First VITALAS Dissemination Conference
D8.2.1

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ABSTRACT:
This document contains proceedings of the 1st VITALAS Dissemination Conference, held in Cannes, France, on 11-12 February 2008, jointly with the NoE MUSCLE Final Conference. The conference clustered members of communities in the field of Multimedia Understanding through Semantics, Computation and Machine Learning.

The main objective of this conference was to present achieved results within the VITALAS project.

KEYWORD LIST: Dissemination, promotion visibility, conference
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- Daniel Schneider, FhG
- Gérard Dupont, EADS
- Hervé Goëau, INA

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- Joost Geurts, INRIA
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1. Introduction


This scientific conference was co-chaired by Nozha Boujemaa (scientific coordinator of MUSCLE and VITALAS) and Eric Pauwels (CWI)

In addition to the keynote talks, this event included MUSCLE e-Team presentations and showcase demonstrations as well as presentations from other EU-funded projects: VITALAS and PASCAL.

For each VITALAS presentation, a brief description is reported in section 3, and slides are set in section 5.

2. Agenda and list of participants

2.1 Agenda

Monday 11 February 2008

09:40 - 10:00  Registration - Welcome coffee
10:00 - 10:15  Introduction - MUSCLE achievements, Nozha Boujemaa, INRIA Imedia
10:15 - 11:00  Keynote speaker: Prof. Andrew Zisserman, University of Oxford
11:00 - 11:30  Coffee break - Muscle showcase demonstrations
11:30 - 12:00  Shape modelling via higher-order active contours and phase fields - Ian Jermyn, INRIA Ariana
12:00 - 12:30  A contrario matching of local features between images, Yann Gousseau, ENST
12:30 - 14:00  Lunch
14:00 - 14:30  Recognising Animals, Allan Hanbury, TU Vienna-PRIP
14:30 - 15:00  Person detection and recognition, tracking and analysis - Montse Pardas, UPC
15:00 - 15:30  Action class detection and recognition - Ivan Laptev, INRIA Vista
15:30 - 16:00  Coffee break – MUSCLE showcase demonstrations
16:00 - 16:30  On Sequence Kernels for SVM classification of sets of vectors - Khalid Daoudi, IRIT
16:30 - 17:00  Active machine learning based on kernels on bags and on graphs - Sylvie Philipp-Foliguet, ENSEA
17:00 - 17:20  Crossing textual and visual content in different application scenarios - Gabriela Csurka & Jean-Michel Renders, Xerox (PASCAL)
17:20 - 17:50  Fully Bayesian Source Separation with Application to the CMB - Simon Wilson, TCD

Tuesday 12 February 2008
09:00 - 09:45  Keynote speaker: Joachim Köhler, Fraunhofer IAIS, "Audio Content Search"
09:45 - 10:15  Audio-Visual Speech Analysis & Recognition - Nassos Katsamanis, NTUA
10:15 - 10:45  Multimodal Interfaces - Alexandros Potamianos, TUC
10:45 - 11:15  Coffee break – MUSCLE showcase demonstrations
11:45 - 12:05  Interactive Visualization tool with Graphic Table of Video Contents - Hervé Goëau, INA (VITALAS)
12:05 - 12:30  Open Vocabulary Speech Analysis in VITALAS, Daniel Schneider, FhG (VITALAS)
12:30 - 14:00  Lunch
14:00 - 14:30  Feature extraction from audio and their application in music organization and transient enhancement in recorded music, Jakob Frank, TUWIEN and Massimo Magrini, CNR-ISTI
14:30 - 15:00  BilVideo: MPEG-7 Compliant Video Database Management System, Onur Kucuktunc, Bilkent University
15:00 - 15:20  Implicit feedback learning in semantic and collaborative information retrieval systems, Gérard Dupont, EADS (VITALAS)
15:30  End
2.2 List of participants

