On Feasibility of Attribute-aware Relationship-Based Access Control Policy Mining

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Background

- *Access Control:* Legitimate users get legitimate access only
  - *ReBAC (Relationship-Based Access Control)*
  - *ABAC (Attribute-Based Access Control)*

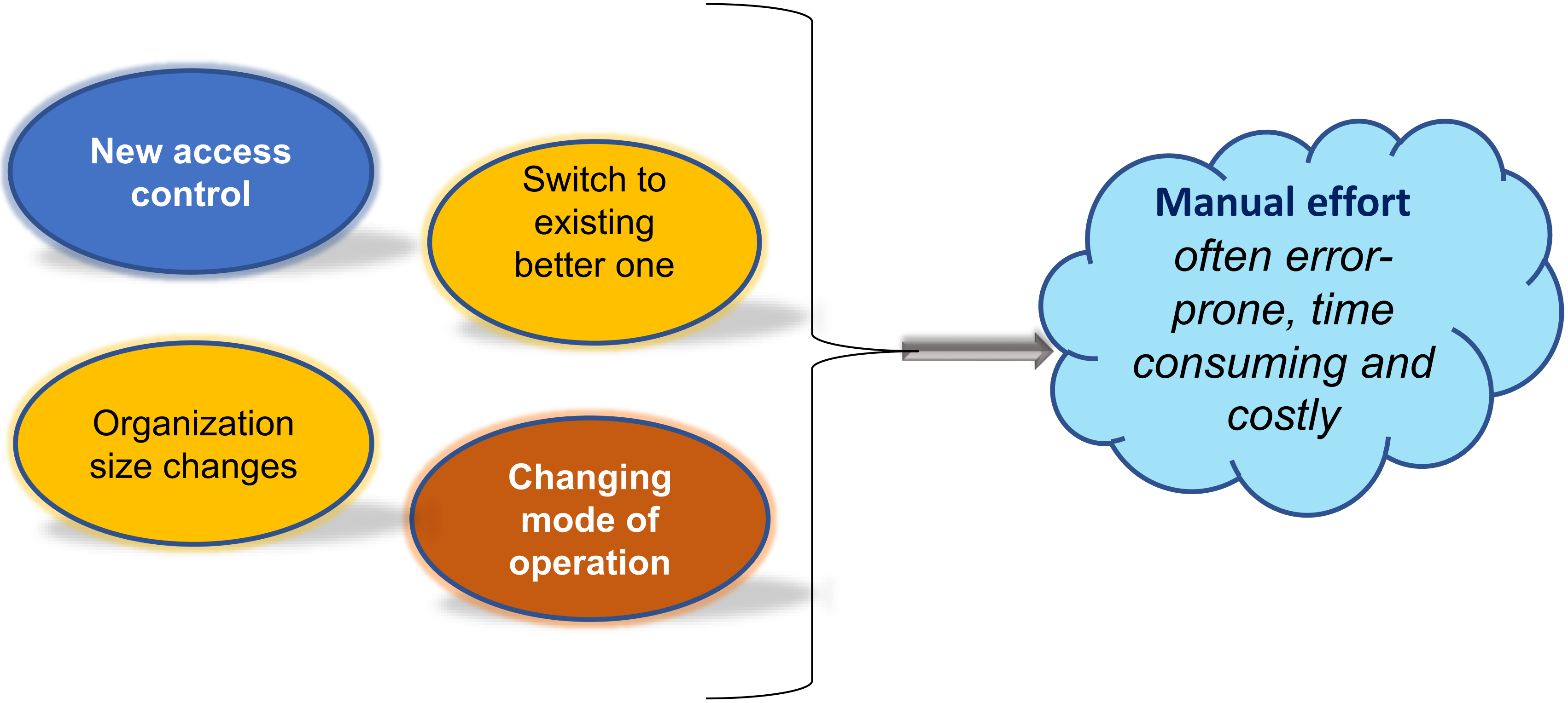
- *AReBAC ≡ Attribute-aware ReBAC*
  - Integrate attribute information with ReBAC
  - Makes policy generation more flexible and convenient
  - Attribute-aware Relationship Graph (ARG)

Assumption

- ARG where users(node) are connected(edge) where user and edge have attributes
- Each user and edge have corresponding user and edge attribute values, respectively
- Only user-to-user relationships are considered

Policy Mining

- **Problem:** migration from an existing access control model to another one


New access control
Switch to existing better one
Organization size changes
Changing mode of operation
Manual effort *often error-prone, time consuming and costly*

Is automation possible?

