Utrecht University

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Testing iRODS-based applications: Experiences with Yoda

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Facts & Figures

PROFESSORS

>700

FACULTIES

7+2

teaching institutes

STUDENTS

>39,000

>25,000 Bachelor
>12,000 Master
>2,510 International
118 Nationalities

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Strategic Themes

- Strong links between teaching & research
- Integrated approach to academic / scientific and societal issues
- Strong disciplinary research programmes
- Eleven interdisciplinary focus areas

PATHWAYS TO SUSTAINABILITY

DYNAMICS OF YOUTH

INSTITUTIONS FOR OPEN SOCIETIES

LIFE SCIENCES

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What is Yoda?

- System to preserve, share, archive and publish research data during several stages of the research process
- Integrated Research Data Management solution
- Important strategic development for reaching Research Data Management goals

Yoda
research data management

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History

- Institutional service, developed and maintained by Utrecht University
- Cross domain archive and repository
- Developed as open-source software
- Sustained funding by the board, delivered through university corporate services

- Production service as of 2015
- First data package published in 2017
- Presented at the 2018 iRODS User Group Meeting
  - https://irods.org/uploads/2018/irods_ugm2018_proceedings.pdf
- Updates on Yoda presented at the 2023 iRODS User Group Meeting
  - https://irods.org/uploads/2023/irods_ugm2023_proceedings.pdf

Your research data and work according to FAIR principles, organize

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Yoda Consortium

Launched March 2023

Safeguard the development of Yoda as a national RDM platform

Effective collaboration on:
- Knowledge base
- Support for researchers
- Product development

SURF

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TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

