

16TIN2054 – Teknik Pemrograman

Week 11 – Defensive Programming



Dikerjakan oleh:

Fakkar Muhammad Faza – 201524006

1AD4 Jurusan Teknik Komputer dan Informatika

Tugas ini dikumpulkan untuk memenuhi sebagian persyaratan kelulusan mata kuliah Teknik Pemrograman Praktek

Program Studi D4 Teknik Informatika
Jurusan Teknik Komputer dan Informatika
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Case 1 : Exceptions Aren't Always Error File

CountLetters.java contains a program that reads a word from the user and prints the number of occurrences of each letter in the word. Save it to your directory and study it, then compile and run it to see how it works. In reading the code, note that the word is converted to all upper case first, then each letter is translated to a number in the range 0..25 (by subtracting 'A') for use as an index. No test is done to ensure that the characters are in fact letters.

1. Run CountLetters and enter a phrase, that is, more than one word with spaces or other punctuation in between. It should throw an `ArrayIndexOutOfBoundsException`, because a non-letter will generate an index that is not between 0 and 25. It might be desirable to allow non-letter characters, but not count them. Of course, you could explicitly test the value of the character to see if it is between 'A' and 'Z'. However, an alternative is to go ahead and use the translated character as an index, and catch an `ArrayIndexOutOfBoundsException` if it occurs. Since you don't want to do anything when a non-letter occurs, the handler will be empty.

Modify this method to do this as follows:

- Put the body of the first for loop in a try.
- Add a catch that catches the exception, but don't do anything with it.

Compile and run your program.

```
//count frequency of each letter in string
for (int i=0; i < word.length(); i++)
    try {
        counts[word.charAt(i)-'A']++;
    } catch (Exception e) {};
```

Enter a single word (letters only, please): Fakkar

A: 2
F: 1
K: 2
R: 1

2. Run Now modify the body of the catch so that it prints a useful message (e.g., "Not a letter") followed by the exception. Compile and run the program. Although it's useful to print the exception for debugging, when you're trying to smoothly handle a condition that you don't consider erroneous you often don't want to. In your print statement, replace the exception with the character that created the out of bounds index. Run the program again; much nicer!

```
//count frequency of each letter in string
    for (int i=0; i < word.length(); i++)
        try {
            counts[word.charAt(i)-'A']++;
        }
        catch (ArrayIndexOutOfBoundsException e) {
            System.out.println("\'" + word.charAt(i) + "\" is not a
letter.");
        }
    };
```

Enter a single word (letters only, please): F1KK2R

|'1' is not a letter.

'2' is not a letter.

F: 1

K: 2

R: 1

Case 2 : Placing Exception Handlers

File ParseInts.java contains a program that does the following:

- Prompts for and reads in a line of input
- Uses a second Scanner to take the input line one token at a time and parses an integer from each token as it is extracted.
- Sums the integers.
- Prints the sum.

Save ParseInts to your directory and compile and run it. If you give it the input

10 20 30 40

10 20 30 40

it should print

The sum of the integers on the line is 100.

The sum of the integers on the line is 100.

Try some other inputs as well. Now try a line that contains both integers and other values, e.g.,
We have 2 dogs and 1 cat.

We have 2 dogs and 1 cat.

You should get a `NumberFormatException` when it tries to call `Integer.parseInt` on "We", which is not an integer. One way around this is to put the loop that reads inside a try and catch the `NumberFormatException` but not do anything with it. This way if it's not an integer it doesn't cause an error; it goes to the exception handler, which does nothing. Do this as follows:

- Modify the program to add a try statement that encompasses the entire while loop. The try and opening `{` should go before the while, and the catch after the loop body. Catch a `NumberFormatException` and have an empty body for the catch.

```
try {  
    while (scanLine.hasNext()){  
        val = Integer.parseInt(scanLine.next());  
        sum += val;  
    }  
}catch (NumberFormatException e) {};
```

Enter a line of text
We have 2 dogs and 1 cat.
The sum of the integers on this line is 0

