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Java Foundations

2-1
The Software Development Process

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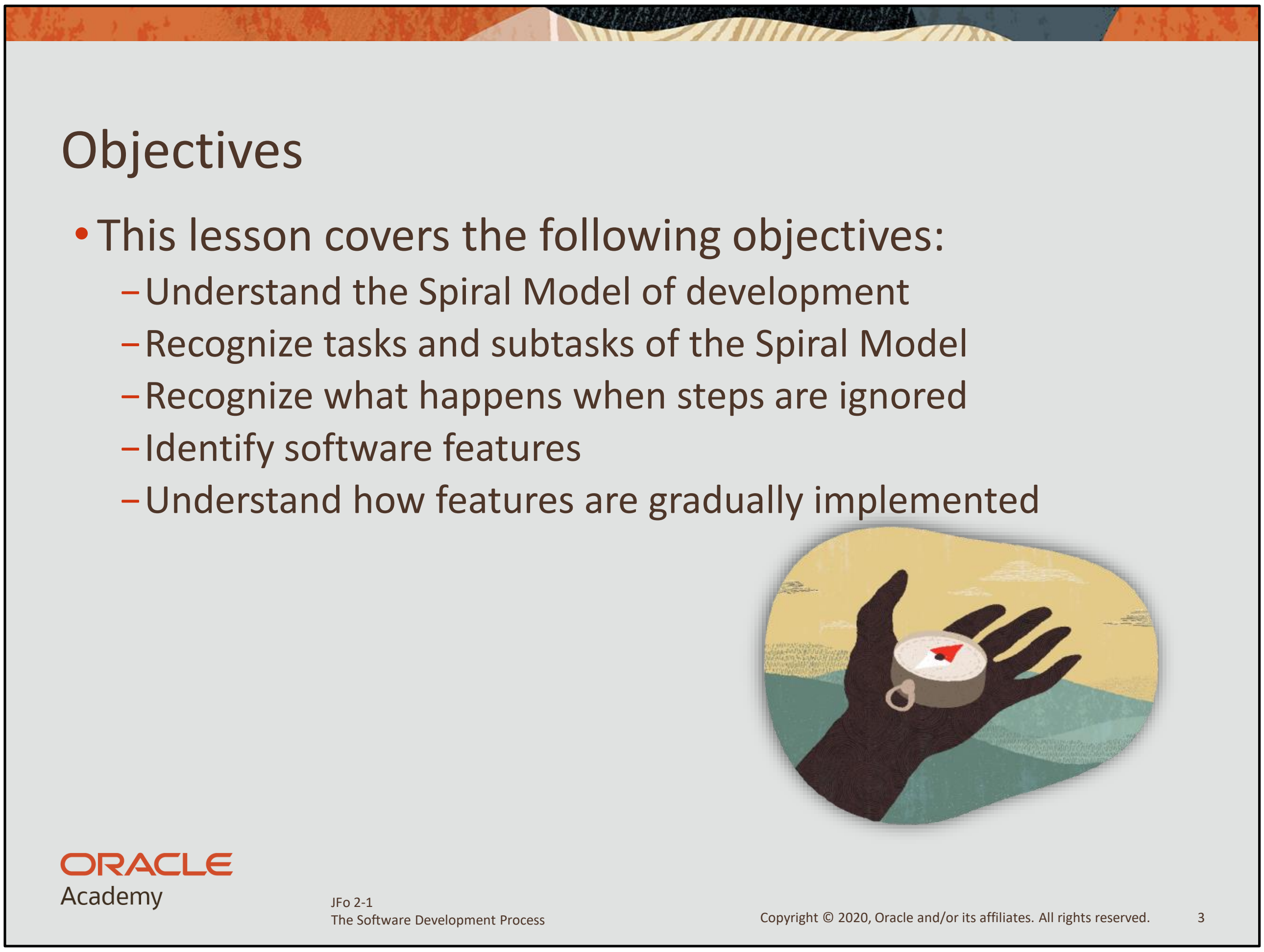

Objectives

- 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

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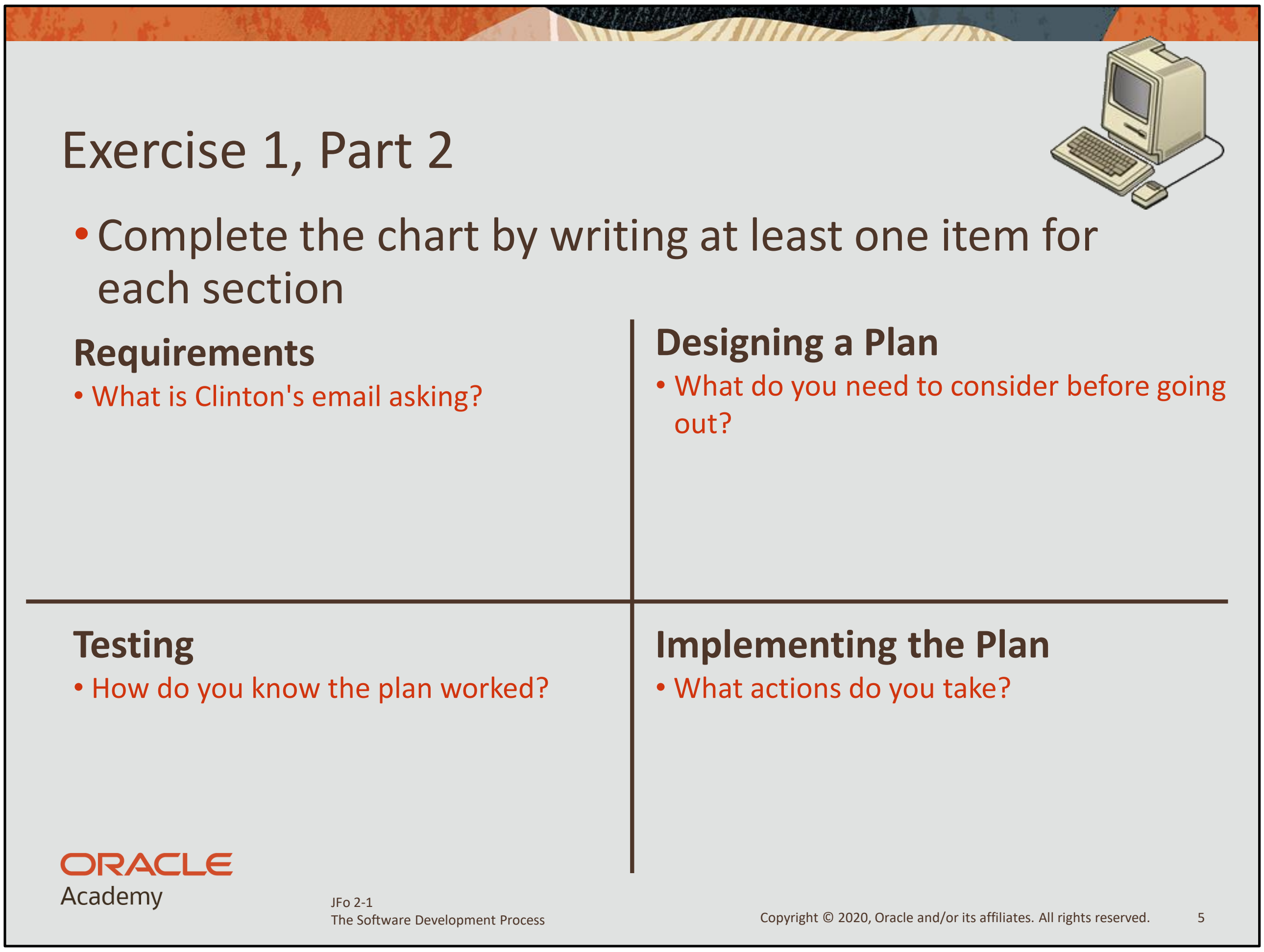
Exercise 1, Part 1

- 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.

