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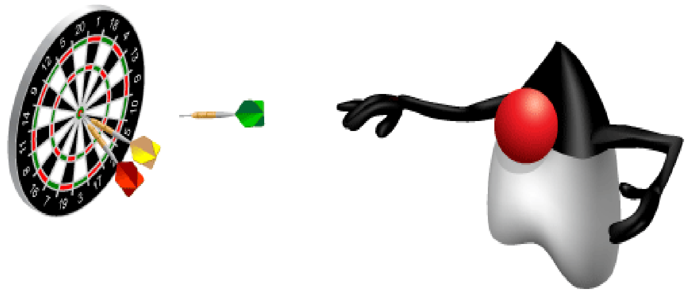
Java Foundations

2-1
The Software Development Process

Objectives

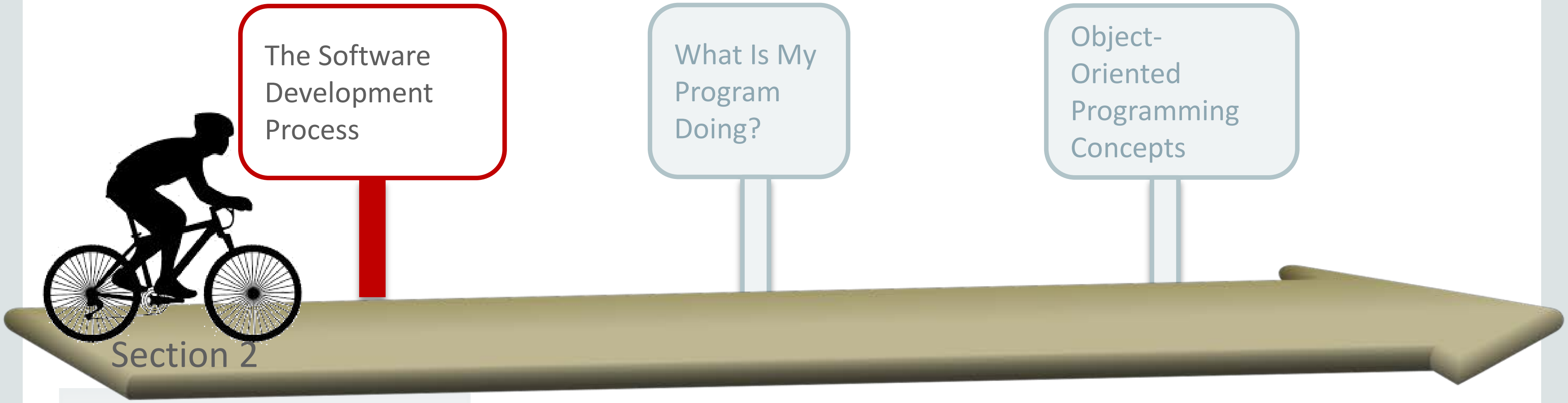
This lesson covers the following objectives:

- Understand the Spiral Model of development
- Recognize tasks and subtasks of the Spiral Model
- Recognize what happens when steps are ignored
- Identify software features
- Understand how features are gradually implemented



Topics

- Introducing the Spiral Model of Development
- Forgetting Steps in the Spiral Model
- Examining Software as It Develops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Section 2

Exercise 1, Part 1

Your buddy, Clinton, has plans for the weekend. Check out his email and think about what steps would be necessary to make these plans happen:

Hey buddy,

There's a special Computer History exhibit at the City Museum this month. A few of us are thinking of going Friday at 5:00 PM. Would you want to join? I think the subway would be the best way to get there.

Clinton

Exercise 1, Part 2

Complete the chart by writing at least one item for each section.

Requirements

- What is Clinton's email asking?

Designing a Plan

- What do you need to consider before going out?

Testing

- How do you know the plan worked?

Implementing the Plan

- What actions do you take?

Friday at the Museum

You may have written something similar to this:

Requirements

- What is Clinton's email asking?
  - Be at the City Museum at 5:00 PM on Friday.

Designing a Plan

- What do you need to consider before going out?
  - Find a time to meet at the campus subway station before 5:00 PM.
  - Look up subway and street maps.

Testing

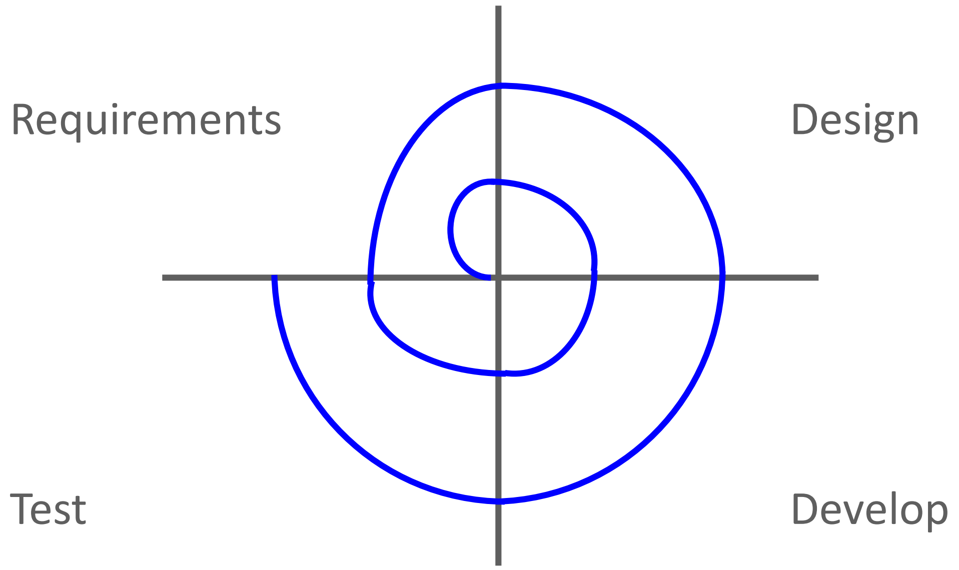
- How do you know the plan worked?
  - Did you get off at the right stop?
  - Are the streets and buildings named what you expect?
  - Do you see any computers?

