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Ranking database results based on context.

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Overview

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- Motivation
- A model of relevance
- Introduction to preference rules
- Connecting preference rules and relevance
- Implanting the model on top of a DBMS
- Summary and outlook

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Motivation

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- Many information available in digital form.
- Need for personalization
  - Based on person
  - Based on situation
  - ➢ Based on context

MultimediaN

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A model of relevance

- Traditional:

$$P(D = d|Q = q \wedge U = u) = \frac{P(Q = q|D = d \wedge U = u)P(D = d|U = u)}{P(Q = q|U = u)}$$

- Adding “situatedness” to user:

$$P(D = d|Q = q \wedge U = u_{sit}) = \frac{P(Q = q|D = d \wedge U = u_{sit})P(D = d|U = u_{sit})}{P(Q = q|U = u_{sit})}$$

Influence of context

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- Context affects query generation.
- Context affects general relevance of tuple.
- If query has lower probability to follow from situation, resulting documents more likely to be relevant.

$$P(D = d|Q = q \wedge U = u_{sit}) = \frac{P(Q = q|D = d \wedge U = u_{sit})P(D = d|U = u_{sit})}{P(Q = q|U = u_{sit})}$$

Influence of situatedness

- Context affects query generation.
- Context affects general relevance of a document.
- If query has lower probability to follow from situation, resulting documents more likely to be relevant.

$$P(D = d|Q = q \wedge U = u_{sit}) =$$

$$\frac{P(Q = q|D = d \wedge U = u_{sit})P(D = d|U = u_{sit})}{P(Q = q|U = u_{sit})}$$

Introduction to preference rules

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- Relates contextual features to features of documents together with a weight (C,P,σ)
- Examples:
  - (KoffieRoom, Jazz, 0.8)
  - (Cheerful, Eighties, 0.7)
- Semantics:
  - Preferences taken from choices in history.
  - *If we pick a random moment in history when a situation had feature C and a user made a choice, the chance that (s)he chose a document with feature P is σ.*

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Preference rules and relevance

- Introducing features in relevance model

$$P(D = d|U = u_{sit}) = P(D = d|F(d) = \underline{f}, G(u_{sit}) = \underline{g})$$

- The most relevant document in a situation:
  - *The document for which the chance is highest that we chose before, in the situation with the same features, a document with the same features.*
  - Relevance of one document:

$$= \prod_{r_p | r_c \in \underline{g}} \begin{cases} \sigma & \text{if } r_p \in \underline{f} \\ 1 - \sigma & \text{if } r_p \notin \underline{f} \end{cases}$$

Example & assumptions

Situation: KoffieRoom, Cheerful

¬ Jazz , ¬ Eighties : (1-0.8)(1-0.7)= 0.06

- Document features of rules do not depend on document features of other rules.
- Rules define “everything”
  - Information not coded in rules (e.g. music is loud, reading a paper) does not play any role.
- What if situation did not occur before
  - System don’t know: Default rules

Uncertainty of features

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- Conditioning

$$P(D=d|G(u_{sit})=\underline{g}) = \sum_{F(d)=\underline{f}} P(F(d)=\underline{f}) \cdot P(D=d|F(d)=\underline{f}, G(u_{sit})=\underline{g})$$

$$P(D=d) = \sum_{G(u_{sit})=\underline{g}} P(G(u_{sit})=\underline{g}) \cdot (\sum_{F(d)=\underline{f}} P(F(d)=\underline{f}) \cdot P(D=d|F(d)=\underline{f}, G(u_{sit})=\underline{g}$$

  - Leads to probability that document is the ideal document P(D=d) of:

$$= \sum_{G(u_{sit})=\underline{g}} P(G(u_{sit})=\underline{g}) \cdot (\sum_{F(d)=\underline{f}} P(F(d)=\underline{f}) \cdot \prod_{r_p|r_c \in \underline{g}} \begin{cases} \sigma & \text{if } r_p \in \underline{f} \\ 1-\sigma & \text{if } r_p \notin \underline{f} \end{cases})$$

A word about querying (1/2)

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- Rules coded in Description Logics

$$Context : \{PETER\} \sqcap (\exists\, hasActivityType.FreeTimeActivity)$$

$$Preference : TvProgram \sqcap (\exists\, hasGenre.\{HUMAN\text{-}INTEREST\})$$

- DL model, maps to database
  - Concept tables
    - Movie, Person, Genre, ...
  - Role tables
    - hasGenre, hasRoom, hasMood, ...

Another word about querying (2/2)

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- Uncertainty addressed with event expressions
  - Special DL operators that include calculation of event expression
  - Construct view
- Preference view is generated from rules
  - Contains view on all preferred documents with relevance score
  - Can be queried
  - Could be domain specific

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Wrap-up and outlook

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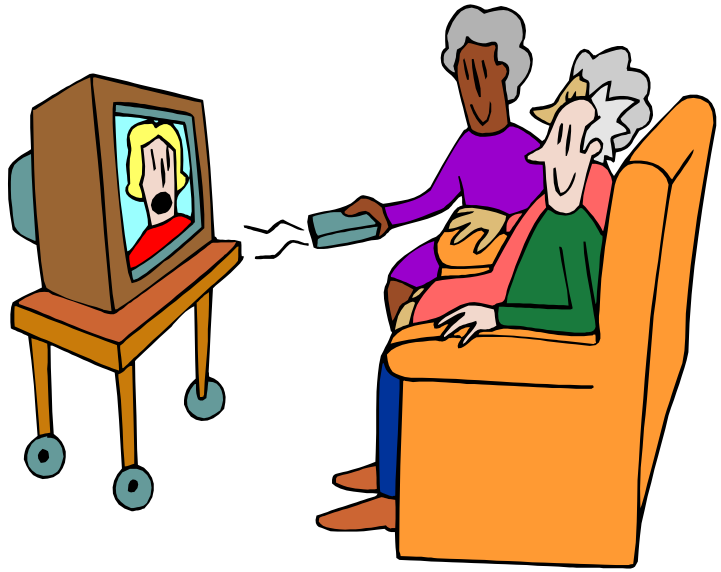
- Wrap-up
  - Relevance
  - Preference rules
  - Querying
- What's next?
  - More implementation
  - Addressing efficiency
  - Explanation of results



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Questions?

