RECOMMENDATION AS A SERVICE (RaaS)

NEW CHALLENGES FOR AND EVALUATION METRICS OF RECOMMENDER SYSTEMS

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RECOMMENDATION AS A KEY BUSINESS DRIVER

Teaser

Recommendation

Advertisement

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3. Application analysis
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4. Recommendation as a Service
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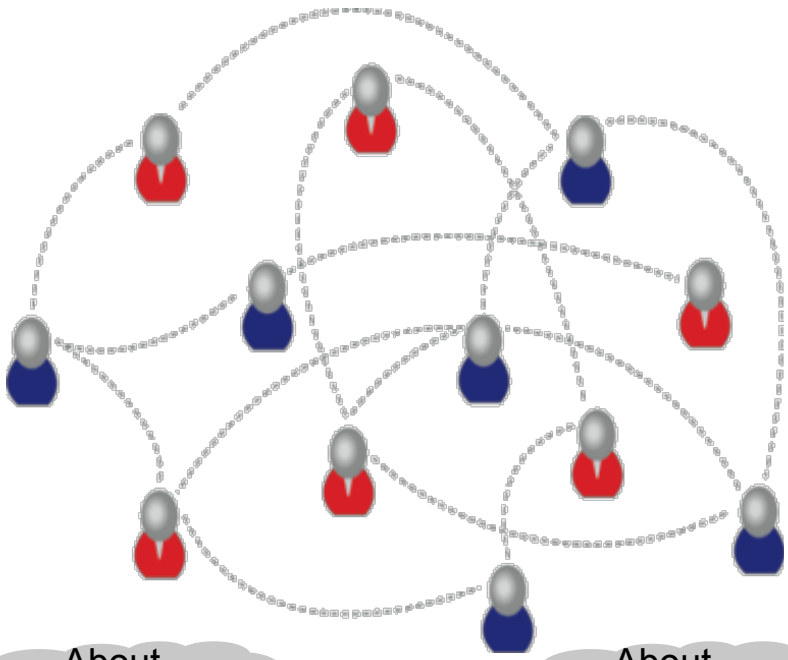
Spree the knowledge exchange network

MOTIVATION, TRENDS AND FOCUS FROM ADVERTISEMENT TO RECOMMENDATION



About users

Towards

About items

Community networks in a cross-domain and context-aware environment

New challenges for recommendation as an accepted, value added service (RaaS)

Individual usage

- single user → social network based

Recommendation object type

- single domain → cross-domain targeting
- classical sales → virtual goods

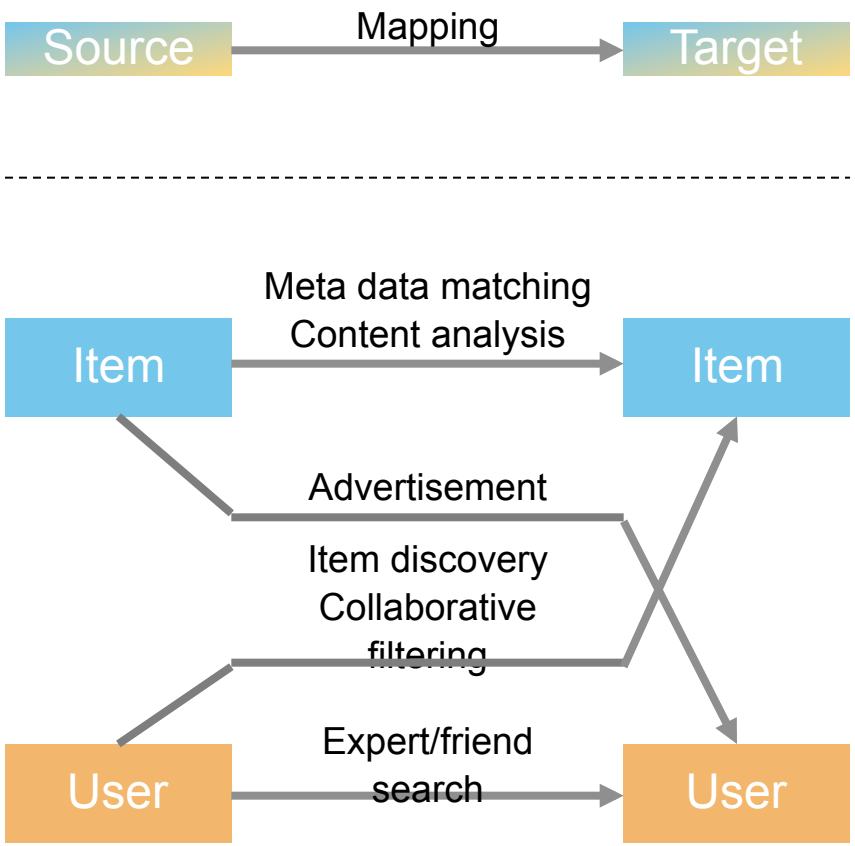
Device and context

- PC → smartphone, tablet, companion device
- profile → adaptive context-awareness

Business model and integration

- product → pay per success rate
- B2C → B2B for C2C
- browser plug-in → ease of integration

