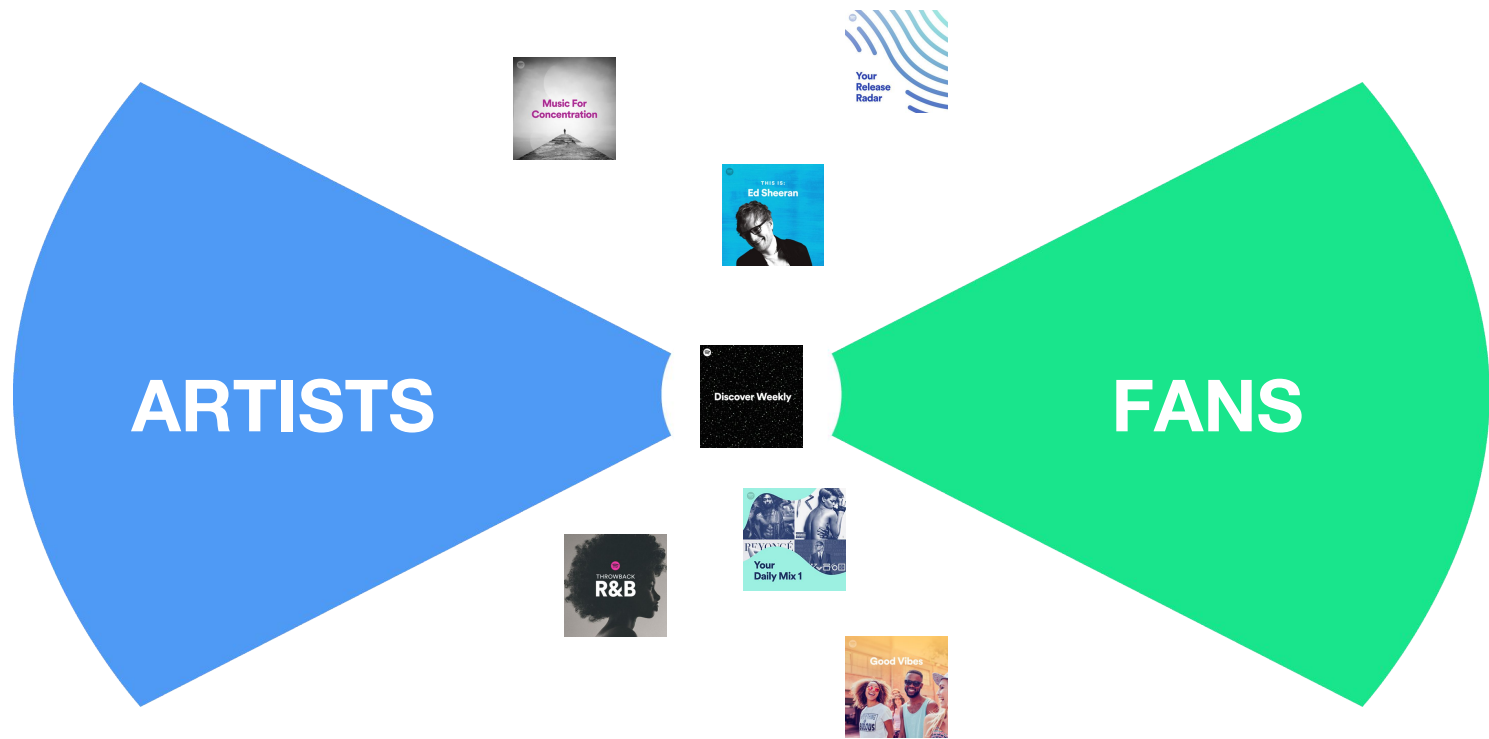# What we do

Spotify's mission is to unlock the potential of human creativity — by giving a million creative artists the opportunity to live off their art and billions of fans the opportunity to enjoy and be inspired by it.
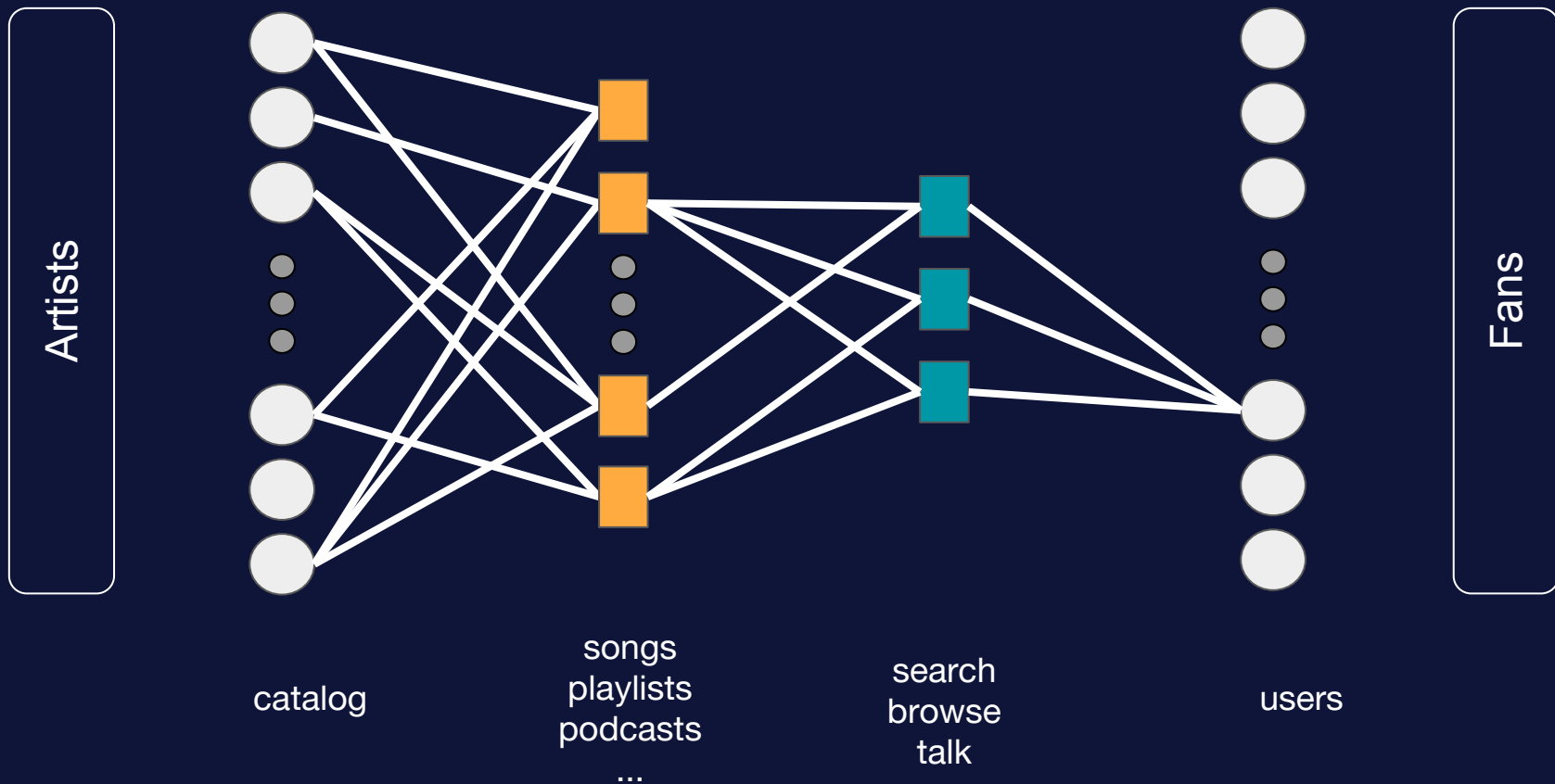
german metal
spanish modern rock
swedish idol pop
kaneka
israeli hip h
neo-trad metal
j-indie
rap metal
finnish dance pop
intelligent dance music
chillwave
nintendocore
rock cristiano
post-disco
scratch
deep thrash metal
madchester
modern country rock
french indietronica
antiviral pop
gangster rap
folk metal
sleaze rock
shibuya-kei
deep rai
spanish reggae
fallen angel
wrestling
new wave pop
bulgarian rock
danish hip hop
southern soul blues
screamo
christian alternative rock
spanish pop rock
pinoy hip hop
rap
jazz boom bap
gothic symphonic metal
christian punk
alberta country
czech hip hop
traditional reggae
italian metal
modern alternative rock
rap metalcore
turbo folk
malaysian hip hop
dirty south rap
funk cari
gothic metal
post-grunge
canadian rock
fussball
new wave
vapor pop
urban contemporary
azonto
dub
hard glam
j-poppunk
deep turkish pop
zim hip hop
jazz rap
power metal
swedish hard rock
turkish metal
gauze pop
volkstumliche musik
southern hip hop
melodic progressive metal
gothic post-punk
tecnobrega
finnish hip hop
russian metal
alternative metalcore
trio batak
vapor soul
neue deutsche welle
horrorcore
native american hip hop
melodic metalcore
symphonic metal
modern uplift
northern irish indie
witch house
macedonian pop
redneck
polynesian pop
bulgarian hip hop
djent
swedish alternative rock
ukrainian indie
australian hip hop
trap mexicano
scottish indie rock
paraguayan rock
antideutsche
swedish soul
romanian hip hop
swiss metal
deep melodic metalcore
scottish new wave
deep german indie
dangdut koplo
cuarteto
drill
cumbia pop
swedish reggae
outer hip hop
hip hop
deep east coast hip hop
neo classical metal
j-punk
medieval rock
alternative r&b
lovers rock
odic death metal
christian metal
