Manipulating Web Application Interfaces – a New Approach to Input Validation Testing

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Abstract

- This talk will present two arguments against performing input validation testing at the HTTP request level (using proxies) and suggest a new approach: performing input validation testing directly in the user interface
- It will also introduce Groundspeed, an open-source add-on for Mozilla Firefox that allows you to modify, on the fly, the forms and form fields in the page loaded in the browser
- Groundspeed is available at:

http://groundspeed.wobot.org

1. Introduction

An Answer with no Question

- In the “Hitchhikers Guide to the Galaxy”, some super intelligent beings build a super computer to answer “the ultimate question of life the universe and everything”
- After seven and a half million years, the computer gives its answer: “42”
- Puzzled and disappointed, they ask the computer what the question was
- But the computer is not powerful enough to respond that

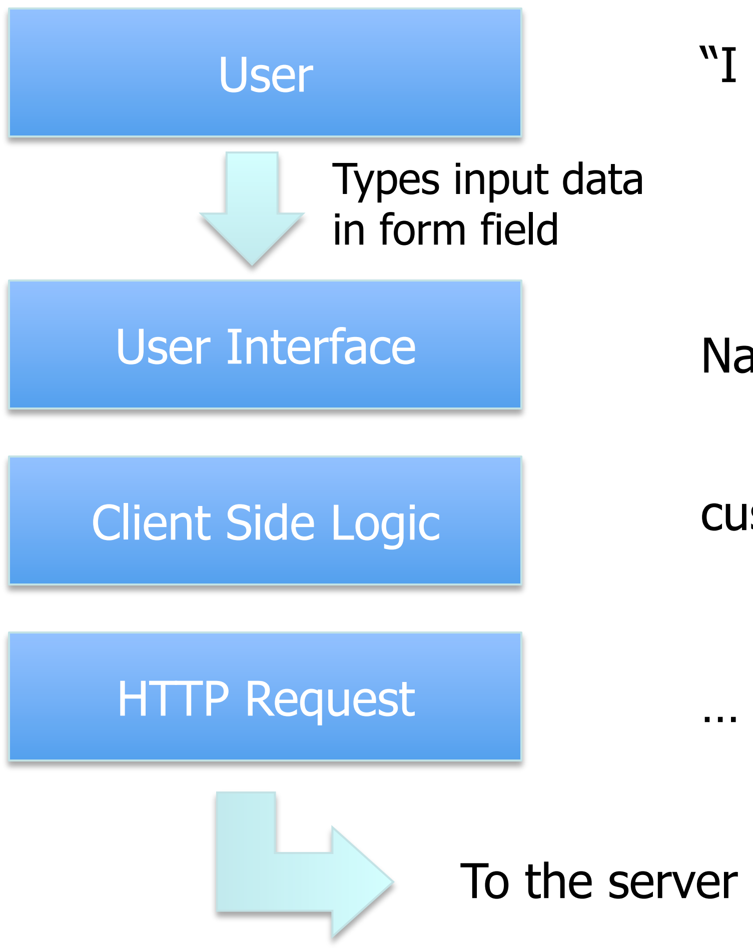
Information Needs Context to be Useful

- In the book, the joke is in the fact that the answer “42” makes no sense without the question
- In order to understand the information in the answer, we need to know the question because the question provides context to the answer
- This is an usual problem when people try to understand a piece data, and it affects us more than we first imagine
- Let’s consider a normal example of interaction with a web application

Example: User Submits a Form

- User loads a web page with a form
- User types a value in a form field and submits
- Client side logic validation is executed
- Browser creates an HTTP with the input data in a parameter in the GET or POST request
- Browser sends the request to the server
- Server reads the HTTP request and handles data to application
- Application processes the data and responds

The Life Cycle of Input Data



"I am John Smith"

Name: "John Smith"

custname.value = "John Smith";

… &custname="John Smith"& …

Interface Labels Provide Context to Humans

- The form label next to the textbox field (for example “Name: ”) is the question being asked to the user
- The value typed inside the textbox is the response to that question
- As data travels down through the layers, the answer is separated from the question
- When considered from the perspective of the HTTP request, the data is no longer in its original context (the labels provided context)

Argument 1: The Mapping Problem

- Usually this is not a big problem because we can use the HTTP parameter names as “pseudo” labels
- But parameter names do not need to match the labels, they are meant for server-side code not for humans so it could be any arbitrary value
- In order to compensate for the lack of context, we need to solve this “mapping problem” (mapping label to parameter name), and this makes the test a little more difficult

Filling the Gaps

- When performing input validation with a proxy, the tester has to solve the mapping problem
- We probably figured out some tricks to help with this process:
  - Typing input data that explain what each field is
  - Using the source code of the page to map parameters and label names
- But these tricks only work well for simple web applications

A Problem That Will Get Harder to Solve

- The problem is that in order for the tricks to work, we have to assume two conditions:
  - That one form will translate to one HTTP request, form fields matching HTTP parameters one to one
  - That submitting one form will cause one HTTP request to be sent, at the time of the click
- But those conditions are not true all the time:
  - As client-side logic gets more complex, data can be consolidated, pre-processed, encoded on the client
  - AJAX (no synchronicity of the user actions and HTTP)
- And things will only get more complicated

Argument 2: Working at Two Places

- Another problem of working at the HTTP level is that it forces the tester to switch between two worlds (user interface and HTTP)
- Ideally, manipulation of the input data should happen in the user interface, but testers have to work at the HTTP level to bypass browser limitations
- This switching has a cost associated to it
- Let’s consider the task of performing one input validation test on one form field

Task Breakdown

- In the browser, fill in the field to be tested
- Submit the form
- Select the proxy window
- Scan through the HTTP request to find where the request parameters are located
- Scan through the parameters to find the one that needs to be modified
- Insert the attack string
- Send the request to the server and select the browser window to see the result

Hard Problems

- Even considering a simple task (1 test on 1 field) there are a lot of steps to complete
- Some steps are distracting
- But some steps create problems
  - Scanning through text requires "parsing"
  - Find the right parameter requires "mapping"
- There are even more tasks if some fields are encoded or if there is form validation
- There are a lot of secondary steps that do not contribute to the main goal: test input validation

Test Friction

- Consider now all the tests we have to perform on all the parameters of the web application
- There will be a lot of secondary tasks, this is not an optimal process
- The secondary steps are like energy that is lost in things that do not contribute to the goal
  - We could think about them as “test friction”
- This is a user experience problem not a usability problem

2. A New Approach

Why do We Work at the HTTP Level?

