Deviation-based Ranking System

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Introduction

Rating System

How can we know quality of object?

과학 > 과학일반

세상물정의 물리학

복잡한 세상을 꿰뚫어 보는 통계물리학의 아름다움

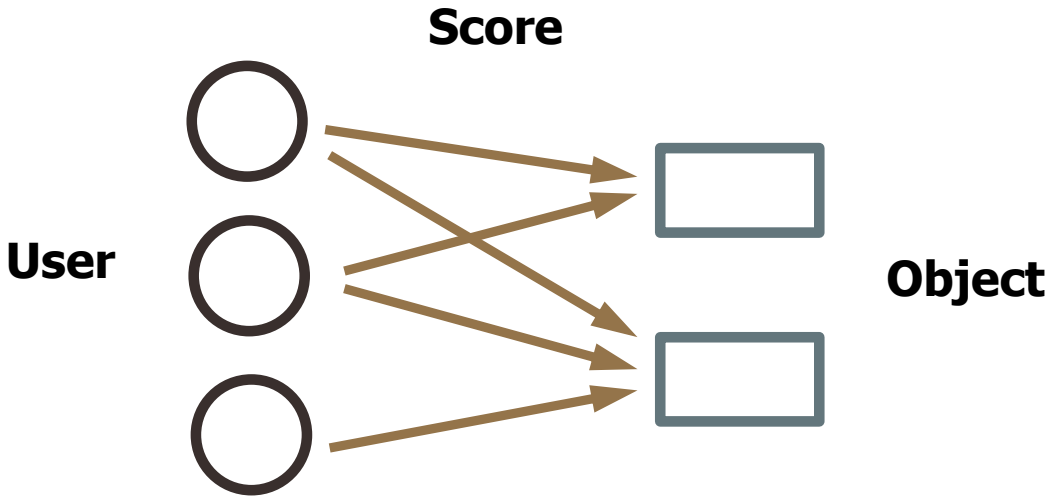
김범준 저

4.3점 (20명)

도서정보 동아시아 출판 | 2015년 09월 16일 출간 | EPUB | 13.5 MB

지원기기 PAPER iOS Android PC Mac

듣기기능 듣기 가능

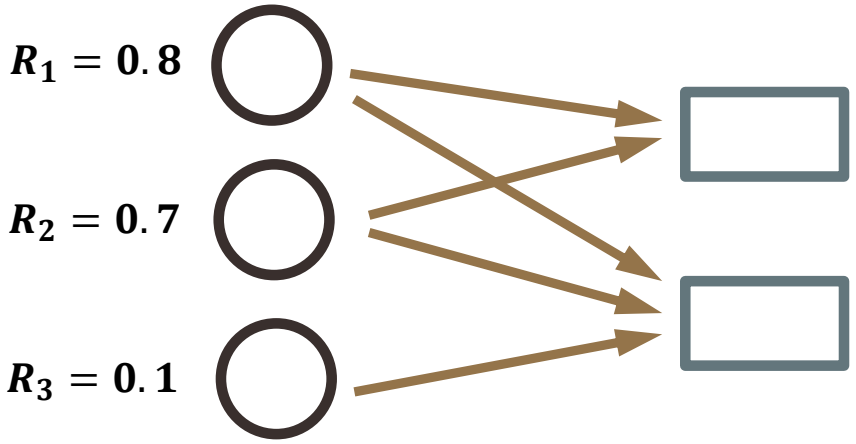


- Users evaluate objects and assign discrete scores
- Quality of object is determined by average score
- Vulnerable to distortion by spammer

Introduction

Reputation System

Score



IR, CR, RR, cosRA, ···

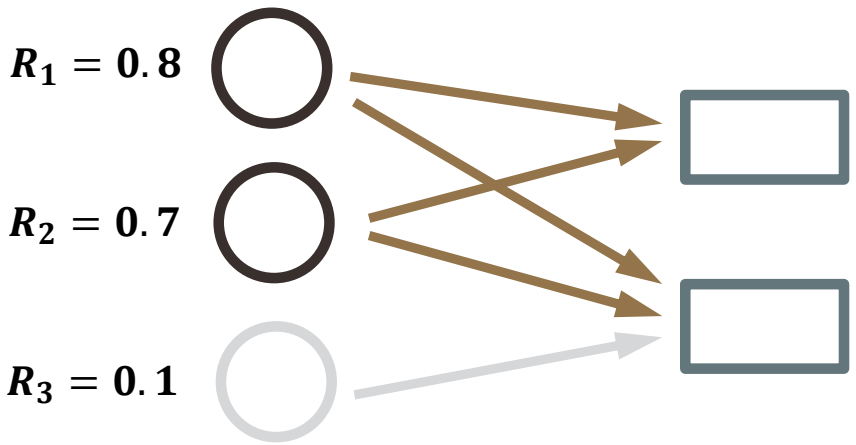
GR [1)]
Group-based Ranking System

1)Europhys. Lett. 110 (2) (2015) 28003

Introduction

Reputation System

Score



IR, CR, RR, cosRA, …

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Reputation System

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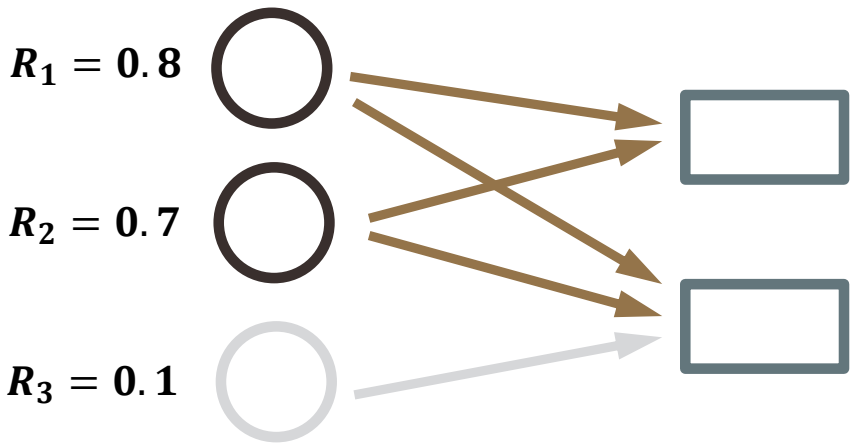

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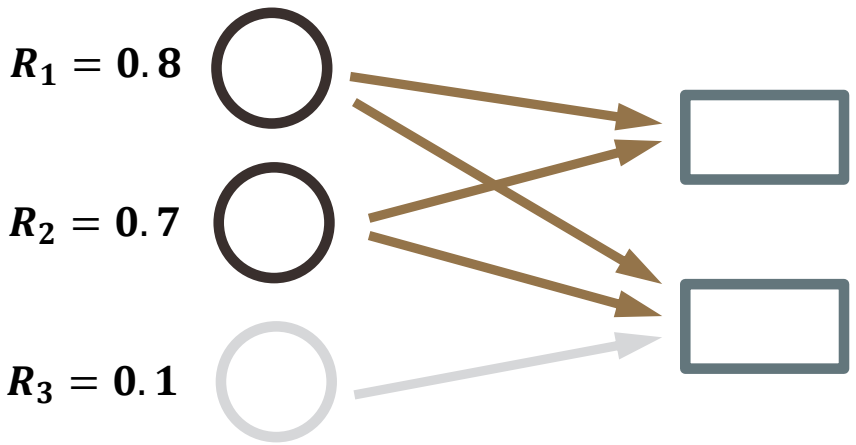

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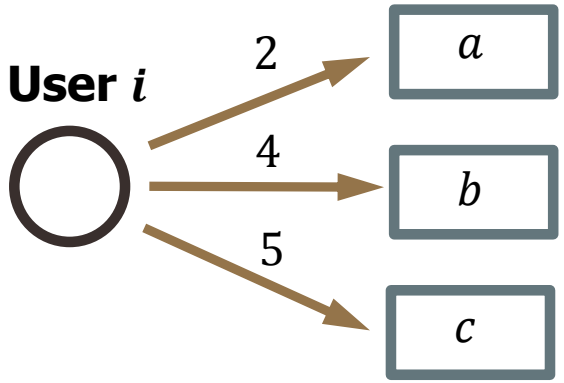
GR method

