

# AI × MUSIC

Matinée Talk  
Music Information Retrieval:  
Inside and Outside the Music



# SPEAKERS

**Christine  
Bauer**



**Peter  
Knees**



# MUSIC INFORMATION RETRIEVAL

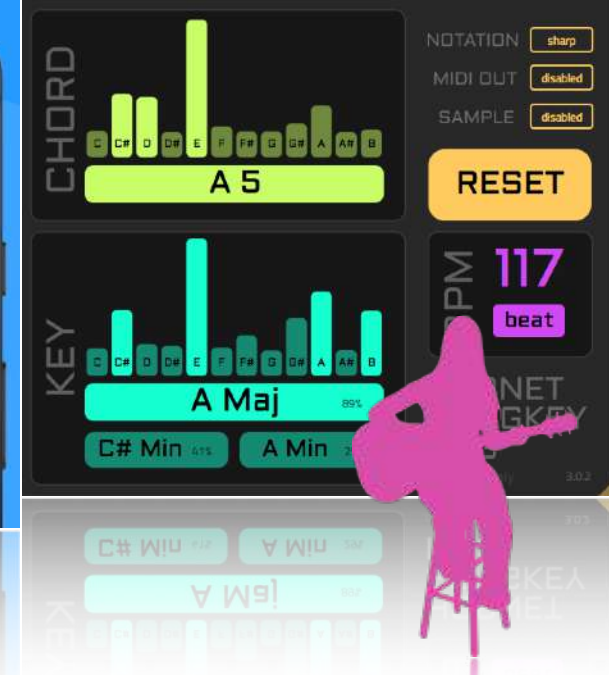
- ▶ *“A multidisciplinary research endeavor that strives to develop innovative **content-based searching schemes**, novel **interfaces**, and evolving **networked delivery mechanisms** in an effort to make the world’s vast store of music accessible to all.” [Downie, 2004]*
- ▶ Retrieving information from and about music



Recommendations for  
listeners



Song identification



Chord and key  
identification

Applications driven by Music Information Retrieval

# HOW TO MAKE MUSIC RECOMMENDATIONS?

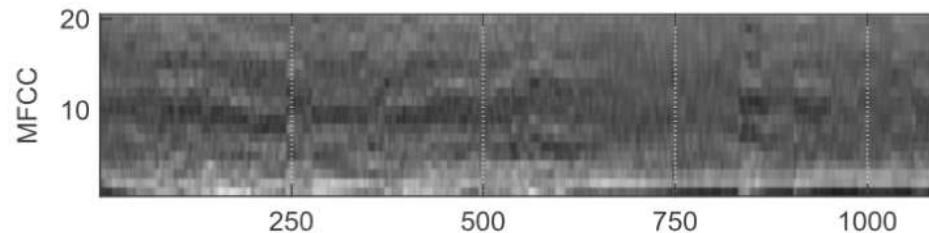
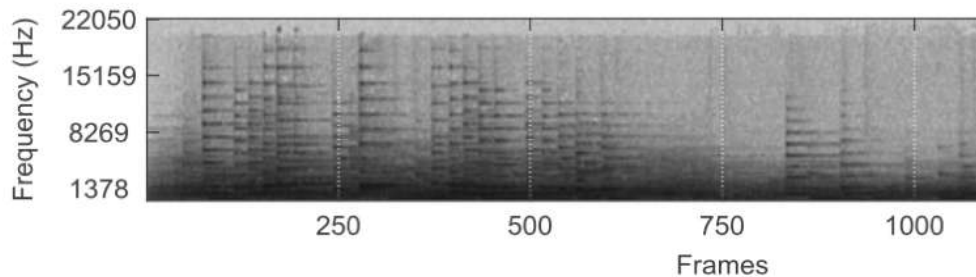
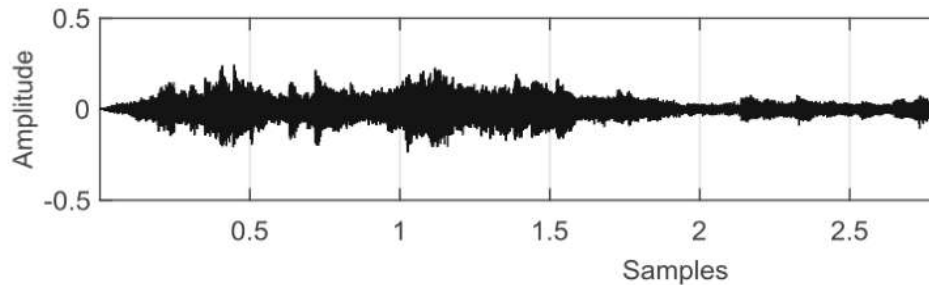
- ▶ Goal: predict what people will like, based on what they have liked
- ▶ There is a multitude of data and data sources to do that



