

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

Muhammad Ahmad Bashir, Sajjad Arshad, Christo Wilson



Northeastern University

Content Recommendation Networks (CRNs)

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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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Heseltine: I did not strangle dog to death 

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

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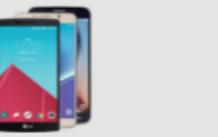
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Mashable

THE HUFFINGTON POST

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

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**Remember Barbi
Benton? What She
Looks Like Today Is**

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Elsewhere on BBC

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BBC News

Pound jumps in wake of Brexit ruling

Widgets

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

Some Terminology

Widgets

The image shows a sidebar with a purple border. At the top left, the word "Headline" has a yellow arrow pointing down to a box labeled "PAID PROMOTED STORIES". At the top right, the word "Disclosure" has a yellow arrow pointing down to a "Recommended by Outbrain" badge. The sidebar contains three 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)

To the right of the promoted stories is a "Elsewhere on BBC" section with a "Recommended by Outbrain" badge, showing a thumbnail of a pound coin and a BBC news article about the pound jumping after Brexit.

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

Some Terminology

Widgets

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Links + \$\$\$



Some Terminology

Widgets



- Link to the publisher (first-party link) — Recommendation
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Links + \$\$\$



Widgets



Some Terminology

Widgets



- Link to the publisher (first-party link) — Recommendation
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Links + \$\$\$



Widgets



Click



Some Terminology

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Links + \$\$\$



\$\$



Click



Why study CRNs?

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

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

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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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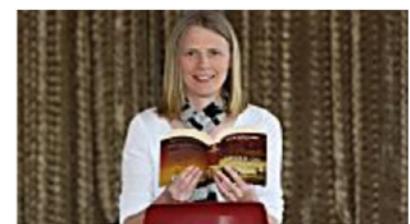
We recommend



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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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?

Better Business Bureau Tells
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Conduct a study to observe current practices of CRNs.

- 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 Spamy Content Marketers

Data Collection

Data Collection

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

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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 PENSBLOG



Random sample from Alexa top 1M

Data Collection

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



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

Data Collection

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

This diagram shows the workflow for data collection. It begins with a browser icon (Google Chrome) followed by a blue arrow pointing to a box containing information about XPath queries. The box is titled 'XPath Queries' and lists two bullet points: 'Developed 12 queries.' and 'Covering 5 CRNs.' Below this, under the heading 'Examples', are two more bullet points with specific XPath code examples: 'Outbrain: //a[@class='ob-dynamic-rec-link']' and 'ZergNet: //div[@class='zergentity']'.

XPath Queries

- Developed 12 queries.
- Covering 5 CRNs.

Examples

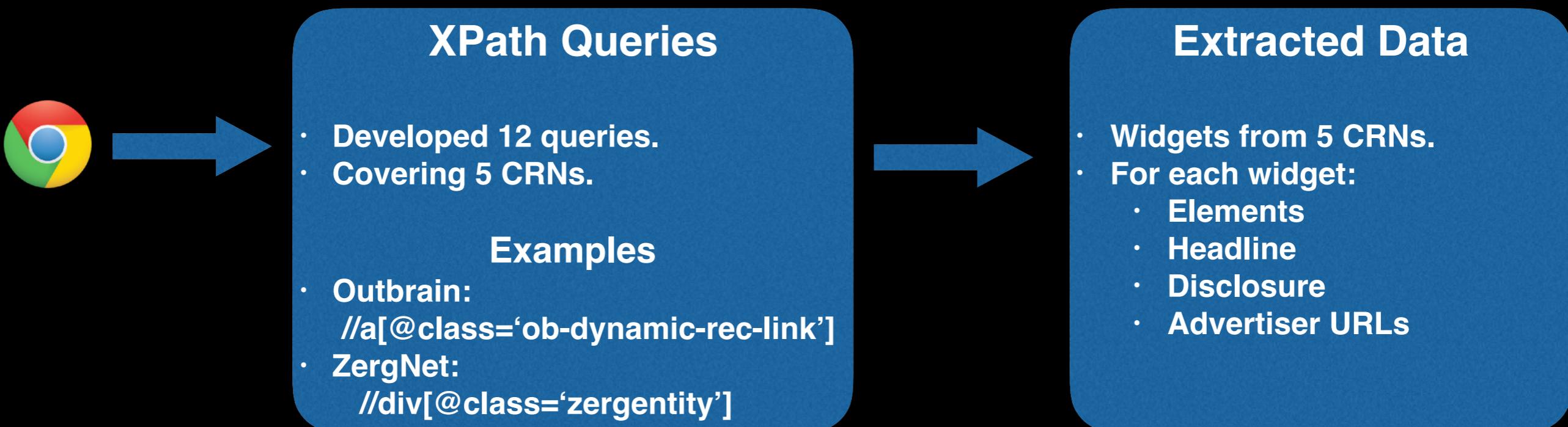
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Final Dataset

