Tool Support for Testing

Software Testing: INF3121 / INF4121

Summary:

Types of test tools

Tool support for testing | Test tool classification

Tools for …

Test management / Static testing / Test specification / Execution and logging

Performance and monitoring / Specific testing needs

Effective use of test tools

Benefits and risks | Special considerations for tools

Introducing a test tool into an organisation

Part I: Close-ended questions

Question 1

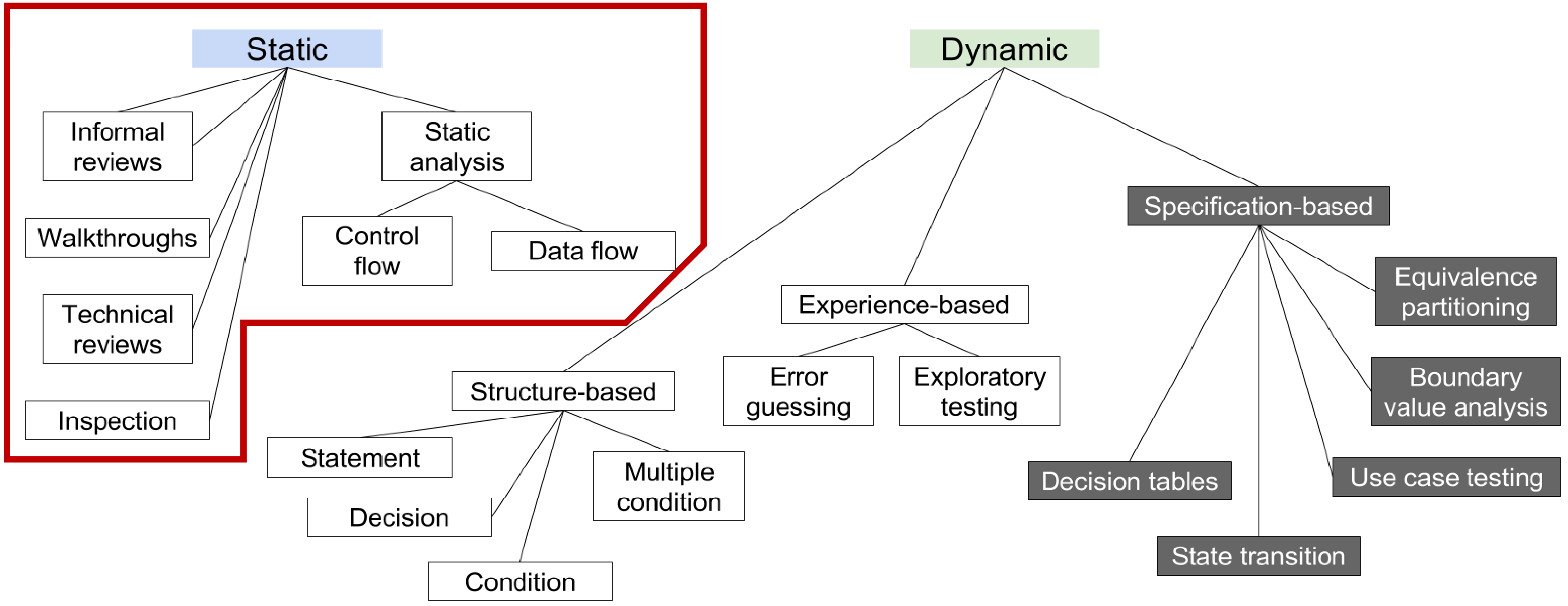
Which tools help support static testing?

a. Static analysis tools and test execution tools
b. Review process support tools, static analysis tools and coverage measurement tools
c. Dynamic analysis tools and modelling tools
d. Review process support tools, static analysis tools and modelling tools

Question 1: Answer

Which tools help support static testing?

Recall the different types of testing



Question 1: Answer

Which tools help support static testing?

- Static testing and analysis
  - Examination of code and work products without executing it
  - Understanding structures and dependencies
  - May help to ensure code adheres to industry / organisational standards
  - Reviews → Powerful techniques in static testing
- Dynamic testing
  - Software is executed using a set of input values and conditions
  - Output is examined and compared to expected results
  - Can only be applied to software code

Question 1: Answer

Which tools help support static testing?

Tools for static testing

Tools that aid in improving the code / work product, without executing it

Categories

Review tools

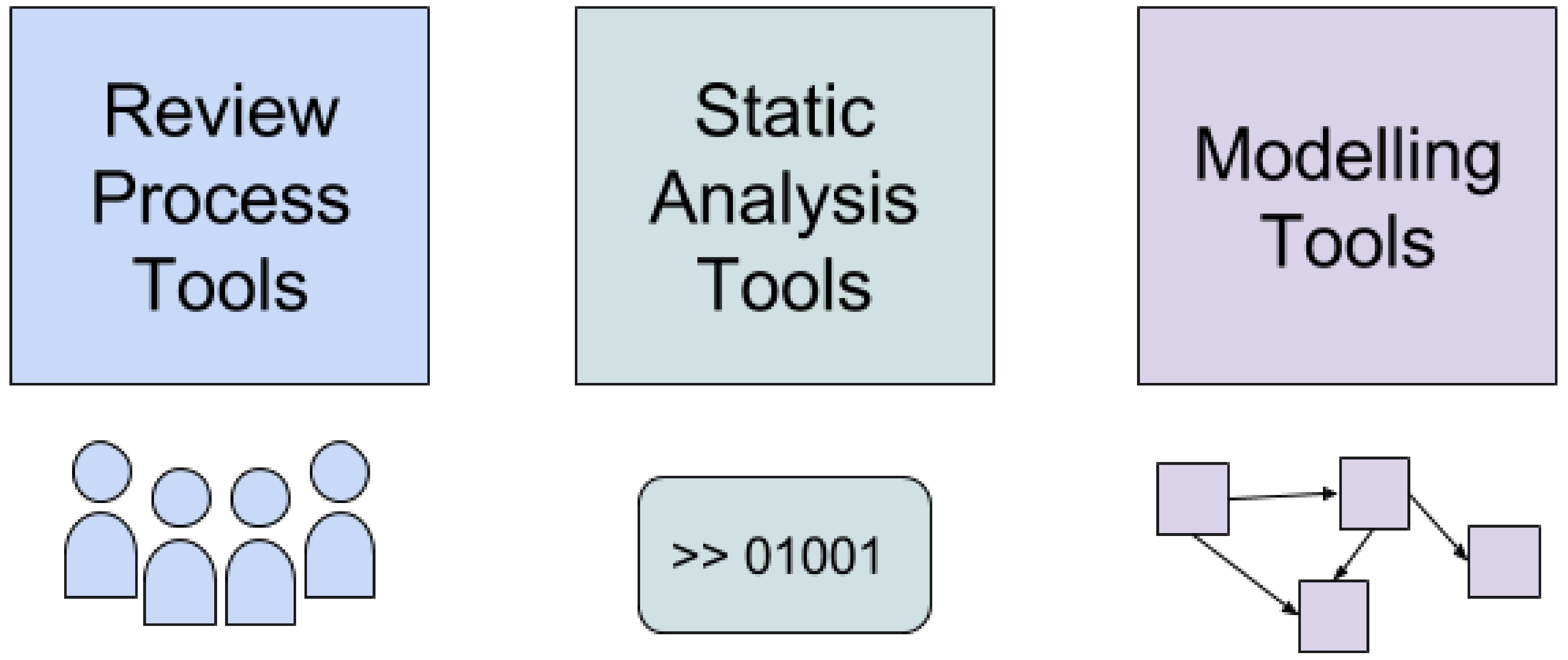
Supports the review process

Static analysis tools

Supports code examination

Modelling tools

Validate models of system / software



Question 1: Answer

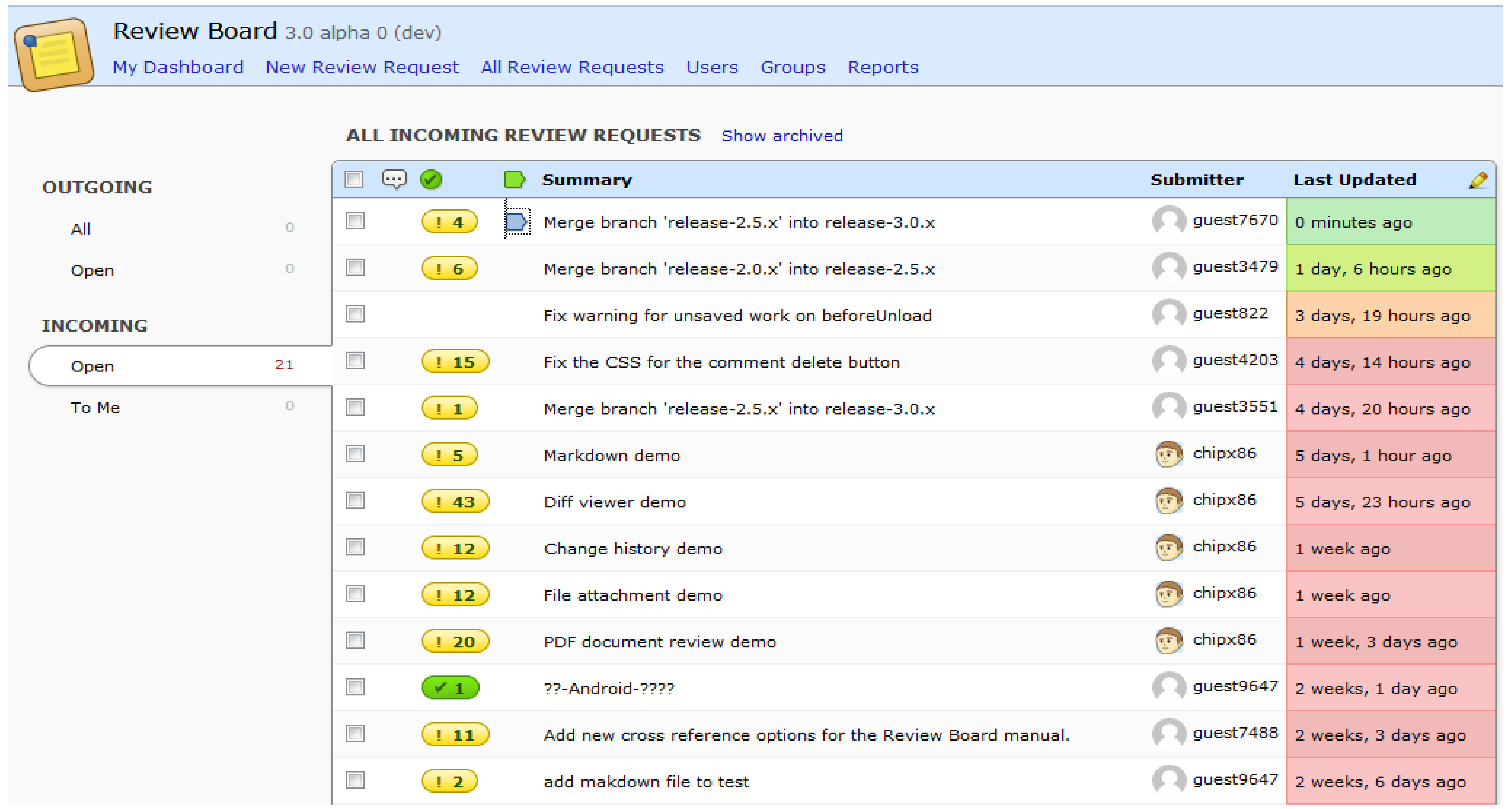
Which tools help support static testing?

- Review process tools
  - Common reference for the review processes conducted
  - Keep track of all the information from the review process
  - Store and communicate review comments, report on defects and effort
  - Monitoring review status → Passed, passed with corrections, requires re-review
- When to use?
  - Suitable for more formal review processes
  - Geographically dispersed teams

Question 1: Answer

Which tools help support static testing?

- Review process tool example: Review Board
  - Collaborative code review tool
  - Tracks changes to code and documents
    - Changes must be approved
  - Feature to discuss proposed changes
  - Shows difference in code
    - Current and proposed side by side



Review Board 3.0 alpha 0 (dev)

My Dashboard · New Review Request · All Review Requests · Users · Groups · Reports

OUTGOING	
All	0
Open	0
INCOMING	
Open	21
To Me	0

ALL INCOMING REVIEW REQUESTS · Show archived

		Summary	Submitter	Last Updated
	! 4	Merge branch 'release-2.5.x' into release-3.0.x	guest7670	0 minutes ago
	! 6	Merge branch 'release-2.0.x' into release-2.5.x	guest3479	1 day, 6 hours ago
		Fix warning for unsaved work on beforeUnload	guest822	3 days, 19 hours ago
	! 15	Fix the CSS for the comment delete button	guest4203	4 days, 14 hours ago
	! 1	Merge branch 'release-2.5.x' into release-3.0.x	guest3551	4 days, 20 hours ago
	! 5	Markdown demo	chipx86	5 days, 1 hour ago
	! 43	Diff viewer demo	chipx86	5 days, 23 hours ago
	! 12	Change history demo	chipx86	1 week ago
	! 12	File attachment demo	chipx86	1 week ago
	! 20	PDF document review demo	chipx86	1 week, 3 days ago
	✓ 1	??-Android-????	guest9647	2 weeks, 1 day ago
	! 11	Add new cross reference options for the Review Board manual.	guest7488	2 weeks, 3 days ago
	! 2	add makdown file to test	guest9647	2 weeks, 6 days ago

Question 1: Answer

Which tools help support static testing?

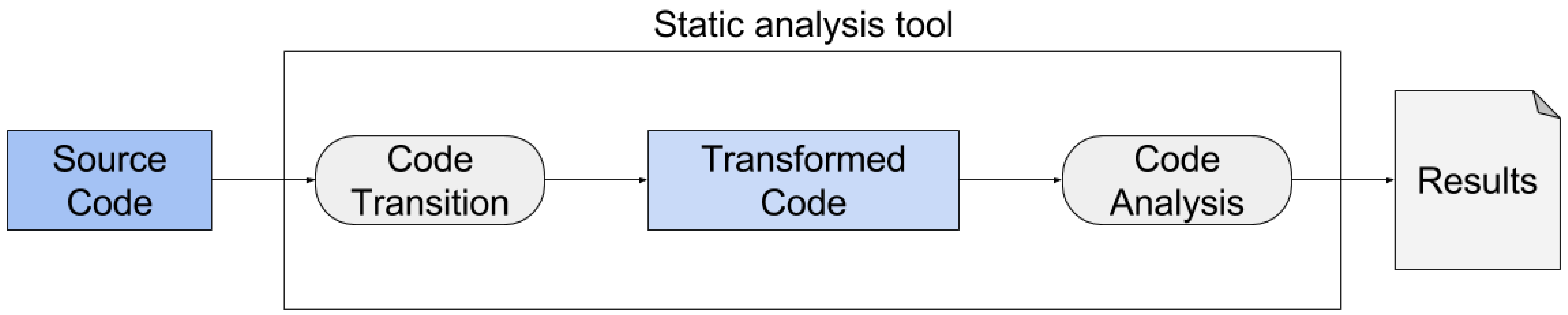
Static analysis tools (D)

Mostly used by developers → Component (unit) testing

Tool is executed → Code is not

The source code serves as input data to the tool

Extension of compiler technology



Question 1: Answer

Which tools help support static testing?

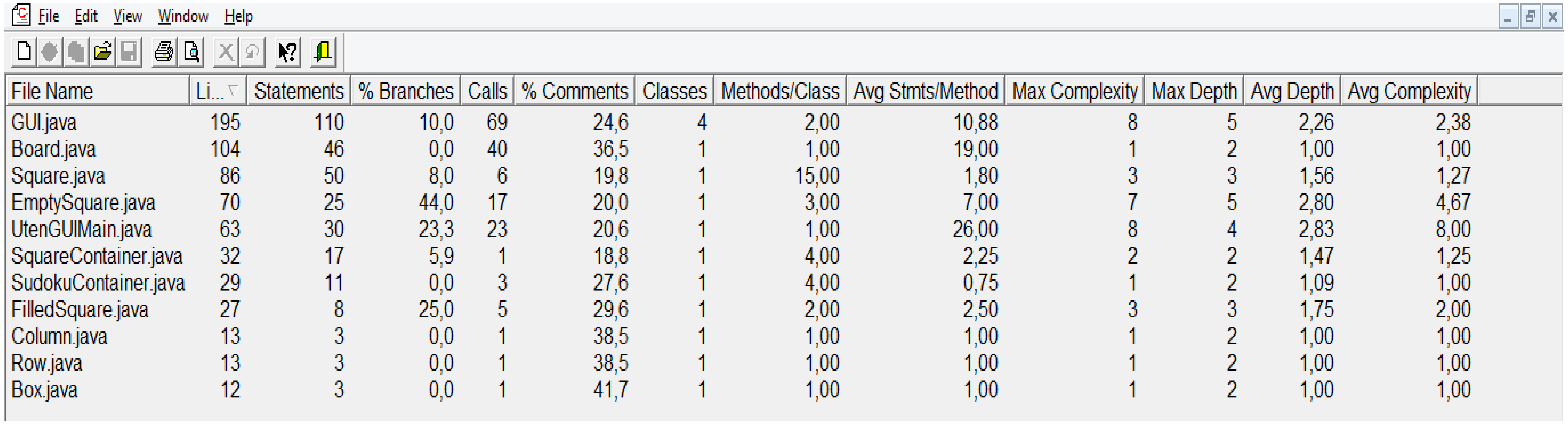
- Static analysis tools (D)
    - Support developers and testers in finding defects before dynamic testing
- Purpose
    - To better understand the code, and find ways of improving it
- Common features
    - Calculate metrics → Complexity, nesting levels → Identify areas of risk
    - Enforce coding standards
    - Analyse code structures and dependencies

Question 1: Answer

Which tools help support static testing?

Static analysis tool example: Source Monitor

- Collects metrics from source code files
- Displays and prints metrics in tables and charts



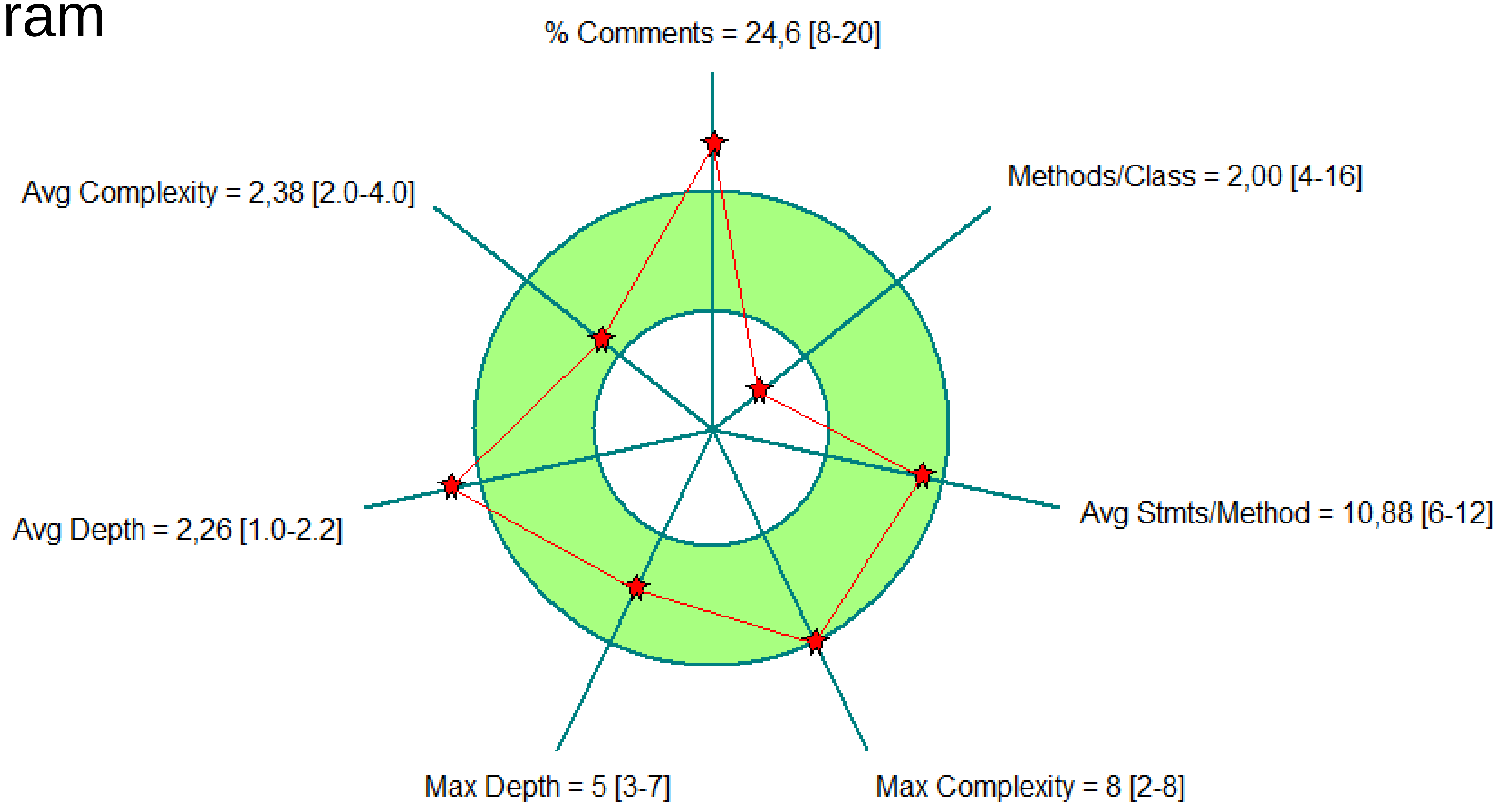
File Name	Li...	Statements	% Branches	Calls	% Comments	Classes	Methods/Class	Avg Stmts/Method	Max Complexity	Max Depth	Avg Depth	Avg Complexity
GUI.java	195	110	10,0	69	24,6	4	2,00	10,88	8	5	2,26	2,38
Board.java	104	46	0,0	40	36,5	1	1,00	19,00	1	2	1,00	1,00
Square.java	86	50	8,0	6	19,8	1	15,00	1,80	3	3	1,56	1,27
EmptySquare.java	70	25	44,0	17	20,0	1	3,00	7,00	7	5	2,80	4,67
UtenGUIMain.java	63	30	23,3	23	20,6	1	1,00	26,00	8	4	2,83	8,00
SquareContainer.java	32	17	5,9	1	18,8	1	4,00	2,25	2	2	1,47	1,25
SudokuContainer.java	29	11	0,0	3	27,6	1	4,00	0,75	1	2	1,09	1,00
FilledSquare.java	27	8	25,0	5	29,6	1	2,00	2,50	3	3	1,75	2,00
Column.java	13	3	0,0	1	38,5	1	1,00	1,00	1	2	1,00	1,00
Row.java	13	3	0,0	1	38,5	1	1,00	1,00	1	2	1,00	1,00
Box.java	12	3	0,0	1	41,7	1	1,00	1,00	1	2	1,00	1,00

Question 1: Answer

Which **tools** help support **static testing**?

Static analysis tool example: Source Monitor

Kiviat diagram



Question 1: Answer

Which tools help support static testing?