Object ∈ $\{a, b, c\}$
Score ∈ $\{1, 2, 3, 4, 5\}$



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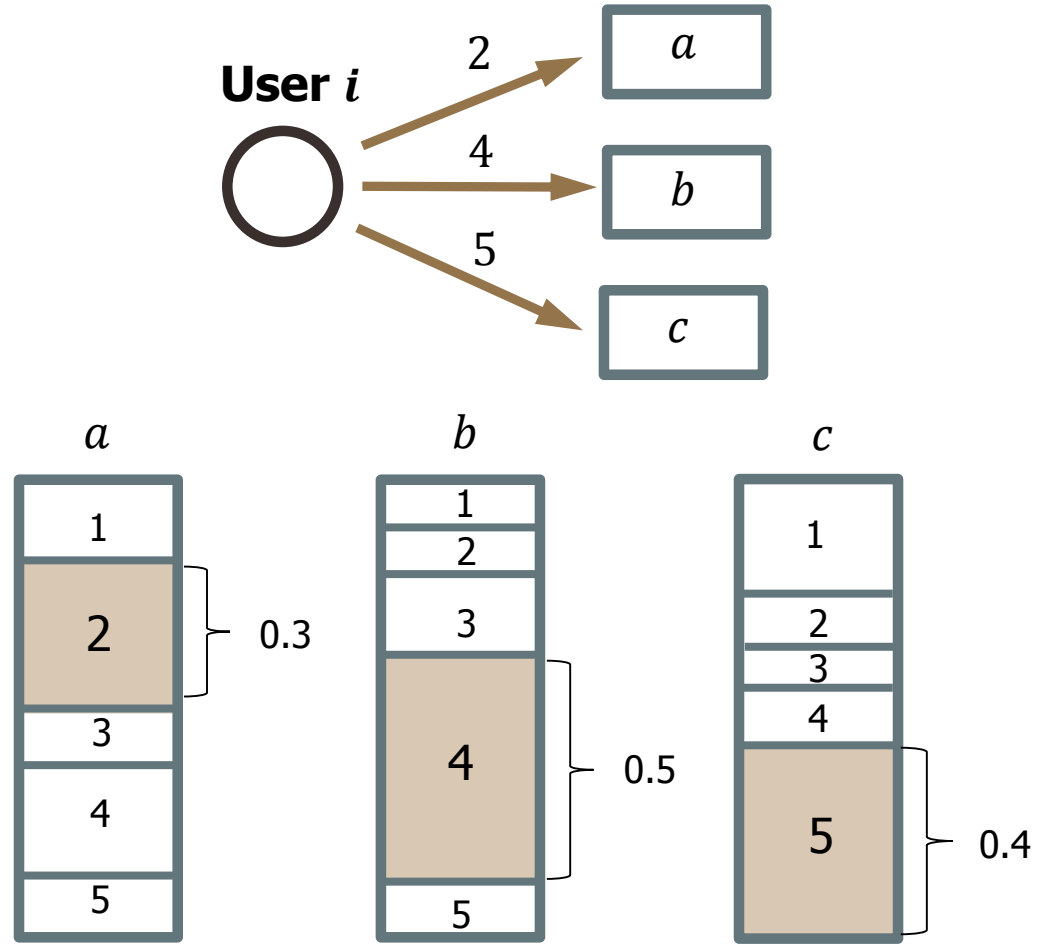


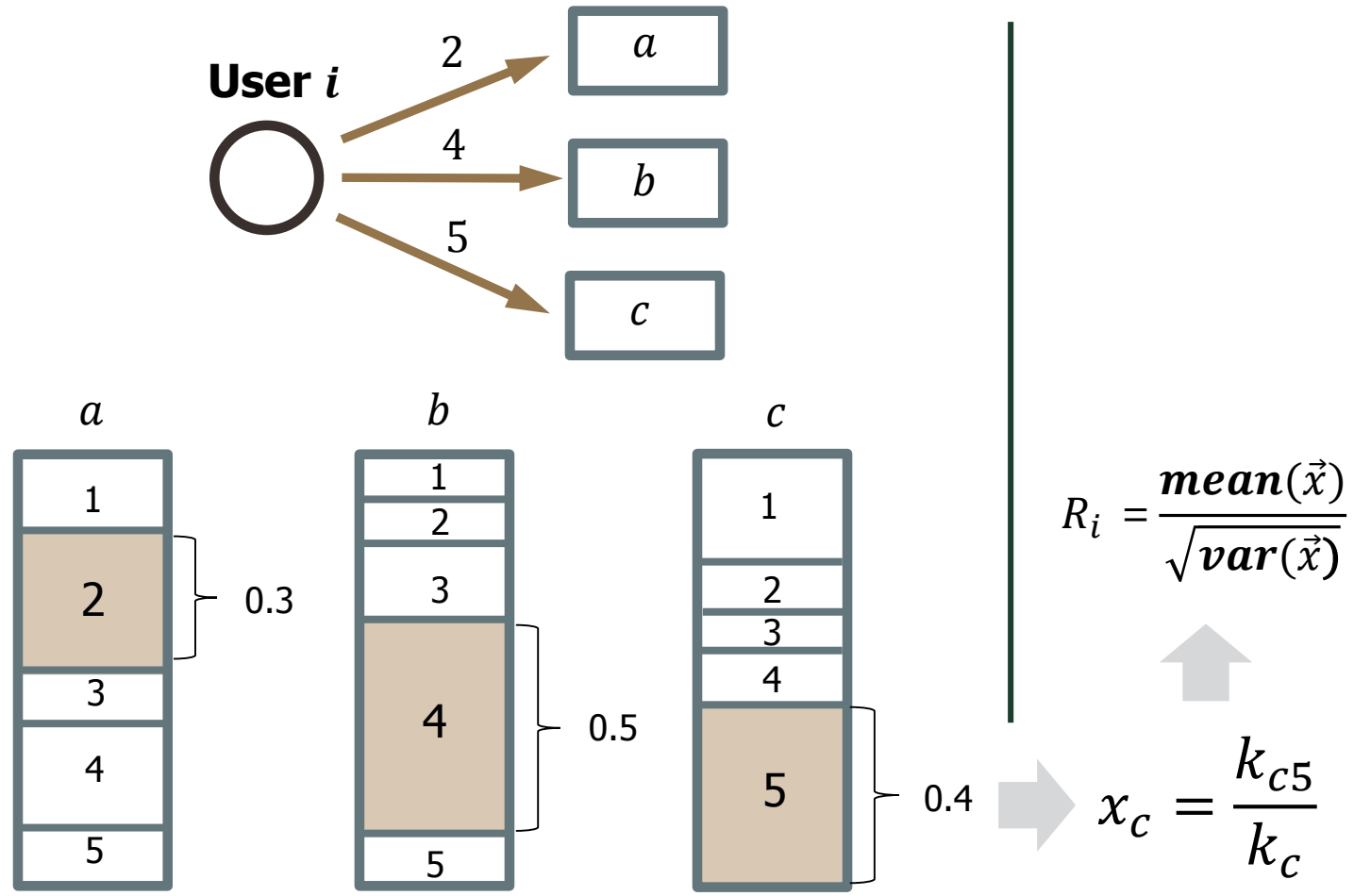
$$\vec{x}=(0.3, 0.5, 0.4)$$

Reputation : $R_i = \frac{mean(\vec{x})}{\sqrt{var(\vec{x})}} = \frac{0.4}{0.1} = 4$

- **User who gives popular score to each object takes high reputation**
- **Better performance than others**
- **Fragile to malicious attack**

IGR method

Object ∈ $\{a, b, c\}$
Score ∈ $\{1, 2, 3, 4, 5\}$



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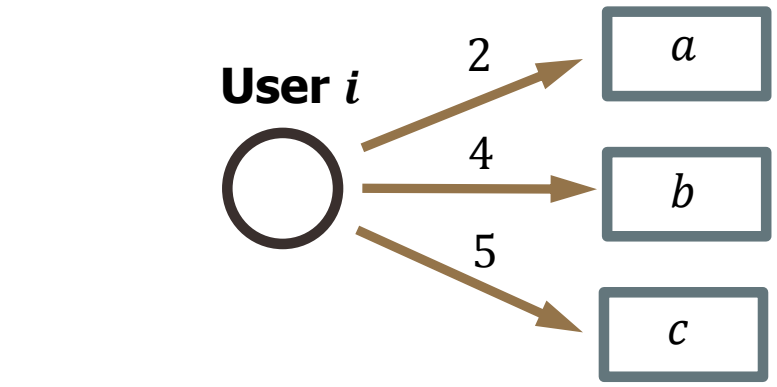