Amiaz Tomer Tel Aviv University
Bertini Graziano ISTI-CNR
Boujemaa Nozha INRIA - projet Imédia
Buisson Olivier INA
Canterakis Nikos Albert-Ludwigs University of Freiburg
Cetin Ahmet Enis Bilkent University
Chailloux Jérôme GEIE ERCIM
Chetverikov Dmitry MTA SZTAKI
Christmas Bill University of Surrey
Cord Matthieu UPMC
Csurka Gabriela Xerox Research Centre Europe
Cunningham Padraig UCD
Cvejic Nedeljko University of Cambridge
Dahyot Rozenn TCD
Daoudi Khalid IRIT-UPS
Debili Fathi CNRS LLACAN
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Godsil Simon university of cambridge (UCAM-DENG)
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Gousseau Yann ENST
Gudukbay Ugur Bilkent University
Haindl Michal Institute of Information Theory and Automation
Hanbury Allan Vienna University of Technology
Ho-Hune Patricia ERCIM
Jermyn Ian INRIA
Joachim Koehler Fraunhofer IAIS
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Katsamanis Athanassios National Technical University of Athens
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Lavirotte Alexandra ERCIM
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Levente Kovács MTA SZTAKI
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Moellic Pierre-Alain CEA LIST
Noelle Michael Austrian Research Centers GmbH - ARC
Onaran Ibrahim Bilkent University
3. VITALAS presentations

This section gives the abstracts from the presentations provided by the presenters. The slides are annexed at the end of this document.

Interactive visualization tool with graphic table of video contents

_Hervé Goëau_
INA

In this paper, we present an interactive visualization, called Table Of Video Contents (TOVC), for browsing structured TV programs such as news, magazines or sports. In these telecasts, getting a good segmentation can be very time-consuming, especially in an annotating context. Our visualization, connected with a classical media player, offers a very handy video browser. This system allows a global overview by showing the temporal structure and by giving some semantic information. The drawn structure enables a non linear video access by suggesting relevant key frames. The TOVC is created from a graphic framework designed for computing similarities on visual contents, and displaying the associated proximities in a 2D map with graph representation. TOVC is one of its first applications and shows interesting capabilities.

Open Vocabulary Speech Analysis in VITALAS

_Daniel Schneider_
FhG IAIS

Automatic indexing of TV and radio speech data requires robust components for both speech recognition and spoken document retrieval. Due to the high topic variability and the resulting large vocabularies, classic word-based approaches have to cope with a high number of out-of-vocabulary words. This talk presents a phonetic approach to open vocabulary indexing based on syllable decoding and retrieval. Current experimental results are presented,
followed by a demonstration of the Fraunhofer IAIS AudioMining system for spoken term detection.

Implicit feedback learning in semantic and collaborative information retrieval systems

Gérard Dupont
EADS

Information retrieval is a very wide domain which can involve various types of activities and tasks. Many complex factors are participating in a search for information and many systems have been experimented. Nowadays a general consensus has been established around a keyword/document matching process which appears to be efficient on large scale and have enough reliability to satisfy a significant part of the users. But this claim has to be limited and for some subjects, search is still a difficult task. Many reasons can be proposed to explain this phenomenon, but the most salient ones are the difficulty for users to express their needs while searching for information and the limitation of shared knowledge between users and information retrieval systems, meaning that both users and machines don't really understand the information and knowledge space used as references by the other.

This presentation try to provide an overview of one way to resolve those gaps: using feedback learning. The aim is to make the system learning on user behaviour in order to better define its current needs. Machine learning algorithms applied on signal coming from user while performing a search can lead to the understanding of what is really relevant to the users and then can be exploited to help him during its tasks.

The work, engaged through the VITALAS1 project, is presented: study of users search logs and definition of a feedback learning framework. Then research on implicit relevance feedback and query optimisation is presented as a first attempt to exploit the feedback learning framework. Finally an overview of the next steps within those studies is presented and especially their impact on the VITALAS project.
4. Dissemination impact

This Conference was open to the scientific community in the field of Multimedia Understanding through Semantics, Computation and Machine Learning.

In order to relay the event, the conference announcement was posted on the VITALAS project website and on the website of CHORUS, the European Coordination Action. After the event, video recordings of the presentations (recorded by videolectures.net) were made available through the project website.
VITALAS D8.2.1 – First VITALAS Dissemination Conference

MCVC '08 - Cannes

MUSCLE Conference joint with VITALAS Conference

Description

The Conference is open to the scientific community at large, including the whole Musle Community, the European Commission, as well as all EU funded projects. This event will be an opportunity for MUSCLE NoE to highlight and demonstrate to all, the major results achieved by the members of its community in the field of Multimedia Understanding through Semantics, Computation and Machine Learning. The MUSCLE scientific conference will be co-chaired by Nozza Boujemaa and Eric Pauwels. In addition to the keynote talks, this event includes MUSCLE e-Team presentations and showcase demonstrations as well as presentations from other EU-funded projects.

