# Emotion-Based Recommender System for Overcoming the Problem of Information Overload

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# Motivation

With the technological advance registered in the last decades, there has been an exponential growth of the textual information available (Bawden et al., 1999)

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Personal Assistant Agents (PAAs) can help humans to cope with the task of filtering out irrelevant information

PAAs should consider not only the user's preferences, but also their context and intentions when recommending a new piece of information

# Main Goal

Help humans with the Information Overload problem

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Develop a Emotion-Based News Recommender System
using a Multiagent Approach

# Background Knowledge

Natural Language Processing (NLP)

Affective Computing (AC)

Multiagent Systems (MAS)

Recommender Systems (RS)

# NLP & AC

Natural Language Processing
(Jurafsky and Martin, 2009)
*understand the language*

*Information Extraction (IE)*

*automatically extract structured information from unstructured natural language resources*

*Information Retrieval (IR)*

*locate specific information in natural language resources*

# NLP & AC

## Natural Language Processing

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## Affective Computing

(Picard, 1997)
*simulate human affect*

*Detect Affective States*

*explicitly or implicitly*

*Affective Interaction*

*make emotional experiences available for reflection*

# MAS & RS

Multiagent Systems
(Wooldridge, 2009)
*work in dynamic environments*

*Agents*

*multiple, independent,*
*autonomous and goal-oriented*

# MAS & RS

## Multiagent Systems
(Wooldridge, 2009)
*work in dynamic environments*

### *Agents*
*multiple, independent,*
*autonomous and goal-oriented*

## Recommender Systems
(Jannach et al., 2011)
*filter information*

### *Approaches*
*Collaborative Filtering,*
*Content-Based, Hybrid*

# Tasks

Collect

Extract

Represent

Share

Deliver

# Tasks

Collect information from different sources (Paliouras et al., 2008)

Extract

Represent

Share

Deliver

# Tasks

- Collect
- Extract information from the news (Ritter et al., 2011; Li et al., 2011)
- Represent
- Share
- Deliver

# Tasks

Collect

Extract

Represent the extracted information into a structured representation (Sacco and Bothorel, 2010; IJntema et al., 2010)

Share

Deliver

# Tasks

Collect

Extract

Represent

Share information between users, such as users' preferences and emotional features (González et al., 2002; Stickel et al., 2009; Yu et al., 2011)

