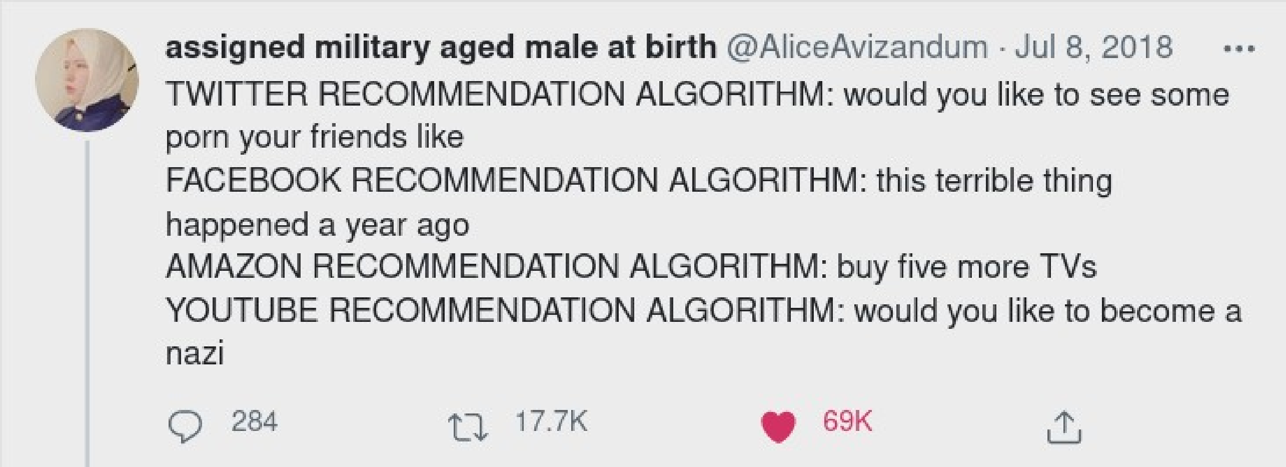
Simple, open music recommendations

Sam Thursfield, GUADEC 2021

Recommenders are everywhere



assigned military aged male at birth @AliceAvizandum · Jul 8, 2018

TWITTER RECOMMENDATION ALGORITHM: would you like to see some porn your friends like
FACEBOOK RECOMMENDATION ALGORITHM: this terrible thing happened a year ago
AMAZON RECOMMENDATION ALGORITHM: buy five more TVs
YOUTUBE RECOMMENDATION ALGORITHM: would you like to become a nazi

@AliceAvizandum, Twitter

Can I make a recommendation algorithm?

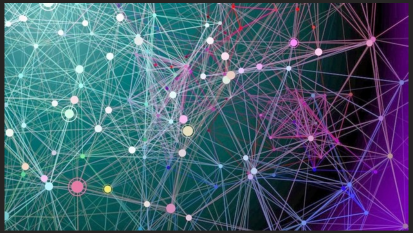
Recommendation basics:

data → process → more data

Recommendation basics:

Music collection

Social data



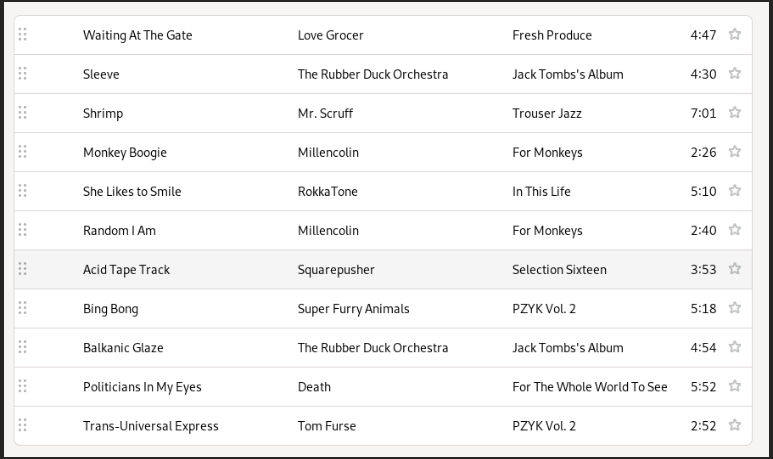
Listen history

Audio analysis

....