Implementing the Plan

- What actions do you take?
  - Take the red-line train to South Station.
  - Walk east for 3 blocks .

Introducing the Spiral Model of Development

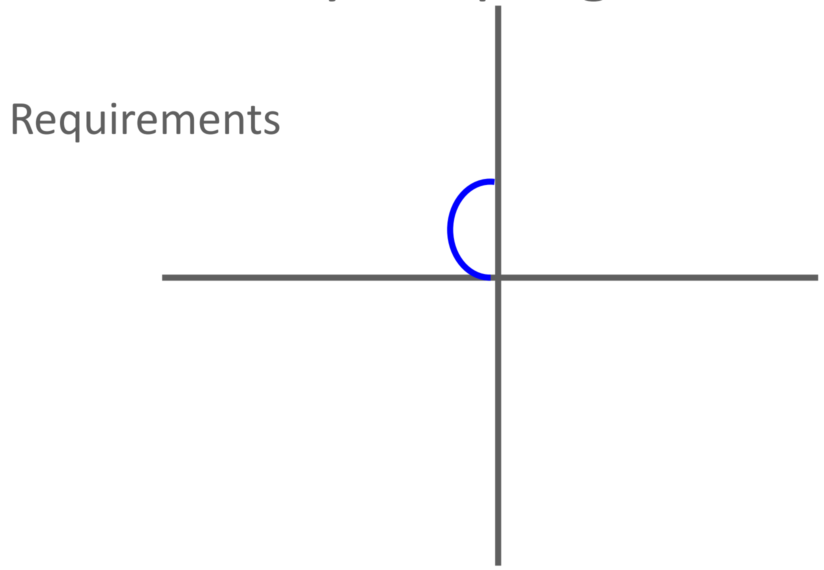
- Developing software requires a similar thought process.
- This is represented by the **Spiral Model**.
- There are other models, but the Spiral Model best reflects what you'll be doing in this course.



Requirements

Carefully read any instructions:

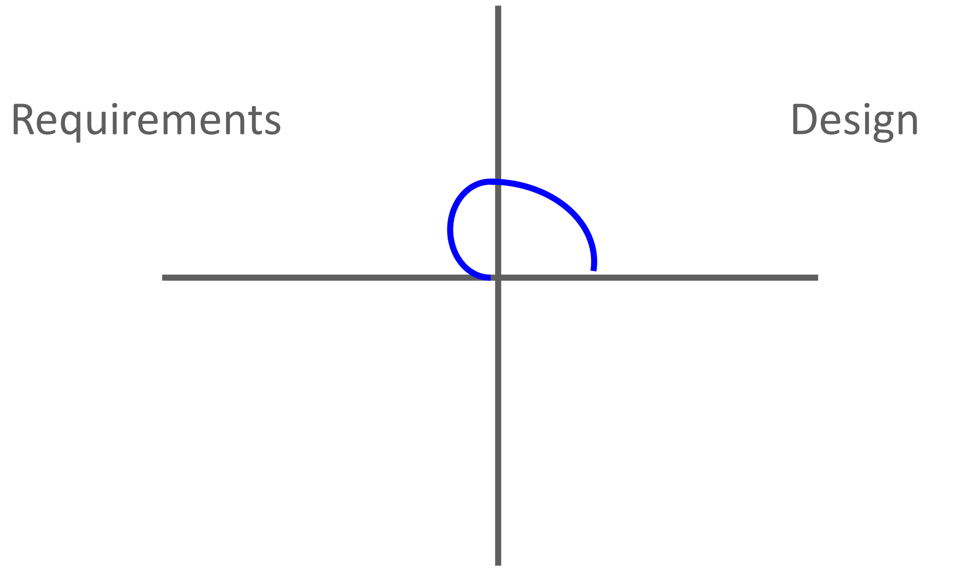
- What should your program do?
- What problems is it trying to solve?
- What features must your program have?



Design

Plan your approach:

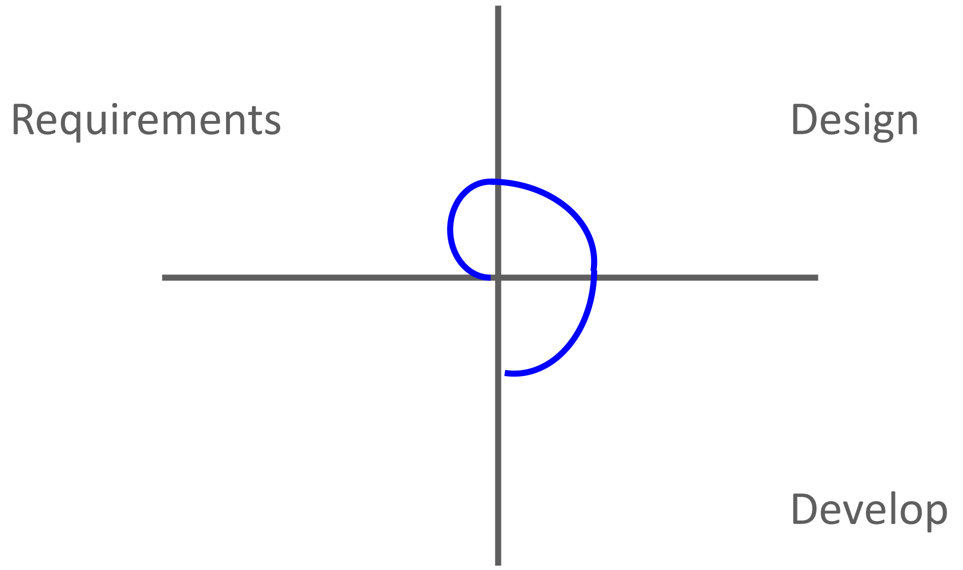
- Are there data or behaviors your program must model?
- Will certain parts of your program need to be finished before work can begin on other parts?



Develop

Start coding:

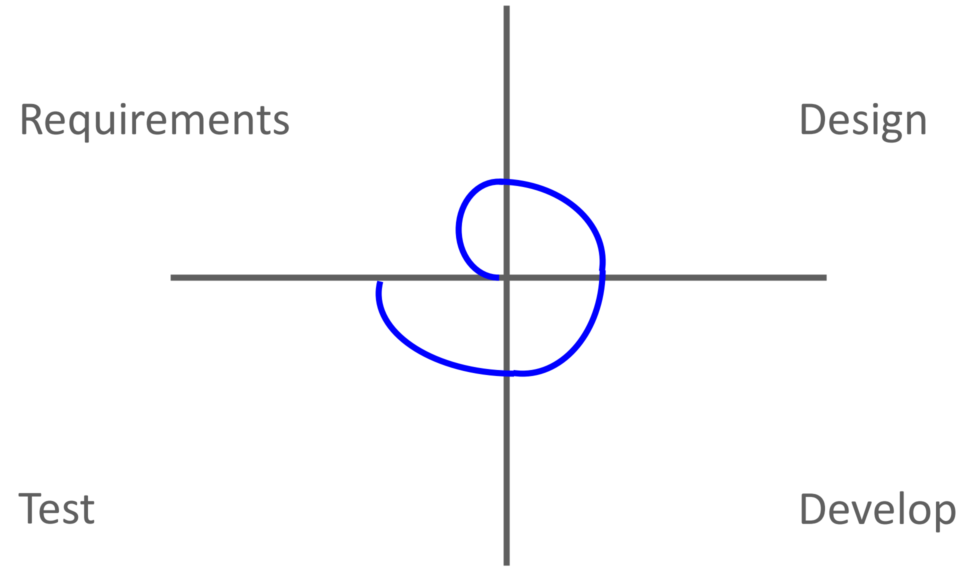
- Create a simplified version of your program.
- Focus on a small number of simple or important features.



Test

Test your code:

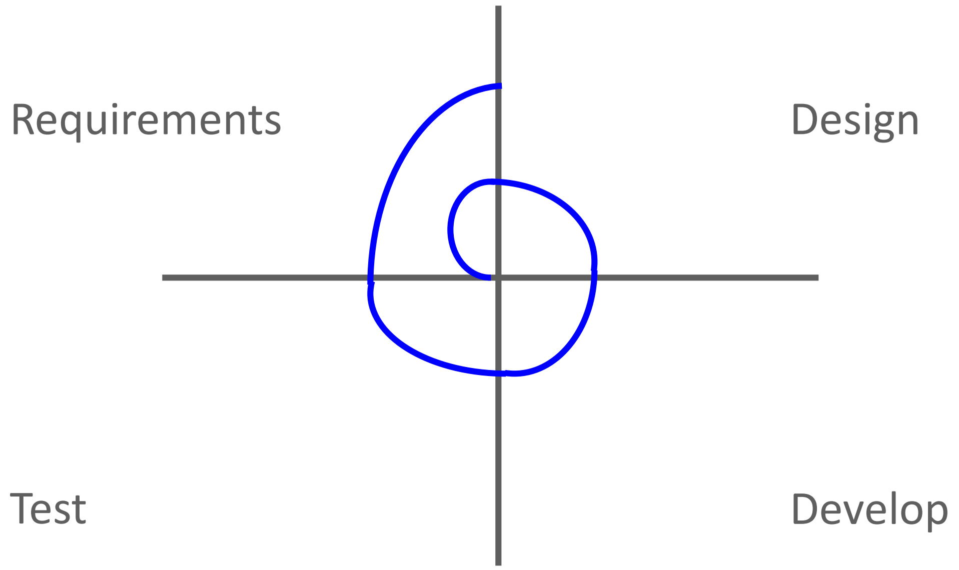
- Does the program give the results that you expect?
- Can you find scenarios that produce unwanted results?
- Depending on their impact, these bugs may need fixing.