WAGENINGEN UNIVERSITY & RESEARCH

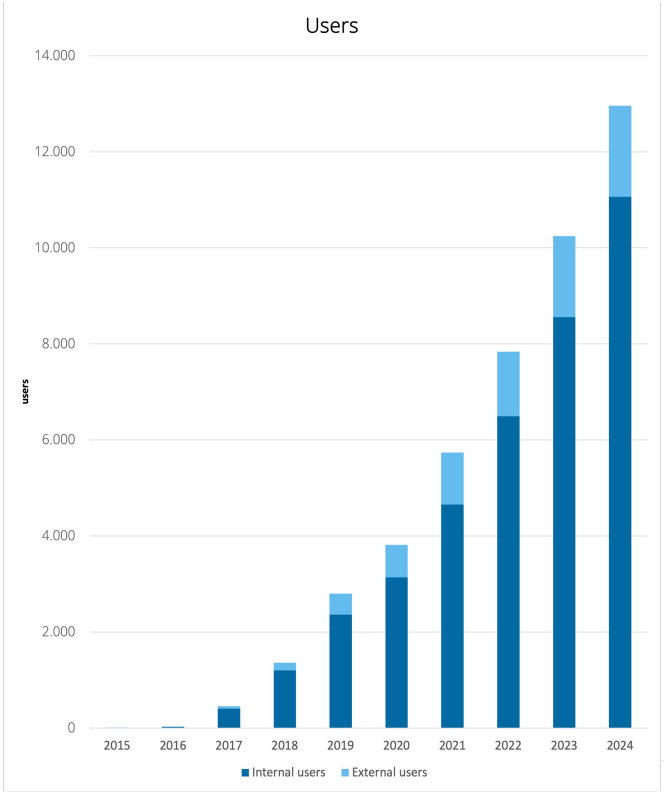
Amsterdam UMC

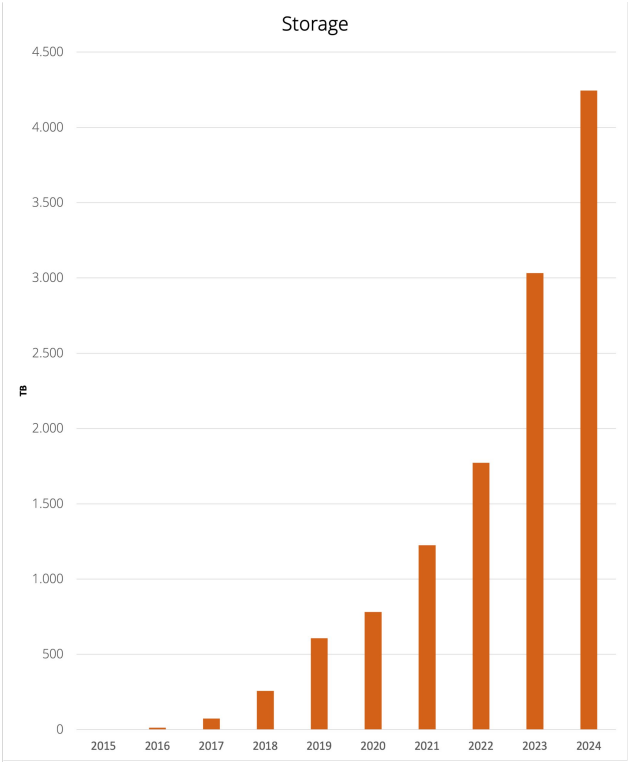
Erasmus Universiteit Rotterdam

