RESEARCH FUNDING DATABASE

Introduction

Grant-based funding has large implications for a domain's ability to conduct scientific research and drive innovation. The research funding landscape across the United States includes federal funding, state funding, private foundations and non-profit organizations, corporate and industry funding, and philanthropic funding, among others. Funding's impacts, as well as scientific development itself (science of science), have been studied extensively and offer us a more clear view into what factors facilitate scientific progress by examining different patterns that exist in the creation and dissemination of knowledge. Lots of tools and methods exist to analyze these factors; network analysis, in particular, provides useful information on the relationship-driven aspects of science, such as researcher centrality and importance, and collaboration and information flow. There exist a number of databases and analyses at the national level with science and funding as a focus. However, the literature points out that a scientific network in a smaller, sub-regional ecosystem may be quite distinct. Considering the unique selection of Minnesota's funding options, position in health-focused innovation, and serving as the home of an educational research giant, there remains a need to examine Minnesota's research ecosystem and funding systems at a state level.

Research Objectives

RQ1

What are the structural characteristics (collaboration, community structure, lead innovators, and thematic composition) of Minnesota's NSF- and NIH-funded research ecosystem as revealed through a graph-based network model?

RQ2

What structural characteristics (interdisciplinarity, funded innovation concentrations, connected or siloed researchers) define Minnesota's AI-related funded research within the NSF/NIH funding ecosystem?

- a.How do the structural patterns of AI research differ from those of the broader funded research ecosystem?
- b.How might these patterns inform statewide planning for AI research and innovation?

RQ3

·What research themes are most and least represented within Minnesota's AI-related NIH/NSF grant funded projects, and does this indicate potential gaps in areas such as sustainability, planning, or public-sector AI readiness?

Literature Review

7.1 Introduction to Research Funding Ecosystems and their Challenges

7.2 Network Science & Graph Theory in Research and Innovation Studies

7.3. Graph Databases in Research Evaluation & Science of Science

7.4. Prior Work on Research Funding Analysis

7.5. Classification of Topic in Research Abstracts

7.6. Regional Innovation Systems & Geographic Clustering

7.7. Gaps in Current Literature

Gaps & Opportunities

- State-focused grant/research databases with relational/graph exploration.
- Funding-based scientific network analysis
- Lack of integrated public interactive visualizations for grant relationships.
- AI-related science: how AI is emerging within Minnesota's broader research ecosystem.

What Exists

LENS.ORG — Patent & scholarly work database: maps influence & innovation

NIH RePORT 〉 RePORTER — Tracks and links grants to papers & patents (outcomes)

U.S. National Science Foundation — Searchable database of projects funded by the U.S. National Science Foundation since 1989

OpenAlex — Catalog of scholarly output- also tracks of the connections between these works, finding associations through things like journals, authors, institutional affiliations, citations, concepts, and funder

Opportunity: A State-based funding ecosystem database & interactive knowledge graph

—> Who funds what, who is collaborating, where, on what, and how it translates into science.

