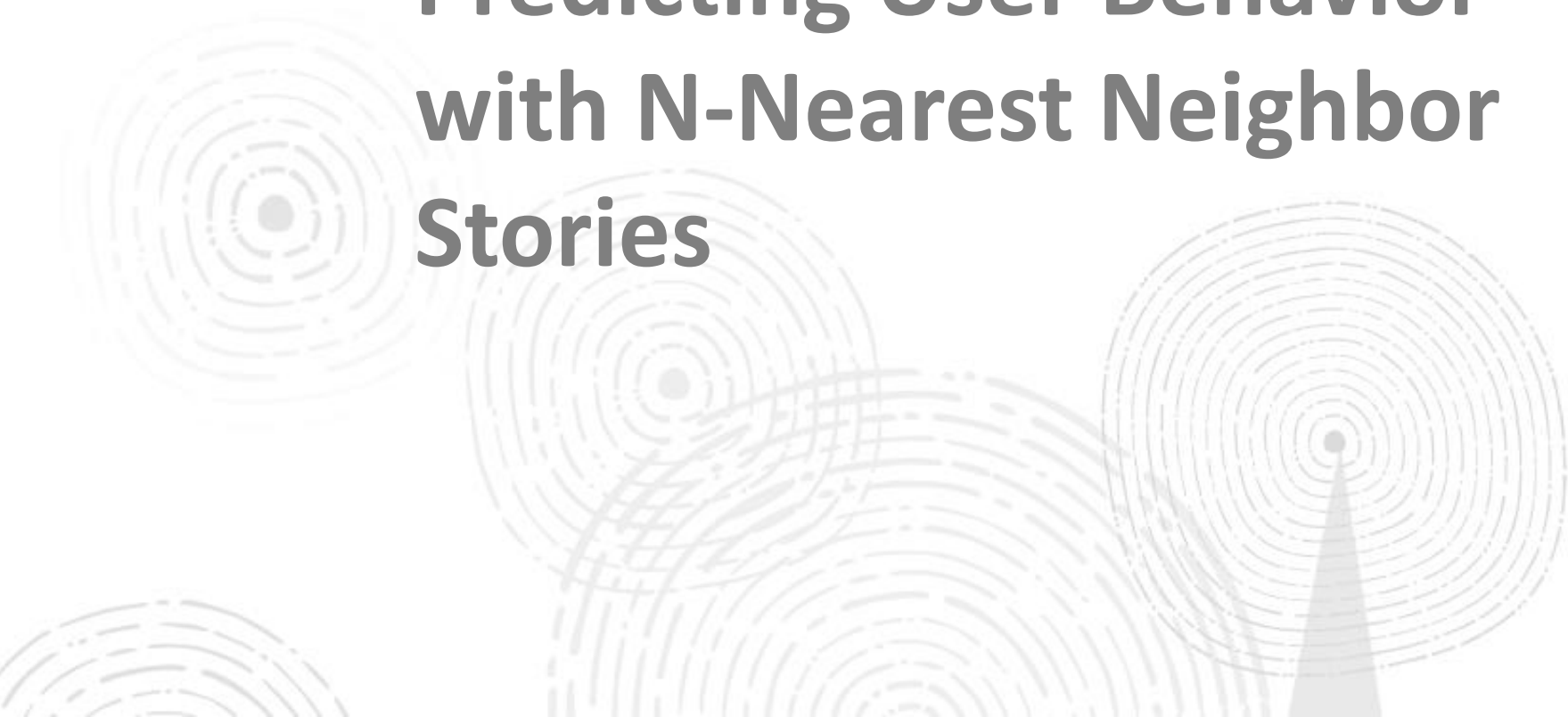




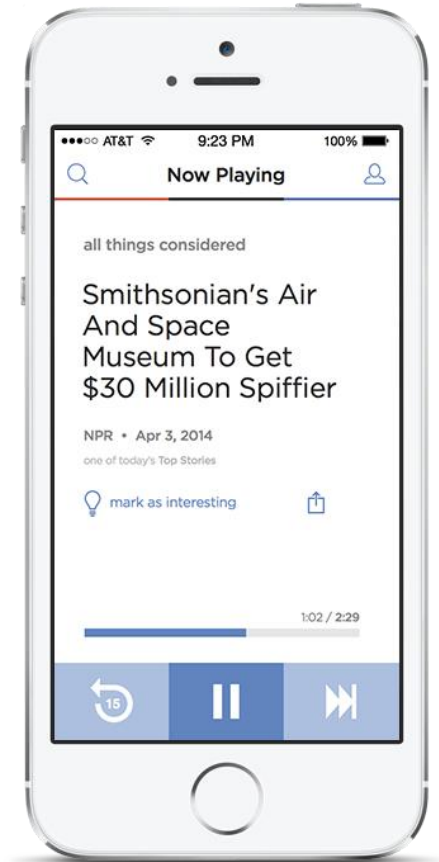
NPR One: Predicting User Behavior with N-Nearest Neighbor Stories



NPR One

Public radio made personal

- Serendipitously play you your favorite stories
- Minimize the touches required
- Find things that you love
- Demote things that you don't love



Value in Personalization

- Some skips are good, many are not

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	8.927e-01	7.880e-03	113.285	< 2e-16	***
HRNCs.per.day	-2.869e-02	2.286e-03	-12.552	< 2e-16	***
LOCALNCs.per.day	-1.062e-01	3.486e-03	-30.470	< 2e-16	***
podcasts.per.day	5.303e-03	2.963e-04	17.894	< 2e-16	***
localstories.per.day	5.834e-03	1.166e-03	5.004	5.63e-07	***
skip_rate	1.590e-01	8.298e-03	19.166	< 2e-16	***
thumbup_rate	1.676e-01	2.174e-02	7.710	1.26e-14	***
TLM.per.day	8.935e-04	7.983e-06	111.932	< 2e-16	***
Searches	-1.642e-02	2.368e-03	-6.935	4.09e-12	***
got_RatedTRUE	-3.007e-01	3.871e-03	-77.679	< 2e-16	***
used_iPhoneTRUE	-2.238e-01	7.796e-03	-28.706	< 2e-16	***
used_AndroidTRUE	-1.916e-01	7.807e-03	-24.544	< 2e-16	***
used_webappTRUE	-3.657e-02	7.352e-03	-4.974	6.56e-07	***
HRNC_skip_rate	2.476e-02	3.675e-03	6.738	1.61e-11	***
LOCALNCskip_rate	-2.593e-02	5.772e-03	-4.493	7.03e-06	***
Lead_skip_rate	-2.264e-02	3.975e-03	-5.695	1.23e-08	***
Break_skip_rate	-1.021e-01	4.320e-03	-23.636	< 2e-16	***
Rated_skip_rate	8.045e-02	7.938e-03	10.135	< 2e-16	***
Podcast_skip_rate	-2.287e-01	4.689e-03	-48.775	< 2e-16	***

Two Approaches

