

# **A Role Based Administration Model For Attribute**

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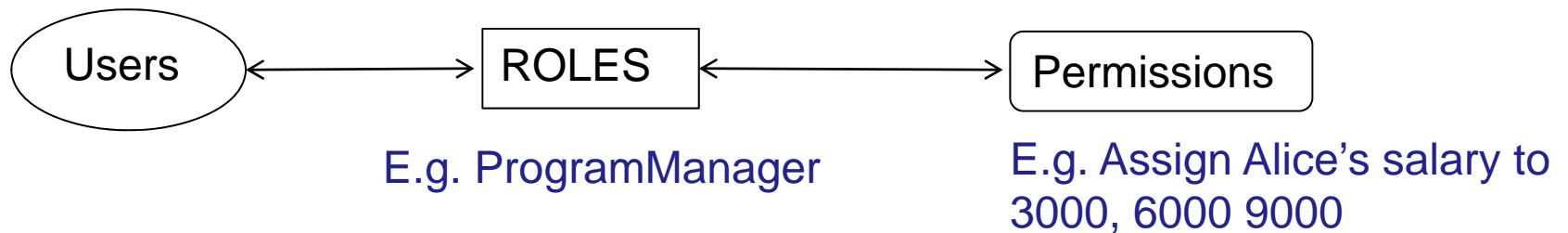
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- Motivation
- Background
- Proposed Approach
- Discussion and Future Work

- Attribute Based Access Control provide flexibility and scalabilities for distributed access control
  - ❖ Role based trust management (RT)[Oakland02]
  - ❖ Unified ABAC model (ABAC-alpha) [DBSEC12]
  - ❖ Attribute based Encryption (ABE) [CCS06]
  - ❖ Usage control model (UCON) [TISSEC]
  - ❖ Logical based framework for ABAC [FMSE04], etc.
  
- What is user attribute(credential, certificate , etc.)?
  - ❖ Name, address, country...
  - ❖ ID, clearance...

- Much effort in how to use and store user attributes.
  - Authorization policy evaluate attribute of subject and object in the request ( s, o ) (ABAC-ALPHA, UCON, Logical based framework for ABAC)
  - Attribute Encryption (ABE, PKI)
  - Industry Implementation Standard (XACML, SAML, etc.)
  
- Not enough on user attribute management
  - ❖ Who is authorized to assign user attributes?
    - ❖ Who is authorized to assign value for Salary(Alice)?
    - ❖ Can Bob say that Salary(Alice)=3000?
  - ❖ How should permissions be assigned to administrators?
    - ❖ Manually one by one? No!

- Effective user attribute administration model needed
  - ❖ Ease of Administration one of desired features
- Role based Access Control



- Good candidate for user attribute Administration
  - Proved ease of administration
  - Efficient safety analysis
  - Sizable literature, etc.

## ➤ User role assignment model (URA97)

Can\_assign( administration role, prerequisite role, role range notation )

Example: *Programmanager* *Employee*  $\wedge$  *projectmanager* { *prj1leader*, *proj2leader* }

Can\_revoke( administration role, role range notation )

Example: *Programmanager* { *prj1leader*, *proj2leader* }

## ➤ User attributes

- **Atomic:** User can only have one value for this kind of attribute. E.g. user id, clearance, etc.
- **Set:** User can be assigned multiple values. E.g. role, phonenumber, etc.
- **Range(ua), attType(ua)**

- Generalize Role as one of user attributes
  - Difference between role and user attribute
    - Role represents permissions while attributes do not  
(Alice's *role* is Program Chair VS Alice's *age* is 23)
    - Role has hierarchy while attribute may not  
(Role: CEO is senior role of employee. Attribute: Address)
  - Difference between atomic user attributes and set-valued user attributes
    - Assign new value to atomic user attribute automatically remove old value
    - Add new values to set-valued attribute does not guarantee permissions to delete existing attribute values.

