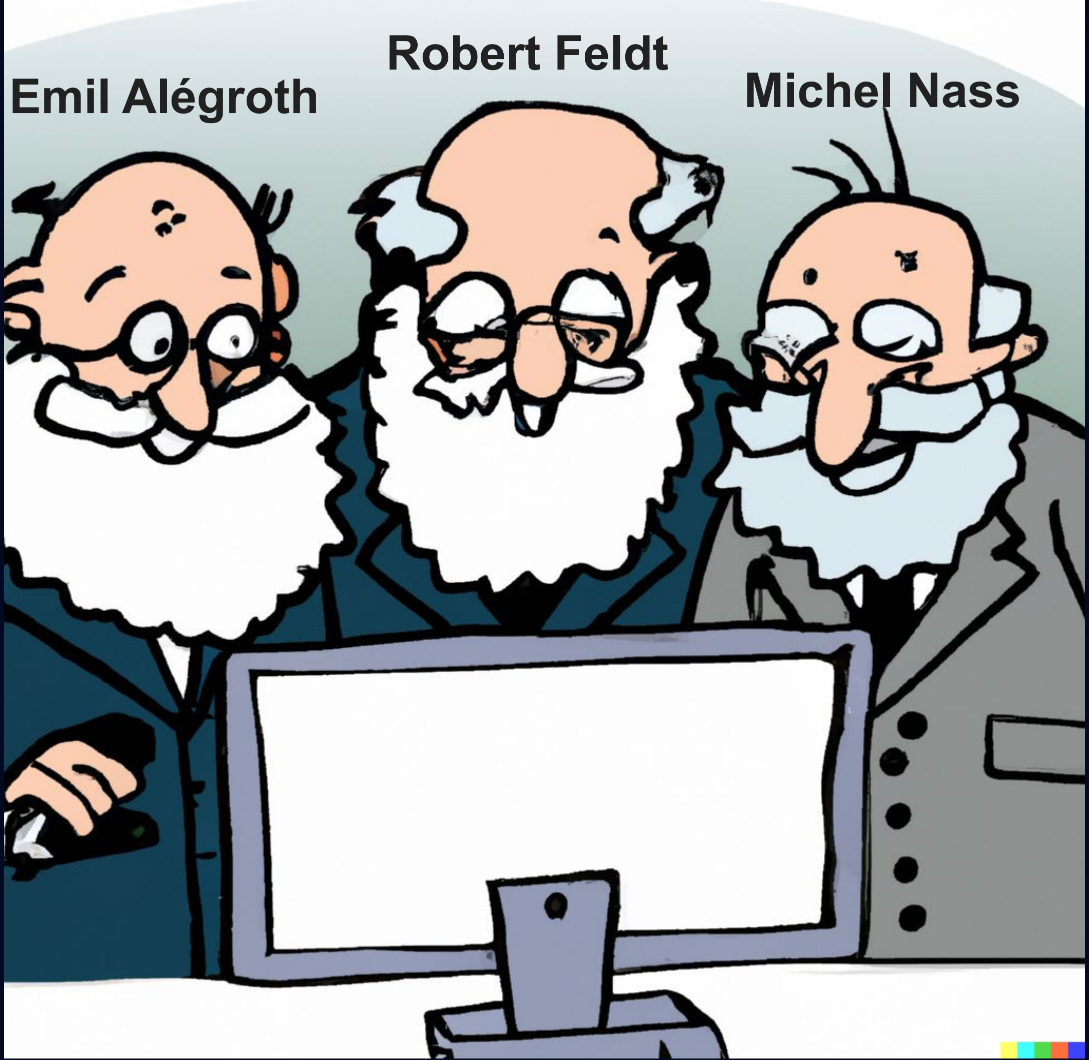
Equivalence-based widget identification

(by considering visual overlaps)

Why is GUI-based test automation so difficult?

Why is GUI-based test automation so difficult?

GUIs are designed for humans, not machines!



100 years later…

Selenium WebDriver Example

```
System.setProperty("webdriver.chrome.driver", (new File("chromedriver.exe")).getAbsolutePath());
WebDriver webDriver=new ChromeDriver();
webDriver.get(“https://michelnass.com/traveler”);

WebDriverWait wait = new WebDriverWait(webDriver, Duration.ofSeconds(30));
wait.until(ExpectedConditions.urlContains(url));
try {
        Thread.sleep(1000);
        WebElement element;
        element=wait.until(ExpectedConditions.visibilityOfElementLocated(By.linkText("Contact")));
        element.click();
        element=wait.until(ExpectedConditions.visibilityOfElementLocated(By.tagName("H1")));
        assertTrue(element.getText().contains("Get In Touch"));
        element=wait.until(ExpectedConditions.visibilityOfElementLocated(By.id("name")));
        element.sendKeys("Michel");
        element=wait.until(ExpectedConditions.visibilityOfElementLocated(By.id("email")));
        element.sendKeys("michel.nass@bth.se");
        element=wait.until(ExpectedConditions.visibilityOfElementLocated(By.id("subject")));
        element.sendKeys("Contact me");
        element=wait.until(ExpectedConditions.visibilityOfElementLocated(By.linkText("Send Message")));
        element.click();
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        assertTrue(element.getText().contains("we will contact you shortly"));
} catch(Exception e) {}
webDriver.quit();
```