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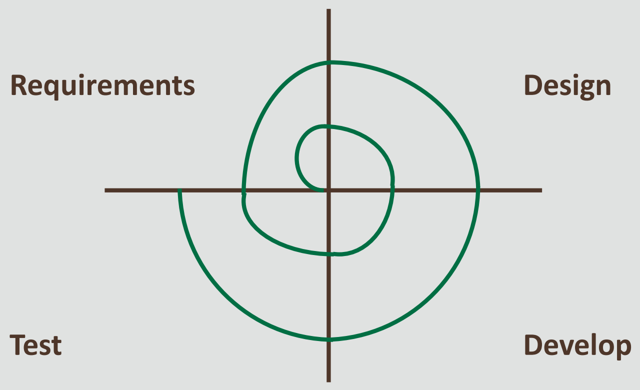
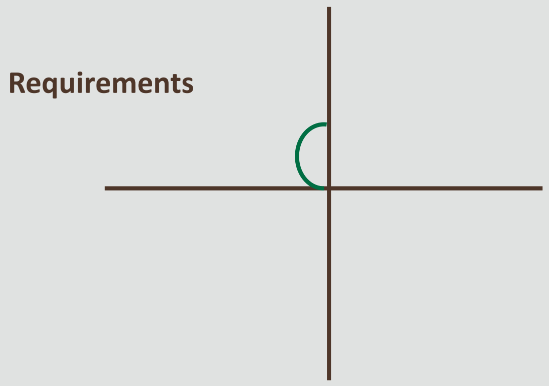
Introducing the Spiral Model of Development

- 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



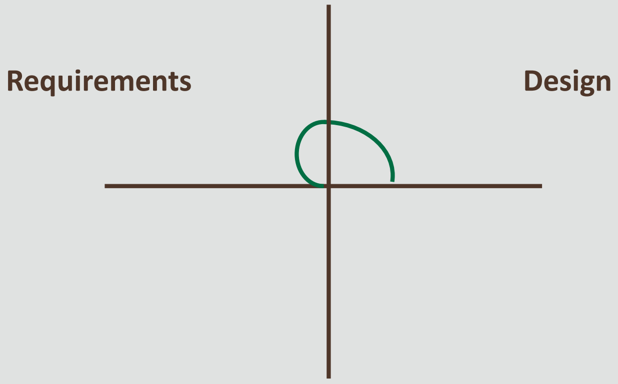
Requirements

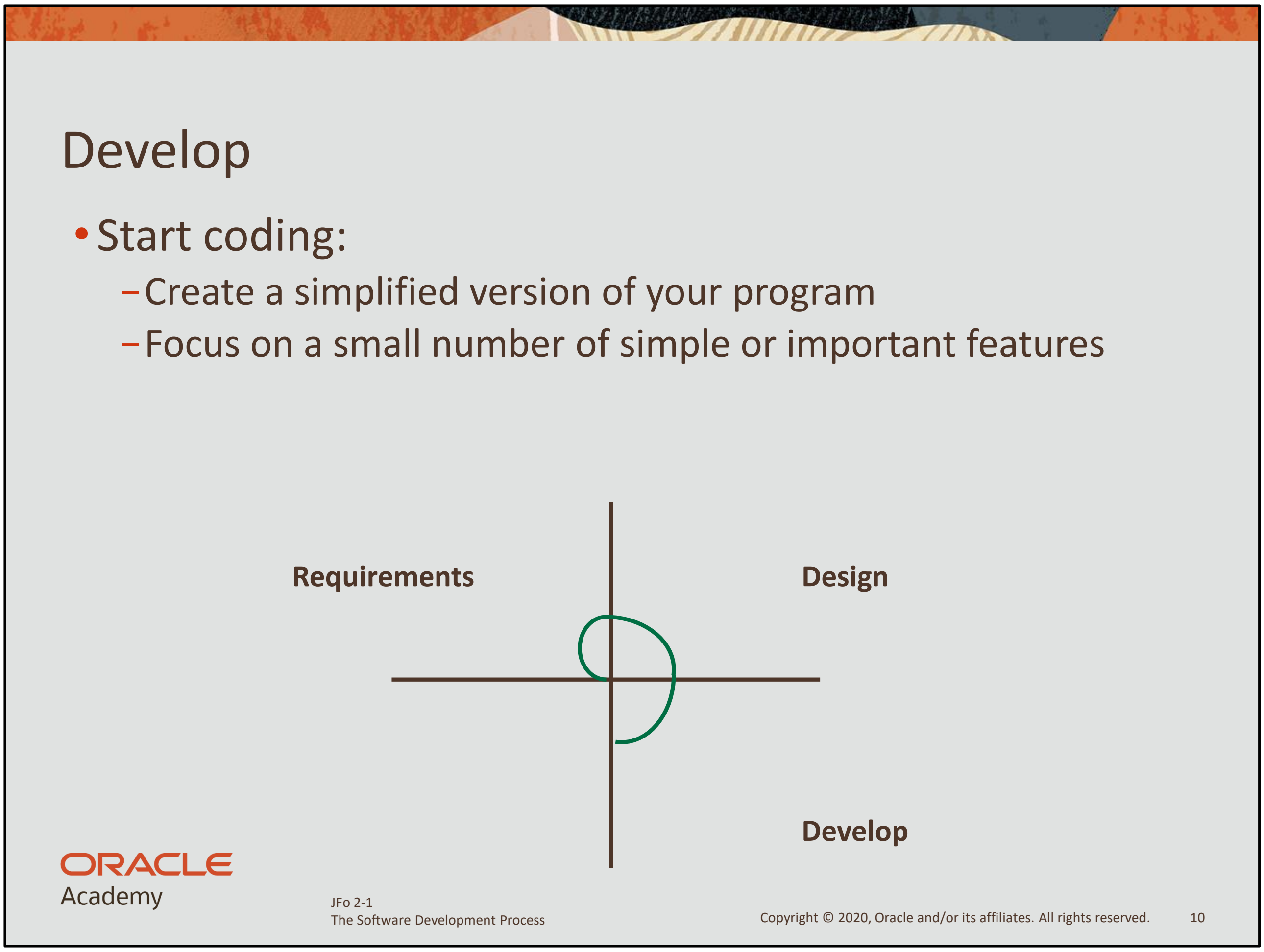
- Carefully read any instructions:
  - What should your program do?
  - What problems is it trying to solve?
  - What features must your program have?



Design

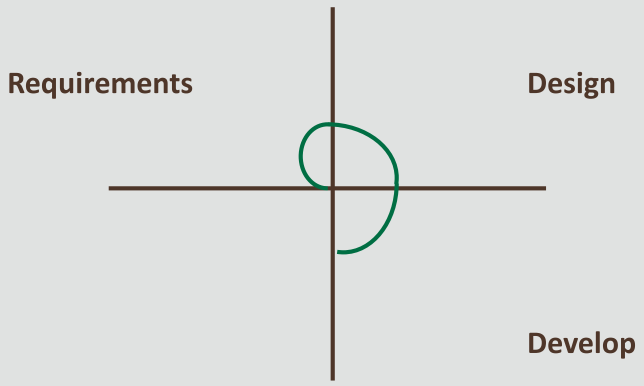
- Plan your approach:
  - Are there data or behaviors your program must model?
  - Will certain parts of your program need to be finished before work can begin on other parts?





