VeriWeb

Automatically Testing Dynamic Web Sites

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Presented by

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Outline

1. Motivation
2. Previous Works
3. What is VeriWeb?
4. VeriWeb Architecture
5. Exploring Algorithm
6. Automatically Filling Form
7. Conclusion

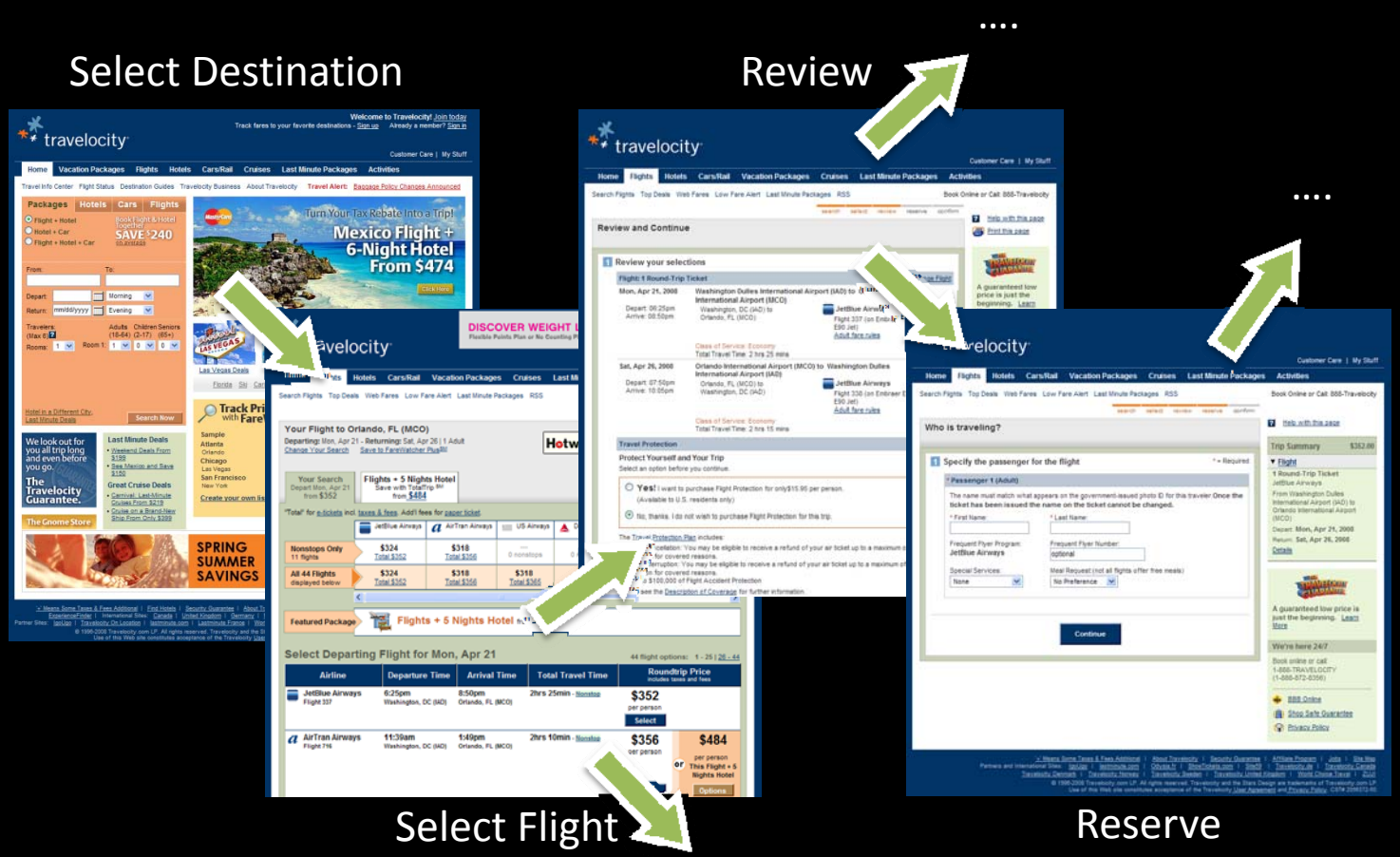
1.1 Motivation

Web pages became very complex.

- 154 Links
- 7 Forms
- >161 Actions?

1.1 Motivation

Web navigation became very complex.



1.1 Motivation

Many things can go wrong.

- Interaction between HTML pages
- Application on pages
  - Java Applet, JavaScript, etc.
- Application on server side
  - Dynamic pages, Database Interfaces, CGI
- Wide variety of server and browsers
- Rapidly Changing Technology

1.2 Challenges

- Web sites are complex applications.
- Web sites are updated often.
  - Hard to keep test suite updated
- Web sites are highly intertwined with the environment
  - e.g. browser, OS, etc.
  - Impossible to test stand-alone
- Users are inexperienced
  - Unexpected behavior

2. Previous Works

- Crawlers

  check links and pages for common errors
  - e.g. LinkCheck, SiteInspector, Weblint, Webtrends
  - broken links, unreachable pages, HTML errors, etc.
  - Go through links
- Capture-replay tools

  explore particular scenario in a dynamic web site
  - e.g. MacroBot, Silktest, etester, etc.
  - Record interactions that can be played back unattended.
  - Must manually create interactions.