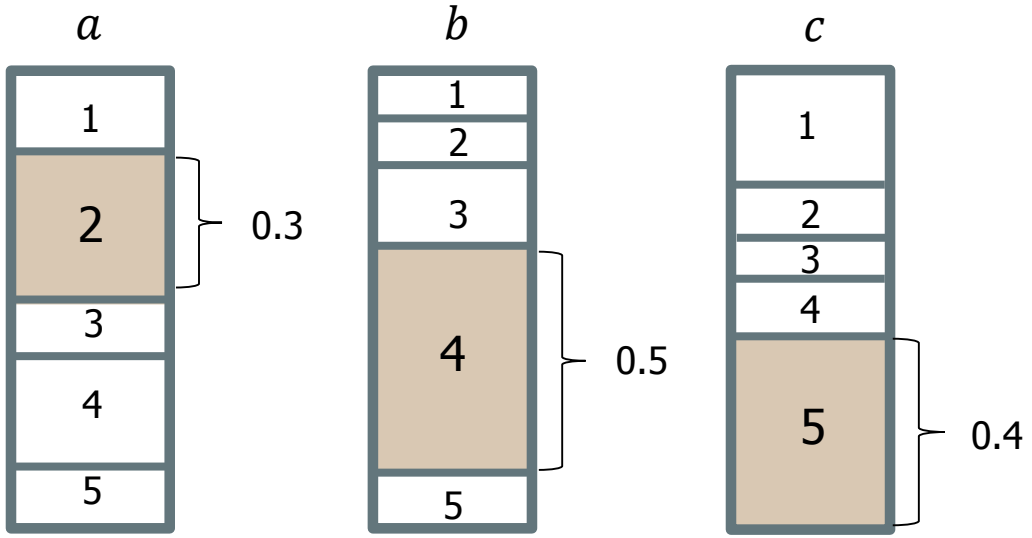

$$x_c' = \frac{\sum_{i \in c5} R_i}{\sum_{i \in c} R_i}$$

$$R_i = \frac{\boldsymbol{mean}(\vec{x})}{\sqrt{\boldsymbol{var}(\vec{x})}}$$

$$x_c = \frac{k_{c5}}{k_c}$$

IGR method

Object ∈ $\{a, b, c\}$
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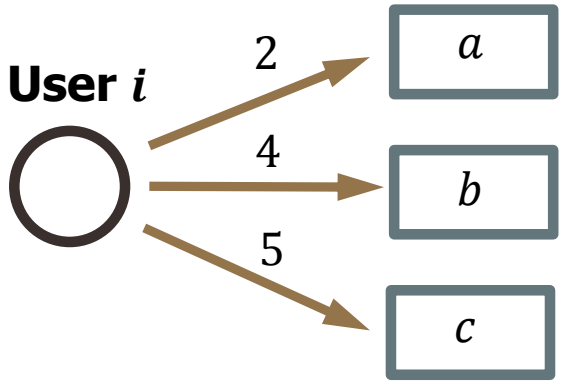
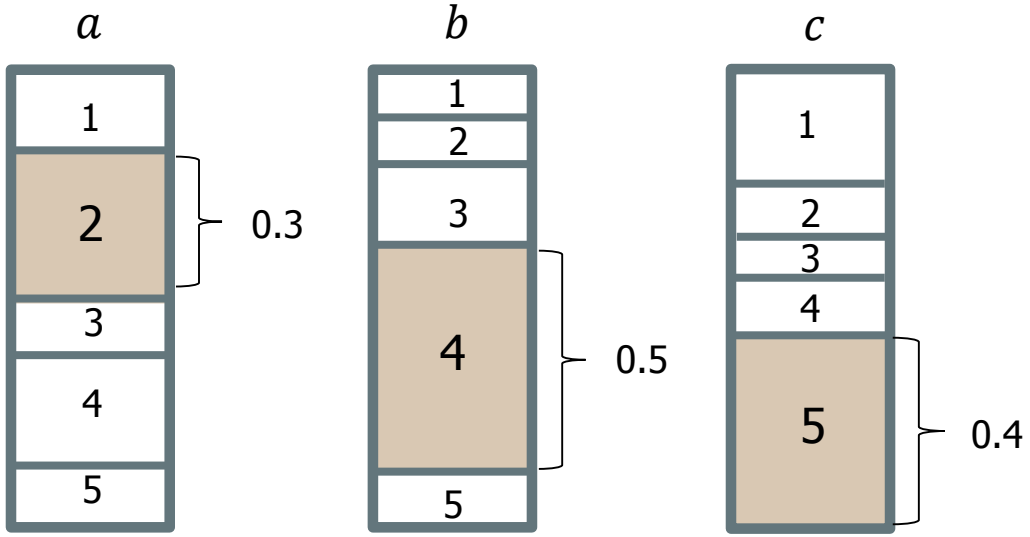




$$x_c = \frac{k_{c5}}{k_c}$$

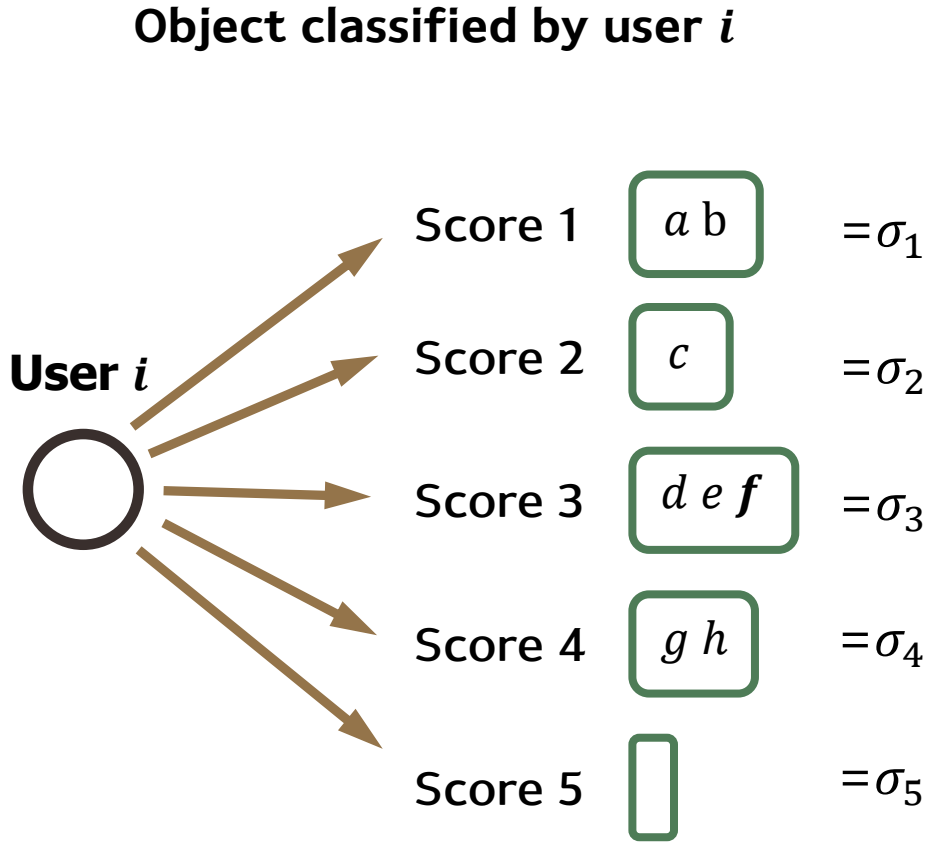
$$R_i = \frac{\boldsymbol{mean}(\vec{x})}{\sqrt{\boldsymbol{var}(\vec{x})}}$$

$$x_c{}' = \frac{\sum_{i \in c5} R_i}{\sum_{i \in c} R_i}$$

$$R_i{}' = \frac{\boldsymbol{mean}(\vec{x'})}{\sqrt{\boldsymbol{var}(\vec{x'})}}$$

