10 MINUTES

DTU Informatics, Technical University of Denmark   Jan Larsen   26/08/2009

10 MINUTES

is the average general attention span.
Continuous attention span is only 8 secs.

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Continuous attention span is only 8 secs.

Context detection and 360 degrees modeling are essential for succesful application of technolgies in complex environments

Technology facilitators for experience economy and creativity

Jan Larsen

Cognitive Systems Section

Dept. of Informatics and Mathematical Modelling

Technical University of Denmark

jl@imm.dtu.dk, www.imm.dtu.dk/~jl

DTU Informatics
Department of Informatics and Mathematical Modeling

Potential of technological contributions

- Involvement of people and the inclusiveness goal
- Handling of massive amounts of often conflicting data
- Enabling user-centric crowd computing
- Context detection and adaptation
- New intelligent tools eliminating trival work - enhancing experience

Data modeling

Cognitive modeling

Technological platforms

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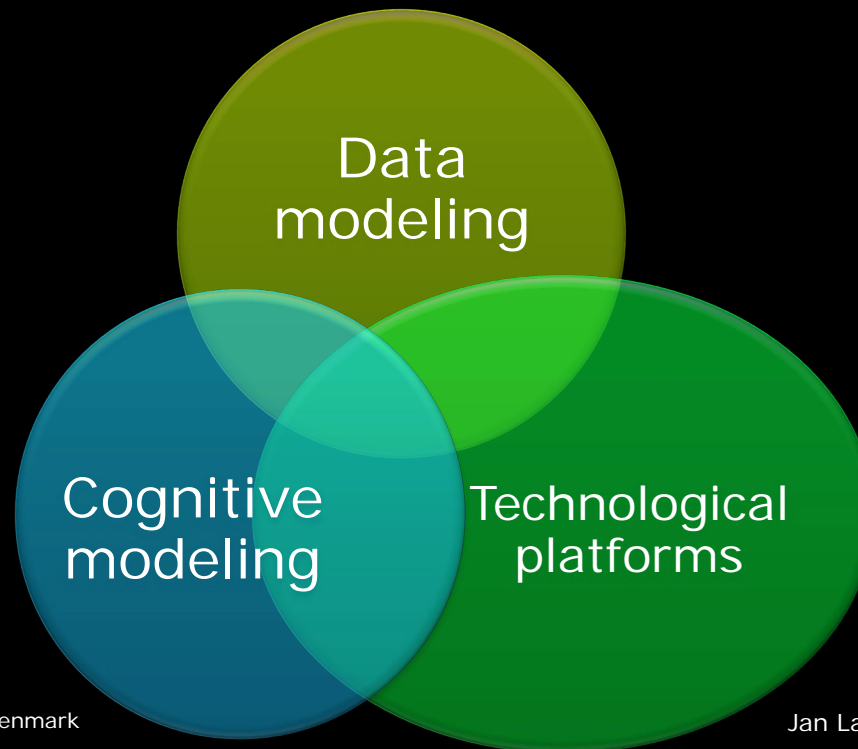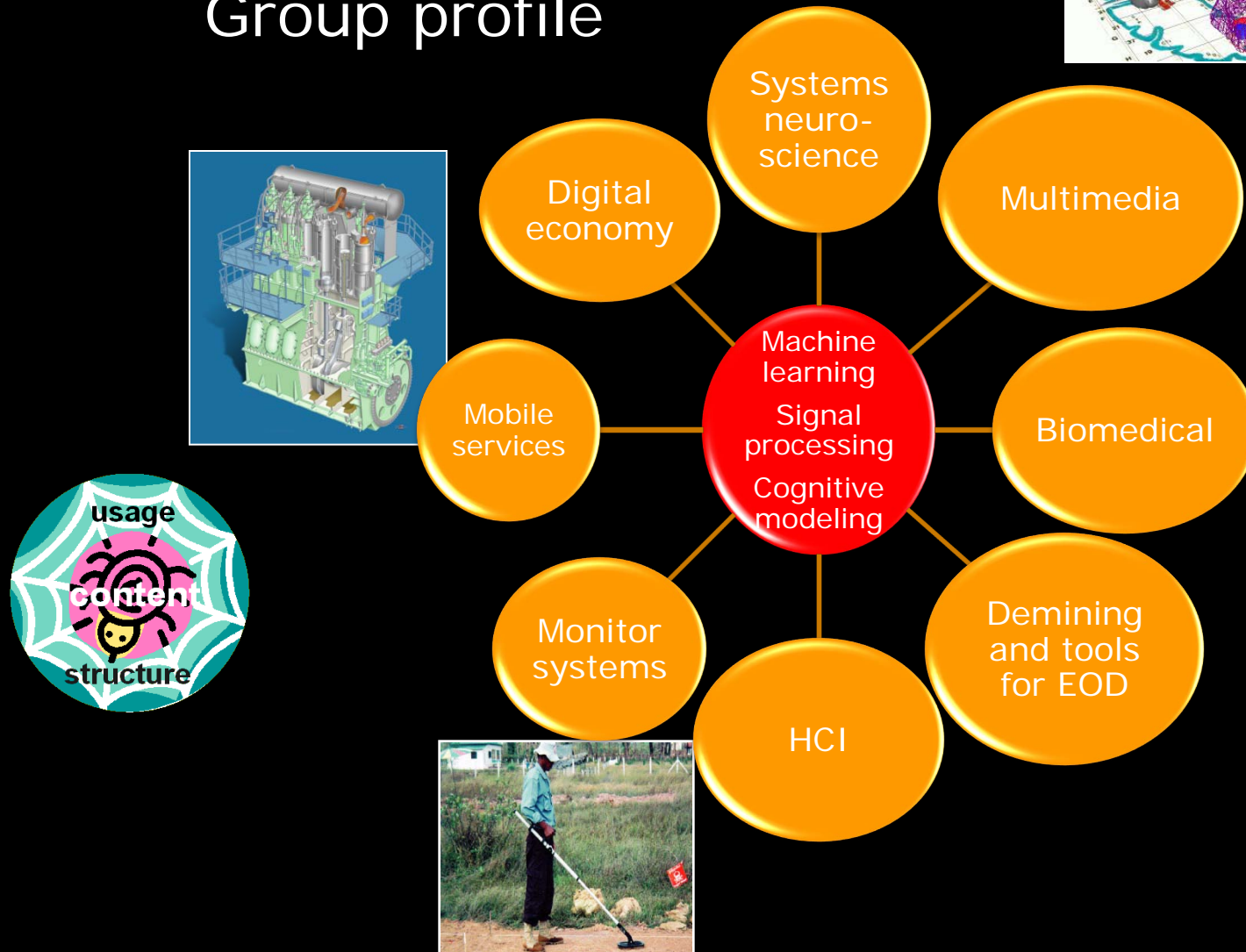
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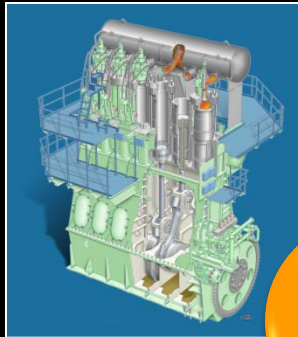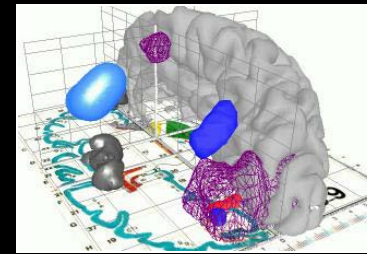- New intelligent tools eliminating trival work - enhancing experience