Problem Statement

The feasibility analysis of the AReBAC policy mining problem studies whether the migration process from a given authorization set to AReBAC policy is feasible or not under the set of imposed criteria:

- Attribute-aware Relationship Graph (ARG) is given
- AReBAC rule structure is given
- <u>Use of entity ID is not allowed</u>
  - <u>Existing literature allows ID</u>
- Equivalent set of AReBAC rules are required

- <u>Solution is guaranteed even if inconsistency arises</u>
  - <u>Infeasibility problem</u>

AReBAC Rule Structure

$Rule_{op}$ ::= $Rule_{op} \vee Rule_{op}$ | $pathRuleExpr$ | Attexp

$pathRuleExpr$ ::= $pathRuleExpr \wedge pathRuleExpr$ | ($pathLabelExpr$)

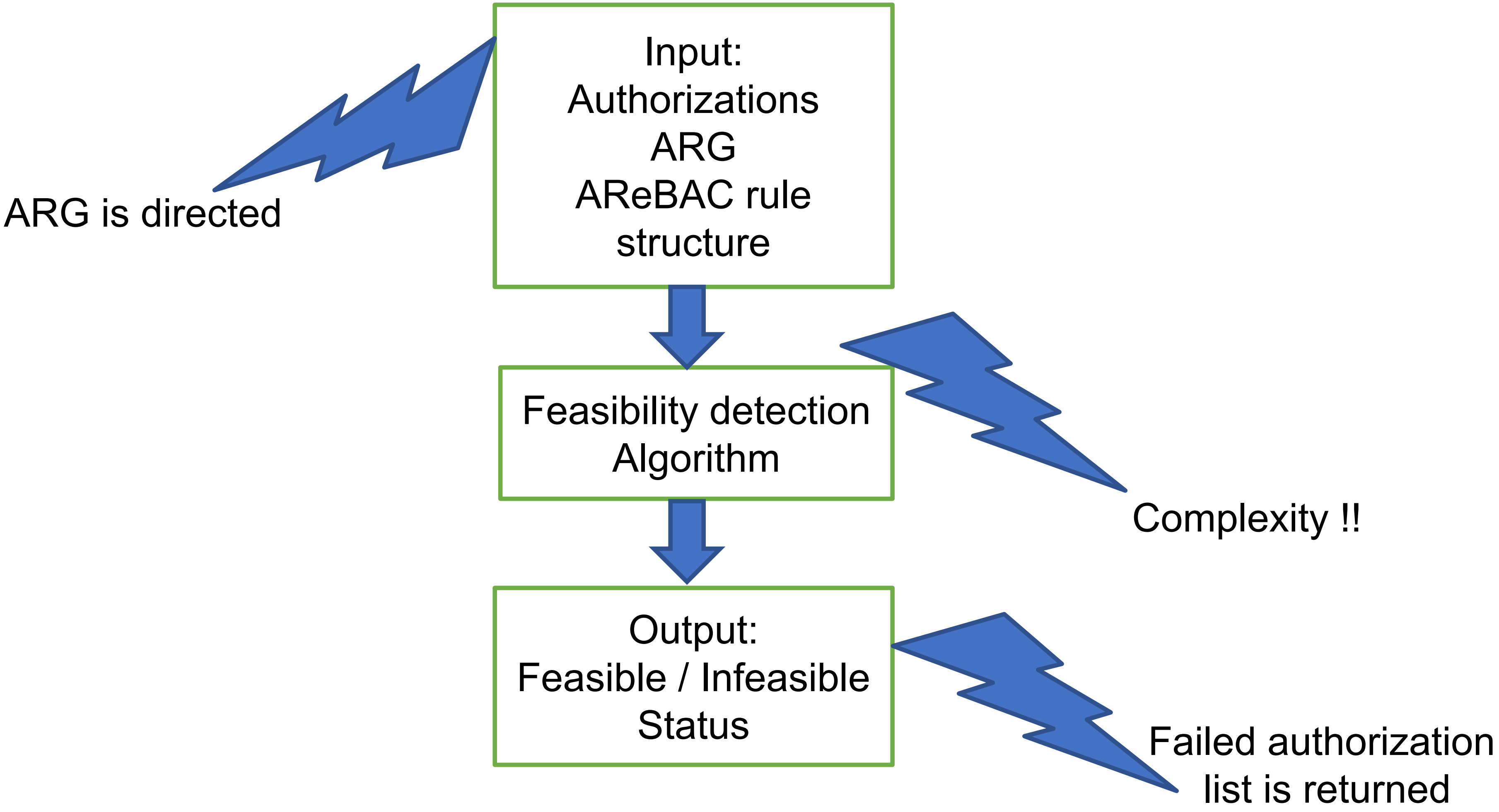
$pathLabelExpr$ ::= $pathLabelExpr.pathLabelExpr$ | $edge$Expr