Requirements Iteration

Check the requirements again:

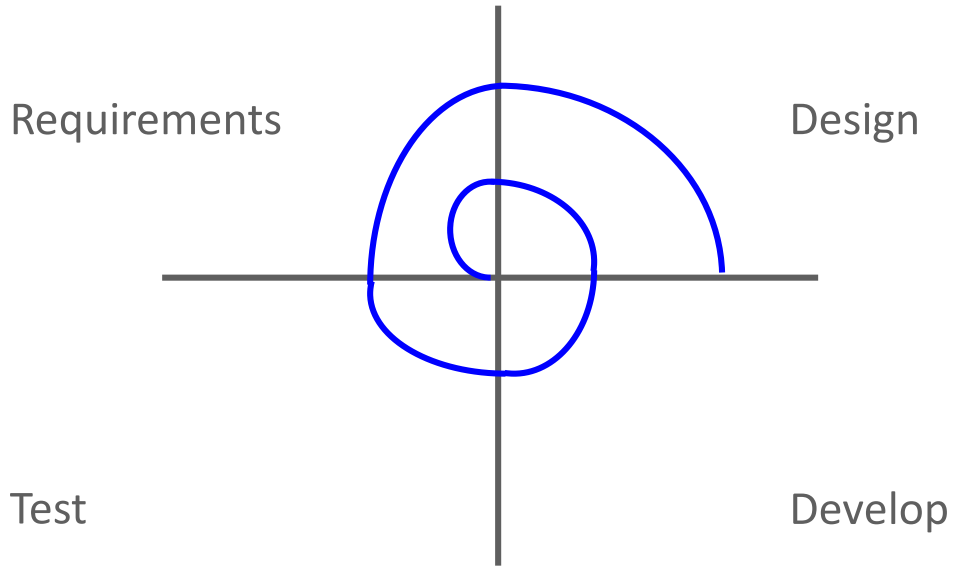
- Does the program's behavior match the requirements?
- Are there additional requirements or features to build?
- Should some requirements change?



Design Iteration

Plan your changes:

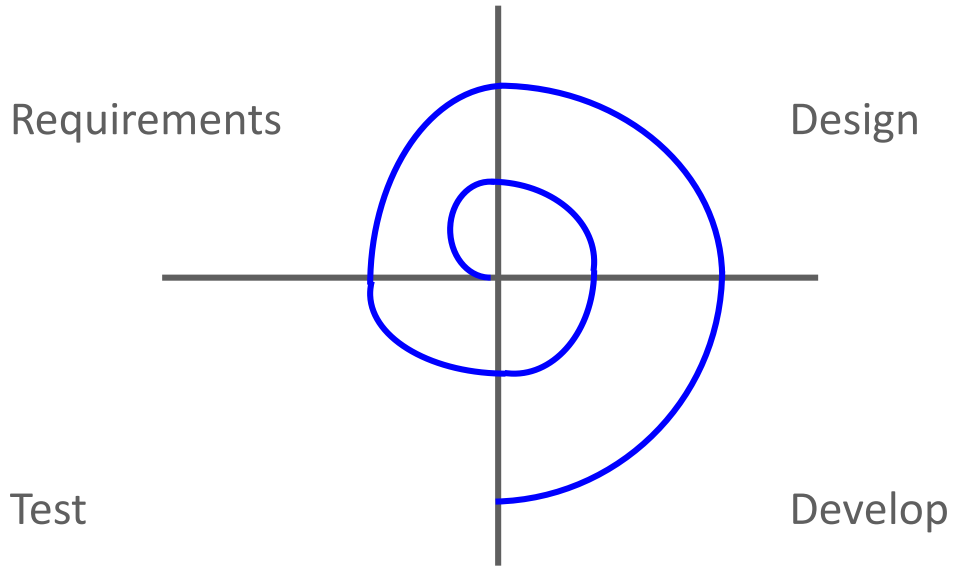
- How should you model additional features?
- Should the existing design change to better support expanding current features or adding new features?



Development Iteration

Continue developing:

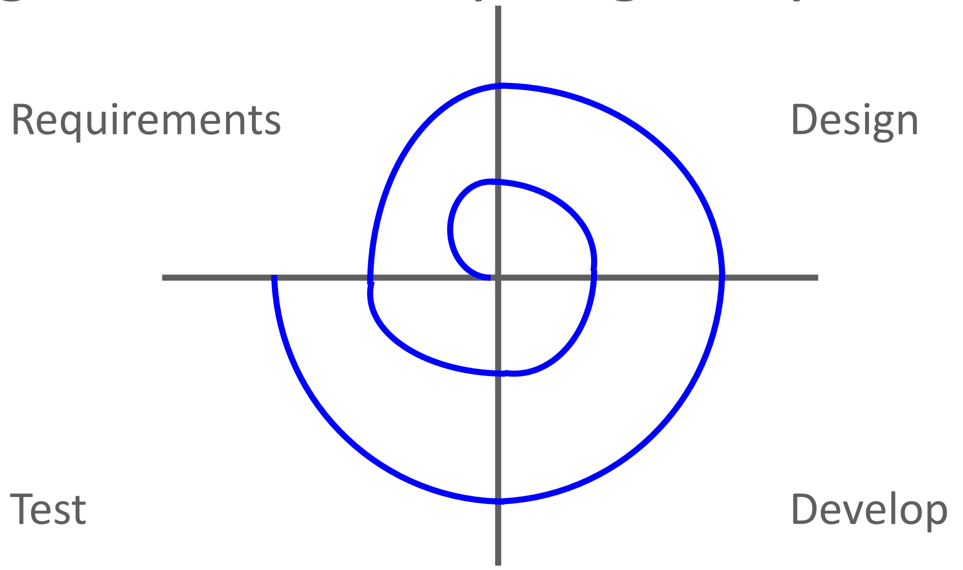
- Add new features.
- Modify or enhance existing features, if necessary.



