

:: Workshop ::

“Music 2.0: Music and the (Semantic) Web (2.0)”

**Music recommendation and discovery... in
which Web?**

Oscar Celma (Music Technology Group, UPF)


AES 122 Vienna. Austria Center Vienna, May, 6th. 2007

outline




- introduction
 - ❖ motivation
 - ❖ music recommendation
 - ❖ music discovery
 - ❖ the (musical) semantic gap
- web 2.0
 - ❖ music context
 - ❖ music recommendation and discovery
 - ❖ the (musical) semantic gap
- semantic web
 - ❖ music context
 - ❖ music recommendation and discovery
 - ❖ the (musical) semantic gap

introduction: motivation

- 
- in recent years the typical music consumption behavior has changed dramatically
 - personal music collections have grown thanks to improvements in:
 - ❖ networks, storage, portability of devices, Internet services and peer-to-peer networks

introduction:: motivation

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- ⇒ the way users **search**, **find**, and **discover** new music has changed too!

introduction: motivation


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 - personal music collections have grown thanks to improvements in:
 - ❖ networks, storage, portability of devices, Internet services and peer-to-peer networks
- ⇒ the way users **search**, **find**, and **discover** new music has changed too!
- ⇒ but...the recommendation algorithms are *still* the same, and there's a *lack* of tools for music discovery

introduction:: **music recommendation**



- **personalized choice assistance** playlist
user profile interests filtering **large music collections**
semantic audio analysis **social media** user preferences **mates**

introduction:: **music recommendation**

- 
- personalized **choice assistance** playlist
user profile interests filtering **large music collections**
semantic audio analysis **social media** user preferences mates
- ⇒ it is *impossible* to be up-to-date of the potentially interesting new music

introduction:: music recommendation

- personalized choice assistance playlist
user profile interests filtering large music collections
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⇒ it is *impossible* to be up-to-date of the potentially interesting new music

⇒ moreover, deal with the loooong tail effect...



introduction:: **music discovery**



- anonymous **laid-back** podcasting **browsing** hype-machine
serendipity sunday evening **social media** mp3-blogs

introduction:: **music discovery**



- anonymous **laid-back** podcasting **browsing** hype-machine
serendipity sunday evening **social media** mp3-blogs

- (vs. music recommendation):

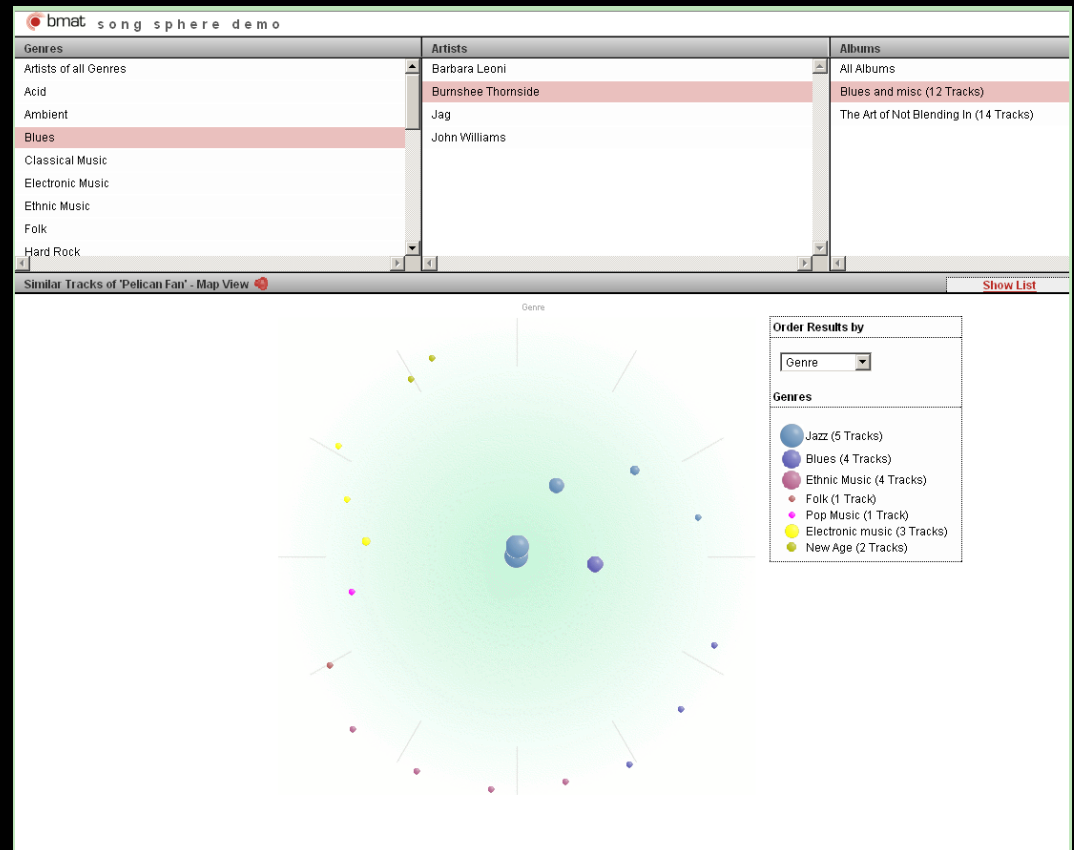
personalized **choice assistance** playlist

user profile interests filtering **large music collections**

semantic audio analysis **social media** user preferences **mates**

introduction:: music discovery:: long tail

- explore the **long tail**, by means of (content-based) audio similarity




music recommendation and discovery...in which web? :: òscar celma. aes 122 vienna workshop