3.1 What is VeriWeb?

Exercises multiple scenarios in a web application that are automatically discovered

VeriWeb = Crawlers + Capture-replay tools + more

exploits scenarios that include dynamic portions of sites

Unlike a capture-replay tool, no recording is needed

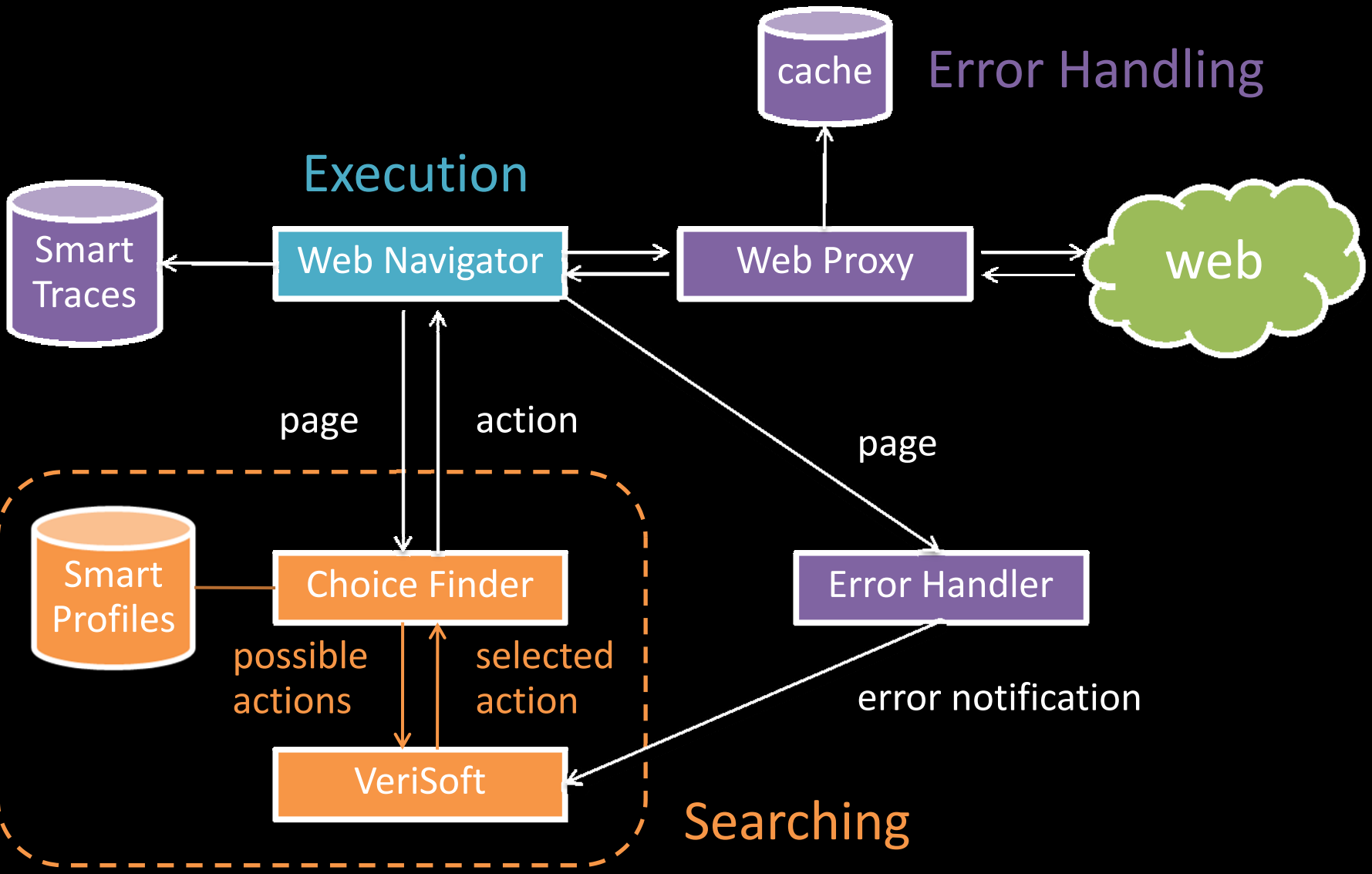
exhaustively searches the site for errors