- The browser is a tool designed for normal users, so it does not provide all the functionality that web app testers need
- A few years ago, to modify the browser was too hard (closed source) and to create a browser from scratch was too much work
- Working outside the browser, at the HTTP level was the best alternative
  - The mapping problem was easy to solve in the old web
  - The user experience problem was a reasonable price to pay

Now Things are Different

- Because of the richer web apps, mapping parameters to interface labels is getting harder
- The mapping problem might still be tolerable but will only get worse as apps get more complex
- Working at the HTTP level forces the tester has to switch between two worlds: user interface (browser) and HTTP (proxy) adding “friction” to the process
- Another important change: browsers are now easier to modify (open source and add-on systems)

Suggesting a New Approach

- We should reconsider the strategy for input validation tests
  - It makes sense to keep some tests at the HTTP level
  - But most could benefit from work at the interface level
- It is easier and more efficient to manipulate data from the user interface instead of the HTTP level
  - That would eliminate the mapping problem
  - Data makes more sense at the user interface level (bigger chance of business logic exploitation)
  - Improves user experience for tester (reduces friction)

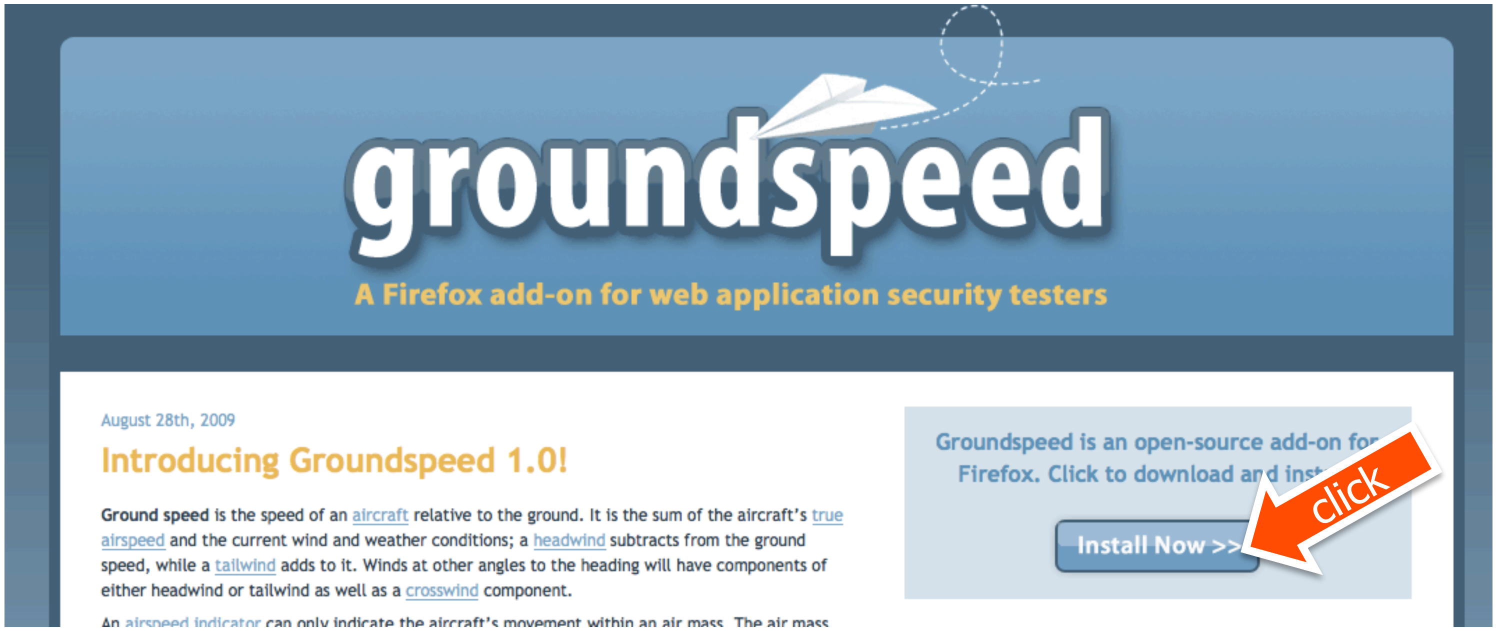
3. Introducing Groundspeed

Introducing Groundspeed

- Groundspeed is an open-source add-on for Mozilla Firefox (http://groundspeed.wobot.org)
- Groundspeed allows a tester to perform input validation testing from the web app user interface
- Groundspeed modify the browser in order to adapt it to the needs of web app testers:
  - Manipulate the application’s user interface
  - Remove client side validation and other limitations

Download and Install Groundspeed

- Visit http://groundspeed.wobot.org



August 28th, 2009

Introducing Groundspeed 1.0!

Ground speed is the speed of an aircraft relative to the ground. It is the sum of the aircraft's true airspeed and the current wind and weather conditions; a headwind subtracts from the ground speed, while a tailwind adds to it. Winds at other angles to the heading will have components of either headwind or tailwind as well as a crosswind component.

An airspeed indicator can only indicate the aircraft's movement within an air mass. The air mass

Groundspeed is an open-source add-on for Firefox. Click to download and ins

- The following screenshots were taken on demo forms available at groundspeed.wobot.org/demo