→ process →

List of songs



Waiting At The Gate	Love Grocer	Fresh Produce	4:47	☆
Sleeve	The Rubber Duck Orchestra	Jack Tombs's Album	4:30	☆
Shrimp	Mr. Scruff	Trouser Jazz	7:01	☆
Monkey Boogie	Millencolin	For Monkeys	2:26	☆
She Likes to Smile	RokkaTone	In This Life	5:10	☆
Random I Am	Millencolin	For Monkeys	2:40	☆
Acid Tape Track	Squarepusher	Selection Sixteen	3:53	☆
Bing Bong	Super Furry Animals	PZYK Vol. 2	5:18	☆
Balkanic Glaze	The Rubber Duck Orchestra	Jack Tombs's Album	4:54	☆
Politicians In My Eyes	Death	For The Whole World To See	5:52	☆
Trans-Universal Express	Tom Furse	PZYK Vol. 2	2:52	☆

Music recommendation basics:

playlist → process → playlist

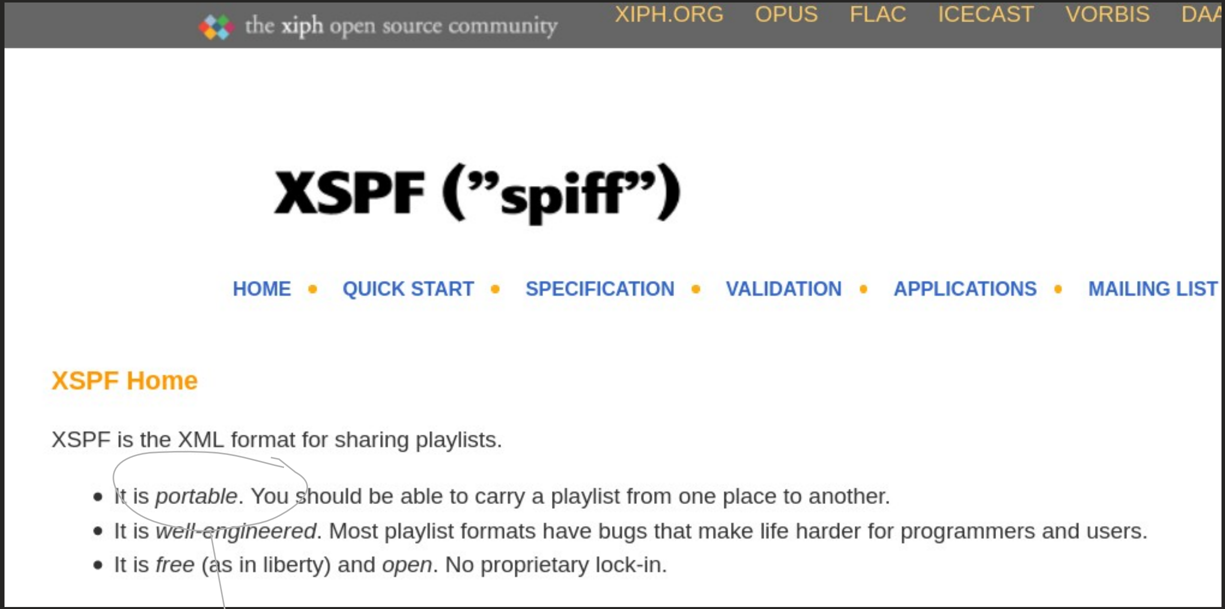
Music recommendation basics:

playlist → process → playlist

```
> cpe tracker tracks | cpe shuffle --count 5 - | jq ‘{ title: .title, creator: .creator }’ -c
{"title":"Find the River","creator":"R.E.M."}
{"title":"Good Good Things","creator":"Descendents"}
{"title":"Yuko and Hiro","creator":"Blur"}
{"title":"The Basset Hound’s Lament","creator":"Thomas Truax"}
{"title":"Widowmaker","creator":"The Impossibles"}
```

cpe = Calliope – set of commandline tools that work with playlists
playlist = list of JSON objects

Playlist format



XSPF ("spiff")

XSPF Home

XSPF is the XML format for sharing playlists.

- It is *portable*. You should be able to carry a playlist from one place to another.
- It is *well-engineered*. Most playlist formats have bugs that make life harder for programmers and users.
- It is *free* (as in liberty) and *open*. No proprietary lock-in.

Resolve the playlist in order to listen.

Demo: **resolve a playlist**

```
cpe tracker resolve-content five-songs.cpe | jq
```

You can now **export** the playlist as .m3u, .xspf, etc.