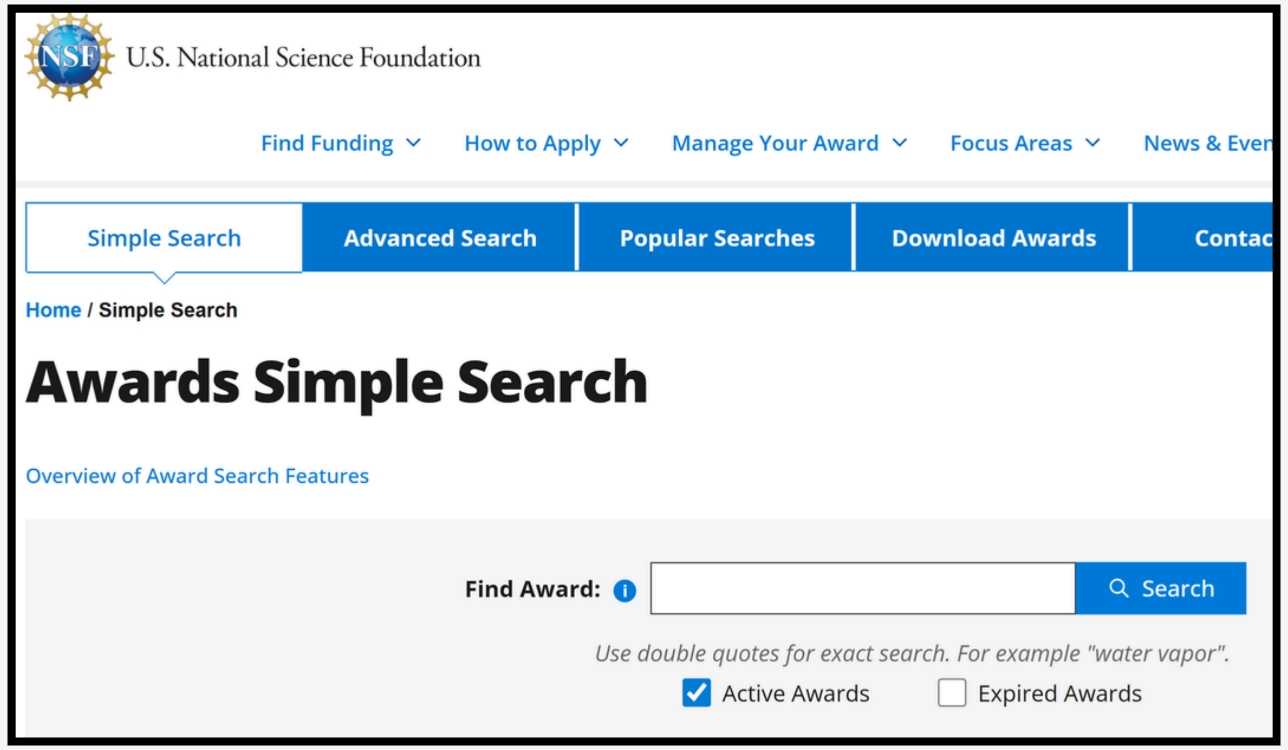
+ AI Comparative Subgraph

Datasets

National Institute of Health (NIH)

2024-2025

National Science Foundation (NSF)



Usage & Queries

Database and application Users

- Policy analysts
- Strategic Planners
- Researchers
- Funding agencies
- University research offices
- State government

Search/filter Queries

“Show me all publications linked to NSF-funded projects on HCI.”

“Which funding agencies most often support projects in renewable energy?”

Visual/graph Queries

“Who are the central nodes in the collaboration network for cancer research?”

“What research topics form clusters around ‘digital health’ projects?”

Research Theme Classification

Table 2.2. **Fields of R&D classification**

Broad classification	Second-level classification
1. Natural sciences	1.1 Mathematics
	1.2 Computer and information sciences
	1.3 Physical sciences
	1.4 Chemical sciences
	1.5 Earth and related environmental sciences
	1.6 Biological sciences
	1.7 Other natural sciences
2. Engineering and technology	2.1 Civil engineering
	2.2 Electrical engineering, electronic engineering, information engineering
	2.3 Mechanical engineering
	2.4 Chemical engineering
	2.5 Materials engineering
	2.6 Medical engineering
	2.7 Environmental engineering
	2.8 Environmental biotechnology
	2.9 Industrial biotechnology
	2.10 Nano-technology
	2.11 Other engineering and technologies
3. Medical and health sciences	3.1 Basic medicine
	3.2 Clinical medicine
	3.3 Health sciences
	3.4 Medical biotechnology
	3.5 Other medical science
4. Agricultural and veterinary sciences	4.1 Agriculture, forestry, and fisheries
	4.2 Animal and dairy science
	4.3 Veterinary science
	4.4 Agricultural biotechnology
	4.5 Other agricultural sciences
5. Social sciences	5.1 Psychology and cognitive sciences
	5.2 Economics and business
	5.3 Education
	5.4 Sociology
	5.5 Law
	5.6 Political science
	5.7 Social and economic geography
	5.8 Media and communications
	5.9 Other social sciences
6. Humanities and the arts	6.1 History and archaeology
	6.2 Languages and literature
	6.3 Philosophy, ethics and religion
	6.4 Arts (arts, history of arts, performing arts, music)
	6.5 Other humanities

