

# Strings and Regular Expressions

## Question

Which regular expression matches all non-negative real numbers?

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## Answer

```
"[1-9]\\d*(\\.\\d+)?"
```

Number of students enrolled in the course: 212

Number of students that eChecked Check05C: 38 (18%)

Number of students enrolled in the course: 209

Number of students that eChecked Check05C: 17 (8%)

# Software Development (Chapter 7)

CSE 1020

October 27, 2010

As we have already seen in Chapter 3, the process of **software development** consists of several phases including

- analysis
- design
- implementation
- testing
- maintenance

An **analyst** is responsible for translating the requirements of the customer into a **specification**.

Software Engineering Requirements  
(CSE4312)



Stephen LeDrew

(political analyst)

A **designer**/architect is responsible for developing a plan/**algorithm** to fulfill the specification.

Fundamentals of Data Structures (CSE2011) and Design and Analysis of Algorithms (CSE3101)



Karl Lagerfeld

(fashion designer)



A **developer**/implementer is responsible for writing **code** that implements the algorithm.

Introduction to Computer Science I  
and II (CSE1020 and CSE1030)



Donald Trump

(real estate developer)

- databases  
Introduction to Databases (CSE3412)
- networks  
Computer Network Protocols and Applications (CSE3214)
- applications  
Introduction to Computer Science I and II (CSE1020 and CSE1030)

A **tester** is responsible for checking whether the code satisfies the specification.

Software Engineering Testing  
(CSE4313)



Ryan Stock

(cast member of Guinea Pig)

# Team Composition

A team may be composed of

analysts      25%

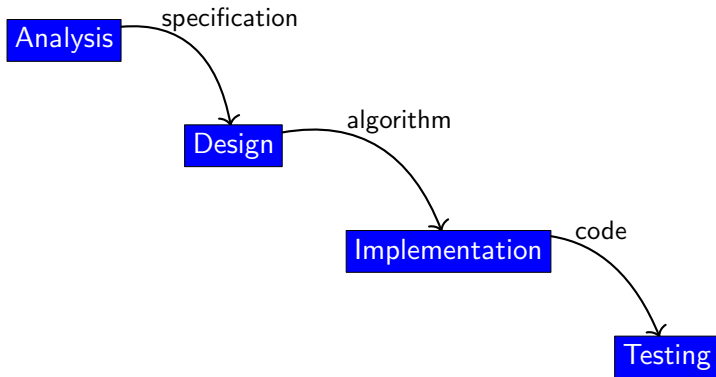
designers      10%

developers    40%

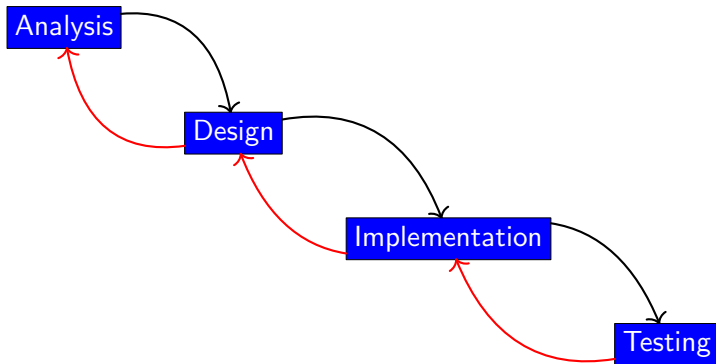
testers        25%

These numbers are estimates provided by someone in the field of software development.