- 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
ZergNet	14	15375	0

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- Outbrain (1.5x), Taboola & Revcontent (5x) display more ads on average per page.
- 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.

Paid Content → **Headline**

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

- How To Fix Your Fatigue (Do This Every Day)
Gundry MD
- Try Not To Gasp When You See These 40 Photos
Choice or Life
- Abandoned Cruise Ships That Will Give You The Chills
Mozo Travel
- Wild Wolf Caught A Dog - What Happened Next Was Unbelievable
Semesterz

More from CNN

- Putting a price on her virginity ►
- Debate coach: Trump simply couldn't stand being criticized
- How much I really earn as a legal prostitute ►
- 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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trending now	1	we recommend	2

- 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
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Overall 94 % widgets had disclosures.

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Donald Trump's favorite Bible verse is one Jesus specifically repudiated ([NEWSVINE](#))

I'm back ([NEWSVINE](#))

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Celebrity Kids All Grown Up ([MOM.ME](#))

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How To: Get Rid Of Spider Veins [Watch] ([BEVERLY HILLS MD](#))

[what's this]

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Outbrain	90.8	✓
Taboola	97.1	✓
Revcontent	100.0	✓
Gravity	81.6	✗
ZergNet	24.1	✗

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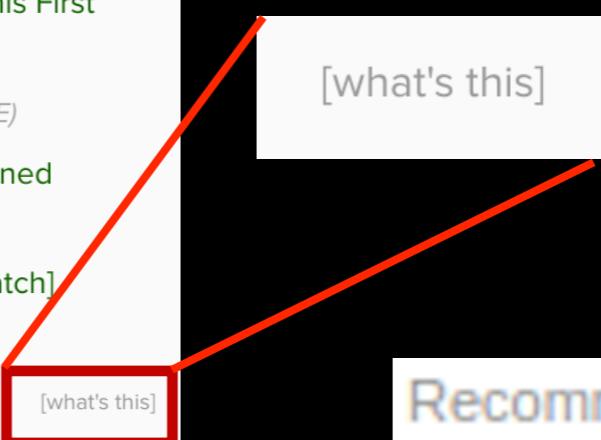
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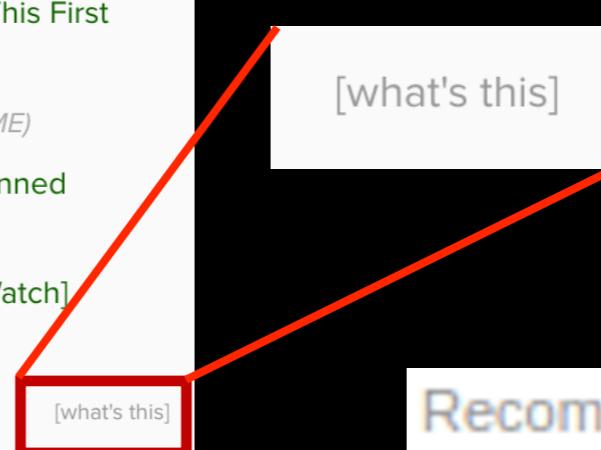
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CRN	Mixed (%)
Outbrain	16.9
Taboola	9.0
Revcontent	0
Gravity	25.5
ZergNet	0

Widgets with Mixed Content

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CRN	Mixed (%)	Verdict
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Revcontent	0	
Gravity	25.5	
ZergNet	0	

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’.

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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	✗	✗	✗	✗
Taboola	✗	✓	✗	✗
Revcontent	✗	✓	✓	✗
Gravity	✗	✗	✗	✗
ZergNet	✗	✗	✓	-

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

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

Questions?

ahmad@ccs.neu.edu

personalization.ccs.neu.edu