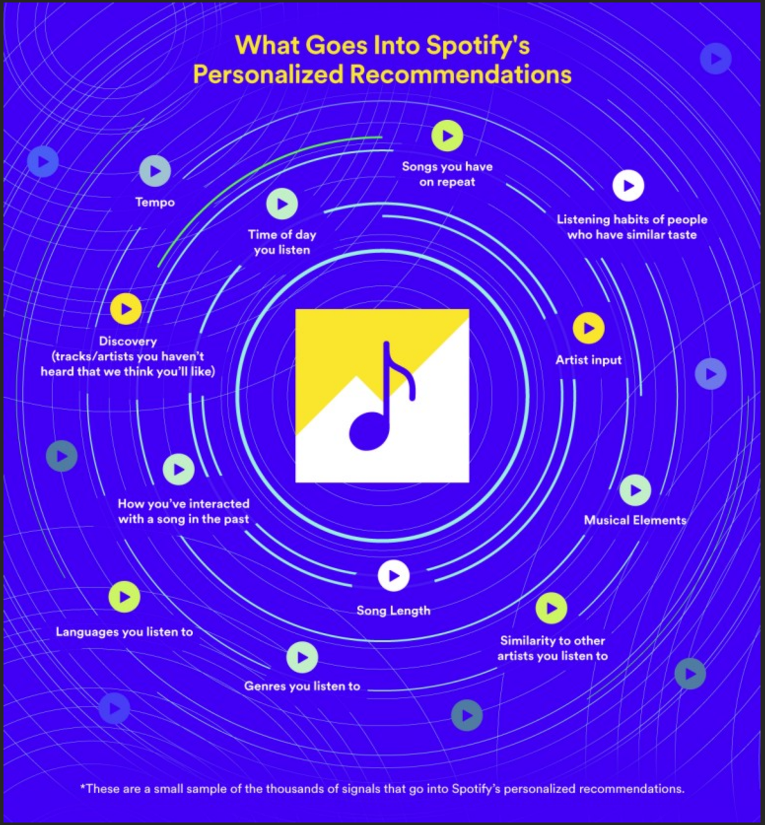
```
cpe spotify resolve five-songs.cpe | jq
```

Requires a free Spotify API key.
You can now **upload** the playlist to Spotify.

Spotify facts

9000+ data pipelines

1600+ engineers

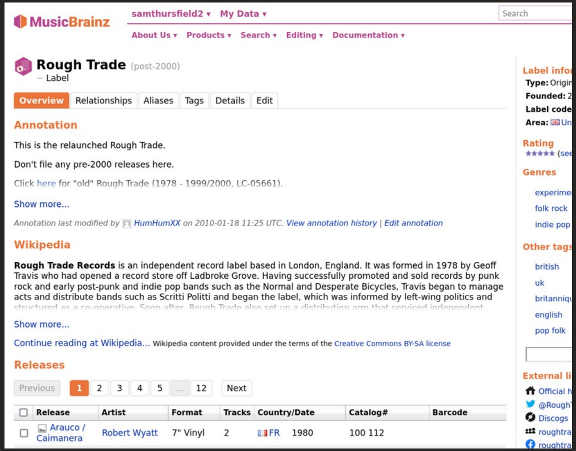

What Goes Into Spotify's Personalized Recommendations
Songs you have on repeat
Tempo
Time of day you listen
Listening habits of people who have similar taste
Discovery (tracks/artists you haven't heard that we think you'll like)
Artist input
How you've interacted with a song in the past
Musical Elements
Song Length
Languages you listen to
Similarity to other artists you listen to
Genres you listen to
*These are a small sample of the thousands of signals that go into Spotify's personalized recommendations.

50 million tracks (25% of which have zero listens)

> half a trillion events captured per day

Source: https://research.atspotify.com/

Data sources



MusicBrainz samthursfield2 ▾ My Data ▾ Search

About Us ▾ Products ▾ Search ▾ Editing ▾ Documentation ▾

Rough Trade (post-2000)
~ Label

Overview | Relationships | Aliases | Tags | Details | Edit

Annotation

This is the relaunched Rough Trade.

Don't file any pre-2000 releases here.

Click here for "old" Rough Trade (1978 - 1999/2000, LC-05661).

Show more...

Annotation last modified by HumHumXX on 2010-01-18 11:25 UTC. View annotation history | Edit annotation

Wikipedia

Rough Trade Records is an independent record label based in London, England. It was formed in 1978 by Geoff Travis who had opened a record store off Ladbroke Grove. Having successfully promoted and sold records by punk rock and early post-punk and indie pop bands such as the Normal and Desperate Bicycles, Travis began to manage acts and distribute bands such as Scritti Politti and began the label, which was informed by left-wing politics and structured as a co-operative. Soon after, Rough Trade also set up a distribution arm that serviced independent

Show more...

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Releases

Previous 1 2 3 4 5 ... 12 Next

☐	Release	Artist	Format	Tracks	Country/Date	Catalog#	Barcode
☐	Arauco / Caimanera	Robert Wyatt	7" Vinyl	2	FR 1980	100 112	

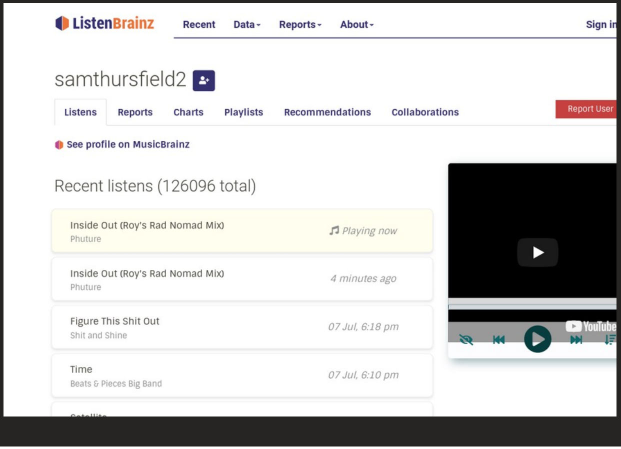
Label infor
Type: Origin
Founded: 2
Label code
Area: Un

