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Bibliometric analysis of a scientific journal based on OpenAlex data

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IMFM, UP IAM, FMF

Applied statistics

Koper, 21-23. september 2025

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Current version of slides (September 21, 2025 at 03:37): [slides PDF](#)

<https://github.com/bavla/OpenAlex>



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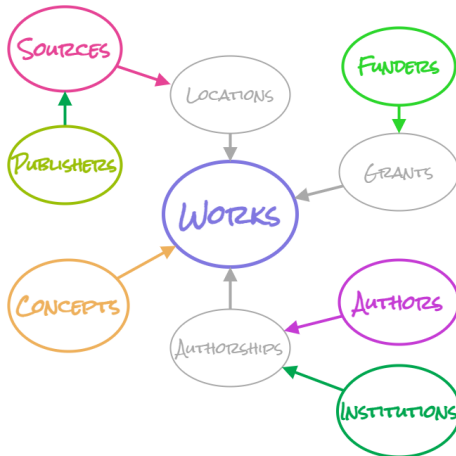
References

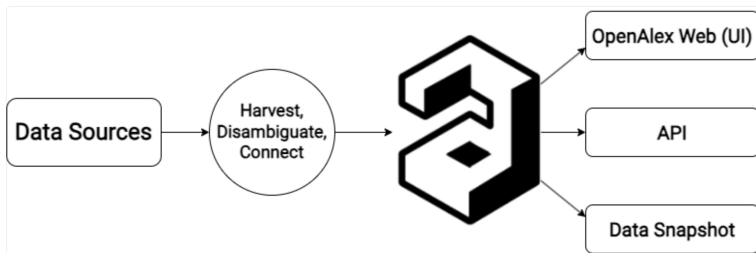
OpenAlex is a fully open catalog of the global research system. It's named after the ancient Library of Alexandria and was made by the nonprofit OurResearch. OpenAlex launched in January 2022 with a free API and data snapshot [1]. It is a free alternative to commercial bibliographic services such as Web of Science and Scopus. Through its API, it provides programming access to bibliographic data and enables complex analyses and the development of higher-order bibliographic services.

We are developing an R package, **OpenAlex2Pajek**, for creating bibliographic networks from the OpenAlex database. The basic package version supports the collection of data on selected topics.

Usually, the first step is to prepare a list of interesting works. In the second step, we create corresponding bibliographic networks for the works from this list. We continue with the analysis of the obtained networks.

OpenAlex is based on 7 types of units (entities): **W**(ork), **A**(uthor), **S**(ource), **I**(nstitution), **C**(oncept), **P**(ublisher), or **F**(under)





OpenAlex solves several important questions for the analysis of bibliographic data:

- ① identification of bibliographic units (IDs, [disambiguation](#))
- ② free access (share derived data, [Download to your machine](#))
- ③ improving content through user participation ([Submit a request](#))



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In this contribution, we present an extension, the function `OpenAlexSources`, that creates networks related to a selected journal (all papers published by the chosen journal and all works citing/cited by these papers). Since in networks the units (works, authors, sources, keywords, etc.) are identified by their OpenAlex IDs, another function, `unitsInfo`, provides the user with additional information about the units appearing in the results of analyses.

We applied the new functions to create bibliographic networks for the journals Metodološki zvezki – Advances in Methodology and Statistics ([S4210169332](#), [AMS](#)) and Ars Mathematica Contemporanea ([S61442588](#), [AMC](#)).



Collecting works

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If you open these examples in a web browser, they will look much better if you have a browser plug-in such as **JSONVue** installed.

A. List of works published by a given source (journal) (**call**) – in a single line

```
https://api.openalex.org/works?  
filter=primary_location.source.id:S4210169332&  
select=id,title,type,cited_by_count,publication_year
```

B. List of citing works of a given work (**call**)

```
https://api.openalex.org/works?filter=cites:W4206962290&  
select=id,title,type,cited_by_count,publication_year&  
per_page=200&page=1
```

C. List of works cited by a given work (**call**)

```
https://api.openalex.org/works?filter=openalex:  
W4205437711|W4206962290|W2096252182|W4206003933&  
select=id,title,publication_year,referenced_works
```

D. Let j be the selected source (journal). Determine **(A)** the set W_j of works published in the journal j . Now we can determine

- the set W_{in} of works citing some work from W_j – for each $k \in W_j$ determine **(B)** the set W_k of works citing the work k . The set W_{in} is the union of all W_k s.
- the set W_{out} of works cited from some work from W_j – for each $k \in W_j$ determine **(C)** the set W_k of works cited by the work k . The set W_{out} is the union of all W_k s.
- the set of relevant works is $W = W_{in} \cup W_j \cup W_{out}$. To get networks, apply the procedure `OpenAlex2PajekAll` on W .

