

SECTION 2:

HW3 Setup

cse331-staff@cs.washington.edu

slides borrowed and adapted from Alex Mariakis, CSE 390a, Justin Bare, Deric Pang, Erin Peach, Vinod Rathnam

LINKS TO DETAILED SETUP AND USAGE INSTRUCTIONS

- **All References**
 - <http://courses.cs.washington.edu/courses/cse331/16sp/docs.html>
- **Working from home (& setup info): Java, Eclipse, SSH**
 - <http://courses.cs.washington.edu/courses/cse331/16sp/tools/WorkingAtHome.html>
- **Editing, Compiling, Running, and Testing Programs**
 - <http://courses.cs.washington.edu/courses/cse331/16sp/tools/editing-compiling.html>
- **Eclipse Reference**
 - http://courses.cs.washington.edu/courses/cse331/16sp/tools/eclipse_reference.html
- **Version Control - Git**
 - <http://courses.cs.washington.edu/courses/cse331/16sp/tools/versioncontrol.html>
- **Assignment Submission**
 - <http://courses.cs.washington.edu/courses/cse331/16sp/tools/turnin.html>

DEVELOPER TOOLS

- **Remote access**
- **Eclipse and Java versions**
- **Version Control**

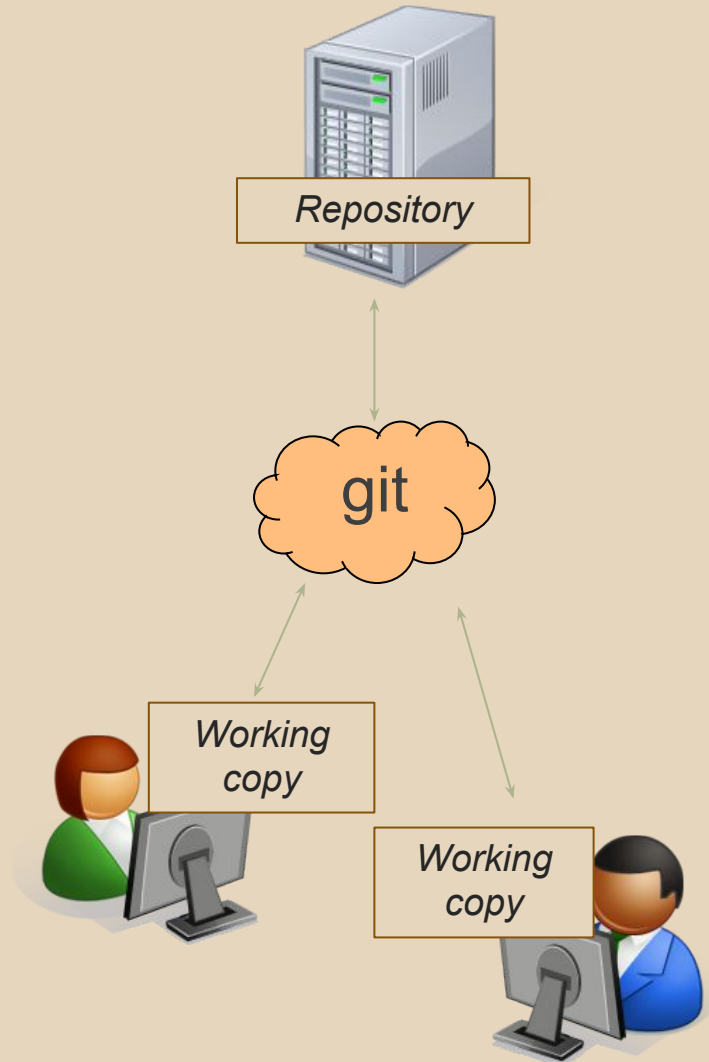
VERSION CONTROL

WHAT IS VERSION CONTROL?

- Also known as source control/revision control
- System for tracking changes to code
 - Software for developing software
- Essential for managing projects
 - See a history of changes
 - Revert back to an older version
 - Merge changes from multiple sources
- We'll be talking about git/GitLab, but there are alternatives
 - Subversion, Mercurial, CVS
 - Email, Dropbox, USB sticks (don't even think of doing this)

VERSION CONTROL ORGANIZATION

- A *repository* stores the master copy of the project
 - Someone creates the repo for a new project
 - Then nobody touches this copy directly
 - Lives on a server everyone can access
- Each person *clones* her own *working copy*
 - Makes a local copy of the repo
 - You'll always work off of this copy
 - The version control system syncs the repo and working copy (with your help)



REPOSITORY

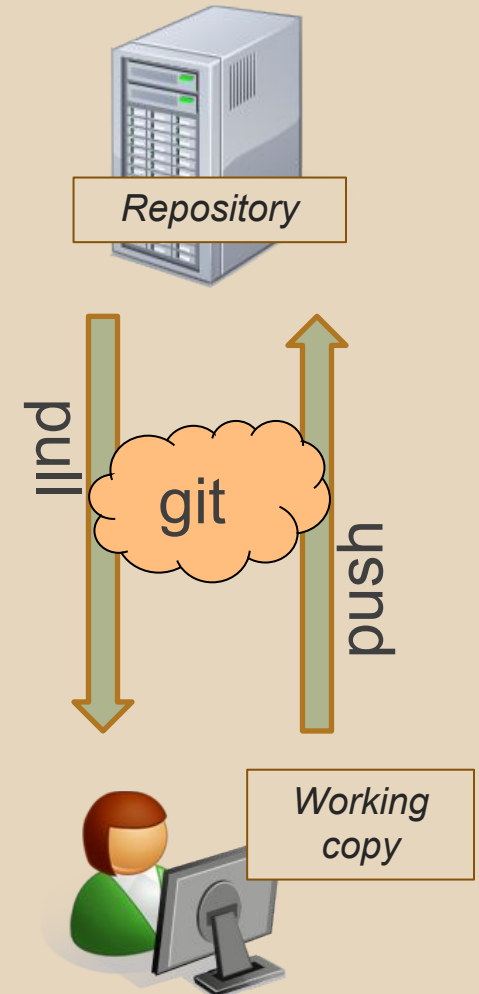
- Can create the repository anywhere
 - Can be on the same computer that you're going to work on, which might be ok for a personal project where you just want rollback protection
- But, usually you want the repository to be robust:
 - On a computer that's up and running 24/7
 - Everyone always has access to the project
 - On a computer that has a redundant file system
 - No more worries about that hard disk crash wiping away your project!
- We'll use CSE GitLab – very similar to GitHub but tied to CSE accounts and authentication

VERSION CONTROL

COMMON ACTIONS

Most common commands:

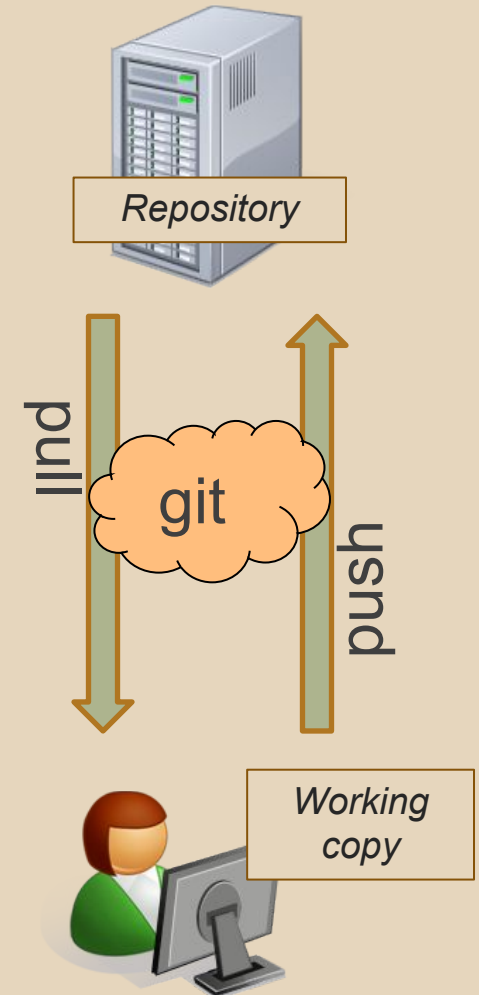
- **add / commit / push**
 - integrate changes *from* your working copy *into* the repository
- **pull**
 - integrate changes *into* your working copy *from* the repository



VERSION CONTROL UPDATING FILES

In a bit more detail:

- You make some local changes, test them, etc., then...
- `git add` – tell git which changed files you want to save in repo
- `git commit` – save all files you've "add"ed in the local repo copy as an identifiable update
- `git push` – synchronize with the GitLab repo by pushing local committed changes

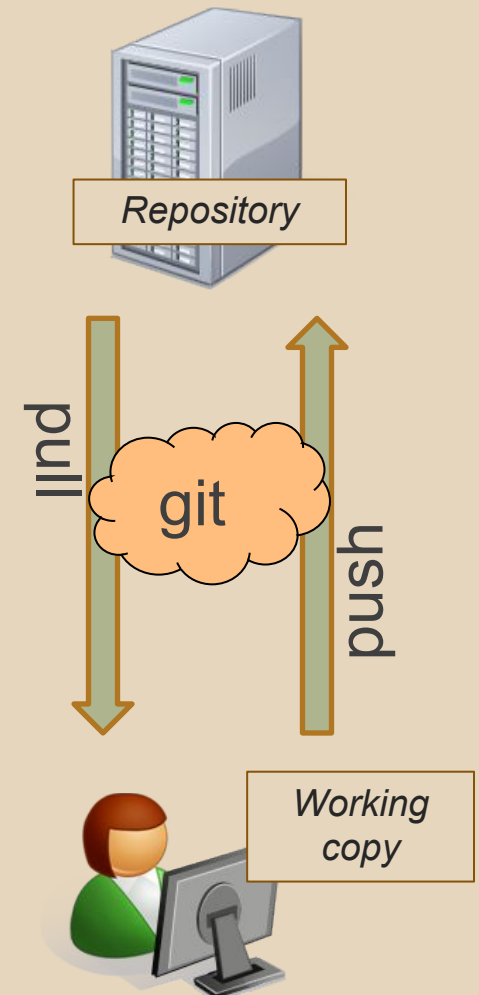


VERSION CONTROL

COMMON ACTIONS (CONT.)

