

DATA-DRIVEN DESIGN

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SYMPOSIUM ON FRONTIERS OF BIG DATA



COMPUTER SCIENCE DEPARTMENT
UNIVERSITY OF ILLINOIS @ URBANA-CHAMPAIGN

THE ERA OF DESIGN



Experience digital design *constantly*



Better UX is a competitive advantage



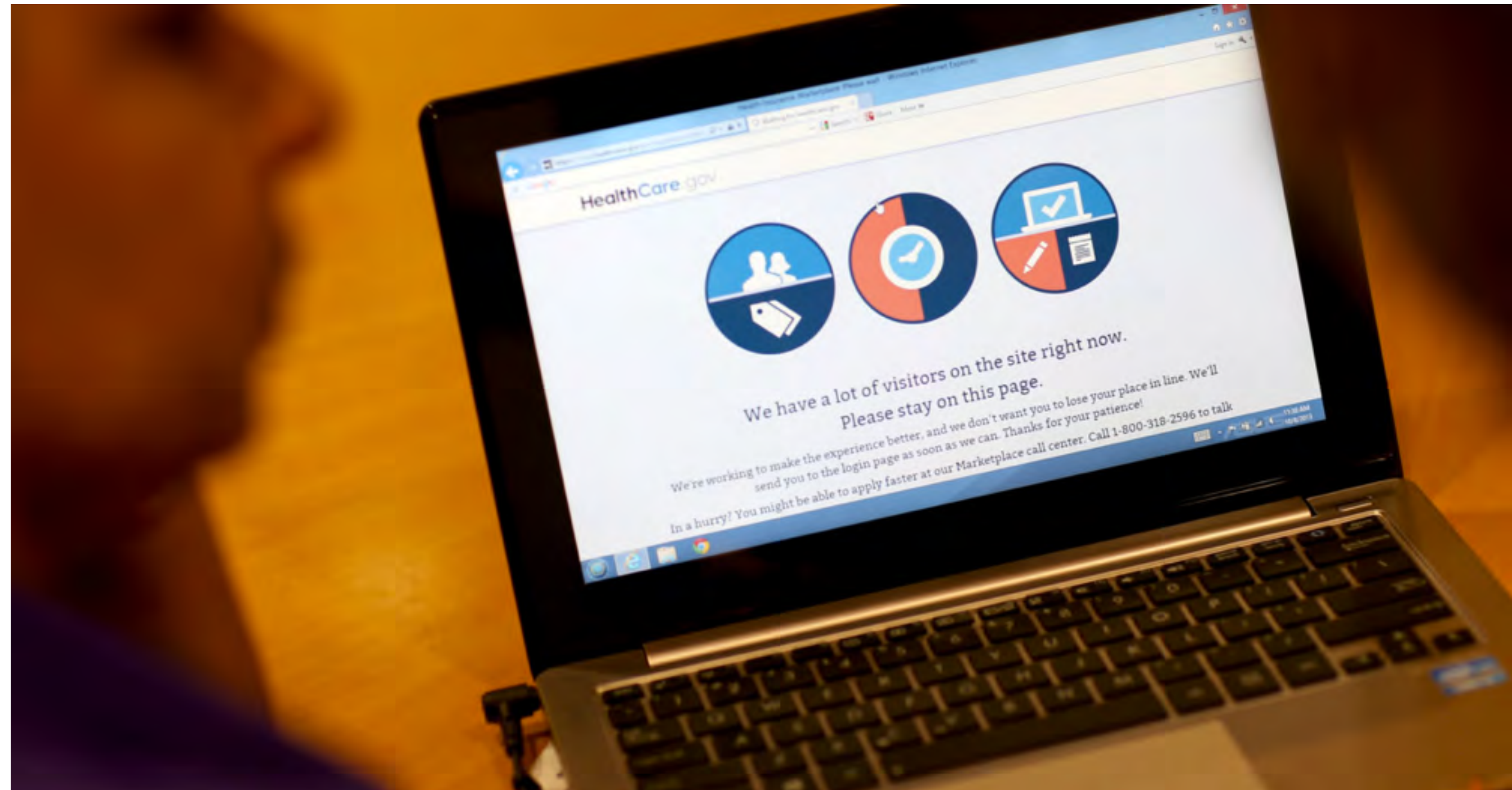
Pay premiums for higher-quality, personalized products

Tens of billions of dollars spent annually

Decisions based on intuition and HiPPOs



MONEY DOESN'T GUARANTEE RESULTS



DESIGN DATA IS EVERYWHERE

dribbble

Pinterest

COLOURlovers

Bēhance

bon appétit

POLYVORE



KICKSTARTER



3D Warehouse

houzz

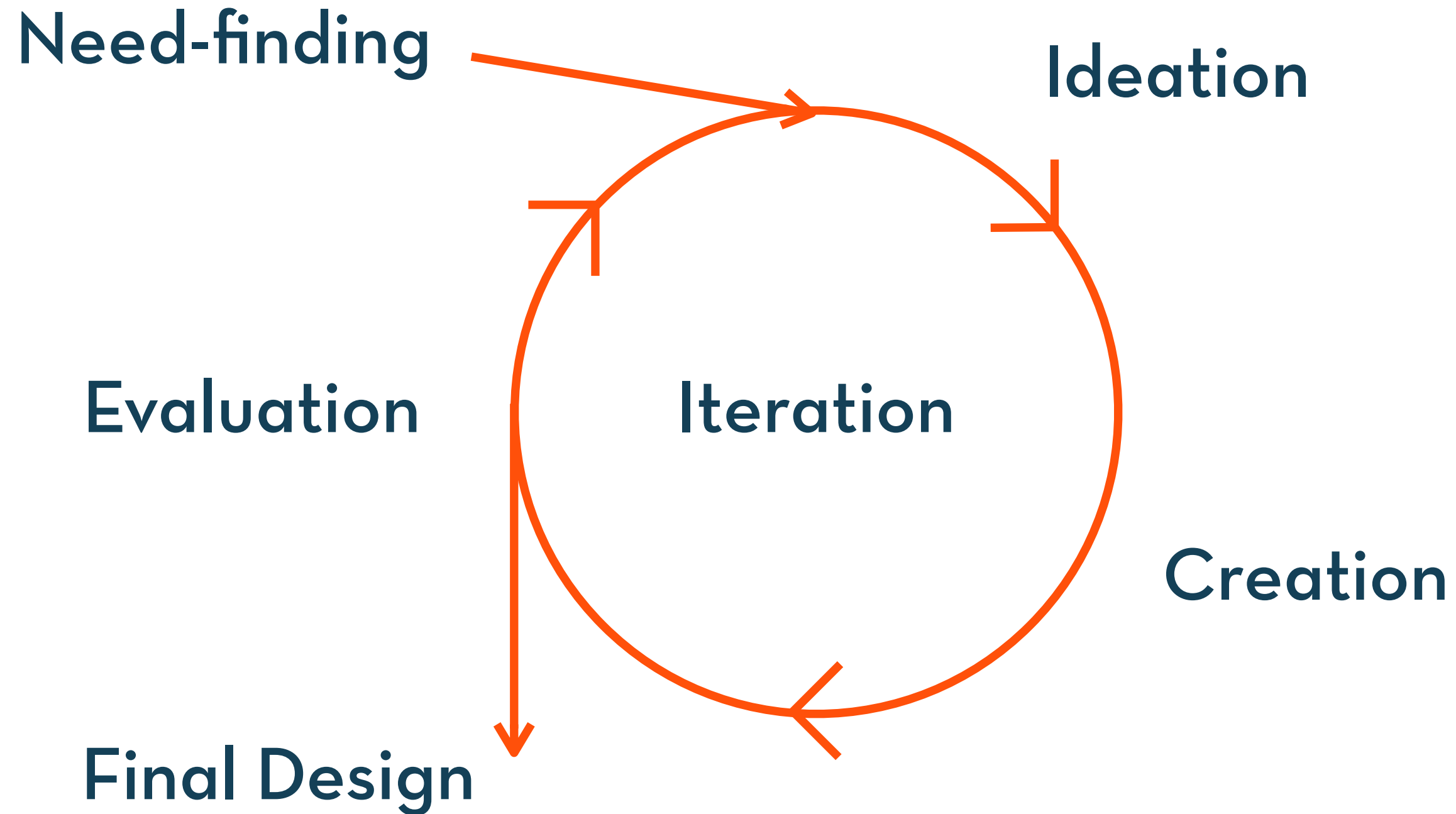
Vine

MakerBot Thingiverse

GitHub

DESIGN MINING: using knowledge discovery and data mining techniques to build data-driven design tools

THE DESIGN PROCESS



SCAFFOLD THE DESIGN PROCESS

find inspiration & relevant examples

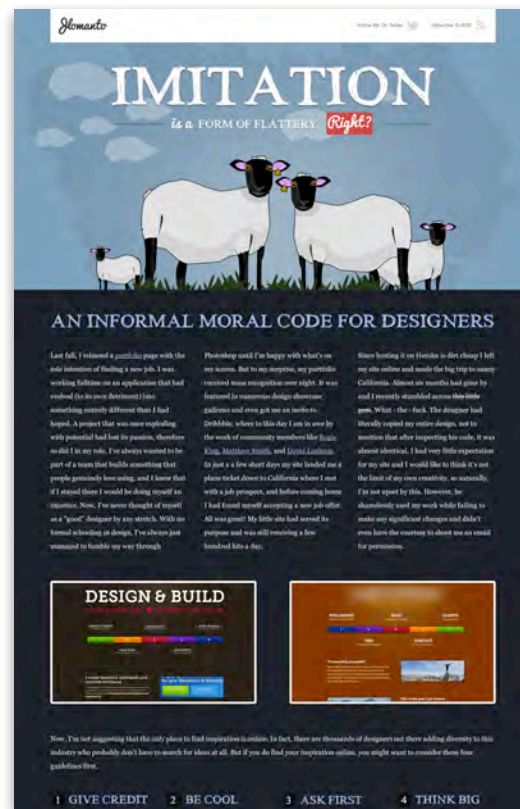
understand successful patterns and trends

generate new designs

evaluate alternatives

BUILD DOMAIN SPECIFIC SYSTEMS FOR CAPTURING DATA, MODELING SEMANTICS

WEB PAGES



MOBILE APPS



FASHION OUTFITS



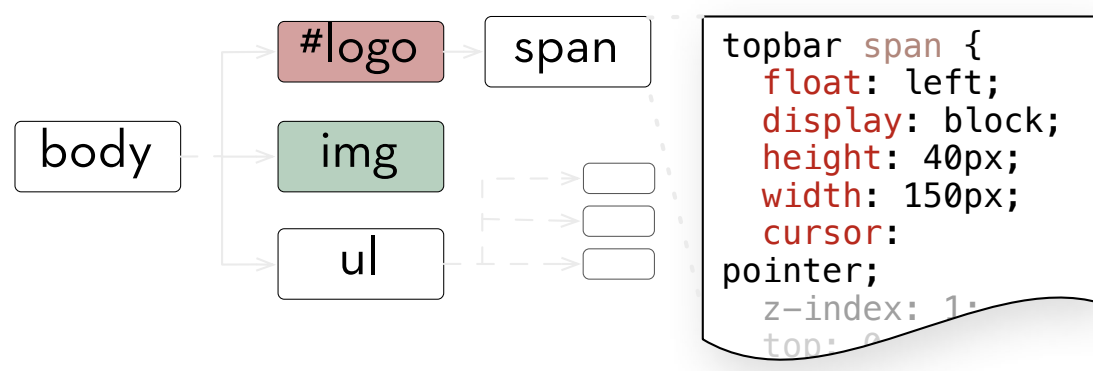
DESIGN MINING THE WEB

WEBZEITGEIST

HTML

```
http://creativecommons.org
<a><span id="home-button">
</span></a>
<div id="logo">
<span>
Creative Commons
</span>
</div>
```

