

“Recommended For You”: A First Look at Content Recommendation Networks

Muhammad Ahmad Bashir, Sajjad Arshad, Christo Wilson



Northeastern University

Content Recommendation Networks (CRNs)

BBC Sign in News Sport Weather Shop Earth Travel More Search

NEWS

Home Video World US & Canada UK Business Tech Science Magazine Entertainment & Arts Health More

World Africa Asia Australia Europe Latin America Middle East

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Several hundred migrants remain inside the "Jungle" camp in Calais, BBC reporters at the scene say, despite French officials claiming the camp is now empty.

About 200 unaccompanied minors have been left with nowhere to sleep, our Europe reporter Gavin Lee says.

Migrant crisis

What next after the Jungle?

The desperate children of the Calais Jungle

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From Around the Web

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8 Retail Chains Closing Hundreds of Stores in 2016

Bankrate



Before You Try A Meal Kit Delivery Service, Read This

HelloFresh



Secret Restaurant Recipes Revealed

Food Network



Homeowners Must Claim their \$4271 Before End of 2016

FetchRate



I Found Out Why Millions Are Switching to...

Dollar Shave Club



The Hearing Aid of the Future is Here

Hear.com

More Videos from the BBC

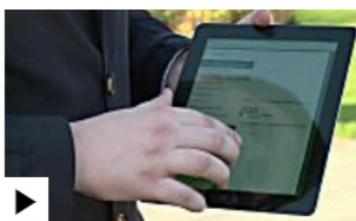
Recommended by Outbrain



Halloween: Barack and Michelle Obama dance to Michael Jackson's Thriller



Heseltine: I did not strangle dog to death



The TaxPayers' Alliance app has council spending data



350 potential job losses will have 'massive impact' on Merthyr



Man shot in 'large scale disturbance' in Luton



Italy earthquake: Helicopter video shows cracks in mountainside

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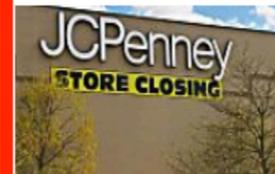
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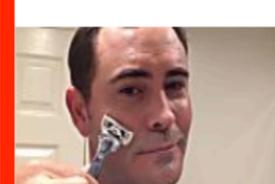
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Content Recommendation Networks (CRNs)

The screenshot shows the BBC News homepage. At the top, there's a navigation bar with 'BBC' logo, 'Sign in', and various news categories like News, Sport, Weather, Shop, Earth, Travel, and More. Below this is a secondary navigation bar with 'NEWS' and sub-categories like Home, Video, World, US & Canada, UK, Business, Tech, Science, Magazine, Entertainment & Arts, Health, and More. A third navigation bar lists regional areas: World, Africa, Asia, Australia, Europe (highlighted), Latin America, and Middle East. An advertisement for Verizon is displayed, offering a \$100 discount on smartphones. The main content area features a large article titled 'Migrant crisis' with a sub-headline 'Several hundred migrants remain inside the "Jungle" camp in Calais, BBC reporters at the scene say, despite French officials claiming the camp is now empty.' Other sub-headlines include 'What next after the Jungle?' and 'The desperate children of the Calais Jungle'.

Promoted content by Outbrain

This section is titled 'From Around the Web' and is labeled as 'Promoted content by Outbrain'. It features a grid of article recommendations, each with a small image and a title. The articles include: '8 Retail Chains Closing Hundreds of Stores in 2016' by Bankrate (with a JCPenney store closing sign); 'Before You Try A Meal Kit Delivery Service, Read This' by HelloFresh (with an image of avocados); 'Secret Restaurant Recipes Revealed' by Food Network (with a pizza); 'Homeowners Must Claim their \$4271 Before End of 2016' by FetchRate (with stacks of cash); 'I Found Out Why Millions Are Switching to...' by Dollar Shave Club (with a man shaving); and 'The Hearing Aid of the Future is Here' by Hear.com (with an image of an ear).



This section is titled 'More Videos from the BBC' and is labeled as 'Recommended by Outbrain'. It features a grid of video recommendations, each with a video thumbnail and a title. The videos include: 'Halloween: Barack and Michelle Obama dance to Michael Jackson's Thriller'; 'Heseltine: I did not strangle dog to death'; 'The TaxPayers' Alliance app has council spending data'; '350 potential job losses will have 'massive impact' on Merthyr'; 'Man shot in 'large scale disturbance' in Luton'; and 'Italy earthquake: Helicopter video shows cracks in mountainside'.

