Graphical Representation of Authorization Policies for Weighted Credentials

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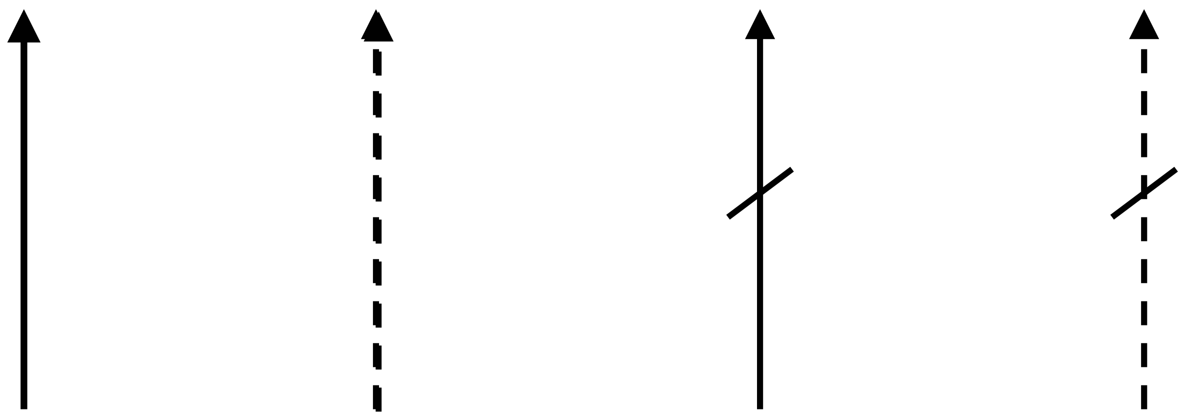
Introduction

- Make use of weighted credentials to define authorization and delegation relationships.
- Define three main indexes which help on deciding authorization requests.
- Define authorization flexible policies
- Define graphical representation for:
  - Credentials
  - Authorization “power” between pairs of entities
  - Authorization policies

Credentials

- **Issuer**
- **Subject**
- **Type**
  - *Weight*: real number in [0,1]
  - *Delegable*: 1 for Delegation, 0 for Authorization
  - *Sign*: 1 for positive, 0 for negative
- **Right**
  - *Resource*
  - *Access Mode or Operation*

Kind of Credentials



Positive Delegation

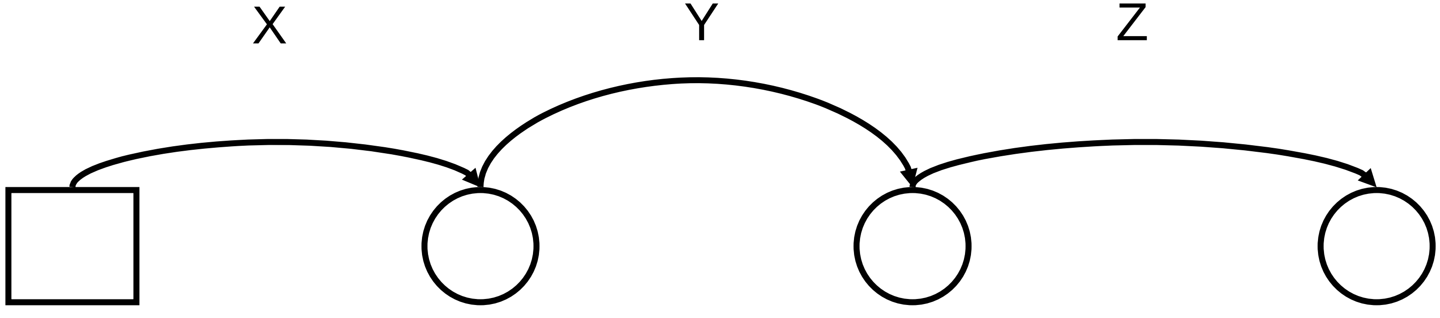
Positive Authorization

Negative Delegation

Negative Authorization

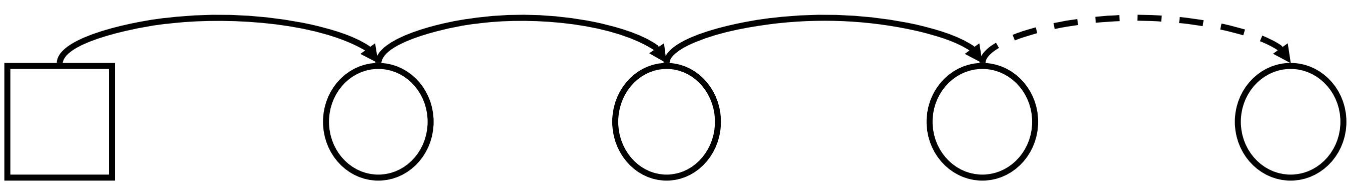
Paths or Chains of Credentials

- Source of Authorization (SOA)
- Credentials or edges
- Final entity
- Weights



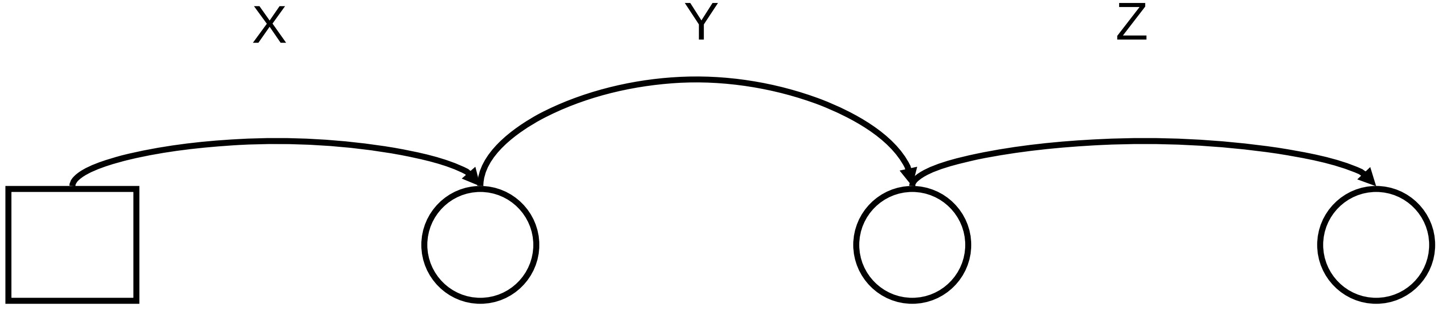
Paths or Chains of Credentials

- Delegation Path
  - All credentials in the path are delegation credentials
- Authorization Path
  - Delegation path + Authorization credential



Metrics over Paths

- Multiplicative: X·Y·Z
- Additive: X+Y+Z
- Minimun: Min(X,Y,Z)
- Maximun: Max(X,Y,Z)



Measuring Authorization

L_{AB} Is defined as the lowest weight over the weight of all authorization paths from A to B.