introduction:: **music discovery:: long tail**



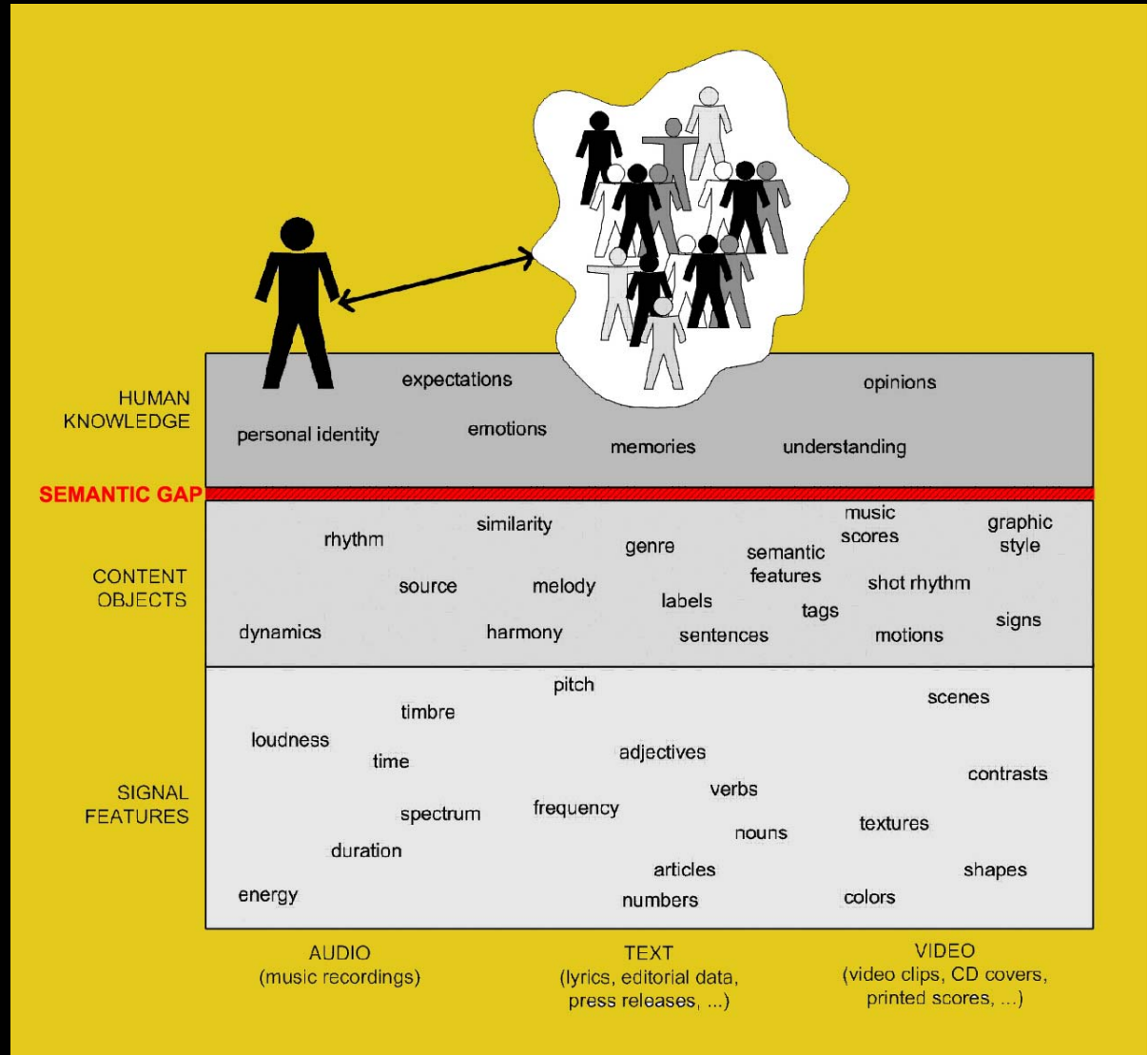
- now, let's see a video...

introduction:: music discovery:: long tail

- 
- **Bruce Springsteen**
 - ❖ # total songs played in last.fm = 4,172,964
 - ❖ # plays for "Better days" (seed song) = 26,865
 - **The Rolling Stones**
 - ❖ # total songs played in last.fm = 8,653,621
 - ❖ # plays for "Mixed emotions" (similar song) = ~1,000
 - **Mike Shupp**
 - ❖ # total songs played in last.fm = 312
 - ❖ # plays for "Letter to Annete" (similar song) = 0?

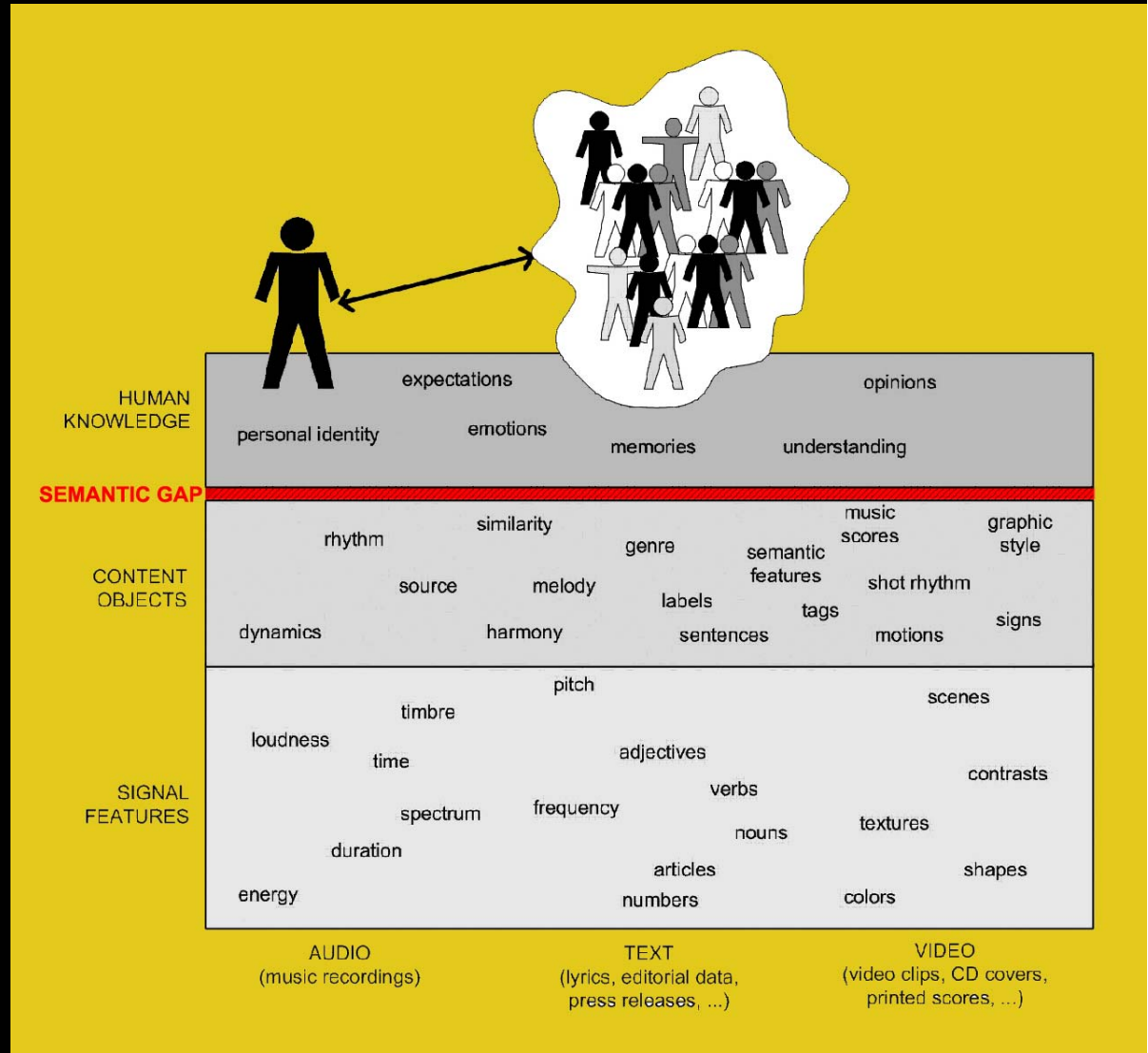
(BTW, applying CF we would never reach him!)