It takes a cross-disciplinary effort to release the potential

Group profile

Systems neuro-science

Digital economy

Multimedia

Machine learning
Signal processing
Cognitive modeling

Mobile services

Biomedical

Monitor systems

HCI

Demining and tools for EOD

usage
content
structure

- 5 faculty
- 1 adj. prof.
- 3 postdocs
- 4 adm
- 20 Ph.D. students
- 10 M.Sc. students

Group profile

Systems neuro-science

Digital economy

Multimedia

Mobile services

Machine learning
Signal processing
Cognitive modeling

Biomedical

extraction of meaningful and actionable information by ubiquitous learning from data
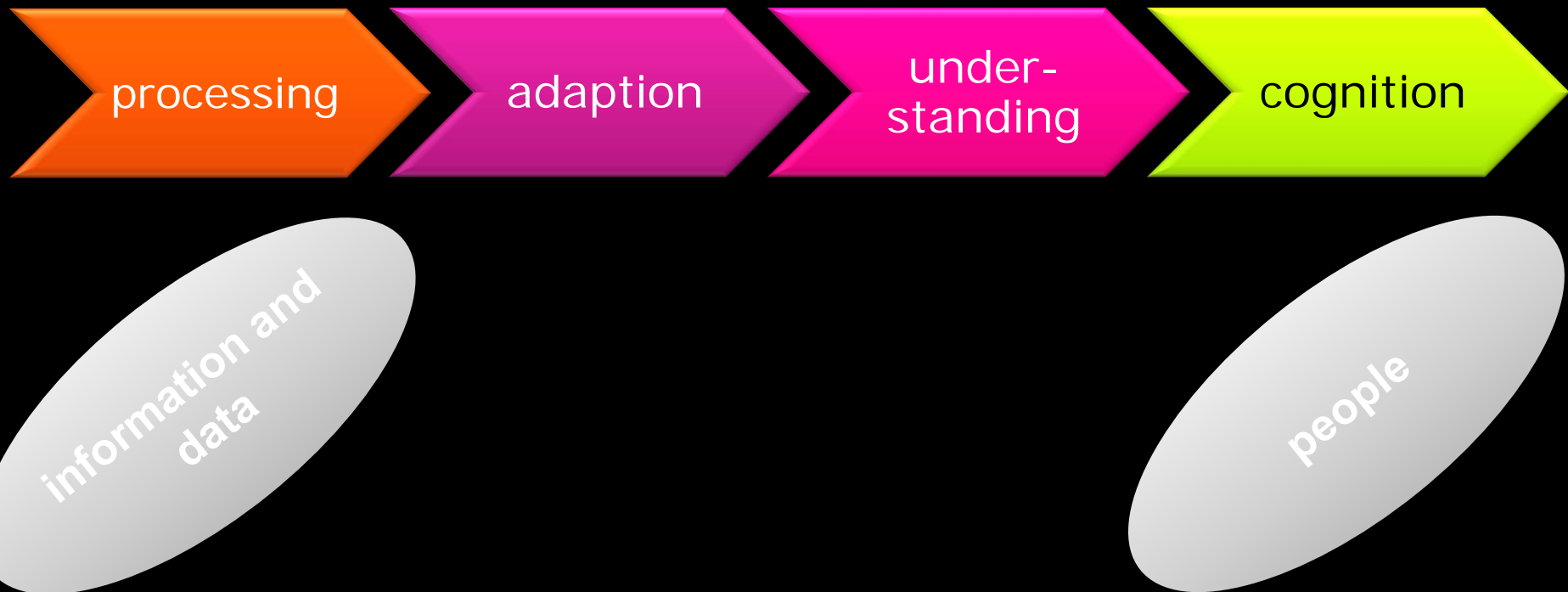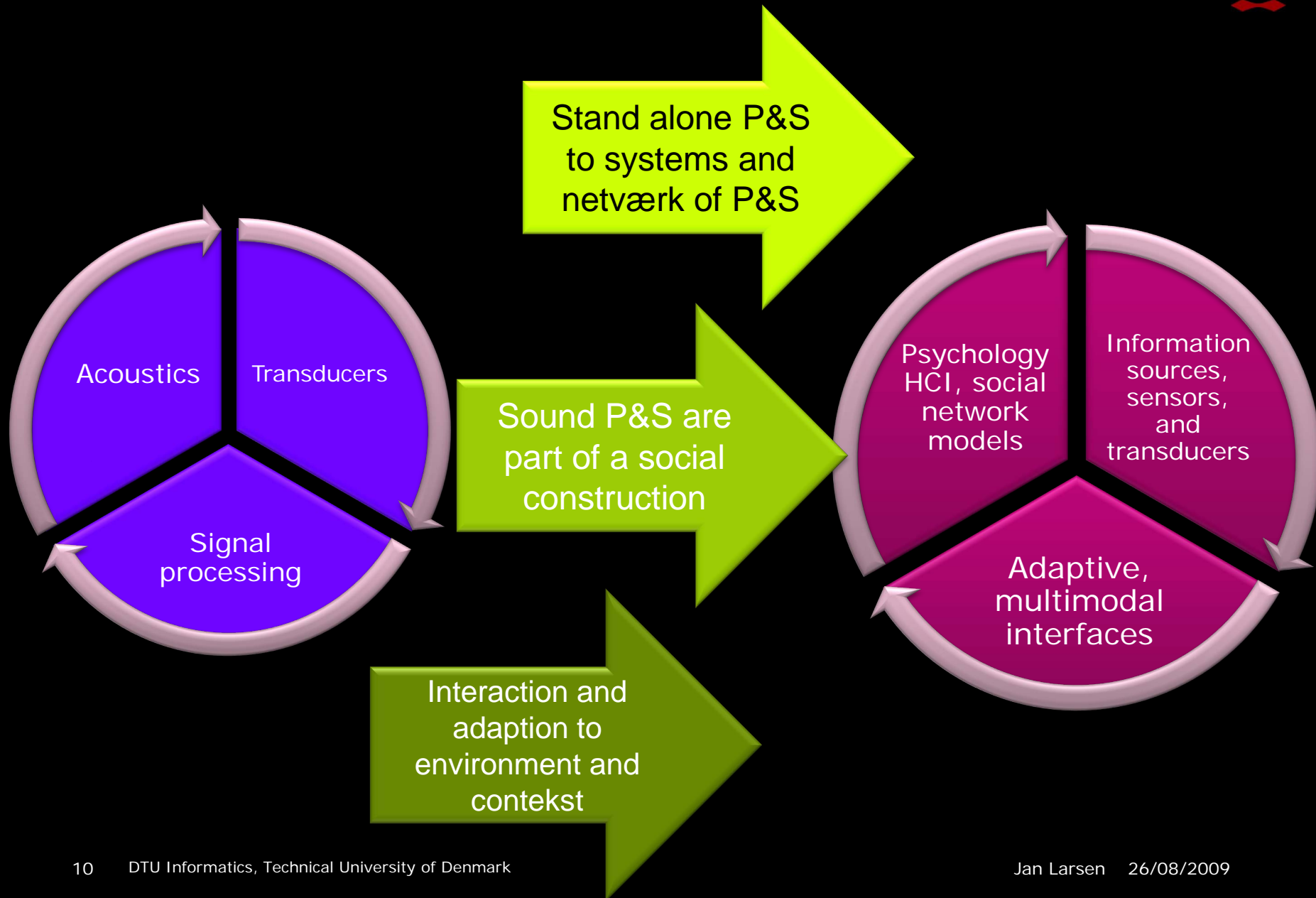
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usage