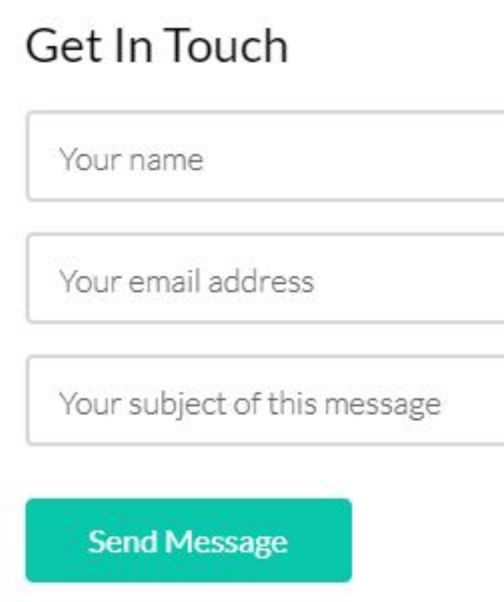

Get In Touch

Selenium WebDriver Example

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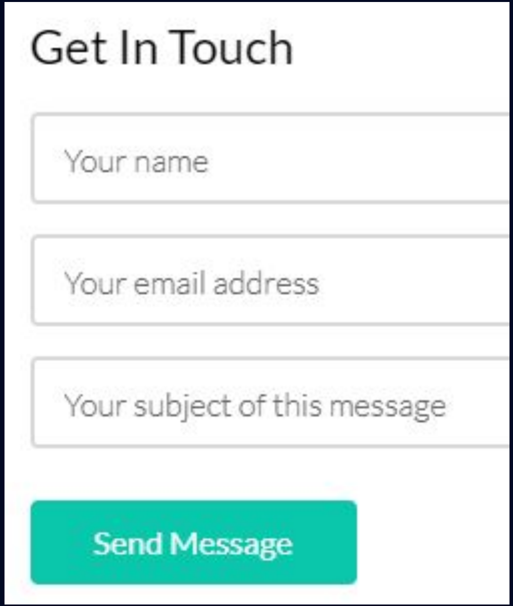
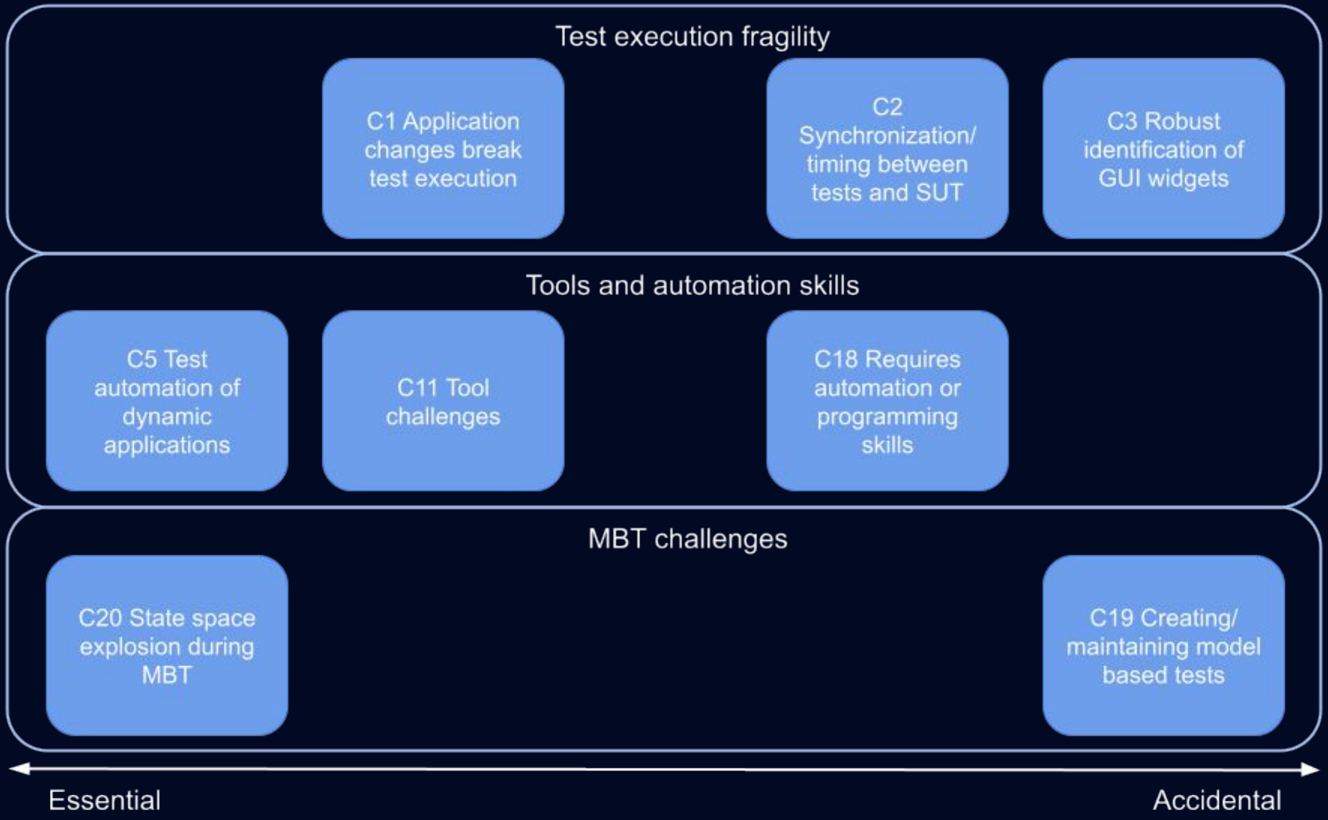


What are the challenges of GUI-based test automation?

What are the challenges of GUI-based test automation?