Rating
★★★★★ (see

Genres
experime
folk rock
indie pop

Other tags
british
uk
britanniq
english
pop folk

External li
Official h
@Rough
Discogs
roughtra
roughtra



ListenBrainz Recent Data ▾ Reports ▾ About ▾ Sign in

samthursfield2

Listens | Reports | Charts | Playlists | Recommendations | Collaborations | Report User

See profile on MusicBrainz

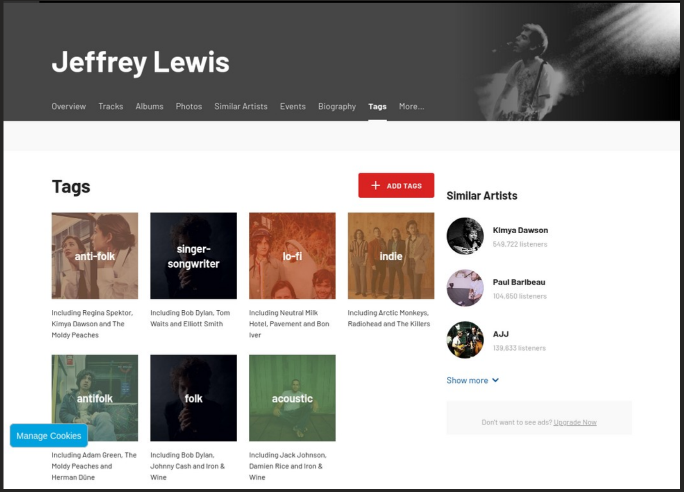
Recent listens (126096 total)

Inside Out (Roy's Rad Nomad Mix) — Phuture — Playing now

Inside Out (Roy's Rad Nomad Mix) — Phuture — 4 minutes ago

Figure This Shit Out — Shit and Shine — 07 Jul, 6:18 pm

Time — Beats & Pieces Big Band — 07 Jul, 6:10 pm



Jeffrey Lewis

Overview Tracks Albums Photos Similar Artists Events Biography **Tags** More...

Tags + ADD TAGS

anti-folk — Including Regina Spektor, Kimya Dawson and The Moldy Peaches

singer-songwriter — Including Bob Dylan, Tom Waits and Elliott Smith

lo-fi — Including Neutral Milk Hotel, Pavement and Bon Iver

indie — Including Arctic Monkeys, Radiohead and The Killers

antifolk — Including Adam Green, The Moldy Peaches and Herman Düne

folk — Including Bob Dylan, Johnny Cash and Iron & Wine

acoustic — Including Jack Johnson, Damien Rice and Iron & Wine

Similar Artists

Kimya Dawson — 549,722 listeners

Paul Baribeau — 104,650 listeners

AJJ — 139,633 listeners

Show more

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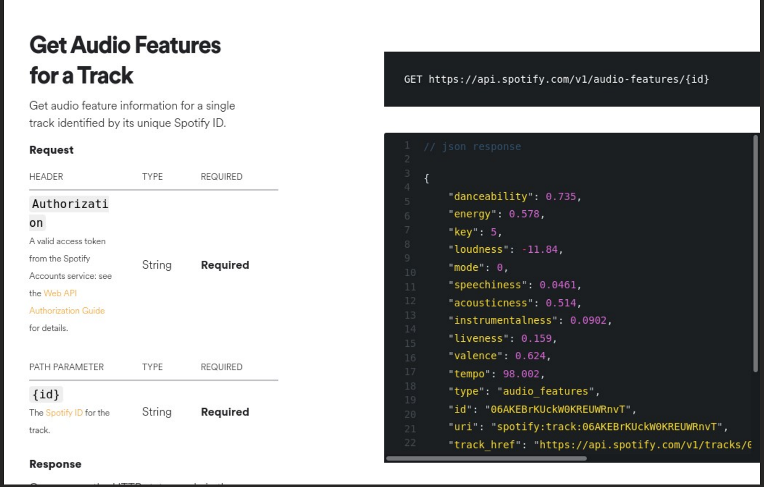


Get Audio Features for a Track

Get audio feature information for a single track identified by its unique Spotify ID.