rock chapin
indian indie
south african pop
argentine reggae
danish metal
indonesian rock
belgian pop
albanian pop
rap cristiano
lavic folk metal
polish punk
spanish rock
latin arena pop
danish pop rock
euroska
hyphy
progressive alternative
basque indie
colombian rock
thai hip hop
mexican hip hop
brutal deathcore
alternative metal
k-rock
dance rock
latin viral pop
indie pop rap
lithuanian hip hop
oriental metal
ccm
canadian ccm
abstract idm
lounge house
arabic hip hop
deep funk
progressive metal
vegas indie
deep australian indie
chip hop
norwegian pop rap
underground latin hip hop
indian metal
emo
indie surf
industrial
german pop
classic portuguese pop
cumbia sonidera
arab metal
indonesian metal
turkish alternative
indian rock
classic french pop
dancehall
talogaze
screamocore
indie pop rock
dangdut
spanish new wave
egyptian pop
gospel reggae
rap maroc
deep swedish rock
funk metal
african rock
karneval
escape room
colombian hip hop
latin gothic metal
galician rock
mexican rock
deep pop r&b
cancoes infantis
nu gaze
argentine alternative rock
indonesian indie
ska argentino
bongo flava
german reggae
israeli metal
power-pop punk
indonesian punk
country road
emo rap
italian hip hop
roots reggae
deep folk metal
ethereal gothic
australian pop
latin ska
gospel rap
metal
welsh rock
italian pop rock
thai pop
latin alternative
rap uruguayo
progressive post-hardcore
polish alternative rock
punk ska
latin afrobeat
slovak hip hop
bachata
canadian punk
britpop
turkish punk
indie electro-pop
rif
afrobeats
reggae
celtic metal
british indie rock
neomelodici
wonky
polish hip hop
metal
fast melodic punk
modern hard rock
uae indie
italian arena pop
norwegian hip hop
zambian pop
west coast trap
ghanaian hip hop
nwothm
la indie
peruvian indie
jawaiian
soca
death core
colombian hardcore
brooklyn indie
shiver pop
latin rock
thai folk rock
deep flow
olish metal
alternative emo
pop quebecois
korean pop
p funk
east coast hip hop
dish metal
spanish punk
spanish indie pop
estonian pop
electronica
musica per bambini