Test execution fragility

C1 Application changes break test execution

C2 Synchronization/ timing between tests and SUT

C3 Robust identification of GUI widgets

Tools and automation skills

C5 Test automation of dynamic applications

C11 Tool challenges

C18 Requires automation or programming skills

MBT challenges

C20 State space explosion during MBT

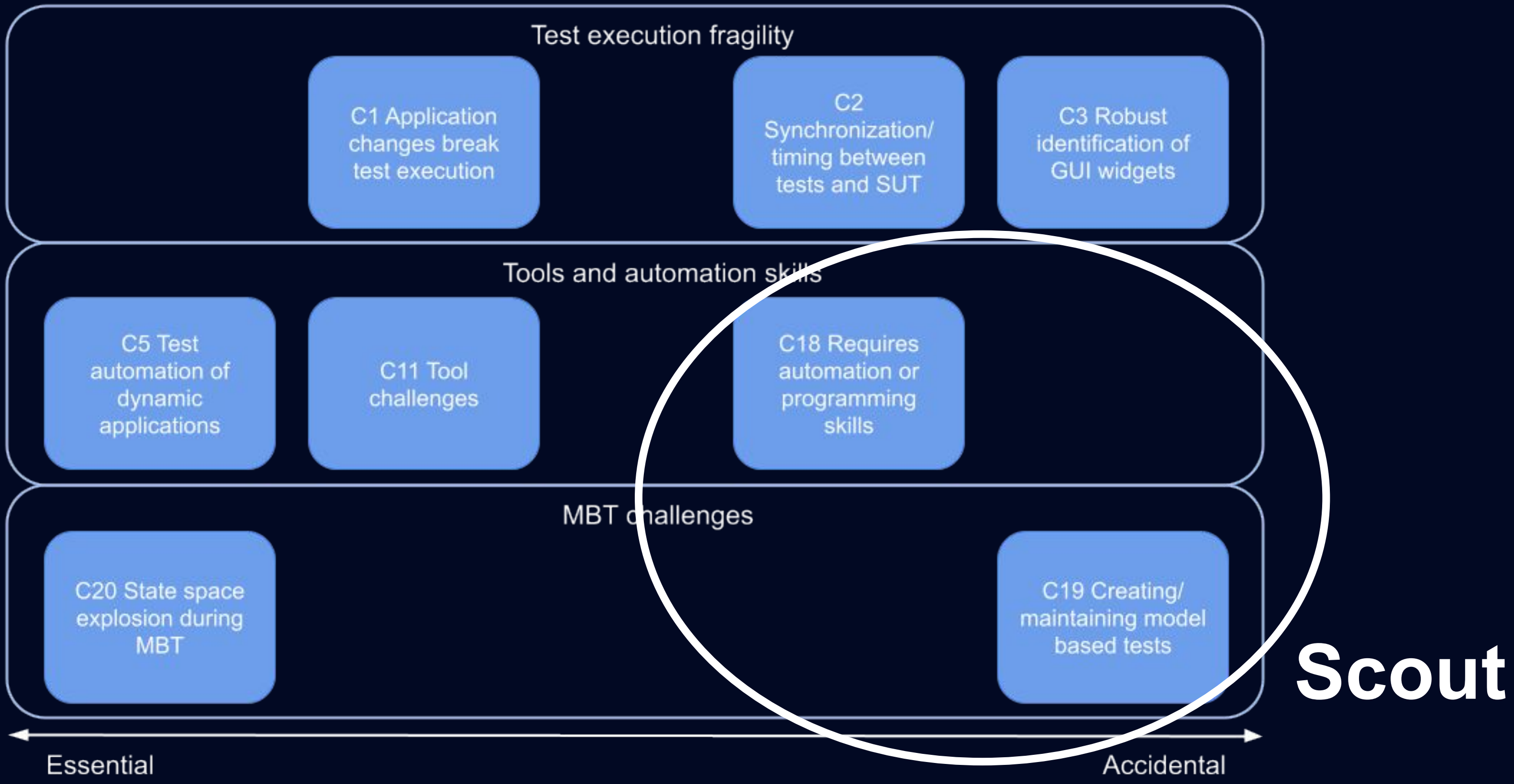
C19 Creating/ maintaining model based tests

Essential

Accidental

[1] Why many challenges with GUI Test Automation (will) remain (Michel Nass, Emil Alégroth, and Robert Feldt)

What are the challenges of GUI-based test automation?



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C18 Requires automation or programming skills

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C19 Creating/ maintaining model based tests