AI-related Project Tagging

nonmonotonic reasoning	OECD_2021
object recognition	OECD_2021
oppinion mining	OECD_2021
optimal search	OECD_2021
pattern analysis	OECD_2021
pattern recognition	OECD_2021
perception	OECD_2021
person re identification	OECD_2021
principal component	OECD_2021
question answering	OECD_2021
radial basis function	OECD_2021
random forest	OECD_2021
rbf kernel	OECD_2021
rbf neural network	OECD_2021
recurrent neural network	OECD_2021
reinforcement learning	OECD_2021
rigid registration	OECD_2021
robot system	OECD_2021
robotic	OECD_2021
robot	OECD_2021
sarsa	OECD_2021
self organizing map	OECD_2021
sensor datum fusion	OECD_2021
sensor network	OECD_2021
speech recognition	OECD_2021

Database information

Nodes (3,372)

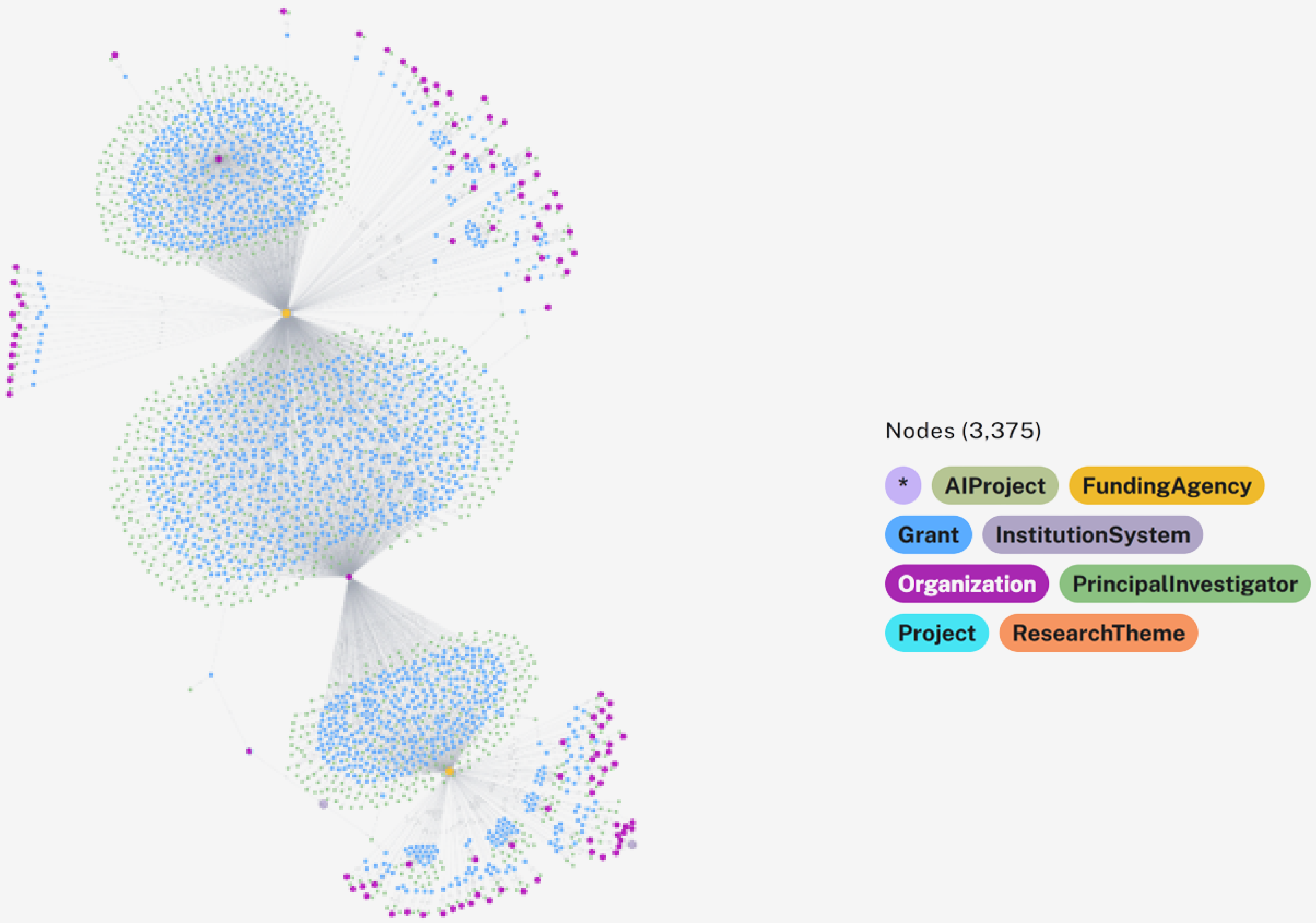
* AIProject FundingAgency Grant Organization PrincipalInvestigator Project ResearchTheme

