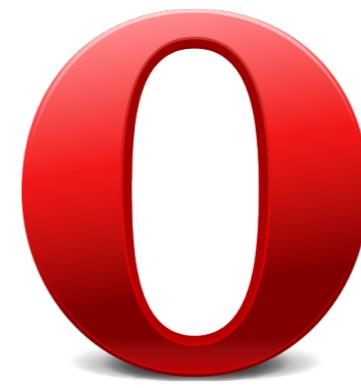


THOMAS WALSH¹, PHIL MCMINN¹, GREGORY KAPFHAMMER²

¹UNIVERSITY OF SHEFFIELD, ²ALLEGHENY COLLEGE

AUTOMATED LAYOUT FAILURE DETECTION FOR RESPONSIVE WEB PAGES WITHOUT AN EXPLICIT ORACLE

A LONG TIME AGO...



THE WEB TODAY



WHY SUPPORT ALL DEVICES?

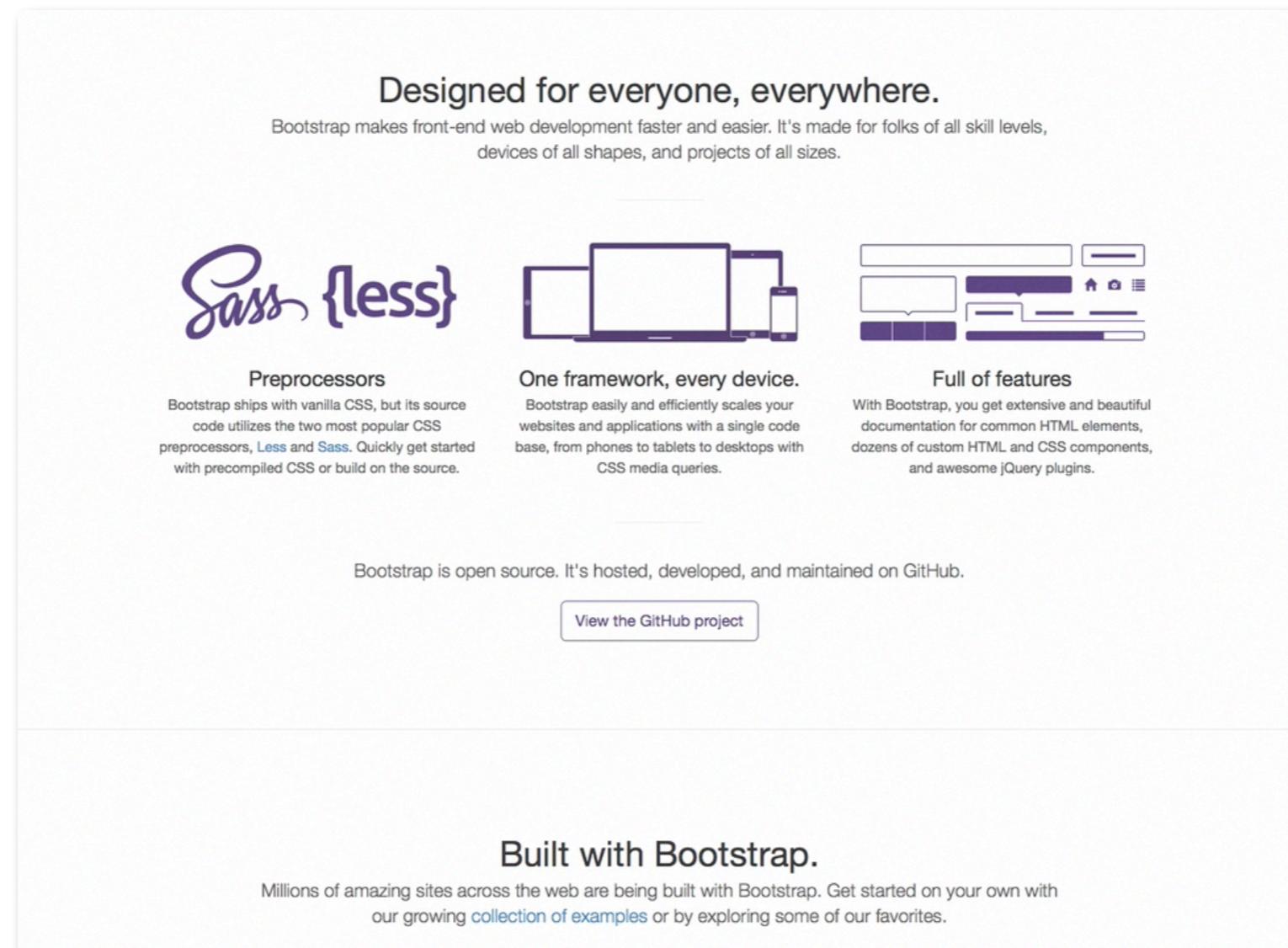
**HOW CAN DEVELOPERS MAKE WEBSITES SUPPORT
ALL DEVICES?**

USE RESPONSIVE WEB DESIGN.

RESPONSIVE WEB DESIGN

Designed for everyone, everywhere.

Bootstrap makes front-end web development faster and easier. It's made for folks of all skill levels, devices of all shapes, and projects of all sizes.



Sass {less}

Preprocessors
Bootstrap ships with vanilla CSS, but its source code utilizes the two most popular CSS preprocessors, [Less](#) and [Sass](#). Quickly get started with precompiled CSS or build on the source.

One framework, every device.
Bootstrap easily and efficiently scales your websites and applications with a single code base, from phones to tablets to desktops with CSS media queries.

Full of features
With Bootstrap, you get extensive and beautiful documentation for common HTML elements, dozens of custom HTML and CSS components, and awesome jQuery plugins.

Bootstrap is open source. It's hosted, developed, and maintained on GitHub.

[View the GitHub project](#)

Built with Bootstrap.

Millions of amazing sites across the web are being built with Bootstrap. Get started on your own with our growing [collection of examples](#) or by exploring some of our favorites.

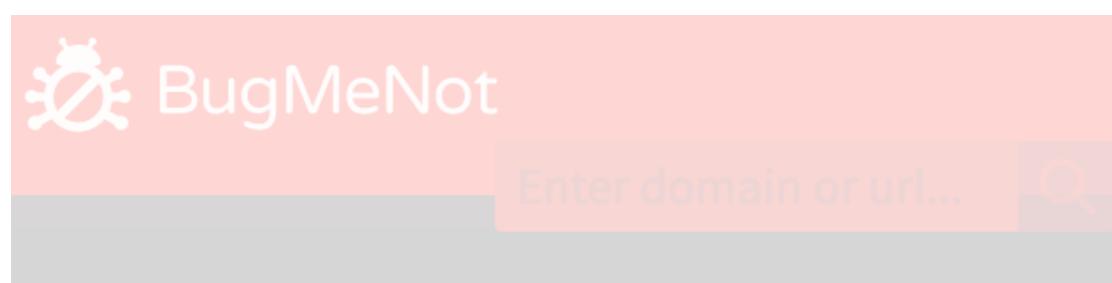
<http://getbootstrap.com>

RESPONSIVE LAYOUT FAILURES



How It Works Learn More Card Gallery Request Samples

Pricing

A screenshot of the WhereIsEveryone? website. It features two main input fields: 'Where is everyone?' and 'What do you want to do?'. The 'Where is everyone?' field contains the placeholder 'Enter a starting address'. The 'What do you want to do?' field contains the placeholder "'coffee', 'bar', 'Italian food'" and has a 'Go!' button to its right. Below these fields, there's a note: 'Enter the starting location for each member of your...'. To the right of the input fields is a small map showing several locations with pins.

RESPONSIVE LAYOUT FAILURES



How It Works Learn More Card Gallery Request Samples

Pricing

A screenshot of a map-based search interface. It features two main input fields: 'Where is everyone?' and 'What do you want to do?'. The 'Where is everyone?' field contains the placeholder 'Enter a starting address'. The 'What do you want to do?' field contains the placeholder "'coffee', 'bar', 'Italian food'" and has a blue 'Go!' button to its right. Below these fields is a map showing several locations with pins. A text instruction 'Enter the starting location for each member of your' is visible on the left side of the map.

RESPONSIVE LAYOUT FAILURES



How It Works Learn More Card Gallery Request Samples

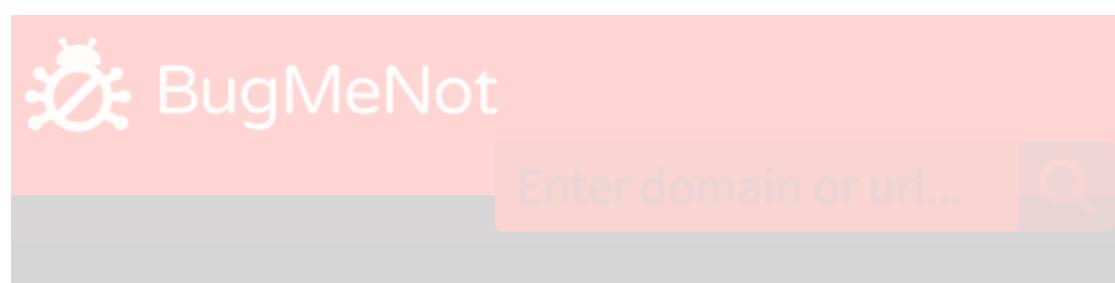
Pricing

Where is everyone?

What do you want to do?

Enter a starting address 'coffee', 'bar', 'Italian food' Go!

Enter the starting location
for each member of your

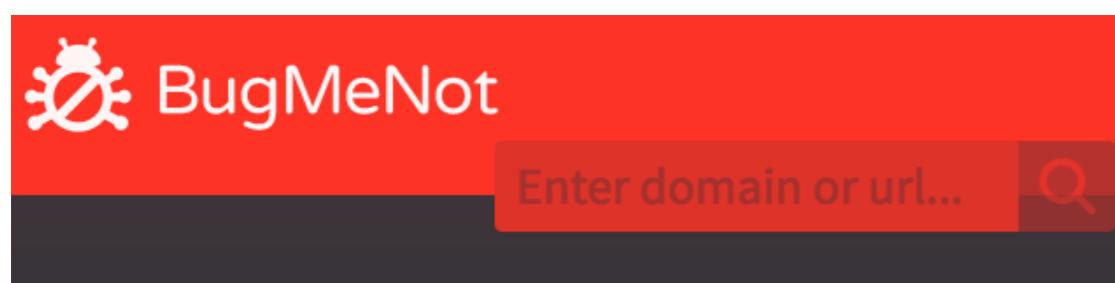


RESPONSIVE LAYOUT FAILURES



How It Works Learn More Card Gallery Request Samples

Pricing

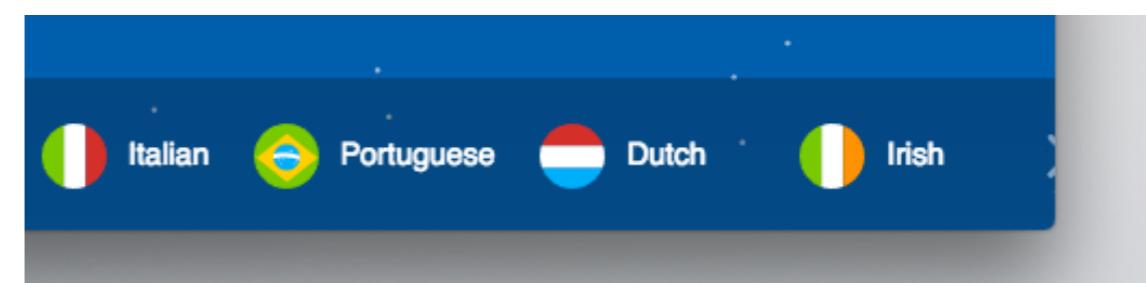
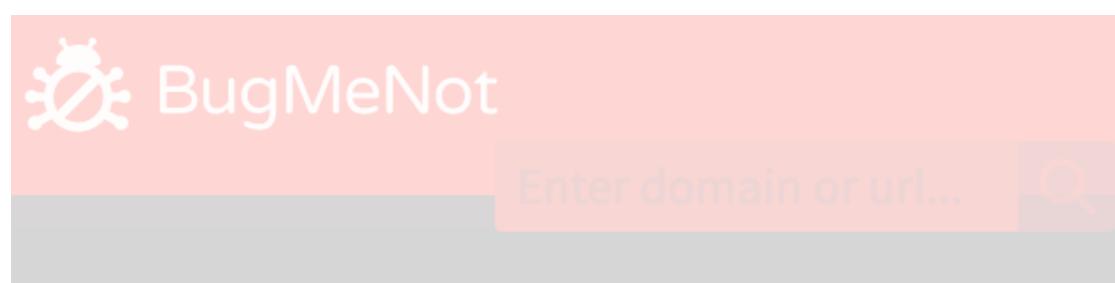
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RESPONSIVE LAYOUT FAILURES