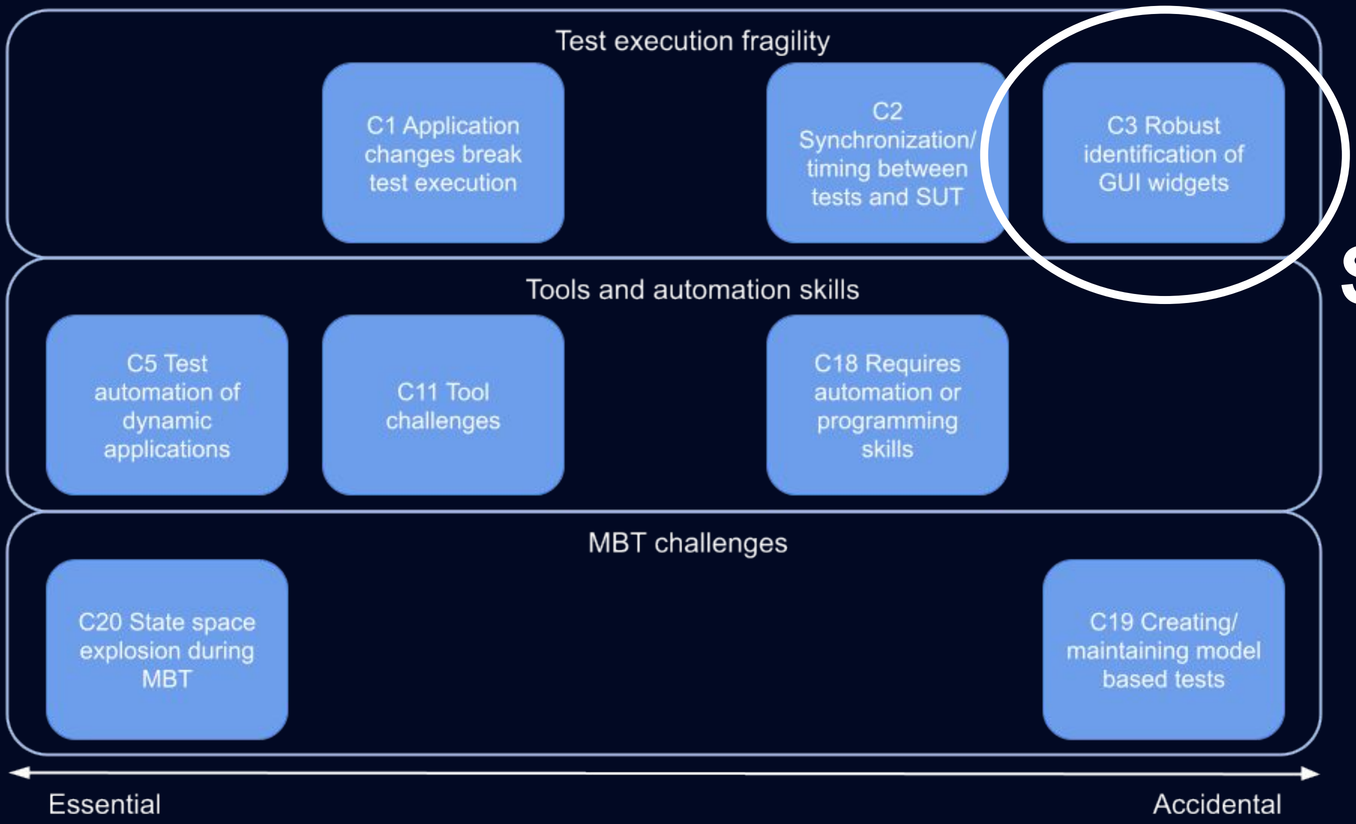
Essential

Accidental

Scout

[1] Augmented Testing: Industry Feedback To Shape a New Testing Technology (Michel Nass, Emil Alégroth, and Robert Feldt)
[2] On the Industrial Applicability of Augmented Testing: An Empirical Study (Michel Nass, Emil Alégroth, and Robert Feldt)

What are the challenges of GUI-based test automation?



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Similo

[1] Similarity-based web element localization for robust test automation (Michel Nass, Emil Alégroth, Robert Feldt, Maurizio Leotta, and Filippo Ricca)

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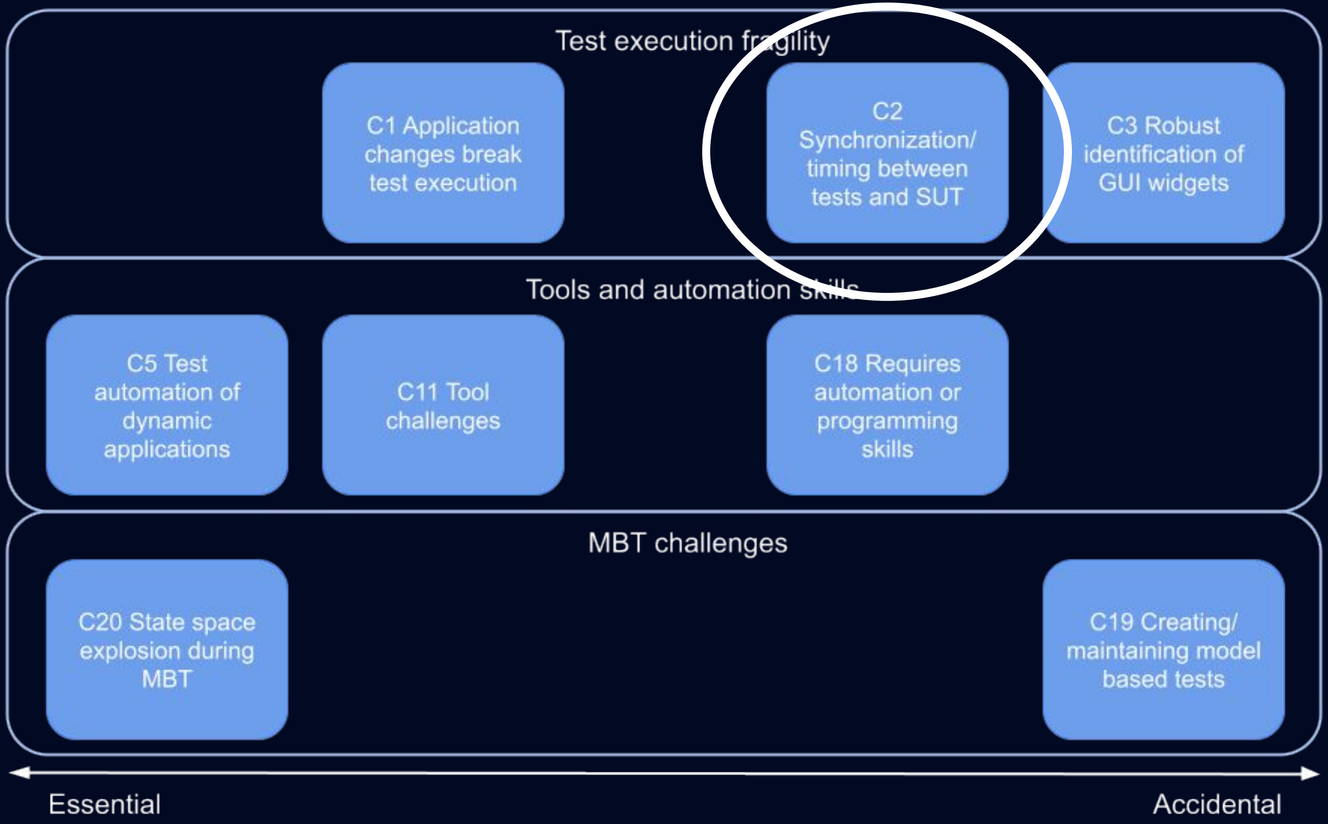

