

新兴趋势与伦 Emerging Trends & Ethics

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新兴趋势与伦 Emerging Trends & Ethics



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02

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软件工程中的人工智能

AI in Software Engineering

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2. *The AI-Assisted Development Lifecycle*
3. *Emerging Technical Approaches & Architectures*
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软件工程中的人工智能

AI in Software Engineering

1. *The AI-Augmented Software Engineering*

The screenshot displays the Scopus search interface. At the top left is the Scopus logo. A search bar contains the text "Software Engineering". To the right of the search bar is a toggle for "Advanced query" and a search icon. Below the search bar are buttons for "Save search", "Set search alert", and "Add search field". A "Reset" button and a "Search" button are also present. Below the search bar, there are tabs for "Documents", "Preprints", and "Secondary documents". The "Documents" tab is selected, and a "Beta" badge is visible. Below the tabs, it says "173,444 documents found". To the right of this text is a link to "Analyze results". Below the search results, there are buttons for "Refine search", "All", "Export", "Download", "Citation overview", "More", "Show all abstracts", "Sort by", "Date (newest)", and a table icon. Below these buttons is a table with columns for "Document title", "Authors", "Source", "Year", and "Citation".

Scopus

Advanced query ☐

Search within
Article title, Abstract, Keywords

Search documents *
"Software Engineering"

Save search

Set search alert

+ Add search field

Reset

Search

Documents Preprints Secondary documents

Beta

173,444 documents found

Analyze results

Refine search

☐ All ☐ Export ☐ Download ☐ Citation overview ☐ More ☐ Show all abstracts

Sort by Date (newest)

Document title	Authors	Source	Year	Citation
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软件工程中的人工智能

AI in Software Engineering

11639/ Only 6% of total documents

1. *The AI-Augmented Software Engineering*

The image shows the Scopus search interface. At the top left is the Scopus logo. On the right is a search icon. Below the logo is a toggle for 'Advanced query'. The search area contains two rows of search criteria. The first row has a dropdown for 'Search within' (Article title, Abstract, Keywords) and a text input for 'Search documents *' containing '"Software Engineering"'. The second row has a similar dropdown and text input containing '"Artificial Intelligence"'. Between the two rows is an 'AND' connector. To the left of the search area are links for 'Save search' and 'Set search alert'. Below the search area is a '+ Add search field' button. To the right are 'Reset' and 'Search' buttons. At the bottom, there are tabs for 'Documents', 'Preprints', and 'Secondary documents', with 'Documents' selected. Below the tabs, it says '11,639 documents found'. At the bottom right, there is an 'Analyze' button and a citation icon.

Scopus

Advanced query

Search within
Article title, Abstract, Keywords

Search documents *
"Software Engineering"

AND

Search within
Article title, Abstract, Keywords

Search documents
"Artificial Intelligence"

Save search

Set search alert

+ Add search field

Reset

Search

Documents Preprints Secondary documents

11,639 documents found

Analyze

Citation

软件工程中的人工智能

AI in Software Engineering

1. The AI-Augmented Software Engineering

Save search
Set search alert
Add search field
Reset
Search

Documents Preprints Secondary documents

11,639 documents found

Refine search
Search within results

Filters
Year
Range Individual

Export Download Citation overview
More Show all abstracts
Sort by Date (newest)

Saved preferences
My CSV settings
File types
CSV
RIS
BibTeX
Plain text

	Authors	Source	Year	Cit
1	Costa, L.A., Fontão, A., Santos, R.P.D., Serebrenik, A.	Journal of Systems and Software	2026	, 234, 112723
2	Yu, L., Aléaroth, E.	Empirical Software	2026	

软件工程中的人工智能

AI in Software Engineering

1. *The AI-Augmented Software Engineering*

The screenshot displays a web interface for exporting search results. A modal window titled "Export 11,639 documents to CSV" is open, showing the following options:

- ☐ All documents on this page
- ☒ Documents 1 - 11639

What information do you want to export?

<input checked="" type="checkbox"/> Citation information	<input checked="" type="checkbox"/> Bibliographical information	<input checked="" type="checkbox"/> Abstract & keywords	<input checked="" type="checkbox"/> Funding details	<input type="checkbox"/> Other information
<input checked="" type="checkbox"/> Author(s)	<input checked="" type="checkbox"/> Affiliations	<input checked="" type="checkbox"/> Abstract	<input checked="" type="checkbox"/> Number	<input type="checkbox"/> Tradenames & manufacturers
<input checked="" type="checkbox"/> Document title	<input checked="" type="checkbox"/> Serial identifiers (e.g. ISSN)	<input checked="" type="checkbox"/> Author keywords	<input checked="" type="checkbox"/> Acronym	<input type="checkbox"/> Accession numbers & chemicals
<input checked="" type="checkbox"/> Year	<input checked="" type="checkbox"/> PubMed ID	<input checked="" type="checkbox"/> Indexed keywords	<input checked="" type="checkbox"/> Sponsor	<input type="checkbox"/> Conference information
<input checked="" type="checkbox"/> EID	<input checked="" type="checkbox"/> Publisher		<input checked="" type="checkbox"/> Funding text	<input type="checkbox"/> Include references
<input checked="" type="checkbox"/> Source title	<input type="checkbox"/> Editor(s)			
<input checked="" type="checkbox"/> Volume, issues, pages	<input checked="" type="checkbox"/> Language of original document			
<input checked="" type="checkbox"/> Citation count	<input checked="" type="checkbox"/> Correspondence address			
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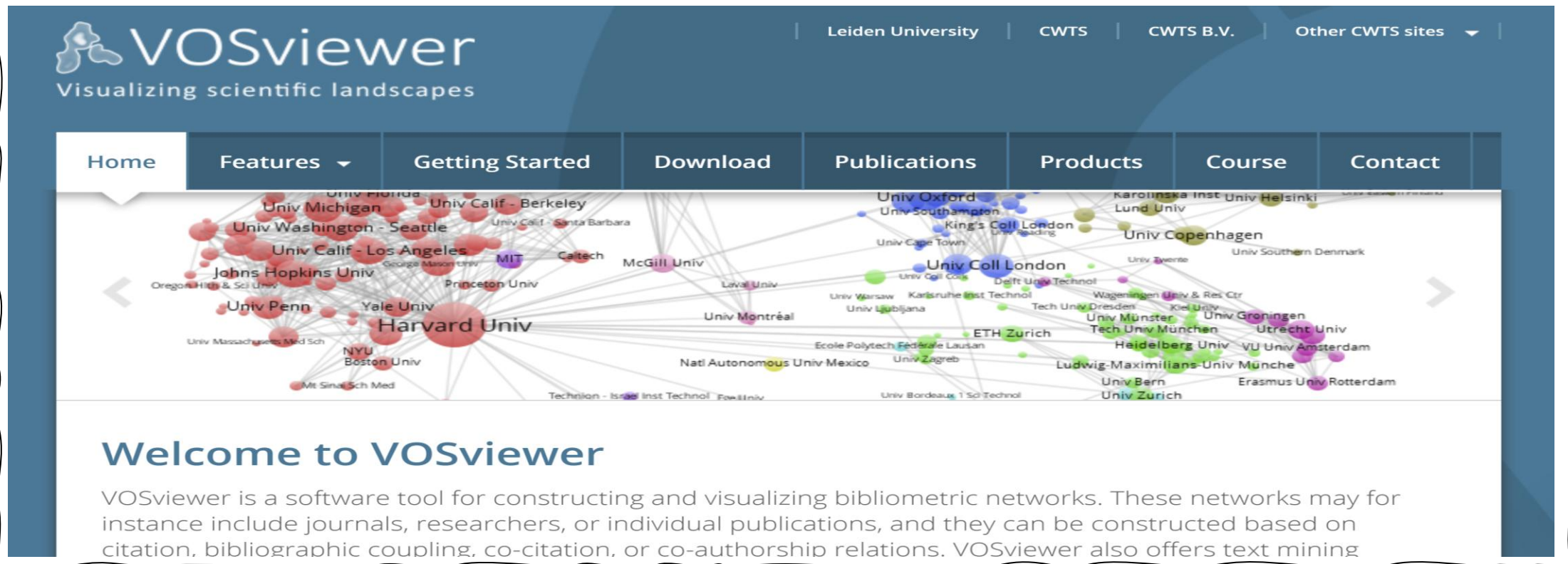
[Select all information](#) ☒ Truncate to optimize for Excel [?](#) ☐ Save as preference [Export](#)

The background interface shows a search results page with a sidebar for refining search and filters. The main results table is partially visible, showing columns for Year and Citations.