Introduction

Introduction to the Conference
Nozza Boujemaa

Lectures

Automated Character Annotation in Multimedia
Andrew Zimmerman

Shape modelling via higher-order active contours and phase fields
Ian Jermyn

A contraste matching of local features between images
Yann Gousseau

Recognising Animals
Allen Harbury
ERCIM took the opportunity of this 1st conference to improve the VITALAS poster, assigning a communication agency. The result is of a great quality and the 60x80cm posters have been distributed to each partner for dissemination at a local level.

5. Conclusion

International researchers from different scientific disciplines participated in the VITALAS Conference and engaged interesting and fruitful discussions with VITALAS project partners. Based on positive feedback from the participants and the number of visitors who viewed the video presentations after the event, we may consider the VITALAS conference a success. The next VITALAS Conference is planned for February 2009.

6. Annex: Presentations
INTERACTIVE VISUALIZATION TOOL WITH GRAPHIC TABLE OF VIDEO CONTENTS

Hervé Goëau
1. Context
2. Solutions in the state of the art
3. Framework and method
4. Results
5. Evaluation
6. Future works
Context and objectives

- **51 channels daily collected** (100 in 2010)

- **Constant staff of 80 archivists** (DL)

- **News telecast**: a strategic issue
  - very time consuming
  - one daily program for each main channel
  - finest level of annotation

→accelerate the access to the content by giving a quick overview
Video summarization and browsing interfaces

Basic

Time line or grid

Too compact

video slider

Lack of scalability
Video summarization and browsing interfaces

Merging

one shot, no global motion
Video summarization and browsing interfaces

Stiching - dynamic

page setting
Video summarization and browsing interfaces

3D representation

Readability?
Video summarization and browsing interfaces

Keyframes tiling

Semantic analysis of content?
Our solution

• *Table Of Video Contents (TOVC)*

• *Highlights the video structure*

→ non linear access
→ fast access
→ location in the content
Generic Framework

- Media analysis:
  - similarity measures computation

- User oriented experimental framework:
  - video browsing with TOVC
  - semi-supervised or unsupervised photo annotation
  - navigation, proximity exploration
Current implementation of TOVC

- Media analysis:
  - visual descriptors extraction
  - similarity measures computation

- MultiDimensional Scaling (MDS)

- Graph representation
  - numerous drawing algorithms
An example
An example

1. No key frame detection (constant frequency extraction)

2. Feature combination

3. Instantaneous feedback by using MDS
An example

4. Cluster detection

5. “Backbone” selection

6. Structure filtering and drawing
An example

Backbone = anchorman

Reports
An example
An example

Interview
Some Results in Various Programs

deaf and hard hearing or news in brief

Headlines

View visual content
TOVC in sport program

One loop = one event
Evaluation / usability test

**How to evaluate a user interface?**

- 12 users
- TOVC versus basic grid visualization
- 2 news programs
- Timed search tasks
- Interview

VS
Evaluation Results

• Search task:
  - 50% are faster with TOVC
  - 25% indifferent
  - 25% are more efficient with the grid view
  - 20% time average on search task

• Interview:
  - localization in the video content
  - remember an already seen frame
Future works

- Experiment on less structured video like fictions, series, documentaries
- Double backbone on one episode of "Friends"
Future works

- Audio description
- Fusion formalism
- Learning process (for news)
- Evaluation process
Open Vocabulary Speech Analysis in Vitalas

Daniel Schneider
Speech Group, Fraunhofer IAIS
Outline

- Vitalas Scenario: Broadcast News Audio Indexing
- Structural Audio Analysis
- Open Vocabulary Speech Recognition
- Demo: AudioMining
Challenge in Vitalas: Large Scale Broadcast News Indexing

- Huge amount of data (> 10,000 hours)

- Heterogeneous material
  - From various sources of unknown type
  - High topic variability
  - Huge vocabulary
  - Multilingual data

- Requires efficient and robust algorithms for...
  - Information extraction
  - Information retrieval
Structural Audio Analysis in Vitalas

- Unstructured Audio Data
- Homogeneous Segmentation
- Speech Detection
- Gender Detection
- Speaker Clustering
- Programme Identification via Jingle

Start of News Show
Speech Recognition

- Structural Analysis

- Speech Recognition

Transcripts can be used for...

