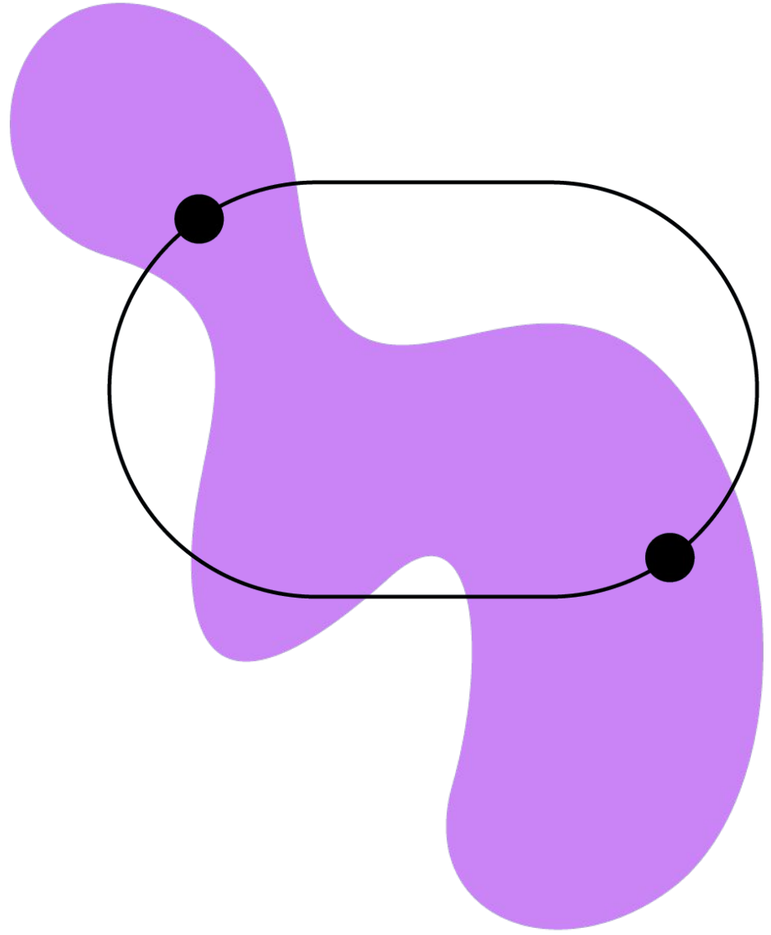
Finding the Right Audio Content for You

Brammert Ottens
On behalf of great teams at Spotify

Our mission

To unlock the potential of human creativity, by giving a million creative artists the opportunity to live off of their work, and billions of fans the opportunity to enjoy and be inspired by it.



