PRISM: Semantics Prioritization of Software Requirements

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Research Motivation

Problem

Software projects often generate requirement sets that are large, semantically inconsistent, and difficult to evaluate.
Redundancy, ambiguity, and evolving constraints make requirements prioritization **subjective, inconsistent, and non-reproducible**

Goal

Develop a **semantics-aware, reproducible** approach that evaluates requirement quality directly from text and supports **consistent, transparent, and scalable** prioritization across diverse software systems.

Solution

PRISM addresses these challenges by integrating:

1. **Semantic redundancy detection** to consolidate overlapping requirements
2. **Interpretable metrics** quantifying importance, clarity, and stability
3. A **weight-free, deterministic ranking process** that produces reproducible priorities

Research Questions

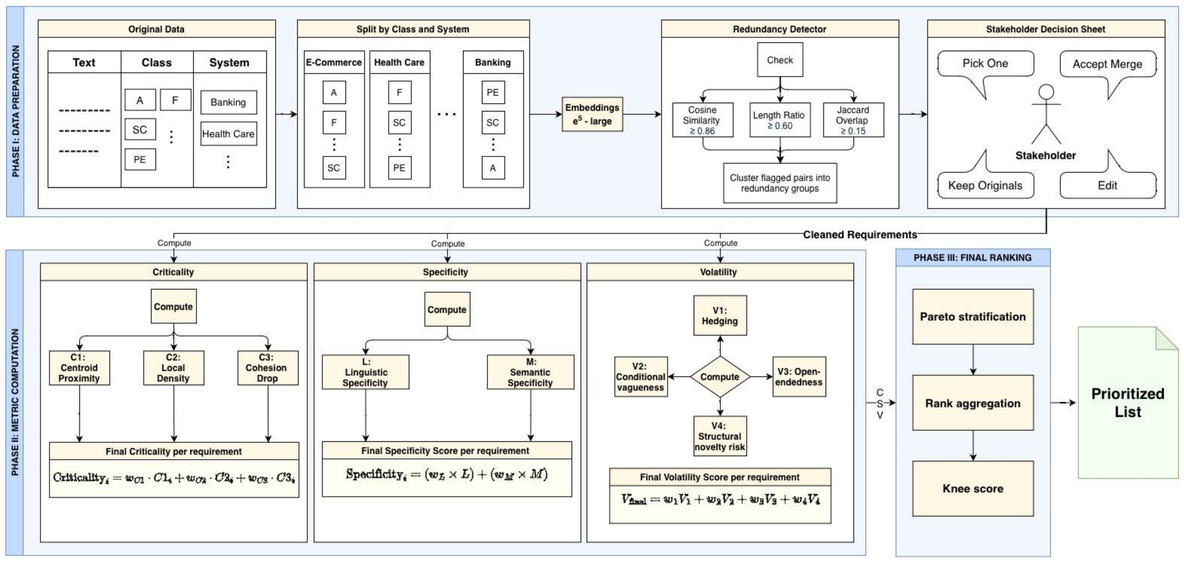
1 How can requirement-level qualities such as *criticality, specificity,* and *volatility* be quantified systematically and defensibly?

2 How can redundancy and semantics overlap be integrated into the prioritization process to improve reliability?

3 To what extent can the Semantics yield consistent and interpretable rankings across multiple system contexts?

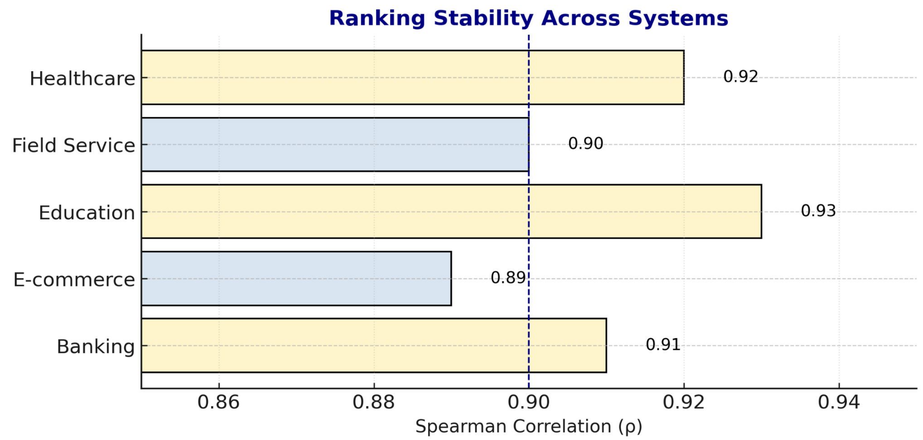
Methodology

Three-phase PRISM process: redundancy resolution → semantic metrics → reproducible, weight-free Ranking



Results and Validation

Component	Main Finding	Key Evidence
Metrics	Independent and interpretable quality dimensions.	Correlation ≤ 0.27.
Redundancy Resolution	Stable ranking after merging equivalent requirements	See Figure Below
Ranking Process	Consistent prioritization across domains.	ρ = 0.84–0.98, 99% top-100 overlap
Framework Behavior	Clear and critical requirements ranked highest.	Observed in five system domains.



Discussion and Impact

- PRISM introduces **requirement-level semantic metrics** that quantify importance, clarity, and stability capabilities missing in prior prioritization methods.
- The framework unifies **semantic redundancy detection** with interpretable metrics, preventing duplicated influence and improving ranking stability.
- A **weight-free multi-**objective ranking pipeline ensures deterministic, reproducible results independent of subjective judgment.
- Cross-system validation confirms **robust and domain-independent** prioritization, demonstrating PRISM's scalability and practical applicability.
- The approach systematically exposes **ambiguous, unstable, or weakly specified** requirements, supporting earlier refinement and stronger engineering decisions.

Conclusion

Novel Framework
Semantic, metric-based alternative to subjective prioritization

Redundancy-Aware
Eliminates overlapping requirements to increase ranking stability.

PRISM

Multi-Metric Analysis
Quantifies importance, clarity, and stability using interpretable semantic metrics

Reproducible & Scalable
Produces deterministic results across domains without pairwise comparisons.