Relationships (7,488)

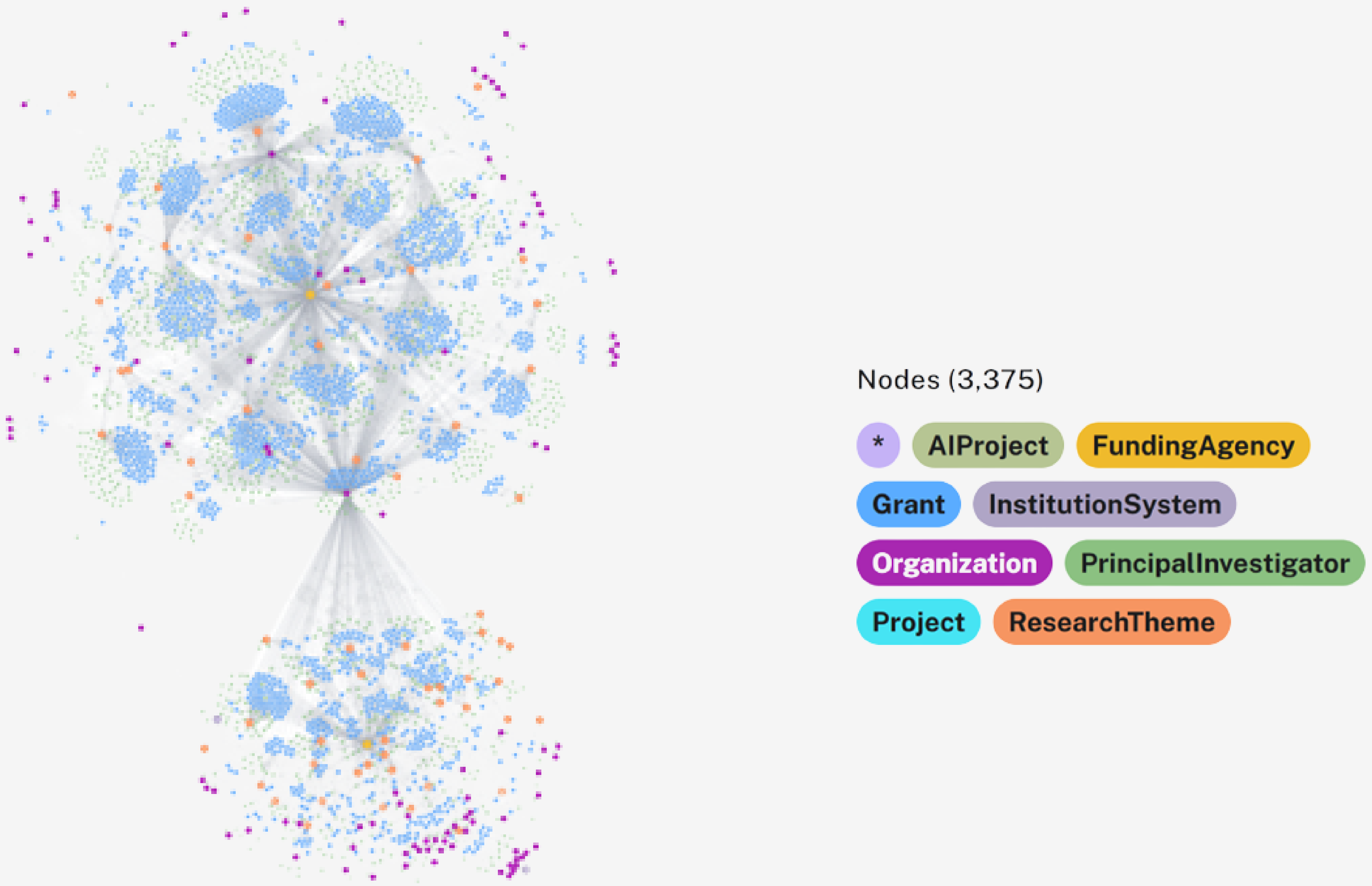
* ADDRESSES FUNDED_BY HELD_AT LED_BY

Property keys

Abstract ai_community ai_flag ai_type Amount AwardNumber city data EndDate id name nodes relationships StartDate style Title visualisation visualSize