H_{AB} Is defined as the greatest weight over the weight of all authorization paths from A to B.

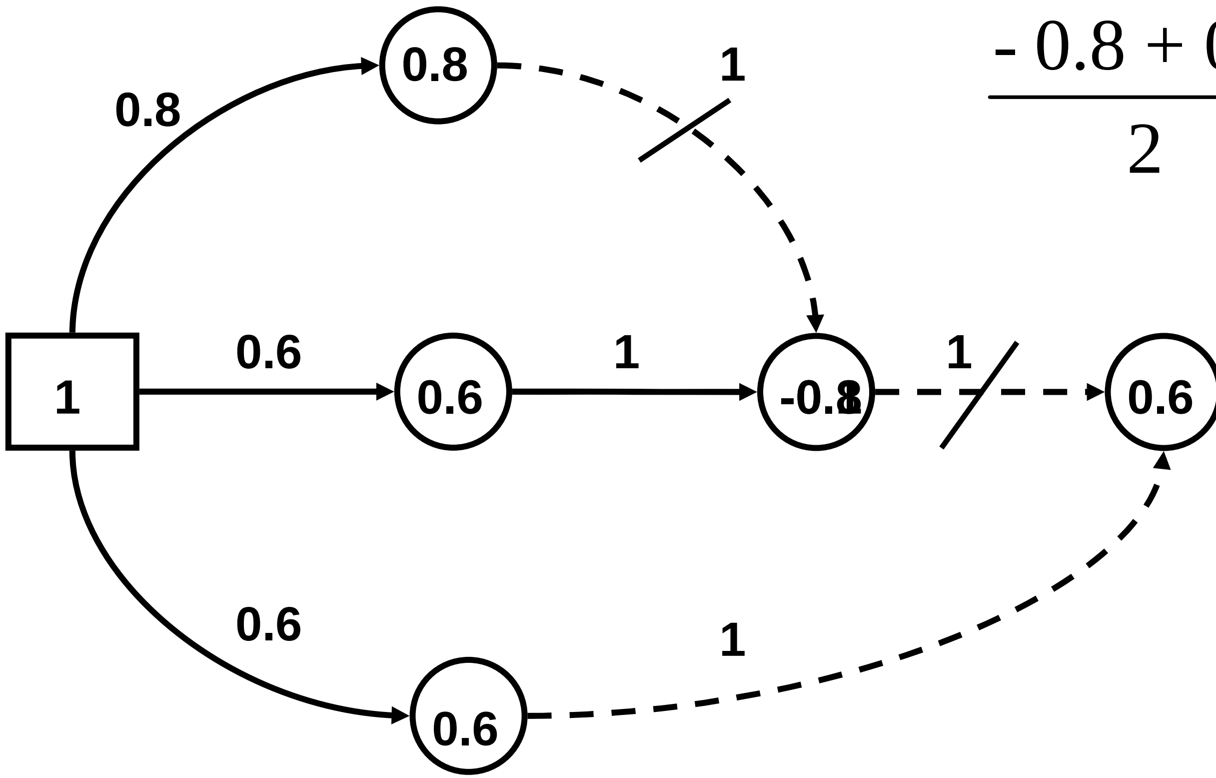
Mean Index (M_{AB})

- Initialization
  - m(a,x)=0 for all x<>a, m(a,a)=1 and p=a
- Loop over all neighbors, p', of p
  - If the credential from p' to p is a delegation credential:

    m(a,p')=m(a,p)*|pp'|*sign(pp')+m(a,p')
  - If the credential from p' to p is a negative authorization credential:

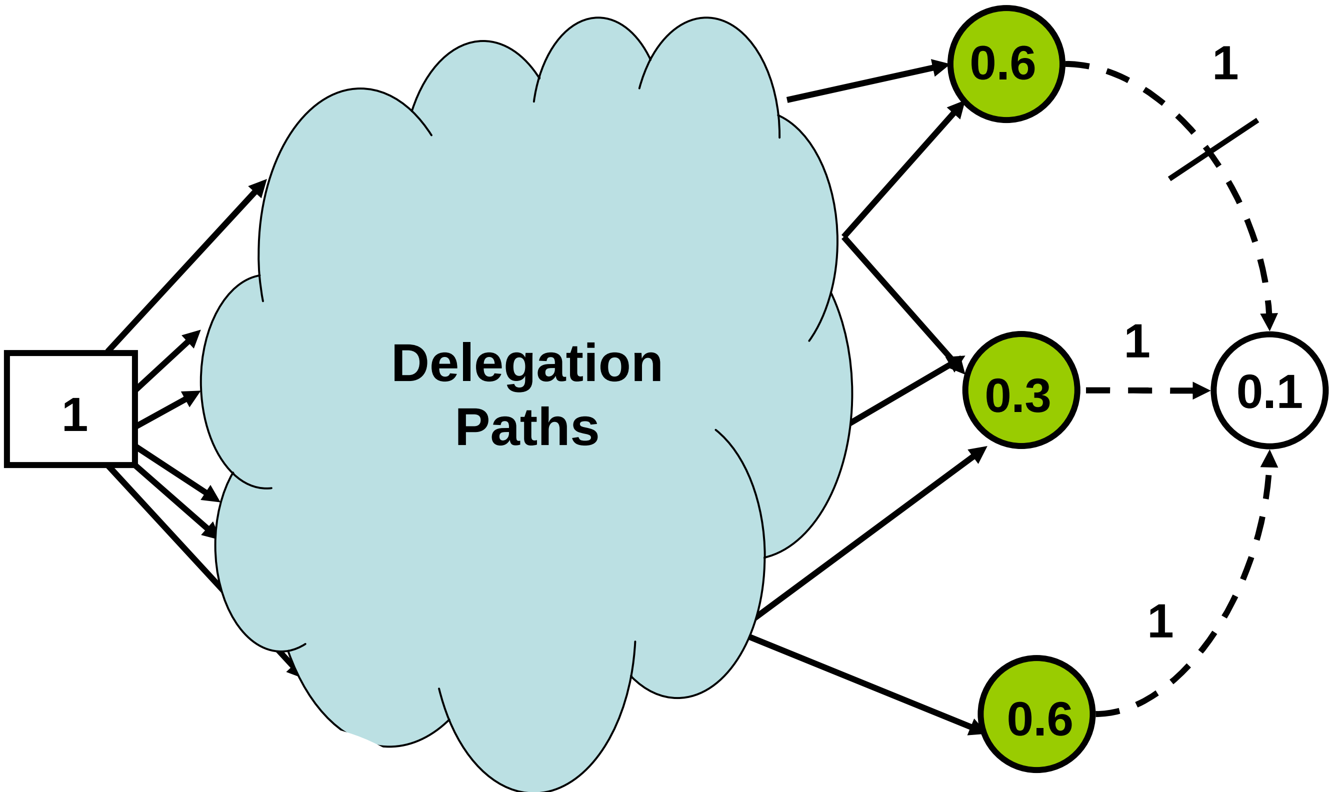
    m(a,p')=m(a,p') - m(a,p)*|pp'|
- Expand a neighbor p' with m(a,p')>0, in decreasing order of m(a,p').

