CMPT 473
Software Testing, Reliability and Security

User Interface Testing & Automation

Nick Sumner
wsumner@sfu.ca

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- Recall the automated testing pyramid:

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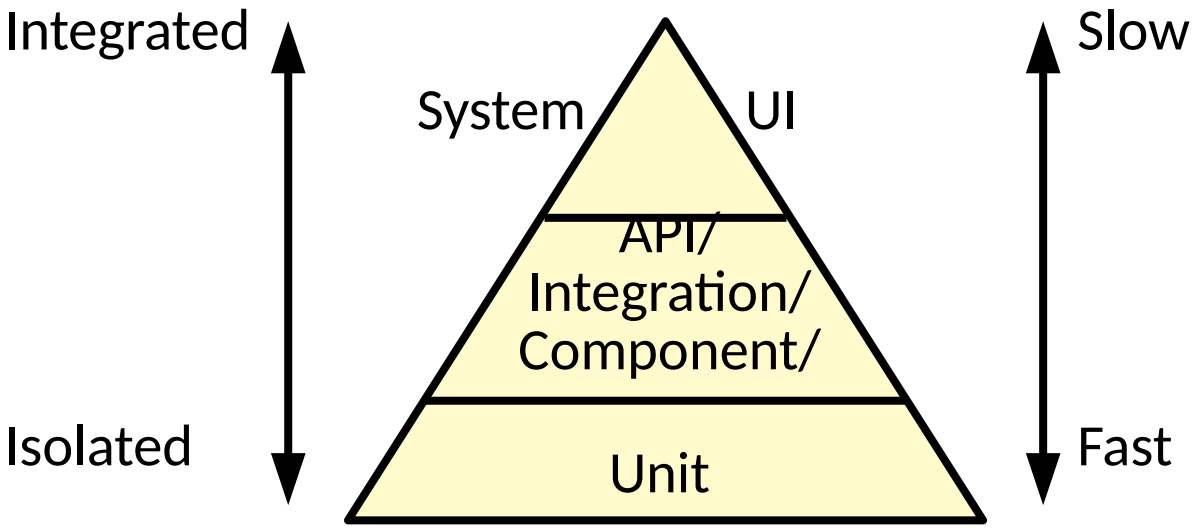