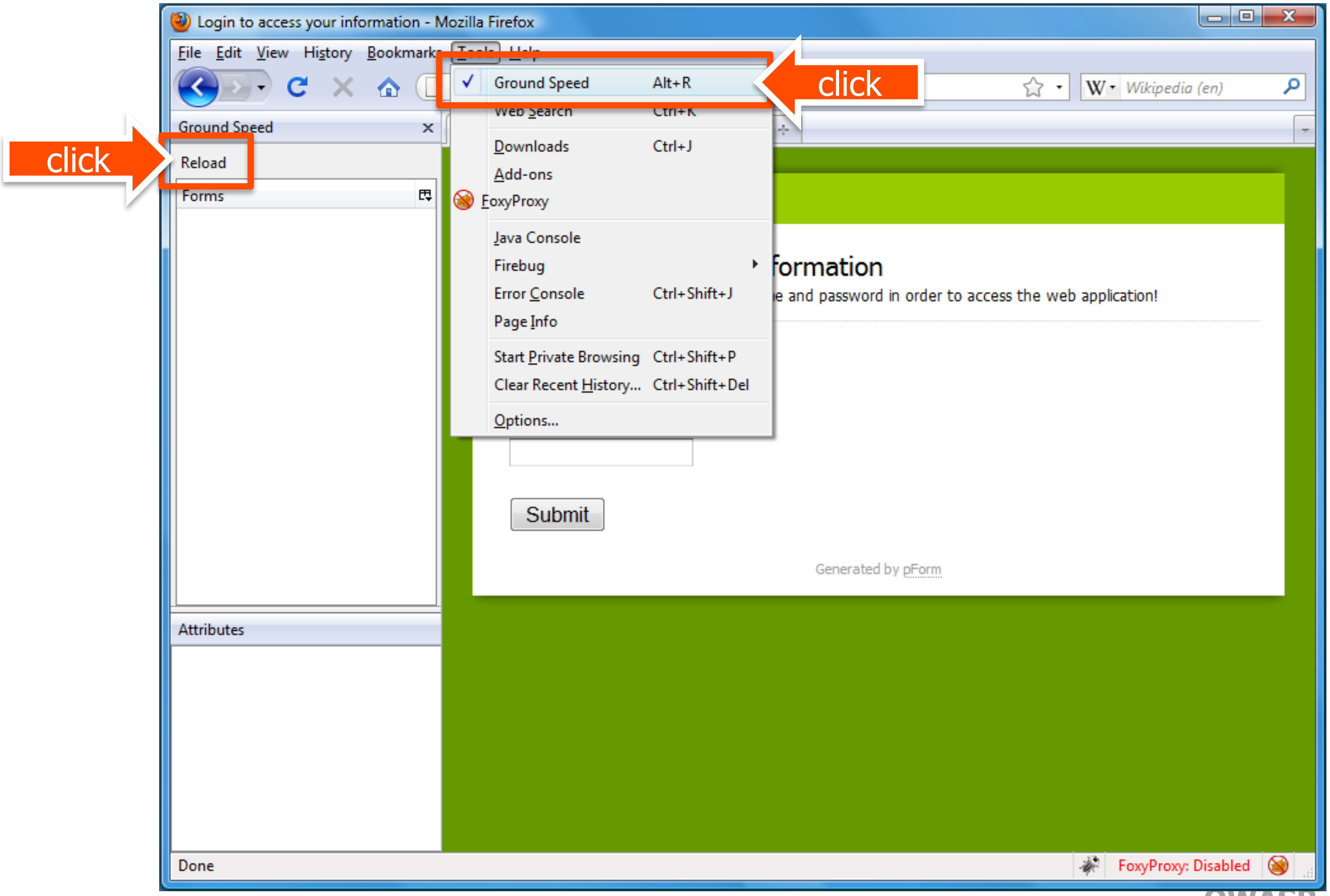
How to Start Groundspeed

- In order to start working with groundspeed, open the sidebar using:

  Tools – Groundspeed

- Once groundspeed is open, load the form information from the current page using the “Reload” button

How to Start Groundspeed


Login to access your information - Mozilla Firefox
File Edit View History Bookmarks Tools Help
Ground Speed Alt+R
Web Search Ctrl+K
Downloads Ctrl+J
Add-ons
FoxyProxy
Java Console
Firebug
Error Console Ctrl+Shift+J
Page Info
Start Private Browsing Ctrl+Shift+P
Clear Recent History... Ctrl+Shift+Del
Options...
click
Ground Speed
Reload
Forms
Attributes
click
formation
e and password in order to access the web application!
Submit
Generated by pForm
Done
FoxyProxy: Disabled
Wikipedia (en)

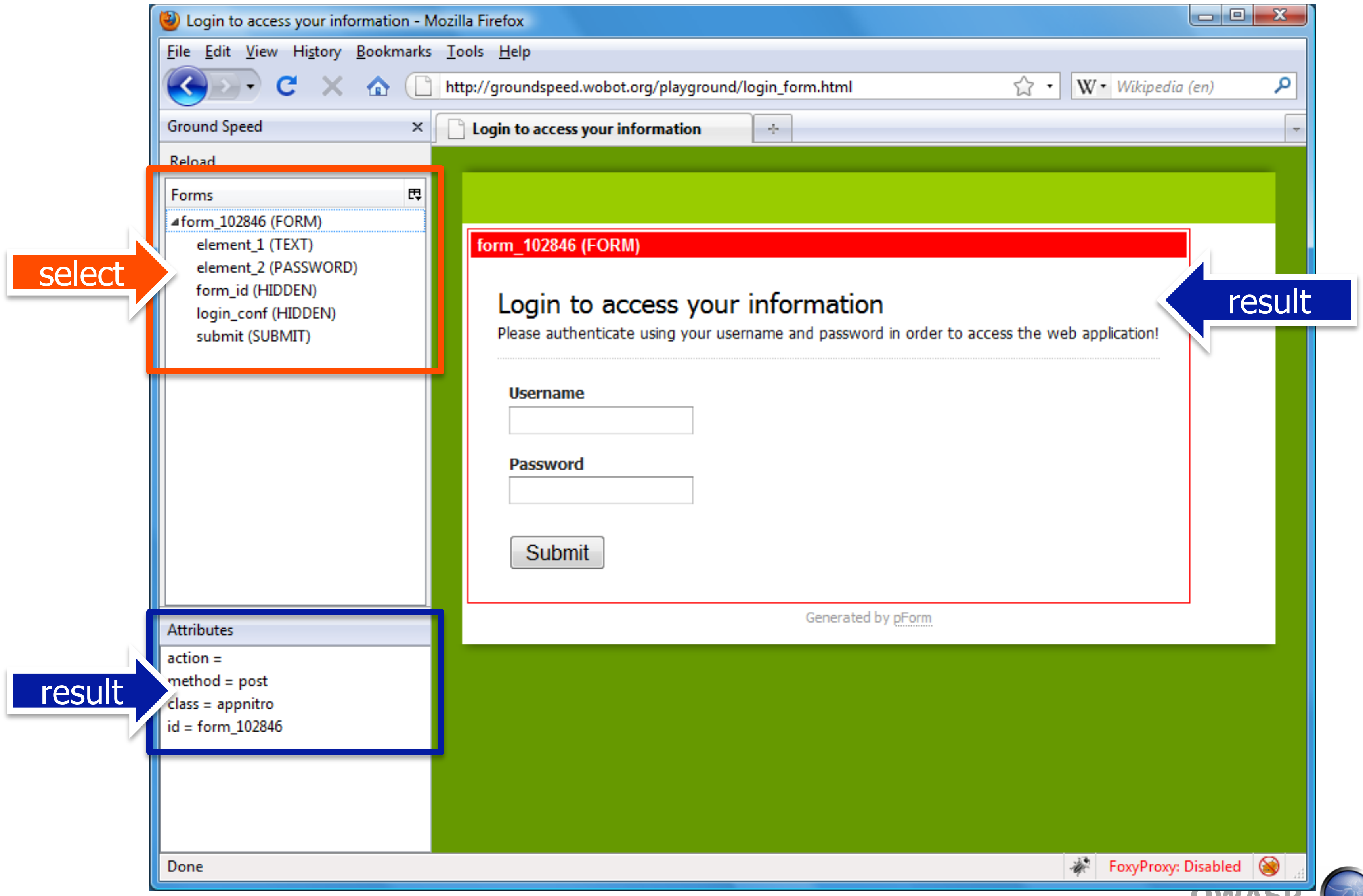
OWASP

Select a Form or a Form Field

- The groundspeed sidebar has two sections
  - The top section lists the forms and fields in the page
  - The bottom section lists the HTML attributes of the selected form or form element

- Select one form or field in the list in the top section, and groundspeed will highlight that element in the page and display its attributes in the lower part of the sidebar

View the Selected Form and its Attributes


Login to access your information - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://groundspeed.wobot.org/playground/login_form.html
Wikipedia (en)
Ground Speed
Login to access your information
Reload
Forms
select
result
result
Done
FoxyProxy: Disabled

form_102846 (FORM)
element_1 (TEXT)
element_2 (PASSWORD)
form_id (HIDDEN)
login_conf (HIDDEN)
submit (SUBMIT)

Attributes
action =
method = post
class = appnitro
id = form_102846

form_102846 (FORM)

Login to access your information
Please authenticate using your username and password in order to access the web application!