More Testing

Continue testing:

- Does new code work as you expect?
- Will old code still work properly?
- Depending on the severity, bugs may need fixing



Developing, Testing, and Fixing

The process of developing, testing, and fixing bugs is sometimes frustrating:

- Code often doesn't work.
- Unexpected bugs reveal themselves.
- Solutions seem difficult and elusive.

Programming Is like Solving Puzzles

- It may take time…
  - Thinking
  - Experimenting
  - Researching and iterating
- But it feels very rewarding to…
  - See your code finally working (or behaving slightly better).
  - Watch your program evolve and become more robust.
  - Find yourself becoming more skillful.
  - Mischievously find ways to produce bugs.

How to Research

Are you still confused after tinkering? There are many resources to help you make progress:

- Lecture notes and completed small exercises
  - Do they use commands or techniques you're looking for?
- Oracle's Java documentation
  - They outline available Java commands.
  - http://docs.oracle.com/javase/8/docs/api/index.html
- Internet
  - Other people may have asked questions similar to yours.
  - You may uncover helpful examples or promising new commands.
  - But your solutions should be your own, not copied code.

Topics

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- Forgetting Steps in the Spiral Model
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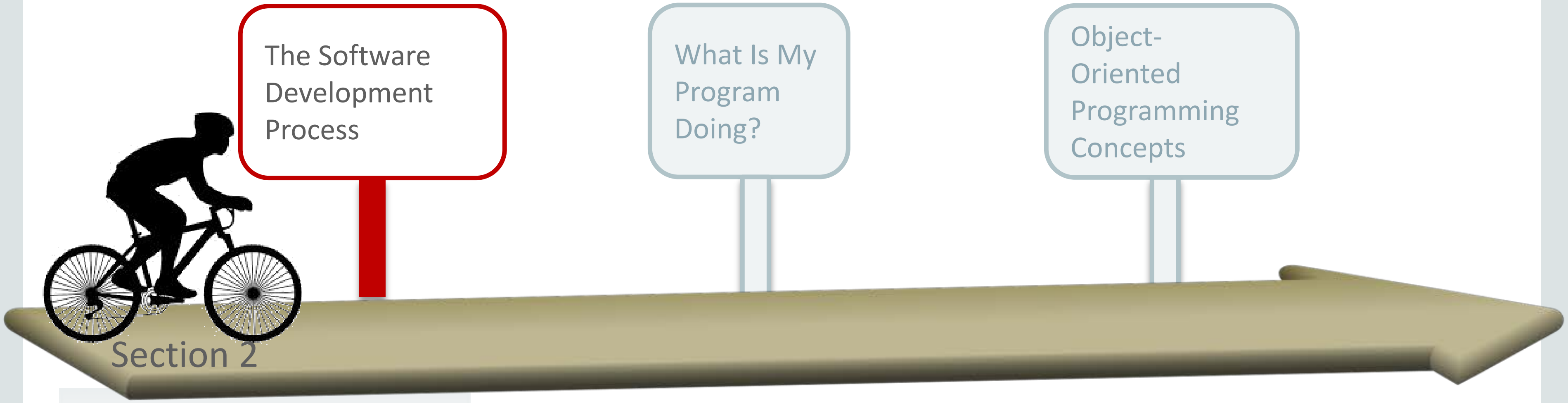
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Exercise 2, Part 1

Here is Clinton's email again, in case you need it for this exercise.

Hey buddy,

There's a special Computer History exhibit at the City Museum this month. A few of us are thinking of going Friday at 5:00 PM. Would you want to join? I think the subway would be the best way to get there.

Clinton

Exercise 2, Part 2

Complete this chart. Imagine what might happen to your night at the museum if a particular step were forgotten:

Requirements	**Designing a Plan**
Testing	**Implementing the Plan**

Forgotten Friday

You may have written something similar to this:

Requirements

- You do something else on Friday.

Designing a Plan

- Everyone is on the train but nobody knows where they're going.
- You ride the train for hours but never reach the museum.

Testing

- You walk past the museum.
- You arrive at the wrong building.
- The museum is closed.

Implementing the Plan

- Despite a wonderful plan, nobody goes to the museum.
- Clinton is sad.

Forgetting Steps in the Spiral Model

Similarly, bad things can happen when a particular step of the Spiral Model is forgotten.

Requirements

- The program works, but doesn't solve the right problem.
- Features are missing.

Design

- Code is messy.
- Bugs are difficult to fix.
- Features are difficult to enhance.

Testing

- The program keeps crashing.
- The program gives incorrect results.
- Users are frustrated.
- Users can't stop laughing.

Development

- There is no program.