Other common commands:

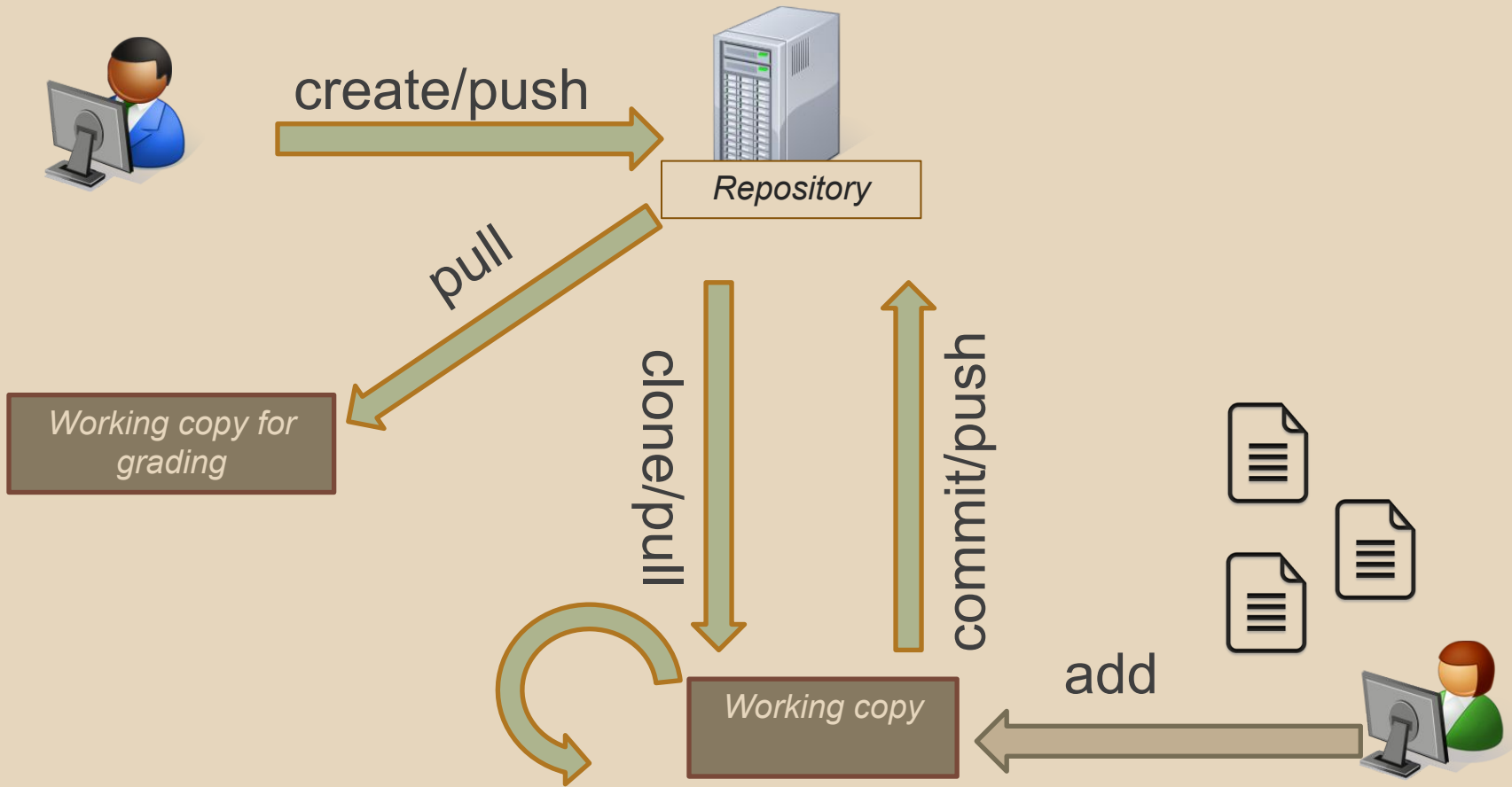
- **add, rm**
 - add or delete a file in the working copy
 - just putting a new file in your working copy does not add it to the repo!
 - still need to commit to make permanent



THIS QUARTER

- We distribute starter code by adding it to your GitLab **repo**. You retrieve it with **git clone** the first time then **git pull** for later assignments
- You will write **code** using Eclipse
- You turn in your files by **adding** them to the repo, **committing** your changes, and eventually **pushing** accumulated changes to GitLab
- You “turn in” an assignment by **tagging** your repo and pushing the tag to GitLab
 - Do this after committing and pushing your files
- You will **validate** your homework by **SSHing** onto attu, cloning your repo, and running an Ant build file

331 VERSION CONTROL



ECLIPSE

WHAT IS ECLIPSE?

- Integrated development environment (IDE)
- Allows for software development from start to finish
 - Type code with syntax highlighting, warnings, etc.
 - Run code straight through or with breakpoints (debug)
 - Break code
- Mainly used for Java
 - Supports C, C++, JavaScript, PHP, Python, Ruby, etc.
- Alternatives
 - NetBeans, Visual Studio, IntelliJIDEA

ECLIPSE SHORTCUTS

Shortcut

Ctrl + D

Alt + Shift + R

Ctrl + Shift + O

Ctrl + /

Ctrl + Shift + F

Purpose

Delete an entire line

Refactor (rename)

Clean up imports

Toggle comment

Make my code look nice 😊

ECLIPSE and Java

- Get Java **8**
- Important: Java separates compile and execution, eg:
 - `javac Example.java` $\xrightarrow{\text{produces}}$ `Example.class`
 - Both compile and execute have to be the same Java!
- Please use **Eclipse 4.5 (Mars)**, “Eclipse for Java Developers”
- Instructions: http://courses.cs.washington.edu/courses/cse331/16sp/tools/WorkingAtHome.html#Step_1

331 VERSION CONTROL

- Your main repository is on GitLab
- Only clone once (unless you're working in a lot of places)
- Don't forget to add/commit/push files!
 - Do this regularly for backup even before you're done!
- Check in your work!

HW 3

- Many small exercises to get you used to version control and tools and a Java refresher
- More information on homework instructions: <http://courses.cs.washington.edu/courses/cse331/16sp/hws/hw3/hw3.html>
- Cloning your repo: [Instructions](#)
- Committing changes: [Instructions](#)
 - How you turn in your assignments
- Updating changes: [Instructions](#)
 - How you retrieve new assignments

GIT BEST PRACTICES

- Add/commit/push your code **EARLY** and **OFTEN!!!**
 - You really, really, really don't want to deal with merge conflicts
 - Keep your repository up-to-date all the time
- Use the combined 'Commit and Push' tool in Eclipse
- Do not rename folders and files that we gave you – this will mess up our grading process and you could get a bad score
- Use the repo only for the homework
 - Adding other stuff (like notes from lecture) may mess up our grading process

Turning in HW3

- [Instructions](#)
- Create a **hw3-final tag** on the last commit and push the tag to the repo (this can and should be done in Eclipse)
 - You can push a new hw3-final tag that overwrites the old one if you realize that you still need to make changes (Demo)
 - In Eclipse, just remember to check the correct checkboxes to overwrite existing tags
 - But keep track of how many late days you have left!
- After the final commit and tag pushed, remember to log on to attu and run ant validate

Turning in HW3

- Add/commit/push your final code
- Create a **hw3-final tag** on the last commit and push the tag to the repo (this can and should be done in Eclipse)
 - You can push a new hw3-final tag that overwrites the old one if you realize that you still need to make changes (Demo)
 - In Eclipse, just remember to check the correct checkboxes to overwrite existing tags
 - But keep track of how many late days you have left!
- After the final commit and tag pushed, remember to log on to attu and run ant validate