# WHICH DATA DESCRIBES MUSIC?

## Content

- ▶ Human labelling
- ▶ Machine listening, content analysis

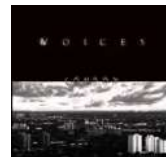


# AUDIO CONTENT ANALYSIS: SELECTED FEATURES



Disturbed  
The Sound of Silence

- ▶ Timbre  
e.g. for genre classification,  
"more-like-this" recommendations
- ▶ Beat/downbeat → Tempo: 85 bpm
- ▶ Tonal features  
e.g. for melody extraction, cover version identification



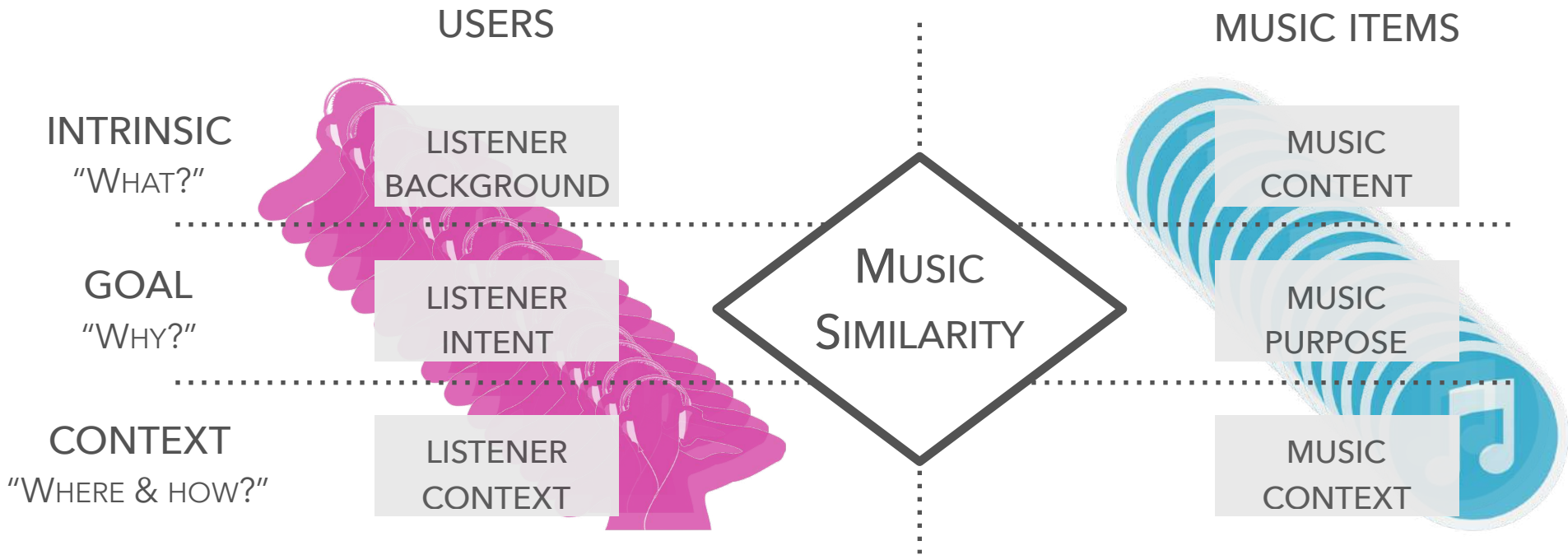
## Different versions of this song:

Simon & Garfunkel - The Sound of Silence  
Anni-Frid Lyngstad (ABBA) - En ton av tystnad  
etc.