Modelling tools (D)

Validate models of the system / software

Purpose

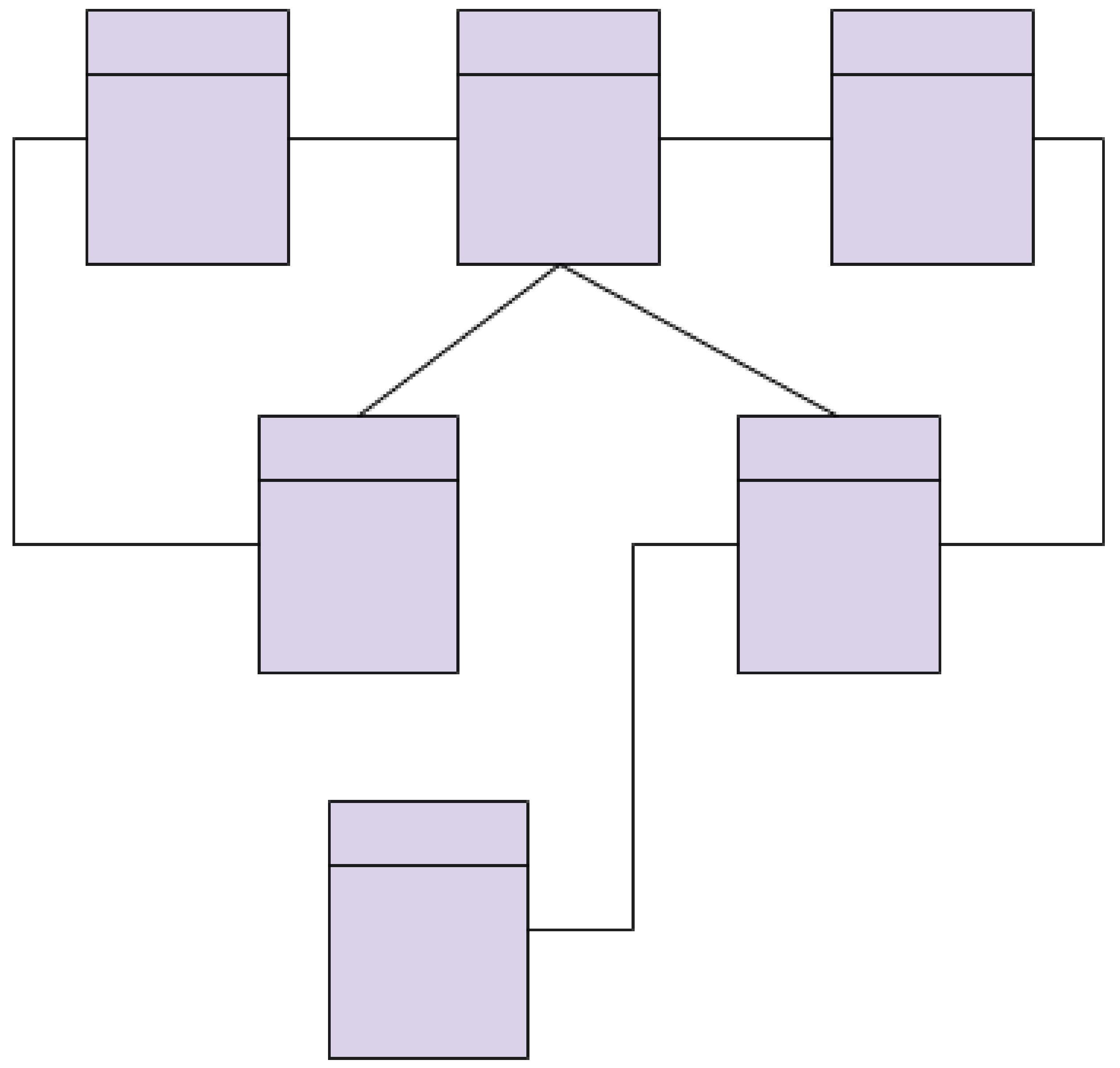
To better aid in designing the software

Common features and characteristics

Identify inconsistencies and defects within the models

Identify and prioritise risk areas

Predicting system response and behaviour under various situations

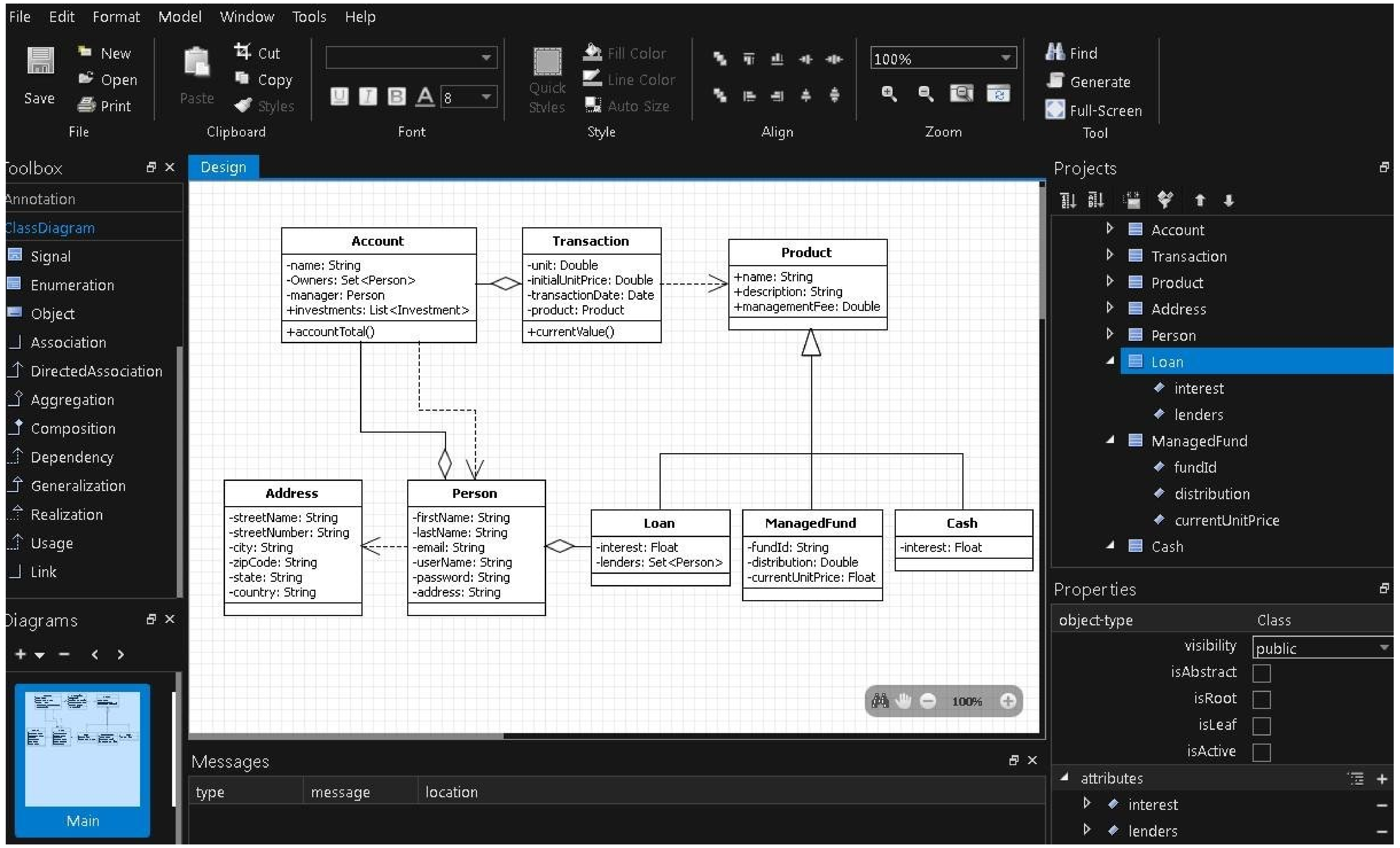


Question 1: Answer

Which tools help support static testing?

Modelling tool example: Star UML

- UML tool
- Variety of diagrams
  - Class / Domain
  - Use case
  - Sequence



Question 1: Answer

Which tools help support static testing?

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b. Review process support tools, static analysis tools and coverage measurement tools
c. Dynamic analysis tools and modelling tools
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Question 2

Which test activities are supported by test harness or unit test framework tools?

a. Test management and control
b. Test specification and control
c. Test execution and control
d. Performance and monitoring

Question 2: Answer

Which test activities are supported by test harness or unit test framework tools?

- Test harness and unit test framework tools (D)
  - The two types are similar
  - Support tools for testing individual components or software units
  - Harness: Stubs and drivers → Small programs that interact with software
  - Unit test framework tools → Support for object-oriented software
- When are these tools used?
  - During test execution and logging

Question 2: Answer

Which test activities are supported by test harness or unit test framework tools?

Test harness tools (D)

"Enabler" that does all the work of:

(i) Executing the tests, using

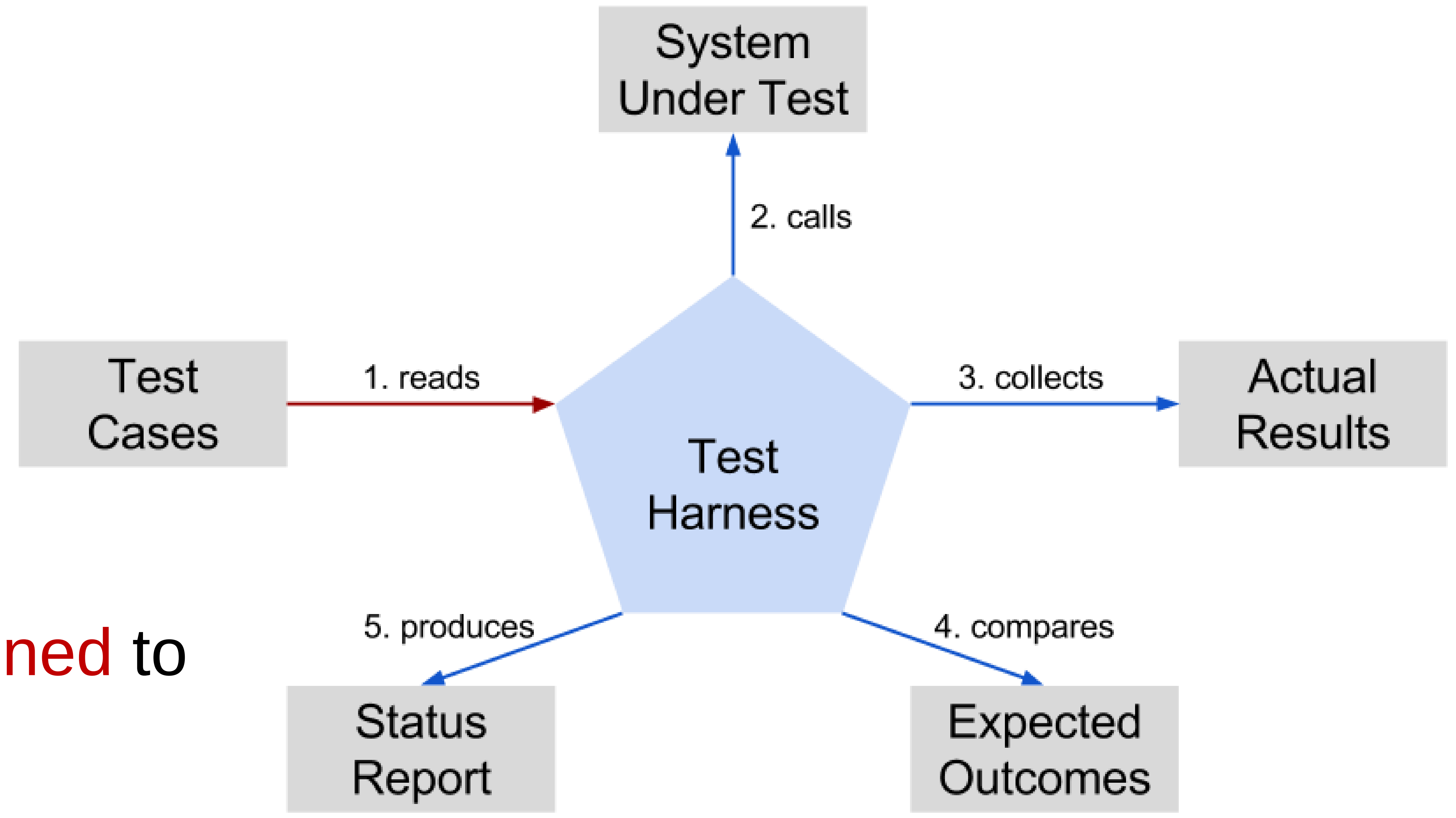
(ii) A test library, and

(iii) Generates reports

Requires that the test scripts are designed to

(iv) Handle different data, and

(v) Test scenarios



Question 2: Answer

Which test activities are supported by test harness or unit test framework tools?

Example: Using stubs and drivers

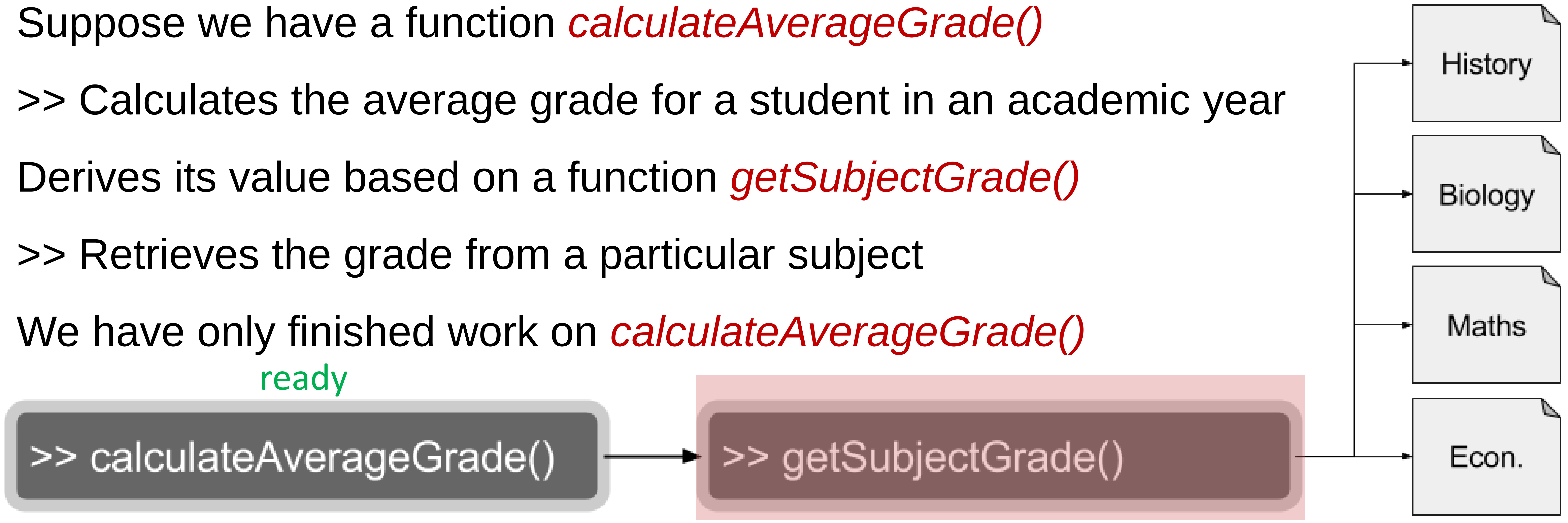
Suppose we have a function *calculateAverageGrade()*

>> Calculates the average grade for a student in an academic year

Derives its value based on a function *getSubjectGrade()*

>> Retrieves the grade from a particular subject

We have only finished work on *calculateAverageGrade()*



Question 2: Answer

Which test activities are supported by test harness or unit test framework tools?

Example: Using stubs and drivers

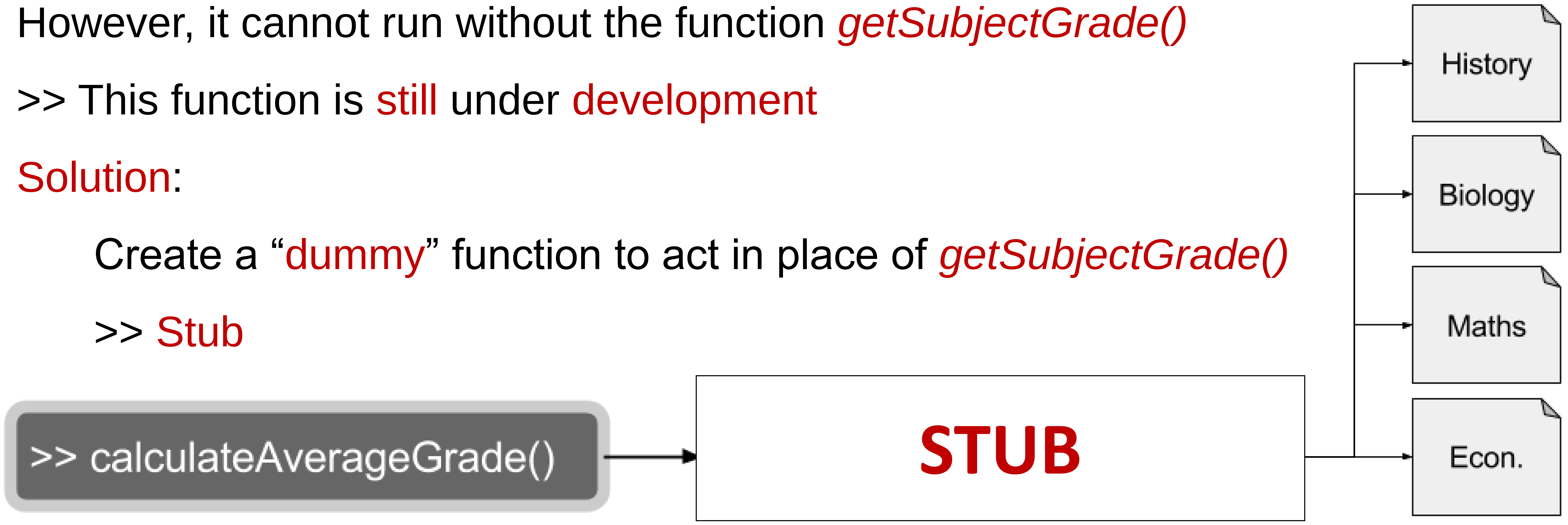
However, it cannot run without the function *getSubjectGrade()*

>> This function is still under development

Solution:

Create a "dummy" function to act in place of *getSubjectGrade()*

>> Stub



Question 2: Answer

Which test activities are supported by test harness or unit test framework tools?

Drivers

Calls the component to be tested

In other words: A component that calls the *Tested Unit*

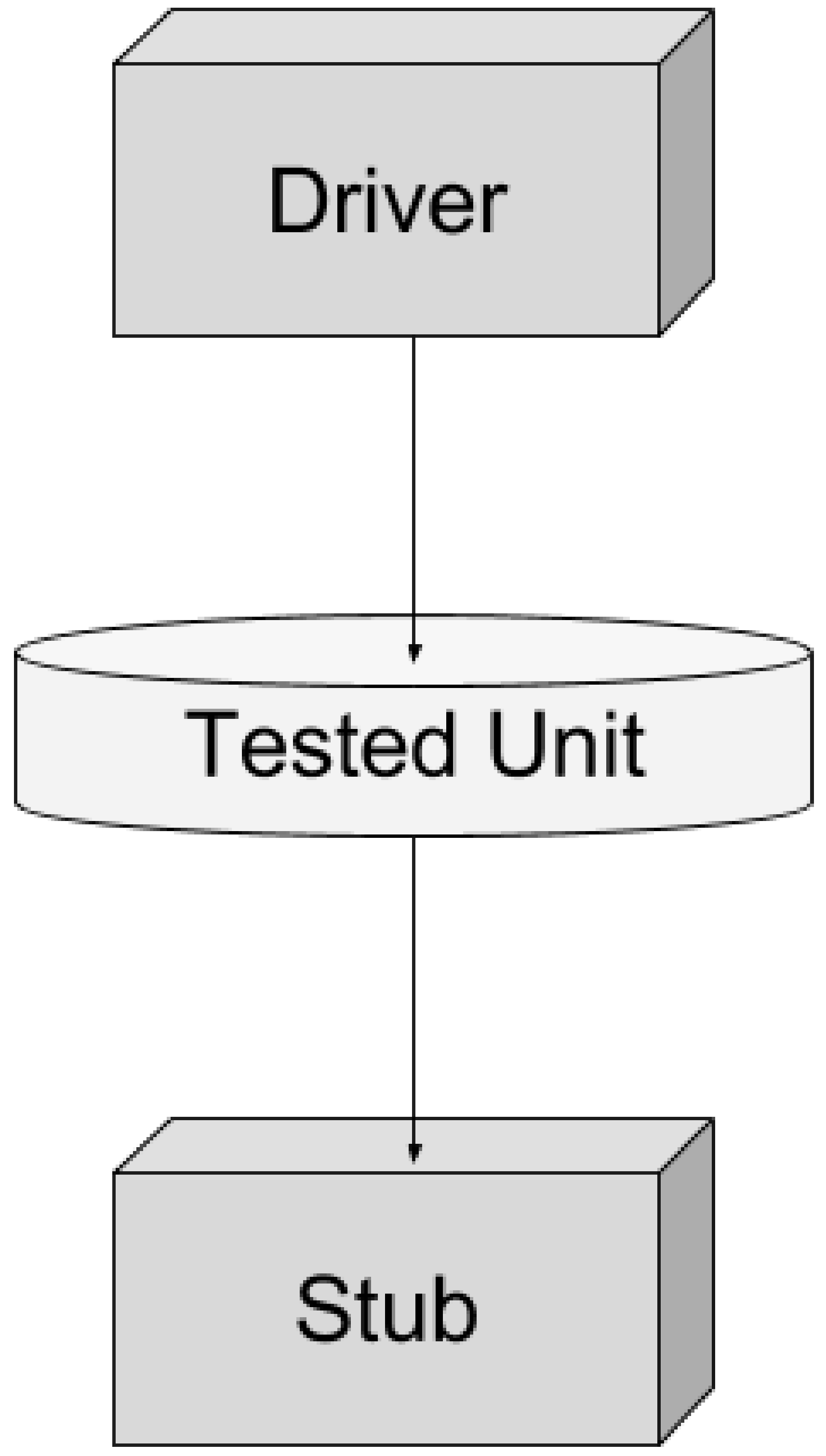
Stubs

Called *from* the software component to be tested

In other words: A component the *Tested Unit* depends on

Partial implementation

Fake values



Question 2: Answer

Which test activities are supported by test harness or unit test framework tools?

Characteristics of test harness and unit test framework tools

Supply inputs to the software being tested

Receive outputs generated by the software being tested

Execute a set of tests within the framework

Record pass / fail results of each test

Store tests

Coverage measurement at code level

Provide support for debugging

Question 2: Answer

Which test activities are supported by test harness or unit test framework tools?

a. Test management and control
b. Test specification and control
c. **Test execution and control**
d. Performance and monitoring

Question 3

What are the potential benefits from using tools in general to support testing?

a. Greater quality of code, reduction in the number of testers needed, better objectives for testing
b. Greater repeatability of tests, reduction in repetitive manual work, objective assessment
c. Greater responsiveness of users, reduction of tests run, objectives not necessary
d. Greater quality of code, reduction in paperwork, fewer objectives to the tests

Question 3: Answer

What are the potential benefits from using tools in general to support testing?

- There are some things humans can do better than a computer
  - >> You see a friend in an unexpected place → You immediately recognise them
  - Humans are very good at this type of pattern recognition
  - Complex to write software for facial recognition
- There are things computers can do better / more quickly than humans
  - >> Adding up five twenty-digit numbers quickly
  - A computer can perform this accurately and in “no time”
  - Unlike humans, computers are not inclined to get tired / find a task to be boring

Question 3: Answer

What are the potential benefits from using tools in general to support testing?

- Let computers do what they do best
  - Reduction of repetitive, manual work
    - Repeat the exact same procedure as previously
    - No human errors → People are prone to make errors
  - Greater consistency and reliability
    - Can prove more efficient and reliable
  - Objective assessment
  - Ease of access to information about testing

Question 3: Answer

What are the potential benefits from using tools in general to support testing?