MOTIVATION, TRENDS AND FOCUS
DEFINITION OF RECOMMENDATION



Recommendation

represents a support for object discovery which

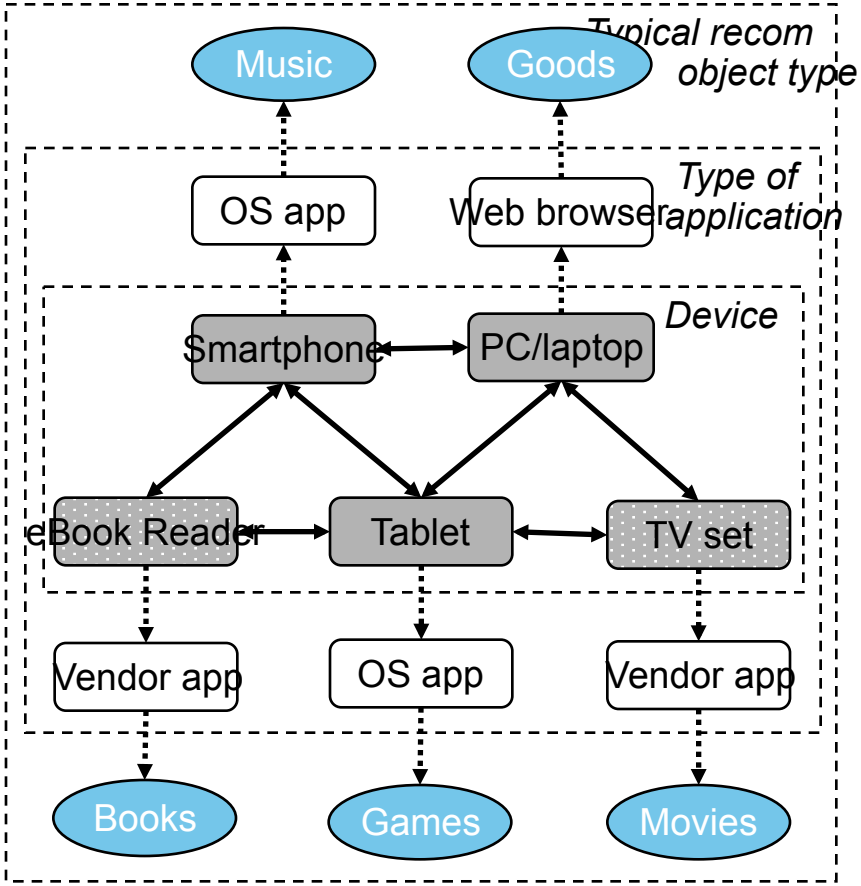
- maps sources onto targets
- clusters items within domains
- touches users within communities
- combines different methodologies

Recommendation (Definition)

Mathematically, a recommendation $\Re$ is a mapping function of a set of source objects onto a set of target objects by means of similarity detection, where objects are either items I or users U.

$\Re := \{I_1,\ldots, I_i, U_1,\ldots, U_j\} \rightarrow \{I_1,\ldots, I_m, U_1,\ldots, U_n\}$

MOTIVATION, TRENDS AND FOCUS DEVICE-CENTRIC RECOMMENDATION APPLIANCE



New devices drive the recommendation field

Device trends

- smart designs & mobility of devices
- dedicated personal use & specific use cases

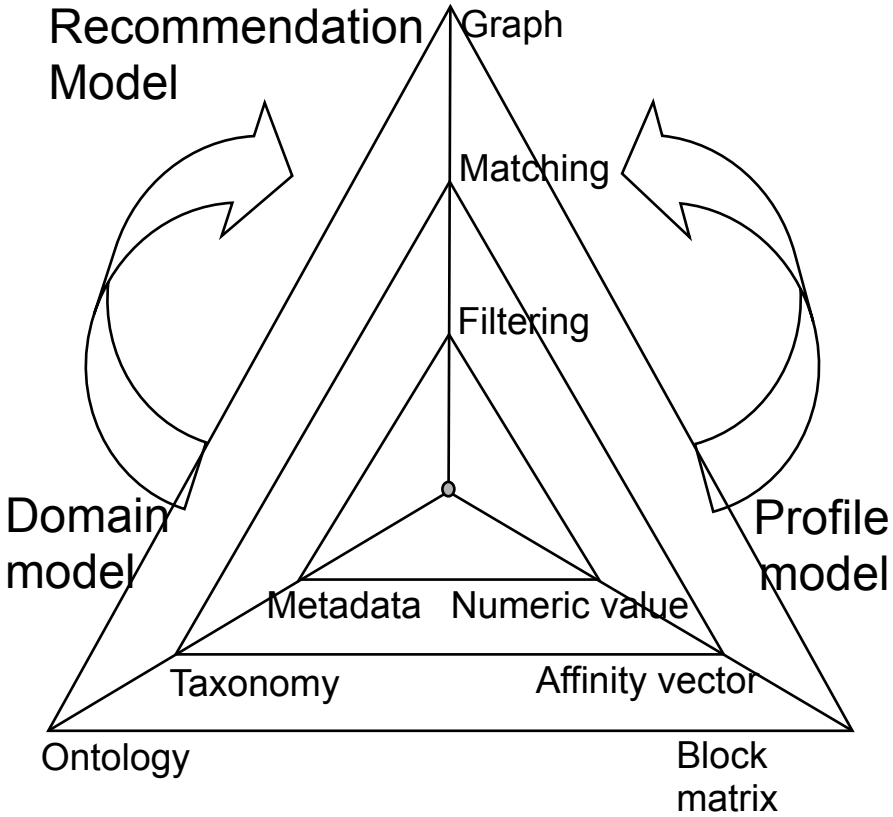
Application trends

- move from web to apps
- platform/operating system specific applications

Recommendation object trends

- multi-media objects are the key driver
- change from material to virtual goods
- community and inter-domain integration

