Lecture 8: Type Casting and Design

Last time:

1. Project
2. More assignment operators

Today:

1. Precedence and short-circuiting (from last lecture)
2. Type casting
3. Basics of program design

Project #1 Due Tomorrow (9/19) at 11 pm!

- The assignment is on the CMSC 131 web-site (click "Projects" link).
- It is due Tuesday, 9/19 at 11 pm
- The project is open
- Start now!
    - Read entire assignment from beginning to end before starting to code
    - Check out assignment now from CVS
    - Follow the instructions *exactly*, as much of grading is automated

Type Casting

Which of the following are legal?

- `int x = 3.5;`

  Illegal: 3.5 is not an `int`
- `float x = 3;`

  Legal: 3 is an `int`, which is also a `float`
- `long i = 3;`

  Legal: 3 is an `int`, which is also a `long`
- `byte x = 155;`

  Illlegal: 155 is to big to be a `byte` (> 127)
- `double d = 3.14159F;`

  Legal: 3.14159F is a `float`, which is also a `double`

What is “Type Casting”?

- Type casting: automatic conversion of values from one type to another

e.g.	`int`	→	`double`
	`float`	→	`double`
	`int`	→	`long`

- Type casts can be:
  - Implicit: performed automatically
  - Explicit: programmed by developer

Implicit Type Casting in Java

- Hierarchy of primitive numerical types

  `double` higher
  `float`
  `long`
  `int`
  `short`
  `byte` lower

- Idea
  - Higher types have more precision
  - Lower types are “subsets” of higher types
- Java only performs implicit upcasts (casting from lower to higher type)

  e.g. `int` → `double`
  `float` → `double`
  `int` $\not\rightarrow$ `byte`

Explicit Type Casting in Java

- To explicitly cast a value to a type t, use `(<t>)` value

  ```
  int x = (int)3.7;
  ```

  - Assigns value 3 to `x`
  - Reason: (int) operator converts double to int by truncation (chopping off decimal) when double is small enough
  - This is an example of downcasting