introduction:: the (musical) semantic gap



introduction:: the (musical) semantic gap

- bottom-up approach
 - ❖ signal/audio processing
 - ❖ machine learning
 - ⇒ no context at all
- top-down approach
 - ❖ free
 - users' annotations
 - folksonomies/personomies
 - ❖ controlled
 - ontologies
 - taxonomies



introduction:: the (musical) semantic gap

- bottom-up approach
 - ❖ extracting mid-level features from the audio[, text, and images]
 - ❖ but...are these descriptors close enough to the user?

Computational models of human music perception

Content

Energetic, happy

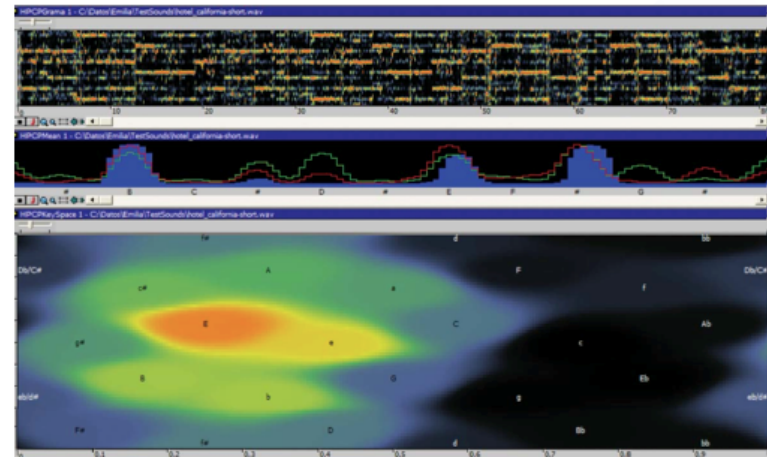
130 bpm, binary rhythm,
C major, strong beat, guitar

Abstraction

Signal



Disciplines involved: signal processing, musicology, psychoacoustics, artificial intelligence and information retrieval.



introduction:: the (musical) semantic gap



- top-down approach
 - ❖ users' annotations (tagging)
 - last.fm
 - new audio games (similar to ESP for labeling images)
 - ❖ majorminer.com
 - ❖ listengame.com
 - ❖ ontology-based
 - defining concepts of your domain

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 - ❖ **music context**
 - ❖ **music recommendation and discovery**
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- semantic web
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 - ❖ music recommendation and discovery
 - ❖ the (musical) semantic gap

web 2.0:: introduction

- folksonomies JSON **social networks** personomies tag cloud
web syndication del.icio.us RSS JavaScript Atom AJAX flickr google maps
eventful mashup **wiki** last.fm blogging XML OpenAPI communities CSS

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web 2.0:: music context



- tagging music collections
 - ❖ folksonomies / personomies
 - tag clouds
 - ⇒ ease navigation of large music collections
- geographic information
 - ❖ my digital collection in a map
 - ❖ tracing routes (playlist generation)
- mashups
 - ❖ based on content syndication from music related sites
- collaborative efforts for editorial data (vs. AMG editors)
 - ❖ musicbrainz.org
 - ❖ musicmoz.org

web 2.0:: music context:: tagging

- tagging music collections
 - ❖ folksonomies / personomies
 - tag clouds

web 2.0:: music context:: tagging

- tagging music collections
 - ❖ folksonomies / personomies
 - tag clouds
 - ⇒ based on the “wisdom of crowds”
but...what if the crowd becomes a herd? (i.e not that *wise*?)

web 2.0:: music context:: tagging

Overview | **Pics** | Bio | Events | Albums | Listeners | Similar | Charts | Tags | Journals

THE DEAR HUNTER
act II The Meaning of & All Things Regarding Ms. Leading
Available May 22nd 2007

The Dogs D'Amour [\(read more\)](#)

38,960 plays scrobbled on Last.fm

The Dogs D'Amour are a [sleaze rock](#) band founded in 1983. The Dogs D'Amour went through various instrumentation changes over the years which has resulted in their sound shifting over time. Front man Tyla still leads the band as "Tyla & the Dogs D'Amour." Their original style was a... [\(read more\)](#)

[edit this artist description](#)

Listen Now [\(change settings\)](#)

Play this artist in the Last.fm software

Track	Time	Listeners
Heroine	0:30	275
How Come It Never Rains	0:30	197
Last Bandit	0:30	162
Drunk Like Me	0:30	172