Develop

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



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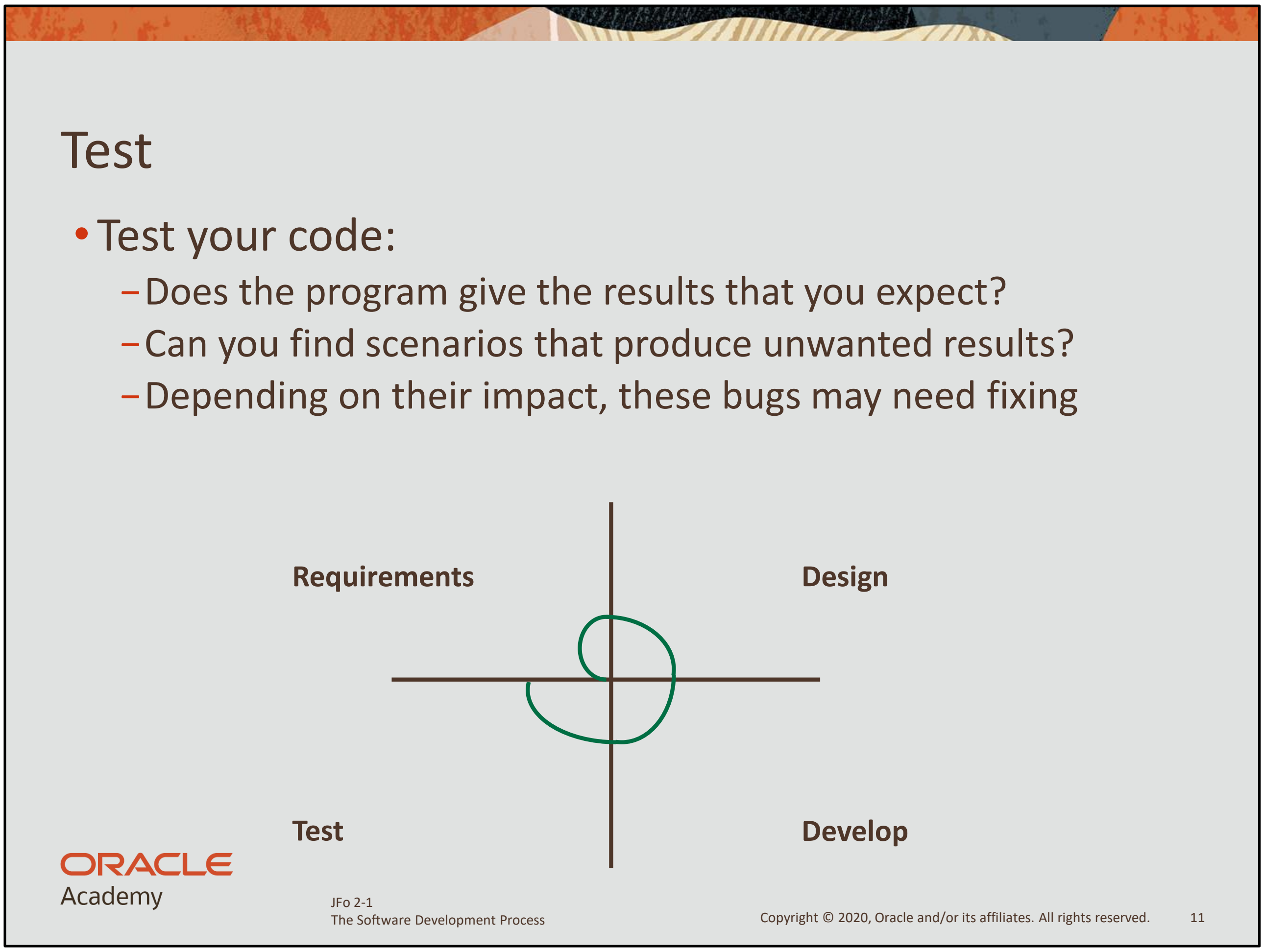
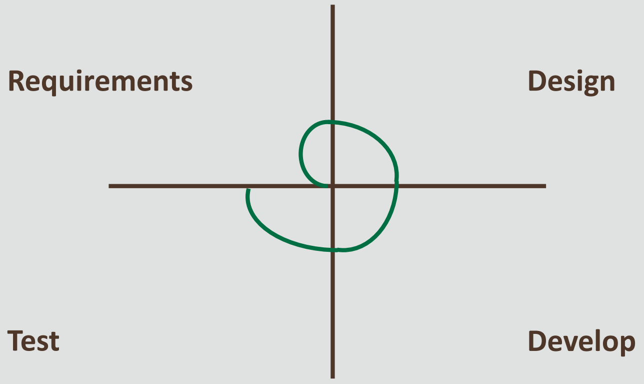


Test

- 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



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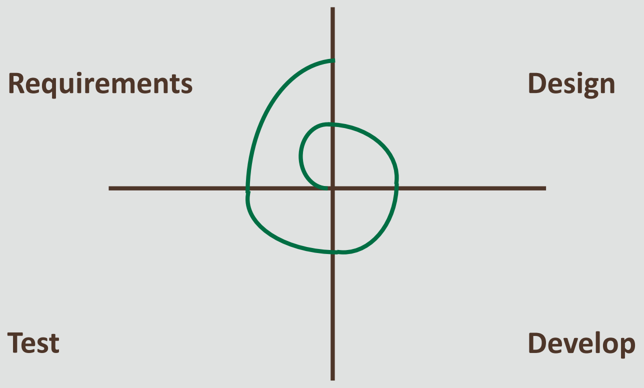
Requirements Iteration

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



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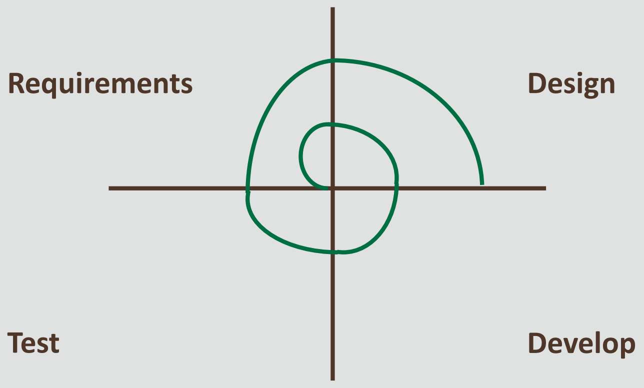
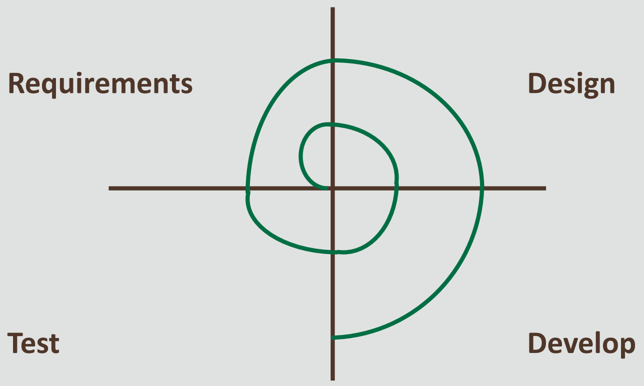
Design Iteration

- 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



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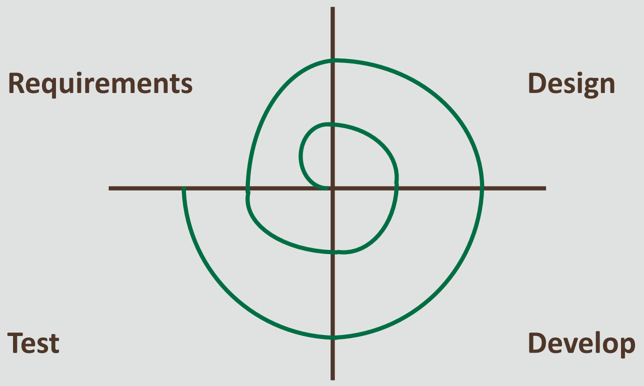
More Testing

- 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

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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

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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

