

WEBDIFF

**Automated Identification of
Cross-browser Issues in Web Applications**

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Georgia Institute of Technology

Partially supported by the NSF awards CCF-0916605 and CCF-0725202 to Georgia Tech

Web Applications



Google Docs



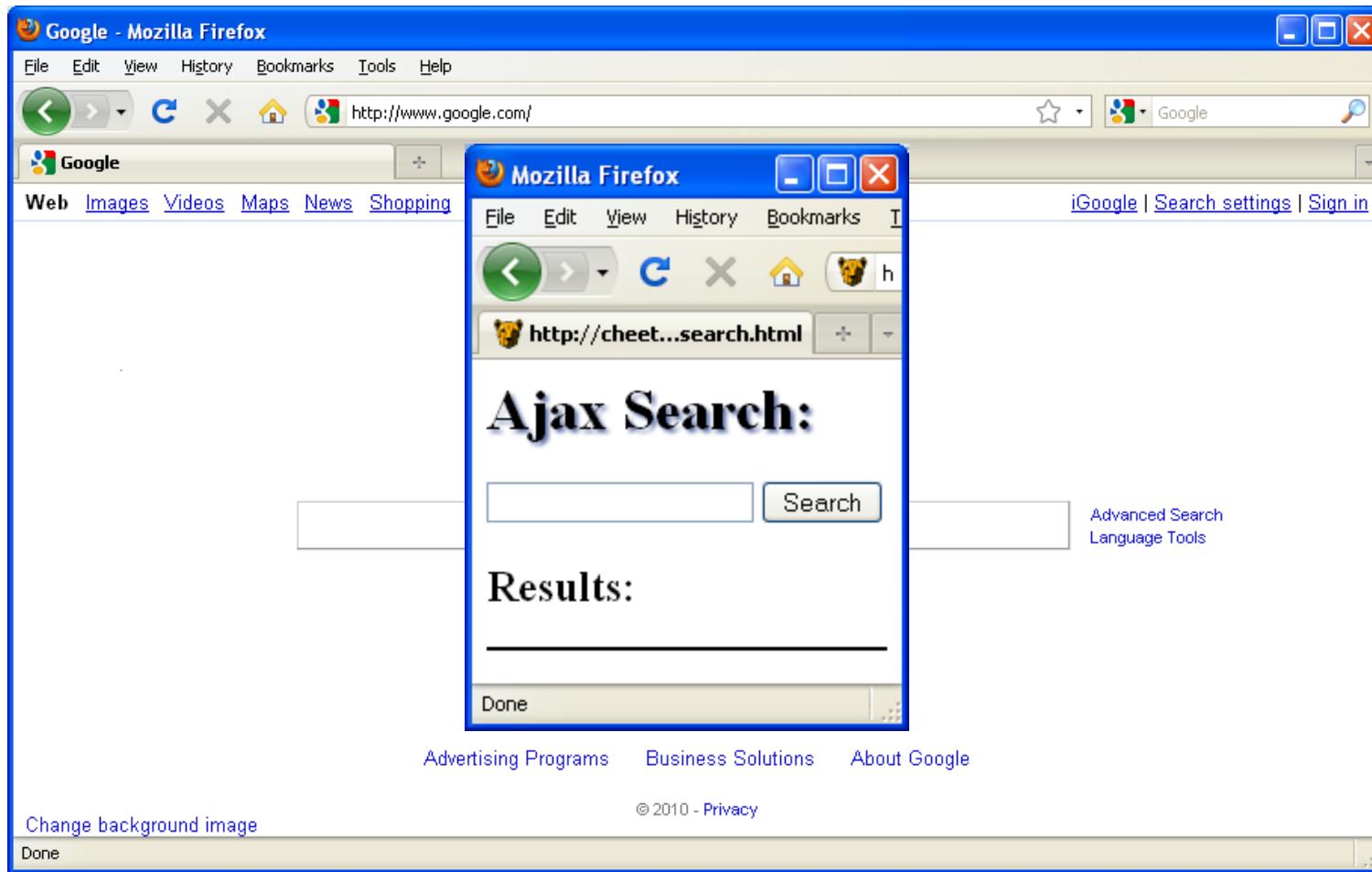
Web Applications



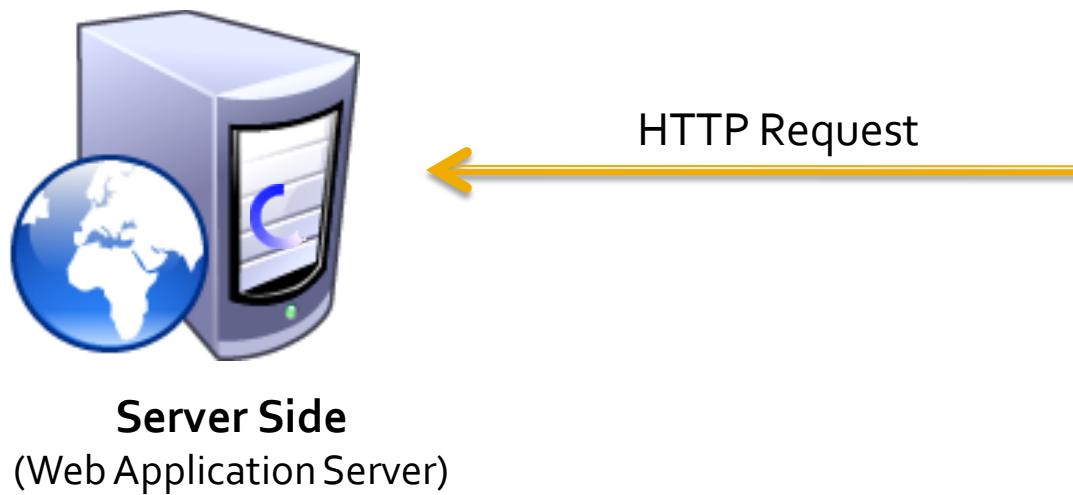
Google Docs



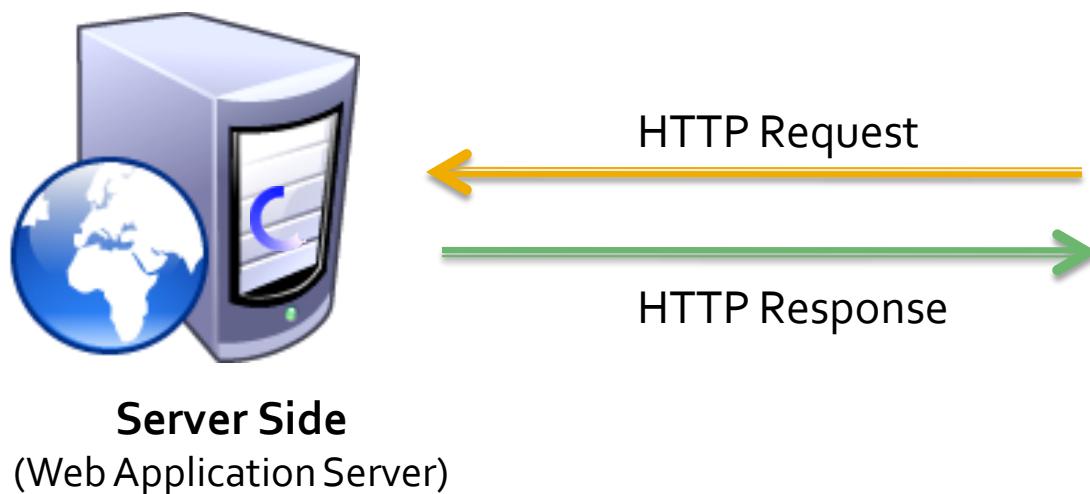
Motivating Example



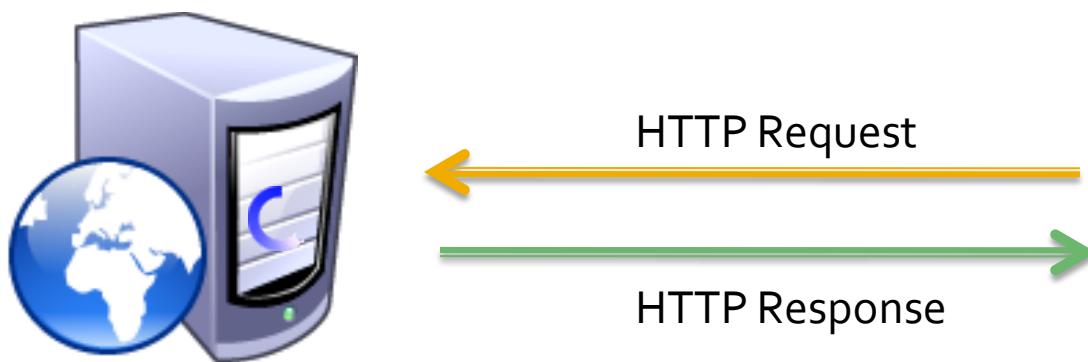
Motivating Example



Motivating Example



Motivating Example



Server Side
(Web Application Server)

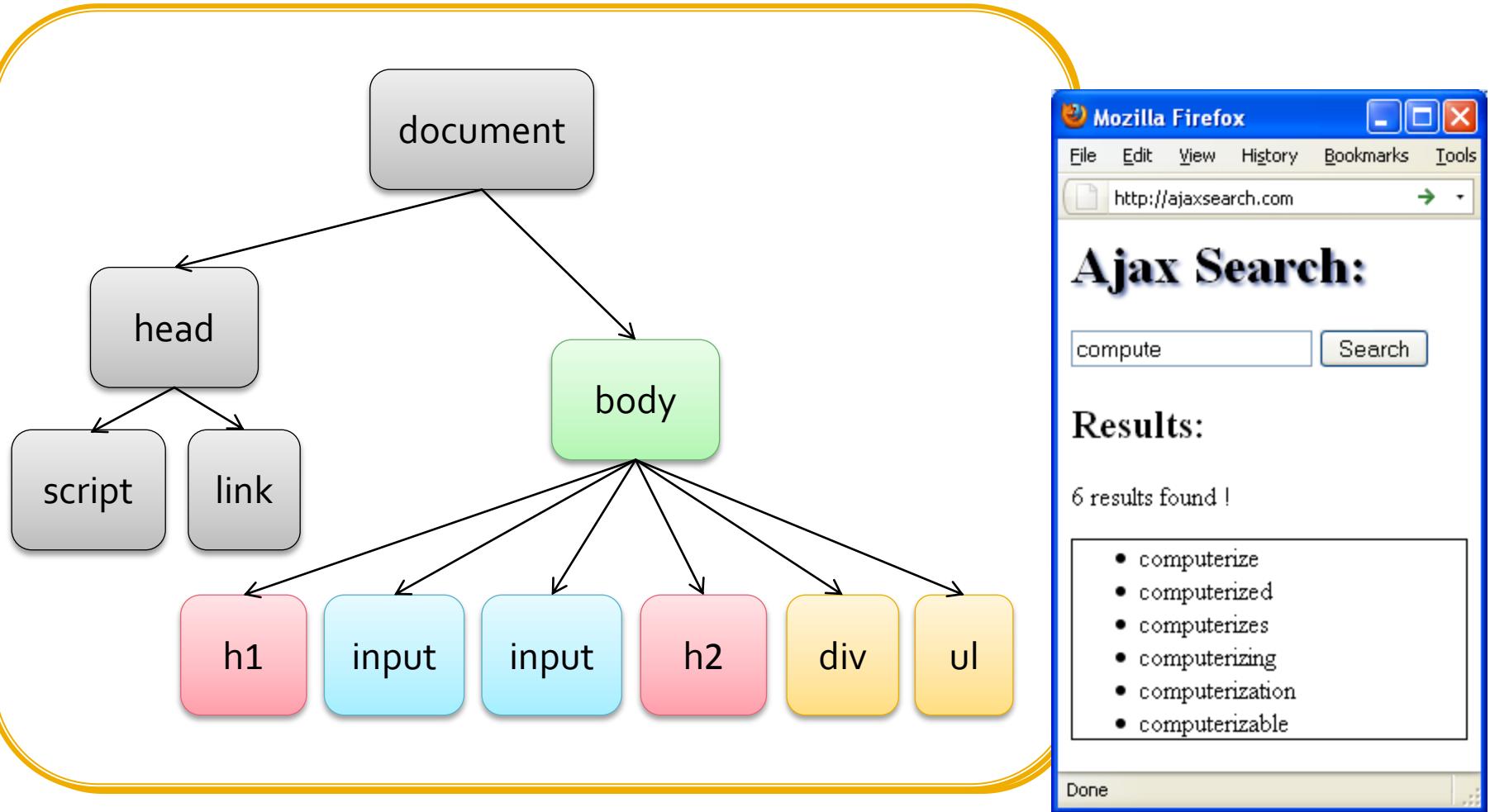


Motivating Example

```
<html>
  <head>
    <script src="script.js"></script>
    <link href="style.css" rel="stylesheet" />
  </head>
  <body>
    <h1>Ajax Search:</h1>
    <input type="text" id="query" />
    <input type="button" onclick="search()"
           value="Search" />
    <h2>Results:</h2>
    <div id="stats"></div>
    <ul id="results"></ul>
  </body>
</html>
```



Motivating Example



Motivating Example

The image shows two side-by-side browser windows. On the left is a Microsoft Internet Explorer window titled 'http://cheetah.cc.gt.atl...'. It displays the text 'Ajax Search:' above a search bar with the word 'compute' and a 'Search' button. Below the search bar, it says 'Results:' and 'undefined results found !'. A list of search suggestions follows: computerize, computerized, computerizes, computerizing, computerization, and computerizable. An orange callout box points to the list with the text 'Displaced border'. On the right is a Mozilla Firefox window titled 'Mozilla Firefox' with the URL 'http://ajaxsearch.com'. It also displays 'Ajax Search:' and a search bar with 'compute' and a 'Search' button. Below it, it says 'Results:' and '6 results found !'. The same list of search suggestions is shown. An orange callout box points to the text '6 results found !' with the text 'Result count'. Another orange callout box points to the top edge of the suggestion list with the text 'No shadow'.

