

# A NEW APPROACH FOR SERVICE DISCOVERY AND PREDICTION ON PERVASIVE INFORMATION SYSTEM

Salma Najjar, **Manuele Kirsch Pinheiro**, Carine Souveyet

Centre de Recherche en Informatique (CRI)  
Université Paris 1 - Panthéon Sorbonne  
[Manuele.Kirsch-Pinheiro@univ-paris1.fr](mailto:Manuele.Kirsch-Pinheiro@univ-paris1.fr)

# Outline

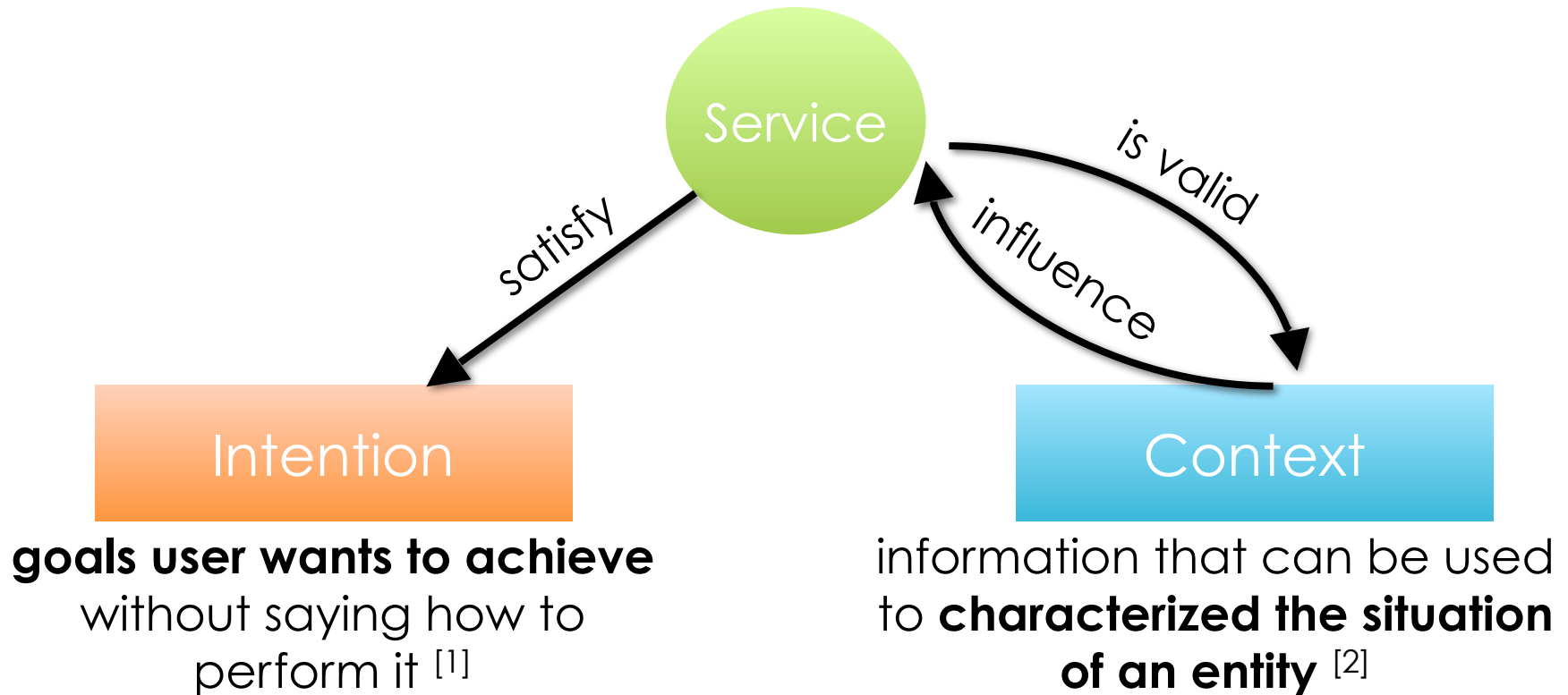
- Motivations
- A vision for Pervasive Information System
- Service discovery
- Service prediction
- Evaluation
- Conclusions & perspectives