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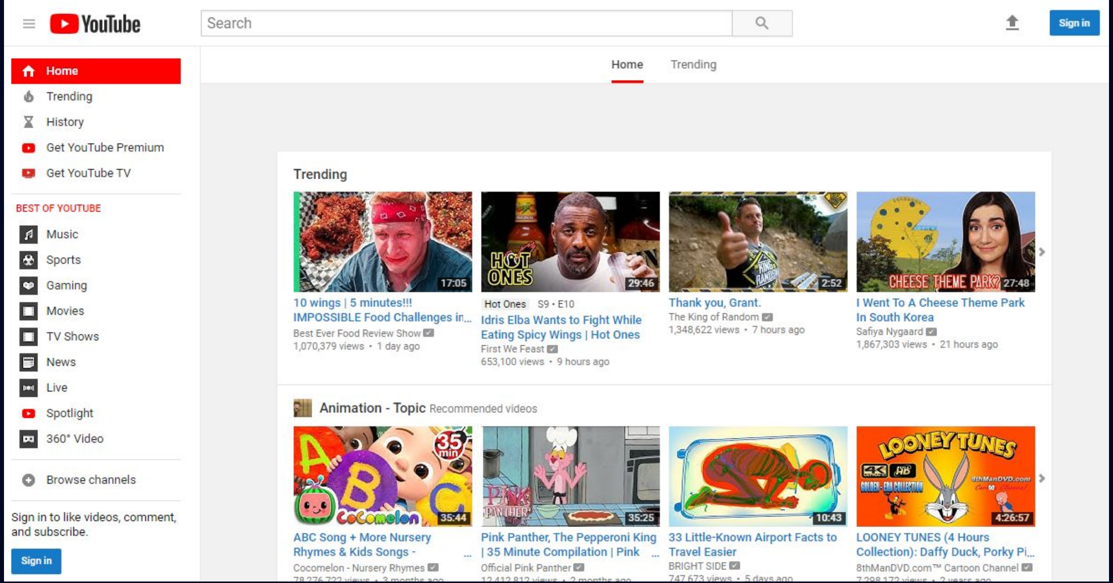
Similo

Similarity-based web element localization for robust test automation

[1] Similarity-based web element localization for robust test automation (Michel Nass, Emil Alégroth, Robert Feldt, Maurizio Leotta, and Filippo Ricca)

How many similarities can you find?