Mean Index



$$\frac{-0.8 + 0.6}{2} = -0.1$$

x-Percentage Interval



There are 3 authorization paths, C_1, C_2, C_3 ,

with $|C_1| = -0.6, |C_2| = 0.3, |C_3| = 0.6$

so we get: $L_{AB} = -0.6 \quad M_{AB} = 0.1 \quad H_{AB} = 0.6$

x-Percentage Interval

Then the **x-percentage interval** is defined as

$$[L_{AB}^{x}, H_{AB}^{x}] = [\max(L_{AB}, M_{AB} - r_x), \min(H_{AB}, M_{AB} + r_x)]$$

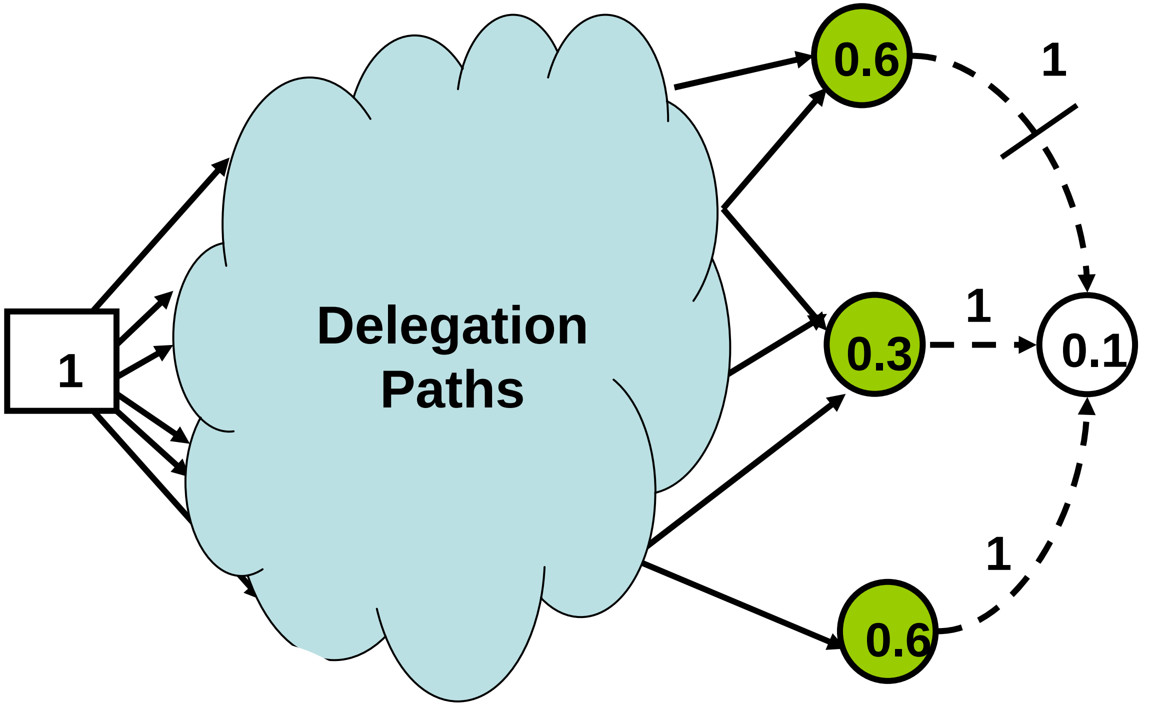
where $r_x = \min\left\{ y \in \mathbb{R} : \left[M_{AB} - y, M_{AB} + y \right]\right.$ includes the x% of weights $\}$

All defined indexes are related in this way

$$-1 \leq L_{AB} \leq L_{AB}^{x} \leq M_{AB} \leq H_{AB}^{x} \leq H_{AB} \leq 1$$

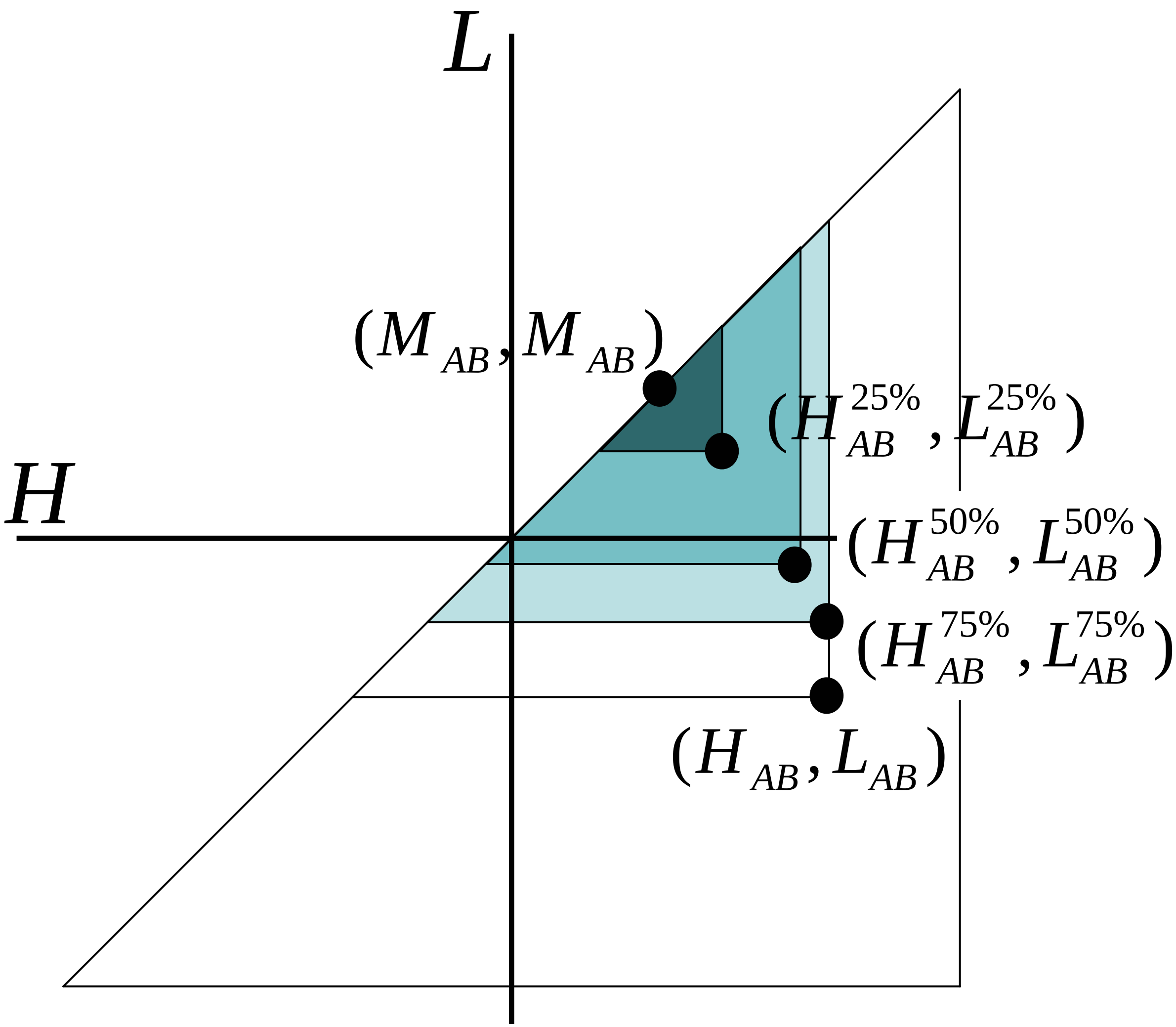
$$\lim_{x \to 100\%} L_{AB}^{x} \downarrow L_{AB} \qquad \lim_{x \to 100\%} H_{AB}^{x} \uparrow H_{AB}$$