ARTISTS

FANS

Our team mission:

Match fans and artists in a personal and relevant way.

What does it mean to match fans and artists in a personal and relevant way?

Artists

Fans

catalog

songs
playlists
podcasts
...

search
browse
talk

users

What does it mean to match fans and artists in a personal and relevant way?

↓

Personalization

Research @ Personalization

Areas of research expertise

Machine learning

Information retrieval

Evaluation

Language technologies

Content analysis

Algorithmic bias

Human computer interaction

Recommender systems

User modeling

5 labs   … Boston, London, New York & San Francisco

hai: we research the interactions between the rich diversity of people and personalized audio experiences that matter to them.

LiLT: we research how Spotify users and creators communicate using written and spoken language, and how machine-learning models using this knowledge can improve user satisfaction.

preamp: we research how to match audience to artists using machine learning, search & recommendation, and rigorous experimentation.

SIA: we develop machine learning based solutions to understand, interpret and influence interactions and consumption signals.

algo-bias: we empower Spotify teams to assess & address algorithmic bias and better serve underserved audiences & creators.

Examples

Home
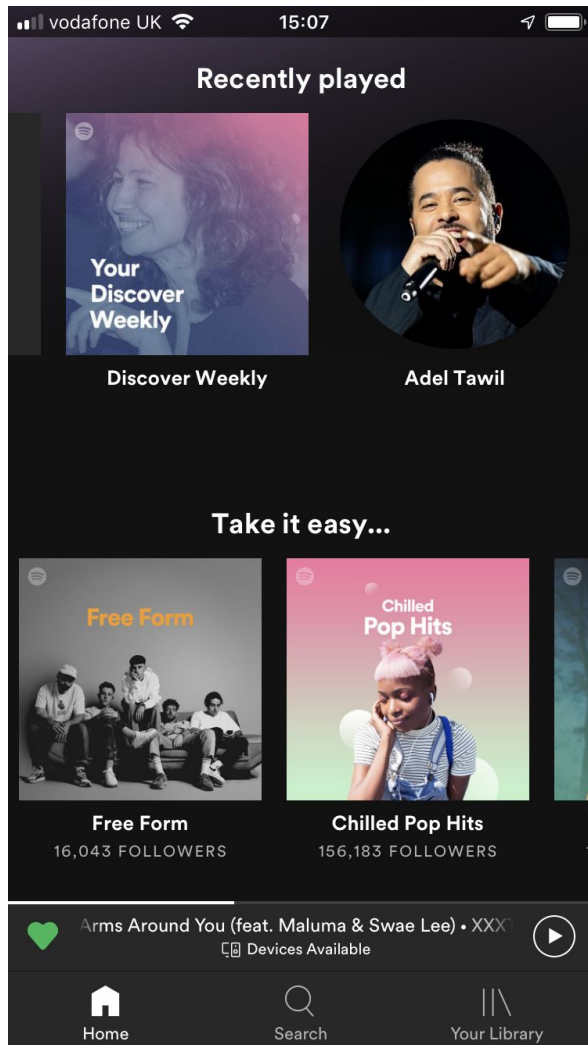
Home 🏠

Home is the **default screen** of the mobile app for all our users worldwide.