The legacy of Allan Touring and Nobert Wiener

- theory of computing
- cybernetics

processing → adaption → under-standing → cognition

information and data

people

Transformation of sound technologies

Stand alone P&S to systems and netværk of P&S

Sound P&S are part of a social construction

Interaction and adaption to environment and contekst

Acoustics

Transducers

Signal processing

Psychology HCI, social network models

Information sources, sensors, and transducers

Adaptive, multimodal interfaces

Transformation of sound technologies

Stand alone P...
to systems a...
netværk of P&...

Acou...

Information sources, sensors, and ...nsducers

The transformationen happens across business areas, sectors and disciplines

...daptive, multimodal interfaces

Interaction and adaption to environment and contekst

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Mega trends

Computation
distributed and ubiquitous computing

Connectivity
internet, communication technologies and social networks

Pervasive sensing
digital, accessible information on all levels

New theories of the human brain
Neuroinformatics, brain-computer interfaces, mind reading

New business models
Free tools paid by advertisement, 99+1 principle: 99% free, 1% buys, the revolution in digital economy

Information processing pipeline
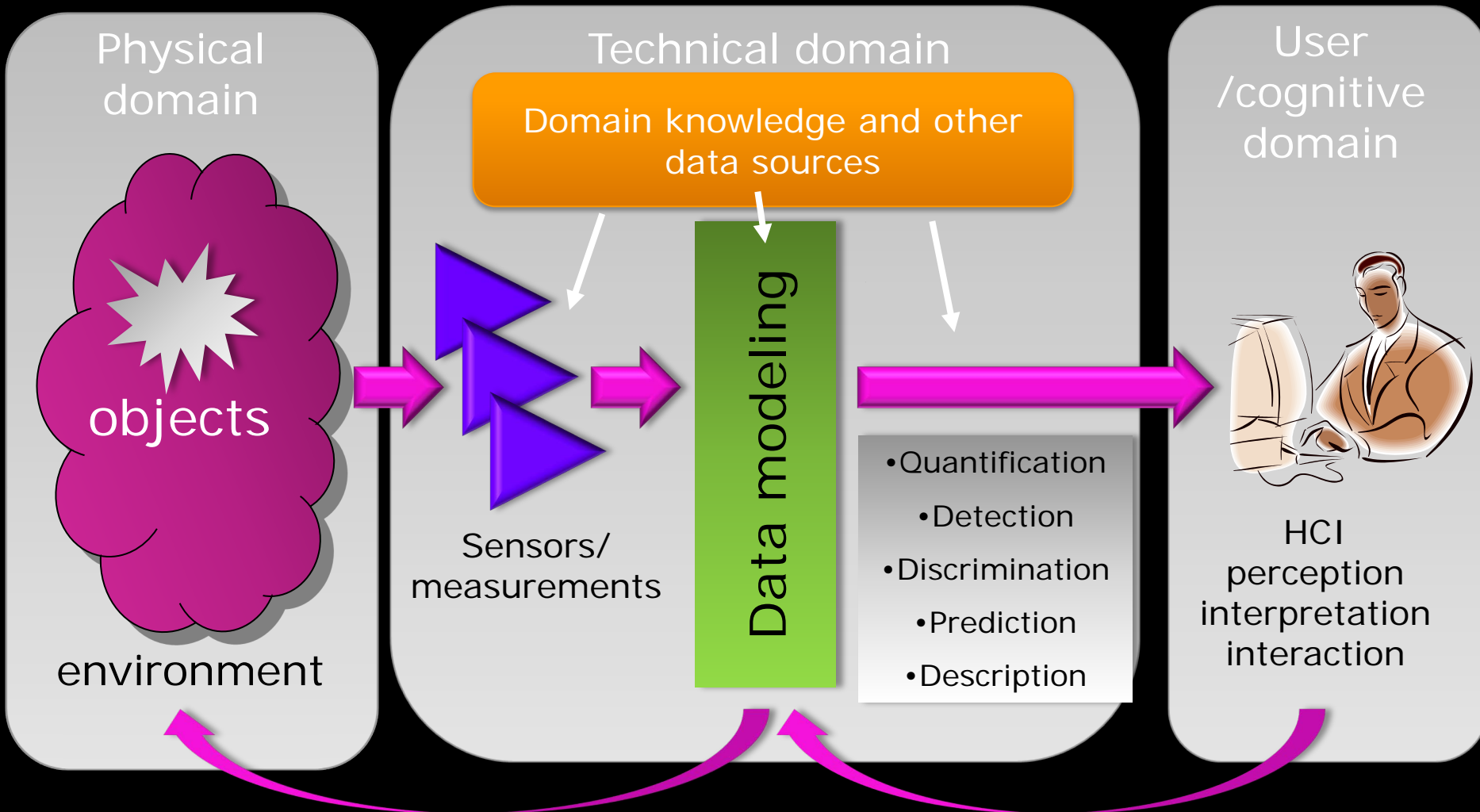
Physical domain

objects

environment

Technical domain

Domain knowledge and other data sources

Sensors/ measurements

Data modeling

- Quantification
- Detection
- Discrimination
- Prediction
- Description

User /cognitive domain

HCI perception interpretation interaction

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Learning from massive data sets

Disentanglement of confusing, ambiguous, conflicting and vast amounts of information

Perform specific tasks

- Exploration
- Retrieval
- Search
- Physical operation and manipulation
- Information enrichment
- Making information actionable
- Navigation and control

- Decision support
- Meaning extraction
- Knowledge discovery
- Creative process modeling
- Facilitating and enhancing communication
- Narration

Jan Larsen   26/08/2009

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  actionable
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– Decision support

Examples

- Detecting topics in large text corpra
- Automatic annnotation/labeling of songs with genre, mood, etc.
- Speech and image recognition

The unreasonable effectiveness of data

- E. Wigner 1960: The unreasonable efffectiveness of mathematics in the natural sciences
- There is often a sufficient number of data such that simple methods performs better than complex methods
- The power of learning with from unlabeled data which are abundant
- The power of linking many different sources
- Bridiging semantic gaps
  - The same meaning can be expressed in many ways – and the same expression can convey many different meanings
  - Shared cognitive and cultural contexts helps the disambiguation of meaning
  - Ontologies: a social construction among people with a common shared motive
  - Classical handcrafted ontology building is infeasible – crowd computing / crowd sourcing is possible!

Ref: A. Halevy, P. Norvig, F. Pereira: The unreasonbale effectiveness of data,

IEEE Intelligent Systems, March/April, pp. 8-12, 2009.