Note that for sources different from j only the citations from/to j are complete. Other citations consider only cases where at least one end-node is related to a work from the source j . The obtained networks can be used to determine the set of important sources J .



Collecting works

Creating the set of relevant works W and networks

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E. For each important source j from J , we determine (**D**) the corresponding set of relevant works. The union of these sets W_j is used in the procedure `OpenAlex2PajekAll` to create networks. Now, the citation data are complete for all sources from J (but not for the other sources).

The size of the set W_j can be very large. To reduce it, we can consider some restrictions, such as the interval of considered years of publication, the type of publication, etc.

The programming of support for the collection of the selected source data resulted in two functions **OpenAlexSources** and **unitsInfo**.



Collecting works

Creating the set of relevant works W and networks

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To build networks for a selected source sID is now simple. First, we create a vector R of all works from sID , works citing them, and works cited by them. -

```
> setwd(wdir <- "C:/test/OpenAlex/sources")
> library(httr); library(jsonlite)
> source("https://raw.githubusercontent.com/bavla/Rnet/master/R/Pajek.R")
> source("https://raw.githubusercontent.com/bavla/OpenAlex/main/code/OpenAlex2Pajek.R")
> sID <- "s42i0233660"
> R <- OpenAlexSources(sID,step=250)
OpenAlex2Pajek / Sources Tue May 6 19:32:47 2025
...
2522 source s42i0233660 works collected Tue May 6 19:32:50 2025
...
4092 citing works collected Tue May 6 19:38:59 2025
.....
14515 cited works collected Tue May 6 19:39:10 2025
17642 different works Tue May 6 19:39:10 2025
```

We save the vector R in a file.

```
> csv <- file("worksTest.csv","w",encoding="UTF-8")
> write(R,sep="\n",file=csv)
> close(csv)
```

To get the networks, we apply 'OpenAlex2PajekAll' to R



Collecting works and creating networks

Metodološki zvezki – Advances in Methodology and Statistics

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```
> setwd(wdir <- "C:/Users/vlado/docs/papers/2025/AS/MZ")
> library(httr); library(jsonlite)
> source("https://raw.githubusercontent.com/bavla/Rnet/master/R/Pajek.R")
> source("https://raw.githubusercontent.com/bavla/OpenAlex/main/code/Ope
> sID <- "S4210169332"
> R <- OpenAlexSources(sID,step=250)
OpenAlex2Pajek / Sources Mon May 26 05:08:49 2025
  238 source S4210169332 works collected Mon May 26 05:08:50 2025
  1423 citing works collected Mon May 26 05:10:29 2025
  4490 cited works collected Mon May 26 05:10:31 2025
  5323 different works Mon May 26 05:10:31 2025
> csv <- file("worksMZ.csv","w",encoding="UTF-8")
> write(R,sep="\n",file=csv)
> close(csv)
> OpenAlex2PajekAll(NULL,name="MZ",listF="worksMZ.csv")
OpenAlex2Pajek / All - Start Mon May 26 05:12:37 2025
*** OpenAlex2Pajek / All - Process Mon May 26 05:12:37 2025
...
*** OpenAlex2Pajek / All - Data Collected Mon May 26 05:46:36 2025
hits: 5323 works: 157256 authors: 10268 anon: 120 sources: 1776
>>> Citation Cite
>>> publication year, type of publication, language of publication
>>> cited by count, countries distinct count, referenced works
>>> Authorship WA, Sources WJ, Countries WC, Keywords WK
*** OpenAlex2Pajek / All - Stop Mon May 26 05:47:50 2025
```



Analysis

Works citing/cited_by the journal MZ

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We first clean the networks **Ci**, **WA**, **WJ**, ..., removing multiple links and loops.