- Search in entire archive ("Audio-Google")
- Media observation (Alert if keyword occurs)
- Input for text mining (e.g. Topic Detection)
Speech Recognition Challenges

- Out-of-Vocabulary problems with classic word based ASR of broadcast data
  - New and popular words (e.g. Gammelfleischskandal - „rotten meat scandal“)
  - Proper names (companies, cities, people)

- Compound words in German (climate conference – Klimakonferenz)
- Huge Lexica required – large effort

"... der Klimakonferenz der Vereinten Nationen ..."

der Kiel Markt Konferenz der Vereinten Nationen
Phonetic Approach to Open Vocabulary Indexing

- Idea:
  - Search on phonetic subword level instead of word level
  - Search for a sequence of sounds instead of words
Phonetic Approach to Open Vocabulary Indexing

1. Generate transcription on subword level (phone or syllable)

2. Break down search term into subword units
   Klimakonferenz → kli:ma:kOn.fe:rEnts

3. Fuzzy Phonetic Search

Klimakonferenz
Phonetic Approach (1): Generate Subword Transcription

Feature Extraction
\[ x_1^T = x_1 \cdots x_T \]

Search best matching syllable sequence
\[ s_1^N = \max_{s_i^N} p(s_i^N) p(x_1^T | s_i^N) \]

Output: Syllable Transcription
\[ s_1^N = s_1 \cdots s_N \]

- Cross-Word Triphone Hidden Markov Models
- Bi- / Trigram Models

\[ \ldots \text{?u:.?En.kli:.ma:.kO.fe:.rEnts}\ldots \]
Phonetic Approach (2): Fuzzy Syllable Search

- Break down search term: Klimakonferenz $\rightarrow$ kli:.ma:.kOn.fe:.rEnts
- Goal: Retrieval of documents containing similar syllable sequences
- Fuzzy search based on Levenshtein Distance between
  - Single syllables
  - Syllable sequences

Examples distances between single syllables:

- d_e:_s_ d_e:_s_ zero
- d_e:_s_ k_O_n_ high
- d_e:_s_ d_i:_s_ low
- d_e:_s_ d_l:s_ medium

Examples distances between syllable sequence:

- k_l_i:_ m_a:_ k_l_i:_ m_a:_ zero
- k_l_i:_ m_a:_ k_l_i:_ n_a:_ low
- k_l_i:_ m_a:_ k_l_i:_ n_6_ high

- Solution based on Dynamic Programming (c.f. Speech Decoding)
Properties of Phonetic Subword Approach

- The set of subword units is finite and (rather) small
  - Complete vocabulary coverage (no OOV)
  - 10,000 syllables compared to 300,000+ words
  - Compact ASR search space

- Implicit decomposition of compounded words
  - \textit{kli:.ma:.kOn.fe:.rEnts} gives 100\% hit for the search terms
    \textit{Klima, Konferenz, Klima Konferenz, Klimakonfernez}

- Implicit stemming capabilities of fuzzy search
  - Skandal – skan.da:l
    Skandals – skan.da:ls (less important to learn genitive explicitly)
Experiments: Fraunhofer AudioMining Corpus

- High Quality Studio Data
  - Accurate sentence level transcriptions
  - (Almost) no background noise
  - Only one speaker per segment

- 14 hours of carefully annotated training data
- 3 hours of evaluation data (disjoint from training set)

- Main Challenges
  - Speaking rate (interview vs. read speech)
  - Spontaneous Speech in interview situation

Data: German News Shows
Comparable to VITALAS data sets from IRT and INA

Broadcast News
Broadcast Conversation
Experiments: Model Setup

- **Acoustic Models**
  - Maximum Likelihood Reestimation
  - Phonetic Clustering of triphones
  - 7300 triphone HMMs with up to 16 Gaussian mixture components