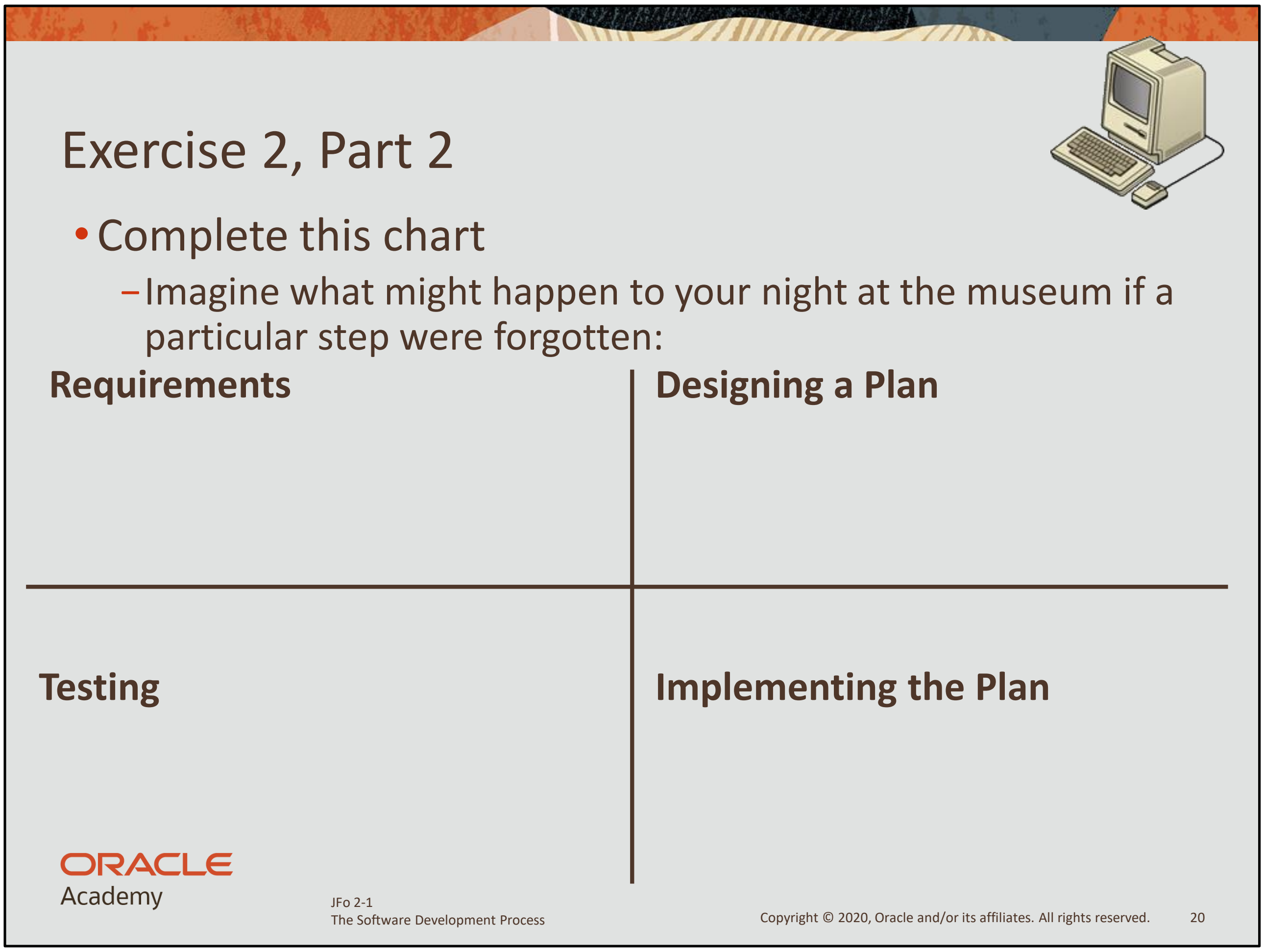
Exercise 2, Part 1

- 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**

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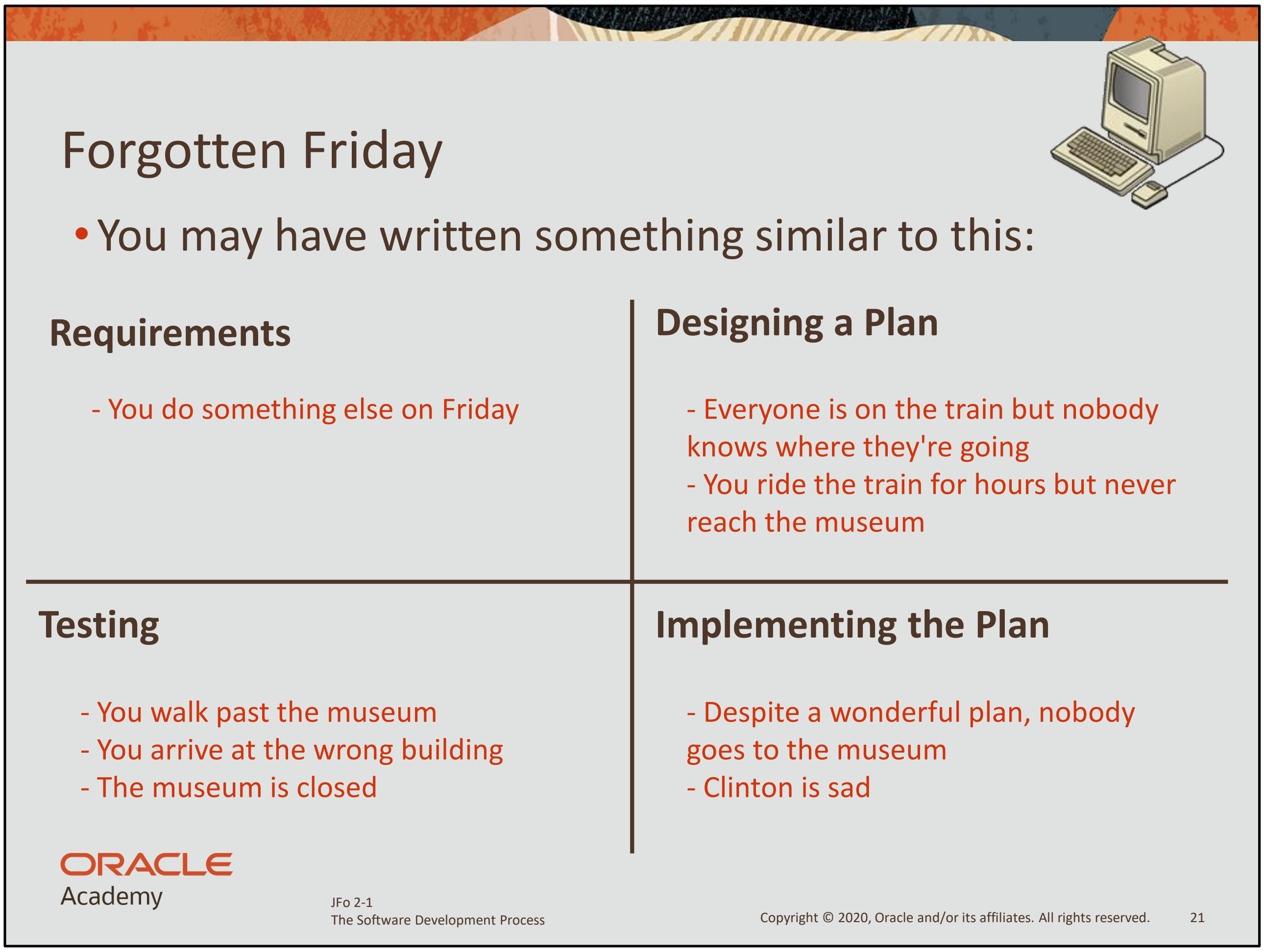