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Question 4

What is a potential risk in using tools to support testing?

a. Unrealistic expectations, expecting the tool to do too much
b. Insufficient reliance on the tool, i.e. still doing manual testing when a test execution tool has been purchased
c. The tool may find defects that are not there
d. The tool will repeat exactly the same thing it did the previous time

Question 4: Answer

What is a potential risk in using tools to support testing?

Risks

- Underestimating time, cost, effort → Introducing a tool
- Underestimating time, effort → Achieve significant and continuing benefits from tool
- Underestimating effort → Required to maintain test assets generated by the tool
- Unrealistic expectations and over-reliance on the tool
  - Expecting tools to be able to do “anything”

Simply purchasing a tool does not guarantee benefit

- Must be chosen carefully
- What are the objectives of the test effort?

Question 4: Answer

What is a potential risk in using tools to support testing?

a. **Unrealistic expectations, expecting the tool to do too much**
b. Insufficient reliance on the tool, i.e. still doing manual testing when a test execution tool has been purchased
c. The tool may find defects that are not there
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Question 5

Which of the following are advanced scripting techniques for test execution tools?

a. Data-driven and keyword-driven
b. Data-driven and capture-driven
c. Capture-driven and keyhole-driven
d. Playback-driven and keyword-driven

Question 5: Answer

Which of the following are advanced scripting techniques for test execution tools?

Background

As software systems grow, manual software testing becomes increasingly difficult

Aim to decrease testing time → Automation of tests

Scripting techniques

Concerns: What tests should we execute? How de we run these tests?

Test execution tool → Needs to know what to do → SCRIPT

Tools are software → Script must be a program

Question 5: Answer

Which of the following are advanced scripting techniques for test execution tools?

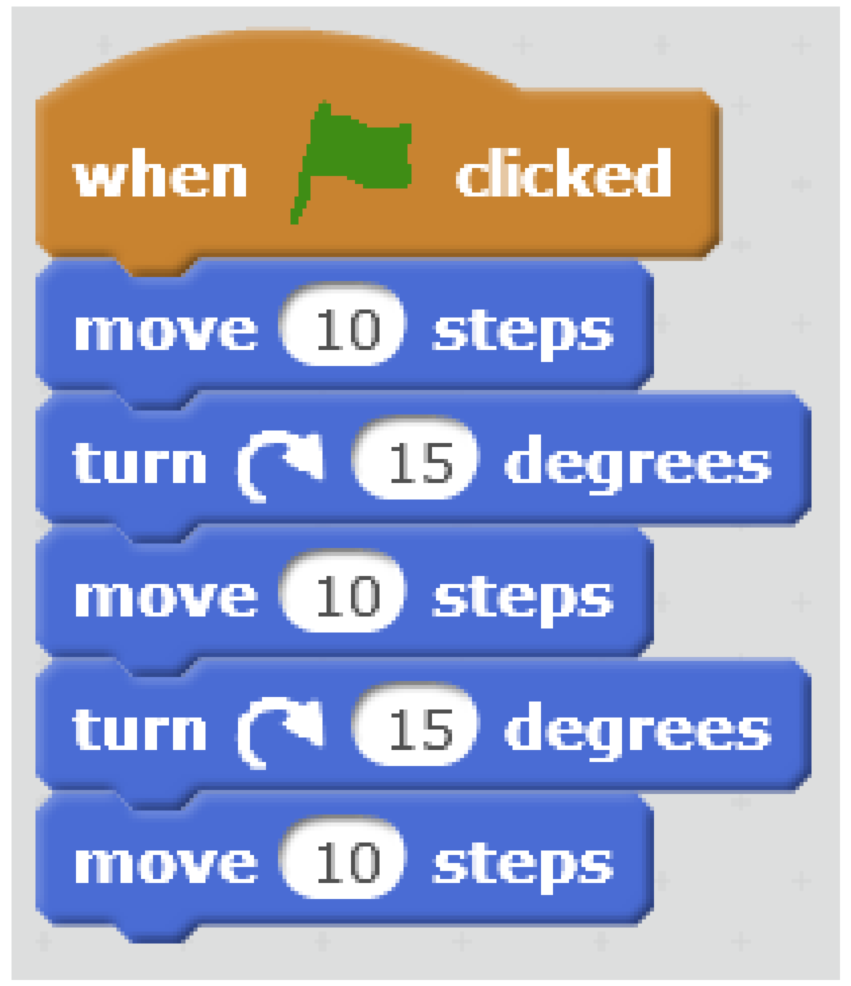
Levels of scripting

- Linear Scripts
- Structured Scripts
- Shared Scripts
- Data-Driven Scripts
- Keyword-driven Scripts

Question 5: Answer

Which of the following are advanced scripting techniques for test execution tools?

- Linear scripting
  - Created manually or by recording a manual test
  - Advantages
    - Can be automated quickly
    - Tester does not need programming skills
  - Disadvantages
    - Hard coded data into scripts
    - Vulnerable to changes / No sharing or reuse

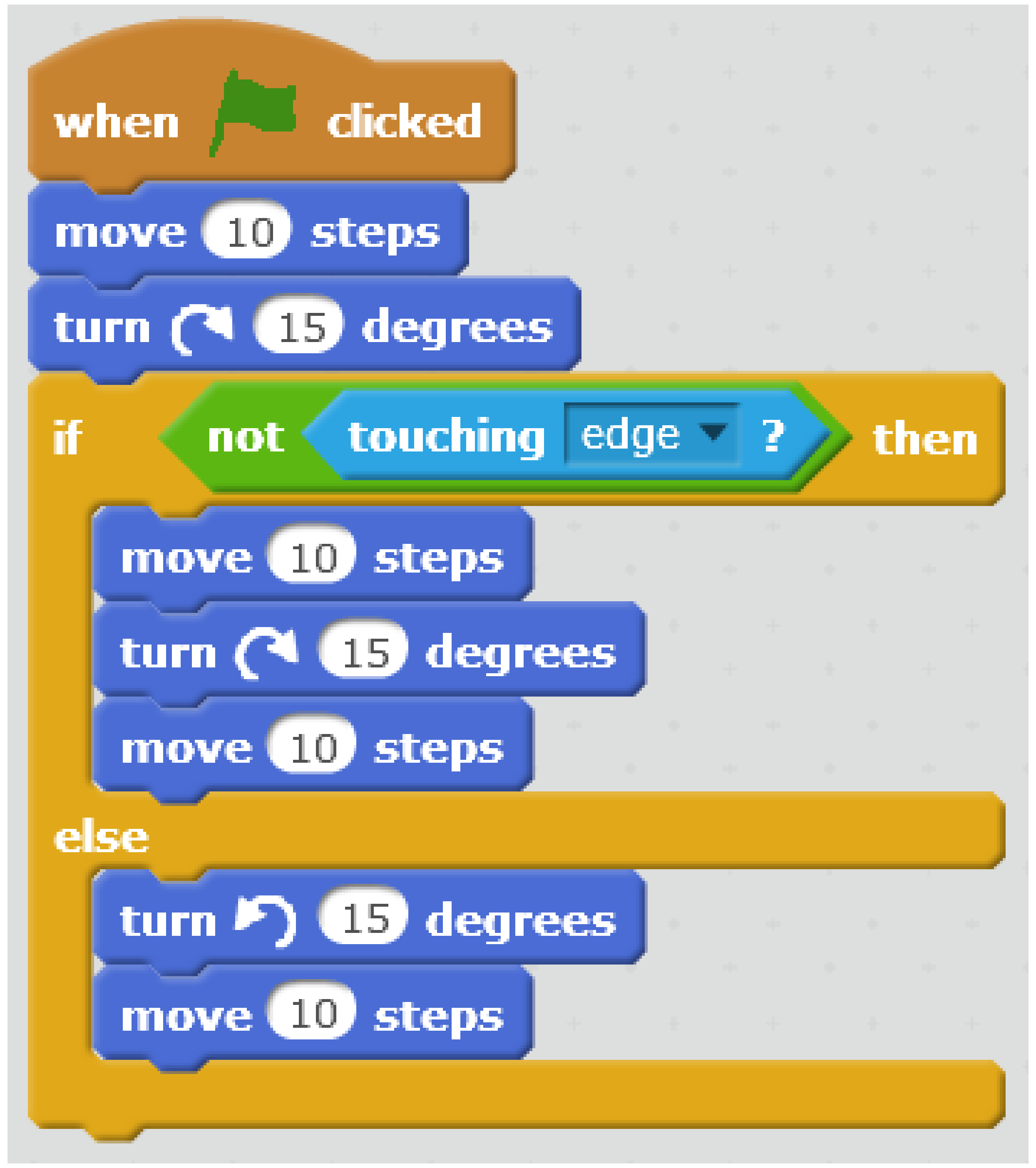


Question 5: Answer

Which of the following are advanced scripting techniques for test execution tools?

Structured scripting

- Using selection and iteration structures
- Linear scripts + if + for / while loops
- Advantages
  - More robust than linear scripts / Reusable
- Disadvantages
  - Requires programming skills / understanding
  - Test data hard coded into scripts



```
when [flag] clicked
move (10) steps
turn ↻ (15) degrees
if <not <touching [edge ▾] ?>> then
    move (10) steps
    turn ↻ (15) degrees
    move (10) steps
else
    turn ↺ (15) degrees
    move (10) steps
```

Question 5: Answer

Which of the following are advanced scripting techniques for test execution tools?

Shared scripting

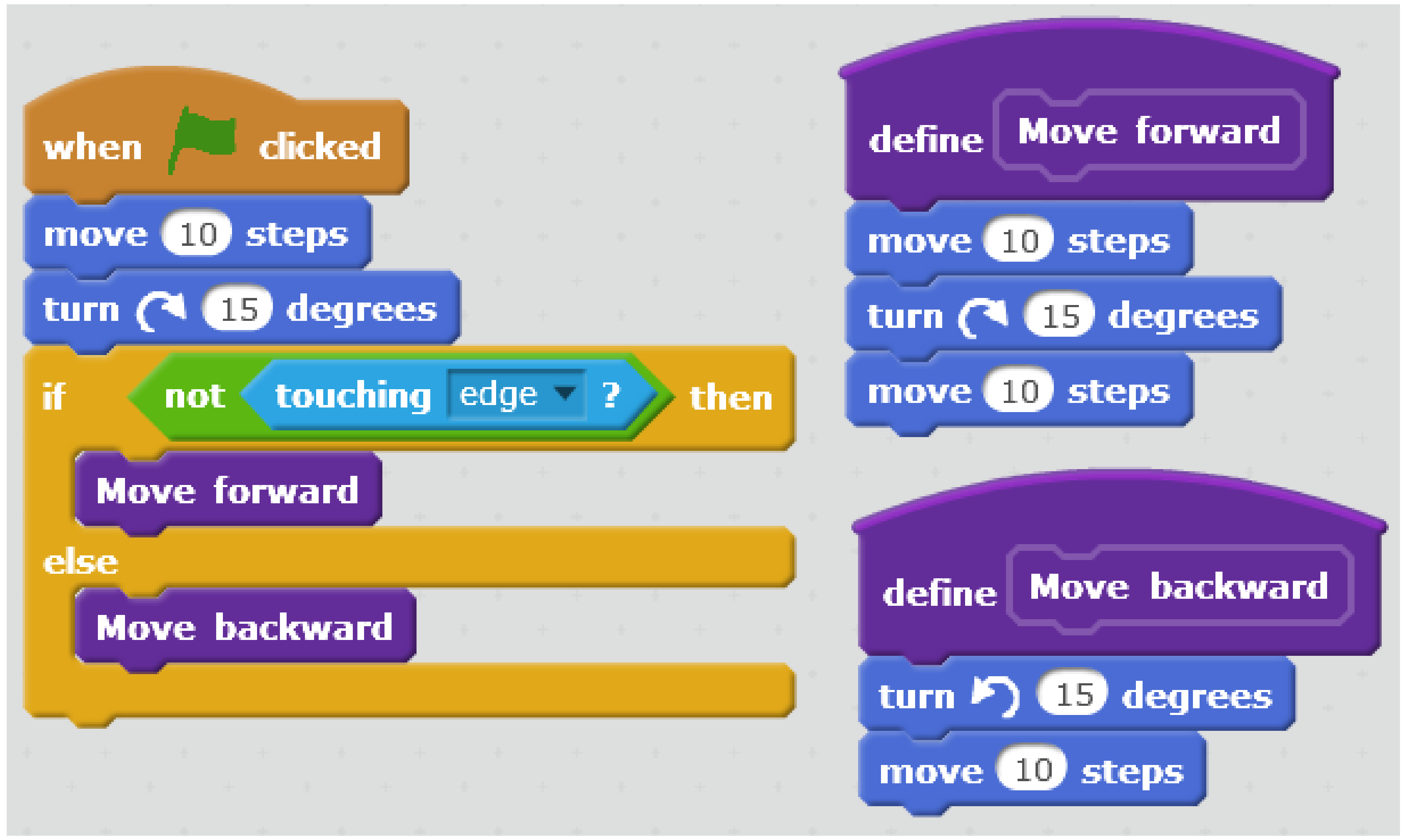
Scripts used / called by other scripts

Advantages

- Less effort to implement similar tests
- Reuse: Eliminate repetitions
- Keeps changes to a minimum

Disadvantages

- Often specific to parts of the system



```
when [flag] clicked
move (10) steps
turn ↻ (15) degrees
if <not <touching [edge ▾] ?>> then
    Move forward
else
    Move backward

define Move forward
move (10) steps
turn ↻ (15) degrees
move (10) steps

define Move backward
turn ↺ (15) degrees
move (10) steps
```

Question 5: Answer

Which of the following are advanced scripting techniques for test execution tools?

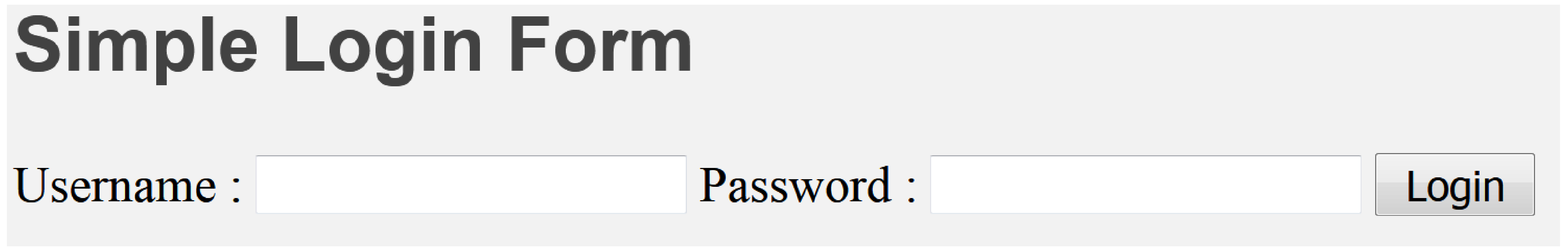
- Data-driven scripting
  - Separate test scripts and instructions from data (input / expected results)
  - Single test script to run with different data
  - Advantages
    - Similar tests can be added very quickly
    - Time-saving → Reduction of repetitive manual work
  - Disadvantages
    - Changes to either data file or script requires alteration of both

Question 5: Answer

Which of the following are advanced scripting techniques for test execution tools?

Example: Simple Login Form

Test with different combinations of username and password



Problem: Necessary to write three scripts for three different combinations?

1. Go to login page 2. Type username "Hansen" 3. Type password"oslo123" 4. Click "Login" button	1. Go to login page 2. Type username "Olsen" 3. Type password"bergen456" 4. Click "Login" button	1. Go to login page 2. Type username "Jensen" 3. Type password"harstad789" 4. Click "Login" button

Question 5: Answer

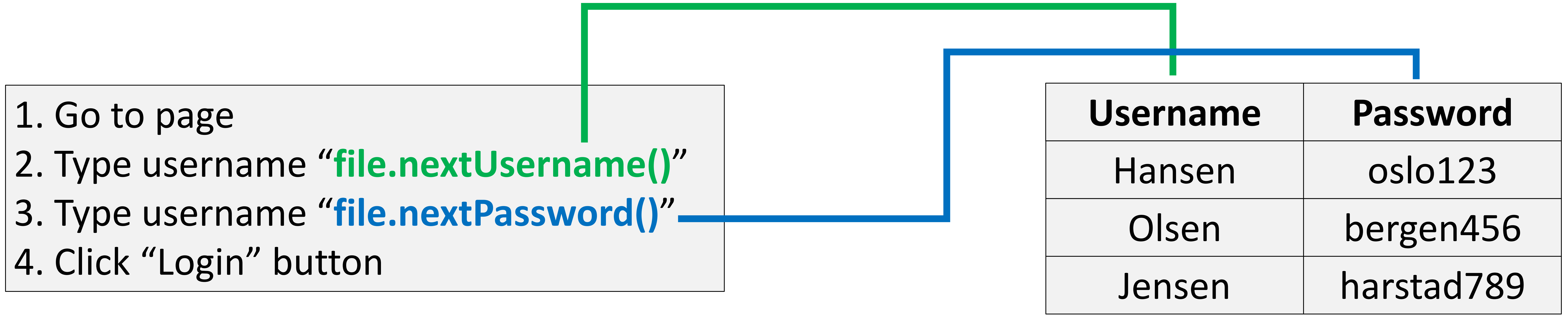
Which of the following are advanced scripting techniques for test execution tools?

Example: Simple Login Form

This test approach is time-consuming

Solution: Separate test script from data (username, password) → No hard-coding

One script retrieves different combinations of username and password



1. Go to page
2. Type username “**file.nextUsername()**”
3. Type username “**file.nextPassword()**”
4. Click “Login” button

Username	**Password**
Hansen	oslo123
Olsen	bergen456
Jensen	harstad789

Question 5: Answer

Which of the following are advanced scripting techniques for test execution tools?

Keyword-driven scripting

- Keywords symbolising actions (functionality)
- “One level up” from data-driven scripting
- Can write tests using keywords
- *“What to test, rather than how to test it”*

Keyword	Script
Login	script1
CH_password	script2
Logout	script3

[script1]
1. Go to page
2. Type username “file.nextUsername()”
3. Type username “file.nextPassword()”
4. Click “Login” button

[script2]
1. Click on user avatar
2. Click “Change password”
3. Type current password
4. Type new password
5. Click “Confirm” button

[script3]
1. Click on user avatar
2. Click “Logout” button

Question 5: Answer

Which of the following are advanced scripting techniques for test execution tools?

a. **Data-driven and keyword-driven**
b. Data-driven and capture-driven
c. Capture-driven and keyhole-driven
d. Playback-driven and keyword-driven

Question 6

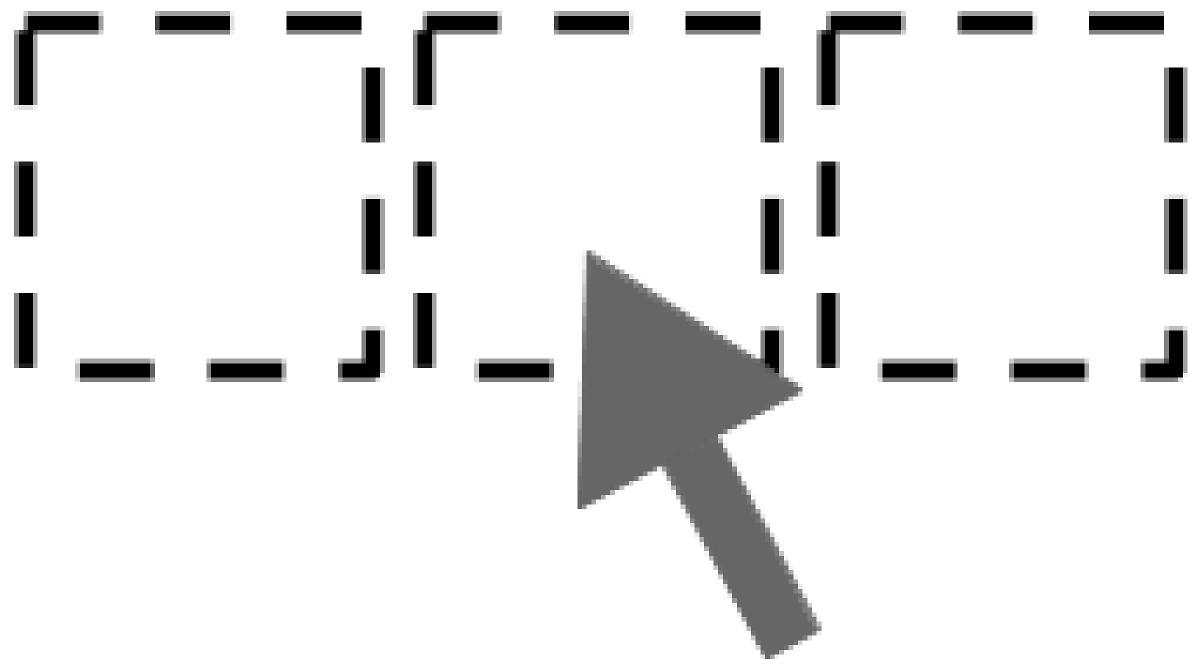
Which of the following would NOT be done as part of selecting a tool for an organisation?

a. Assess the organisational maturity, strengths and weaknesses
b. Roll out the tool to as many users as possible within the organisation
c. Evaluate the tool features against clear requirements and objective criteria
d. Identify internal requirements for coaching and mentoring in the use of the tool

Question 6: Answer

Which of the following would NOT be done as part of selecting a tool for an organisation?

- Tools aid in the testing process
  - Tools do not *ensure* the test effort alone
- For a tool to provide benefit, it must:
  - Match the need within the organisation
  - Be carefully selected to meet the objectives
- Recall test principle 6: Testing is context-dependent
  - The chosen tool must match the given context



Question 6: Answer

Which of the following would NOT be done as part of selecting a tool for an organisation?

- Considerations for selecting a test tool
  - Assessment of the organisational maturity
  - Identify areas within the organisation where tool support will improve the test effort
  - Evaluate the tools against clear requirements / objectives
  - Proof-of-concept
    - Ensure the product works as desired / Actually meets the requirements
  - Evaluate the vendor (or open-source network) → Training, support, etc.
  - Identify planning and internal implementation → Coaching, mentoring, etc.

Question 6: Answer

Which of the following would NOT be done as part of selecting a tool for an organisation?

Success factors for selecting a test tool

- Incremental roll-out → As opposed to “big bang”
- Adapt and improve processes / testware / tool artefacts
- Provide adequate support and training for users of the tool
- Define guidelines for using the tool
- Monitor use of the tool and the benefits achieved / Ask for feedback

Beware of:

- Selecting tool based on “hype” / unrealistic expectations

Question 6: Answer

Which of the following would NOT be done as part of selecting a tool for an organisation?

a. Assess the organisational maturity, strengths and weaknesses
b. **Roll out the tool to as many users as possible within the organisation**
c. Evaluate the tool features against clear requirements and objective criteria
d. Identify internal requirements for coaching and mentoring in the use of the tool

Question 7

Which of the following is a goal for a pilot phase of introducing a new tool to an organisation?

a. Decide which tool to acquire
b. Decide the main objectives and requirements for this type of tool
c. Evaluate the vendor including training, support, and commercial aspects
d. Decide on standard ways of using, managing, storing, and maintaining the tool and the test assets

Question 7: Answer

Which of the following is a goal for a pilot phase of introducing a new tool to an organisation?

- Proof-of-concept
  - Demonstration to verify that some concept (tool) has potential within the context
- Pilot project → Tool has already been chosen
  - Use the tool on a small scale
  - Learn more about the tool and explore ways of using it
    - Explore various settings, functionality
  - Decide on standard ways of using the tool
    - Naming conventions, creation of libraries, maintenance of test assets, etc.