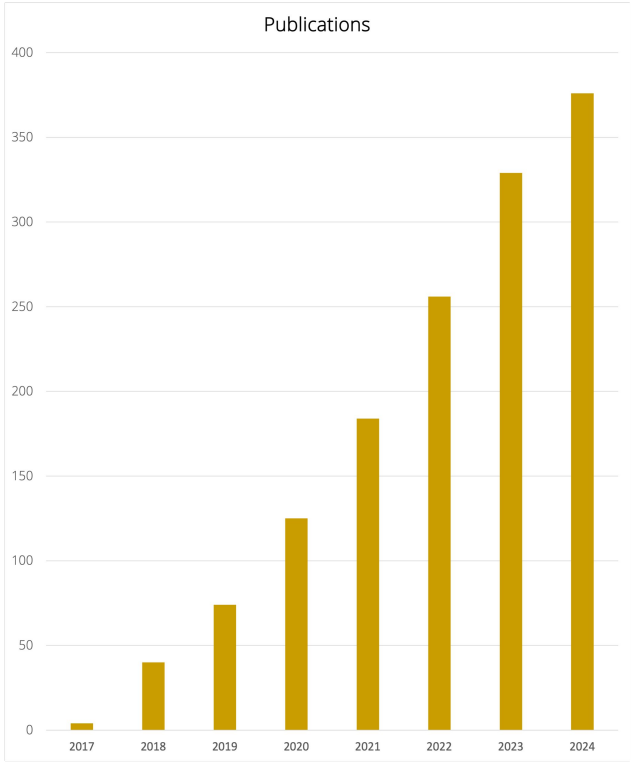
VU VRIJE UNIVERSITEIT AMSTERDAM

Universiteit Leiden

Utrecht University iRODS managed research data







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