Forgotten Friday

- 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

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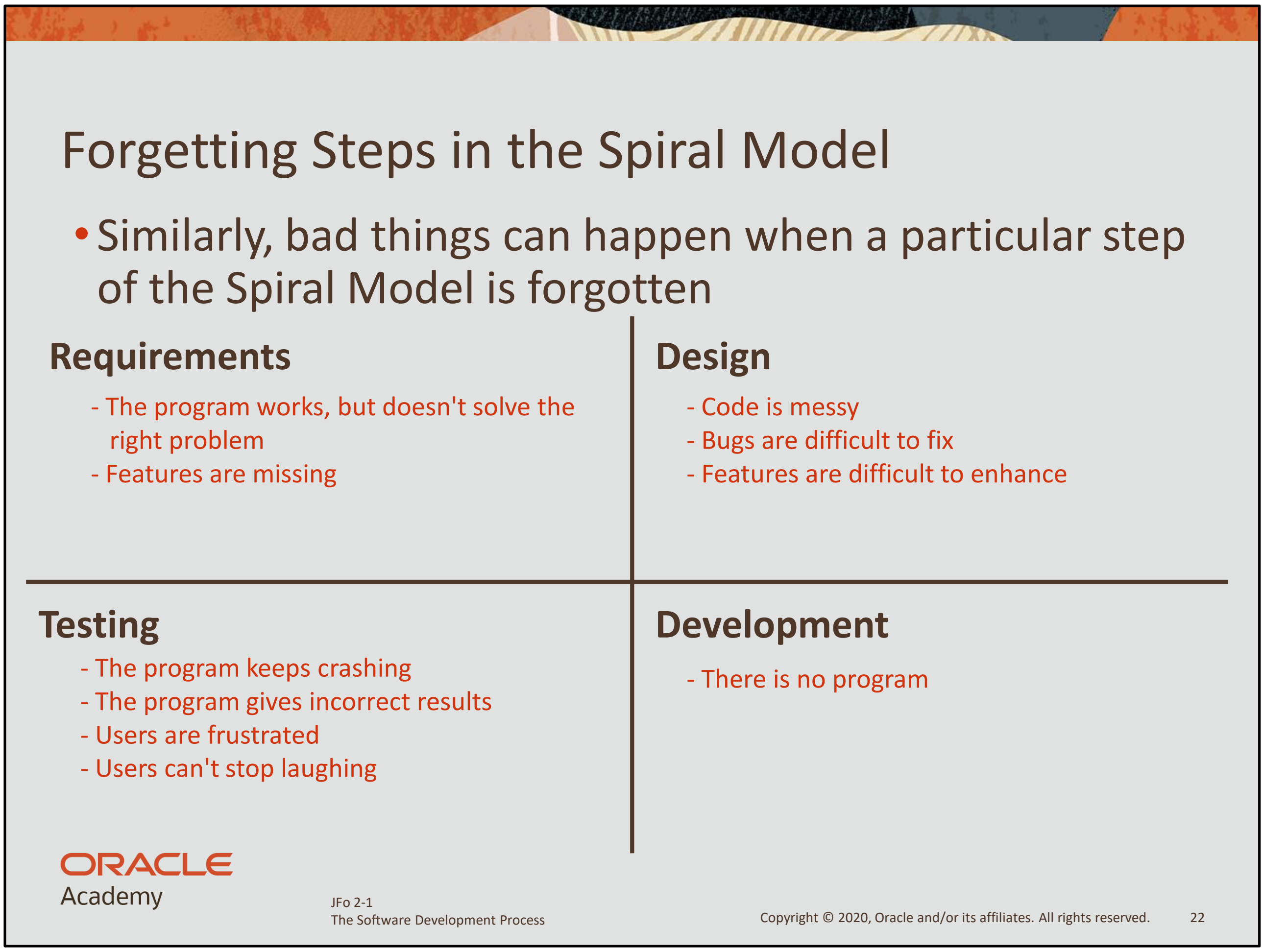

Forgetting Steps in the Spiral Model

- 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

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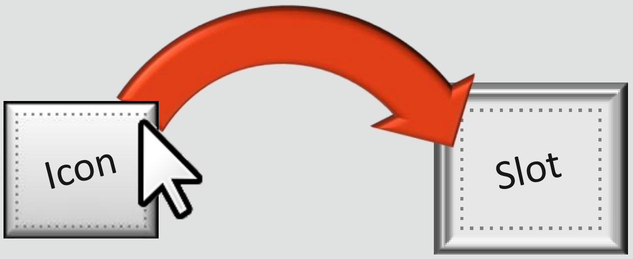
Sometimes buggy programs are very funny.

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



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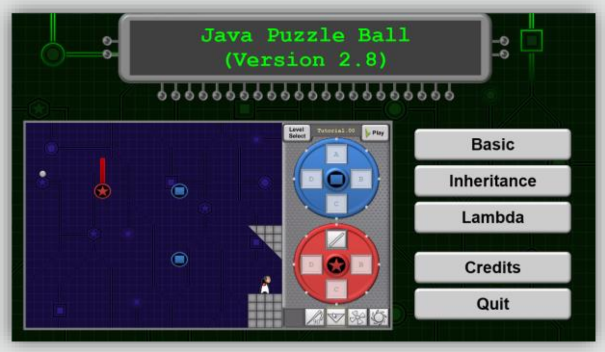
Implementing "Drag and Drop"

- 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!



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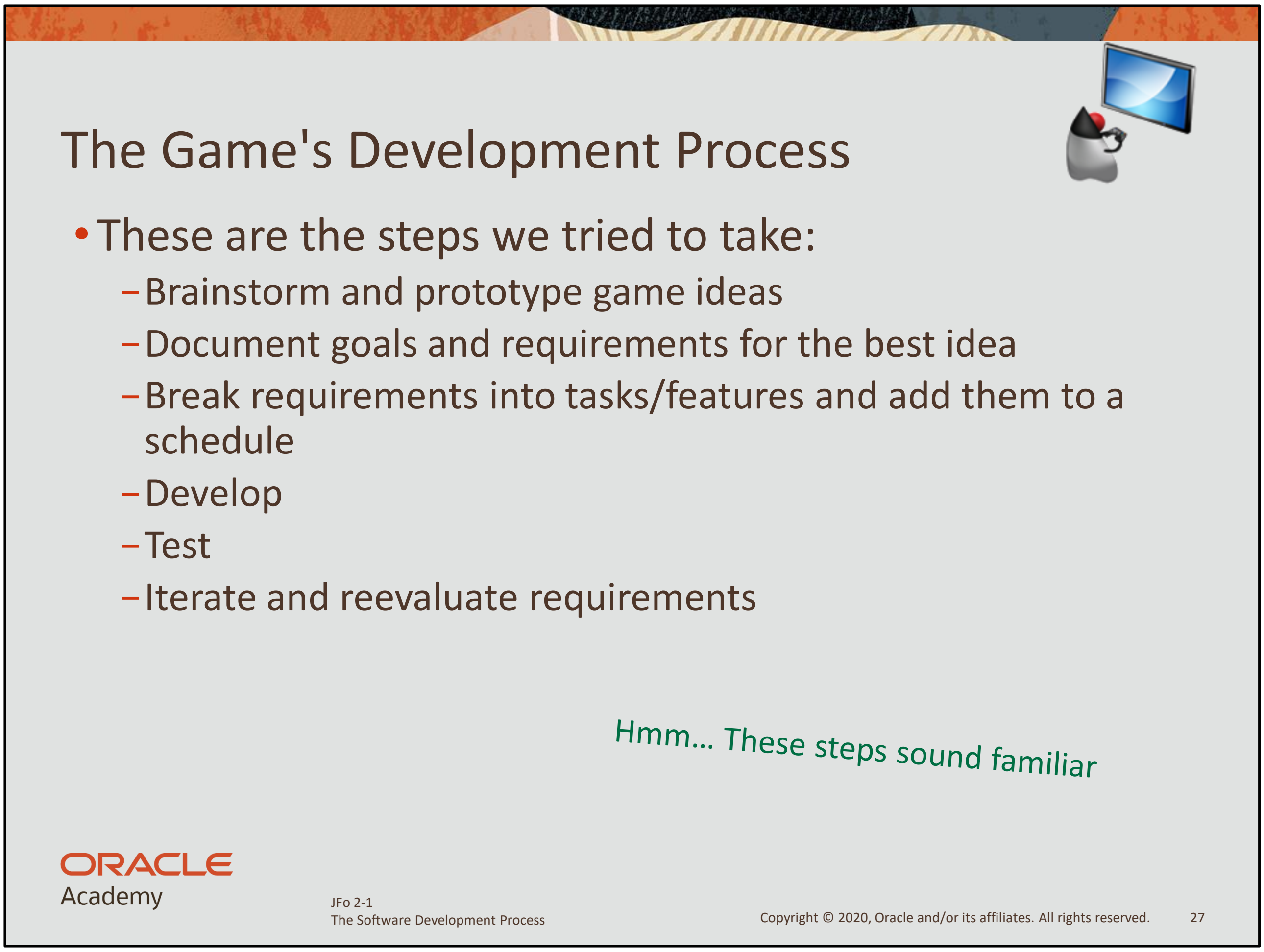
Have you installed Java on your machine yet? You'll need JRE 8 or later installed to run this game.