The Dogs D'Amour's Radio [\(show all stations\)](#)

Play The Dogs D'Amour's **Similar Artists** [Play in pop up](#)

Play The Dogs D'Amour's **Top Listeners** [Play in pop up](#)

Top Albums [\(see all\)](#)

User Tags [\(see more\)](#)

emo female vocalists hair metal hard rock metal punk rock rap **rock**

[tag this artist](#)

Weekly Top Listeners [\(see more\)](#)

1,933 listeners total

- [Zerimski](#)
- [KayeKayeKaye](#)
- [JasonsMusic](#)
- [PeteStar](#)
- [jewofunk](#)
- [PunkRockCunt](#)

Related Journals [\(read more\)](#)

- [Mainstream?](#) by [happydufus](#), 2 comments
- [Similar Artists](#) by [jewofunk](#), 1 comment
- [Animals!](#) by [raison_detre](#), 44 comments
- [Tyla does Area 81](#) by [DiamondDave](#)

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~~pop~~ ~~fema vocalists~~ ~~rock~~ ~~metal~~ ~~punk rock~~ **hair metal** **hard rock** **metal** **punk rock** **rock**

[tag this artist](#)

Weekly Top Listeners [\(see more\)](#)

1,933 listeners total

- [Zerimski](#)
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- [PeteStar](#)
- [jewofunk](#) Male, 19, United States
- [PunkRockCunt](#)

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web 2.0:: music context:: tagging

- tagging music collections
 - ❖ automatically extracted from the ID3 metadata

SearchSounds
The first content-based audio search engine

Keyword Search Genres Artists About Contact

Search

Genres

Alternative, A capella, Acid, Acid Jazz, Acid Punk, Acoustic, AlternRock, Ambient, Avantgarde, Ballad, Bass, Bebop, Big Band, Bluegrass, Booty Bass, Cabaret, Celtic, Chamber Music, Chanson, Chorus, Christian Rap, Classic Rock, Classical, Club, Comedy, Country, Cult, Dance, Dance Hall, Darkwave, Death Metal, Disco, Dream, Drum Solo, Duet, Easy Listening, Electronic, Ethnic, Euro-House, Euro-Techno, Eurodance, Fast Fusion, Folk, Folk-Rock, Folklore, Funk, Fusion, Game, Gangsta, Gospel, Gothic, Gothic Rock, Grunge, Hard Rock, Hip-Hop, House, Humour, Industrial, Instrumental, Instrumental Pop, Instrumental Rock, Jazz, Jazz+Funk, Jungle, Latin, Lo-Fi, Meditative, Metal, Musical, National Folk, New Age, New Wave, Noise, Oldies, Opera, Polka, Pop, Pop-Folk, Pop/Funk, Porn Groove, Power Ballad, Pranks, Primus, Progressive Rock, Psychedelic, Psychedelic Rock, Punk, Punk Rock, R&B, Rap, Rave, Reggae, Retro, Revival, Rhythmic Soul, Rock, Rock & Roll, Samba, Satire, Showtunes, Ska, Slow Jam, Slow Rock, Soul, Sound Clip, Soundtrack, Southern Rock, Space, Space Filler, Speech, Swing, Symphonic Rock, Symphony, Tango, Techno, Techno-Industrial, Top 40, Trance, Tribal, Trip-Hop, Vocal,

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web 2.0:: music context:: tagging

- tagging music collections

- ❖ folksonomies / personomies

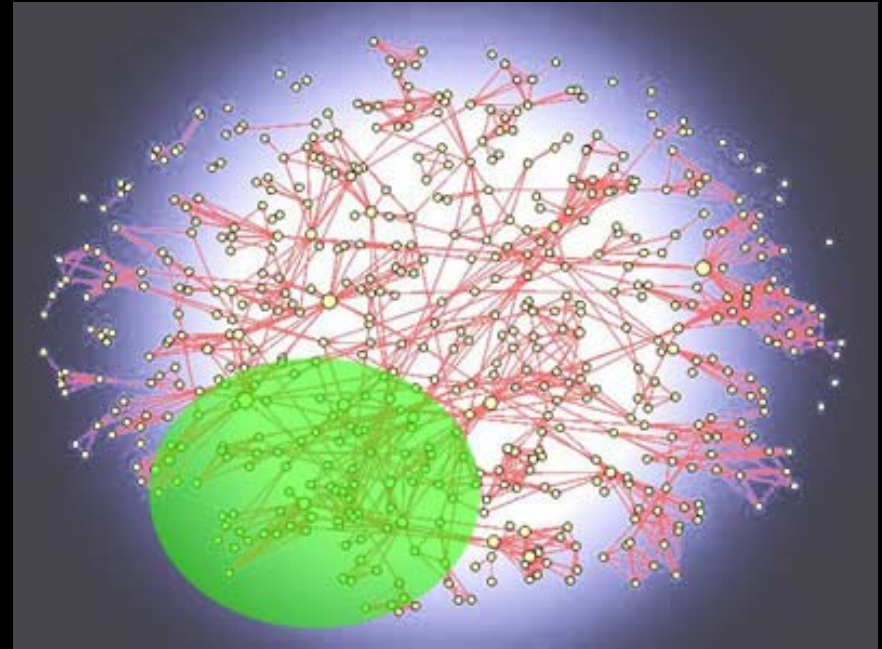
- tag clouds

⇒ based on the “wisdom of crowds”

but...what if the *crowd* is only a few thousands users?

web 2.0:: music context:: tagging

- “wisdom of crowds”
 - ❖ but...what if the *crowd* is only a few thousands users? (scalability problems!)
 - ⇒ only partially annotated DB!




web 2.0:: music context:: tagging

- “wisdom of crowds”
 - ❖ but...what if the *crowd* is only a few thousands users? (scalability problems!)
 - ⇒ propagate tags based on audio similarity

(this idea applies too for Pandora’s Music Genome Project effort)



web 2.0:: music context:: tagging

- 
- from tagging to words and sentences (example taken from **Pandora**):
 - ❖ The Stranglers "Golden brown"
 - "This is folky, soft rock song that is calming and tender. It features horn section, acoustic guitar, organ, a nice acoustic guitar solo, and emotional, falsetto vocals. It is a song with an acoustic texture and with low energy that you might like listen to while going to sleep."