Question 7: Answer

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Question 8

Pair the following testing tools with the main activity they support

Tools for test execution and logging	Used for traceability of tests, test results and incidents. Used to connect tests with their originating documents, such as requirements specifications.
Tools for static testing	Enable tests to be executed automatically using stored inputs and expected outcomes.
Tools for performance and monitoring	Used for testing the structure and dependencies of the code. Used to measure code coverage with tests.
Tools for test management	They simulate a load on: - An application / A database / A system environment

Question 8: Answer

Pair the following testing tools with the main activity they support

Tools for **test execution** and **logging**	Used for **traceability** of **tests**, test **results** and **incidents**. Used to **connect** tests with their originating **documents**, such as requirements **specifications**.
Tools for **static testing**	Enable **tests** to be **executed automatically** using stored **inputs** and **expected outcomes**.
Tools for **performance** and **monitoring**	Used for **testing** the **structure** and **dependencies** of the code. Used to **measure** code **coverage** with tests.
Tools for **test management**	They **simulate** a **load** on: - An **application** / A **database** / A system **environment**

Question 9

Test comparators are used when the executed test generates a lot of output. In order to validate the output against an oracle, one needs to use a test tool.

E.g. Send SMS with less than 10 special characters to 20.000 users

a. True
b. False

Question 9: Answer

Test comparators are used when the executed test generates a lot of output.

- Testing is more than providing inputs
  - Need to check if software produces the correct result
  - Compare actual outcomes to expected results
- Two ways of comparing results
  - Dynamic comparison → Comparison done during test execution
  - Post-execution comparison → Comparison performed after test has finished
    - Software under test is no longer executing

Question 9: Answer

Test comparators are used when the executed test generates a lot of output.

- Dynamic comparison
  - Best done by test execution tools
  - Useful when actual results do not match expected results in the middle of a test
  - Tool may be programmed to take recovery actions / go to a different set of tests
- Example
  - Good for comparing wording of an error message
  - Does the pop-up message match the correct wording for that error message?

Question 9: Answer

Test comparators are used when the executed test generates a lot of output.

- Post-execution comparison
  - Done by a separate, standalone tool (not test execution tool)
  - >> Test comparator / test comparison tool
  - Best for comparing large amounts of data
- Example
  - Comparing the contents of an entire file
    - Does the produced file match the expected contents of that file?
  - Comparing a large set of records from a database to the expected contents

Question 9: Answer

Test comparators are used when the executed test generates a lot of output. In order to validate the output against an oracle, one needs to use a test tool.

E.g. Send SMS with less than 10 special characters to 20.000 users

a. **True**
b. False

Question 10

A potential ______________ of using a test tool is the reduced repetitive manual work.

E.g. When running regression tests, re-entering the same input data, etc.

Question 10: Answer

A potential _____________ of using a test tool is the reduced repetitive manual work.

E.g. When running regression tests, re-entering the same input data, etc.

ADVANTAGE / BENEFIT

Question 11

Which of the following are benefits and which are risks of using tools to support testing?

1. Over-reliance on the tool
2. Greater consistency an repeatability
3. Objective assessment
4. Unrealistic expectations
5. Underestimating the effort required to maintain the tool
6. Ease of access to information about tests or testing
7. Repetitive work is reduced

Question 11

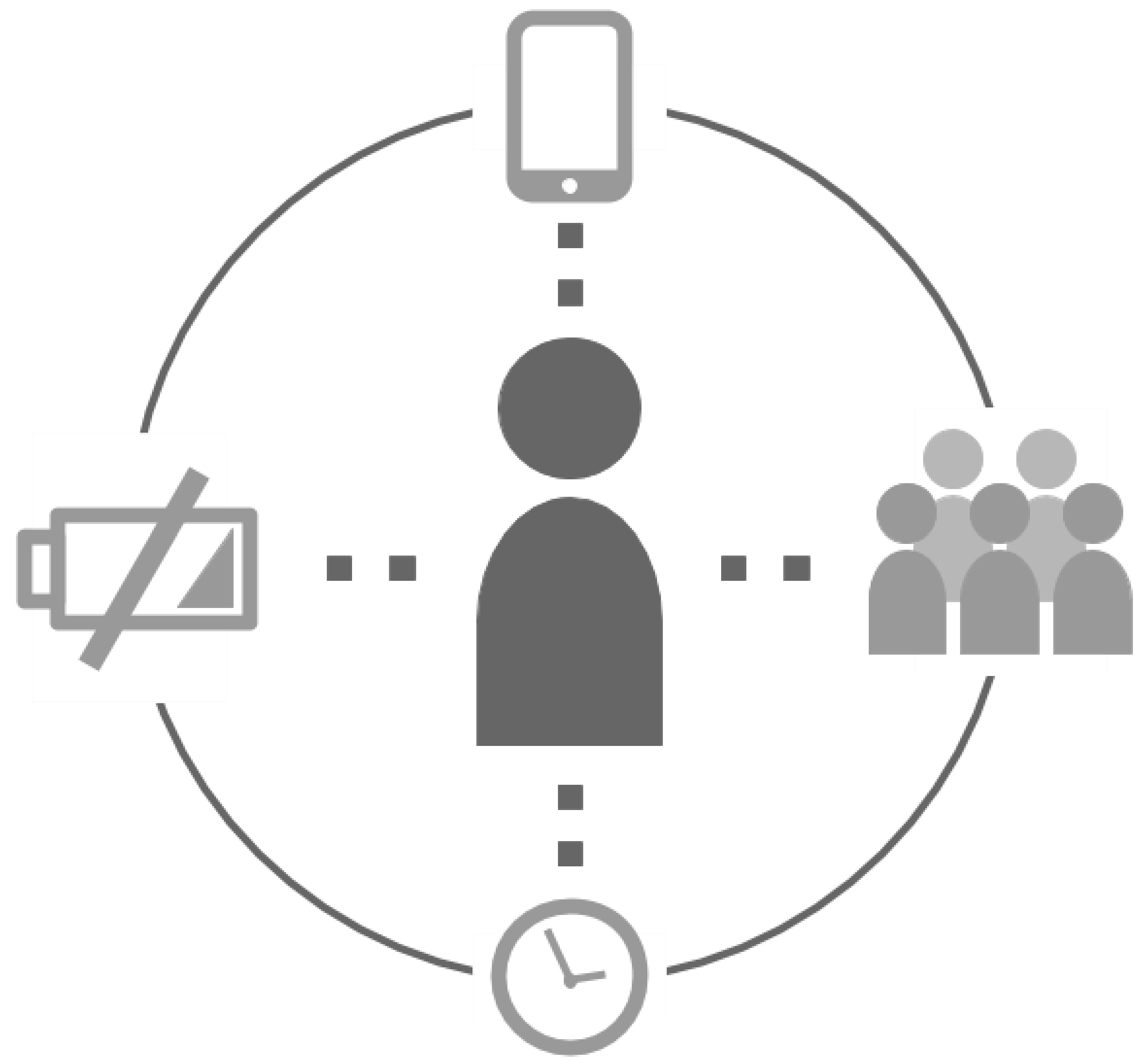
Which of the following are benefits and which are risks of using tools to support testing?

a. Benefits: 3, 4, 6 and 7. Risks: 1, 2, and 5
b. Benefits: 1, 2, 3 and 7. Risks: 4, 5, and 6
c. Benefits: 2, 3, 6 and 7. Risks: 1, 4, and 5
d. Benefits: 2, 3, 5 and 6. Risks: 1, 4, and 7

Question 11: Answer

Which of the following are benefits and which are risks of using tools to support testing?

- Greater consistency and repeatability
  - People tend to do the same tasks in a slightly different way
  - Distractions affect human performance
    - Doing more than one task simultaneously
    - Interruptions by peers / co-workers
    - Fatigue and personals issues
    - External pressures
  - Tools will reproduce the exact same procedure as previously



Question 11: Answer

Which of the following are benefits and which are risks of using tools to support testing?

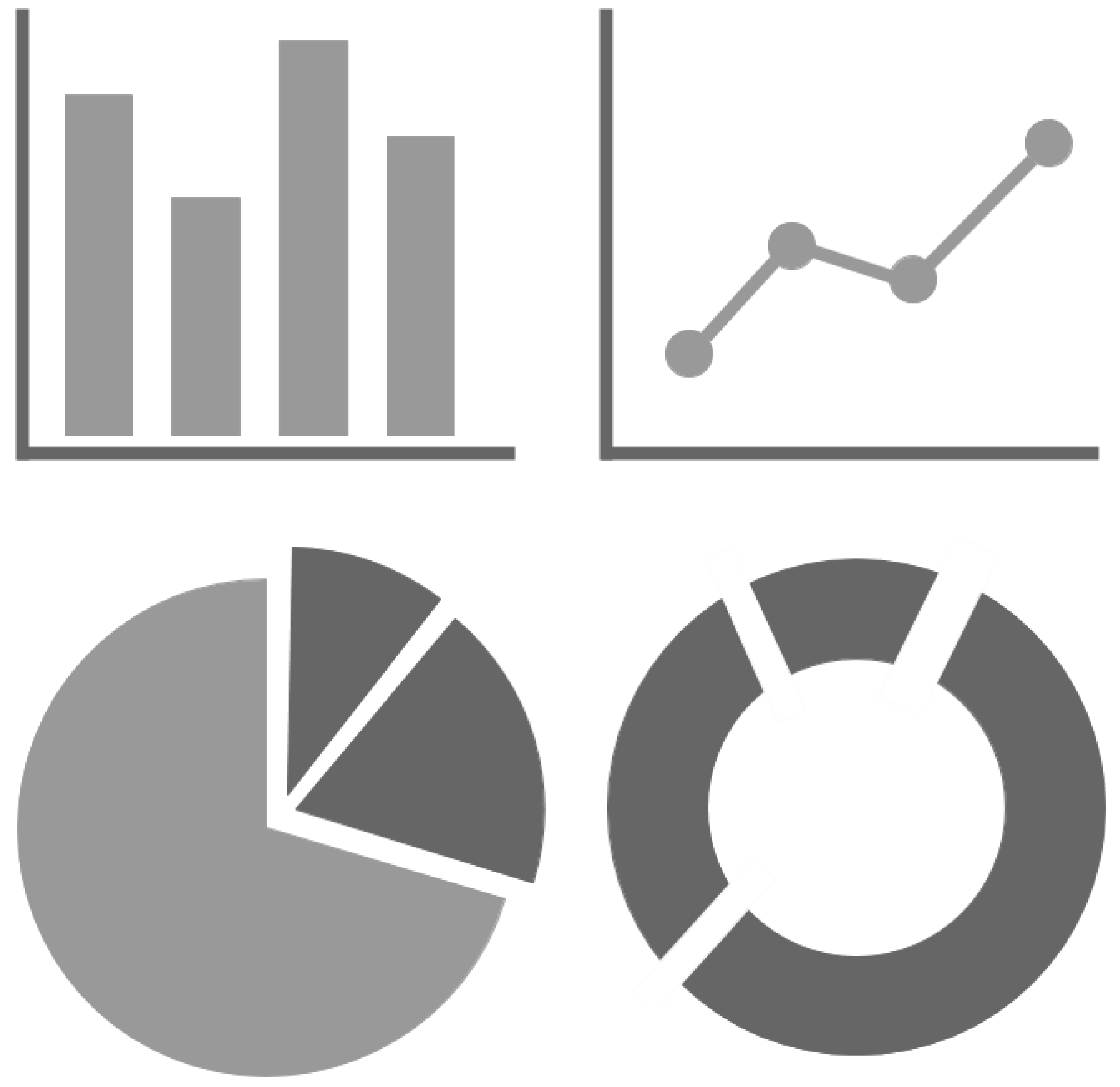
- Objective assessment
  - Humans are prone to make errors
  - Subjective preconceived notions and bias toward verification
  - Testing tools on the other hand …
    - Objective “preconceived notions”
    - Assessment → Repeatable and consistently calculated
      - Cyclomatic complexity, nesting levels
      - Coverage, system behaviour, incident statistics

Question 11: Answer

Which of the following are benefits and which are risks of using tools to support testing?

Ease of access to information about the tests or test effort

- Information presented visually
- Easier for the human mind to understand
  - Chart, graphs > Long list of numbers
- Special purpose tools provide features directly
  - Statistics and graphs
  - Incident rates
  - Performance



Question 11: Answer

Which of the following are benefits and which are risks of using tools to support testing?

a. Benefits: 3, 4, 6 and 7. Risks: 1, 2, and 5
b. Benefits: 1, 2, 3 and 7. Risks: 4, 5, and 6
c. **Benefits: 2, 3, 6 and 7. Risks: 1, 4, and 5**
d. Benefits: 2, 3, 5 and 6. Risks: 1, 4, and 7

Question 12

Which test activities are supported by test data preparation tools?

a. Test management and control
b. Test specification and control
c. Test execution and control
d. Performance and monitoring

Question 12: Answer

Which test activities are supported by test data preparation tools?

- Tests should reflect realistic (correct) scenarios
  - Systems are often required to handle significant load / interactions
  - Inadequate / insufficient testing compromises system quality
- Setting up test data → Significant effort
  - Extensive range or volume of data needed
  - Creating this data can be very resource-consuming
- Test data preparation tools help us manage this effort

Question 12: Answer

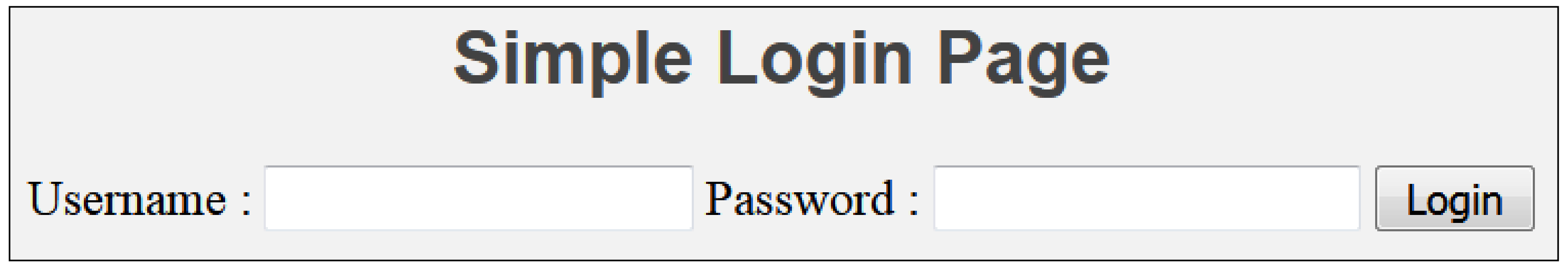
Which test activities are supported by test data preparation tools?

- Common features of test data preparation tools
  - Data can be selected from an existing database
  - Data can be created, generated, and altered for use in tests
  - Construct a large number of similar records → Volume tests
- When to use?
  - During test specification and control → Test data management is difficult
  - Ensure the system under test is being tested *realistically*
  - Useful for performance and reliability testing

Question 12: Answer

Which test activities are supported by test data preparation tools?

Example: Simple login site

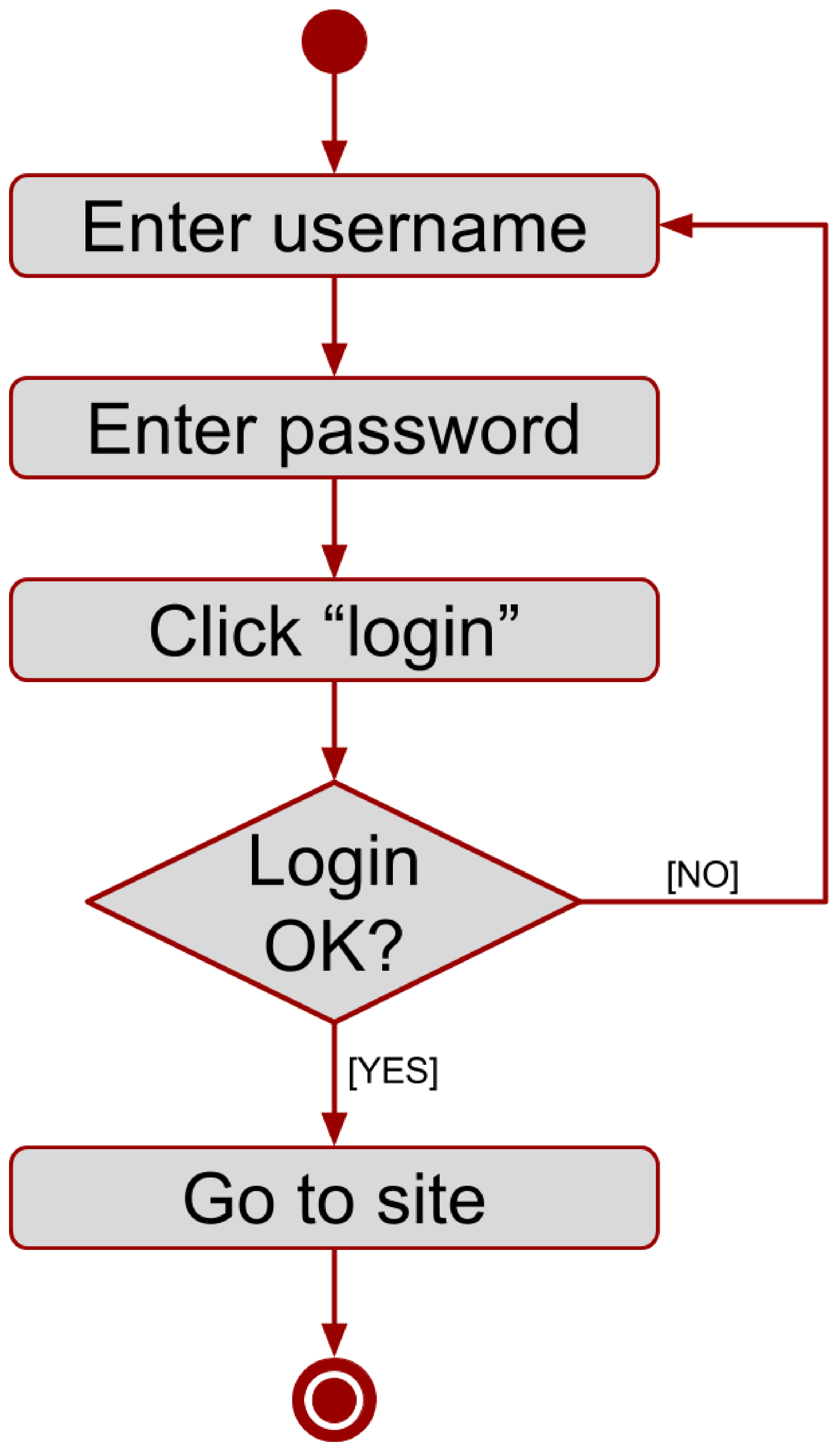

Simple Login Page

Username : Password : Login

Data need for testing website

- List of various usernames
- List of various passwords
- Database of existing users

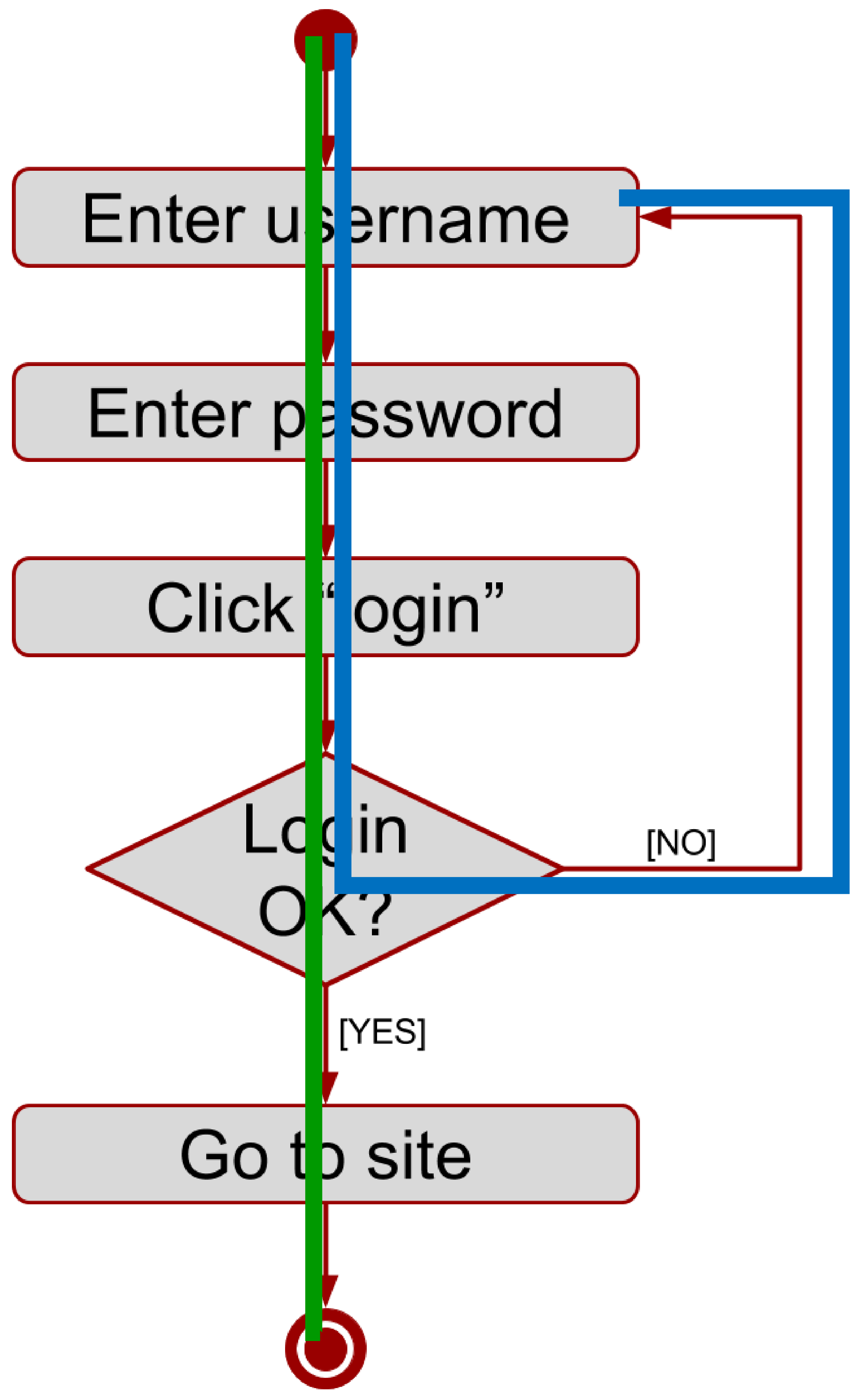
We do not want to create all this by hand!



Question 12: Answer

Which test activities are supported by test data preparation tools?