How It Works Learn More Card Gallery Request Samples

Pricing

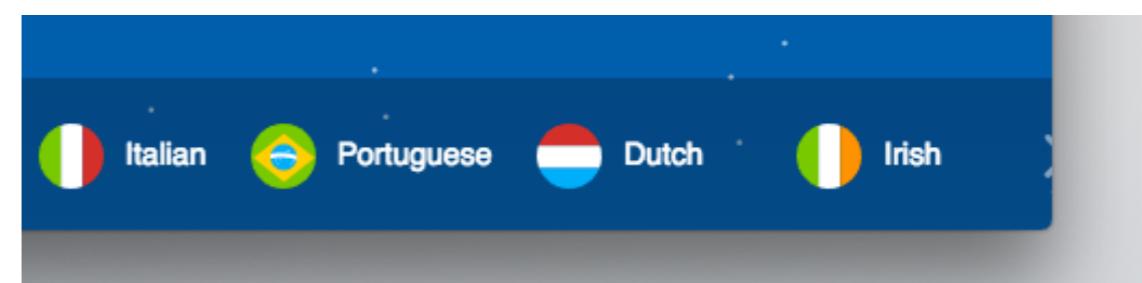
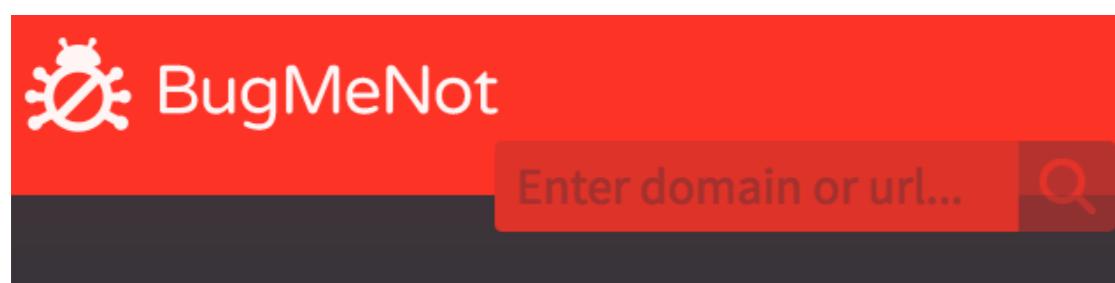
A screenshot of the WhereIsEveryone? website. It features two main input fields: 'Where Is everyone?' and 'What do you want to do?'. The first field contains the placeholder 'Enter a starting address' and the second contains 'coffee', 'bar', 'Italian food'. To the right of the second field is a blue 'Go!' button. Below these fields is a small map showing several locations with pins.

RESPONSIVE LAYOUT FAILURES



How It Works Learn More Card Gallery Request Samples

Pricing

A screenshot of a map-based search interface. It features two main input fields: 'Where is everyone?' and 'What do you want to do?'. The 'Where is everyone?' field contains the placeholder 'Enter a starting address'. The 'What do you want to do?' field contains the placeholder "'coffee', 'bar', 'Italian food'" and has a blue 'Go!' button to its right. Below these fields, there's a smaller instruction 'Enter the starting location for each member of your' followed by a small map preview.

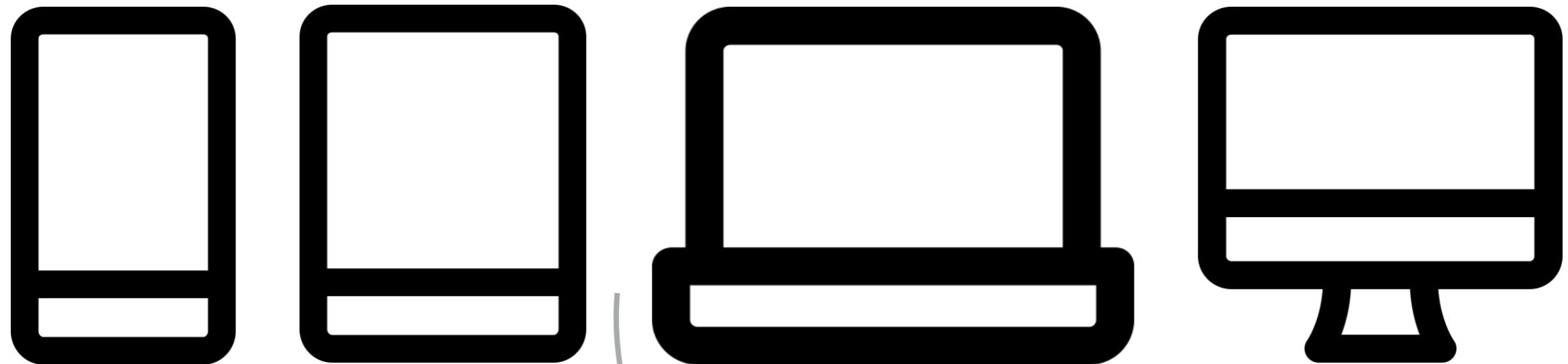
**HOW DO DEVELOPERS TEST RESPONSIVE
WEBSITES?**

THEY “SPOT-CHECK”.

WHAT IS THE ORACLE FOR RESPONSIVE WEBSITES?

THE HUMAN TESTER.