Deliver

# Tasks

Collect

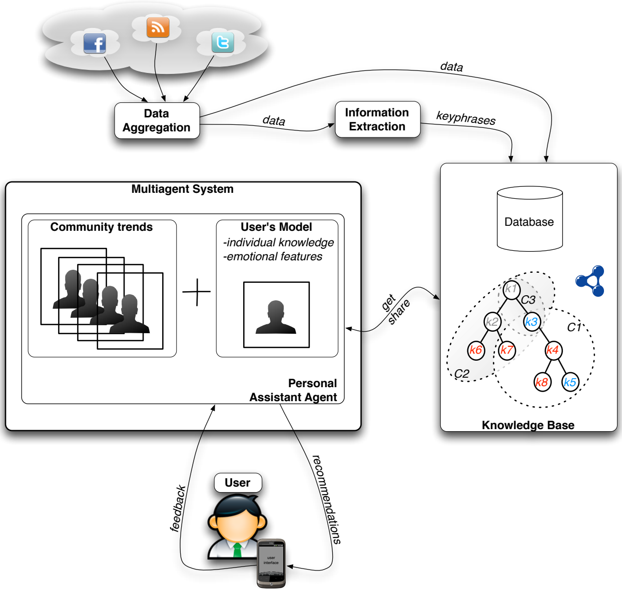
Extract

Represent

Share

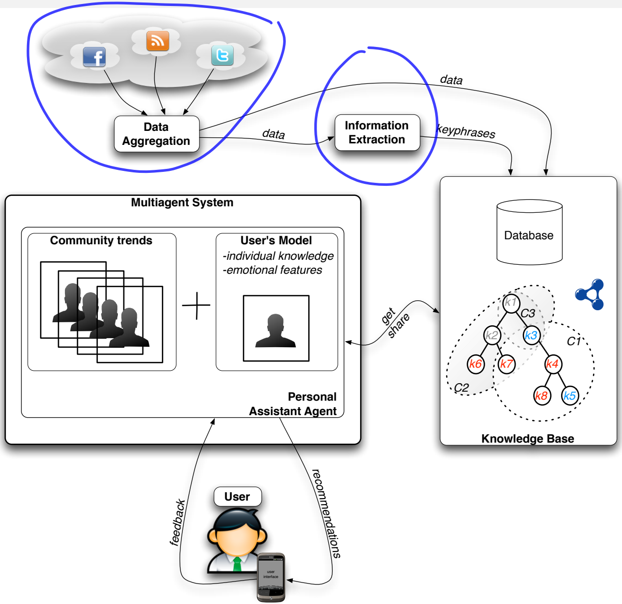
Deliver information based on the learned preferences and expected human's intentions (Knijnenburg et al., 2011; Lops et al., 2011; Costa et al., 2012)

# Approach



data
Data Aggregation
data
Information Extraction
keyphrases
Multiagent System
Community trends
User's Model
-individual knowledge
-emotional features
Personal Assistant Agent
get
share
Database
k1
C3
k2
k3
C1
k6
k7
k4
C2
k8
k5
Knowledge Base
feedback
User
recommendations

# Emotion-Based News RS's Architecture



# Data Aggregation and Extraction

## Data Aggregation

- capable of gathering information from a wide number of Web sources
- responsible for the information's quantity and quality

[1] http://dmir.inesc-id.pt/project/SentiLex-PT_02

[2] http://ontopt.dei.uc.pt

[3] http://dbpedia.org

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## Information Extraction

- automatically extract the most relevant terms
- terms polarity, e.g., ML algorithms and SentiLex[1]

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pre-filter

keyphrase extraction algorithm
post-filter

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pre-filter
: stopwords, POS tagger or grammars (Costa, 2010)

keyphrase extraction algorithm

post-filter
: e.g., discard verbs and rate the keyphrases (Onto.PT[2] and DBpedia[3])

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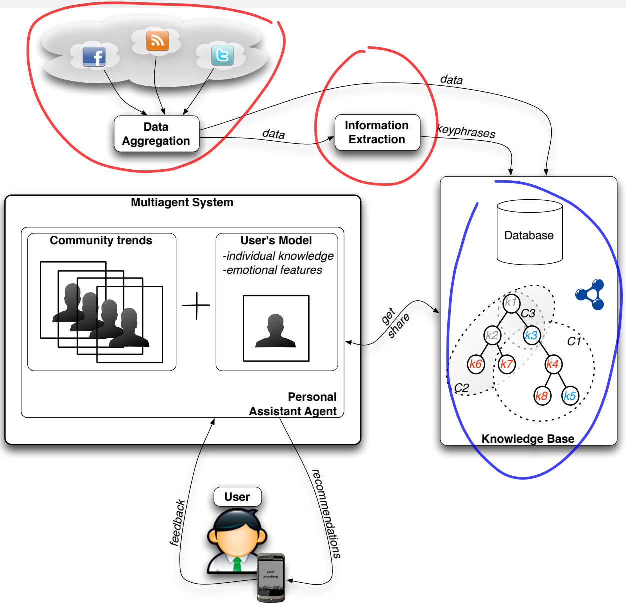


# Knowledge Base

Traditional Database

Ontology

# Knowledge Base

## Traditional Database

- store
  - the gathered information
  - users' feedback
  - community trends
- perform
  - tests
  - debug