It surfaces the **best of what Spotify has to offer**, including music and podcasts for every situation, personalized playlists, new releases, old favorites, and undiscovered gems.

Value to the user here means helping them find something they're going to enjoy listening to, **quickly**.

BaRT: Machine learning algorithm for Spotify Home

BaRT

Streaming

User
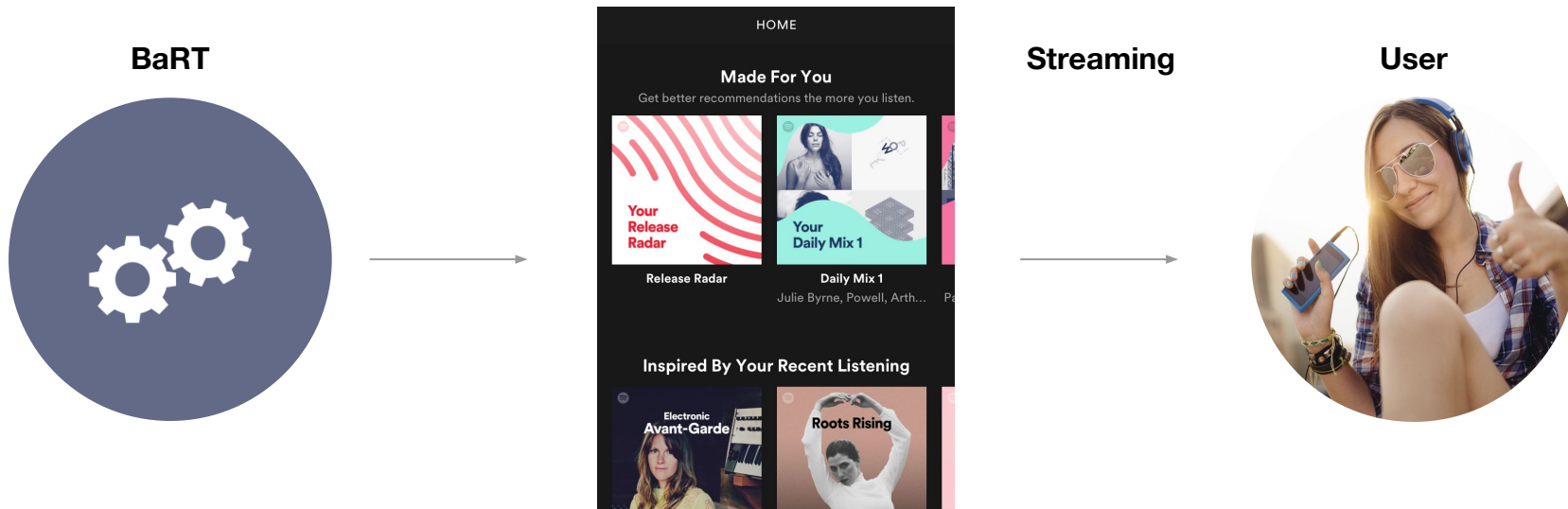
Explore, Exploit, Explain: Personalizing Explainable Recommendations with Bandits, J McInerney, B Lacker, S Hansen, K Higley, H.Bouchard, A Gruson, R Mehrotra, ACM RecSys 2018.