A SPOTCHECKING EXAMPLE



320 pixels

768 pixels

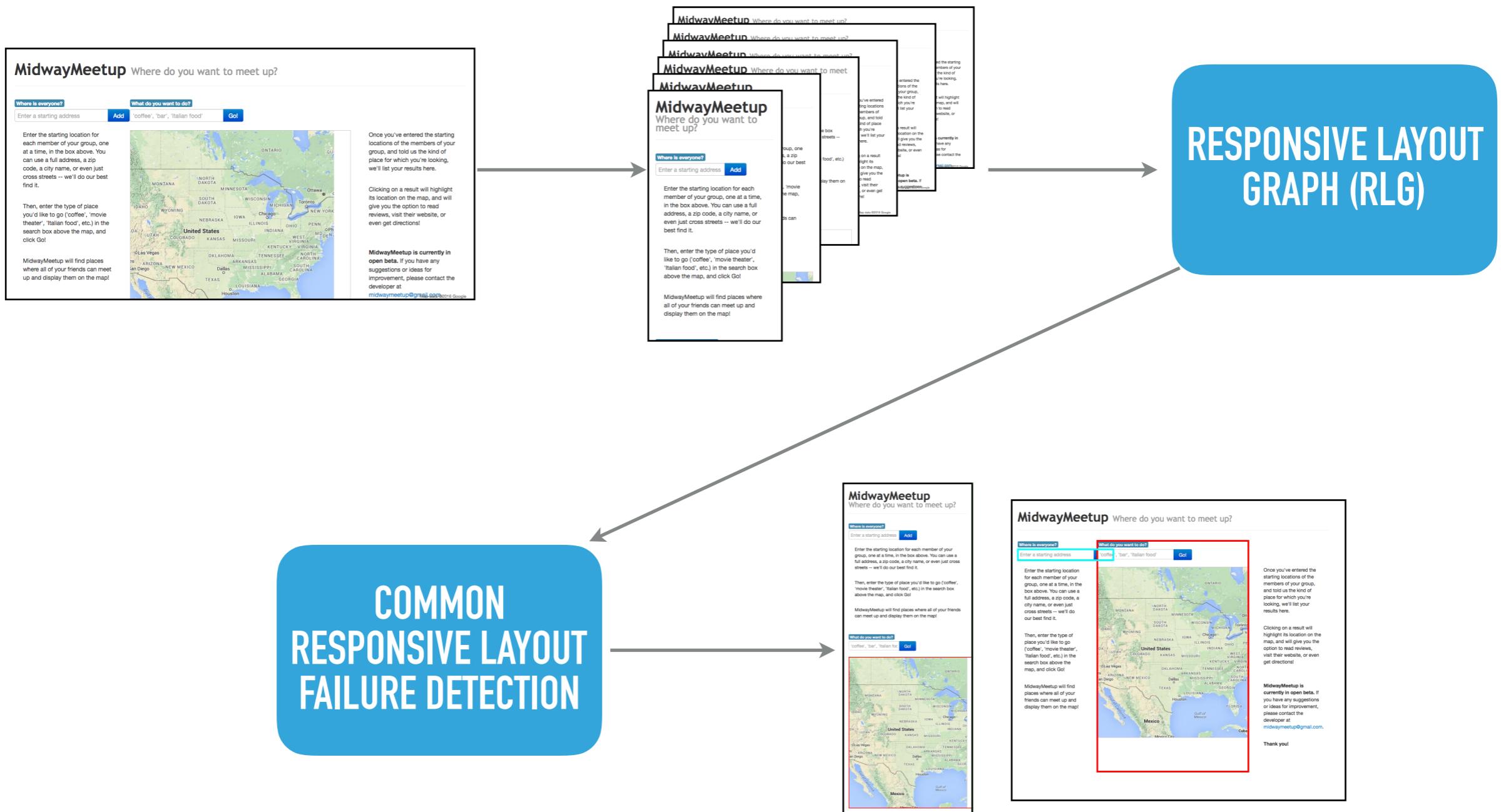
1024 pixels

1200 pixels

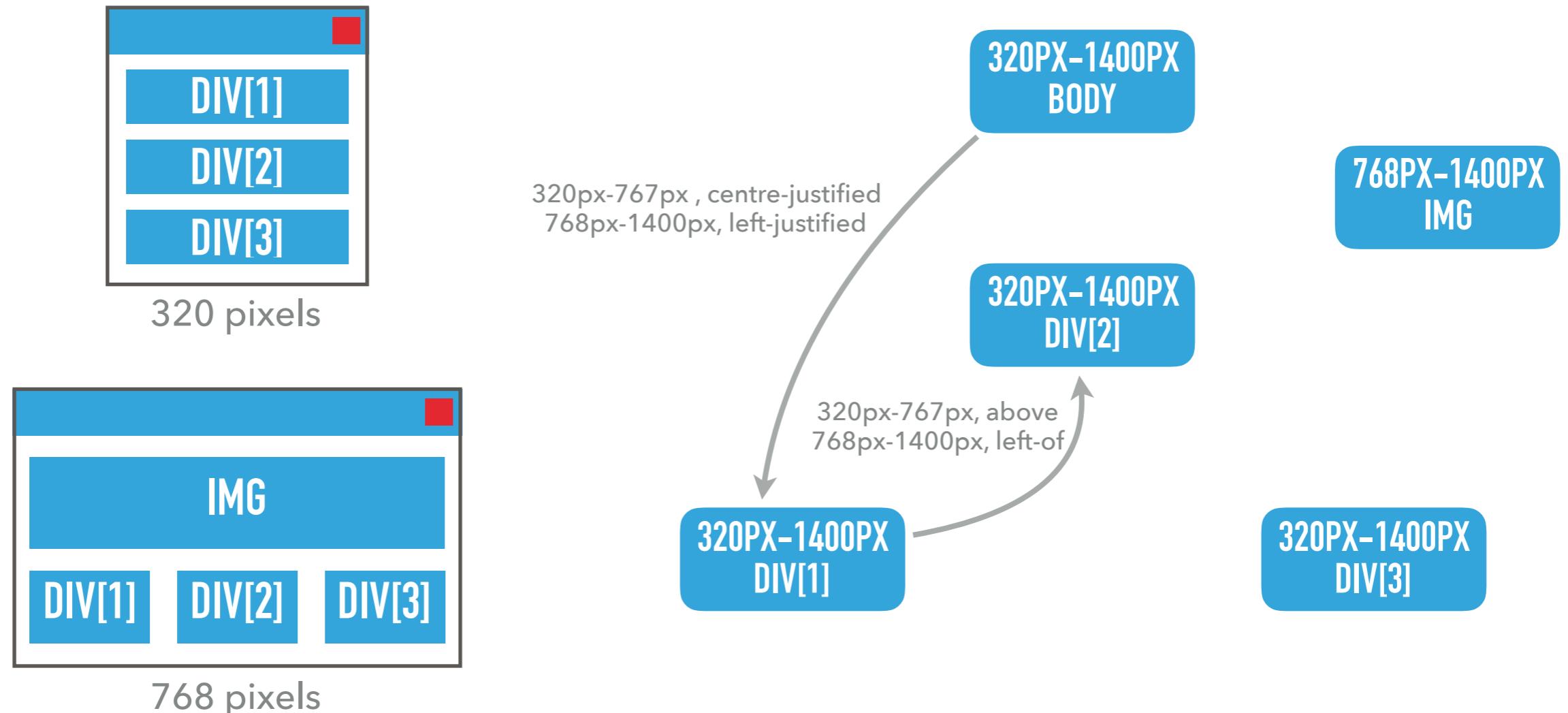
 Select Files

980 pixels

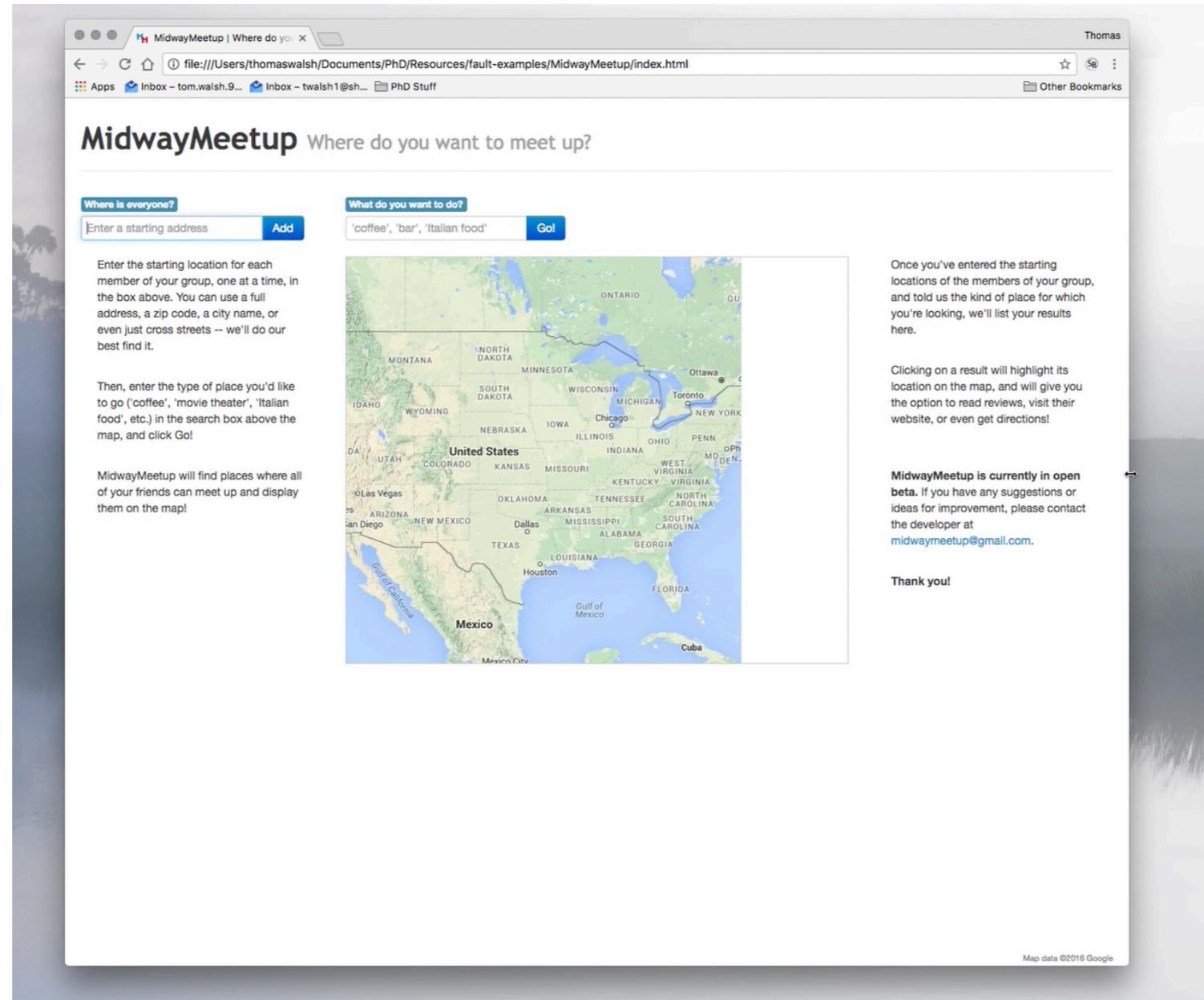
SUMMARY OF APPROACH



THE RESPONSIVE LAYOUT GRAPH



RLF 1 - ELEMENT COLLISION



MidwayMeetup Where do you want to meet up?

Where is everyone?

Enter a starting address

Enter the starting location for each member of your group, one at a time, in the box above. You can use a full address, a zip code, a city name, or even just cross streets -- we'll do our best find it.

Then, enter the type of place you'd like to go ('coffee', 'movie theater', 'Italian food', etc.) in the search box above the map, and click Go!

MidwayMeetup will find places where all of your friends can meet up and display them on the map!

What do you want to do?

'coffee', 'bar', 'Italian food'

Go!



The entire input section is highlighted with a red border.

Once you've entered the starting locations of the members of your group, and told us the kind of place for which you're looking, we'll list your results here.

Clicking on a result will highlight its location on the map, and will give you the option to read reviews, visit their website, or even get directions!

MidwayMeetup is currently in open beta. If you have any suggestions or ideas for improvement, please contact the developer at midwaymeetup@gmail.com.

Thank you!

MidwayMeetup

Where do you want to m

Where is everyone?

Enter a starting address

What do you want to do?

'coffee', 'bar', 'Italian food'

Go!

Enter the starting location for each member of your group, one at a time, in the box above. You can use a full address, a zip code, a city name, or even just cross streets -- we'll do our best find it.

Then, enter the type of place you'd like to go



RLF 1 - ELEMENT COLLISION

- 1. Check whether any pair of elements are overlapping at any point.**
2. If two elements are overlapping, check the layout at the wider viewport width.
3. If elements no longer overlapping, report an element collision failure.

RLF 1 - ELEMENT COLLISION

MidwayMeetup Where do you want to meet up?

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Thank you!

320PX-1400PX
FORM

320px-767px, above
768px-1000px, overlapping
1001px-1400px, left-of

320PX-1400PX
DIV

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FORM

320px-767px, above
768px-1000px, overlapping
1001px-1400px, left-of

320PX-1400PX
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Thank you!

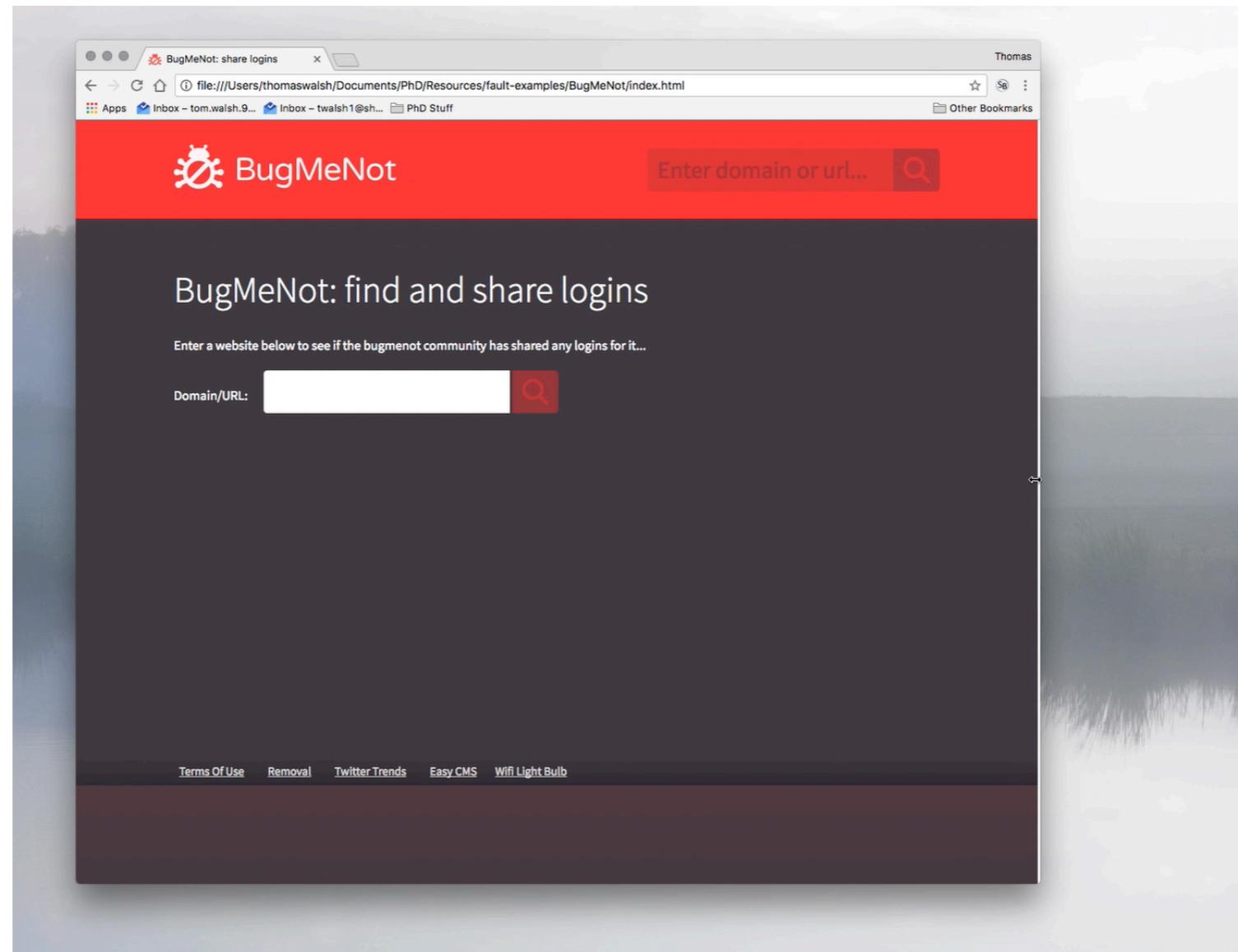
320PX-1400PX
FORM

320px-767px, above
768px-1000px, overlapping
1001px-1400px, left-of

320PX-1400PX
DIV

**Element collision between
768px and 1000px.**

RLF 2 - ELEMENT PROTRUSION





27



BugMeNot: find and share logins

Enter a website below to see if the bugmenot community has shared any logins for it...

Domain/URL:



Enter domain or url...



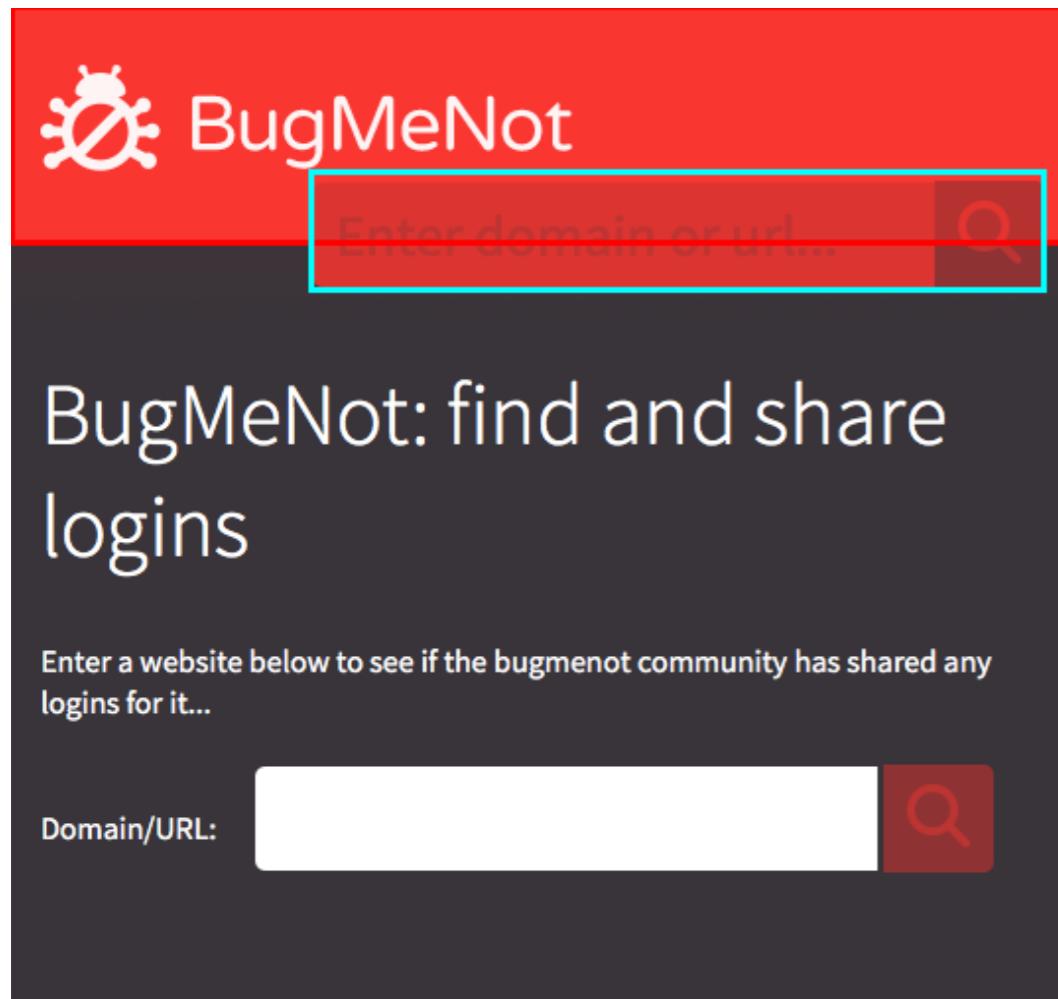
BugMeNot: find and share
origins

Enter a website below to see if the bugmenot community has shared any
origins for it...