Ant Validate

- **What will this do?**

- You start with a freshly cloned copy of your repo and do “git checkout hw3-final” to switch to the files you intend for us to grade, then run ant validate
- Makes sure you have all the **required** files
- Make sure your homework builds without errors
- Passes specification and implementation tests in the repository
 - **Note:** this does not include the additional tests we will use when grading
 - This is just a sanity check that your current tests pass

Ant Validate

- **How do you run ant validate?**
 - Has to be done on attu from the command line since that is the environment your grading will be done on
 - Do not use the Eclipse ant validate build tool!
 - Be *sure* to use a fresh copy of your repo, and discard that copy when you're done
 - If you need to fix things, do it in your primary working copy (eclipse)

Ant Validate

- How do you run ant validate?
 - Steps
 - Log into attu via [SSH](#)
 - In attu, checkout a brand new local copy (clone) of your repository through the [command-line](#)
 - **Note:** Now, you have two local copies of your repository, one on your computer through Eclipse and one in attu
 - May need to create an SSH key on attu and add to GitLab: [instructions](#)
 - Go to the hw folder which you want to validate through the 'cd' command, then switch to the hw3 tag
 - For example: `cd ~/cse331/src/hw3`
`git checkout hw3-final`
 - Run ant validate

Ant Validate

- **How do you know it works?**
 - If successful, will output **Build Successful** at the bottom
 - If unsuccessful, will output **Build Failed** at the bottom with information on why
 - If ant validate failed, discard the validate copy of the repo on attu, fix and commit changes through eclipse, go back to attu, clone a fresh copy of the repo, and try ant validate again

ECLIPSE DEBUGGING (if time)

- `System.out.println()` works for debugging...
 - It's quick
 - It's dirty
 - Everyone knows how to do it
- ...but there are drawbacks
 - What if I'm printing something that's null?
 - What if I want to look at something that can't easily be printed (e.g., what does my binary search tree look like now)?
- Eclipse's debugger is powerful...if you know how to use it

ECLIPSE DEBUGGING

The screenshot displays the Eclipse IDE interface during a debugging session. The top toolbar includes standard development tools like Run, Stop, and Step Over. The main workspace is divided into several panels:

- Debug Console:** Shows the execution stack of the current thread. The top frame is `DelegatingMethodAccessorImpl.invoke(Object, Object[])`. Below it, the current frame is `Method.invoke(Object, Object...) line: not available`. Other frames include `FrameworkMethod$1.runReflectiveCall()` (line 45), `FrameworkMethod$1(ReflectiveCallable).run()` (line 15), `InvokeMethod.evaluate()` (line 20), `BlockJUnit4ClassRunner(ParentRunner<T>).runLeaf(Statement)`, `BlockJUnit4ClassRunner.runChild(FrameworkMethod, Runnable)`, `BlockJUnit4ClassRunner.runChild(Object, RunNotifier)` (line:), `ParentRunner$3.run()` (line: 231), `ParentRunner$1.schedule(Runnable)` (line: 60), `BlockJUnit4ClassRunner(ParentRunner<T>).runChildren(RunNotifier)`, and `ParentRunner<T>.access$000(ParentRunner, RunNotifier)`.
- Variables View:** Displays the current state of variables. It shows a single variable named `this` with the value `RatPolyStackTest (id=33)`.
- Code Editor:** Shows the source code of `RatPolyStackTest.java`. The current line is 157, which is highlighted in green: `RatPolyStack stk1 = stack("3");`. The code includes a `@Test` annotation and a `testDupWithOneVal()` method that performs stack operations and assertions.
- Outline View:** Lists the methods of the class, including `testClear()`, `testCtor()`, `testDifferentiate()`, `testDivMultiElems()`, `testDivTwoElems()`, `testDupWithMultVal()`, `testDupWithOneVal()` (which is selected), `testDupWithTwoVal()`, and `testIntegrate()`.

ECLIPSE DEBUGGING

The screenshot displays the Eclipse IDE interface during a debug session. The top toolbar includes standard development icons. The main workspace is divided into several panes:

- Debug Console:** Shows a stack trace of the current execution, with the following entries:
 - DelegatingMethodAccessorImpl.invoke(Object, Object[]) lir
 - Method.invoke(Object, Object...) line: not available
 - FrameworkMethod\$1.runReflectiveCall() line: 45
 - FrameworkMethod\$1(ReflectiveCallable).run() line: 15
 - FrameworkMethod.invokeExplosively(Object, Object...) line:
 - InvokeMethod.evaluate() line: 20
 - BlockJUnit4ClassRunner(ParentRunner<T>).runLeaf(Statem
 - BlockJUnit4ClassRunner.runChild(FrameworkMethod, RunN
 - BlockJUnit4ClassRunner.runChild(Object, RunNotifier) line:
 - ParentRunner\$3.run() line: 231
 - ParentRunner\$1.schedule(Runnable) line: 60
 - BlockJUnit4ClassRunner(ParentRunner<T>).runChildren(Ru
 - ParentRunner<T>.access\$000(ParentRunner RunNotifier) li
- Variables View:** Displays the current state of variables:

Name	Value
this	RatPolyStackTest (id=33)
- Code Editor:** Shows the source code for `RatPolyStackTest.java`. A green vertical bar on the left side of the editor indicates a breakpoint is set on line 57. The code includes comments and assertions.
- Outline View:** Shows the project structure on the right side.

A text box overlaid on the code editor provides instructions: "Double click in the grey area to the left of your code to set a breakpoint. A breakpoint is a line that the Java VM will stop at during normal execution of your program, and wait for action from you."

ECLIPSE DEBUGGING

Click the Bug icon to run in Debug mode. Otherwise your program won't stop at your breakpoints.

```
151 ///////////////////////////////////////////////////
152 /// Duplicate
153 ///////////////////////////////////////////////////
154
155 @Test
156 public void testDupWithOneVal() {
157   RatPolyStack stk1 = stack("3");
158   stk1.dup();
159   assertStackIs(stk1, "33");
160   stk1 = stack("123");
161   stk1.dup();
162   assertStackIs(stk1, "1123");
}
```


ECLIPSE DEBUGGING

The screenshot displays the Eclipse IDE interface during a debugging session. At the top, a toolbar contains several icons, with a green box highlighting the Run, Pause, and Stop buttons. Below the toolbar, the 'Debug' console shows a stack trace of method calls, including `DelegatingMethodAccessorImpl.invoke`, `Method.invoke`, `FrameworkMethod$1.runReflectiveCall`, `FrameworkMethod$1(ReflectiveCallable).run`, `InvokeMethod.evaluate`, `BlockJUnit4ClassRunner.runLeaf`, `BlockJUnit4ClassRunner.runChild`, `ParentRunner$3.run`, `ParentRunner$1.schedule`, and `ParentRunner.access$000`. To the right, a 'Variables' window is partially visible, showing a table with 'Name' and 'Value' columns. A text box overlaid on this window reads: 'Controlling your program while debugging is done with these buttons'. The main editor window shows the source code of `RatPolyStackTest.java`, with line 157 highlighted: `@Test public void testDupWithOneVal() { RatPolyStack stk1 = stack("3"); stk1.dup(); assertStackIs(stk1, "33"); stk1 = stack("123"); stk1.dup(); assertStackIs(stk1, "1123"); }`. The 'Outline' window on the bottom right lists test methods: `testClear() : void`, `testCtor() : void`, `testDifferentiate() : void`, `testDivMultiElems() :`, `testDivTwoElems() :`, `testDupWithMultVal`, `testDupWithOneVal(`, `testDupWithTwoVal(`, and `testIntegrate() : void`.

ECLIPSE DEBUGGING

The screenshot displays the Eclipse IDE interface during a debugging session. The top toolbar features a green play button, a red stop button, and a yellow pause button, all of which are highlighted with a green rectangular box. A text box with a black border is overlaid on the Variables view, containing the text: "Play, pause, stop work just like you'd expect".

The Debug console on the left shows a stack trace of the current execution, with the following methods listed from top to bottom:

- DelegatingMethodAccessorImpl.invoke(Object, Object[]) line: not available
- Method.invoke(Object, Object...) line: not available
- FrameworkMethod\$1.runReflectiveCall() line: 45
- FrameworkMethod\$1(ReflectiveCallable).run() line: 15
- FrameworkMethod.invokeExplosively(Object, Object...) line: not available
- InvokeMethod.evaluate() line: 20
- BlockJUnit4ClassRunner(ParentRunner<T>).runLeaf(Statement) line: not available
- BlockJUnit4ClassRunner.runChild(FrameworkMethod, Runnable) line: not available
- BlockJUnit4ClassRunner.runChild(Object, RunNotifier) line: not available
- ParentRunner\$3.run() line: 231
- ParentRunner\$1.schedule(Runnable) line: 60
- BlockJUnit4ClassRunner(ParentRunner<T>).runChildren(RunNotifier) line: not available
- ParentRunner<T>.access\$000(ParentRunner, RunNotifier) line: not available

The Variables view on the right shows a table of variables for the current thread:

Name	Value
this	RatPolyStackTest (id=33)

The Java code editor at the bottom shows the source code for `RatPolyStackTest.java`. A debugger breakpoint is set at line 157, which is highlighted in green. The code snippet is as follows:

```
151 ////////////////////////////////////////////////////
152 /// Duplicate
153 ////////////////////////////////////////////////////
154
155 @Test
156 public void testDupWithOneVal() {
157     RatPolyStack stk1 = stack("3");
158     stk1.dup();
159     assertStackIs(stk1, "33");
160     stk1 = stack("123");
161     stk1.dup();
162     assertStackIs(stk1, "1123");
}
```

The Outline view on the right shows a list of methods in the `RatPolyStackTest` class, with `testDupWithOneVal()` selected and highlighted in green.