No shadow

Result count

Displaced border

Ajax Search:

compute Search

Results:

undefined results found !

- computerize
- computerized
- computerizes
- computerizing
- computerization
- computerizable

Mozilla Firefox

File Edit View History Bookmarks Tools

http://ajaxsearch.com

Ajax Search:

compute Search

Results:

6 results found !

- computerize
- computerized
- computerizes
- computerizing
- computerization
- computerizable

Done

Georgia Tech Website

The screenshot shows the Georgia Tech website homepage. At the top, there's a banner for "U.S. News Graduate Rankings" with a "2011 RANKINGS" ribbon. Below the banner, the Georgia Tech logo is on the left, and a search bar is on the right. A main headline reads "South Can Cut Utility Bills, Create Jobs and Conserve Billions of Gallons of Water" with a photo of a dam. To the right, there's a sidebar with links for prospective students, current students, faculty & staff, parents, alumni, business & industry, government partners, and visitors. There are also sections for "STRATEGIC VISION" (featuring "Designing the Future"), "VIDEOS @ TECH", "BLOGS @ TECH", "TWEETS @ TECH", "APPLY TO TECH", "GREEN BUZZ", "GIVING TO TECH", "CAREERS @ TECH", and "EMERGENCY PROCEDURES". At the bottom, there's a "NEWS & EVENTS" section with three items: "Institute Names Next College of Computing Dean" (April 16), "DramaTech presents 'The Producers'" (April 16), and "Latin American Film Festival: 'Secuestro Express'" (April 17). A "DID YOU KNOW?" box on the left states: "Georgia Tech's school song is the 'Ramblin' Wreck,' whose copyright was once owned by former Beatle Paul McCartney."

Georgia Tech

**U.S. News
Graduate Rankings** 2011 RANKINGS

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CAMPUS MAP | DIRECTORIES | Search

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[Admissions](#)

[Campuses & Global Reach](#)

[Colleges & Schools](#)

[Degree Programs](#)

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[Professional Education](#)

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[News Room](#)

[Research](#)

[Libraries & Info Center](#)

[Sports](#)

[Alumni Association](#)

[Economic Development](#)

[Tickets & Merchandise](#)

[Campus Calendar](#)

[Contact Us](#)

DID YOU KNOW?

Georgia Tech's school song is the "Ramblin' Wreck," whose copyright was once owned by former Beatle Paul McCartney.

South Can Cut Utility Bills, Create Jobs and Conserve Billions of Gallons of Water

STRATEGIC VISION

Designing the Future

VIDEOS @ TECH

BLOGS @ TECH

TWEETS @ TECH

APPLY TO TECH

GREEN BUZZ

GIVING TO TECH

CAREERS @ TECH

EMERGENCY PROCEDURES

NEWS & EVENTS

Institute Names Next College of Computing Dean
Dr. Zell Hall will assume the leadership role effective July 1, 2010.

DramaTech presents "The Producers"
The latest production from Georgia Tech's student-run theater company.

Latin American Film Festival: "Secuestro Express"
(2005)
Sponsored by the Georgia Tech Spanish Speaking Organization.

Listening Machines 2010
Concert to showcase Center for Music Technology work.

CONTACT US • [LEGAL & PRIVACY INFO](#) • [ACCOUNTABILITY](#) • [SITE MAP](#) • [TECH LINQ](#) • [RSS 2.0](#)
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Georgia Tech Website



U.S. News
Graduate Rankings
2011 RANKINGS
[Learn More >](#)

NEWS & EVENTS



Institute Names Next College of Computing Dean
Dr. Zvi Galil will assume the leadership role effective July 1, 2010.

APR 16

DramaTech presents "The Producers"
The latest production from Georgia Tech's student-run theater company.

APR 16

Latin American Film Festival: "Secuestro Express" (2005)
Sponsored by the Georgia Tech Spanish Speaking Organization.

APR 17

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NEWS & EVENTS



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The latest production from Georgia Tech's

CONTACT

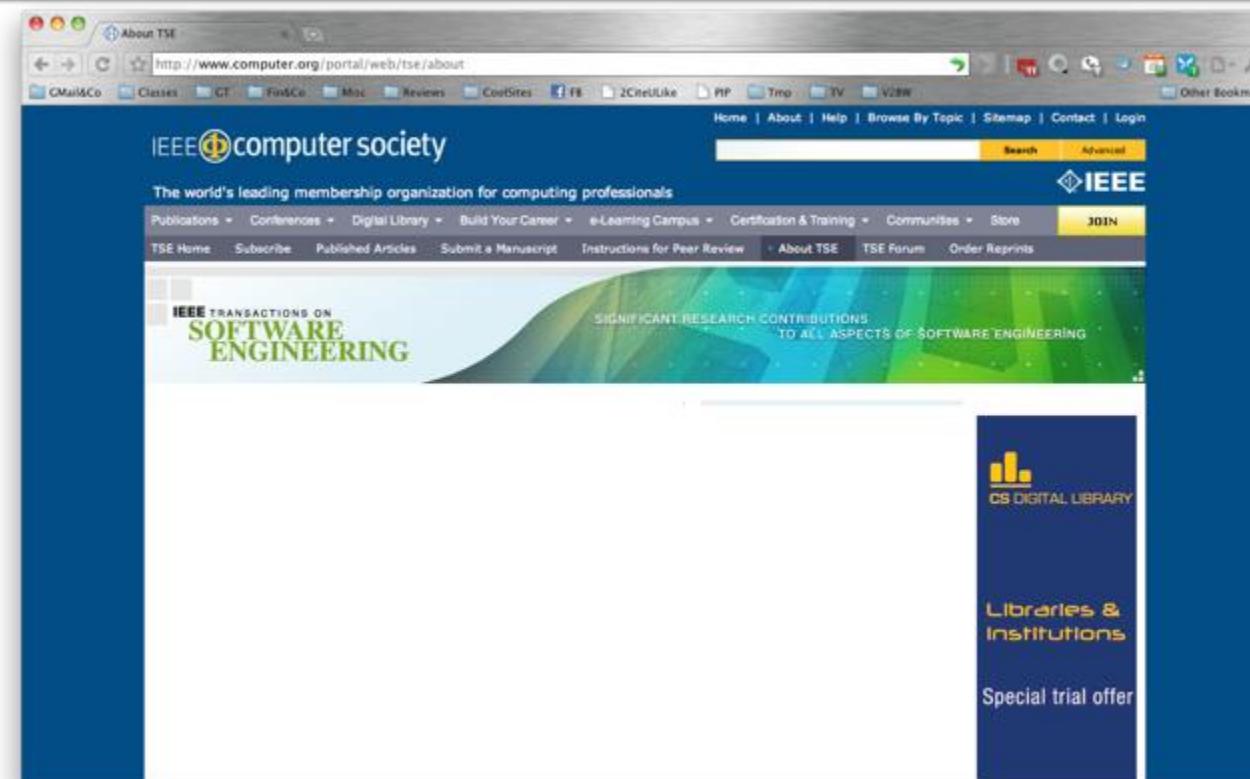
Mozilla Firefox

APL + TECH LINQO + RSS 2.0
Georgia 30332

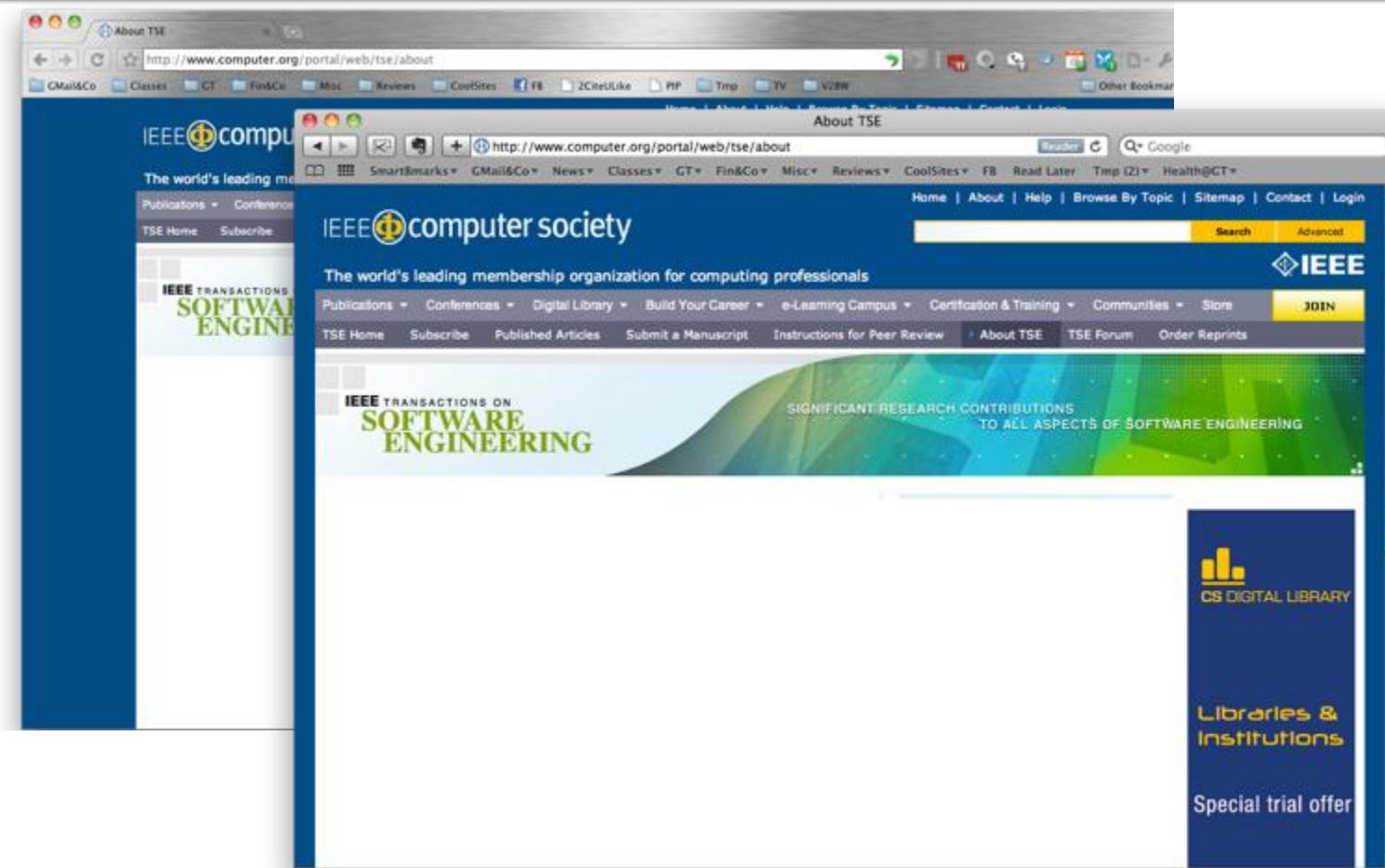
Internet Explorer

12

IEEE TSE Website



IEEE TSE Website



IEEE TSE Website

The image shows a dual-monitor setup displaying the IEEE Transactions on Software Engineering (TSE) website. The left monitor shows the site in Mozilla Firefox, and the right monitor shows it in Google Chrome. Both browsers have the URL <http://www.computer.org/portal/web/tse/about> in the address bar.

Mozilla Firefox View:

- Header:** About TSE - Mozilla Firefox, File, Edit, View, History, Bookmarks, Tools, Help.
- Address Bar:** http://www.computer.org/portal/web/tse/about
- Page Content:** IEEE computer society, The world's leading membership organization for computing professionals, Publications, Conferences, Digital Library, Build Your Career, e-Learning Campus, Certification & Training, Communities, Store, JOIN, TSE Home, Subscribe, Published Articles, Submit a Manuscript, Instructions for Peer Review, About TSE, TSE Forum, Order Reprints.
- Left Sidebar:** IEEE computer society logo, The world's leading membership organization for computing professionals, Publications, Conferences, Digital Library, TSE Home, Subscribe, Published Articles, IEEE TRANSACTIONS ON SOFTWARE ENGINEERING logo.