Full Research Funding Ecosystem Graph



Full Research Funding Ecosystem Graph with Research Theme Clusters

Table 1.3 Raw structural metrics for full, AI, and non-AI graphs

Structural Metric	**Full Graph – All NSF/NIH Grants**	**AI Subgraph**	**Non-AI Subgraph**	**Interpretation Notes**
Graph Level Metric				
Node count (N)	3375	797	2747	Scale of activity
Edge count (E)	15008	1500	5988	Collaboration volume
Modularity (Louvain)	0.46	0.40	0.296	Fragmentation (for direct comparison)
Num. communities	35	104	726	Clustering
Largest community	1393	209	355	Size-sensitive
% Singleton grants	0	28.0%	28.8%	Isolation indication
Average clustering coefficient	0			Local cohesion
Top PageRank organization	University of MN: 208.19	Bethel University: 0.27	Myogenica Inc.: 0.48	Influence hubs
Top betweenness organization	"University Of Minnesota-twin Cities": 2790963	"Carleton College": 113.5	"University Of Minnesota-twin Cities": 2275	Bridge entities

Table 1.4 Normalized Comparison Metrics: AI vs. the Full Graph

Structural Metric	Full Graph – All NSF/NIH Grants (Normalized)	AI Subgraph (Normalized)	Difference	Interpretation Notes
Graph Level Metric				
Nodes (proportion)	1.00	0.236	-76.4%	AI-related grants make up 24% of the full ecosystem
Edges (proportion)	1.00	0.100	-90%	AI represents 10% of collaboration links
Modularity (direct)	0.46	0.40	-0.06	AI share is slightly less fragmented than the full graph
% Singleton nodes	0%	28%	+28%	AI has substantial isolated activity
% in largest community	0.413	0.262	-0.151	AI is less centralized and more distributed
PageRank (top 5 rank)	University of Minnesota	Bethel is the highest in AI	Different ranking	Influence shifts in AI network
Betweenness (percentile)	University of Minnesota > 99th percentil	Carlson is unusually central	Structural role shifts	Bridges differ from the full ecosystem

Table 1.5 Normalized Comparison Metrics: AI vs. Non-AI Graph

Structural Metric	**AI Subgraph (Normalized)**	**Non-AI Subgraph (Normalized)**	**Difference**	**Interpretation Notes**
Graph Level Metric				
Nodes (proportion)	0.236	0.814	-65%	Non-AI has more grants
Edges (proportion)	.100	0.399	-29.9%	AI has fewer collaborative links
Modularity (direct)	0.40	0.296	-0.104	AI is less fragmented
% Singleton nodes	28%	28%	+0.8%	Both subgraphs show strong isolation
% in largest community	0.262	0.129	-0.133	AI forms larger cohesive clusters
PageRank (top 5 rank)	Bethel	Myogenica	Different influence hubs	AI and non-AI have distinct hubs
Betweenness (percentile)	Carlton	University of Minnesota	Role reversal	AI bridges differ from non-AI

Results

- Minnesota's NSF/NIH research ecosystem is highly centralized, with the University of Minnesota–Twin Cities acting as the dominant hub for influence, collaboration, and knowledge flow.
- AI-related research forms a smaller but structurally distinct network: less centralized, more isolated, yet containing tightly connected clusters.
- Unlike the full ecosystem, the AI subgraph shows unexpected centrality from smaller institutions (e.g., Bethel, Carleton), indicating more distributed AI activity across the state.
- Research themes are heavily concentrated in medical and health sciences, with comparatively limited AI engagement in sustainability, environmental engineering, or public-sector domains.
- AI-related grants display more fragmentation and more small, siloed projects, but also pockets of strong interdisciplinary bridging across institutions and fields.
- Network analysis reveals structural patterns not visible through descriptive statistics alone, highlighting strengths, gaps, and emerging interdisciplinary connections.
- Findings can support state-level strategy, funding decisions, and responsible AI planning, strengthening Minnesota's capacity for future innovation.