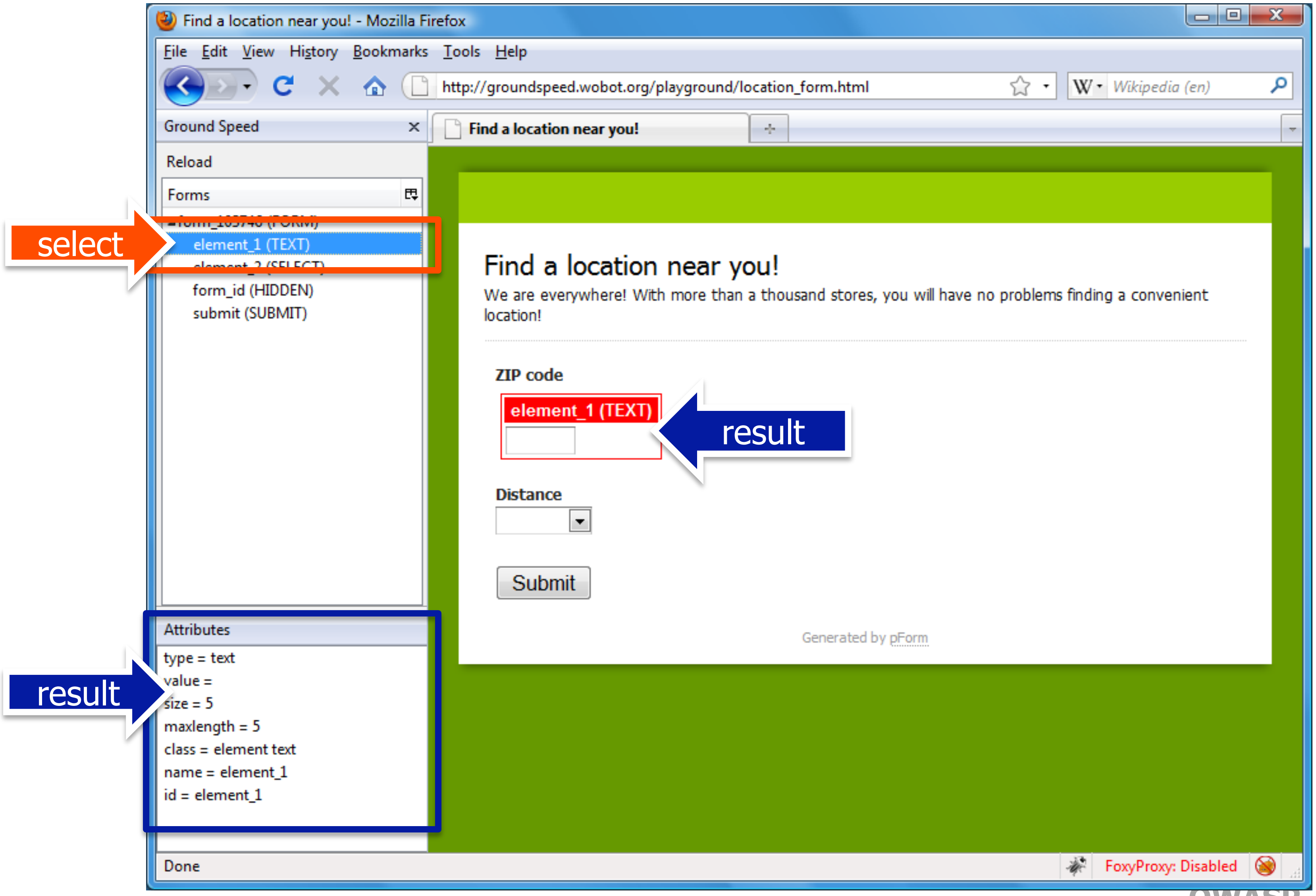
Username

Password

Submit

Generated by pForm

View the Selected Field and its Attributes



Find a location near you!

We are everywhere! With more than a thousand stores, you will have no problems finding a convenient location!

Attributes

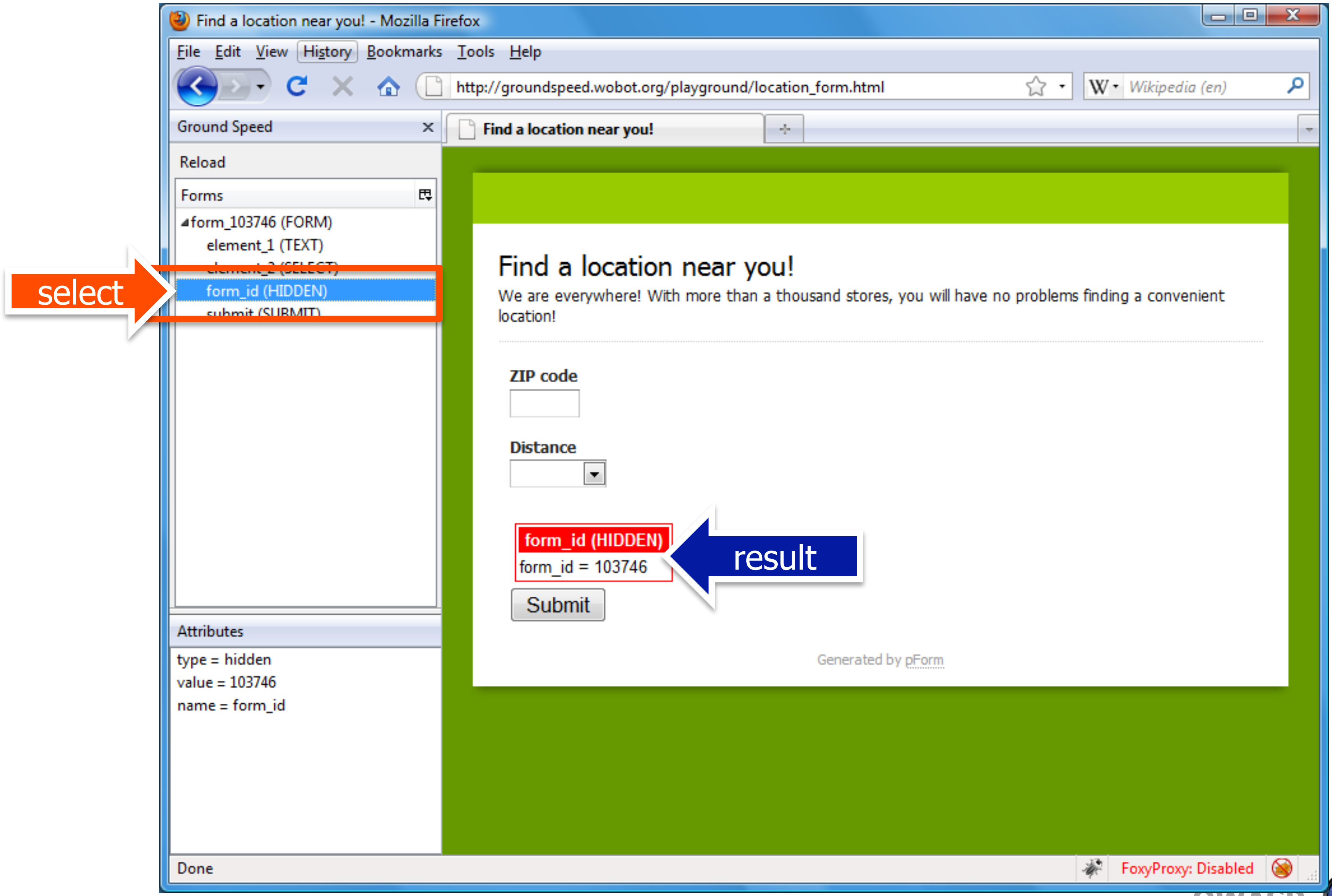
type = text
value =
size = 5
maxlength = 5
class = element text
name = element_1
id = element_1