Google Chrome View:

- Header:** About TSE - Mozilla Firefox, File, Edit, View, History, Bookmarks, Tools, Help.
- Address Bar:** http://www.computer.org/portal/web/tse/about
- Page Content:** IEEE computer society, The world's leading membership organization for computing professionals, Publications, Conferences, Digital Library, Build Your Career, e-Learning Campus, Certification & Training, Communities, Store, JOIN, TSE Home, Subscribe, Published Articles, Submit a Manuscript, Instructions for Peer Review, About TSE, TSE Forum, Order Reprints.
- Left Sidebar:** IEEE computer society logo, The world's leading membership organization for computing professionals, Publications, Conferences, Digital Library, TSE Home, Subscribe, Published Articles, IEEE TRANSACTIONS ON SOFTWARE ENGINEERING logo.

Right Sidebar (Visible in Chrome View):

- Contact Information:** Editor-in-Chief, Bashar Nuseibeh, Lero (Ireland) and The Open University (UK), +353 61 233761, tse-eic@computer.org.
- TSE Publication Coordinator:** IEEE Computer Society, PO Box 3014, Los Alamitos, CA 90720-1314, USA, EMAIL: TSE@computer.org, PHONE: +1.714.821.8380, FAX: +1.714.821.9975.
- CS DIGITAL LIBRARY:** Libraries & Institutions, Special trial offer, Learn More.

Bottom Footer:

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- MARSHA CHECHIK, chechik@cs.toronto.edu
- JANE CLELAND-HUANG, jhuang@cs.depaul.edu
- ELISABETTA DI NITTO, dinitto@elet.polimi.it
- PHYLLIS FRANKL, pfrankl@poly.edu

Commercial Services

Supported browsers - Gmail Help - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://mail.google.com/support/bin/answer.py?hl=en&answer=6557

Gmail by Google Search Help

Gmail Help

[Help articles](#) [Gmail](#) > [Help articles](#) > [Troubleshooting](#) > [General Issues](#) > Supported browsers

Supported browsers

Share Comment Print

You can access Gmail at <http://mail.google.com/> wherever you have an Internet connection via a PC, Linux, or Macintosh (Mac) computer. To take advantage of the newest Gmail features, you'll need to use one of the following fully supported browsers:

- Google Chrome (download: [Windows](#) [Mac](#) [Linux](#))
- Firefox 2.0+ (download: [Windows](#) [Mac](#) [Linux](#))
- Internet Explorer 6.0+ (We recommend [Internet Explorer 7.0+](#) for the best experience, and you'll need it to use Gmail labs and Themes.)
- Safari 3.0+ (download: [Mac](#))

We don't test the following browsers, but believe they will work with all of Gmail's features:

- Opera 9.5+ (download: [Windows](#) [Mac](#) [Linux](#))

You can also get access Gmail -- but you won't have some of the latest features -- with any of the following browsers:

- IE 5.5+ (download: [Windows](#))
- Netscape 7.1+ (download: [Windows](#) [Mac](#) [Linux](#))
- Mozilla 1.4+ (download: [Windows](#) [Mac](#) [Linux](#))
- Firefox 0.8+ (download: [Windows](#) [Mac](#) [Linux](#))
- Safari 1.3+ (download: [Mac](#))

If you use a browser other than those listed above, you'll be automatically directed to the [basic HTML view](#) of Gmail. Basic HTML view works with the following browsers, as well as many others:

Known issues with Gmail

Review our [Known Issues page](#) for a list of known bugs, suggested workarounds and recent fixes.

Recommended articles

[Changing your password](#)
[Loading issues](#)
[Deleting messages](#)
[Importing CSV files](#)
[Adding a custom 'From' address](#)

Help resources

 [Getting Started Guide](#)
A beginner's guide to Gmail

 [Support options](#)
A list of available resources to help you get your answer fastest

 [Known issues](#)
Recently reported problems

 [Suggest a Feature](#)
Let us know what you'd like to see in Gmail

Done

Commercial Services

The screenshot shows two Mozilla Firefox windows side-by-side. The left window is titled 'Supported browsers - Gmail Help - Mozilla Firefox' and displays the 'Gmail Help' sidebar with various links like 'Help articles', 'Your Account', and 'Troubleshooting'. The right window is titled 'Gmail Known Issues - Gmail Help - Mozilla Firefox' and shows the 'Gmail Known Issues' page. This page includes a search bar, a breadcrumb trail ('Gmail > Help articles > Gmail Known Issues'), and a main content area with sections for 'Gmail Known Issues', 'Recent Fixes', and 'Compose and Read Mail'. Two specific items in the 'Compose and Read Mail' section and one in the 'Recent Fixes' section are highlighted with red boxes.

Gmail Known Issues

Recent Fixes

- ✓ Internet Explorer - Loading issues on clicking Contacts
- ✓ 'Contacts' and 'Tasks' links will not stay hidden
- ✓ Trouble viewing or downloading certain older attachments
- ✓ Incoming messages do not appear in Inbox
- ✓ Issue with mail client failing to connect to server
- ✓ Auto-forwarding not working properly
- ✓ Internet Explorer - 500 error when downloading attachments
- ✓ Labels are automatically being created
- ✓ The 'All Mail', 'Chats', 'Trash', and 'Spam' labels will not stay unhidden
- ✓ Groups are not appearing in autocomplete
- ✓ Unable to moderate comments

Compose and Read Mail

- ⊕ Safari 3 - Unable to compose messages
- ⊕ Stuck on 'Loading...' when opening messages

Commercial Services

The screenshot displays three Mozilla Firefox browser windows side-by-side:

- Gmail Help - Mozilla Firefox**: Shows the Gmail Help sidebar with links like Help articles, Your Account, Your Messages, Other ways to access Gmail, Troubleshooting, Help forum, What's New, Gmail Blog, For work or school, and Gmail service status.
- Gmail Known Issues - Mozilla Firefox**: Shows the Gmail Known Issues page.
- YUI Graded Browser Support - Mozilla Firefox**: Shows the YAHOO! DEVELOPER NETWORK homepage with a "Graded Browser Support" section and an "A-Grade Browser Support Chart".

YAHOO! DEVELOPER NETWORK

MY PROJECTS | SERVICES & TOOLS | RESOURCES | SUPPORT

YDN / YUI / Graded Browser Support

Graded Browser Support

- A-Grade GBS Chart
- C-Grade Browser List (Draft)
- GBS Updates Archive
- About the GBS Approach
 - What Does "Support" Mean?
 - Progressive Enhancement vs. Graceful Degradation
 - What are Grades of Support?
 - Three Grades of Support

A-Grade Browser Support Chart

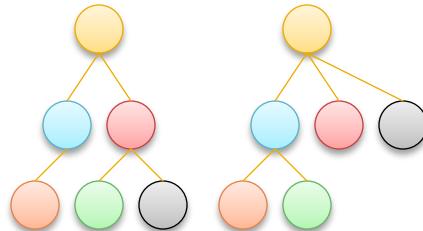
This chart lists browsers that receive A-grade support as defined by Graded Browser Support. All YUI projects, including YUI 2 and YUI 3, aim to provide at least full A-grade support.

	Win XP	Win 7	Mac 10.5.†	Mac 10.6.†
Firefox 3.0.†	A-grade			
Firefox 3.6.†	A-grade	A-grade		A-grade
Chrome 4.0.†	A-grade			
IE 8.0	A-grade	A-grade		
IE 7.0	A-grade			
IE 6.0	A-grade			

Challenges and Issues



Manual inspection
is expensive



DOM differs
between browsers



Mimic end user's
perception



Ignore variable elements
on webpage

<!DOCTYPE
<HTML>
<HEAD>
<TITLE>RA
<LINK REV
<META NAM

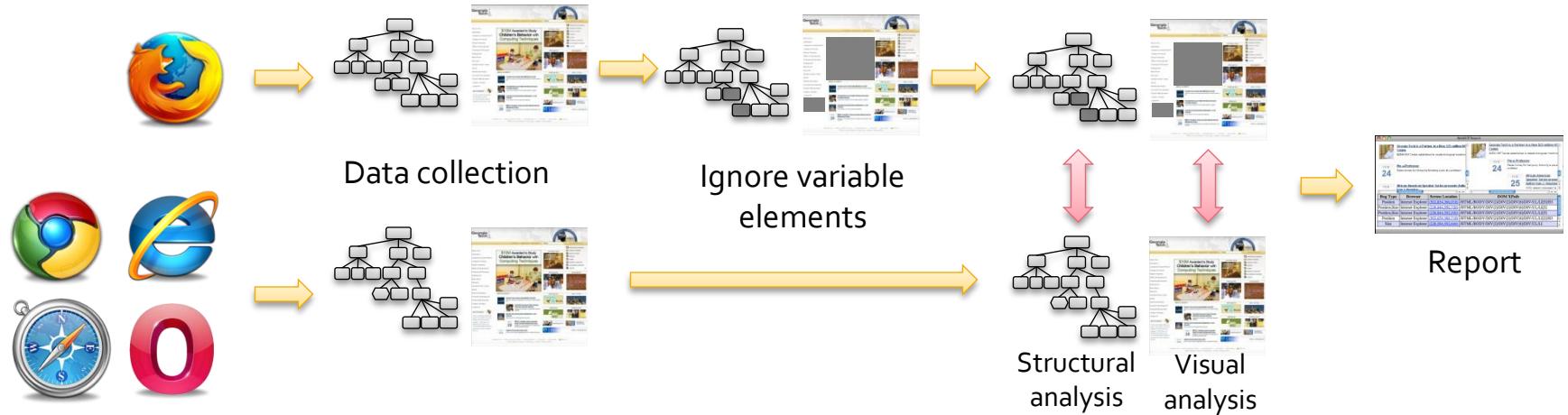
Locate broken
element in code



Even work with
browser security controls

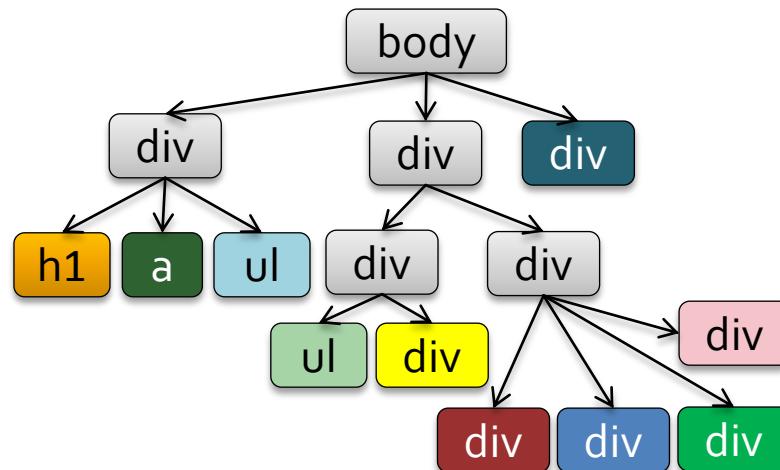
Our Technique

- **Goal:**
Compare behavior of web pages in different browsers
- High level view of the approach:



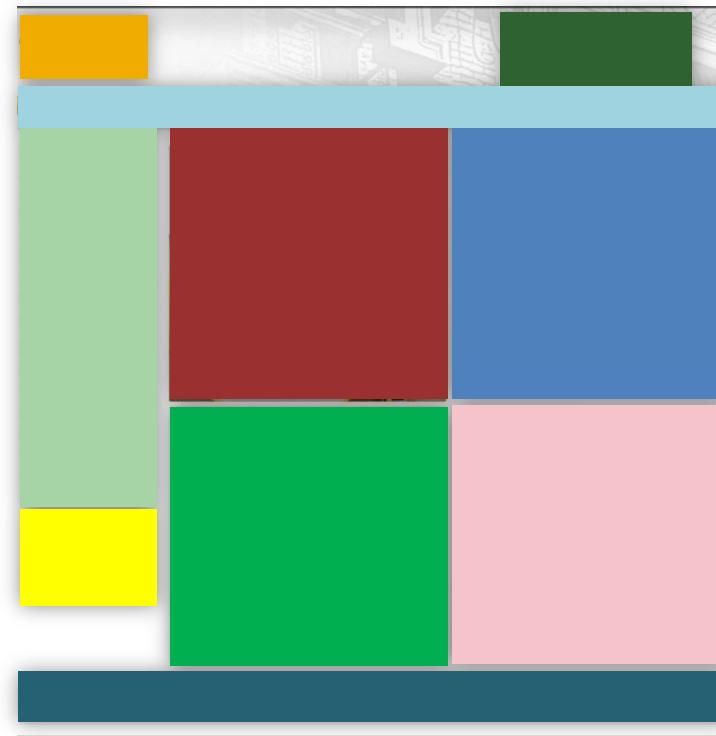
1. Data Collection

- From each browser under consideration, the technique collects:



Structural Information (DOM)

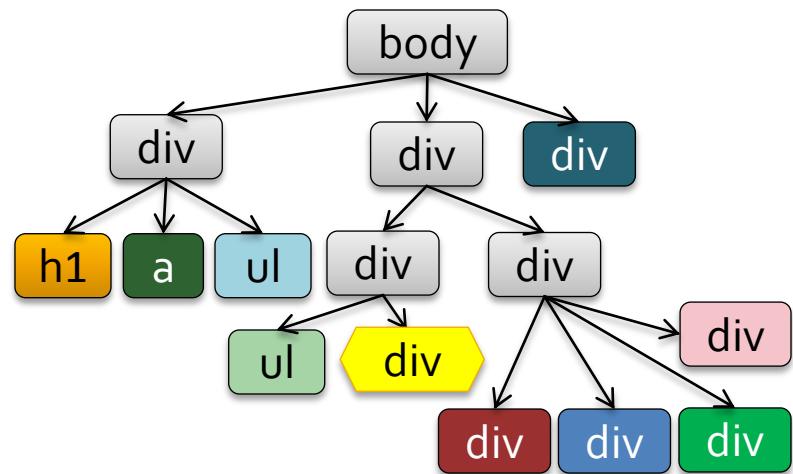
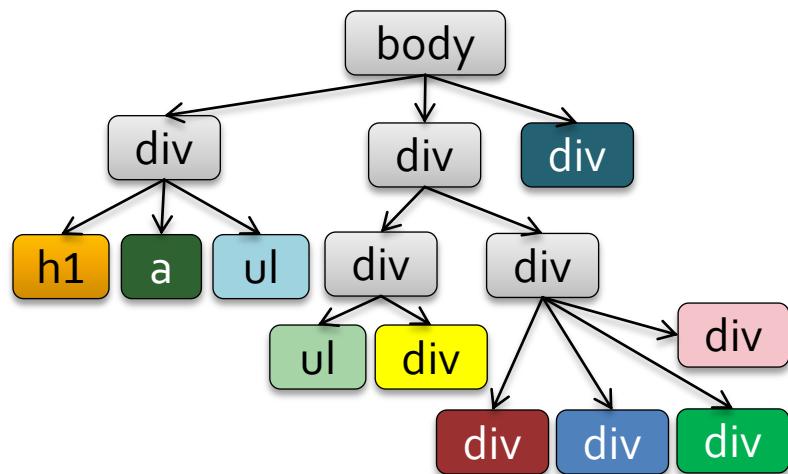
(*tagname, id, xpath, coord,
clickable, visible, zindex, hash*)



Visual Information (Screenshot)

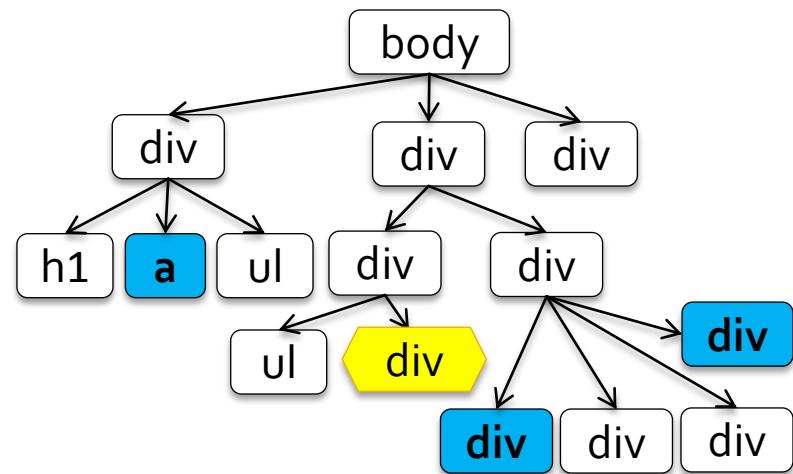
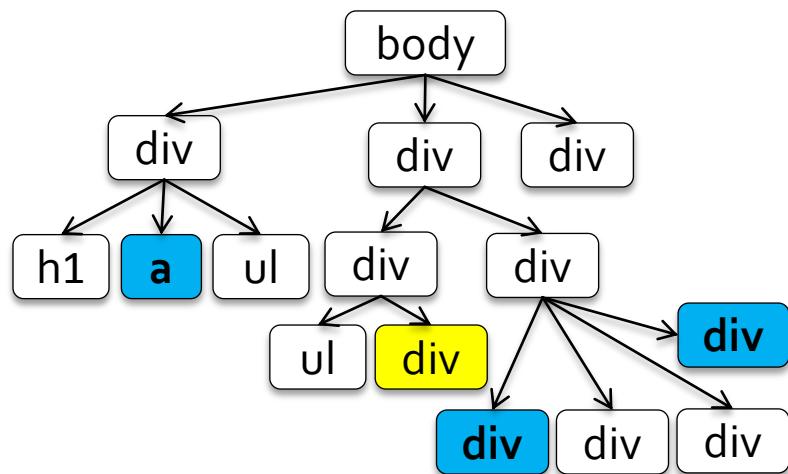
2. Detection of Variable Elements

- Load page twice in reference browser:



2. Detection of Variable Elements

- Load page twice in reference browser:



2. Detection of Variable Elements

- Page in reference browser over two subsequent requests:

The screenshot shows the Georgia Tech homepage. At the top right, there is a banner for "COMMENCEMENT JACKETS SUMMER 2010". On the left, there is a sidebar with links to "About Tech", "Admissions", "Campuses & Global Reach", "Colleges & Schools", "Degree Programs", "Offices & Departments", "Professional Education", "Employment", "News Room", "Research", "Libraries & Info Center", "Sports", "Alumni Association", "Economic Development", "Tickets & Merchandise", "Campus Calendar", and "Contact Us". A "DID YOU KNOW?" section features a bee icon and a quote about Georgia Tech being the first institution to provide low-cost housing for married students as part of the G.I. Bill. The main content area has a large image of two children playing with wooden blocks. Below it, there are sections for "NEWS & EVENTS", "TWEETS @ TECH", "APPLY TO TECH", "GREEN BUZZ", "GIVING TO TECH", "CAREERS @ TECH", and "EMERGENCY PROCEDURES". At the bottom, there is a digital lounge section with a "L10N" graphic.

The screenshot shows the same Georgia Tech homepage after a subsequent request. The banner at the top right now says "RESOLVING THE PARADOX OF THE ANTARCTIC SEA ICE". The main content area has been updated to feature a large image of the Antarctic sea ice. The sidebar and other page elements remain largely the same, including the "NEWS & EVENTS", "TWEETS @ TECH", "APPLY TO TECH", "GREEN BUZZ", "GIVING TO TECH", "CAREERS @ TECH", and "EMERGENCY PROCEDURES" sections, as well as the "CONTACT US" and "DID YOU KNOW?" boxes at the bottom.

2. Detection of Variable Elements

- Page in reference browser over two subsequent requests:

The screenshot shows a news article titled "\$10M Awarded to Study Children's Behavior with Computing Techniques". The article features a photograph of two young boys playing with wooden blocks at a table. Below the article are several navigation links: TWEETS @ TECH, GREEN BUZZ, GIVING TO TECH, CAREERS @ TECH, and EMERGENCY PROCEDURES. At the bottom is a digital lounge section with a large "DID YOU KNOW?" box containing information about the G.I. Bill.

The screenshot shows a news article titled "Resolving the Paradox of the Antarctic Sea Ice". The article features a photograph of a vast, icy landscape. Below the article are the same navigation links as the first screenshot: TWEETS @ TECH, GREEN BUZZ, GIVING TO TECH, CAREERS @ TECH, and EMERGENCY PROCEDURES. At the bottom is a digital lounge section with a "DID YOU KNOW?" box containing information about former President Jimmy Carter.

2. Detection of Variable Elements

- Page in reference browser over two subsequent requests:

The screenshot shows a news article titled "\$10M Awarded to Study Children's Behavior with Computing Techniques". The article features a photograph of two young boys playing with wooden blocks at a table. Below the article are several links: "TWEETS @ TECH", "APPLY TO TECH", "GREEN BUZZ", "GIVING TO TECH", "CAREERS @ TECH", "EMERGENCY PROCEDURES", and "DIGITAL LOUNGE @ TECH". A "DID YOU KNOW?" box is highlighted with a red border.

The screenshot shows a news article titled "Resolving the Paradox of the Antarctic Sea Ice". The article features a photograph of a vast, icy landscape. Below the article are the same links as the first screenshot: "TWEETS @ TECH", "APPLY TO TECH", "GREEN BUZZ", "GIVING TO TECH", "CAREERS @ TECH", "EMERGENCY PROCEDURES", and "DIGITAL LOUNGE @ TECH". A "DID YOU KNOW?" box is highlighted with a red border.

2. Detection of Variable Elements

- Page in reference browser over two subsequent requests:

\$10M Awarded to Study Children's Behavior with Computing Techniques

TWEETS @ TECH

APPLY TO TECH

GREEN BUZZ

GIVING TO TECH

CAREERS @ TECH

EMERGENCY PROCEDURES

DID YOU KNOW?

DIGITAL LOUNGE @ TECH

Resolving the Paradox of the Antarctic Sea Ice

TWEETS @ TECH

APPLY TO TECH

GREEN BUZZ

GIVING TO TECH

CAREERS @ TECH

EMERGENCY PROCEDURES

DIGITAL LOUNGE @ TECH

2. Detection of Variable Elements

- Page in reference browser over two subsequent requests:

The screenshot shows a news article titled "\$10M Awarded to Study Children's Behavior with Computing Techniques". Below the title is a photograph of two young boys playing with colorful blocks at a table. At the bottom left, there is a "DID YOU KNOW?" box with a red border containing text about Georgia Tech's low-cost housing for married students in 1945. At the bottom right, there is a "L10N" digital lounge element.

The screenshot shows a news article titled "Resolving the Paradox of the Antarctic Sea Ice". Below the title is a photograph of a vast, icy landscape. At the bottom left, there is a "DID YOU KNOW?" box with a red border containing text about former President Jimmy Carter's membership in Georgia Tech's Class of 1946. At the bottom right, there is a "L10N" digital lounge element.

2. Detection of Variable Elements

- Page in reference browser over two subsequent requests:

The screenshot shows a news article titled "\$10M Awarded to Study Children's Behavior with Computing Techniques". Below the title is a photograph of two young boys playing with colorful blocks at a table. At the bottom of the page, there is a "DID YOU KNOW?" box with a yellow background and a red border. The box contains the following text:
DID YOU KNOW?
In 1945, Georgia Tech was the first institution to provide low-cost housing for married students as part of the G.I. Bill.

The screenshot shows a news article titled "Resolving the Paradox of the Antarctic Sea Ice". Below the title is a photograph of a vast, icy landscape. At the bottom of the page, there is a "DID YOU KNOW?" box with a yellow background and a red border. The box contains the following text:
DID YOU KNOW?
Former President Jimmy Carter was a member of Georgia Tech's Class of 1946.

2. Detection of Variable Elements

- Page in reference browser over two subsequent requests:

The screenshot shows the Georgia Tech homepage. A news article titled "\$10M Awarded to Study Children's Behavior with Computing Techniques" is highlighted with a red box. Below the article, there are sections for "NEWS & EVENTS", "TWEETS @ TECH", "APPLY TO TECH", "GREEN BUZZ", "GIVING TO TECH", "CAREERS @ TECH", and "EMERGENCY PROCEDURES". At the bottom left, a "DID YOU KNOW?" box is highlighted with a red box, containing information about Georgia Tech being the first institution to provide low-cost housing for married students as part of the G.I. Bill.

\$10M Awarded to Study Children's Behavior with Computing Techniques

NEWS & EVENTS

TWEETS @ TECH

APPLY TO TECH

GREEN BUZZ

GIVING TO TECH

CAREERS @ TECH

EMERGENCY PROCEDURES

DID YOU KNOW?

In 1945, Georgia Tech was the first institution to provide low-cost housing for married students as part of the G.I. Bill.

AUG 26

IMPACT Speaker Series presents: Nobel Laureate Muhammad Yunus

Professor Yunus will talk about his latest book Building Social Business.

CONTACT US • **LEGAL & PRIVACY INFO** • **ACCOUNTABILITY** • **SITE MAP** • **TECH LINGO** • **RSS 2.0**

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The screenshot shows the Georgia Tech homepage after a subsequent request. The news article from the previous screenshot has been replaced by a new one titled "Resolving the Paradox of the Antarctic Sea Ice". This article is also highlighted with a red box. The rest of the page layout remains the same, including the sidebar menu, news sections, and footer links.

