新兴趋势与伦
Emerging Trends & Ethics

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Emerging Trends & Ethics

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AI in Software Engineering

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软件工程中的人工智能
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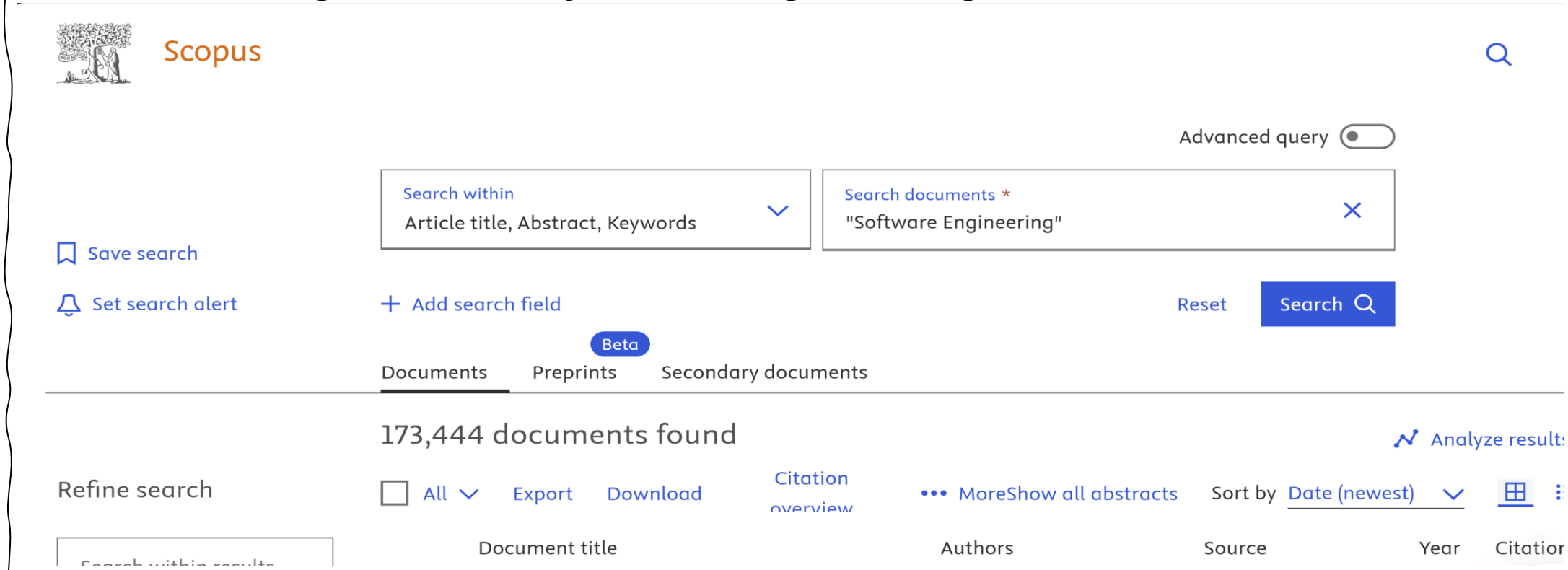

软件工程中的人工智能
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11639/ Only 6% of total documents

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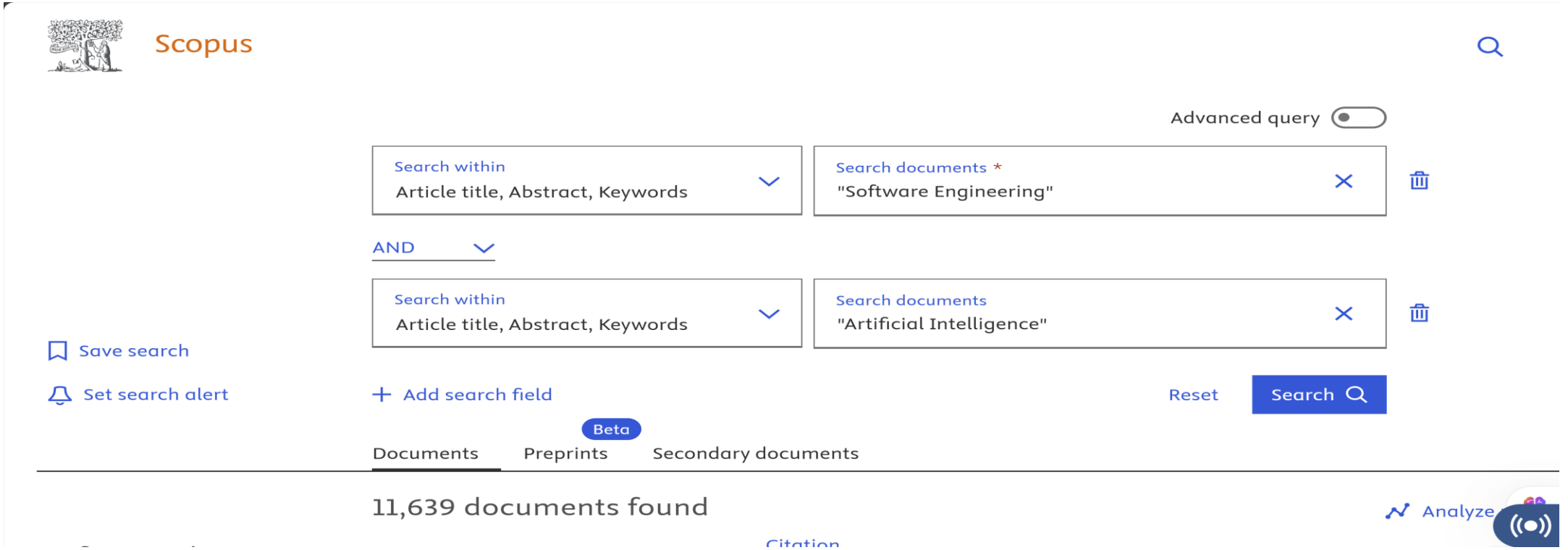

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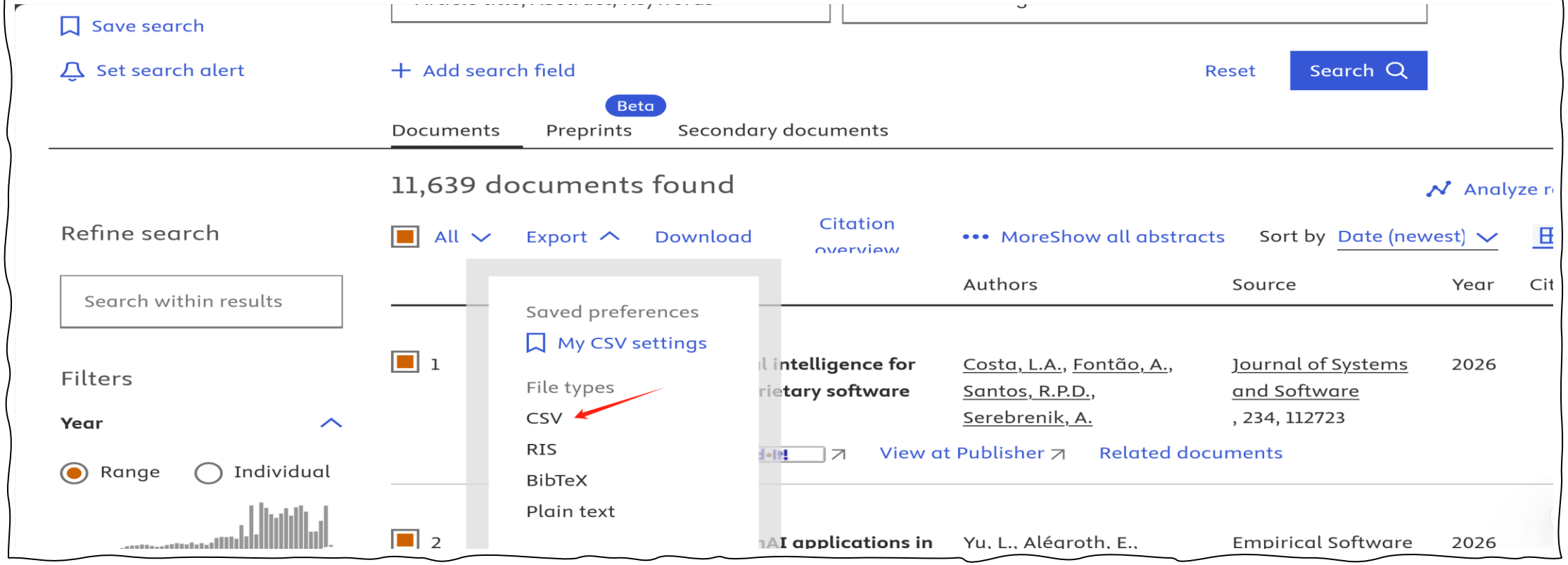

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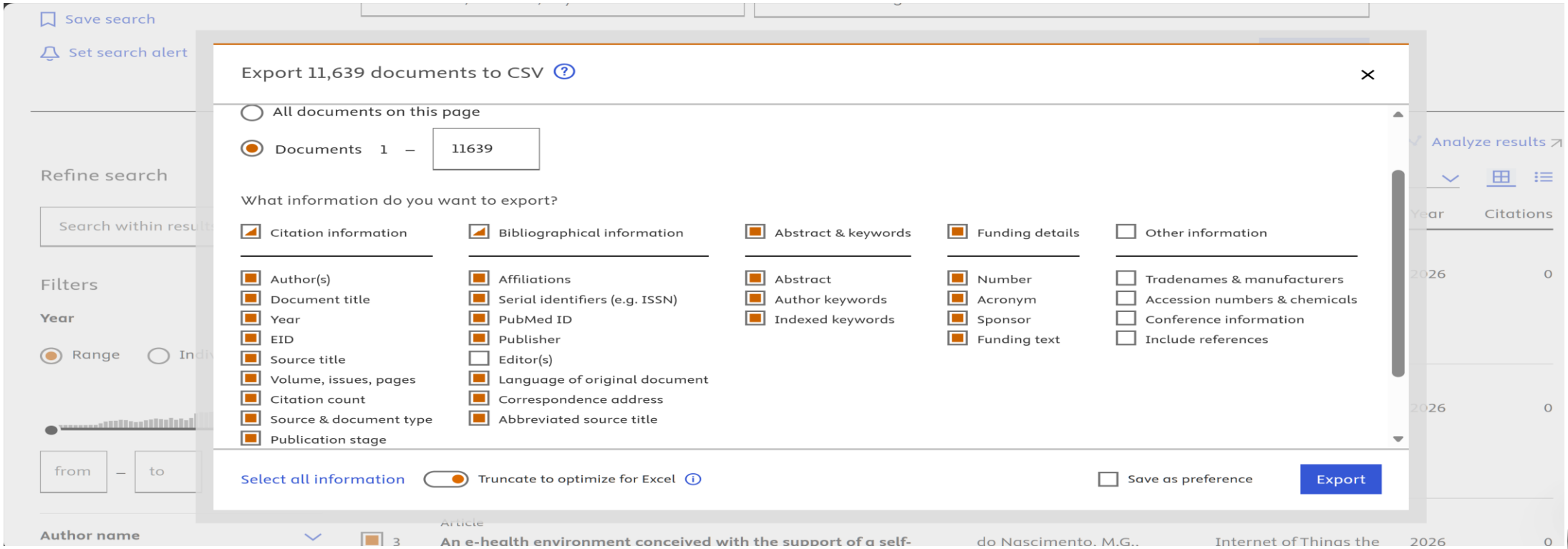