- Compile and run the program and enter a line with mixed integers and other values. You should find that it stops summing at the first non-integer, so the line above will produce a sum of 0, and the line "1 fish 2 fish" will produce a sum of 1. This is because the entire loop is inside the try, so when an exception is thrown the loop is terminated. To make it continue, move the try and catch inside the loop. Now when an exception is thrown, the next statement is the next iteration of the loop, so the entire line is processed. The dogs-and-cats input should now give a sum of 3, as should the fish input.

```
while (scanLine.hasNext()){  
    try {  
        val = Integer.parseInt(scanLine.next());  
        sum += val;  
    } catch (NumberFormatException e) {}  
}
```

```
Enter a line of text  
we have 2 dogs and 1 cat  
The sum of the integers on this line is 3
```

Case 3 : Throwing Exceptions

File `Factorials.java` contains a program that calls the `factorial` method of the `MathUtils` class to compute the factorials of integers entered by the user. Save these files to your directory and study the code in both, then compile and run `Factorials` to see how it works. Try several positive integers, then try a negative number. You should find that it works for small positive integers (values < 17), but that it returns a large negative value for larger integers and that it always returns 1 for negative integers.

1. Returning 1 as the factorial of any negative integer is not correct—mathematically, the factorial function is not defined for negative integers. To correct this, you could modify your factorial method to check if the argument is negative, but then what? The method must return a value, and even if it prints an error message, whatever value is returned could be misconstrued. Instead it should throw an exception indicating that something went wrong so it could not complete its calculation. You could define your own exception class, but there is already an exception appropriate for this situation—`IllegalArgumentException`, which extends `RuntimeException`.

Modify your program as follows:

- a. Modify the header of the factorial method to indicate that factorial can throw an `IllegalArgumentException`.

```
public static int factorial(int n) throws IllegalArgumentException
{
    /* body */
}
```

- b. Modify the body of factorial to check the value of the argument and, if it is negative, throw an `IllegalArgumentException`. Note that what you pass to throw is actually an instance of the `IllegalArgumentException` class, and that the constructor takes a `String` parameter. Use this parameter to be specific about what the problem is

```
public static int factorial(int n) throws IllegalArgumentException
{
    if (n < 0)
        throw new IllegalArgumentException("Can not
        input negative value");
}
```

- c. Compile and run your Factorials program after making these changes. Now when you enter a negative number an exception will be thrown, terminating the program. The program ends because the exception is not caught, so it is thrown by the main method, causing a runtime error.

```
Enter an integer: -10
Exception in thread "main" java.lang.IllegalArgumentException: Can
not input negative value
    at MathUtils.factorial(MathUtils.java:15)
    at Factorials.main(Factorials.java:14)
```

- d. Modify the main method in your Factorials class to catch the exception thrown by factorial and print an appropriate message, but then continue with the loop. Think carefully about where you will need to put the try and catch.

```
while (keepGoing.equals("y") || keepGoing.equals("Y")){
    System.out.print("Enter an integer: ");
    int val = scan.nextInt();
    try {
        System.out.println("Factorial(" + val + ") = "+
MathUtils.factorial(val));
    } catch (IllegalArgumentException e) {
        System.out.println(e.getMessage());
    }
    System.out.print("Another factorial? (y/n) ");
    keepGoing = scan.next();
}
```

```
Enter an integer: -10
Can not input negative value
Another factorial? (y/n) y
Enter an integer: 10
Factorial(10) = 3628800
Another factorial? (y/n)
```

2. Returning a negative number for values over 16 also is not correct. The problem is arithmetic overflow—the factorial is bigger than can be represented by an int. This can also be thought of as an `IllegalArgumentException`—this factorial method is only defined for arguments up to 16. Modify your code in factorial to check for an argument over 16 as well as for a negative argument. You should throw an `IllegalArgumentException` in either case, but pass different messages to the constructor so that the problem is clear.

```
public static int factorial(int n) throws IllegalArgumentException {
    if (n < 0)
        throw new IllegalArgumentException("Can not input negative
value");
    else if (n > 16)
        throw new IllegalArgumentException("Arithmetic Overflow");
}
```

```
} /*body*/
```

```
Enter an integer: -10
Can not input negative value
Another factorial? (y/n) y
Enter an integer: 20
Arithmetic Overflow
Another factorial? (y/n) y
Enter an integer: 5
Factorial(5) = 120
Another factorial? (y/n) n
|
```