Resolving the Paradox of the Antarctic Sea Ice

NEWS & EVENTS

TWEETS @ TECH

APPLY TO TECH

GREEN BUZZ

GIVING TO TECH

CAREERS @ TECH

EMERGENCY PROCEDURES

DID YOU KNOW?

Former President Jimmy Carter was a member of Georgia Tech's Class of 1946.

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IMPACT Speaker Series presents: Nobel Laureate Muhammad Yunus

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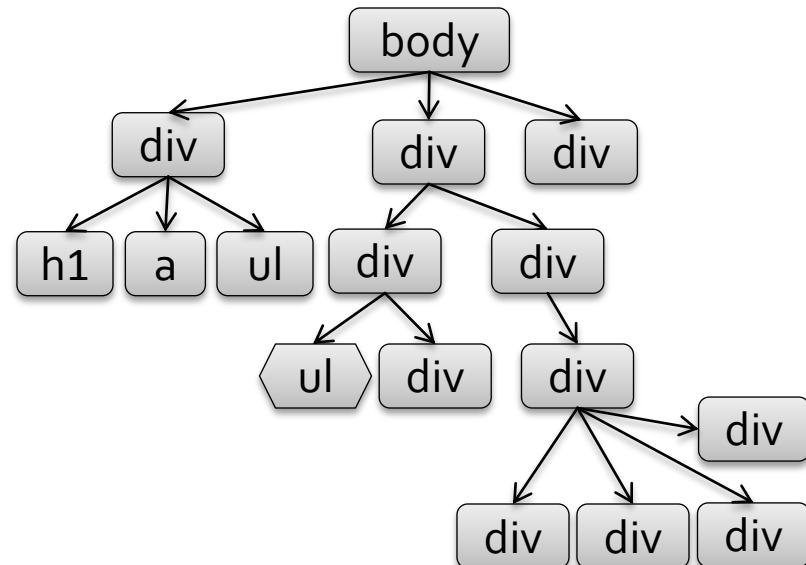
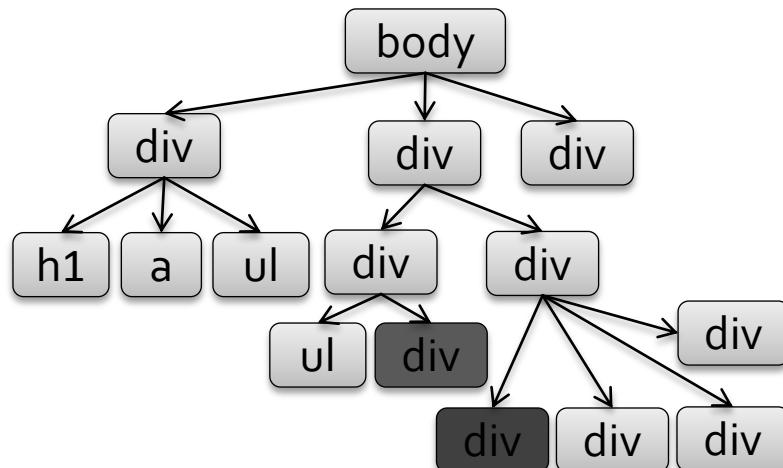
CONTACT US • **LEGAL & PRIVACY INFO** • **ACCOUNTABILITY** • **SITE MAP** • **TECH LINGO** • **RSS 2.0**

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3a. Cross-browser Comparison

Structural Analysis

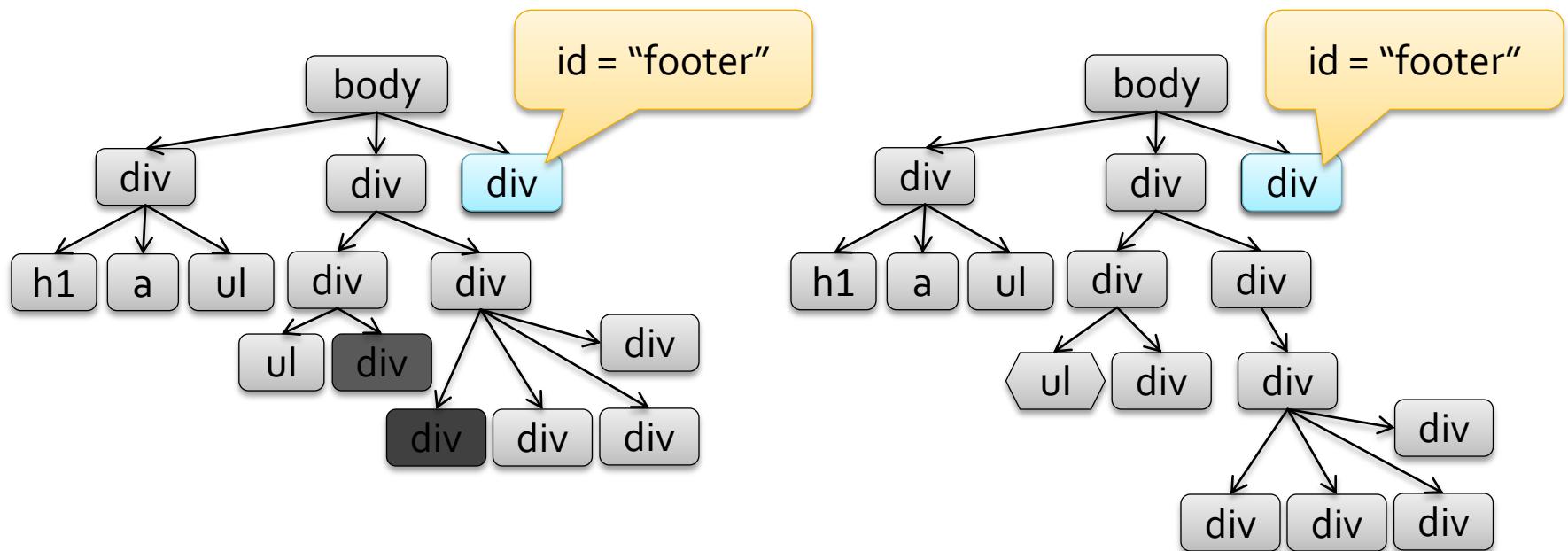
- Match the nodes in the DOM tree of each browser to those in reference browser:



3a. Cross-browser Comparison

Structural Analysis

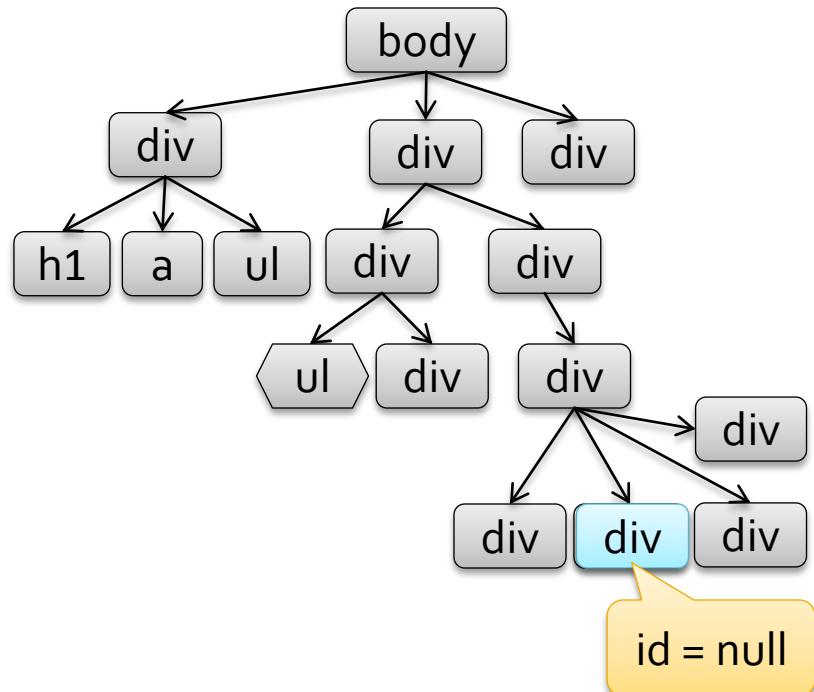
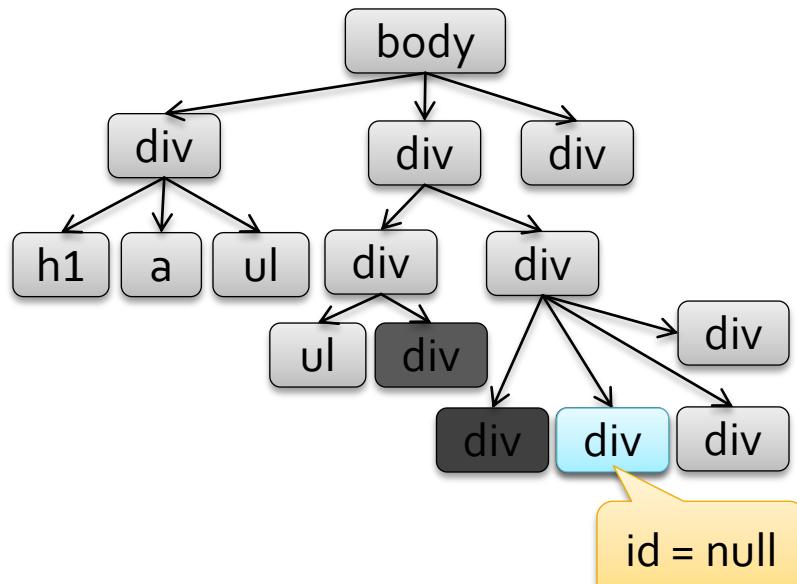
- Match the nodes in the DOM tree of each browser to those in reference browser:



3a. Cross-browser Comparison

Structural Analysis

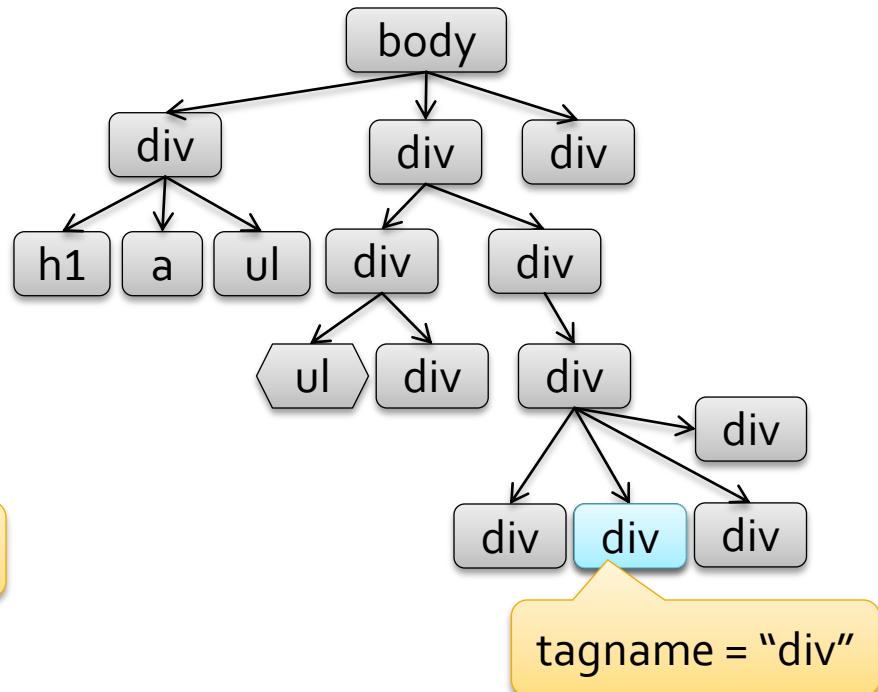
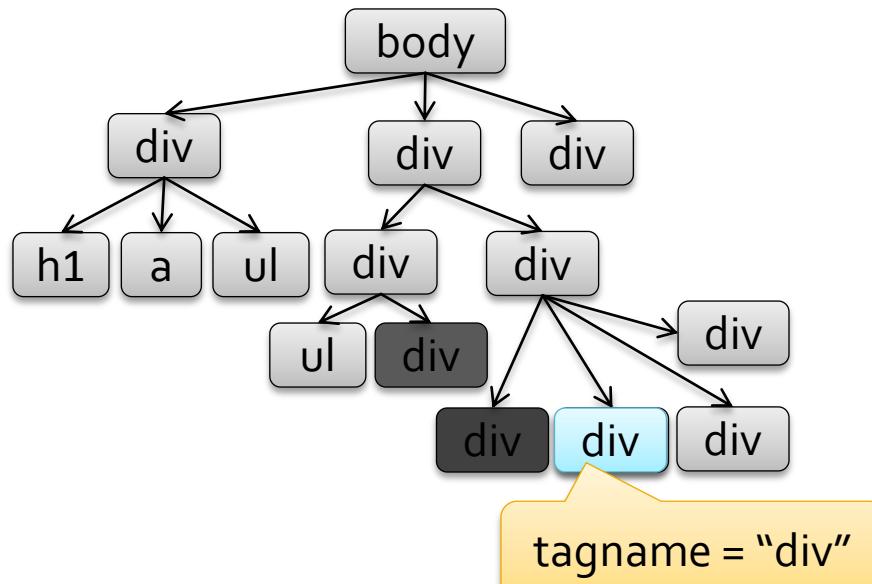
- Match the nodes in the DOM tree of each browser to those in reference browser:



3a. Cross-browser Comparison

Structural Analysis

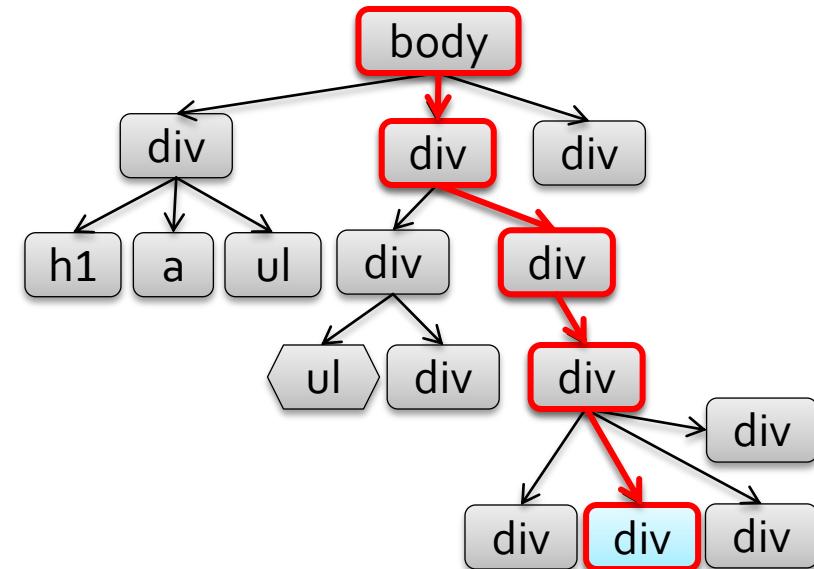
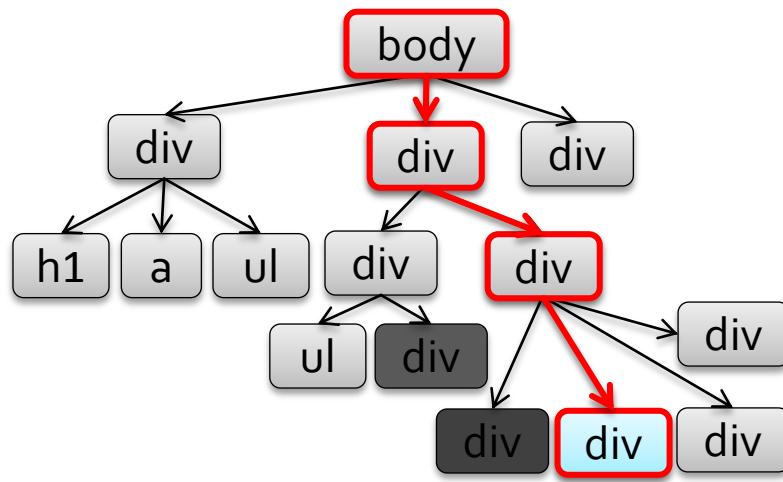
- Match the nodes in the DOM tree of each browser to those in reference browser:



3a. Cross-browser Comparison

Structural Analysis

- Match the nodes in the DOM tree of each browser to those in reference browser:



xPath1 = /html/body/div[1]/div[1]/div[1]

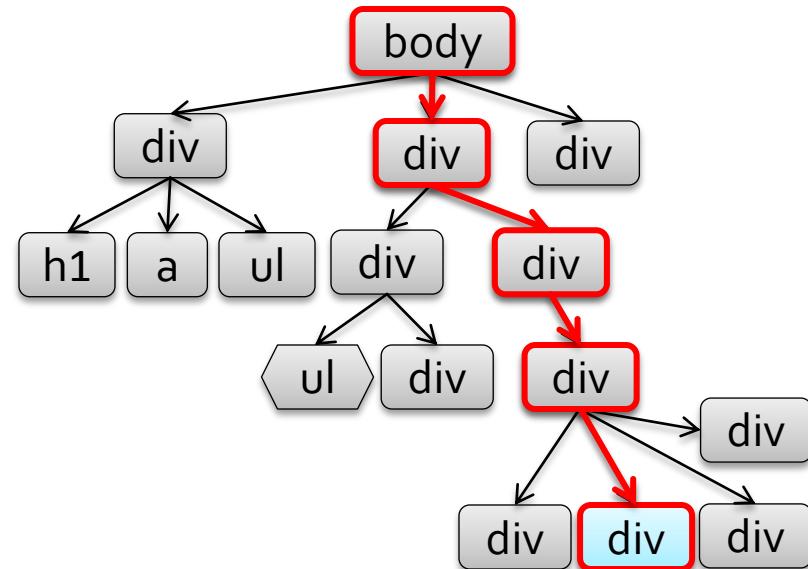
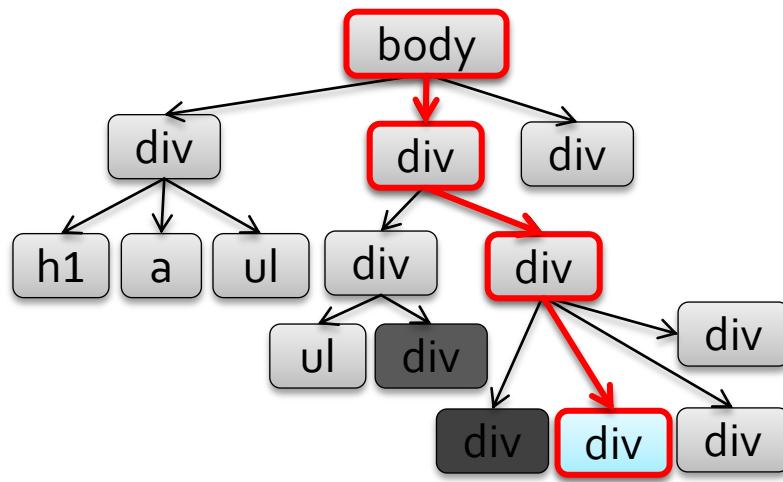
xPath2 = /html/body/div[1]/div[1]/div/div[1]

Match Index =

3a. Cross-browser Comparison

Structural Analysis

- Match the nodes in the DOM tree of each browser to those in reference browser:

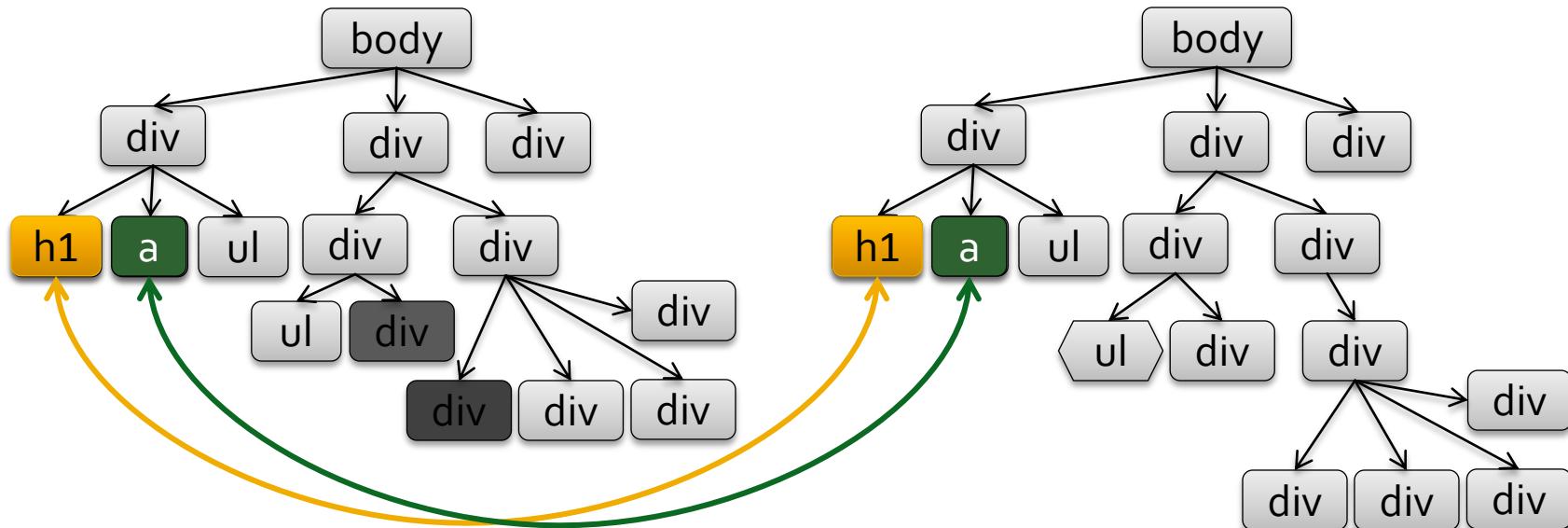


$$\text{Match Index} = \begin{cases} 0.9 \times xPath \text{ Similarity} = 1 - \frac{\text{LevenshteinDistance}(xPath1, xPath2)}{\max(\text{len}(xPath1), \text{len}(xPath2))} \\ 0.1 \times (\text{"coord"}, \text{"clickable"}, \text{"visible"}, \text{"zindex"}, \text{"hash"}) \end{cases}$$

3a. Cross-browser Comparison

Structural Analysis

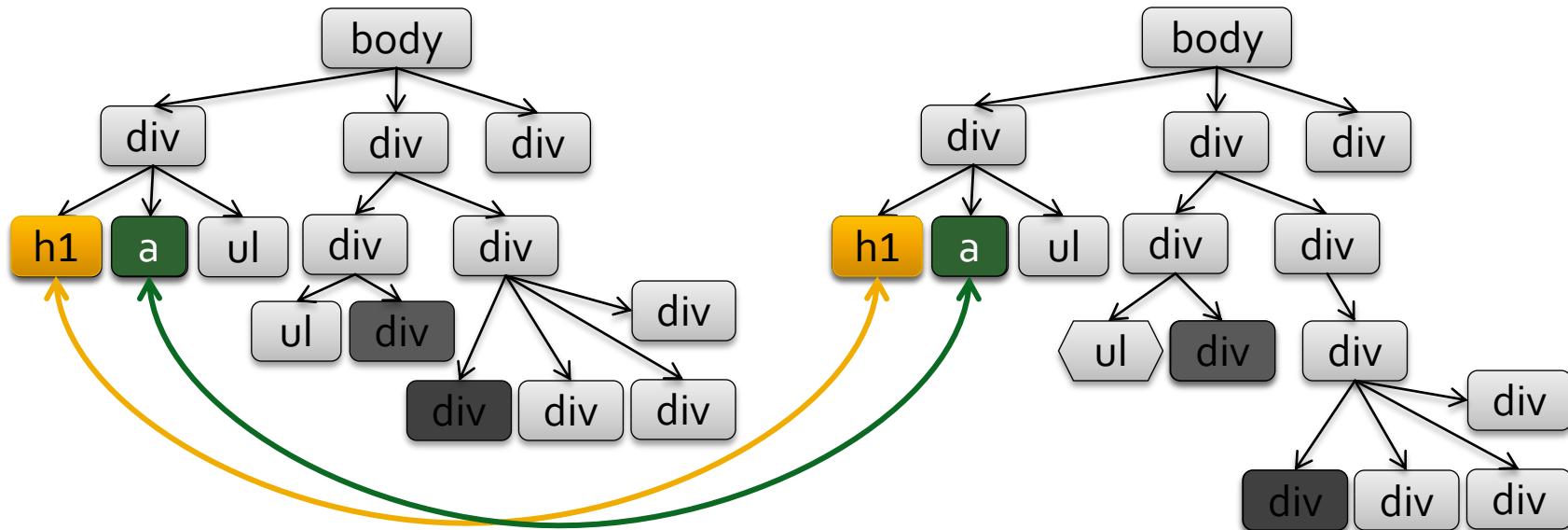
- Match the nodes in the DOM tree of each browser to those in reference browser:



3a. Cross-browser Comparison

Structural Analysis

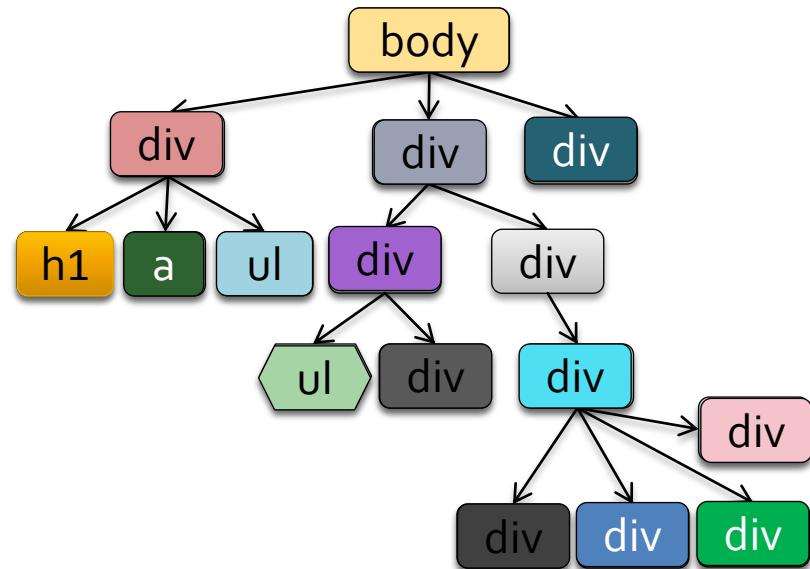
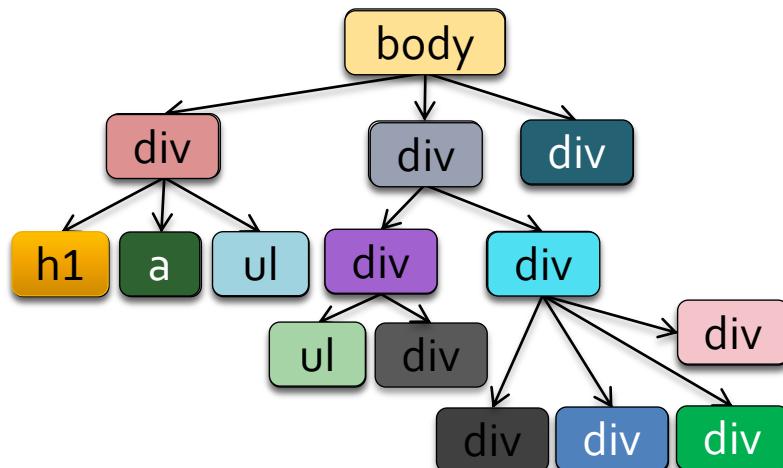
- Match the nodes in the DOM tree of each browser to those in reference browser:



3a. Cross-browser Comparison

Structural Analysis

- Match the nodes in the DOM tree of each browser to those in reference browser:



3b. Cross-browser Comparison

Visual Analysis

Georgia Tech

BuzzPort | Campus Map | Directories | Search

COMMENCEMENT HIGHLIGHTS SUMMER 2010

- About Tech
- Admissions
- Campuses & Global Reach
- Colleges & Schools
- Degree Programs
- Offices & Departments
- Professional Education
- Employment
- News Room
- Research
- Libraries & Info Center
- Sports
- Alumni Association
- Economic Development
- Tickets & Merchandise
- Campus Calendar
- Contact Us

NEWS & EVENTS

- Georgia Tech to Host FutureMedia Fest 2010
- Powerful Processors May Threaten Password Security Systems
- Georgia Tech Among Sierra Magazine's "Cool Schools"
- IMPACT Speaker Series presents: Nobel Laureate Muhammad Yunus

AUG 26

PROSPECTIVE STUDENTS

STRATEGIC VISION

PRESIDENT TO LAUNCH PLAN AUGUST 31

VIDEOS @ TECH

BLOGS @ TECH

TWEETS @ TECH

APPLY TO TECH

GREEN BUZZ

GIVING TO TECH

CAREERS @ TECH

EMERGENCY PROCEDURES

DIGITAL LOUNGE @ TECH

CONTACT US • LEGAL & PRIVACY INFO • ACCOUNTABILITY • SITE MAP • TECH LINGO • RSS 2.0
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Georgia Tech

BuzzPort | Campus Map | Directories | Search

COMMENCEMENT HIGHLIGHTS SUMMER 2010

- About Tech
- Admissions
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- Colleges & Schools
- Degree Programs
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- Libraries & Info Center
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- Alumni Association
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NEWS & EVENTS

- Georgia Tech to Host FutureMedia Fest 2010
- Powerful Processors May Threaten Password Security Systems
- Georgia Tech Among Sierra Magazine's "Cool Schools"
- IMPACT Speaker Series presents: Nobel Laureate Muhammad Yunus
- Student Involvement Week 2010

\$10M Awarded to Study Children's Behavior with Computing Techniques

AUG 26

STRATEGIC VISION

PRESIDENT TO LAUNCH PLAN AUGUST 31

VIDEOS @ TECH

BLOGS @ TECH

TWEETS @ TECH

APPLY TO TECH

GREEN BUZZ

GIVING TO TECH

CAREERS @ TECH

EMERGENCY PROCEDURES

DIGITAL LOUNGE @ TECH

CONTACT US • LEGAL & PRIVACY INFO • ACCOUNTABILITY • SITE MAP • TECH LINGO • RSS 2.0
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3b. Cross-browser Comparison

Visual Analysis

The screenshot shows the Georgia Tech homepage. At the top, there is a banner for "COMMENCEMENT JACKETS SUMMER 2010". Below the banner, the Georgia Tech logo is on the left, followed by a navigation bar with links to BUZZPORT, CAMPUS MAP, DIRECTORIES, and a search bar. A sidebar on the left lists various university departments and offices. The main content area features sections for NEWS & EVENTS, TWEETS @ TECH, APPLY TO TECH, GREEN BUZZ, GIVING TO TECH, CAREERS @ TECH, and EMERGENCY PROCEDURES. A digital lounge section at the bottom displays a blue digital sign.

The screenshot shows the same Georgia Tech homepage as the first one, but in a different browser (Google Chrome). The layout is identical, but there are noticeable differences in the visual presentation. The fonts appear slightly more modern and the overall color palette is more vibrant. The sidebar on the left and the main content sections look slightly sharper. The digital lounge at the bottom also appears more polished.

3b. Cross-browser Comparison

Visual Analysis

This screenshot shows the Georgia Tech website as it appears in Internet Explorer 8. The layout is slightly different from the modern browser version, with some visual elements and text appearing differently. The main navigation bar at the top includes links for BUZZPORT, CAMPUS MAP, DIRECTORIES, and a search bar. A large banner at the top right features the text "COMMENCEMENT JACKETS SUMMER 2010". The left sidebar contains a list of links for About Tech, Admissions, Campuses & Global Reach, Colleges & Schools, Degree Programs, Offices & Departments, Professional Education, Employment, News Room, Research, Libraries & Info Center, Sports, Alumni Association, Economic Development, Tickets & Merchandise, Campus Calendar, and Contact Us. The main content area includes sections for NEWS & EVENTS, TWEETS @ TECH, APPLY TO TECH, GREEN BUZZ, GIVING TO TECH, CAREERS @ TECH, and EMERGENCY PROCEDURES. At the bottom, there is a digital lounge section with a blue glowing background.

This screenshot shows the same Georgia Tech website as it appears in Google Chrome. The visual presentation is more consistent with modern web standards. The main navigation bar, banner, and sidebar links are identical to the IE8 version. The main content area features the same news and event sections, but the layout and styling are updated. The digital lounge section at the bottom also appears more polished and modern compared to the IE8 version.

3b. Cross-browser Comparison

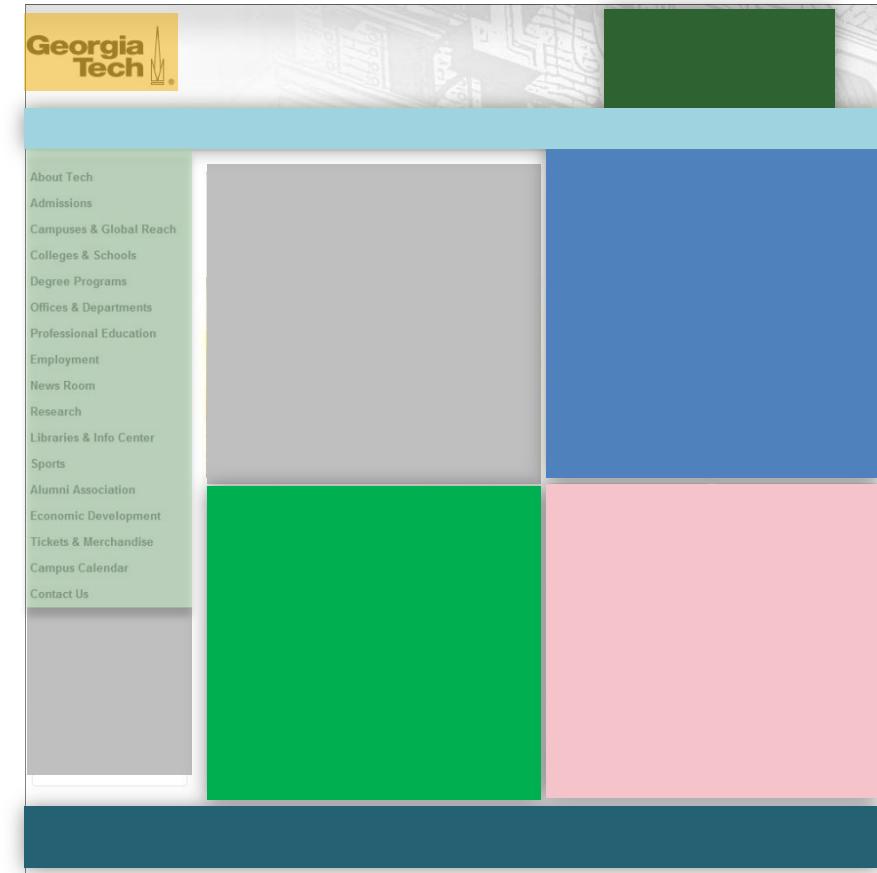
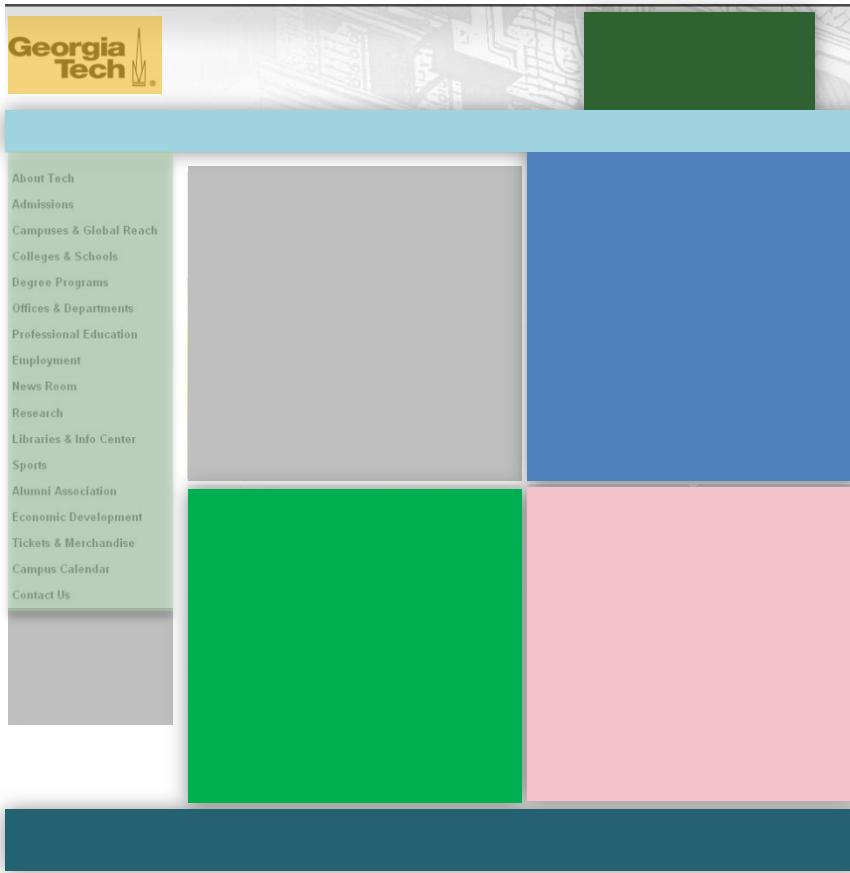
Visual Analysis

This screenshot shows the Georgia Tech website as it appears in Internet Explorer 8. The layout is slightly different from the modern browser version, with some visual elements and text appearing differently. The main navigation bar at the top includes links for BUZZPORT, CAMPUS MAP, DIRECTORIES, and a search bar. A large banner at the top right features the text "COMMENCEMENT JACKETS SUMMER 2010". The left sidebar contains a green navigation menu with links to About Tech, Admissions, Campuses & Global Reach, Colleges & Schools, Degree Programs, Offices & Departments, Professional Education, Employment, News Room, Research, Libraries & Info Center, Sports, Alumni Association, Economic Development, Tickets & Merchandise, Campus Calendar, and Contact Us. The main content area includes sections for NEWS & EVENTS, TWEETS @ TECH, APPLY TO TECH, GREEN BUZZ, GIVING TO TECH, CAREERS @ TECH, and EMERGENCY PROCEDURES. At the bottom, there is a digital lounge section with a blue background and text.