+

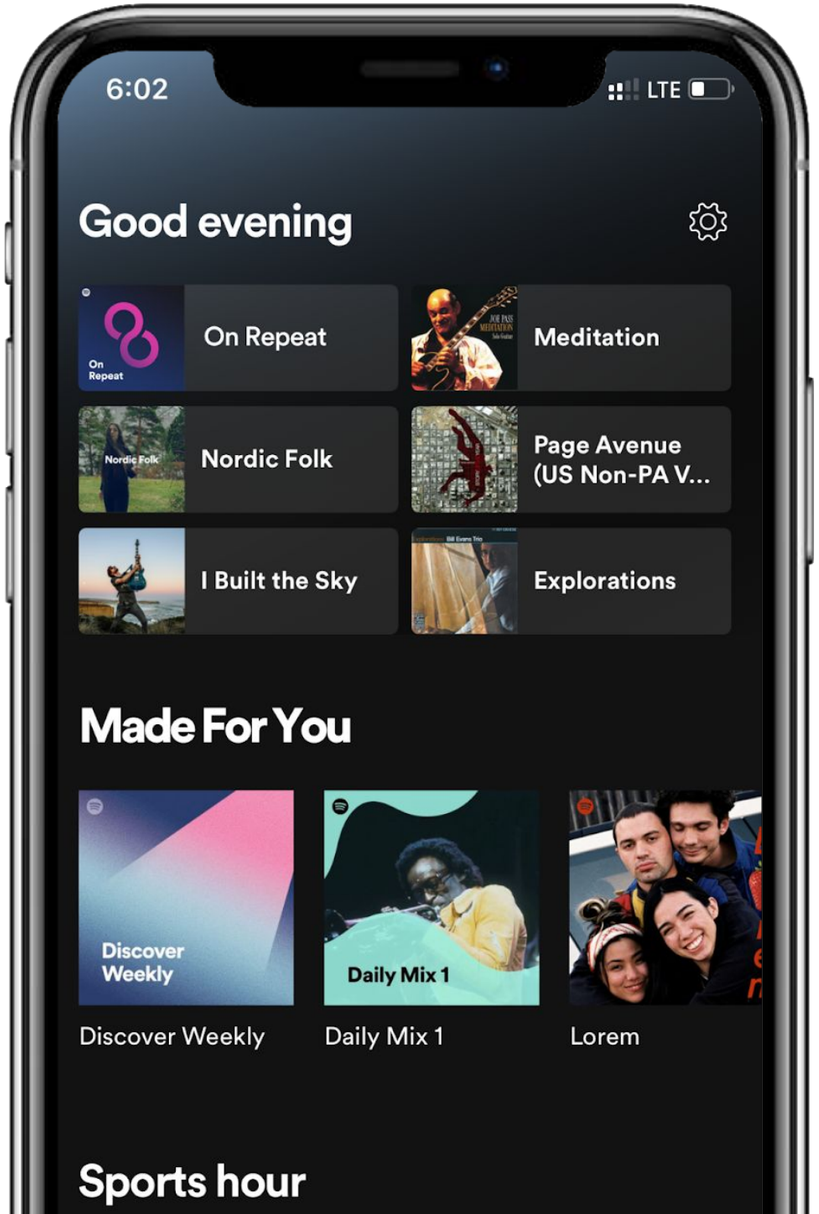
456M
Active Users

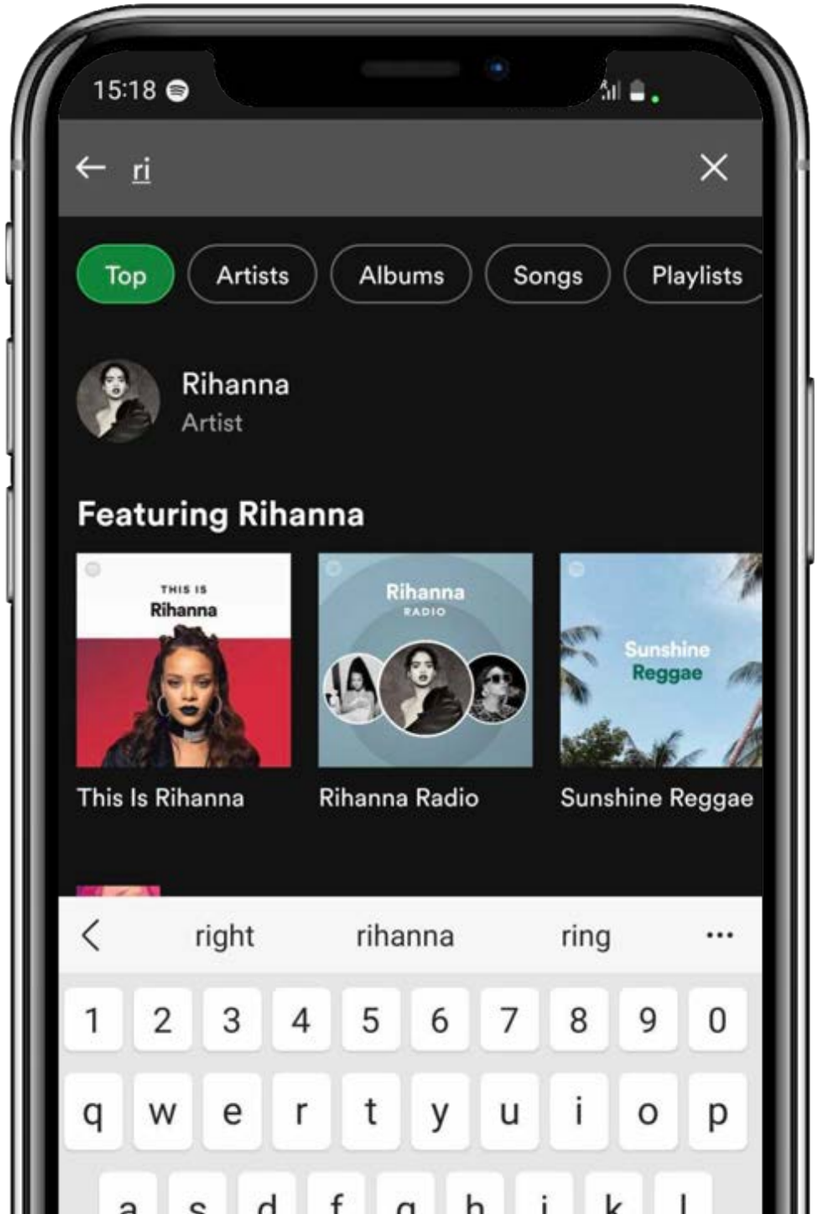
184
Markets

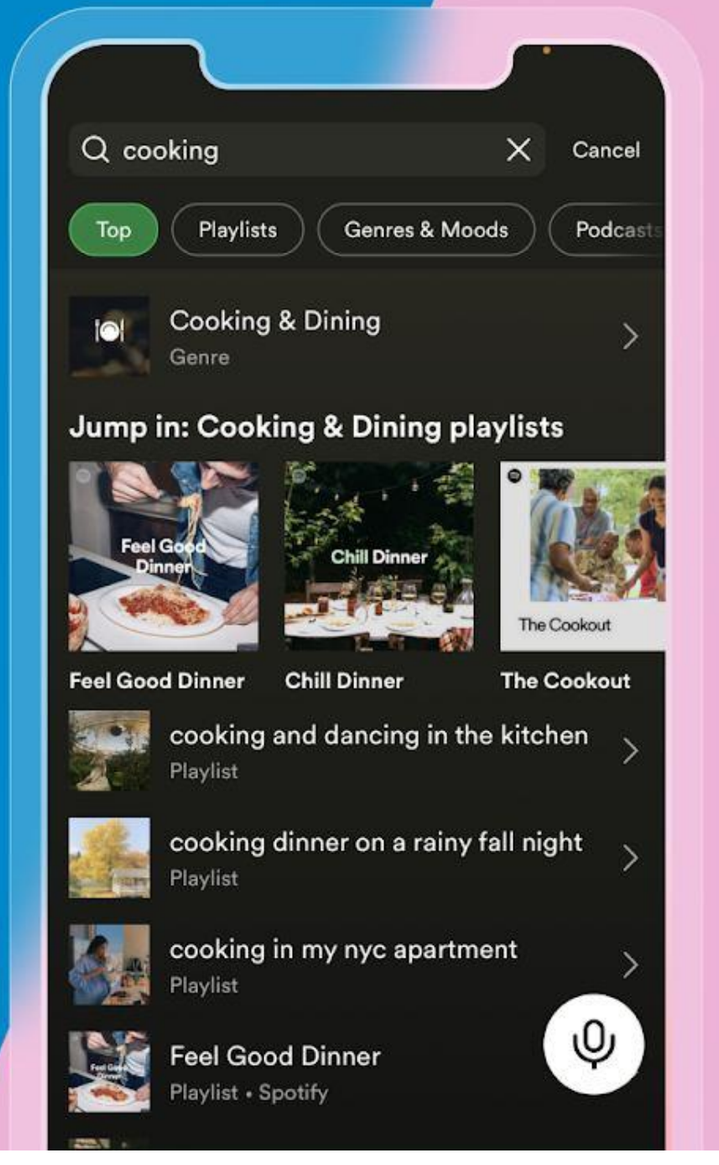
82M+
Music Tracks

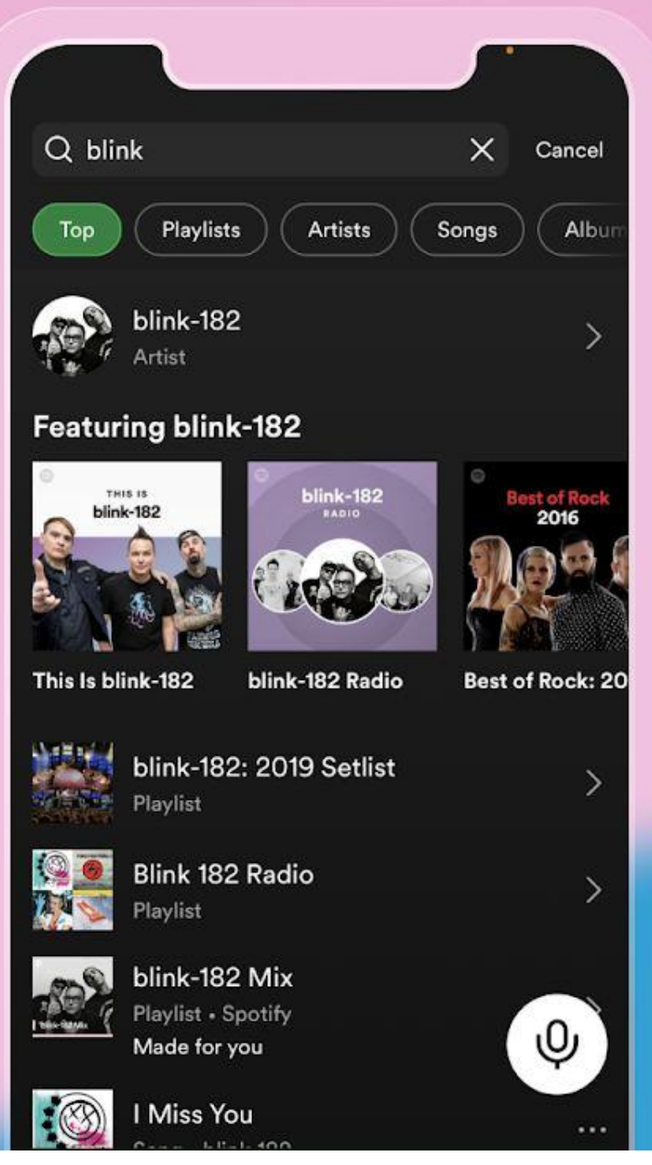
3.6M+
Podcast Titles

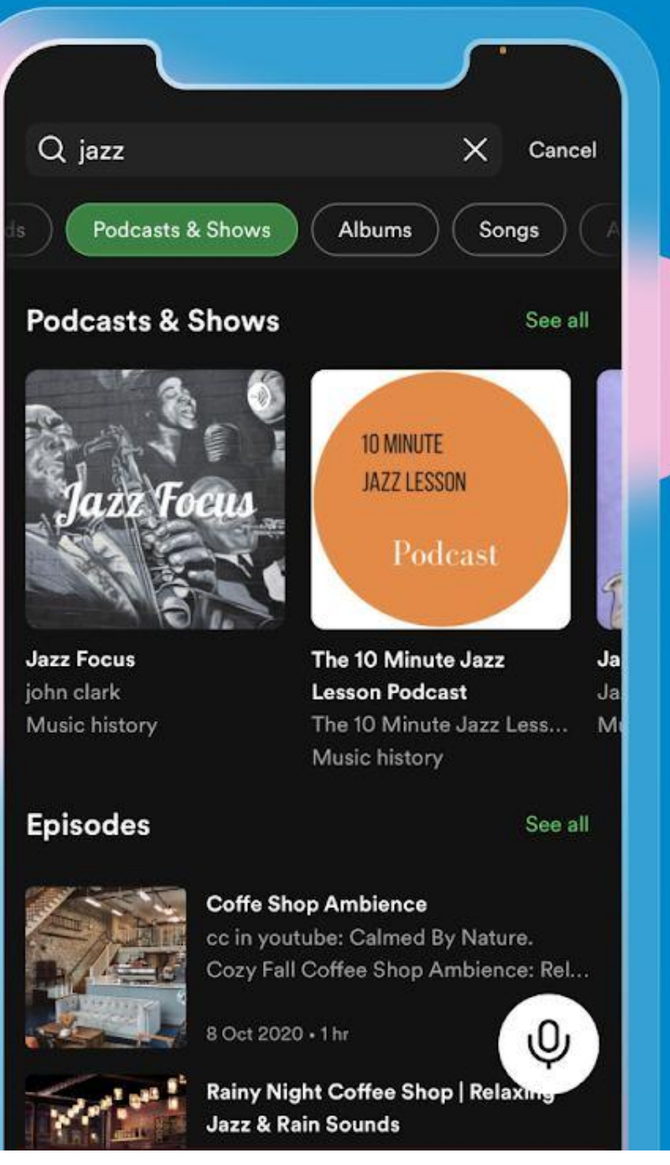
4B+
Playlists


6:02
LTE
Good evening
On Repeat
Meditation
Nordic Folk
Page Avenue (US Non-PA V...
I Built the Sky
Explorations
Made For You
Discover Weekly
Daily Mix 1
Lorem
Sports hour


15:18
ri
Top
Artists
Albums
Songs
Playlists
Rihanna
Artist
Featuring Rihanna
This Is Rihanna
Rihanna Radio
Sunshine Reggae
right
rihanna
ring

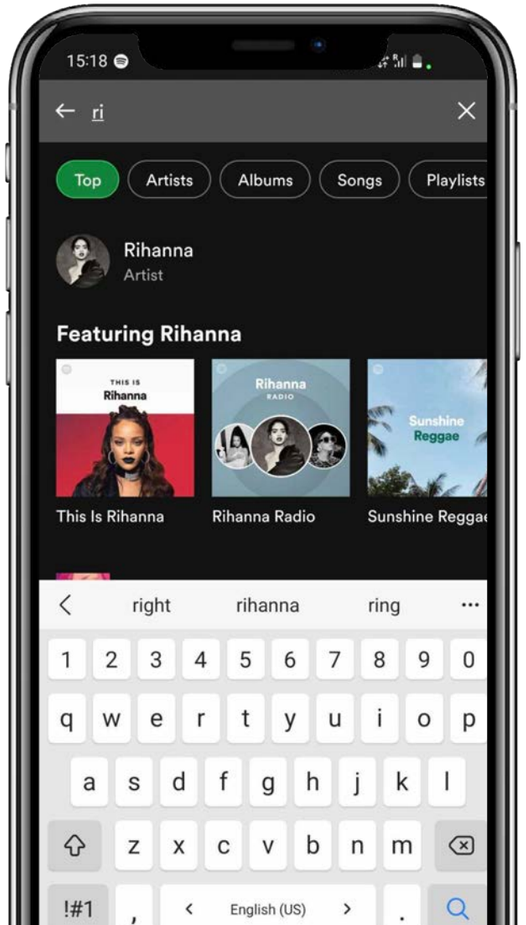

cooking
Cancel
Top
Playlists
Genres & Moods
Podcasts
Cooking & Dining
Genre
Jump in: Cooking & Dining playlists
Feel Good Dinner
Chill Dinner
The Cookout
Feel Good Dinner
Chill Dinner
The Cookout
cooking and dancing in the kitchen
Playlist
cooking dinner on a rainy fall night
Playlist
cooking in my nyc apartment
Playlist
Feel Good Dinner
Playlist • Spotify


blink
Cancel
Top
Playlists
Artists
Songs
blink-182
Artist
Featuring blink-182
This Is blink-182
blink-182 Radio
Best of Rock: 20
blink-182: 2019 Setlist
Playlist
Blink 182 Radio
Playlist
blink-182 Mix
Playlist • Spotify
Made for you
I Miss You