# How does the information flow?

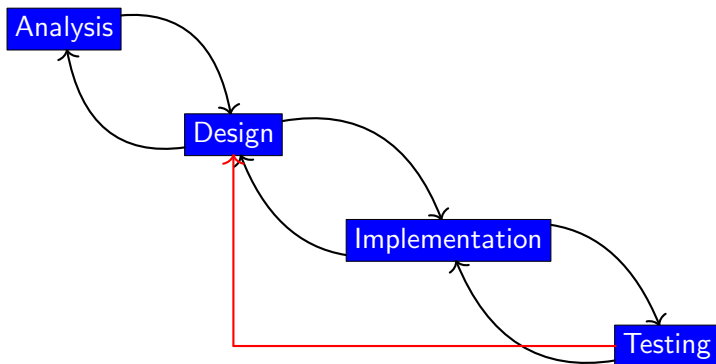


# How does our team collaborate?



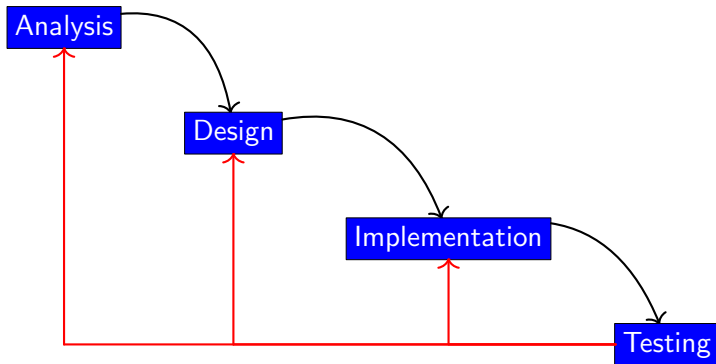
In an ideal world, a phase only has impact on the ones immediately before and after it. However, ...

# Testing may have impact on design



Winston W. Royce. Managing the development of large software systems. In *Proceedings of WESCON*, pages 1–9, Los Angeles, CA, USA, August 1970. IEEE.

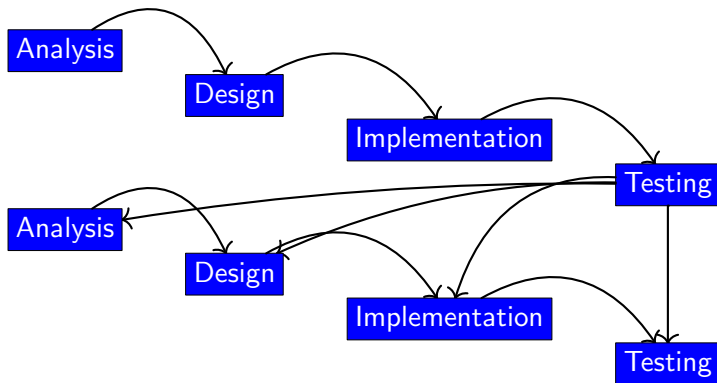
# Waterfall model



Although the waterfall model is often attributed to Royce, neither the above diagram nor the term “waterfall model” can be found in his paper.



# Royce's model



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# Overview of development methodologies

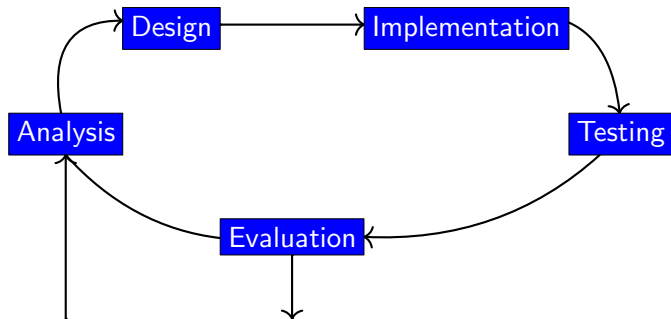
waterfall model	do it once	risky
Royce's model	do it twice	less risky
	do it ...	even less risky

# Overview of development methodologies

waterfall model	do it once	risky
Royce's model	do it twice	less risky
IID	do it <b>many times</b>	even less risky

IID = iterative and incremental development

# Iterative and Incremental Development



# Examples of IID projects

**project:** command and control system for submarine

**decade:** 1970s

**iterations:** four iterations of six months each

Craig Larman and Victor R. Basili. Iterative and incremental development: a brief history. *IEEE Computer*, 36(6):47–56, June 2003.

# Examples of IID projects

**project:** light airborne multipurpose system

**decade:** 1970s

**iterations:** 45 iterations of one month each

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# Examples of IID projects

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# Different IID methodologies

- extreme programming (XP)  
Software Design (CSE3311)
- rational unified process (RUP)
- ...



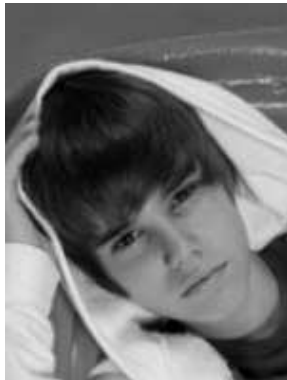


# Meet Our Customer

Our customer will be visiting Toronto<sup>a</sup>, Montreal and many other cities. He would like an app that provides the current temperatures of those cities.

---

<sup>a</sup>Our customer will be in Toronto on November 23.



customer: Can you develop such an app for me?



**customer:** Can you develop such an app for me?

**analyst:** To limit our risks, we can start with an app that reads the web page of the Weather Network that contains the current temperature of Toronto and prints the HTML of that web page on the screen.