Tech examples with potential

- Brain computer interfaces and neuro-economics
- Intelligent sound project applications
- Cognitive radio networks
- Autonomous robots
- Crowdsourcing
  - Cultural heritage
  - ESP game
  - Recapcha
  - Responsible business in the blogosphere

Toward Brain-Computer Interfacing

edited by

Guido Dornhege, José del R. Millán,
Thilo Hinterberger, Dennis J. McFarland,
and Klaus-Robert Müller

- control

- monitoring

- mind reading

DTU Informatics, Technical University of Denmark

Intelligent Sound Project

- FTP project 2005-2009
- 14 mil DKK
- Participants: DTU and Aalborg University

www.intelligentsound.org

Huge demand for tools

Organization, search and retrieval

- –Recommender systems ("taste prediction")
- –Playlist generation
- –Finding similarity in music (e.g., genre classification, instrument classification, etc.)
- –Hit prediction
- –Newscast transcription/search
- –Music transcription/search

Specialized search and music organization

FindSounds
Search the Web for Sounds

Search for [   ] [Search] Help
Need Examples?

File Formats	Number of Channels	Minimum Resolution	Minimum Sample Rate	Maximum File Size
☑ AIFF	☑ mono	8-bit	8000 Hz	2 MB
☑ AU	☑ stereo			
☑ WAVE				

allmusic •AMG

last·fm the social music revolution

Using social network analysis

Explore by Genre, mood, theme, country, instrument

Query by humming

Fraunhofer IDMT Institut Digitale Medientechnologie

The National Gallery of the Spoken Word

NGSW

The NGSW is creating an online fully-searchable digital library of spoken word collections spanning the 20th century

moodlogic
MOODLOGIC 2.7   NETWORK   FAQs   AB

moodlogic
File Edit View Mix Tools Gear Help
View   Genre   Artist
♪ My Music   ··· Any Genre ···   ··· Any Artist ···
MP3 Player   Alternative   A Taste of Honey
Messages   Blues   Aaron Neville & Brothers
Instant Mix   Country   ABBA
Profile Center   Easy Listening   Afro Celt Sound System
                    Electronica   Afro Cuban All Stars
Mellow Mix   Gospel/Christian   Al Di Meola & John McLau
70s Disco Party
Classic Rock   ✔ Tempo   ✔ Year
Romantic 80s   Slow   Fast   < 60 70 80 90 00 <
Like Chemical Bros
                    Aggressive | Upbeat | Happy | Romantic | Mellow | Sad
                    Artist ▲   Track Name   Duration
                    Chemical Brothers The Sunshine Underground   8:38

PANDORA™

search for related songs using the "400 genes of music"

Organize songs according to tempo, genre, mood
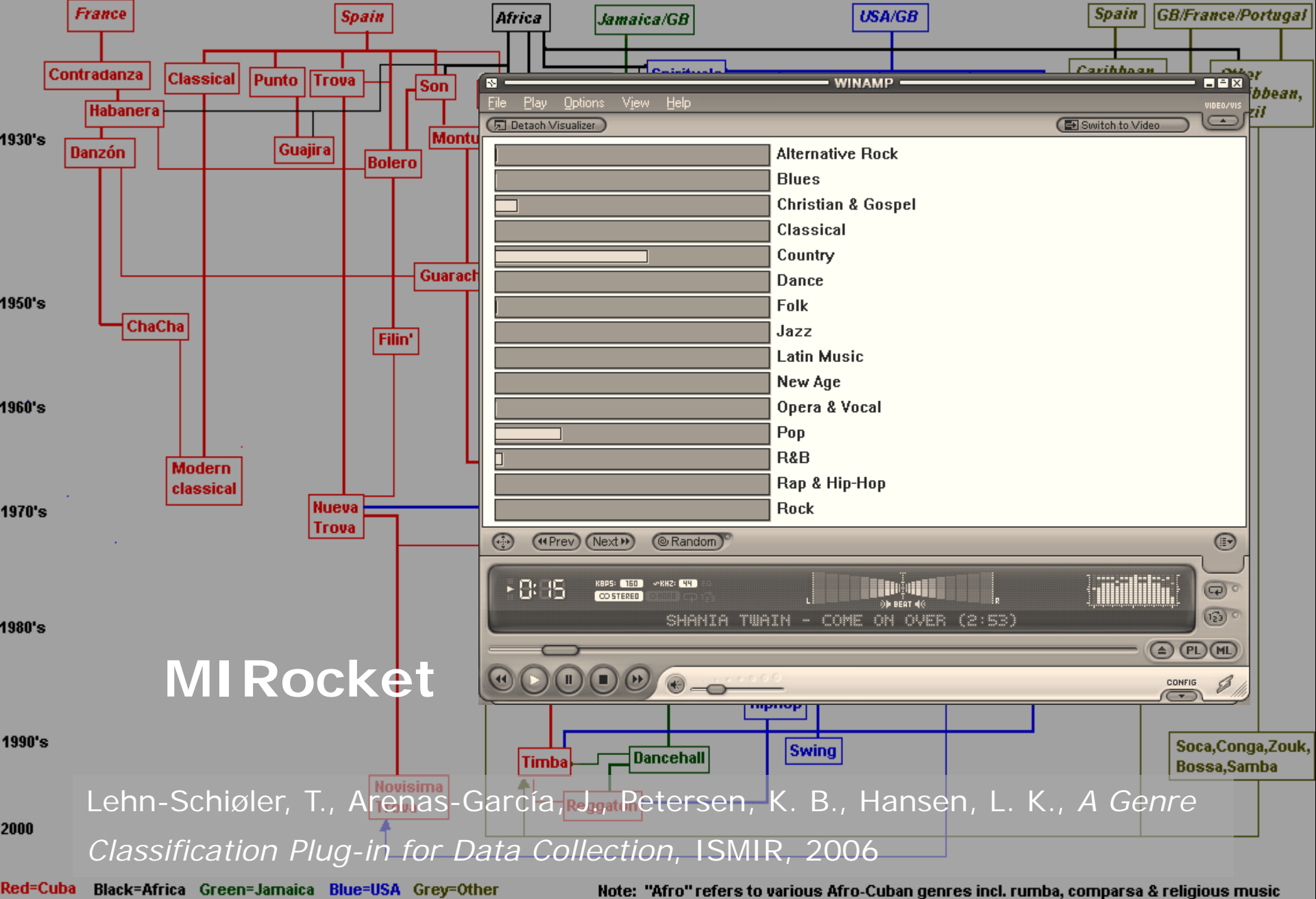
MI Rocket