软件工程中的人工智能

AI in Software Engineering

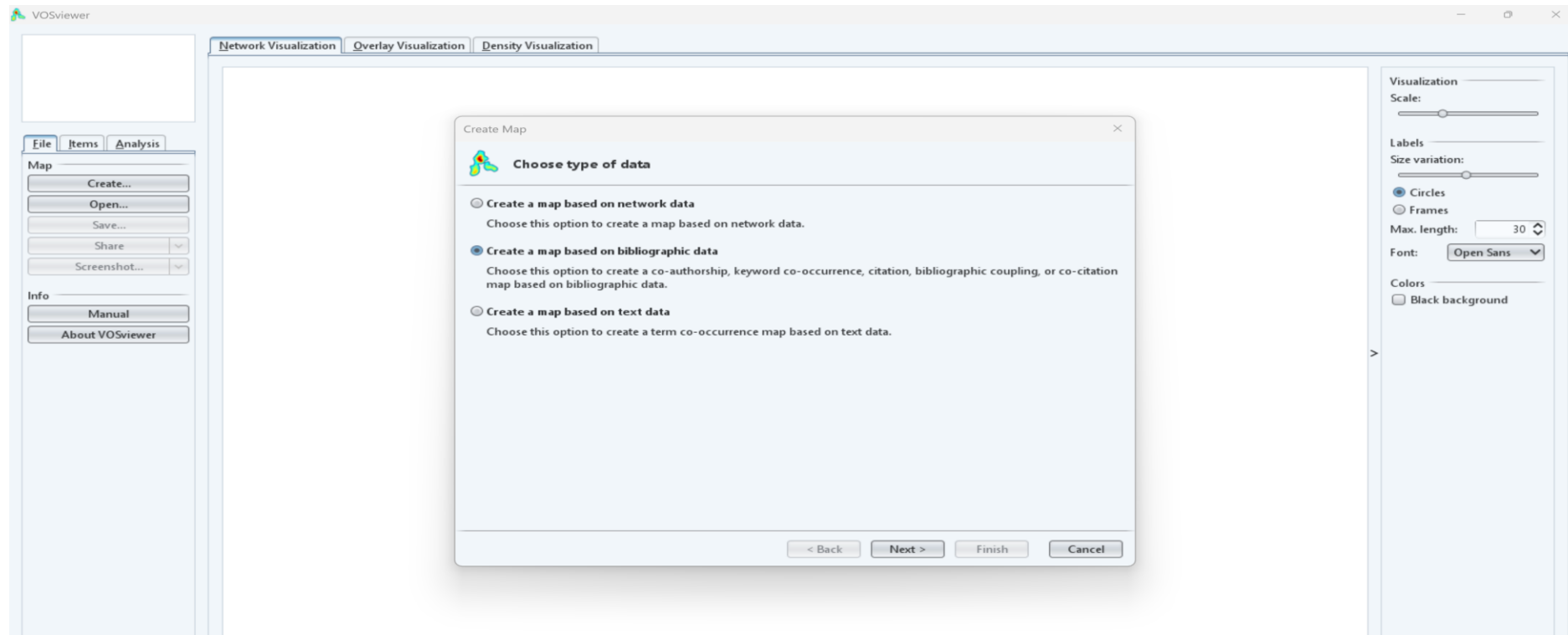
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AI in Software Engineering