RLF 2 - ELEMENT PROTRUSION

- 1. Check whether any pair of elements are overlapping at any point.**
- 2. If two elements are overlapping, check the layout at the wider viewport width.**
- 3. If one element now contains the other, report an element protrusion failure.**

RLF 2 - ELEMENT PROTRUSION



320PX-1400PX
HEADER

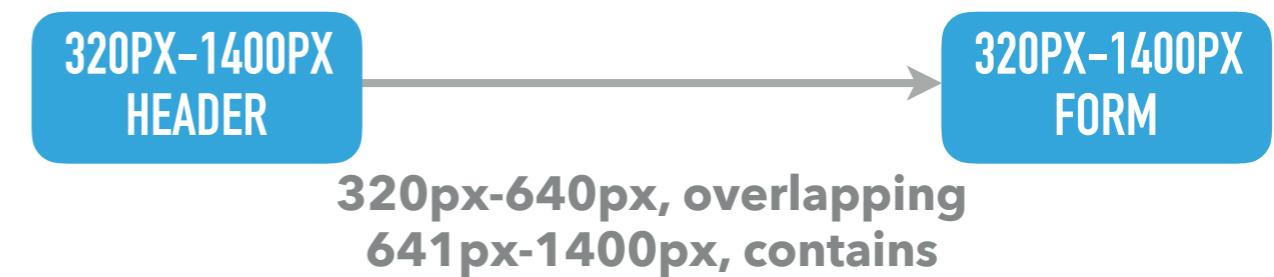
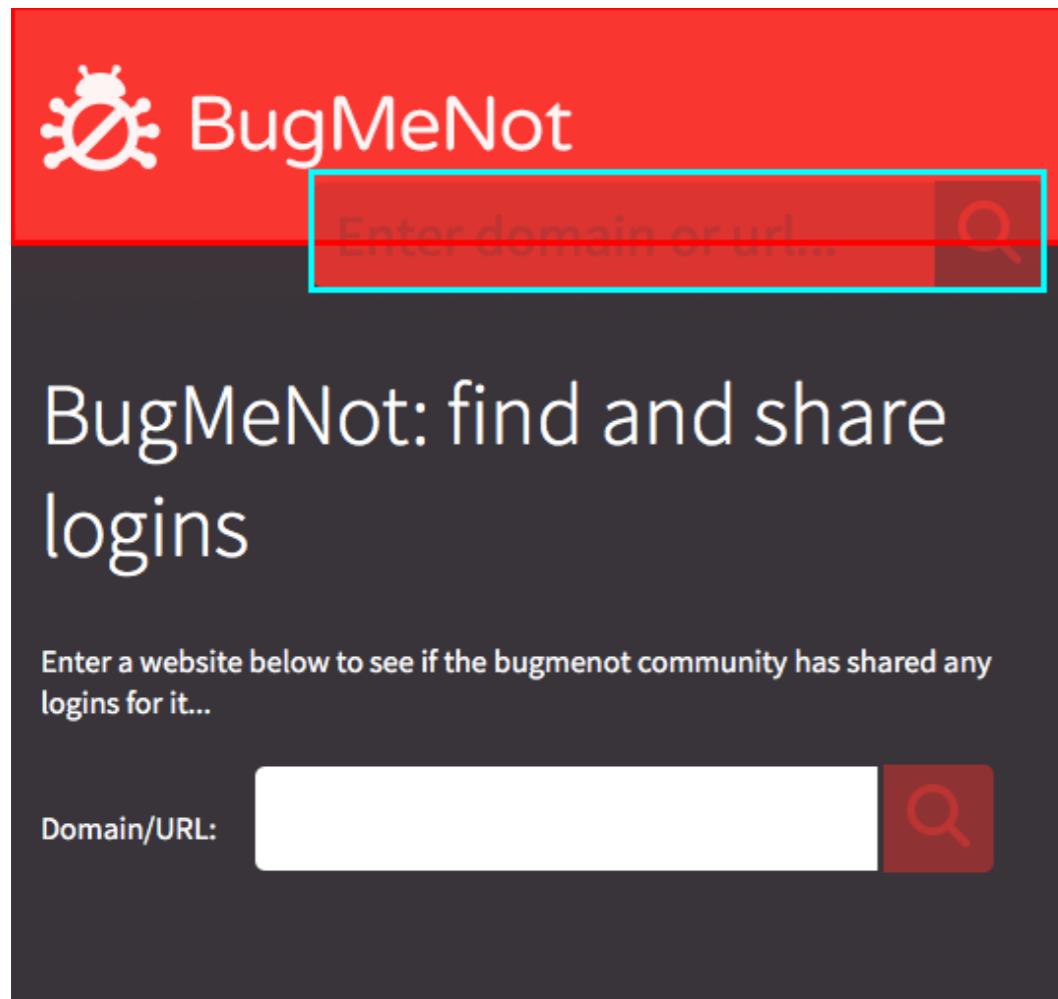
320px-640px, overlapping
641px-1400px, contains

320PX-1400PX
FORM

RLF 2 - ELEMENT PROTRUSION

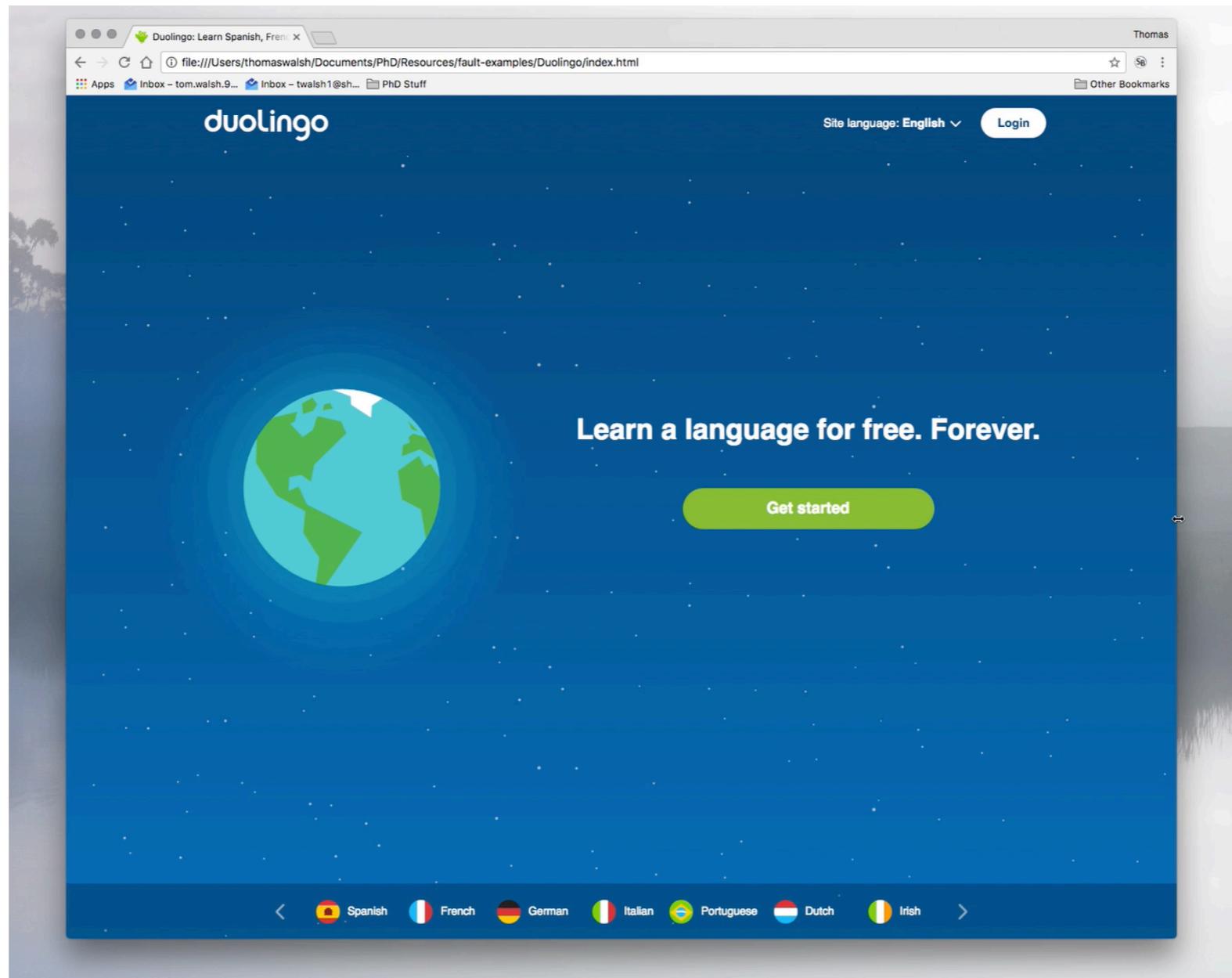
1. Check whether any pair of elements are overlapping at any point.
2. If two elements are overlapping, check the layout at the wider viewport width.
3. **If one element now contains the other, report an element protrusion failure.**

RLF 2 - ELEMENT PROTRUSION



**Element protrusion between
320px and 640px.**

RLF 3 - VIEWPORT PROTRUSION



Learn a language for free.
Forever.

Get started

Spanish French German Italian Portuguese Dutch Irish



The best new way to learn a language.

Learning with Duolingo is fun and addictive. Earn points for correct answers, race against the clock, and level up. Our bite-sized lessons are effective, and we have proof that it works.

See how we do it

Gamification poured into every lesson.

German



Italian



Portuguese



Dutch



Irish



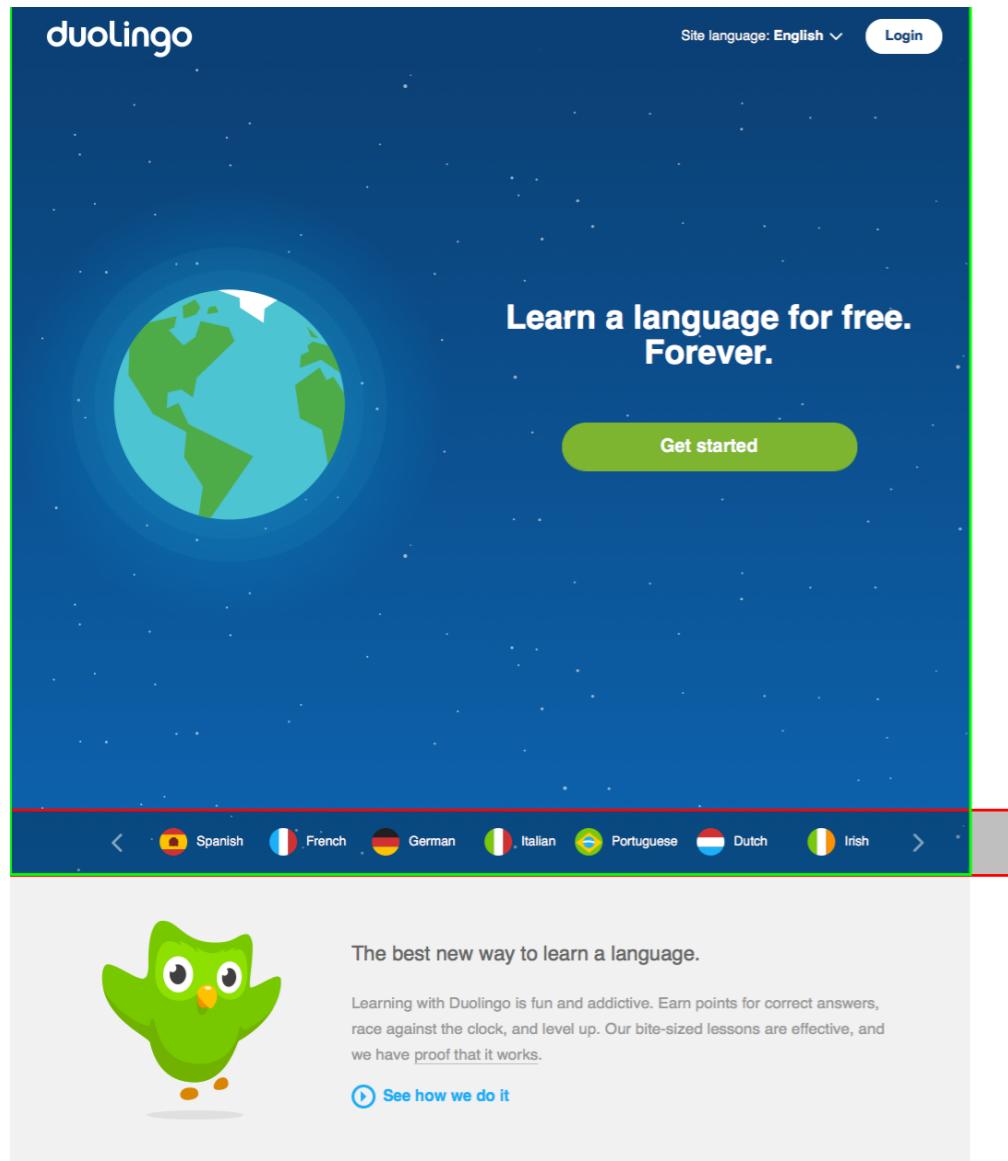
best new way to learn a language.

with Duolingo is fun and addictive. Earn points for correct answers, race against the clock, and level up. Our bite-sized lessons are effective, and we have the proof that it works.