This screenshot shows the same Georgia Tech website as it appears in Google Chrome. The visual presentation is more consistent with modern web standards. The main navigation bar, banner, and sidebar menu are identical to the IE8 version. The main content area features a larger, more prominent NEWS & EVENTS section. Below it are TWEETS @ TECH, APPLY TO TECH, GREEN BUZZ, GIVING TO TECH, CAREERS @ TECH, and EMERGENCY PROCEDURES sections. The digital lounge section at the bottom is also present but looks slightly different due to the browser's rendering.

3b. Cross-browser Comparison

Visual Analysis



3b. Cross-browser Comparison

Visual Analysis

The screenshot shows the Georgia Tech homepage. At the top, there is a banner for "COMMENCEMENT HIGHLIGHTS SUMMER 2010" featuring a graduation cap icon. Below the banner, the Georgia Tech logo is on the left, followed by a search bar and navigation links for BUZZPORT, CAMPUS MAP, DIRECTORIES, and a general search. A large sidebar on the left contains links to various university departments like Admissions, Research, and Athletics. The main content area includes sections for "STRATEGIC VISION" (with a "PRESIDENT TO LAUNCH PLAN AUGUST 31" image), "VIDEOS @ TECH" (with a thumbnail of people), "BLOGS @ TECH" (with a word cloud image), and "NEWS & EVENTS". The "NEWS & EVENTS" section highlights "Georgia Tech to Host FutureMedia Fest 2010" (October 4-7) and "Powerful Processors May Threaten Password Security Systems". It also features a calendar entry for "IMPACT Speaker Series presents: Nobel Laureate Mohammad Yunus" on August 26. Other sections include "TWEETS @ TECH", "GREEN BUZZ", "GIVING TO TECH", "CAREERS @ TECH", and "EMERGENCY PROCEDURES". The footer contains links for CONTACT US, LEGAL & PRIVACY INFO, ACCOUNTABILITY, SITE MAP, TECH LINGO, RSS 2.0, and copyright information.

The screenshot shows the same Georgia Tech homepage in Google Chrome. The layout is identical to the IE version, but with some visual differences. The "NEWS & EVENTS" section is highlighted with a red border. The "IMPACT Speaker Series presents: Nobel Laureate Mohammad Yunus" event on August 26 is shown with a larger, more prominent date box. The overall design is cleaner and more modern than the IE version.

3b. Cross-browser Comparison

Visual Analysis

- Type of issues found:
- Positional shifts
 - Size differences
 - Visibility differences
 - General appearance issues

The image shows a side-by-side comparison of the Georgia Tech website in two different browsers. On the left is a screenshot from Internet Explorer, and on the right is a screenshot from Google Chrome. A large yellow callout box is positioned over the left screenshot, containing a bulleted list of four types of visual issues found during the comparison.

Left (Internet Explorer):

- About Tech
- Admissions
- Campuses & Global Reach
- Colleges & Schools
- Degree Programs
- Offices & Departments
- Professional Education
- Employment
- News Room
- Research
- Libraries & Info Center
- Sports
- Alumni Association
- Economic Development
- Tickets & Merchandise
- Campus Calendar
- Contact Us

Right (Google Chrome):

- PROSPECTIVE STUDENTS
- CURRENT STUDENTS
- FACULTY & STAFF
- PARENTS
- ALUMNI
- BUSINESS & INDUSTRY
- GOVERNMENT PARTNERS
- VISITORS

Common Elements:

- Georgia Tech logo
- BUZZPORT | CAMPUS MAP | DIRECTORIES | Search
- COMMENCEMENT JACKETS SUMMER 2010
- STRATEGIC VISION: PRESIDENT TO LAUNCH PLAN AUGUST 31
- VIDEOS @ TECH: tweets @ Tech
- BLOGS @ TECH: GREEN BUZZ
- TWEETS @ TECH: GIVING TO TECH
- APPLY TO TECH: CAREERS @ TECH
- DIGITAL LOUNGE @ TECH
- CONTACT US | LEGAL & PRIVACY INFO | ACCOUNTABILITY | SITE MAP | TECH LINGO | RSS 2.0
- ©2010 Georgia Institute of Technology :: Atlanta, Georgia 30332

Produced Report

Flock

Georgia Tech Public Service Announcement Hits
Right Note
PSA features Center for Music Technology Robot and College of Architecture student.

Competition Seeks the 'Hungriest Hacker at Georgia Tech'
Winner receives cash and a chance to interview at Georgia Tech Research Institute.

Georgia Tech Night at Six Flags
Shorter lines means more fun!

Green Awareness 5K Run/Walk
Hosted by the School of Building Construction and the Greater Atlanta Homebuilders Association.

SEP 10

SEP 11

Georgia Tech Public Service Announcement Hits
Right Note
PSA features Center for Music Technology Robot and College of Architecture student.

Competition Seeks the 'Hungriest Hacker at Georgia Tech'
Winner receives cash and a chance to interview at Georgia Tech Research Institute.

Georgia Tech Night at Six Flags
Shorter lines means more fun!

Green Awareness 5K Run/Walk
Hosted by the School of Building Construction and the Greater Atlanta Homebuilders Association.

SEP 11

SEP 11

Mozilla Firefox

(+/-) Issue Type	Screen Location	DOM XPath
+ Positional, Appearance	(220,630,584,930)	/HTML/BODY/DIV[2]/DIV[2]/DIV[6]/DIV/UL/LI
- Appearance	(796,162,966,187)	/HTML/BODY/DIV/DIV[3]/UL/LI/UL/LI
Appearance	(796,162,966,187)	/HTML/BODY/DIV/DIV[3]/UL/LI/UL/LI/A
Appearance	(796,162,966,187)	/HTML/BODY/DIV/DIV[3]/UL/LI/UL/LI

Internet Explorer

(+/-) Issue Type	Screen Location	DOM XPath
+ Positional, Appearance	(220,630,584,930)	/HTML/BODY/DIV[2]/DIV[2]/DIV[6]/DIV/UL/LI
- Appearance	(796,162,966,187)	/HTML/BODY/DIV/DIV[3]/UL/LI/UL/LI
Appearance	(796,162,966,187)	/HTML/BODY/DIV/DIV[3]/UL/LI/UL/LI/A
Appearance	(796,162,966,187)	/HTML/BODY/DIV/DIV[3]/UL/LI/UL/LI

Produced Report

Reference Browser screenshot

The screenshot shows a calendar interface for Mozilla Firefox. On September 10, there is an event titled "Georgia Tech Public Service Announcement Hits" featuring a video thumbnail of a person at a drum set. On September 11, there are two events: "Competition Seeks the 'Hungriest Hacker at Georgia Tech'" with a cartoon character thumbnail, and "Georgia Tech Night at Six Flags" with a text description. The Firefox developer tools DOM Inspector is overlaid, showing the DOM structure for these elements.

Target Browser screenshot

The screenshot shows the same calendar view in Internet Explorer. The layout is identical to the Firefox version, displaying the same events for September 10 and 11. A red box highlights the event on September 11, "Competition Seeks the 'Hungriest Hacker at Georgia Tech'", which includes a thumbnail image of a cartoon character.

Mozilla Firefox

(+/-) Issue Type	Screen Location
+ Positional, Appearance	(220, 630, 584, 930)
- Appearance	(796, 162, 966, 187)
Appearance	(796, 162, 966, 187)
Appearance	(796, 162, 966, 187)

Internet Explorer

DOM XPath
/HTML/BODY/DIV[2]/DIV[2]/DIV[6]/DIV/UL/LI
/HTML/BODY/DIV/DIV[3]/UL/LI/UL/LI
/HTML/BODY/DIV/DIV[3]/UL/LI/UL/LI/A
/HTML/BODY/DIV/DIV[3]/UL/LI/UL/LI

Empirical Evaluation

- **RQ1** : Can WEBDIFF identify cross-browser issues in web applications?
- **RQ2** : Can WEBDIFF identify such issues without generating too many false positives?

Experimental Settings

Test Subjects

Subject Name	URL	Type
GATECH	http://www.gatech.edu	University
BECKER	http://www.beckerelectric.com	Company
CHESNUT	http://www.chestnutridgecabin.com	Lodge
CRSTI	http://www.crsti.org	Hospital
DUICTRL	http://www.duicentral.com	Lawyer
JTWED	http://www.jtweddings.com	Photography
ORTHO	http://www.otorohanga.co.nz	Informational
PROTOOLS	http://www.protoolsexpress.com	Company
SPEED	http://www.speedsound.com	E-Commerce

For each page P and browser B considered

1. Load P in B and in the reference browser
2. Compare the page in the two browsers using our technique
3. Store the produced reports
4. Manually checked for false positives and false negatives

Results

Subject	# Issues Reported					False Positives	False Negatives
	Pos.	Size	Vis.	Gen.	Tot.		
GATECH	2	3	0	1	6	0 (0%)	0
BECKER	2	12	0	3	17	1 (6.25%)	0
CHESNUT	8	4	0	4	16	2 (14.3%)	0
CRSTI	4	4	0	2	9	0 (0%)	0
DUICTRL	9	8	0	6	23	4 (21%)	0
JTWED	3	9	0	1	14	0 (0%)	0
ORTHO	0	0	0	4	4	2 (100%)	0
PROTOOLS	4	5	0	11	20	9 (81%)	0
SPEED	23	5	0	5	33	3 (10%)	0
TOTAL	55	50	0	37	142	21 (17%)	0

Results

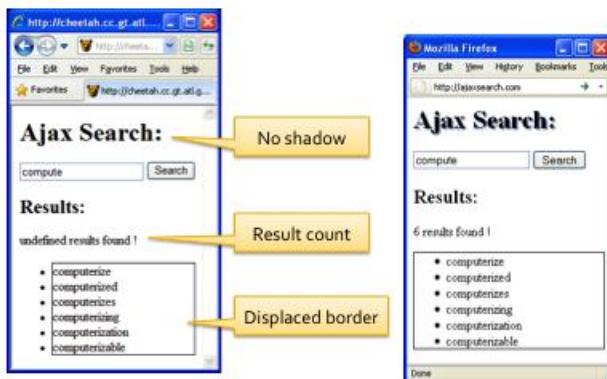
Subject	# Issues Reported					False Positives	False Negatives
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CHESNUT	8	4	0	4	16	2 (14.3%)	0
CRSTI	4	4	0	2	9	0 (0%)	0
DUICTRL	9	8	0	6	23	4 (21%)	0
JTWED	3	9	0	1	14	0 (0%)	0
ORTHO	0	0	0	4	4	2 (100%)	0
PROTOOLS	4	5	0	11	20	9 (81%)	0
SPEED	23	5	0	5	33	3 (10%)	0
TOTAL	55	50	0	37	142	21 (17%)	0

Related Work

- Industrial Tools
 - Adobe Browser Lab & MS Expression Web
 - Require manual inspection
 - Browsera (launched Summer 2010)
 - Simple DOM matching (from experience using the tool)
- Research Tools
 - Eaton & Memon [IJWET07]
 - Requires manual classification. Limited to html tags only
 - Tamm [GTACo9]
 - Expensive and is focused on layout of text elements

Summary

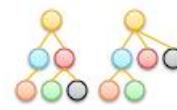
Motivating Example



Challenges and Issues



Manual inspection
is expensive



DOM differs
between browsers



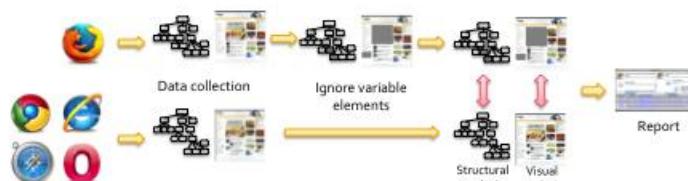
Ignore variable elements
on webpage



Even work with
browser security controls

Our Technique

- **Goal:**
Compare behavior of web pages in different browsers
- High level view of the approach:



Results

Subject	# Issues Reported					False Positives
	Pos.	Size	Vis.	Gen.	Tot.	
GATECH	2	3	0	1	6	0 (0%)
BECKER	2	12	0	3	17	1 (6.25%)
CHESNUT	8	4	0	4	16	2 (14.3%)
CRSTI	4	4	0	2	9	0 (0%)
DUICTRL	9	8	0	6	23	4 (21%)
JTWED	3	9	0	1	14	0 (0%)
ORTHO	0	0	0	4	4	2 (100%)
PROTOOLS	4	5	0	11	20	9 (81%)
SPEED	23	5	0	5	33	3 (10%)
TOTAL	55	50	0	37	142	21 (17%)

- RQ1 (Effectiveness): No false negatives in test subjects
- RQ2 (Efficiency): False positive rate of 17%