BaRT (Bandits for Recommendations as Treatments)
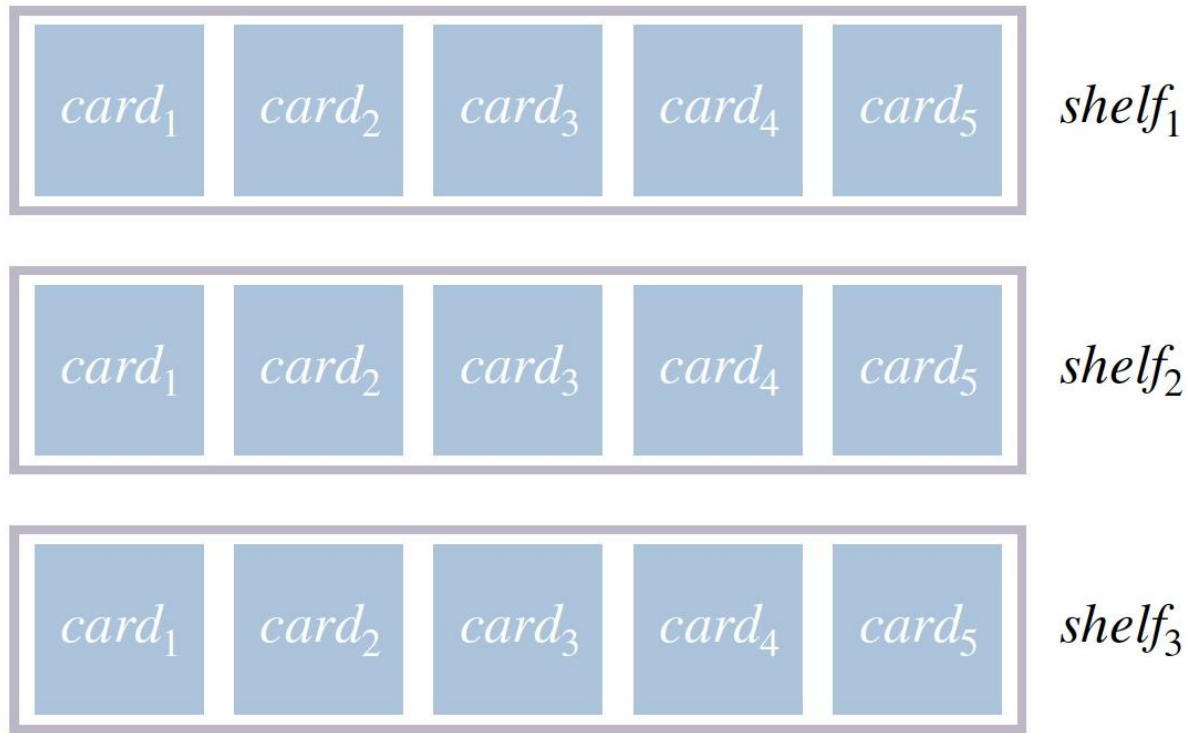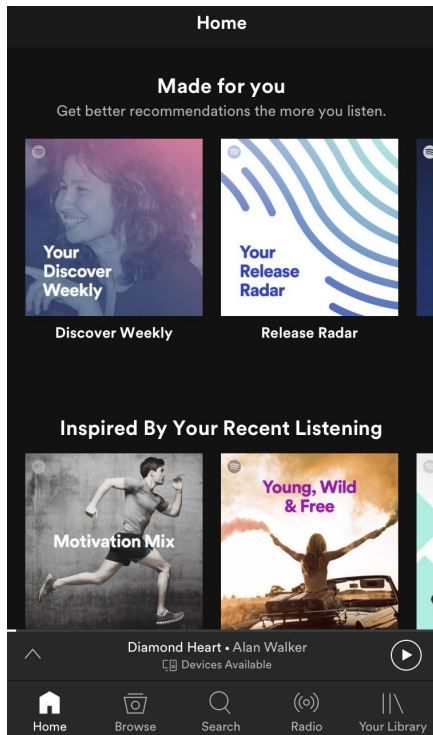
How to rank playlists (cards) in each shelf first, and then how to rank the shelves?