Content Recommendation Networks (CRNs)

The screenshot shows the BBC News homepage with a navigation bar at the top. Below the navigation, there's a red banner for "NEWS". A Verizon advertisement is prominently displayed, offering a \$100 discount on smartphones. The main content area features a "Migrant crisis" section with several articles, including "Several hundred migrants remain inside the 'Jungle' camp in Calais" and "What next after the Jungle?". A "From Around the Web" section is also visible, featuring articles from various sources like Bankrate, HelloFresh, Food Network, FetchRate, Dollar Shave Club, and Hear.com. At the bottom, there's a "More Videos from the BBC" section with a grid of video thumbnails and titles such as "Halloween: Barack and Michelle Obama dance to Michael Jackson's Thriller" and "350 potential job losses will have 'massive impact' on Merthyr".

Promoted content by Outbrain



Some Terminology

PAID PROMOTED STORIES



ABC7 News Reports Meal Service is Cheaper Than Grocery Store

Home Chef



Thinking About Installing Solar Panels? Read This First

Energy Bill Cruncher



Remember Barbi Benton? What She Looks Like Today Is

SemesterTimes

Recommended by  Outbrain

Elsewhere on BBC

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BBC News

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- Link to the publisher (first-party link) — Recommendation

Some Terminology

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- Link to the publisher (first-party link) — Recommendation
- Links to third-party websites — Ads

Some Terminology

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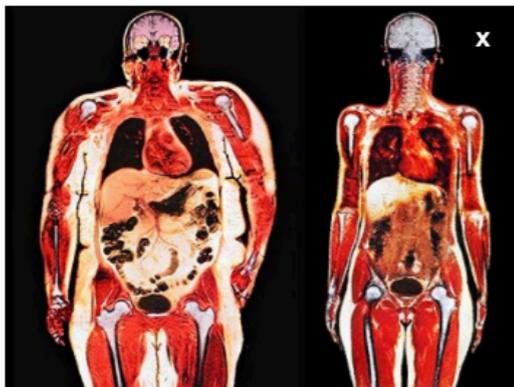
Sponsored by Revcontent



28 Pictures That Hillary Clinton Wishes Would Go



93% of Lotto Winners Do This One Thing Before Buying a



No Need for Diet or Gym if You Do This Before Bed



Chinese Homemade Cream Destroys Nail Fungus In 1 Day

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Outbrain Expects 25% Revenue Hit As It Cuts Off Spammy Content Marketers

ASA ruling on Outbrain link heightens 'native advertising' debate

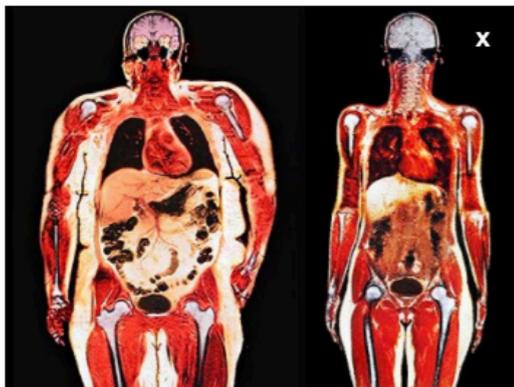
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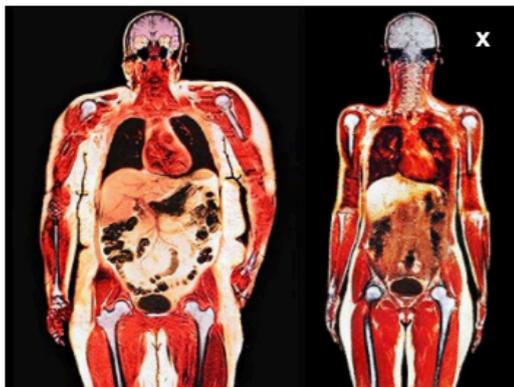
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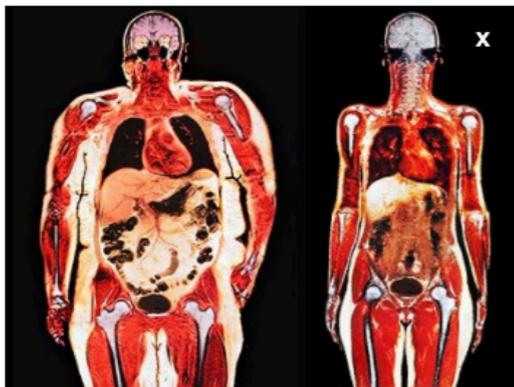
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We recommend