The Game's Development Process

- These are the steps we tried to take:
  - Brainstorm and prototype game ideas
  - Document goals and requirements for the best idea
  - Break requirements into tasks/features and add them to a schedule
  - Develop
  - Test
  - Iterate and reevaluate requirements

Hmm… These steps sound familiar

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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

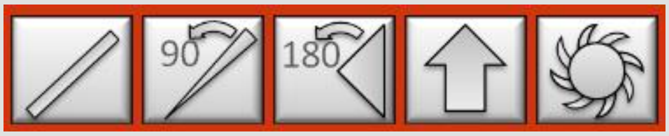
- Spend a couple minutes exploring each version
- Note any new features, bugs, or changes between versions
- Don't worry about beating levels
  - Levels (if they even exist) aren't ordered correctly by difficulty
  - A lot of helpful tutorial features are missing

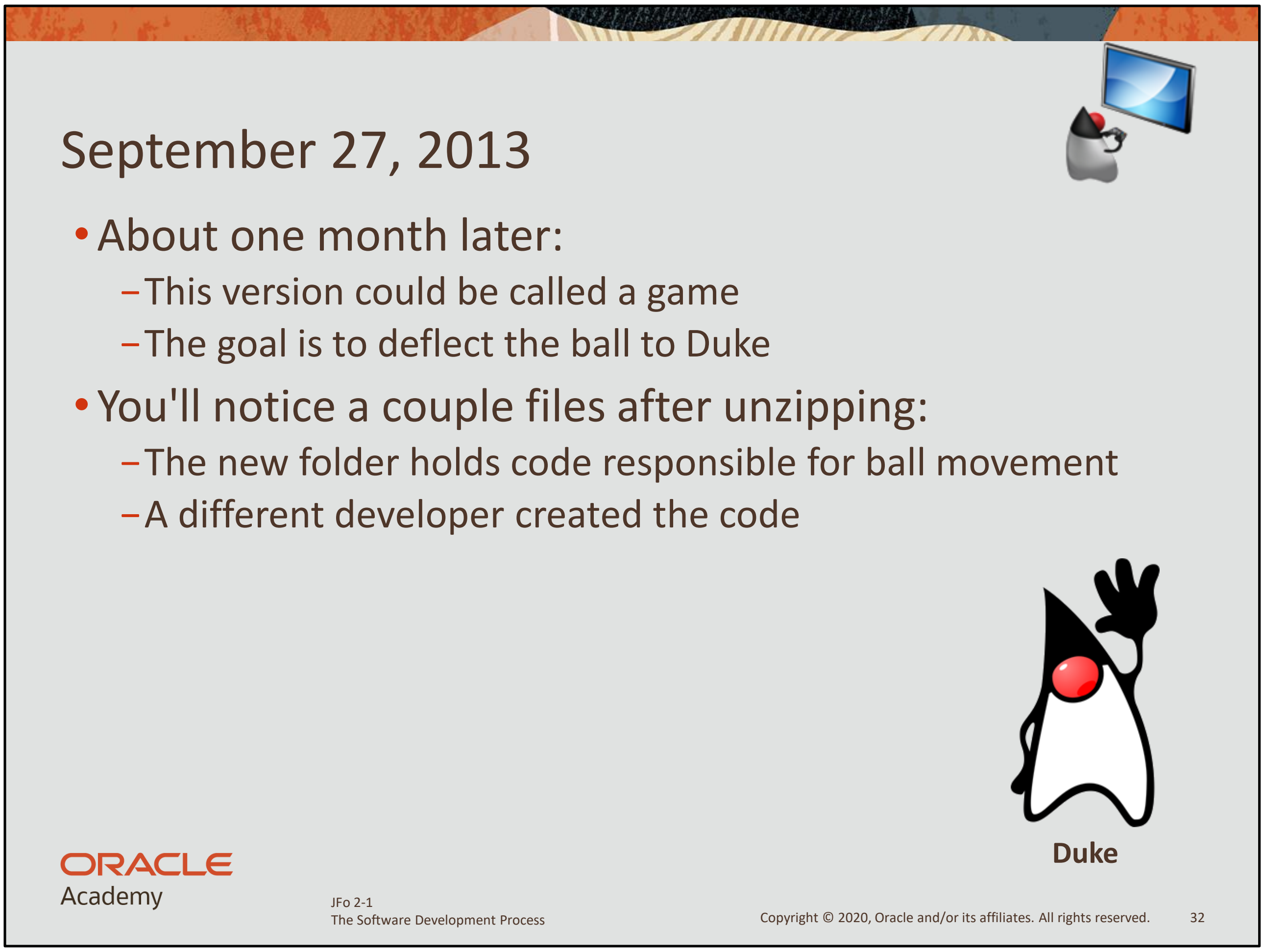
August 16, 2013

- 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

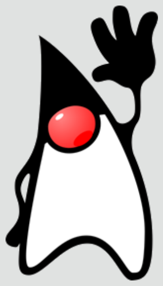
- One week later:
  - This version still isn't a game
  - But it's looking more impressive
- Notable features:
  - User Interface (UI) wheels and icons positioned on the right
  - A RedBumper
  - Colorized attachments
  - More icons to drag and drop





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



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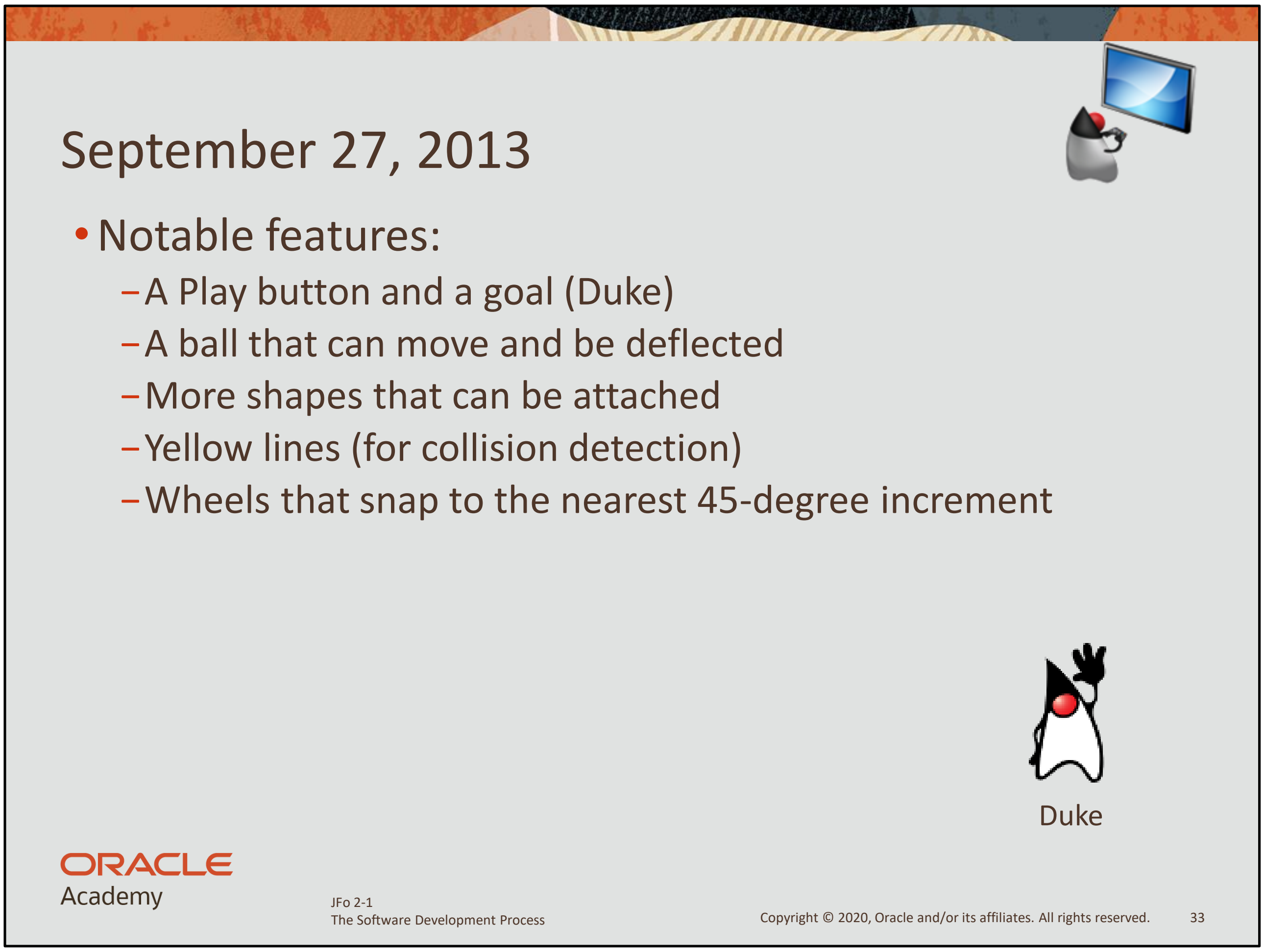
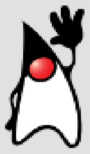
Wheels snap every 45 degrees because the code responsible for ball movement wasn't designed to calculate only eight possible collision/angle scenarios.