x-Percentage Interval



- The 25% interval is [0.1,0.1]
- The 50% interval is [-0.1,0.3]
- The 75% interval is [-0.4,0.6]
- The 100% interval is [-0.6,0.6]

Authorization Indexes



L_{AB} and H_{AB}

M_{AB}

$L_{AB}^{25\%}$ and $H_{AB}^{25\%}$

$L_{AB}^{50\%}$ and $H_{AB}^{50\%}$

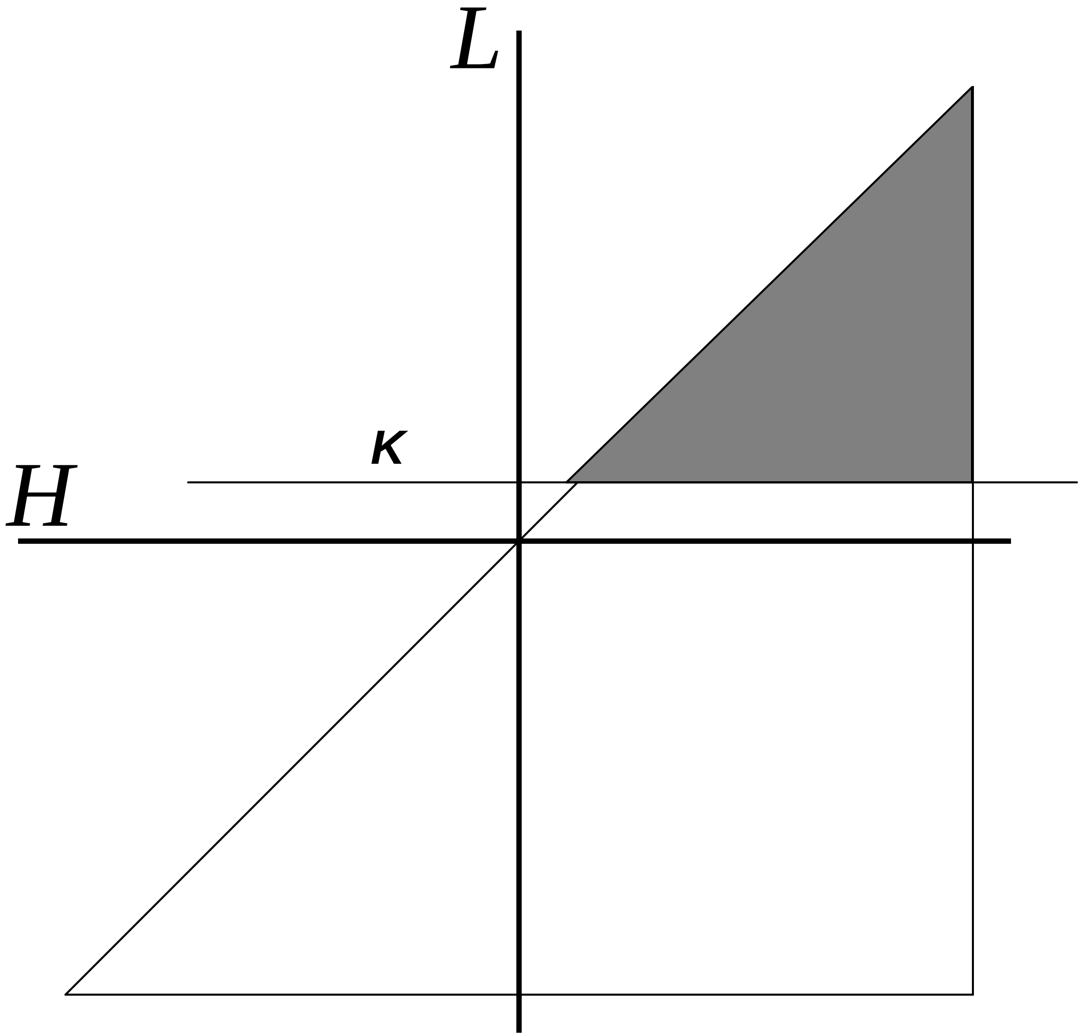
$L_{AB}^{75\%}$ and $H_{AB}^{75\%}$

Authorization Policies Principles

- Worst path. Grant If $L_{AB} \geq K$
- Best path. Grant if $H_{AB} \geq K$
- Mean index. Grant if $K_1 \leq M_{AB} \leq K_2$