DR method

Object $\in \{a, b, c, d, e, f, g, h\}$
Score $\in \{1, 2, 3, 4, 5\}$



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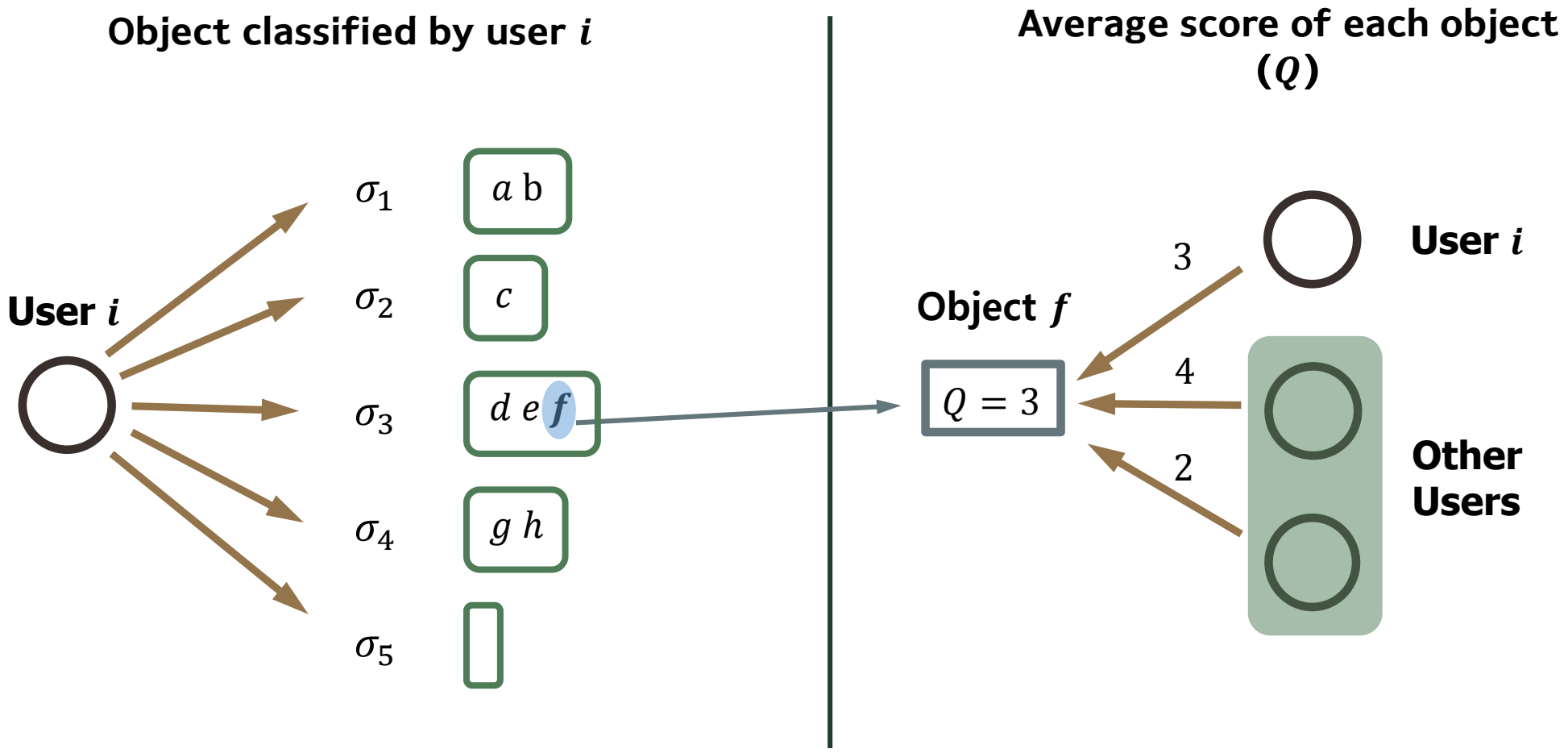

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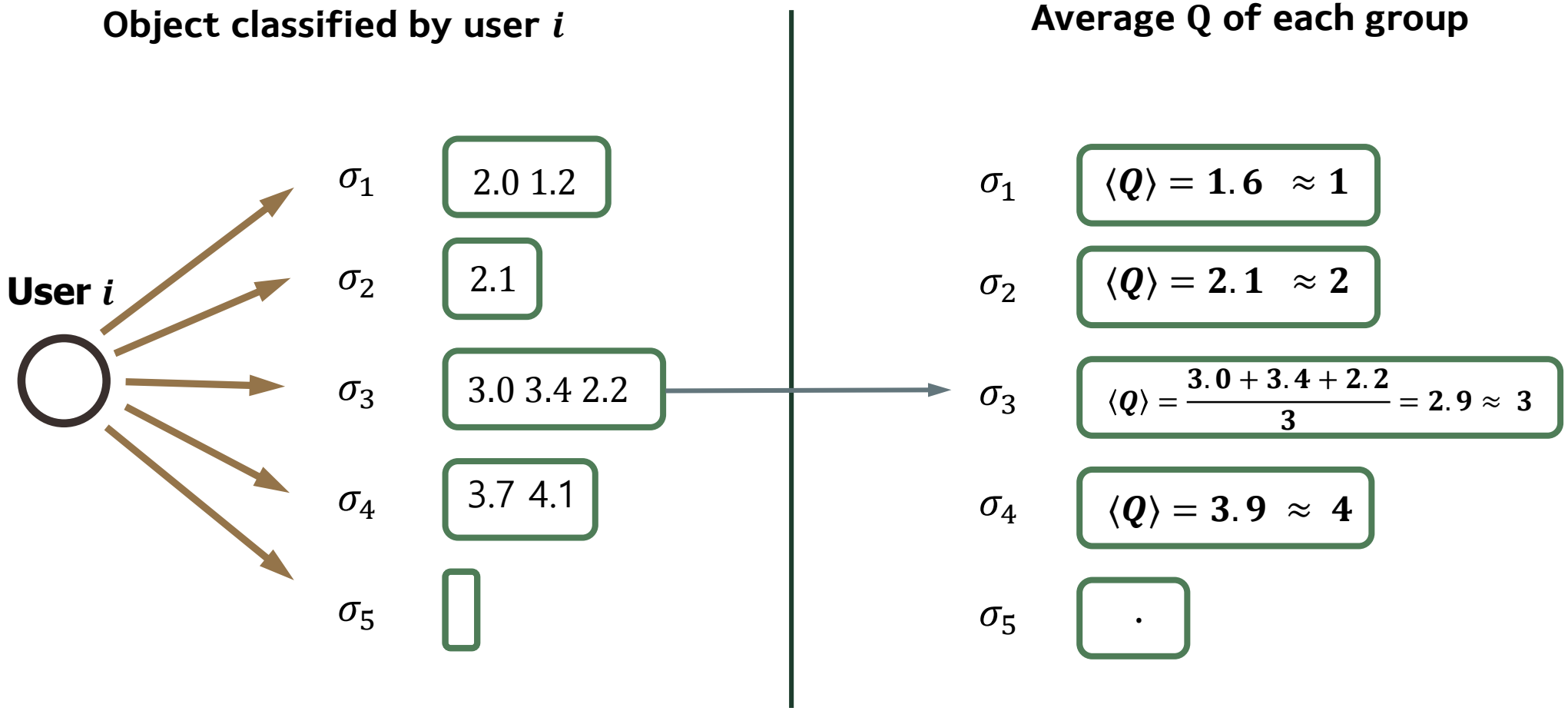


DR method

Average Q of each group (ideal case)