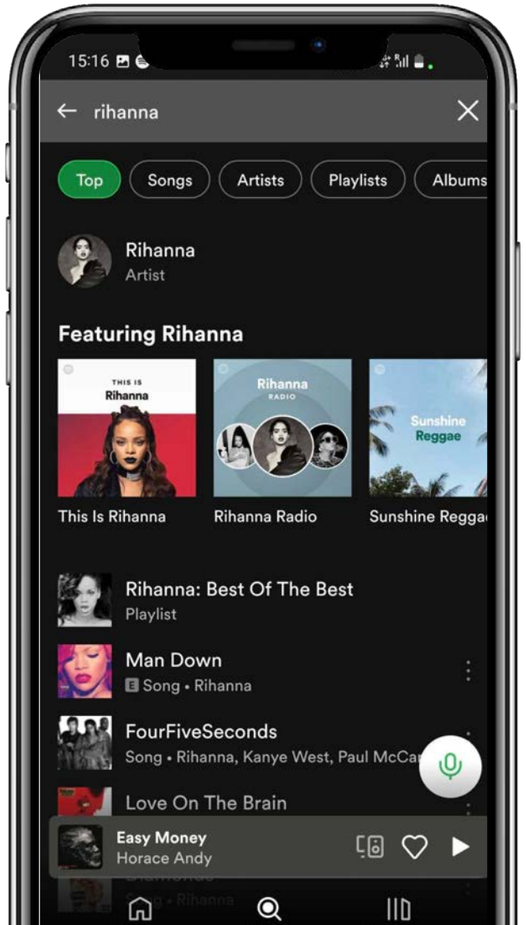

jazz
Cancel
Podcasts & Shows
Albums
Songs
Podcasts & Shows
See all
Jazz Focus
john clark
Music history
10 MINUTE JAZZ LESSON
Podcast
The 10 Minute Jazz Lesson Podcast
The 10 Minute Jazz Less...
Music history
Episodes
See all
Coffe Shop Ambience
cc in youtube: Calmed By Nature.
Cozy Fall Coffee Shop Ambience: Rel...
8 Oct 2020 • 1 hr
Rainy Night Coffee Shop | Relaxing Jazz & Rain Sounds

The Search Journey

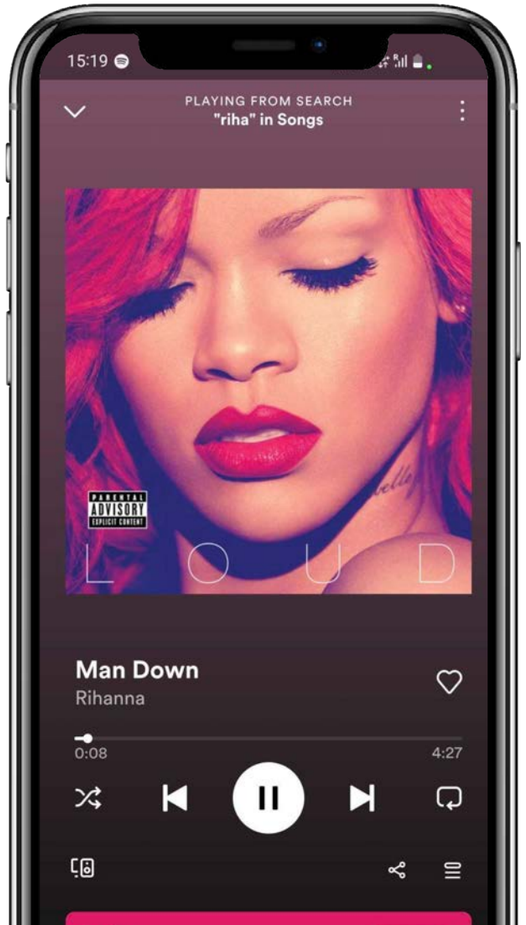
TYPE/TALK
User communicates with us



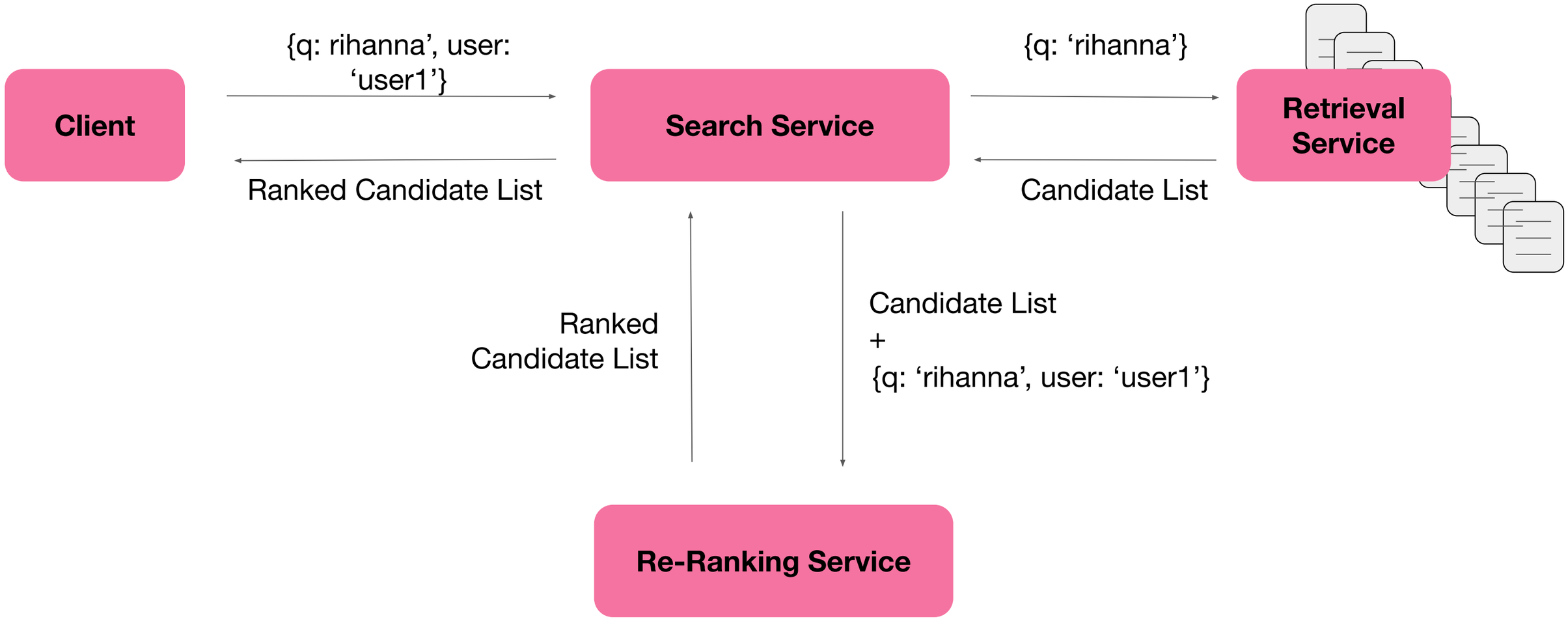
CONSIDER
User evaluates what we show them