Multi-armed bandit algorithms

https://hackernoon.com/reinforcement-learning-part-2-152fb510cc54

Action distribution

$$\pi_{s,r}(M)$$

Exploration strategy
e.g., epsilon greedy,
Thompson sampling

Reward function
e.g., logistic regression,
factorization machine

Candidate action set
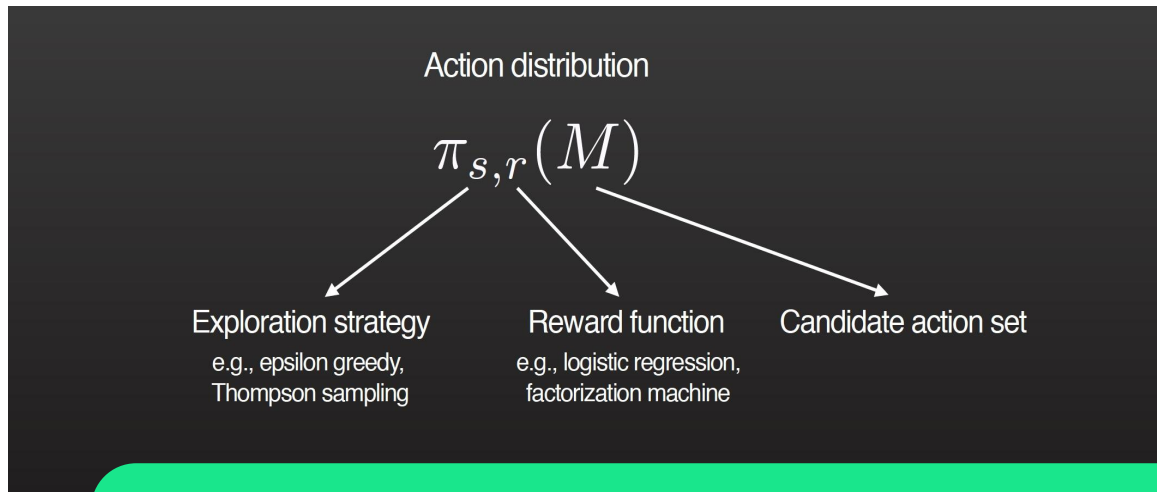
Explore vs Exploit

Flip a coin with given probability of tail
If head, pick best card in M according to predicted reward r → EXPLOIT
If tail, pick card from M at random → EXPLORE
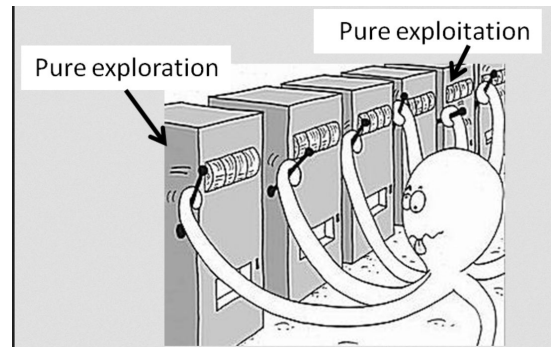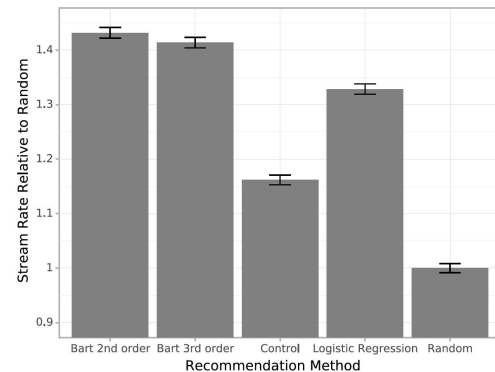
Discover Weekly

Richer understanding of user satisfaction

Unambiguously positive signals for Discover Weekly

Album view duration

Artist view duration

Downstream msPlayed

Ds completed plays

Album views count

Artist views count

Collection saves count

Playlist adds count

Four main goals emerged; behaviors differ by goal

Play new background music

No skipping
↑ Saves or adds
↑ Listening time
↑ Sessions per week

Listen to new music now and later

↑ Saves or adds
↑ % tracks heard
↑ Streams over half the song
↑ Downstream listening

Find new music for later

↑ Saves or adds
↑ Streams
↑ Downstream listening

Engage with new music

↑ Artist page views
↑ Album page views
↑ Downstream listening

Trained model to predict satisfaction for each track

Features were informed by hypotheses from user interviews

This Week's Data (User interactions with the playlist)

Historical Data (Deviation from Normal Behavior)

This Week's Cluster Data (User Goal)

Model (Gradient Boosted Decision Tree)

Survey Satisfaction
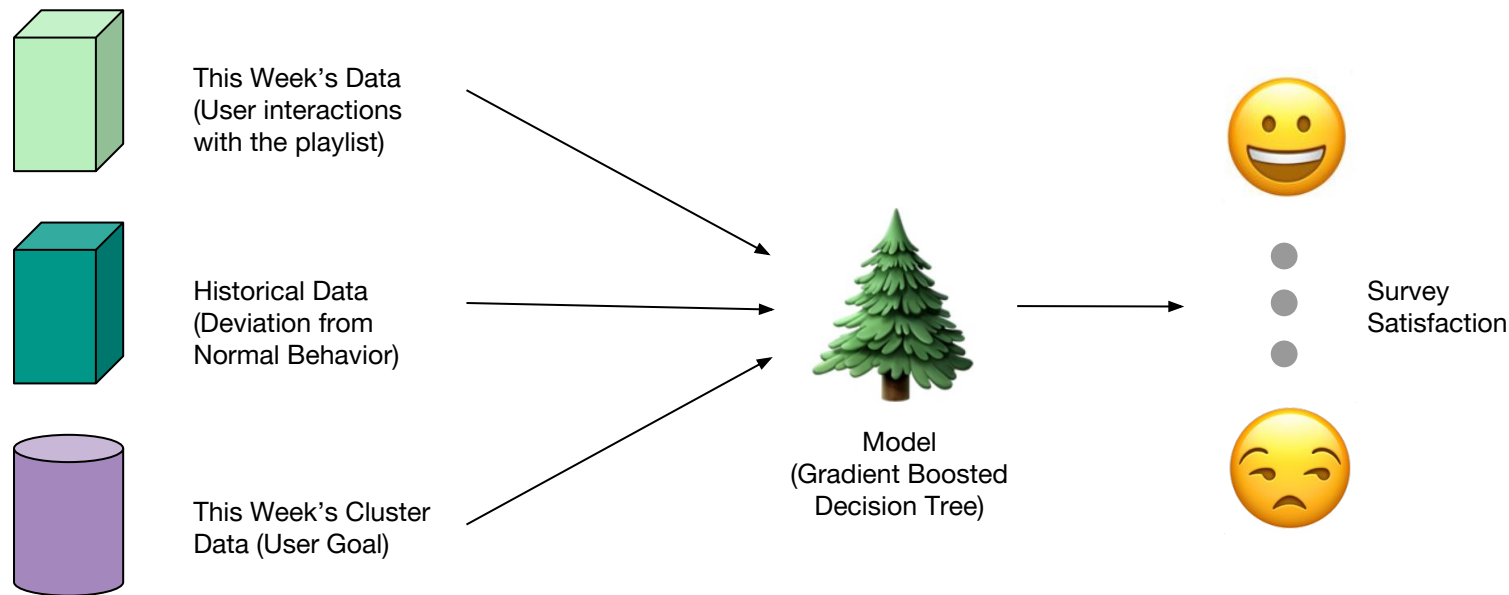
Current work: Modeled metric as an optimization target