DOCUMENT OBJECT MODEL



RESOURCES

```
cforms.js
//Collap
String.p
function
return
this.rep

creativecommons.css
topbar #home-button{
position: relative;
float: left;
display: block;
height: 40px;
width: 150px;

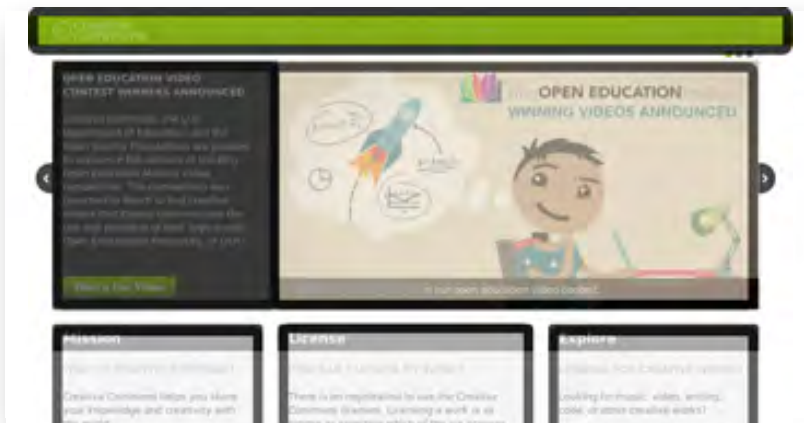
cc-logo.png

```

DERIVED FEATURES

```
avgColor: #EF0
gistFeatures:
aspectRatio: 1.2
treeLevel: 3
area: 60230
numberOfChildren: 5
numberOfSiblings: 2
numberOfImages: 5
freqColor: #EEE
numberOfWords: 32
percentEdgeP
```

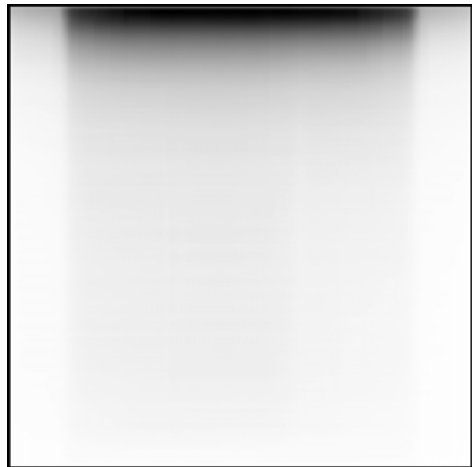
VISUAL SEGMENTATION



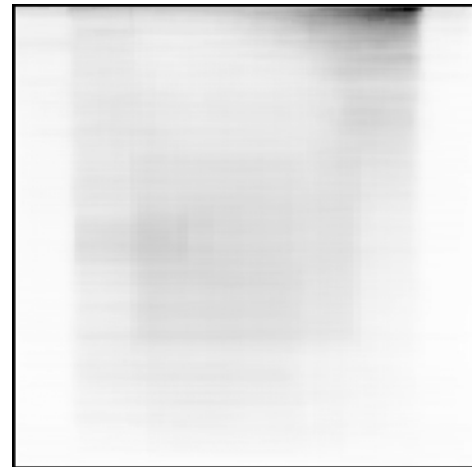
SCREENSHOT



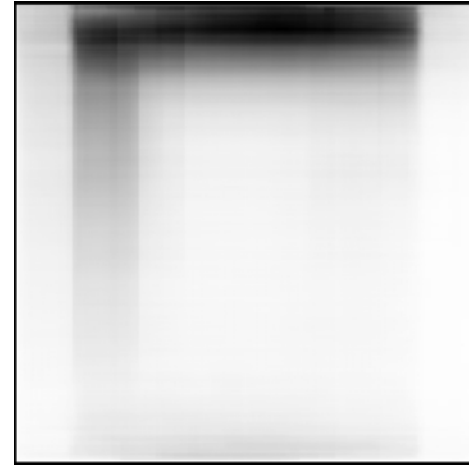
DESKTOP



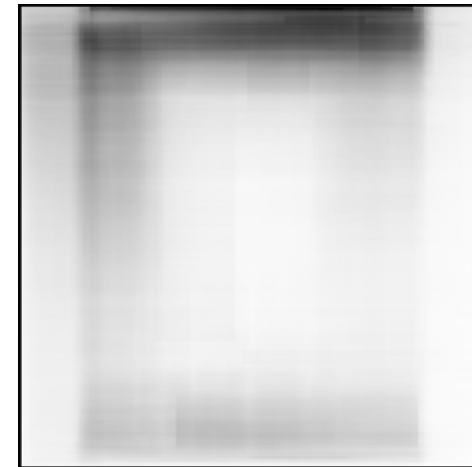
HEADER



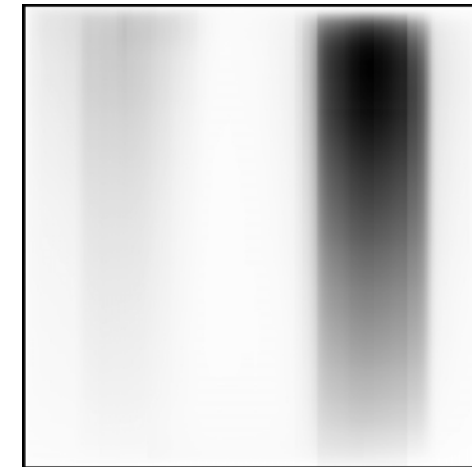
LOGIN



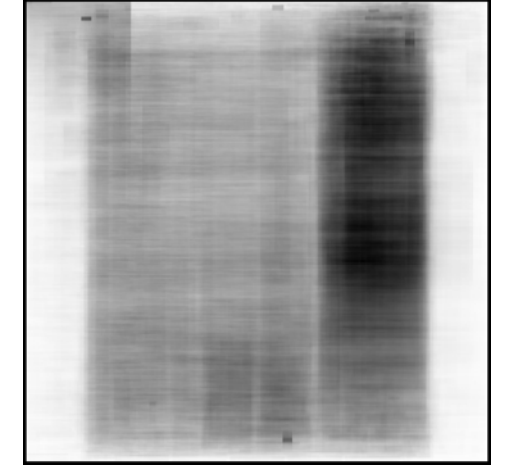
NAV



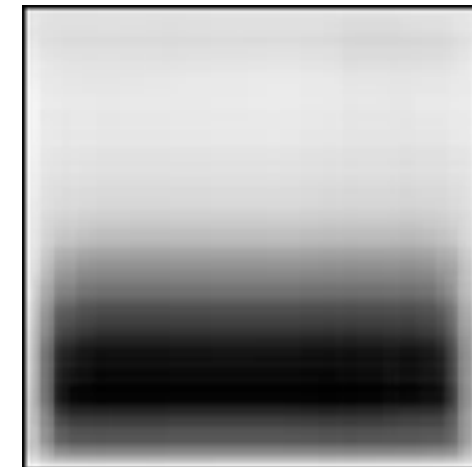
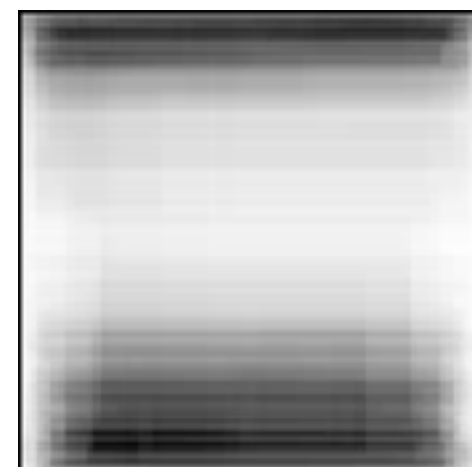
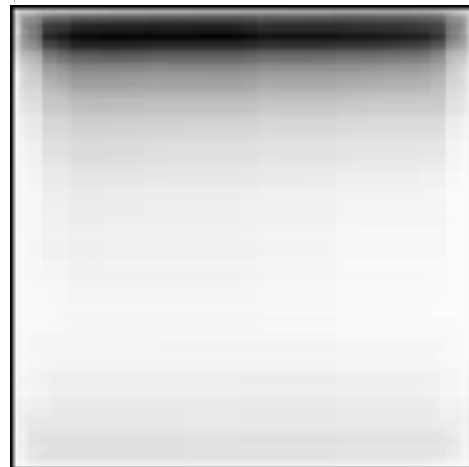
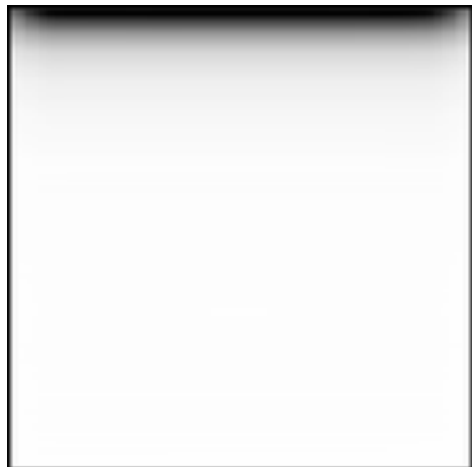
MENU



SIDEBAR



TWITTER



MOBILE

DESIGN SEARCH

Search for desktop pages that

are about: coffee contain: Image Background Add more...

370 results found in Food. Related Categories: [Drinks \(306\)](#), [Travel \(122\)](#).

Select view: Screenshot Font Color Element



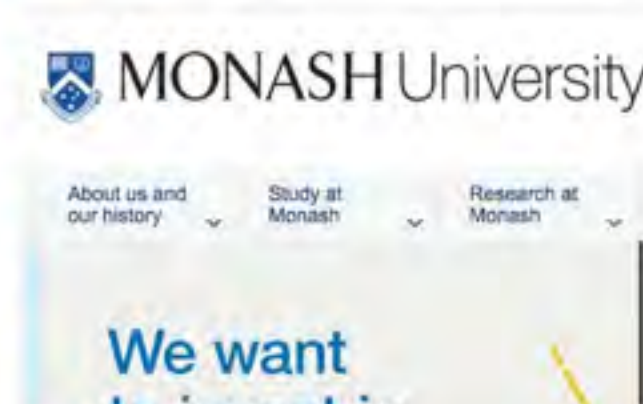
Color selection and font size controls. Includes a line graph icon, a series of colored circles (brown, dark brown, yellow, orange, light orange, dark brown), and a vertical stack of 'Aa' text size indicators.

Search for desktop pages that

are about: university are from: Australia contain: Logo Add more

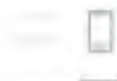
33 results found in Education.

Select view: Screenshots Color Element: Logo



A vertical sidebar on the right side of the page. It contains a series of colored circles (purple, yellow, teal, red, purple) and a search icon at the top. Below the circles are several instances of the text 'Aa', likely representing a font size or readability control.

Search for mobile pages that



contain: Signup Add more...



12277 results found.

Select view:

Screenshot

Font

Color

Element

S'mores Sandwich Cookies

Get our latest recipes and expert tips right in your inbox.

YOUR EMAIL ADDRESS SIGN UP

RECIPE OF THE DAY

EXPLORE CAMPAIGNS

START A CAMPAIGN

SIGN UP FOR DAILY INSPIRATION

Your email address SIGN UP NOW

Private, secure, spam-free

GET THE LATEST

f t g+ v

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About Us Blog Careers Playbook

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Don't miss out - get the best of Vanity Fair delivered directly to your inbox.

SUBSCRIBE

MINNIE WATCHA SAY? The OC Is Being Turned into a Musical

Flirchi

Millions of people are already with us!

Log In Registration

Name

Email

Sex Age

Registration

f B @

LEARN MORE

STAY UP TO DATE

Get news & updates on upcoming shows and events

EMAIL

KEEP ME UPDATED

Accomplish more - today.

Everyone works differently, so let's see whether Taco is right for you.

email address

password

Create account now

Join Our Team

Apply Today

Get News Alerts

First Name Last Name

Email

Subscribe

websites.