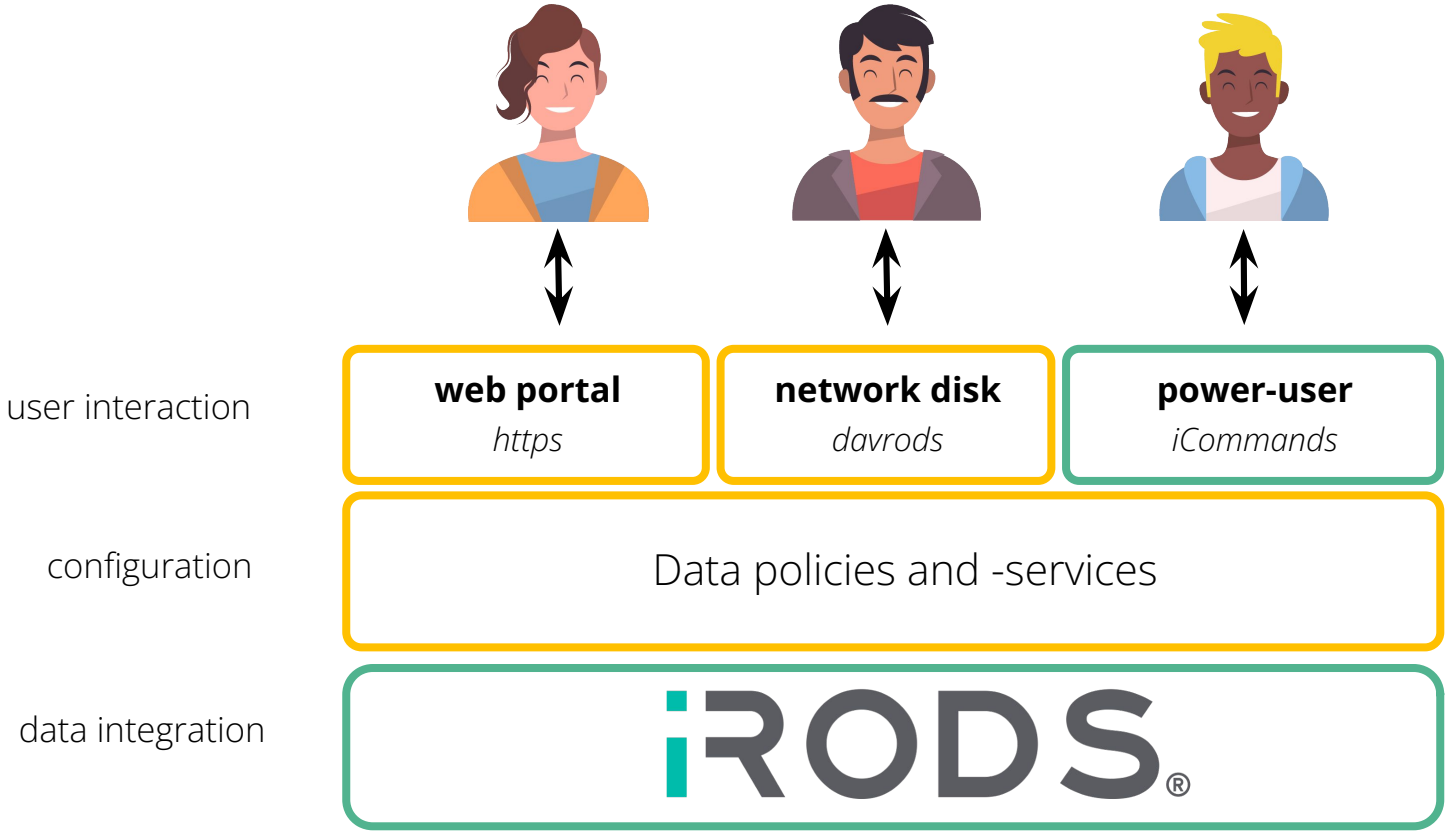
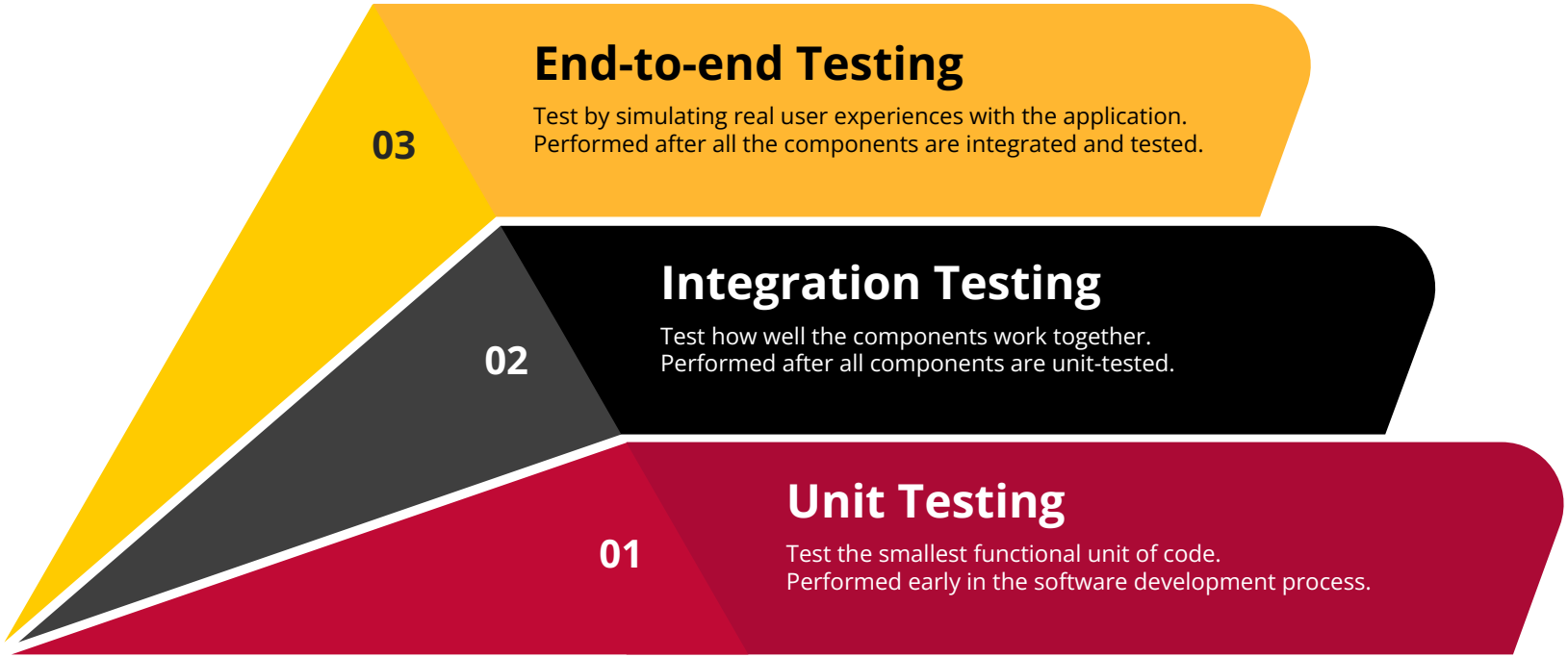
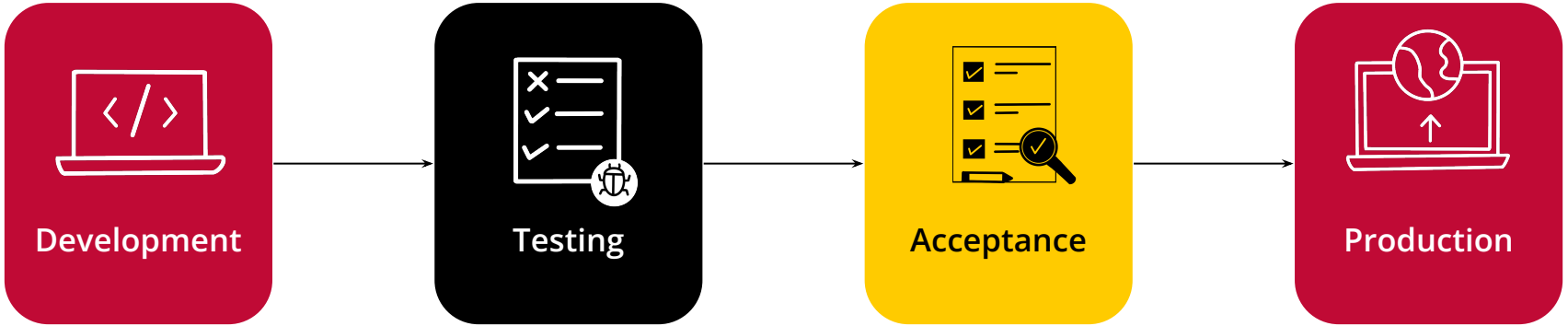
Yoda is built on iRODS