## Ontology

# Knowledge Base

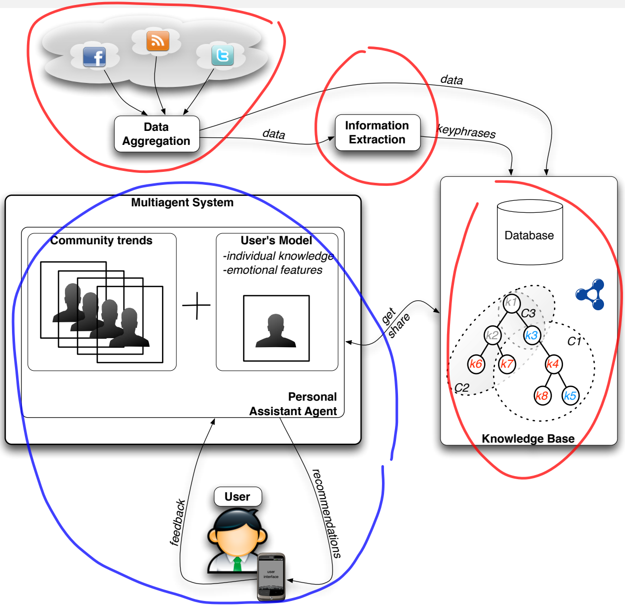
## Traditional Database

- store
  - ★ the gathered information
  - ★ users' feedback
  - ★ community trends
- perform
  - ★ tests
  - ★ debug

## Ontology

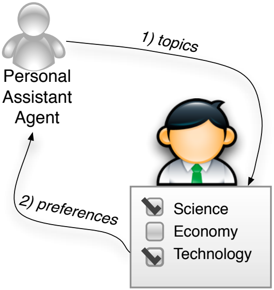
- represent structured information, i.e., keyphrases and their relations
- infer new knowledge, e.g., main topics by using clustering algorithms (to reduce the cold-start problem (Schein et al., 2002))

# Emotion-Based News RS's Architecture



# Personal Assistant Agents

## User's preferences



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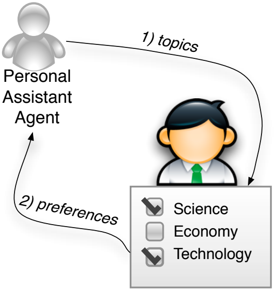
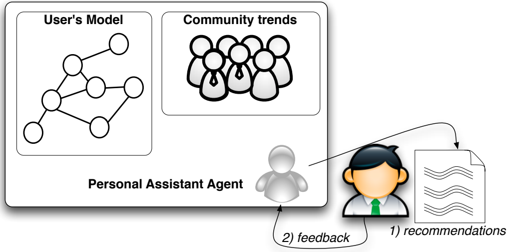



## User's feedback



# Validation

Knowledge Extracted

System's Recommendations

# Extraction Methods and Knowledge Extracted

## Manual Evaluation

- using a reliable sample size

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## Manual Evaluation

- using a reliable sample size

## Information Retrieval Methods

- quality
  - amount of keyphrases that are correctly identified (precision)
- quantity
  - amount of keyphrases among those that should have been extracted (recall)

# Recommender's Evaluation

Quality and Quantity

Performance

Usability

# Recommender's Evaluation

## Quality and Quantity

- users' feedback
- IR methods, e.g., precision, recall and $F_1$

## Performance

## Usability

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## Performance

- time the system consumes while executing the expected tasks
- system scales and keeps responding under different circumstances

## Usability

# Recommender's Evaluation

## Quality and Quantity

- users' feedback
- IR methods, e.g., precision, recall and $F_1$

## Performance

- time the system consumes while executing the expected tasks
- system scales and keeps responding under different circumstances

## Usability

- questionnaires to identify interface needs and assess the users' satisfaction

# Expected Contributions

Make a comparative view of the most common algorithms used to identify keyphrases and clusters

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Study the most suitable metrics to quantify and quality the information extracted