MATCHING BASICS AND STRATEGIES QUALITATIVE & QUANTITATIVE SIMILARITY MODELING



A model of the environment focusing on high quality and performing matching results

Domain part

- characterizes the object types
- assigns qualitative attributes to objects

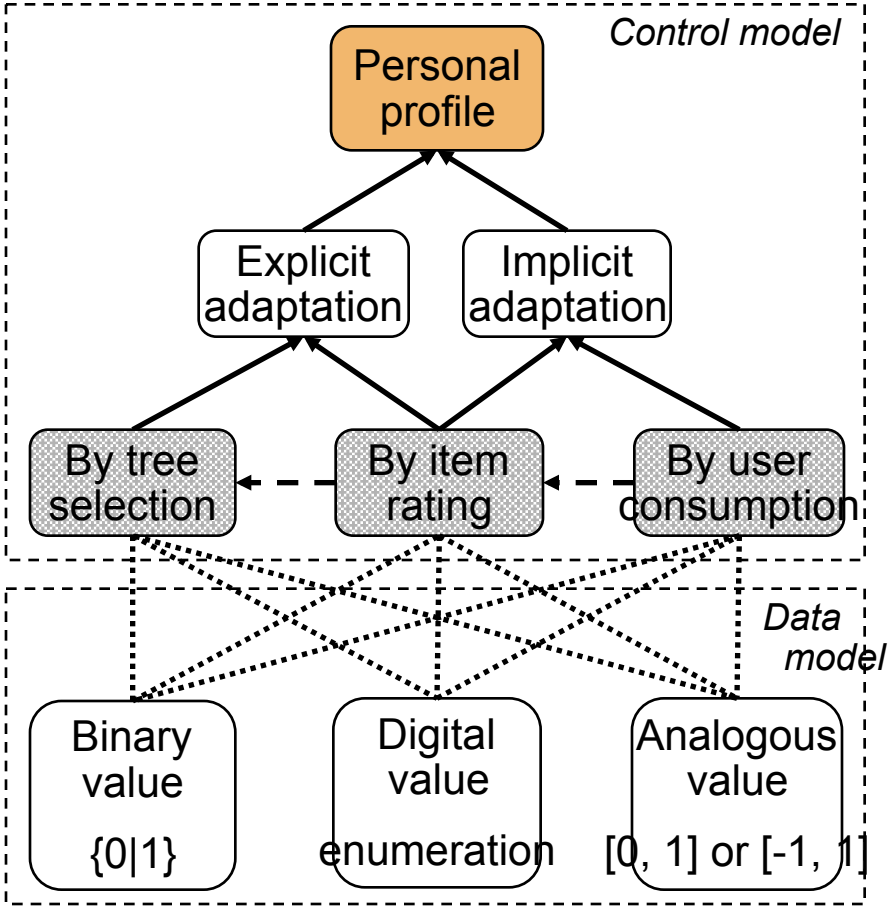
Profile part

- provides a database representation of attributes
- assigns **quantitative** affinity to attributes

Recommendation part

- offers mapping algorithms
- selects matching keys
- enables feedback loops

MATCHING BASICS AND STRATEGIES PROFILE HANDLING



Continuously adaptive profile adjustment as user driven (explicit) or consumption-driven (implicit) process

Selection tree

- hierarchical tree of key-value-pairs (taxonomy)