Splash is the world's first experience marketing software that maximizes event impact - before, during, and after.

f SIGN UP WITH FACEBOOK

CREATE YOUR FREE EVENT NOW



Aa Aa Aa Aa Aa Aa

TRACK DESIGN CHANGES & TRENDS

APROPOSE		Analyze	Track	Settings
Updates: Email Marketing / Tracked Pages		Modify Tracked Pages		
URL	Design Changes	Most Recent Design	Previous Design	
workfront.com Last crawled on 7/12/2016	Tagline Changed			
precisiondialogue.com Last crawled on 7/11/2016	CTA Color Changed CTA Text Changed Image Content Changed ABF Tagline Changed			
mailigen.com Last crawled on 7/8/2016	CTA Count Decreased CTA Color Changed CTA Text Changed Image Content Changed ABF			

CORRELATE DESIGN WITH PERFORMANCE

APROPOSE Business Software / All Business Software / Main CTA Intent / Testing Culture Analyze Track Settings

COMPARISON SET: All Business Software

SEGMENT: All, Testing Culture, Bounce Rate, Time on Site, Pages Per User, Traffic Ranking

FEATURE: Main CTA Intent

FEATURE DISTRIBUTION: For Main CTA Intent across Sites With an Established Testing Culture

Feature	Percent of Sites (762 pages)
Sign Up	21-60%
Free Offer	6-43%
Demo	74-118%
Learn More	55-83%
Request	
Watch	
Download	
Contact	

INSIGHTS: Sites With an Established Testing Culture are:

Feature	Usage	Example
Sign Up	less likely to use	'Contact'
Free Offer	more likely to use	'Demo'
Demo	more likely to use	'Free Offer'
Learn More	more likely to use	'Sign Up'

EXAMPLES FOR: MAIN CTA INTENT "SIGN UP" [see more examples](#)

dropbox.com

eventbrite.com

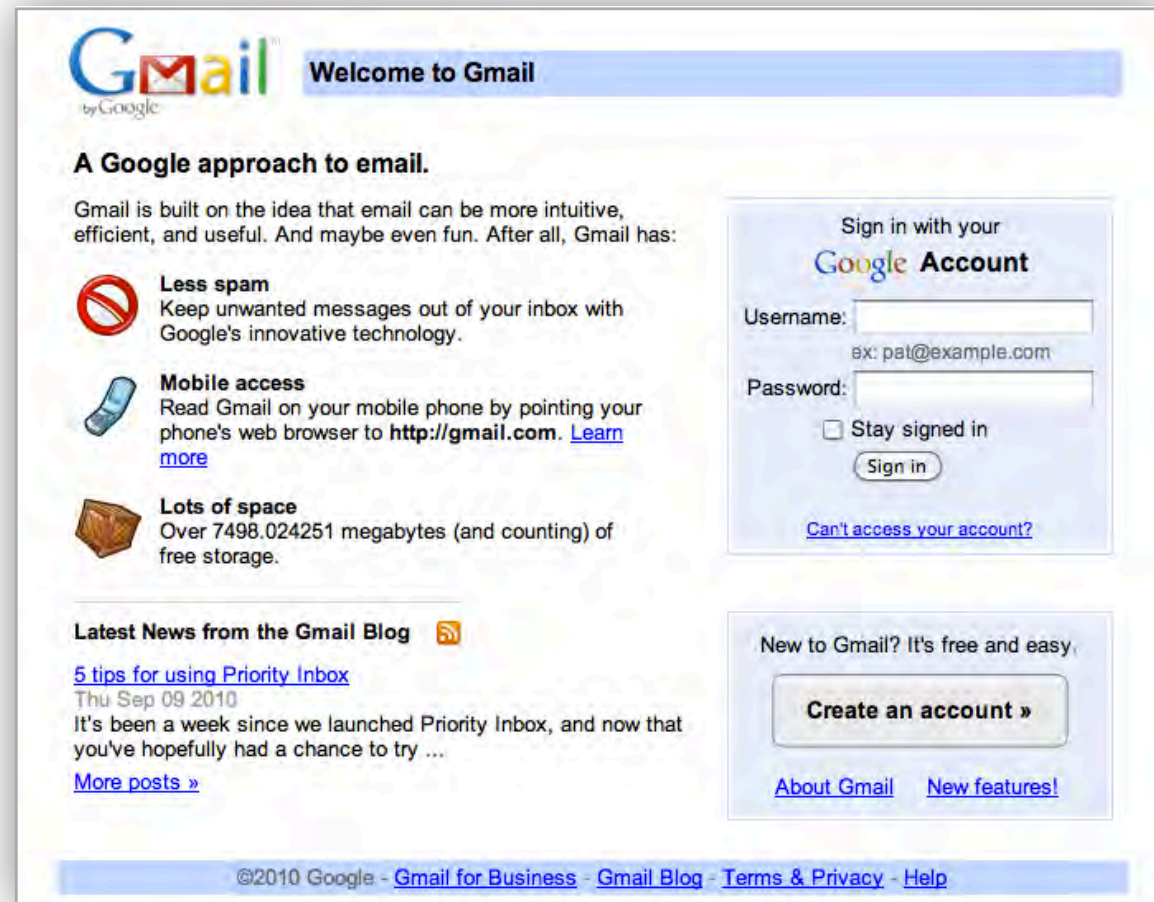
hubspot.com

EXAMPLES FOR: MAIN CTA INTENT "FREE OFFER" [see more examples](#)