RLF 3 - VIEWPORT PROTRUSION

1. **Look through each *element*.**
2. Check that for every viewport width the element is visible, it is contained within some other element.
3. If, at any point, the element is not contained at all, report a viewport protrusion failure.

RLF 3 - VIEWPORT PROTRUSION



320PX-1400PX
BODY

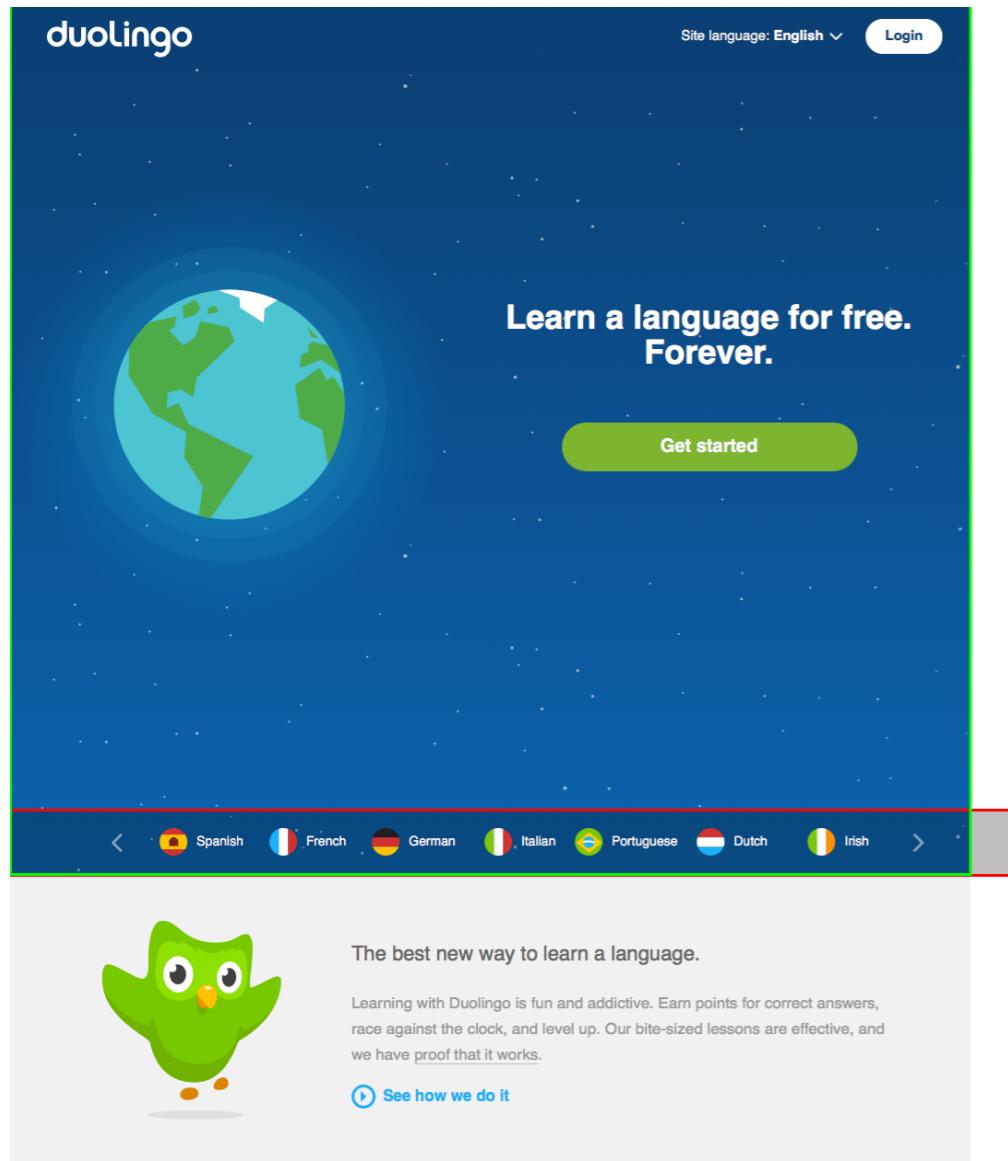
1050px-1400px, contains

981PX-1400PX
DIV

RLF 3 - VIEWPORT PROTRUSION

1. Look through each *element*.
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RLF 3 - VIEWPORT PROTRUSION



320PX-1400PX
BODY

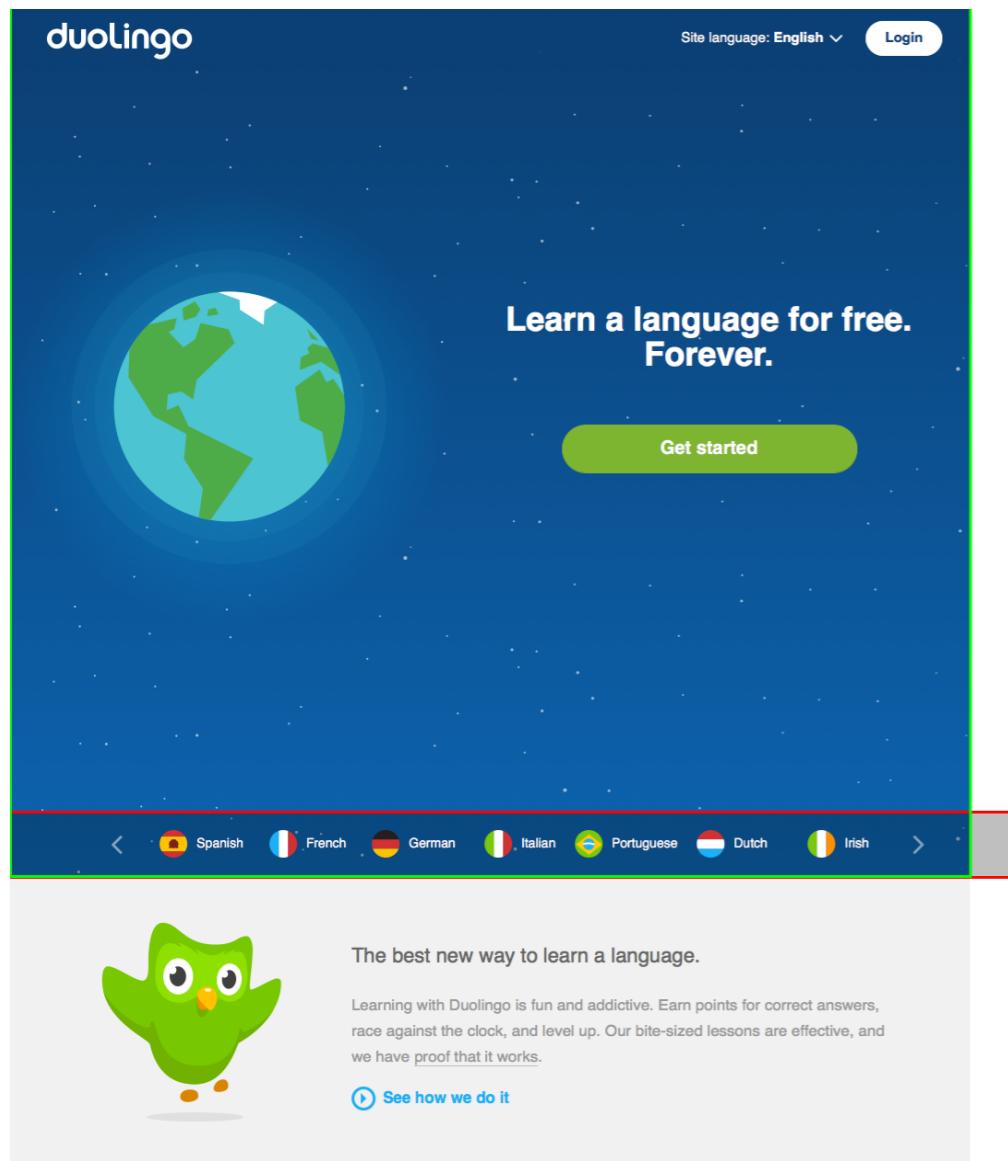
1050px-1400px, contains

981PX-1400PX
DIV

RLF 3 - VIEWPORT PROTRUSION

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RLF 3 - VIEWPORT PROTRUSION



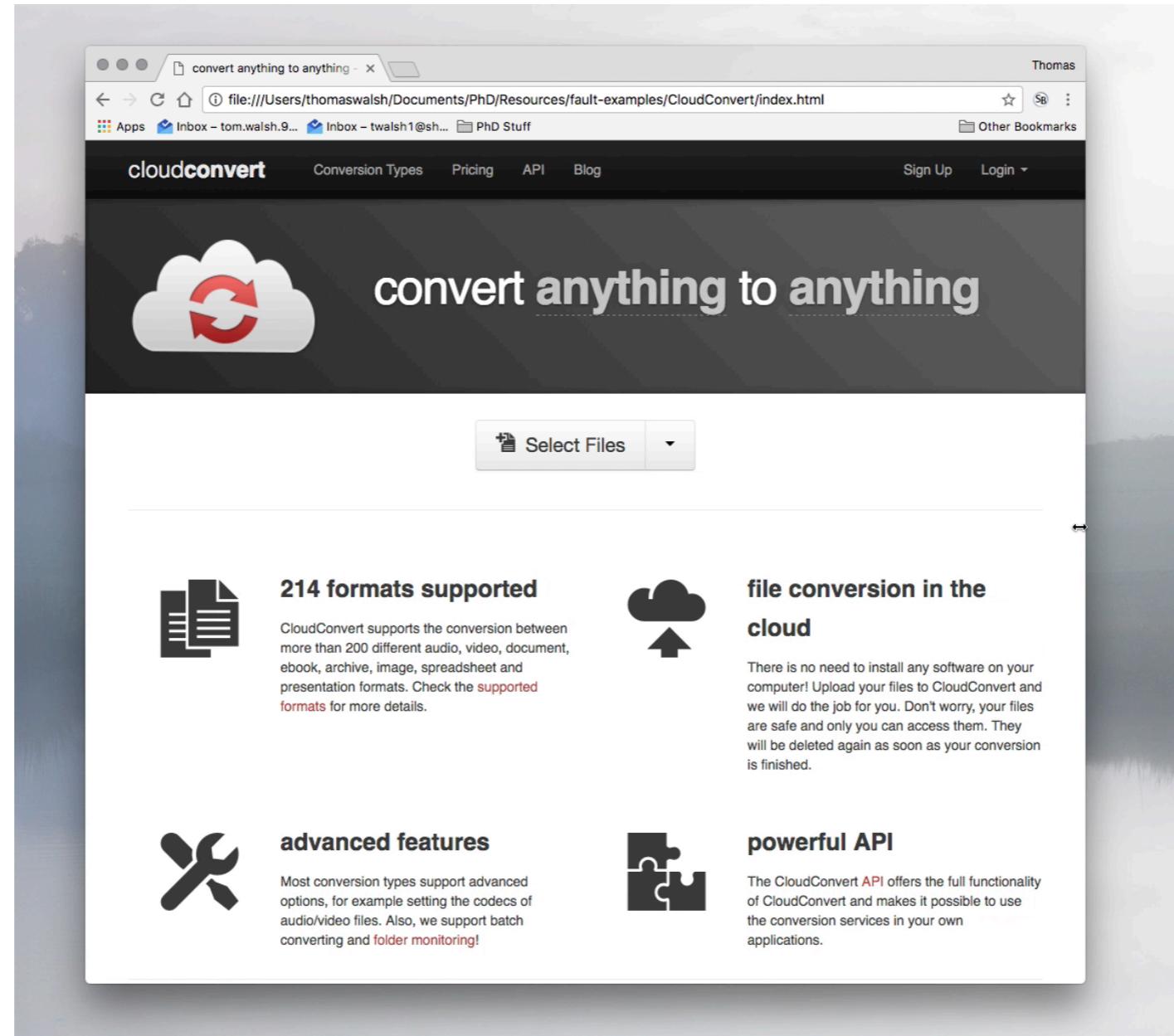
320PX-1400PX
BODY

1050px-1400px, contains

981PX-1400PX
DIV

Viewport protrusion between
981px and 1049px.