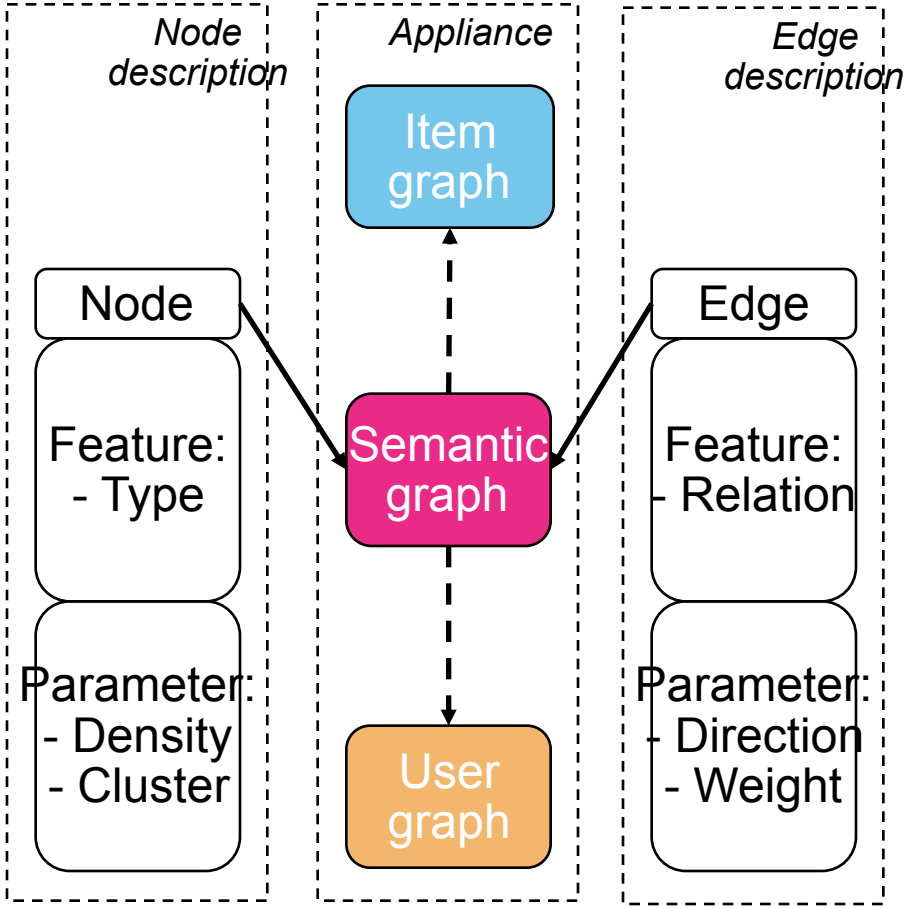
Item rating

- like-dislike (binary) or scale-based (digital or analogous) response after consumption

User consumption

- offers mapping algorithms
- selects matching keys
- enables feedback loops

MATCHING BASICS AND STRATEGIES SEMANTIC GRAPHS



An ontology is a graph representation of a semantic network.

Appliance of semantic graphs

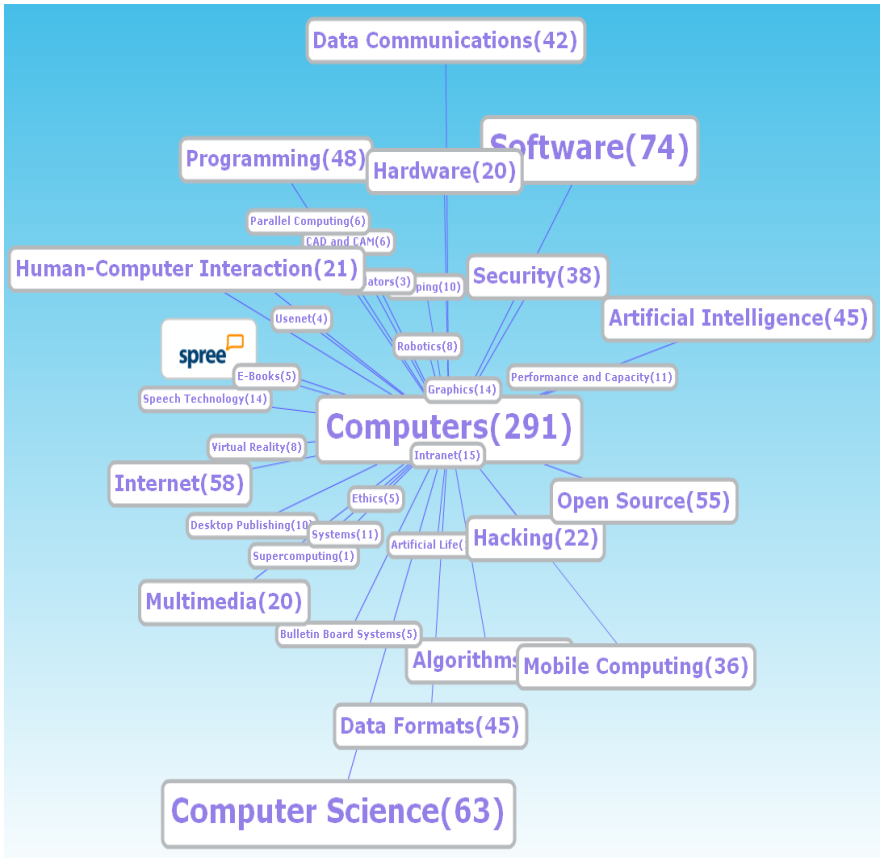
- item graph, e.g. product portfolio
- user graph, e.g. experts' community

Graph (Definition)

A graph Γ is defined a diagram representing a system of a set of connections or interrelations called edges **E** among a set of objects, called nodes or vertices **V**. Thus, mathematically Γ is a tuple of sets.