Lehn-Schiøler, T., Arenas-García, J., Petersen, K. B., Hansen, L. K., *A Genre Classification Plug-in for Data Collection*, ISMIR, 2006
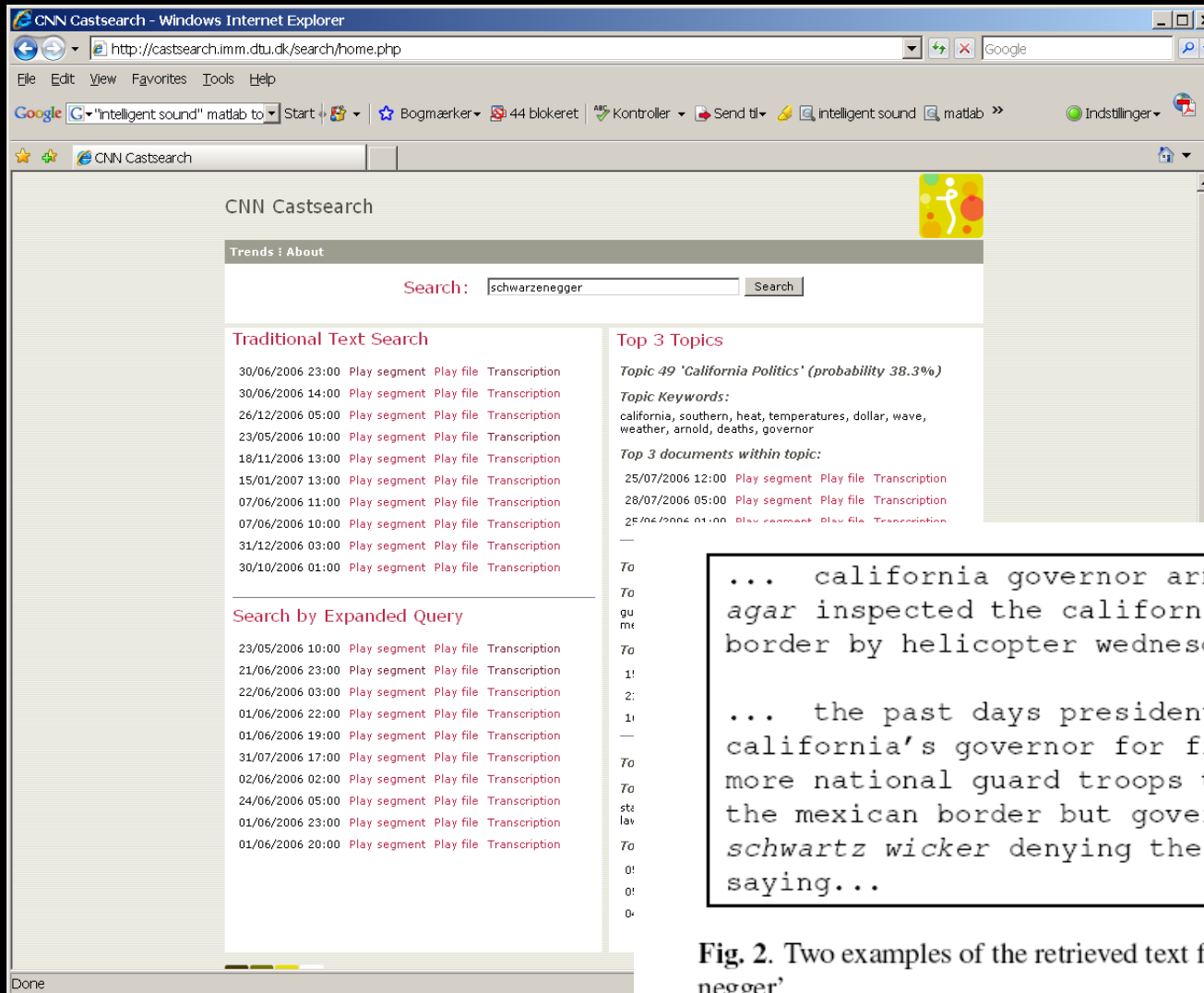
A cognitive search engine - Muzeeker

- Wikipedia based common sense
- Wikipedia used as a proxy for the music users mental model
- Implementation: Filter retrieval using Wikipedia's article/ categories

- Muzeeker.com
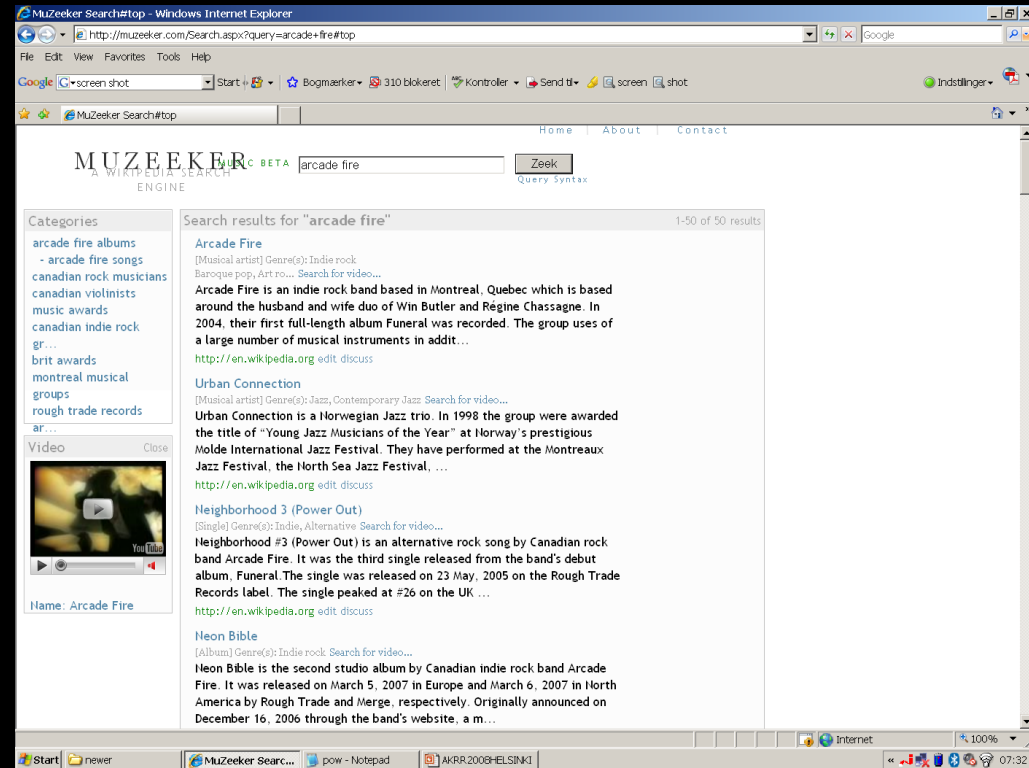
A cognitive search engine – CASTSEARCH: Context based Spoken Document Retrieval
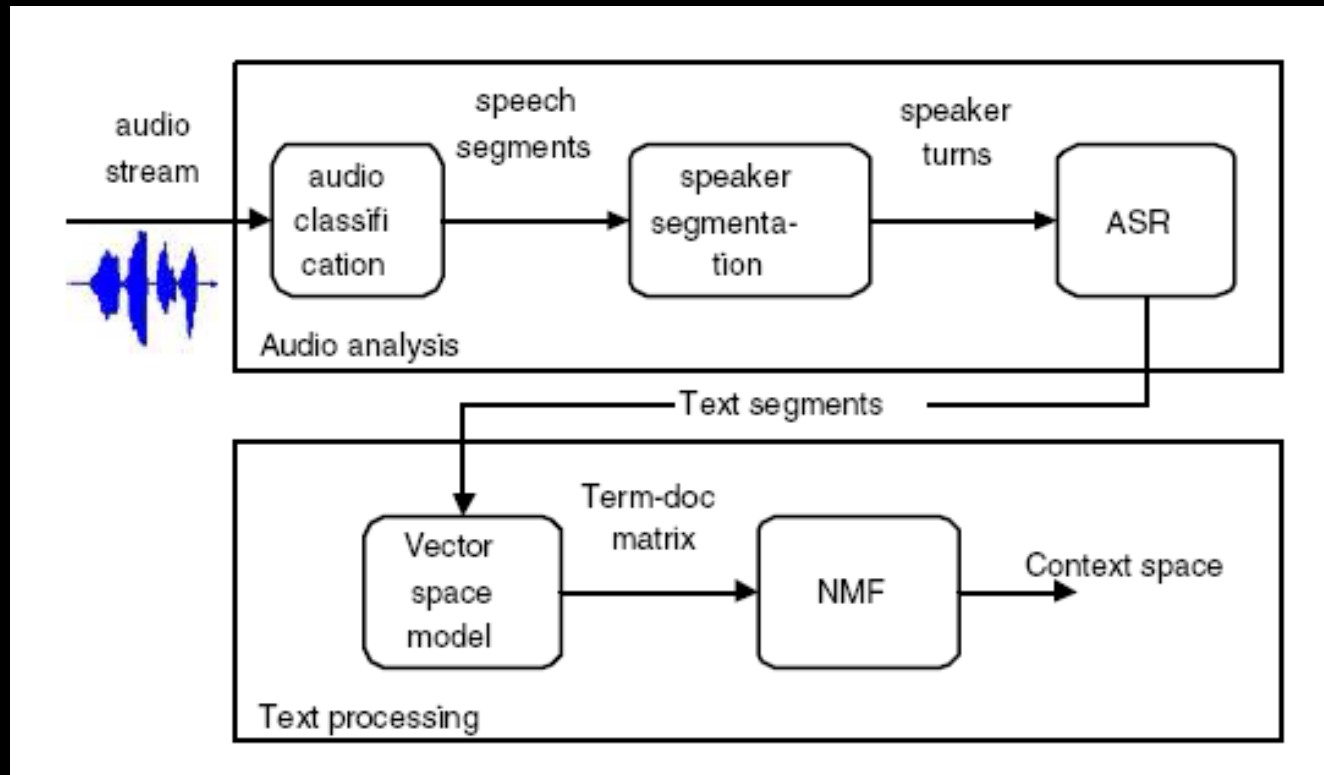
Ref: Lasse Mølgaard, Kasper Jørgensen, Lars Kai Hansen: "CASTSEARCH: Context based Spoken Document Retrieval," ICASSP2007