- **Language Models**
  - Trained on 2000-2006 newswire data with CMU SLM toolkit
  - 80 million running words
  - Text transformed to syllables
  - Corpus Topics: Politics, Economy, Culture, Sports

- **Pronunciation Lexicon**
  - 10000 most frequent syllables from LM training
Current Results - Speech Recognition

- Task: Syllable Transcription of 3 hours of Broadcast Data (Radio Shows)

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<th>Syllable Error Rate</th>
<th>ASR Realtime Factor</th>
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<td>34.3</td>
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- High error rates (test set includes several BC shows)
- Example for frequent substitution error:
  - Reference: U_n_t_ (and)
  - Recognized: U_n_ (an‘)
- Errors partly covered by fuzzy retrieval
Current Results – Fuzzy Phonetic Retrieval

- Task: Detect 213 keywords and keyphrases in recognition results
- Confidence thresholds of the fuzzy search can be chosen depending on the application

<table>
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<th>Confidence Threshold</th>
<th>Precision</th>
<th>Recall</th>
<th>Remark</th>
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<td>0.70</td>
<td>0.66</td>
<td>0.65</td>
<td>Equal Error</td>
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<tr>
<td>0.85</td>
<td>0.91</td>
<td>0.53</td>
<td>Tuned for Precision</td>
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- Some errors due to...
  - Search term is substring of actual spoken compound word (Klima – Klimakonferenz)
  - Short search terms consisting of highly frequent syllables (Mutter – mU.t6)
Additional Word Context for Enhanced Display of Results

1. Vocabulary Independent Syllable Recognition

   Audiofile
   
   | Speech | Speech |
   
   ...u:.?En.kli:.ma:.kOn.fe:.rEnts...

   Syllable Database

   Syllable-Search

2. "Classic" Word ASR

   Audiofile
   
   | Speech | Speech |
   
   ...der Kiel Markt Konferenz der Vereinte...

   Full Text Transcription

   Result Context

   Fusion
Demo: AudioMining
Next Steps

- **Evaluate the syllable approach on other languages**
  - Vitalas End-Users: IRT (German) and INA (French)

- **Improve Recognition Accuracy**
  - Use information extracted by structural analysis
  - Speaker / domain / programme adaptivity

- **Improve Information Retrieval Accuracy**
  - Fusion of word, syllable and phoneme recognition results
  - Exploit ASR output graph instead of 1-Best

- **Consider Scalability**
  - Current search approach not applicable for 10k hours archive
  - Evaluate efficient implementations and alternatives
Thank you!
Implicit feedback learning in semantic and collaborative information retrieval systems

by Gérard Dupont\(^1, 2\)

written under the direction of

Sébastien Adam\(^1\), Yves Lecourtier\(^1\), Bruno Grilheres\(^1, 2\), Stephan Brunessaux\(^2\)

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Summary

• Introduction
• Enhanced IRS with feedback learning
• Feedback learning in VITALAS
• Focus on learning using behavior measure as feedback
• Conclusion and future work
Introduction
Information retrieval?

“Information retrieval (IR) is finding material (usually documents) of an unstructured nature (usually text) that satisfy an information need from within large collections (usually stored on computers)”


Variables:

– Document and collection of documents: library, database, Intranet, Internet...

– Unstructured information without precise meaning

– Information needs expressed by users
Simple view of IRS

Aim: Matching query with documents (or part of documents)
- Information model to represent document and needs
- Similarity evaluation theory to produce ranked list of documents
Information model

- Vector model dedicated to text document retrieval

Document term vectors

\[
\vec{D}_i = \begin{pmatrix}
\text{word}_1 - 0.24 \\
\text{word}_2 - 0.4 \\
\text{word}_3 - 0.1 \\
\vdots \\
\text{word}_N - 0.1
\end{pmatrix}
\]

Query term vectors

\[
\vec{Q} = \begin{pmatrix}
\text{word}_1 - 0 \\
\text{word}_2 - 1 \\
\text{word}_3 - 0 \\
\vdots \\
\text{word}_N - 1
\end{pmatrix}
\]