$\Gamma := (\mathbf{N}, \mathbf{V})$

MATCHING BASICS AND STRATEGIES USER GRAPH EXAMPLE “SPREEGRAPH”



“Spree - the knowledge exchange network” is an expert search and community application

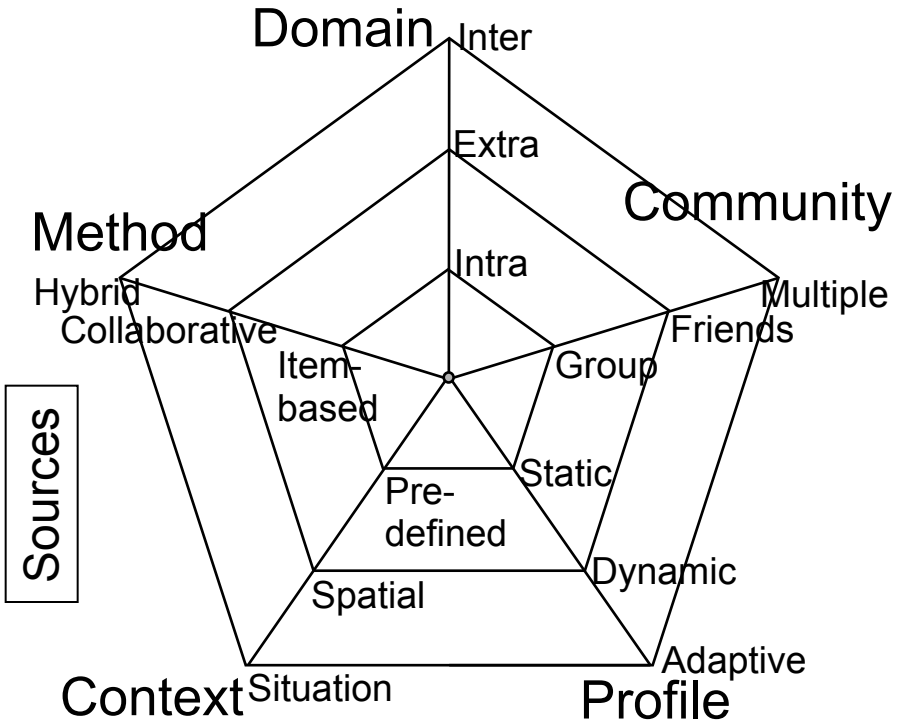
The “spree topic graph” GUI

- has topics as nodes
- visualizes topic relations as edges
- indicates the number of related experts in ( )
- can be centered to any node

The “spree user graph” GUI

- has experts as nodes
- visualizes user similarities as edges
- indicates the expertise overlapping in ( )
- can be centered to any node

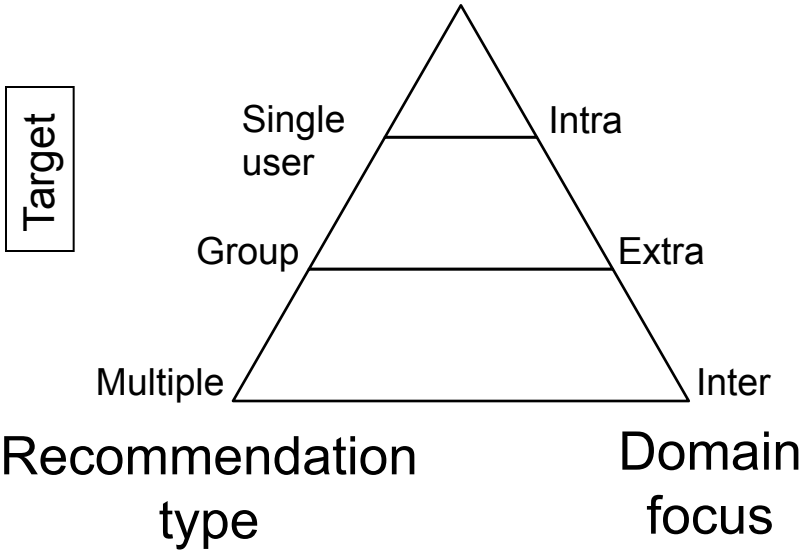
RECOMMENDER EVALUATION SOURCES: FIVE DIMENSIONS FOR CLASSIFICATION



Metrics for easily evaluation of implementations

- Domain: characterizes the knowledge domain
  - attributes: intra, extra, inter domain
- Community: addressing recommendations to a single user or a group of people
  - attributes: group, friends, multiple
- Profile: interests represented as personal profile
  - attributes: static, dynamic, adaptive
- Context: generalization of environmental and personal situations
  - attributes: predefined, spatial, situation
- Method: use of a single key