# Motivations

- New technologies and practices (BYOD, smartphone) expanding **Information System (IS)**
- A new generation of IS is rising ...
- **Pervasive Information System (PIS)**
  - IS **services** available **anytime, anywhere**
  - **Heterogeneity & Transparency**
- Evolving IS into PIS demands a new vision
  - Focus on the **user's needs**, not in the technology
  - Satisfying **user's goals** according to the **context**
  - **Anticipating** user's goals for more proactivity

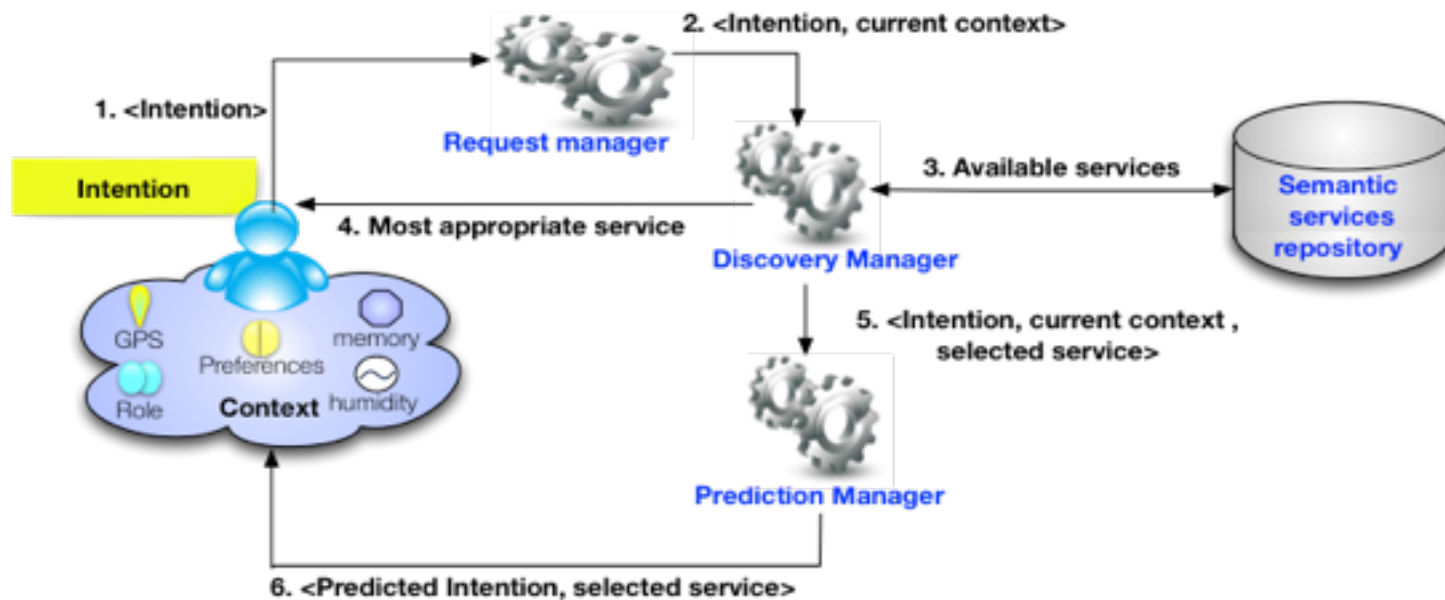
## A vision for Pervasive Information System

- A new user-centric vision for PIS :
  - **Services** satisfying an **intention** in a given **context**