```
Network/Create new network/Transform/Remove/Multiple lines [Single line]
Network/Create new network/Transform/Remove/Loops [No]
```

$|W| = 157256, |J| = 1776, |A| = 10268, \dots, m_{Ci} = 233191,$
 $m_{WJ} = 5294, m_{WA} = 13491, \dots$ Initially, in the citation network, there were 1481615 arcs.

The product $\mathbf{u} = \mathbf{A} \cdot \mathbf{v}$ of the network **A** with the vector **v** is defined as

$$u_i = \sum_{j:(i,j) \in L} A_{ij} \cdot v_j$$

We need the index j of the node representing MZ in the set of journals J. We can get it from $\mathbf{JW} = \mathbf{WJ}^T$

```
select WJ as the First network
Network/2-mode/Transpose
File/Network/Change label [JW]
```



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We apply the command Info/Vertex label -> Vertex number [S4210169332] on the network **JW**. We get $j = 142$ – the index of the node representing MZ.

We start with the set W_j of all works published by the journal j .

$$W_j = \{w : WJ[w, j] > 0\}$$

Let \mathbf{w}_j be its characteristic vector. Then $\mathbf{w}_j = \mathbf{WJ} \cdot [j]$ where $[j]$ is a vector over J having 1 at the j th place. We create the vector $[j]$

```
Vector/Create constant vector [1776, 0]
using vector editor (magnifying glass icon for vectors),
  change the 142nd value to 1
File/Vector/Change label [ [j] ]
select WJ as the First network
Operations/Network+Vector/Network*Vector
File/Vector/Change Label [Wj]
```



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Next, for the set W_j , we determine the set W_I of citing works and the set W_O of cited works.

$$W_I = \{w : \exists z \in W_j : Ci[w, z] > 0\} \quad \text{and}$$

$$W_O = \{w : \exists z \in W_j : Ci[z, w] > 0\}$$

The vectors $\mathbf{d}_I = \mathbf{C}\mathbf{i} \cdot \mathbf{w}_j$ and $\mathbf{d}_O = \mathbf{C}\mathbf{i}^T \cdot \mathbf{w}_j$

$$d_I(i) = \sum_k Ci[i, k] \cdot w_j(k) \quad \text{and}$$

$$d_O(i) = \sum_k Ci^T[i, k] \cdot w_j(k) = \sum_k Ci[k, i] \cdot w_j(k)$$

count: $d_I(i)$ - how many works from W_j are cited by the work i ; and
 $d_O(i)$ - how many works from W_j are citing the work i .

```
select Ci as the First network
select Wj as the First vector
Operations/Network+Vector/Network*Vector
File/Vector/Change Label [dI]
```



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Inspect the vector *dI*. We list the largest 20 nodes [+20]. Extract the selected top lines and copy them in a text file in TextPad. Remove the Rank and Vertex columns. We get a table

4.0000 W2995900225

...

Save it to a CSV file *dI.csv*. We will collect in R from OpenAlex the additional information about the selected works.

It turns out that the authors' names are not directly accessible as a data field – they are contained inside the field *authorships*. To extract them, we use the function

```
authors <- function(L) {  
  A <- L$authorships; k <- length(A); N <- rep("",k)  
  for (i in 1:k) N[i] <-  
    paste(A[i][[1]]$author$display_name,collapse=", ")  
  return(N)  
}
```



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Now we are ready to get the information about the selected works. Some data (authors and title) can be very long. To get a readable report we truncate them.

```
> LI <- read.table("dI.csv",head=FALSE,sep="")
> selW <- paste0("id,language,countries_distinct_count,cited_by_count",
+ "relevance_score,publication_year,title,authorships")
> RW <- unitsInfo(IDs=LI$V2,units="works",select=selW,order="input")
> rep <- data.frame(id=RW$id,cdc=RW$countries_distinct_count,
+ cby=RW$cited_by_count,dI=LI$V1,year=RW$publication_year,
+ authors=substr(authors(RW),1,35),title=substr(RW$title,1,45))
> rep
```




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	id	cdc	cby	dl	year	authors	title
1	W2995900225	3	3	4	2019	C Nordlund, A Žiberna	Blockmodeling of Valued Networks
2	W2184570220	1	9	4	2009	T Kogovšek, V Hlebec	Stability of typologies produced on the
3	W2240460603	3	15	4	2015	L Prota, P Doreian	Finding roles in sparse economic hierarc
4	W2185659002	2	2	4	2012	V Hlebec, T Kogovšek, +	Measurement quality of social support su
5	W4205564009	0	0	4	2012	A Žnidaršič	Impact of fixed choice design on blockmo
6	W4205097511	1	2	3	2008	T Kogovšek, V Hlebec	Measuring ego-centered social networks
7	W2807932250	1	0	3	2018	JHP Hoffmeyer-Zlotnik, +	Introduction, Problem, and Research Ques
8	W44400362431	0	0	3	2024	R González, E Aedo-Muño	Nonresponse in name generators across co
9	W4206030688	1	1	3	2010	T Kogovšek, M Mrzel, +	"Please name the first two people you wo
10	W3129803968	3	4	3	2021	M Cugmas, A Ferligoj, +	Global structures and local network mech
11	W2498378275	1	2	3	2011	V Hlebec, M Mrzel, +	The Comparability of Event-Related and G
12	W2166296097	1	9	3	2011	V Hlebec, M Mrzel, +	Assessing social support networks in cro
13	W2071989778	1	98	3	2008	V Vehovar, KL Manfreda	Measuring ego-centered social networks o
14	W4206130755	1	2	3	2011	V Hlebec, T Kogovšek	How (not) to measure social support netw
15	W2083653613	1	114	3	2014	DE Eagle, RJ Proeschold	Methodological considerations in the use
16	W2024234381	1	27	3	2012	V Hlebec, T Kogovšek	Different approaches to measure ego-cent
17	W2995396414	3	5	2	2019	A Žnidaršič, P Doreian,+	An Treating Missing Network Data Before
18	W2335008118	1	189	2	2016	A Mrvar, V Batagelj	Analysis and visualization of large netw
19	W2741577583	1	2	2	2017	D Döring, BE Haberla	Consistency in behavior: Evaluation of b
20	W2308243582	1	2	2	2014	Selvarangam	SELECTING PERFECT INTERESTINGNESS MEASUR



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Some improvements: add source; in names, use only the last name, or initials + last name; ...

We can check selected works – for example [W3129803968](#).