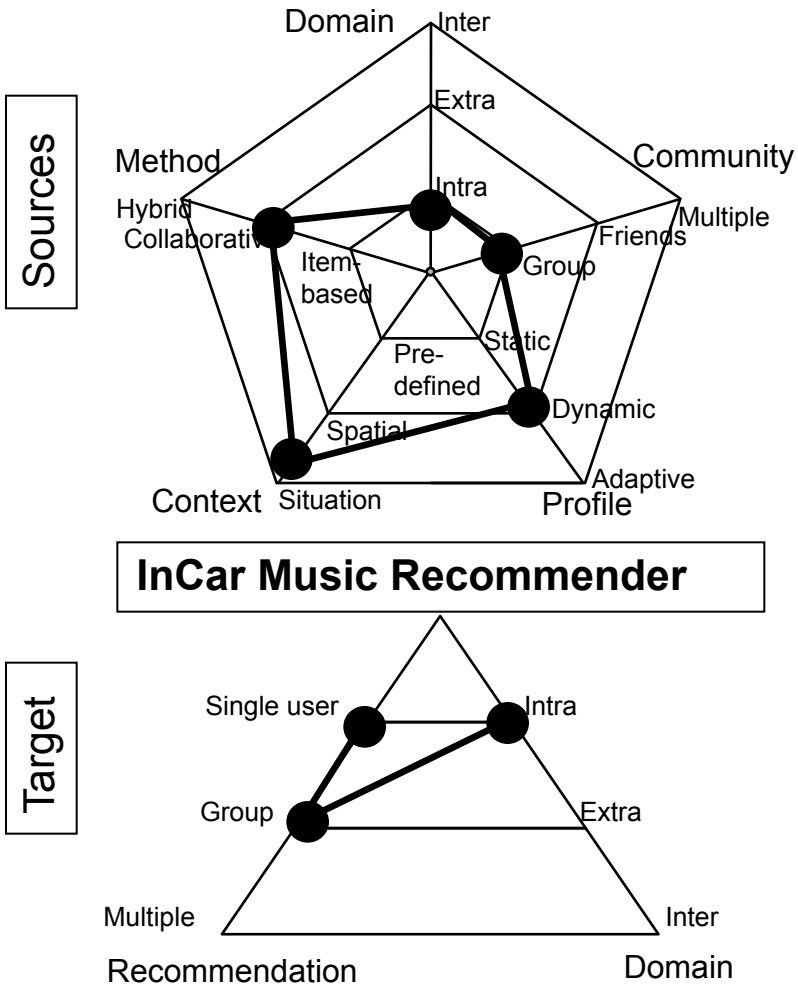
RECOMMENDER EVALUATION
ENHANCED TARGETS OF RECOMMENDATION



Targets focus on the recipients of presented items which are described in two categories

- "Communification":
  Providing recommendation items for more than one individual
  - attributes: a single user, a group of users or multiple users in a certain context
- "Domainification":
  Providing best recommendation items concerning the knowledge or product domain
  - attributes: intra, extra and inter domain)

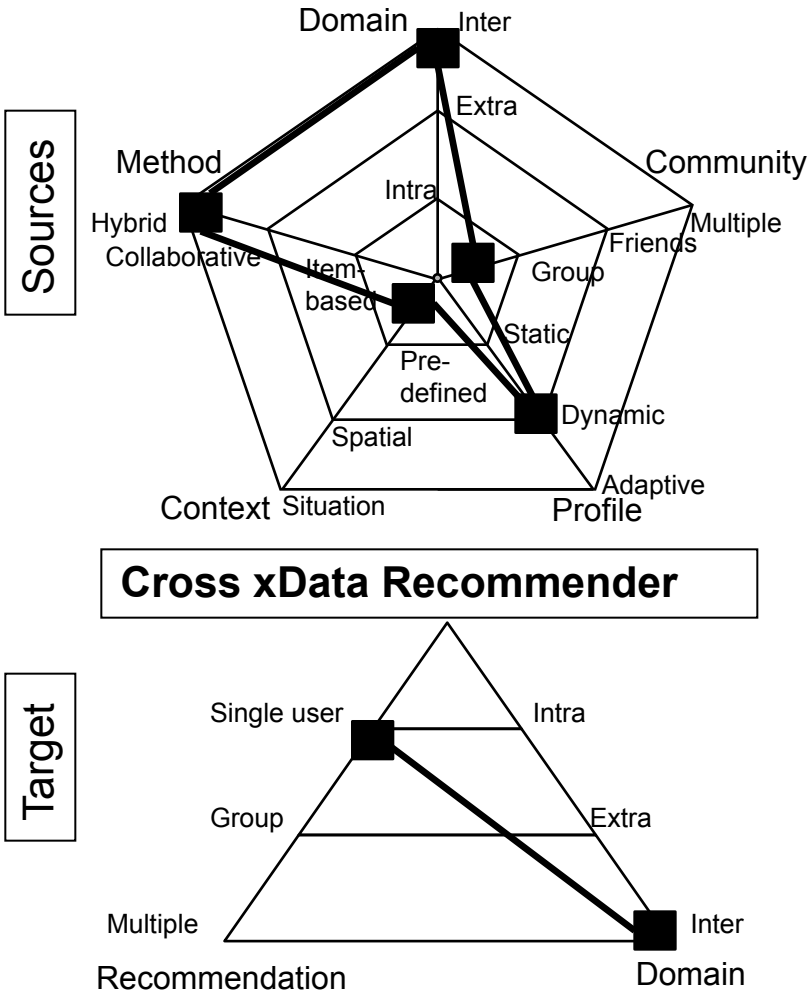
RECOMMENDER EVALUATION EXAMPLE: INCAR MUSIC RECOMMENDER



Music recommendations for a individual user or a group of people, while sitting in a car

- Onboard music consumption can be highly affected by the context (e.g. traffic, road type, weather)
- InCar Music Recommender adjusts the specific context situation
- Music items are presented to a group (people who are sitting in a car) or to a single user within (intra) the music domain