- **Permissions to each administrative role**
  - Add value to set-valued user attributes
  - Delete value from set-valued attributes
  - Assign value to atomic-valued attributes
  
- **Specify the three permission sets for each role**
  - Add value to set-valued user attributes
  - Delete value from set-valued attributes
  - Assign value to atomic-valued attributes



➤ Add values to set-valued user attributes:

$$\forall sua \in SUA. can\_add_{sua} \subseteq AR \times EXPR(sua) \times 2^{Range(sua)}$$

**AR**: set of administrative roles

**SUA**: set of set-valued user attributes

**EXPR(sua)**: logical expression composed of user attribute *sua*

➤ Delete values from set-valued user attributes:

$$\forall sua \in SUA. can\_delete_{sua} \subseteq AR \times EXPR(sua) \times 2^{Range(sua)}$$

**AR:** set of administrative roles

**SUA:** set of set-valued user attribute

**EXPR(sua):** logical expression composed of user attribute *sua*

➤ Assign value to atomic-valued user attributes:

$$\forall sua \in AUA. can\_assign_{aia} \subseteq AR \times EXPR(aia) \times 2^{Range(aia)}$$

**AR:** set of administrative roles

**AUA:** set of atomic-valued user attributes

**EXPR(aia):** logical expression composed of user attribute *aia*

## ➤ Common Expression Language

$$\begin{aligned} \varphi ::= & \varphi \wedge \varphi \mid \varphi \vee \varphi \mid (\varphi) \mid \neg \varphi \mid \exists x \in \text{set}.\varphi \mid \\ & \forall x \in \text{set}.\varphi \mid \text{set setcompare set} \mid \text{atomic} \in \text{set} \mid \\ & \text{atomic} \notin \text{set} \mid \text{atomic atomiccompare atomic} \\ \text{atomiccompare} ::= & < \mid = \mid \leq \mid \neq \\ \text{setcompare} ::= & \subset \mid \subseteq \mid \not\subseteq \end{aligned}$$

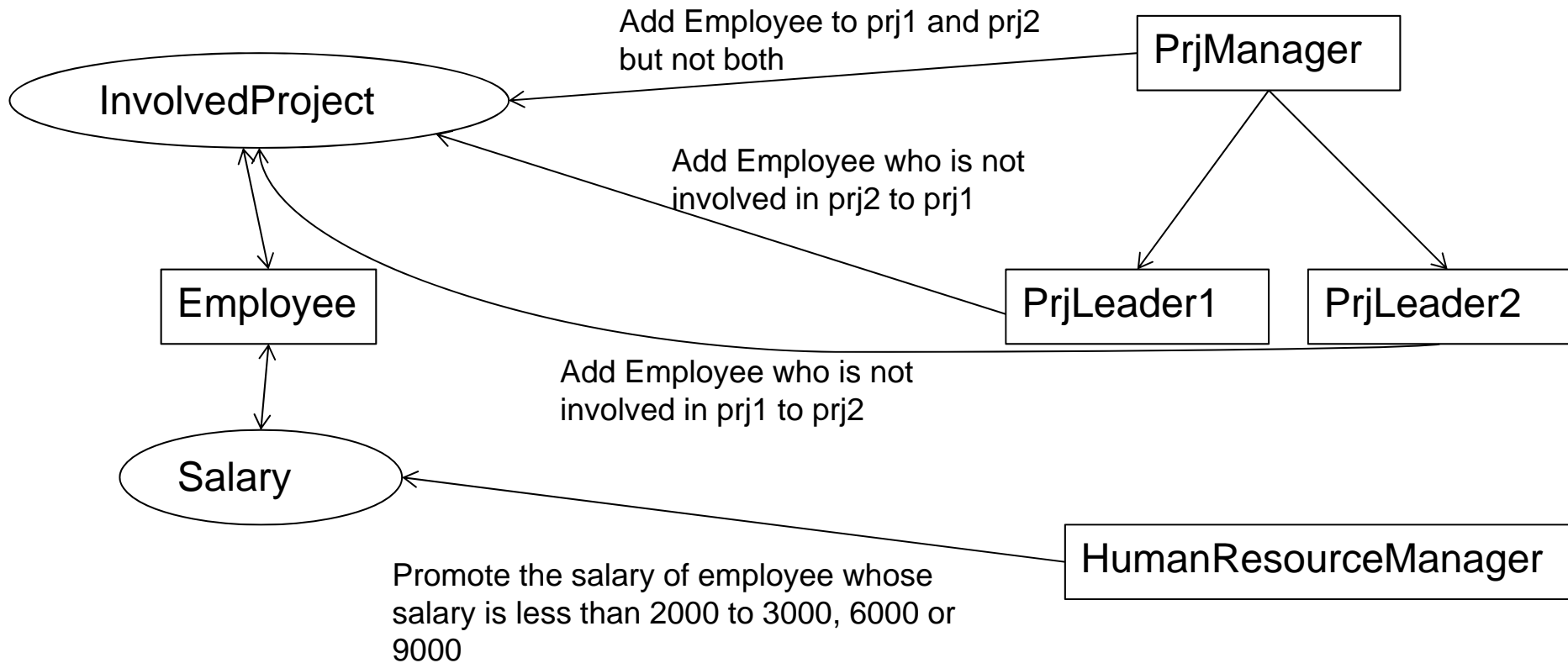
## ➤ Example: set-valued attributes in GURA<sub>0</sub>