RLF 4 – SMALL-RANGE LAYOUTS





convert anything to anything

Select Files



214 formats supported

CloudConvert supports the conversion between more than 200 different audio, video, document, ebook, archive, image, spreadsheet and presentation formats. Check the [supported formats](#) for more details.

file conversion in the cloud

There is no need to install any software on your computer! Upload your files to CloudConvert and we will do the job for you. Don't worry, your files are safe and only you can access them. They will be deleted again as soon as your conversion is finished.



advanced features

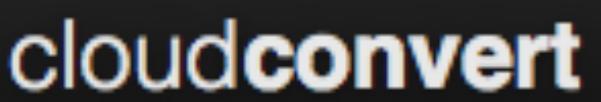
Most conversion types support advanced options, for example setting the codecs of audio/video files. Also, we support batch converting and [folder monitoring!](#)



powerful API

The CloudConvert [API](#) offers the full functionality of CloudConvert and makes it possible to use the conversion services in your own applications.

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Conversion Types Pricing API Blog

Convert anything to

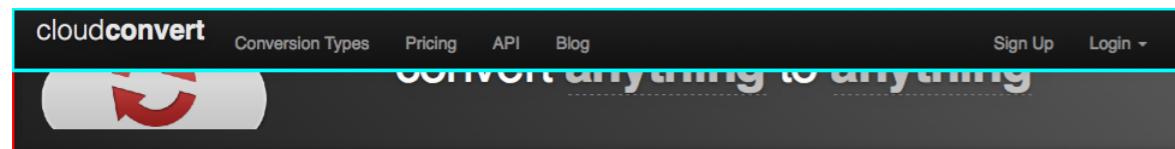
 Select Files 214 formats supported

fi

RLF 4 - SMALL-RANGE LAYOUTS

1. Are any layouts only applied for a *small number* of viewport widths (e.g., 5)?
2. If so, check if similar layouts exist both *before* and *after* the small-range layout.
3. If so, report the small-range layout failure.

RLF 4 - SMALL-RANGE LAYOUTS

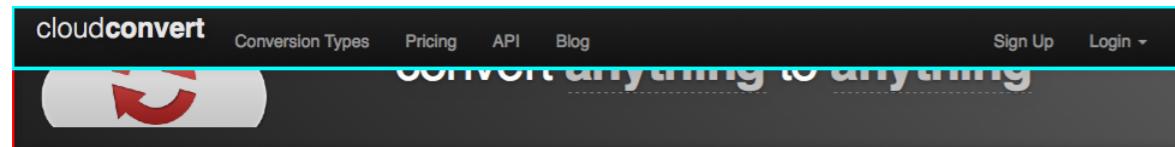


320px-979px, above
980px-980px, overlapping
981px-1400px, above

RLF 4 - SMALL-RANGE LAYOUTS

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RLF 4 - SMALL-RANGE LAYOUTS

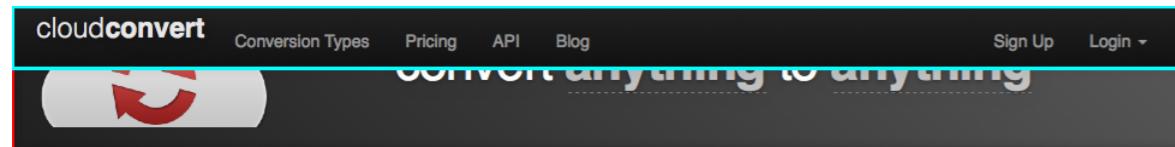


**320px-979px, above
980px-980px, overlapping
981px-1400px, above**

RLF 4 - SMALL-RANGE LAYOUTS

1. Are any layouts only applied for a *small number* of viewport widths (e.g., 5)?
2. If so, check if similar layouts exist both *before* and *after* the small-range layout.
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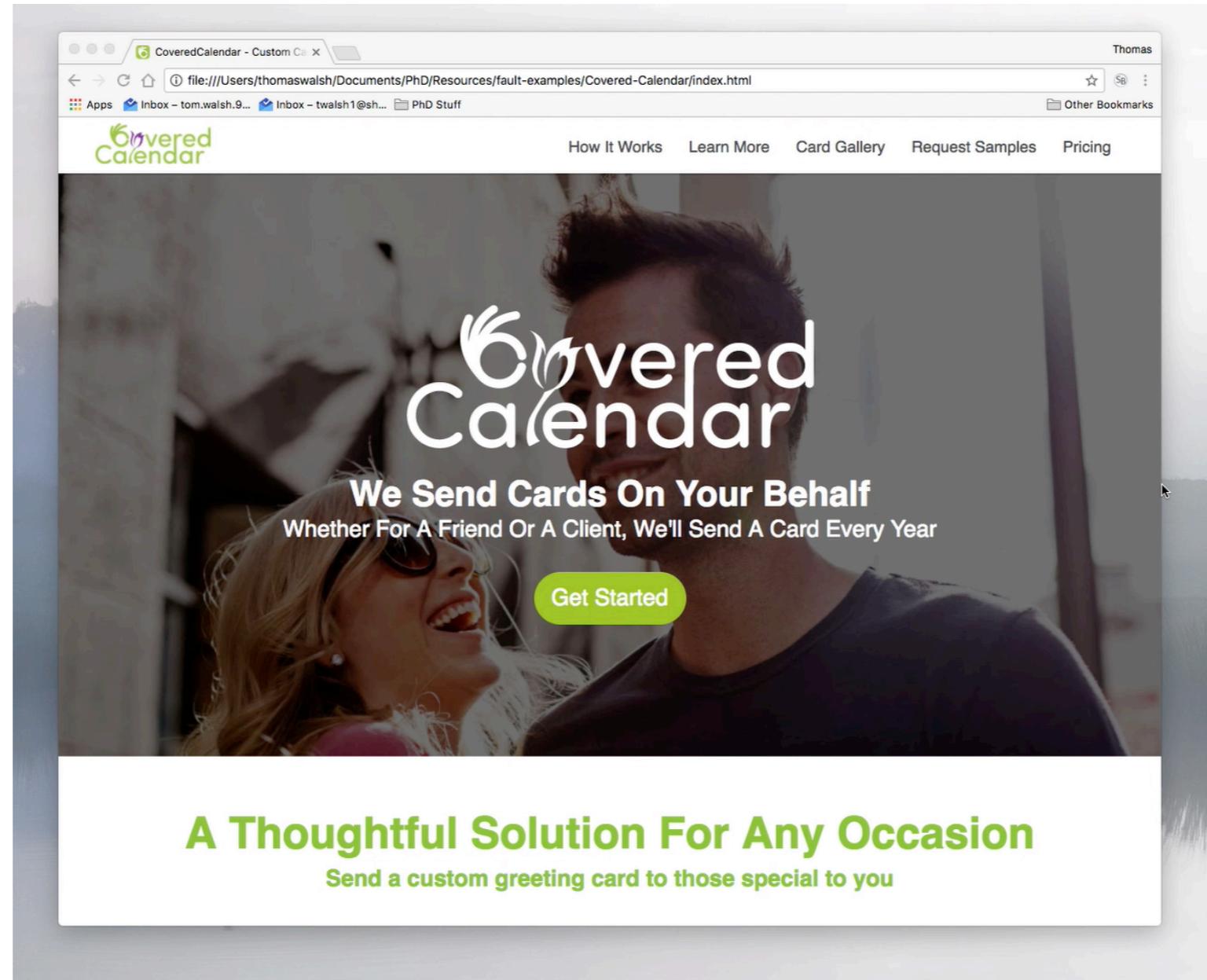
RLF 4 - SMALL-RANGE LAYOUTS



320px-979px, above
980px-980px, overlapping
981px-1400px, above

Small-range layout at 980 pixels.

RLF 5 - ELEMENT WRAPPING





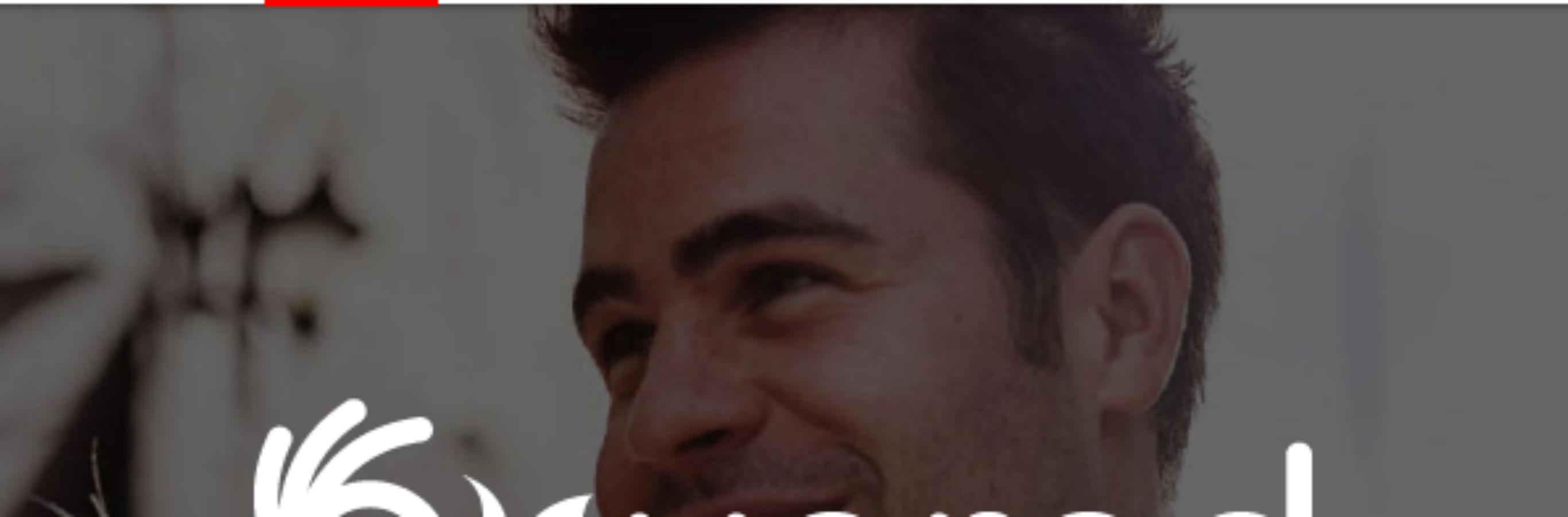
A Thoughtful Solution For Any Occasion
Send a custom greeting card to those special to you



ered
dar

How It Works Learn More Card Gallery Request Samples

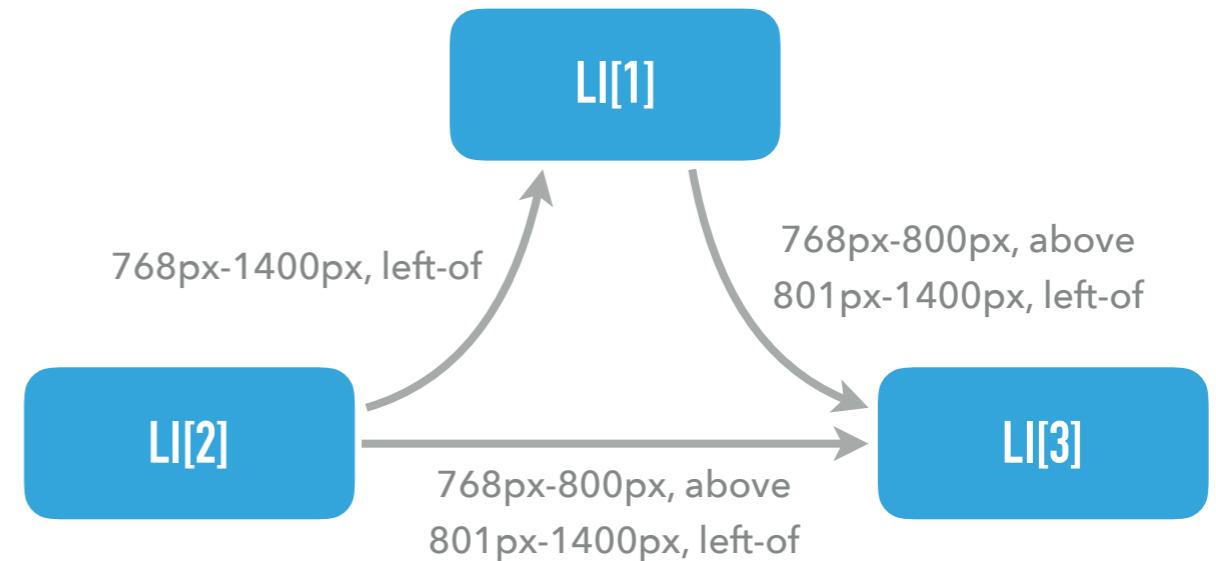
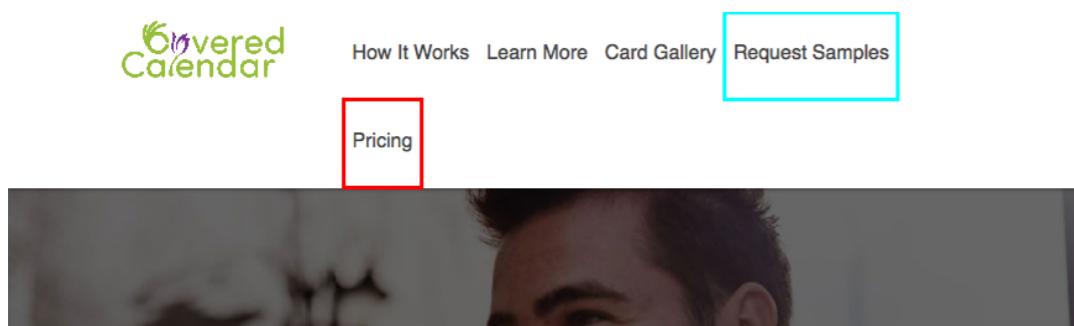
Pricing



RLF 5 - ELEMENT WRAPPING

- 1. Analyse layout information to determine which elements are laid out in rows.**
2. Are there any rows which one element is not in?
3. If this element is *in* the row at a wider viewport, report an element wrapping failure.