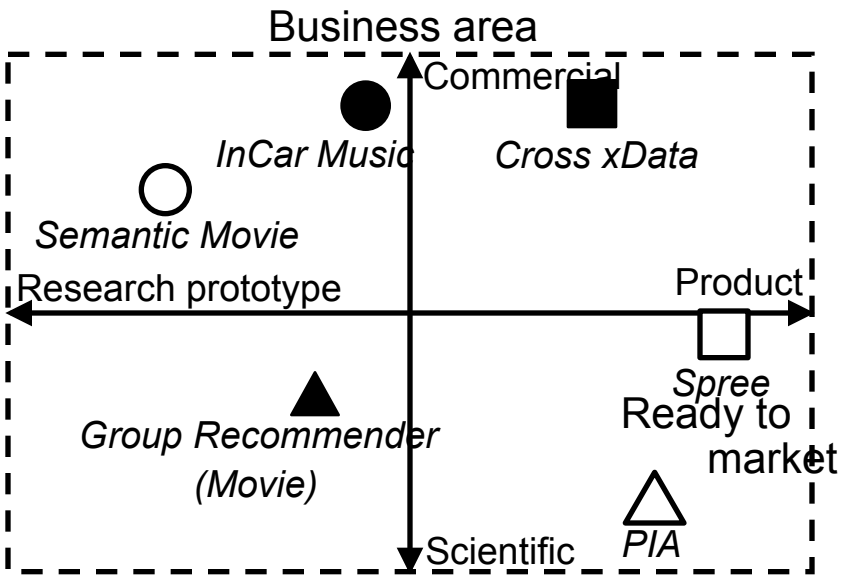
RECOMMENDER EVALUATION EXAMPLE: CROSS XDATA RECOMMENDER



Recommender system with a flexible hybrid recommender linguistic engine

- Hybrid recommender combining all applied algorithms to gain results
- Emphasizes items that do not have best rating by a single source algorithm
- A single user retrieves recommendations from several (inter) domains
- Application targets: ad-on for scout24 group, family@home

RECOMMENDER EVALUATION
BUSINESS EVALUATION SUMMARY



Regarded prototypes can be assigned to different stages of marketability

- Scientific aspects cover recommendation engines, profile, domain modeling, interface and implementation issues
- Commercial aspects focus on the portfolio offering for RaaS and product development
- Research prototype describes the status as a “research project”
- Product view focusses on the status ready to market

● InCar Music: InCar Music Recommendation

■ Cross xData: Hybrid Recommender for media

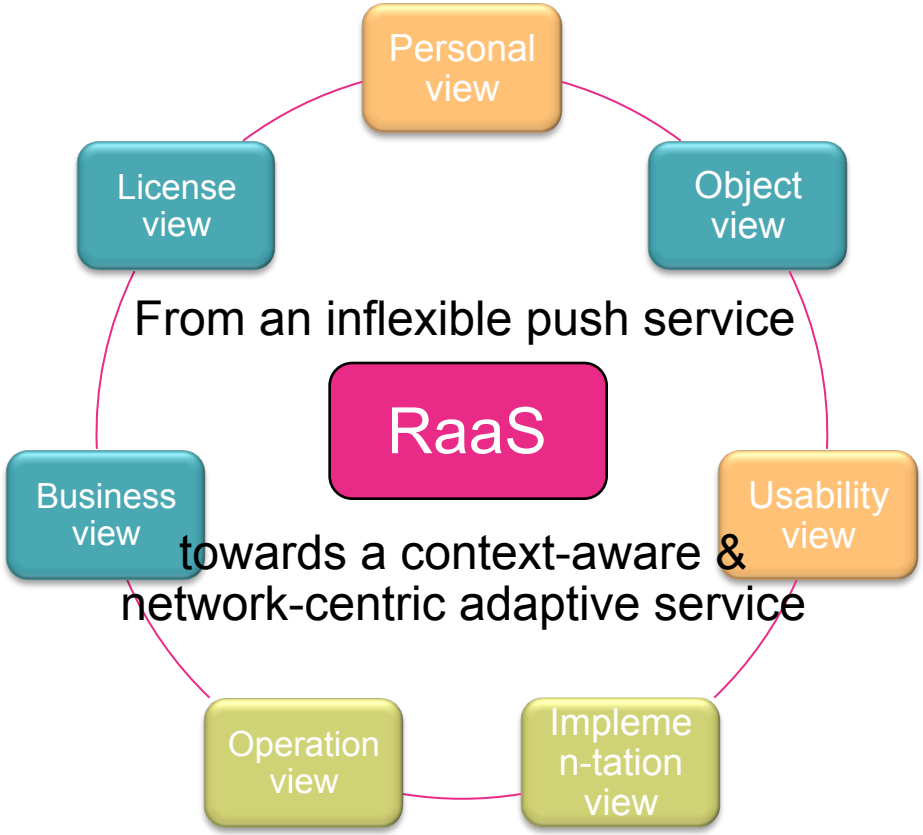
▲ Group Recommender (movie): Group Recommendation for movie items

○ Semantic Movie: Personalized movie recommendati

□ Spree: Knowledge Exchange Network

△ PIA: Personal Information Assistant

GUIDE FOR RECOMMENDATION SERVICES MULTI-DIMENSIONAL ASPECTS OF RAAS



- Personal view: based on interests of a group of people or a special community
- Object view: cross-domain enhancement for business for e.g. shopping portals
- Usability view: proofed presentation of recommendation results to be significant
- Implementation view: RaaS will enrich technology and interfaces, e.g. profiles
- Operation view: information storage, data processing and interfaces to be considered for operation of recommendation
- Business view: development of new business models
- License view: attractive B2B lice models to be considered in future

