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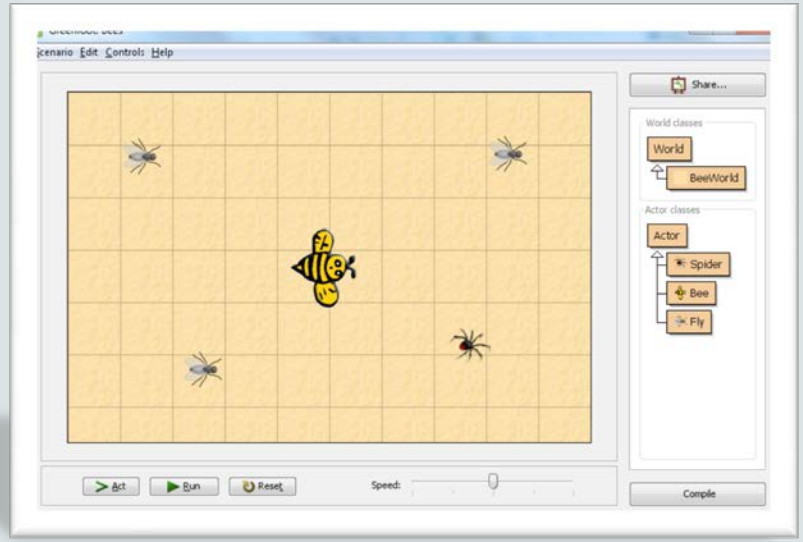
Java Fundamentals

3-4
Developing and Testing an Application



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Objectives

This lesson covers the following objectives:

- Demonstrate program testing strategies
- Recognize phases for developing a software application

Program Testing Strategies

- A programmer tests a program many times during the course of its development to ensure it works properly.
- Program testing strategies:
  - Test frequently after each method, or a sequence of methods, are written.
  - Compile the program to ensure it is error-free. If errors appear, correct them.
  - Run the program to observe how the methods make the objects move.
  - Continue to add methods and adjust as necessary.

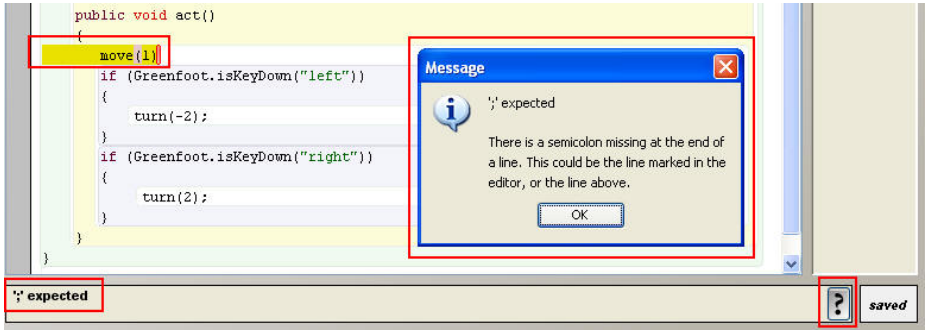
Compilation and Debugging

- Every character in source code counts. One missing or incorrect character could cause your program to fail.
- In Greenfoot, compilation highlights syntax errors and what is required to correct them.
- This helps you develop good programming techniques.

Bugs are errors in the code of a computer program. To debug a program, the programmer compiles the program and reads any error messages that Greenfoot provides. Then, the programmer corrects those errors in the syntax and re-compiles the program. Testing will then move onto the logic in the code.

Steps to Debug Your Program

- Click Compile to compile the code.
- If there are no errors, the message "Class compiled – no syntax errors" displays.
- If there are errors, the incorrect syntax is highlighted and a message attempts to explain the error.
- Click the question mark icon to display additional information about the error.

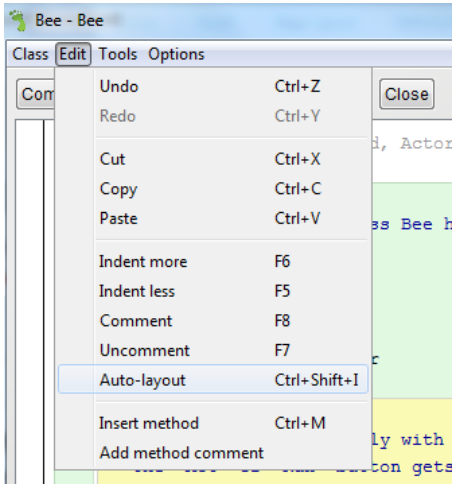


Keys to Recognizing Java Syntax Errors

1	Locate the beginning and end of a method.
2	Ensure all beginning { and ending } braces exist.
3	Ensure all open (and closed) parentheses exist.
4	Ensure all lines of code end with a semicolon.
5	Ensure class names are spelled and capitalized properly.
6	Review all dot notation (i.e., System.out.println).
7	Ensure similar-looking characters are correct (number 1 versus letter i).
8	Ensure all string quotes are double " not single '.

Auto-Layout

- A useful function within the Greenfoot code editor is the Auto-Layout feature.
- You will find this automatically structures your code and is a great tool to find where your missing brackets are!



Phases to Develop an Application

- Analyze the problem to solve or task to perform.
- Design the solution, which is commonly a game in Greenfoot.
- Develop the game in Greenfoot.
- Test the game to ensure it works and meets the requirements of your analysis and design.
- Developing a game in Greenfoot follows the same steps as developing a software application.