***EXPR(SUA)*** is specified using an instance of the above language where

$$\begin{aligned} \text{set} ::= & \text{sua}(u) \mid \text{constantSet} \\ \text{atomic} ::= & \text{constantAtomic} \end{aligned}$$

## Users And User Attributes

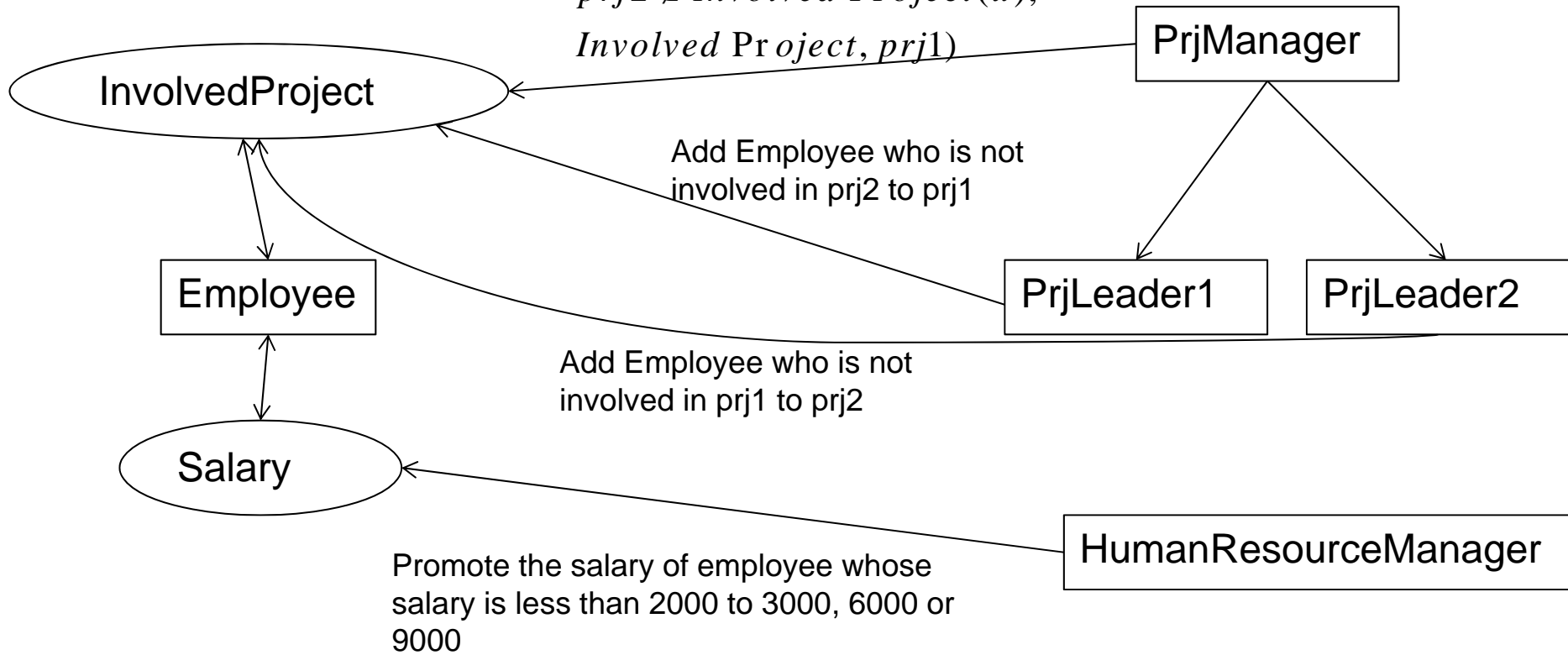
## Administrative Roles



**Users And User Attribute**

*can\_add(PrjManager, prj1 ∈ InvolvedProject(u), involvedProject, prj2)*  
*can\_add(PrjManager, prj2 ∈ InvolvedProject(u), InvolvedProject, prj1)*

