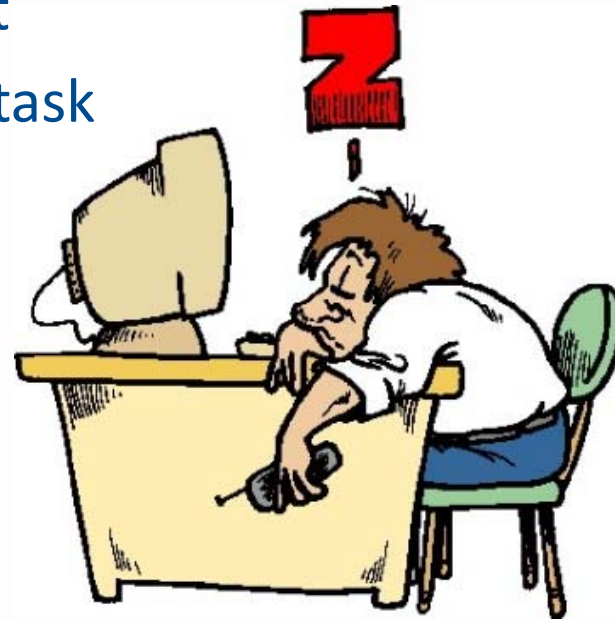**AUTOMATED REGRESSION ANALYSIS THROUGH GRAPHICAL USER INTERFACE**

Presented by Pekka Aho, VTT Technical Research Centre of Finland

(in collaboration with Matias Suarez, F-Secure Ltd)

Motivation

- Manual testing of graphical user interfaces (GUIs)
  - Requires a lot of time and effort
  - Usually a boring and repetitive task

Motivation

- ~~Manual testing of graphical user interfaces (GUIs)~~

- Capture & replay
  - Able to detect changes between consequent GUI versions
  - Easy and intuitive to use
  - Requires manual re-capture after each change in the GUI

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Motivation

- ~~Manual testing of graphical user interfaces (GUIs)~~

- ~~Capture & replay~~

- ## Script-based testing
  - Requires effort and expertise when creating the scripts
  - Enables to check many kinds of properties but each one have to be manually written into the script
  - A lot of maintenance effort after GUI changes

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Motivation

- ~~Manual testing of graphical user interfaces (GUIs)~~

- ~~Capture & replay~~

- ~~Script-based testing~~

- Model-based GUI testing
  - Manually creating models for MBT requires effort, expertise and tools
  - Maintenance is easier through models, but requires effort

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Motivation

- ~~Manual testing of graphical user interfaces (GUIs)~~

- ~~Capture & replay~~

- ~~Script-based testing~~

- ~~Model-based GUI testing~~

- How about automated regression analysis?

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Automated regression analysis through GUI

- Why is it better?

  - Initially significantly less work than modelling or scripting

  - Able to detect most changes between GUI versions

  - Usually GUI changes do not require maintenance effort

  - Change analysis can be fully automated, also in CI (Jenkins)

  - Open source tool available:

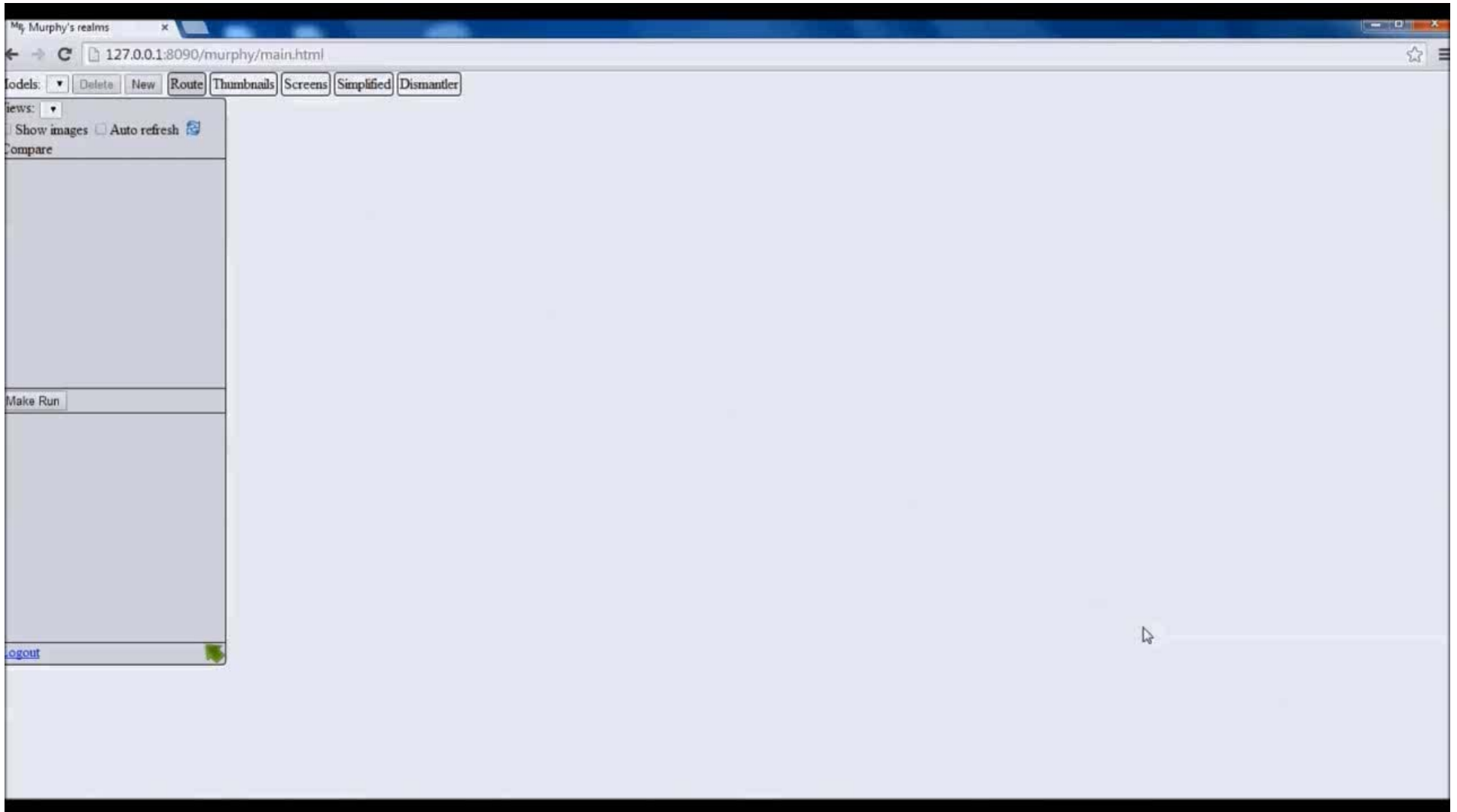   - https://github.com/F-Secure/murphy

Automated regression analysis through GUI

- How does it work?
  1. Manually writing GUI application-specific instructions for model extraction (iteratively)
     - For example username and password for a login screen
     - Setting boundaries for parts that are not supposed to be modelled

```
extractor = base_extractor.BaseExtractor('7zipWinScraper', '7z920.exe')
extractor.add_boundary_node('Browse For Folder')
```

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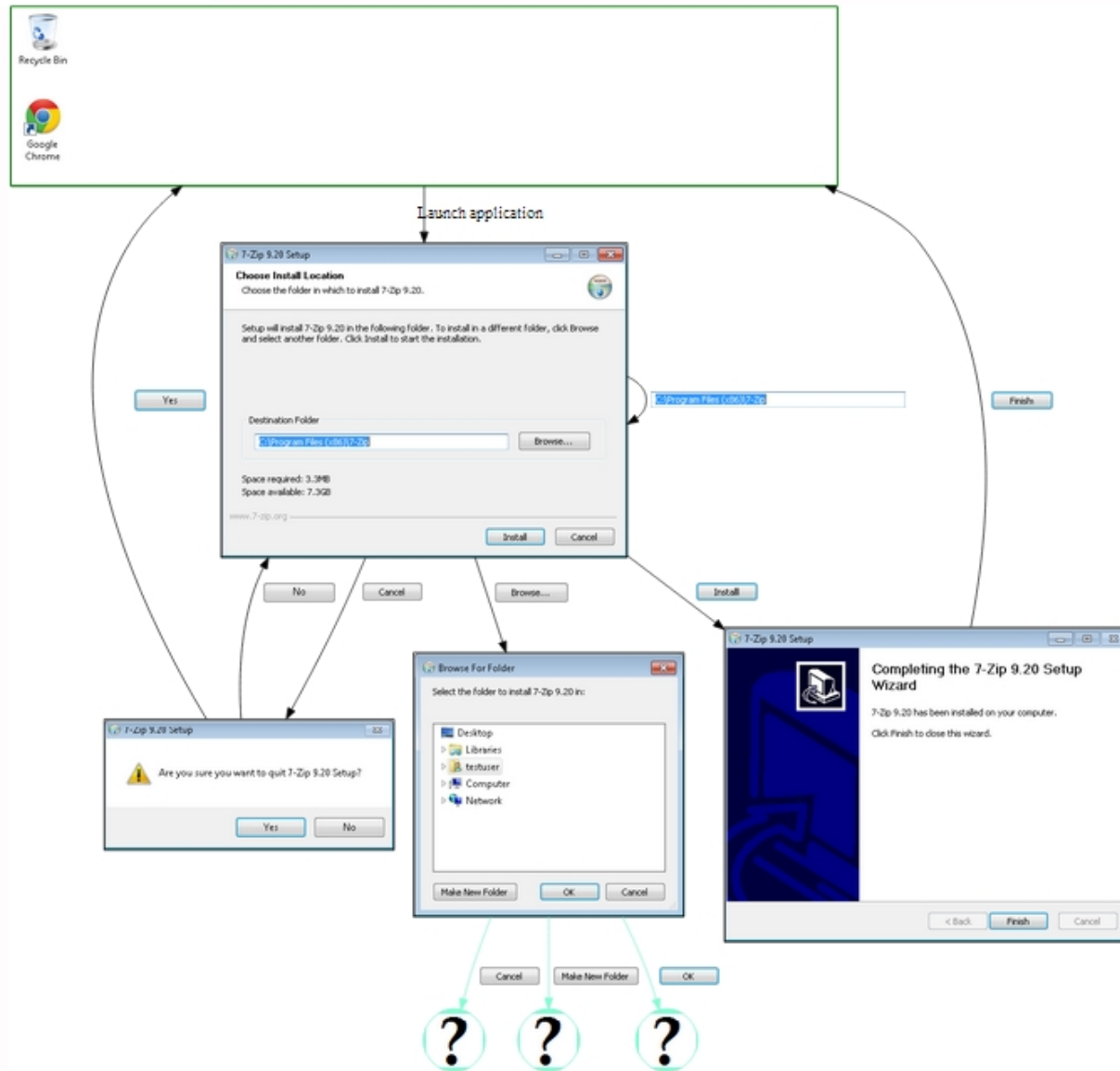Advanced Automated Testing**