- ▶ Semantic categories via machine learning  
not\_danceable, gender\_male, mood\_not\_happy, ...

**Result: computable similarity; Issue: not how people "use" music**

# CONTENT IS JUST ONE ASPECT





# WHICH DATA DESCRIBES MUSIC? – BEYOND THE AUDIO

## Interaction data

- ▶ Listening logs
- ▶ Feedback (“thumbs”), purchases

## Editorial and curatorial meta-data

- ▶ e.g., genre, artist, release year

## User-generated data

- ▶ e.g., tags, reviews, stories, social media

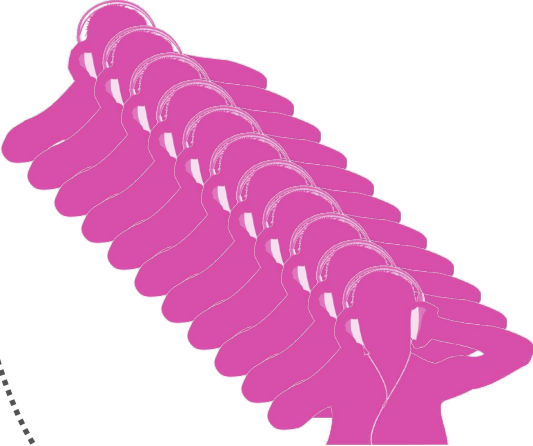
## Curated collections

- ▶ Playlists, radio channels
- ▶ CD album compilations



# LEVERAGING USAGE DATA

USERS



MUSIC ITEMS



# COLLABORATIVE FILTERING

- ▶ Exploits interaction data (e.g., listening logs)
- ▶ No information about music content required
- ▶ Operates on the basis of **feedback** of a **user community**