DECIDE
User ends the search session

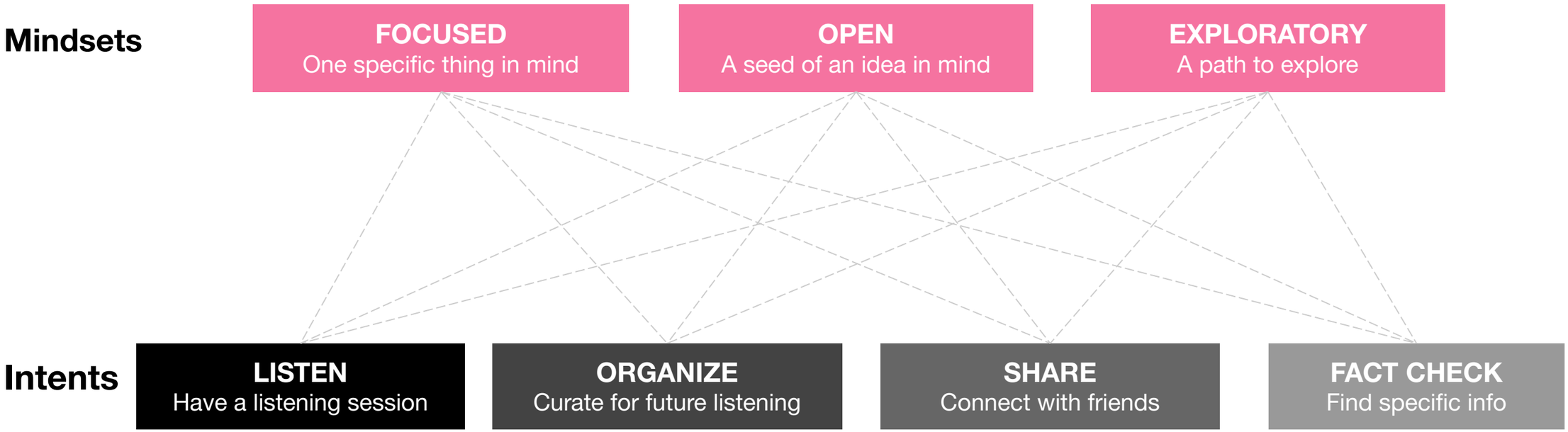


High level architecture

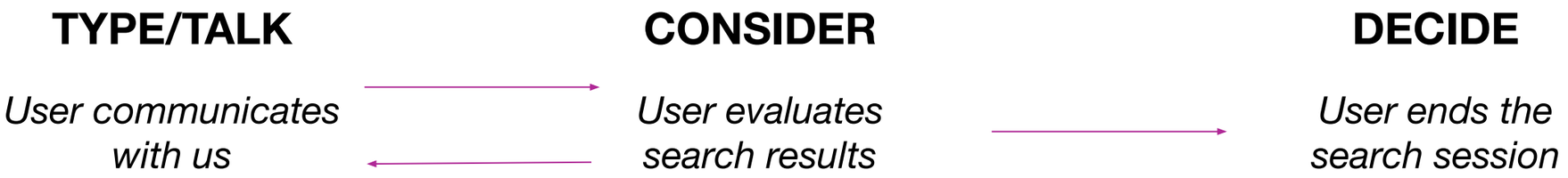


Metrics

Listeners come to Spotify with different *mindsets* and *intents*



[1] 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.



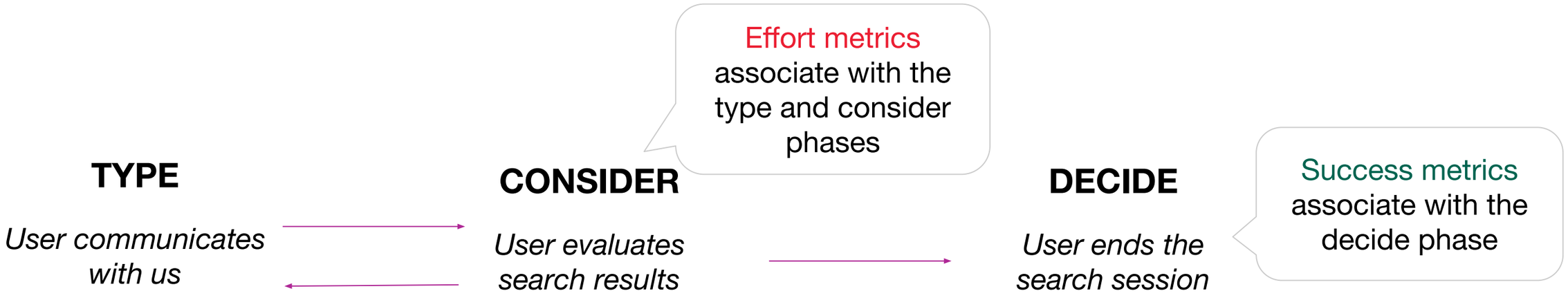
[2] Developing Evaluation Metrics for Instant Search Using Mixed Methods. P Ravichandran, J Garcia-Gathright, C Hosey, B St. Thomas & J Thom. SIGIR 2019.

Search Satisfaction ≅

SUCCESS ∆ EFFORT =

DECIDE metrics ∆ (TYPE metrics ⊕ CONSIDER metrics)

[2] Developing Evaluation Metrics for Instant Search Using Mixed Methods. P Ravichandran, J Garcia-Gathright, C Hosey, B St. Thomas & J Thom. SIGIR 2019.



EFFORT METRICS

character deletions

session duration

reformations before success in a search session

…

SUCCESS METRICS

Listen goal: stream

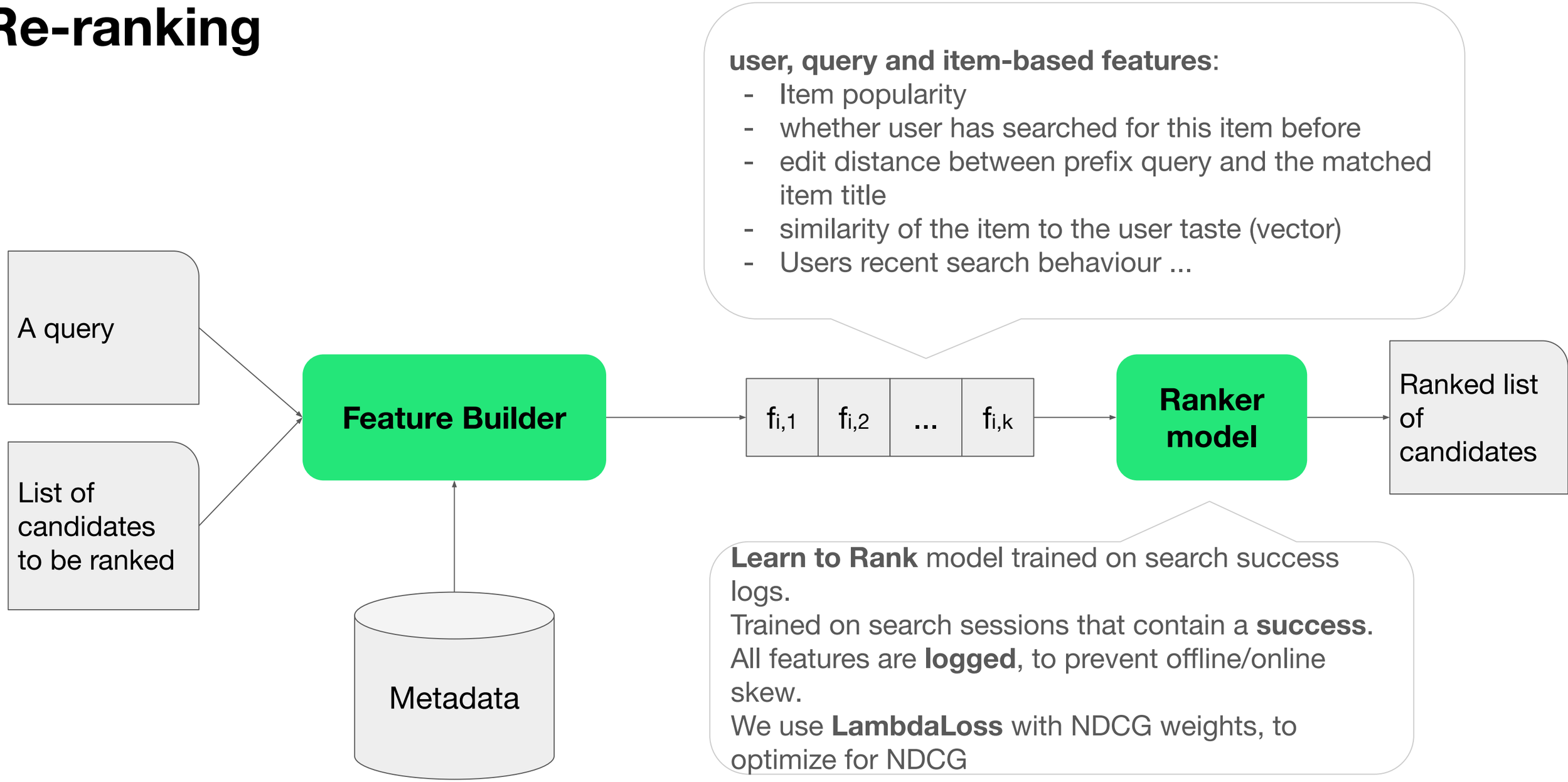
Organize goal: add to a playlist, save to collection, follow artist/playlist, download