Attexp ::= Attexp ∧ Attexp | uexp = value | vexp = value

edgeExp ::= edgeExp ∧ edgeExp | edgeuexp = value | edgevexp = value | edgeattexp = value

- Evaluation of access request (a, b, op)
  - Checks with user attribute values of a and b
  - If there exists simple path from a to b in ARG, Checks with them too!
  - The resulting boolean expression evalutes to true → grant, deny otherwise

Feasibility Detection



Input:
Authorizations
ARG
AReBAC rule structure

Feasibility detection Algorithm

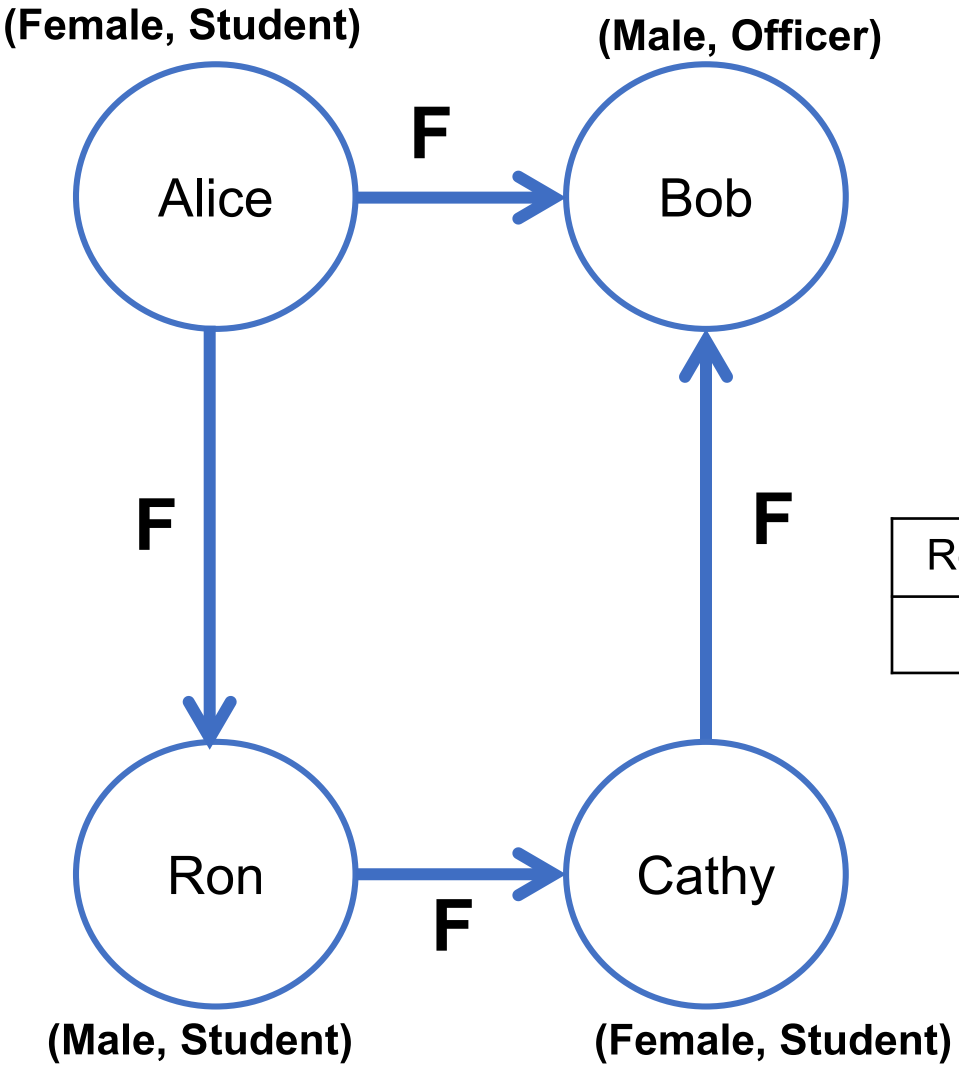
Output:
Feasible / Infeasible Status

ARG is directed

Complexity !!

Failed authorization list is returned

ARG Example



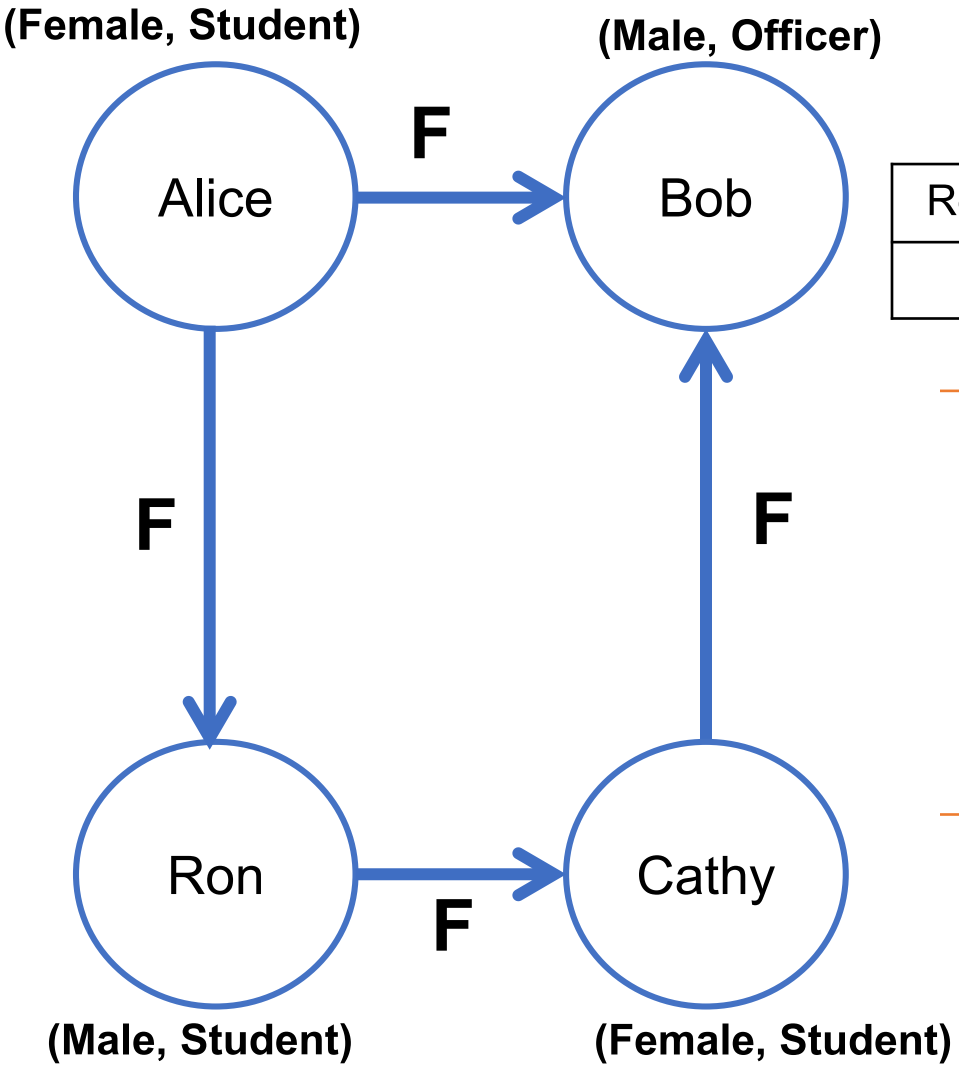
UA = {Gender, Profession}

EA = {Relation-type}

ReBAC	ABAC	AReBAC	AUTH
✗	✗	✓	(Alice, Ron, op)