OWASP

View Hidden Fields

- If you select a hidden field from the list of forms and form fields, the hidden field becomes visible in the page

View Hidden Fields



Find a location near you! - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://groundspeed.wobot.org/playground/location_form.html

Ground Speed

Reload

Forms

form_103746 (FORM)
element_1 (TEXT)
element_2 (SELECT)
form_id (HIDDEN)
submit (SUBMIT)

Attributes

type = hidden
value = 103746
name = form_id

Find a location near you!

We are everywhere! With more than a thousand stores, you will have no problems finding a convenient location!

ZIP code

Distance

form_id (HIDDEN)
form_id = 103746

Submit

Generated by pForm

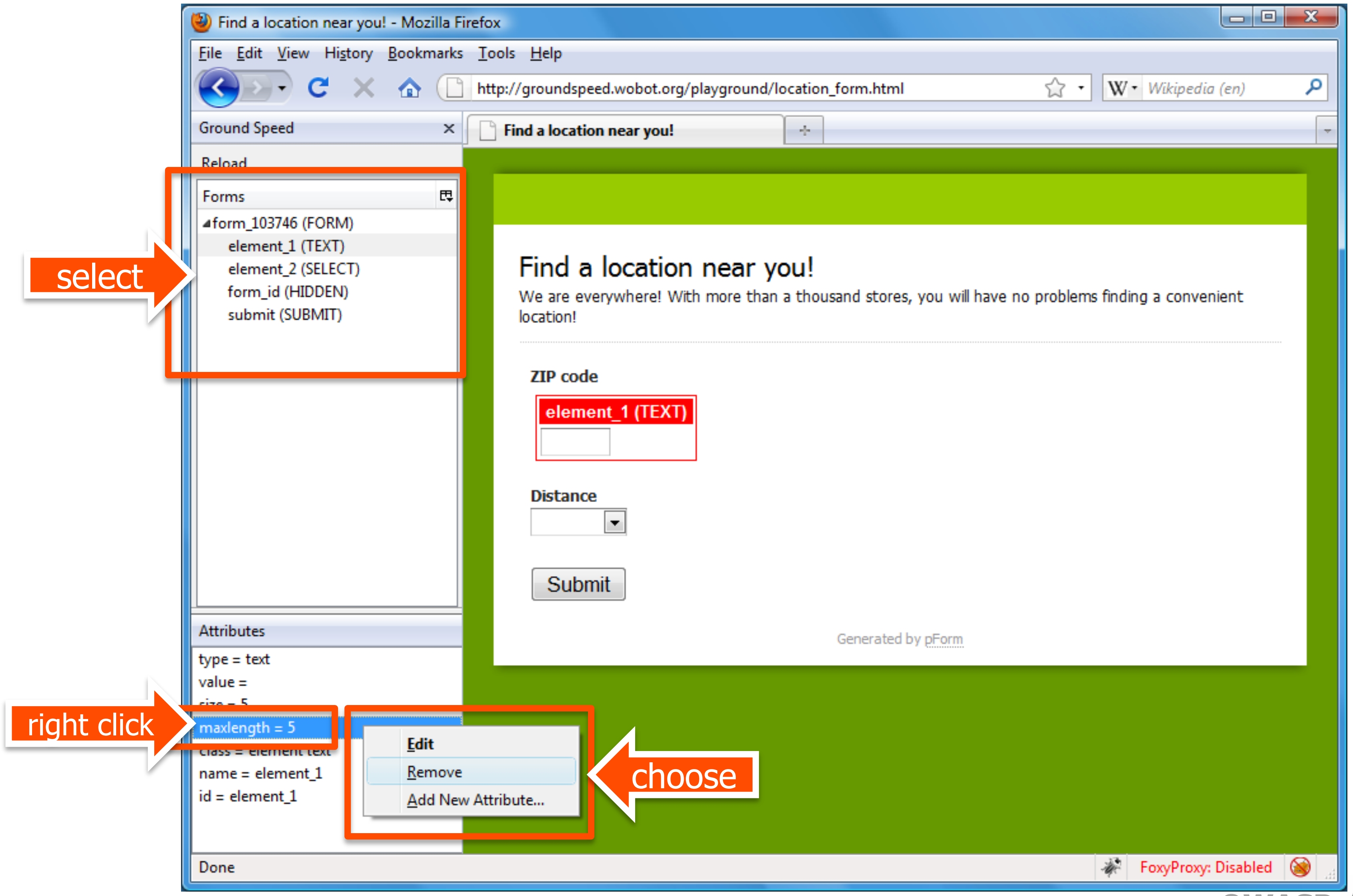
Done

FoxyProxy: Disabled

Edit Attributes of Forms and Fields

- Groundspeed lets you modify, add and remove HTML attributes on the form and the form fields
- In the upper list, select the form or the form field that you want to change the attributes
- Right-click on the attribute in the lower list and select from the context menu
- A double-click on a selected attribute will edit the current value