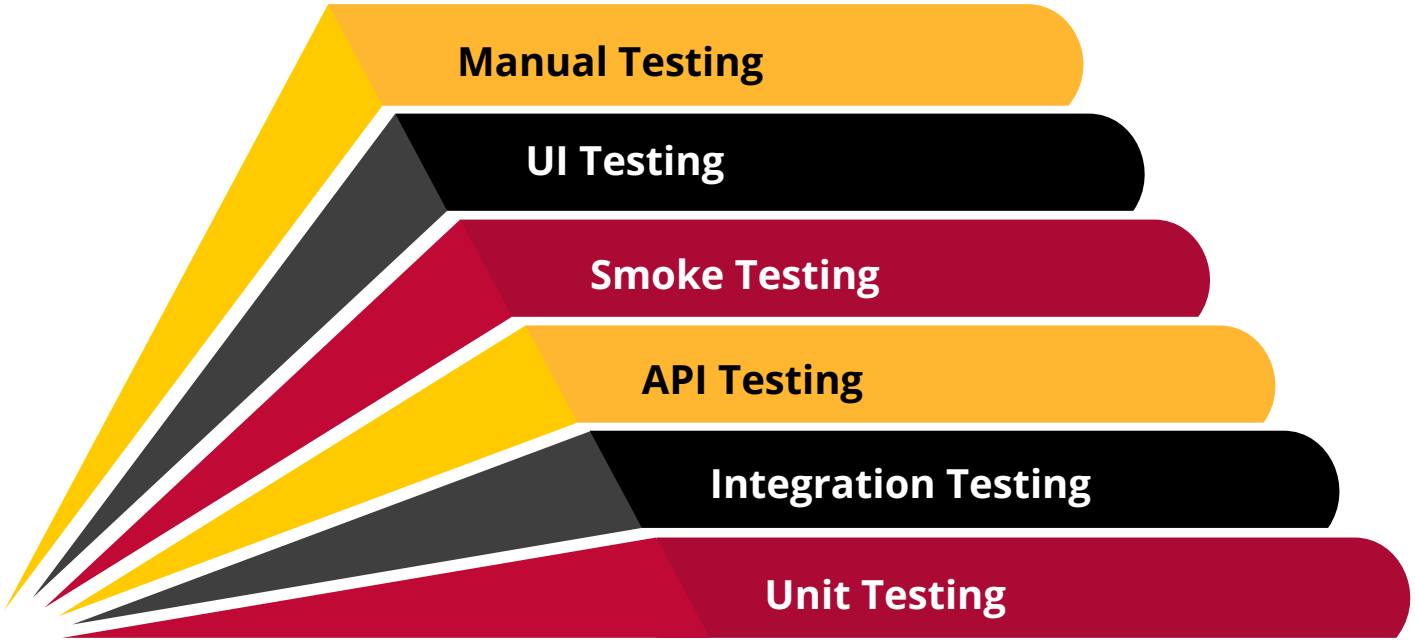
General Software Testing Strategy



Testing Strategy for Yoda



Testing Strategy for Yoda



Se

pytest

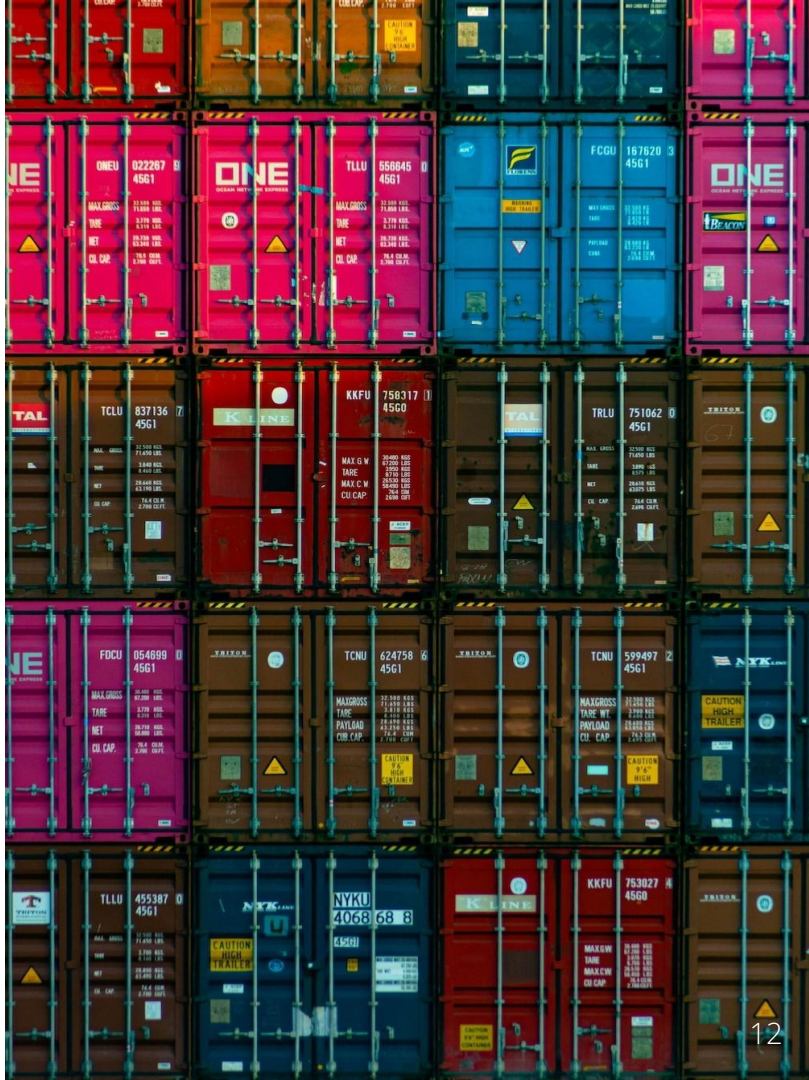
Docker

- Containerized version of Yoda
- Developed for local development
- Continuous integration

```
$ git clone https://github.com/UtrechtUniversity/yoda.git
$ cd yoda/docker/compose
$ docker compose pull
$ ../up.sh
```

More information:

https://utrechtuniversity.github.io/yoda/development/docker-setup.html



Unit Testing

- Test the smallest unit of code.
- Automated and scripted tests.
- Use python unittest framework for Yoda portal and MOAI and pytest for EUS.
- Run locally.
- Also run as part of GitHub workflow.
- Test suites differ per Yoda component.

More information:
https://utrechtuniversity.github.io/yoda/development/running-unit-integration-tests.html

```
# test_util_names.py
from unittest import TestCase

class UtilNamesTest(TestCase):

    def test_is_valid_category(self):
        self.assertEquals(is_valid_category(""), False)
        self.assertEquals(is_valid_category("foo"), True)
        self.assertEquals(is_valid_category("foo123"), True)
        self.assertEquals(is_valid_category("foo-bar"), True)
        self.assertEquals(is_valid_category("foo_bar"), True)

# unit_tests.py
from test_util_names import UtilNamesTest

def suite():
    test_suite = TestSuite()
    test_suite.addTest(...)
    test_suite.addTest(...)
    test_suite.addTest(makeSuite(UtilNamesTest))
    return test_suite

# Run unit tests
$ cd unit-tests
$ python -m unittest unit_tests
.................
----------------------------------------------------------------------
Ran 17 tests in 0.001s
```

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Integration Testing

- Test multiple components as a group.
- Automated and scripted tests.
- Use python unittest framework for MOAI and pytest for EUS. Tests can be run through integration rule in Yoda ruleset.
- Run either on development VM or dockerized version of Yoda using GitHub actions.