OLD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Get YouTube TV
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Sports
Gaming
Movies
TV Shows
News
Live
Spotlight
360° Video
Browse channels
Sign in to like videos, comment, and subscribe.
Sign in
Trending
17:05
10 wings | 5 minutes!!! IMPOSSIBLE Food Challenges in...
Best Ever Food Review Show
1,070,379 views • 1 day ago
29:46
Hot Ones S9 • E10
Idris Elba Wants to Fight While Eating Spicy Wings | Hot Ones
First We Feast
653,100 views • 9 hours ago
2:52
Thank you, Grant.
The King of Random
1,348,622 views • 7 hours ago
CHEESE THEME PARK? 27:48
I Went To A Cheese Theme Park In South Korea
Safiya Nygaard
1,867,303 views • 21 hours ago
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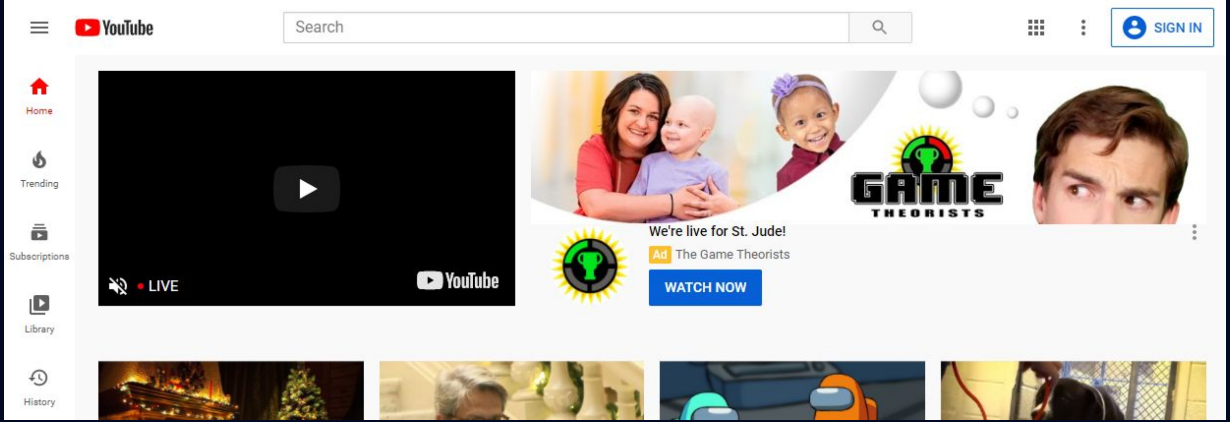
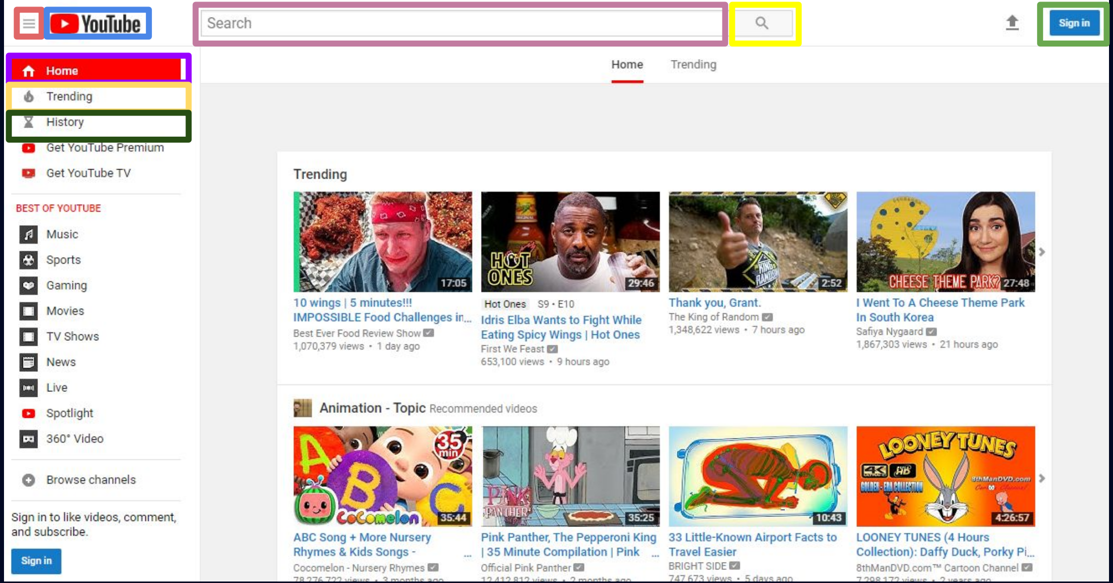
35:44
ABC Song + More Nursery Rhymes & Kids Songs - ...
Cocomelon - Nursery Rhymes
35:25
Pink Panther, The Pepperoni King | 35 Minute Compilation | Pink ...
Official Pink Panther
10:43
33 Little-Known Airport Facts to Travel Easier
BRIGHT SIDE
747,673 views • 5 days ago
LOONEY TUNES
4:26:57
LOONEY TUNES (4 Hours Collection): Daffy Duck, Porky Pi...
8thManDVD.com™ Cartoon Channel

NEW



OLD



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Hot Ones S9 • E10
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Cocomelon - Nursery Rhymes
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Pink Panther, The Pepperoni King | 35 Minute Compilation | Pink ...
Official Pink Panther
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33 Little-Known Airport Facts to Travel Easier
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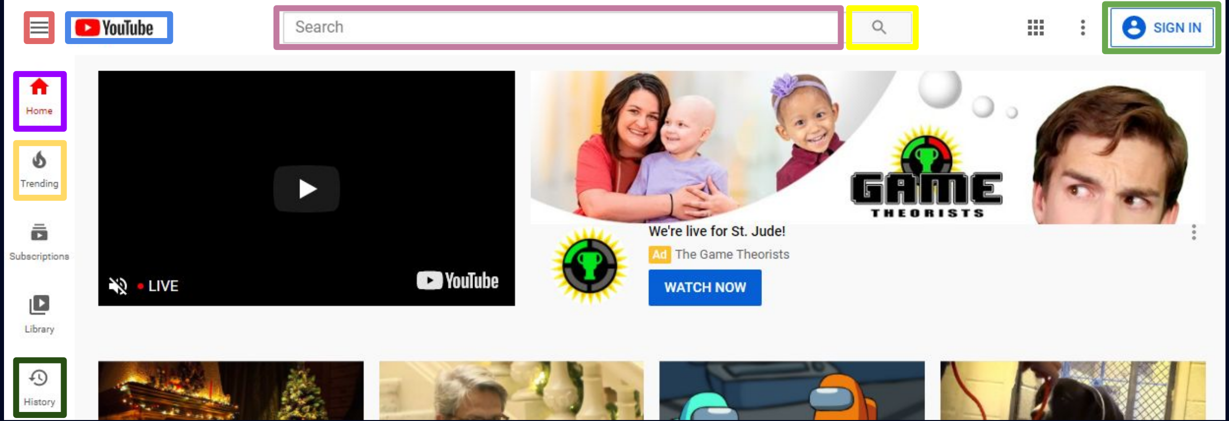
NEW



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We're live for St. Jude!