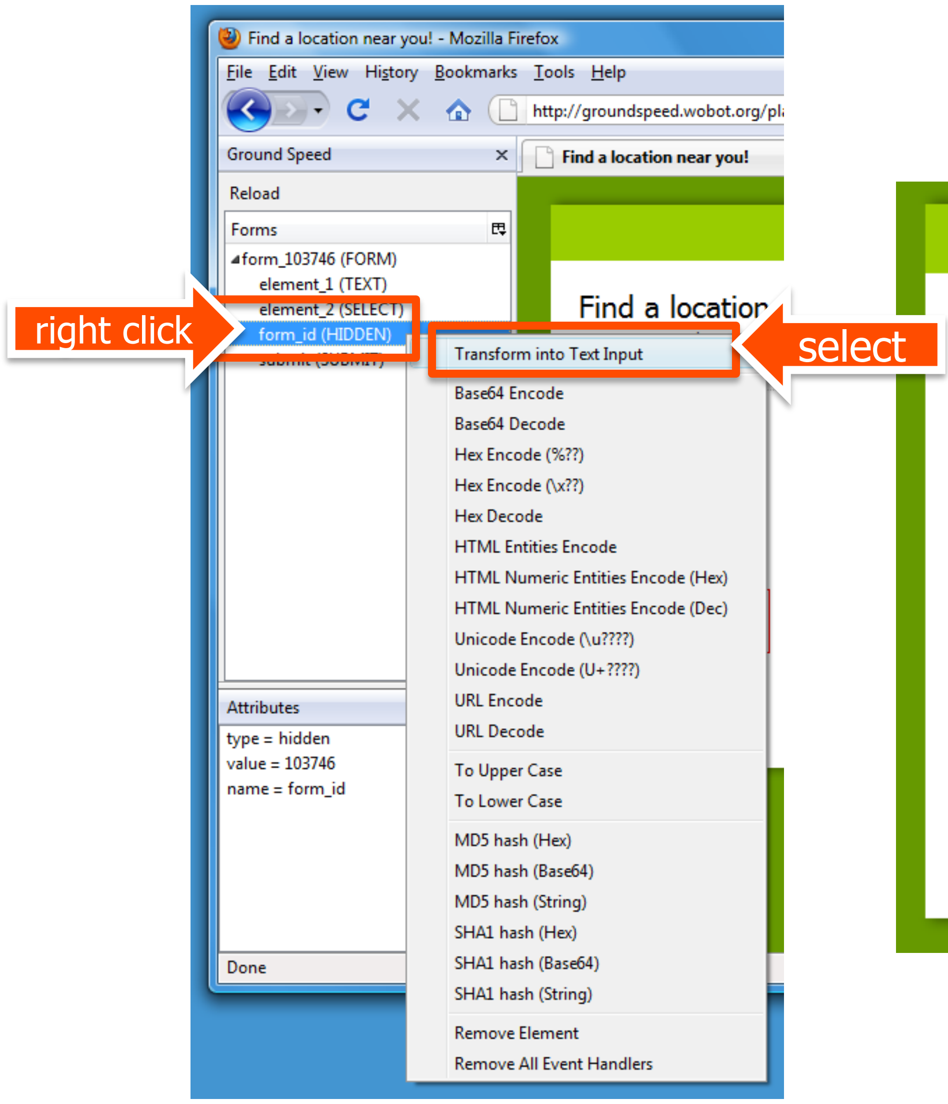
Edit Attributes of Forms and Fields



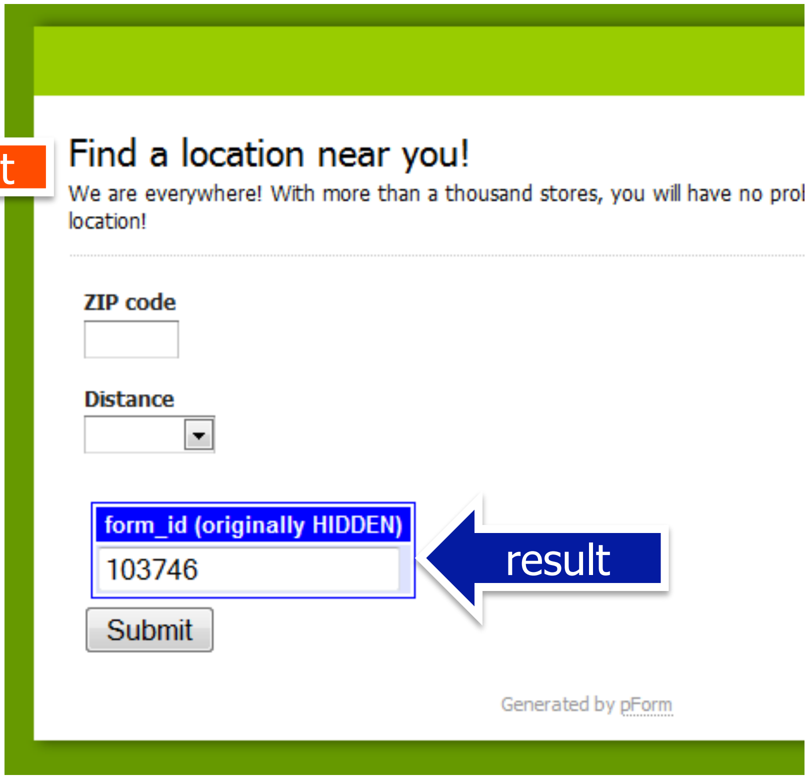
Change the Type of any Form Field

- Groundspeed allows you to change any form field into a textbox with 2 clicks:
  - Right-click on the element you want to convert
  - Choose the “Transform into Text Input”
- After the change, you can edit the contents of the field directly in the page
- Groundspeed will create a label that matches the field “name” or “id” attribute
- For “Select” elements, groundspeed adds a “cheat-sheet” with the options that existed in the drop down list