ECLIPSE DEBUGGING

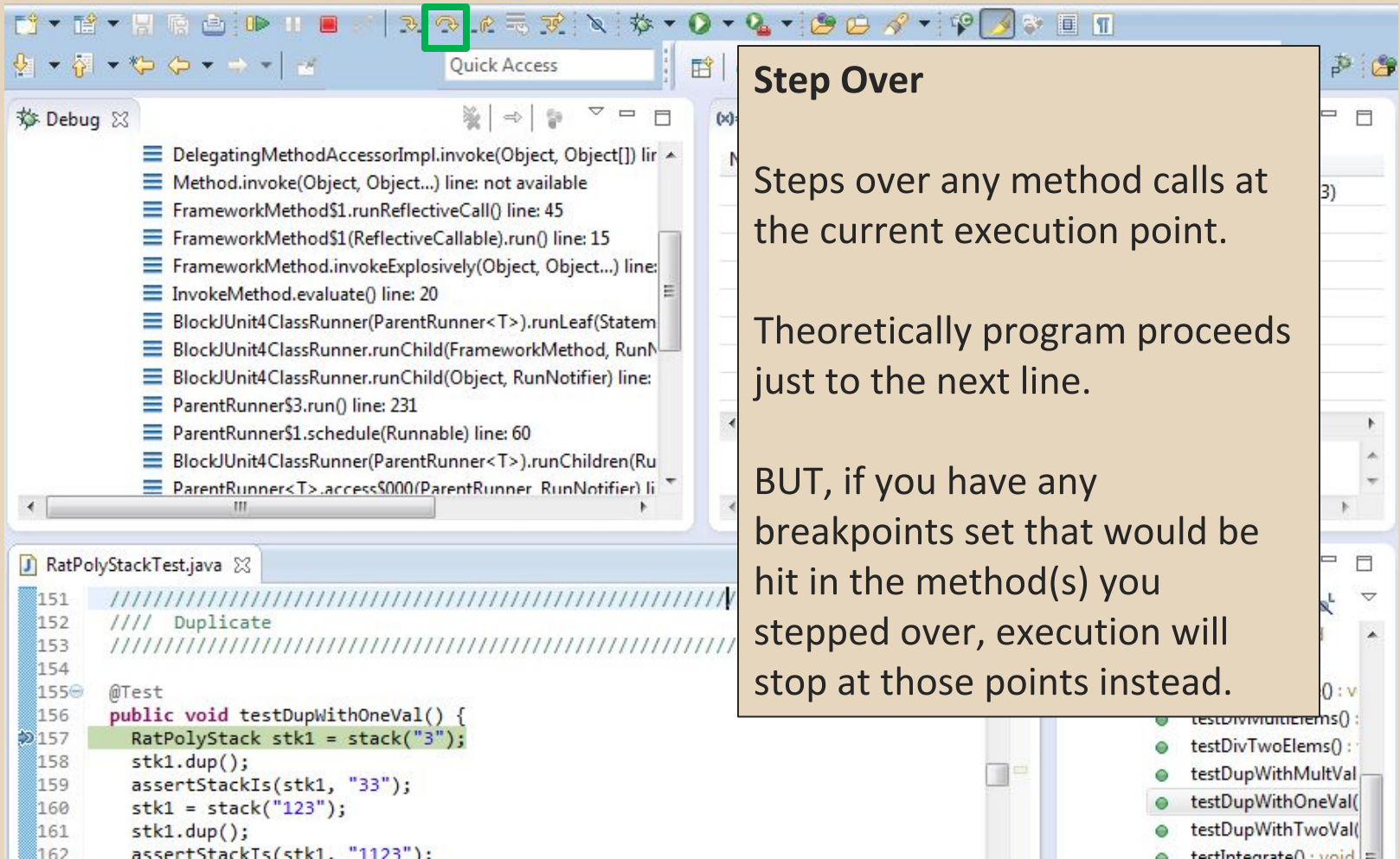
The screenshot shows the Eclipse IDE interface. At the top, the toolbar contains various icons, with the 'Step Into' icon (a green square with a white arrow) highlighted by a green box. Below the toolbar, the 'Debug' console displays a stack trace of method calls. The code editor shows the file 'RatPolyStackTest.java' with a breakpoint set at line 157, which is highlighted in green. The code at line 157 is `RatPolyStack stk1 = stack("3");`. To the right of the code editor, a list of test methods is visible, with 'testDupWithOneVal()' selected.

Step Into

Steps into the method at the current execution point – if possible. If not possible then just proceeds to the next execution point.

If there's multiple methods at the current execution point step into the first one to be executed.

ECLIPSE DEBUGGING



Step Over

Steps over any method calls at the current execution point.

Theoretically program proceeds just to the next line.

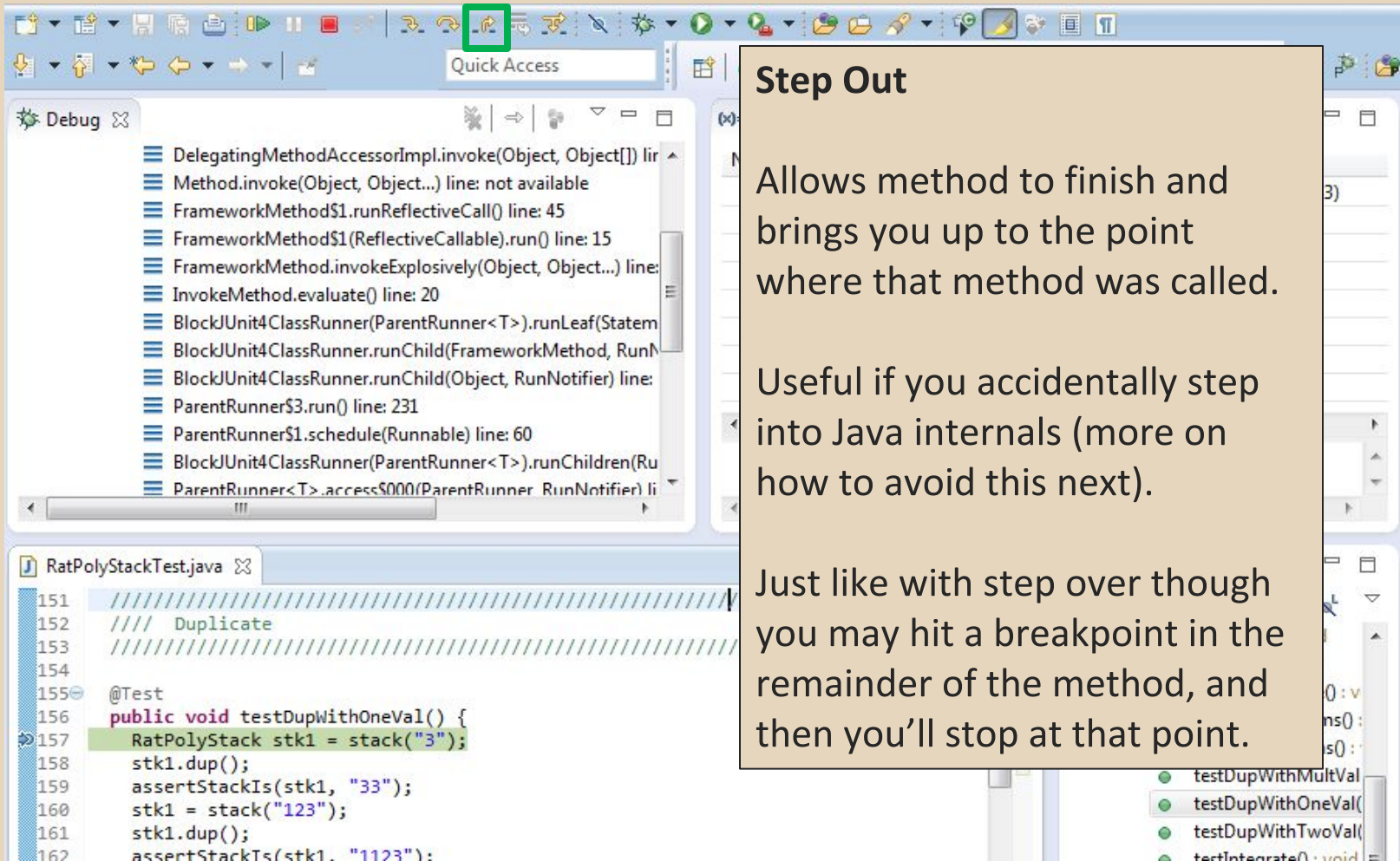
BUT, if you have any breakpoints set that would be hit in the method(s) you stepped over, execution will stop at those points instead.

```
Debug Console:  
DelegatingMethodAccessorImpl.invoke(Object, Object[]) line:  
Method.invoke(Object, Object...) line: not available  
FrameworkMethod$1.runReflectiveCall() line: 45  
FrameworkMethod$1(ReflectiveCallable).run() line: 15  
FrameworkMethod.invokeExplosively(Object, Object...) line:  
InvokeMethod.evaluate() line: 20  
BlockJUnit4ClassRunner(ParentRunner<T>).runLeaf(Statem  
BlockJUnit4ClassRunner.runChild(FrameworkMethod, RunN  
BlockJUnit4ClassRunner.runChild(Object, RunNotifier) line:  
ParentRunner$3.run() line: 231  
ParentRunner$1.schedule(Runnable) line: 60  
BlockJUnit4ClassRunner(ParentRunner<T>).runChildren(Ru  
ParentRunner<T>.access$000(ParentRunner, RunNotifier) li
```

```
RatPolyStackTest.java  
151 ///////////////////////////////////////////////////  
152 /// Duplicate  
153 ///////////////////////////////////////////////////  
154  
155 @Test  
156 public void testDupWithOneVal() {  
157 RatPolyStack stk1 = stack("3");  
158 stk1.dup();  
159 assertStackIs(stk1, "33");  
160 stk1 = stack("123");  
161 stk1.dup();  
162 assertStackIs(stk1, "1123");
```