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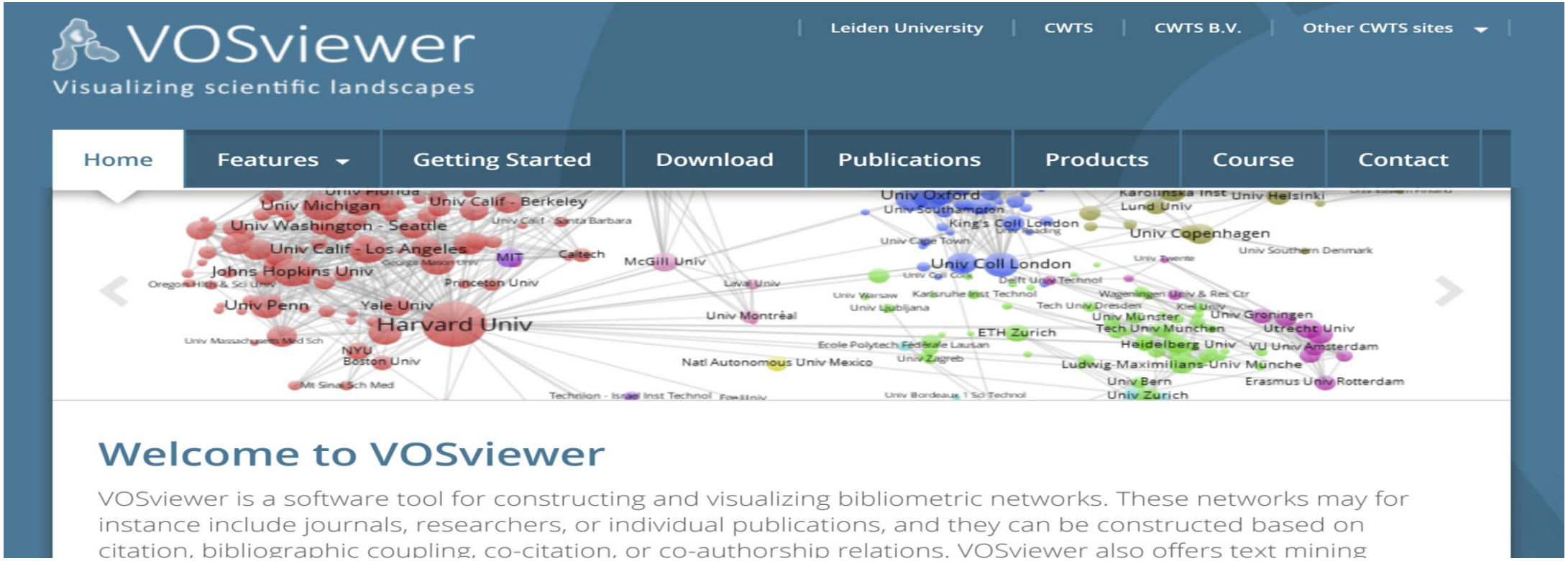

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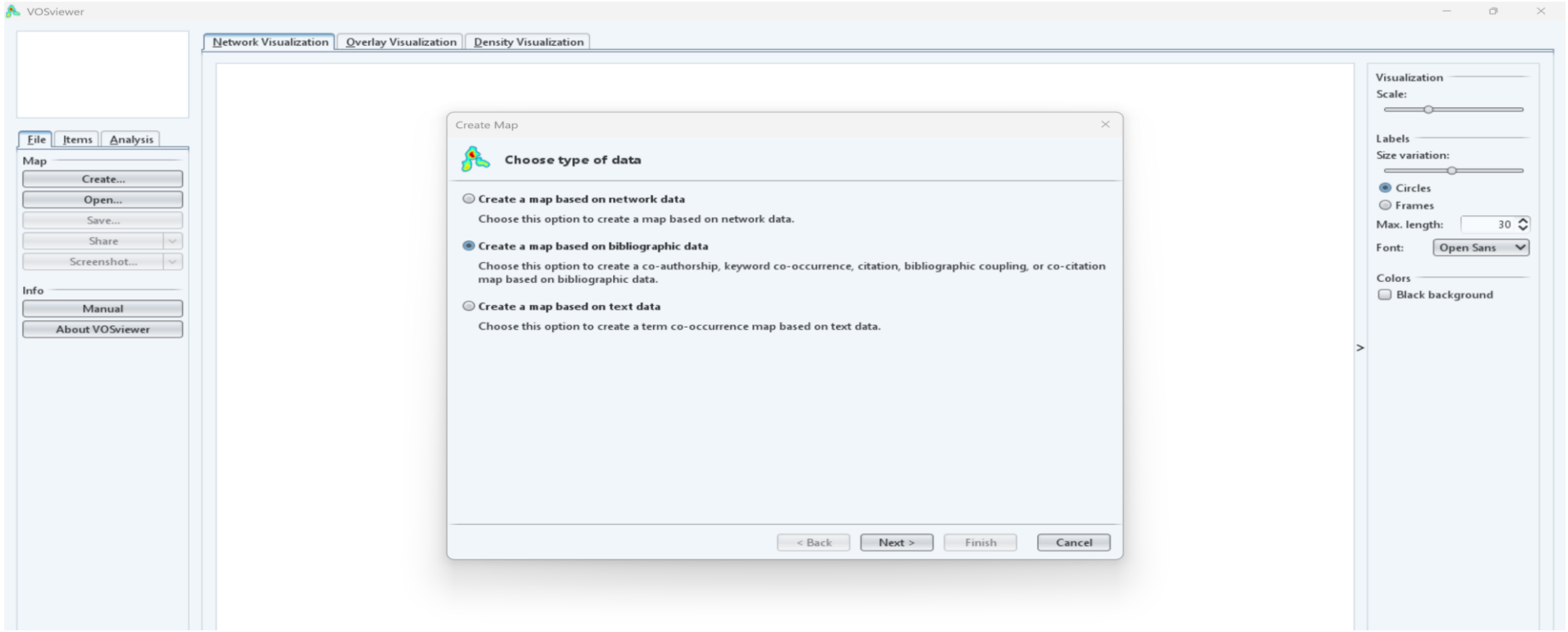

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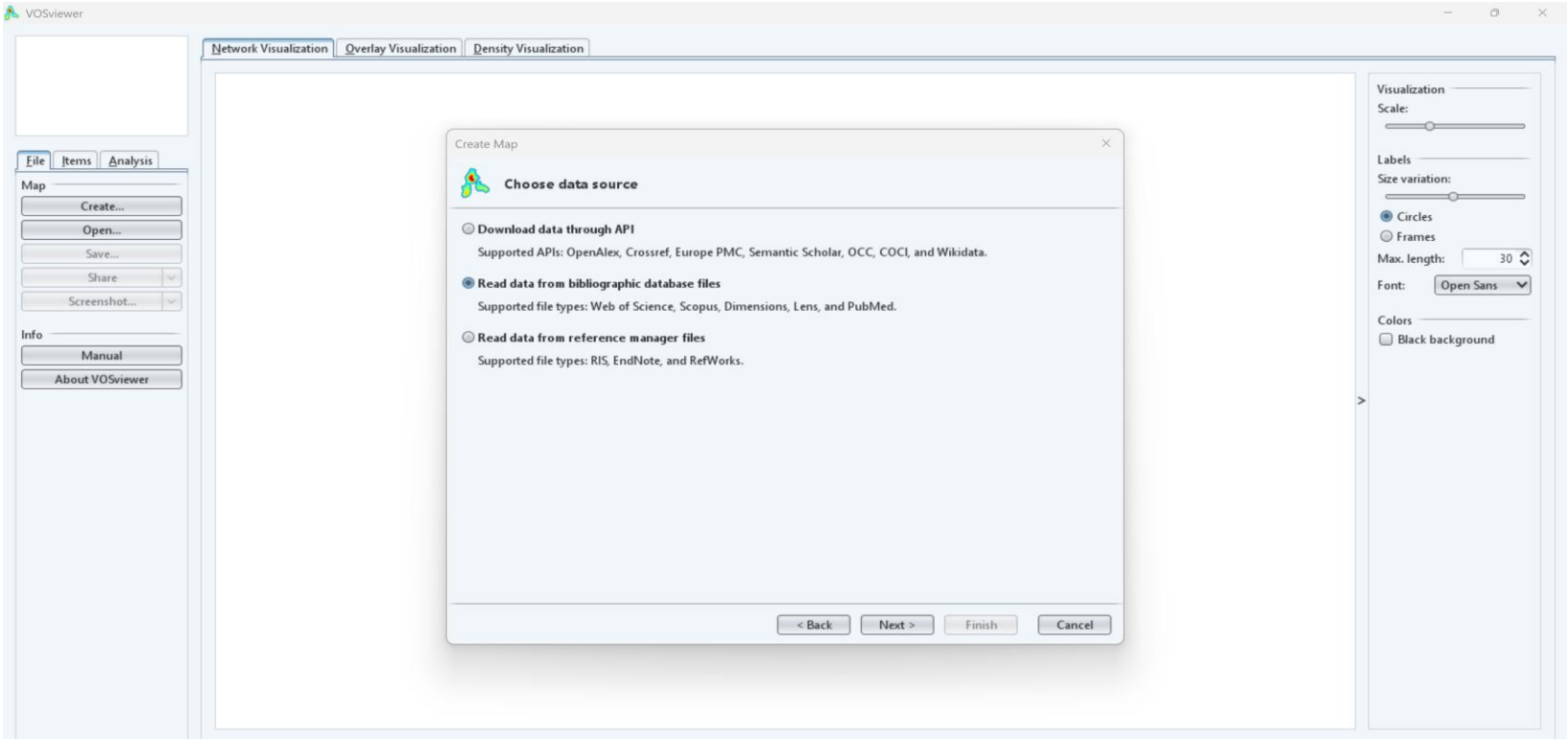