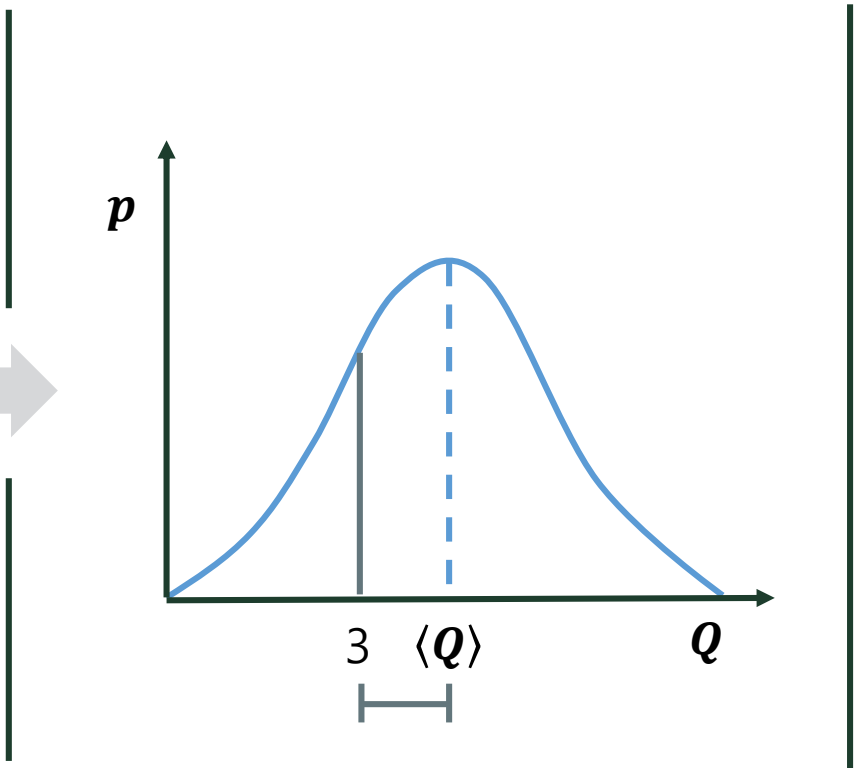
σ_1 $\langle Q \rangle \approx 1$

σ_2 $\langle Q \rangle \approx 2$

σ_3 $\langle Q \rangle \approx 3$

σ_4 $\langle Q \rangle \approx 4$

σ_5 $\langle Q \rangle \approx 5$



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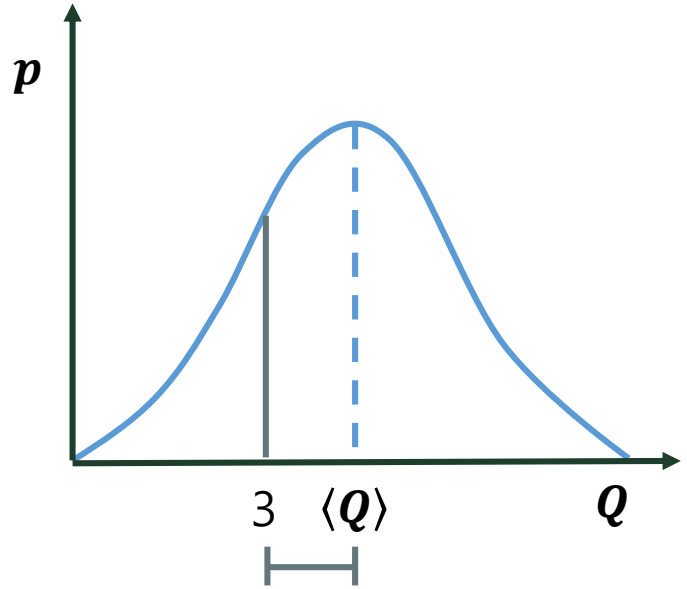

group size = w_3

$$R_i^3 = -\left|\frac{\langle Q \rangle - 3}{\sigma\,(Q)}\right|$$

$$= -\sqrt{w_3}\,|\langle Q \rangle - 3|$$

DR method

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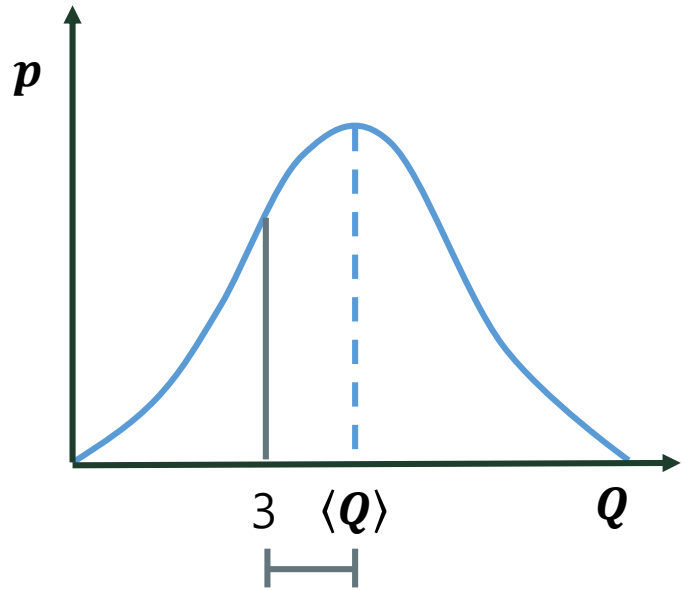

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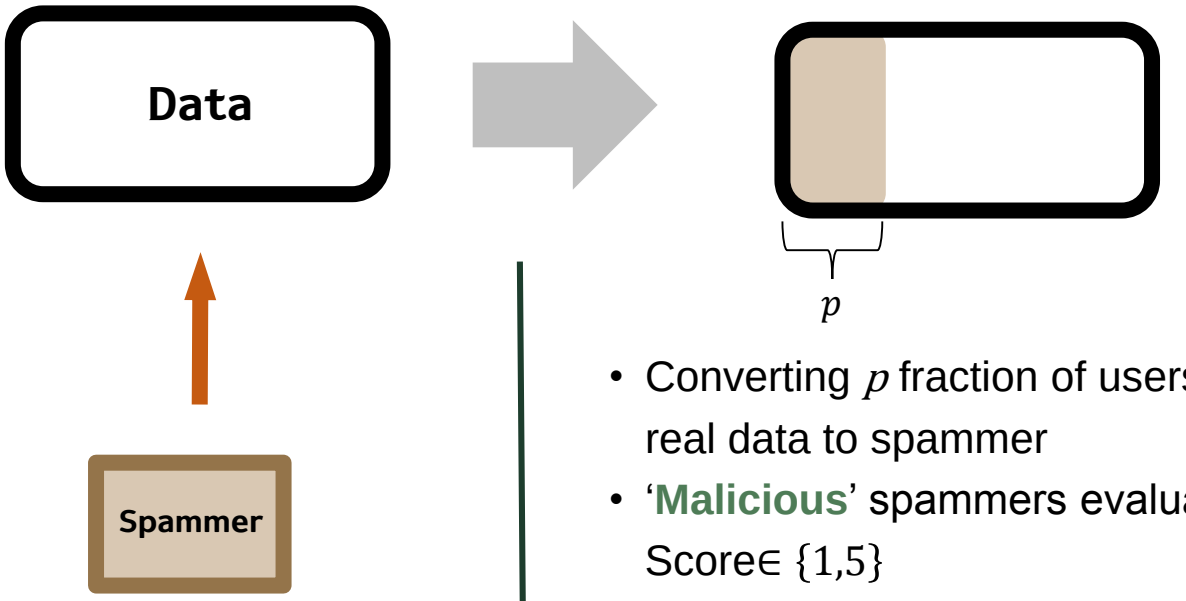
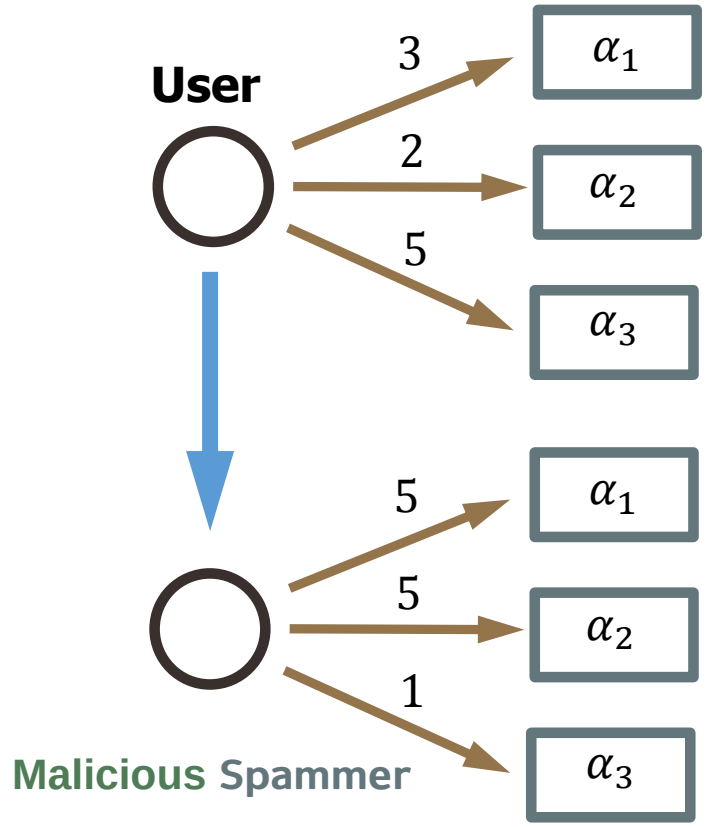
$$R_i = \sum_{m=1}^{5} R_i^m$$

Measurement

(MovieLens, Netflix, Amazon)



- Converting p fraction of users in real data to spammer
- '**Malicious**' spammers evaluate with Score$\in \{1,5\}$
- '**Random**' spammer evaluate with Score$\in \{1,2,3,4,5\}$