More information:
https://utrechtuniversity.github.io/yoda/development/running-unit-integration-tests.html

```
# integration_tests.py
__all__ = ['rule_run_integration_tests']

basic_integration_tests = [
    {"name":   "util.user.is_admin.yes",
     "test": lambda ctx: user.is_admin(ctx, "rods"),
     "check": lambda x: x},
    {"name":   "util.user.is_admin.no",
     "test": lambda ctx: user.is_admin(ctx, "researcher"),
     "check": lambda x: not x}
]

@rule.make(...)
def rule_run_integration_tests(ctx):
    ...


# run-integration-tests.r
def main(rule_args, callback, rei):
    result = callback.rule_run_integration_tests("")
    callback.writeLine("stdout", result["arguments"][0])

...

# Run integration tests
$ /usr/bin/irule -r irods_rule_engine_plugin-python-instance
    -F /etc/irods/yoda-ruleset/tools/run-integration-tests.r
util.user.is_admin.yes VERDICT_OK
util.user.is_admin.no VERDICT_OK
```

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API Testing

- Automated and scripted tests.
- Written with pytest-BDD.
- Run either on development VM or dockerized version of Yoda using GitHub actions.

More information:

https://utrechtuniversity.github.io/yoda/development/running-api-ui-tests.html

```
#api_browse.feature
@api
Feature: Browse API

    Scenario Outline: Browse folder
        Given user <user> is authenticated
        And the Yoda browse folder API is queried with <collection>
        Then the response status code is "200"
        And the browse result contains <result>

        Examples:
            | user       | collection                 | result     |
            | researcher | ~/research-initial         | testdata   |
            | researcher | ~/research-initial/testdata | lorem.txt  |


# test_api_browse.py
@given(parsers.parse("the Yoda browse folder API is queried with {collection}"),
    target_fixture="api_response")
def api_browse_folder(user, collection):
    return api_request(user, "browse_folder", {"coll": collection})

@then(parsers.parse("the browse result contains {result}"))
def api_response_contains(api_response, result):
    _, body = api_response

    assert len(body['data']['items']) > 0

    # Check if expected result is in browse results.
    found = False
    for item in body['data']['items']:
        if item["name"] == result:
            found = True

    assert found
```

UI Testing

- Automated and scripted tests.
- Written with pytest-BDD.
- Use pytest-splinter (Selenium wrapper) to automate browser actions.
- Tests are only run locally.

More information:

https://utrechtuniversity.github.io/yoda/development/running-api-ui-tests.html

```
#ui_login.feature
@ui
Feature: Login UI

    Scenario Outline: Invalid user login flow
        Given user is not logged in
        And the user is at the login gate
        When user <user> enters email address
        And user <user> logs in
        Then incorrect username / password message is shown

        Examples:
        | user                |
        | chewbacca@yoda.test |

# test_ui_login.py
@given('user is not logged in')
def ui_logout(browser):
    browser.visit(url) #url = "~/user/logout"

@given('the user is at the login gate')
def ui_gate(browser):
    browser.visit(url) #url = "~/user/gate"

@when(parsers.parse("user {user} enters email address"))
def ui_gate_username(browser, user):
    # Fill in username and click the 'Next' button

@when(parsers.parse('user {user} logs in'))
def ui_login(browser, user):
    browser.visit(url)
    # Fill in username and password and click the 'Sign in' button

@then("incorrect username / password message is shown")
def ui_user_incorrect(browser):
    assert browser.is_text_present("Username/password was incorrect")
```

Smoke and Manual Testing

- Smoke tests are subset of tests to confirm that a Yoda environment has been deployed or updated correctly.
- Smoke tests are usually run in acceptance environment.
- Manual tests are run before a new release of software mainly for components that do not have good automated test coverage yet.
- Since much of our automated tests are run in development environment, manual tests ensure that the code works properly in acceptance and production environments.
- Maintain list of required functionality that needs to be tested manually.