Unlike a crawler, it can go through forms

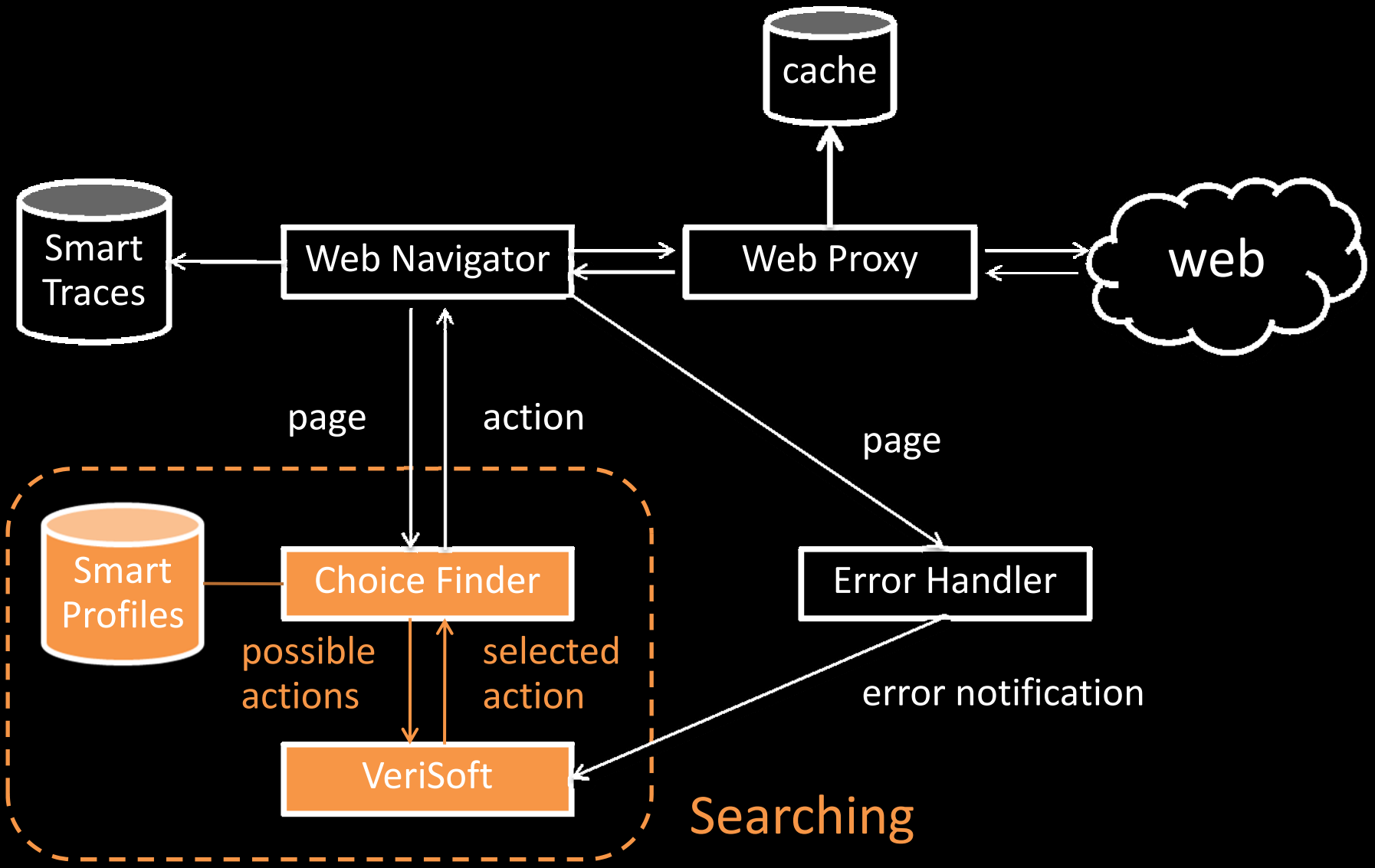
3.2 VeriWeb Features

- Functional testing
  - both static and dynamic elements of Web site
- Regression testing
- Standard correctness checks
  - e.g., broken links, malformed URLs
- Realistic testing
  - Tests are run through a Web browser and closely mimic users' actions

4. VeriWeb Architecture



4.1 Searching



4.1 Searching

Exercise all possible execution paths a user might follow in a web site

- 2 tasks
  1. Action Discovery – ChoiceFinder
  2. Exploration Control - VeriSoft