GUIDE FOR RECOMMENDATION SERVICES USERS PERSPECTIVE: PERSONAL & USABILITY

Personal view

The interests of a group of people or a special community will be important in future:

- Group recommendation:
  consideration of the interest of a group instead of delivering recommendations to a single user
- Community:
  integrating friends and experts instead of commercial sources as valuable new source for recommendation

Usability view

- Mobile screen:
  the small screen size of a mobile phone limits the number of recommendation results
- Psychological aspects:
  a user has limited suscepti-bility for evaluating presented items
- Personal clustering:
  buying decision is easier if the similarity of items is limited
- Context awareness:
  context parameters can highly improve the customer's acceptance

GUIDE FOR RECOMMENDATION SERVICES OPERATORS VIEW: IMPLEMENTATION & OPERATION

Implementation view

Implementation of RaaS needs to be adaptive to existing pieces of software:

- Adaptive profiles:
  fast integration in existing software environment and profile adjustments
- Adaptive algorithms:
  flexible algorithm configuration can fit to business requirements
- Adaptation to mobile environment:
  fast integration into mobile services and apps

Operation

- Distributed information storage:
  distribution over the involved IT infrastructure: security, scalability and performance
- Distributed data processing:
  data should be processed always close to their storage location under one legal responsibility.
- Interfaces:
  supporting of flexible B2B APIs or classical browser plug-ins for all commonly used browsers on fixed and mobile platforms

GUIDE FOR RECOMMENDATION SERVICES BUSINESS, OBJECTIVE & LICENCE VIEW

Business view

- Vendor of recommendation service:
  growth of profit for selling recommendations services must be sufficient
- Vendor portals:
  enterprises should benefit from this solution
- RaaS:
  third party provisioning of recommendation solutions as venture candidates

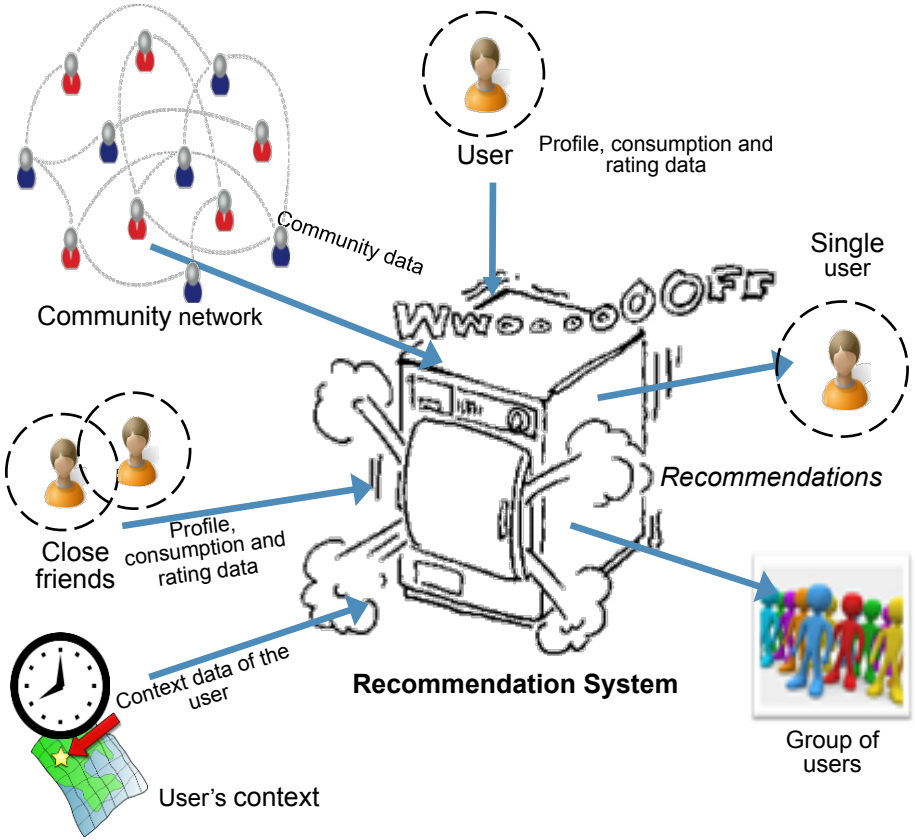
Objective view

- Transfer learning:
  Analyzing customer's behavior (big data) and adaption these findings to an unknown domain
- Shopping portals:
  Enterprises can benefit from a cross-domain solution

Licence view

- RaaS license model:
  pay-per-use as innovative license model
- Success verification:
  success rate measurements of targeted advertising

GUIDE FOR ECOMMENDATION SERVICES MODULAR SERVICES



Offering successful RaaS the sources and targets should be extended in a flexible and modular manner:

- User's context: context data, e.g. time, location
- Friends: ratings and profile data from close friends
- Community network: integrating friends and experts from multiple communities
- Recommendation for a single user: using personalized and adaptive profile
- Recommendation for a group: recommended items fit to the interest of the group of people
- Cross-domain: combine different item sets

THANKYOU! Ideas & comments?

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