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**customer:** This better be cheap.



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**analyst:** How about a cup of coffee?



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**customer:** Deal.



**designer:** First, I want to determine which classes am I going to use. Which class do I usually use for reading (from the keyboard, from a file, etc)?



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**designer:** The web page of the Weather Network of interest has a particular url. How can I find out if there is a class to deal with url's?



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**designer:** Search the Java standard library.



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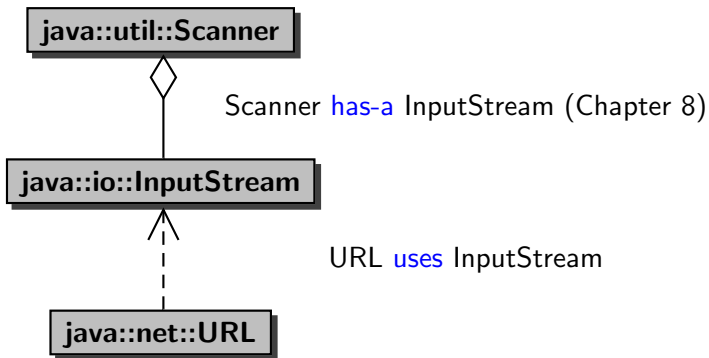
**designer:** I have found the classes `Scanner` and `URL`. Which constructor do I use to create a `Scanner` that reads from a `URL`?

# Unified Modeling Language (UML)

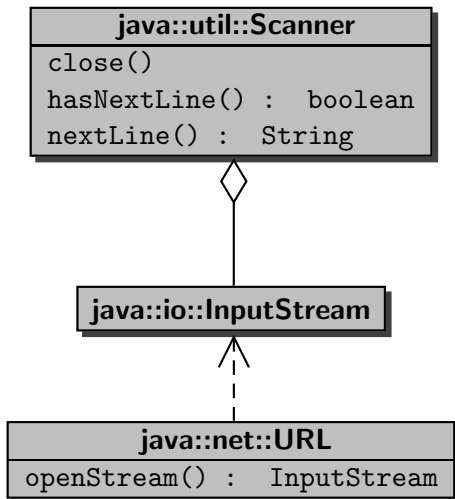
UML was designed by “the three amigos” Grady Booch, Ivar Jacobson and James Rumbaugh in the mid 1990s.

UML provides a large variety of different types of diagrams. These diagrams can be used to model software.

# A Class Diagram



# A More Detailed Class Diagram







developer: You're fired!







**developer:** You're fired!

**designer:** No Donald, you cannot fire me. You have to implement my design.





**developer:** You're fired!

**designer:** No Donald, you cannot fire me. You have to implement my design.

**developer:** #!?!%&\*!



# Compile Time Error

Error message: unreported exception `BlaBlaBlaException`; must be caught or declared to be thrown

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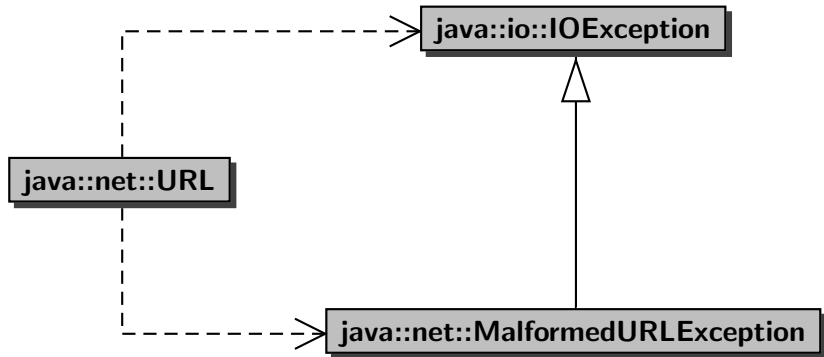
# Compile Time Error

**Error message:** unreported exception `BlaBlaBlaException`; must be caught or declared to be thrown

**Quick fix:** add `throws BlaBlaBlaException` to the header of the main method

**Proper solution:** will be discussed in Chapter 11

# Why only “throws IOException”?



MalformedURLException is a IOException (Chapter 9)

## Question

Should we test?

Based on the software developer and user surveys, the national annual costs of an inadequate infrastructure for software testing is estimated to range from \$22.2 to \$59.5 billion.

The Economic Impacts of Inadequate Infrastructure for Software Testing. Planning Report 02-3. May 2002.