CNN Castsearch

Search: schwarzenegger [Search]

Traditional Text Search

30/06/2006 23:00 Play segment Play file Transcription
30/06/2006 14:00 Play segment Play file Transcription
26/12/2006 05:00 Play segment Play file Transcription
23/05/2006 10:00 Play segment Play file Transcription
18/11/2006 13:00 Play segment Play file Transcription
15/01/2007 13:00 Play segment Play file Transcription
07/06/2006 11:00 Play segment Play file Transcription
07/06/2006 10:00 Play segment Play file Transcription
31/12/2006 03:00 Play segment Play file Transcription
30/10/2006 01:00 Play segment Play file Transcription

Search by Expanded Query

23/05/2006 10:00 Play segment Play file Transcription
21/06/2006 23:00 Play segment Play file Transcription
22/06/2006 03:00 Play segment Play file Transcription
01/06/2006 22:00 Play segment Play file Transcription
01/06/2006 19:00 Play segment Play file Transcription
31/07/2006 17:00 Play segment Play file Transcription
02/06/2006 02:00 Play segment Play file Transcription
24/06/2006 05:00 Play segment Play file Transcription
01/06/2006 23:00 Play segment Play file Transcription
01/06/2006 20:00 Play segment Play file Transcription

Top 3 Topics

Topic 49 'California Politics' (probability 38.3%)

Topic Keywords:
california, southern, heat, temperatures, dollar, wave, weather, arnold, deaths, governor

Top 3 documents within topic:
25/07/2006 12:00 Play segment Play file Transcription
28/07/2006 05:00 Play segment Play file Transcription
25/06/2006 01:00 Play segment Play file Transcription

... california governor arnold's *fortson agar* inspected the california mexico border by helicopter wednesday to see ...

... the past days president bush asking california's governor for fifteen hundred more national guard troops to help patrol the mexican border but governor orville *schwartz wicker* denying the request saying...

Fig. 2. Two examples of the retrieved text for a query on 'schwarzenegger'.
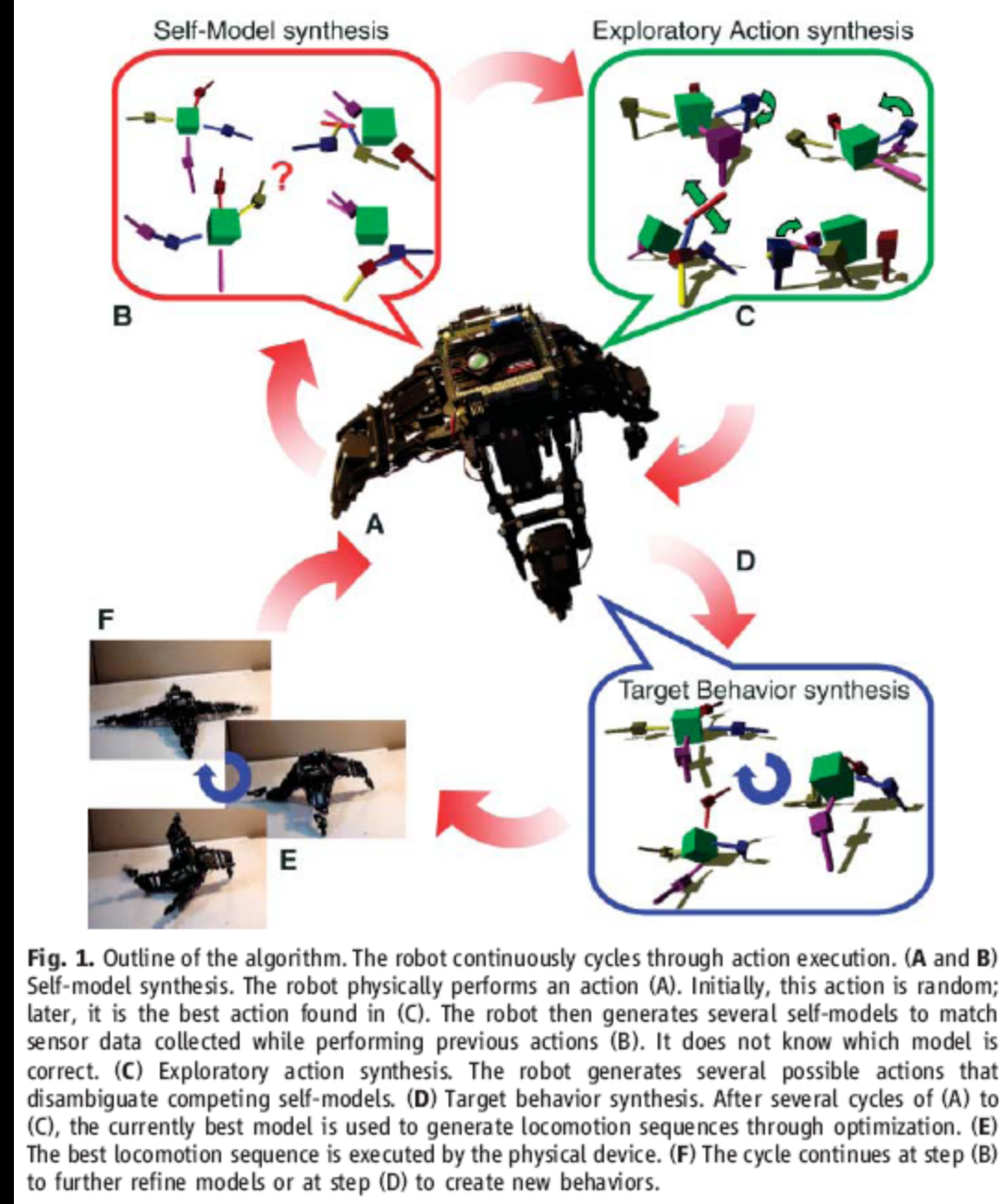
Ref: http://castsearch.imm.dtu.dk