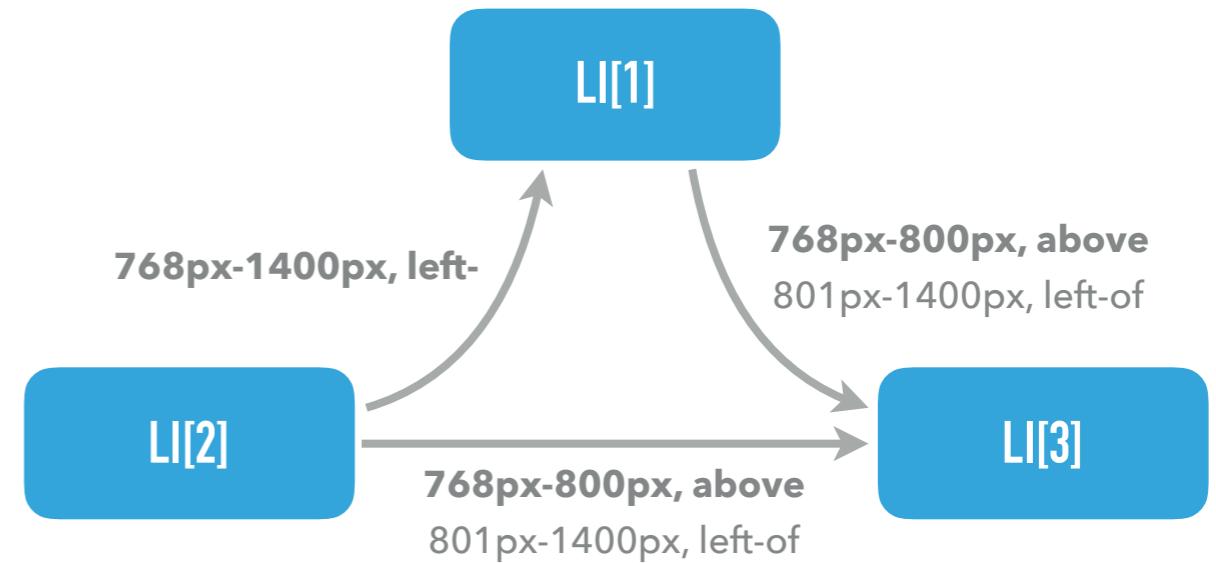
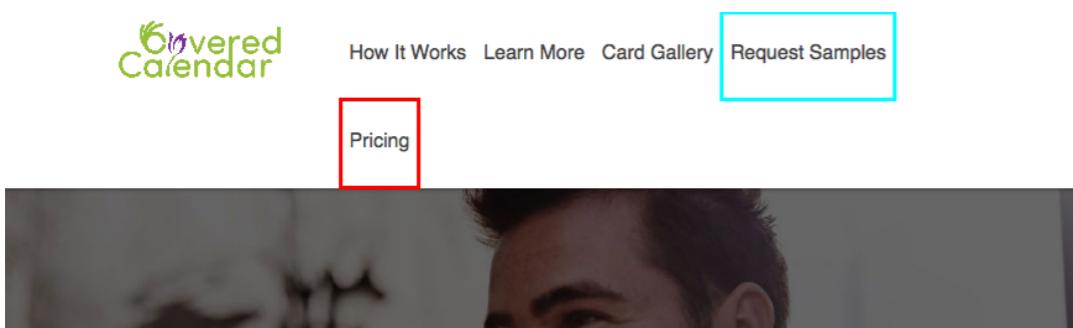
RLF 5 - ELEMENT WRAPPING



RLF 5 - ELEMENT WRAPPING

1. Analyse layout information to determine which elements are laid out in rows.
2. **Are there any rows which one element is not in?**
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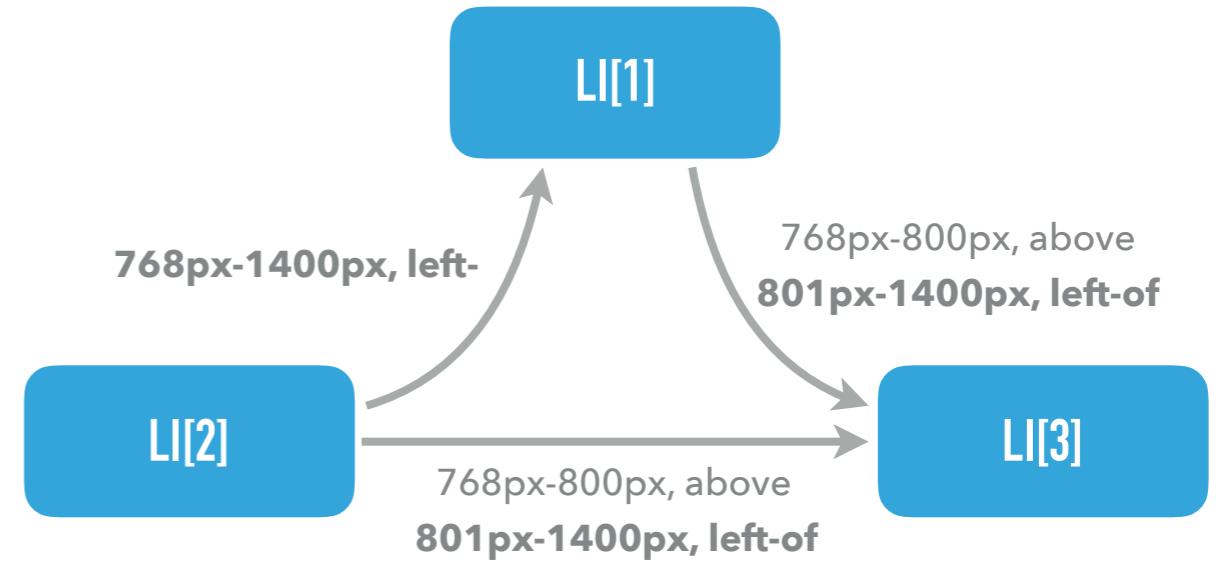
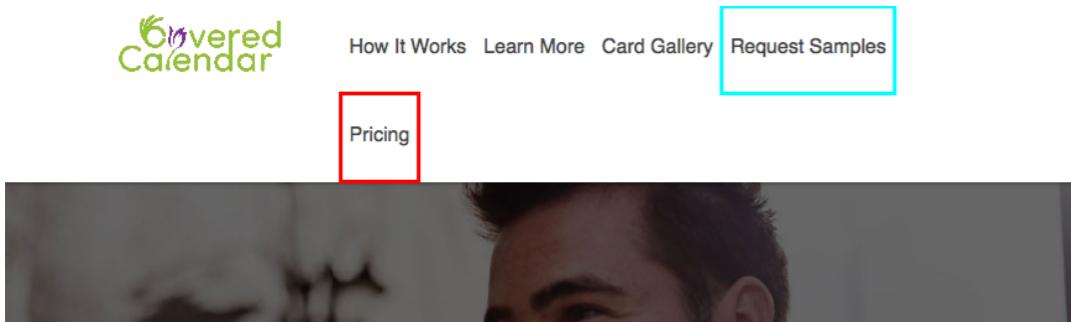
RLF 5 - ELEMENT WRAPPING



RLF 5 - ELEMENT WRAPPING

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RLF 5 - ELEMENT WRAPPING

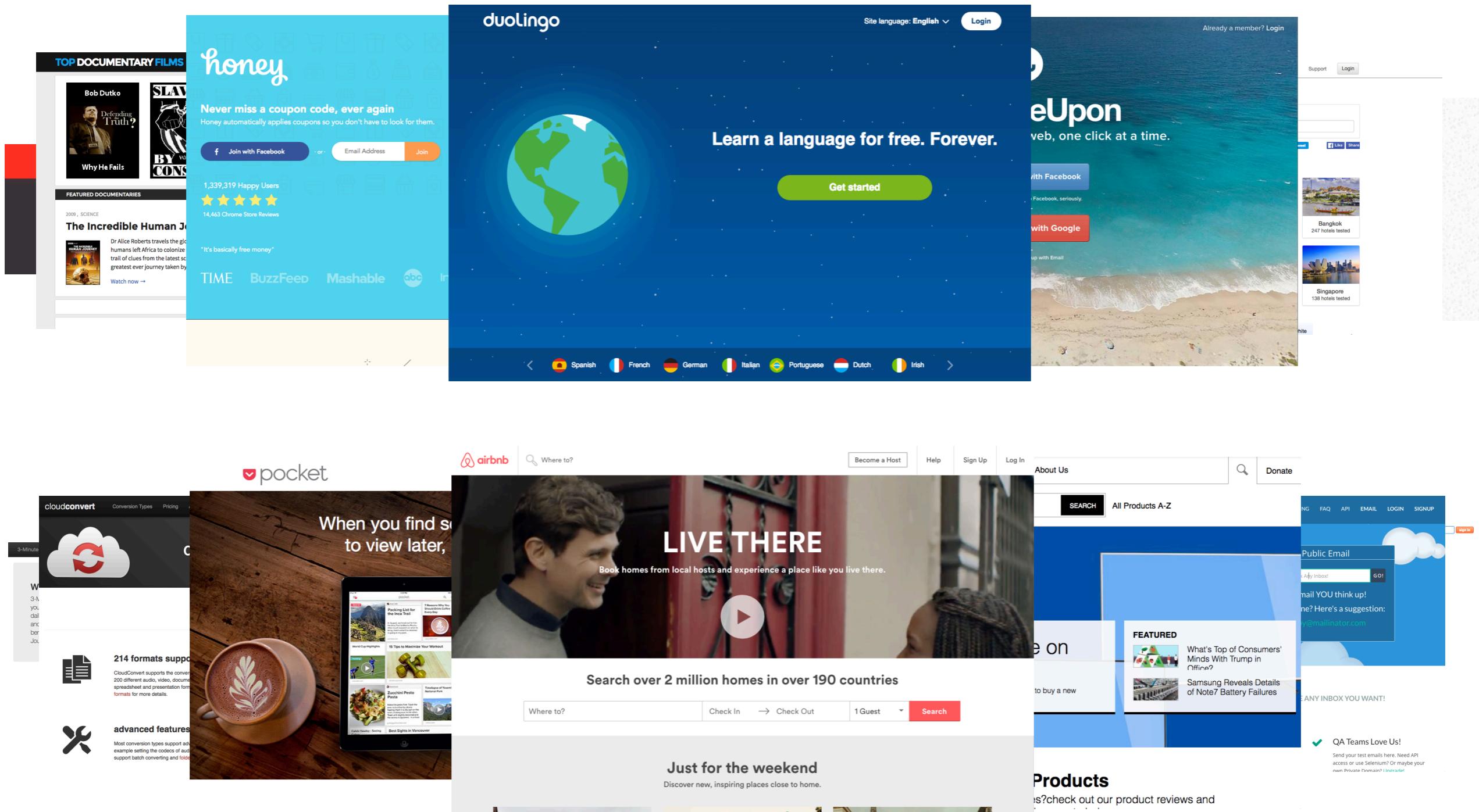


**Element wrapping between
768px and 800px.**

EMPIRICAL EVALUATION

1. Can the approach detect responsive layout failures in real-world responsive web pages?
2. How effective are manual “spotchecking” approaches in comparison to our approach?
3. How long do our techniques take to run?

ReDeCheck - Responsive Design Checker



RQ1

CAN THE APPROACH DETECT RESPONSIVE LAYOUT FAILURES IN REAL-WORLD RESPONSIVE WEB PAGES?