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



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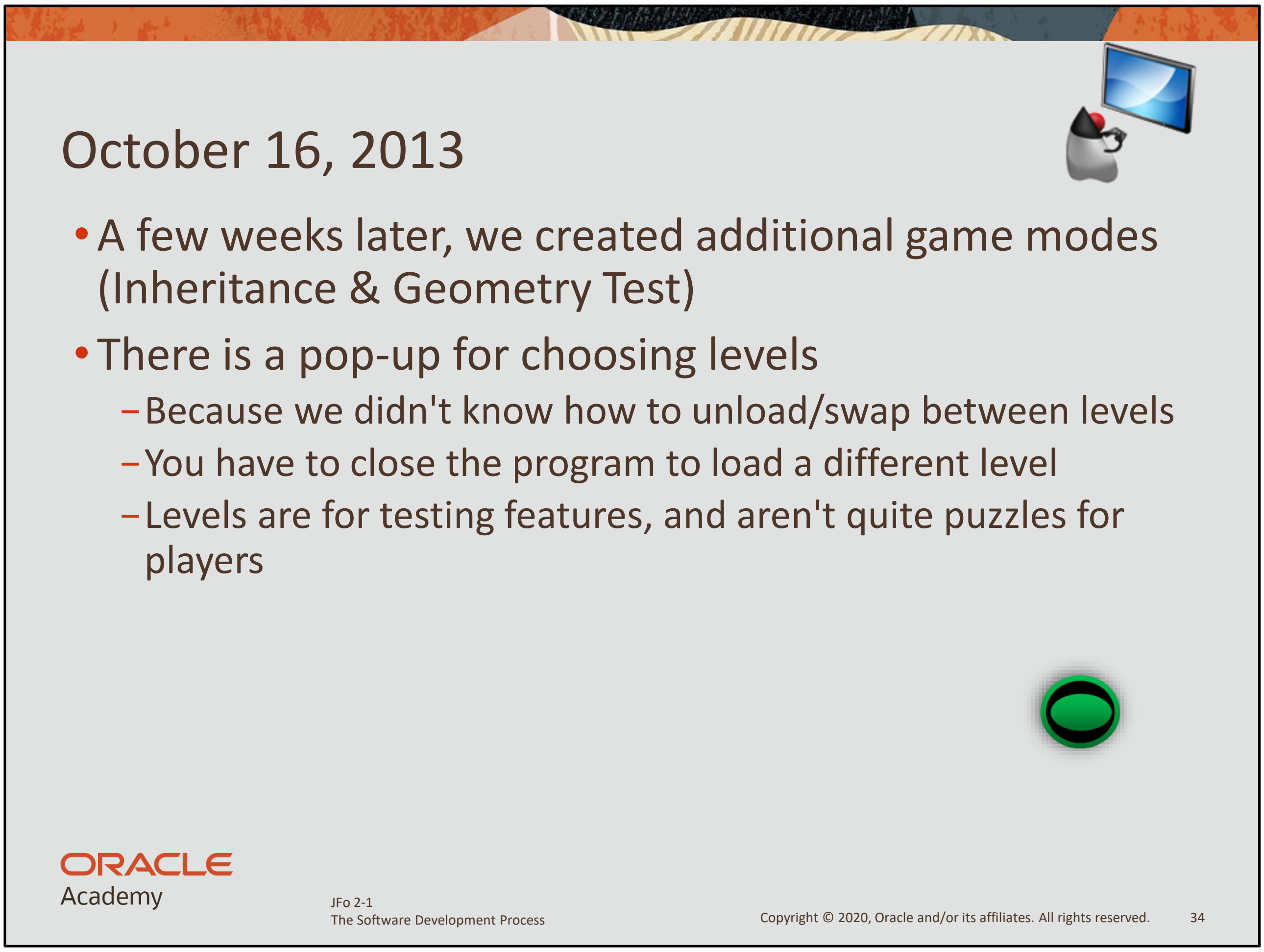
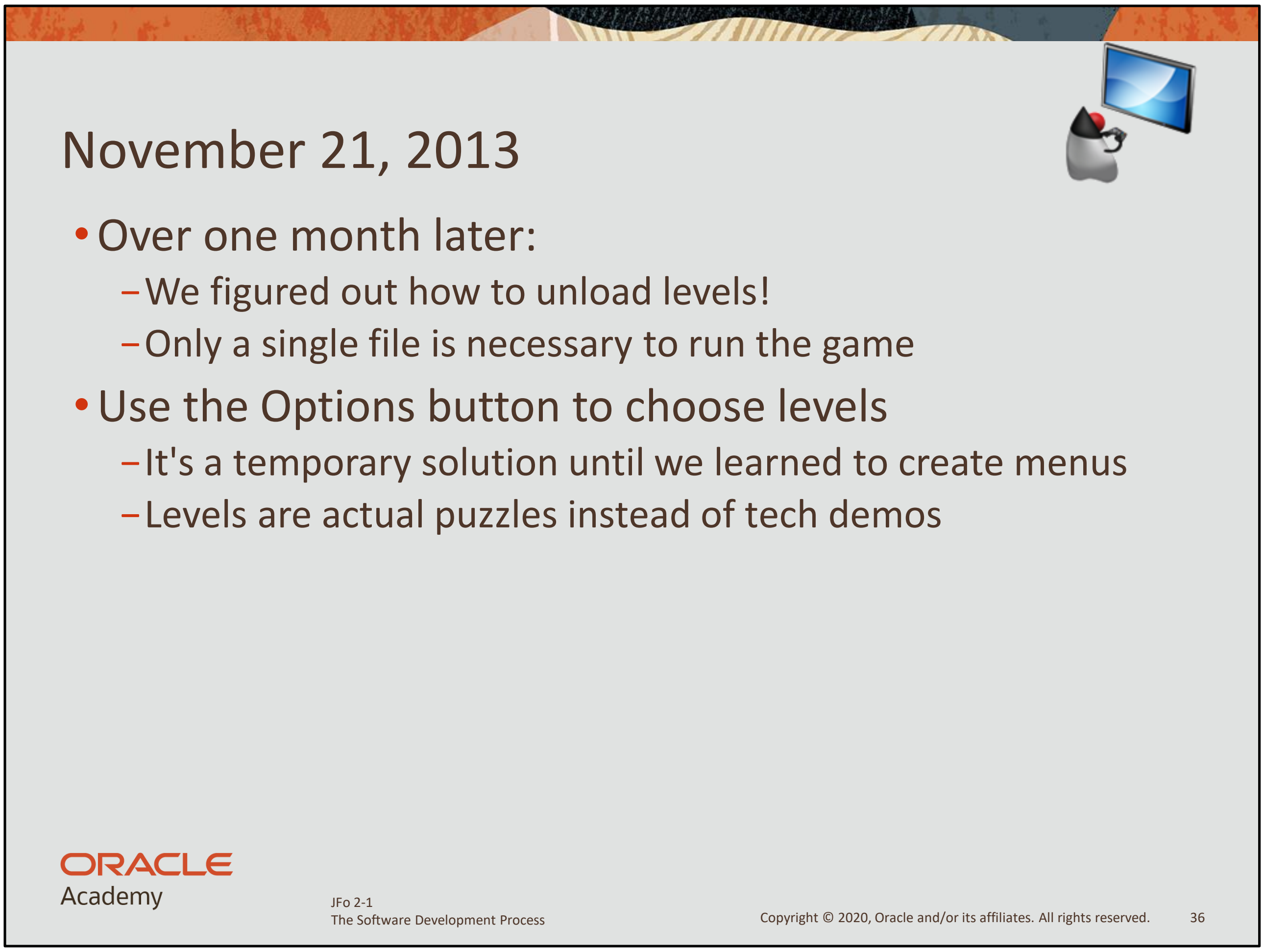


