



JOHNS HOPKINS  
UNIVERSITY

EN.601.422 / EN.601.622

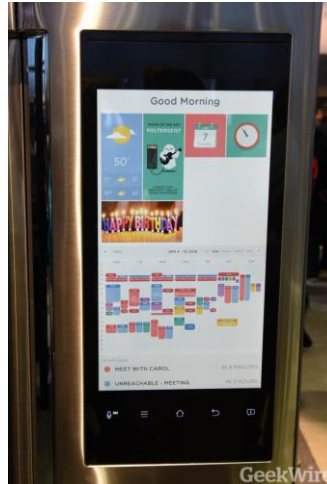
# Software Testing & Debugging

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# GUI Testing

## ► Graphical User Interface:

- ❖ where all the functionality comes together
- ❖ interacts with the underlying code



# Plan for Today

- ▶ GUI Testing
- ▶ Selenium Tool

# GUI Testing

## ▶ (Functional) GUI Testing:

- ❖ Many applications come with a GUI front-end:
  - computers, phones, tablets, medical devices, cars, refrigerators etc.
- ❖ GUI is the user's perspective; the topmost layer via which user interacts with the application
- ❖ GUI Testing = Testing the application from user's perspective:
  - detecting real failures (both GUI and business logic ones)

## ▶ Non-functional GUI Testing:

- ❖ Usability testing

# OpenCV GUI Error Handler



Incorrect size of input array (Non-positive cols or rows)  
in function cvInitMatHeader, C:\User\VP\opencv\cxcore\src\cxarray.cpp(182)

Press "Abort" to terminate application.  
Press "Retry" to debug (if the app is running under debug).  
Press "Ignore" to continue (this is not safe).

Abbrechen Wiederholen Ignorieren

### Windows 720

Additional error information:  
Error: \*\*\* ERROR \*\*\*  
Date: Jul 31 17:20:55 2012  
Release: 720  
Version: 40

### Unhandled Access Violation Reading 0x0000X Exception At 60c068h. Net Framework 2.0 missing library.

ABORT CHECK FOR UPDATES

### DATAFLEX CRITICAL ERROR

Cannot Find TERMLIST.CFG

OK

### Windows Internet Explorer

Configuration change failed. Please report the following error: Parser return code failed.

OK

### Microsoft .NET Framework

Unhandled exception has occurred in a component in your application. If you click Continue, the application will ignore this error and attempt to continue.

The pipeline has been stopped.

Details Continue

The application failed to initialize because the window station is being shut down.

OK

### VirtualBox - Error

Failed to get the accessibility state of the media. Some of the registered media may become inaccessible.

Callee RC: 0x80004002

OK

### Jape

About Jape

Services

Hide Jape ⌘H  
Hide Others ⌘⇧H  
Show All  
Quit Jape ⌘Q

### GUI error

Dispatcher sees null line -- is jape\_engine ok?