Share goal: share link

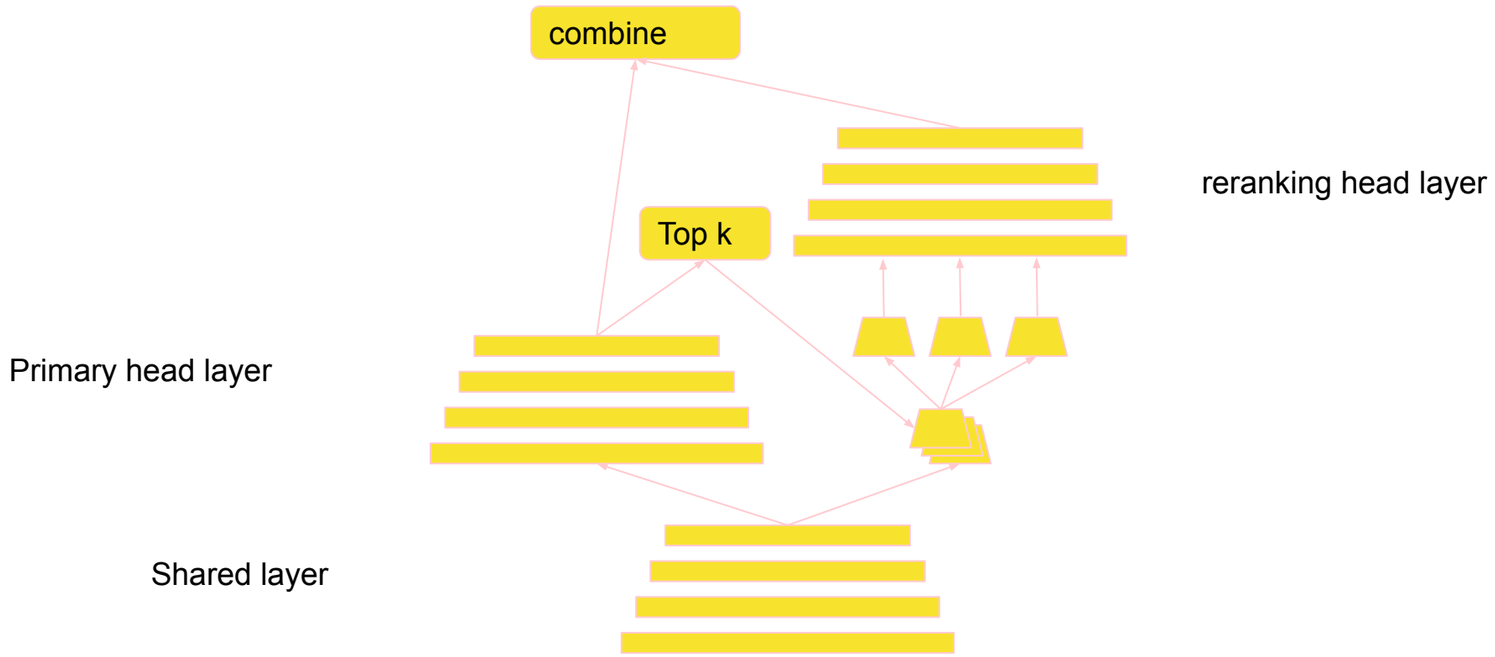
[2] Developing Evaluation Metrics for Instant Search Using Mixed Methods. P Ravichandran, J Garcia-Gathright, C Hosey, B St. Thomas & J Thom. SIGIR 2019.

Ranking

Re-ranking


user, query and item-based features:
- Item popularity
- whether user has searched for this item before
- edit distance between prefix query and the matched item title
- similarity of the item to the user taste (vector)
- Users recent search behaviour ...
A query
List of candidates to be ranked
Feature Builder
Metadata
$f_{i,1}$
$f_{i,2}$
...
$f_{i,k}$
Ranker model
Ranked list of candidates
Learn to Rank model trained on search success logs.
Trained on search sessions that contain a **success**.
All features are **logged**, to prevent offline/online skew.
We use **LambdaLoss** with NDCG weights, to optimize for NDCG