4.1.1 ChoiceFinder

Find the set of possible actions from that page

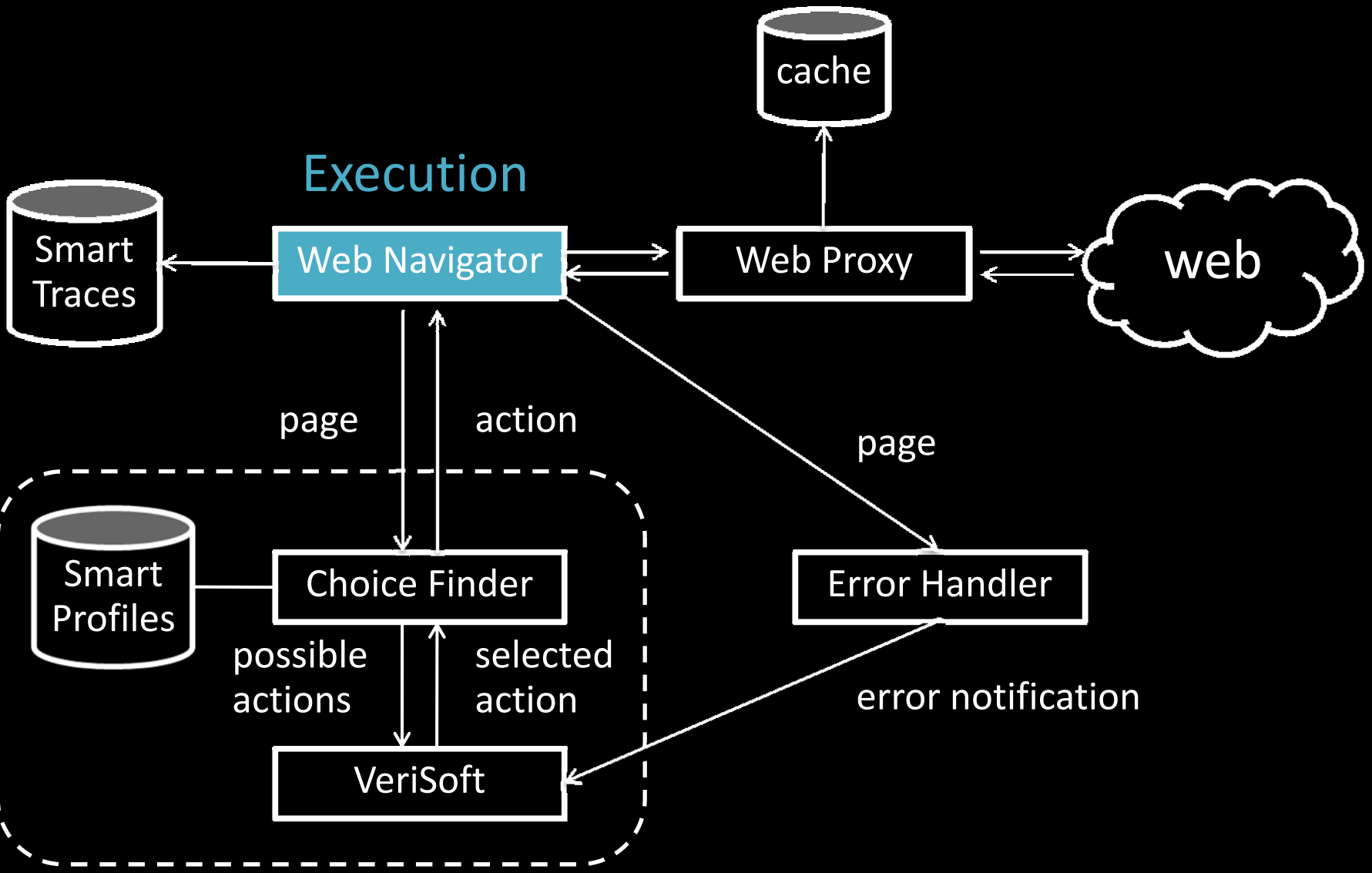
- Analyze HTML to find links, forms, buttons, etc.
- 2 challenges
  1. How to fill in forms?
  2. How to prune the search spaces?

4.1.2 Verisoft

Explore the state spaces

- Guarantee complete coverage of the state space up to some depth
- When error is detected, a scenario leading to error state is saved.
- Saved scenarios can be replayed.