RESEARCH QUESTION ONE

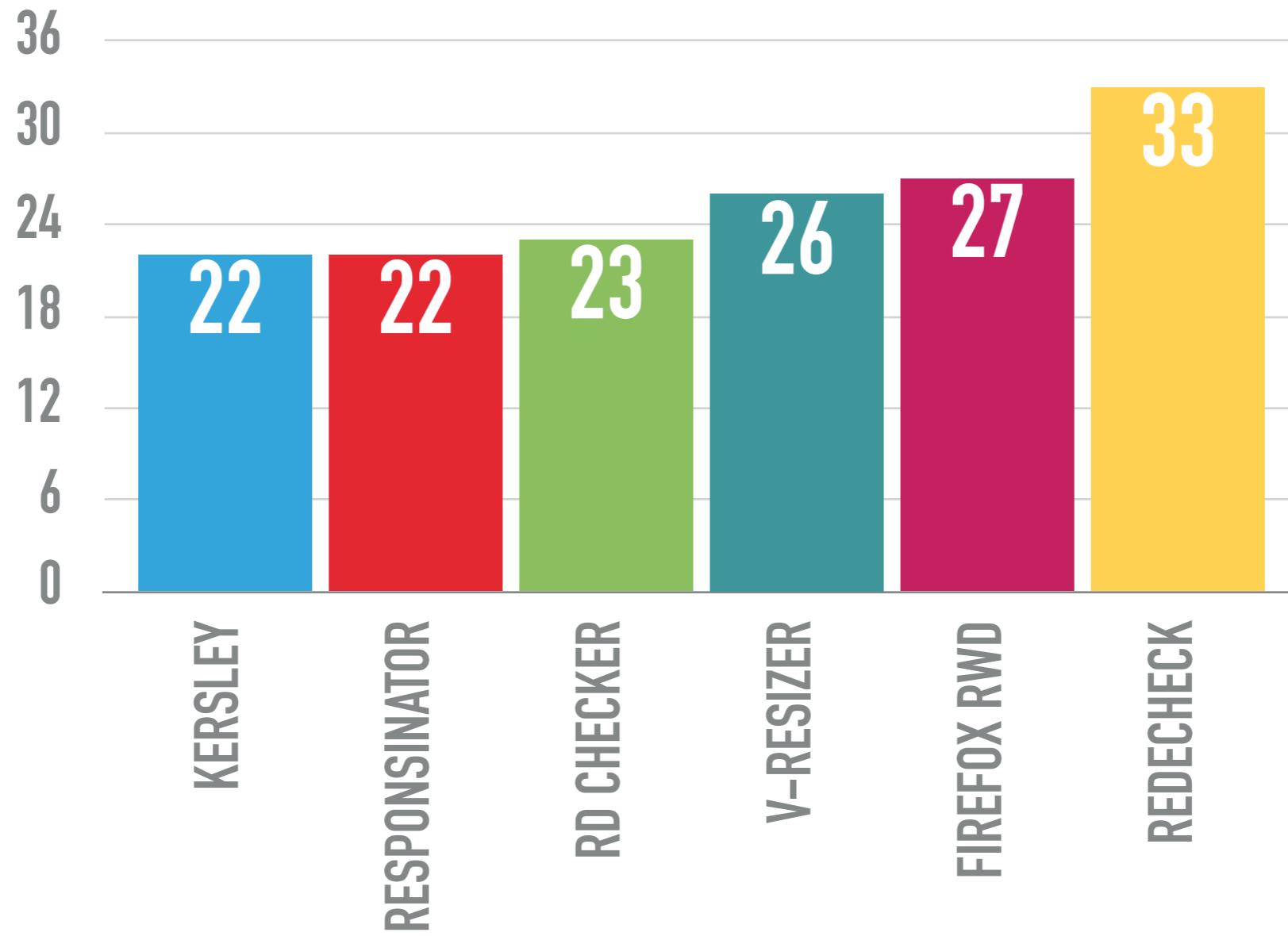
- ▶ Responsive layout failures found in 16 of the 26 web pages.
- ▶ 196 true positive results conflated to 33 *distinct* RLFs.
- ▶ False positives mainly caused by “coincidental” attributes being assigned to constraints.
- ▶ Many NOIs showed significant structural issues, which could easily manifest as TPs in the future.
- ▶ On average, developers need to check 4 distinct viewport ranges to observe each TP failure.

Failure Type	TP	FP	NOI	RLFs
Element Collision	8	0	24	8
Element Protrusion	3	0	36	3
Viewport Protrusion	24	0	23	11
Small-Range	152	43	0	1
Wrapping	10	5	0	10
Total	196	48	83	33

RQ2

**HOW EFFECTIVE ARE MANUAL “SPOTCHECKING”
APPROACHES IN COMPARISON TO OUR APPROACH?**

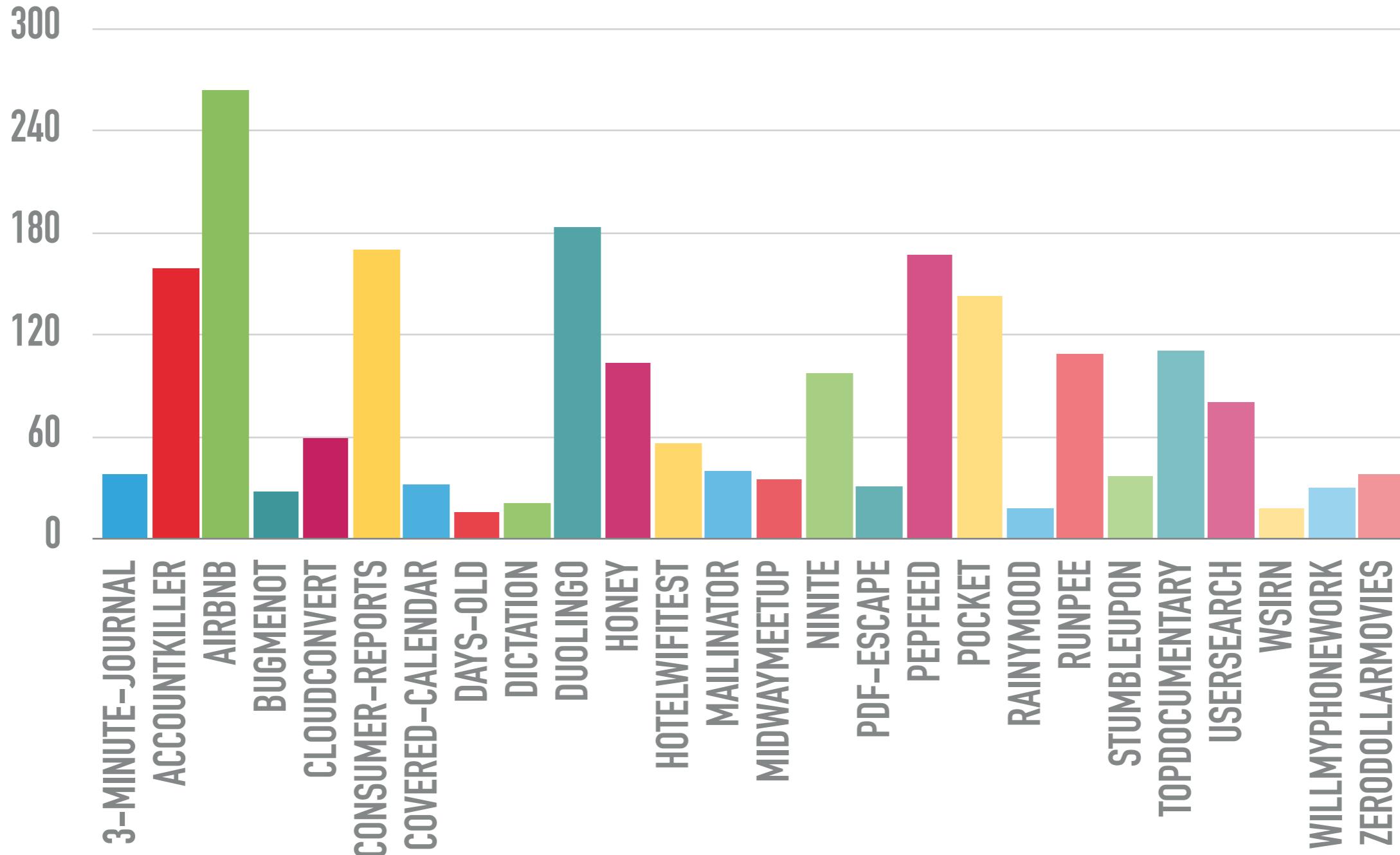
RESEARCH QUESTION TWO



RQ3

HOW LONG DO OUR TECHNIQUES TAKE TO RUN?

RESEARCH QUESTION THREE



THE REDECHECK TOOL

<https://github.com/redecheck/redecheck>

Understanding the Failure Reports

The different failure types are highlighted in different ways to make them as easy to understand as possible. The following table will explain how to interpret the screenshots, followed by several examples:

Failure Type	Interpretation	Example
Element Collision	The two offending elements will be highlighted with red and blue boxes, respectively. In the example on the right, the panels numbered 1 and 2 are clearly shown to be overlapping.	 Screenshot from MidwayMeetup More Info
Element Protrusion	The protruding element will be highlighted in blue, with the ancestor it is currently overlapping with (signifying the protrusion) highlighted in red. The example shows a set of "invisible" navigation links (blue) which have protruded outside of the header bar (red).	 Screenshot from BugMeNot More Info
Viewport Protrusion	The viewport window will be highlighted in green, while the element protruding outside of the viewport will be highlighted in red. The example image shows a carousel bar (red) protruding outside of the viewport window (green).	 Screenshot from Duolingo More Info

<http://redecheck.org>

<https://github.com/redecheck/example-webpages>

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THE WEB TODAY



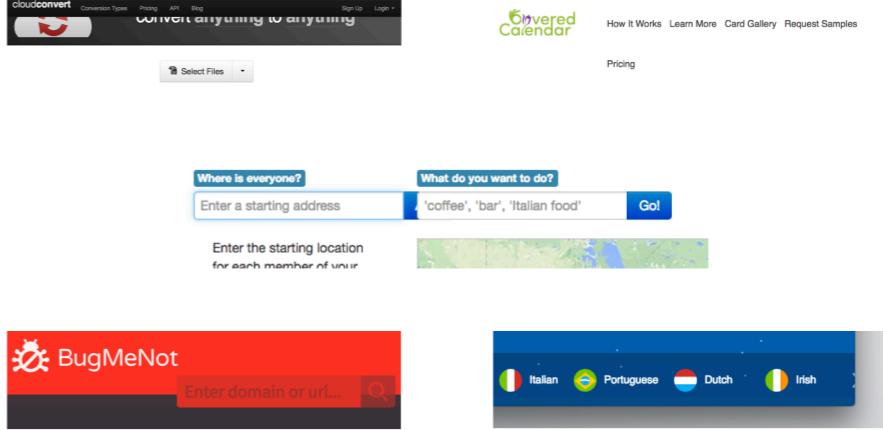
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AUTOMATED LAYOUT FAILURE DETECTION FOR RESPONSIVE WEB PAGES WITHOUT AN EXPLICIT ORACLE

3

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RESPONSIVE LAYOUT FAILURES



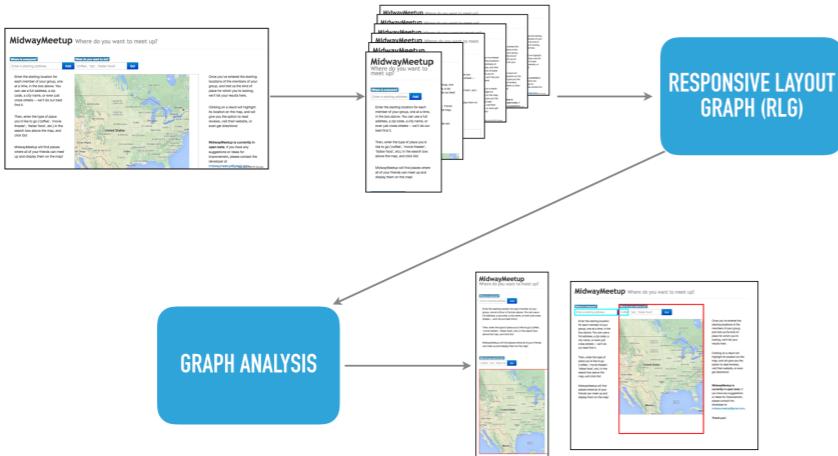
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12

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SUMMARY OF APPROACH



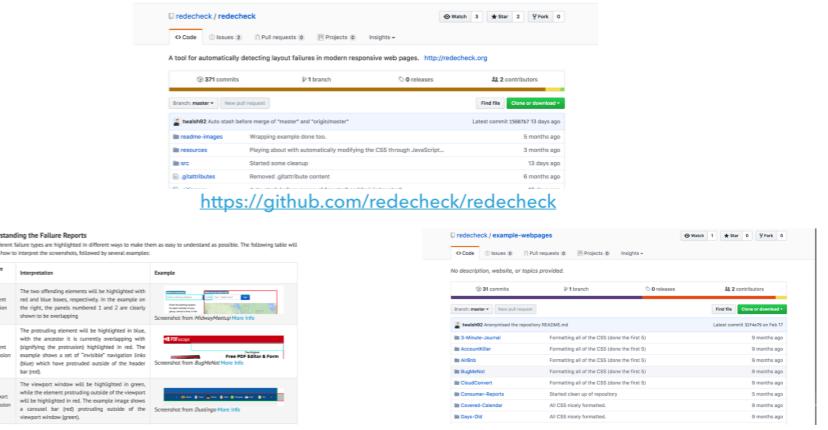
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15

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THE REDECHECK TOOL



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70

THANK YOU

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REDECHECK.ORG