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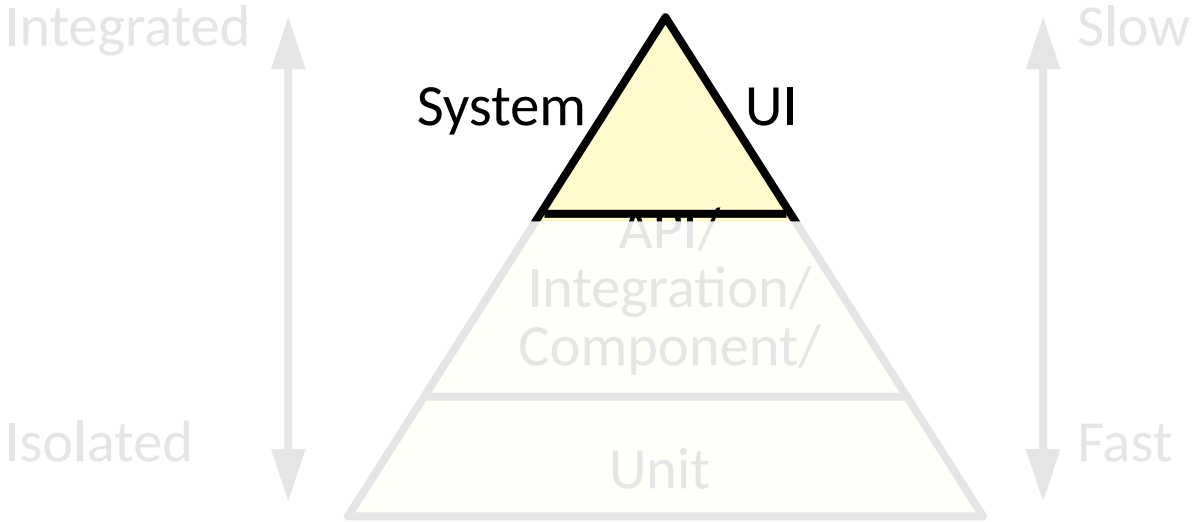
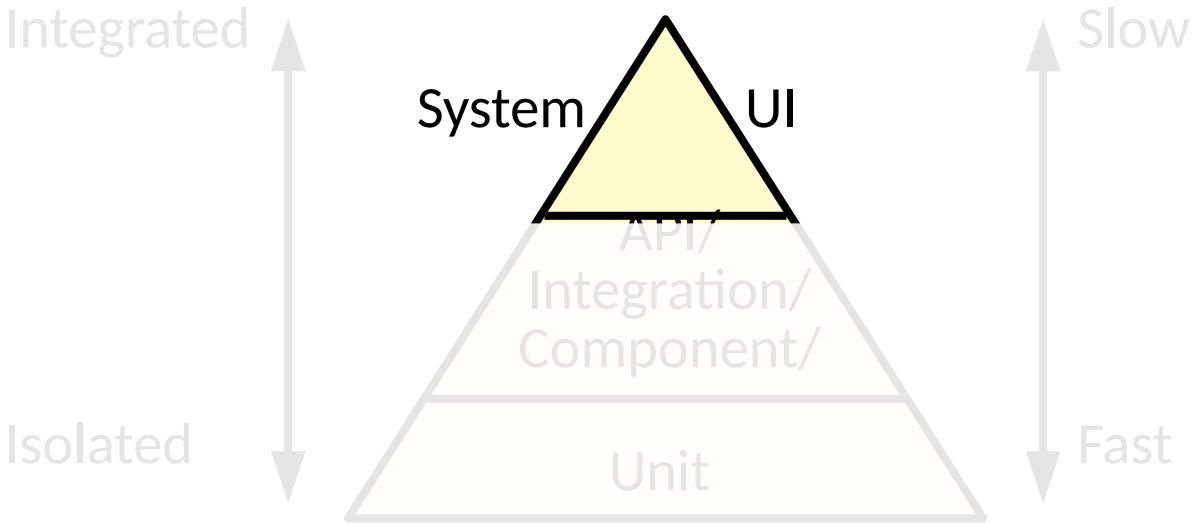


How can we automate the top of the pyramid?

- Recall the automated testing pyramid:
  - The top is: high value, more expensive, challenging to automate
  - But why?!



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TEST_CASE("empty") {
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  auto result = evaluate(tree, env);