web 2.0:: music context:: tagging

- WAIT!!! but...this is **NOT** from Pandora!
- it is automatically generated based on audio analysis and semantically meaningful words!!!
 - ❖ The Stranglers "Golden brown"
 - "This is **folky**, **soft rock** song that is **calming** and **tender**. It features **horn** section, **acoustic guitar**, **organ**, a nice acoustic **guitar solo**, and **emotional**, **falsetto** vocals. It is a song with an **acoustic texture** and with **low energy** that you might like listen to while going to sleep."
 - ❖ (from the guys at **Computer Audition Laboratory**, **San Diego**. <http://cosmal.ucsd.edu/cal>)

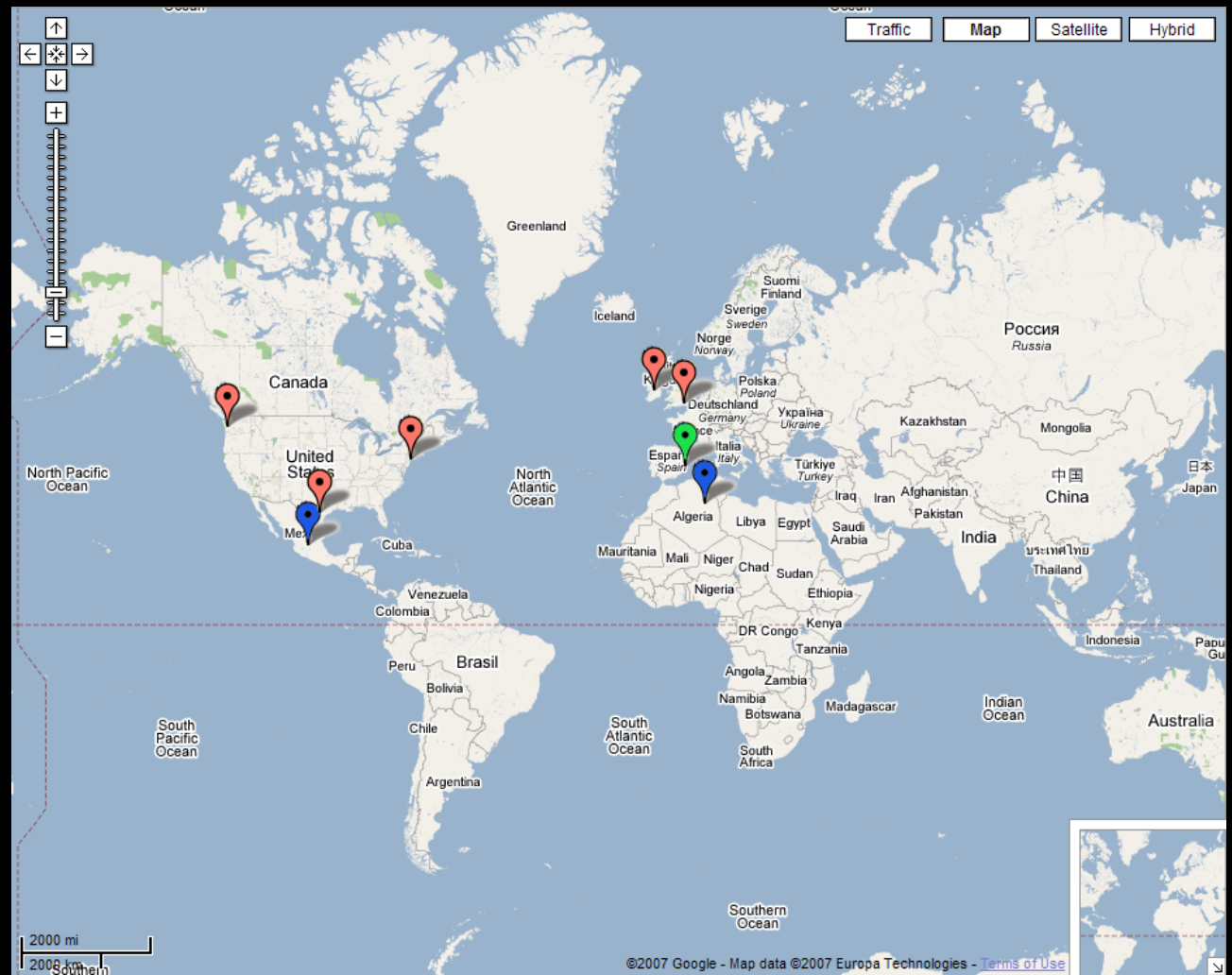
web 2.0:: music context:: maps



- geographic information
 - ❖ my iTunes music collection in a world map
 - ❖ trace routes (playlist generation)

web 2.0:: music context:: maps

- (part of) my iTunes music collection in a map
 - ❖ colours are genres
 - ❖ size could be based on listening habits



web 2.0:: music context:: maps

- tracing routes for playlist generation



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web 2.0:: music recommendation

- what is more important in (web2.0) music recommendation?
 - ❖ the artists' recommendations, playlists, etc.?
 - ❖ ...or, being part of a community, the social network interaction, *meet* people, etc.?