- Test data for whitebox-testing
  - Concern: Coverage
  - Ensure all branches are tested at least once
  - Generate data for this purpose
- Example
  - Invalid combination of username and password
  - Valid combination of username and password

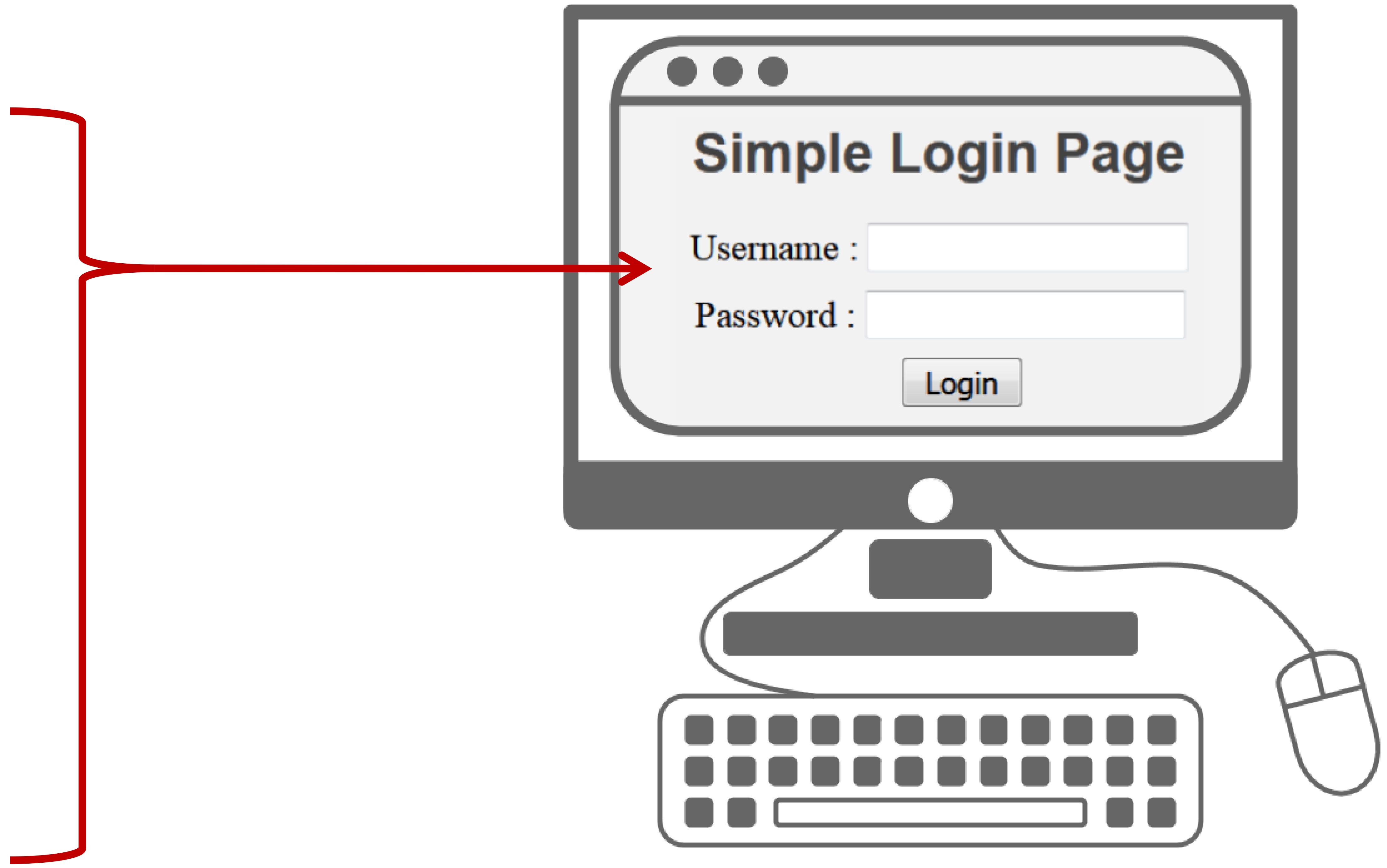


Question 12: Answer

Which test activities are supported by test data preparation tools?

Test data for blackbox-testing

- No data
- Valid / Invalid data sets
- Illegal data sets
- Equivalence and Boundary data sets
- Decision table data sets
- State transition data sets
- Use case data sets



Question 12: Answer

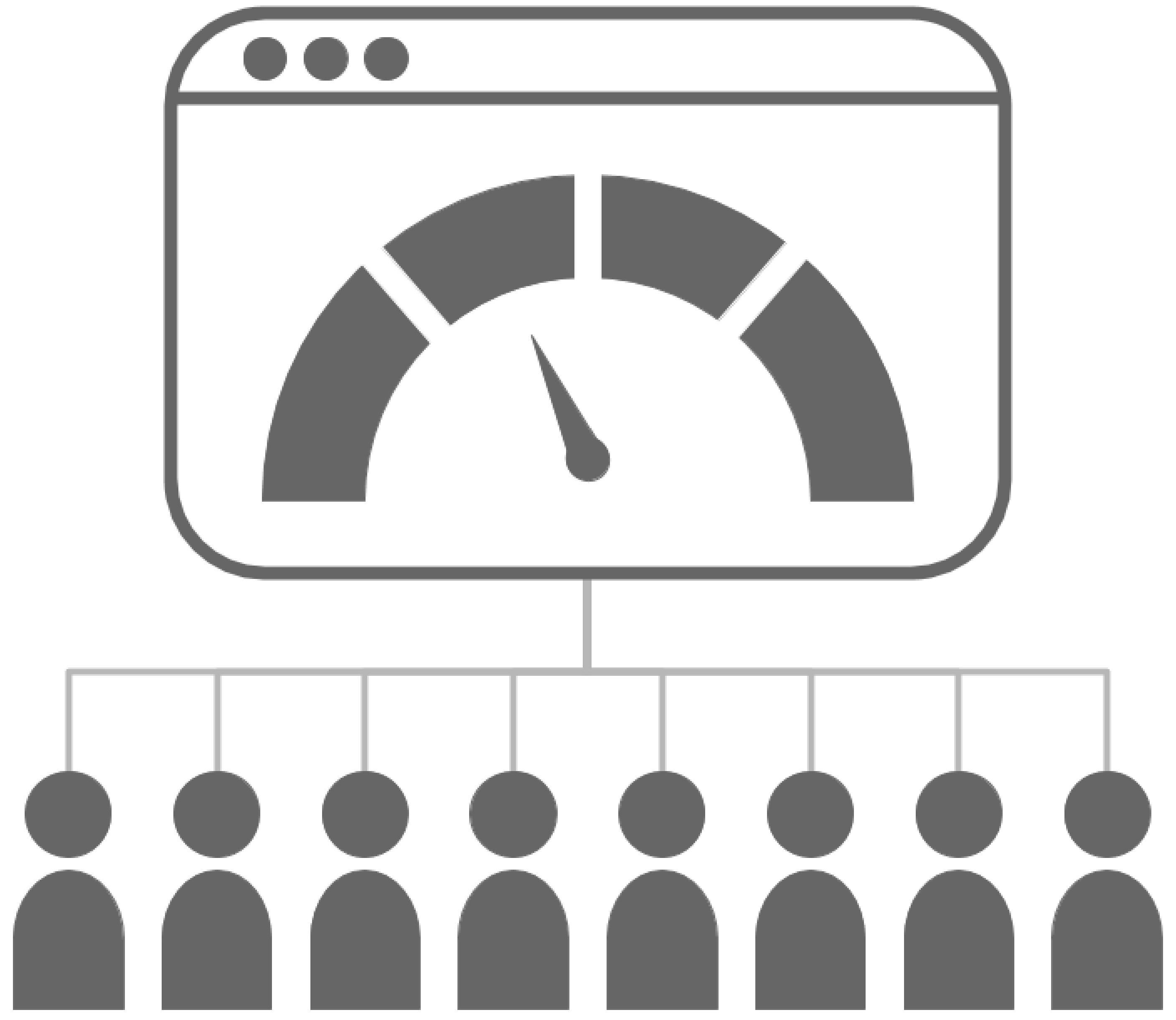
Which test activities are supported by test data preparation tools?

- Test data for security testing
  - Confidentiality
    - Test data to verify correct encryption
  - Integrity
    - Test data to verify correct information provided
  - Authentication and authorisation
    - Test data to verify correct identity management
    - Combinations of users, roles, operations

Question 12: Answer

Which test activities are supported by test data preparation tools?

- Test data for performance testing
  - *Real* data
    - Test data obtained from users
  - Load
    - Large amounts of test data can be produced
  - Maintenance
    - Test data from the production environment



Question 12: Answer

Which test activities are supported by test data preparation tools?

a. Test management and control
b. Test specification and control
c. Test execution and control
d. Performance and monitoring

Question 13

Consider the following types of tools:

1. Test management tools
2. Static analysis tools
3. Modelling tools
4. Dynamic analysis tools
5. Performance testing tools

Question 13

Which of the following tools are most likely to be used by developers?

a. Static analysis tools, modelling tools, and dynamic analysis tools
b. Test management tools, dynamic analysis tools, and performance testing tools
c. Test management tools, static analysis tools, and performance testing tools
d. Modelling tools, dynamic analysis tools, and performance testing tools

Question 13: Answer

Which of the following tools are most likely to be used by developers?

- Developers are primarily concerned with *building* and creating
  - Want to produce something of value and quality
  - Concerned with code quality, design, performance, etc.
- As such, developers are likely to use tools that help meet the objectives
  - Static analysis tools → Examines work products without execution
  - Modelling tools → Validate models of system / software
  - Dynamic analysis tools → Require code to be running

Question 13: Answer

Which of the following tools are most likely to be used by developers?

- Static analysis tools
  - Examination of code without executing it
  - Can additionally perform static analysis on requirements
- Advantages and contribution to quality
  - Ensure and enforce coding standards
  - Greater analysis of structures and dependencies
  - Can be used before dynamic testing

Question 13: Answer

Which of the following tools are most likely to be used by developers?

- Modelling tools
  - Validate models of system / software
  - Check consistency of data objects in a database
  - Reveal inconsistencies and defects
- Advantages and contribution to quality
  - Ensure system is built / designed in the right (most sensible) way
  - Can be used before dynamic testing

Question 13: Answer

Which of the following tools are most likely to be used by developers?

- Dynamic analysis tools
  - Require code to be executed during tests
  - Analyse what is happening → Behind the scenes
  - Analogy: Test driving a car (engine must be running), not simply sitting in it (static)
- Advantages and contribution to quality
  - Helps detect memory leaks, time dependencies, and pointer arithmetic errors
  - Can be used before dynamic testing

Question 13: Answer

Which of the following tools are most likely to be used by developers?

a. **Static analysis tools, modelling tools, and dynamic analysis tools**
b. Test management tools, dynamic analysis tools, and performance testing tools
c. Test management tools, static analysis tools, and performance testing tools
d. Modelling tools, dynamic analysis tools, and performance testing tools

Question 14

Which success factors are required for good tool support within an organisation?

a. Acquiring the best tool and ensuring that all testers use it
b. Adapting processes to fit with the use of the tool and monitoring tool use and benefits
c. Setting ambitious objectives for tool benefits and aggressive deadlines for achieving them
d. Adopting practices from other successful organisations and ensuring that initial ways of using the tool are maintained

Question 14: Answer

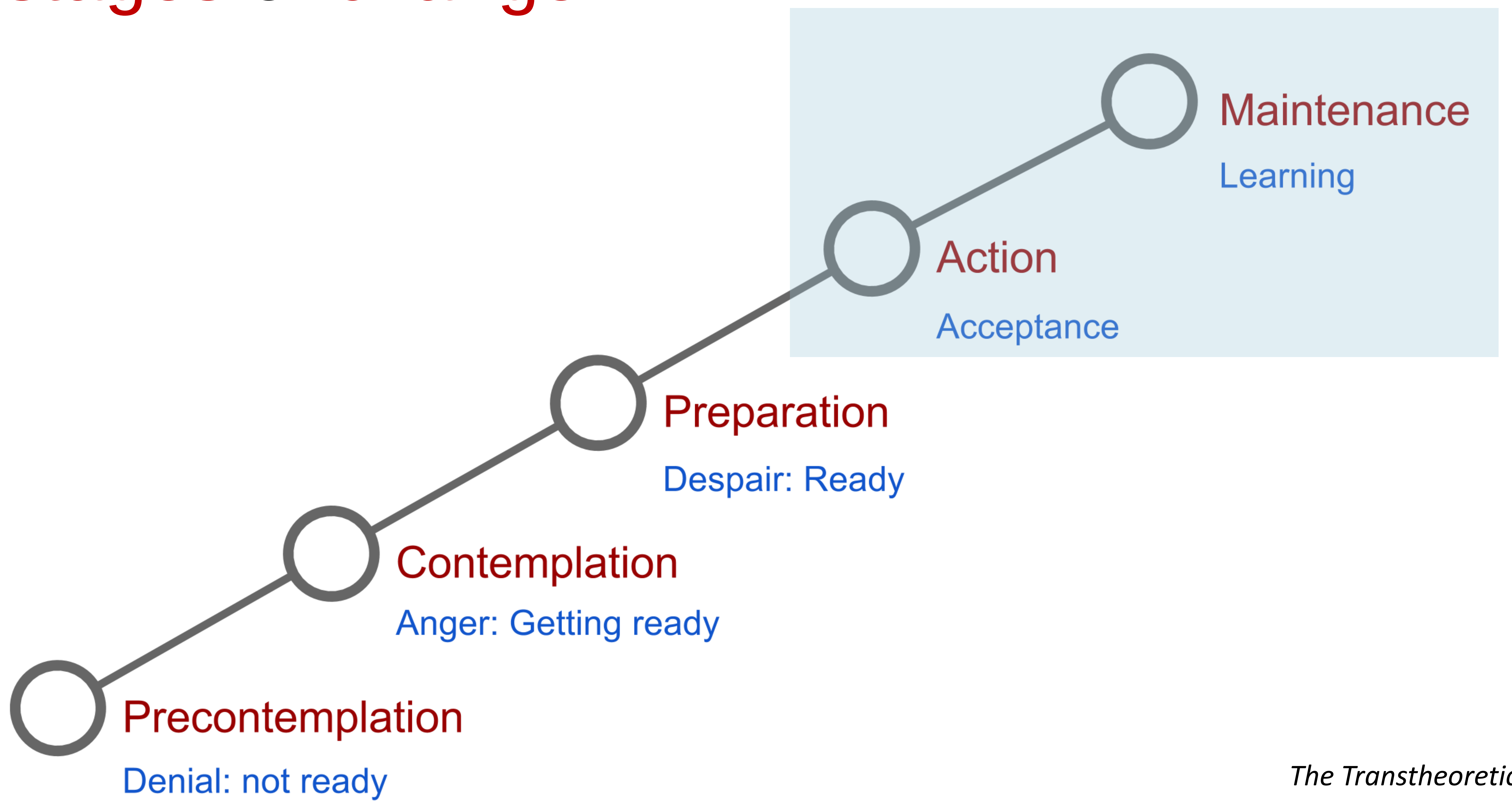
Which success factors are required for good tool support within an organisation?

- Introducing and using a tool can be a complex task
  - Internal resistance, scepticism
  - Lack of skill
- Necessary to have a good framework for optimal use of the tool
  - How can we benefit from using this tool?
- After all, introducing a tool constitutes a *change*
  - How can we best manage this process?
  - Recall, success is not guaranteed

Question 14: Answer

Which success factors are required for good tool support within an organisation?

The various stages of change



The Transtheoretical Model (Prochaska and Velicer, 1997)

Question 14: Answer

Which success factors are required for good tool support within an organisation?

- Learning from using the tool
  - Cannot expect the tool do solve all testing-related problems
  - Adapt processes to fit with the use of the tool
  - Continuous(!) improvement of testware and tool artefacts
- Mapping how the tool is being used
  - Monitor usage
  - Assess benefits and challenges experienced when using the tool
  - Provide adequate training, coaching, and mentoring

Question 14: Answer

Which success factors are required for good tool support within an organisation?

a. Acquiring the best tool and ensuring that all testers use it

b. Adapting processes to fit with the use of the tool and monitoring tool use and benefits

c. Setting ambitious objectives for tool benefits and aggressive deadlines for achieving them

d. Adopting practices from other successful organisations and ensuring that initial ways of using the tool are maintained

Question 15

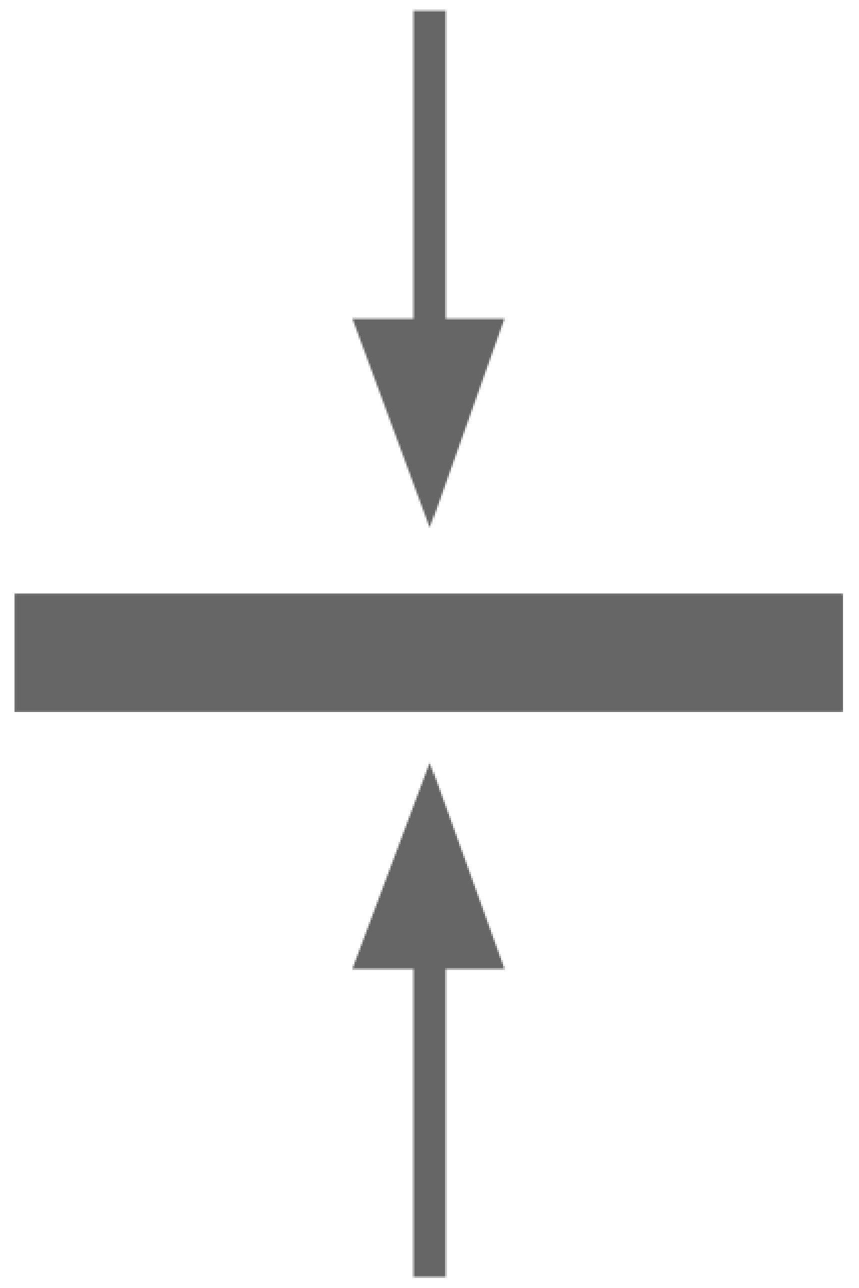
What kind of interface can be used to automate tests?

a. API – Application programming interface
b. GUI – Graphical user interface
c. Both API and GUI
d. None of the above

Question 15: Answer

What kind of interface can be used to automate tests?

- What is an interface?
  - Barrier / boundary →*“Grensesnitt”*
  - Shared resource that separates various components
- Can be between …
  - Software
  - Computer hardware
  - Peripheral devices
  - Humans
  - A combination of the above



Question 15: Answer

What kind of interface can be used to automate tests?

- API – Application Programming Interface
  - Set of routines, definitions, protocols and tools → Building software
  - Methods for communication between software components
- APIs in test automation
  - Selenium Java API
    - Classes to use Selenium with Java
  - JSONPlaceholder
    - Provides a variety of fake data for testing applications

Question 15: Answer

What kind of interface can be used to automate tests?

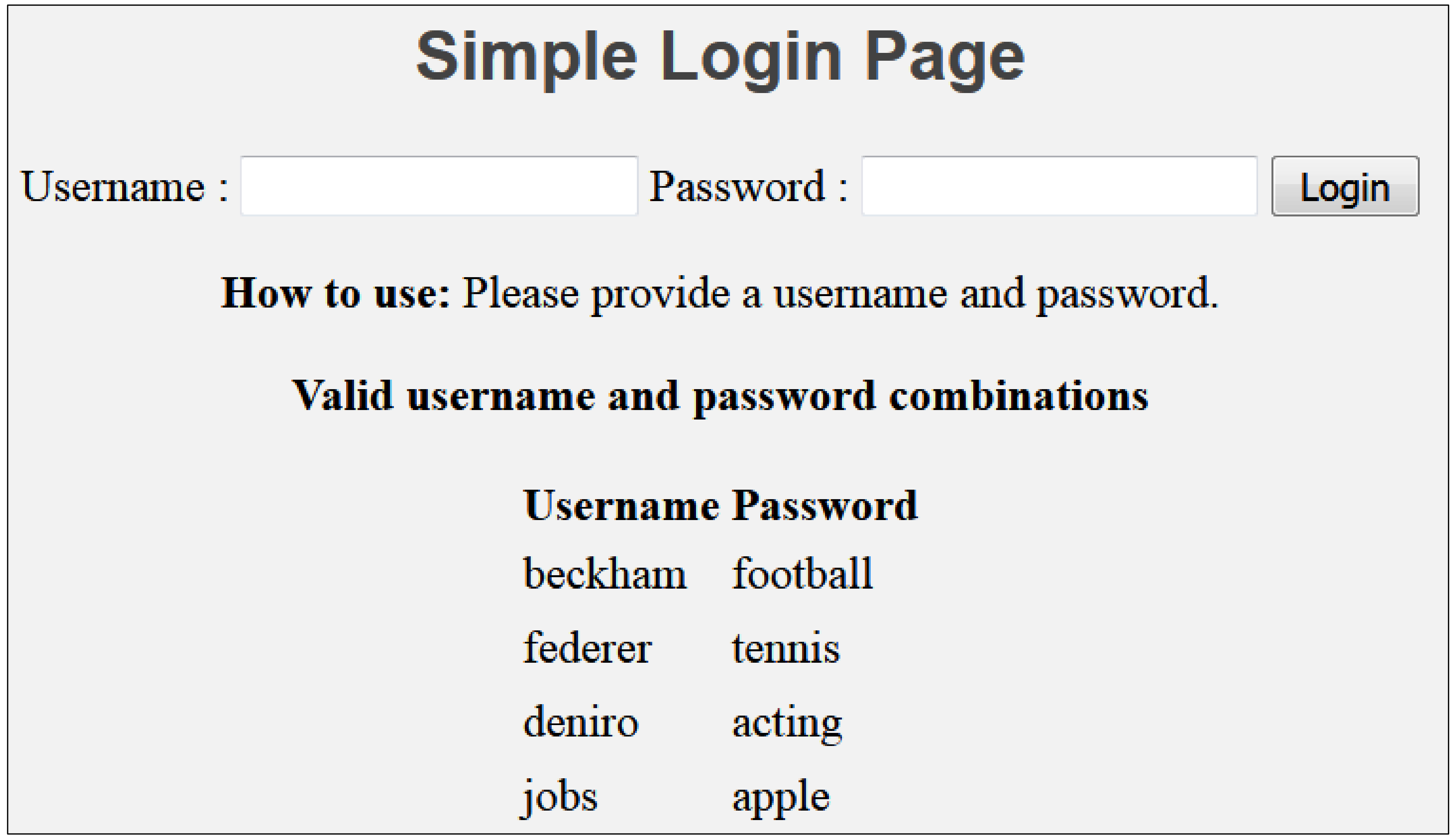
- GUI – Graphical User Interface
  - Interface for the interaction between users and electronic devices
  - Information presented through graphical icons / visual indicators
- GUI in test automation
  - Selenium IDE
    - Record and play test cases
    - Can be exported in various formats (C#, Java, Python, Ruby)
    - For more information, see *W08 – Tool Support for Testing*

Question 15: Answer

What kind of interface can be used to automate tests?