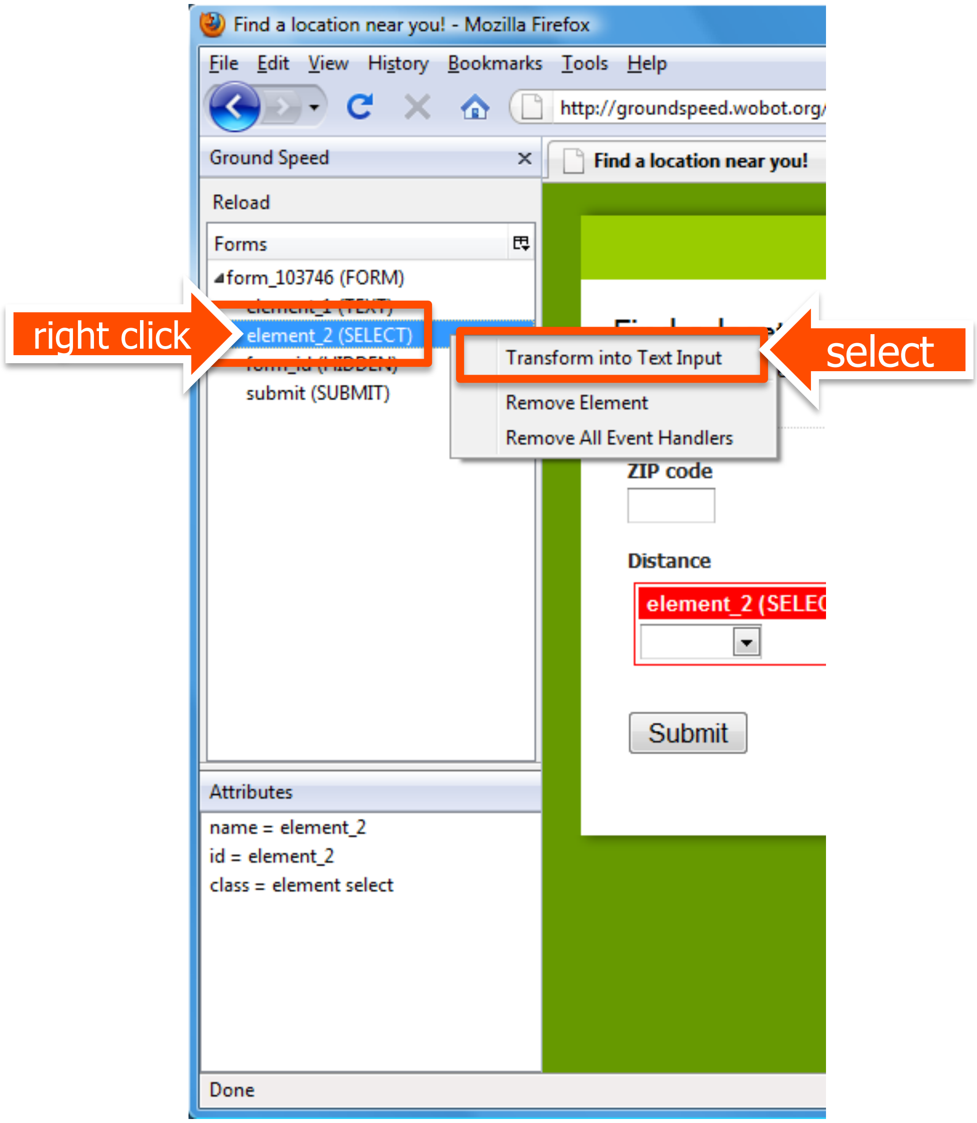
Change the Type of any Form Field

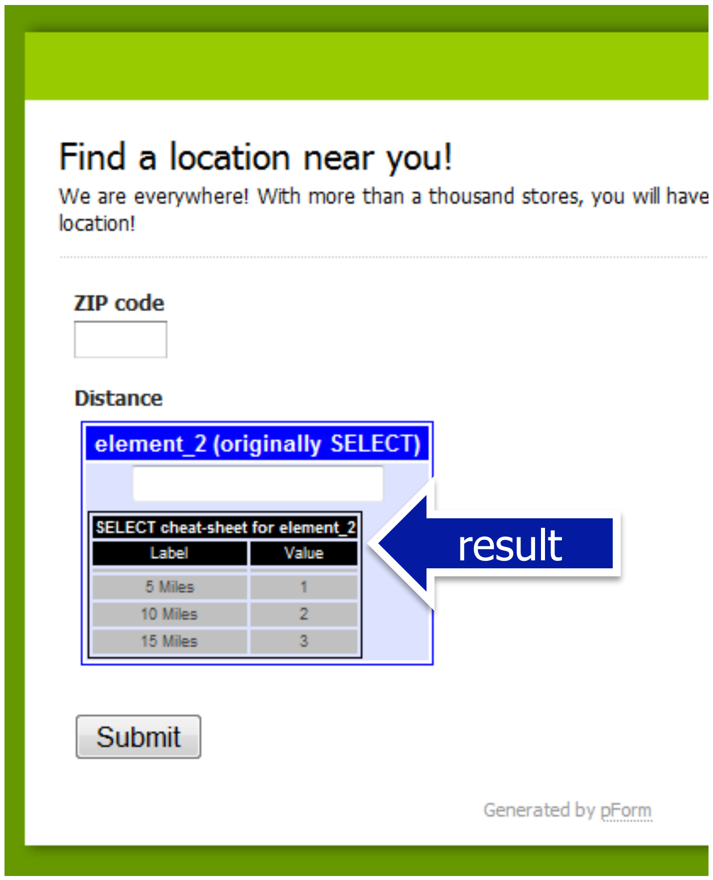


type = hidden
value = 103746
name = form_id


result
Find a location near you!
We are everywhere! With more than a thousand stores, you will have no prol location!
ZIP code
Distance
form_id (originally HIDDEN)
103746
Submit
Generated by pForm

Changing a Select into textbox




Find a location near you!
We are everywhere! With more than a thousand stores, you will have location!
ZIP code
Distance
element_2 (originally SELECT)
result
Submit
Generated by pForm