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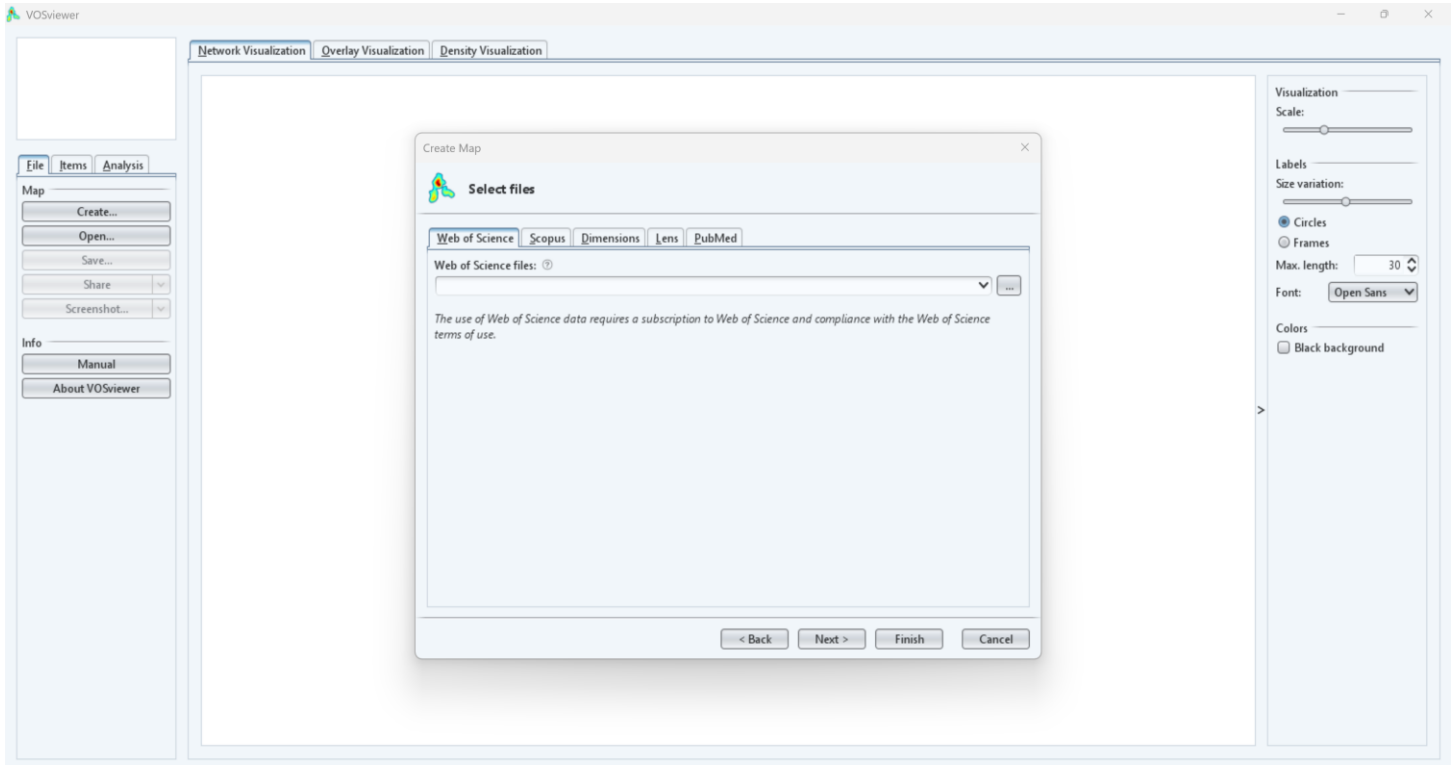

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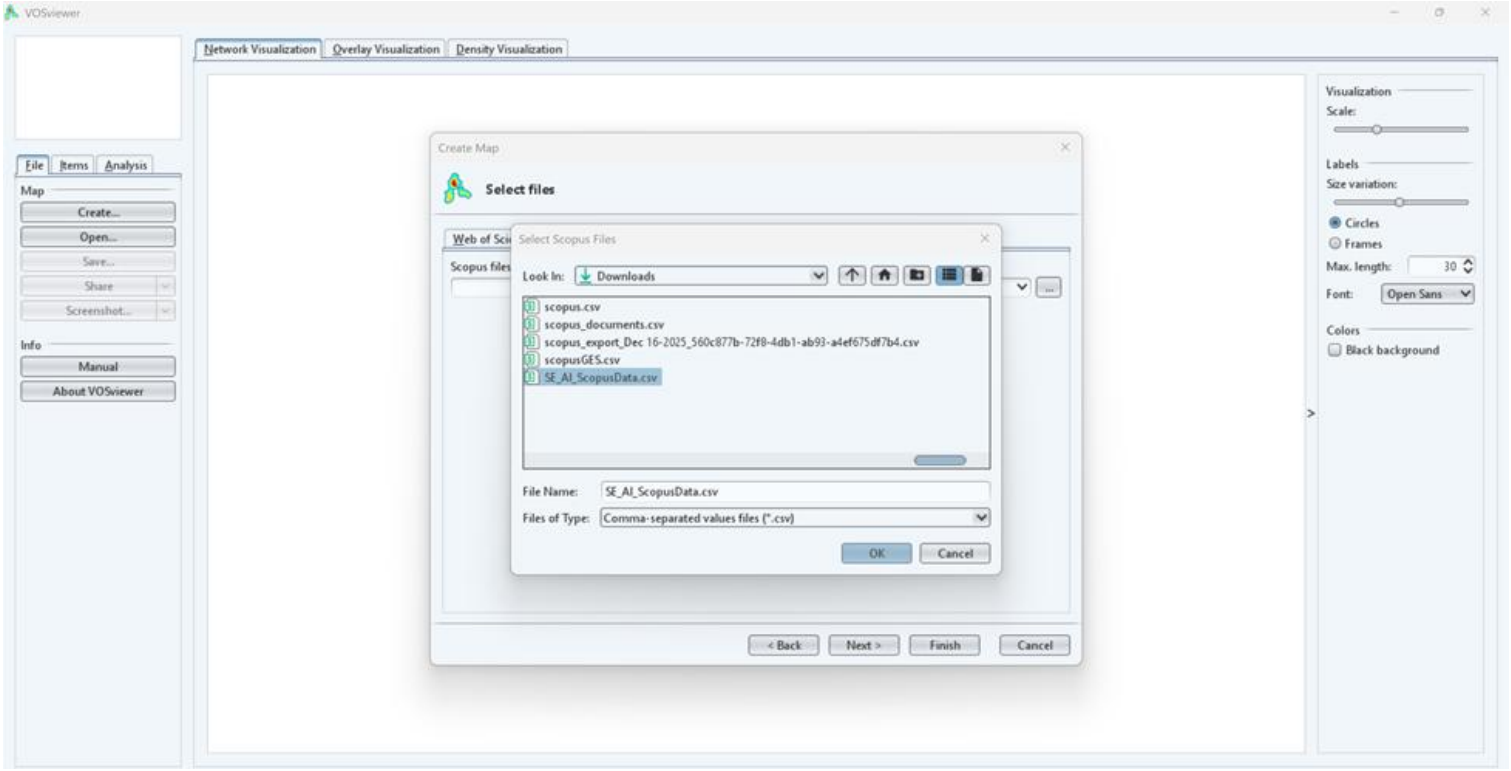

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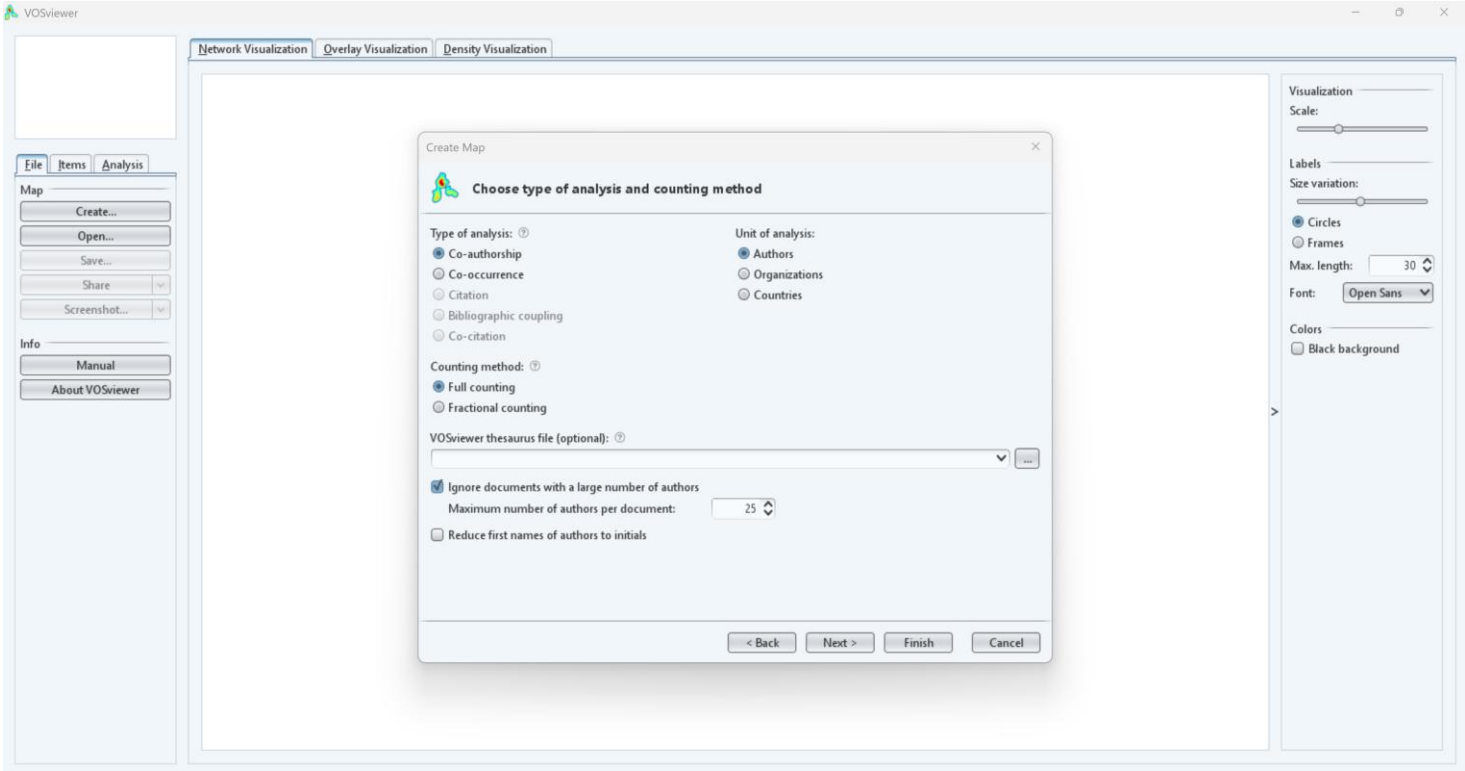

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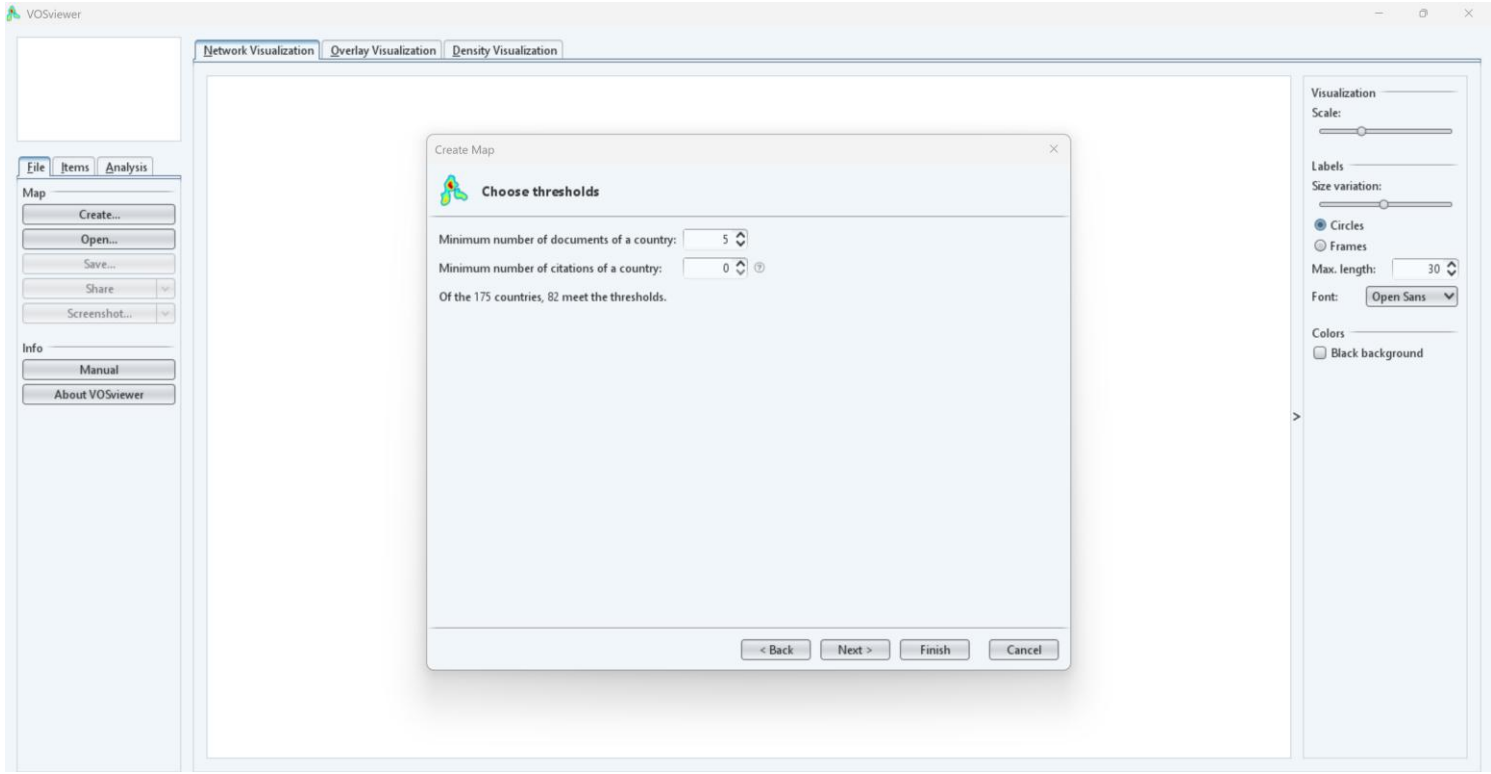