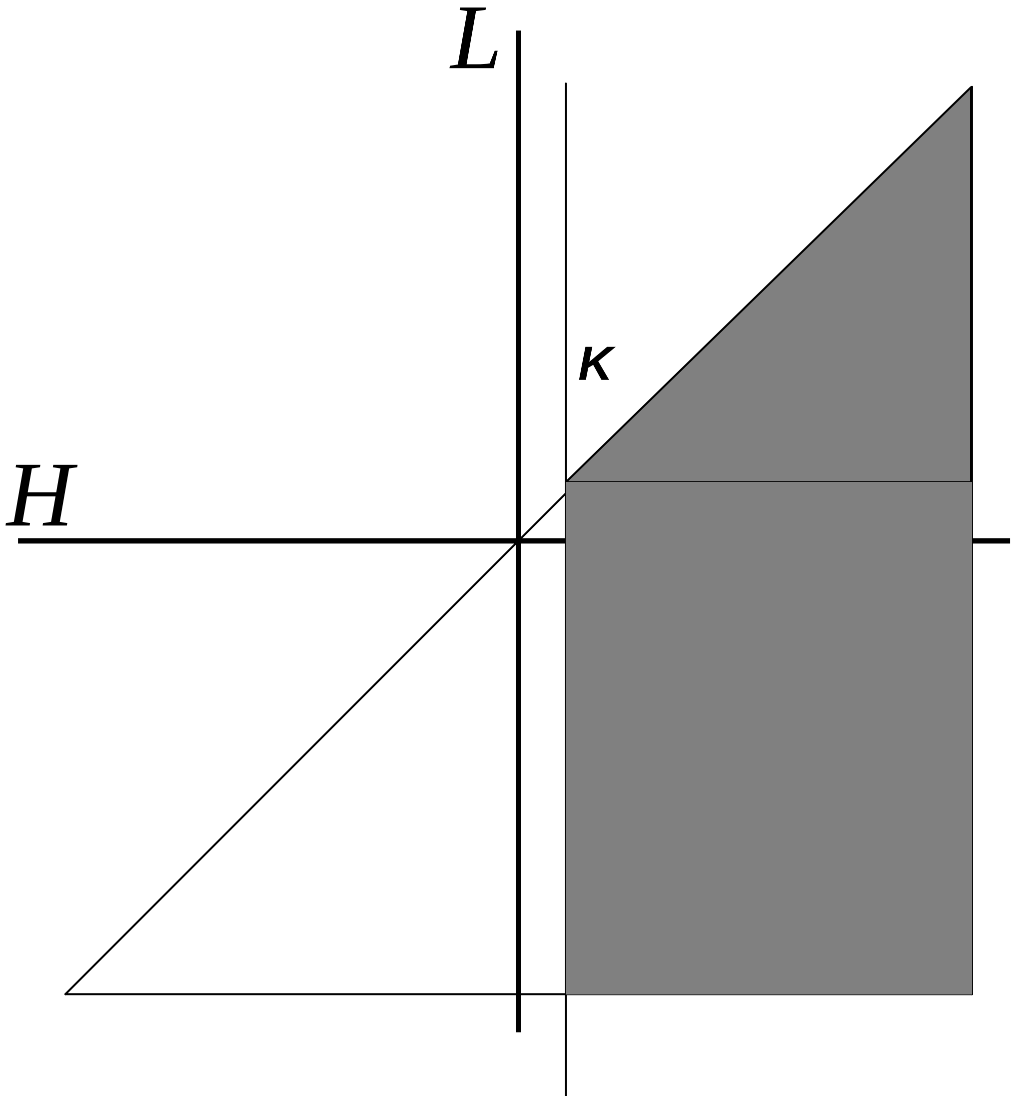
$$L_{AB} + H_{AB} \geq 2K$$

Authorization Policies



$$L_{AB} \geq K$$

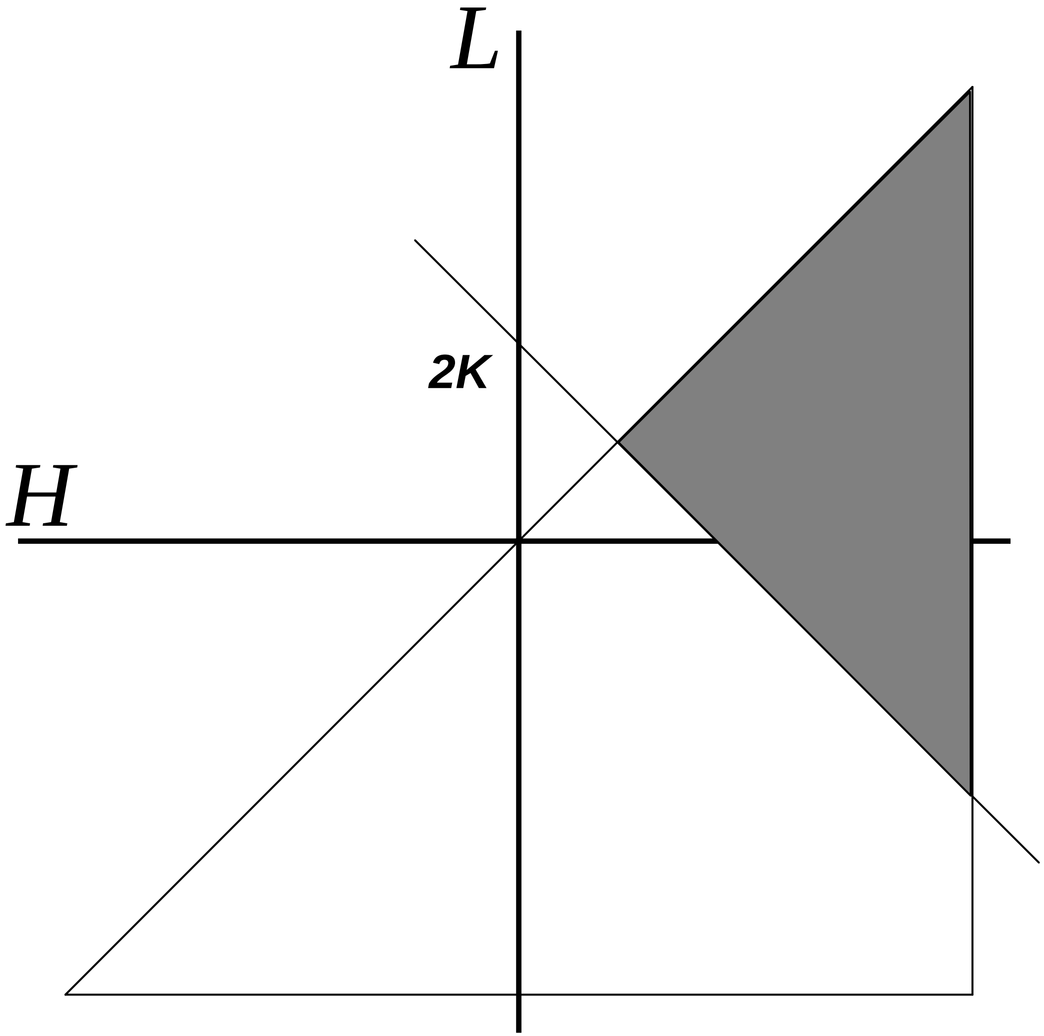
Authorization Policies



$$L_{AB} \geq K$$

$$H_{AB} \geq K$$

Authorization Policies