Example of similarity formula (normalized cosinus)

\[
\text{score}(\vec{D}_i, \vec{Q}) = \frac{\langle \vec{D}_i, \vec{Q} \rangle}{\| \vec{D}_i \| \cdot \| \vec{Q} \|} = \frac{\sum_{k=1}^{N} d_{i,k} \times q_k}{\sqrt{\sum_{k=1}^{N} d_{i,k}^2 \times \sum_{k=1}^{N} q_k^2}}
\]

- Generalized probabilistic model

\[
P(D|L) = \prod_i P(A_i=a_i|L)
\]

- Term vector extended to description through attributes/values
- Relevance as probability
- Possibility to handle multimedia features as attributes
Limits of current IRS

Strong assumptions:

- Dimensions of the vector model or attributes in the probabilistic model are independent
- User information needs is fully described by its query

Not verified in most of the cases:

- Linguistic study tells us that terms are not independent in texts (synonymous, antonymous,...) neither are features extracted in CBIR
- User can not define precisely their needs since they are trying to complete their knowledge
Enhanced IRS with feedback learning
Feedback learning

By giving feedback about the presented documents, users tell more about their needs to the system.

Search becomes (again) an iterative process.

The IRS can enhance itself at multiple levels:
- information representation
- similarity evaluation
Feedback learning strategies

Many possibilities explored:

– Query rewriting (short term)
– Search context modelling (mid term)
– User model learning (long term)

Proven efficiency of explicit relevance feedback learning concept:

ex: “Rocchio” Algorithm established in the 70's
Explicit vs Implicit feedback

Experimental (and operational) studies have shown that users are reluctant to provide explicit feedback on documents.

Use of implicit (behavioral) indicators to fill the gap:
  - reading time, scroll behavior, click trough data, ...

Implicit data are known:
  - to raise privacy issues (but solutions exist)
  - to be noisy (or biased, but issues are raised on explicit bias too)
  - to be easy to gather in large amount
Explicit vs Implicit feedback

Hybrid approaches combine explicit and implicit data.

**Indicators**
- clicking
- scrolling
- command uses: saving, printing, sending, ...
- reading time/eye's tracking
- querying/input
- rating

**Behaviours**
- examine
- retain
- reference
- annotate
- create

**User's model**
- interests
- preferences
- usage patterns
- immediate information needs

are measured by

are inferred through
Feedback learning and search in context in VITALAS
Analysis of search logs

Search in context and relevance feedback : starting with search log data study in collaboration with CWI.

Research issues are :

- Do users of professional images IRS have the same behavior as classic users from state-of-the-art studies ?
- Are they advanced searchers ?
- Can we detect specific behavior pattern ?

Aim is to select the right approach.
First experiments

Experiments (conducted by CWI) with “implicit collaboration” using past search sessions:
- query suggestion
- term suggestion
- results suggestion

Experiments (conducted by EADS) on using implicit feedback data to infer document interests/relevance:
- interaction events tracking in web based GUI
- framework to learn search context in WebLab platform
- optimization framework for query/term suggestion
Focus on learning using behavior measurements as feedback
Search context with feedback

Explicit and implicit feedback have advantages and drawbacks. It is better to combine feedback through a common framework.

Measurements of current user behavior to extract interests:
- Time spent on reading a document
- Selection of terms in abstract
- Click on a link after reading its description
- Explicit rating of items

Matrix $X$ of measurements per documents/parts of documents

$$X = \begin{pmatrix} m_{1,1} & m_{1,2} & m_{1,3} & m_{1,4} \\ m_{2,1} & m_{2,2} & m_{2,3} & m_{2,4} \\ m_{3,1} & m_{3,2} & m_{3,4} & m_{3,4} \end{pmatrix}$$
Search context with implicit feedback

• Using past search history to learn relevance pattern in behavior measurements

\[
\text{Rel} = \begin{pmatrix} r_{1,1} & r_{1,2} & r_{1,3} & r_{1,4} \\
r_{2,1} & r_{2,2} & r_{2,3} & r_{2,4} \\
r_{3,1} & r_{3,2} & r_{3,4} & r_{3,4} \end{pmatrix}
\]

\[
\text{Irr} = \begin{pmatrix} s_{1,1} & s_{1,2} & s_{1,3} & s_{1,4} \\
s_{2,1} & s_{2,2} & s_{2,3} & s_{2,4} \\
s_{3,1} & s_{3,2} & s_{3,4} & s_{3,4} \end{pmatrix}
\]