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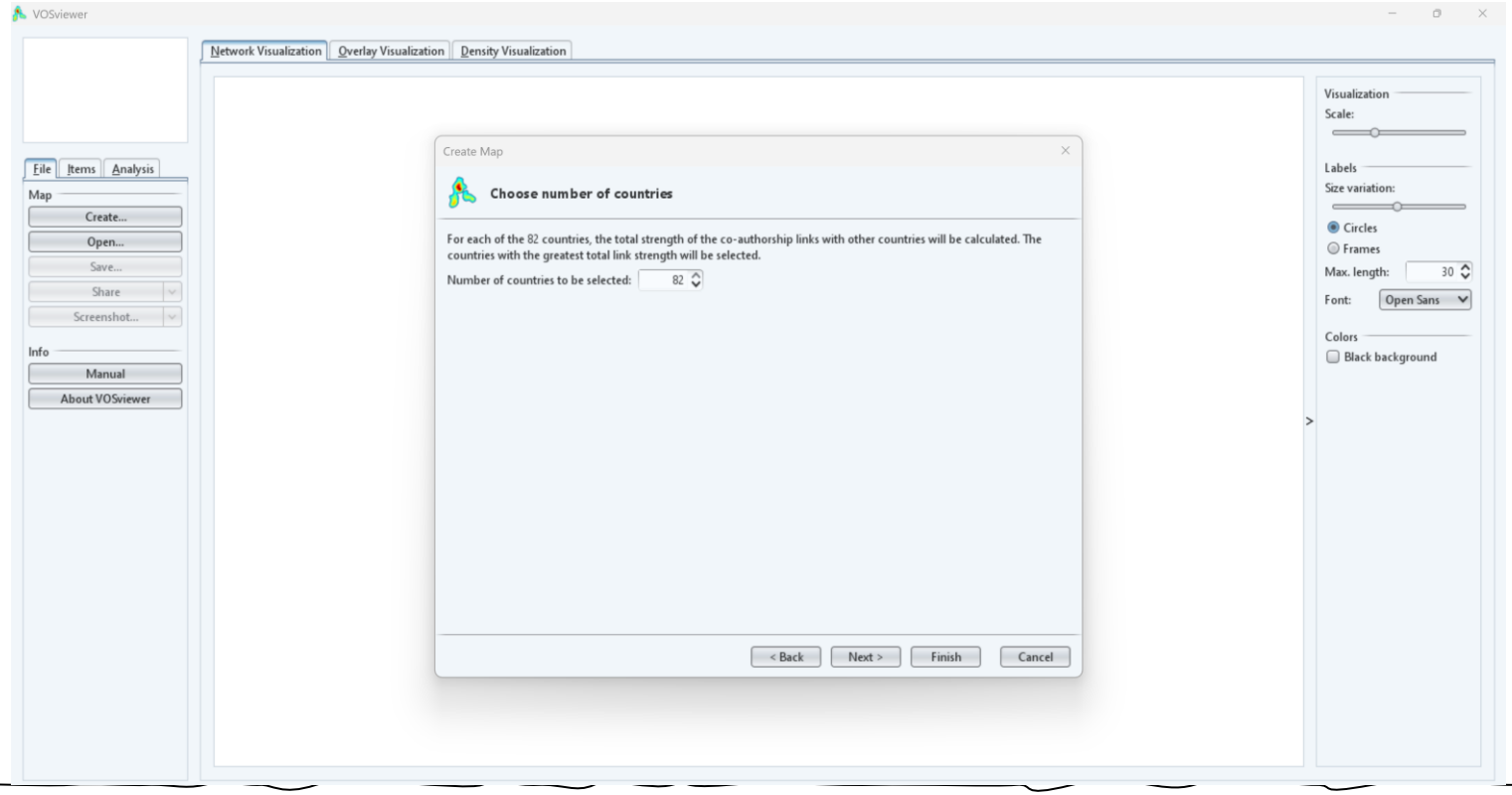

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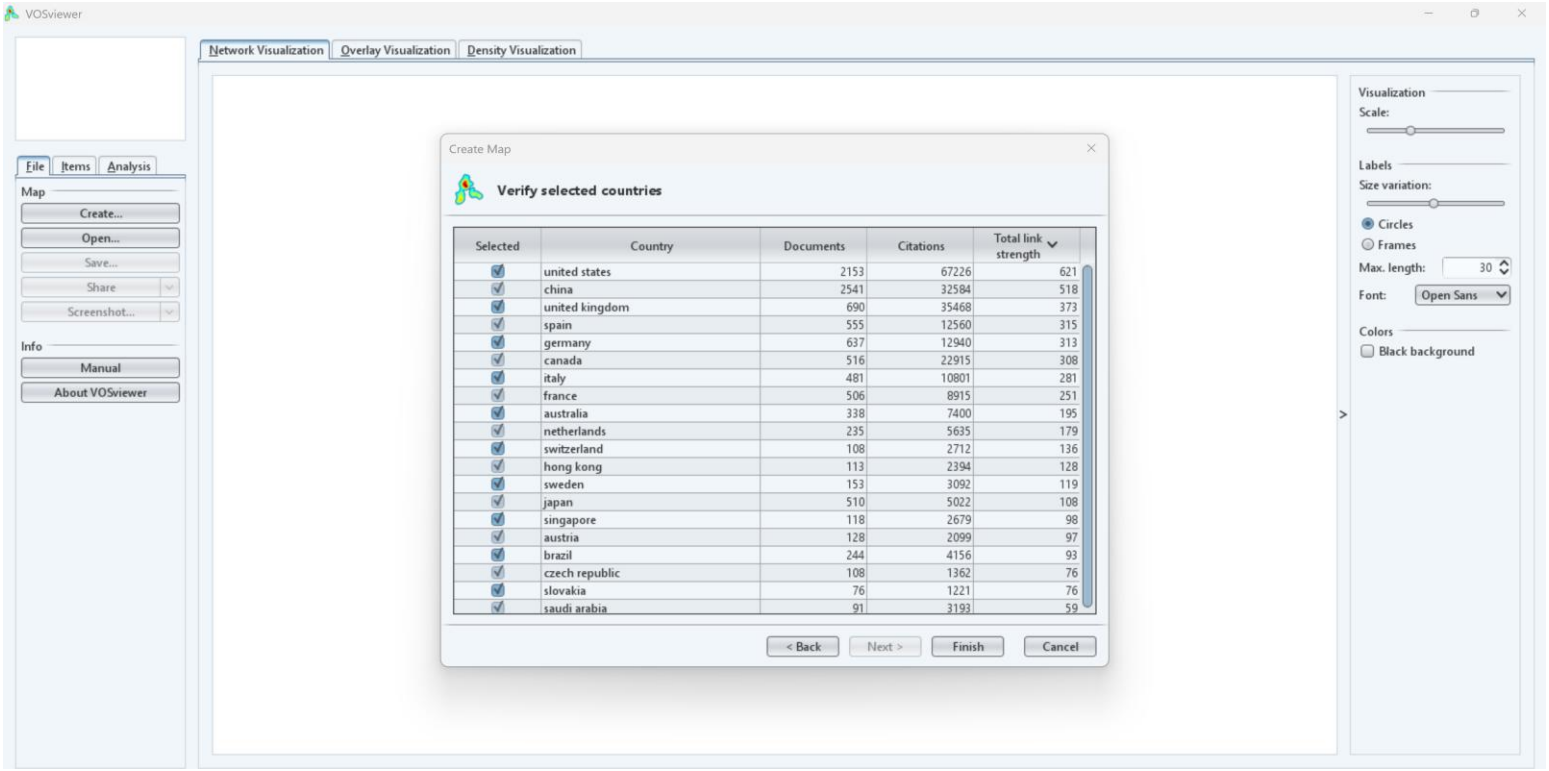

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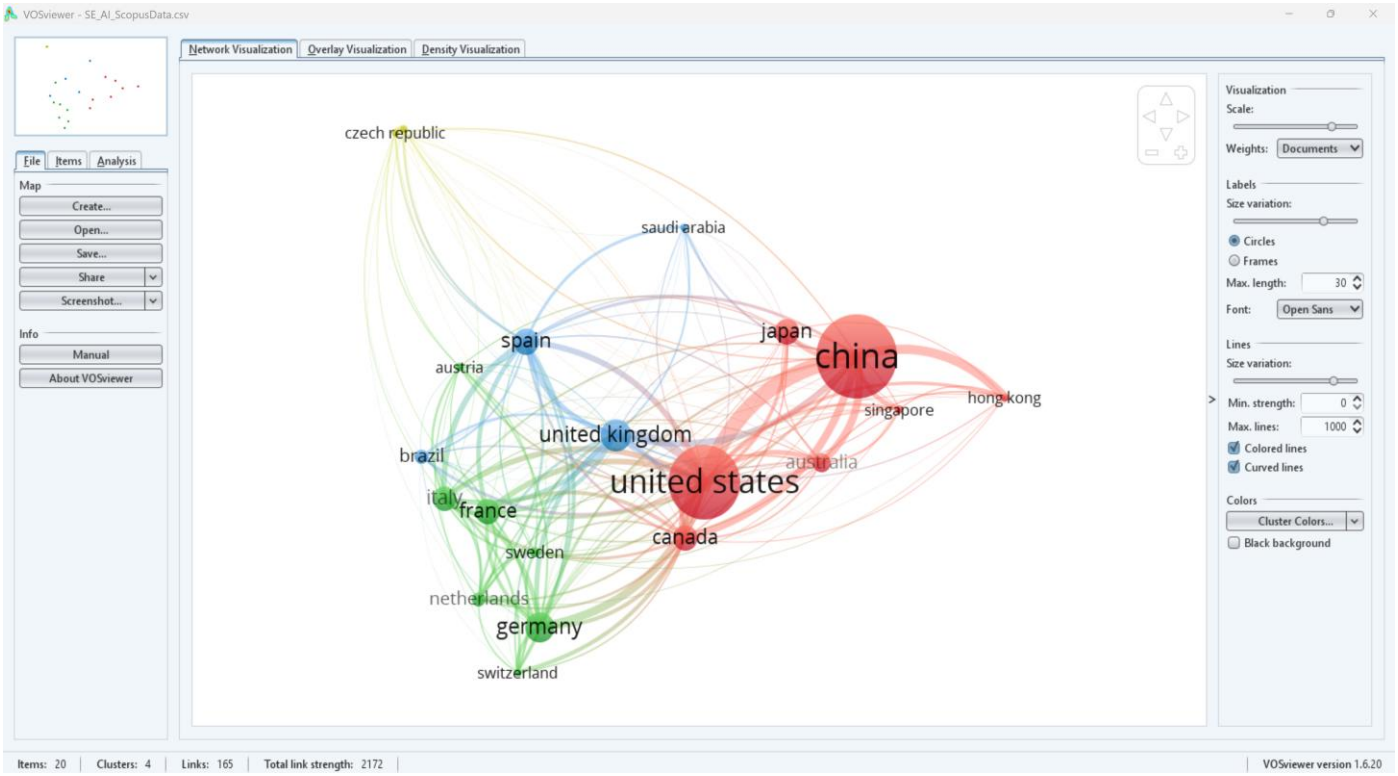