Sample test set for Research module

ID	Ref	Prio	WAT testen (requirement, logisch testgeval)
1			**Research**
1.1			Research
1.1.1			*Browsing in folder*
1.1.2			*Show adjust number of folders*
1.1.3			*Show system metadata*
1.1.4			*Show provenance information*
1.1.5			*Show checksum report*
1.1.6			*Create folder*
1.1.7			*Upload small file (58kb)*
1.1.8			*Upload medium file > 330 MB*
1.1.9			*Upload large file (1gb)*
1.1.10			*Upload files*
1.1.11			*Upload folders*
1.1.12			*Play video (webm)*
1.1.13			*Check image (jpg)*
1.1.14			*Check for compliance with policy*
1.1.15			*Go to vault button*
1.1.16			*Lock folder/unlock folder*
1.1.17			*Lock found button*
1.1.18			*Submit folder to vault happy flow*
1.1.19			*Submit/unsubmit*
1.1.20			*Submit > reject*
1.1.21			*Submit > accept*
1.1.22			*Try to submit folder without metadata*
1.1.23			*Clean up temporary files*
1.1.24			*Upload files*
1.1.25			*Upload folders*
1.1.26			*File/folder Rename*
1.1.27			*File/folder Copy*
1.1.28			*File/folder move*

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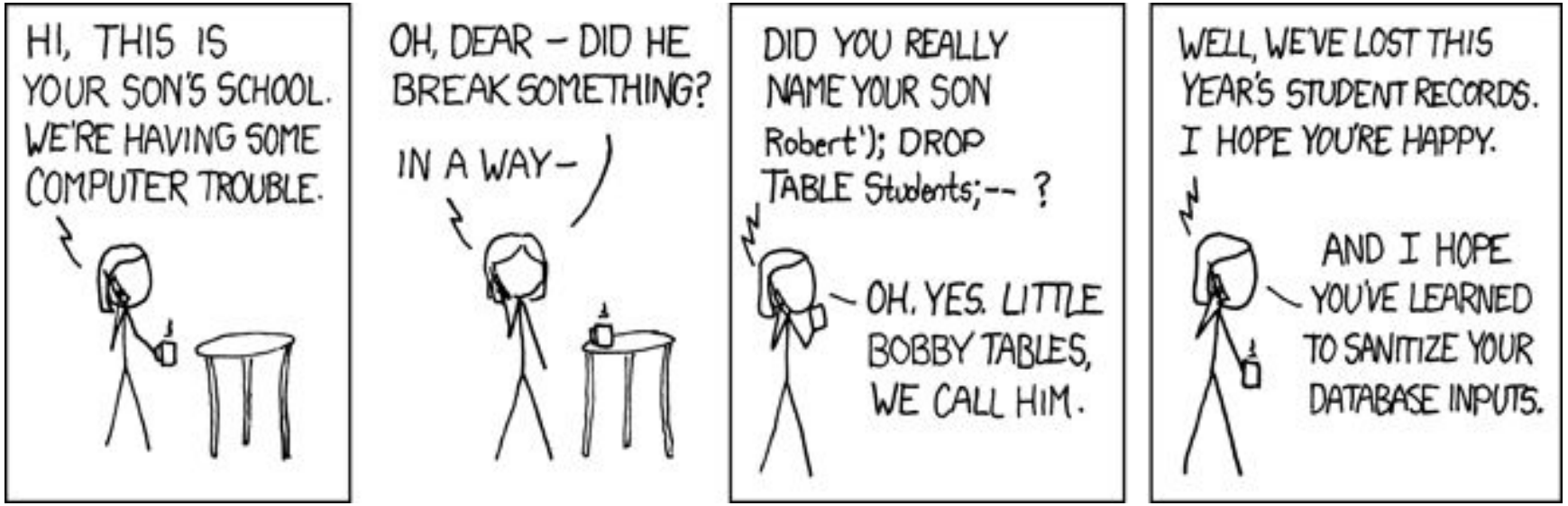
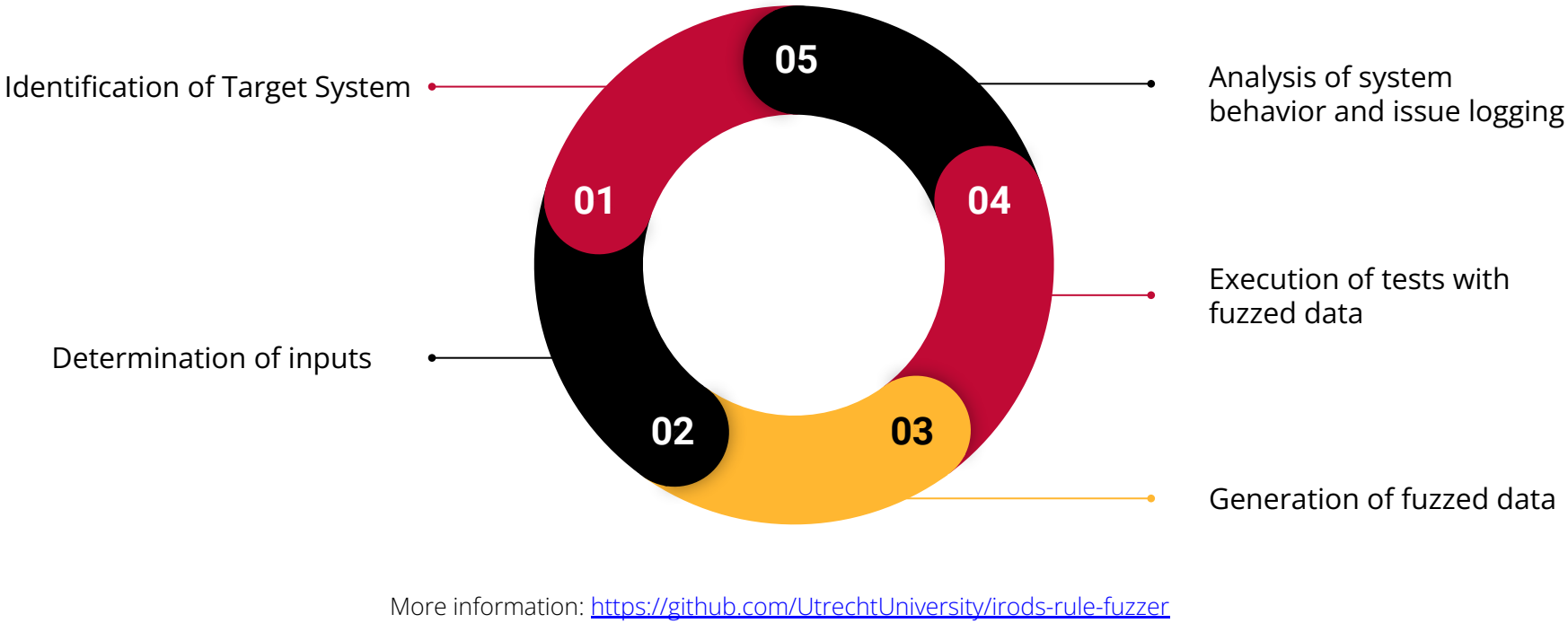
Fuzzing and scriptless testing: testing the unexpected