October 16, 2013

- 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

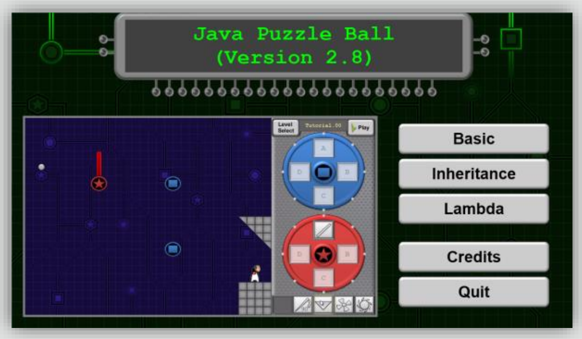
- Over one month later:
  - We figured out how to unload levels!
  - Only a single file is necessary to run the game
- Use the Options button to choose levels
  - It's a temporary solution until we learned to create menus
  - Levels are actual puzzles instead of tech demos

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)

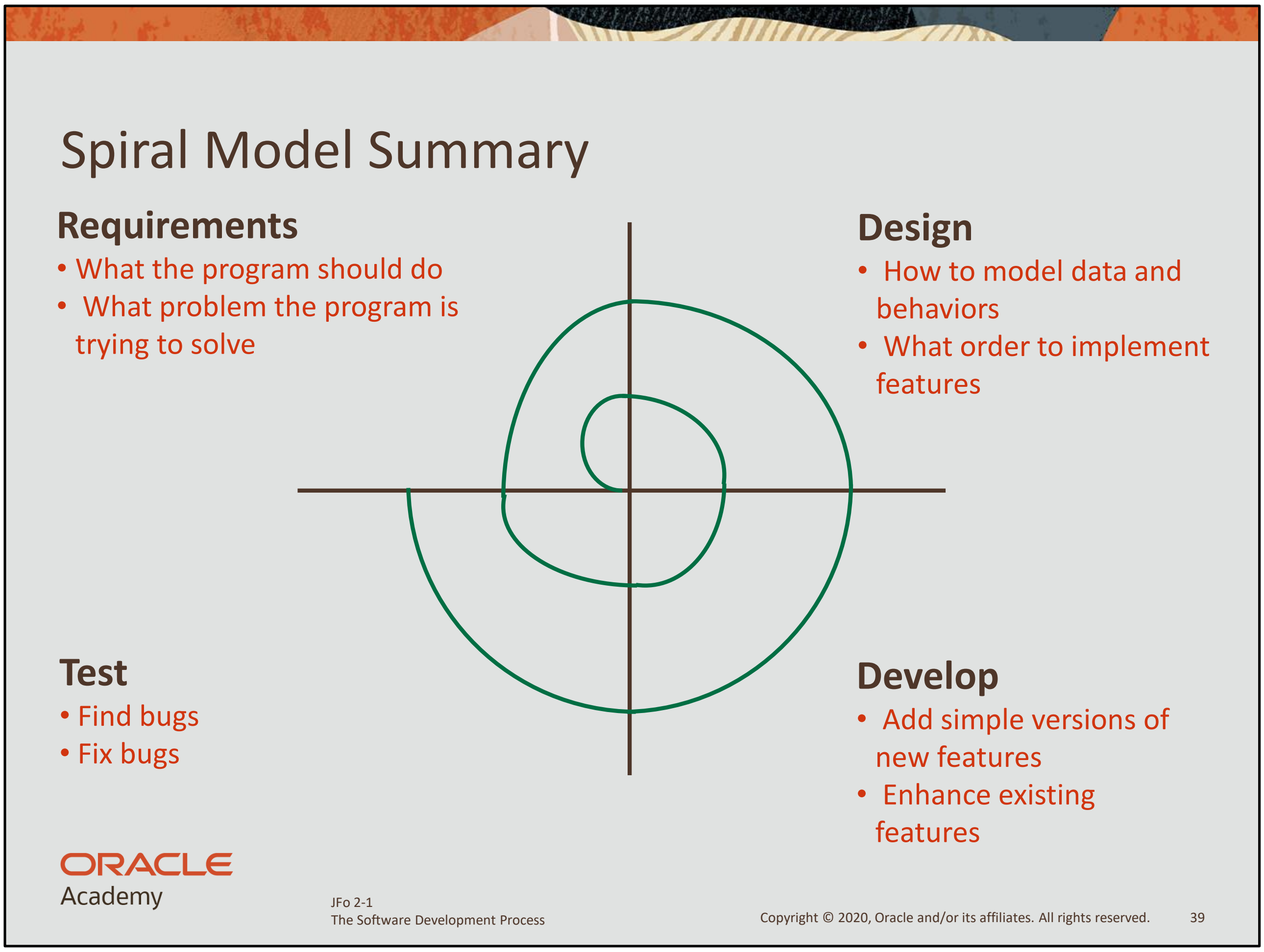
The Current Version

- 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



There were features that never made it into the game, either because we didn't have time or we thought they would be a bad idea; for example, puzzles with more than one ball (super difficult multi-threading puzzles). There are also a few bugs with the current version.

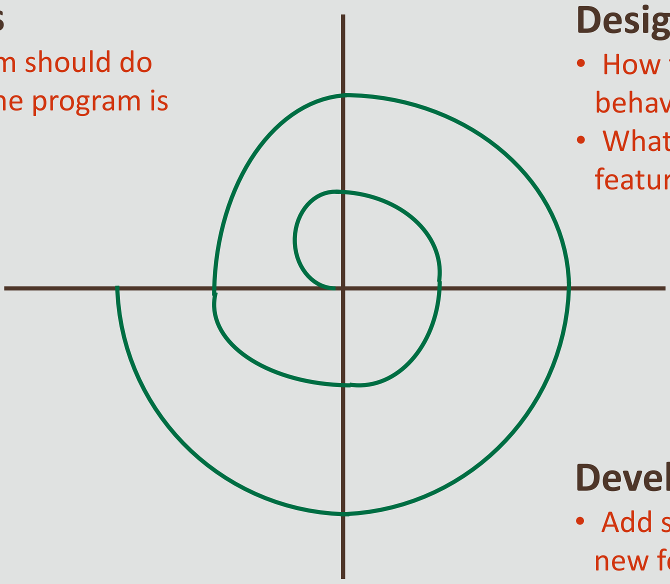
We'll encounter Java Puzzle Ball next in Lesson 3 of this section.



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

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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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