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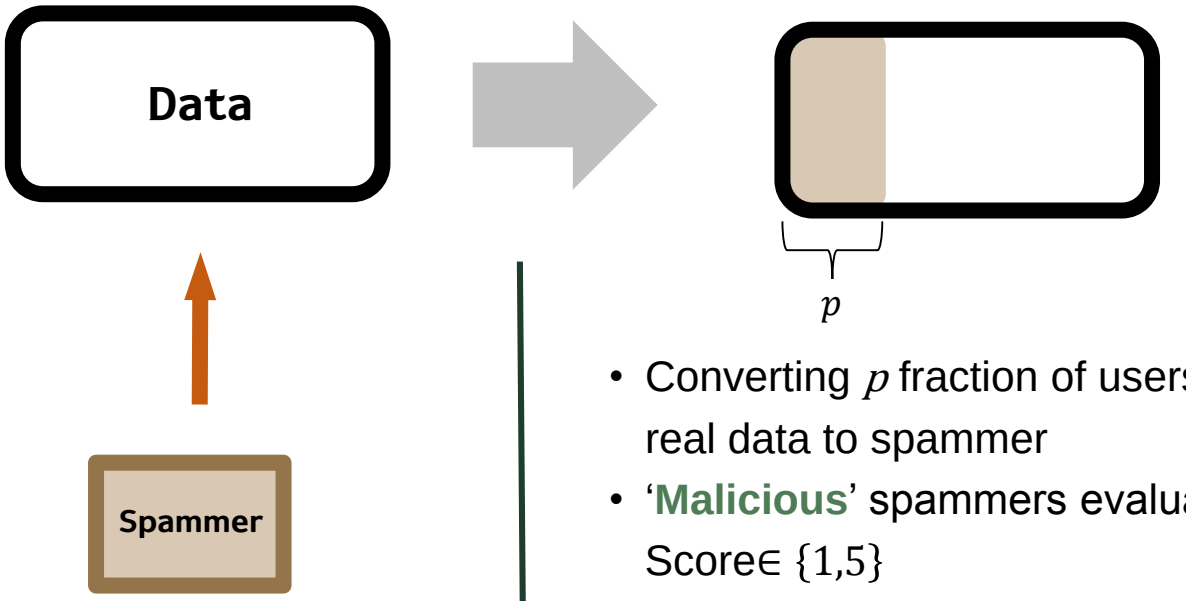

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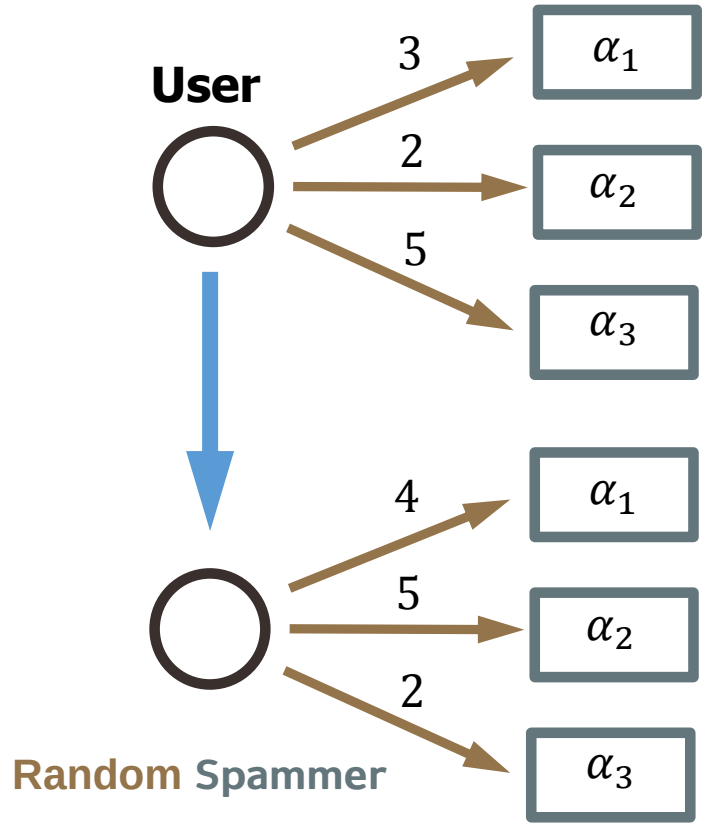

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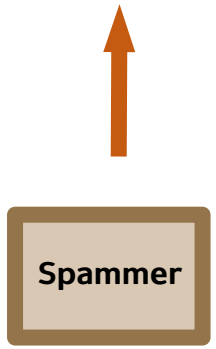
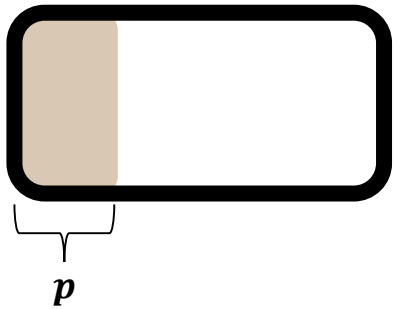
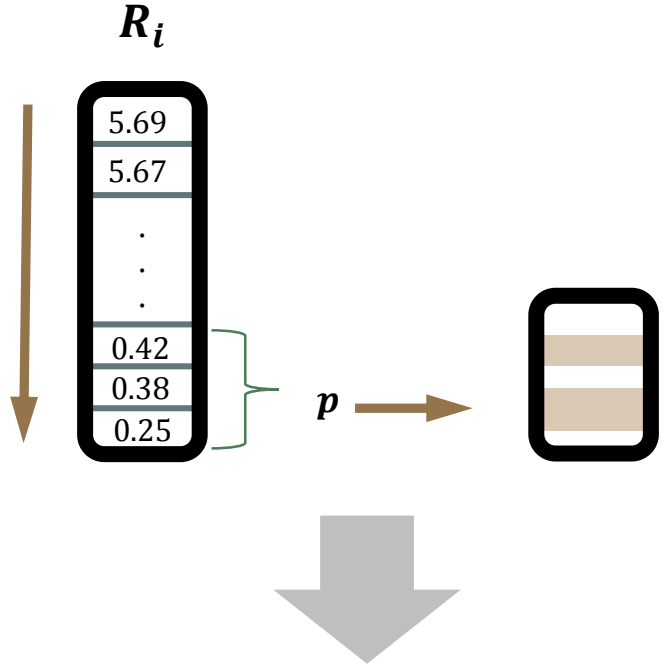




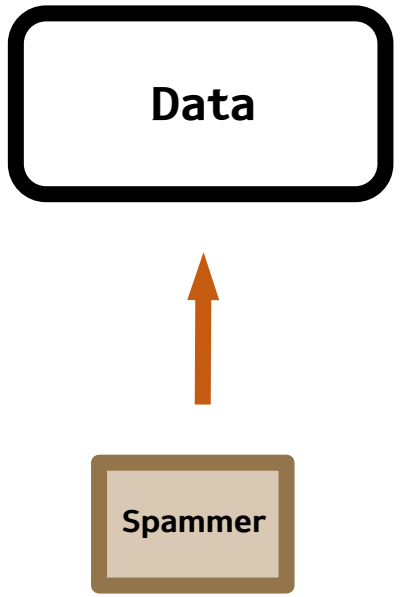
- Recall: fraction of spammers in low reputation group(fraction p)
- Range: $0<p<1$
- Marginal value: p

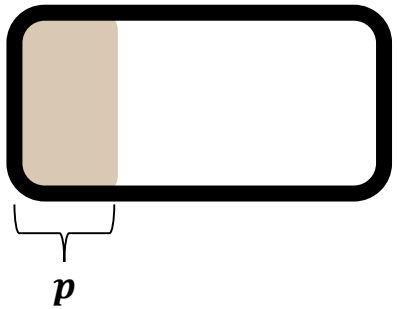


$$\text{Recall} = \frac{\text{spammers}}{\text{low reputation users}}$$

Measurement

(MovieLens, Netflix, Amazon)