Feasible

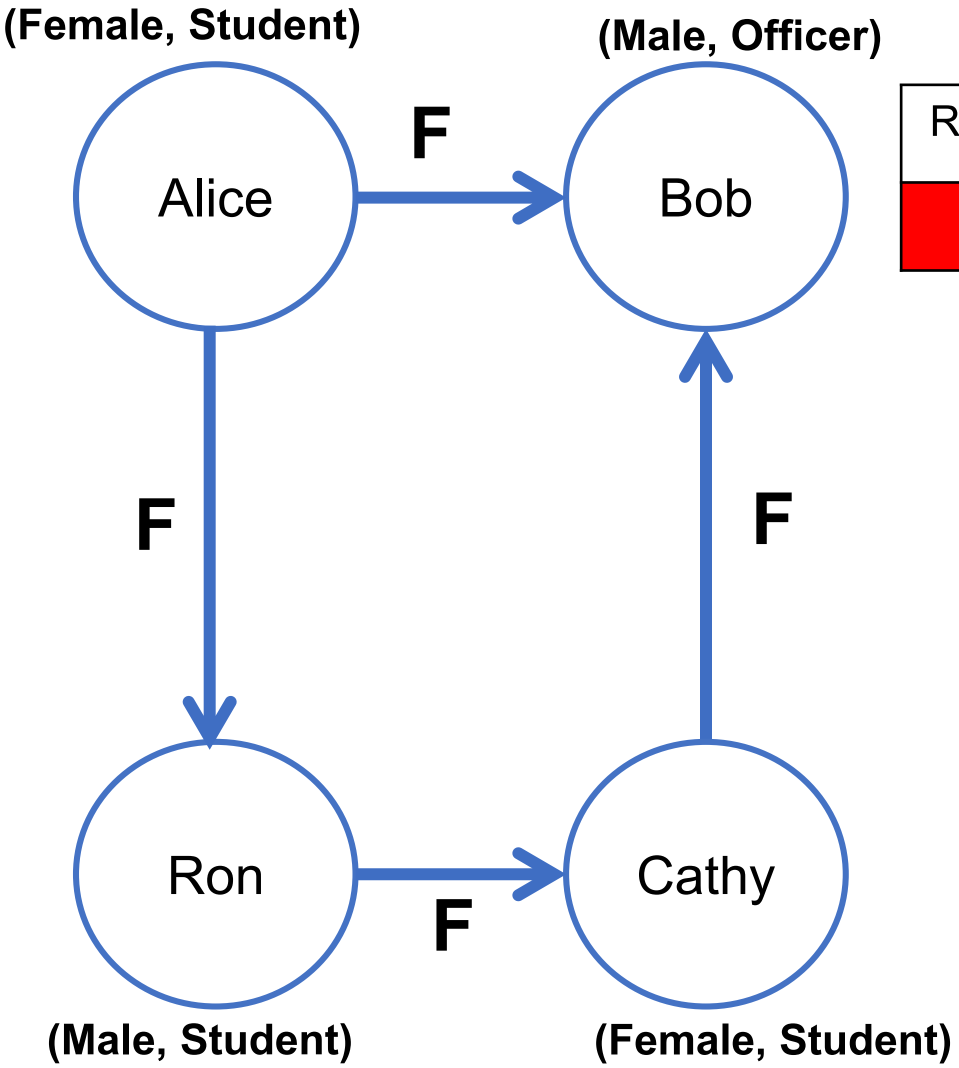
ARG Example



ReBAC	ABAC	AReBAC	AUTH
✗	✗	✓	(Alice, Ron, op)