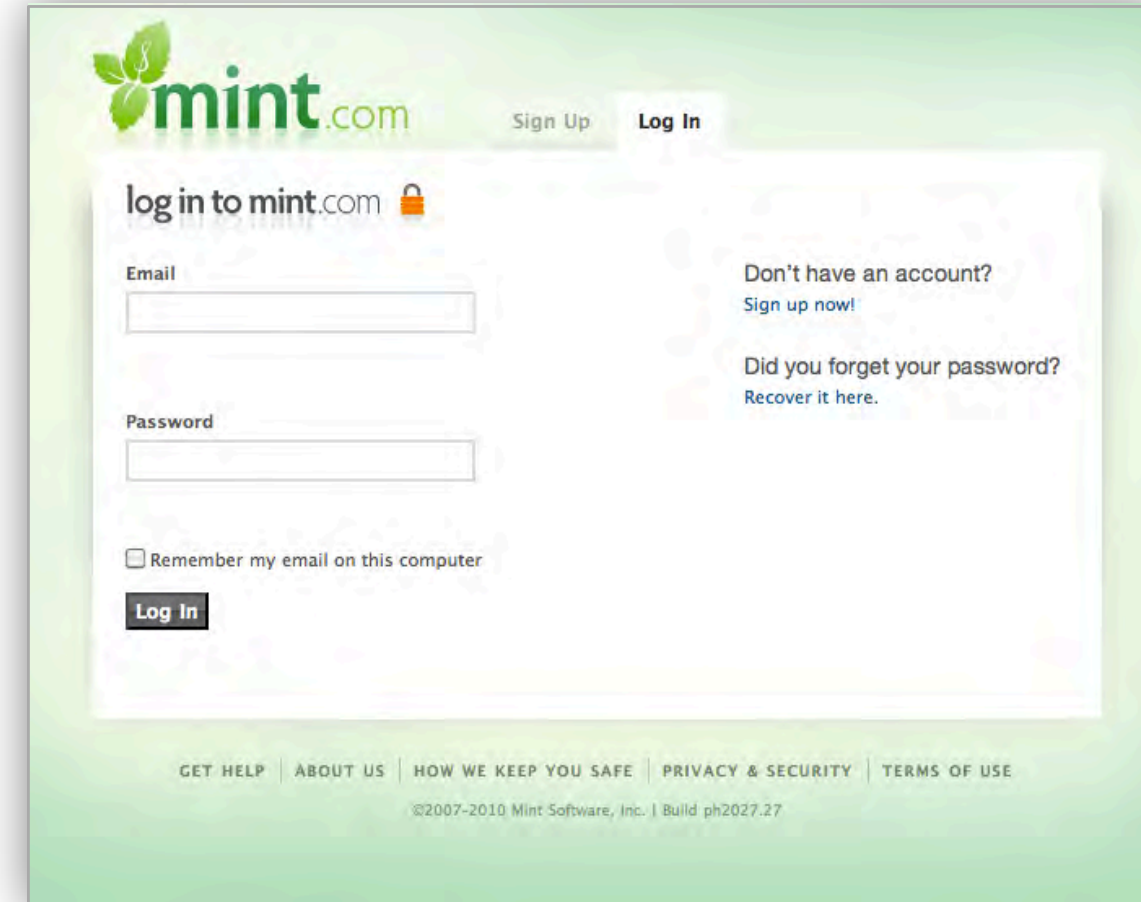
AUTOMATIC RETARGETING

**Bricolage: Example-Based
Retargeting for Web Design**
Kumar et al., CHI '11

AUTOMATIC RETARGETING

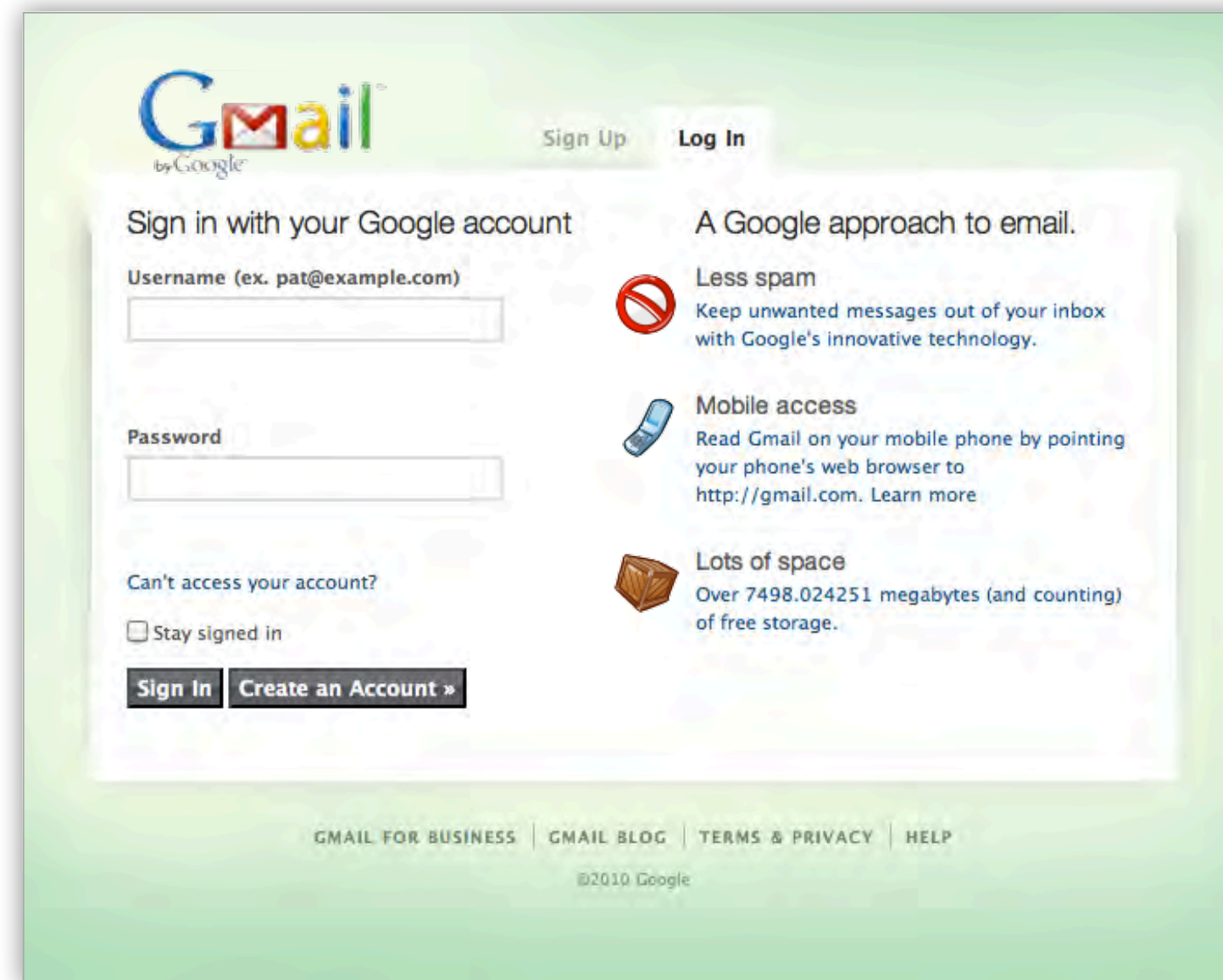
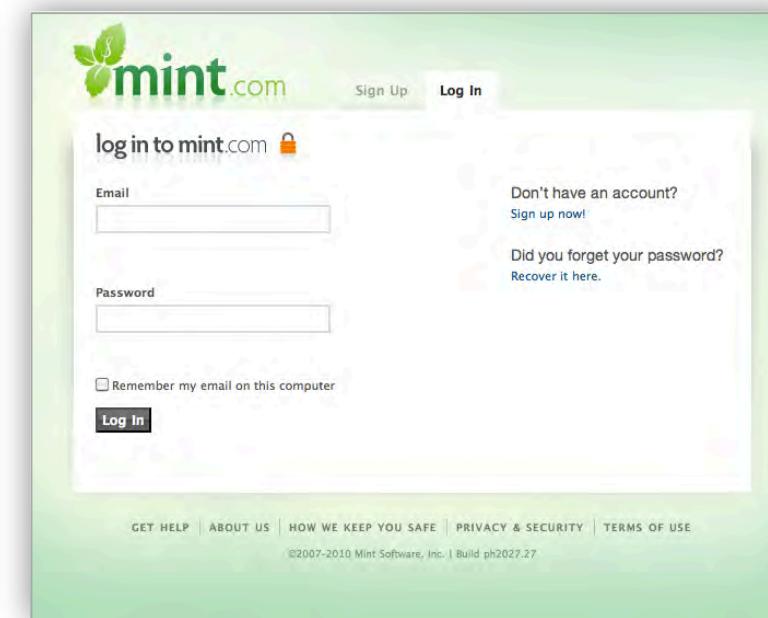
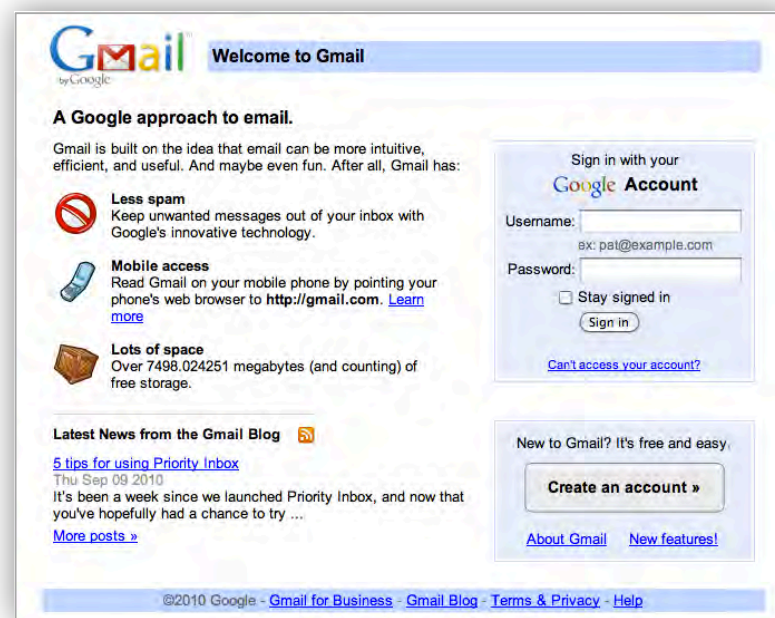


The screenshot shows the Gmail homepage. At the top left is the Gmail logo with the text "by Google". To its right is a blue header bar with the text "Welcome to Gmail". Below the header, there is a section titled "A Google approach to email." followed by a paragraph: "Gmail is built on the idea that email can be more intuitive, efficient, and useful. And maybe even fun. After all, Gmail has:". This is followed by three bullet points: "Less spam" (Keep unwanted messages out of your inbox with Google's innovative technology.), "Mobile access" (Read Gmail on your mobile phone by pointing your phone's web browser to <http://gmail.com>. [Learn more](#)), and "Lots of space" (Over 7498.024251 megabytes (and counting) of free storage.). Below this is a section titled "Latest News from the Gmail Blog" with a feed icon, containing a link to "5 tips for using Priority Inbox" dated "Thu Sep 09 2010" and a "More posts »" link. On the right side, there is a "Sign in with your Google Account" box with fields for "Username:" (with an example "pat@example.com") and "Password:", a "Stay signed in" checkbox, a "Sign in" button, and a "Can't access your account?" link. Below that is a "New to Gmail? It's free and easy." box with a "Create an account »" button and links for "About Gmail" and "New features!". At the bottom, there is a footer with copyright information: "©2010 Google - [Gmail for Business](#) - [Gmail Blog](#) - [Terms & Privacy](#) - [Help](#)".

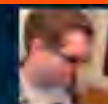


The screenshot shows the login page for mint.com. At the top left is the mint.com logo. To its right are links for "Sign Up" and "Log In". The main heading is "log in to mint.com" with a lock icon. Below this are two input fields: "Email" and "Password". To the right of these fields is a section with links: "Don't have an account? Sign up now!" and "Did you forget your password? Recover it here.". Below the password field is a "Remember my email on this computer" checkbox and a "Log In" button. At the bottom, there is a footer with navigation links: "GET HELP | ABOUT US | HOW WE KEEP YOU SAFE | PRIVACY & SECURITY | TERMS OF USE" and copyright information: "©2007-2010 Mint Software, Inc. | Build ph2027.27".

Bricolage: Example-Based Retargeting for Web Design
Kumar et al., CHI '11



Bricolage: Example-Based Retargeting for Web Design
Kumar et al., CHI '11



Blog

Spring 2010 jQuery Talks

I gave a number of talks this spring on jQuery and especially on some of the recent additions made in jQuery 1.4. Below are all the slides and demos that I've given.

The conferences / meetups that I spoke at (or will speak at, in the case of MIX), and the talks that I gave, are [...]

24 Comments · **Posted:** March 4th, 2010 · **Tags:** jquery, speaking, talks, workshop

.closest(Array) in jQuery 1.4

A new method signature is slated for jQuery 1.4: .closest(Array). It builds upon the previous .closest() method and hyper-optimizes the logic needed for handling event delegation (and live events).

closest() (and by extension, is()) has become a critical function in jQuery. With more people using live events reducing any overhead has become of the utmost importance. [...]

50 Comments · **Posted:** December 18th, 2009 · **Tags:** closest, live, jquery

.nodeName Case Sensitivity

When working with the DOM .nodeName property there are two hard-and-fast rules that most people abide by:

The node names of HTML elements are always uppercase, even if they're explicitly created using lowercase characters. <html> will result in a .nodeName === "HTML" (see the HTML 5 draft).

The node names of XML elements are always in the [...]

31 Comments · **Posted:** November 24th, 2009 · **Tags:** dom, javascript, browsers

« Previous entries

JavaScript Books



JavaScript Secrets

Secret techniques of top JavaScript programmers.



Pro JavaScript

The best techniques for professional JavaScript. Published by Apress.

Micro Updates



@jeresig

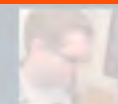
Infrequent, short, updates and links.

JavaScript Jobs

[Ninja Jobs: JavaScript Jobs](#)

[Mozilla: Browser Jobs](#)

Hosting provided by:



Blog

Spring

I gave a number of talks this spring on JQuery and especially on some of the recent additions made in JQuery 1.4. Below are all the slides and demos that I've given.

The content talks that

24 Comments

.closest

A new method signature is slated for JQuery 1.4: .closest(Array). It builds upon the previous .closest() method and hyper-optimizes the logic needed for handling event delegation (and live events). closest() (and by extension, is()) has become a critical function in JQuery. With more people using live events reducing any overhead