• Classic supervised learning problem which enables the computation of current search context.

ex: a weighted vector of terms reflecting current interests.
Searching in context

Using the search context to enhance user experience while in a search session:

– Query expansion and/or suggestion to help users to define their needs
– Changing the similarity and ranking algorithm to personalize the behavior of the system to the user and its current needs
– Adapting the presentation of results
– Providing tools to interact/explore the corpus (to provide more accurate data for implicit relevance feedback)
Searching in context: a multi objective optimisation problem

Query expansion and/or suggestion as a multi objective optimization problem:
finding the “best query” regarding multiple criteria and constraints

\[ \tilde{f}(\tilde{x}) = [f_1(\tilde{x}), \ldots, f_i(\tilde{x}), \ldots, f_n(\tilde{x})] \]

with \[ \tilde{g}(\tilde{x}) \geq 0 \Longleftrightarrow [g_1(\tilde{x}) \geq 0, \ldots, g_i(\tilde{x}) \geq 0, \ldots, g_m(\tilde{x} \geq 0)] \]

Criteria examples: Precision, Recall, Diversity, Novelty

\[ P = \frac{N_{\text{relevant results}}}{N_{\text{results}}} \quad \quad R = \frac{N_{\text{relevant results}}}{N_{\text{relevant doc}}} \]

Adapted and personalized for each user or community of users
Evolutionary algorithm for query expansion/suggestion

Evolutionary algorithms to optimize the first user query:

1. Given a query of $N$ terms
2. Rank document
3. Evaluate criteria through user's feedback
4. Optimise the query vector to maximize the criteria
Evolutionary algorithm for query expansion/suggestion

Difficulties:

- High dimensionality of term space
  reduced through the use of search context learned from feedback
- Combinaison advanced query operator
  use of genetic programming to compute advanced queries

Multiple level of impact:

- Query suggestion (with or without complex syntax)
- Term suggestion to disambiguate with context
- Implicit rewriting with “push” of new documents
Evolutionary algorithm for query expansion/suggestion

User query vector in the whole vocabulary of N terms

\[ \tilde{Q} = \begin{bmatrix} \text{word}_1 - 0 \\ \text{word}_2 - 1 \\ \text{word}_3 - 0 \\ \vdots \\ \text{word}_N - 1 \end{bmatrix} \]

Search context which "activate" some parts of the vocabulary

\[ \tilde{C} = \begin{bmatrix} \text{word}_1 - 0,0 \\ \text{word}_2 - 0,89 \\ \text{word}_3 - 0,5 \\ \vdots \\ \text{word}_N - 0,01 \end{bmatrix} \]

Geometrical representation of search space, initial user query and search context used to limit the searched area
Expanding context using semantic and collaboration

Use of semantic knowledge bases to expand the context: changing the information model to concept space

– Classification/clustering problem in a graph or a hierarchy of semantic concepts

– Use of Word Sense Disambiguation (WSD) techniques

Knowledge representation comes out users past searches: use of collaborative search experiences and/or external bases (ontologies, wikipedia...)

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Conclusion and future work
Future research paths

– Finalisation of Logs analysis

– Exploration of feedback learning approaches
  - Implicit relevance learning with already existent data: Experimentation of state-of-the-art approaches in IR based on statistics and of pattern recognition approaches
  - Query expansion with evolutionary algorithms to optimise query weights with operators
  - Extension of collaboration to enlarge user search context by using user model similarity matching and developing new paradigm of collaboration

– Evaluation of proposed approaches

– Integration within WebLab platform (VITALAS V2 ?)
Bibliography


About the author

• Research engineer at EADS DS
• PhD thesis since November 2006 (in collaboration with LITIS laboratory)
• Involved in VITALAS (EC project 2007/2009)
  - EADS DS as software architect
  - Personal involvement in “search in context”
• Research interests:
  information retrieval, search engine, Web intelligence, information extraction, semantic extraction, machine learning, evolutionary algorithm, swarm algorithm, optimisation
Enhanced IRS

Information retrieval system

Query

Semantic Information Extraction

Query representation

Document representation

Similarity computation

Ranked document

Document base

Knowledge base

User logs

Learning engine

User models