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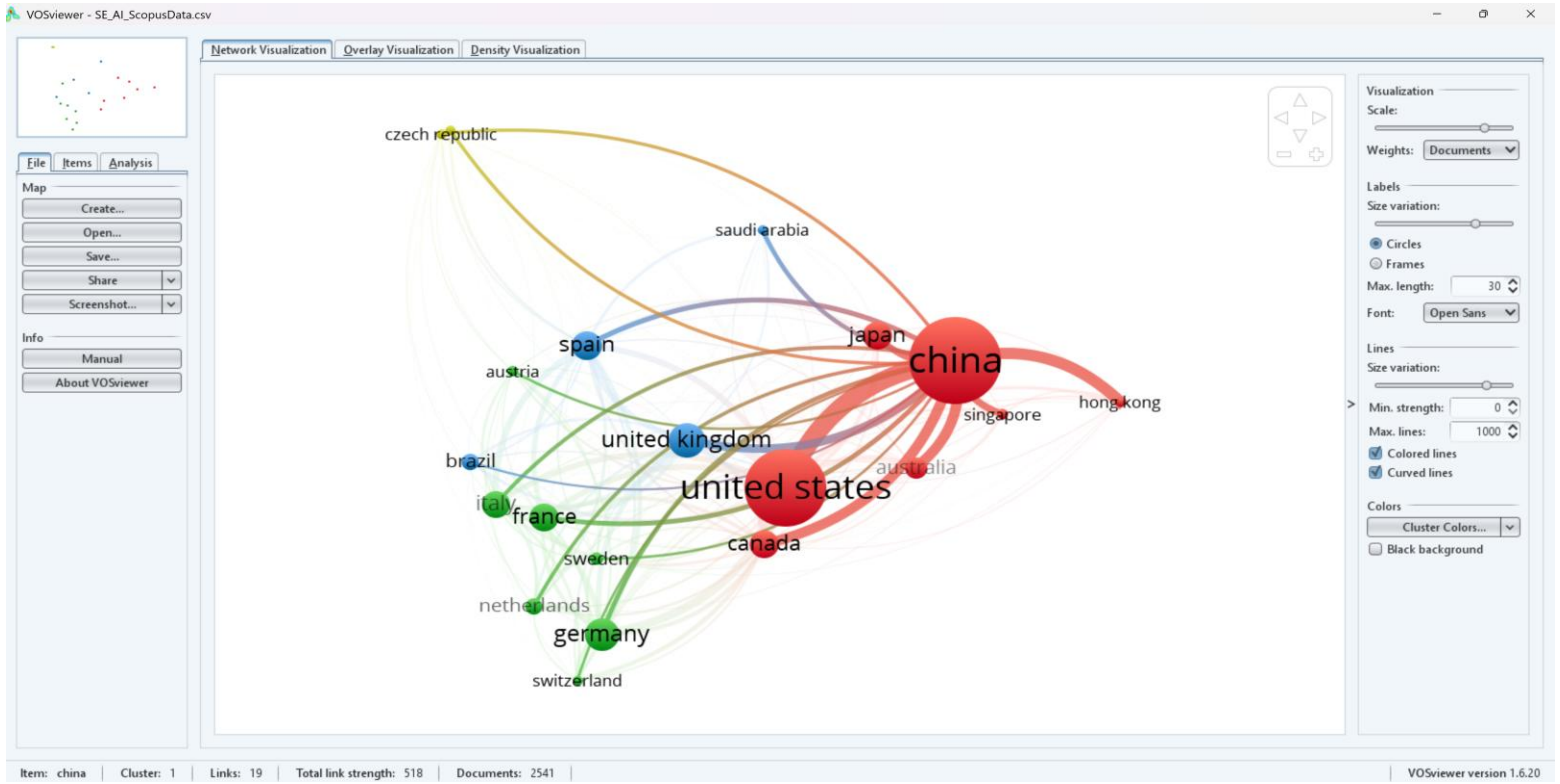

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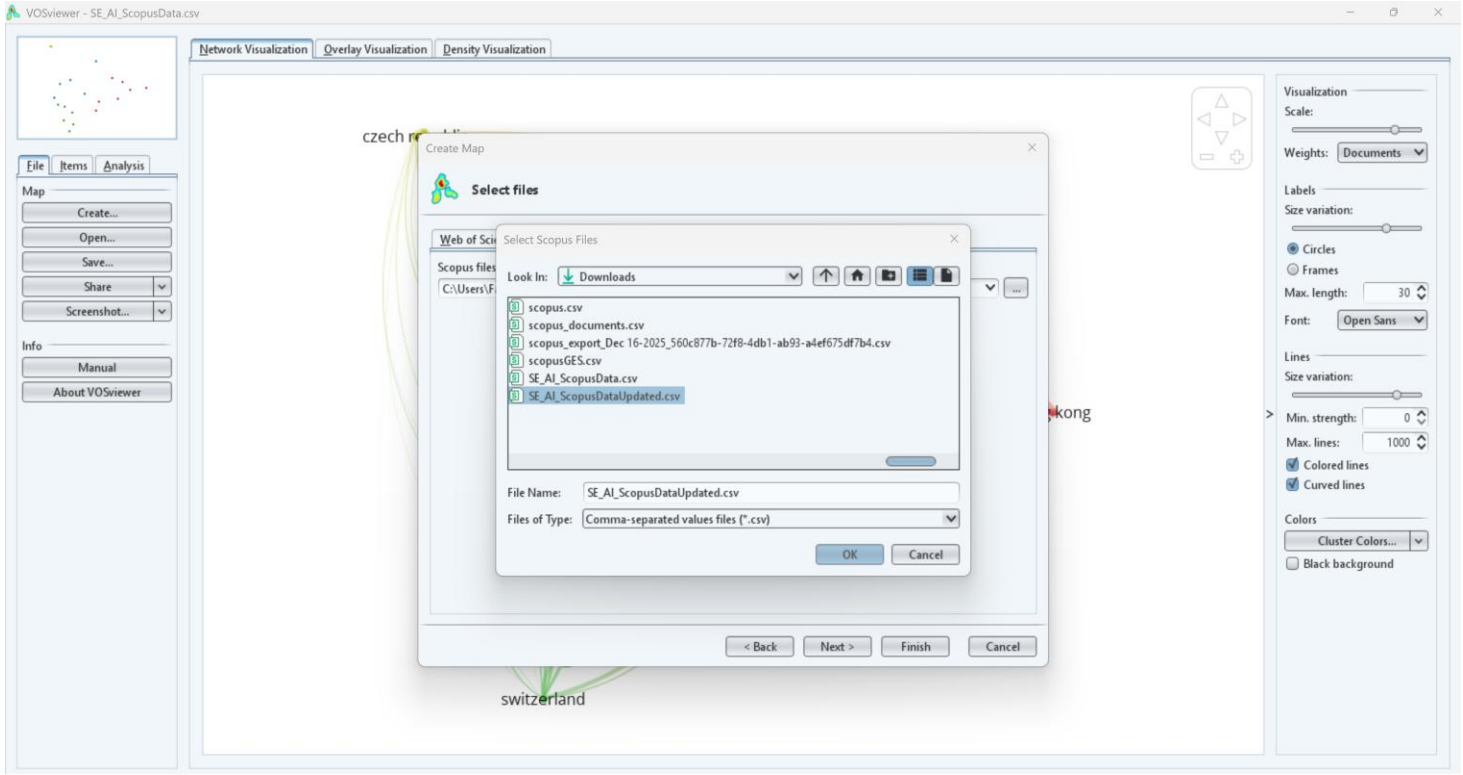

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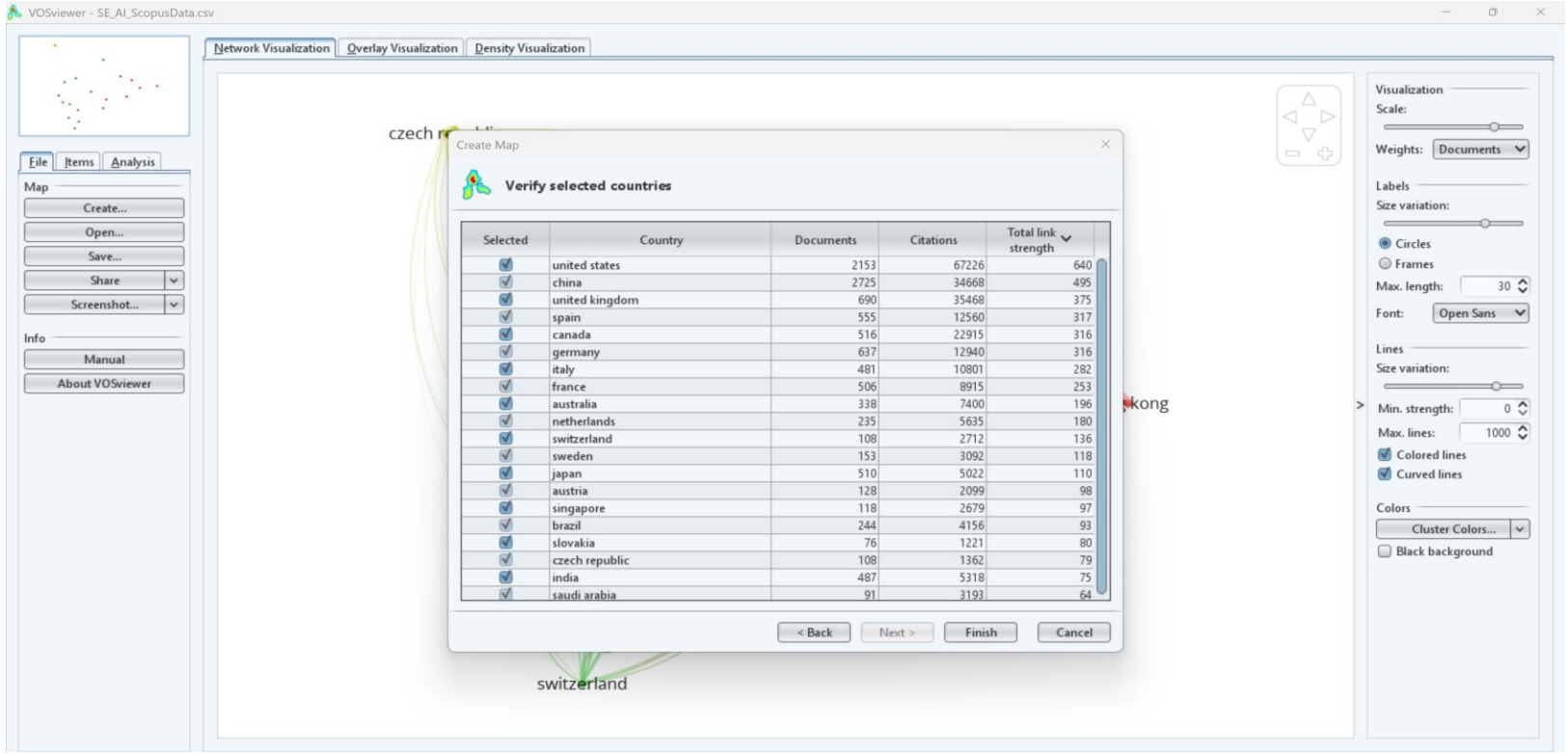