Ad The Game Theorists

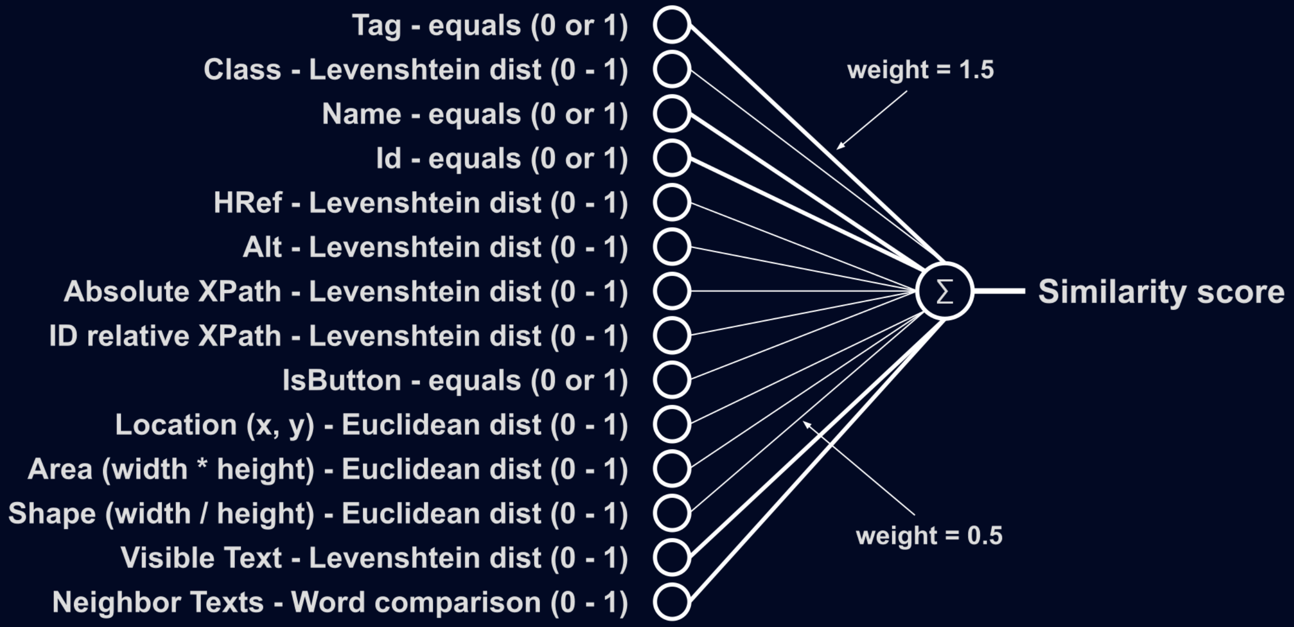
WATCH NOW

Web element properties (for the History button in YouTube.com)

	Newer version of YouTube.com	Older version of YouTube.com
Tag:	SPAN	SPAN
Text:	History	History
XPath:	/html[1]/body[1]/ytd-app[1]/div[1]/ytd-mini-guide-renderer[1]/div[1]/ytd-mini-guide-entry-renderer[5]/a[1]/span[1]	/html[1]/body[1]/div[4]/div[4]/div[1]/div[1]/div[1]/div[1]/div[1]/ul[1]/li[1]/div[1]/ul[1]/li[3]/a[1]/span[1]/span[2]/span[1]
IDXPath:	id("content")/ytd-mini-guide-renderer[1]/div[1]/ytd-mini-guide-entry-renderer[5]/a[1]/span[1]	id("history-guide-item")/a[1]/span[1]/span[2]/span[1]
Class:	title style-scope ytd-mini-guide-entry-renderer	

Similarity-based GUI web element localization (Similo)

The core functionality of the approach consists of finding the web element among a set of candidate web elements (e.g., web elements extracted from a webpage), which has the most similar locator parameters to the target web element (i.e., desired capabilities).



Tag - equals (0 or 1)

Class - Levenshtein dist (0 - 1)

Name - equals (0 or 1)

Id - equals (0 or 1)

HRef - Levenshtein dist (0 - 1)

Alt - Levenshtein dist (0 - 1)

Absolute XPath - Levenshtein dist (0 - 1)

ID relative XPath - Levenshtein dist (0 - 1)

IsButton - equals (0 or 1)

Location (x, y) - Euclidean dist (0 - 1)

Area (width * height) - Euclidean dist (0 - 1)

Shape (width / height) - Euclidean dist (0 - 1)

Visible Text - Levenshtein dist (0 - 1)

Neighbor Texts - Word comparison (0 - 1)

weight = 1.5

weight = 0.5

Similarity score

[1] Similarity-based web element localization for robust test automation (Michel Nass, Emil Alégroth, Robert Feldt, Maurizio Leotta, and Filippo Ricca)

Results

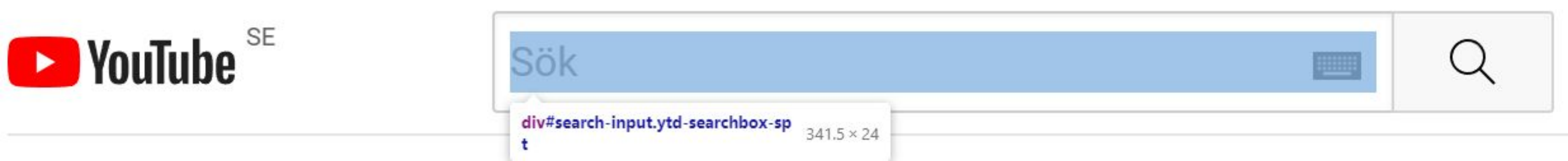
Locator	**Located**	**Non-Located**	**Non-Located %**
Absolute XPath	136	665	83
Relative ID-based XPath	326	475	59
Selenium IDE	394	407	51
Montoto	422	379	47
Robula+	490	311	39
LML (theoretical limit)	**587**	**214**	**27**
Similo	**710**	**91**	**11**

[1] Similarity-based web element localization for robust test automation (Michel Nass, Emil Alégroth, Robert Feldt, Maurizio Leotta, and Filippo Ricca)