Continue Quit

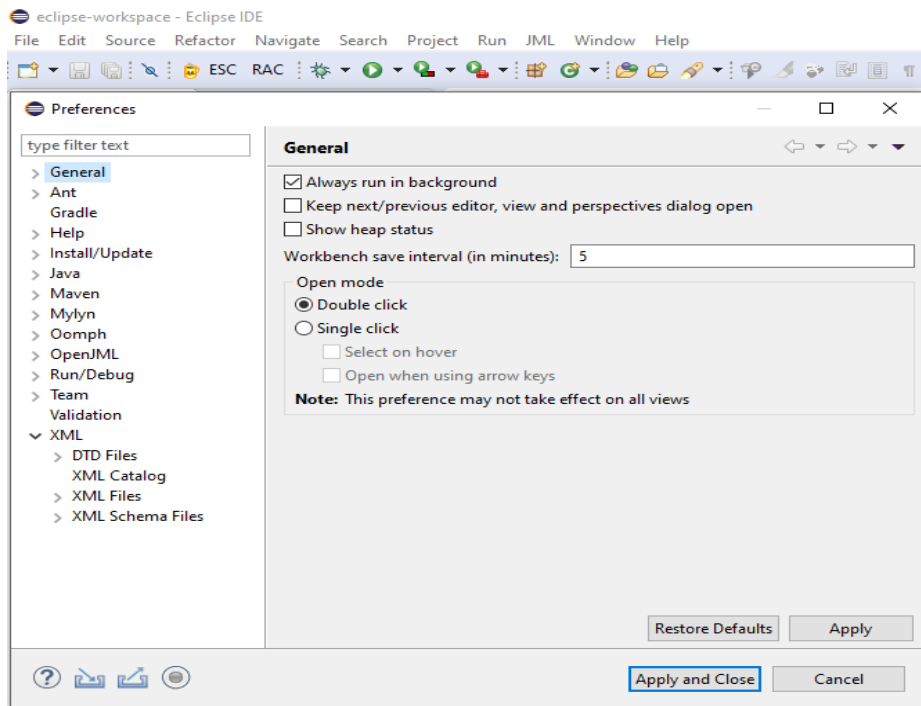
# GUI

## ► GUI: set of visual manipulable objects called controls or *widgets*

### ❖ Each widgets has:

- a set of properties  $P$  where each property  $p \in P$  has a value  $V$  at any point of time during execution
- a set of events associated with it

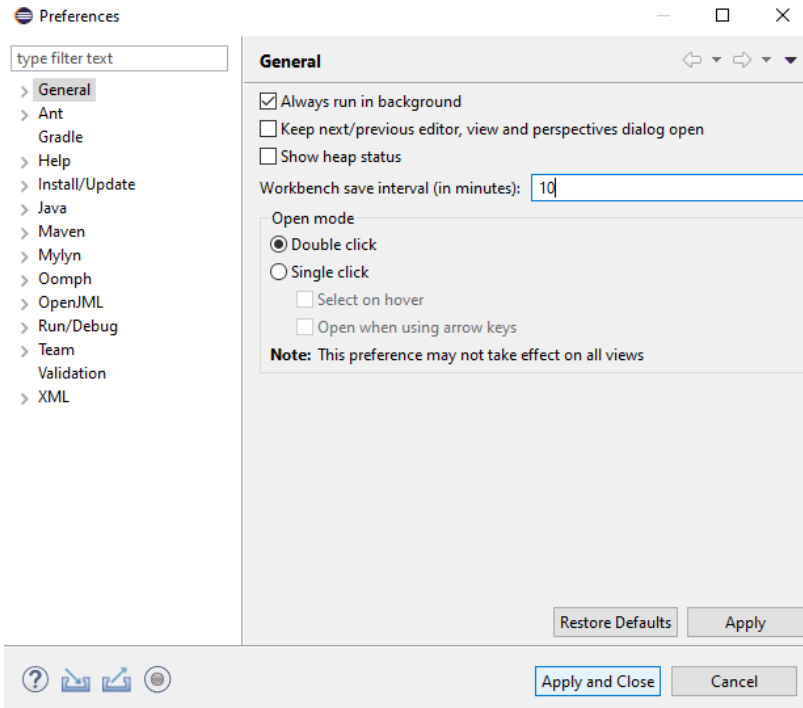
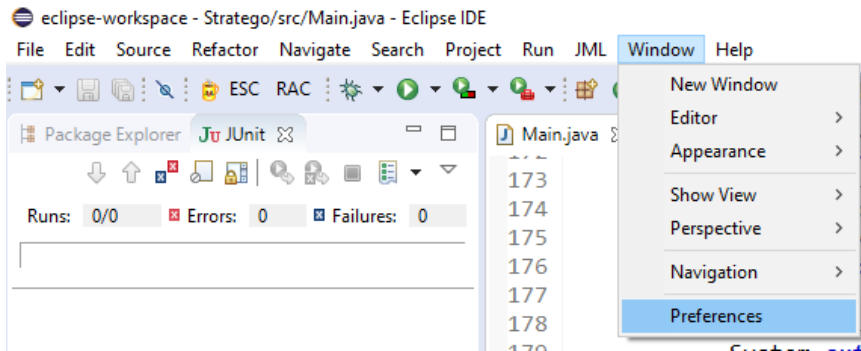
### ❖ Example: widget $w = \text{button}$ has property $\text{width} = 120$ and a number of events for instance *pressed*