# A vision for Pervasive Information System

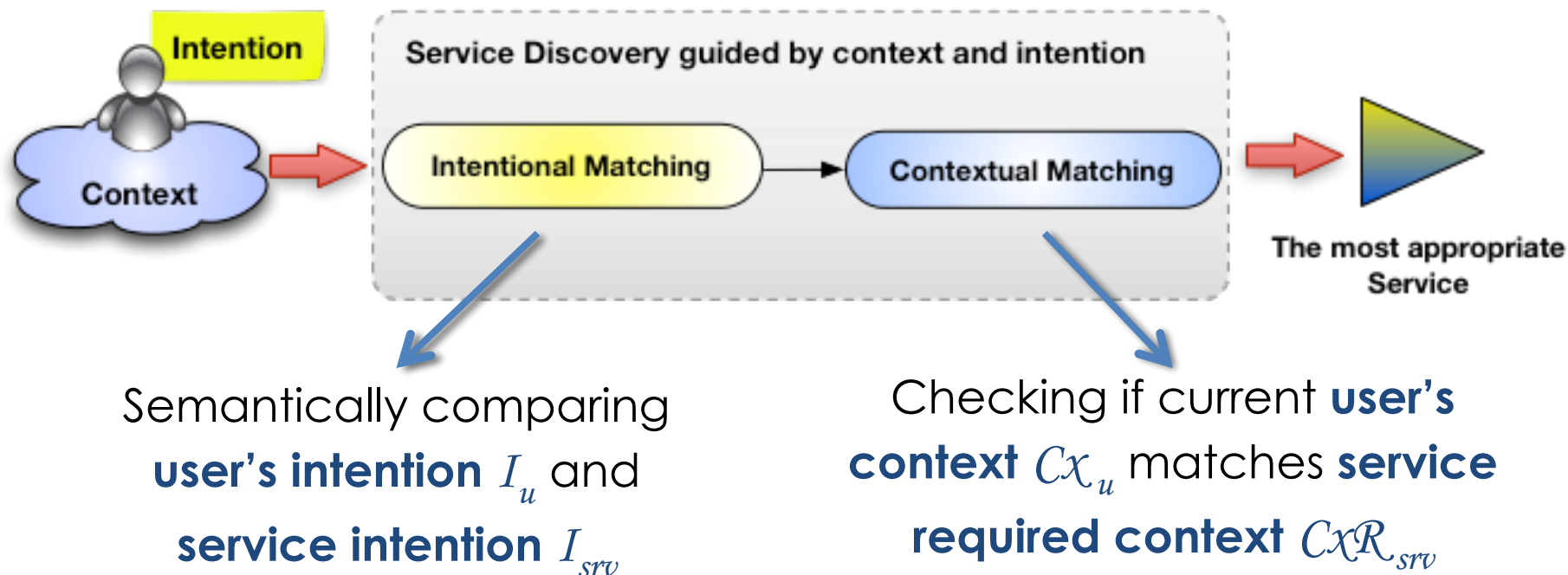
- **Service Discovery:**
  - Offering appropriate service according **immediate** user's **intention and context**
- **Service Prediction:**
  - **Anticipating** user's situation (intention & context)



# Service Discovery

## • Service discovery

- Selecting the **better ranked service** according user's **current < intention, context >**



# Service Discovery

- **Intention matching**

- An intention can be represented as <sup>[1]</sup>:

$$I = \langle \textit{verb} , \textit{target} , [\textit{parameter}]^{\star} \rangle$$

- Semantic matching based on dedicated ontologies

- **Target matching**

- **Target ontology**: possible targets made available by the PIS
- Level of matching: **Exact, Subsume, Plugin, Fail**

- **Verb matching**

- **Verb ontology**: significant actions authorized by the PIS
- Level of matching: **Exact, Synonym, Hypernym, Hyponym, Fail**

# Service Discovery

- **Context matching**

- **User's context ( $Cx_u$ )**: a set of observed **values** considering **context elements** for a given **subject**

$$Cx_u = \langle \text{Subject, Context element, [ Values ] } * \rangle$$

- **Service required context ( $CxR_{srv}$ )**: a set of **conditions** expressed over **context elements**
- Evaluating the satisfaction  $CxR_{srv}$  with respect to  $Cx_u$ 
  - **Ontology matching** for **subject** and **context element**
  - Evaluating **condition** expressed over **context values**