closest() using live

50 Comments

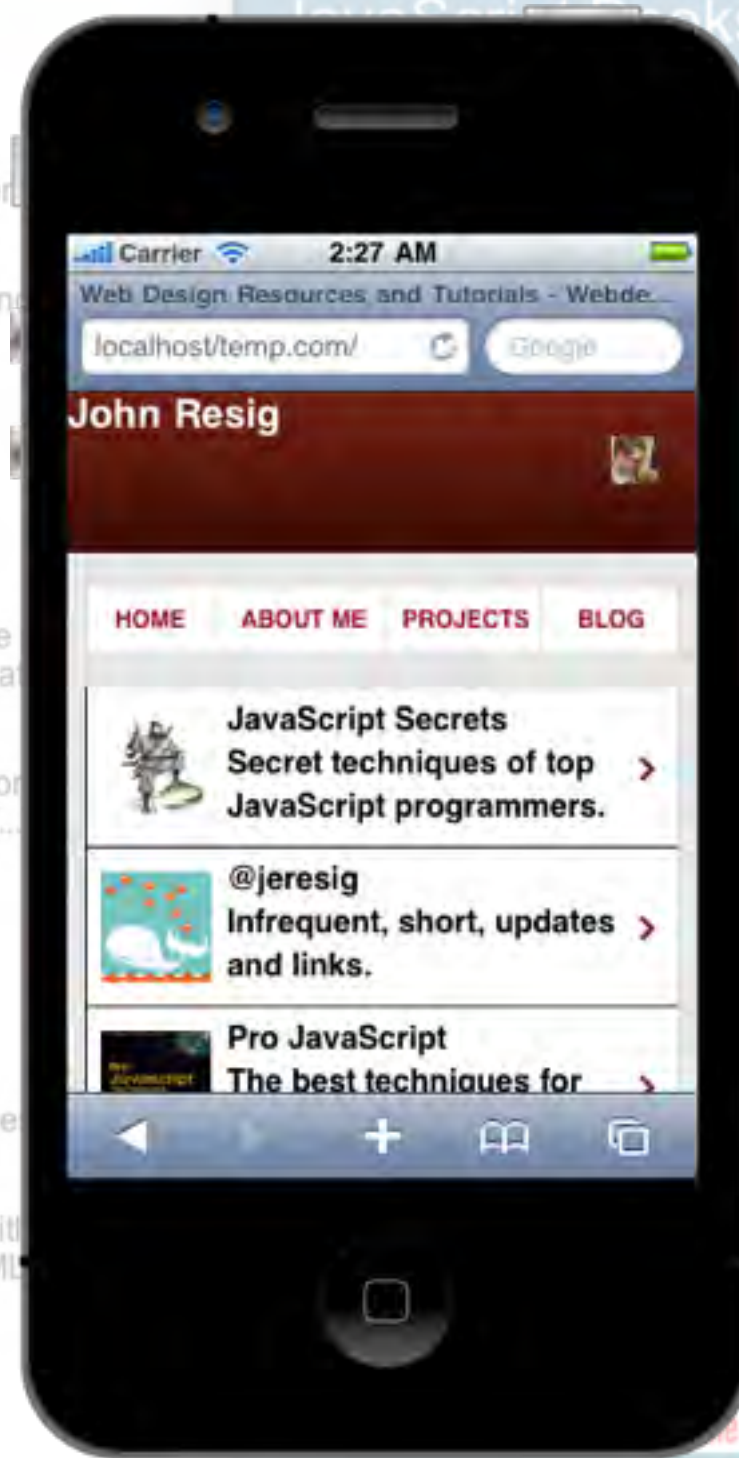
.node

When we most people

The node created the HTML The node

31 Comments

« Previous entries



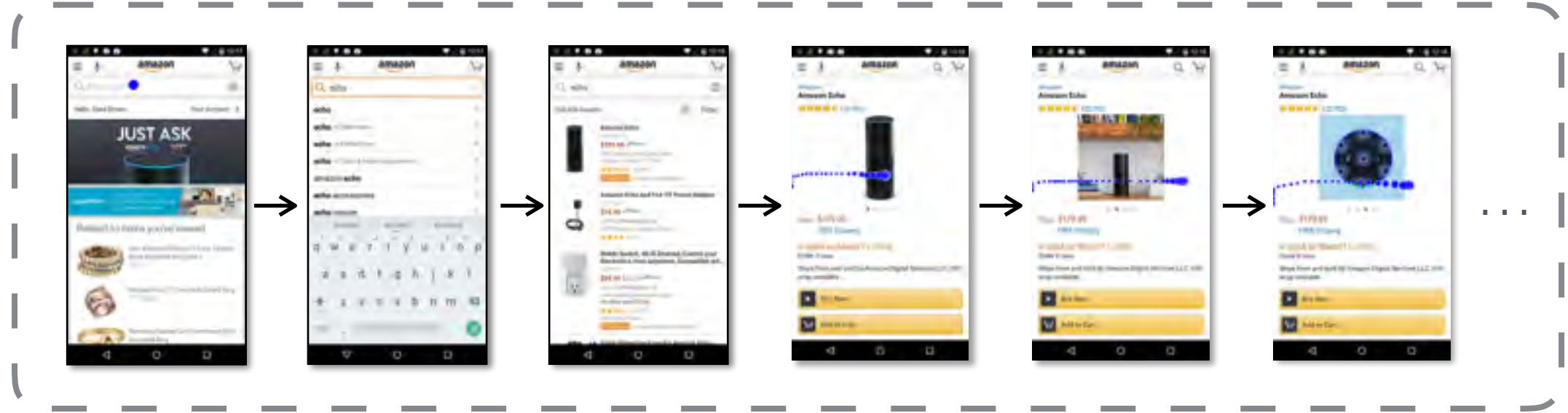
INTERACTION MINING FOR MOBILE APPS

ERICA

APP + USER



UI HIERARCHY



USER INTERACTION TRACE



USER INTERACTION

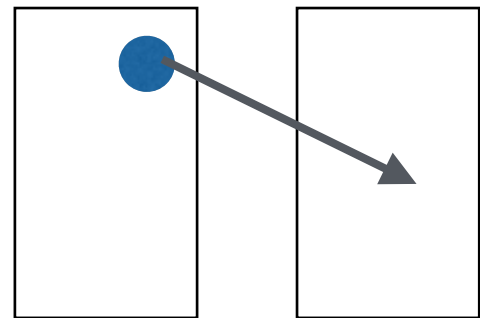


SCREENSHOT



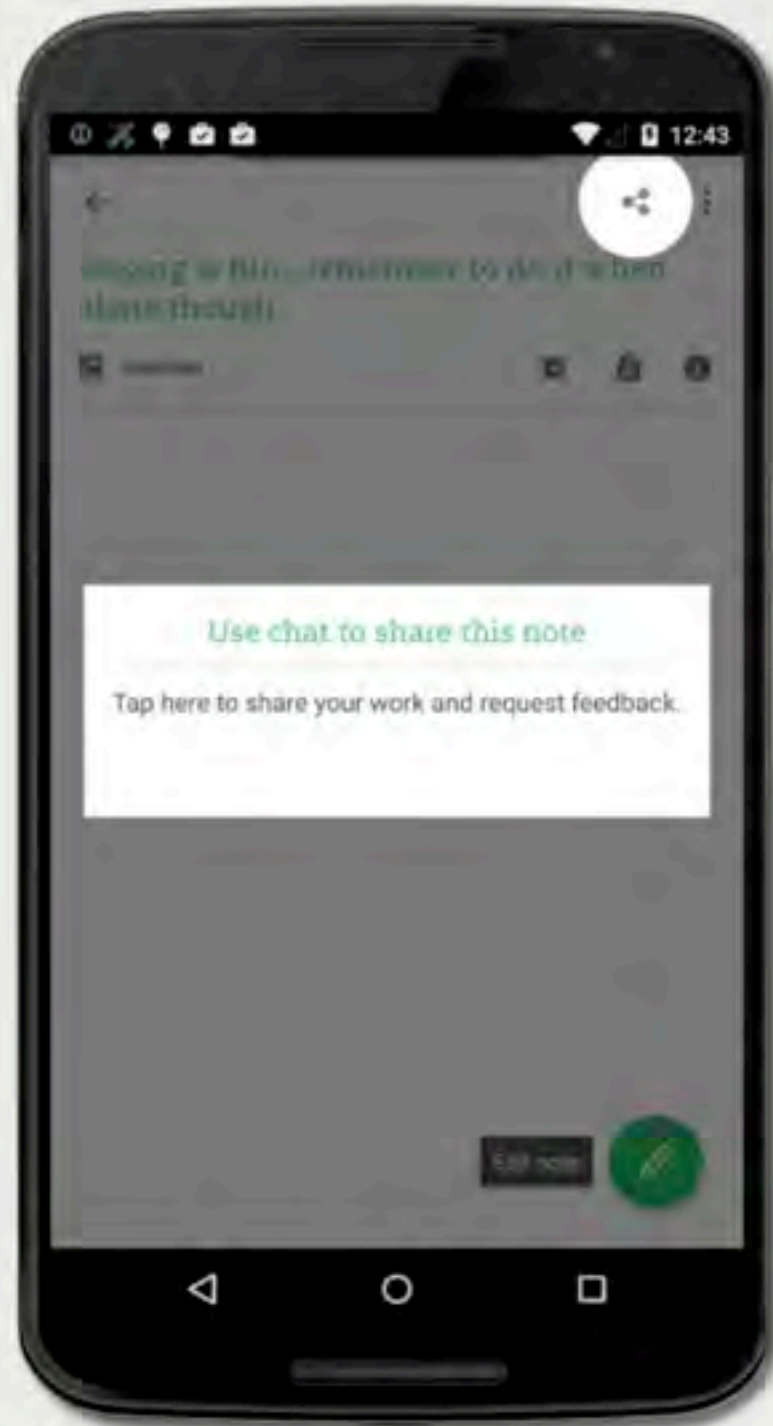
x: 0.9
y: 0.81
resource-id:
location_button
clicked: true

EXTRACT ELEMENT PROPERTIES



CONNECT VIEWS WITH INTERACTIONS

with Biplab Deka and Zifeng (Forrest) Huang
UIST 2016



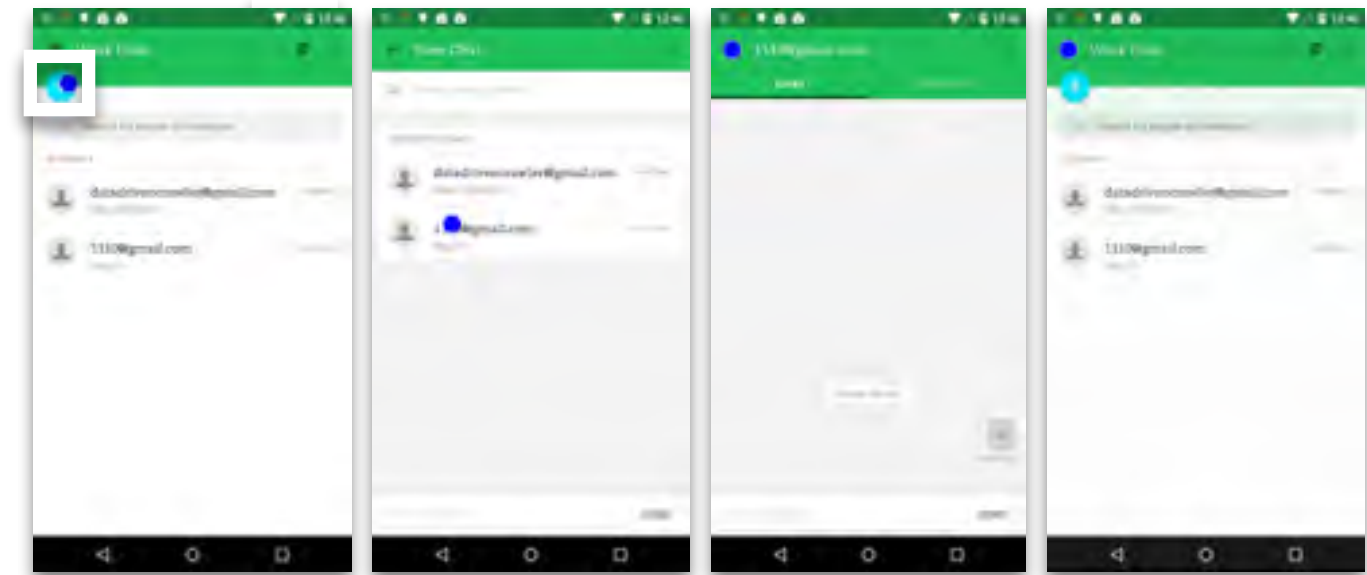
with Biplab Deka and Zifeng (Forrest) Huang
UIST 2016

FLOW PATTERNS

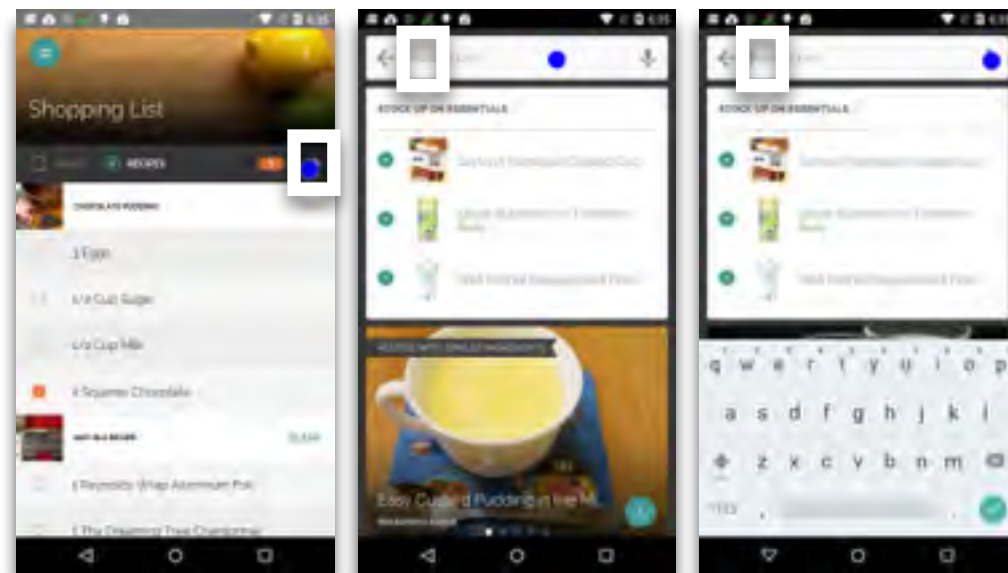
ADDING



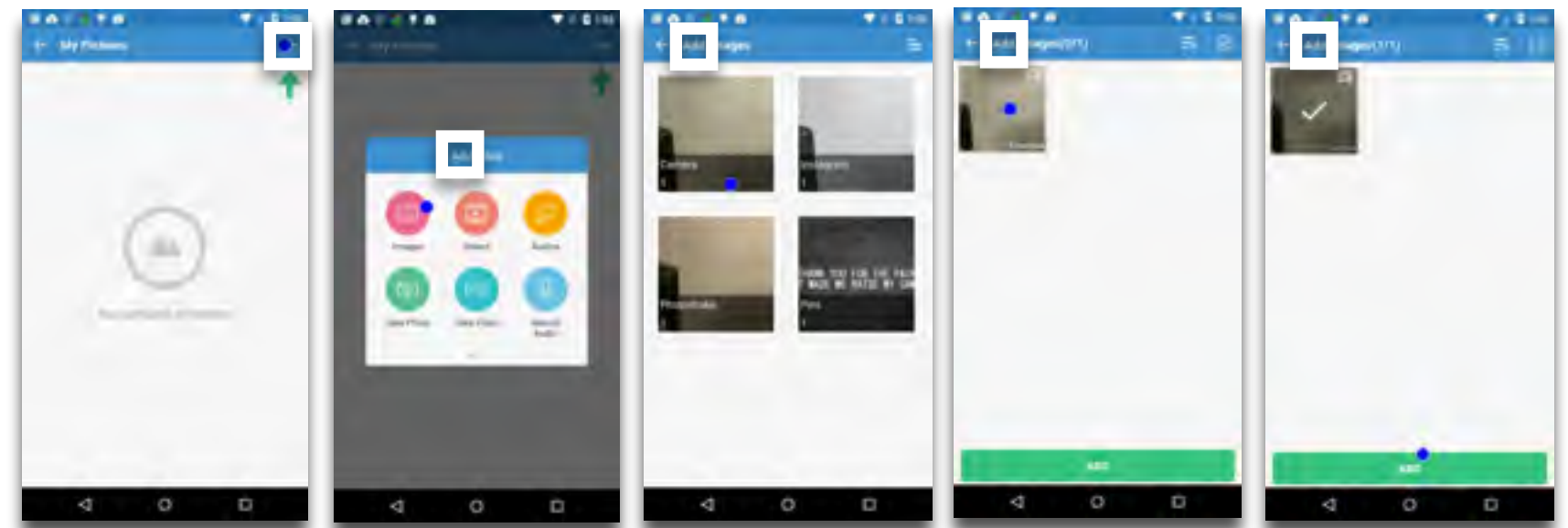
“create”, “add”