Example: Testing a simple login page

Address: http://inf3121-login-example.bitballoon.com/



Simple Login Page

Username : Password : Login

How to use: Please provide a username and password.

Valid username and password combinations

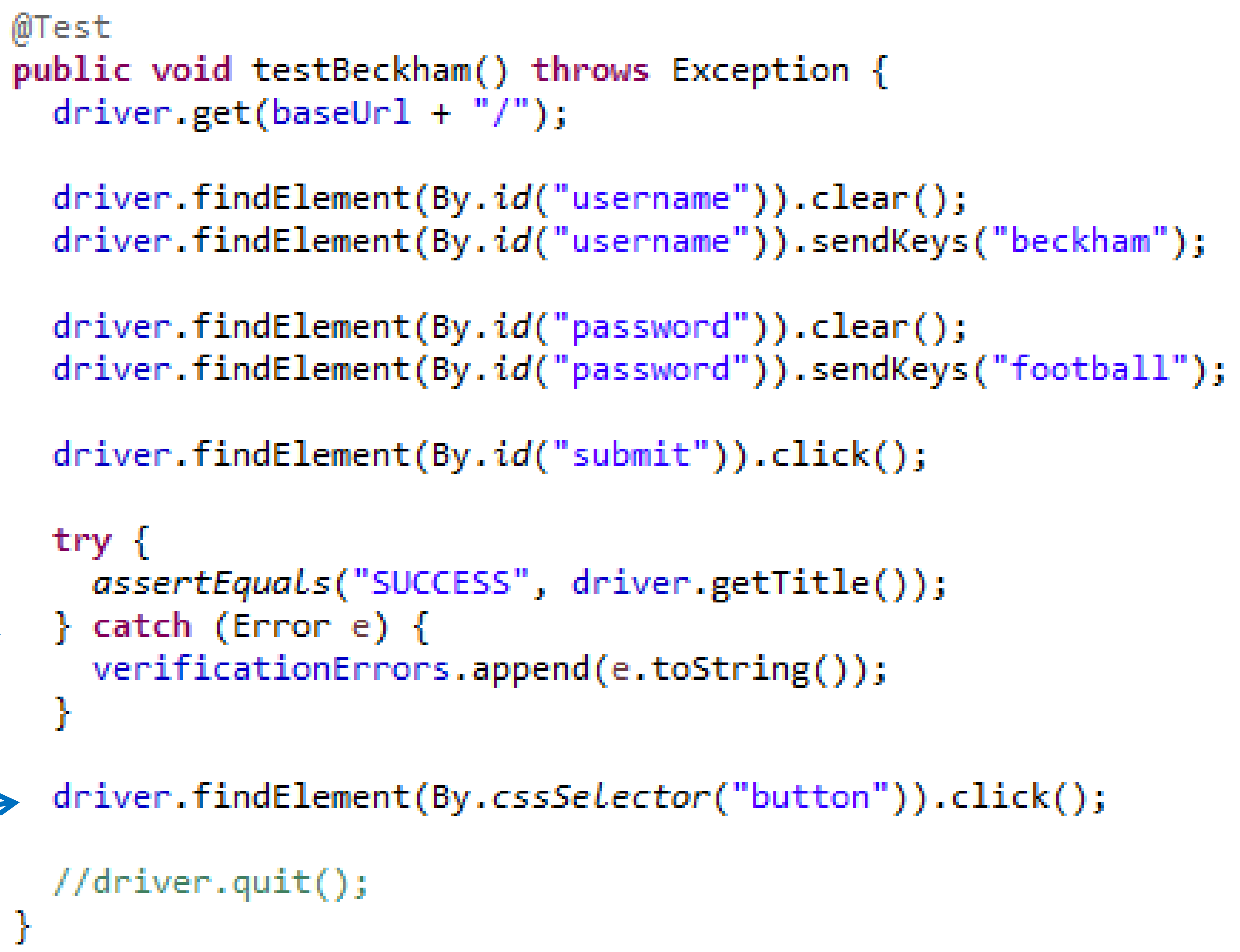
Username	**Password**
beckham	football
federer	tennis
deniro	acting
jobs	apple

Question 15: Answer

What kind of interface can be used to automate tests?

Login Procedure (API)

1. Open site
2. Type username
3. Type password
4. Click “login” button
5. Verify successful login
6. Go back to start



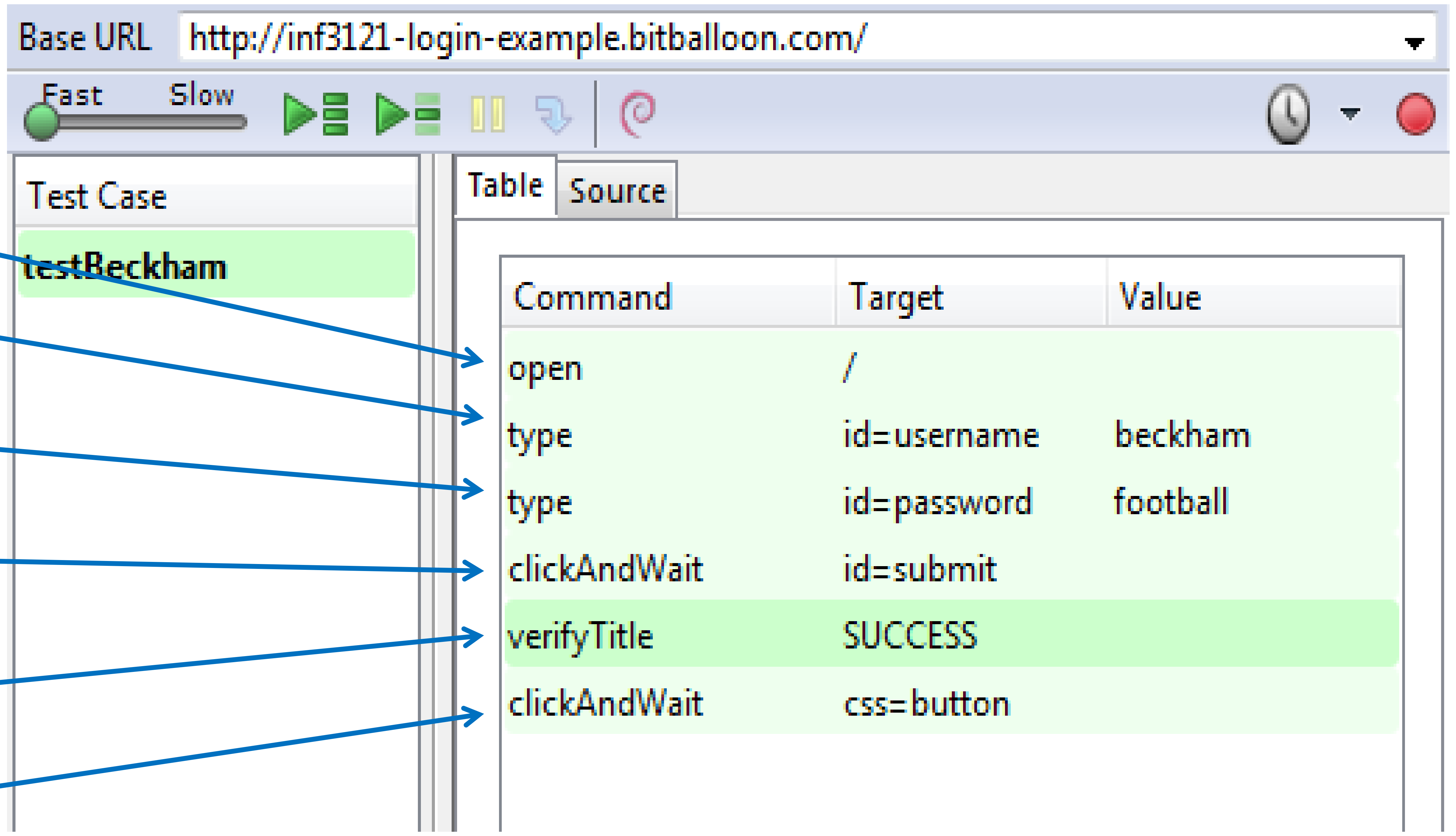
```
@Test
public void testBeckham() throws Exception {
  driver.get(baseUrl + "/");

  driver.findElement(By.id("username")).clear();
  driver.findElement(By.id("username")).sendKeys("beckham");

  driver.findElement(By.id("password")).clear();
  driver.findElement(By.id("password")).sendKeys("football");

  driver.findElement(By.id("submit")).click();

  try {
    assertEquals("SUCCESS", driver.getTitle());
  } catch (Error e) {
    verificationErrors.append(e.toString());
  }

  driver.findElement(By.cssSelector("button")).click();

  //driver.quit();
}
```

Question 15: Answer

What kind of interface can be used to automate tests?

Login Procedure (GUI)

1. Open site
2. Type username
3. Type password
4. Click “login” button
5. Verify successful login
6. Go back to start



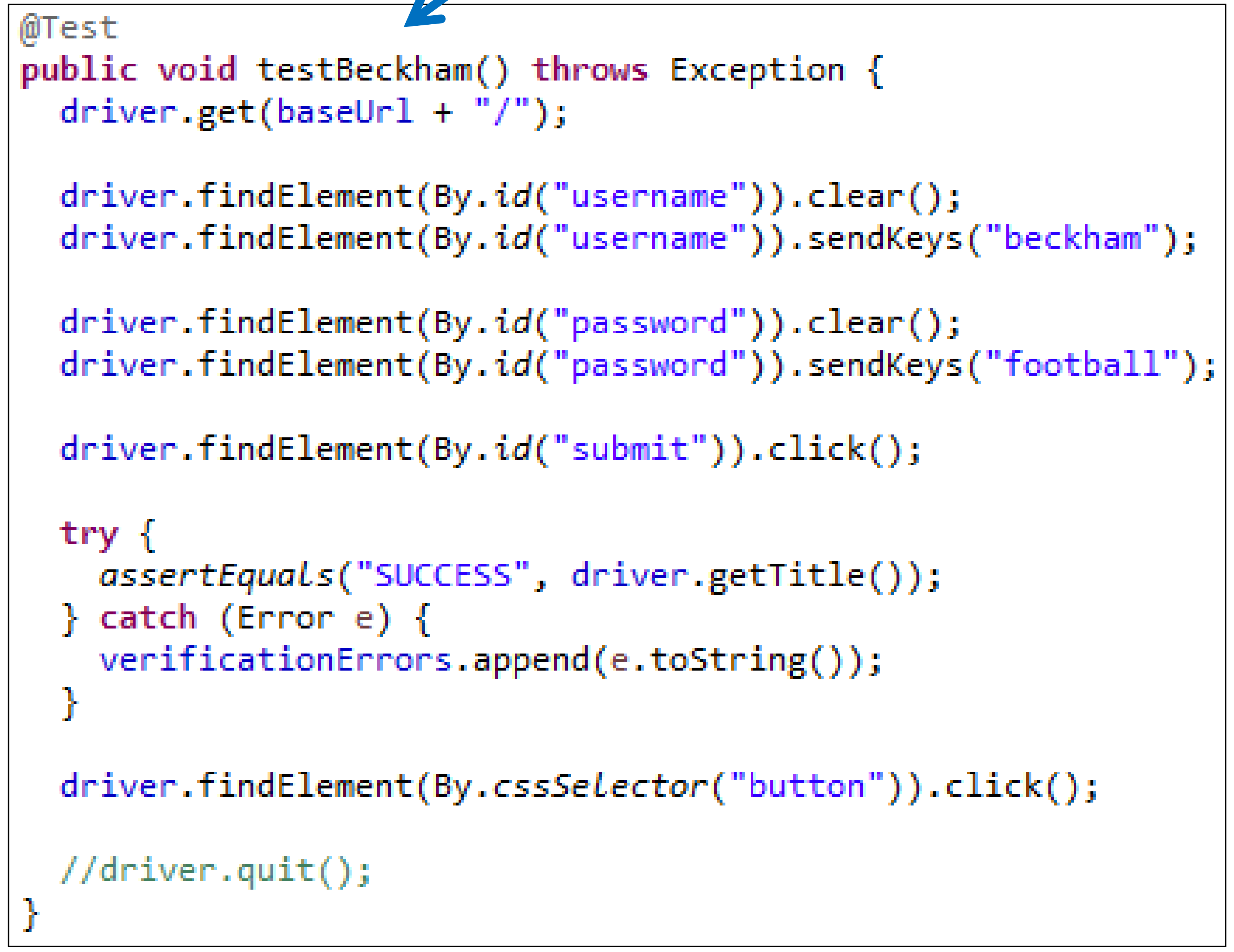
Base URL http://inf3121-login-example.bitballoon.com/

Command	Target	Value
open	/	
type	id=username	beckham
type	id=password	football
clickAndWait	id=submit	
verifyTitle	SUCCESS	
clickAndWait	css=button	

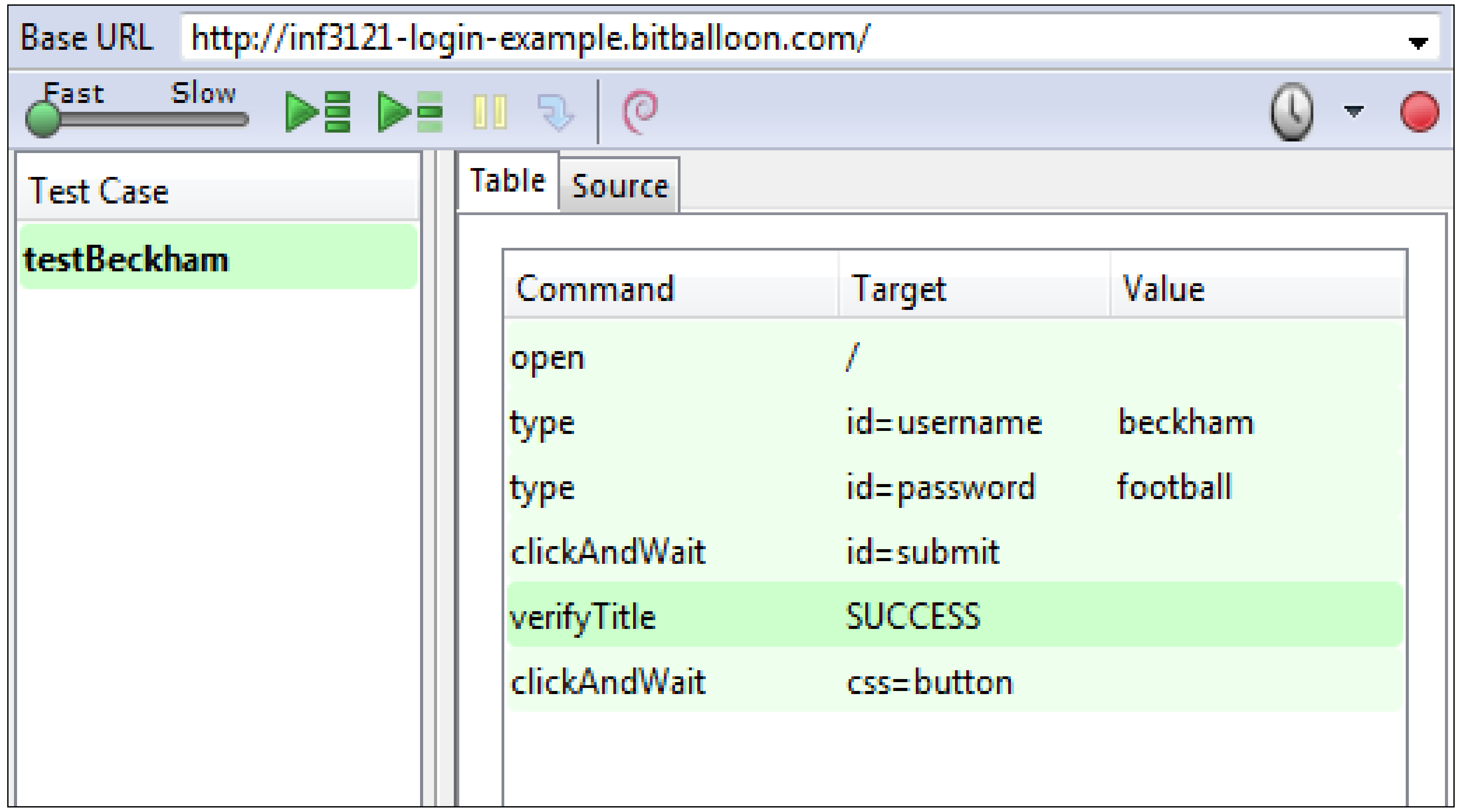
Question 15: Answer

What kind of interface can be used to automate tests?

Can use both API and GUI to automate testing



```
@Test
public void testBeckham() throws Exception {
  driver.get(baseUrl + "/");

  driver.findElement(By.id("username")).clear();
  driver.findElement(By.id("username")).sendKeys("beckham");

  driver.findElement(By.id("password")).clear();
  driver.findElement(By.id("password")).sendKeys("football");

  driver.findElement(By.id("submit")).click();

  try {
    assertEquals("SUCCESS", driver.getTitle());
  } catch (Error e) {
    verificationErrors.append(e.toString());
  }

  driver.findElement(By.cssSelector("button")).click();

  //driver.quit();
}
```



Base URL http://inf3121-login-example.bitballoon.com/

testBeckham

Command	Target	Value
open	/	
type	id=username	beckham
type	id=password	football
clickAndWait	id=submit	
verifyTitle	SUCCESS	
clickAndWait	css=button	

Question 15: Answer

What kind of interface can be used to automate tests?

a. API – Application programming interface
b. GUI – Graphical user interface
c. Both API and GUI
d. None of the above

Question 16

Which of the following are advantages of test automation?

a. Tests run faster and can be more complex
b. Tests are run by machines and the results are interpreted by humans
c. Data sets used in testing can be very simple
d. The results of running the tests is always the same

Question 16: Answer

Which of the following are advantages of test automation?

Run faster

More complex

Repeatability of tests

Objective assessment of results

More efficient use of tester

Use of external APIs and use of GUIs

Question 16: Answer

Which of the following are advantages of test automation?

a. **Tests run faster and can be more complex**
b. Tests are run by machines and the results are interpreted by humans
c. Data sets used in testing can be very simple
d. The results of running the tests is always the same

Question 17

Which of the following is a limitation of test automation?

a. Tests can be very simple
b. Tests need to be complex in order to be considered for automation
c. One cannot automate all tests
d. Data sets used in testing are not stored, therefore tests are not always reproducible

Question 17: Answer

Which of the following is a limitation of test automation?

- Computers can only do so much …
  - You *cannot automate all* tests
- CAPTCHA
  - Completely Automated Public Turing test to tell Computers and Humans Apart
  - If you could automate it → CAPTCHA poorly implemented
- Environment- / Production-dependant scenarios
  - E.g. payment gateway timeouts → Depend on throughput capability of network
- Human factors → Gestures, reactions, thought processes

Question 17

Which of the following is a limitation of test automation?

a. Tests can be very simple
b. Tests need to be complex in order to be considered for automation
c. **One cannot automate all tests**
d. Data sets used in testing are not stored, therefore tests are not always reproducible

Question 18

Pair the following approaches to automated testing with their corresponding description:

Capture and Replay	The test inputs are extracted or generated with scripts. To automate testing, we reuse one main script together with this data to implement a number of tests.
Data-driven approach	The automated test scripts are built by putting together reusable smaller scripts, name keywords.
Keyword-driven approach	Tools are used to capture interactions with the system under test (SUT) while performing the sequence of actions as defined by a test procedure.

Question 18: Answer

Pair the following approaches to automated testing with their corresponding description:

Capture and **Replay**	The test **inputs** are **extracted** or generated with **scripts**. To automate testing, we reuse **one** main script together with this **data** to implement a number of tests.
Data-driven approach	The automated test **scripts** are **built** by putting together **reusable** smaller **scripts**, name **keywords**.
Keyword-driven approach	Tools are used to **capture interactions** with the system under test (**SUT**) while **performing** the **sequence** of actions as defined by a **test procedure**.

Question 19

Which of the following factors must be considered when transitioning from manual to automated testing?

1. Frequency of use of the tested feature
2. The upcoming release date
3. How complex it is to automate the test
4. The current cyclomatic complexity of the code

Question 19: Answer

Which of the following factors must be considered when transitioning from manual to automated testing?

- Frequency
  - Automation still takes time
  - If the tested feature is rarely used, automating could be *more* time-consuming
  - Opt to automate repetitive tests
- Complexity
  - Automation requires skill
  - Unskilled testers may slow down the testing process if required to automate
  - Assess the skill level of potential testers

Question 19: Answer

Which of the following factors must be considered when transitioning from manual to automated testing?

1. **Frequency of use of the tested feature (YES)**
2. The upcoming release date (**NO**)
3. **How complex it is to automate the test (YES)**
4. The current cyclomatic complexity of the code (**NO**)

Question 20

A test manager does not need to take into account re-educating the team when preparing to go from manual to automated testing

a. True
b. False

Question 20: Answer

There is no need to assess re-education of the team when preparing to go from manual to automated testing

- Typical tasks of a test manager
  - Responsible for project management of the test effort
  - Directs, controls, administers, plans, regulates the test effort and objects
  - Decide what should be automated, to what degree, and how
  - Introduce suitable metrics for progress monitoring and quality assessment
  - Make decisions about the implementation of the test environment
  - Select tools to support testing
  - Organise any training (re-education) and mentoring for testers

Question 20: Answer

A test **manager** does **not need** to take into account **re-educating** the team when **preparing** to go from **manual** to **automated** testing

a. True
b. False

Part II: Exercises and Open-ended questions

Exercise 1: Test Automation Tools

Browse the internet to find an example of a tool used for test automation.

Explain briefly how the tool works.