# GUI Test Case

## ► Test Case: a sequence of events to be run consecutively on the GUI

- ❖ Example: Press “Window” menu, select “Preferences” menu item, select “General”, tick “Always run in background” checkbox, type “10” in “workbench save interval” textbox, press “Apply and close”



# GUI Testing

- ▶ Three approaches to GUI testing
  - ❖ Manual testing
  - ❖ Capture and replay
  - ❖ Model-based testing



# Manual Testing

▶ A human should interact with all different parts of the GUI to make sure the software works as expected:

❖ Pros:

- human is expert and has the domain knowledge
- human acts as an oracle

❖ Cons:

- error-prone
- slow
- costly

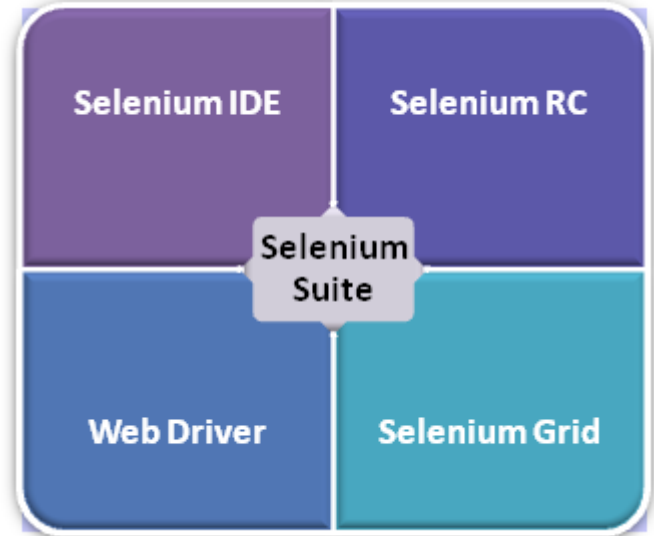


# Capture-then-Replay

- ▶ **Capture** (i.e., record) the interactions of a user with the GUI
- ▶ **Replay** (automatically) the recorded sessions over and over
- ▶ Many capture-then-replay tools available:
  - ❖ **Free Software:** Selenium, Abbot, Watir, Autolt etc.
  - ❖ **Commercial:** IBM Robot Tester, Sahi, QF-Test etc.

# Selenium

- ▶ An open-source GUI testing tool for web applications
  - ❖ **Selenium IDE**: capture-then-replay
  - ❖ **Web Driver**: automated test script