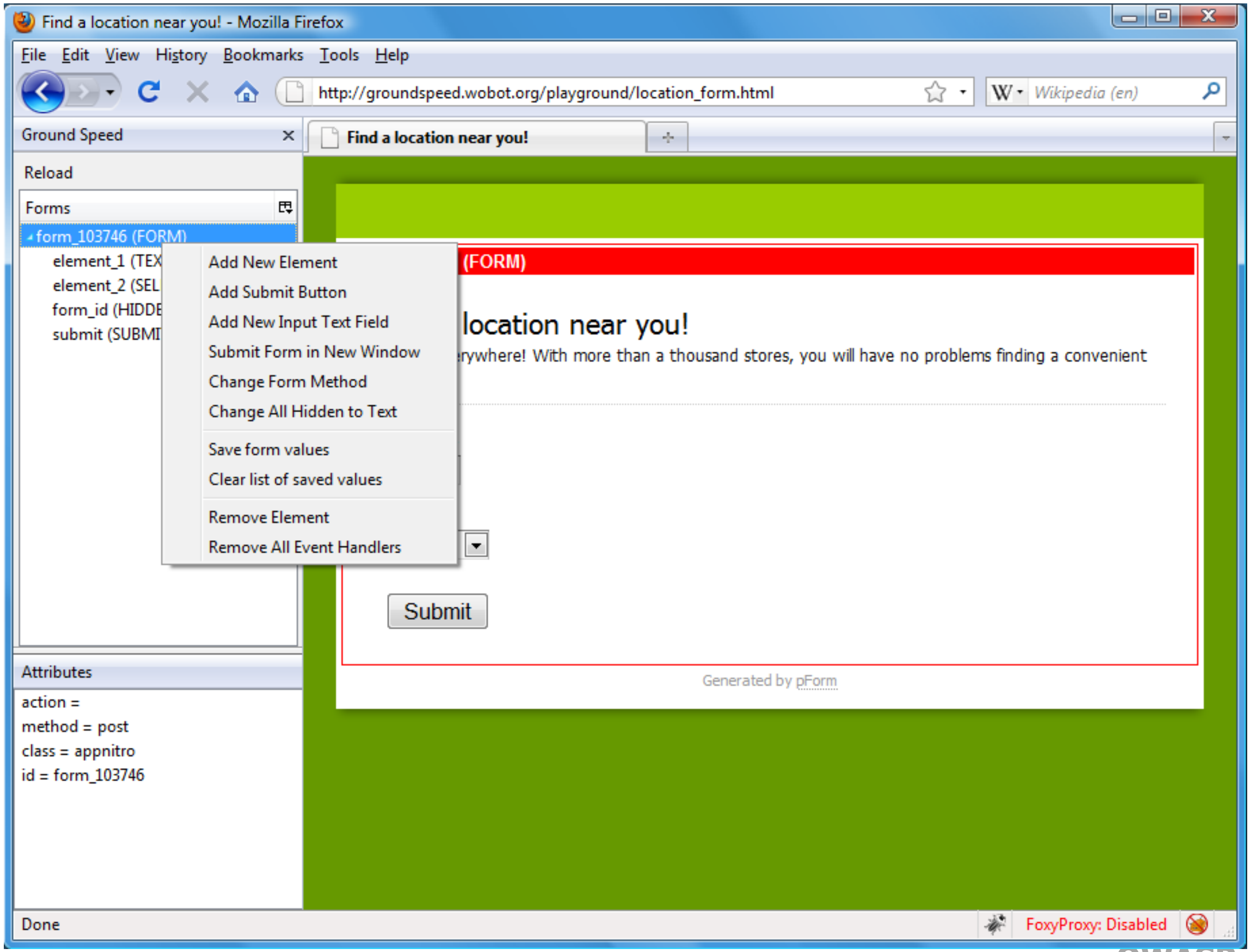
SELECT cheat-sheet for element_2

Label	Value
5 Miles	1
10 Miles	2
15 Miles	3

Other Manipulations in Forms

- Other useful things you can do in a form:
  - Add a new form fields
  - Make the form submit in a new window (so you don't have to manipulate the interface all over again)
  - Change all hidden fields into textboxes
  - Save all form field values (and clear the saved values)
  - Remove all JavaScript event handlers (in the form and its fields)
- These are all options available when right clicking the form in the list

Other Manipulations in Forms


Find a location near you! - Mozilla Firefox
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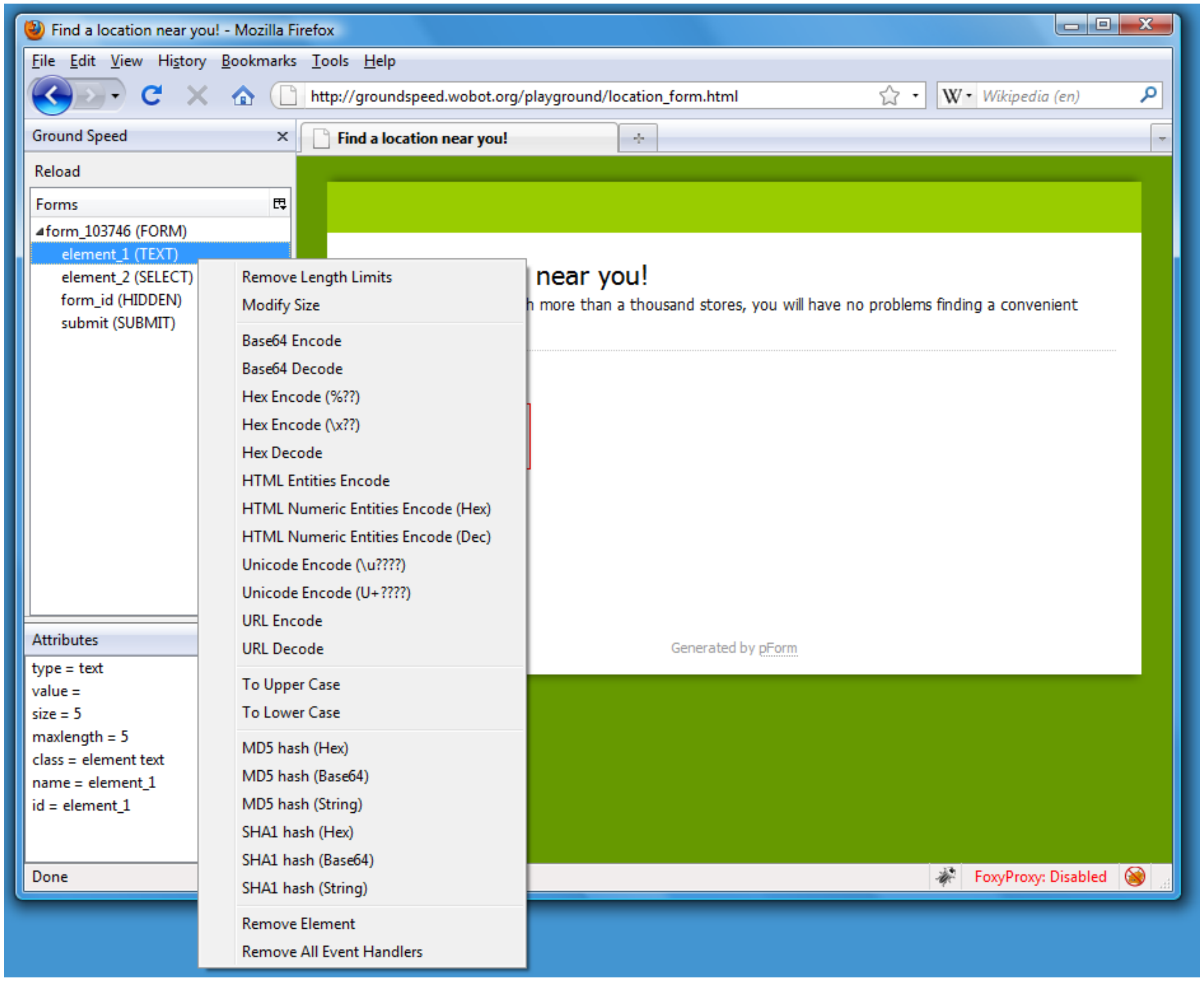
http://groundspeed.wobot.org/playground/location_form.html
Wikipedia (en)
Ground Speed
Find a location near you!
Reload
Forms
form_103746 (FORM)
element_1 (TEX
element_2 (SEL
form_id (HIDDE
submit (SUBMI
Add New Element
Add Submit Button
Add New Input Text Field
Submit Form in New Window
Change Form Method
Change All Hidden to Text
Save form values
Clear list of saved values
Remove Element
Remove All Event Handlers
(FORM)
location near you!
rywhere! With more than a thousand stores, you will have no problems finding a convenient
Submit
Generated by pForm
Attributes
Done
FoxyProxy: Disabled

action =
method = post
class = appnitro
id = form_103746

Other Manipulations in Fields

- Other useful things you can do in a text or hidden field:
  - Remove length limits (so you can add more data)
  - Modify size (so the field looks bigger in the page)
  - Encode and decode the contents (Base64, Hex, HTML Entities, Unicode, URL Encode)
  - Hash the contents of the field (MD5, SHA1)
  - Remove all JavaScript Event Handlers
- These options are available when you right-click on a field in the list

Other field manipulation options



type = text
value =
size = 5
maxlength = 5
class = element text
name = element_1
id = element_1

Groundspeed

- Adapts the web application interface to fit the needs of the security tester
  - What you need, where you need: no friction
  - Eliminates the complex secondary tasks
- Allows input validation to be performed from the interface
  - Eliminates the mapping problem

Groundspeed Limitations and Bugs

- Groundspeed does not work with poorly designed pages (where layout is made with HTML tables) because of DOM hierarchy
- Groundspeed does not see JavaScript event handlers that are set programmatically using JavaScript