

Robust Information Retrieval



WSDM 2025 tutorial

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<https://wsm2025-robust-information-retrieval.github.io/>

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Section 6:
Conclusions and future directions



- **Introduction**
- **Preliminaries**
 - Definition of robustness in IR
 - Taxonomy of robustness in IR
- **Adversarial robustness**
 - Benchmark, settings, task definition and evaluations
 - Adversarial attacks: steal black-box knowledge → identify vulnerable positions → add adversarial perturbations
 - Adversarial defenses: empirical defense, certified defense and attack detection
- **Out-of-distribution robustness**
 - OOD generalizability on unseen documents: new corpus and incrementation of original corpus
 - OOD generalizability on unseen queries: query variation and unseen query type
- **Robust IR in the age of LLMs**

Robustness: The Achilles' heel of neural IR models

Thetis Dipping Achilles into the River Styx - Antoine Borel (1743-1810)



If robustness is so hard, what can we do with our neural IR systems today?

- **Before going-to-production:** Optimizing training objectives, introducing perturbations in advance
- **While in production:** Customizing analysis tools, monitoring of operational status regularly
- **Post-hoc correction:** Improving system interpretability, optimizing for weaknesses

What about tomorrow?

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Much done, much left to do

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- **Game theory:** Modeling the market behavior of real SEO
- **Toolkit:** A systematic platform for integrating attack and defense methods
- **Industrial practice:** Considering the deployment in specific operations

Background: In real search engine SEO scenarios, there are **multiple attackers**, working individually or in groups, with consistent or not-exactly-consistent goals.

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Promising way: Game theory

- Multiple attackers seeking to profit is essentially a gaming problem
- Game theory can be used to find an equilibrium in this scenario
- SEO can be curbed by adjusting search engine rules to tilt the balance in favor of the user

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Promising way: Toolkit

- A high-quality codebase for robust IR research
- A unified data processing pipeline, simplified model configuration and automatic hyper-parameters tuning features equipped

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Promising way: Industrial practice

- Foster academic-industrial collaborations on the topic
- Designing appropriate defense mechanisms for realistic and specific SEO scenarios

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- **Causality modeling:** Identifying spurious correlation factors between documents and queries
- **Toolkit:** A systematic platform for integrating OOD documents and queries
- **Industrial practice:** Considering the deployment in specific operations

Background: Some neural IR models focus on **spurious correlations** within the domain, leading to poor out-of-distribution performance

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Promising way: Causality modeling

- Causal modeling can effectively identify the key factors in a document that determine the relevance of a query
- When the domain changes, these key factors remain the same

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Promising way: Toolkit

- A unified experimental platform is needed to accommodate possible OOD problems
- A good solution should perform consistently in a variety of OOD scenarios

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Promising way: Industrial practice

- Conduct experiments on real data from industrial scenarios, such as corpus increments over time
- Designing the appropriate OOD solutions for realistic and specific search engine scenarios

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- **Exploring synergies** between different aspects of robustness, such as adversarial and OOD
- **Enhancing model agility** to quickly adapt to new data without extensive retraining
- **Resources and sharing**

There is still a long way to go ...

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“Oh, you mean adversarial robustness? OOD robustness? data distribution? model architecture?”

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“Oh, you mean adversarial robustness? OOD robustness? data distribution? model architecture?”

“Actually, I mean this deployed model will not fail next month.”

Ultimate goal for robust IR ...

Built to withstand, designed to last!

Q & A

Thank you for joining us today!

All materials are available at

[https:](https://wsgm2025-robust-information-retrieval.github.io/)

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References