Modeled metric
(user-track scores)

Learn to
Rank

Broken Heart
Spiritualized • Ladies & Gentlemen We Are Floati... ...

You Always Hurt The One You Love
The Mills Brothers • The Anthology: 1931 - 1968 ...

Our Mutual Friend
The Divine Comedy • Absent Friends ...

Autumn Serenade
John Coltrane, Johnny Hartman • John Coltrane... ...

In the Kingdom
Mazzy Star • Seasons of Your Day ...

Artifact #1
Conor Oberst • Upside Down Mountain ...

While You Were Sleeping
Elvis Perkins • Ash Wednesday ...

What we are working on now ... some examples

Multiple objective functions

$$a_t = \arg\min_{a_t} \pi$$

Metric 1

VS

Metric 2

Metric 3

$$a_t = \arg\min_{a_t} f(\pi_1, \pi_2, \pi_3 \ldots)$$

Home

Optimising for fairness and satisfaction at the same time

"Fairness" <------> Relevance

Towards a Fair Marketplace: Counterfactual Evaluation of the trade-off between Relevance, Fairness & Satisfaction in Recommendation Systems. R Mehrotra, J McInerney, H Bouchard, M Lalmas & F Diaz, CIKM 2018.
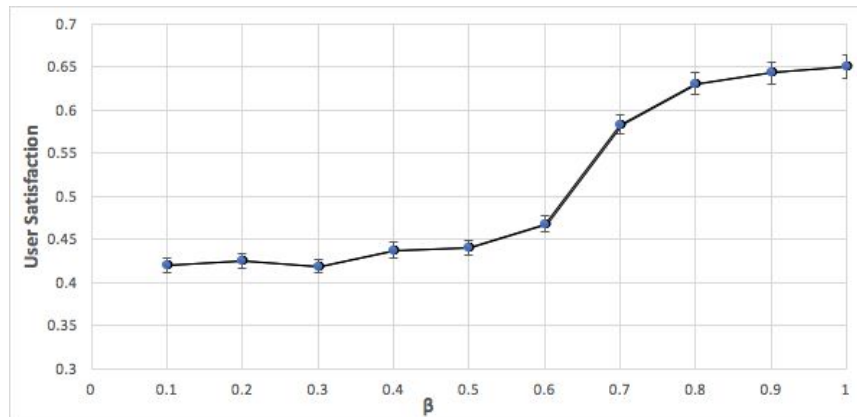
Search