Ranking Architecture



Challenges

456M
Active Users

184
Markets

82M+
Music Tracks

3.6M+
Podcast Titles

4B+
Playlists

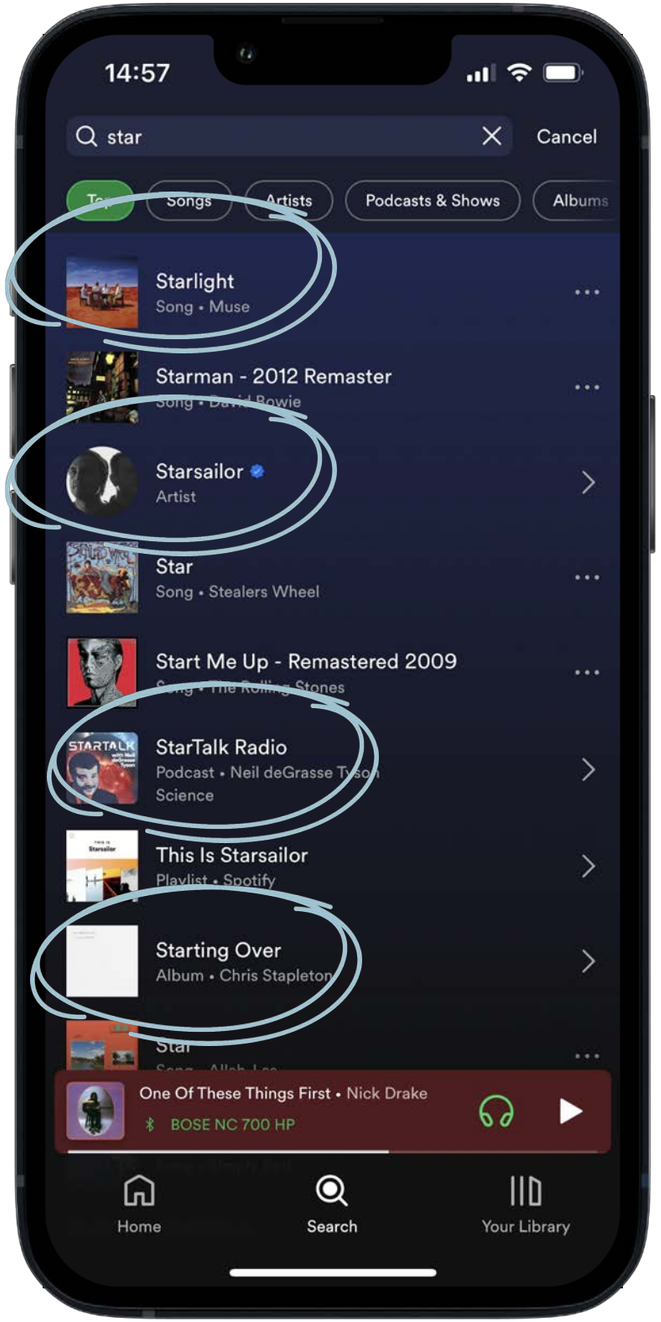
One App
One Search Experience

One App

~~One~~ **456M** Search Experience**s**

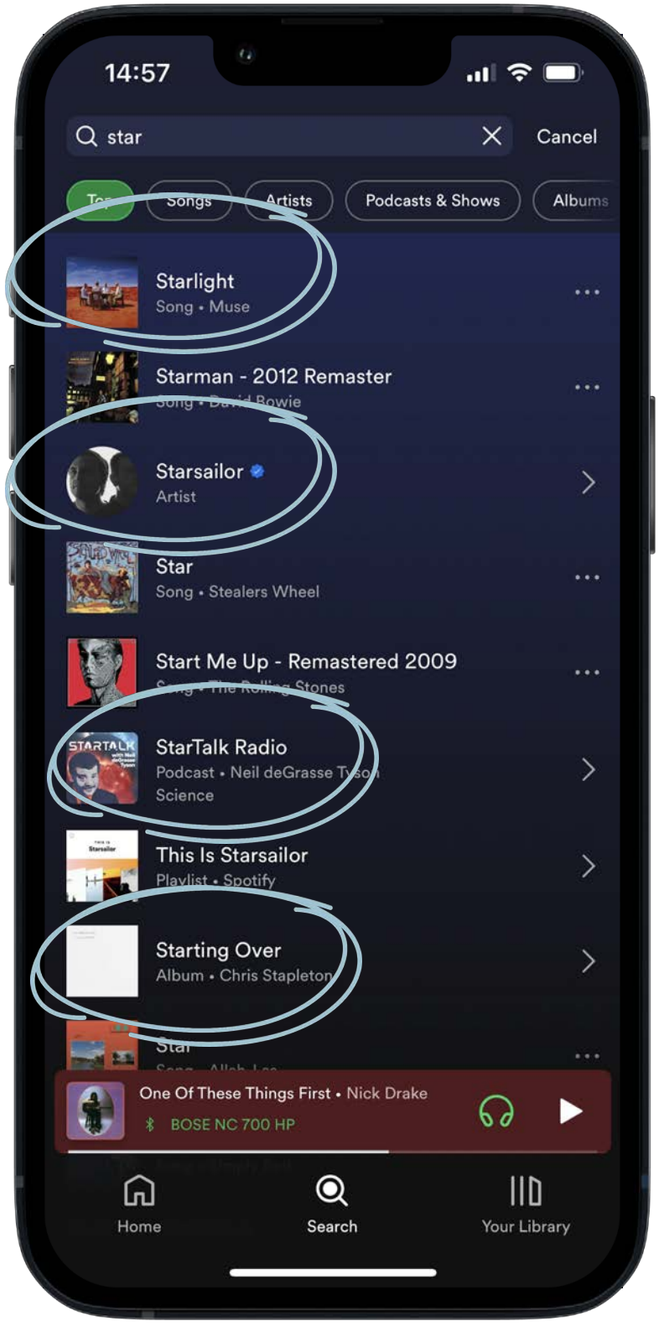
A diverse catalogue

One list to rule them all



We need to rank many different types of content

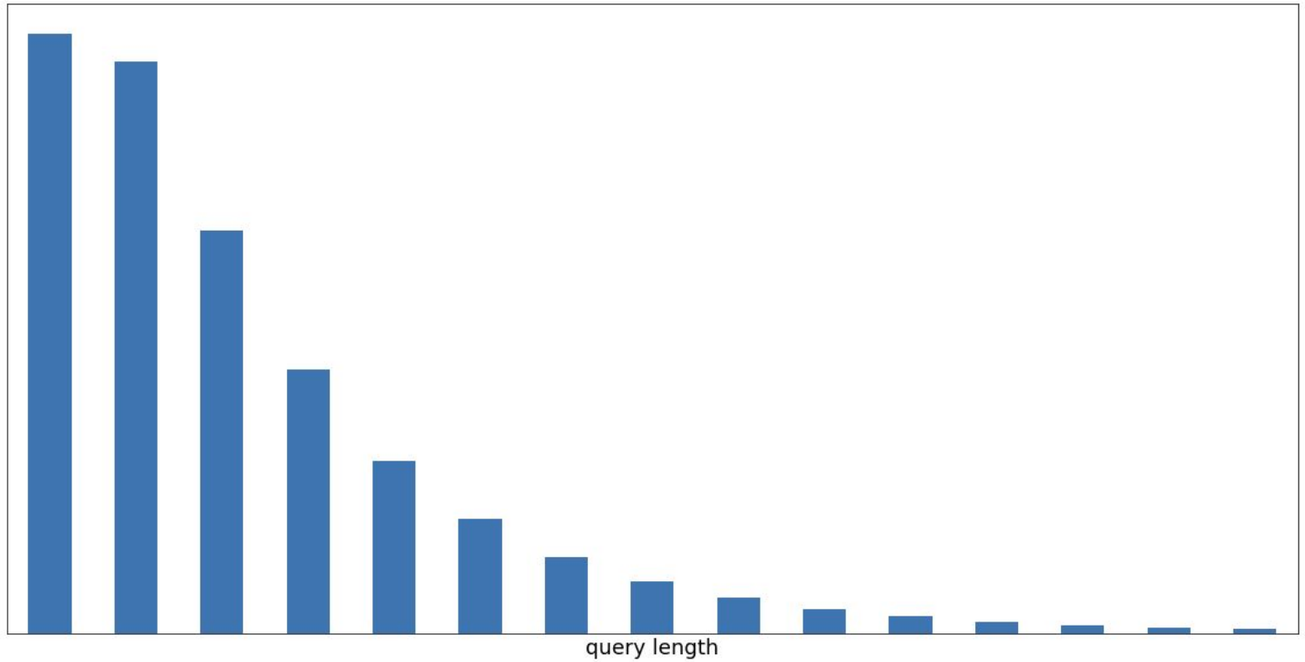
- We have vectors for some types of content, but not all
- Success for music queries looks different from success for podcast queries
- Not all features are available for all different content types



Short Queries

Short Queries

- Most queries we see are short, and thus not very informative and ambiguous.
- Personalization works very well for ***known intent*** searches
- Open searches are a challenge for instant search



Music & Podcasts

Differences in behavioural patterns

Relative difference in success metrics

Stream	+3%
Add to collection	+30%
Add to playlist	-59%
Follow artist	-92%
Download	+593%
Share	+44%

Relative difference in effort metrics

Average relative character deletions	+53%
Average query length in characters	+13%

** Tian, Mi; CHIIR 2022 industry day presentation*

Differences in behavioural patterns

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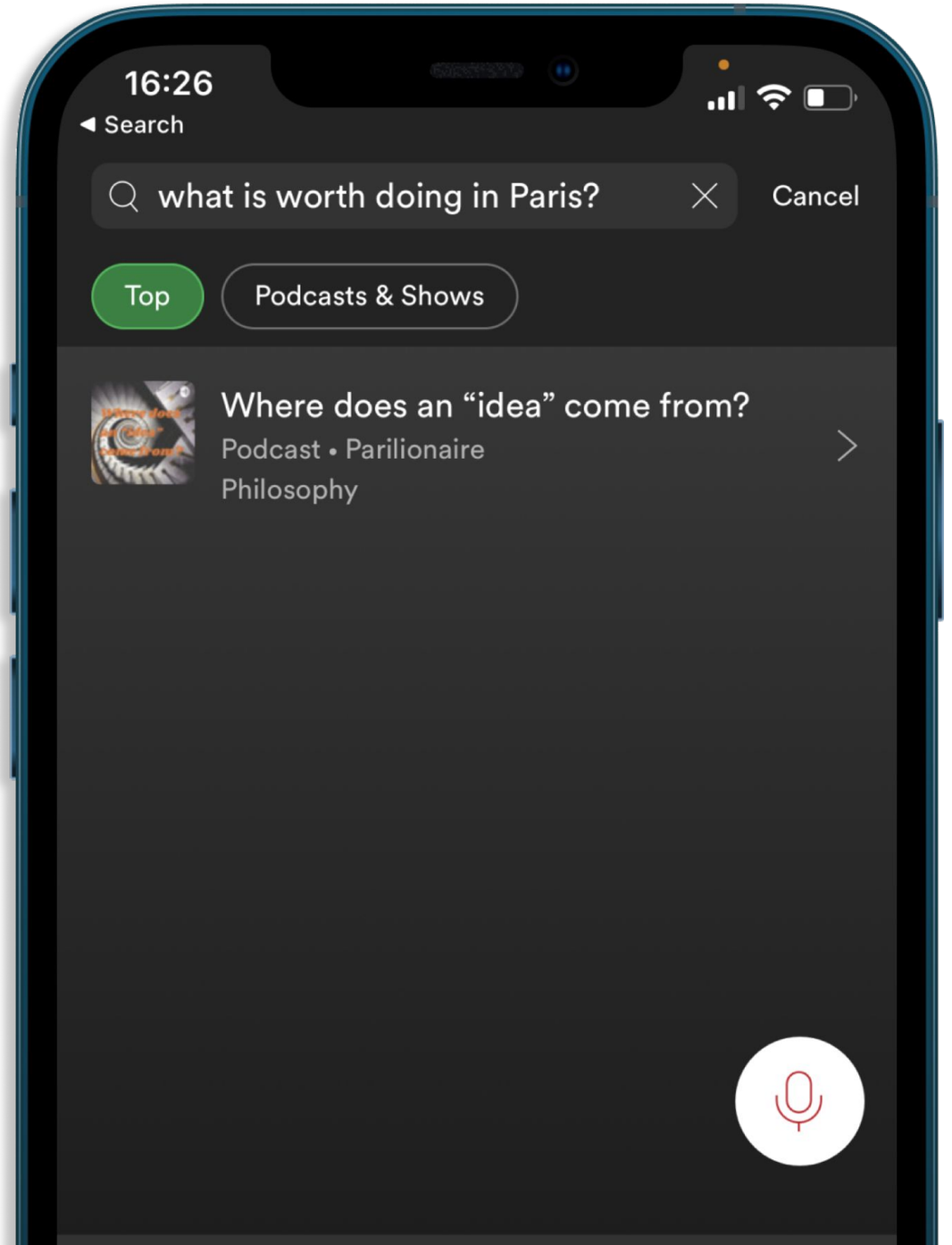
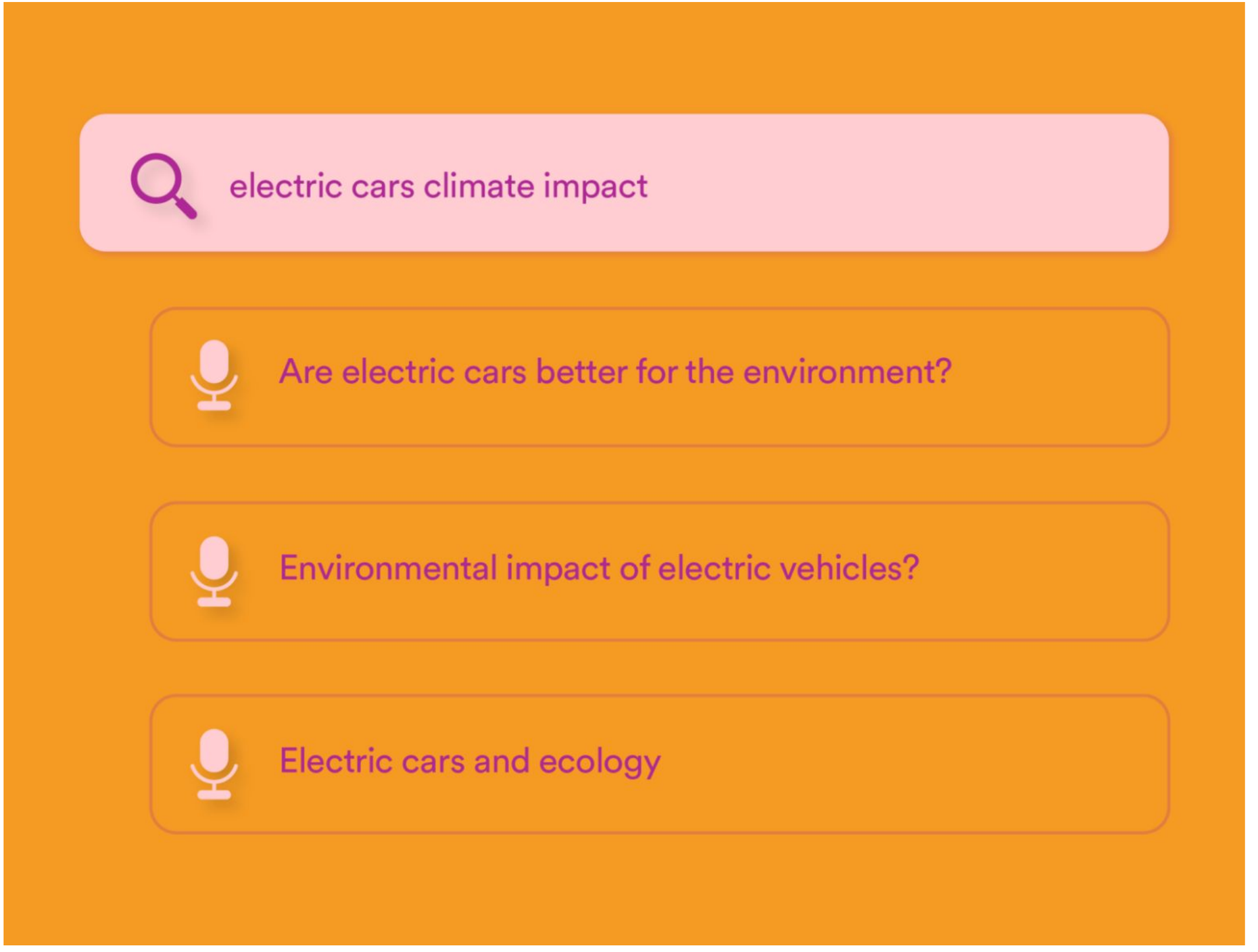
Users may have different goals searching for different content types