- **Collaborative Filtering**

- User – user similarities predict what stories to play
- Attempted with beta audience
- Computationally difficult

- **Personal Listening History Determination**

- Story – story relationships in listening history predict what stories to play
- Acknowledges differences in user preferences and gives no weight to “wisdom of the crowd”

- True solution is probably a combination of both

N-Nearest Neighbor Similarity

■ Approach:

- Find Similar stories by shared word frequency
- Use this similarity algorithm to predict the “rating” assigned
- Determine a cutoff score and measure predictability

■ Data:

- Title text + Teaser text concatenated
- Rating assigned by user (converted to binary positive / negative)

'Why Hamas Is A Bigger Challenge For Israel Now Than In The Past Christian Science Monitor reporter Christa Case Bryant tells Renee Montagne why the Israeli army is finding Hamas a more formidable foe now than during the 2009 war.'

"Who's The Man? Hollywood Heroes Defined Masculinity For Millions From silent stars to John Wayne to Iron Man, film critic Bob Mondello looks at the role that Hollywood has played in defining manliness, and how that definition has changed over several decades."

Title + Teaser text

'Why Hamas Is A Bigger Challenge For Israel Now Than In The Past Christian Science Monitor reporter Christa Case Bryant tells Renee Montagne why the Israeli army is finding Hamas a more formidable foe now than during the 2009 war.'