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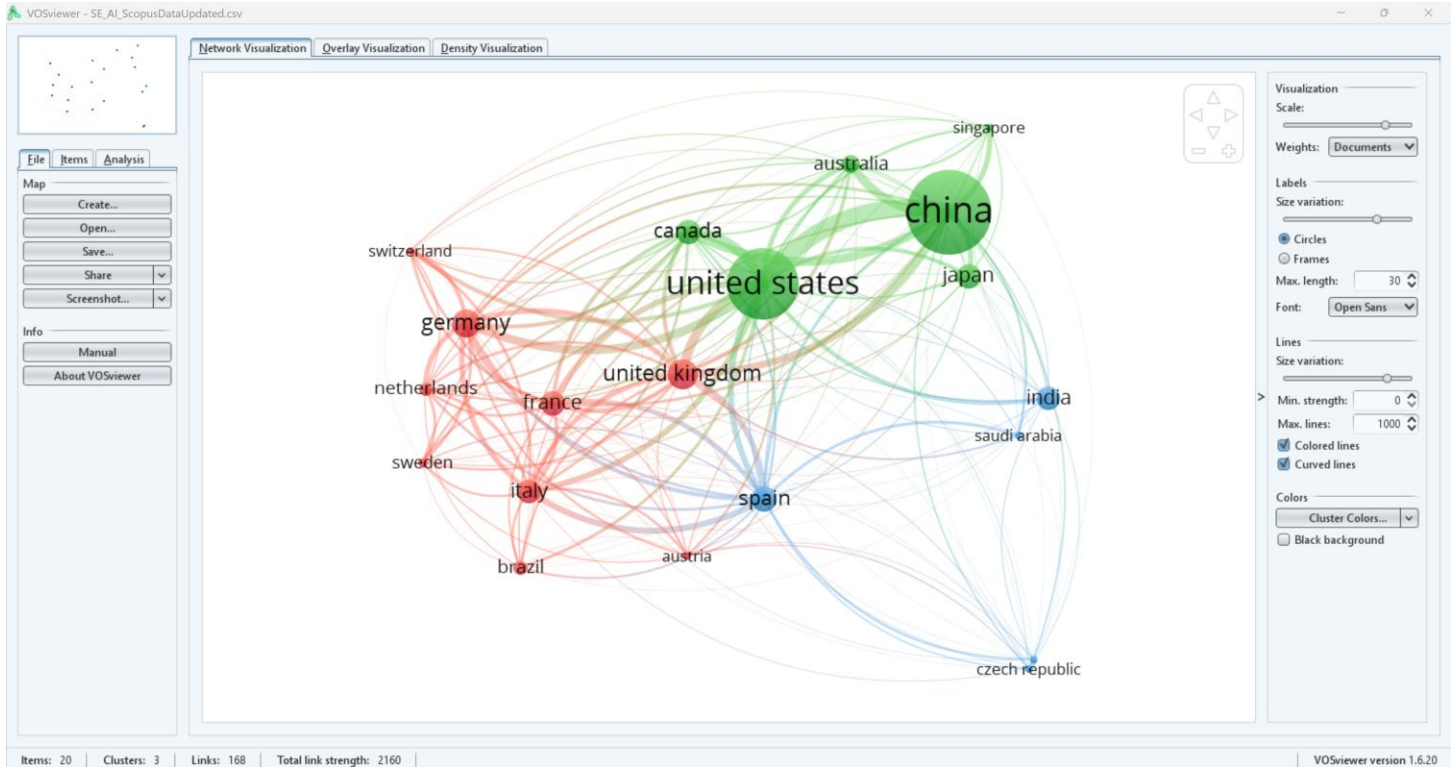

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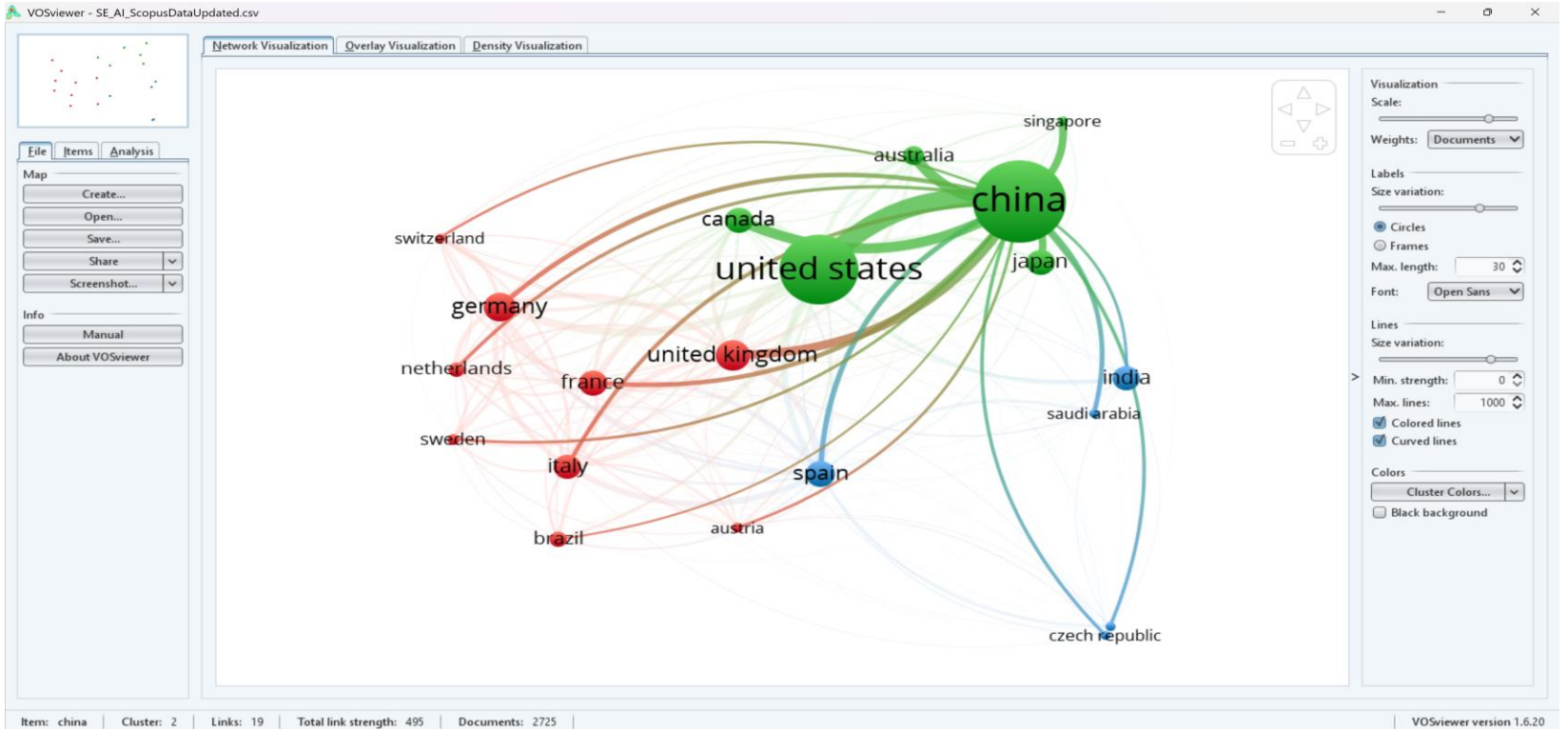

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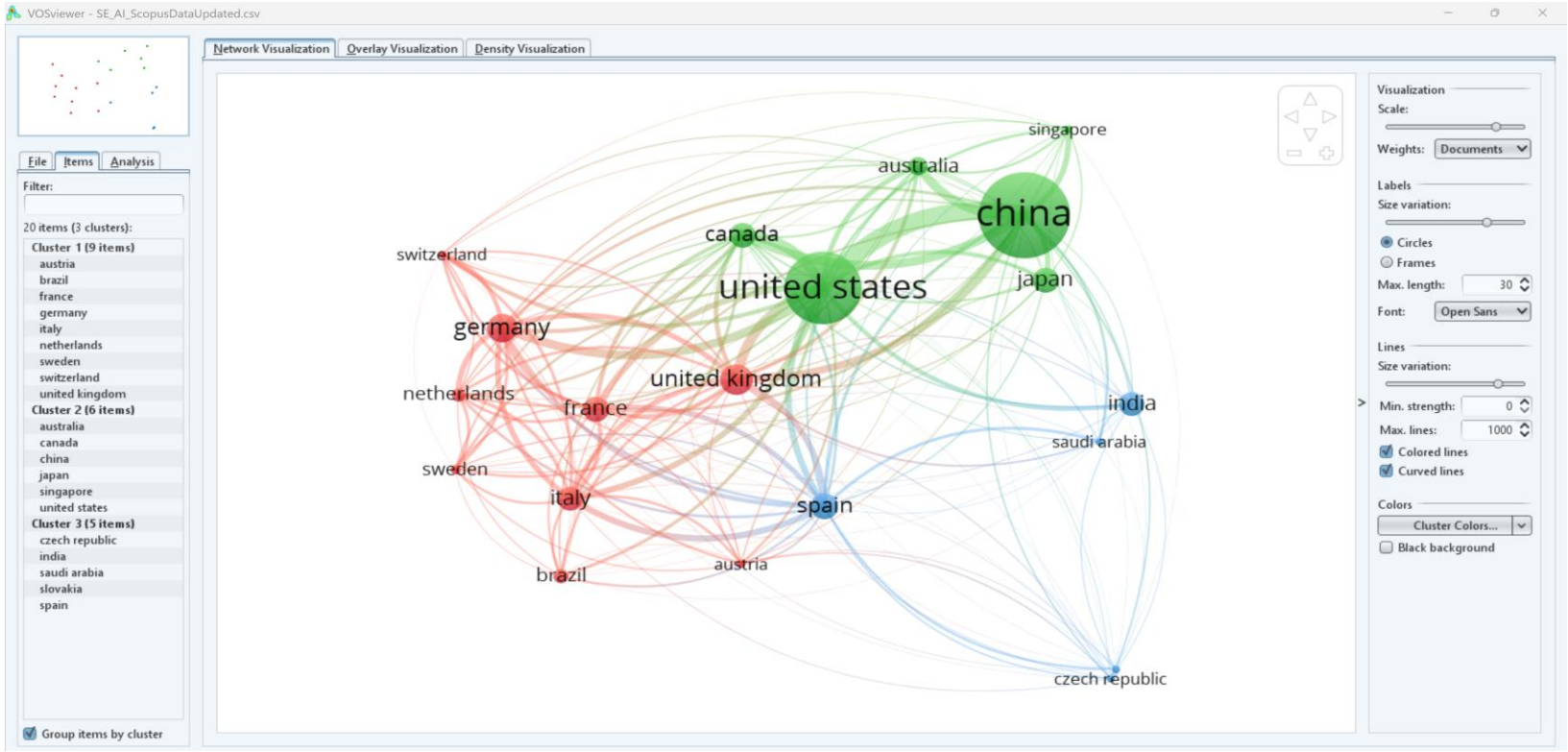