testDivWithTwoElems():
testDivTwoElems():
testDupWithMultVal():
testDupWithOneVal():
testDupWithTwoVal():
testIntegrate(): void

ECLIPSE DEBUGGING



Step Out

Allows method to finish and brings you up to the point where that method was called.

Useful if you accidentally step into Java internals (more on how to avoid this next).

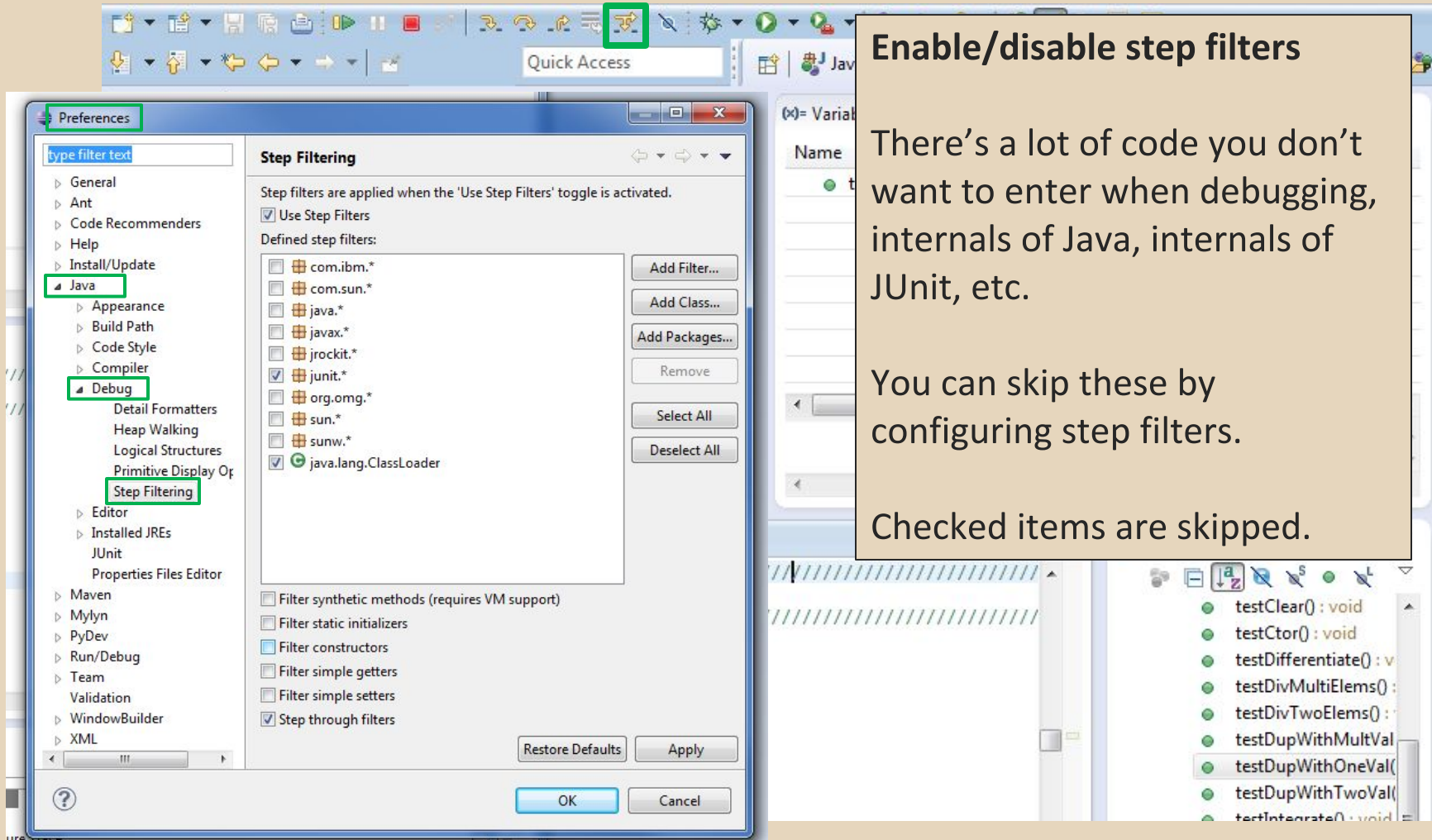
Just like with step over though you may hit a breakpoint in the remainder of the method, and then you'll stop at that point.

```
Debug
DelegatingMethodAccessorImpl.invoke(Object, Object[]) lir
Method.invoke(Object, Object...) line: not available
FrameworkMethod$1.runReflectiveCall() line: 45
FrameworkMethod$1(ReflectiveCallable).run() line: 15
FrameworkMethod.invokeExplosively(Object, Object...) line:
InvokeMethod.evaluate() line: 20
BlockJUnit4ClassRunner(ParentRunner<T>).runLeaf(Statem
BlockJUnit4ClassRunner.runChild(FrameworkMethod, RunN
BlockJUnit4ClassRunner.runChild(Object, RunNotifier) line:
ParentRunner$3.run() line: 231
ParentRunner$1.schedule(Runnable) line: 60
BlockJUnit4ClassRunner(ParentRunner<T>).runChildren(Ru
ParentRunner<T>.access$000(ParentRunner, RunNotifier) li

RatPolyStackTest.java
151 ////////////////////////////////////////////////////////////////////
152 /// Duplicate
153 ////////////////////////////////////////////////////////////////////
154
155 @Test
156 public void testDupWithOneVal() {
157 RatPolyStack stk1 = stack("3");
158 stk1.dup();
159 assertStackIs(stk1, "33");
160 stk1 = stack("123");
161 stk1.dup();
162 assertStackIs(stk1, "1123");

testDupWithMultVal
testDupWithOneVal(
testDupWithTwoVal(
testIntegrate0: void
```

ECLIPSE DEBUGGING



The image shows the Eclipse IDE interface. In the foreground, the 'Preferences' dialog is open, with the 'Step Filtering' section selected. The 'Use Step Filters' checkbox is checked. A list of defined step filters is shown, with 'java.lang.ClassLoader' checked. Below this list, several options are checked: 'Filter constructors', 'Filter simple getters', 'Filter simple setters', and 'Step through filters'. The 'Run/Debug' icon in the top toolbar is highlighted with a green box. In the background, a list of methods is visible, with several items marked with a green circle, indicating they are filtered out.

Enable/disable step filters

There's a lot of code you don't want to enter when debugging, internals of Java, internals of JUnit, etc.

You can skip these by configuring step filters.

Checked items are skipped.