```
Network/Create new network/Transform/Transpose [yes]
File/Network/Change label [CiT]
select Wj as the First vector
Operations/Network+Vector/Network*Vector
File/Vector/Change Label [d0]
```

Using the same approach as for **d₁** we get



The top works cited by the journal MZ

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	id	cdc	cby	d0	year	authors	title
	1	W2582743722	0	303929	19	2014	R Core Team R: A language and environment for statistical computing
	2	W2061901927	1	18568	10	1994	S Wasserman, K Faust Social Network Analysis: Methods and applications
	3	W4285719527	0	0	9	1955	Deleted Work
	4	W977705565	2	473	9	2004	P Doreian, V Batagelj, + Generalized Blockmodeling
	5	W2023723604	2	128	9	1992	V Batagelj, A Ferligoj, + Direct and indirect methods for structural equation models
	6	W2116814842	3	68	8	2002	T Kogovšek, A Ferligoj, + Estimating the reliability and validity of network data
	7	W1987455866	1	258	7	1973	PW Holland, S Leinhardt The structural implications of measurement error
	8	W2017099446	1	1642	7	1971	F Lorrain, HC White Structural equivalence of individual nodes in a network
	9	W2001947224	2	105	7	1992	V Batagelj, P Doreian, + An optimizational approach to regularity in social networks
	10	W4205589890	0	29	6	2004	K L Manfreda, V Vehovar Collecting ego-centred network data
	11	W2182840202	0	15	6	2005	V Hlebec, T Kogovšek Hypothetical versus actual support in social networks
	12	W2186748749	0	16	6	2006	P Zihlerl, H Iglič, + Research Groups' Social Capital: A Case Study
	13	W1893868194	0	14	6	2006	L Coromina Soler Social networks and performance in knowledge management
	14	W2151243887	1	82	6	2006	A Žiberna Generalized blockmodeling of valued networks
	15	W2054720216	1	112	6	1999	A Ferligoj, V Hlebec Evaluation of social network measures
	16	W1556604050	1	1120	6	1989	A Vaux Social support: theory, research, and applications
	17	W2133011836	1	361	6	1983	DR White, K Reitz Graph and semigroup homomorphisms on networks
	18	W1981385379	2	201	6	2004	P Doreian, V Batagelj, + Generalized blockmodeling of two-mode networks
	19	W2109278577	1	1404	6	1999	V Batagelj, A Mrvar Pajek - Program for Large Network Analysis
	20	W1873057782	1	4378	5	2000	R Tourangeau, LJ Rips, + The Psychology of Survey Response



The top authors by the number of works in the journal MZ

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$$a_j = \mathbf{WA}^T \cdot \mathbf{w}_j$$

$a_j(a) = \#$ of works in the journal j co-authored by the author a .

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	id	orcid	wc	cbc	papers	name
1	A5038897789	0000-0002-3691-7959	160	2391	18	Valentina Hlebec
2	A5049753566	0009-0001-4355-8608	60	642	14	Tina Kogovšek
3	A5029499420	0000-0002-3682-6854	139	2740	12	Anuška Ferligoj
4	A5039511070	0000-0002-5204-6882	153	3696	10	Germà Coenders
5	A5040950908	<NA>	65	2024	8	Katarina Košmelj
6	A5083575454	0000-0002-3253-7959	145	4129	6	Vasja Vehovar
7	A5023248667	<NA>	59	217	6	Uwe Warner
8	A5010863389	0000-0003-1534-6971	41	443	6	Aleš Žiberna
9	A5068940001	<NA>	51	3063	5	Katja Lozar Manfreda
10	A5025019965	0000-0001-6461-3007	86	661	5	Rosalía Castellano
11	A5002890522	0000-0001-7851-6216	109	678	4	Jana Mali
12	A5044693419	0000-0003-0769-0633	79	1179	4	Lluís Coromina
13	A5019207040	0000-0002-2564-8781	70	3835	4	Janez Stare
14	A5033311124	0000-0001-8557-4692	100	8835	4	Andrej Mrvar
15	A5001676164	0000-0002-0240-9446	271	13374	4	Vladimir Batagelj
16	A5046373528	0000-0002-2248-1517	68	376	4	Irena Ograjenšek
17	A5041301436	0000-0003-3069-9863	66	743	4	Nataša Kejžar
18	A5022627222	<NA>	160	1316	4	Jürgen H. P. Hoffmeyer-Zlotnik
19	A5052875930	0000-0001-7906-0580	1024	13664	4	Dario Gregori
20	A5102781233	0000-0002-5550-7007	131	401	4	Malgorzata Graczyk
21	A5025045918	0000-0002-5395-1593	113	280	4	Bronislaw Ceranka
22	A5011534481	<NA>	28	102	3	Anton Cedilnik
23	A5065490876	0000-0002-3301-7840	182	5385	3	Patrick Doreian
24	A5055592225	0000-0001-6861-9553	68	579	3	Gennaro Punzo
25	A5084724910	0000-0003-4261-8928	89	1241	3	Giuseppe Scandurra

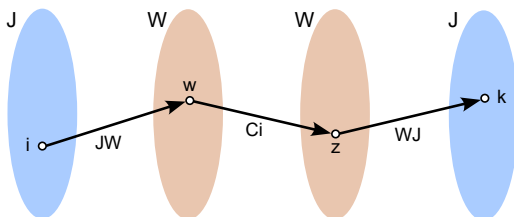
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$$ACiA = WA^T \cdot Ci \cdot WA$$

$ACiA[a, b] = \#$ of times author a cites author $b \equiv$
 $\#$ of citations of a work of author a to a work of author b .



$$JJ = WJ^T \cdot Ci \cdot WJ$$

$JJ[i, k] = \#$ of times journal i cites journal $k \equiv$
 $\#$ of citations of a work from journal i to a work from journal k .



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Citations between authors (and journals)

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```
select Ci as the First network
Network/Create new network/Transform/1-mode to 2-mode
select WA as the First network
Network/2-mode/Transpose
File/Network/Change label [AW]
select 2-mode Ci as the Second network
Networks/Multiply networks
select WA as the Second network
Networks/Multiply networks [yes]
File/Network/Change label [ACiA]
```