4.2 Execution

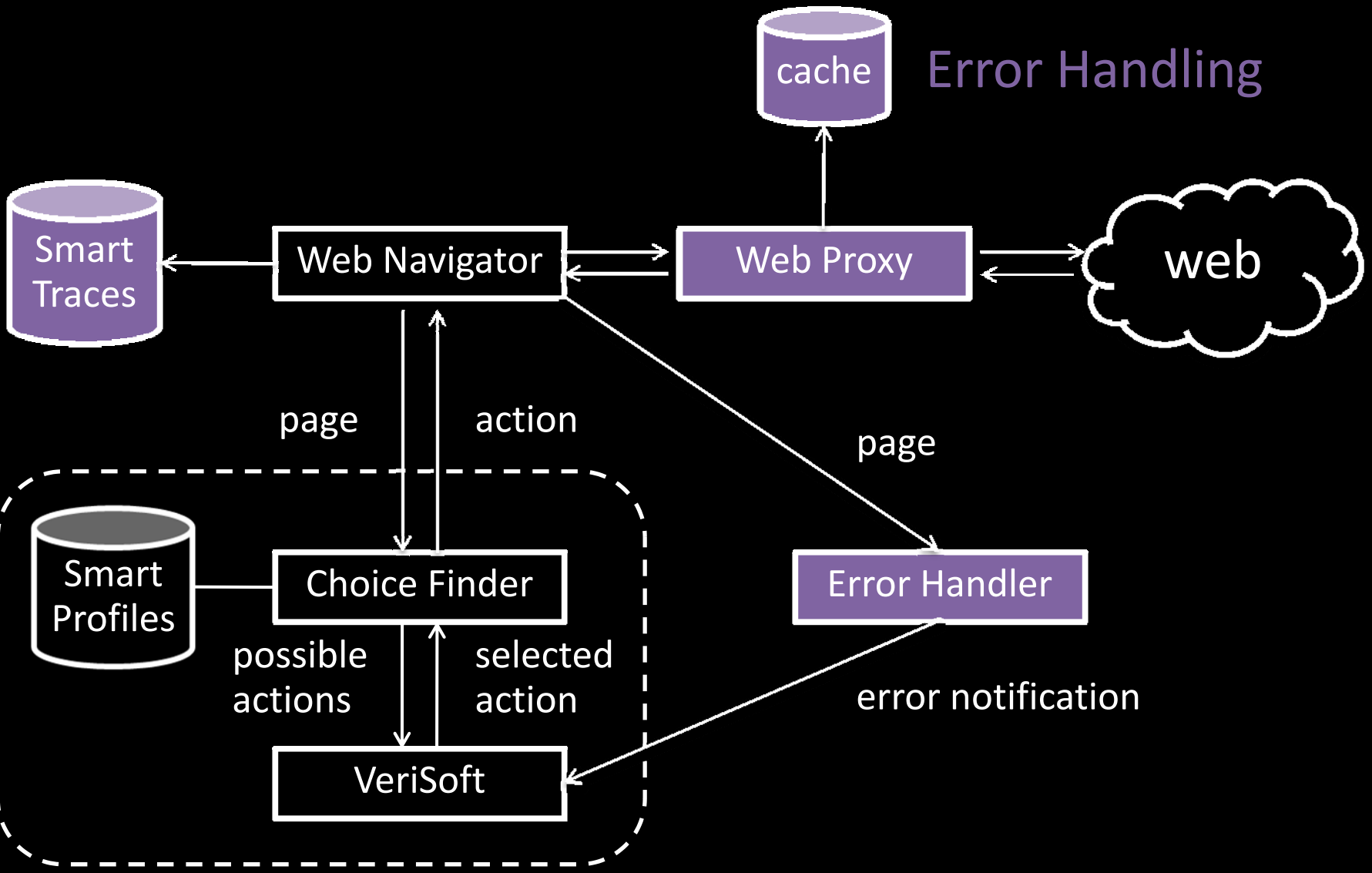


4.2.1 Web Navigator

Mimics what a user would do while interacting with Browser

- Execute actions for selected choice
  - Link: follow link
  - Form: fill and submit form
  - etc.