  CHECK(!result.has_value());
}
```

Arrange

Act

Assert

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What implications does testing the UI have for each of these?

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  - Not a command line or simple API call!

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And more....

The concerns we had about ***testability*** are only amplified.

We must design UIs to be testable and codesign the testing methods.

UI Testing Frameworks

- Tools to facilitate UI testing will focus on
  - UI Frameworks (e.g. Flutter, React, etc.)
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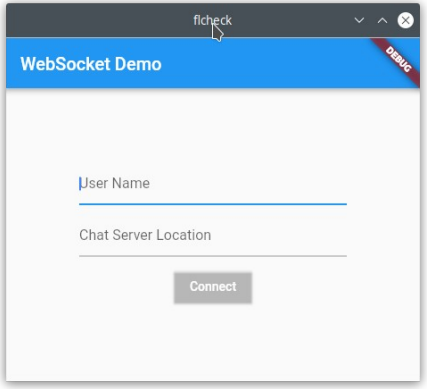
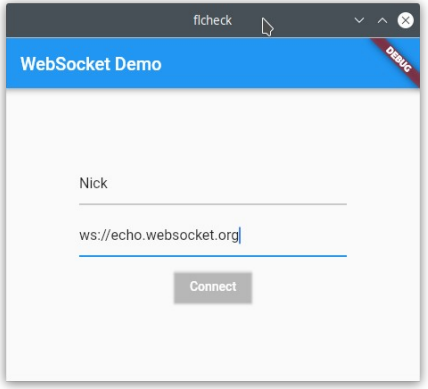
  - Feed information in
  - Extract information out
  - Provide logical time based on events

Feeding information into a UI

- Let us consider a simple chat program





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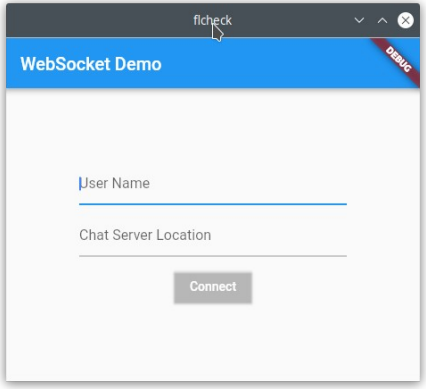

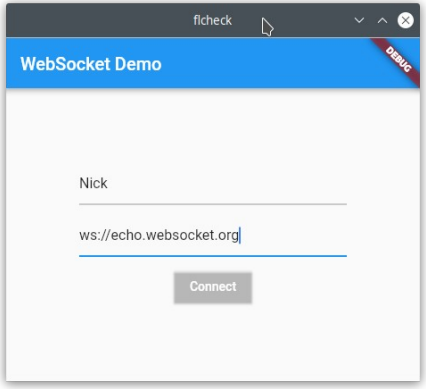

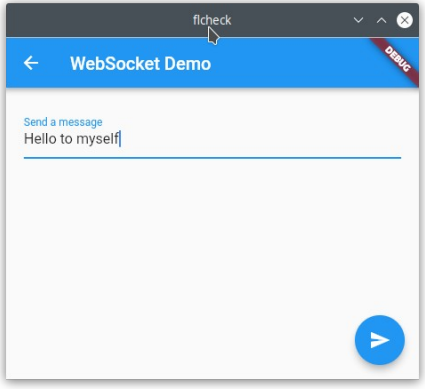

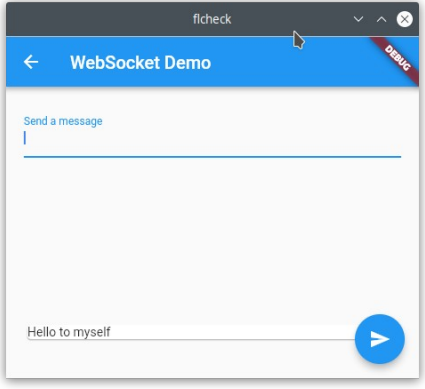

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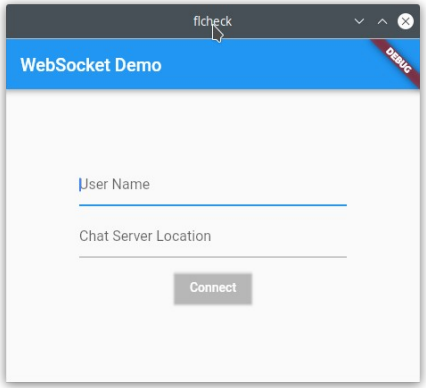

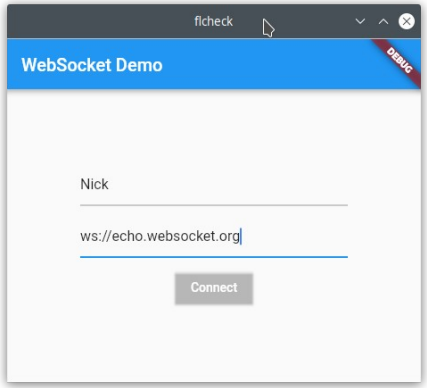

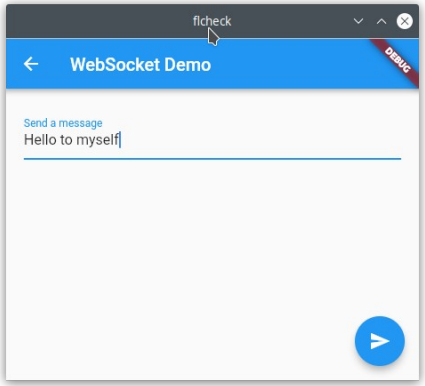

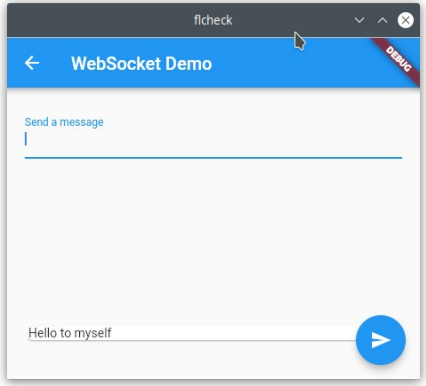

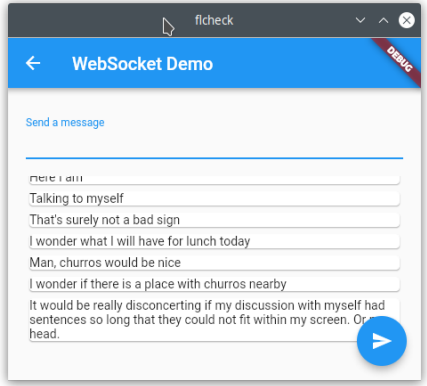

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Managing IDs well helps to deal with churn and evolution

Finding things to interact with

- Manging IDs in Flutter