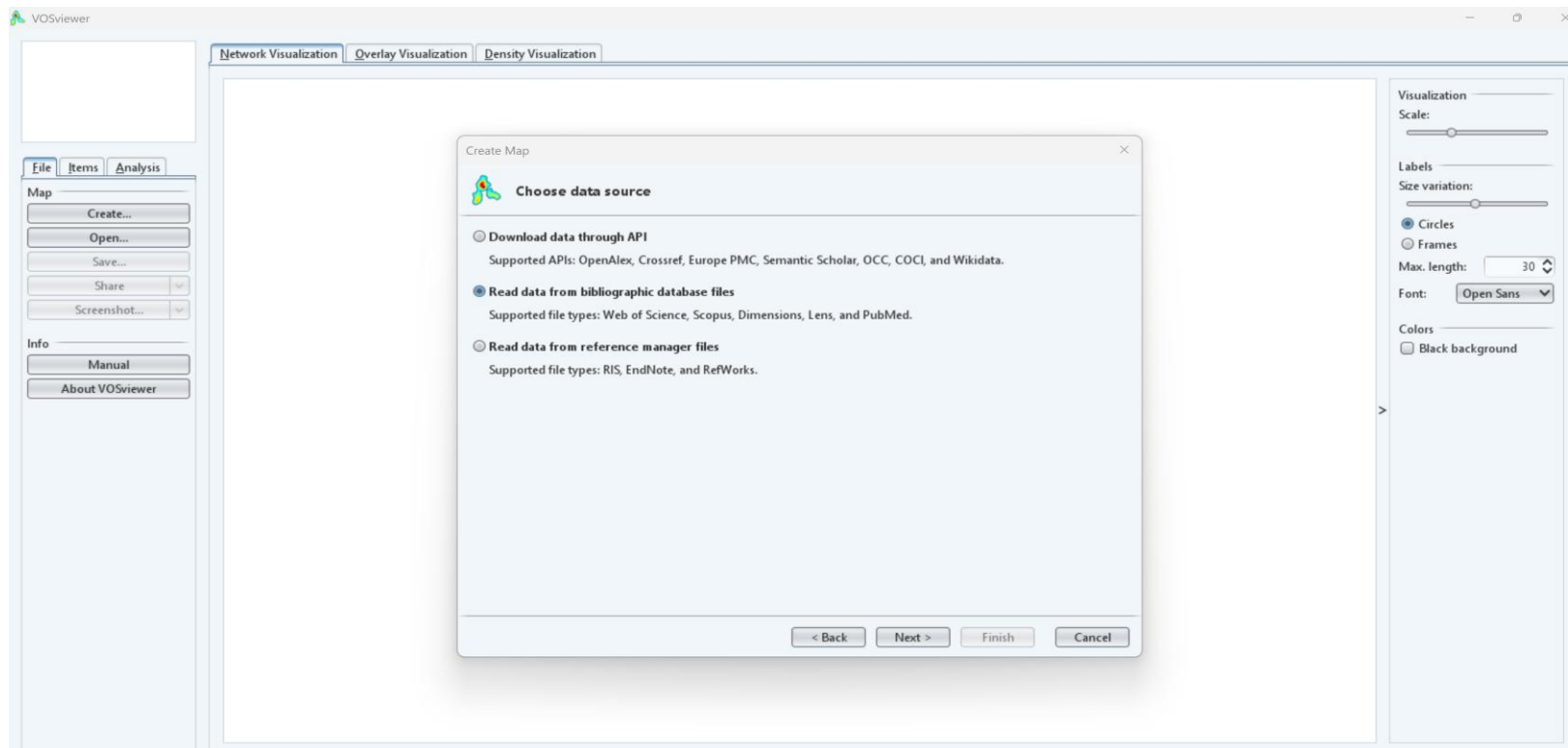
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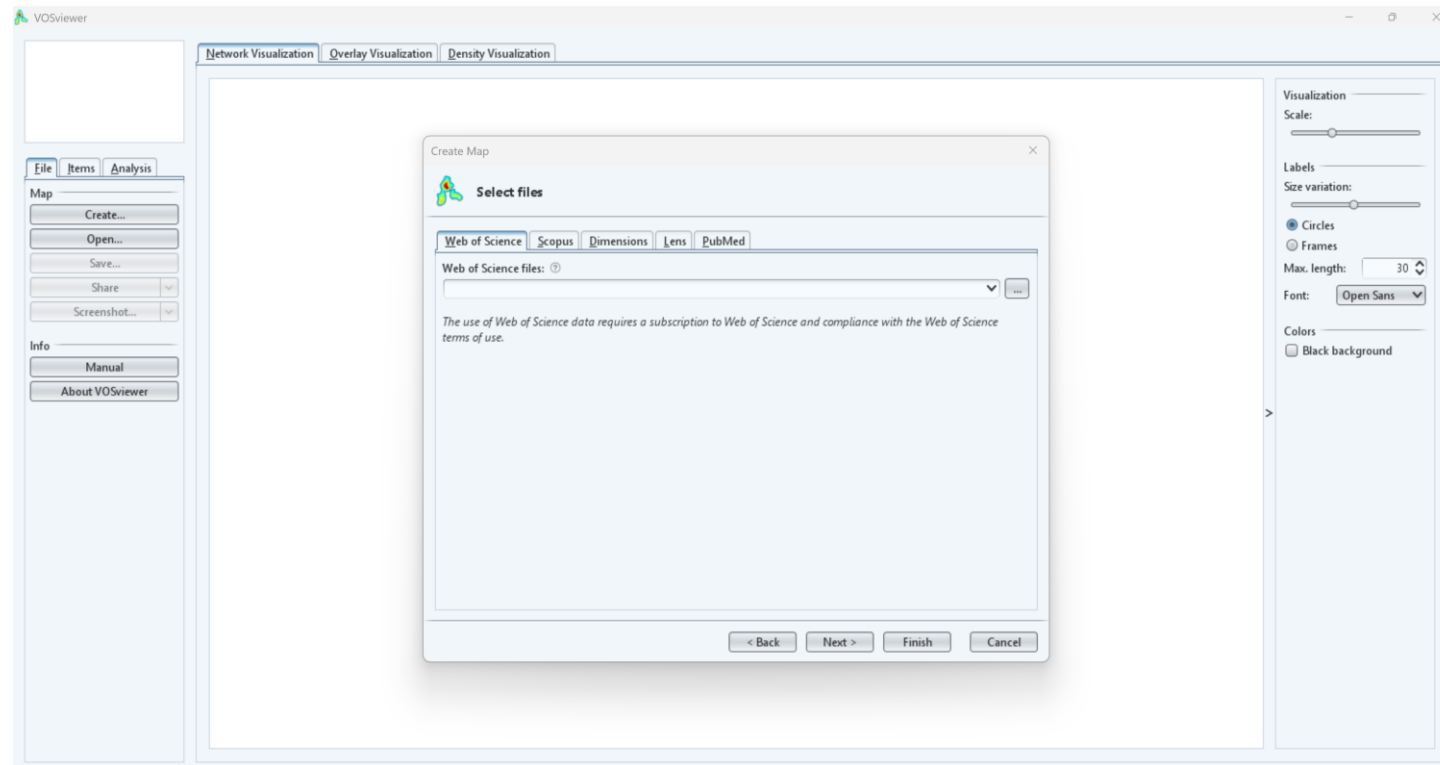
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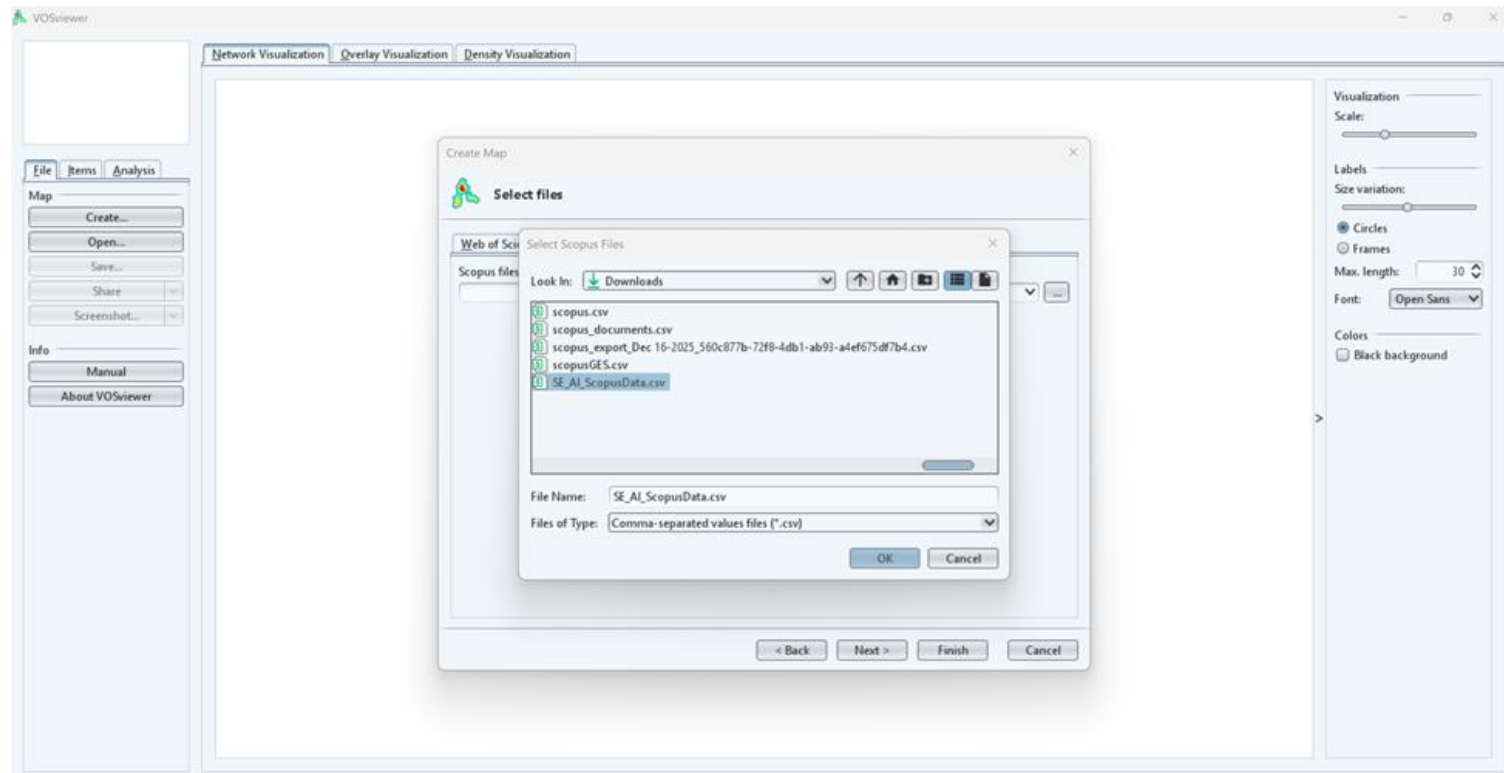
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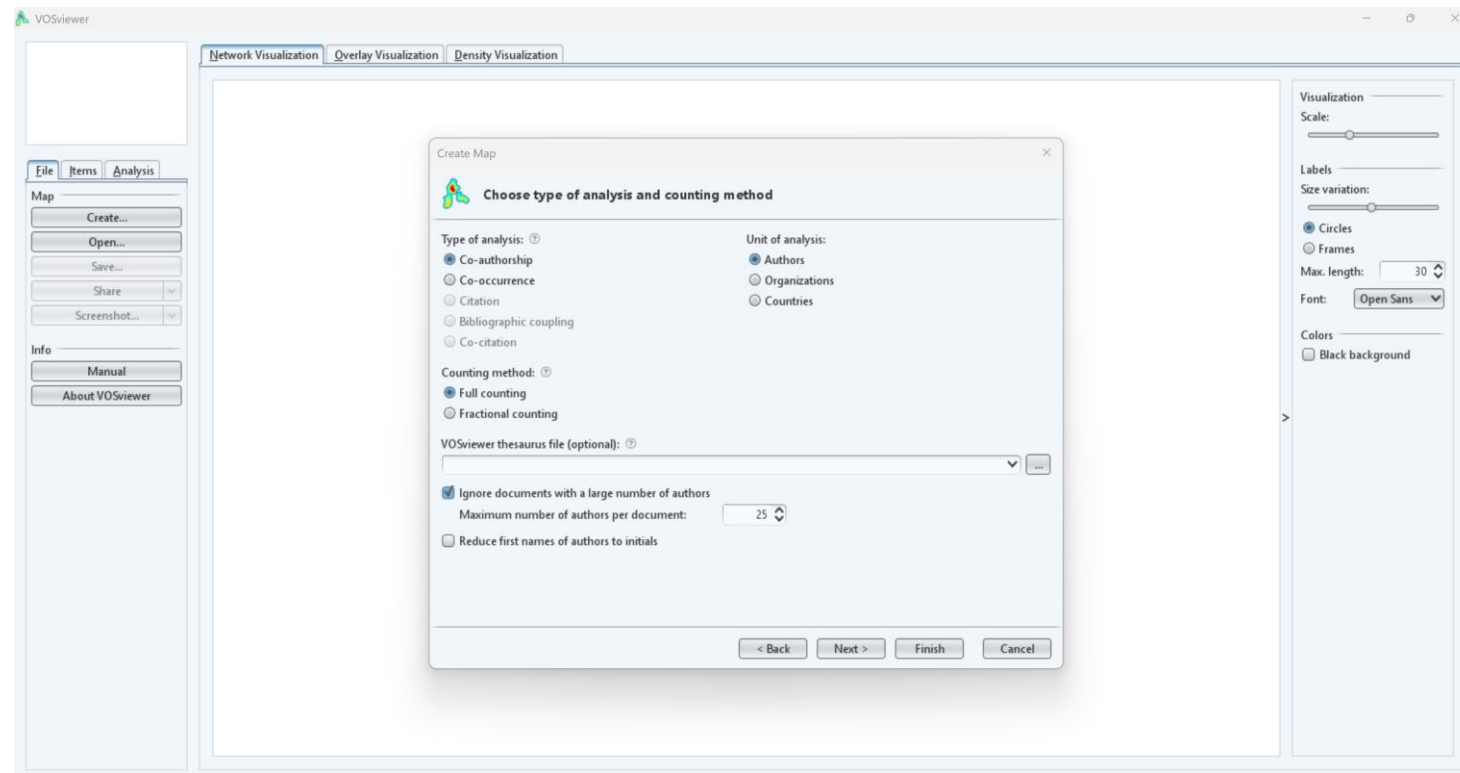