ECLIPSE DEBUGGING

The screenshot shows the Eclipse IDE interface. The top toolbar contains various icons for file operations and debugging. Below the toolbar is the 'Quick Access' search bar. The main workspace is divided into several panes. On the left, the 'Debug' console displays a stack trace with the following entries (from top to bottom):

- DelegatingMethodAccessorImpl.invoke(Object, Object[]) line: not available
- Method.invoke(Object, Object...) line: not available
- FrameworkMethod\$1.runReflectiveCall() line: 45
- FrameworkMethod\$1(ReflectiveCallable).run() line: 15
- FrameworkMethod.invokeExplosively(Object, Object...) line: not available
- InvokeMethod.evaluate() line: 20
- BlockJUnit4ClassRunner(ParentRunner<T>).runLeaf(Statement) line: not available
- BlockJUnit4ClassRunner.runChild(FrameworkMethod, Runnable) line: not available
- BlockJUnit4ClassRunner.runChild(Object, RunNotifier) line: not available
- ParentRunner\$3.run() line: 231
- ParentRunner\$1.schedule(Runnable) line: 60
- BlockJUnit4ClassRunner(ParentRunner<T>).runChildren(RunNotifier) line: not available
- ParentRunner<T>.access\$000(ParentRunner, RunNotifier) line: not available

The stack trace is highlighted with a green border. Below the stack trace, the 'Variables' pane shows a table with columns for 'Name' and 'Value'. The code editor at the bottom shows the file 'RatPolyStackTest.java' with the following code:

```
151 ////////////////////////////////////////////////////
152 /// Duplicate
153 ////////////////////////////////////////////////////
154
155 @Test
156 public void testDupWithOneVal() {
157     RatPolyStack stk1 = stack("3");
158     stk1.dup();
159     assertStackIs(stk1, "33");
160     stk1 = stack("123");
161     stk1.dup();
162     assertStackIs(stk1, "1123");
}
```

The line `stk1 = stack("123");` is highlighted in green. On the right side of the IDE, a list of test methods is visible, including `testDifferentiate()`, `testDivMultiElems()`, `testDivTwoElems()`, `testDupWithMultVal()`, `testDupWithOneVal()`, `testDupWithTwoVal()`, and `testIntegrate(): void`.

Stack Trace

Shows what methods have been called to get you to current point where program is stopped.

You can click on different method names to navigate to that spot in the code without losing your current spot.

ECLIPSE DEBUGGING

Variables Window

Shows all variables, including method parameters, local variables, and class variables, that are in scope at the current execution spot. Updates when you change positions in the stackframe. You can expand objects to see child member values. There's a simple value printed, but clicking on an item will fill the box below the list with a pretty format.

```
159   assertStackIs(stk1, "33");
160   stk1 = stack("123");
161   stk1.dup();
162   assertStackIs(stk1, "1123");
```

Name	Value
• this	RatPolyStackTest (id=33)

Some values are in the form of ObjectName (id=x), this can be used to tell if two variables are referring to the same object.

ECLIPSE DEBUGGING

Variables that have changed since the last break point are highlighted in yellow.

You can change variables right from this window by double clicking the row entry in the Value tab.

The screenshot displays the Eclipse IDE interface during a debug session. The top toolbar shows the 'Debug' button is active. The 'Variables' window is open, showing a table of variables:

Name	Value
this	RatTermTest (
t	RatTerm (id=4
coeff	RatNum (id=4
expt	5

The 'expt' variable is highlighted in yellow. Below the table, the expression $-2*x^5$ is visible. The main editor shows the source code for `RatPolyStackTest.java` with a breakpoint at line 157:

```
151 ///////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
152 /// Duplicate
153 ///////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
154
155 @Test
156 public void testDupWithOneVal() {
157   RatPolyStack stk1 = stack("3");
158   stk1.dup();
159   assertStackIs(stk1, "33");
160   stk1 = stack("123");
161   stk1.dup();
162   assertStackIs(stk1, "1123");
```

The Outline view on the right shows the test methods, with `testDupWithOneVal()` selected.

ECLIPSE DEBUGGING

Variables that have changed since the last break point are highlighted in yellow.

You can change variables right from this window by double clicking the row entry in the Value tab.

The screenshot displays the Eclipse IDE interface during a debug session. The top toolbar includes icons for Run, Break, and other debugging functions. The main window is divided into several panes:

- Variables Window (top right, green border):** A table showing the current state of variables. The 'Value' tab is active. The variable 't' is expanded to show its fields: 'coeff' (RatNum) and 'expt' (RatNum). The 'expt' field is highlighted in yellow, indicating it has changed since the last breakpoint. The value of 'expt' is 5. Below the table, the expression $-2*x^5$ is visible.
- Code Editor (bottom left):** Shows the source code for `RatPolyStackTest.java`. Line 157 is highlighted in green, corresponding to the current execution point: `RatPolyStack stk1 = stack("3");`. Other lines include comments, annotations, and method calls like `stk1.dup()`, `assertStackIs(stk1, "33");`, `stk1 = stack("123");`, and `assertStackIs(stk1, "1123");`.
- Outline (bottom right):** Lists the methods in the class, including `testClear()`, `testCtor()`, `testDifferentiate()`, `testDivMultiElems()`, `testDivTwoElems()`, `testDupWithMultVal()`, `testDupWithOneVal()`, `testDupWithTwoVal()`, and `testIntegrate()`. The `testDupWithOneVal()` method is selected.

ECLIPSE DEBUGGING

There's a powerful right-click menu.

- See all references to a given variable
- See all instances of the variable's class
- Add watch statements for that variable's value (more later)

The screenshot shows the Eclipse IDE interface during a debug session. The top toolbar includes icons for file operations, running, and debugging. The main editor displays Java code with line numbers 151 to 162. The code includes comments and a test method:

```
151 ///////////////////////////////////////////////////
152 /// Duplicate
153 ///////////////////////////////////////////////////Runner.class
154
155 @Test
156 public void testDupWithOneVal() {
157     RatPolyStack stk1 = stack("3");
158     stk1.dup();
159     assertStackIs(stk1, "33");
160     stk1 = stack("123");
161     stk1.dup();
162     assertStackIs(stk1, "1123");
```

The Variables view on the right shows the current stack frame. The variable 't' is expanded to show 'coeff' and 'expt'. The 'expt' variable is highlighted in yellow. A right-click context menu is open over 'expt', listing various actions such as 'Select All', 'Copy Variables', 'Find...', 'Change Value...', 'All References...', 'All Instances...', 'Instance Count...', 'New Detail Formatter...', 'Open Declared Type', 'Open Declared Type Hierarchy', 'Instance Breakpoints...', 'Watch', and 'Inspect'. The 'All Instances...' option is highlighted in blue, and its keyboard shortcut 'Ctrl+Shift+N' is visible.

Name	Value
this	RatTermTest (id=33)
t	
coeff	
expt	

ECLIPSE DEBUGGING

Show Logical Structure

Expands out list items so it's as if each list item were a field (and continues down for any children list items)

The screenshot shows the Eclipse IDE interface during a debug session. The top toolbar includes icons for Run, Breakpoints, Expressions, and a green box highlighting the 'Show Logical Structure' icon. The Variables view on the right displays the following structure:

Name	Value
this	RatPolyStackTest (id=33)
stk1	RatPolyStack (id=44)
polys	Stack<E> (id=49)
[0]	RatPoly (id=719)
terms	ArrayList<E> (id=728)
[0]	RatTerm (id=731)
coeff	RatNum (id=733)
expt	0

The bottom-left pane shows the source code for `RatPolyStackTest.java` with the following content:

```
151 ///////////////////////////////////////////////////////////////////
152 /// Duplicate
153 ///////////////////////////////////////////////////////////////////
154
155 @Test
156 public void testDupWithOneVal() {
157     RatPolyStack stk1 = stack("3");
158     stk1.dup();
159     assertStackIs(stk1, "33");
160     stk1 = stack("123");
161     stk1.dup();
162     assertStackIs(stk1, "1123");
```

The bottom-right pane shows a list of test methods, with `testDupWithOneVal()` selected.

ECLIPSE DEBUGGING

Breakpoints Window

Shows all existing breakpoints in the code, along with their conditions and a variety of options.

Double clicking a breakpoint will take you to its spot in the code.

The screenshot displays the Eclipse IDE interface. The top toolbar includes icons for file operations, running, and debugging. The main workspace is divided into several panes:

- Breakpoints Window:** Located in the upper right, it lists four breakpoints:
 - Ones [line: 33] - main(String[])
 - ProjectEuler26 [line: 25] - main(String[])
 - RatPolyStackTest [line: 157] - testDupWithOneVal()
 - RatPolyStackTest [line: 159] [conditional] - testDupWithOneVal() (highlighted)
 - RatPolyStackTest [line: 162] - testDupWithOneVal()Below the list, options for hit count, thread suspension, and conditional execution are visible. The conditional expression field contains `x == 6`.
- Code Editor:** The bottom pane shows the source code for `RatPolyStackTest.java`. Line 157, `RatPolyStack stk1 = stack("3");`, is highlighted in green, corresponding to the selected breakpoint.
- Outline View:** The bottom right pane shows a list of methods, with `testDupWithOneVal()` selected.

ECLIPSE DEBUGGING

Enabled/Disabled Breakpoints

Breakpoints can be temporarily disabled by clicking the checkbox next to the breakpoint. This means it won't stop program execution until re-enabled.

This is useful if you want to hold off testing one thing, but don't want to completely forget about that breakpoint.

```
156 public void testDupWithOneVal() {  
157     RatPolyStack stk1 = stack("3");  
158     stk1.dup();  
159     assertStackIs(stk1, "33");  
160     stk1 = stack("123");  
161     stk1.dup();  
162     assertStackIs(stk1, "1123");
```

The screenshot shows the Eclipse IDE interface during a debug session. The Breakpoints view is open, displaying a list of breakpoints for the current project. The breakpoint at line 162 is disabled, indicated by a green box around the unchecked checkbox. The code editor shows the testDupWithOneVal() method with line 157 highlighted. The Variables view shows the current state of the program, and the Expressions view shows the current expression being evaluated.