 Evernote



 Yummly



 Gallery Vault

with Biplab Deka and Zifeng (Forrest) Huang
UIST 2016

FLOW PATTERNS

ONBOARDING

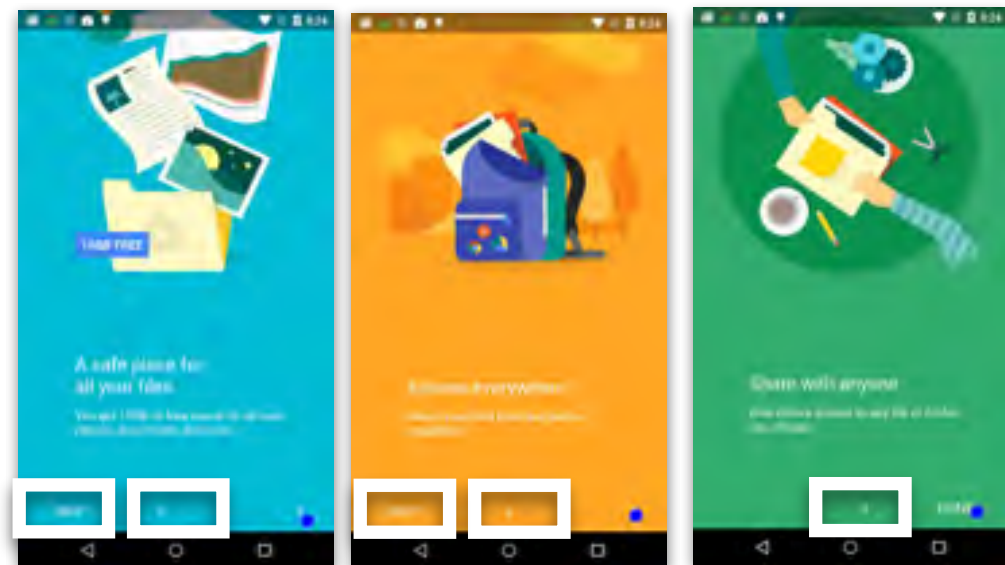


Android
ViewPager

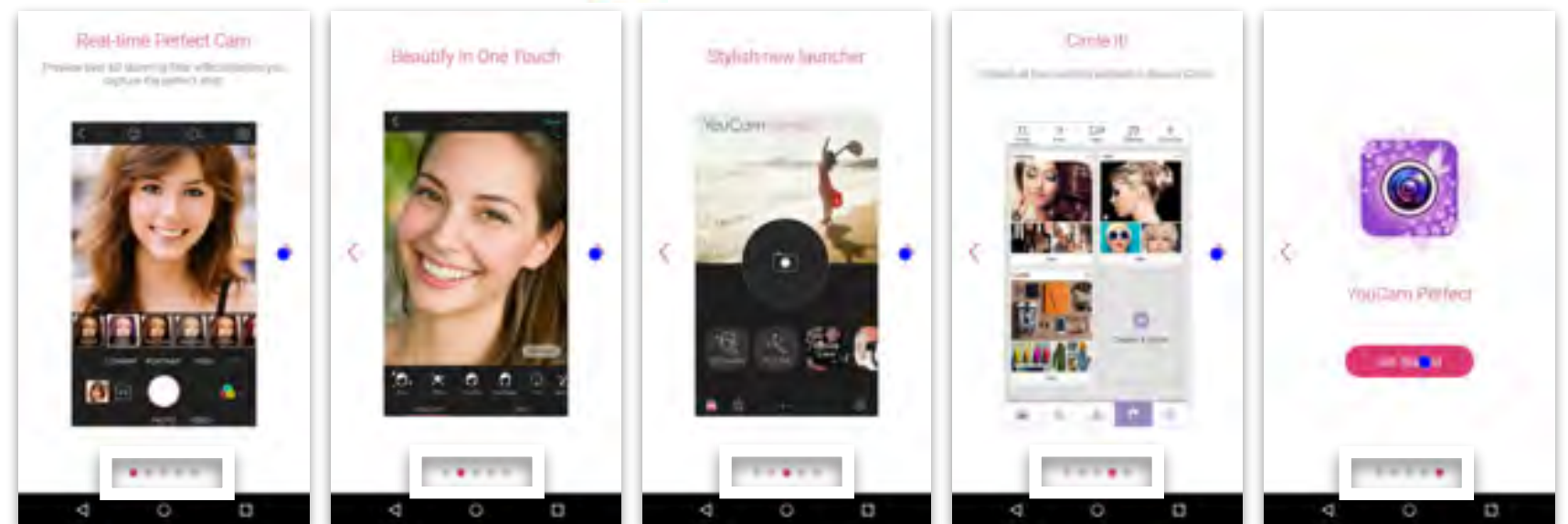
“Tutorial”, “Skip”,
“Get Started”



 Beep'nGo



 Google Drive



 YouCam Perfect

with Biplab Deka and Zifeng (Forrest) Huang
UIST 2016

23 FLOW CLASSES, >3000 EXAMPLES

Flow Search

Search Location Add Go Back Done Close Menu Promote Go to Home Post Profile
Share Refresh Settings Filter Purchase Login Recover Password Signup Logout Consuming
Composing **Onboarding**

onboarding Search

Examples Found in 27 Apps

First Previous 1 2 Next Last

HP ePrint MeituPic Elevate - Brain Training Weather Underground Groupon - Shop Deals & Co. Walmart

HP ePrint: Welcome to HP ePrint. HP ePrint. Over 500 million users use HP ePrint. **Skip** **Activate Now**

MeituPic: MeituPic. Over 500 million users use MeituPic. **Try New Filters**

Elevate - Brain Training: Elevate. We'll build a quiz for you. Retain more of what you read and hear. **Start**

Weather Underground: Weather. San Francisco, CA. 51°. **Write my location**

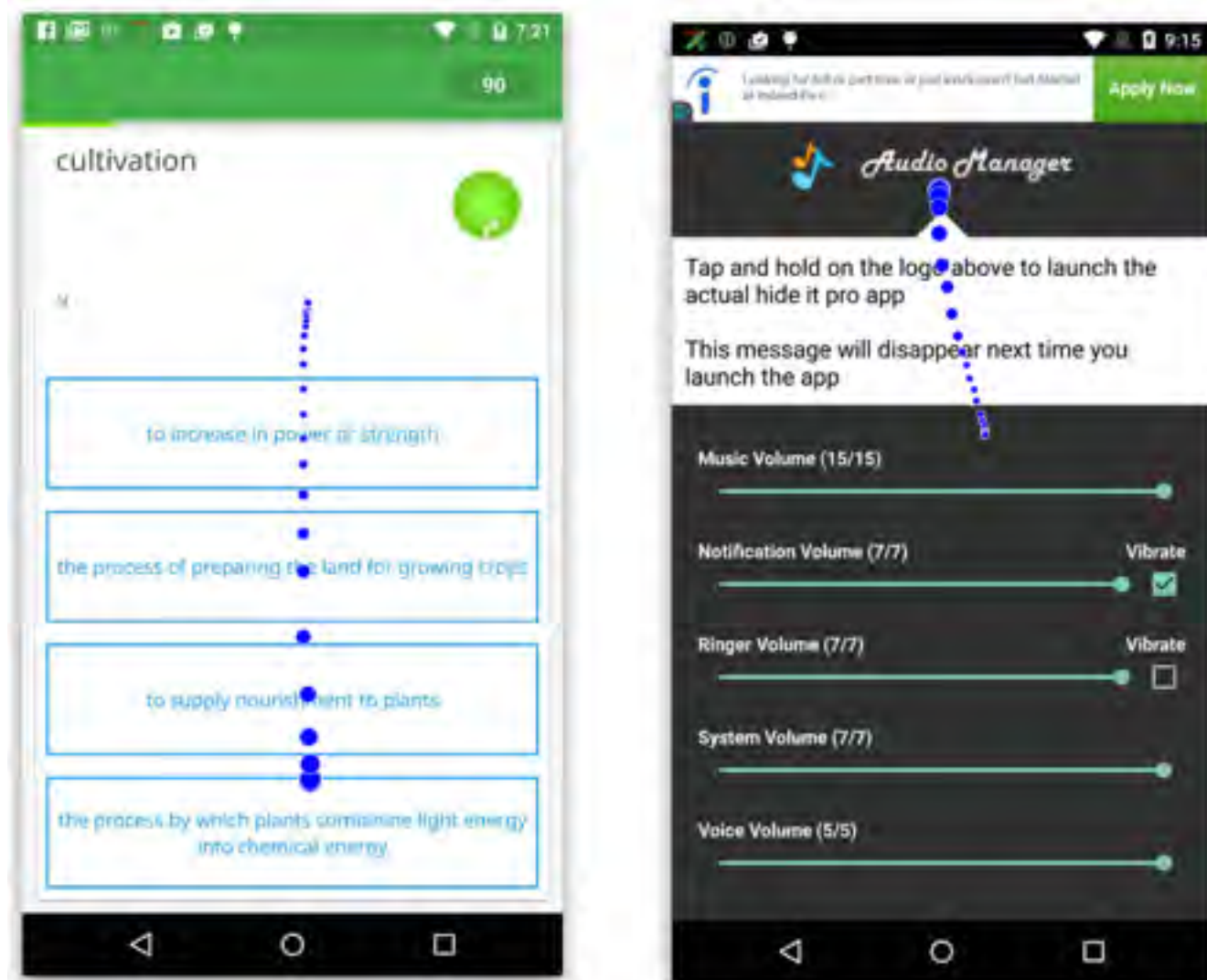
Groupon - Shop Deals & Co.: Groupon. Where would you like to save? 94101. **Continue**

Walmart: Walmart. **Continue**

found and indexed more than one flow example, and based the on the search engine of flows in android apps.