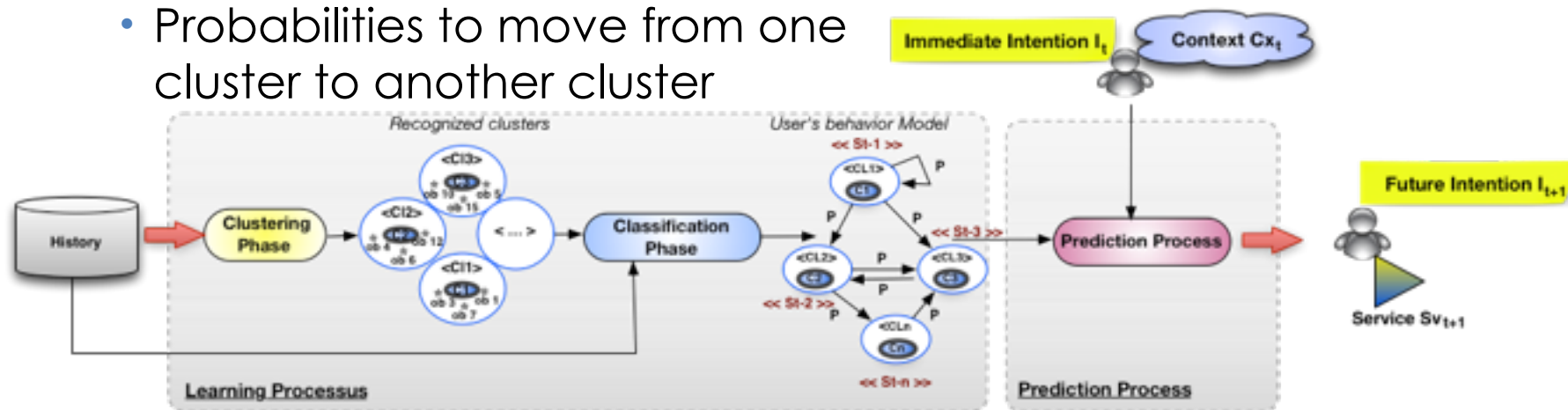
$$\sum_{i=1}^n (w * \text{ContextConditionMatching}(cx_i, cx_j))$$



# Service Prediction

## • Service prediction

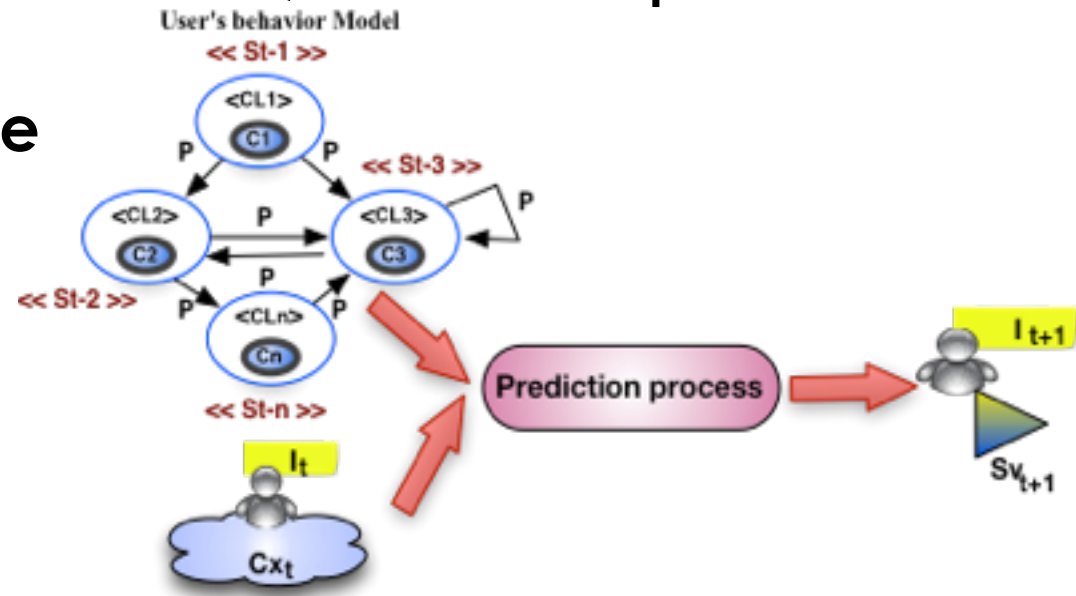
- Proposing next service based on **user's history**
- **Situation**  $S_i = \langle I_{ui}, Cx_{ui}, Srvi \rangle$
- **Clustering**: Similar **situations** grouped into cluster represented by a centroid
- **Classification**: **User's behavior model** represented by a **Markov chain**
  - Probabilities to move from one cluster to another cluster



# Service Prediction

- **Service prediction**

- Prediction based on the **user's behavior model**  $\mathcal{M}_c$
- **Semantically matching** current user's  $\langle I_u, Cx_u \rangle$  with **states (situations)** represented in  $\mathcal{M}_c$ 
  - Finding **most similar situation**, then its **most probable successor**
- **Proposing service** associated with **next situation**



