               System.out.println("Good Morning");
               k++;
         }
         j--;
   }
   ```

5. What is the output of the following code?

   ```
   String name = "Richard M. Nixon";
   boolean startWord = true;
   for (int i = 0; i < name.length(); i++) {
         if (startWord)
               System.out.println(name.charAt(i));
         if (name.charAt(i) == ’ ’)
               startWord = true;
         else
               startWord = false;
   }
   ```

6. What is the output of the following loop? How many times does the loop execute?

```
int j = 1;
while (j <= 11) {
      System.out.println("Hello");
      j = j + 3;
}
```

7. What is the output of the following code?

```
int n = 1, i = 1;
while (i < 7) {
      n = n * i;
      i += 2;
}
System.out.print(n);
```

5.2 Programming Exercises

1. Write a loop that reads in int values until the user enters 0 and prints out how many values entered are greater than 10.
2. Write a loop that will print out every other letter in a String str. For example, if the String was “Hello There”, then “HloTee” will be printed.

6 Introduction to Classes

6.1 Written Exercises

1. Which of the following enforces Encapsulation?
   a) Make instance variables private
   b) Make methods public
   c) Make the class final
   d) Both a and b
   e) All of the above
2. Use the following class to answer the questions below:

```
public class Store {
        private int quantity;
        private double price;

        public Store(int q, double p) {
                quantity = q;
                price = p;
        }

        public int getQuantity() {
                return quantity;
        }

        public void setPrice(double p) {
                price = p;
        }

        public double calcTotal() {
                return price * quantity;
        }
}
```

   a) What is the name of the class?
   b) List all instance variables of the class.
   c) List all methods of the class.
   d) List all mutators in the class.
   e) List all accessors in the class.
   f) List which method is the constructor.
3. True or False? If no constructor is provided, then Java automatically provides a default constructor.
4. True or False? A method must have at least 1 return statement.

6.2 Programming Exercises

1. For the Store class in the Written Exercises above, do the following:
   a) Write a mutator for the quantity.
   b) Write an accessor for the price.
   c) Write a line of code that will create an instance called videoStore that has quantity 100 and a price of 5.99.
   d) Call the calcTotal method with the videoStore object (from part c) to print out the total.
2. Correct the following class definition if you think it will not work:

```java
public class Student {
    private String name, major;
    public Student() {
        name = "???";
        major = "xxx";
    }
    public Student(String n, String m) {
        n = name;
        m = major;
    }
    public String getMajor() {
        return m;
    }
    public String getName() {
        return n;
    }
}
```

3. Implement a class called AsuStudent. The class should keep track of the student's name, number of classes registered, hours spent per week for a class (consider a student devotes the same amount of time for each of his/her classes per week). Implement a toString method to show the name and number of classes registered by a student, a getName method to return the name of the student, a getTotalHours method to return the total number of hours per week, and a setHours method to set the number of hours the student devotes for each class.

7 Methods

7.1 Written Exercises

1. Write the output generated by the following program:

```
public class Two {
     private double real, imag;
     public Two(double initReal, double initImag) {
          real = initReal;
          imag = initImag;
     }
     public double getReal() {
          return real;
     }
     public double getImag() {
          return imag;
     }
     public Two mystery(Two rhs) {
          Two temp = new Two(getReal()+rhs.getReal(),
               getImag()+rhs.getImag());
          return temp;
     }
}
public class Test {
     public static void main(String[] args) {
          Two a = new Two(1.2, 3.4);
          Two b = a.mystery(a);
          Two c = b.mystery(b);
          System.out.println("1. " + a.getReal());
          System.out.println("2. " + a.getImag());
          System.out.println("3. " + b.getReal());
          System.out.println("4. " + b.getImag());
          System.out.println("5. " + c.getImag());
     }
}
```

2. Using these 2 classes, write the output of the following program:

```
public class CDPlayer {
     private int totalTime;
     public CDPlayer() {
          totalTime = 0;
     }
     public int totalPlayTime() {
          return totalTime;
     }
     public void play(CDTrack aTrack) {
        totalTime += aTrack.getPlayTime();
    }
}
public class CDTrack {
    private String myTitle;
    private int myPlayTime, myTimesPlayed;
    public CDTrack(String trackTitle, int playTime) {
        myTitle = trackTitle;
        myPlayTime = playTime;
        myTimesPlayed = 0;
    }
    public int getPlayTime() {
        return myPlayTime;
    }
    public void wasPlayed() {
        myTimesPlayed++;
    }
    public String toString() {
        String result = "";
        int minutes = myPlayTime / 60;
        int seconds = myPlayTime % 60;
        result += myTitle + " " + minutes + ":" + seconds;
        result += " #plays = " + myTimesPlayed;
        return result;
    }
}
public class RunCDPlayer {
    public static void main(String[] args) {
        CDTrack t1 = new CDTrack("Day Tripper", 150);
        CDTrack t2 = new CDTrack("We Can Work it Out", 200);
        CDTrack t3 = new CDTrack("Paperback Writer", 138);
        CDPlayer diskPlayer = new CDPlayer();
        t1.wasPlayed();
        diskPlayer.play(t1);
        t2.wasPlayed();
        diskPlayer.play(t2);
        t1.wasPlayed();
        diskPlayer.play(t1);
        System.out.println(t1.toString());
        System.out.println(t2.toString());
        System.out.println(t3.toString());
        System.out.println("Total play time: " +
            (diskPlayer.totalPlayTime() / 60) + ":" +
            (diskPlayer.totalPlayTime() % 60));
      }
```

```
}
```

7.2 Programming Exercises

1. Write a boolean method called allDifferent that takes 3 int numbers and returns true if the numbers are all different, and false otherwise.
2. Write a boolean method called isPrime that takes in an int number, and returns true if the number is prime, and false otherwise.

8 Static

8.1 Written Exercises

1. What is a static variable? What is a static method?
2. Using the code below, how many copies of the variable number exist after instantiating 374 different AmazingClass objects?

```
public class AmazingClass {
     private static int number;
     public AmazingClass(int a) {
          number = a;
     }
     public int twice() {
          number *= 2;
          return number;
     }
}
```

3. Using the code from above, what is the value of number after each of the following statements? (For each part, assume the preceding parts have already been executed).

```
AmazingClass ac1 = new AmazingClass(3);
AmazingClass ac2 = new AmazingClass(7);
ac1.twice();
ac2.twice();
```

8.2 Programming Exercises

9 Method Overloading

9.1 Written Exercises

1. What is method overloading?
2. What are the valid method headings assuming they are written in the same class?

```
a) public void Void()
b) public double void f2()
c) public double sum(int left, right)
d) public String string(int n)
e) public BankAccount bankAccount()
```

9.2 Programming Exercises

10 Arrays

10.1 Written Exercises

1. What are the indices for the first and last positions of any array?
2. Immediately after instantiating a new array of primitives (ints, doubles, etc.), what fills the array? What about an array of objects?
3. What happens when you try to access an array element past the end of the array?
4. Use the following array x to answer the following questions:

4 8 5 1 6 3 2

   a) What value is given by x[1]?
   b) What value is given by x[6]?
   c) What value is given by x[7]?
   d) What value is given by x.length?

10.2 Programming Exercises

1. Instantiate three arrays called x, y, and z of type int, String, and BackAccount (respectively), all of size 10.
2. Write a for-loop to sum all of the elements of an array x of type int.
3. Write a for-loop to double each element in an array x of type int.
4. Write code to store the largest number in an int array x into a variable called max.
5. Write code to count how many numbers in the array are strictly larger than 4, and store that total in a variable called total.
6. Write code to print out every other element in an array separated by tabs.
7. Write code to shift each number one place to the right (Note: there will be 2 copies of the 1st element when the code finishes).
8. Write code to print the contents of an array in reverse order, one element for each line.
9. Write a method called append that appends the two arrays passed as arguments and returns an array of type int as the result. For example, if the first array argument was {1, 2, 3}, and the second was {4, 5, 6, 7}, append returns {1, 2, 3, 4, 5, 6, 7}.
10. Write a method called findMin that returns the smallest element in an array that is passed as an argument. For example, if the array was {4, 7, 9, 12, 8, 1, 5}, the method would return 1.

11 Searching

11.1 Written Exercises

1. Use the sorted list below and use binary search to look for Mike in the list. Show all the names that will be compared before Mike is found. Then, repeat the same process for Cathy (note: Cathy is not in the list).

Aaron Betsy Doug Elise Mike Pat Steven

2. What is the benefit of using binary search over linear search?

11.2 Programming Exercises

12 Sorting

12.1 Written Exercises

1. Write the contents after each step of selection sort and insertion sort (assume by alphabetical order).

Mike Betsy Aaron Steven Doug Pat Elise

12.2 Programming Exercises