# TYPES OF INPUT

## EXPLICIT FEEDBACK

- ▶ Feedback that users directly report on their interest in items
- ▶ e.g.,

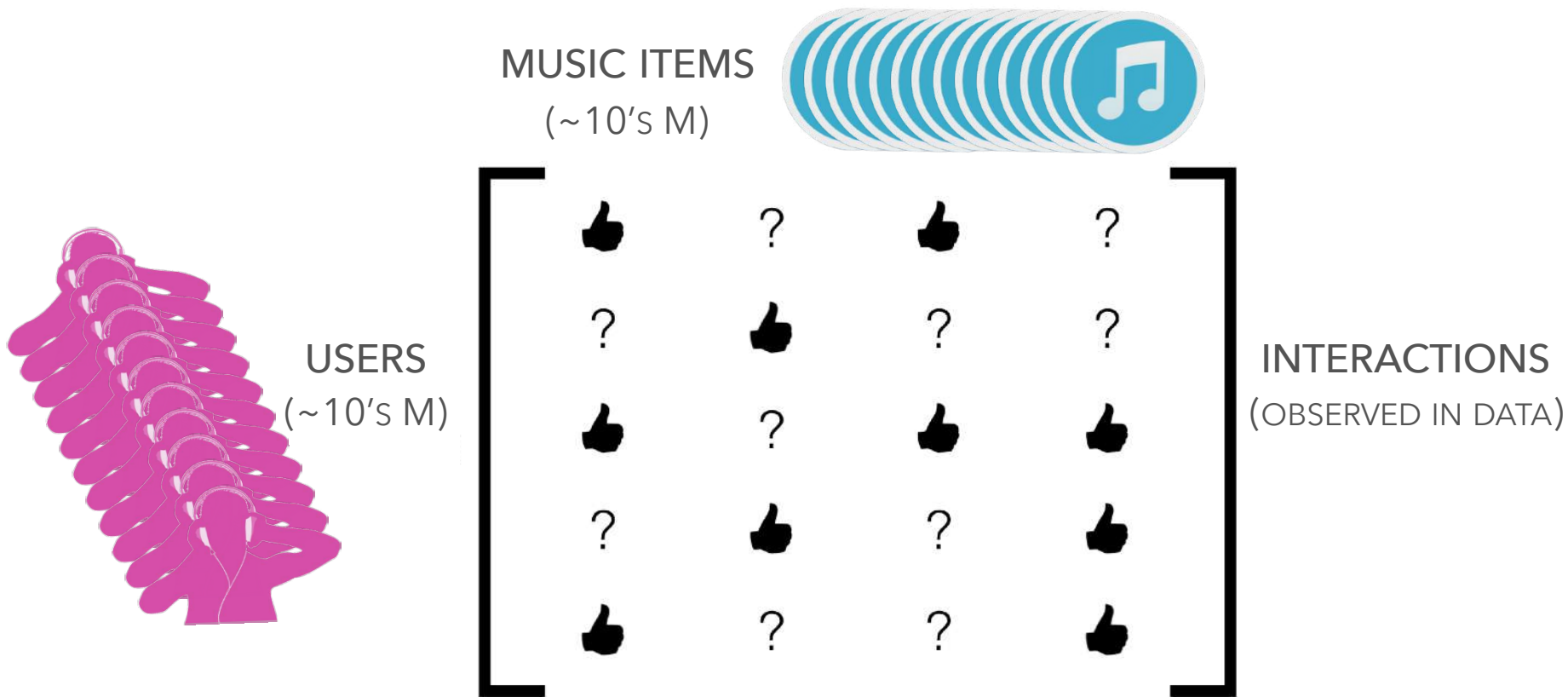