Analysis Phase

- In the analysis phase, determine what problem the game will solve, or the task it will perform, using object oriented analysis.

In object oriented analysis, Java programmers analyze a problem and then create objects to build a system, or more specifically, to solve the problem.

Analysis Phase Tasks

- Identify a problem to solve.
- Write a brief statement of scope that states the type of solution (game) that will solve the problem.
- Gather the target audience's requirements. These are the people who most likely will play your game.
- Identify and describe objects in the game.
  - Physical objects (car, person, tree).
  - Conceptual ("non-physical") objects (timer that counts down time remaining in the game).
  - Attributes of all objects, such as color, size, name, and shape.
  - Operations that the objects perform (move, turn, eat other objects).

Analysis Example

Analysis Item	Description
Problem domain	I want to create a game to teach students to control a Bee with the cursor keys.
Game player's requirements	It should be easy for kids of all ages to play. It requires the player to have a keyboard.
Objects	1 Bee object that will catch flies. Multiple Fly objects. 1 Spider object which will catch flies and the Bee. 1 World with a light colored background.
Objects operations	Bee: Move, turn, and catch flies. Fly: Randomly move around the screen. Life count: Count down by 1 from 3 every time the Bee is caught by a Spider. Background: Do nothing.

Analysis Pre and Post Conditions

- Capture information to support testing for:

Item to Test	Example
Pre- and post game conditions.	Variable initialized values versus final values after program execution.
Anticipated run times and comparison run rates given a set of conditions.	Run rates can vary based on computer memory size variance.
Expected results for statement execution counts.	A loop counter of three will produce three new variables.
Numerical representations and limitations.	An integer's maximum value.

Design Phase

- The solution you design will be in the form of a Greenfoot game that your target audience can play.
- Design your game in a textual storyboard that plans the algorithms, or methods, that objects will perform in response to keyboard commands or mouse clicks.

Textual Storyboard Example

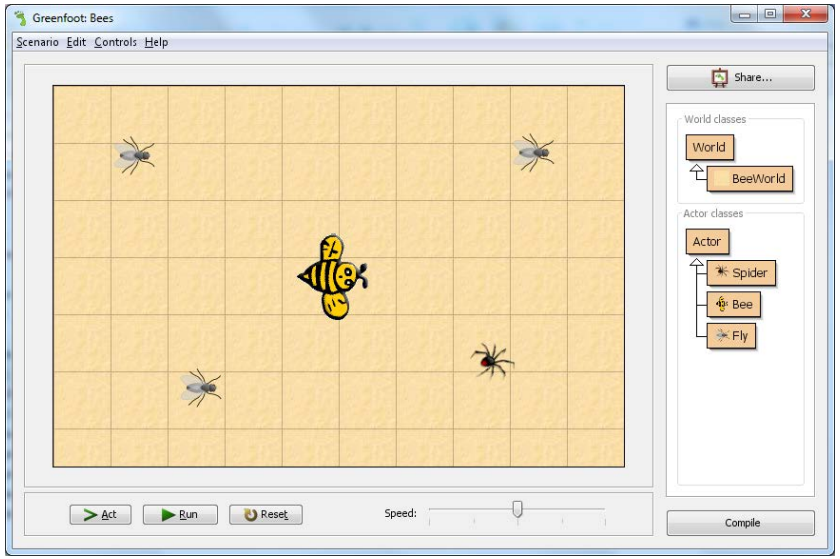
- This textual storyboard on the next slide describes a simple game where you control a Bee to try and catch Flies while avoiding a Spider.
- The spider will also catch flies.
- You will gain points for every Fly caught and lose a life every time a Spider catches the Bee.
- The game ends when you run out of lives.

Textual Storyboard Example

- When the Run button is clicked, the bee will continually move forward.
- The player uses the arrow keys on the keyboard to control the bee's left and right movements.
- When the Bee is in the same square as a randomly moving Fly, it is then caught and removed from the game and another Fly is added.
- A Spider will move randomly around the screen. If the spider catches a Bee then the user loses a life. If it catches a fly then its removed from the game.
- Game ends when the user has no lives remaining.

Development Phase

- After you finalize your storyboard, develop your game in Greenfoot.
- Refer to your storyboard to determine the methods you need to program.



Testing Phase

- After you write a section of code, compile it, then test it by clicking the Run button in the environment.
- Observe the game then revise the code as necessary.
- For quality assurance purposes:
  - Have other people test your game and give you feedback.
  - Seek people who fit the target audience for your game.
- Write test plans that:
  - Examine pre and post conditions.
  - Compare run time rates and execution counts.
  - Thoroughly test numerical representations and limitations.

Testing Numerical Representations and Limits Example 1

- For example, a banking solution requires precise rounding of numbers.
  - This program could produce incorrect results if the rounding of a number was not set to two digits after a decimal point.
  - The addition of a 1/2 of a cent multiplied by a million customers could produce an expensive programming error.

Testing Numerical Representations and Limits Example 2

- For example, an IF construct in a program expects a positive value of 5 through 9 to then add that value to another variable.
  - The program incorrectly feeds the variable a value of 2.
  - This causes the IF construct to fail and the variable expecting a conditional change will not get the expected amount so the operation of the data structure will be different.
  - This is an example of where the program will execute the result of the conditional construct, even if it is incorrect.

Terminology

Key terms used in this lesson included:

- Bugs
- Documentation

Summary

In this lesson, you should have learned how to:

- Demonstrate program testing strategies
- Recognize phases for developing a software application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