Cognitive Radio Applications

Spectrum Trading

Cheaper Radios

Automated Interoperability

Opportunistic Spectrum Utilization

Improved Link Reliability

Advanced Networking

Intelligent Beamforming

Collaborative Techniques

Courtesy of Jeffrey Reed, Virginia Tech

Starfish cognitive robotics

- Animals sustain the ability to operate after injury by creating qualitatively different compensatory behaviors.

- a robot that can recover from such change autonomously, through continuous self-modeling.

- A four-legged machine uses actuation-sensation relationships to indirectly infer its own structure, and it then uses this self-model to generate forward locomotion.

- When a leg part is removed, it adapts the self-models, leading to the generation of alternative gaits.

Fig. 1. Outline of the algorithm. The robot continuously cycles through action execution. (**A** and **B**) Self-model synthesis. The robot physically performs an action (**A**). Initially, this action is random; later, it is the best action found in (**C**). The robot then generates several self-models to match sensor data collected while performing previous actions (**B**). It does not know which model is correct. (**C**) Exploratory action synthesis. The robot generates several possible actions that disambiguate competing self-models. (**D**) Target behavior synthesis. After several cycles of (**A**) to (**C**), the currently best model is used to generate locomotion sequences through optimization. (**E**) The best locomotion sequence is executed by the physical device. (**F**) The cycle continues at step (**B**) to further refine models or at step (**D**) to create new behaviors.

Ref: Josh Bongard et al.: "Resilient Machines Through Continuous Self-Modeling," Science 314, 2006

Crowd computing and user involvement

Challenges: There is a social/phychological interia towards traditional solutions

1. The Retarding Power (or Inertia) of a Word

2. A Partial Restriction Becomes a Blanket Restriction

3. Tradition Cannot be Broken

4. Words and Their Assumed Properties or Characteristics

5. Inadmissible Range of Data

6. Association of Objects with Senses

7. All Information Given is Valid

Ref: James Kowalick http://www.triz-journal.com/archives/1998/08/c/default.asp

Voictor Fey and Eugene Rivin: Innovation on Demand, 2005.

TRIZ The theory of solving inventor's problems, http://en.wikipedia.org/wiki/TRIZ

M.S. Gazzaniga *et al.:* The Cognitive Neurosciences, 1994.

Samer Abdallah, Mark Plumbley: Information dynamics: patterns of expectation and surprise in the perception of music , Connection Science , vol. 21, issue 2, p. 89, 2009

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> Users' engagement and motivation through relevance, surprice and precision of results

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Research based vs user-driven knowledge and folksonomy

> Når man holder op med at tro på forsknings-baseret viden og bare lader, som om det er en holdning som alle andre, så bliver vi me-re og mere bare overladt til, hvad folk me-ner, uafhængigt af fakta

Maja Horst
Assoc.Prof. CBS

• user driven knowledge is often inaccurate and misleading

• how do we avoid dominance by the popular (music recommendation systems)

• sufficient amount of contributions ensures the quality (wikipedia)

Measurement systems for ethical capital in the experience economy socio-economic value of online communication

- New research 3-year research project starting Aug. 2009 (CBS,DTU,Univ. Milan)
- Forrester Research Report shows web2.0 marked grows enormeously
- The assumption is that on-line spontaneous communication processes are predictible as they appear in networks and patterns which can be revealed by combining socio-economic studies, linguistics, text and network modeling

Responsible Business in the Blogosphere

Kulturarven kan ende i digitalt hul

Men hvis brugerne involveres bredt kan vi sammen skabe en levende digital kulturarv, der kan bidrage til sammenhæng i det danske samfund – hvis ikke, er der fare for at arven forsvinder i et digitalt sort hul, utilgængelig og død.

STIFINDERE
LARS KAI HANSEN
PROFESSOR, DTU INFORMATIK

peana. Effektiv eksponering kræver sandsynligvis, at der også laves en struktur for indsamling af metadata«. Med metadata menes beskrivelser af indholdet: hvad betyder det?, hvem indgår?, hvor stammer det fra? Uden metadata er digitalt indhold utilgængeligt og impotent.

Rapporten er desværre noget uambitiøs, når det kommer til involvering af brugerne i skabelse af metadata, og især når det kommer til anvendelse af avanceret data-analyse. Det virker, som om udvalget i høj grad vil forlade sig på traditionelle metadata-kilder, niche eksperter og bibliotekarer. Men det kan blive dyrt og svært at vedligeholde.

KULTURARVEN SKAL kunne tilgås af Google, det er en nødvendighed. Men Google forstår ikke sine data. Søgemaskinen Google er uden konkurrence når man ved, hvad man leder efter. Hvi

http://danskkulturarv.dk

Kulturarven skal gøres tilgængelig for alle

En stor del af den danske kulturarv vil blive tilgængelig på nettet og frit kunne downloades de kommende år I 2012 skal man på Kulturarvsstyrelsens hjemmeside kunne finde samtlige objekter på danske museer, og de fleste vil også være fotograferet og frit tilgængelige for brugerne.

Kulturarven kan ende i digitalt hul

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http://danskkulturarv.dk

Kulturarven skal gøres

objekter på danske museer, og de fleste vil også være fotograferet og frit tilgængelige for brugerne.

- Google only works if you know what you are searching for
- We need to integrate with common knowledge sources (wikipedia)
- We need to use learning to annotate meta data
- We need users to create additional content, collaborate and interact with data

DTU Informatics, Technical University of Denmark

Nu sendes harddiskoptageren på pension

Markedet for TV er i en rygende udvikling. Boxer har præsenteret "vælg-selv"-tv, og YouSee giver alle deres kunder gratis adgang til digitalt tv-signal i hele hjemmet.

I efteråret lancerer YouSee en ny feature kaldet "TV Arkiv" for sine 1,1 millioner kunder. Med denne funktion, er det slut med at optage favoritprogrammerne i hjemmet.