## IMPLICIT FEEDBACK

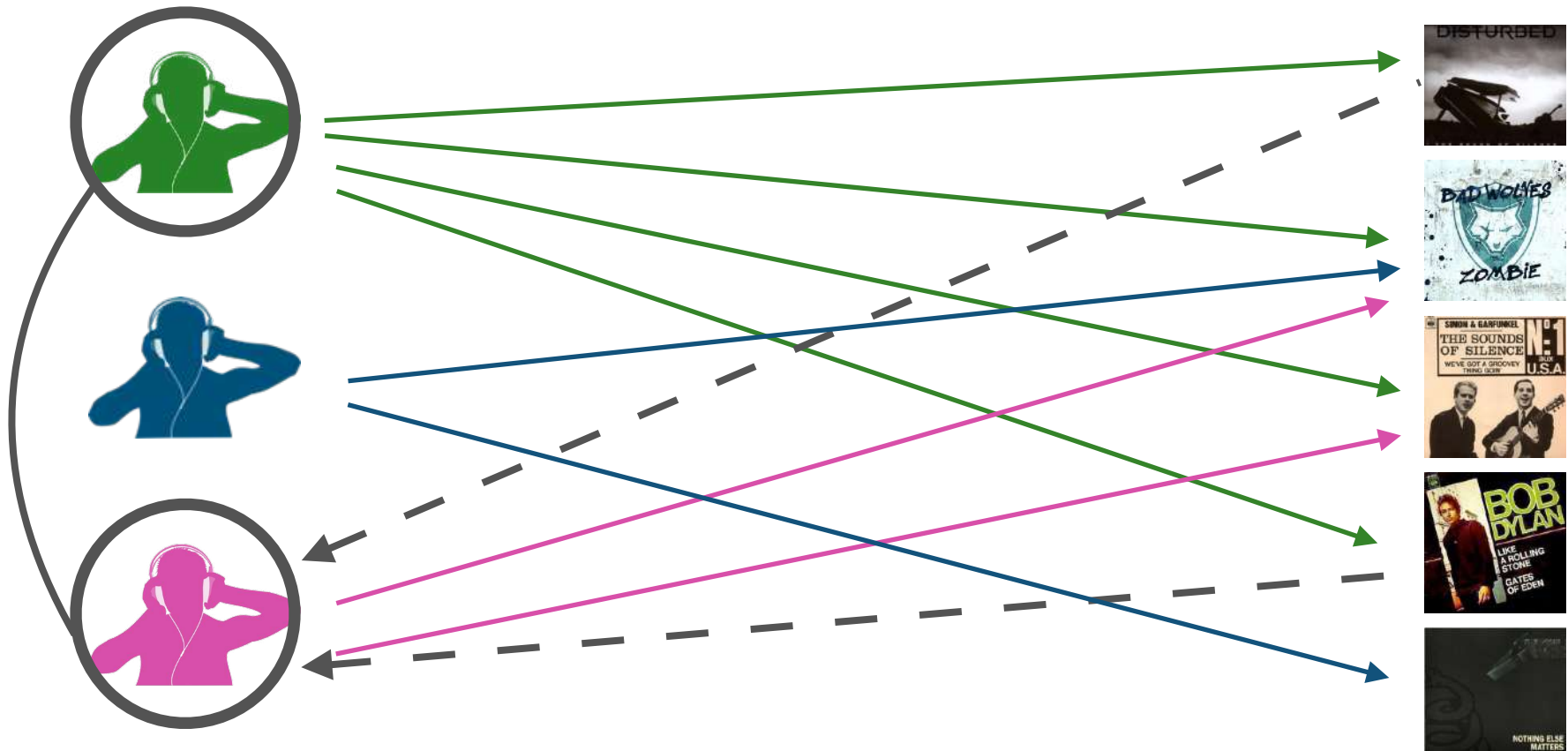
- ▶ Behavior that indirectly reflects opinion
- ▶ e.g.,