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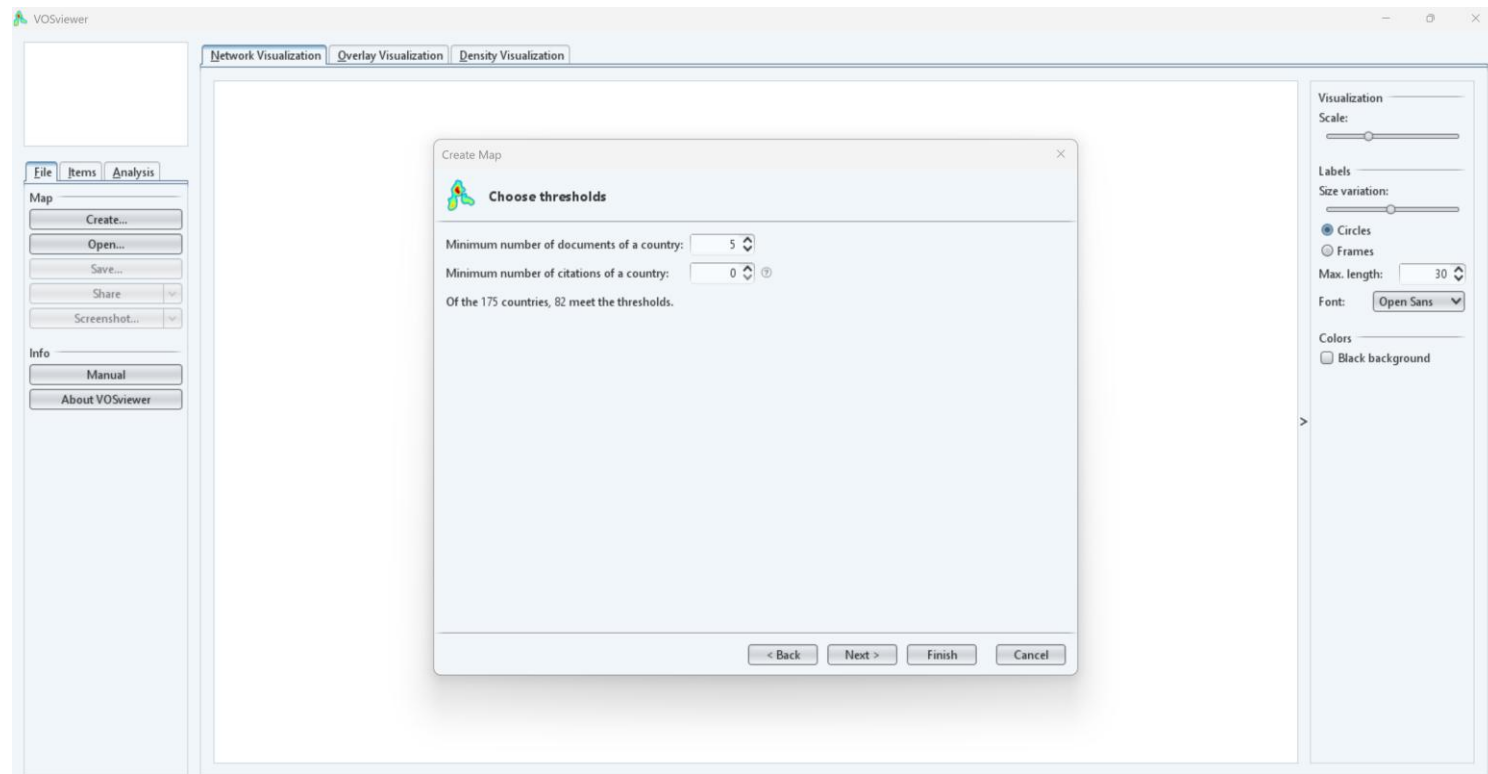
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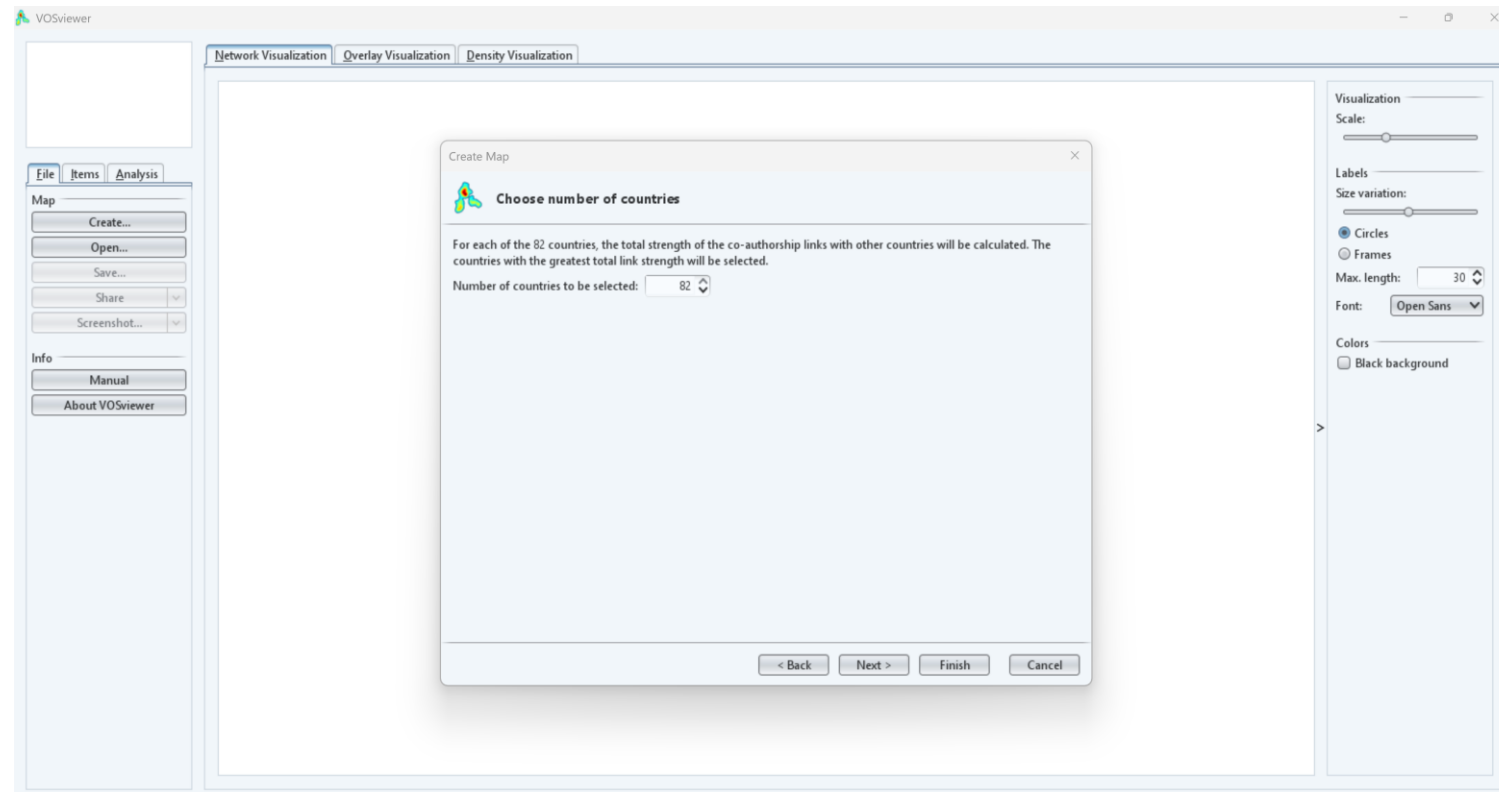
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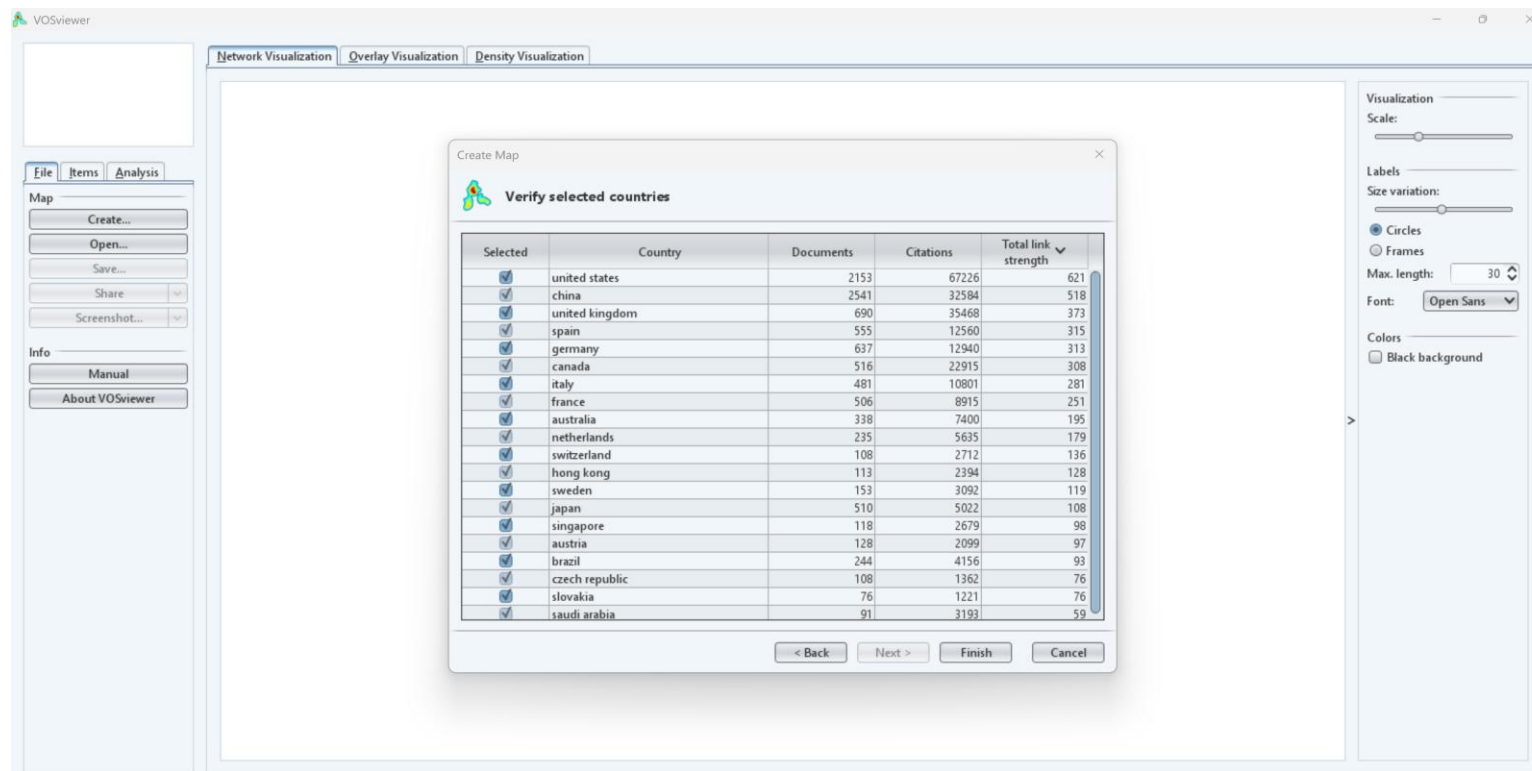
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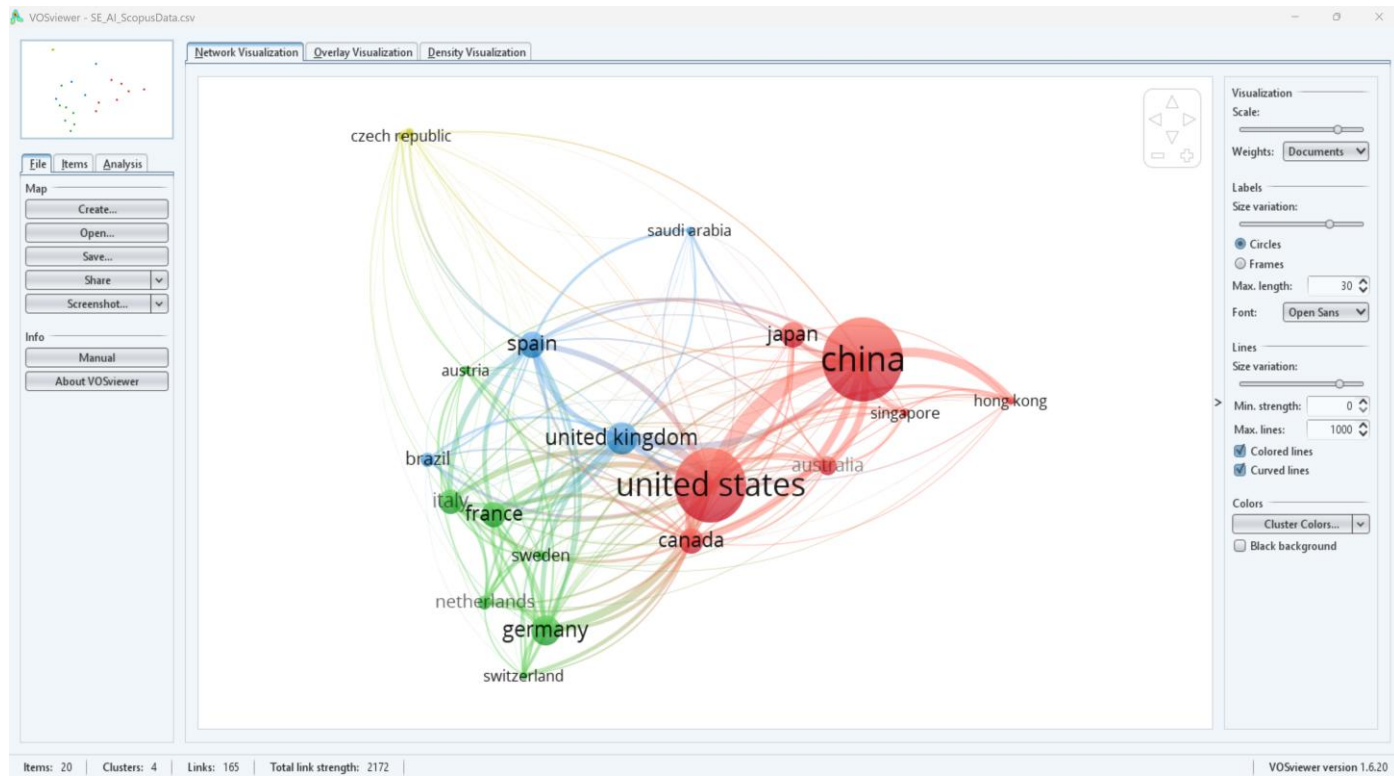