The screenshot displays the Last.fm website interface, specifically the 'My Recommendation Dashboard' for a user logged in as 'ocelma'. The dashboard is organized into several sections:

- Shortcuts:** Links to 'My profile page', 'Start Last.fm radio', and 'My settings'.
- New To My Profile:** A list of recently scrobbled tracks, including 'Scarlet Fever' by Kix, 'Most Recent Shout' (no recent shout to display), and 'Recently Loved' tracks like 'Girl Behind The Glass' by The Dogs D'Amour, 'Hotel Illinois' by The Black Crowes, and 'Highlights (Live)' by Backyard Babies.
- Latest Recommendation:** A section explaining that recommendations appear when a user clicks the 'thumbs up' button.
- Last.fm Announcement:** A notice that 'Last.fm is Hiring' and a call for 'we're looking for a few good people' in London.
- My Friends Online:** A section indicating 'No Active Scrobblers' and suggesting to 'Invite some friends to Last.fm'.
- Recent Event Updates:** A section for 'Last.fm Friend Event Recommendations' with no events to display.
- Recommended Artists (see all):** A list of artists including Aphex Twin, Autechre, Fridge, Department of Eagles, Four Tet, Mogwai, Prefuse 73, M83, Amon Tobin, and Plaid.
- Full-length Tracks:** A section with a music player interface and a list of tracks for listening, such as 'The Clash - Rock the Casbah (Rufus White's We Love The Bass Drum Mix)', 'The Kinks - deep space transmission', 'The White Stripes - Blue Orchid', 'Björk - Pabbi Minn', 'Autechre - Arch Carrier (AtoIyH Remix)', and 'Plaid - Plaid Rmx'. Each track has a 'FREE .mp3' download link.
- My Weekly Neighbours Online:** A section indicating 'No Active Scrobblers' and suggesting that 'Your weekly neighbours aren't playing any music right now'.

web 2.0:: music recommendation::issues



- context awareness
 - ❖ *different* profiles of a user
 - work
 - home (I use to play some tunes for my child!)
 - ❖ location
 - ❖ mood
 - ❖ time (morning, evening, late night, etc.)
 - ❖ ...
- a *complete* user profile? (exploit web 2.0!)
 - ❖ (*i.e not only tracking listening habits, explicit rating, demographic information, etc., but...*)
 - ❖ user's accounts (del.icio.us, flickr, youtube, blogger, livejournal, etc.)
 - ❖ user's blog entries
 - ❖ ...

web 2.0:: music discovery




- exploiting information from mp3-blogs
 - ❖ hypem.com (hype machine)
 - ❖ searchsounds.net
- mashups
 - ❖ www.musicportl.com
 - artist related info (wikipedia, flickr, youtube, amazon, iTunes, etc.)
 - ❖ www.sleevenotez.com
 - last.fm + artist related info (wikipedia, flickr, youtube, amazon, iTunes, etc.)
 - ❖ lasttv.net
 - last.fm + youtube
 - ❖ www.snappradio.com
 - last.fm (or radioparadise.com) + flickr
 - ❖ ...and lots more! (don't forget to try Yahoo! Pipes...)

web 2.0:: music discovery:: mp3-blogs

- exploiting information from mp3-blogs
 - ❖ hypem.com (hype machine)
 - ❖ searchsounds.net

web 2.0:: music discovery:: mp3-blogs








THE HYPE MACHINE

ABOUT RADIO POPULAR NOW PLAYING BLOG LIST CONTACT

Find music you never knew you liked


Listen to music blogs

 **Pop-up Flash Player**




Explore blogs

Popular Blogs our guests visit	Active Recently updated blogs	Top Referrers Blogs that send us guests
The Music Slut >>	cacophonous.org >>	i guess i'm float... >>
Shameless Complacenc... >>	No Rock&Roll Fun >>	Culture Bully >>
Mars Needs Guitars >>	Black Sweater, White ... >>	@ indiechristoph @ >>
Idolator >>	Metro Distortion >>	*Sixeyes >>
HSB: HateSomethingBea... >>	undomondo >>	Between thought and e... >>
@ indiechristoph @ >>	Mainstream isn't so b... >>	An Aquarium Drunkard >>
VIEW MORE >>		


May 5, 2007 **Viewing Tracks**  **Posts** SHOW TOP 50 BLOGS

8AM	Celeste Hutchins - lizardpoints listen posted by cacophonous.org in "Celeste Hutchins: lizardpoin..." read>	What's going on here? <p>The Hype Machine is music that people are talking about.</p> <p>Listen, discover and buy songs that are being blogged by passionate music fans all over the world. Learn more</p> <p>Get RSS feeds XML</p> <p>Get this page using your favorite RSS/podcast application or web aggregator! Learn more</p> <p>IMPORTANT</p> <p>Song listings that appear on this website are automatically gathered from music blogs all over the internet.</p> <p>We do this to let people discover new artists, fall in love, buy their CDs and go to their shows.</p> <p>If you are an artist (or represent an artist) and are concerned about information in our listings, you can find more information here and are welcome to contact us directly.</p>
8AM	Celeste Hutchins - lizardpoints listen posted by cacophonous.org in "Celeste Hutchins: lizardpoin..." read>	
7AM	Quallofill - Her Private Playground listen posted by Black Sweater, White Cat: One-a-Day in "BSWC One-a-Day: Quallofill ~..." read>	
6AM	Kocani Orkestar - Ismail oro listen amazon itunes posted by undomondo in "Ederlezi / Hidrellez" read>	
6AM	Fanfare Savale - Iahabibi listen amazon posted by undomondo in "Ederlezi / Hidrellez" read>	
6AM	Goran Bregovic - Ederlezi (Scena Durdevdana Na Rijeci) listen amazon itunes posted by undomondo in "Ederlezi / Hidrellez" read>	
6AM	Denison Witmer - East From West listen amazon itunes posted by Mainstream isn't so bad...is it? in "See Great Northern in Boston" read>	

web 2.0:: music discovery:: mp3-blogs

- 
- searchsounds
 - ❖ exploits MP3-blogs
 - analyse text (keyword based search)
 - analyse audio (navigate through the audio space similarity)

web 2.0:: music discovery:: mp3-blogs

- 
- now, let's see a video
 - ❖ keyword search "traditional Irish"
 - get relevant blog entries (plus its audio links)
 - ❖ navigate through the audio similarity space
 - get most similar audios

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web 2.0:: the (musical) semantic gap



- (informal) top-down approach
 - ❖ users set the *meaning* to the content, via tagging
 - ❖ “wisdom of crowds” idea
- but...metadata has *no formal* meaning
 - ❖ “Beatles” vs. “The Beatles” vs. “Beatles, The”
 - ❖ difficults the data **integration** of different sources (e.g musicbrainz, cdbaby, magnatune, jamendo, garageband, etc.)
 - ❖ ...is **semantic web** a possible solution?