Det klarer kabel-tv selskabet.

I første omgang indeholder TV Arkiv DR1 og DR2. Kunderne kan frit afspille alle DR's egenproduktioner som Hammerslag, Sporløs, Aftenshowet, Talent, nyhedsudsendelser osv., og endda stoppe, spole og pause udsendelsen.

Flere funktioner på vej

Når TV Arkiv åbner den 15. september er DR med som pionerer. Senere følger programmer fra andre tv-stationer samt adgang til TV 2 Sputnik. Sidstnævnte kræver et Sputnik-abonnement.

Til Mobilsiden.dk oplyser YouSee, at kommercielle tv-stationer under arkivet kan kræve et særskilt abonnement, for at få adgang til deres arkiv.

Allerede nu kan kunderne dog benytte funktionen StartForfra
genstartes. Det forventes, at StartForfra senere vil omfatte al

Prisen...

Skal man have glæde af de nye funktioner kræver det, man f
boks under fjernsynet.

Prisen for boks og adgang til TV Arkiv, StartForfra samt et pa
kortafgift.

Enchaned accesiblity

Af JOHN G. PEDERSEN, Mobilsiden.dk
Offentliggjort 20.08.09 kl. 10:38
http://epn.dk/teknologi2/billed/article1787982.ece

A cognitive architecture for search

Combine bottom-up and top-down processing

- Top-down user feedback
  - High specificity
  - Time scales: long, slowly adapting
- Bottom-up data modeling
  - High sensitivity
  - Time scales: short, fast adaptation
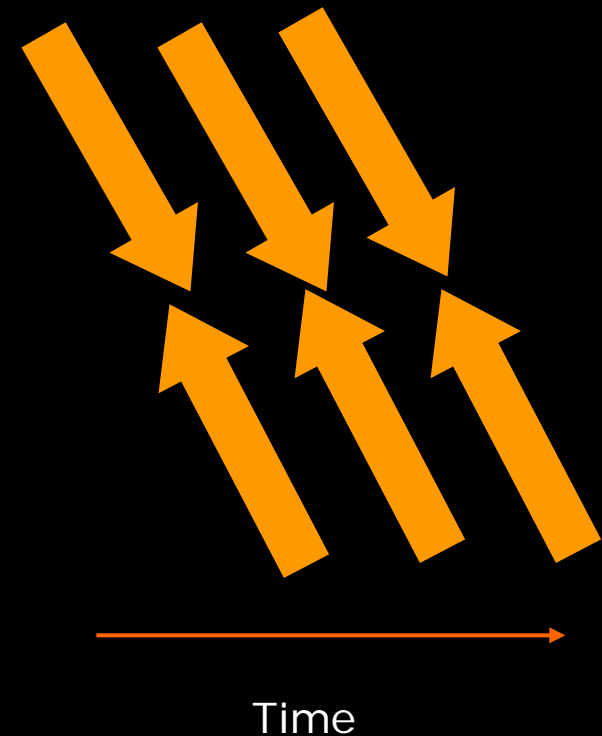
Time

Courtesey of Lars Kai Hansen, DTU

Conceptual diagram of a knowledge discovery multimedia engine

Primary multimedia web data sources

Domain prior information data base

Common knowledge sources

Users

Sampling

Temporal inference engine

Dynamic semantic domain model

Interaction and communication module

Feature extraction

Data ware house

User action data base

- **Bottom-up / Top-down processing**
- **Several cognitive loops e.g. interactive learning wth users**

ESP game

- Guessing tags - fun and useful
- Conceived by Luis von Ahn of Carnegie Mellon University

Summary

- A cross-disciplinary effort is required to make research, innovation and commercial products and services
- Massiveness of data requires learning and cognitive modeling but has huge potential for new capabilities
- Integration of multiple information sources helps context detection and adaptation
- Internet penetration makes crowd sourcing possible and ensures inclusiveness
  - a window for the creative common
  - a way to bridging the semantic gap

Quo vadis?

- Cross-disciplinary demonstration projects in win-win collaborations
- Focus on creative educations as a partnership between technical and natural sciences, art schools, social sciences, business schools, humanities. Maintain the critical mass!

Innovation by briding, common understanding and win-win partnerships
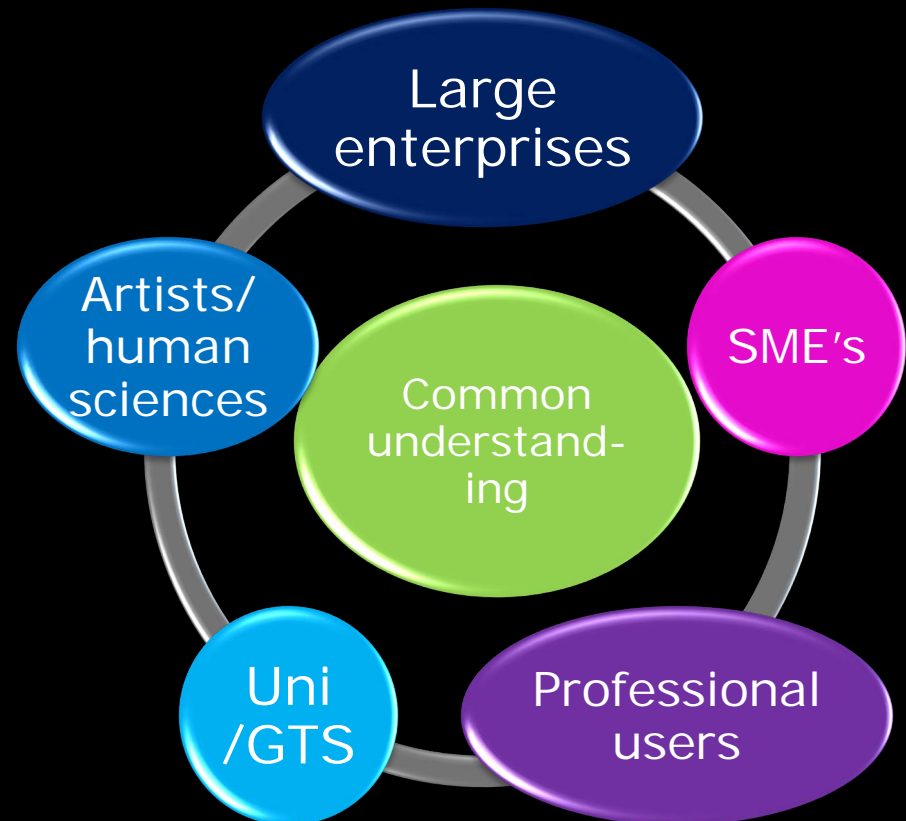
Quo vadis?

- Cross-disciplinary demonstration projects in win-win collaborations

- Focus   s
  as a p
  techni
  scienc
  scienc
  humar
  critica

Innovation by briding, common understanding and win-win partnerships

Barriers
- risk adverseness
- no common interest
- to narrow focus

Carriers
- common understanding
- project output which fits individual interest
- participation in larger collaborative projects can promote/elevate individual businesses

Large enterprises

Artists/ human sciences

Common understand-ing

SME's

Uni /GTS

Professional users

DTU Informatics, Technical University of Denmark

Jan Larsen   26/08/2009