Automated regression analysis through GUI

- How does it work?

  1. Manually writing GUI application-specific instructions for model extraction (iteratively)

  2. Using the tool (Murphy) to extract a model of the GUI
     - Fully automated "test robot" simulating the end user
     - Tool extracts the behavior and properties of the GUI into the model
     - Demo video...
       - (Full demo video: https://www.youtube.com/watch?v=zUYmzYI_pvY)

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Automated regression analysis through GUI

- How does it work?

  1. Manually writing GUI application-specific instructions for model extraction (iteratively)

  2. Using the Murphy tool to extract a model of the GUI

  3. (optional) Visually inspecting the extracted GUI graph

     - Is the behavior of the GUI correct?
     - Were the instructions sufficient to extract a model with good coverage?

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Automated regression analysis through GUI

- How does it work?
    1. Manually writing GUI application-specific instructions for model extraction (iteratively)

    2. Using the Murphy tool to extract a model of the GUI

    3. (optional) Visually inspecting the extracted GUI graph

    4. Using the Murphy tool for regression analysis
        - Automatically extracting GUI model, for example 3 times/day
        - Automatically comparing models of consequent GUI versions and reporting changes (for example email)

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Experiences from F-Secure Ltd

- Regression analysis on commercial GUI software
  - For 1 year
  - 3 non-trivial GUI software products
  - During development, a lot of GUI changes
  - Highly automated testing and continuous integration process

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Experiences from F-Secure Ltd

- Regression analysis on commercial GUI software

  - Testing starts during model extraction and visual inspection
    - Crashes and unhandled exceptions found
    - Unspecified behavior and bugs during visual inspection of the models

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Experiences from F-Secure Ltd

- Regression analysis on commercial GUI software

  - Testing starts during model extraction and visual inspection

  - Reducing manually written test code (maintenance effort)
    - Replacing manually written test scripts with generated ones

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Experiences from F-Secure Ltd

- Regression analysis on commercial GUI software

  - Testing starts during model extraction and visual inspection

  - Reducing manually written test code (maintenance effort)

  - Reducing the time and effort for creating new test cases
    - Generating and automatically executing test scenarios

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Experiences from F-Secure Ltd

- Regression analysis on commercial GUI software

  - Testing starts during model extraction and visual inspection

  - Reducing manually written test code (maintenance effort)

  - Reducing the time and effort for creating new test cases

  - Reducing the need for specific GUI test cases
    - Automated regression analysis found the changes

Experiences from F-Secure Ltd

- Regression analysis on commercial GUI software

  - Testing starts during model extraction and visual inspection

  - Reducing manually written test code (maintenance effort)

  - Reducing the time and effort for creating new test cases

  - Reducing the need for specific GUI test cases

  - Reducing the time and effort for manual testing
    - Automating the uninteresting parts of test cases

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Experiences from F-Secure Ltd

- Technical details:
  - Satisfactory extracts most parts of the GUI (~80% of UI flows)
  - Instructions for extraction were 2-200 lines of Python code
  - Extracted models had 80-180 nodes (GUI states)
  - Partitioning of the models helps visual inspection
    - Boundaries and more than one extraction script
  - GUI apps used in this evaluation were flow based
    - Relatively low amount of the possible input values

Automated regression analysis through GUI

- Testing through GUI
  - Is not testing just the GUI but the whole software, including the possible back-end services, allowing end-to-end testing
  - Should detect the defects seen by the end user, affecting how the quality of the software is perceived (reputation)

- Automated GUI testing allows also non-functional testing, such as performance and robustness testing

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FOR MORE DETAILS:

Email: Pekka.Aho@vtt.fi