Wife accidentally runs over and kills husband in driveway



Car hits power pole in Cobden



Hall fundraiser on way at Wangoom

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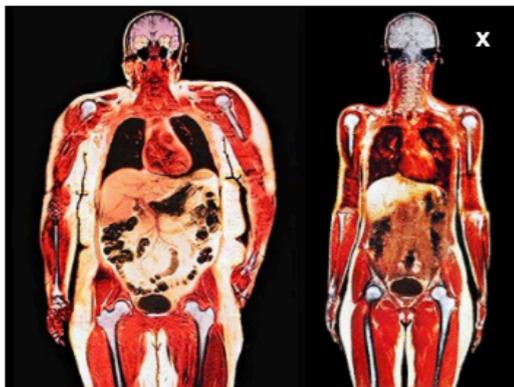
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Third party links

Goal

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Conduct a study to observe current practices of CRNs.

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- How are the widgets labeled and disclosed?

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- What kind of content is being advertised?

**Outbrain Expects 25% Revenue Hit
As It Cuts Off Spammy Content
Marketers**

Data Collection

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- 5 CRNs. Outbrain, Taboola, Gravity, ZergNet, Revcontent

Data Collection

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289



THE HUFFINGTON POST

Alexa Media and News Category

Data Collection

- 5 CRNs. Outbrain, Taboola, Gravity, ZergNet, Revcontent

289

+

211



THE HUFFINGTON POST

Alexa Media and News Category

DecaturDaily.com

THE PENS BLOG



Random sample from Alexa top 1M

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- For each publisher we visited 40 pages, including homepage.

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XPath Queries

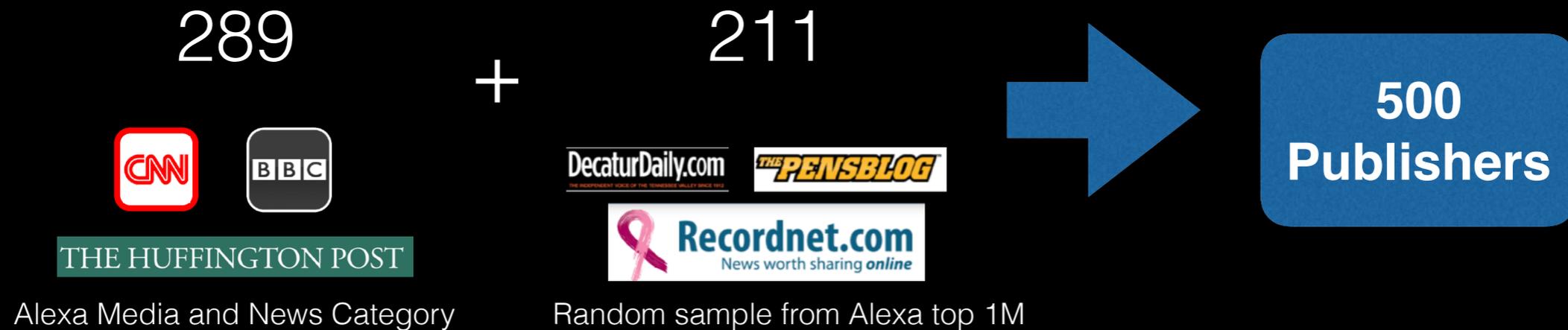
- Developed 12 queries.
- Covering 5 CRNs.