Request

HEADER	TYPE	REQUIRED
`Authorization` A valid access token from the Spotify Accounts service: see the Web API Authorization Guide for details.	String	**Required**

PATH PARAMETER	TYPE	REQUIRED
`{id}` The Spotify ID for the track.	String	**Required**

Response

```
GET https://api.spotify.com/v1/audio-features/{id}
```

```
// json response

{
    "danceability": 0.735,
    "energy": 0.578,
    "key": 5,
    "loudness": -11.84,
    "mode": 0,
    "speechiness": 0.0461,
    "acousticness": 0.514,
    "instrumentalness": 0.0902,
    "liveness": 0.159,
    "valence": 0.624,
    "tempo": 98.002,
    "type": "audio_features",
    "id": "06AKEBrKUckW0KREUWRnvT",
    "uri": "spotify:track:06AKEBrKUckW0KREUWRnvT",
    "track_href": "https://api.spotify.com/v1/tracks/
```

MusicBrainz:
  metadata

ListenBrainz:
  listen history

Last.fm:
  tags
  listen history

Spotify:
  acoustic analysis,
  playlists,
  listen history

...and many more...

Demo: listening history

```
cpe -v 3 lastfm-history --user ssam scrobbles | head -n 5
```

Last 5 tracks I listened to.

```
cpe lastfm-history artists --first-play-since=’6 months ago’ \
                           --min-listens 10
```

Artists I discovered in the last 6 months.

See more examples at: https://calliope-music.readthedocs.io/en/latest/examples/

Demo: ‘forgotten songs’ playlist

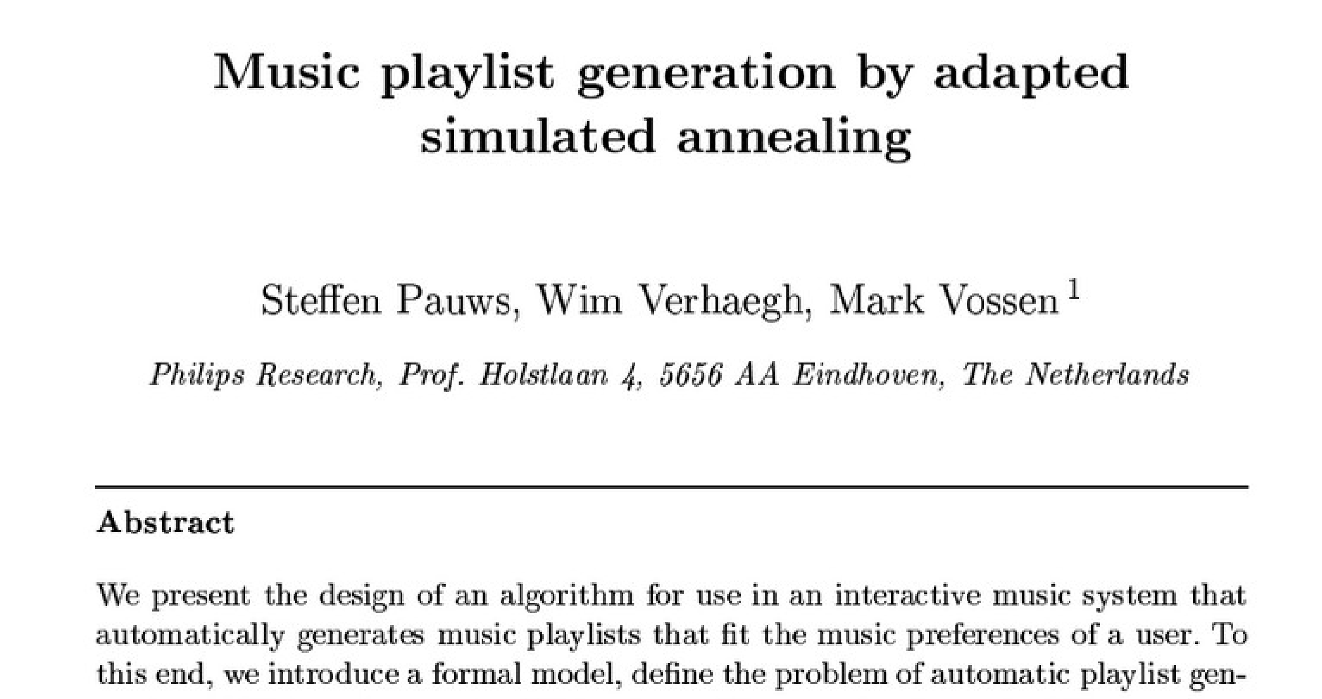
```
cpe lastfm-history tracks --last-play-before=’1 year ago’ \
                          --min-listens=5 | \
    cpe shuffle - --count 20
```

Now select 30 minutes worth of music:

```
cpe tracker resolve-content - | cpe select \
      --constraint=type:playlist-duration,vmin:30m,vmax:30m - | \
    cpe export --format=m3u -
```

See more examples at: https://calliope-music.readthedocs.io/en/latest/examples/

Constraint-based local search



Music playlist generation by adapted simulated annealing

Steffen Pauws, Wim Verhaegh, Mark Vossen[1]