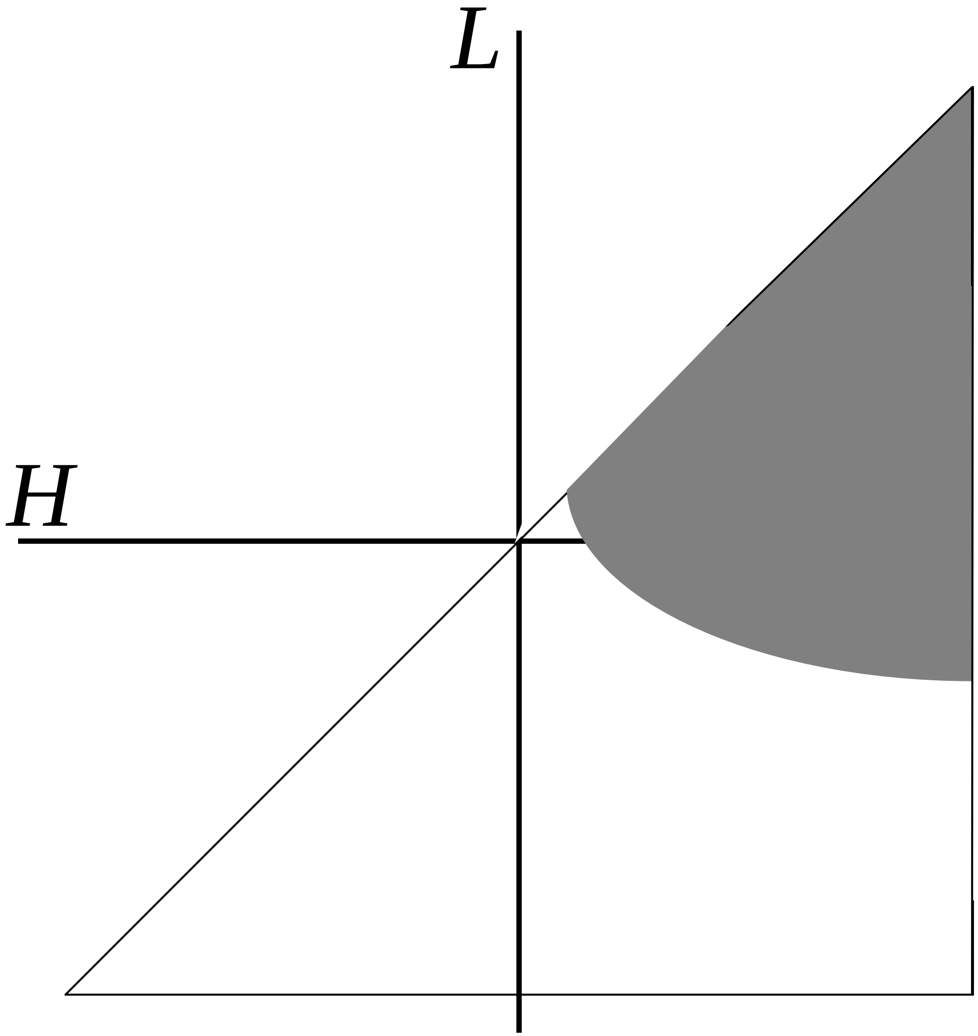


$$L_{AB} \geq K$$

$$H_{AB} \geq K$$

$$L_{AB} + H_{AB} \geq 2K$$

Authorization Policies



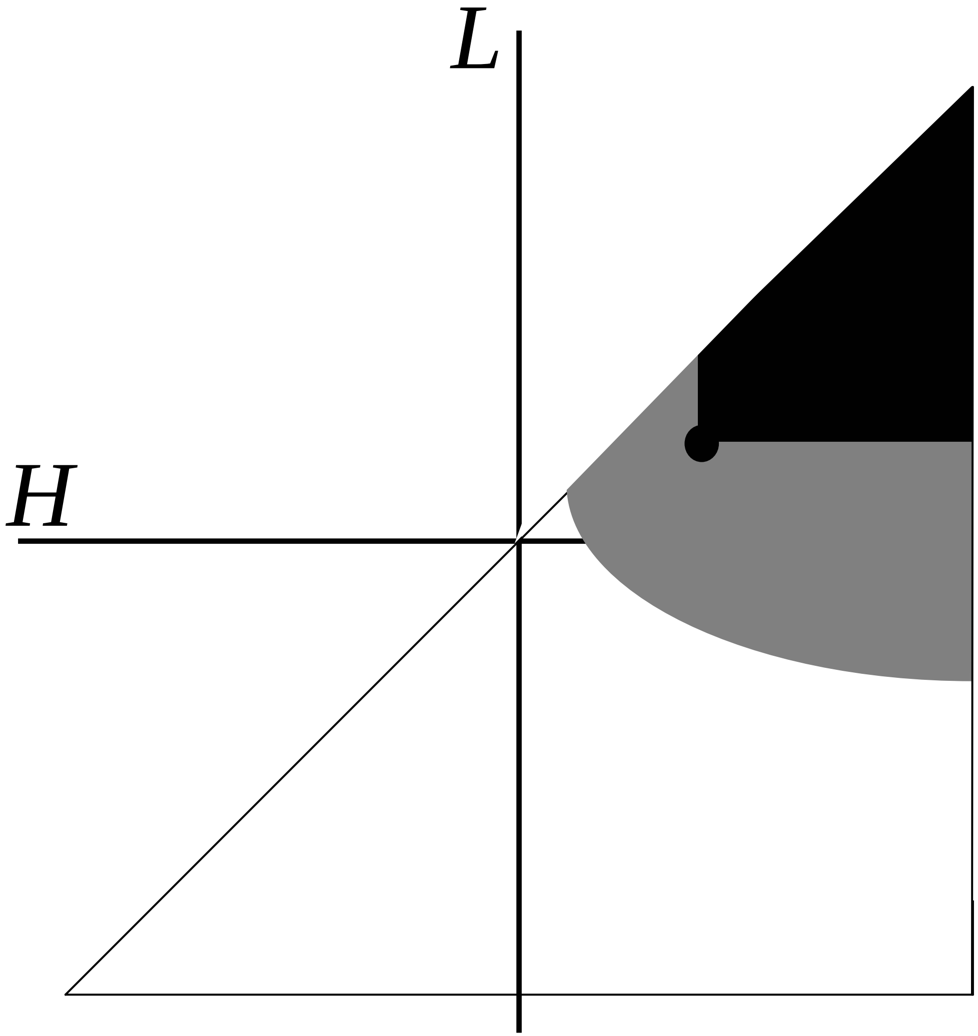
$$L_{AB} \geq K$$

$$H_{AB} \geq K$$

$$L_{AB} + H_{AB} \geq 2K$$