Breakpoints view:

- Ones [line: 33] - main(String[])
- ProjectEuler26 [line: 25] - main(String[])
- RatPolyStackTest [line: 157] - testDupWithOneVal()
- RatPolyStackTest [line: 159] [conditional] - testDupWithOneVal()
- RatPolyStackTest [line: 162] - testDupWithOneVal()

Breakpoint settings:

- Hit count:
- Suspend thread Suspend VM
- Conditional Suspend when 'true' Suspend when value changes
- <Choose a previously entered condition>
- x == 6

Code editor:

```
156 public void testDupWithOneVal() {  
157     RatPolyStack stk1 = stack("3");  
158     stk1.dup();  
159     assertStackIs(stk1, "33");  
160     stk1 = stack("123");  
161     stk1.dup();  
162     assertStackIs(stk1, "1123");
```


ECLIPSE DEBUGGING

Hit count

Breakpoints can be set to occur less-frequently by supplying a hit count of n .

When this is specified, only each n -th time that breakpoint is hit will code execution stop.

The screenshot displays the Eclipse IDE interface during a debugging session. The main window shows a code editor with the following code snippet:

```
153 ////////////////////////////////////////////////////
154
155 @Test
156 public void testDupWithOneVal() {
157     RatPolyStack stk1 = stack("3");
158     stk1.dup();
159     assertStackIs(stk1, "33");
160     stk1 = stack("123");
161     stk1.dup();
162     assertStackIs(stk1, "1123");

```

The 'Hit count' dialog box is open, showing the following configuration:

- Hit count:
- Suspend thread Suspend VM
- Conditional Suspend when 'true' Suspend when value changes
- <Choose a previously entered condition>
- x == 6

The background shows the Eclipse IDE interface with the following components visible:

- Top toolbar with various icons for file operations, running, and debugging.
- Quick Access search bar.
- Debug toolbar with icons for stepping through code.
- Variables panel showing a list of variables: Ones [line: 33] - main(String[]), ProjectEuler26 [line: 25] - main(String[]), RatPolyStackTest [line: 157] - testDupWithOneVal(), RatPolyStackTest [line: 159] [conditional] - testDupWithOneVal(), and RatPolyStackTest [line: 162] - testDupWithOneVal().
- Expressions panel.
- Code editor showing the current line of code being executed.
- Variables panel showing a list of variables: testClear(): void, testCtor(): void, testDifferentiate(): void, testDivMultiElems(): void, testDivTwoElems(): void, testDupWithMultVal(): void, testDupWithOneVal(): void, testDupWithTwoVal(): void, and testIntegrate(): void.

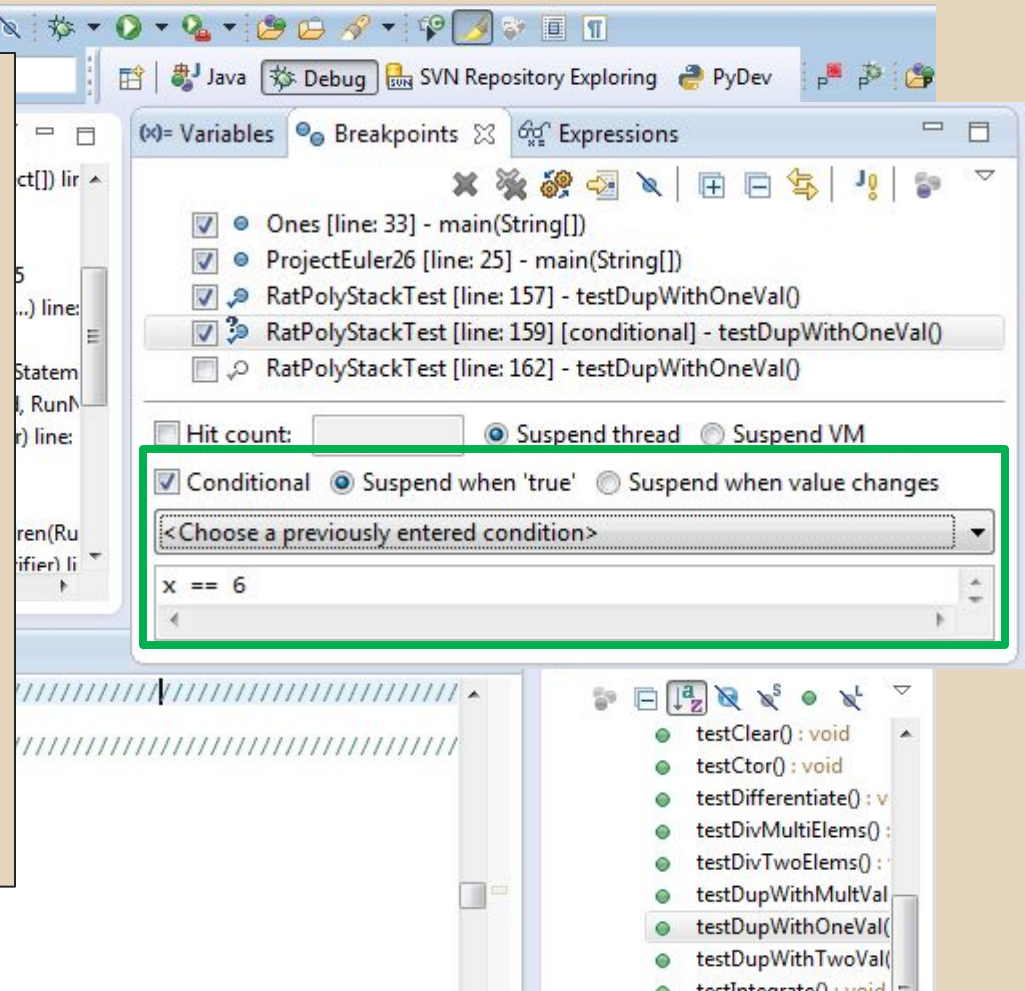
ECLIPSE DEBUGGING

Conditional Breakpoints

Breakpoints can have conditions. This means the breakpoint will only be triggered when a condition you supply is true. **This is very useful** for when your code only breaks on some inputs!

Watch out though, it can make your code debug very slowly, especially if there's an error in your breakpoint.

```
159  assertStackIs(stk1, "33");
160  stk1 = stack("123");
161  stk1.dup();
162  assertStackIs(stk1, "1123");
```

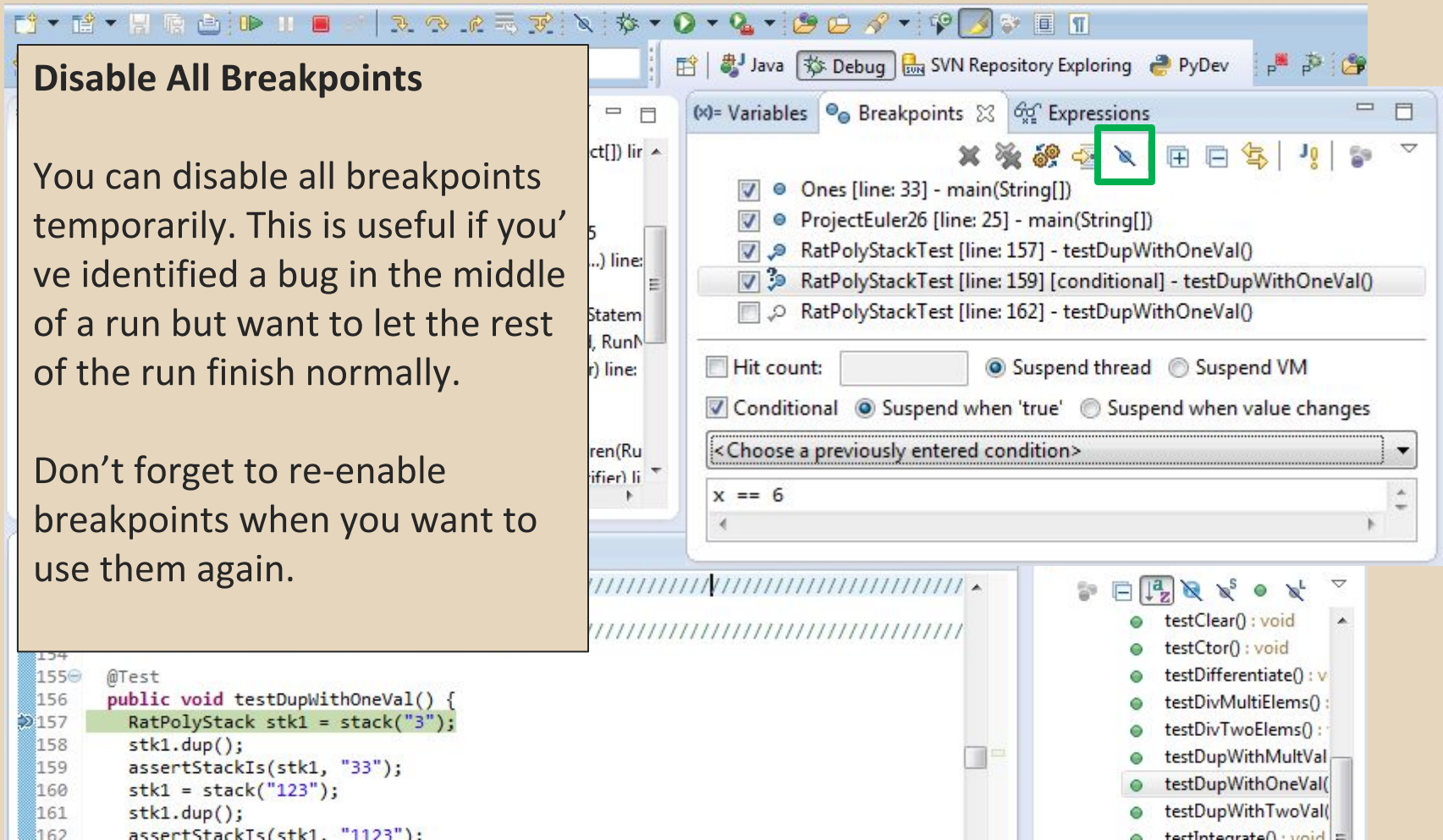


ECLIPSE DEBUGGING

Disable All Breakpoints

You can disable all breakpoints temporarily. This is useful if you've identified a bug in the middle of a run but want to let the rest of the run finish normally.