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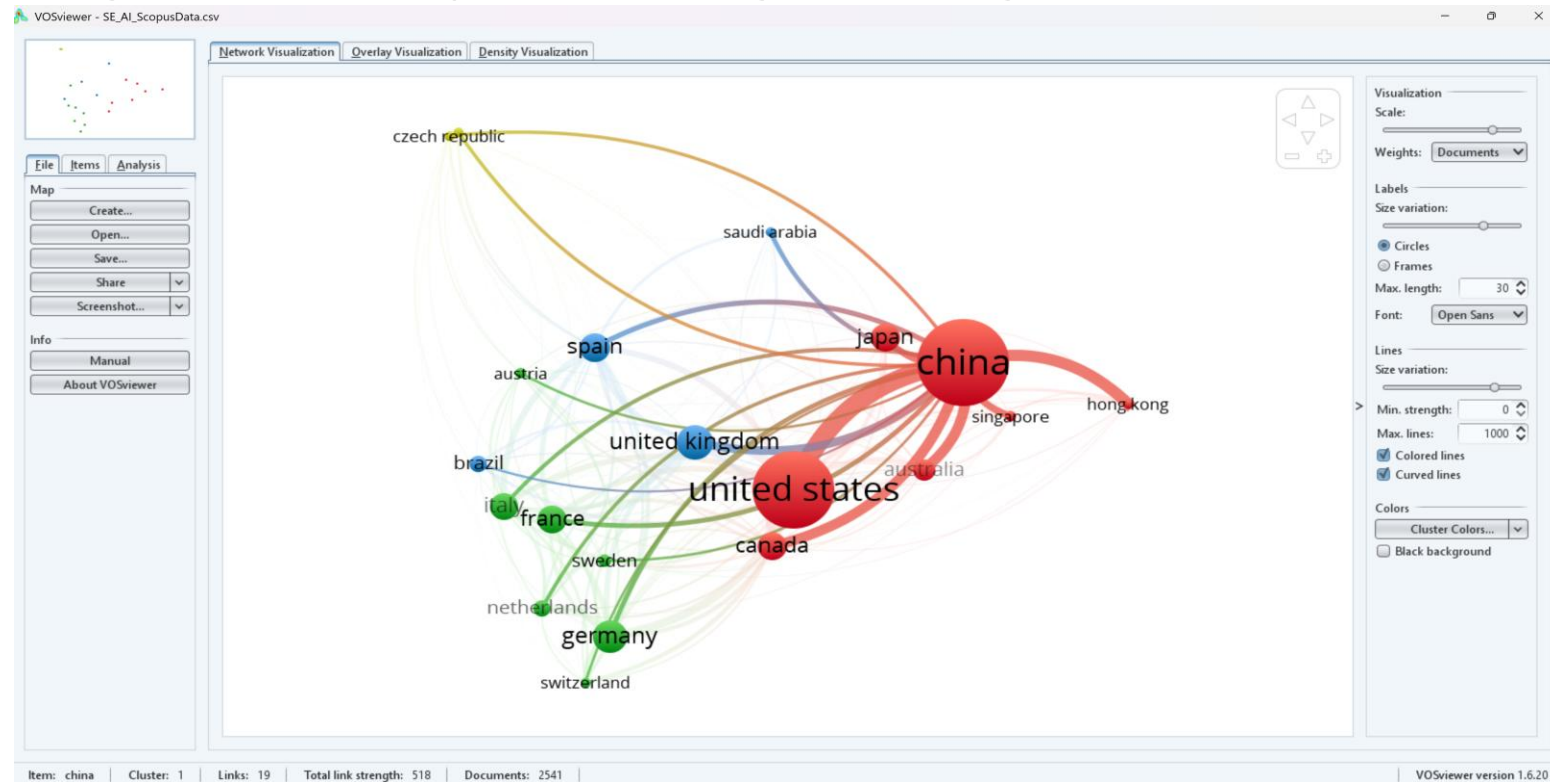
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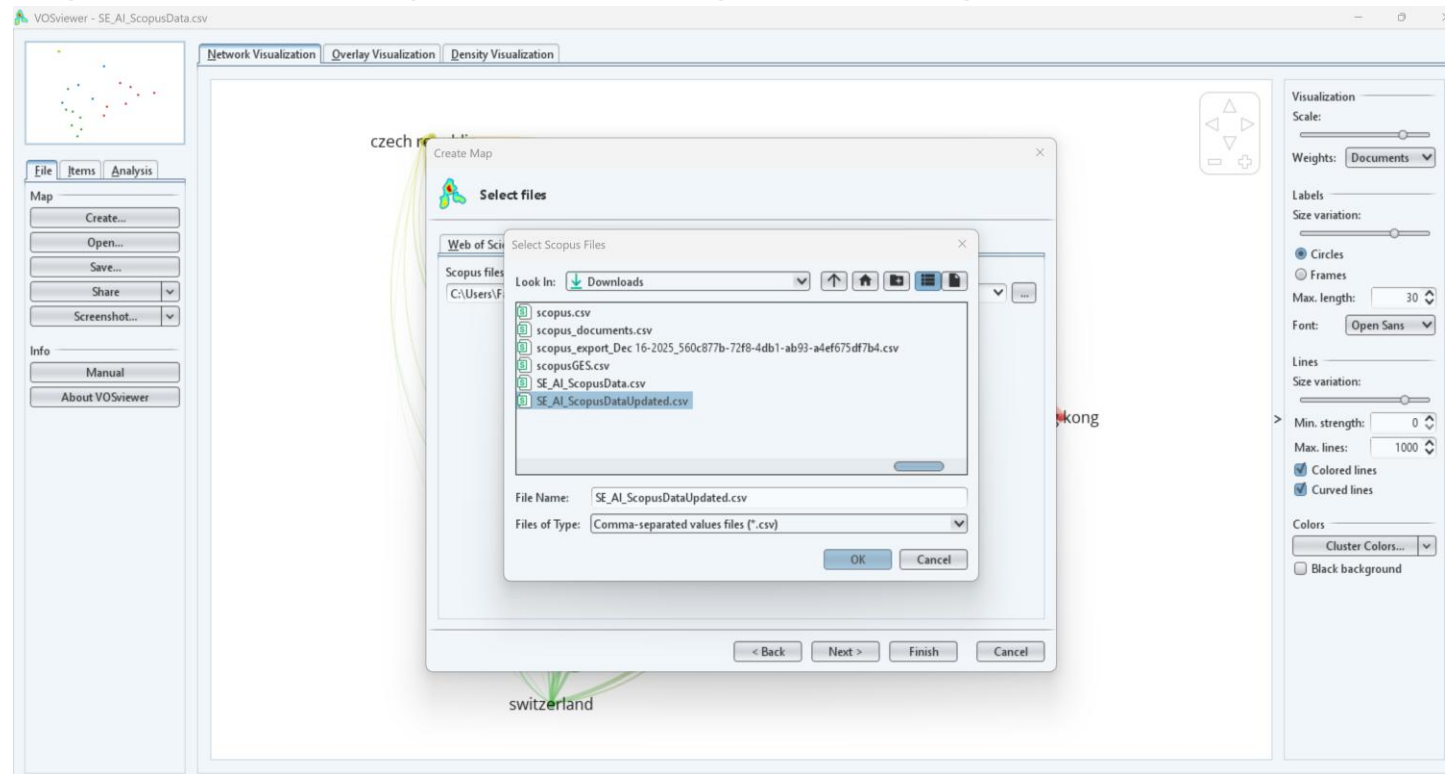
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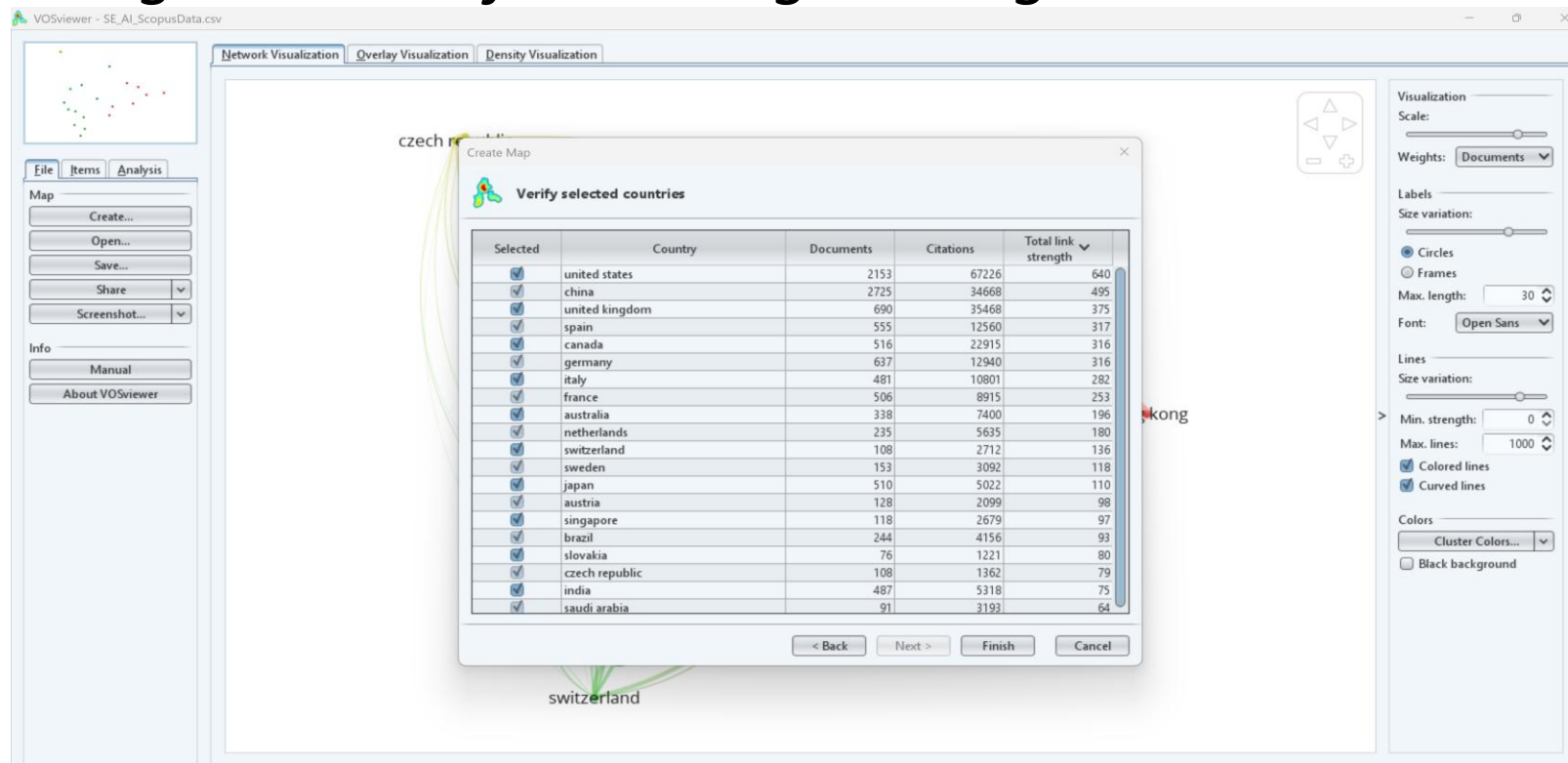