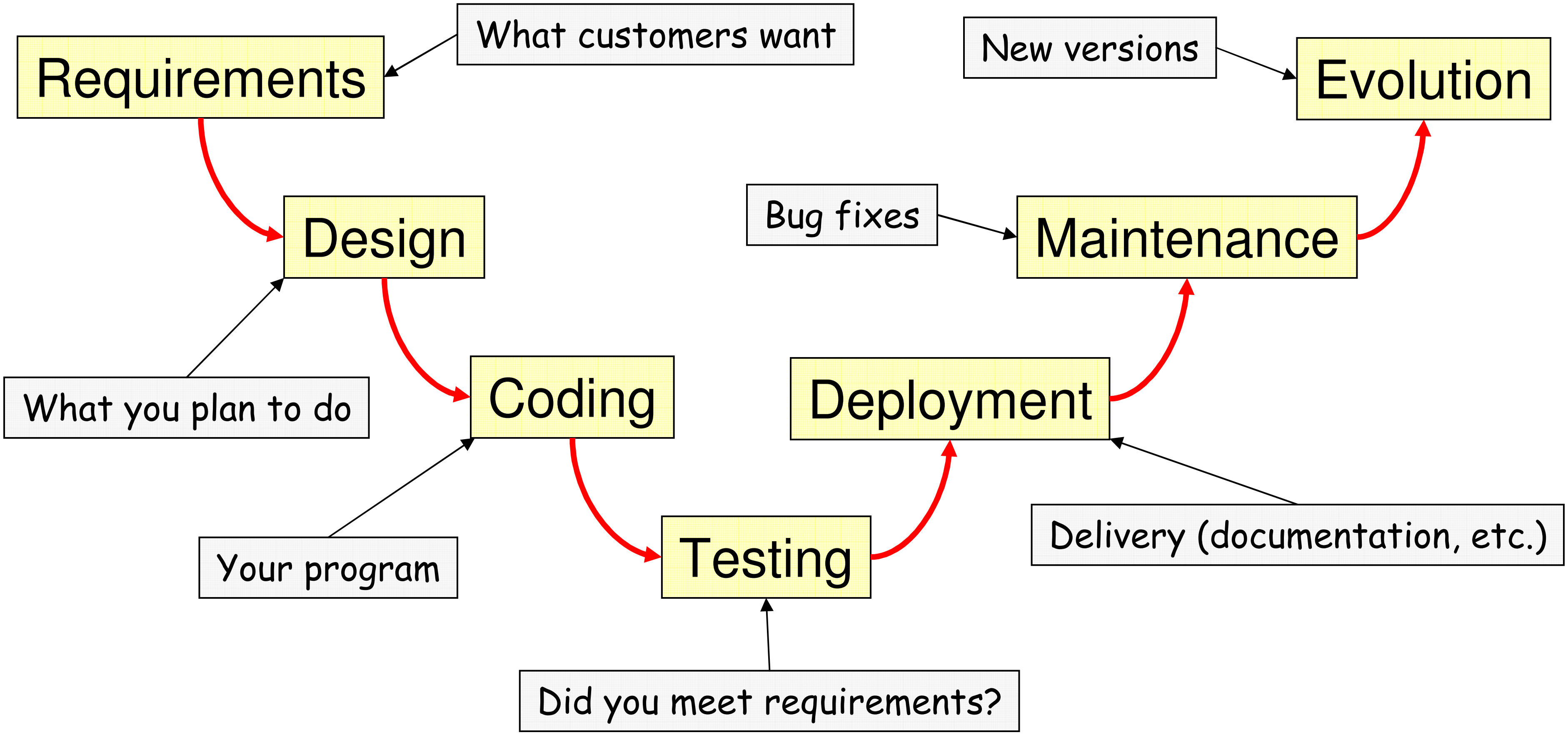
  ```
  byte bt = (byte) 200;
  ```

  - Assigns value -56 to bt
  - Reason: (byte) operator “wraps around” values that are too big
- This sounds confusing
  - It is!
  - Rule of thumb:
    - Only use explicit casts when you know what the answer is likely to be
    - Otherwise (e.g. in “overflow” situations) write your own type-conversion routines (we’ll see how later this semester)

Mixed Expressions

- What is result of
  `float x = 3 / 4;`
  - `x` assigned value `0.0F`
  - Why?
    - 3, 4 are ints
    - So integer / operation is used, yielding `0`, before upcasting is performed
- To get floating point result, use explicit casting
  `float x = (float) 3 / (float) 4;`
  - Assigns x the value `0.75F`
- Can also do following
  `float x = (float) 3 / 4;`
  - Why?
  - `(float) 3` returns a value type float (`3.0F`)
  - `4` is an int
  - In this case, Java compiler uses upcasting on “lower” type (here, `int`) to obtain values in same type before computing operation

The Software Lifecycle



So Far We've Seen…

- Coding
- Requirements (project assignment)
- Testing (submission testing)

What about design?

In the Real World, Requirements and Design Rule

- Getting requirements right is essential for successful projects
  - FBI electronic case file (junked after $180m)
  - IRS system upgrade in late 90s (junked after >$2bn)
  - FAA air-traffic control (false starts, >$10bn spent)
- Good design makes other parts of lifecycle easier
- In “the real world” coding typically < 30% of total project costs

Program Design

- There are many aspects to good design
  - Architecture
  - Modeling
  - Requirements decomposition
  - Pseudo-code
- In this class we will focus on latter

What Is “Pseudo-code”?

- When developing a complex part of a program (an algorithm), one of the tools often useful is pseudo-code.
- It's not English, not programming language -- somewhere between.
- Captures the flow of the program without worrying about language-specific details.

Example:

- Requirement: email program that allows you to send a message either to one person, or to your whole address book
- Pseudo-code:

```
prompt "Enter message: "
input message
prompt "Send to whole address book? "
input answer
if answer == "no“
        prompt "Enter recipient: "
        input recipient
        send message to recipient
otherwise
        for each recipient, r, in address book
                send message to r
```

What Is Pseudo-Code? (cont.)

- NOT English
- NOT a program
- Something in-between
  - Captures the "logic" and "flow" of the algorithm
  - Note that pseudo-code could be translated into ANY programming language (not just Java)
- Good programming practice
  - Write pseudo-code first and keep it as your design
  - Include it as comments in your code to help you connect code to design

Testing

- Some testing is done by customer (acceptance testing)
  - E.g. testing we do on your projects!
  - You want to avoid errors surfacing during acceptance testing
- How to avoid errors during acceptance testing?
  - Test thoroughly before release
  - Cover all cases in code (if/else branches, etc.)
  - Identify “corner cases” (extreme values of inputs) and test with these
- We will study testing more later in semester