with Biplab Deka and Zifeng (Forrest) Huang
UIST 2016

TESTING AND GENERATING UI LAYOUTS

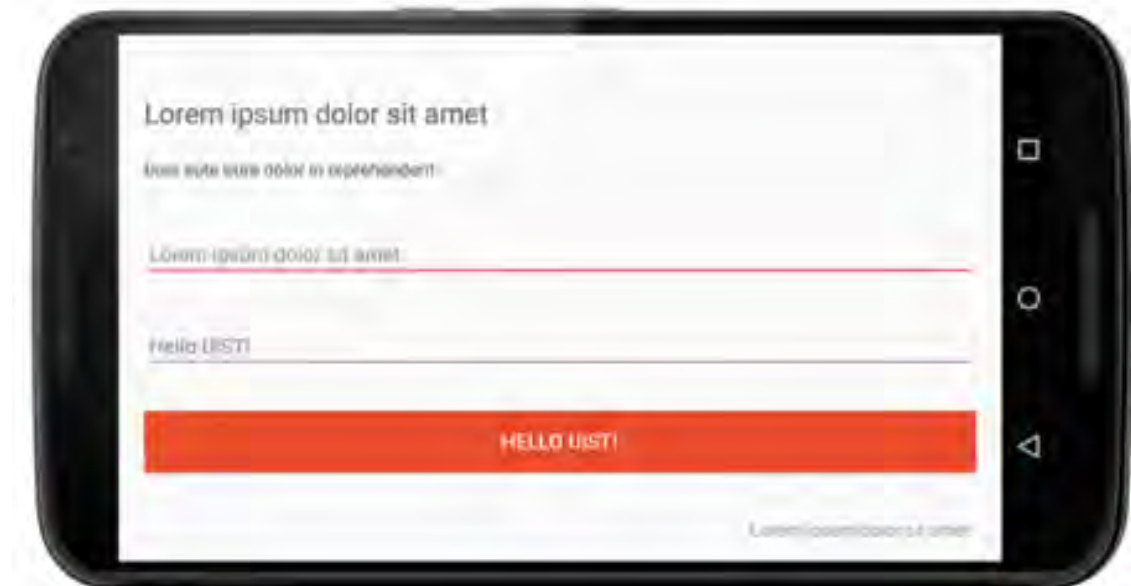


USABILITY ISSUES

Screenshot



XML



REVERSE ENGINEERING

with Biplab Deka and Zifeng (Forrest) Huang
UIST 2016

STYLE MINING FOR FASHION OUTFITS

MINING POLYVORE



Happy Valentine's Day

Happy Valentine's Day! Have a nice time with your boyfriends, and don't forget about people who are alone (like me). The next few days will be in tones of romance, couples, blush colors. Have a nice weekend! Send warm hugs and love.
#valentinesday
#personalstyle
#sweaterweather



Red cardigan,
Long sleeve tops,
Mango tops



Stack heel shoes,
Oxford shoes



Retro sunglasses,
Heart sunglasses,
Hippie glasses



Short sleeve shirts,
White t shirt,
Lightweight shirt,
Mango shirt

with Kristen Vaccaro and Karrie Karahalios
UIST 2016

MINING POLYVORE



Happy Valentine's Day

Happy Valentine's Day! Have a nice time with your boyfriends, and don't forget about people who are alone (like me). The next few days will be in tones of romance, couples, blush colors. Have a nice weekend! Send warm hugs and love.
 #valentinesday
 #personalstyle
 #sweaterweather



STYLE

happy, love, hugs
 blush, valentines
 boyfriends, warm
 couples, romance
 alone, weekend
 valentinesday
 personalstyle
 sweaterweather



Red cardigan,
 Long sleeve tops,
 Mango tops



Stack heel shoes,
 Oxford shoes



ELEMENT

red, short, sleeve
 shirts, white, tshirt
 mango, oxford
 lightweight, stack
 tops, heel, shoes
 sunglasses, heart
 cardigan, long



Retro sunglasses,
 Heart sunglasses,
 Hippie glasses



Short sleeve shirts,
 White t shirt,
 Lightweight shirt,
 Mango shirt

POLYLINGUAL TOPIC MODELS

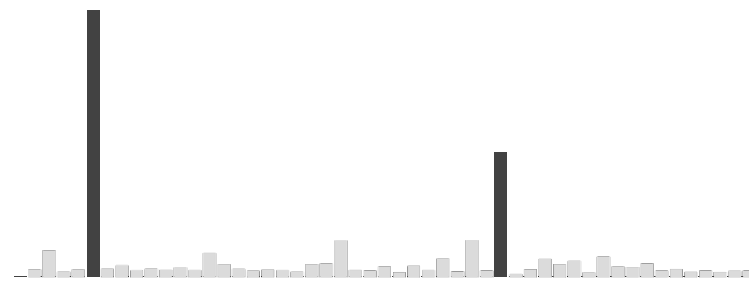


with Kristen Vaccaro and Karrie Karahalios
UIST 2016

POLYLINGUAL TOPIC MODELS



TOPIC DISTRIBUTION



1
STYLE
prom, occasion, special, party, holiday, bridesmaid

ELEMENT
dress, shoe, cocktail, evening, mini, heel, costume

2
STYLE
party, summer, night, sexy, vintage, fitting, botanical

ELEMENT
dress, mini, sleeveless, cocktail, skater, flare, out, lace, floral

TOPIC DISTRIBUTION



1
STYLE
summer, vintage, beach, american, relaxed, retro, unisex

ELEMENT
short, denim, highwaisted, shirt, top, cutoff, form, distressed

2
STYLE
biker, motorcycle, vintage, summer, college, varsity, military

ELEMENT
jacket, black, leather, shirt, zip, denim, sleeve, faux



STYLE QUIZ

USER INPUT



ELEMENTS

triangle bathing
suit swimsuit swim
one-piece white
slimming leather
wedge platform
ankle-strap
peep-toe sandal
red knot silk
head-wrap
headband
polka-dot
dolce&gabbana
cat-eye round
sunglasses white

TOP STYLES

beach
summer
swimming
bathing
sexy
retro
getaway
fishing

STYLE QUIZ

USER INPUT



ELEMENTS

urban outfitters
summer tops
cotton shirts wrap
skirt high low navy
tie-dye purple
summer billabong
beach bag hippie
retro backpack
print day pack
boho jewelry
bohemian rope
bracelet leather
cord

TOP STYLES

boho
bohemian
summer
vintage
holiday
party
wet
sexy

STYLE QUIZ

USER INPUT



ELEMENTS

t-shirt purple
shirt cap sexy
balconette
mesh strappy
lingerie short
pleated skirt
man bag pink
loius vuitton
purse white
shoe leather t-
strap platform
pump pointed-
toe high-heel

TOP STYLES

party
sexy
wedding
night
special
occasion
realreal
season

AUTOMATED PERSONAL STYLIST

USER INPUT



“

I'm in town for New York Fashion Week and I'd like to find something flashy, maybe a little funky, to wear to the shows. You know everyone's out, watching the different groups, the runway-to-street crowd, the blogger-style crowd... Me, I'm more of a streetstyle, streetchic person. Just edgy enough, you know?

”

STYLE

nyfw
funk
funky
streetfashion
runway2street
runway
edgy
flashy
streetstyle
streetchic
bloggerstyle

TOP ITEMS



with Kristen Vaccaro and Karrie Karahalios
UIST 2016

AUTOMATED PERSONAL STYLIST

USER INPUT

“

I need some clothes for a yoga retreat I'm doing next month. We'll be up in the mountains in Colorado, enjoying the calming natural beauty. It is so beautiful up there in nature... and we'll be running, doing yoga all day, sweating and finding zen...

”



STYLE

yoga
activewear
fitness
zen
calming
calm
nature
naturalbeauty
running
athletic
jogging
colorado
retreat
sweat

TOP ITEMS



with Kristen Vaccaro and Karrie Karahalios
UIST 2016

AUTOMATED PERSONAL STYLIST

USER INPUT



“ I need an outfit for a beach wedding that I'm going to early this summer. I'm so excited -- it's going to be warm and exotic and tropical... I want my outfit to look effortless, breezy, flowy, like I'm floating over the sand! Oh, and obviously no white! For a tropical spot, I think my outfit should be bright and colorful. ”

STYLE

beach
wedding
summer
tropical
exotic
effortless
breezy
glowing
radiant
floating
flowy
warm
bright
colorful

TOP ITEMS



with Kristen Vaccaro and Karrie Karahalios
UIST 2016

CONSIDERATIONS

BIG DATA?

10 M

interior designs



40 M

outfits

POLYVORE

BIG DATA?