Rule_{op} = (Gender(e.u) = Female ∧ Profession(e.u) = Student ∧ Relation-type(e) = F ∧ Gender(e.v) = Male ∧ Profession(e.v) = Student)

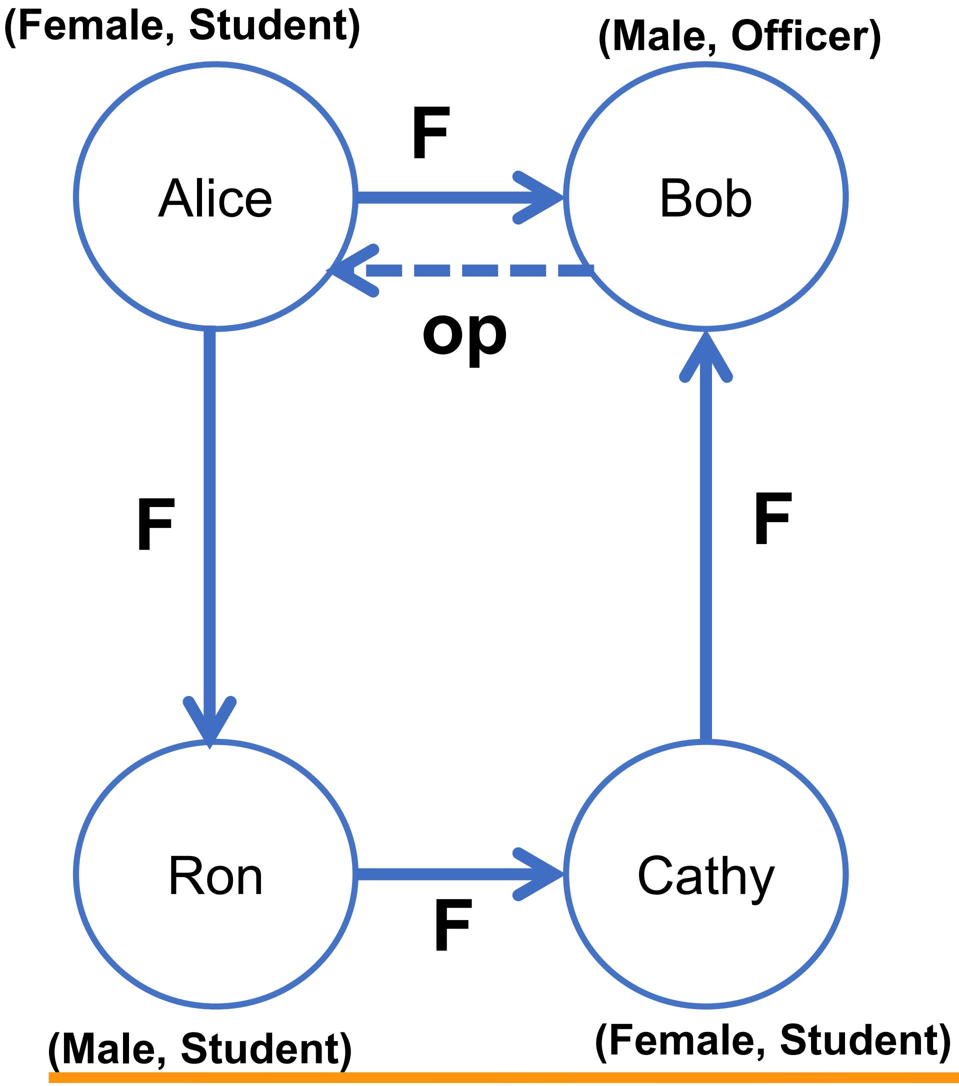
ARG Example



ReBAC	ABAC	AReBAC	AUTH
☒	☒	☒	(Bob, Alice, op)

Infeasible

Infeasibility Solution



Infeasible

(Bob, Alice, op)

Rule$_{op}$ = (Relation-type(e) = op)

Simple

Minimal edges not guaranteed

|Authorization| edges at worst!

Future Enhancement

- Complexity
- Inexact solution
- More path variations
- Cope up with changes in rule structures!
- Other infeasibility solutions
- Extend beyond user-user context

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- Question/ Feedback