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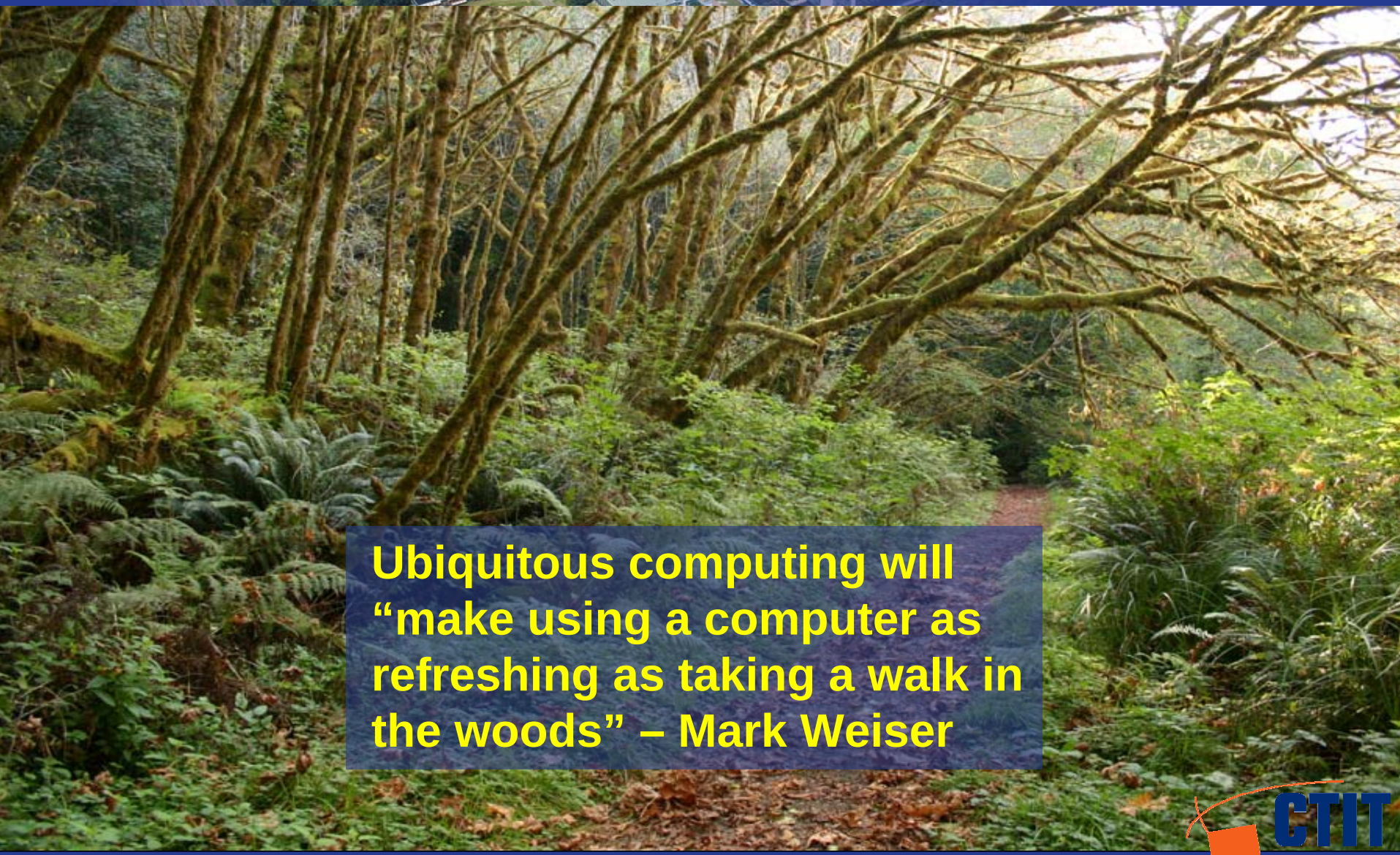

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Example

- Rules
  - (KoffieRoom, Jazz, 0.8)
  - (Cheerfull, Eighties, 0.7)
- Situation
  - KoffieRoom : 0.5
  - Cheerfull : 0.3
  - ...
- Document
  - Eighties: 0.9
  - ...

Example (continued)

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- Sit: CoffeeRoom ∧ Cheerfull
  - Doc: Eighties ∧ Jazz
    - 0.8 * 0.7
  - Doc: Eighties ∧ ¬ Jazz
    - 0.8 * (1-0.7)
  - Doc: ¬ Eighties ∧ Jazz
    - (1-0.8) * 0.7
  - Doc: ¬ Eighties ∧ ¬ Jazz
    - (1-0.8) * (1-0.7)
- Sit: CoffeeRoom ∧ ¬ Cheerfull
- Sit: ¬ CoffeeRoom ∧ Cheerfull
- Sit ¬ CoffeeRoom ∧ ¬ Cheerfull

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