4.3 Error Handling



4.3.1 Type of Errors

2 Types of errors

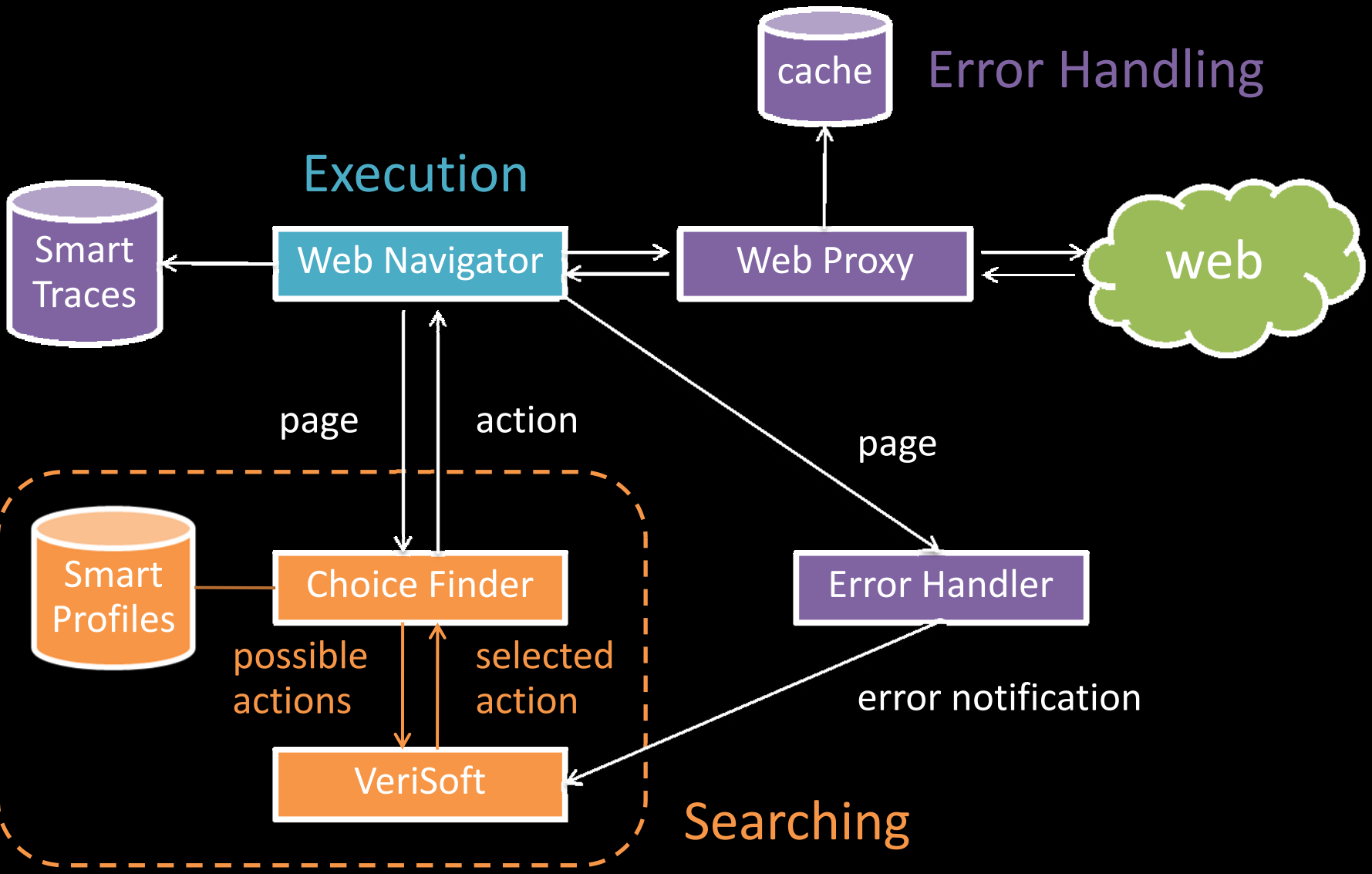
1. Navigation Errors
   - e.g. Failure in retrieving a page
   - Detected by Web Navigator
2. Page Errors
   - Your constraints
   - Detected by Error Handler
   - Various checking modules can be invoked from ErrorHandler

4.3.2 Error Logging

3 Different levels

1. VeriSoft
   - error traces
   - scenario (i.e. state-space path from the starting page)
2. Web Navigator
   - smart traces (smart bookmarks)
   - richer representation of scenario
   - can be replayed by WebVCR
   - robust, can be replayed even web page structural changes
3. Web Proxy
   - cached pages
   - all visited pages or just pages in scenarios that lead to errors
   - offline error detection