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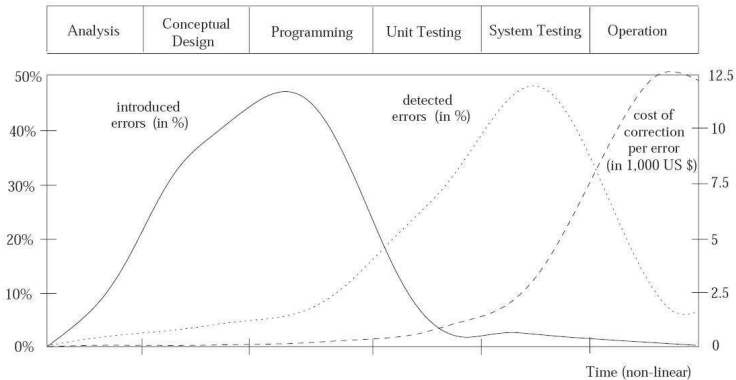
The Economic Impacts of Inadequate Infrastructure for Software Testing. Planning Report 02-3. May 2002.

## Answer

Yes!



# Testing



P. Liggesmeyer, M. Rothfelder, M. Rettelbach and T. Ackermann.  
Qualitätssicherung Software-basierter technischer Systeme.  
*Informatik Spektrum*, 21(5):249–258, 1998.

“Program testing can be used to show the presence of bugs, but never to show their absence!”

Edsger W. Dijkstra. Notes on structured programming. Report 70-WSK-03, Technological University Eindhoven, April 1970.

# Another Way to Find Bugs

**Formal verification:** proving that code satisfies particular properties of interest.

The two most used approaches to formal verification are

- model checking
- theorem proving

Introduction to Program Verification (CSE3341)

# How to Test Code?



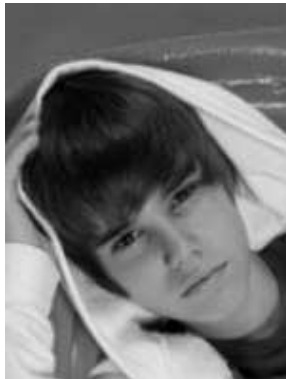
- Provide the input.
- Run the code.
- Compare the output with the expected output.

# Terminology

**Test case:** an input that satisfies the precondition.

**Test suite/test vector:** a collection of test cases.

**customer:** It is printing something on the screen. But what is all that gibberish?





**customer:** Can you extract the current temperature in Toronto from that gibberish for me?





**customer:** Can you extract the current temperature in Toronto from that gibberish for me?

**analyst:** Yes!





# Screen Scraping

Reading the HTML from a URL and extracting information from it is an example of [screen scraping](#).

A robust alternative to screen scraping is [web services](#).

Building E-Commerce Systems (CSE4413)



**customer:** Can you provide the current temperature in Fahrenheit?





**customer:** Can you provide the current temperature in Fahrenheit?

**analyst:** Yes!



# Testing



`developer:` Can you test the  
method `parseInt` of the class  
`Integers` of the package  
`com.cheapbutquestionable` for  
me please?



# Testing

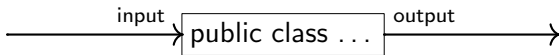


**developer:** Can you test the method `parseInt` of the class `Integers` of the package `com.cheapbutquestionable` for me please?

**tester:** Yes!



# White Box Testing



# Black Box Testing



# Why Black Box Testing?

A Java archive (JAR) file usually only contains the bytecode and not the Java code.

Developers can obfuscate JAR files so that a user of the JAR file does not get much information regarding the original Java code.



# How to Provide the Test Cases?

- Enter the test cases manually.
- Read the test cases from files.
- Generate the test cases by an app.
- Use the `launch` method of the `ToolBox` class.
- Use a testing framework such as JUnit.

# How to Determine the Expected Result?

- Use a different solution to the problem that is known to be correct.
- Use an approximate solution to the problem.
- ...

# How to Compare the Result with the Expected Result?

- Check it manually.
- Read the expected result from a file.
- Generate the expected result by an app.
- Use a testing framework such as JUnit.

Sometimes, it is much easier checking that the output is correct than computing the output. For example, it is much easier checking that a list of elements is sorted than sorting a list of elements.

# Which Test Cases?

- Likely cases (black box and white box testing).
- Boundary cases (black box and white box testing).
- Cases that cover all execution paths (white box testing only).



**customer:** Can you provide the current temperature with a pop up window?





**customer:** Can you provide the current temperature with a pop up window?

**analyst:** Yes!