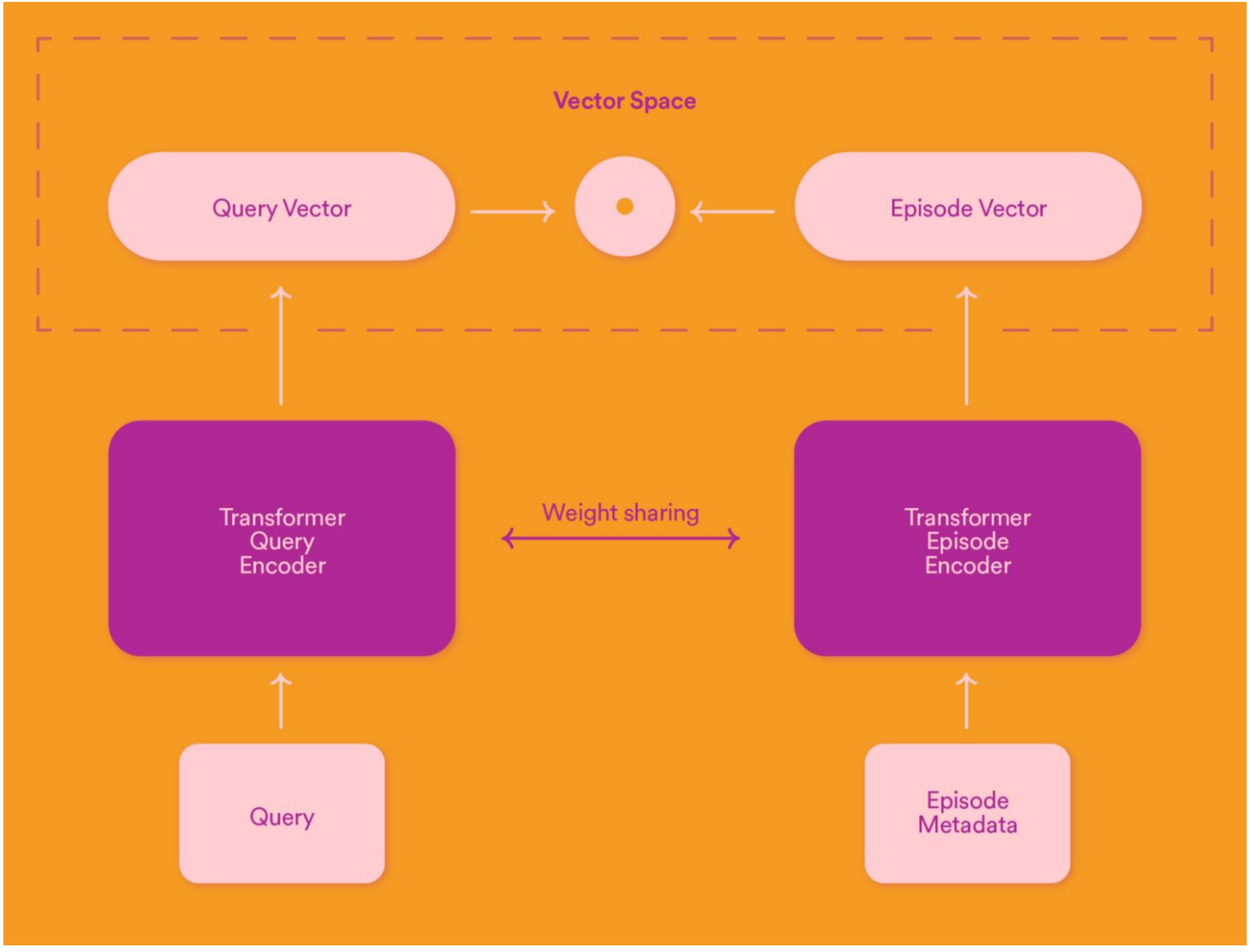
Searching for podcast on Spotify requires much higher effort than music

** Tian, Mi; CHIIR 2022 industry day presentation*

Term-based search *does not* cut it

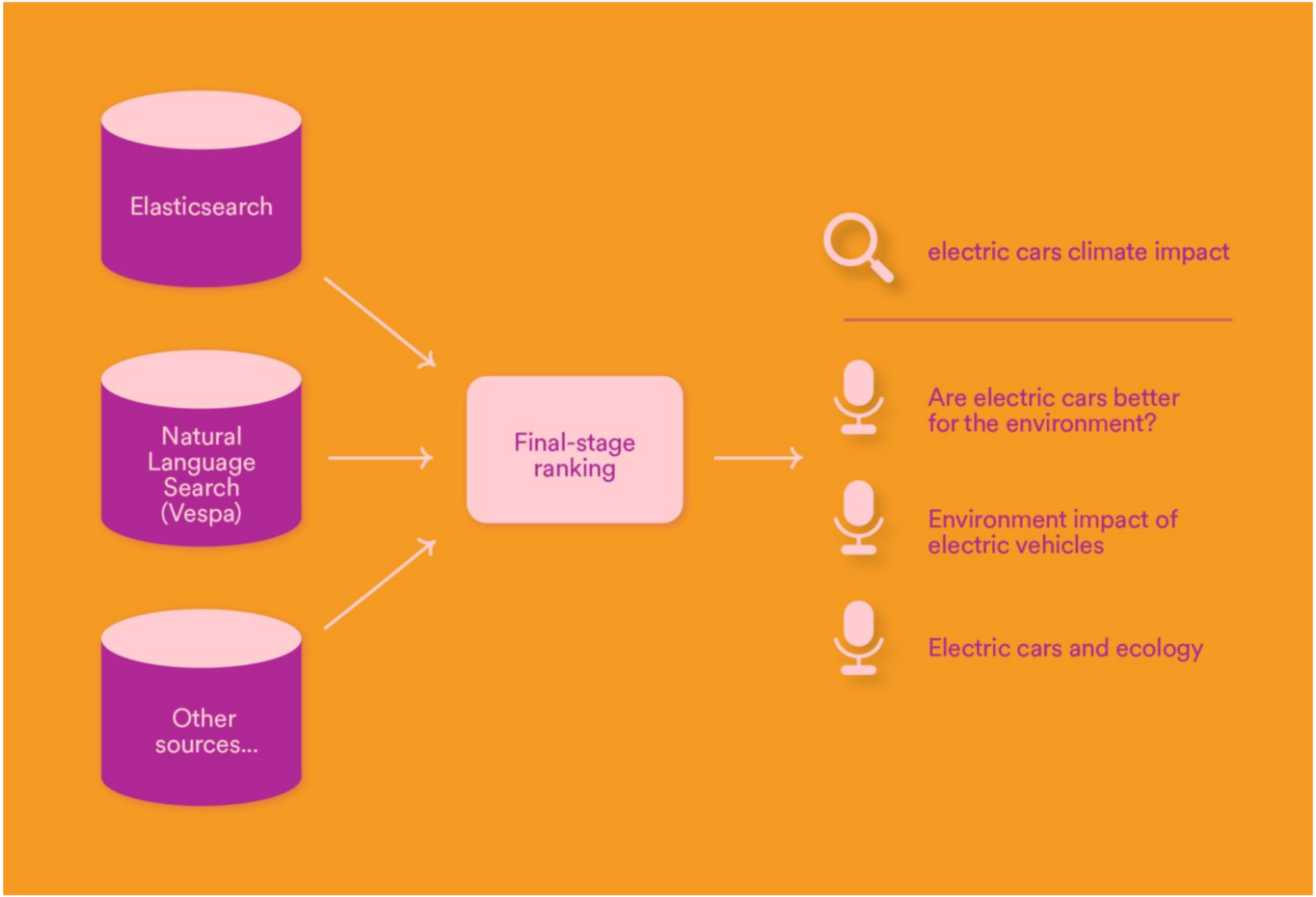



electric cars climate impact
Are electric cars better for the environment?
Environmental impact of electric vehicles?
Electric cars and ecology