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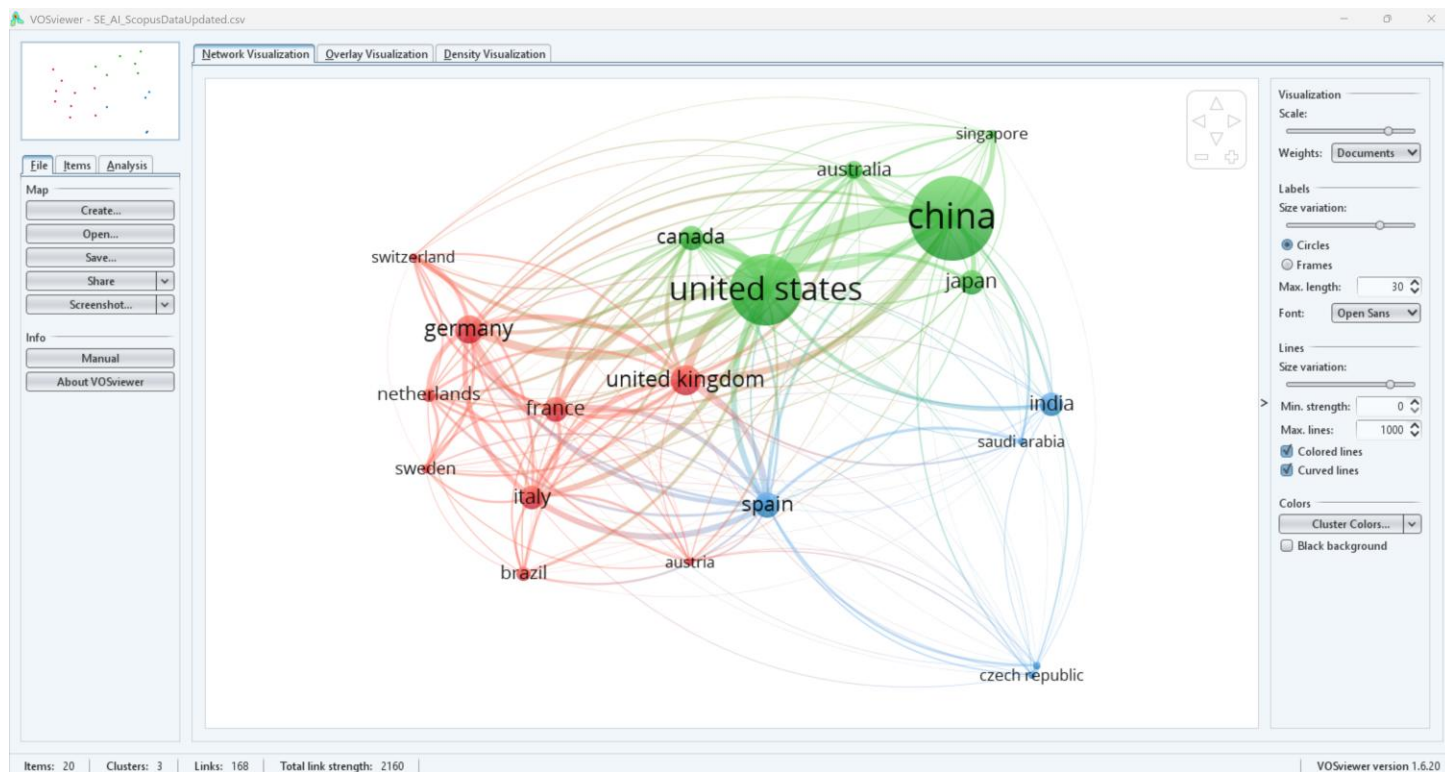
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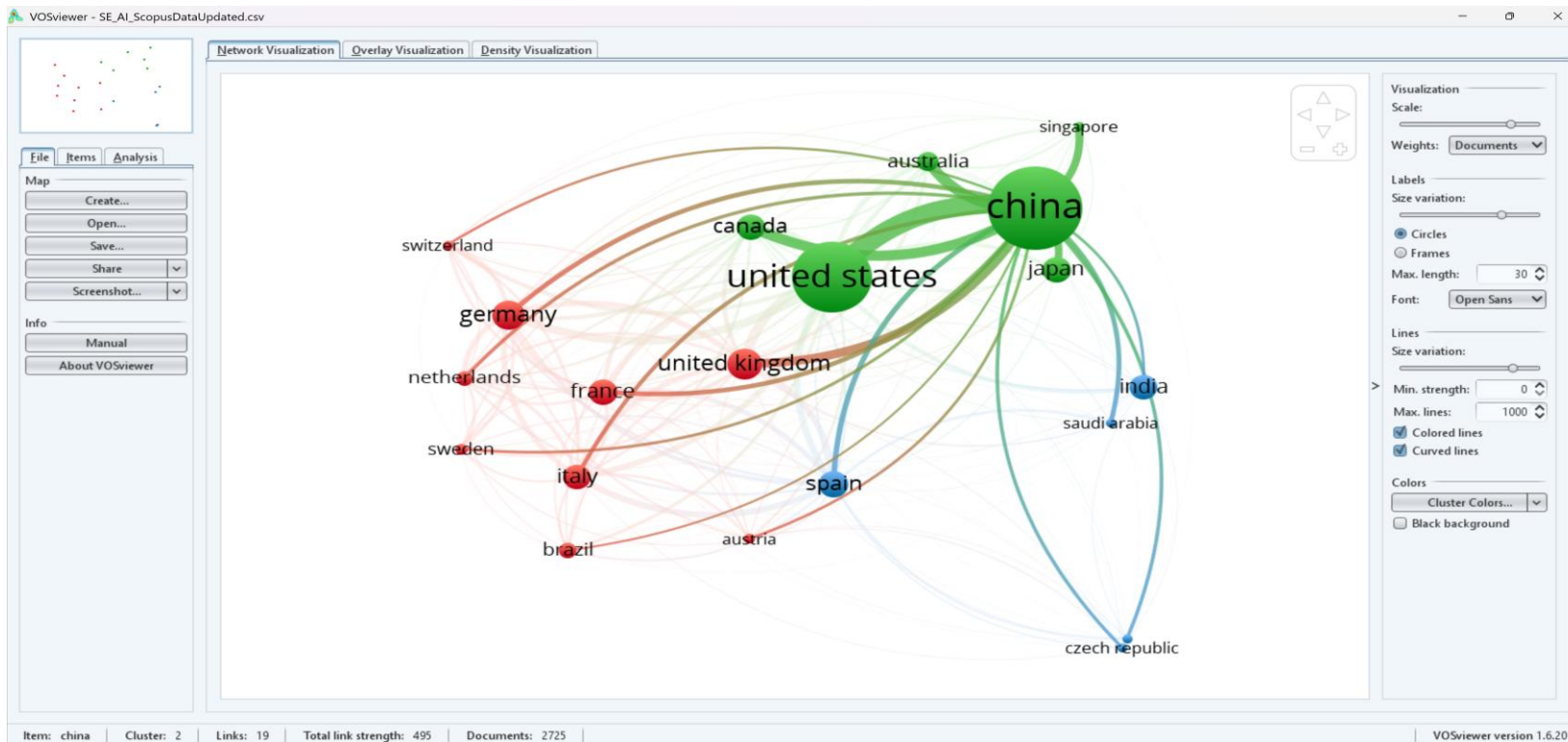
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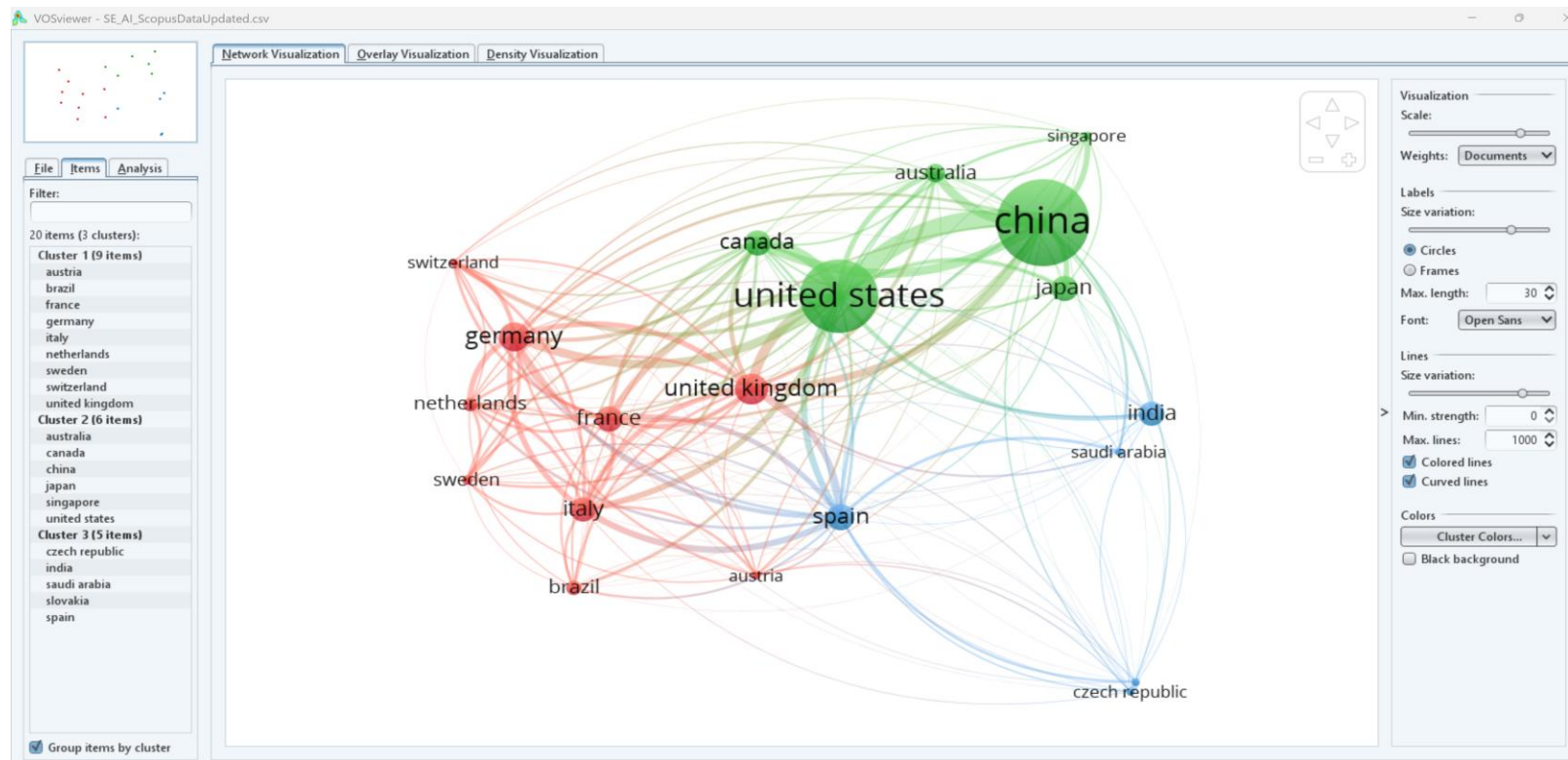
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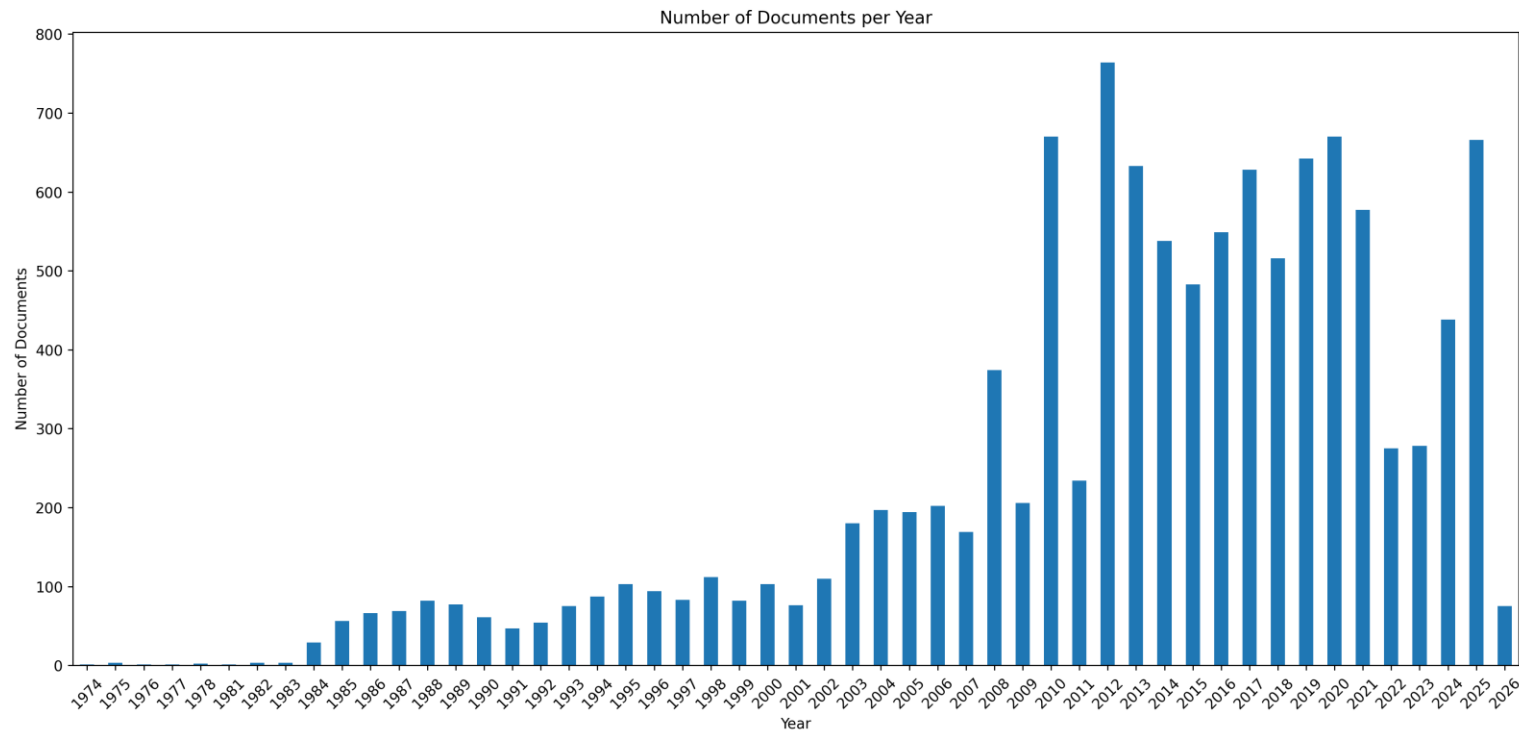