Examples

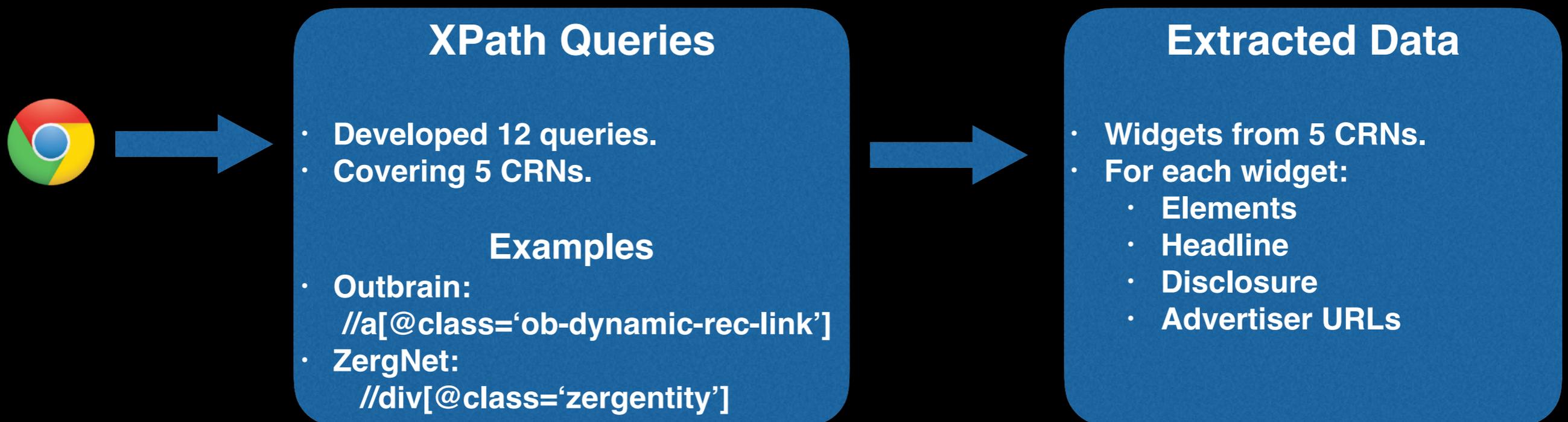
- Outbrain:
`//a[@class='ob-dynamic-rec-link']`
- ZergNet:
`//div[@class='zergentity']`

Data Collection

- 5 CRNs. Outbrain, Taboola, Gravity, ZergNet, Revcontent



- For each publisher we visited 40 pages, including homepage.



Final Dataset

- 5 CRNs
- 500 publishers
- 53K recommendations (links to first-party).
- 131K ads (links to third-party).
 - 2,689 unique advertised domains.

High level Statistics

CRN	#Publishers	Total Ads	Total Recs
Outbrain	147	57446	35476
Taboola	176	56860	15660
Revcontent	29	576	16
Gravity	13	744	2054
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- Gravity shows 2.7x more recommendations per page on average.

Headlines and Disclosures

Question: Are CRNs explicitly labeling sponsored links as advertisements?

- We take a look at widget headlines and disclosures.

The screenshot displays a news widget with two rows of content. The top row features four headlines, each with a small image and a source. The first two are labeled 'Paid Content' with a blue box and arrow pointing to the right. The last two are labeled 'Recommended by Outbrain' with an orange box and arrow pointing to the right. The bottom row features two columns of content. The left column is labeled 'Paid Content' with a blue box and arrow pointing to the right. The right column is labeled 'More from CNN' with a blue box and arrow pointing to the right. At the bottom right, the word 'Disclosure' is written in bold black text, with a grey arrow pointing left towards the 'More from CNN' label. An orange box with 'Recommended by Outbrain' is also present at the bottom right.

Paid Content	Headline	Recommended by Outbrain	
 Angelina's Current Woes Pale Next To Her Mutation <i>Healevate</i>	 2017 Chevrolet Corvette Release Date, Price and Specs <i>CNET</i>	 Wall Street Poster Boy Makes Shocking Prediction <i>The Sovereign Investor</i>	 The Net Worth of Chelsea Clinton <i>Bankrate</i>
Paid Content		More from CNN	
How To Fix Your Fatigue (Do This Every Day) <i>Gundry MD</i>		Putting a price on her virginity ▶	
Try Not To Gasp When You See These 40 Photos <i>Choice or Life</i>		Debate coach: Trump simply couldn't stand being criticized	
Abandoned Cruise Ships That Will Give You The Chills <i>Mozo Travel</i>		How much I really earn as a legal prostitute ▶	
Wild Wolf Caught A Dog - What Happend Next Was Unbelievable <i>Semesterz</i>		Russian warships, likely headed to Syria, withdraw refueling request in Spain	

Disclosure ← Recommended by Outbrain

Headlines

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- 88% widgets provide a headline.