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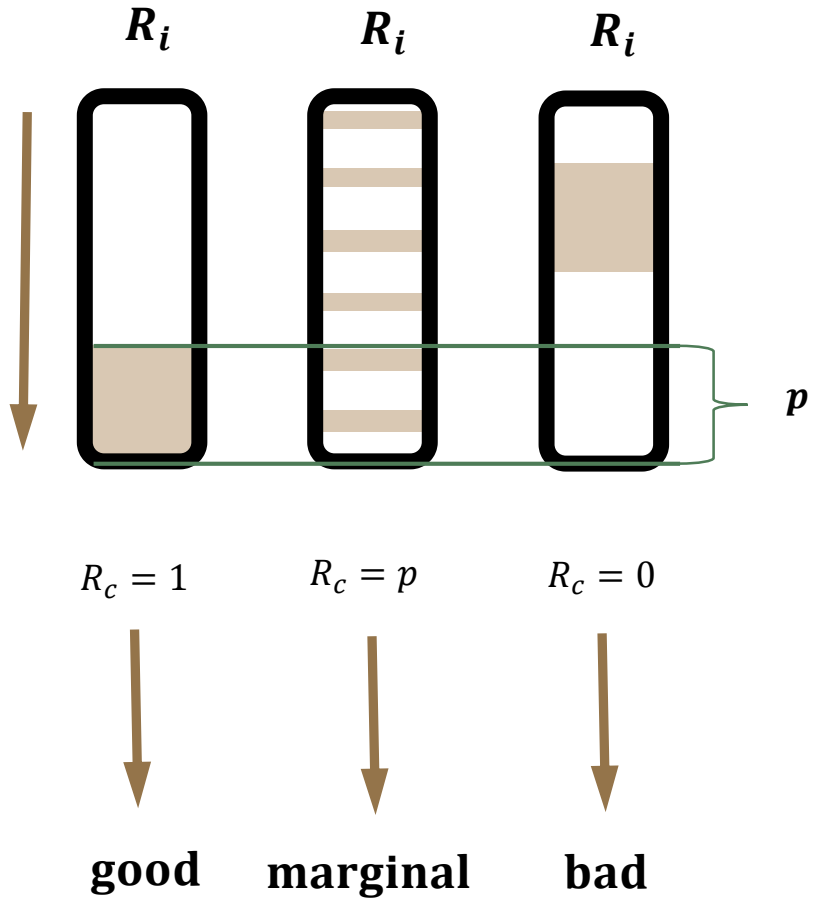
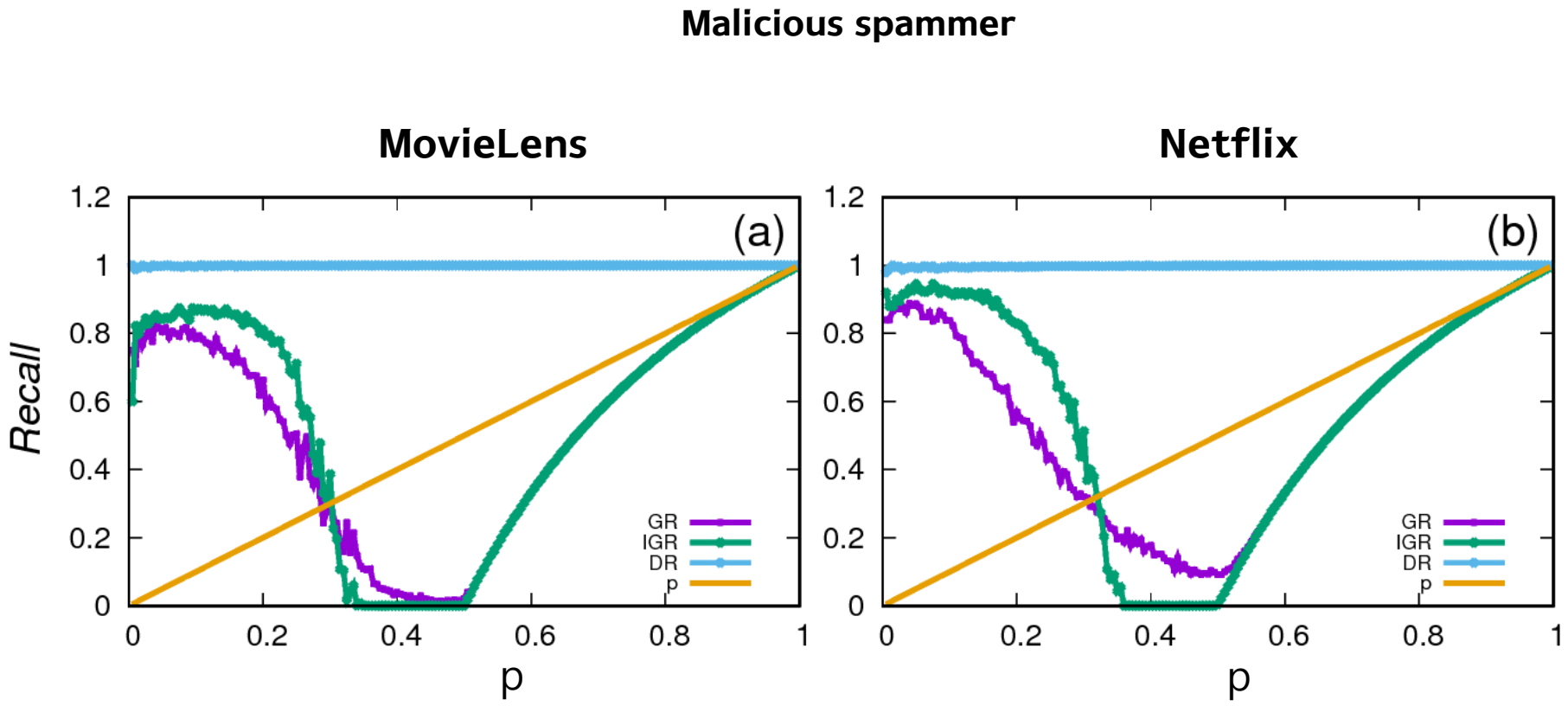


Result

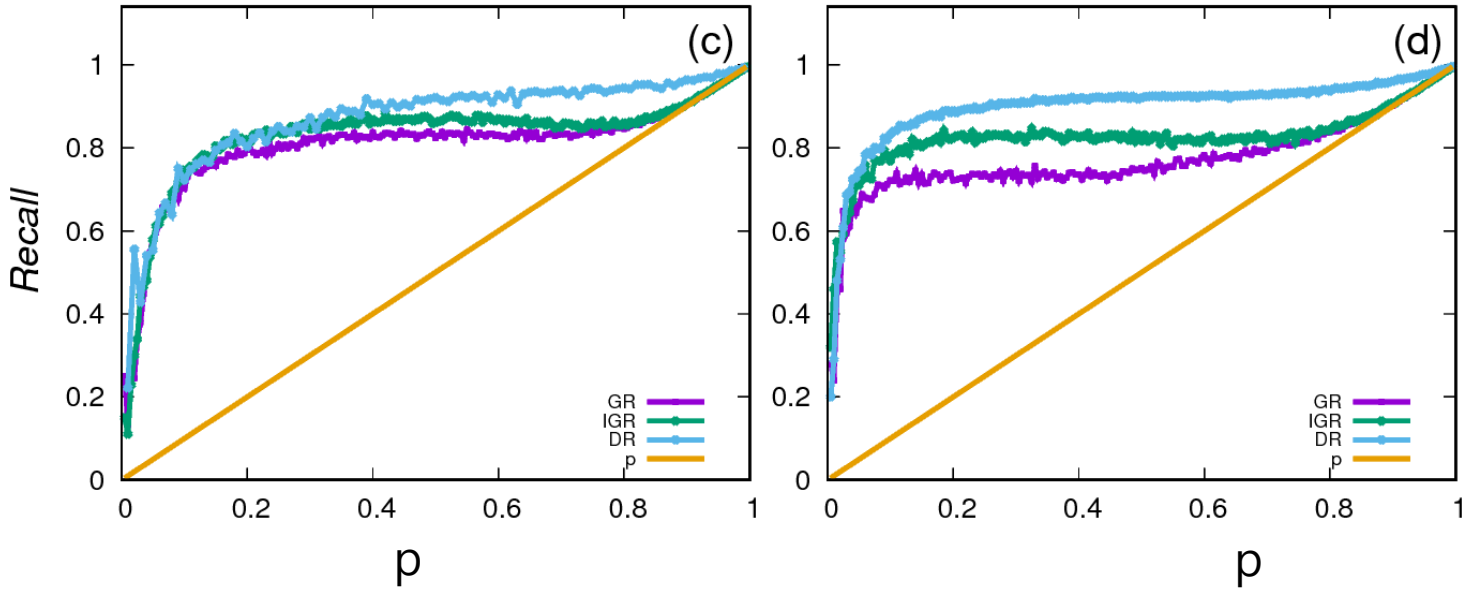


- GR: performing very low value at range p>0.3
- DR: performing higher than 0.98 in entire range
- DR method shows higher robustness from malicious attack