Don't forget to re-enable breakpoints when you want to use them again.



The screenshot shows the Eclipse IDE interface during a debug session. The Breakpoints view is open, displaying a list of breakpoints for the current project. A green box highlights the 'Disable All' icon (a crossed-out pencil) in the toolbar of the Breakpoints view. The list of breakpoints includes:

- Ones [line: 33] - main(String[])
- ProjectEuler26 [line: 25] - main(String[])
- RatPolyStackTest [line: 157] - testDupWithOneVal()
- RatPolyStackTest [line: 159] [conditional] - testDupWithOneVal()
- RatPolyStackTest [line: 162] - testDupWithOneVal()

Below the list, the 'Hit count' is set to 0. The 'Suspend thread' radio button is selected. The 'Conditional' checkbox is checked, and the 'Suspend when 'true'' radio button is selected. The condition field contains the expression `x == 6`.

In the background, the Java editor shows the following code snippet:

```
154  
155 @Test  
156 public void testDupWithOneVal() {  
157     RatPolyStack stk1 = stack("3");  
158     stk1.dup();  
159     assertStackIs(stk1, "33");  
160     stk1 = stack("123");  
161     stk1.dup();  
162     assertStackIs(stk1, "1123");  
}
```


ECLIPSE DEBUGGING

Break on Java Exception

Eclipse can break whenever a specific exception is thrown. This can be useful to trace an exception that is being “translated” by library code.

```
ParentRunner$1.schedule(Runnable) line: 60
BlockJUnit4ClassRunner(ParentRunner<T>).runChildren(Ru
ParentRunner<T>.access$000(ParentRunner RunNotifier) li
```

The screenshot shows the Eclipse IDE interface. The main editor displays the code for `RatPolyStackTest.java` with line 157 highlighted: `RatPolyStack stk1 = stack("3");`. The Breakpoints view on the right shows a breakpoint for `RatPolyStackTest [line: 159] [conditional] - testDupWithOneVal()` with a green box around the '!' icon. The conditional expression field contains `x == 6`. The Hit count field is empty. The Suspend thread option is selected. The dropdown menu for the conditional expression is open, showing a list of test methods.

Breakpoints list:

- Ones [line: 33] - main(String[])
- ProjectEuler26 [line: 25] - main(String[])
- RatPolyStackTest [line: 157] - testDupWithOneVal()
- RatPolyStackTest [line: 159] [conditional] - testDupWithOneVal()
- RatPolyStackTest [line: 162] - testDupWithOneVal()

Conditional expression: `x == 6`

Suspend thread (selected)

Test methods in dropdown:

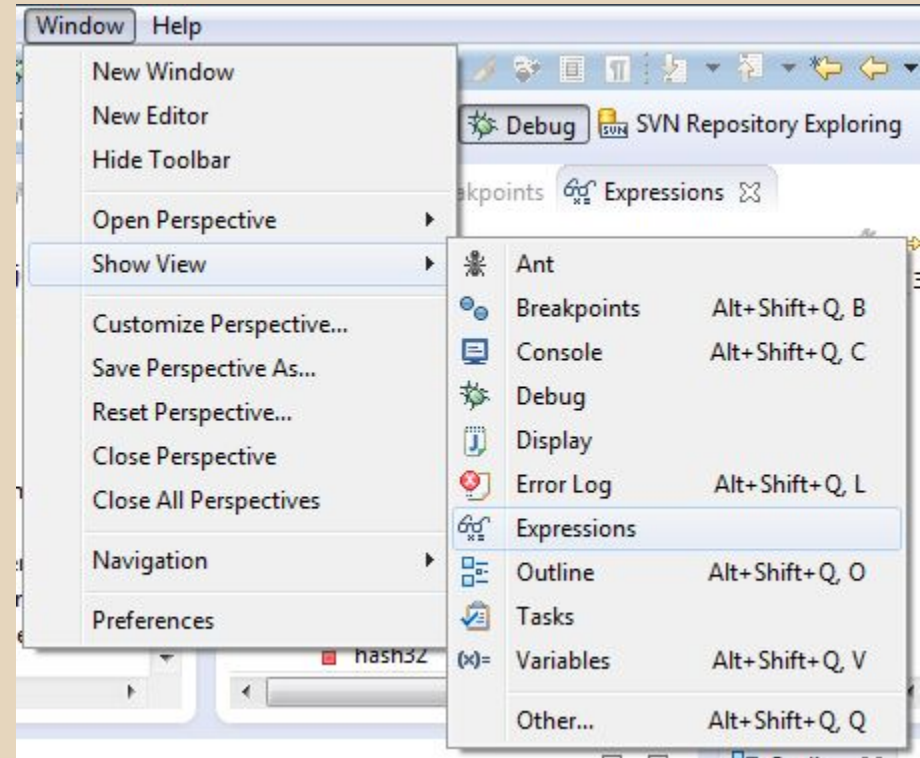
- testClear(): void
- testCtor(): void
- testDifferentiate(): v
- testDivMultiElems():
- testDivTwoElems():
- testDupWithMultVal
- testDupWithOneVal(
- testDupWithTwoVal(
- testIntegrate(): void

ECLIPSE DEBUGGING

Expressions Window

Used to show the results of custom expressions you provide, and can change any time.

Not shown by default but highly recommended.



ECLIPSE DEBUGGING

Expressions Window

Used to show the results of custom expressions you provide, and can change any time.

Resolves variables, allows method calls, even arbitrary statements
"2+2"

Beware method calls that mutate program state – e.g. `stk1.clear()` or `in.nextLine()` – these take effect immediately

The screenshot shows the Eclipse IDE interface. The Expressions Window is open, displaying a table of variables and their values. The table has two columns: 'Name' and 'Value'. The variables listed are:

Name	Value
<code>"this"</code>	(id=33)
<code>"stk1"</code>	(id=57)
<code>"stk1.polys"</code>	(id=61)
<code>capacityIncrement</code>	0
<code>elementCount</code>	3
<code>elementData</code>	Object[10] (id=73)
<code>modCount</code>	3
<code>"stk1.toString()"</code>	hw4.RatPolyStack@...
<code>hash</code>	0
<code>hash32</code>	0

The background shows a code editor with the following Java code:

```
157 RatPolyStack stk1 = stack( 3 );
158 stk1.dup();
159 assertStackIs(stk1, "33");
160 stk1 = stack("123");
161 stk1.dup();
162 assertStackIs(stk1, "1123");
```

Below the code editor, a list of test methods is visible:

- testClear(): void
- testCtor(): void
- testDifferentiate(): void
- testDivMultiElems(): void
- testDivTwoElems(): void
- testDupWithMultVal(): void
- testDupWithOneVal(): void
- testDupWithTwoVal(): void
- testIntegrate(): void

ECLIPSE DEBUGGING

Expressions Window

These persist across projects, so clear out old ones as necessary.

The screenshot shows the Eclipse IDE interface during a debug session. The Expressions window is highlighted with a green border and contains the following data:

Name	Value
$X+Y$ "this"	(id=33)
$X+Y$ "stk1"	(id=57)
$X+Y$ "stk1.polys"	(id=61)
capacityIncrement	0
elementCount	3
elementData	Object[10] (id=73)
modCount	3
$X+Y$ "stk1.toString()"	hw4.RatPolyStack@...
hash	0
hash32	0

The background shows the Java source code for `RatPolyStackTest.java` with the following visible lines:

```
151 ////////////////////////////////////////////////////
152 /// Duplicate
153 ////////////////////////////////////////////////////
154
155 @Test
156 public void testDupWithOneVal() {
157     RatPolyStack stk1 = stack("3");
158     stk1.dup();
159     assertStackIs(stk1, "33");
160     stk1 = stack("123");
161     stk1.dup();
162     assertStackIs(stk1, "1123");
```