Topics

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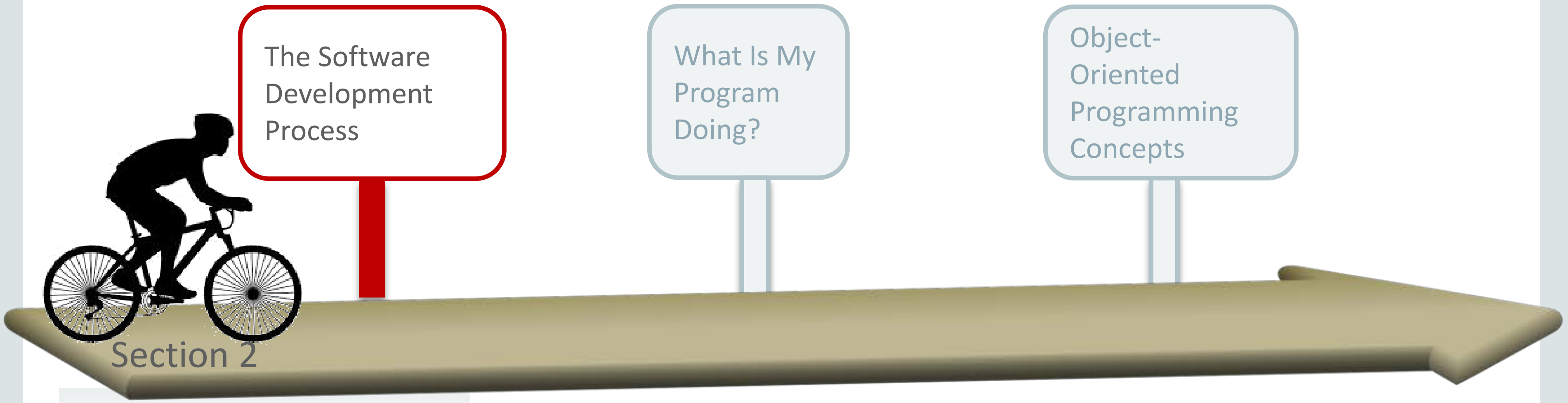
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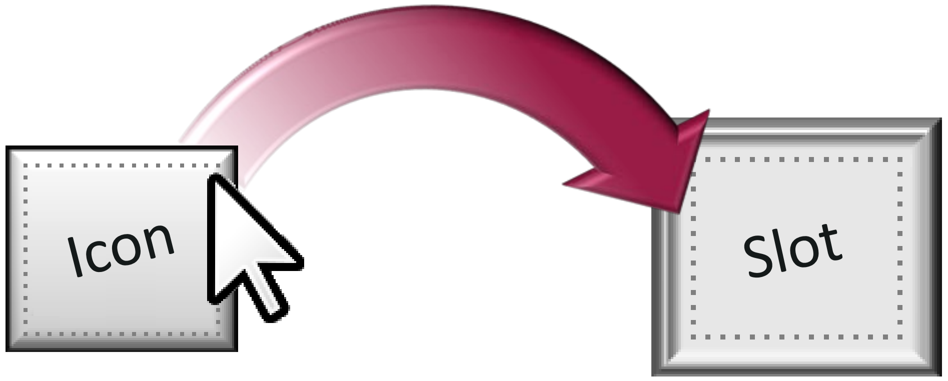
What Is a Software Feature?

- Think of a **feature** as:
  - Something that a program can do
  - Something that you can do with a program
- Examples:
  - Printing text
  - Playing a sound
  - Calculating a value
  - Dragging and dropping an icon
  - Posting a high score to an online leaderboard
  - A new type of enemy in a videogame

Implementing a Feature

- Some features are easier to implement:
  - You can code them in a few simple lines.
  - For example, printing text to NetBean's output window.
- Some features are difficult to implement.
  - They rely on a combination of other features.
  - For example, being able to "drag and drop" an icon.

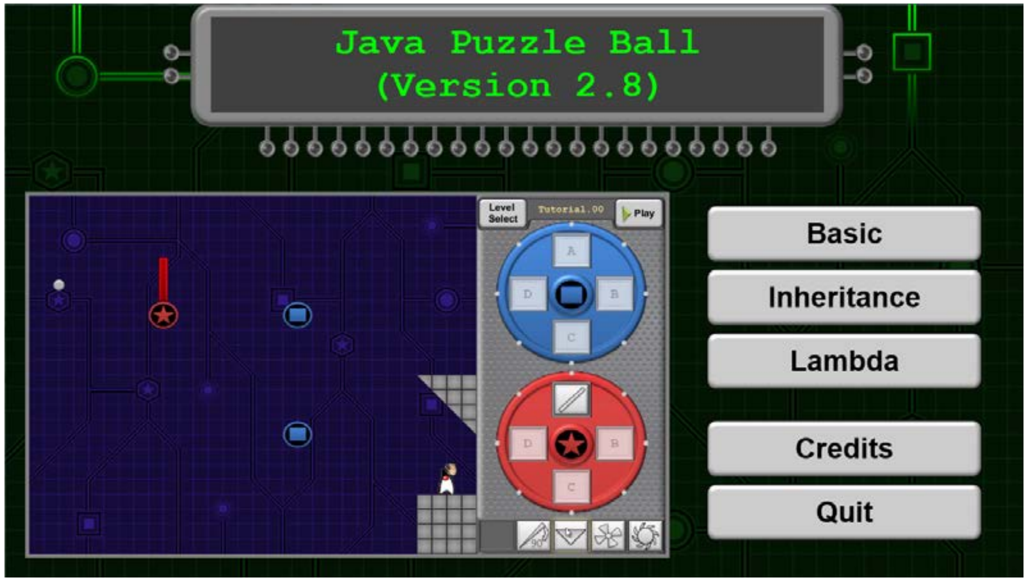


Implementing "Drag and Drop"

- A "drag and drop" feature requires several smaller features:
  - Adding a graphic to the screen
  - Finding the mouse position
  - Detecting a mouse click
  - Detecting a mouse release
  - Changing the position of the graphic
- Implementing just one of these items can feel like a big accomplishment.