Exercise 1: Test Automation Tools

Example: Selenium IDE

Integrated Development Environment for testing

- Record, Edit, and Debug tests
- Firefox extension

Features

- Record and playback of test scripts
- Intelligent field selection
- Walkthrough of test runs
- Save tests as HTML, Ruby scripts, other formats

Exercise 1: Test Automation Tools

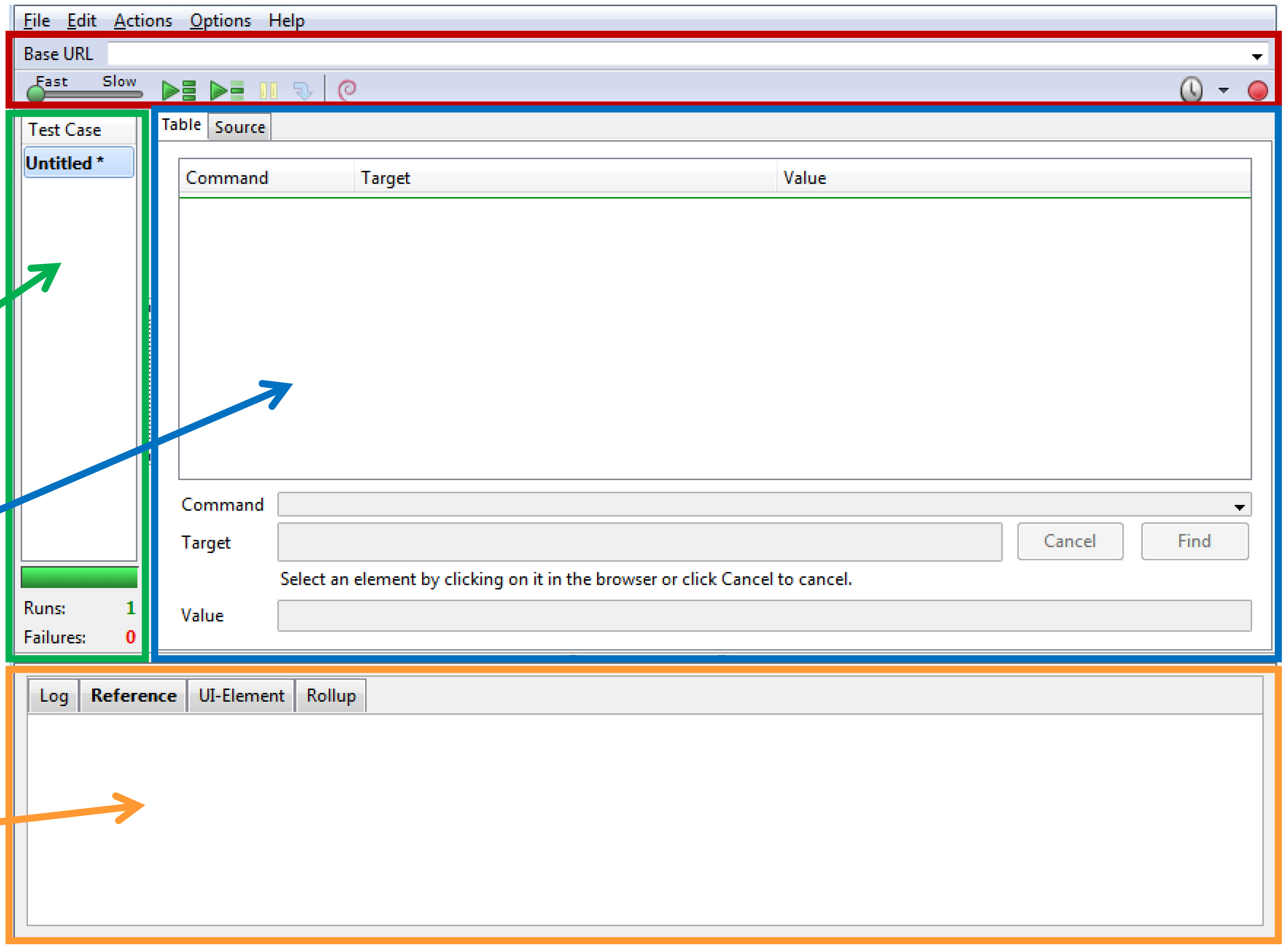
Example: Selenium IDE

Presentation at start-up

Four important sections

Components

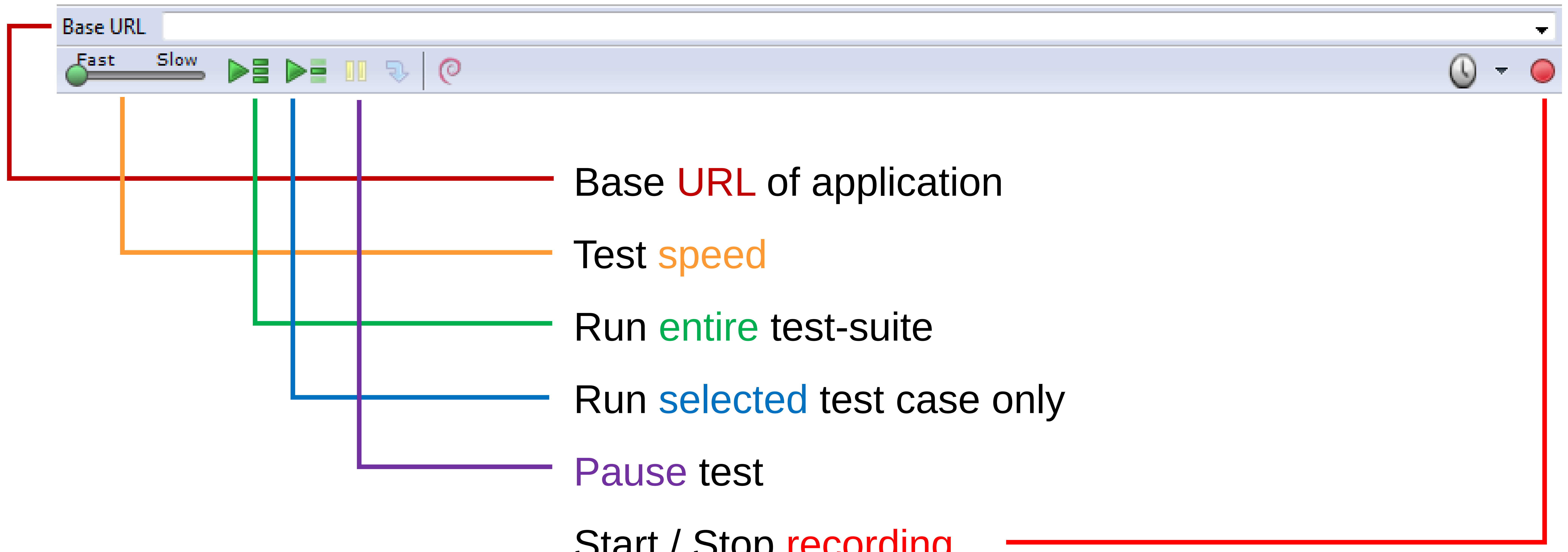
1. Test control
2. Test suite tool
3. Test editor
4. Tool panel


File Edit Actions Options Help
Base URL
Fast Slow
Test Case
Untitled *
Runs: 1
Failures: 0
Table Source
Command Target Value
Command
Target
Cancel Find
Select an element by clicking on it in the browser or click Cancel to cancel.
Value
Log Reference UI-Element Rollup

Exercise 1: Test Automation Tools

Example: Selenium IDE

Test control



Base URL of application

Test speed

Run entire test-suite

Run selected test case only

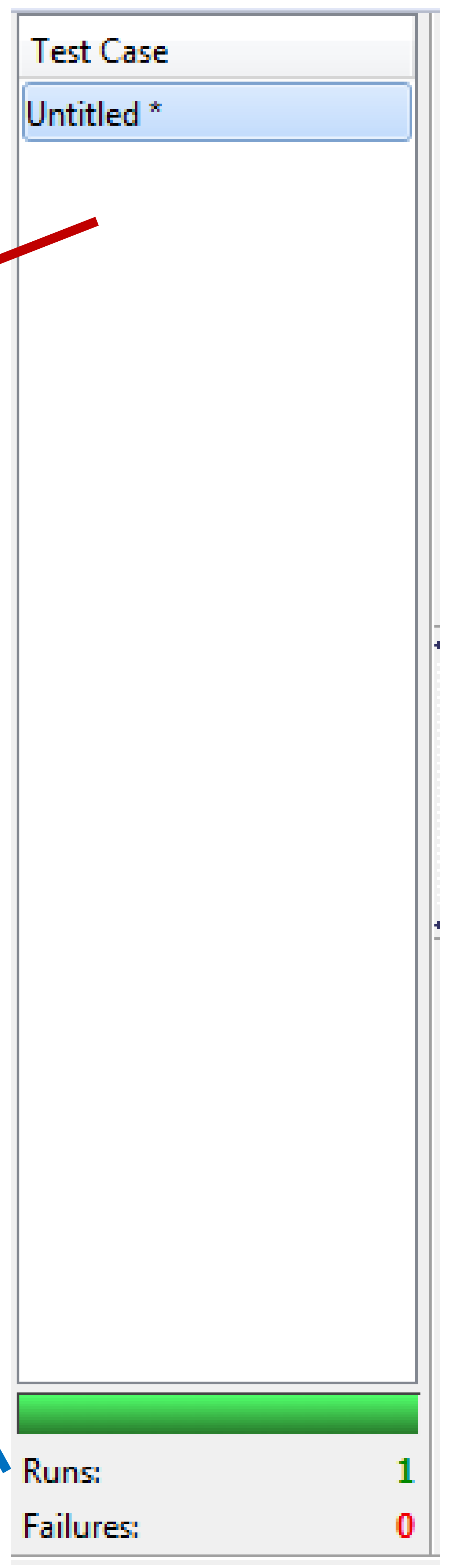
Pause test

Start / Stop recording

Exercise 1: Test Automation Tools

Example: Selenium IDE

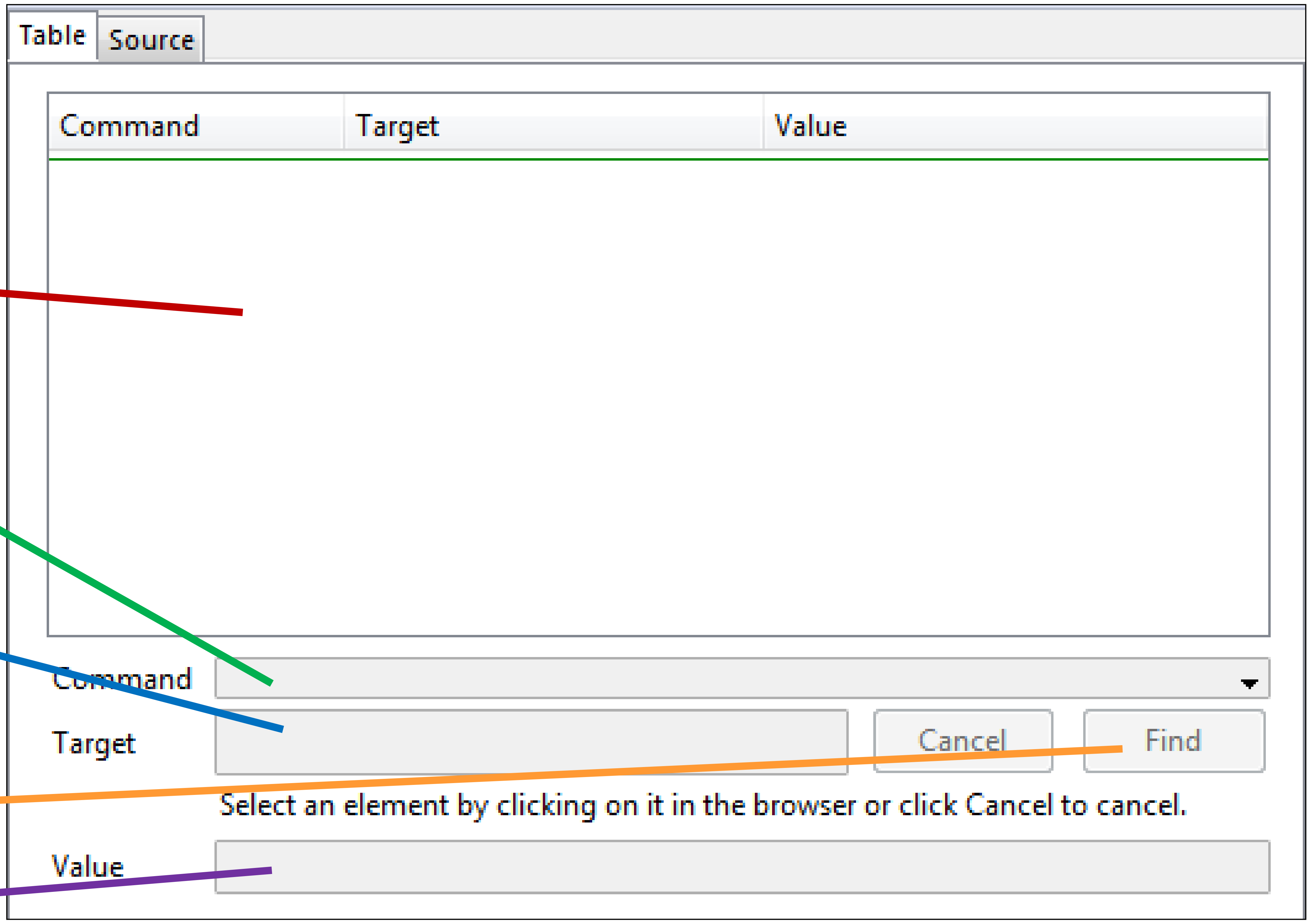
- Test suite tool
  - Shows all tests in a test suite
    - List of all test cases
    - Can be given unique names
  - Shows results of running the tests
    - Number passed / failed
      - Green = pass
      - Red = fail



Exercise 1: Test Automation Tools

Example: Selenium IDE

- Test editor
  - The test steps
  - Command of current step
  - Locator argument
  - Find button
    - Highlights target of locator on page
  - Value argument



Select an element by clicking on it in the browser or click Cancel to cancel.

Exercise 1: Test Automation Tools

Example: Selenium IDE

Test panel

Execution log of current tests

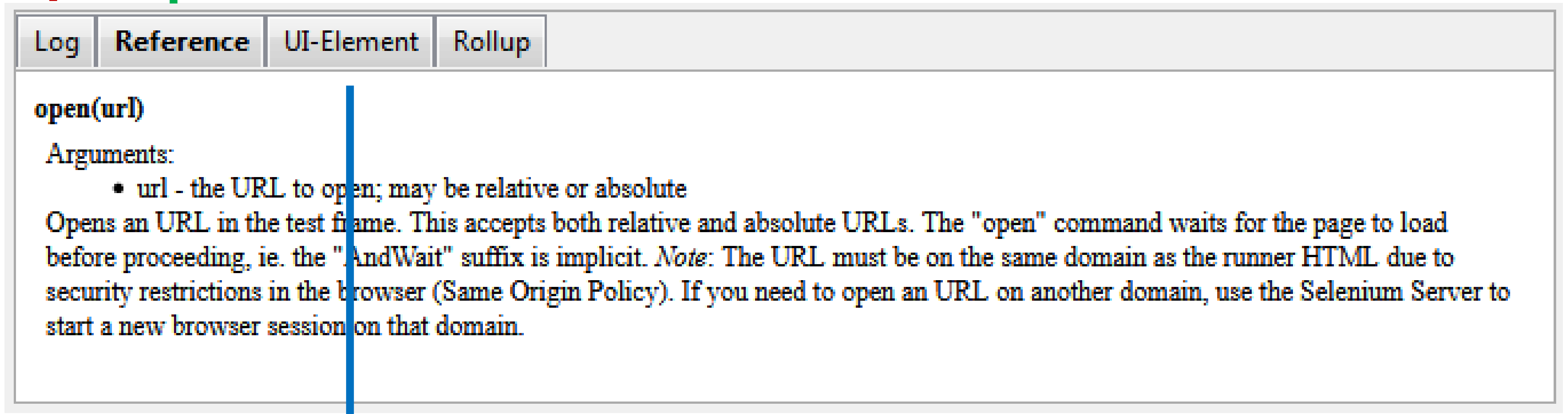
Displays errors

Reference

Documentation of command

UI-element

Displays UI-element in use



open(url)

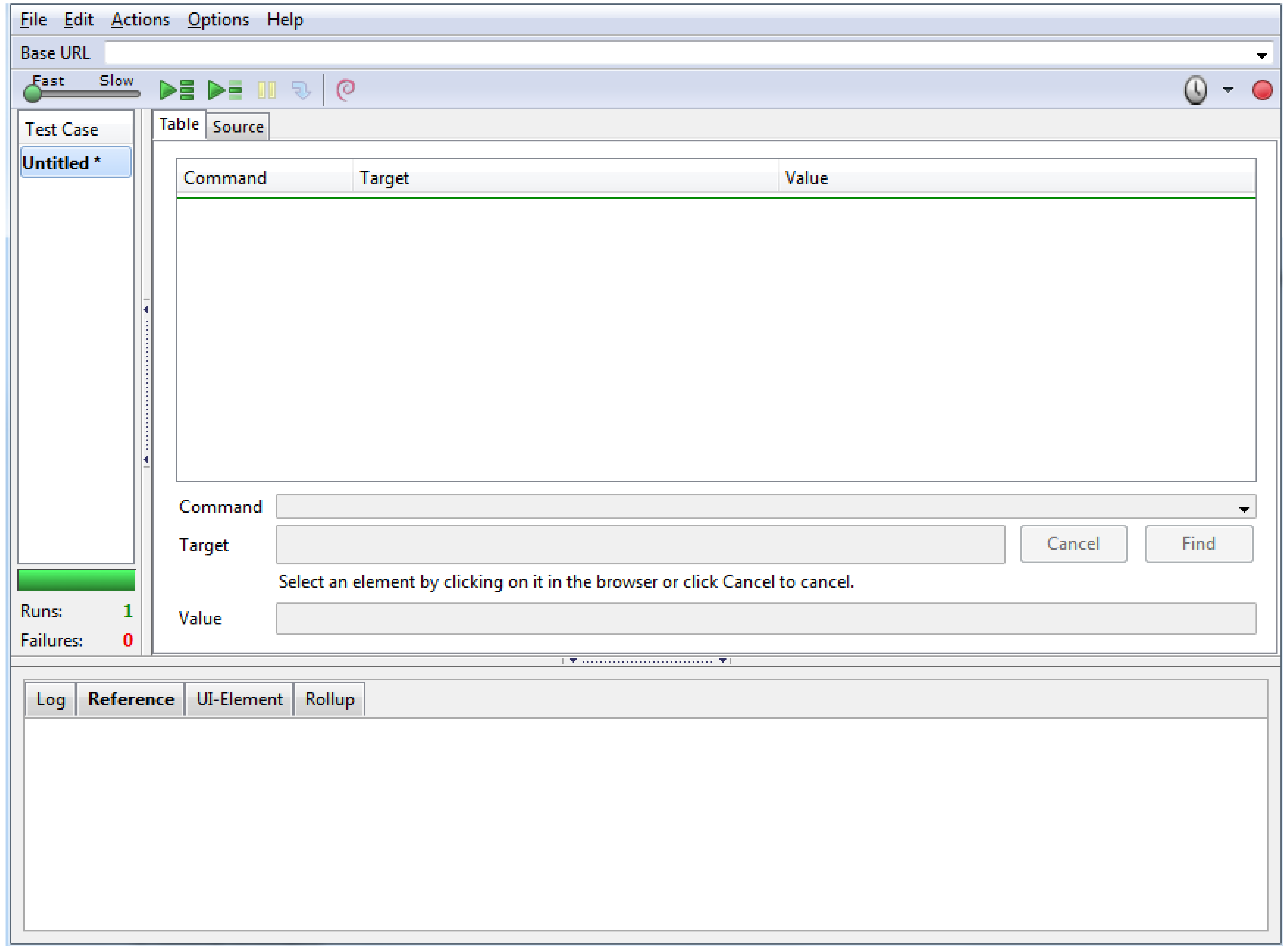
Arguments:

- url - the URL to open; may be relative or absolute

Opens an URL in the test frame. This accepts both relative and absolute URLs. The "open" command waits for the page to load before proceeding, ie. the "AndWait" suffix is implicit. *Note*: The URL must be on the same domain as the runner HTML due to security restrictions in the browser (Same Origin Policy). If you need to open an URL on another domain, use the Selenium Server to start a new browser session on that domain.

Exercise 1: Test Automation Tools

Example: Selenium IDE → All parts combined



Select an element by clicking on it in the browser or click Cancel to cancel.

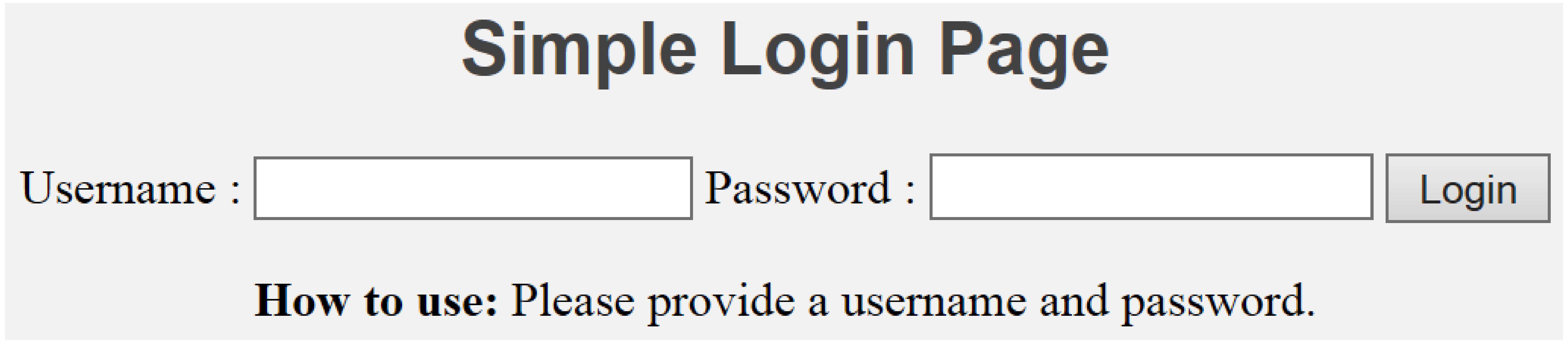
Exercise 1: Selenium IDE

Example: Simple Login Page

We can now use Selenium for test automation

Have created a simple login page for this purpose

Location: http://inf3121-login-example.bitballoon.com/



Simple Login Page

Username : Password : Login

How to use: Please provide a username and password.

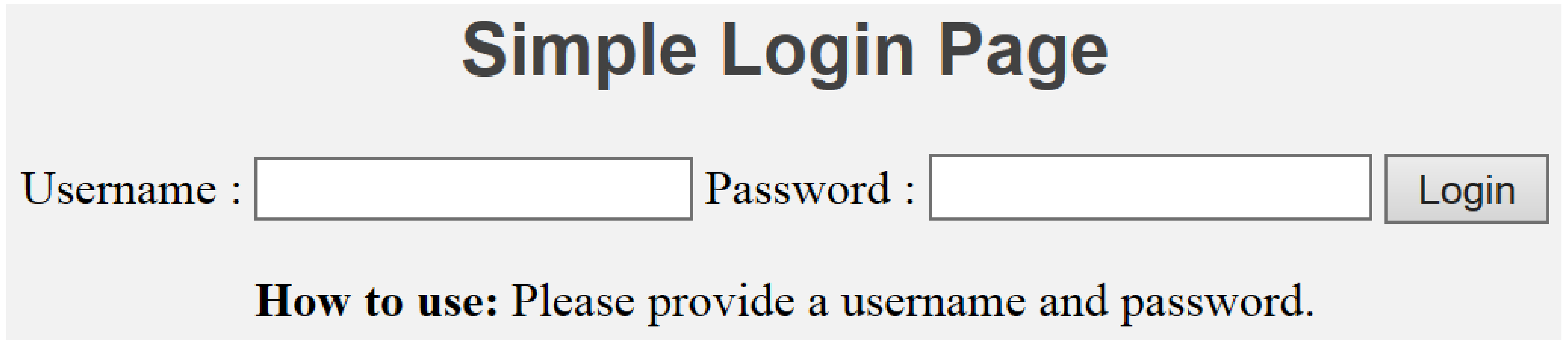
Exercise 1: Selenium IDE

Example: Simple Login Page

How can we the test login functionality?

Write down the login procedure

1. Go to site
2. Type in username
3. Type in password
4. Click "Login" button



Simple Login Page

Username : Password : Login

How to use: Please provide a username and password.