4. VeriWeb Architecture



5.1 Exploration Algorithm

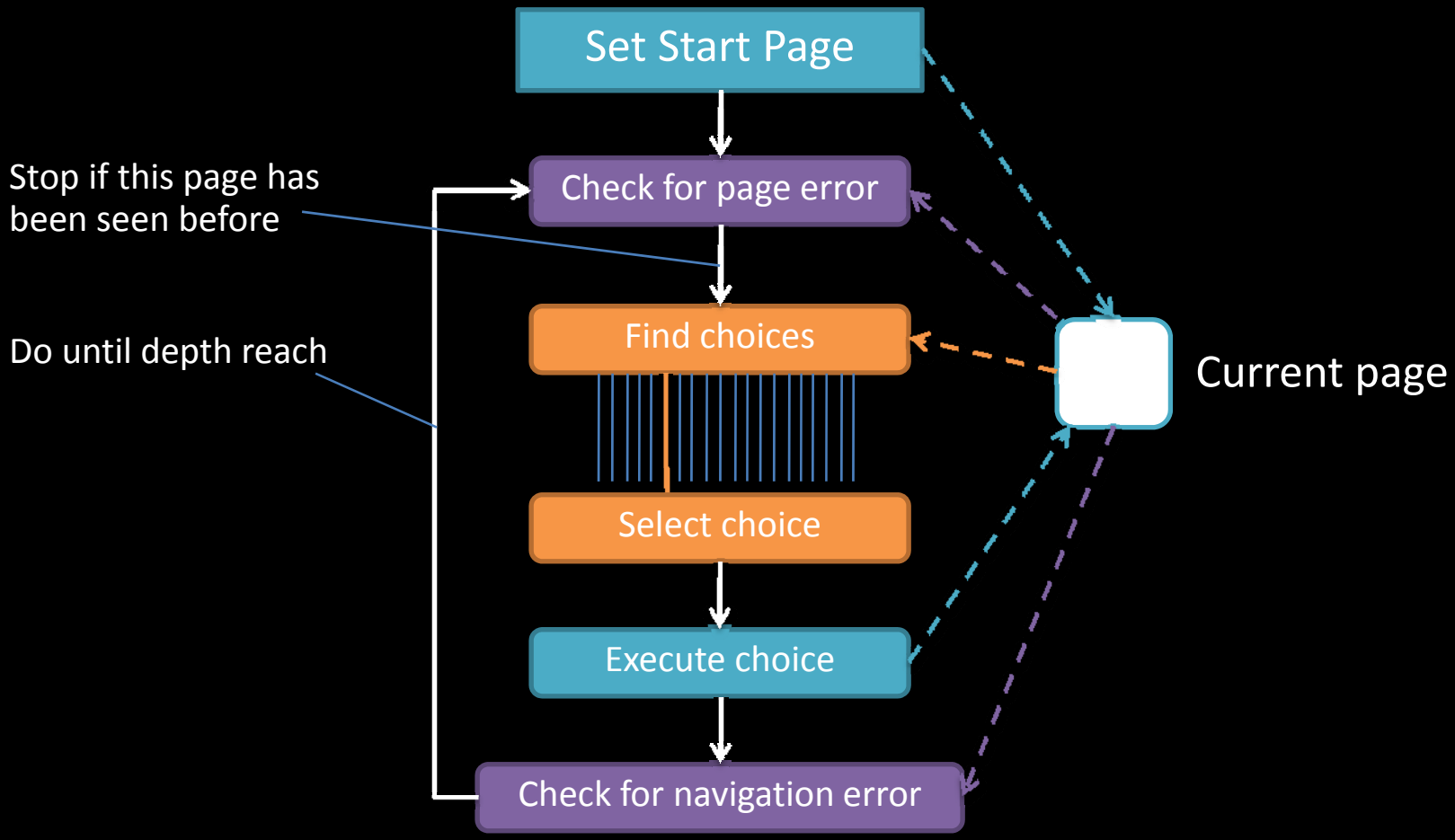
ExploreSite(startingURL,constraints) ⟸ *One run for one Path

```
currentPage = Navigator.load(startingURL);
while (true) {
    error = ErrorHandler(currentPage,constraints);
    if (error.status==true)
        VeriSoft.assert(currentPage,error);
    if (this page has been seen before)
        VeriSoft.abort(currentPage,``cycle'');
    else {
        choices = ChoiceFinder(currentPage);
        selectedChoice = VeriSoft.toss(choices);
        currentPage = Navigator.execute(selectedChoice,choices);
        if (currentPage.error != null)
            VeriSoft.assert(currentPage,error);
    }
  }
}
```

} Page Error

} Navigation Error

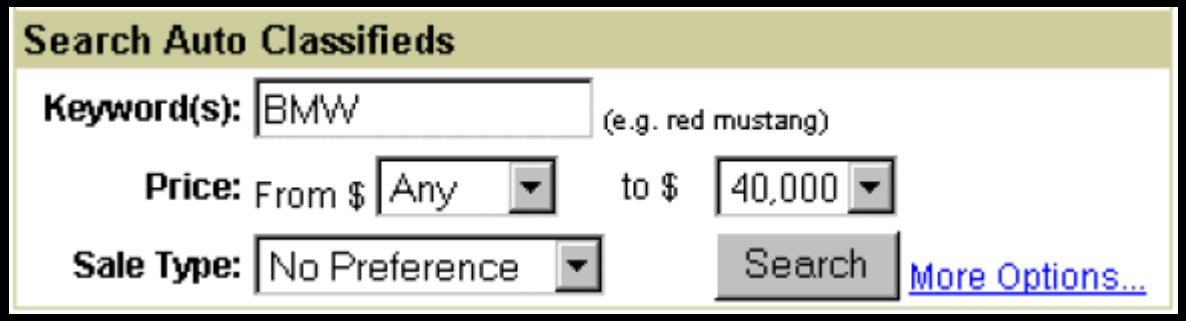
5.1 Exploration Algorithm



5.2 Controlling the search

- Filtering
  - ignore “unimportant” actions
  - e.g. links to PDF , Word documents, external sites, mailto links, etc.
- Cycle detection
  - State vs. stateless: page that look identical may represent different states.
  - e.g., the initial page of Amazon with and without cookies
  - Configurable cycle-detection

6. Automatically filling forms



How to fill this form automatically?

Tester needs to provide some information!