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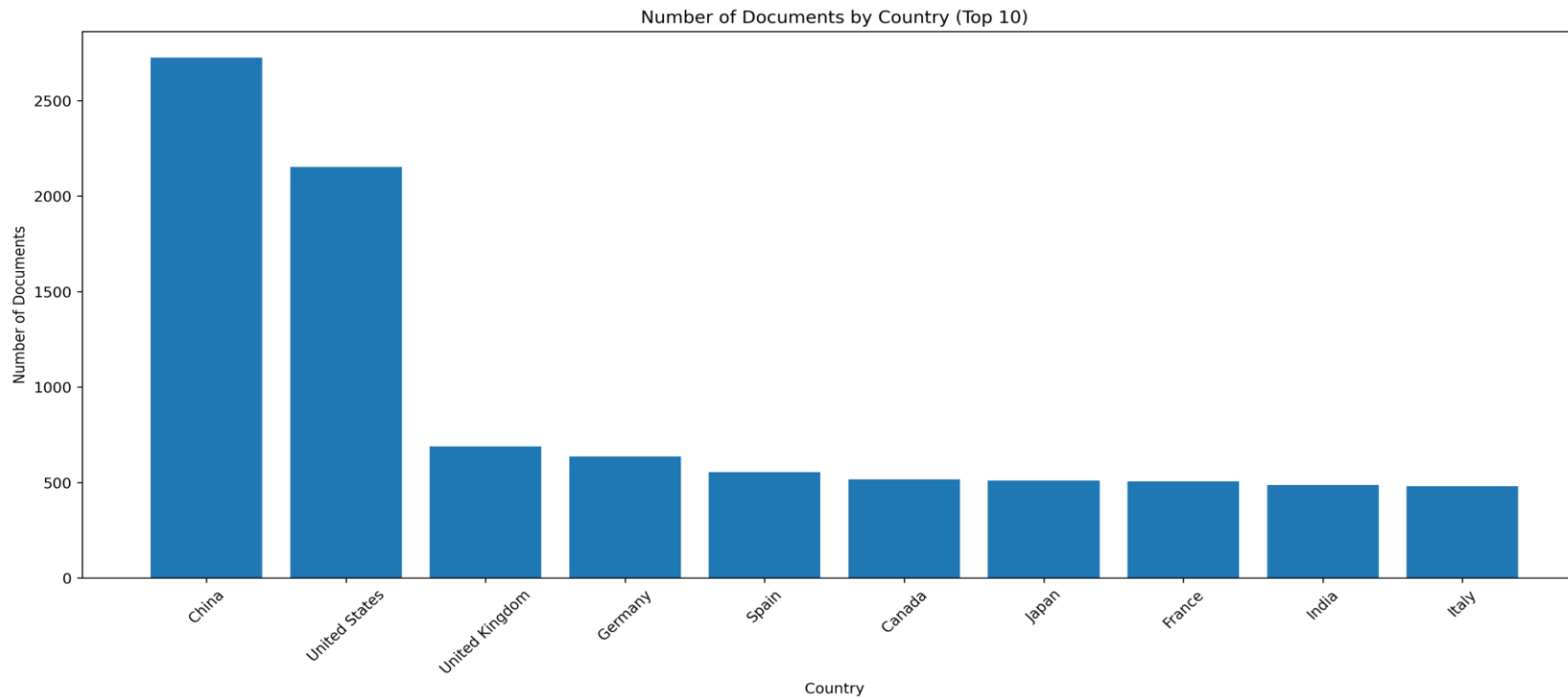
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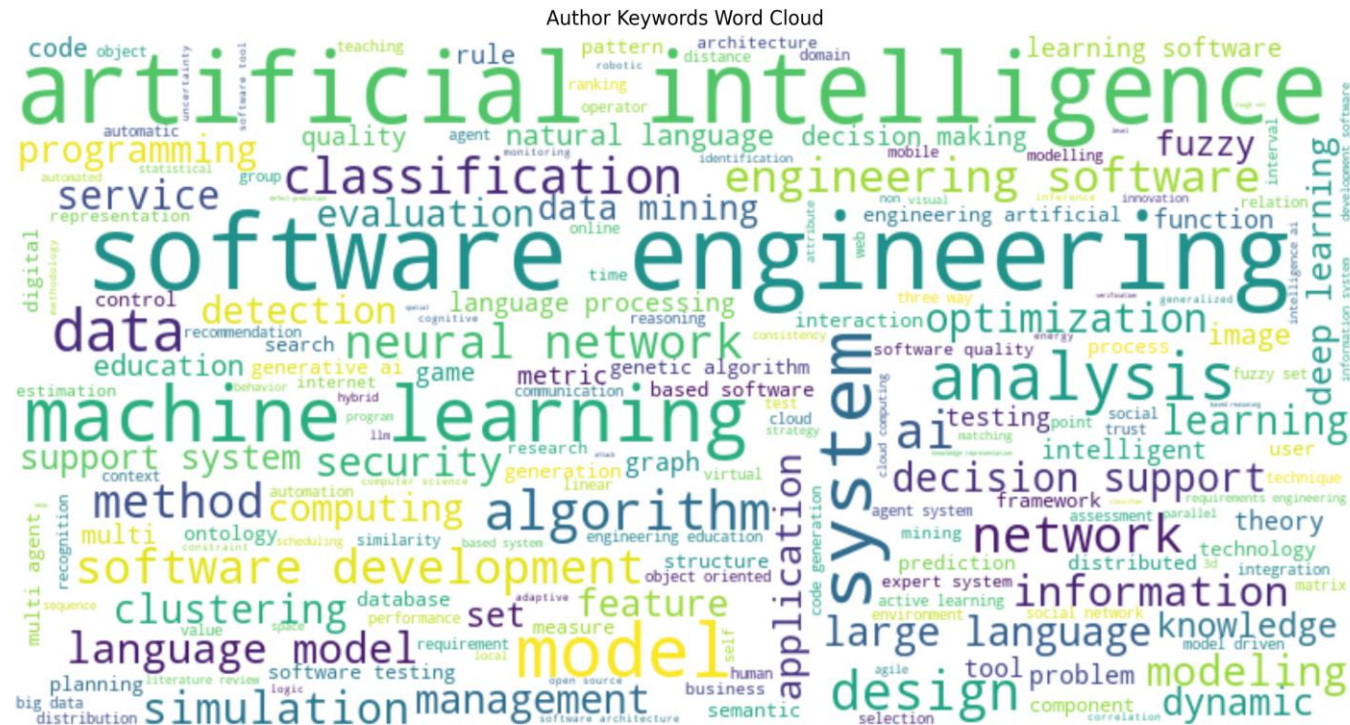
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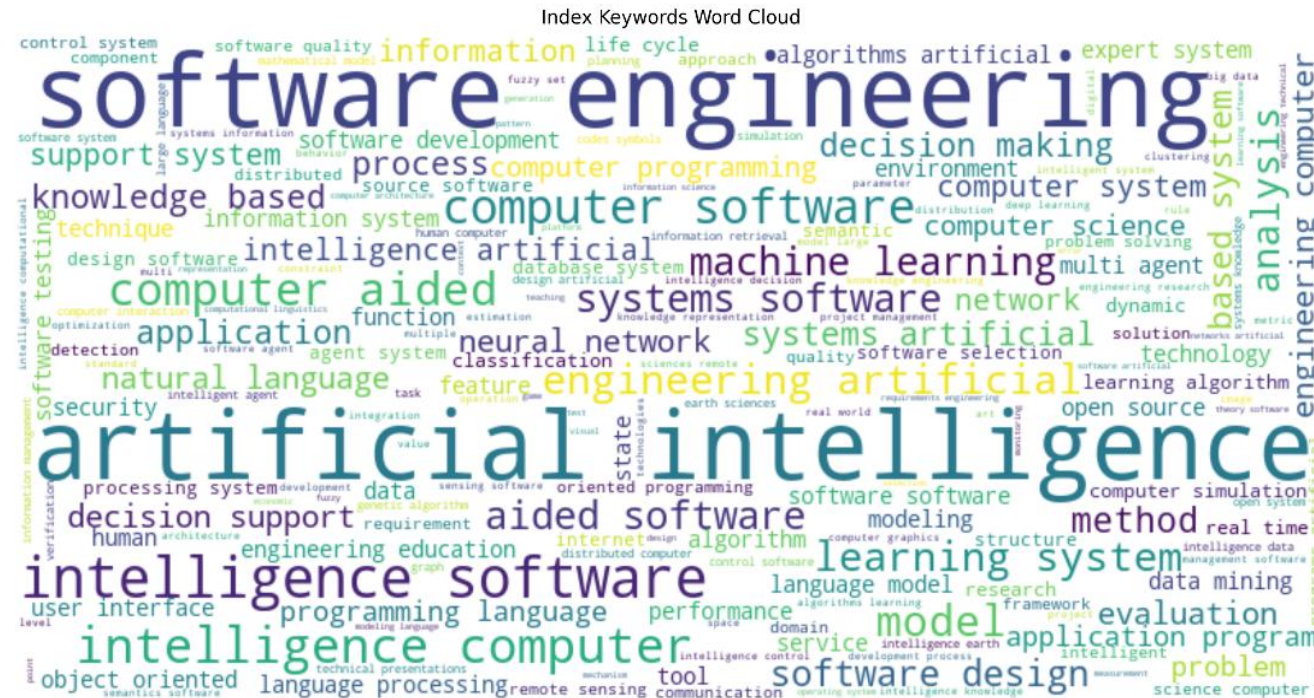
1. The AI-Augmented Software Engineering