```
final serverField = TextField(
  key: ValueKey("ServerField"),
  controller: _serverController,
  onSubmitted: _connectToServer,
  obscureText: false,
  autofocus: true,
);
```

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test('Connects to echo server and receives message', () async {
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```

```
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  // Enter an echo server into the server field.
  await driver.tap(serverFinder);
  await driver.enterText('ws://echo.websocket.org');
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  - Cost
- All of these can be dealt with to some degree
  - Tolerate
  - Abstract away

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- When this option is available to you it is more robust
  - To change, to nondeterminism, …

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- In Flutter

```
await tester.pumpWidget(MyWidget(title: 'T', message: 'M'));

await tester.enterText(find.byValueKey('greeting'), 'hi');
await tester.tap(find.byValueKey('confirm'));

await tester.pump(Duration.zero);

expect(...)
```

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- In Flut

```
Future<bool>
isPresent(SerializableFinder byValueKey,
          FlutterDriver driver,
          {Duration timeout = const Duration(seconds: 1)}) async {
  try {
    await driver.waitFor(byValueKey, timeout: timeout);
    return true;
  } catch(exception) {
    return false;
  }
}
```

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expect(await isPresent(messageFinder, driver), true);
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Revisiting the Chat App (for 1 story)

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final message = 'Hi, there!';
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Arrange

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  - System level by a developer?
  - *The person defining the tests may not be a programmer!*

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- Tools like Selenium can record user interactions as an event series
  - A trace of (Command, Target, Value)s
  - Can be replayed
- This can make it easier to produce tests for nonexperts, but recorded tests can be more brittle

BDD

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Scenario: Breaker joins a game
Given the Maker has started a game with the word "silky"
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[Cucumber.io Docs]

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[Cucumber.io Docs]

- Tools like Cucumber can translate these into, e.g., Selenium tests

Further Directions

- We have only considered automated *functional* UI testing

Further Directions

- We have only considered automated functional UI testing
- We could also consider
  - User Experience (UX)
  - Performance
  - Security
  - Regulatory compliance
  - Exploratory methods
  - Automated test generation

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- Frameworks can intercept behavior to facilitate easier test construction
- Careful design of code to be testable is just as important in this setting.