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Recommendations		Ads	
Headline	%	Headline	%
you might also like	17	around the web	18
featured stories	12	promoted stories	15
you may like	7	you may like	15
we recommend	7	you might also like	6
more from this site	4	from around the wb	2
you might be interested in	2	trending today	2
trending now	1	we recommend	2

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- Keywords used across all headlines for ad widgets.
 - ‘promoted’ (12 %), ‘advertiser’ (<1 %)

Disclosures

CRN	Disclosed (%)
Outbrain	90.8
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Revcontent	100.0
Gravity	81.6
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Overall 94 % widgets had disclosures.

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<p>You Might Be Interested In</p> <p>What the hell? Artist crucifies Jesus on dartboard Fox News <i>(NEWSVINE)</i></p> <p>Donald Trump's favorite Bible verse is one Jesus specifically repudiated <i>(NEWSVINE)</i></p> <p>I'm back <i>(NEWSVINE)</i></p> <p>Election Fraud Proven at Audit by Chicago BOE - flipped precinct by 18pts from Bernie to Hillary <i>(NEWSVINE)</i></p> <p>Demonstrators Storm California GOP Convention to Protest Trump <i>(NEWSVINE)</i></p>	<p>From Around The Web</p> <p>Crowdfunding is Changing Real Estate Investing <i>(TECHCRUNCH)</i></p> <p>Thinking about going solar? Read This First <i>(HOME SOLAR PROGRAMS)</i></p> <p>Celebrity Kids All Grown Up <i>(MOM.ME)</i></p> <p>Pinterest Top Picks: Our 38 Most Pinned Recipes <i>(FOOD.COM)</i></p> <p>How To: Get Rid Of Spider Veins [Watch] <i>(BEVERLY HILLS MD)</i></p> <p>[what's this]</p>
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You Might Be Interested In

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- Donald Trump's favorite Bible verse is one Jesus specifically repudiated (NEWSVINE)
- I'm back (NEWSVINE)
- Election Fraud Proven at Audit by Chicago BOE - flipped precinct by 18pts from Bernie to Hillary (NEWSVINE)
- Demonstrators Storm California GOP Convention to Protest Trump (NEWSVINE)

From Around The Web

- Crowdfunding is Changing Real Estate Investing (TECHCRUNCH)
- Thinking about going solar? Read This First (HOME SOLAR PROGRAMS)
- Celebrity Kids All Grown Up (MOM.ME)
- Pinterest Top Picks: Our 38 Most Pinned Recipes (FOOD.COM)
- How To: Get Rid Of Spider Veins [Watch] (BEVERLY HILLS MD)

[what's this]

Disclosures

CRN	Disclosed (%)	Verdict
Outbrain	90.8	✓
Taboola	97.1	✓
Revcontent	100.0	✓
Gravity	81.6	✗
ZergNet	24.1	✗

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How to plant raspberry canes



Honey fungus is UK's worst disease



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CRN	Mixed (%)
Outbrain	16.9
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ZergNet	0

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Overall 11.9% widgets display mixed content.

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We look at 131K third-party URLs from 2689 unique advertisers.

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Topic	Example Keywords	Landing pages (%)
Listicles	improve, scams, experience	18.46
Credit Cards	credit, card, interest	16.09
Celebrity Gossip	Kardashians, sexiest, caught	10.94
Mortgages	mortgage, HARP, loan	8.76
Movies	Hollywood, Batman, Marvel	5.90
Health & Diet	diabetes, fat, stomach	5.62
Investment	Dow, dividend, stocks	1.57
Penny Auctions	auction, bid, pennies	1.15

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- Almost 35% articles are 'content'.
- More than 20% articles about Mortgage or Credit Cards.

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- Almost 35% articles are 'content'.
- More than 20% articles about Mortgage or Credit Cards.
- Articles about financial services, miracle diets.

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Summary

- We present the first evaluation on Content Recommendation Networks (CRNs).

CRN	Headlines	Disclosures	Mixed	Content Quality
Outbrain	X	X	X	X
Taboola	X	✓	X	X
Revcontent	X	✓	✓	X
Gravity	X	X	X	X
ZergNet	X	X	✓	-

- What can be done?
 - Stronger regulations.
 - CRNs should enforce clear labels.
 - Effective spam filtering.

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- What can be done?
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 - CRNs should enforce clear labels.
 - Effective spam filtering.

Questions?

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personalization.ccs.neu.edu