10 M

interior designs



40 M

outfits



27 bn

words



1,000 bn

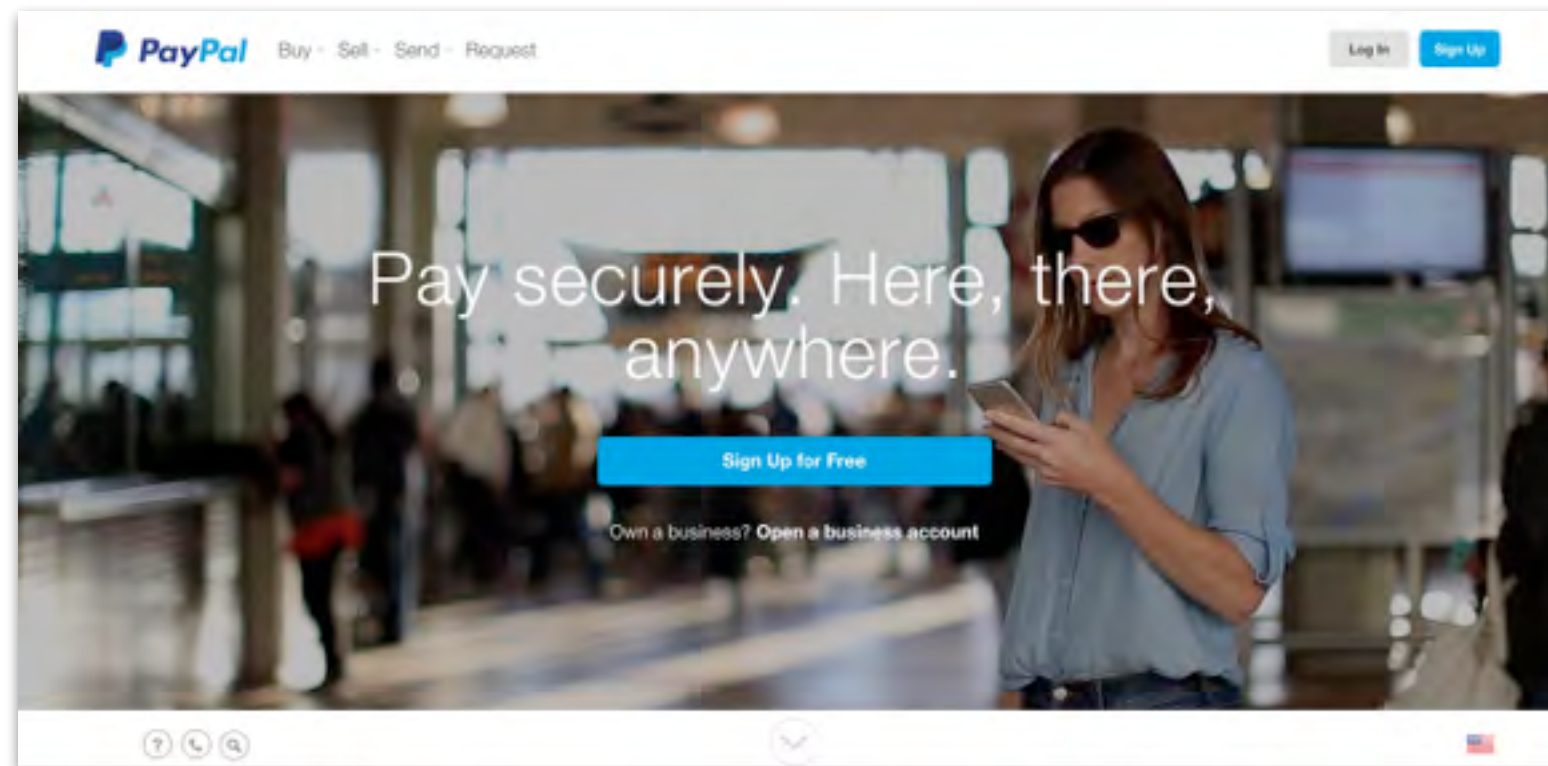
photos



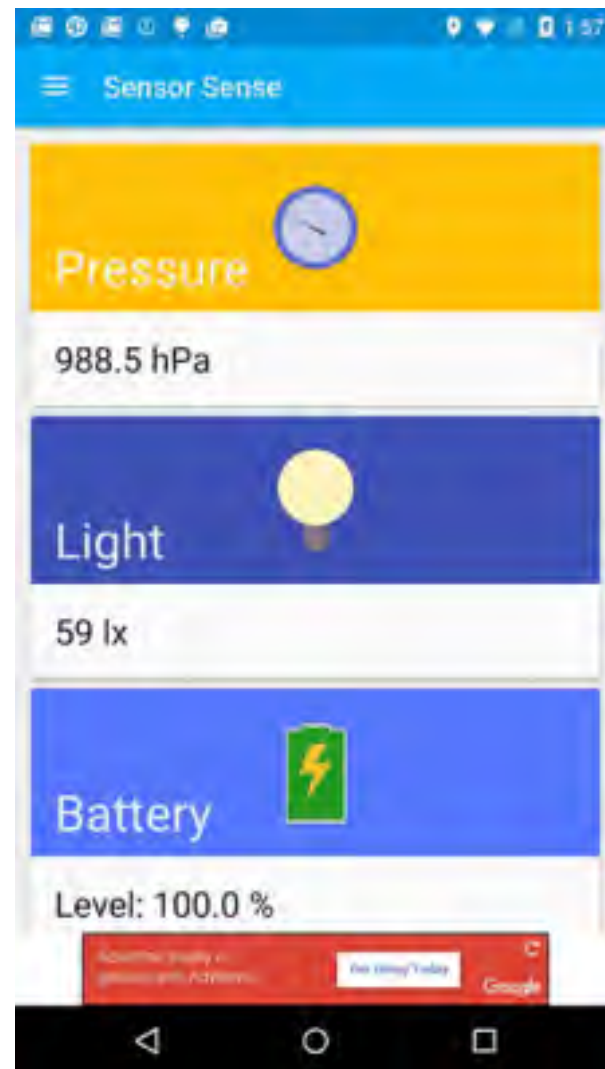
DATA STREAMS IN DESIGN

DATA STREAMS IN DESIGN

Text, Images, Video, Audio



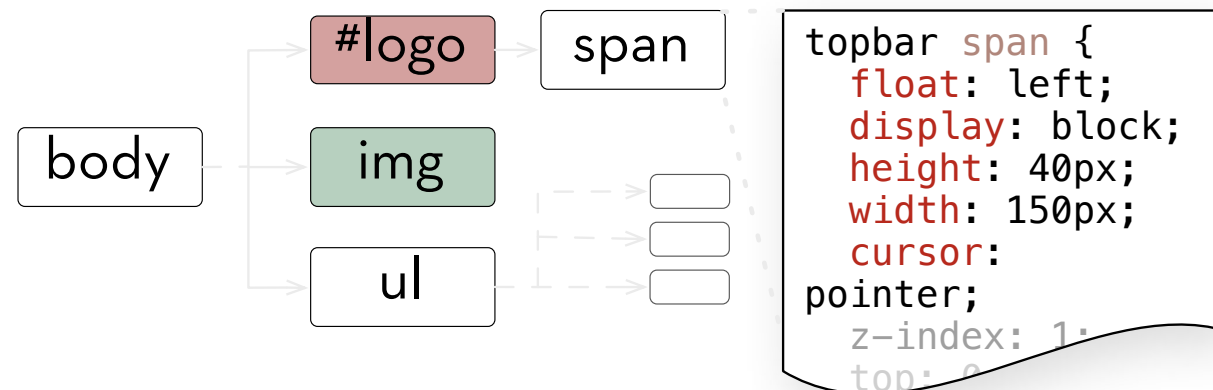
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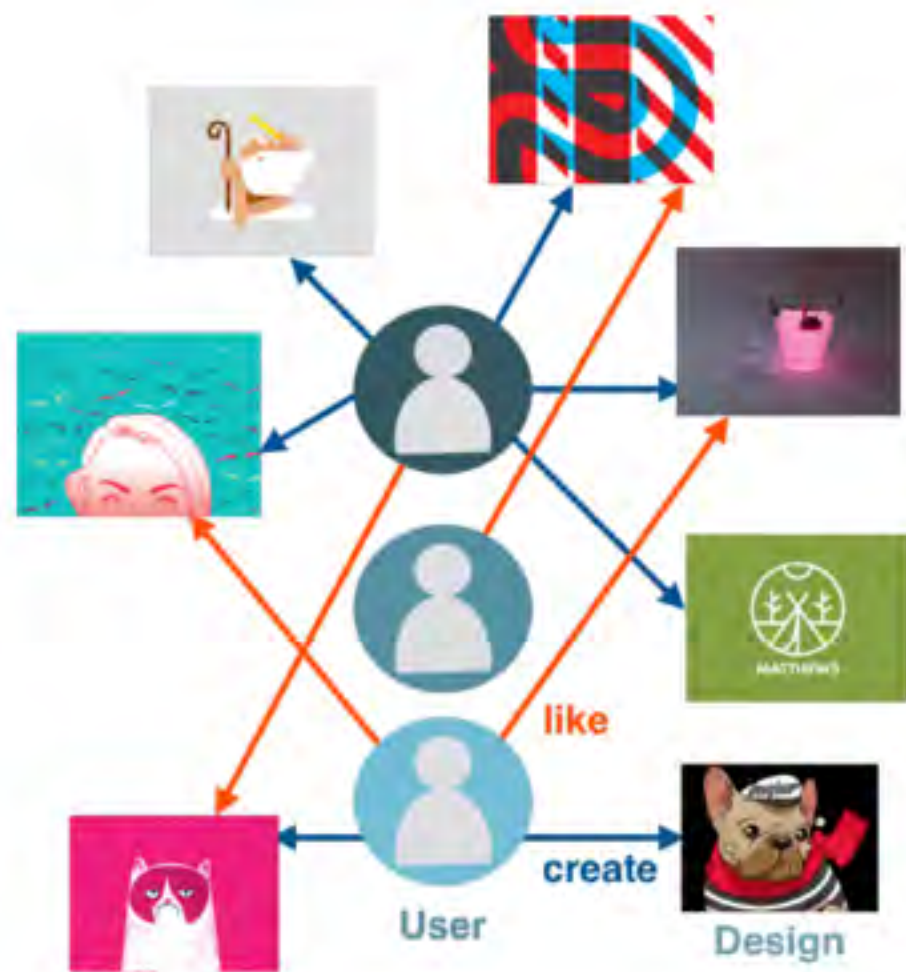
Text, Images, Video, Audio
Human Interaction

DATA STREAMS IN DESIGN

Text, Images, Video, Audio
Human Interaction
Structure



DATA STREAMS IN DESIGN



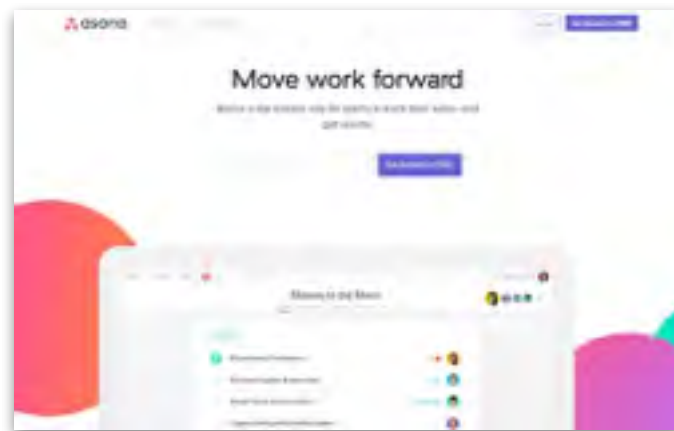
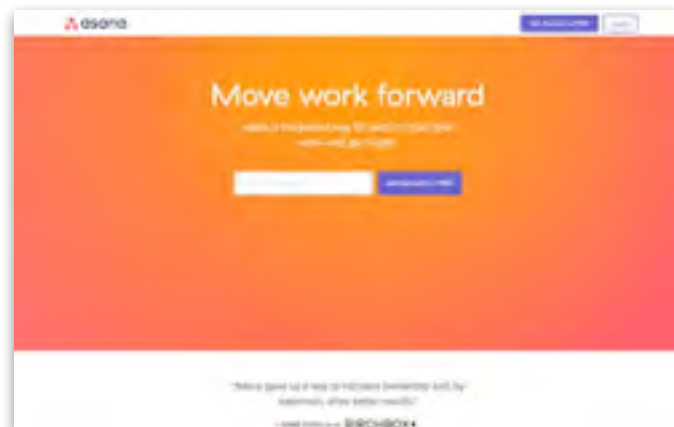
Text, Images, Video, Audio

Human Interaction

Structure

Network Connectivity

DATA STREAMS IN DESIGN



Text, Images, Video, Audio

Human Interaction

Structure

Network Connectivity

History

DATA STREAMS IN DESIGN

CONVERSION

Text, Images, Video, Audio

BOUNCE RATE

Human Interaction

TIME ON SITE

Structure

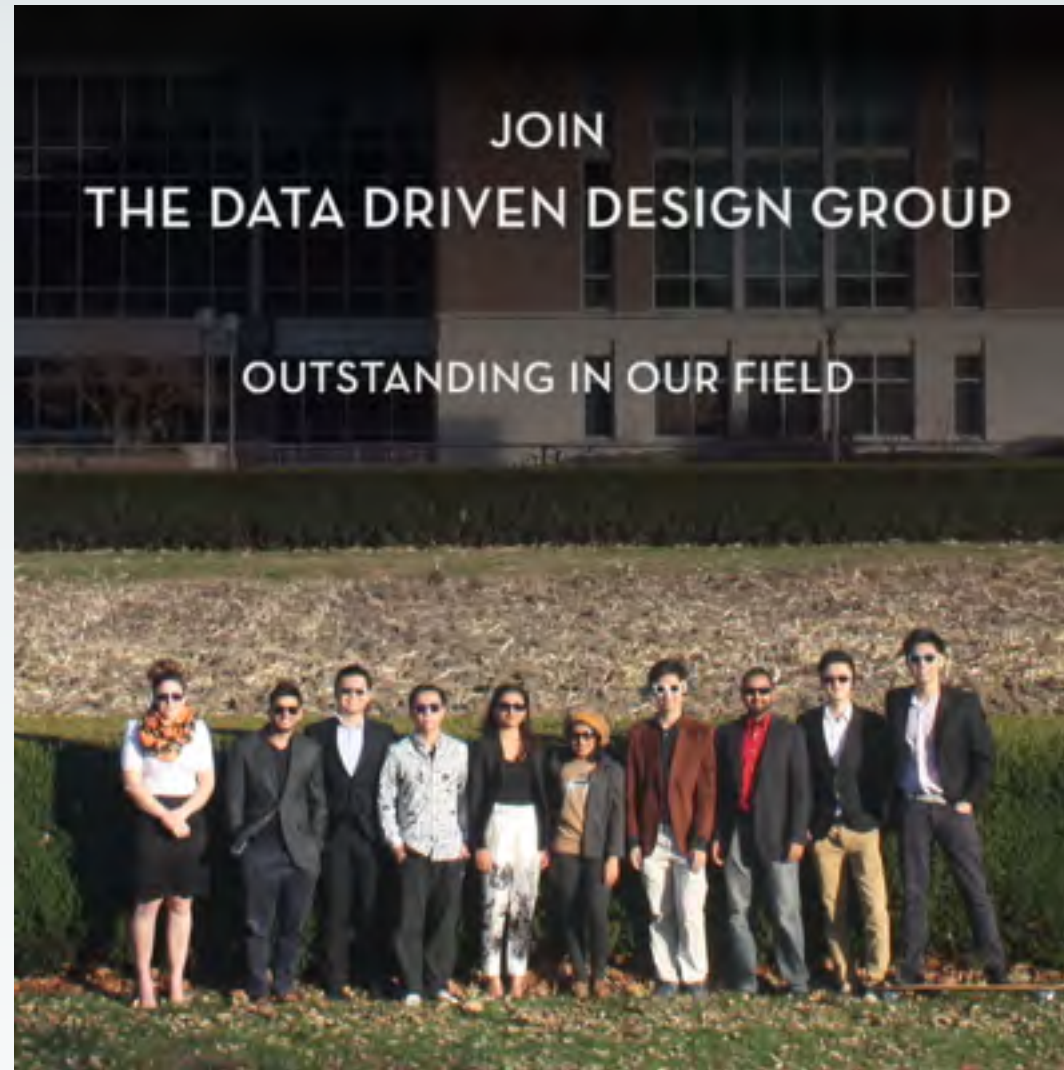
PAGES PER USER

Network Connectivity

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History

Performance



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