Philips Research, Prof. Holstlaan 4, 5656 AA Eindhoven, The Netherlands

Abstract

We present the design of an algorithm for use in an interactive music system that automatically generates music playlists that fit the music preferences of a user. To this end, we introduce a formal model, define the problem of automatic playlist gen-

February 2008 Information Sciences 178(3):647-662

https://www.researchgate.net/publication/223327847_Music_playlist_generation_by_adapted_simulated_annealing

Constraint-based local search

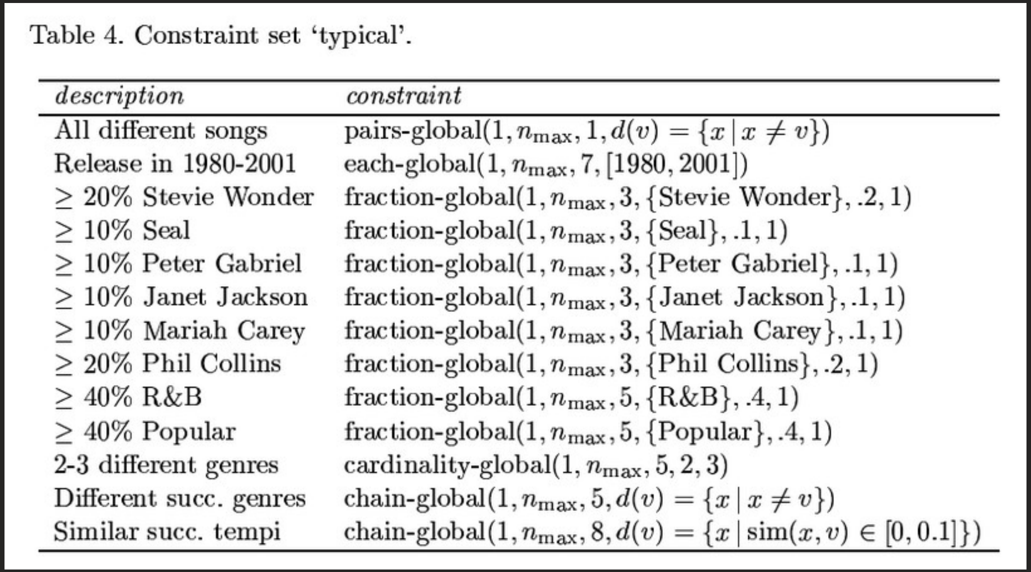


Table 4. Constraint set ‘typical’.

description	*constraint*
All different songs	pairs-global$(1, n_{\max}, 1, d(v) = \{x \mid x \neq v\})$
Release in 1980-2001	each-global$(1, n_{\max}, 7, [1980, 2001])$
$\geq$ 20% Stevie Wonder	fraction-global$(1, n_{\max}, 3, \{$Stevie Wonder$\}, .2, 1)$
$\geq$ 10% Seal	fraction-global$(1, n_{\max}, 3, \{$Seal$\}, .1, 1)$
$\geq$ 10% Peter Gabriel	fraction-global$(1, n_{\max}, 3, \{$Peter Gabriel$\}, .1, 1)$
$\geq$ 10% Janet Jackson	fraction-global$(1, n_{\max}, 3, \{$Janet Jackson$\}, .1, 1)$
$\geq$ 10% Mariah Carey	fraction-global$(1, n_{\max}, 3, \{$Mariah Carey$\}, .1, 1)$
$\geq$ 20% Phil Collins	fraction-global$(1, n_{\max}, 3, \{$Phil Collins$\}, .2, 1)$
$\geq$ 40% R&B	fraction-global$(1, n_{\max}, 5, \{$R&B$\}, .4, 1)$
$\geq$ 40% Popular	fraction-global$(1, n_{\max}, 5, \{$Popular$\}, .4, 1)$
2-3 different genres	cardinality-global$(1, n_{\max}, 5, 2, 3)$
Different succ. genres	chain-global$(1, n_{\max}, 5, d(v) = \{x \mid x \neq v\})$
Similar succ. tempi	chain-global$(1, n_{\max}, 8, d(v) = \{x \mid \mathrm{sim}(x, v) \in [0, 0.1]\})$

```
cat tracks.cpe | cpe shuffle - | cpe select \
   --constraint=type:playlist-duration,vmin:60m,vmax:120m \
   --constraint=type:item-duration,vmin:0s,vmax:6m - > playlist.cpe
```