Large catalog
40M+ songs, 3B+ playlists
2K+ microgenres

Many languages
78 countries

Different modalities
Typed, voice

Various granularities
Song, artist, playlist

Various goals
Focus, discover, lean-back, mood
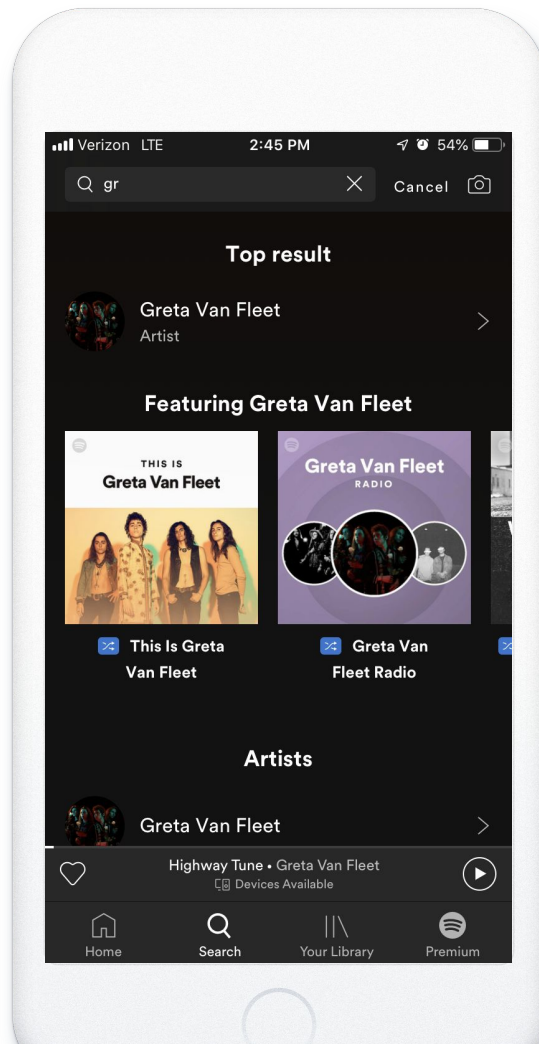
Search

FOCUSED
One specific thing in mind

- Find it or not
- Quickest/easiest path to results is important

How the user thinks about results

OPEN
A seed of an idea in mind

- From nothing good enough, good enough to better than good enough
- Willing to try things out
- But still want to fulfil their intent

EXPLORATORY
A path to explore

- Difficult for users to assess how it went
- May be able to answer in relative terms
- Users expect to be active when in an exploratory mindset
- Effort is expected

Just Give Me What I Want: How People Use and Evaluate Music Search. C Hosey, L Vujović, B St. Thomas, J Garcia-Gathright & J Thom, CHI 2019.

Evaluation

ML Lab

An offline evaluation framework to launch, evaluate and archive machine learning studies, ensuring reproducibility and allowing sharing across teams.

Offline Evaluation to Make Decisions About Playlist Recommendation Algorithms. A Gruson, P Chandar, C Charbuillet, J McInerney, S Hansen, D Tardieu & B Carterette, WSDM 2019.
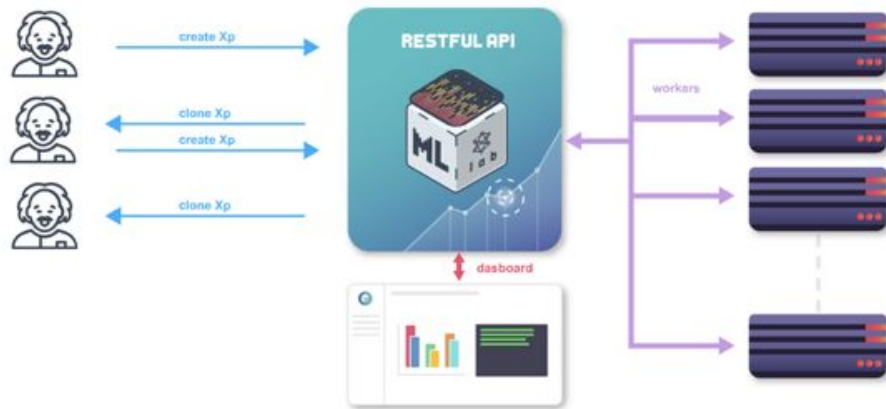
Other things we are doing

RecSys Challenge 2018

Earlier in 2018 we hosted the RecSys Challenge on Automatic Playlist Continuation, together with researchers from JKU Linz and UMass Amherst.

The dataset was 1 million user-created playlists from Spotify.

The challenge was to predict tracks that would complete a given playlist. This is similar to the Recommended Songs feature on Spotify.

Participation

791 participants from over 20 countries & 410 teams with 1497 submissions.
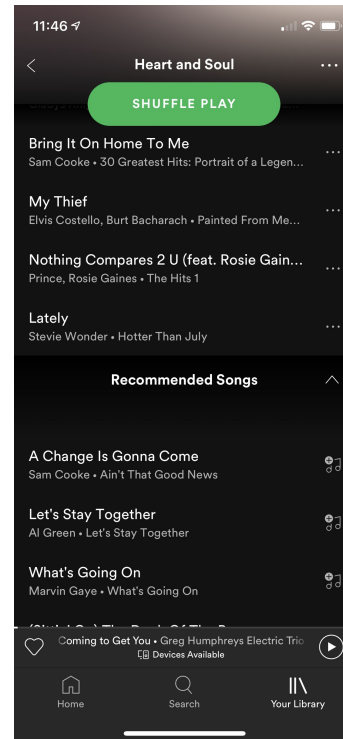
WSDM Cup 2019

We are currently running the WSDM Cup 2019 challenge on Sequential Skip Prediction.

The dataset is 130 million listening sessions on Spotify, along with associated interactions.

The challenge is to predict which tracks in a session will be skipped.

bit.ly/spotify-wsdm-cup-2019

Thank you