6.1 Smart Profiles

Information used to fill in forms

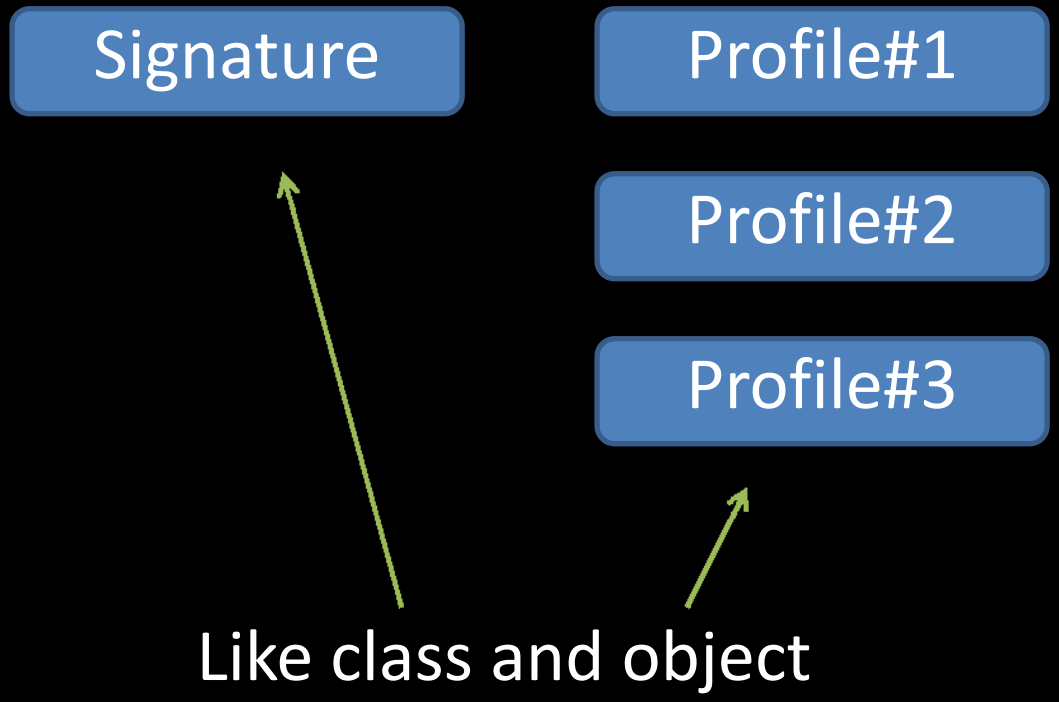
1. Data model level
   - Not form-by-form approach
   - e.g. car sale site
     - Specify a dataset that describe
       - Customer profiles
       - Car models or properties
2. As light-weight as possible
3. independent of the structure of the Web site
4. reusable as structure of Web site changes

6.1 Smart Profiles

XML Schema

```
<!DOCTYPE smartprofile [
<!ELEMENT smartprofile (signature* |
profile*)>
<!ELEMENT signature (name, field+)>
<!ELEMENT field (name,synonym)>
<!ATTLIST field key CDATA>
<!ELEMENT profile (name, signature,
fieldvalue+)>
<!ELEMENT fieldvalue (name,regexp)>
<!ELEMENT regexp (#PCDATA) >
<!ELEMENT name (#PCDATA)>
<!ELEMENT synonym (#PCDATA)>
]>
```

6.1 Smart Profiles



6.1 Smart Profiles

Signature

```
<signature>
    <name> CarType </name>
    <field key=true>
        <name> Make </name>
        <synonym> *carmake* </synonym>
    </field>
    <field key=false>
        <name> Model </name>
    </field>
    <field key=false>
        <name> Year </name>
    </field>
    <field key=false>
        <name> Interior </name>
    </field>
    <field key=false>
        <name> Type </name>
    </fiield>
</signature>
```

Profile

```
<profile>
    <name> Rolls </name>
    <signature> CarType </signature>
    <fieldvalue>
        <name> Make </name>
        <regexp> Rolls-Royce </regexp>
    </fieldvalue>
    <fieldvalue>
        <name> Model </name>
        <regexp> *Corniche* </regexp>
    </fieldvalue>
    <fieldvalue>
        <name> Year </name>
        <regexp> 2002 </regexp>
    </fieldvalue>
    <fieldvalue>
        <name> Type</name>
        <regexp> Convertible* </regexp>
    </fieldvalue>
</profile>
```

6.2 Filling out forms

1. Form Analysis
   - Generate field name for every field
   - Output = Form schema
2. Form Matching
   - Match form schema to smart profiles
   - Output = Candidate profiles
3. Form Completion
   - Match value in candidate profile with field

6.3 More

- Creating profiles is an iterative process
  - System prompts tester for missing information
    - Unknown field

7. Conclusion

As web sites became more complex and change rapidly, we need some automatic and robust way to test them

Contributions of this paper are

- Infrastructure to automate testing of dynamic Web sites
- Search algorithms for automatically exploring all the paths a user might follow in a Web application
- SmartProfiles as a high-level specification of test data to populate forms
- Automatically filling forms strategy.

References

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VeriWeb: Presentation Slides

by Juliana Freire

www.cs.utah.edu/~juliana/pub/**veriweb**-www2002-talk.pdf