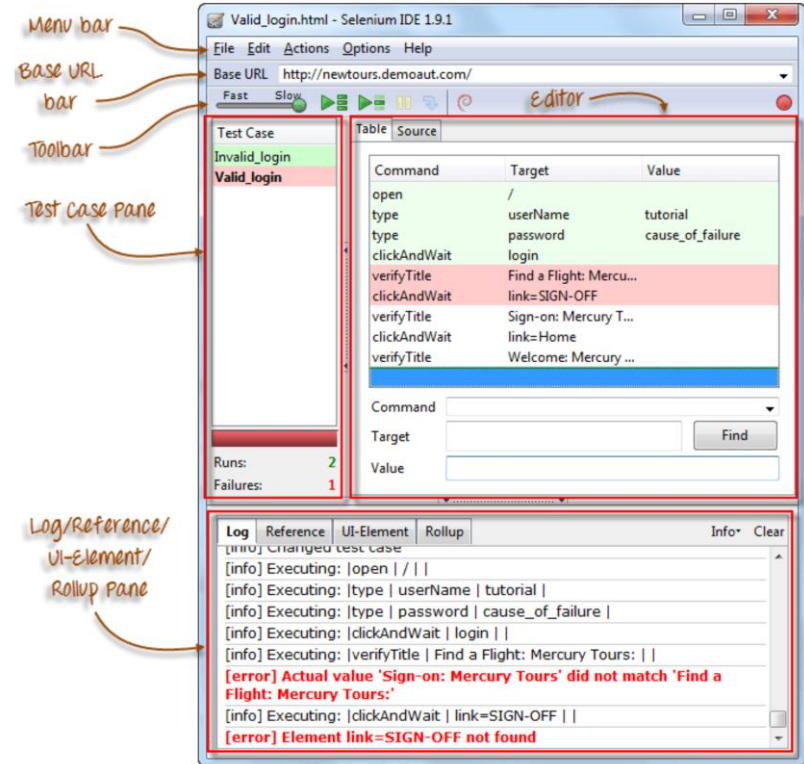


# Why the name “Selenium”?

- ▶ Came from a joke
- ▶ Another automated testing framework was popular at the time by Mercury Interactive (later was acquired by HP)
- ▶ “Selenium” is a well-known antidote for Mercury poisoning

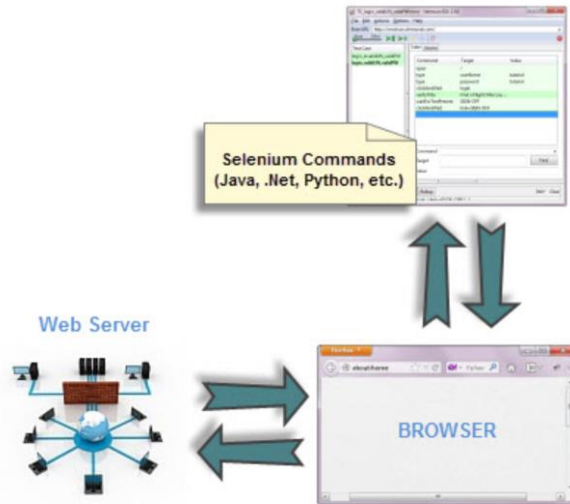
# Selenium IDE

- ▶ Available as a plug-in (i.e., add-on) for different browsers
- ▶ Can record a session and then replay it back
- ▶ Usually used as a prototyping tool. If you want to create more advanced test cases, you will need to use WebDriver.



# WebDriver

- ▶ Write tests in different programming languages (Java, Python, Ruby, PHP, etc.)
- ▶ Run tests on different browsers



# Demo of Selenium IDE

# Demo of Selenium WebDriver



# Selenium Locators

- ▶ By CSS ID: `$(byId(...))`
- ▶ By CSS class name: `$(byClassName(...))`
- ▶ By HTML name attribute: `$(byName(...))`
- ▶ By DOM structure or xpath: `$x(...)`
- ▶ By link text: `$(byLinkText(...))`
- ▶ By partial link text: `$(byPartialLinkText(...))`
- ▶ By HTML tag name: `$(byTagName(...))`

# Summary

- ▶ Make use of “Page Object” Design Pattern
  - ❖ [https://www.selenium.dev/documentation/test\\_practices/encouraged/page\\_object\\_models/](https://www.selenium.dev/documentation/test_practices/encouraged/page_object_models/)
- ▶ When to use which locators?
  - ❖ 1) use `id` if there is a unique one
  - ❖ 2) if no unique `id`, use css selector or xpath selector
  - ❖ 3) avoid selecting by `tag` name as much as possible
  - ❖ [https://www.selenium.dev/documentation/test\\_practices/encouraged/locators/](https://www.selenium.dev/documentation/test_practices/encouraged/locators/)

# Relevant Reads and Resources

- ▶ Selenium IDE Chrome plugin:
  - ❖ <https://chrome.google.com/webstore/detail/selenium-ide/mooikfkahbdckldjjndioackbalphokd?hl=en>
- ▶ Selenium Tutorial:
  - ❖ <https://www.guru99.com/selenium-tutorial.html>
- ▶ Official Selenium Documentation
  - ❖ <https://www.selenium.dev/documentation/>
- ▶ Intellij Selenium
  - ❖ <https://www.jetbrains.com/help/idea/selenium.html>.



JOHNS HOPKINS

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