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Study the most suitable metrics to quantify and quality the information extracted

Define dynamic users' models to work in real-time

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Study the impact of sharing information among the users
*Does the introduction of collaborative recommendations improve the users' trust and usage?*

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Analyse if the affect-based PAA avoid their human owners from receiving irrelevant or emotionless information

# Deployment and Advertisement

## Collect Feedback

- ResearchGate[4], Forum-LP[5], Corpora List[6], Linguist List[7]

[4] https://www.researchgate.net

[5] forum-lp@di.fct.unl.pt

[6] corpora@uib.no

[7] linguistlinguistlist.org

# Deployment and Advertisement

## Collect Feedback

- ResearchGate[4], Forum-LP[5], Corpora List[6], Linguist List[7]

## Website

- get information about the project
- download the Application
- browse and search the Knowledge Base
- provide feedback

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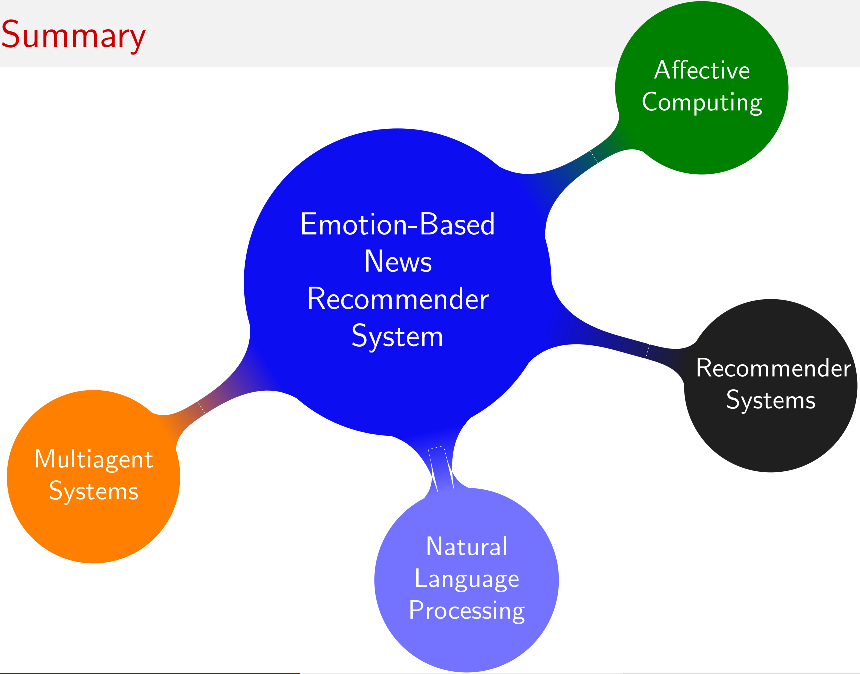
# Summary


Affective Computing
Emotion-Based News Recommender System
Recommender Systems
Multiagent Systems
Natural Language Processing

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Information Overload
Personal Assistant Agents
Recommender Systems
Multiagent Systems
User Modeling
Natural Language Processing
Information Extraction
Information Retrieval
Affective Computing
Beliefs Desires and Intentions
Machine Learning
Knowledge Bases
Affective Interaction
Explicit Feedback
Implicit Feedback
Keyphrases
Artificial Intelligence
Sentiment Analysis
Information Filtering
Precision
Happiness
Selective Filtering
Hybrid Systems
Deployment
Interest
User's Preferences
Evaluation
Clustering
Tagging
Ontologies
Belief-Desire Theory of Emotions
Desire
Agents
Folksonomies
Selective Attention
Validation
Collaborative Filtering
Ubiquitous Computing
Algorithms
User's Intentions
Frameworks
Context
Content-Based
Surprise
Cross-Validation
Advertisement
Recall
Over-Specialisation
Knowledge Based
Human-Computer Interaction
Emotions
Cold-Start