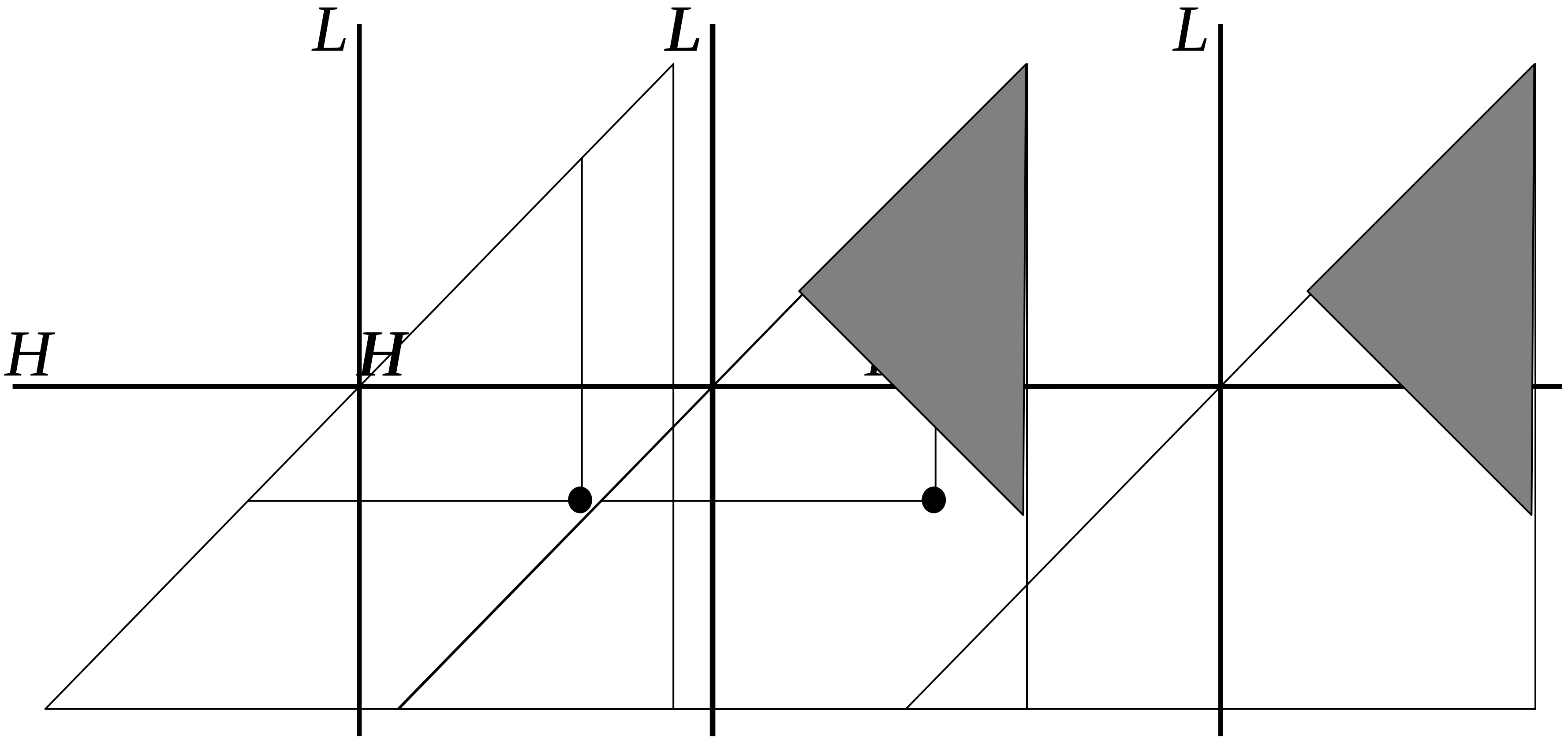
General Set

Authorization Set



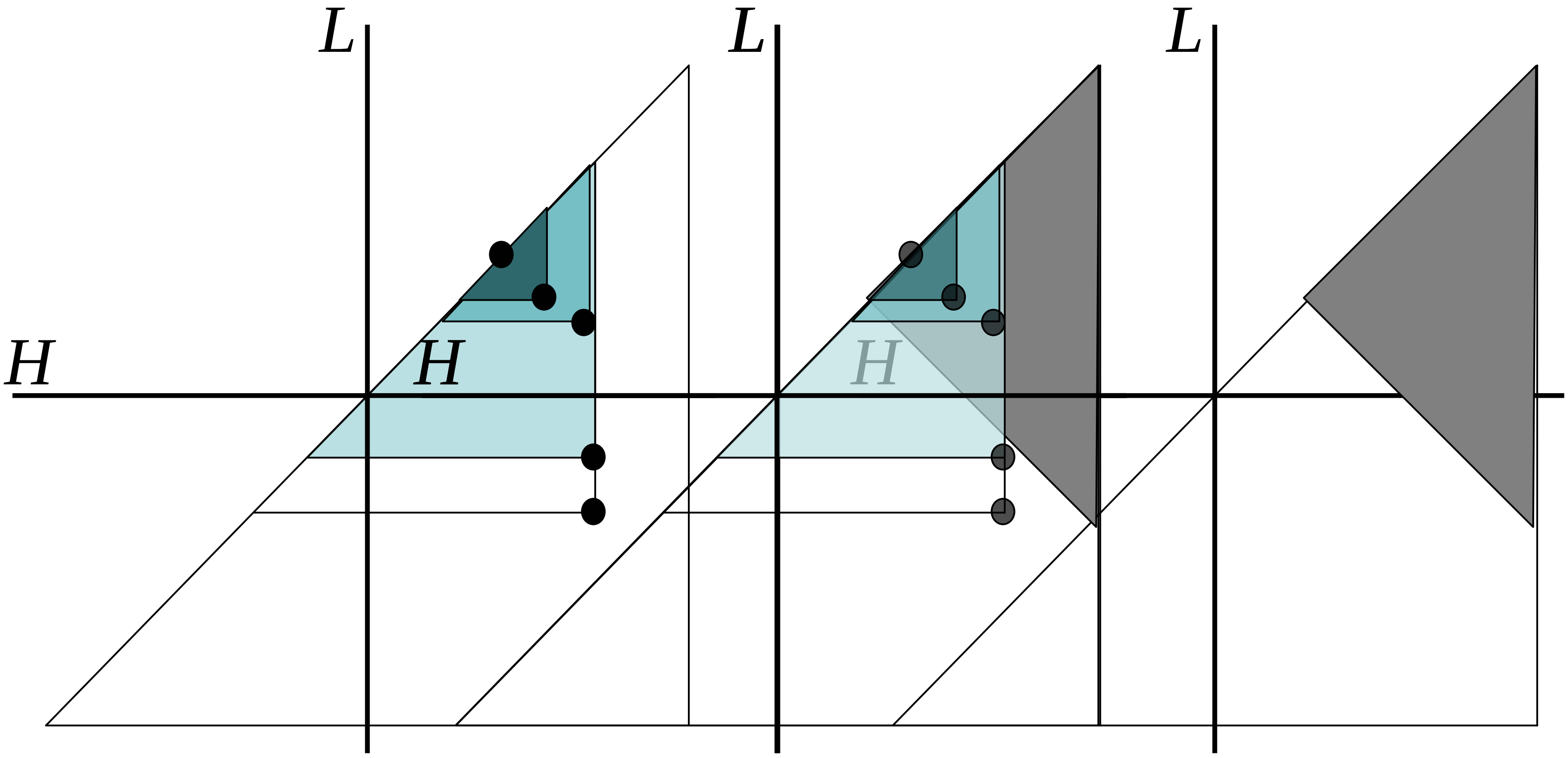
- Included in the triangle *(1,1),(1,-1),(-1,-1)*
- *if (h,l) in S, then (h',l') in S for* $h' \geq h$ *and* $l' \geq l$