Case Study: Java Puzzle Ball

- This game is written entirely in Java FX.
- It's designed to teach programming concepts.
- We've saved all the old versions of this game so that you can explore how features were gradually implemented!



The Game's Development Process

These are the steps we tried to take:

1. Brainstorm and prototype game ideas.
2. Document goals and requirements for the best idea.
3. Break requirements into tasks/features and add them to a schedule.
4. Develop.
5. Test.
6. Iterate and reevaluate requirements.

Hmm... These steps sound familiar.

Exercise 3, Part 1

Download, unzip, and play these versions of the game:

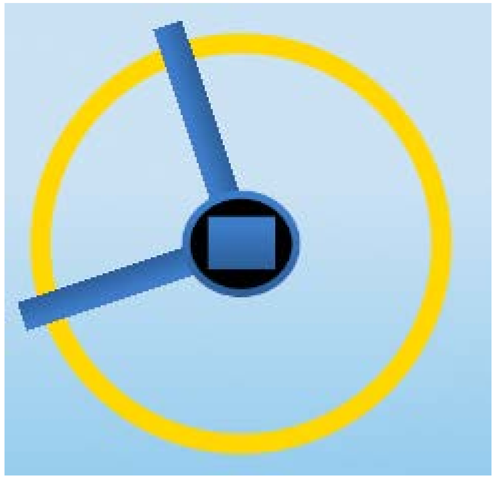
August 16, 2013	(08-16-13.jar)
August 22, 2013	(08-22-13.jar)
September 27, 2013	(09-27-13.jar)
October 16, 2013	(10-16-13.jar)
November 21, 2013	(11-21-13.jar)

Exercise 3, Part 2

- Spend a couple minutes exploring each version.
- Note any new features, bugs, or changes between versions.
- Don't worry about beating levels.
  - Levels (if they even exist) aren't ordered correctly by difficulty.
  - A lot of helpful tutorial features are missing.

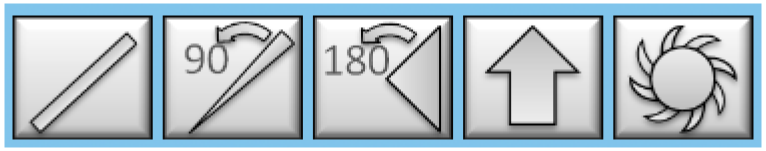
August 16, 2013

- Did you have fun?
  - Probably not. This version isn't a game yet.
- Goals of this version:
  - Have the developer learn Java FX.
  - Implement a few basic features.
- Notable features:
  - Display images on screen.
  - Detect mouse events.
  - Rotate BlueBumpers.
  - Drag and drop an icon into slots (N, E).



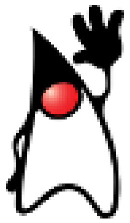
August 22, 2013

- One week later:
  - This version still isn't a game.
  - But it's looking more impressive.
- Notable features:
  - User Interface (UI) wheels and icons positioned on the right
  - A RedBumper
  - Colorized attachments
  - More icons to drag and drop



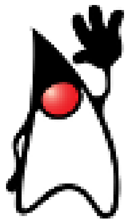
September 27, 2013

- About one month later:
  - This version could be called a game.
  - The goal is to deflect the ball to Duke.
- You'll notice a couple files after unzipping:
  - The new folder holds code responsible for ball movement.
  - A different developer created the code.


Duke

September 27, 2013

- Notable features:
  - A Play button and a goal (Duke)
  - A ball that can move and be deflected
  - More shapes that can be attached
  - Yellow lines (for collision detection)
  - Wheels that snap to the nearest 45-degree increment



Duke

October 16, 2013

- A few weeks later, we created additional game modes (Inheritance & Geometry Test).
- There is a pop-up for choosing levels.
  - Because we didn't know how to unload/swap between levels.
  - You have to close the program to load a different level.
  - Levels are for testing features, and aren't quite puzzles for players.

October 16, 2013

- More notable features:
  - Level geometry
  - A GreenBumper and GreenWheel
  - Level-building instructions are read from a text file (but you couldn't have known that)

November 21, 2013

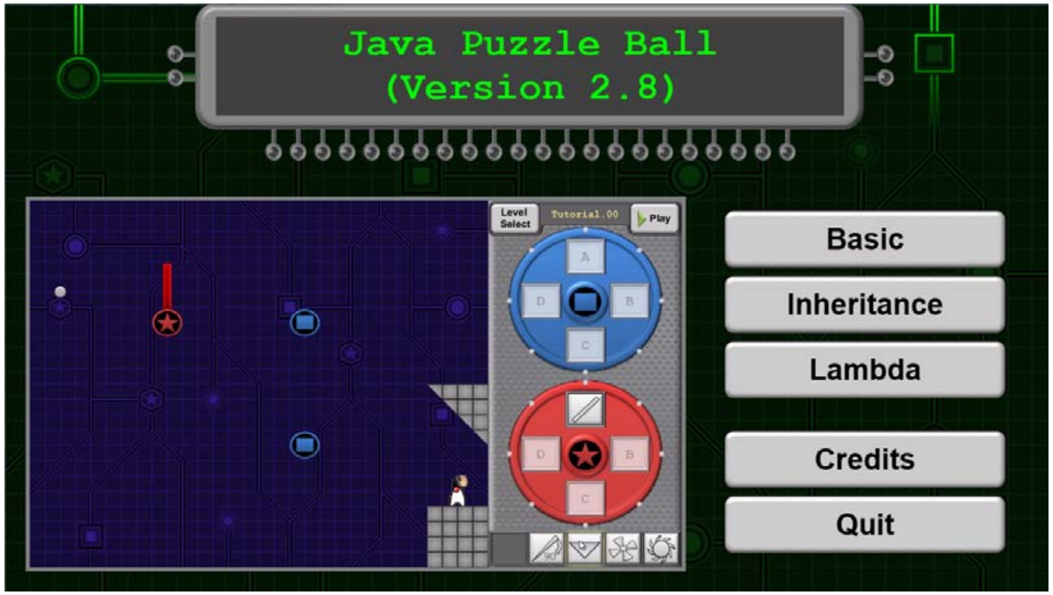
- Over one month later:
  - We figured out how to unload levels!
  - Only a single file is necessary to run the game.
- Use the Options button to choose levels.
  - It's a temporary solution until we learned to create menus.
  - Levels are actual puzzles instead of tech demos.