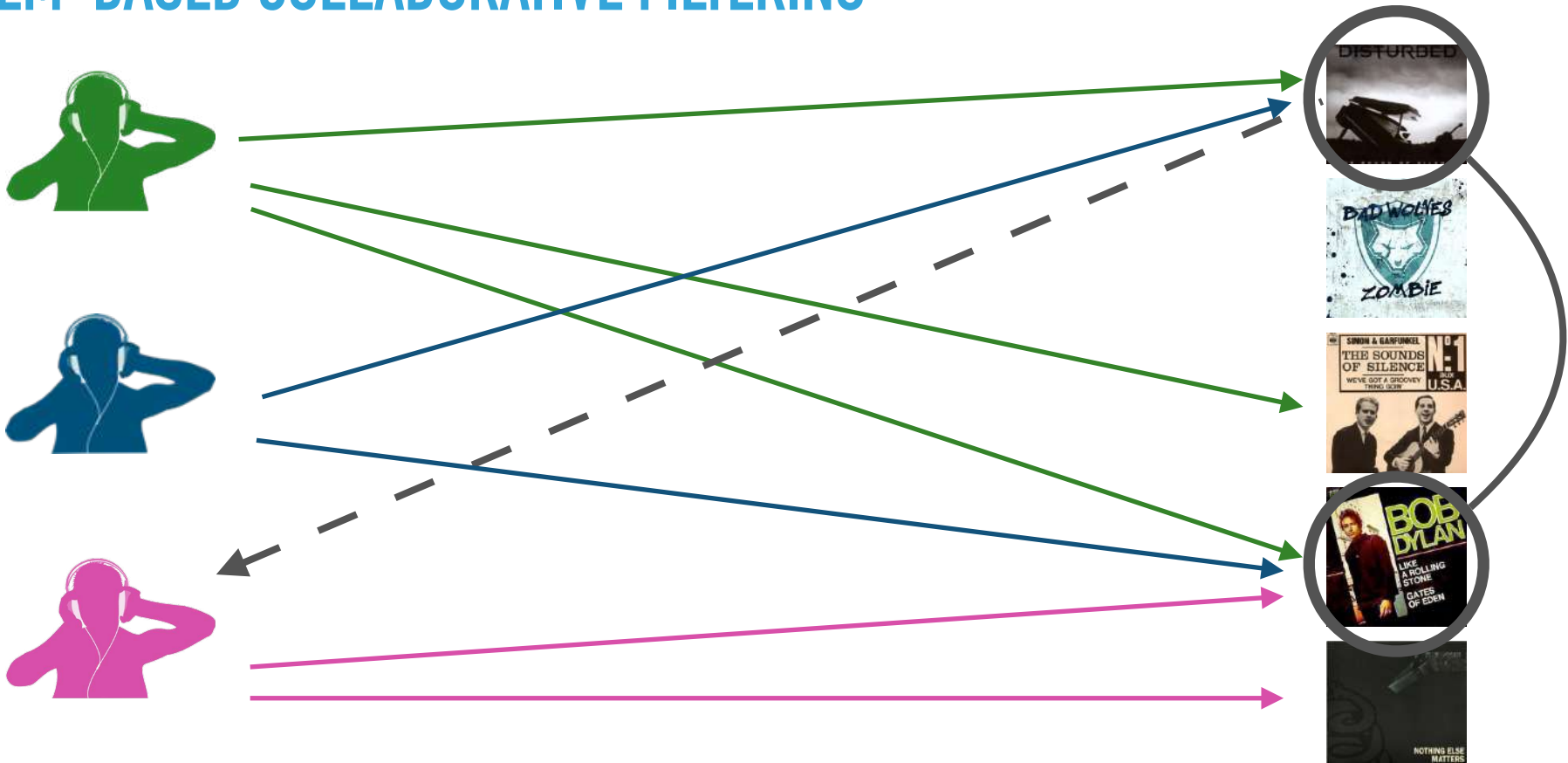
# THE GOAL: PREDICTING THE RATINGS OF CURRENT QUESTION MARKS



# USER-BASED COLLABORATIVE FILTERING

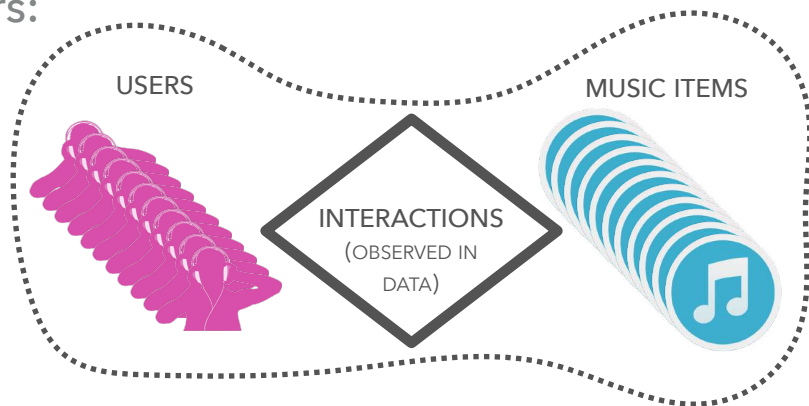


# ITEM-BASED COLLABORATIVE FILTERING



# DELVING DEEPER: FACTORS HIDDEN IN THE DATA

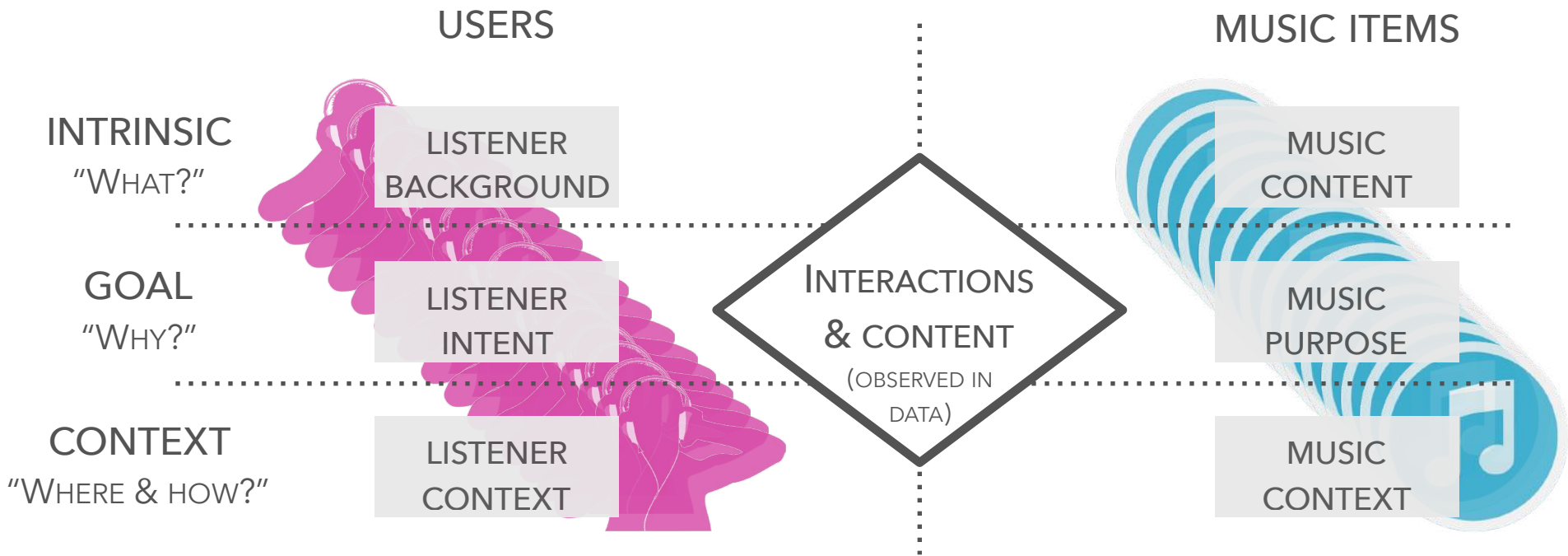
- ▶ Observed data is the interaction of two factors:  
**users** and **items**



- ▶ Consider users and items on a more fine-grained level
  - ▶ Item descriptors: e.g., genre, style, tempo, danceability, emotions
  - ▶ User descriptors: e.g., gender, age, country, level of activity on platform



# BUT IT'S A BIT MORE COMPLEX...



# SOURCES OF DATA ABOUT USERS BEYOND PLATFORM INTERACTION

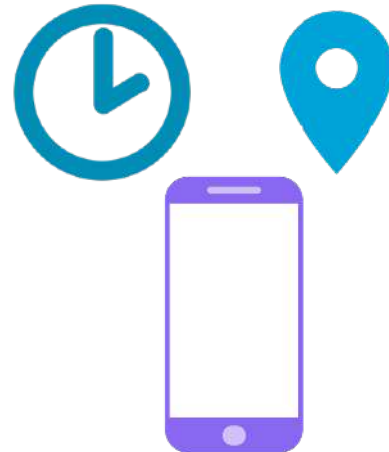
## User-generated data

- ▶ Social media: music-related or general
- ▶ e.g., music preferences, personality, social and cultural context