simpleai: https://pypi.org/project/simpleai/

GNOME Music Ideas

Listenbrainz integration

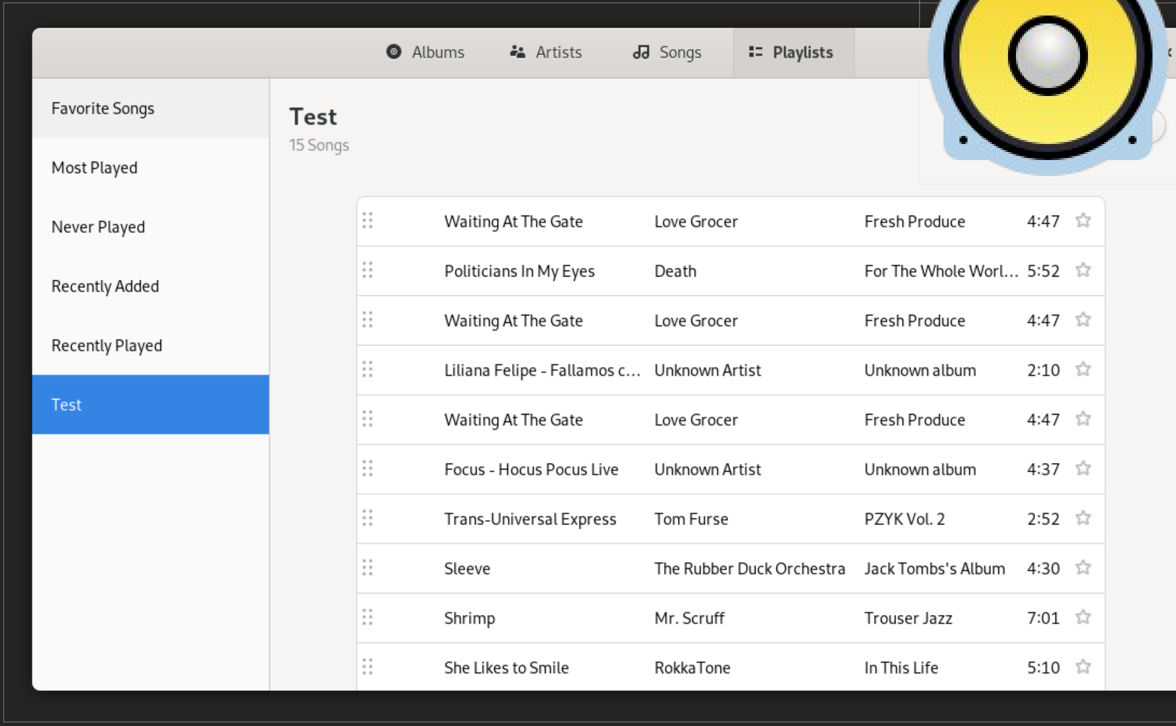
Link to music download sites

Automatic Musicbrainz tagging

Show artist info and links

Suggest ‘artists you might like’

Generate recommendation playlists



Favorite Songs
Most Played
Never Played
Recently Added
Recently Played
Test

Test
15 Songs

Waiting At The Gate	Love Grocer	Fresh Produce	4:47
Politicians In My Eyes	Death	For The Whole Worl...	5:52
Waiting At The Gate	Love Grocer	Fresh Produce	4:47
Liliana Felipe - Fallamos c...	Unknown Artist	Unknown album	2:10
Waiting At The Gate	Love Grocer	Fresh Produce	4:47
Focus - Hocus Pocus Live	Unknown Artist	Unknown album	4:37
Trans-Universal Express	Tom Furse	PZYK Vol. 2	2:52
Sleeve	The Rubber Duck Orchestra	Jack Tombs's Album	4:30
Shrimp	Mr. Scruff	Trouser Jazz	7:01
She Likes to Smile	RokkaTone	In This Life	5:10

Summary

- Recommenders are here to stay.
- **Calliope** lets you build lo-fi music recommendations… and more.

  https://calliope-music.readthedocs.io/

  https://gitlab.com/samthursfield/calliope/

  ```
  pip install calliope-music
  ```
- Same design can work for developing other recommenders: videos, web history, suggested apps, local files…

Thanks for watching!

Spotify facts

1600+
engineers

9000+ data pipelines

> half a trillion events
captured per day

50 million tracks (25% of which have zero listens)

- Drives an increase in people listening to new music and new genres
- Drives a reduction in filesharing
- Pays artists (much more than Apple Music)
- Reduced payment-per-stream 0.008¢ to 0.003¢ in last 6 years

Links:

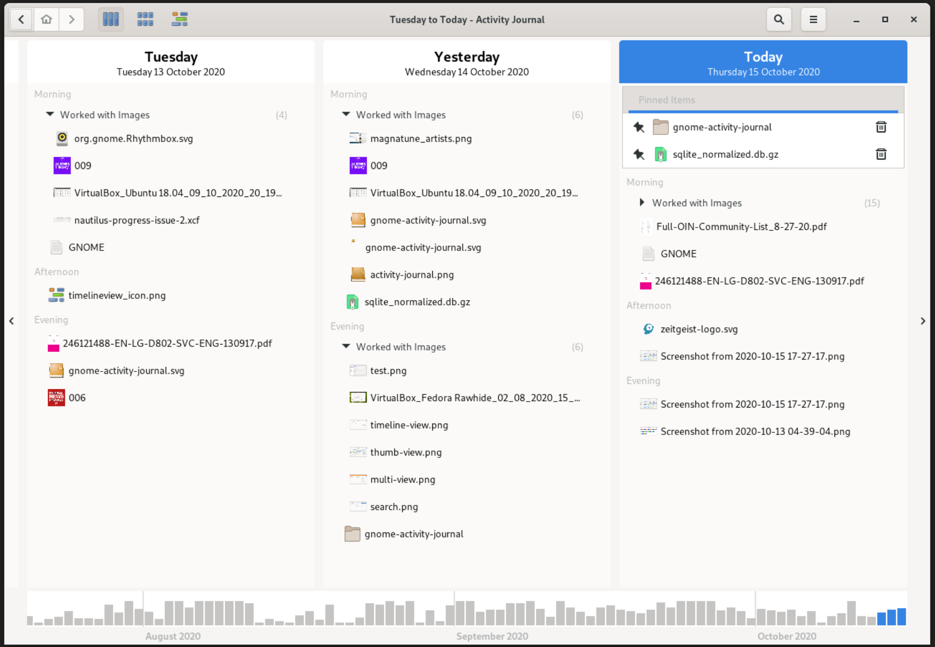
https://research.atspotify.com/publication/

https://www.youtube.com/watch?v=MXudOLStaXA (Should We Hate Spotify? [An Objective View From A Professional Musician])

https://audioxide.com/articles/how-spotify-has-changed-the-way-we-listen-to-music/

Recommendations in GNOME …

- Recent files dialog
- Activity Journal
- ???



Tuesday to Today - Activity Journal

Tuesday
Tuesday 13 October 2020

Morning

Worked with Images (4)

- org.gnome.Rhythmbox.svg
- 009
- VirtualBox_Ubuntu 18.04_09_10_2020_20_19…
- nautilus-progress-issue-2.xcf
- GNOME

Afternoon

- timelineview_icon.png

Evening

- 246121488-EN-LG-D802-SVC-ENG-130917.pdf
- gnome-activity-journal.svg
- 006

Yesterday
Wednesday 14 October 2020

Morning

Worked with Images (6)

- magnatune_artists.png
- 009
- VirtualBox_Ubuntu 18.04_09_10_2020_20_19…
- gnome-activity-journal.svg
- gnome-activity-journal.svg
- activity-journal.png
- sqlite_normalized.db.gz

Evening

Worked with Images (6)

- test.png
- VirtualBox_Fedora Rawhide_02_08_2020_15_…
- timeline-view.png
- thumb-view.png
- multi-view.png
- search.png
- gnome-activity-journal

Today
Thursday 15 October 2020

Pinned Items

- gnome-activity-journal
- sqlite_normalized.db.gz

Morning

Worked with Images (15)

- Full-OIN-Community-List_8-27-20.pdf
- GNOME
- 246121488-EN-LG-D802-SVC-ENG-130917.pdf

Afternoon

- zeitgeist-logo.svg
- Screenshot from 2020-10-15 17-27-17.png

Evening

- Screenshot from 2020-10-15 17-27-17.png
- Screenshot from 2020-10-13 04-39-04.png

Data is available

- Collections: local data, Spotify, Bandcamp, …
- Playlists: local data, Youtube, Spotify, Hype Machine, …
- Audio analysis: Spotify, Acousticbrainz
- Classification: Last.fm, Every Noise at Once, Spotify
- Listen history: Listenbrainz, Last.fm, …
- Metadata: MusicBrainz, Discogs, …

Demo: 1 hour shuffle mix

```
jq < tracks.cpe -C | less -R

cat tracks.cpe | cpe shuffle - | cpe select \
   --constraint=type:playlist-duration,vmin:60m,vmax:120m \
   --constraint=type:item-duration,vmin:0s,vmax:6m - > playlist.cpe

head -n 5 playlist.cpe

cpe export --format=xspf playlist.cpe | head -n 20
```

https://asciinema.org/a/XXn2Ew7q8NDB5KvSJh6eRxZq2

Other ideas

- Backup playlists from Youtube / Spotify
- Sync music to phone / iPod
- ...

Recommended reading

- Reverse engineering how TikTok algorithm works, Veed.io, 2020
- How Spotify's Algorithm Knows Exactly What You Want to Listen To, Dave Gershgorn, 2019
- Recommending music on Spotify with deep learning, Sander Dieleman, 2014
- Brainstorming a better YouTube recommendation algorithm, Francis Irving, 2018
- The history of Amazon's recommendation algorithm, amazon.science, 2019