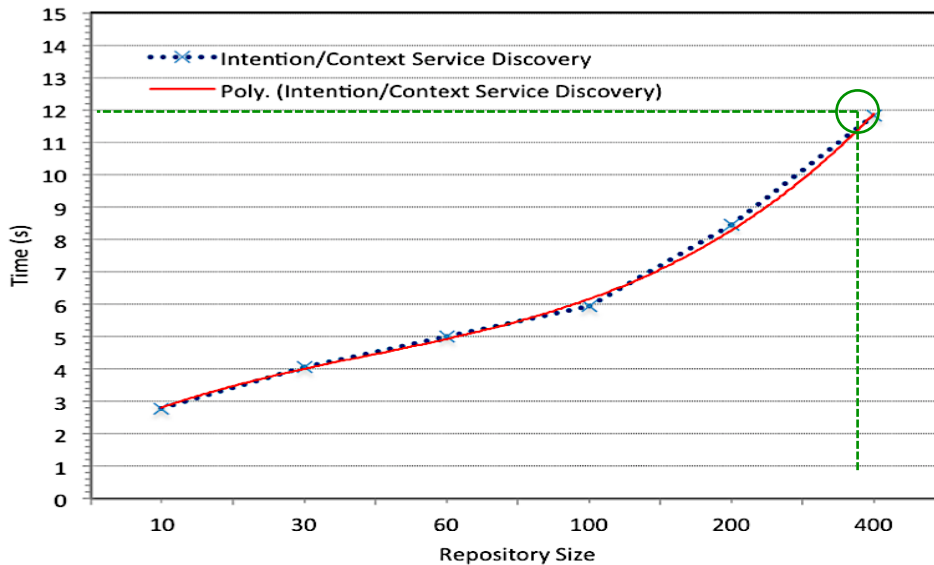
# Evaluation

- Evaluating feasibility of proposed mechanisms
  - **Scalability** and **quality (precision & recall)**
- **Environment:**
  - Intel Core I5 1.3Ghz and 4Gb RAM
  - OWLS-TC2 dataset extended with intention & context descriptions
  - Trace database (scenario & random traces)
- **Results**
  - Promising results
  - Quality depending on the dataset and thresholds

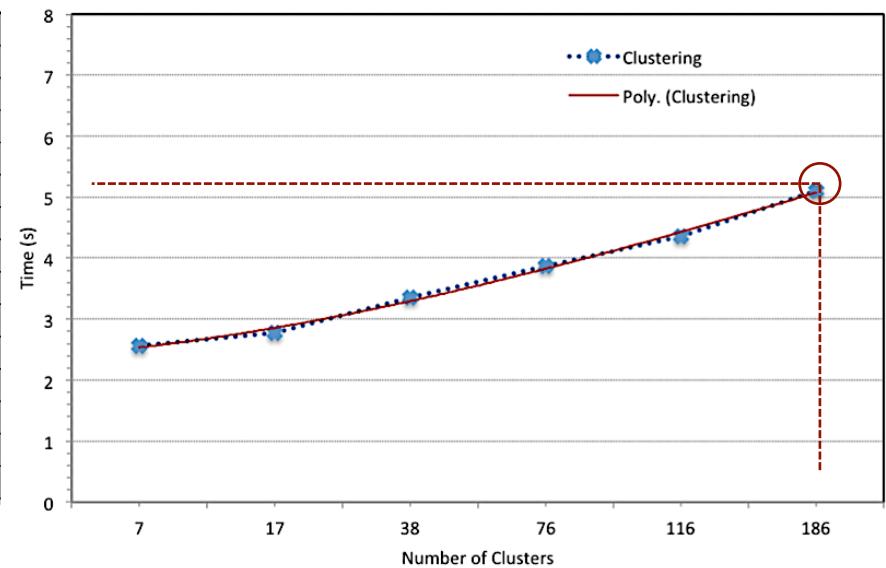
# Evaluation

- Evaluating feasibility of proposed mechanisms

Service Discovery Performance



Clustering algorithm performance



Polynomial trend of degree three

## Results

- Promising results
- Quality depending on the dataset and thresholds

# Conclusions & perspectives

- **Service discovery & prediction**

- User-centric approach < **intention, context** >
- Hiding environment heterogeneity
- Improving proactivity and transparency

- **Perspectives**

- Improving performance by parallel computing
- Experimenting different clustering & classification algorithms
- Experimenting on real data

# Questions?

- References

1. Kaabi R.S., Souveyet C. Capturing intentional services with business process maps. *1st IEEE International Conference on Research Challenges in Information Science RCIS 2007*; 309-318
2. Dey A. Understanding and using context. *Personal and Ubiquitous Computing 2001*; 5(1): 4-7