Result

Random spammer

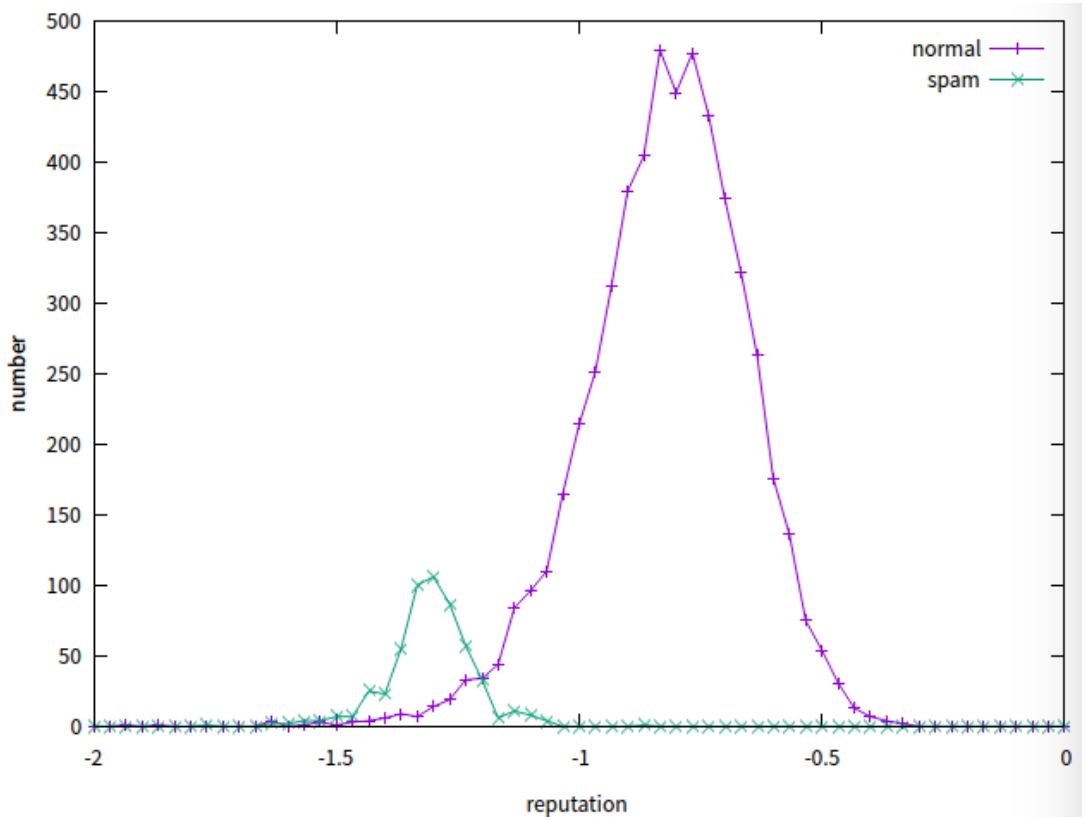
MovieLens **Netflix**



- GR and IGR method show similar curve shape
- DR method shows higher performance, especially in high p region
- 3 curves are similar in low p region

Result

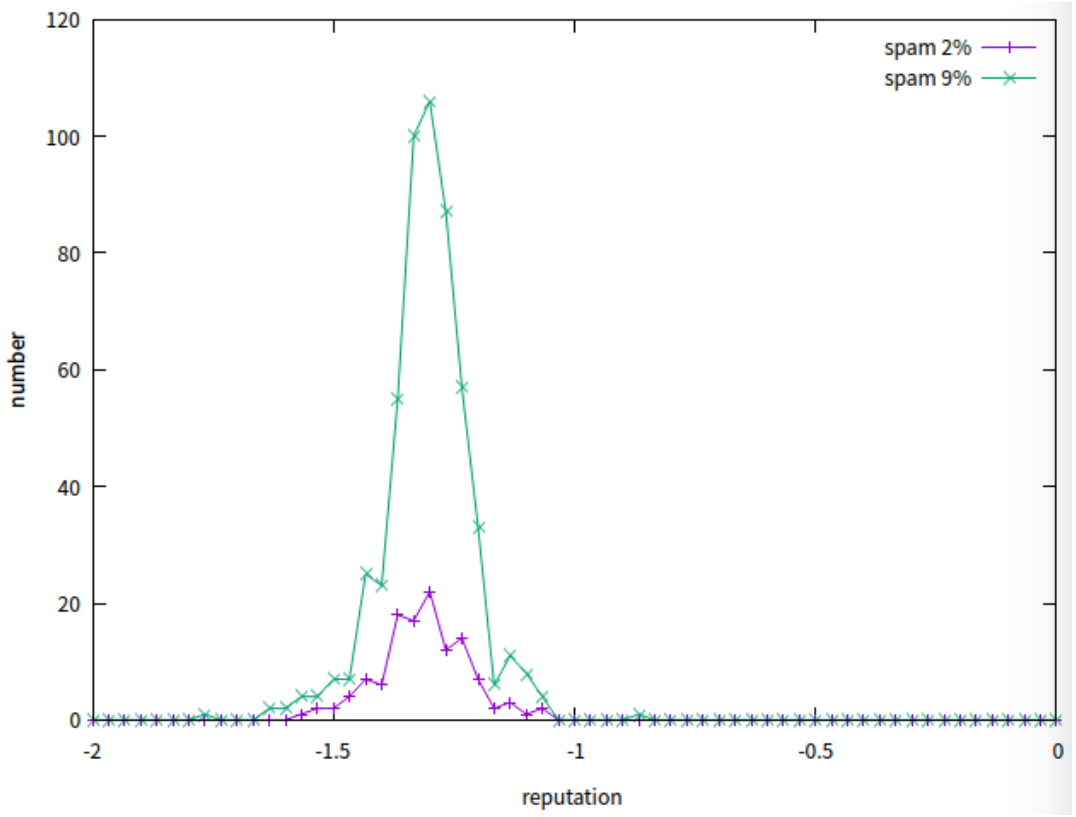
Distribution of reputation



- Overlap between spammer and user

Result

Distribution of reputation

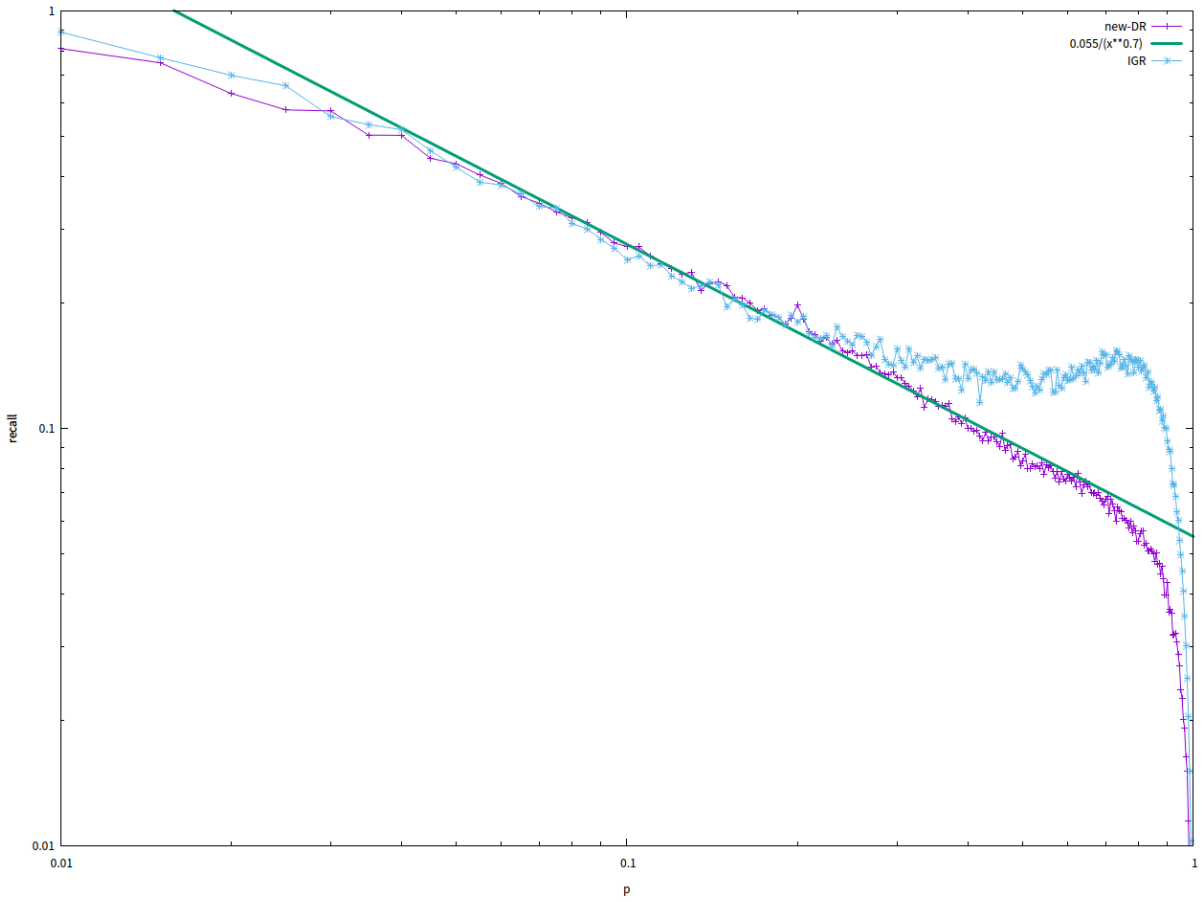


- Overlap between spammer and user
- Spammers' rating distribution is Gaussian(?)
- Overlap = original spammer?

Result

Overlap = power function?

1−recall



$$recall = 1 - 0.055p^{0.7}$$

$$0.055p^{0.7} = original\ spammer?$$

Result

Cutting low reputation user