## General data services

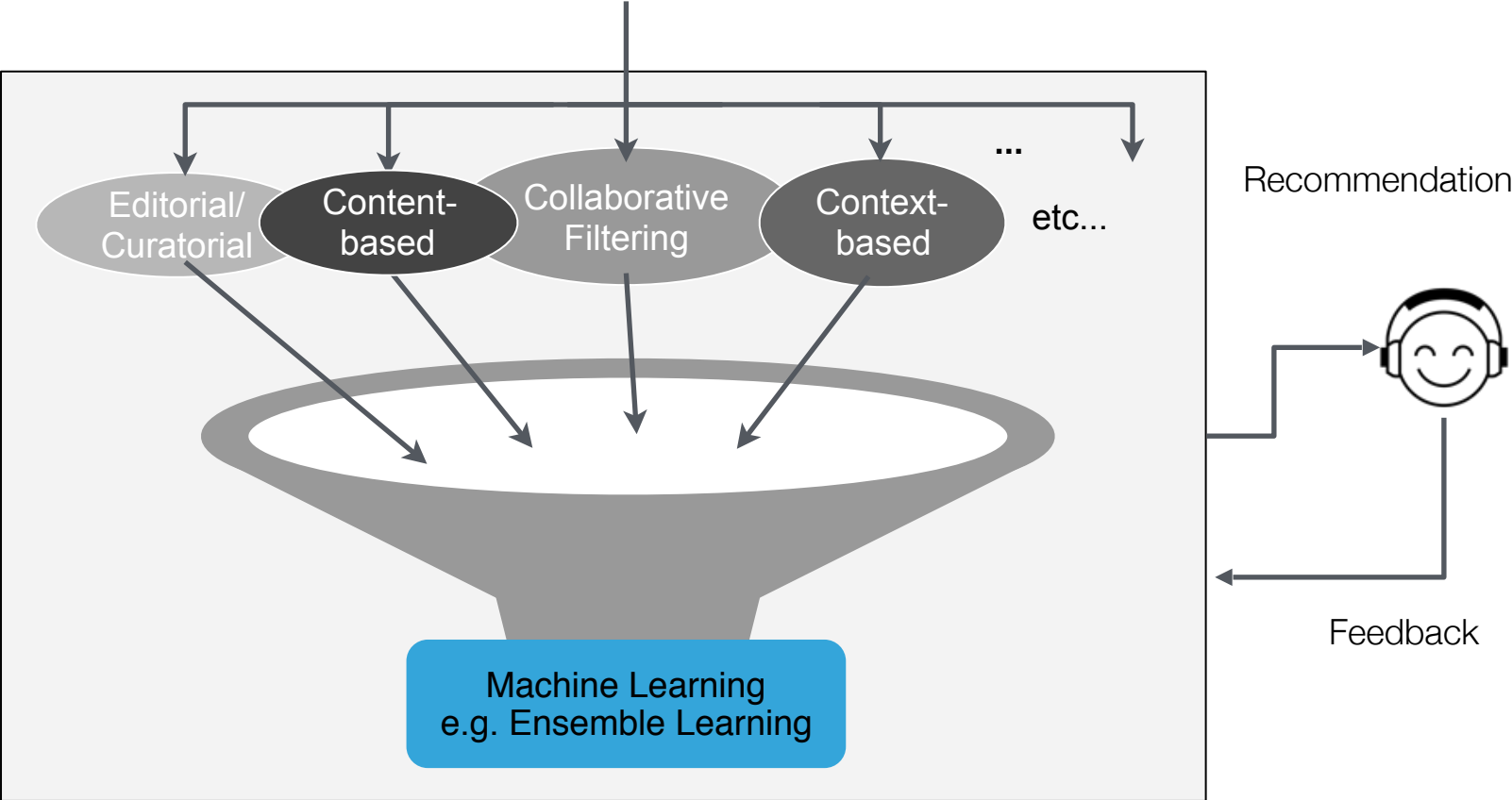
- ▶ e.g., for time, location, noise, weather



## Sensors in smart devices

- ▶ e.g., heart rate, accelerometer, noise level, location




# HOW TO COMBINE ALL THIS INFORMATION?



# CONTACT DETAILS

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