软件工程中的人工智能

AI in Software Engineering

1. *The AI-Augmented Software Engineering*



软件工程中的人工智能

AI in Software Engineering

1. *The AI-Augmented Software Engineering*

Top 20 keywords:

- | | |
|---|----------------------------------|
| 1. Artificial intelligence: 9819 | 1. Computer science: 456 |
| 2. Software engineering: 8912 | 2. Software testing: 434 |
| 3. Learning systems: 1064 | 3. Artificial Intelligence: 432 |
| 4. Computer aided software engineering: 994 | 4. Decision making: 429 |
| 5. Software design: 776 | 5. Data mining: 399 |
| 6. Computer software: 639 | 6. Engineering education: 399 |
| 7. Knowledge based systems: 534 | 7. Decision support systems: 399 |
| 8. Application programs: 492 | 8. Semantics: 342 |
| 9. Machine learning: 482 | 9. Machine-learning: 327 |
| 10. Algorithms: 464 | 10. Optimization: 326 |

软件工程中的人工智能

AI in Software Engineering

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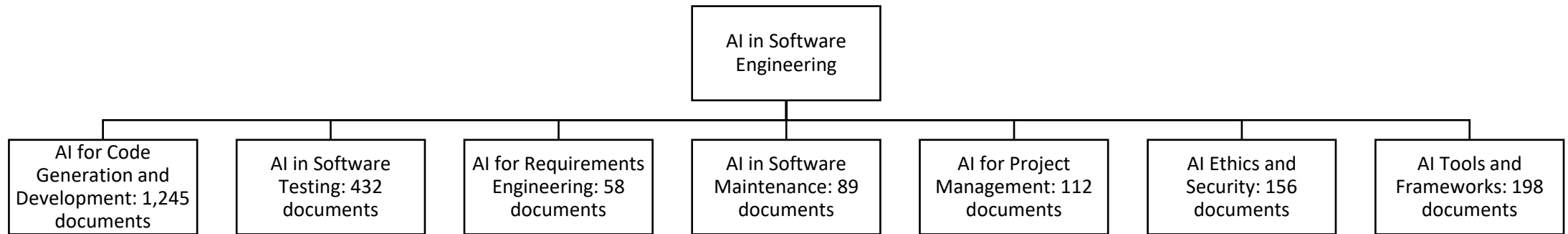
Proposed Categories under AI in Software Engineering:

- ☐ 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

软件工程中的人工智能

AI in Software Engineering

1. *The AI-Augmented Software Engineering*



软件工程中的人工智能

AI in Software Engineering

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")

软件工程中的人工智能

AI in Software Engineering

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

AI in Software Engineering

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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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.

软件项目管理（SPM）是一种规划和领导软件项目的正确方式。

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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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