outline



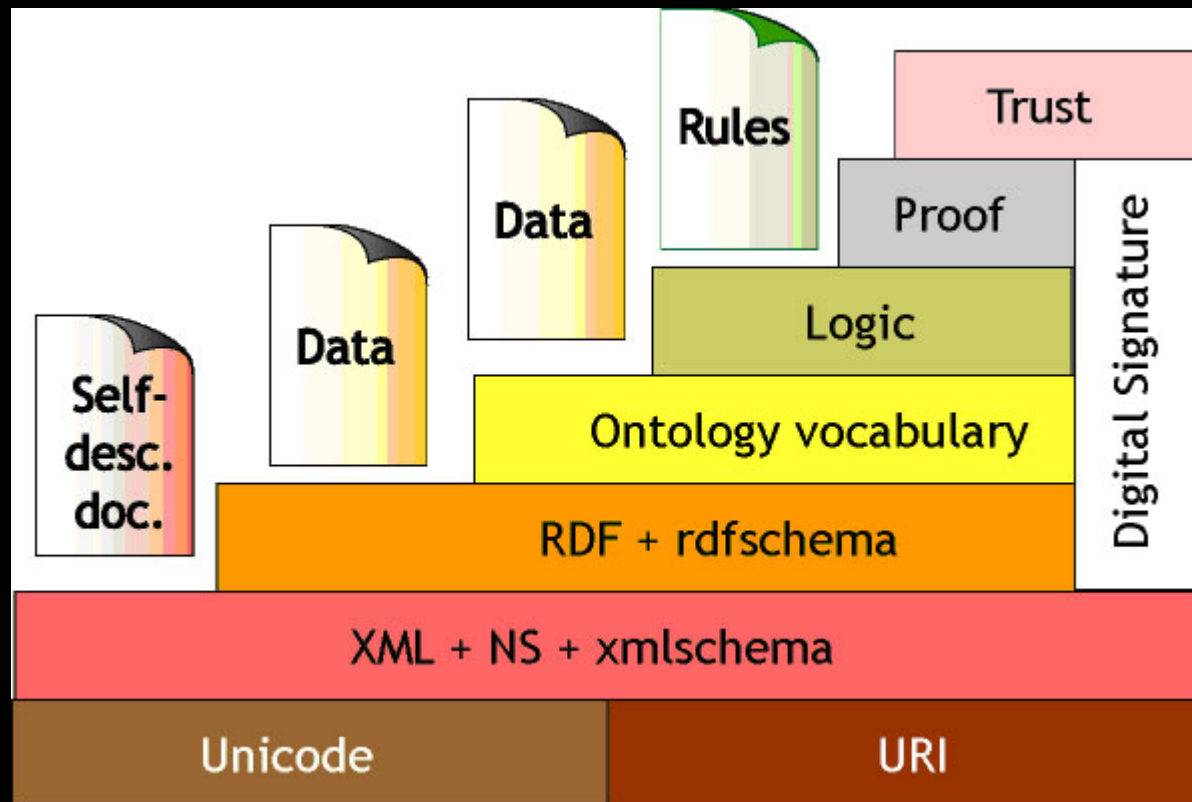
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semantic web:: introduction

- linked data rest **rdf** xml jena redland **sparql** rss1.0 ontologies
graph **subject-predicate-object** skos owl w3c timbl
foaf rdf/a music ontology grddl http303 content-negotiation