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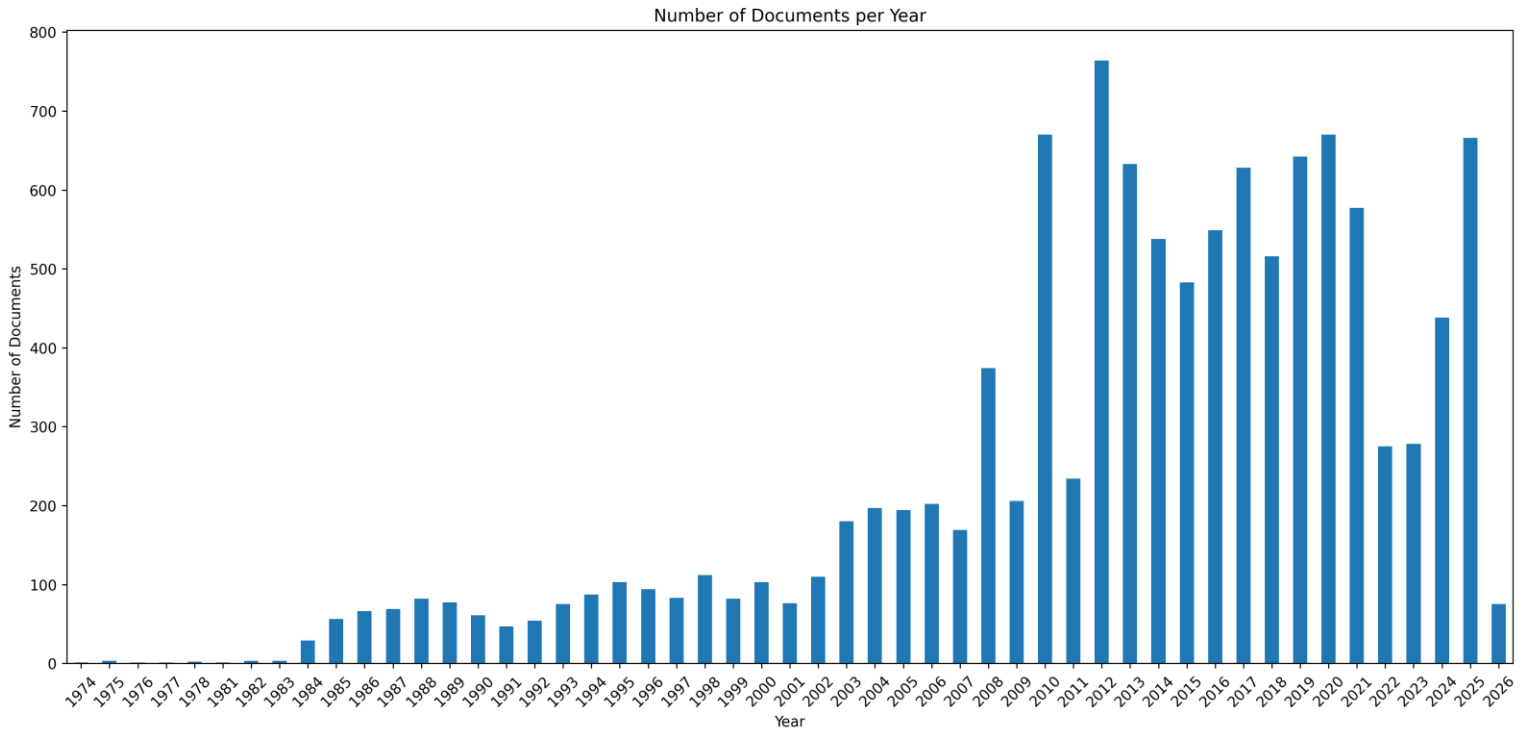

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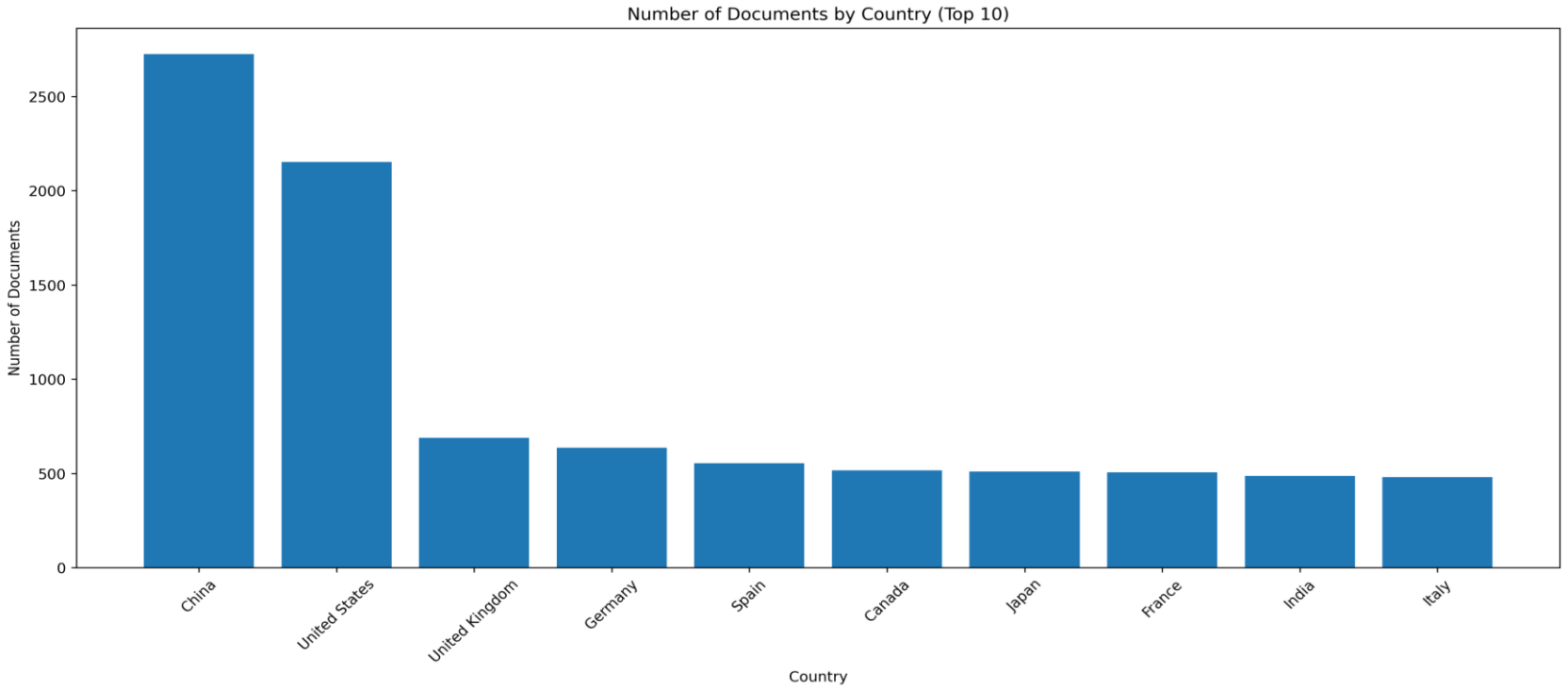

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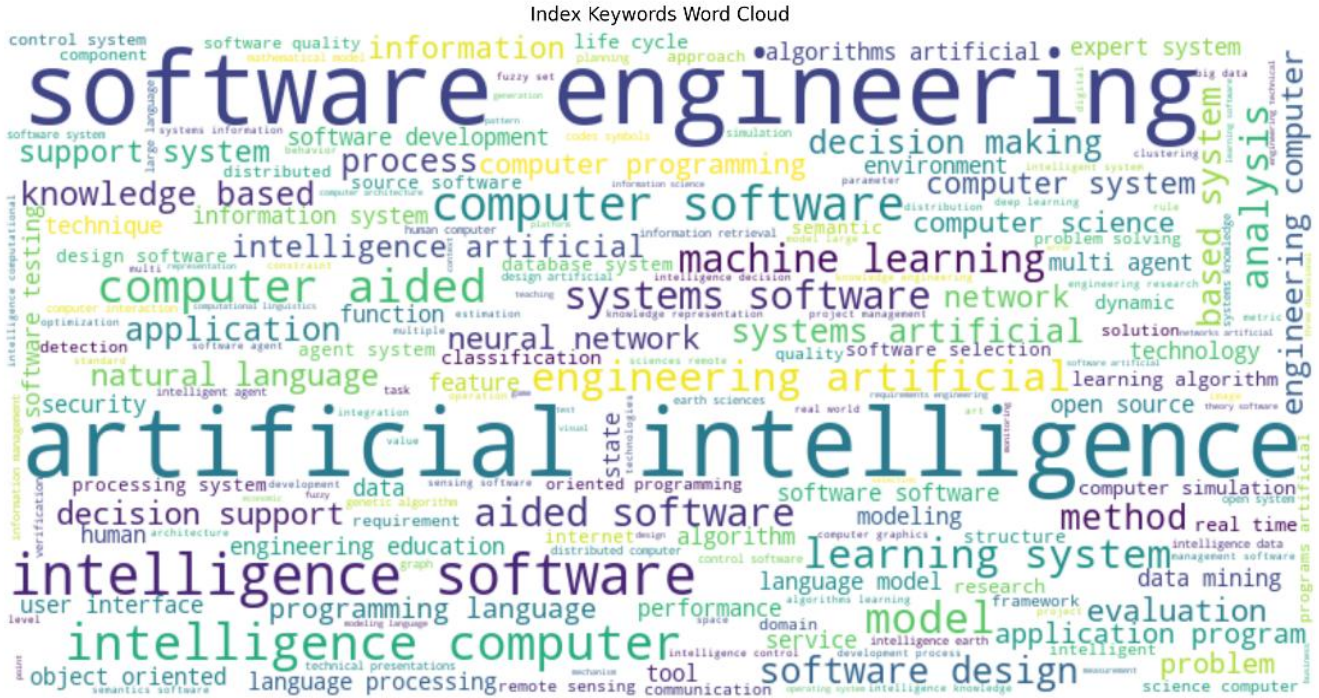

软件工程中的人工智能
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1. The AI-Augmented Software Engineering

Top 20 keywords:

1. Artificial intelligence: 9819
2. Software engineering: 8912
3. Learning systems: 1064
4. Computer aided software engineering: 994
5. Software design: 776
6. Computer software: 639
7. Knowledge based systems: 534
8. Application programs: 492
9. Machine learning: 482
10. Algorithms: 464

1. Computer science: 456
2. Software testing: 434
3. Artificial Intelligence: 432
4. Decision making: 429
5. Data mining: 399
6. Engineering education: 399
7. Decision support systems: 399
8. Semantics: 342
9. Machine-learning: 327
10. Optimization: 326

软件工程中的人工智能
AI in Software Engineering

1. *The AI-Augmented Software Engineering*
   Proposed Categories under AI in Software Engineering:

   - ❑ AI for Code Generation and Development: 249 related keywords
   - ❑ AI in Software Testing: 17 related keywords
   - ❑ AI for Requirements Engineering: 5 related keywords
   - ❑ AI in Software Maintenance: 8 related keywords
   - ❑ AI for Project Management: 14 related keywords
   - ❑ AI Ethics and Security: 35 related keywords
   - ❑ AI Tools and Frameworks: 21 related keywords