"Who's The Man? Hollywood Heroes Defined Masculinity For Millions From silent stars to John Wayne to Iron Man, film critic Bob Mondello looks at the role that Hollywood has played in defining manliness, and how that definition has changed over several decades."

"Drawing On Pentagon Surplus, Police Now Wield Weapons Of War Every year, police and sheriffs' departments receive hundreds of millions of dollars' worth of military-style equipment from the Pentagon. The equipment is passed on with the intent to fight drugs and terrorism, but it was on display in Ferguson, Mo., where it was used for crowd control during protests there."

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Using Euclidian Distance

Input story

5-nearest



score



Two Miles From Protests, Residents Want Calm To Return To Ferguson If you venture away from the protest zone in Ferguson, Mo., there is an idyllic neighborhood, which doesn't have much patience for the out-of-towners who have joined the protests.

0.0

Generation Gap Divides Local Opinion On Ferguson Protests In Ferguson, Mo., some younger and older residents have differing views on whether violence among protesters is appropriate and how best to effect change.

5.47722557505

When Kids Start Playing To Win And, what the adults in their lives should do about it.

5.47722557505

Prediction Our panelists predict who will grace the head of the \$1 trillion coin.

5.56776436283

Prediction Our panelists predict what'll be the big baby name in 2014.

5.56776436283

Prediction Our panelists predict, what will America look like after we go off the Fiscal Cliff?

5.65685424949

As Ferguson Unraveled, The World Found A New Way Of Watching When protests over the shooting of Michael Brown turned violent in Ferguson, Mo., live-streaming videos showed Americans what they couldn't see on TV.

5.74456264654

Using TFIDF Cosine Similarity

Input story

Two Miles From Protests, Residents Want Calm To Return To Ferguson If you venture away from the protest zone in Ferguson, Mo., there is an idyllic neighborhood, which doesn't have much patience for the out-of-towners who have joined the protests.
1.0

5-nearest

Generation Gap Divides Local Opinion On Ferguson Protests In Ferguson, Mo., some younger and older residents have differing views on whether violence among protesters is appropriate and how best to effect change.
0.241360005802

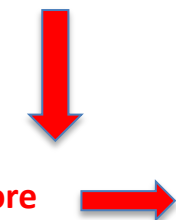
As Ferguson Unraveled, The World Found A New Way Of Watching When protests over the shooting of Michael Brown turned violent in Ferguson, Mo., live-streaming videos showed Americans what they couldn't see on TV.
0.221402121139

Week In Politics: Ferguson And Foreign Policy Political commentators, Jonathan Capehart of The Washington Post and David Brooks of The New York Times, discuss the protests in Ferguson, Mo., and Hillary Clinton's take on President Obama's policy.
0.189728199223

In The Absence Of Answers, Protests Fill Ferguson's Silence The community of Ferguson, Mo., remains on edge after a police shooting left an unarmed black teenager dead over the weekend. Clashes have erupted between protesters and police, and an officer was involved in another shooting overnight.
0.180928835808

Emotional Distress A Worry As Kids Go Back To School In Ferguson One elementary school is less than a mile away from the protest zone where there have been nightly clashes with police. So for some kids, the first day of school might be more stressful than usual.
0.178247378434

score



Another example using TFIDF Cosine Similarity

Input story

Punch Brothers On Mountain Stage Chris Thile's quintet continues to push the boundaries of bluegrass into experimental rock territory on *Who's Feeling Young Now?*
1.0

5-nearest



Ray Wylie Hubbard On Mountain Stage The Texas troubadour and anthem writer performs songs from his newest album, *The Grifter's Hymnal*.
0.180551841812

Chris Potter Quartet On JazzSet We're about to embark on a musical odyssey by sea. Our captain is saxophonist Chris Potter, who's launching his *Odyssey*-inspired album *The Sirens*.
0.157229952161

In 10 Songs, A Pair Of Brothers Beat Tracks Across History Ethan Johns' sophomore album, *The Reckoning*, follows the tale of two brothers as they travel across the 1850s American frontier.
0.140048257504

'Life Of Crime' Has Authentic Elmore Leonard Snap The late author wrote close to 50 novels, and several of them, including *Get Shorty* and *Out of Sight*, were made into films. His 1978 book *The Switch* has been turned into a film called *Life of Crime*.
0.1294990575

Band Of Horses On World Cafe The twangy rock band fine-tunes its sound on *Mirage Rock*, produced by the legendary Glyn Johns.
0.12635095751

score



Predicting User Ratings with TFIDF

What?