**Administrative Roles**

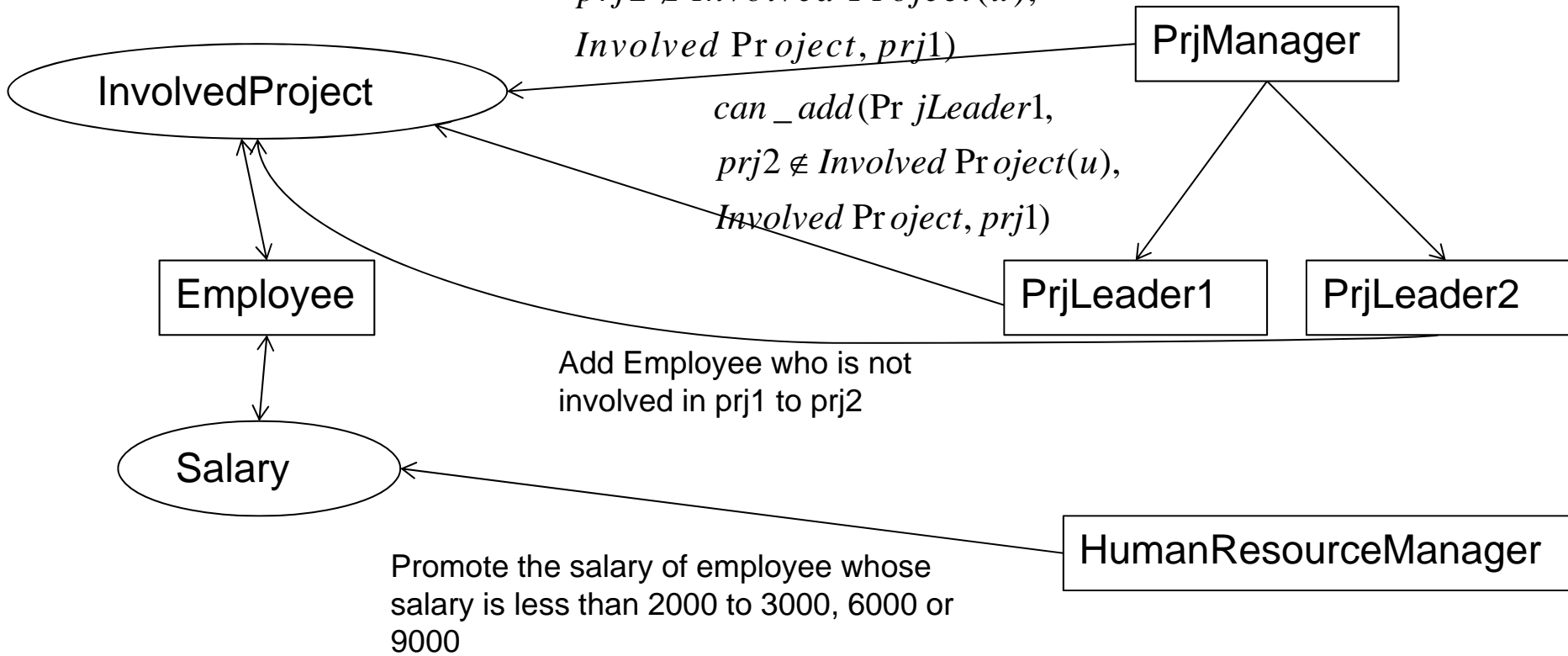


**Users And User Attribute**

*can\_add(PrjManager, prj1 ∈ Involved Project(u), involved Project, prj2)*

**Administrative Roles**

*can\_add(PrjManager, prj2 ∈ Involved Project(u), Involved Project, prj1)*



**Users And User Attribute**

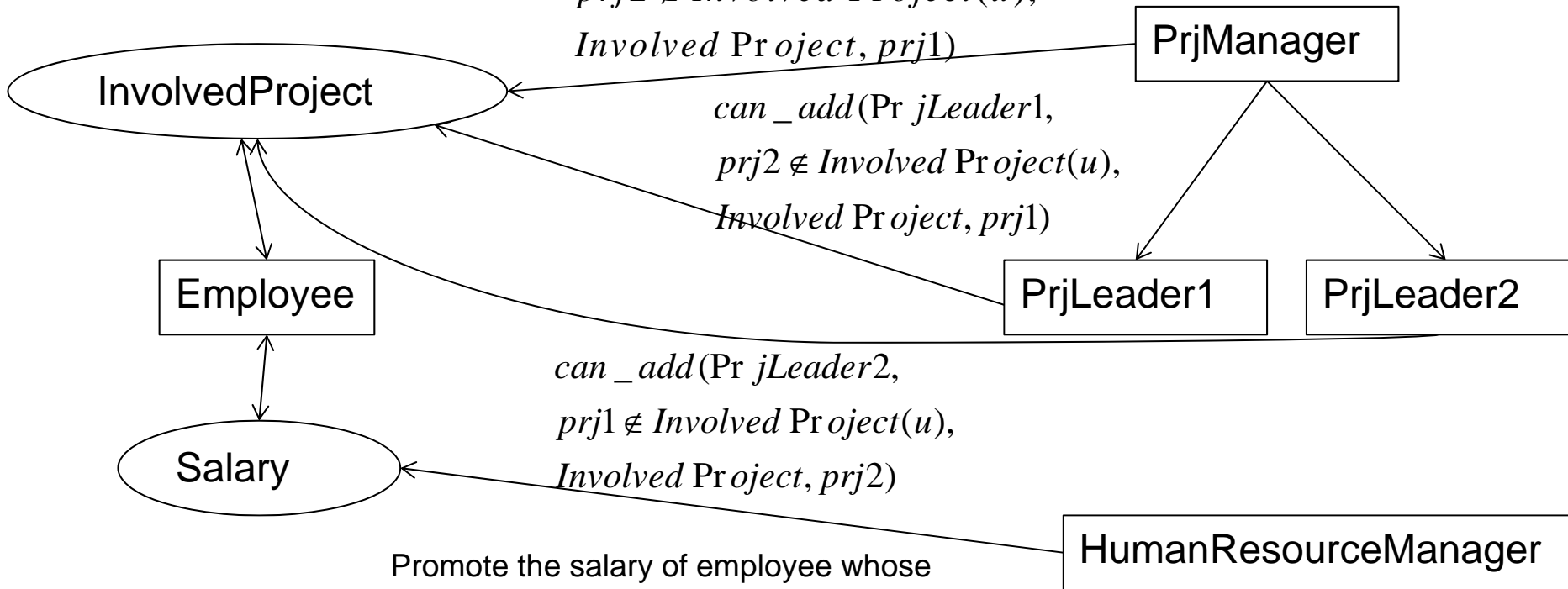
**Administrative Roles**

$can\_add(PrjManager, prj1 \notin InvolvedProject(u), involvedProject, prj2)$   
 $can\_add(PrjManager, prj2 \notin InvolvedProject(u), InvolvedProject, prj1)$

$can\_add(PrjLeader1, prj2 \notin InvolvedProject(u), InvolvedProject, prj1)$

$can\_add(PrjLeader2, prj1 \notin InvolvedProject(u), InvolvedProject, prj2)$

Promote the salary of employee whose salary is less than 2000 to 3000, 6000 or 9000