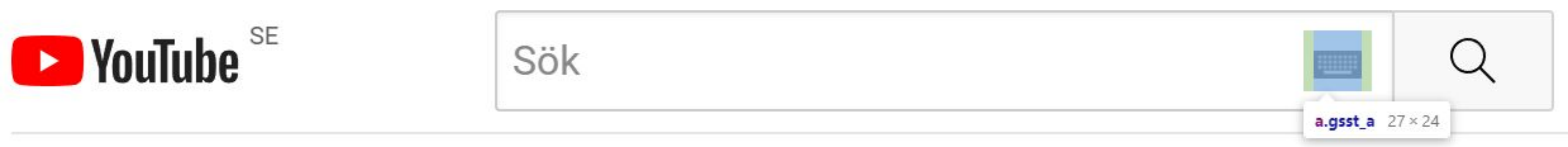
VON Similo

Similo enhanced by Visual Overlapping Nodes

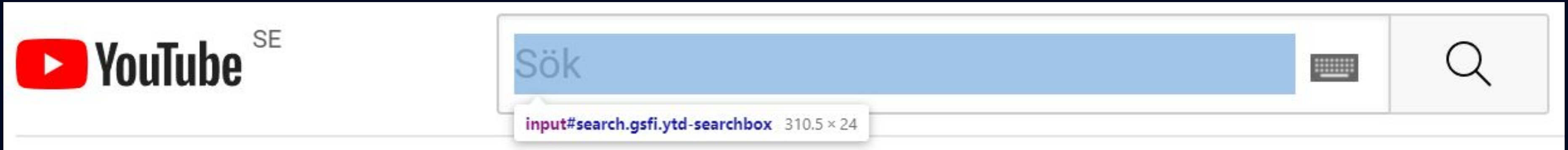
YouTube SE
Sök


YouTube
SE
Sök
div#search-input.ytd-searchbox-sp
t
341.5 × 24

```
<div id="search-input">
    <div>
        <div>
            <a>
                <span>
                    <img src="...">
                </span>
            </a>
        </div>
        <div>
            <input id="search" name="search_query" placeholder="Sök">
        </div>
    </div>
</div>
```


YouTube SE
Sök
a.gsst_a 27 × 24

```
<div id="search-input">
        <div>
                <div>
                        <a>
                                <span>
                                        <img src="...">
                                </span>
                        </a>
                </div>
                <div>
                        <input id="search" name="search_query" placeholder="Sök">
                </div>
        </div>
</div>
```


YouTube SE
Sök
input#search.gsfi.ytd-searchbox 310.5 × 24

```
<div id="search-input">
        <div>
                <div>
                        <a>
                                <span>
                                        <img src="...">
                                </span>
                        </a>
                </div>
                <div>
                        <input id="search" name="search_query" placeholder="Sök">
                </div>
        </div>
</div>
```

Result

The concept of Visually Overlapping Nodes significantly improves web element localization in Similo (94% vs 82% in mean accuracy)

[1] Robust web element identification for evolving applications by considering visual overlaps

VON Similo Selenium Plugin

Selenium WebDriver Example

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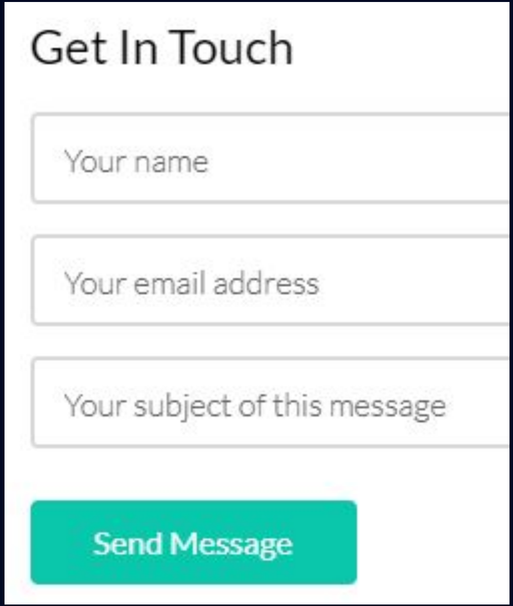


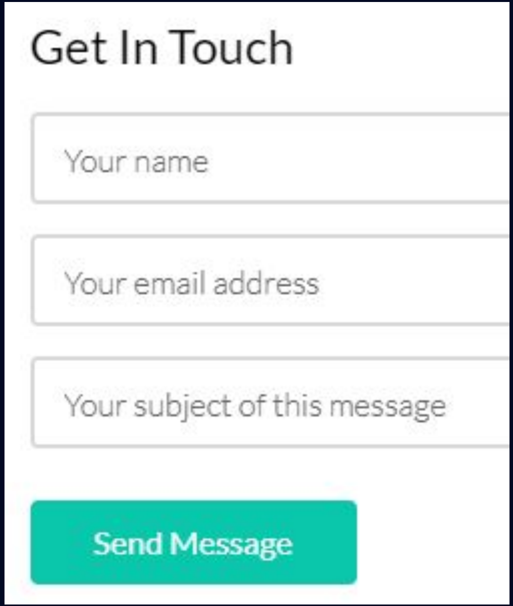
Selenium WebDriver Example with Similo

```
System.setProperty("webdriver.chrome.driver", (new File("chromedriver.exe")).getAbsolutePath());
WebDriver webDriver=new ChromeDriver();
webDriver.get(“https://michelnass.com/traveler”);

// Create the adaptive and self-healing multi-locator
Similo similo=new Similo(webDriver, "locators");

// Fill out and send the contacts form
similo.click("Contact");
assertTrue(similo.check("Get In Touch", "{visible_text} = Get In Touch"));
similo.type("Your name", "Michel");
similo.type("Your email address", "michel.nass@bth.se");
similo.type("Your subject of this message", "Contact me");
similo.click("Send Message");
assertTrue(similo.check("we will contact you shortly", "{visible_text} = we will contact you shortly"));

webDriver.quit();
```



Questions?

Like to try Similo?

michel.nass@bth.se

michelnass.com