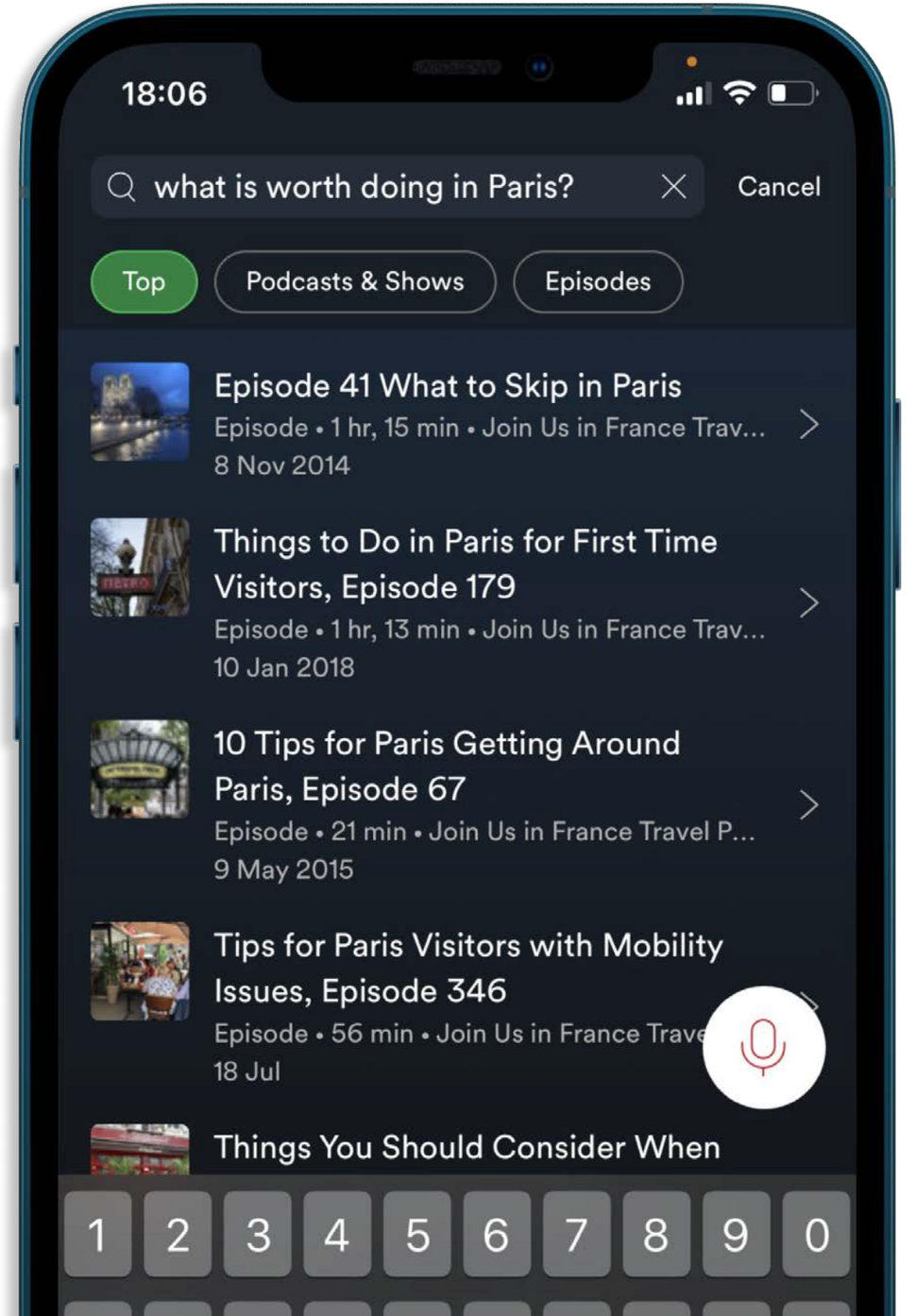

Vector Space
Query Vector
Episode Vector
Transformer Query Encoder
Weight sharing
Transformer Episode Encoder
Query
Episode Metadata

Data for fine tuning

- Query/Episode pairs from **Search logs**
  - successful podcast searches
  - query reformulations
- **Synthetic** queries from popular episode titles and descriptions
- **Manually** written queries for popular episodes


Elasticsearch
Natural Language Search (Vespa)
Other sources...
Final-stage ranking
electric cars climate impact
Are electric cars better for the environment?
Environment impact of electric vehicles
Electric cars and ecology

Semantic Search *does* cut it



How can you help?

Datasets

Dive into datasets for everything from podcasts to music recommendation

https://research.atspotify.com/datasets/

The Million Playlist Dataset:
Learning from Music Playlists

Oct 05, 2020

Dataset for music recommendation and automatic music playlist continuation. Contains 1,000,000 playlists, including playlist- and track-level metadata.

Spotify Podcasts Dataset:
100,000 episodes with text and audio

Apr 15, 2020

Dataset for podcast research. Contains 100,000 episodes from thousands of different shows on Spotify, including audio files and speech transcriptions.

WSDM Cup:
The Music Streaming Sessions Dataset

Nov 15, 2018

Dataset for researching how to model user listening and interaction behavior in music streaming. Also includes data for music information retrieval and session-based sequential recommendations.

OpenMic:
Audio and Crowd-Sourced Instrument Labels

Sep 23, 2018

Dataset for researching multi-instrument recognition in polyphonic recordings, a fundamental problem in music information retrieval.

Research Areas

Turning in-depth audio knowledge into rewarding audio experiences

Algorithmic Responsibility

Audio Intelligence

Evaluation

Human-Computer Interaction

Language Technologies

Machine Learning

Music Creation

Search & Recommendations

User Modeling

Spotify

Locations Being Here Diversity, Equity & Impact Students How We Hire All Jobs

Artist & Label Partnership Manager Independent Music

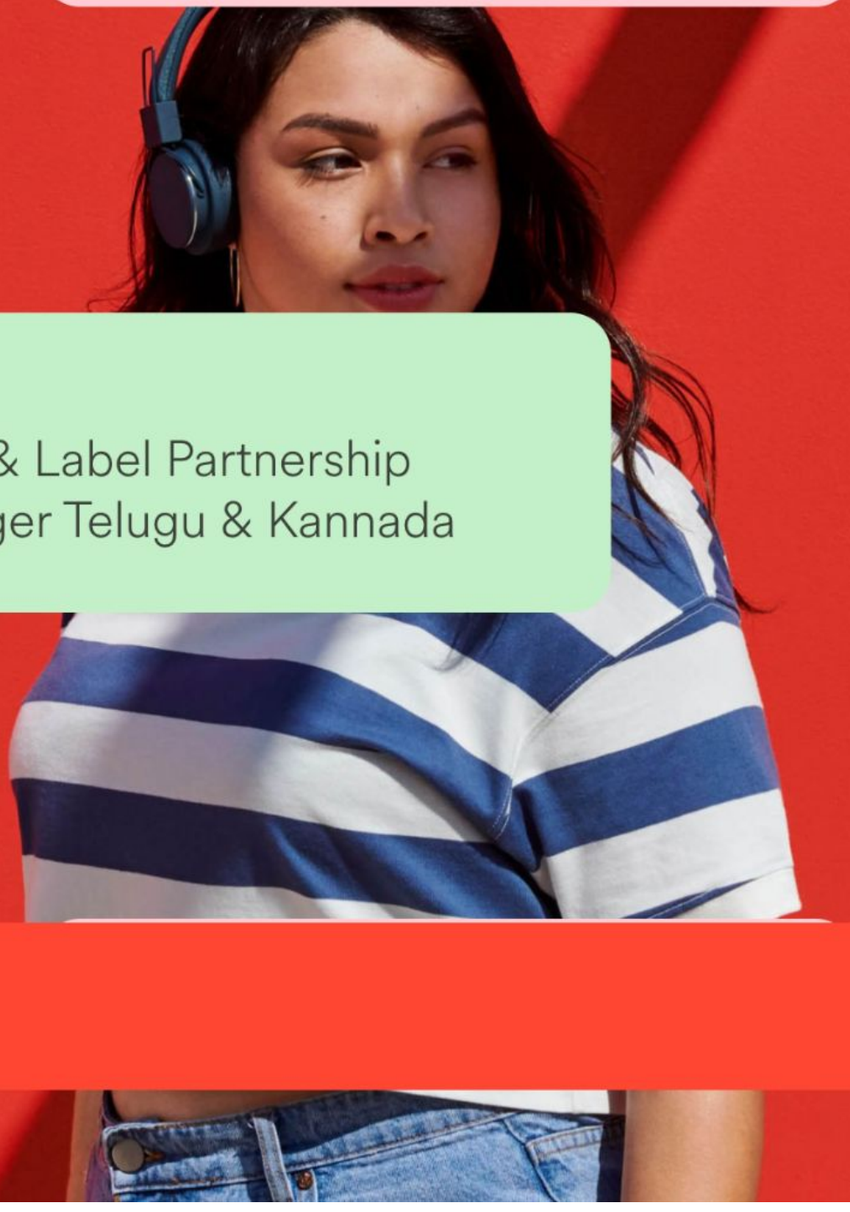
637 jobs in 37 locations

Join the band

Explore all jobs

Mumbai

Artist & Label Partnership Manager Telugu & Kannada



Search jobs and keywords