**Users And User Attribute**

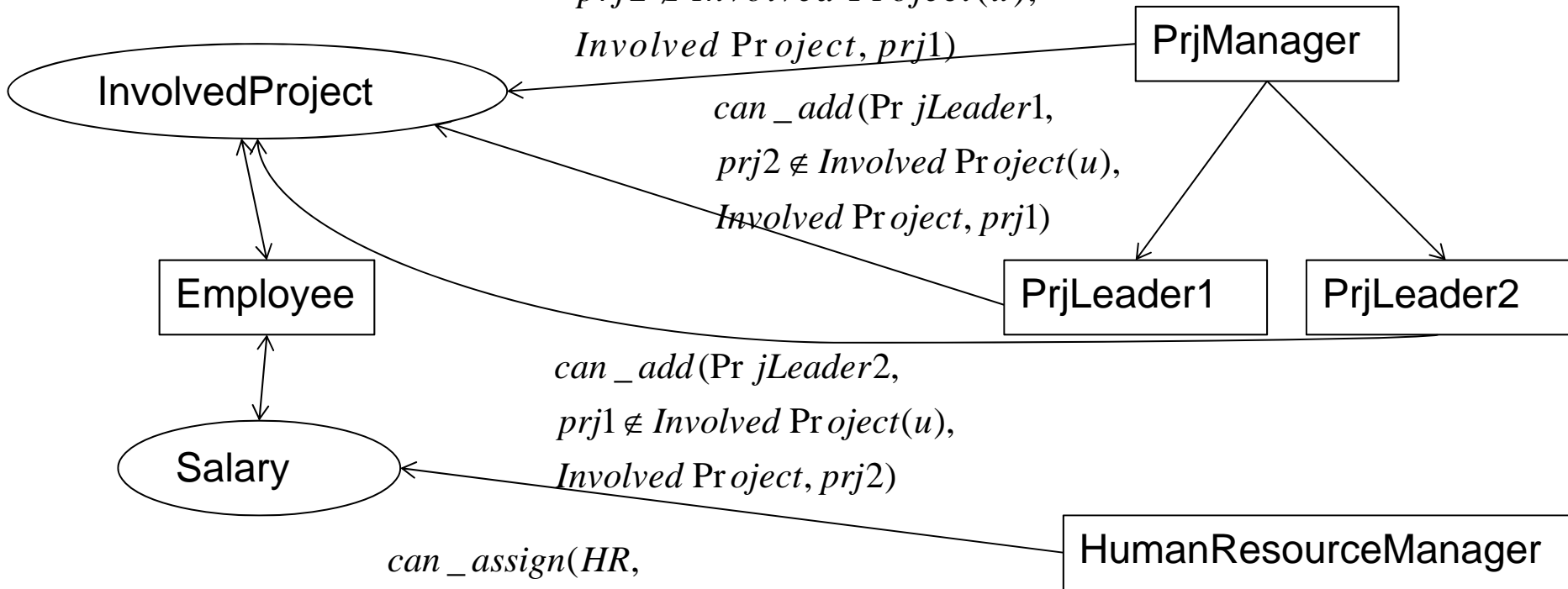
**Administrative Roles**

$can\_add(PrjManager, prj1 \notin Involved Project(u), involved Project, prj2)$   
 $can\_add(PrjManager, prj2 \notin Involved Project(u), Involved Project, prj1)$

$can\_add(PrjLeader1, prj2 \notin Involved Project(u), Involved Project, prj1)$

$can\_add(PrjLeader2, prj1 \notin Involved Project(u), Involved Project, prj2)$

$can\_assign(HR, salary(u) < 2000, salary, \{3000, 6000, 9000\})$



- Limited Expressive Power
  - Expression(ua) ONLY composed using the user attribute in context is not enough.  
Example: PrjLeader1 is only authorized to add employee whose experience with Java is more than 3 years and whose skills include C++.
  
- Least Privilege is not achieved
  - Expression(ua) CAN NOT restrict users to the least set. Need other user attributes to compose the expression.

➤ Further Generalization

$$\forall sua \in SUA. can\_add_{sua} \subseteq AR \times EXPR(sua) \times 2^{Range(sua)}$$



$$\forall sua \in SUA. can\_add_{sua} \subseteq AR \times EXPR(UA) \times 2^{Range(sua)}$$



**EXPR(UA):** logical expression composed of all user attribute  $ua$  in  $UA$

➤ Further Generalization for GURA<sub>1</sub>:

$$\forall sua \in SUA. can\_delete_{sua} \subseteq AR \times EXPR(UA) \times 2^{Range(sua)}$$

$$\forall aua \in AUA. can\_assign_{aua} \subseteq AR \times EXPR(UA) \times 2^{Range(aua)}$$

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## ➤ Example using GURA1

Table 5: Examples

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*can\_add relation for attribute involvedprj:*

(prj1leader, prj2  $\notin$  involvedprj(u)  $\wedge$  trainingpassed(u) = true  $\wedge$  clearance(u) > S  $\wedge$  C  $\in$  skills(u), {prj1})

(prj2leader, prj1  $\notin$  involvedprj(u)  $\wedge$  trainingpassed(u) = true  $\wedge$  clearance(u) > S  $\wedge$  C  $\in$  skills(u), {prj2})

*can\_add relation for attribute skill:*

(secretary, NULL, {C, C++, Java})

*can\_delete relation for attribute involvedprj:*

(prj1leader, prj1  $\in$  involvedprj(u), {prj1})

(prj2leader, prj2  $\in$  involvedprj(u), {prj2})

*can\_delete relation for attribute skill:*

(secretary, NULL, {C, C++, Java})

*can\_assign relation for attribute trainingpassed:*

(trainingmanager, NULL, {true, false})

*can\_assign relation for attribute clearance:*

(humanmanager, NULL, {TS, S, C, U})

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- Advantages
  - Advantages of RBAC inherited
  
- Limitations
  - Awkward for distributed administration of user attributes
  - For fine-grained user attribute administration, many roles with slight different set of permissions need to defined.
  
- Future Work
  - Delegation
  - Attribute based user attribute management

**Any Questions?**