Authorization Policies



Authorization Denied because $(H_{AB}, L_{AB}) \notin P$

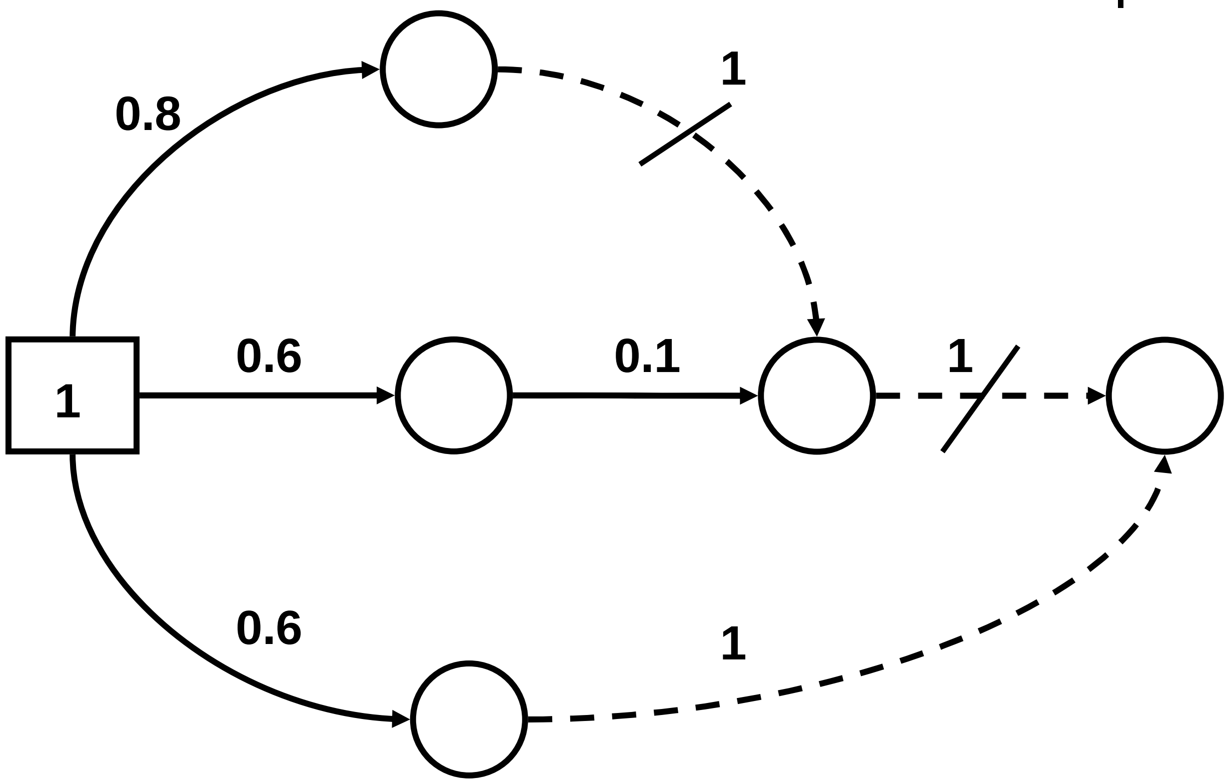
Authorization Policies



Authorization Granted at 50 % because $(H_{AB}^{50\%}, L_{AB}^{50\%}) \in P$

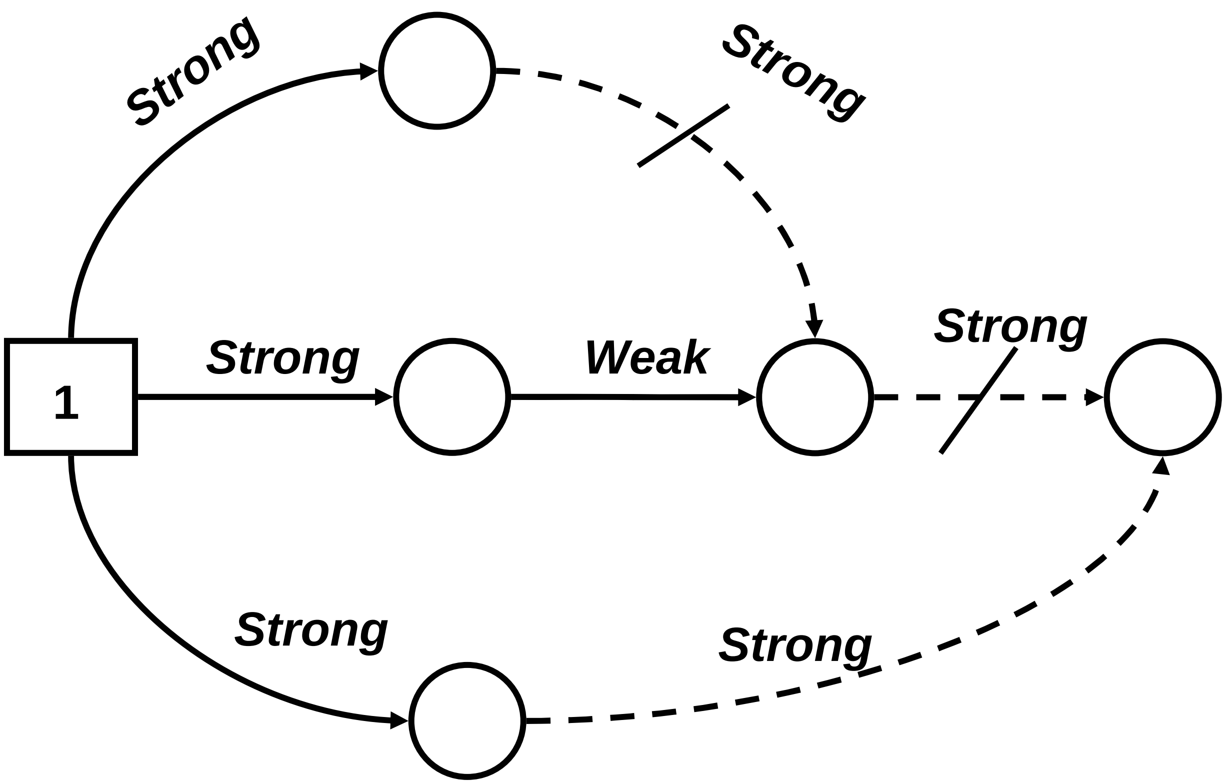
Security Level Policy

$$|m| > 0.5$$



Security Level Policy

|m| > Strong



Strong = 1
Weak = 0.5

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