semantic web:: introduction

- the (in)famous stack



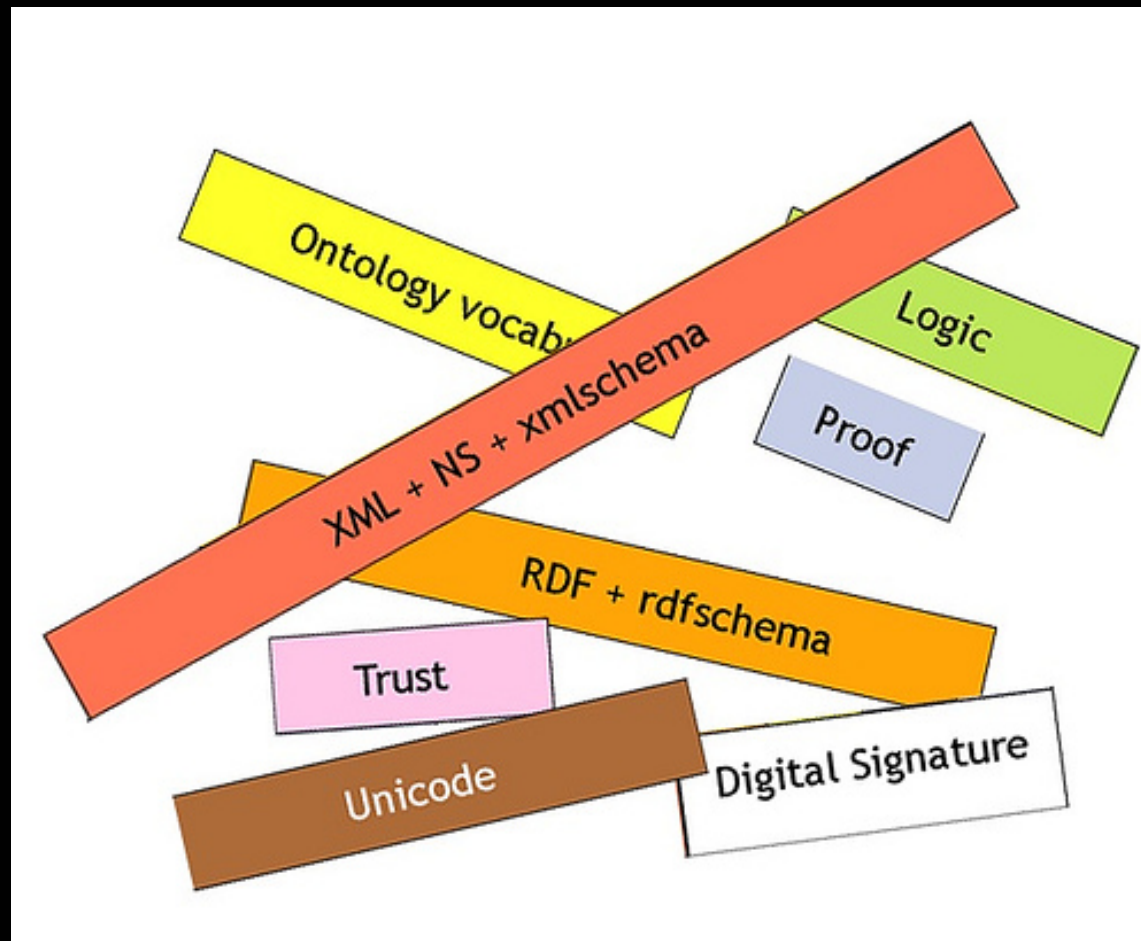
semantic web:: introduction

- some comments (about the upper layers of the stack)
 - ❖ Dave Beckett (<http://journal.dajobe.org>)
 - "The semantic web is: a webby way to link data. That is all."
 - ❖ Jim Hendler (<http://www.mindswap.org/blog/2006/12/13/the-dark-side-of-the-semantic-web/>)
 - "(...) in short, [a web of data] is the Semantic Web vision of Tim's, before Ora and I polluted it with all this ontology stuff"

semantic web:: introduction

- so...the actual reality is this?

from: danbri (<http://www.flickr.com/photos/danbri/428172848/>)



semantic web:: music recommendation

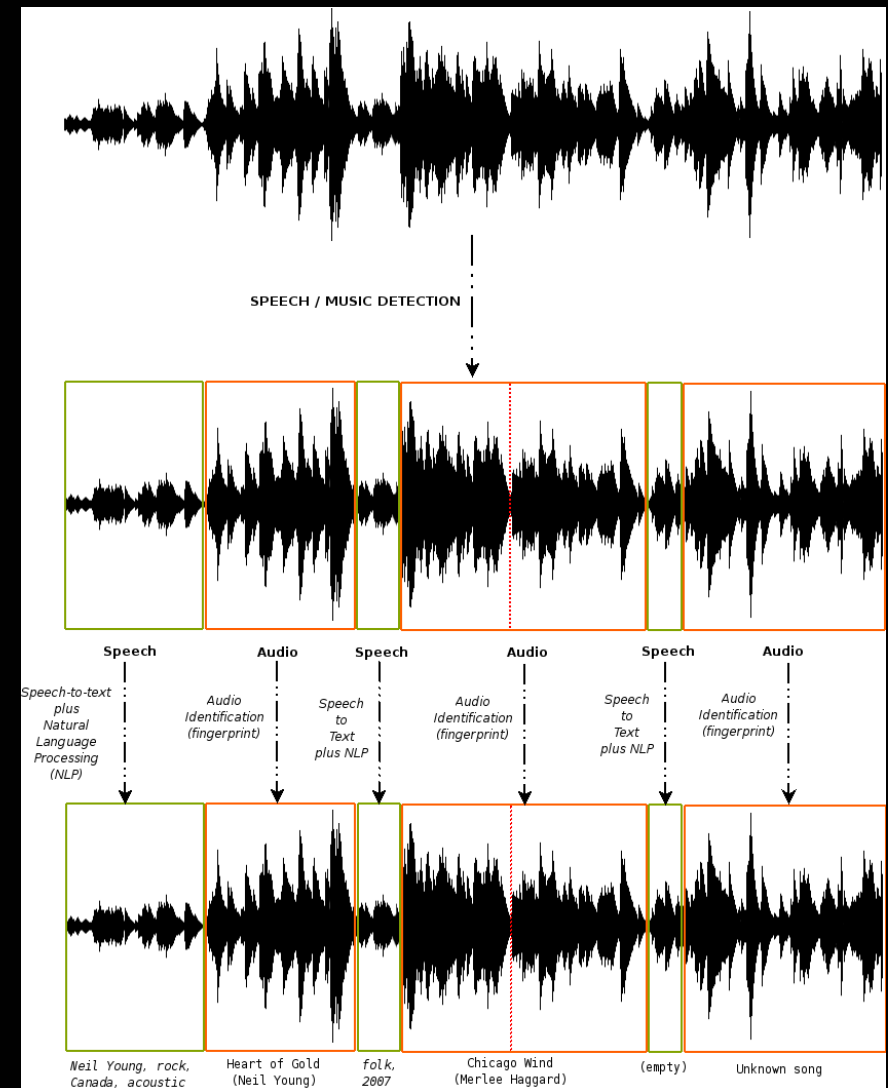
foafing the music: web 2.0 + semweb

- ❖ "Bridging the semantic gap in music recommendation" ☺
- music information from thousands of RSS feeds
 - ❖ new album releases, podcast sessions, audio from MP3 blogs, news about artists and upcoming concerts
- music recommendation and discovery by means of:
 - ❖ user profiling (derived from the user's FOAF profile)
 - ❖ context based information (extracted from music related RSS feeds and available APIs)
 - ❖ content based descriptions (extracted from the audio itself)
- consolidated using a simple ontology (OWL DL) that describes (part of) the music domain
(N.B: see Yves' talk about THE Music Ontology...)
- won the 2nd prize of the Semantic Web Challenge 2006

semantic web:: music discovery

semantic podcast

- discover music available *inside* podcasts (i.e a long mp3 file)
 - ❖ automatic speech/music discriminator
 - ❖ temporal description of the podcast contents
- based on the Music Ontology proposal



semantic web:: the (music) semantic gap

- top-down approach
 - ❖ domain ontologies (RDFS, OWL) / taxonomies (SKOS)
 - ❖ formalization of user profiles (FOAF)

final conclusions



- there is only one web!
- semweb hand in hand with web2.0
- music+semweb still at research stages? (see Yves' talk to find a reasonable answer...)

the end...



- Gràcies!
- Danke schön!
- Thanks!

:: Workshop ::

“Music 2.0: Music and the (Semantic) Web (2.0)”

**Music recommendation and discovery... in
which Web?**

Òscar Celma (Music Technology Group, UPF)

email: oscar.celma@iua.upf.edu

<http://mtg.upf.edu/~ocelma>



AES 122 Vienna. Austria Center Vienna, May, 6th. 2007