We have been given a list of valid usernames and passwords

>> Know which to accept / reject

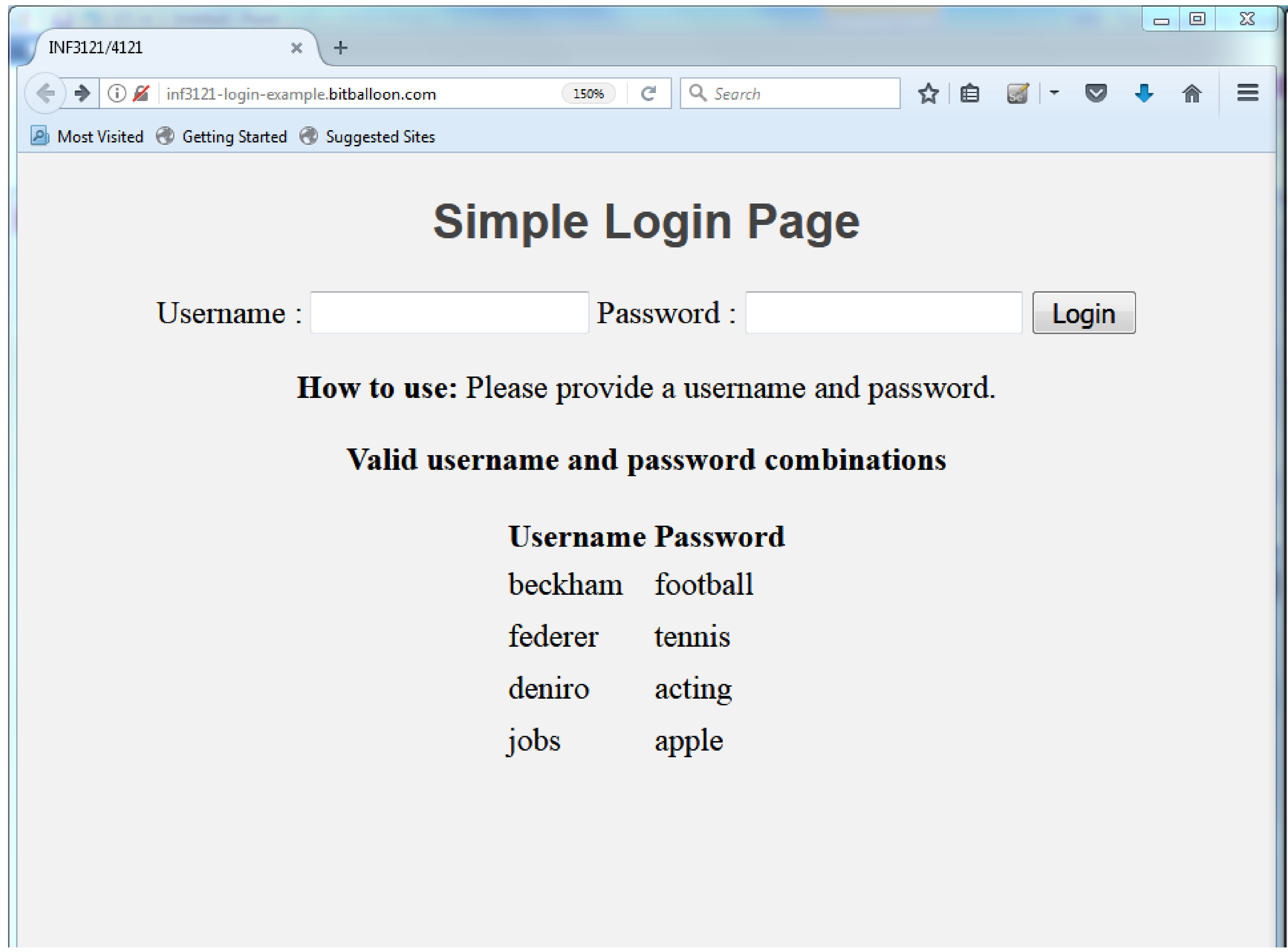
Username	Password
beckham	football
federer	tennis
deniro	acting
jobs	apple

Exercise 1: Selenium IDE

Example: Simple Login Page

1. Go to the login site and open Selenium IDE

Tip: Have the windows side by side



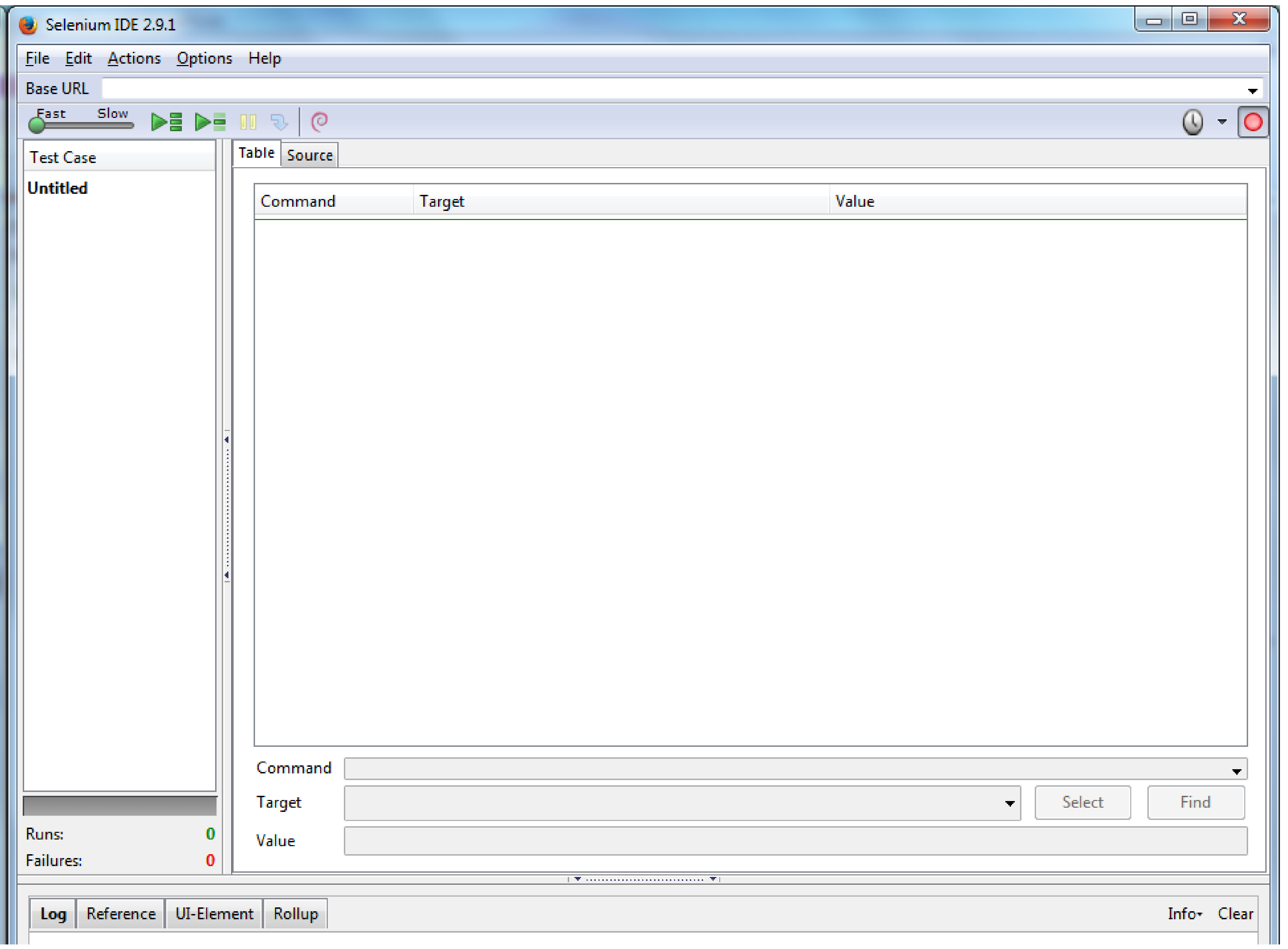
Simple Login Page

Username :		Password :		Login

How to use: Please provide a username and password.

Valid username and password combinations

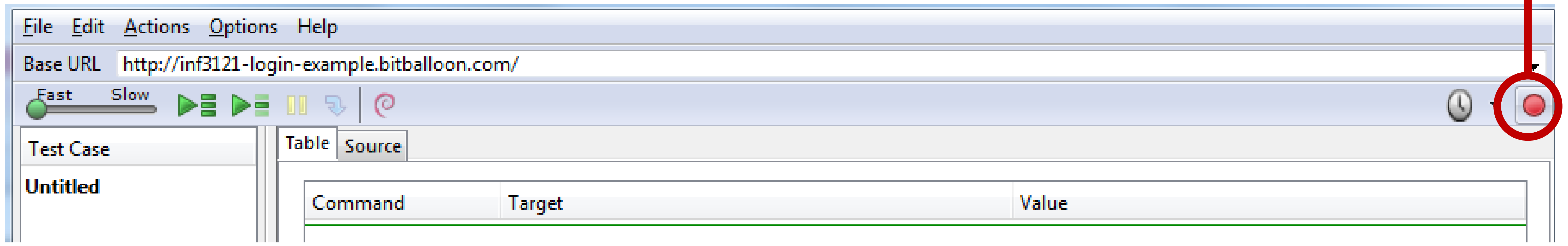
Username	Password
beckham	football
federer	tennis
deniro	acting
jobs	apple



Exercise 1: Selenium IDE

Example: Simple Login Page

2. In Selenium: Click on the record button

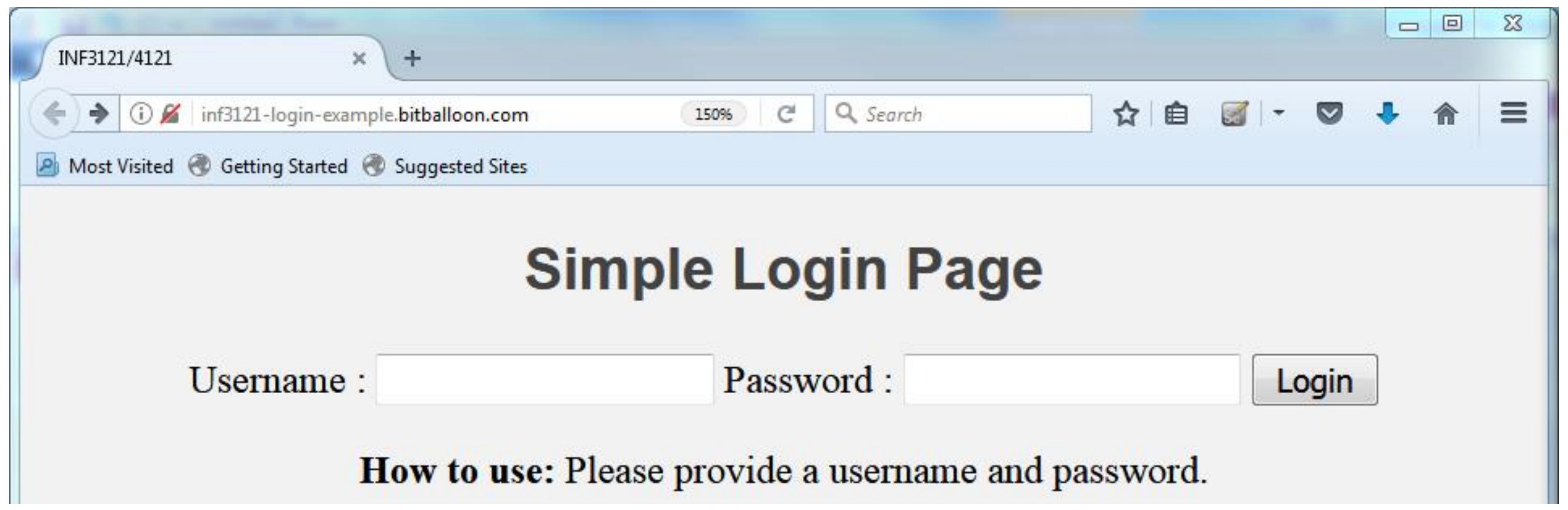


Base URL http://inf3121-login-example.bitballoon.com/

Untitled

Command	Target	Value

3. Switch to the login site



Simple Login Page

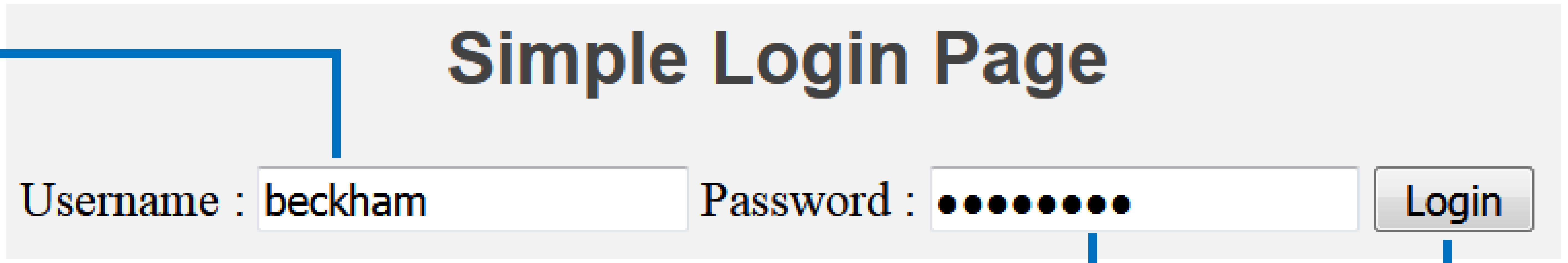
Username : Password : Login

How to use: Please provide a username and password.

Exercise 1: Selenium IDE

Example: Simple Login Page

4. Follow the login procedure for a valid user
   i. Username
   ii. Password
   iii. Click “Login”

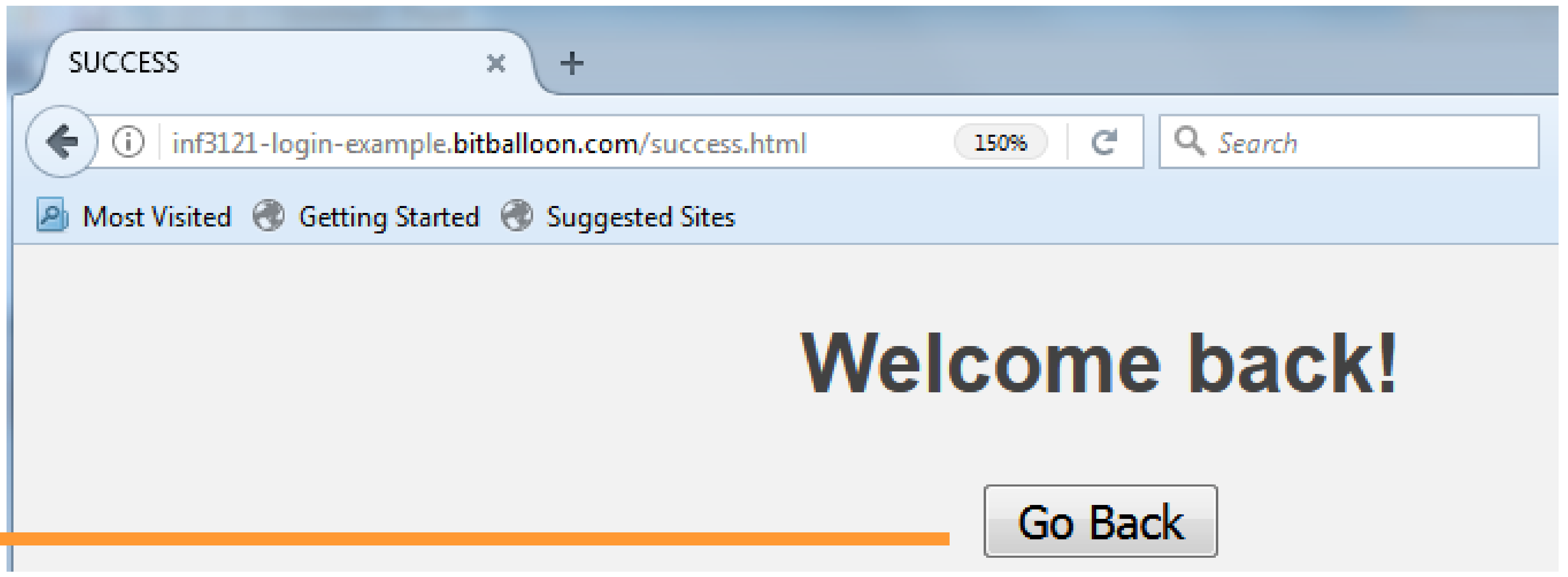


5. Once login is approved

   You are directed to the page ‘success.html’

   Page title can later be used to verify access

6. Click on the “Go Back” button



Exercise 1: Selenium IDE

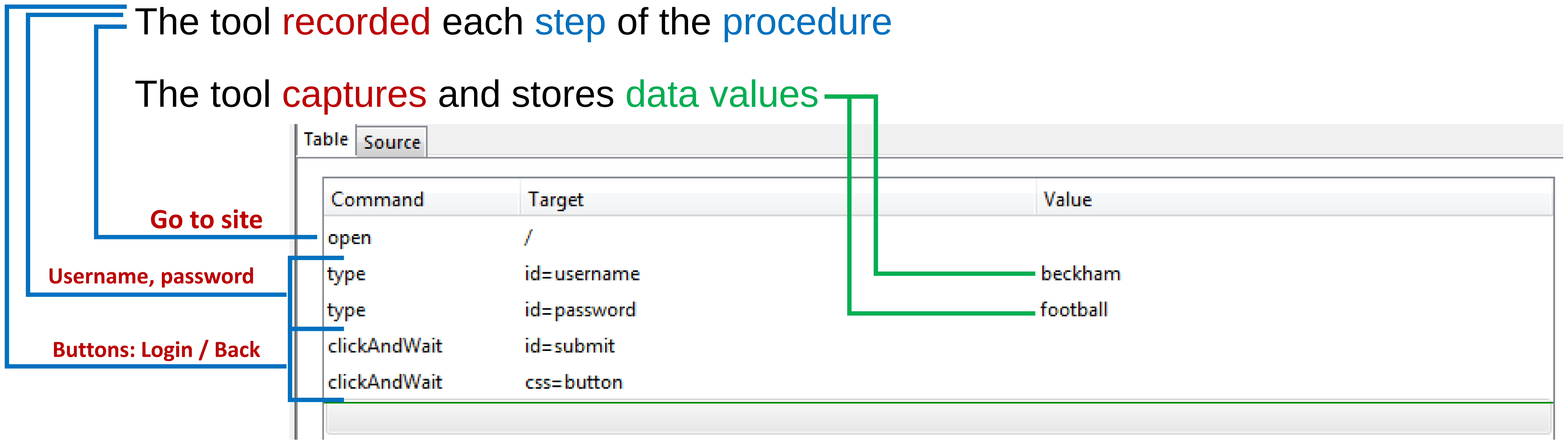
Example: Simple Login Page

7. In Selenium: Stop recording by clicking the record button

8. You now have an automated test for logging in

The tool recorded each step of the procedure

The tool captures and stores data values

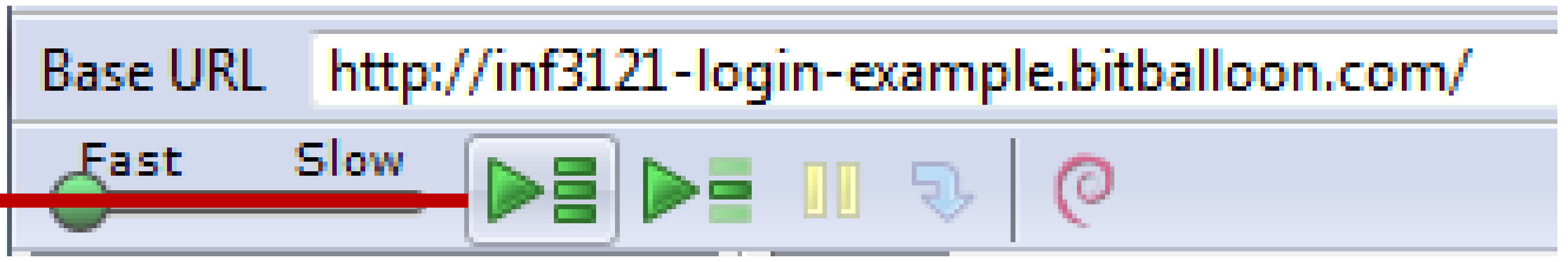


Command	Target	Value
open	/	
type	id=username	beckham
type	id=password	football
clickAndWait	id=submit	
clickAndWait	css=button	

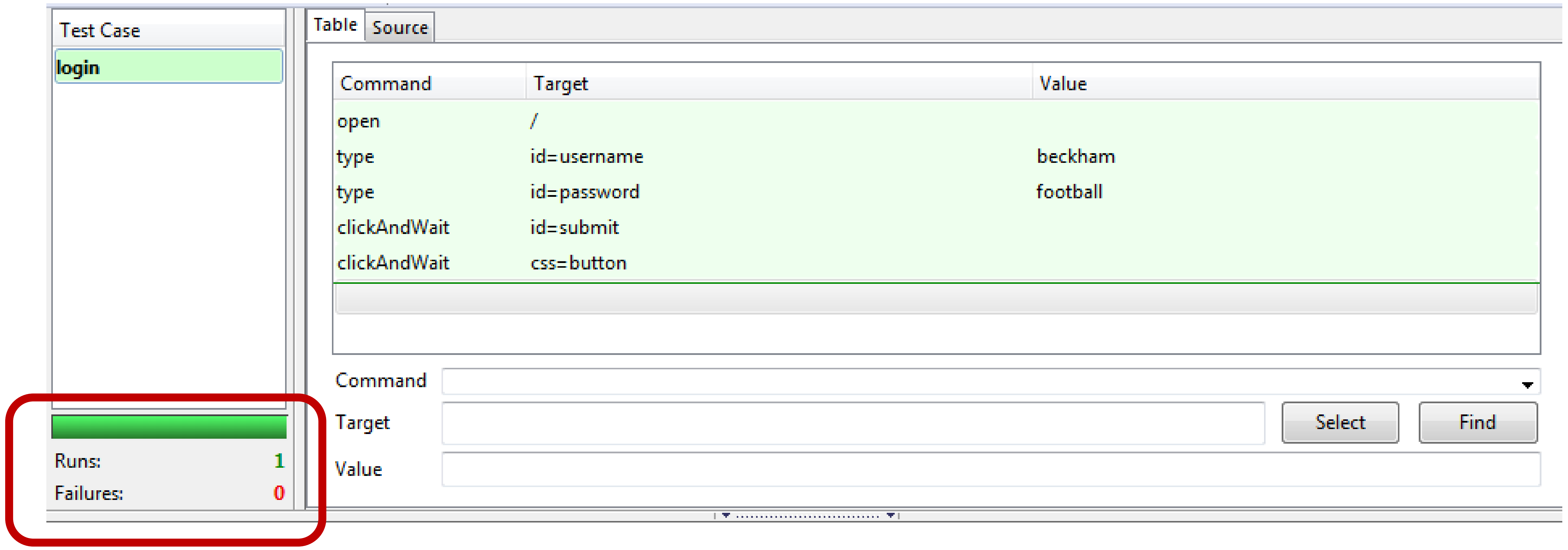
Exercise 1: Selenium IDE

Example: Simple Login Page

9. In Selenium: Click to play entire test suite



10. Wait for the test to run, and verify that it runs without failures



Command	Target	Value
open	/	
type	id=username	beckham
type	id=password	football
clickAndWait	id=submit	
clickAndWait	css=button	

Runs: 1
Failures: 0

Exercise 1: Selenium IDE

Summary

- We have now created a simple automated test using Selenium IDE
  - Testing login procedure for valid username and password combination
- Selenium offers a variety of additional features
- Explore Selenium to see if you can:
  1. Write / record the remaining tests for valid users
  2. Write / record an automated test for an invalid user
  3. Write a Selenium test that logs into your Facebook account

Exercise 2: Benefits and Limitations

Discuss the advantages and limitations of automated testing.

Exercise 2: Answer

Benefits of automated testing

More tests are run

Test that cannot be done manually are enabled

Tests can be more complex

Tests run faster

Tests are less subject to operator error

More effective and efficient use of testers

Improved system reliability

Exercise 2: Answer

Limitations of automated testing

- Cannot automate all manual tests
- Automation can only check machine-interpretable results
- Automation can only check results that can be predicted / verified
- Additional resources
  - Requires a higher skill and proficiency level from testers
  - Requires purchase and implementation of automation tools
- Do not forget(!): Automated tests are code / scripts
  - Grows the codebase and requires maintenance / support

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