November 21, 2013

- More notable features:
  - Fancy new background art
  - More levels
  - Slots are labeled ABCD instead of NESW (People thought their solutions were wrong if the N slot didn't face north.)

The Current Version

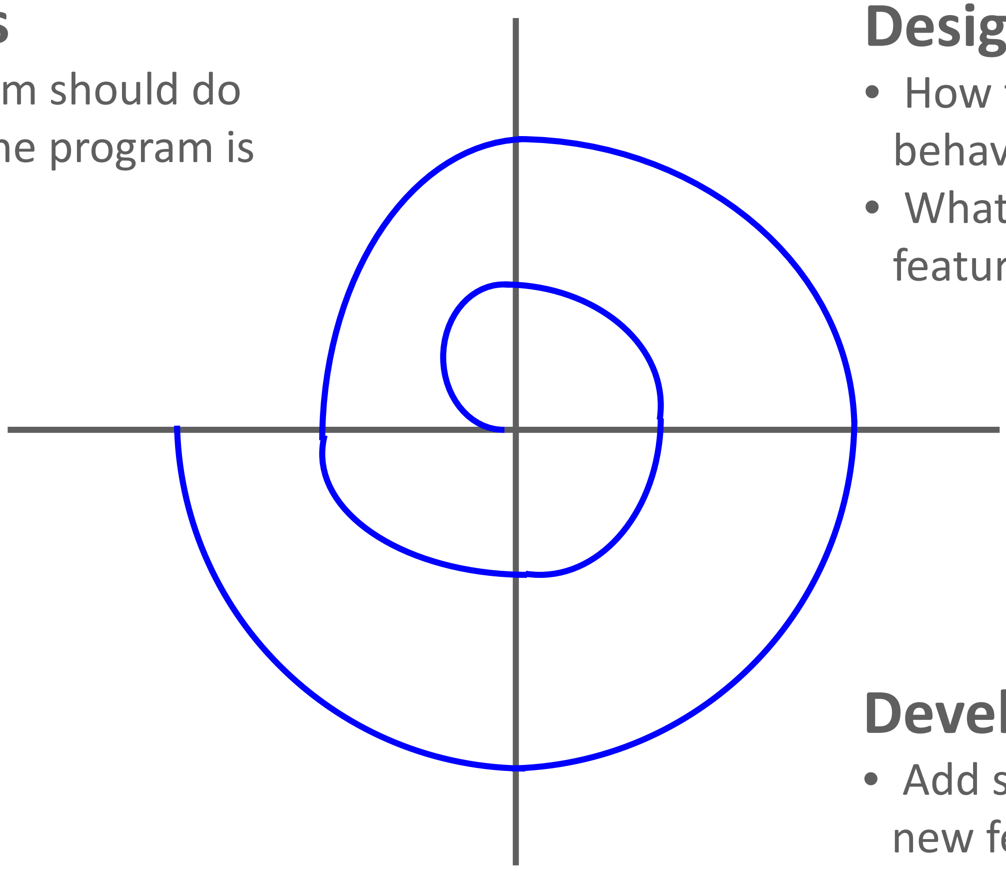
- Development continued several more months into 2014.
- You'll notice new features and changes in the latest version.
- We'll revisit Java Puzzle Ball later in this course.



Spiral Model Summary

Requirements
- What the program should do
- What problem the program is trying to solve

Design
- How to model data and behaviors
- What order to implement features



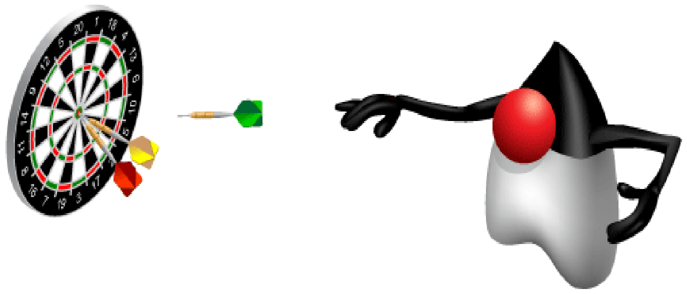
Test
- Find bugs
- Fix bugs

Develop
- Add simple versions of new features
- Enhance existing features

Summary

In this lesson, you should have learned how to:

- Understand the Spiral Model of development
- Recognize tasks and subtasks of the Spiral Model
- Recognize what happens when steps are ignored
- Identify software features
- Understand how features are gradually implemented



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