https://xkcd.com/327 (CC-BY-NC)

Fuzz testing



More information: https://github.com/UtrechtUniversity/irods-rule-fuzzer

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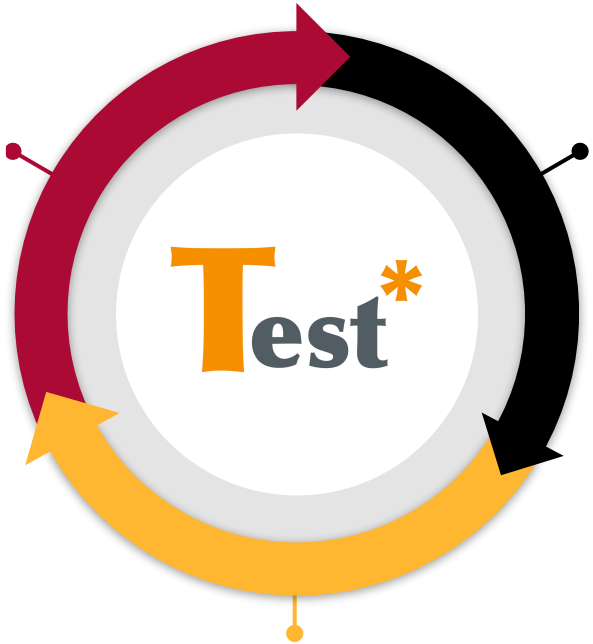
Scriptless GUI testing



Lessons learned

- Write rule preferably in Python, rather than in legacy rule language, to make it easier to test code automatically.
- Prioritize writing unit and low-level integration test over API and UI tests.
- Extract domain logic from the code that performs iRODS operations into separate functions or use dependency inversion principle to improve testability.

Future work

- Test coverage
  - Enhance the test coverage to include components that have limited or no automation.
- Reliable UI tests
  - Flaky in some systems, hence, cannot include them in Continuous Integration.
- Accessibility testing
  - Explore ways to incorporate this into our strategy.

$ iexit

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Sharing science,
shaping tomorrow