- Predict from a user's listening history whether they will react positively or negatively to a story we're thinking about playing

Value Proposition:

- Hide/Demote stories in real-time so user doesn't have to get out the phone and use the skip button
- Dig deep into the archives to pull out something that we haven't played for you that we think you'll like

Predicting User Ratings with TFIDF

Process:

- Input a userid, storyid, and N value
- For each userid and storyid, find the N nearest stories
- Compute a “vote” as a tally of the positive and negative signals sent by the user for N-nearest stories to the given storyid
- Compute the rate of positive signals given among N-nearest
- Set a cutoff rate, make a prediction 1 or 0 for each story
- Measure performance with confusion matrix
- Rinse, Repeat

Scoring: How to think about success

		<u>Prediction</u>	
		0	1
<u>Actual</u>	0	You don't like it and we didn't play it for you	You don't like it and we played it for you
	1	You like it and we didn't play it for you	You like it and we played it for you

Scoring: How to think about success

		<u>Prediction</u>	
		0	1
<u>Actual</u>	0	You don't like it and we didn't play it for you	You don't like it and we played it for you
	1	You like it and we didn't play it for you	You like it and we played it for you

Predicting User Ratings with TFIDF

Many Attempts:

- Tried fixing the number of stories to return N at various values between 5 and 25
- Tried a home-made grid search for N parameter
- Tried a home-made grid search for the cutoff rate
- Tried setting cutoff value at user's avg. rating

Best Results:

- No fixed N... Set a Cosine-Similarity score cutoff at 0.12 rather than a fixed N value
- Use a minimum “votes” parameter
- Rather than use a positive rate, set a min number of negative ratings as an absolute

Results

- Best accuracy score achieved: 77% (compare to overall positive signal rate of 68%)
- But only achieved a True Negative Rate > 50% when using extreme cutoffs that severely limited the affected population

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[ [ 106 1310 ]  
  [ 227 2858 ] ]
```


Additional Challenges / Opportunities

Opportunities for Improvement

- Only performed over a small sample of the users who had a critical mass of listening history
- Not limited to any particular story type (some “aggregations” will likely produce more accurate results)

Challenges

- No cross-validation performed (essentially all train-set)
- Implementation is a challenge

Conclusions

- TFIDF N-nearest similarity is a valid measure of similarity
- But as a signal for predicting a user's behavior, it's rather weak
- In production, it is possible that this algorithm could be tweaked to be effective in demoting stories
- But it would only affect some users and occur infrequently (< 3% of stories)

Next Steps

- Segment algorithm by story type (maybe this is valid for arts/culture stories but not lead news stories)
- Transform the algorithm to find something you'll love rather than something you'll hate
- Re-purpose the code as a tool for finding similar stories (agnostic to user behavior)
- A completely different exercise:
 - Cluster stories together using k-means
 - Measure cluster performance, cluster size

Clustering Stories

Top terms per cluster:

Cluster 0: says people new say kids big time way company year

Cluster 1: music songs country radio new concert dance crowd life dj

Cluster 2: em new book talks says author album npr david film

Cluster 3: ukraine russian russia ukrainian border eastern nato separatists pro city

Cluster 4: police ferguson mo shooting unarmed officer black officers force protests

Cluster 5: new gaza talks afghanistan israel npr president iraq minister david

Cluster 6: care money insurance health doctors patients act affordable hospital medicaid

Cluster 7: holder attorney general australia eric civil thursday step rights morning

Cluster 8: kong hong protests ferguson democracy school protest michael protesters police

Cluster 9: ebola outbreak liberia africa west health virus sierra leone patients

Cluster 10: world years new pop women album league nfl players word

Cluster 11: obama house president white gop senate republicans democratic congress state

Cluster 12: islamic state isis group iraq airstrikes militants syria syrian al

Cluster 13: simon scott npr talks speaks new close ice em iran