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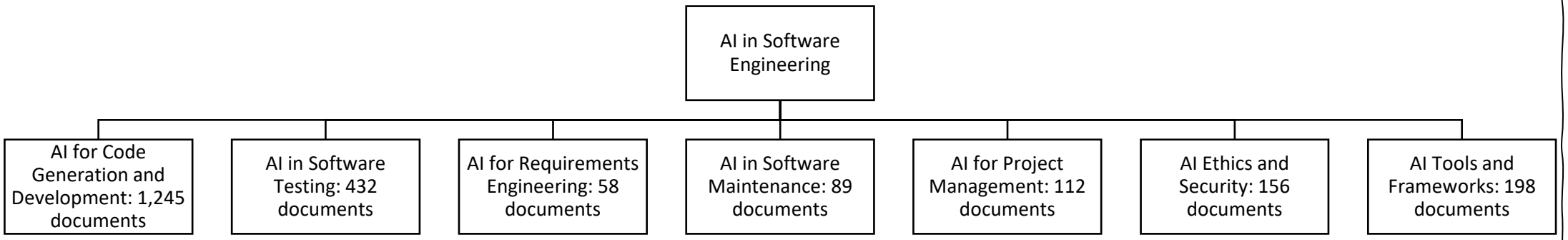

软件工程中的人工智能
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1. *The AI-Augmented Software Engineering*

Documents Categorized Under Each Category

- AI for Code Generation and Development: 1,245 documents (keywords like "machine learning," "deep learning," "neural network," "code generation," "natural language processing," "nlp," "generative ai," "llm," "large language model")
- AI in Software Testing: 432 documents (keywords like "testing," "test case," "bug detection," "quality assurance," "test automation," "defect prediction")
- AI for Requirements Engineering: 58 documents (keywords like "requirements," "elicitation," "specification," "requirements analysis")
- AI in Software Maintenance: 89 documents (keywords like "maintenance," "refactoring," "evolution," "software maintenance")
- AI for Project Management: 112 documents (keywords like "estimation," "planning," "agile," "project management," "effort estimation")
- AI Ethics and Security: 156 documents (keywords like "ethics," "security," "privacy," "bias," "fairness," "trust")
- AI Tools and Frameworks: 198 documents (keywords like "tool," "framework," "automation," "platform," "ide," "integrated development environment")

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1. *The AI-Augmented Software Engineering*

- ❑ Total Documents: 10,000+ (exact count from the dataset).
- ❑ Multi-Category Assignments: Some documents fit into multiple categories (e.g., a paper on AI for testing that also mentions ethics). The counts above are for unique documents per category (i.e., documents that match at least one keyword in that category).
- ❑ Uncategorized Documents: Many documents (around 7,000+) don't match any of the specific category keywords, as they may focus on broader AI-SE topics like "artificial intelligence" or "software engineering" without the targeted terms.

软件工程中的人工智能
AI in Software Engineering

2. The AI-Assisted Development Lifecycle

- *Requirements & Design Phase*
- *Implementation Phase (The "Copilot Era")*
- *Testing Phase*
- *Deployment & Operations Phase (AIOps/MLOps)*
- *Maintenance & Evolution*

2. 人工智能辅助开发生命周期

- 需求与设计阶段
- 实施阶段（“副驾驶时代”）
- 测试阶段
- 部署与运营阶段（AIOps/MLOps）
- 维护与演变

软件工程中的人工智能
AI in Software Engineering

2. The AI-Assisted Development Lifecycle

Requirements & Design Phase

- *AI for Requirements Analysis:*
  - *Natural Language Processing (NLP) to parse stakeholder documents*
  - *Automated generation of user stories from conversations*
  - *Conflict detection in requirements*
- *AI-Enhanced Design:*
  - *Architecture pattern recommendations based on system constraints*
  - *UI/UX design generation from textual descriptions (e.g., "dashboard for monitoring system health")*
  - *Performance prediction for different architectural choices*

2. 人工智能辅助开发生命周期

需求与设计阶段

- 需求分析中的人工智能：
  - 自然语言处理（NLP）用于解析利益相关者文档
  - 从对话中自动生成用户故事
  - 需求中的冲突检测
- 人工智能增强设计：
  - 基于系统约束的架构模式推荐
  - 从文本描述生成UI/UX设计（例如，“用于监控系统健康的仪表盘”）
  - 不同架构选择的性能预测

软件工程中的人工智能
AI in Software Engineering

2. The AI-Assisted Development Lifecycle

Implementation Phase (The "Copilot Era")

- *Code Generation & Completion:*
  - *Tools: GitHub Copilot, Amazon CodeWhisperer, Tabnine, ChatGPT*
  - *How they work: Large Language Models (LLMs) trained on code repositories*
  - *Capabilities: Function generation, test stubs, boilerplate code, documentation*
- *Code Review & Quality:*
  - *AI-powered static analysis beyond traditional linters*
  - *Security vulnerability detection (e.g., Snyk Code, GitHub Advanced Security)*
  - *Style consistency enforcement*
- *Refactoring Assistance:*
  - *Automated identification of code smells*
  - *Suggested refactoring patterns*
  - *Technical debt quantification*

2. 人工智能辅助开发生命周期

实施阶段（“副驾驶时代”）

代码生成与完成：

工具：GitHub Copilot、Amazon CodeWhisperer、Tabnine、ChatGPT

它们的工作原理：大型语言模型（LLM）在代码仓库上训练

功能：函数生成、测试存根、样板代码、文档

代码审查与质量：

超越传统 linter 的 AI 静态分析

安全漏洞检测（例如 Snyk Code，GitHub 高级安全）

样式一致性强制执行

重构协助：

代码气味的自动识别

建议重构模式

技术债务量

软件工程中的人工智能
AI in Software Engineering

2. The AI-Assisted Development Lifecycle

Testing Phase

- *Test Case Generation:*
  - *Unit test generation from function signatures and documentation*
  - *Edge case identification*
  - *Mutation testing automation*
- *Intelligent Test Selection & Prioritization:*
  - *Predicting which tests to run based on code changes*
  - *Reducing CI/CD pipeline time*
- *Automated Bug Detection & Localization:*
  - *Stack trace analysis to pinpoint likely root causes*
  - *Bug pattern matching across repositories*
  - *Log analysis and anomaly detection*

软件项目管理（SPM）是一种规划和领导软件项目的正确方式。

它是项目管理的一部分，软件项目被规划、实施、监控和控制。

软件工程中的人工智能
AI in Software Engineering

2. The AI-Assisted Development Lifecycle

Deployment & Operations Phase (AIOps/MLOps)

- *Deployment Optimization:*
  - *Predictive scaling based on traffic patterns*
  - *Canary release analysis and automated rollback decisions*
- *Production Monitoring:*
  - *Anomaly detection in metrics, logs, and traces*
  - *Automated root cause analysis*
  - *Predictive failure alerts*
- *Incident Response:*
  - *Automated remediation scripts for common issues*
  - *Intelligent alert grouping and prioritization*

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软件工程中的人工智能
AI in Software Engineering

2. The AI-Assisted Development Lifecycle

Maintenance & Evolution

- *Documentation:*
  - *Automatic documentation generation from code*
  - *Keeping documentation synchronized with code changes*
  - *Generating API documentation from usage patterns*
- *Knowledge Management:*
  - *Code search enhanced with semantic understanding*
  - *"Find similar code" across large codebases*
  - *Onboarding assistants for new developers*

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软件工程中的人工智能
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3. Emerging Technical Approaches & Architectures

- *Neurosymbolic AI: Combining neural networks with symbolic reasoning for more reliable code generation*
- *AI for Low-Code/No-Code Platforms: Making development accessible to non-programmers*
- *Self-Improving Systems: Code that can optimize or rewrite itself within constraints*
- *Multi-Agent Systems: Specialized AI agents collaborating on different development tasks*

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AI in Software Engineering

4. Limitations & Current Challenges

- *The "Black Box" Problem: Unexplainable AI-generated code*
- *Technical Debt Accumulation: Over-reliance on generated code without understanding*
- *Copyright & Licensing Issues: Training data provenance and generated code ownership*
- *Skill Erosion Risks: Potential deskilling of developers in fundamental concepts*
- *Overconfidence & Error Propagation: AI tools presenting incorrect solutions with high confidence*
- *Security Implications: Vulnerabilities introduced through AI-generated code*

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它是项目管理的一部分，软件项目被规划、实施、监控和控制。

伦理框架（例如，ACM伦理守则）。
Ethical frameworks (e.g., ACM Code of Ethics).

What Are Ethical Frameworks?

A. The Need for Structure

- *Why Not Just "Be Good"? Complexity demands systematic analysis*
- *Three Levels of Guidance:*
- *Personal Ethics (Individual conscience)*
- *Professional Ethics (Shared standards of a field)*
- *Governance/Legal (Laws, regulations)*

B. Professional Codes: Purpose & Function

- *Guide to acceptable conduct*
- *Statement of shared values that define a profession*
- *Accountability mechanism for members*
- *Public trust building instrument*
- *Educational tool for new practitioners*

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它是项目管理的一部分，软件项目被规划、实施、监控和控制。

Ethical frameworks (e.g., ACM Code of Ethics).

The ACM Code of Ethics: A Deep Dive

History: *Evolved since 1972, major revision in 2018*

Philosophical Approach: *Principle-based ethics with practical guidance*

Key Mindset Shift: *"The Code as a living document" - requires interpretation, not just rule-following*

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Ethical frameworks (e.g., ACM Code of Ethics).

The ACM Code of Ethics: A Deep Dive

B. The Foundational Principles

1. ***PUBLIC*** *– Software engineers shall act consistently with the public interest.*

2. ***CLIENT AND EMPLOYER*** *– Software engineers shall act in a manner that is in the best interests of their client and employer consistent with the public interest.*

3. ***PRODUCT*** *– Software engineers shall ensure that their products and related modifications meet the highest professional standards possible.*

4. ***JUDGMENT*** *– Software engineers shall maintain integrity and independence in their professional judgment.*

5. ***MANAGEMENT*** *– Software engineering managers and leaders shall subscribe to and promote an ethical approach to the management of software development and maintenance.*

6. ***PROFESSION*** *– Software engineers shall advance the integrity and reputation of the profession consistent with the public interest.*

7. ***COLLEAGUES*** *– Software engineers shall be fair to and supportive of their colleagues.*

8. ***SELF*** *– Software engineers shall participate in lifelong learning regarding the practice of their profession and shall promote an ethical approach to the practice of the profession.*

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它是项目管理的一部分，软件项目被规划、实施、监控和控制。

Ethical frameworks (e.g., ACM Code of Ethics).

The ACM Code of Ethics: A Deep Dive

C. Special Features of the 2018 Revision

- *Explicit mention of discrimination, harassment, and diversity*
- *Global perspective beyond Western contexts*
- *Consideration of environmental impact*
- *Emphasis on ethical leadership, not just individual compliance*

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Ethical frameworks (Other Key Frameworks)

A. Complementary Professional Codes

- *IEEE Code of Ethics: Similar principles, slightly different emphasis on public safety*
- *Software Engineering Code of Ethics (joint ACM/IEEE): More detailed guidance specific to SE*

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Ethical frameworks (Other Key Frameworks)

B. Regulatory Frameworks

- *Personal Information Protection Law (PIPL, Effective 2021) CN*
- *GDPR (EU): Data protection by design and default*
- *AI Act (EU): Risk-based approach to AI regulation*
- *Algorithmic Accountability Act (US proposed): Impact assessments for automated systems*

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