$n_{ACiA} = 10268$, $m_{ACiA}^A = 119301$, and 701 loops.

Using Network/Info/Line values we select the threshold $t = 15$. We make a link cut at level t .

For journals we get $n_{JJ} = 1776$, $m_{JJ}^A = 8382$, and 141 loops.

Using Network/Info/Line values we select the threshold $t = 30$. We make a link cut at level t .



MZ citations between authors

link cut at level 15, loops removed

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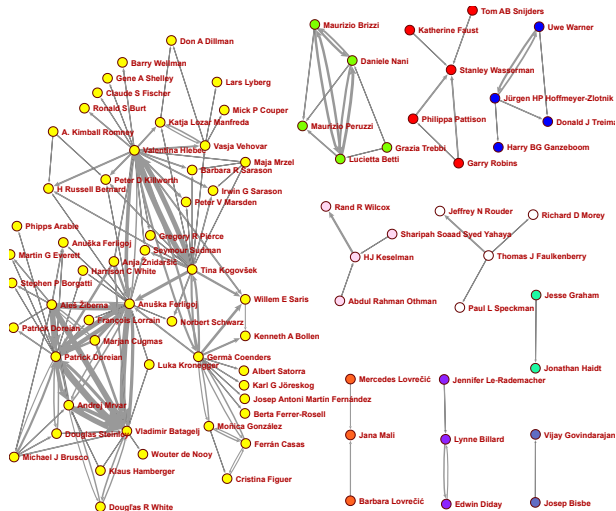
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link cut at level 30, Sunknown removed

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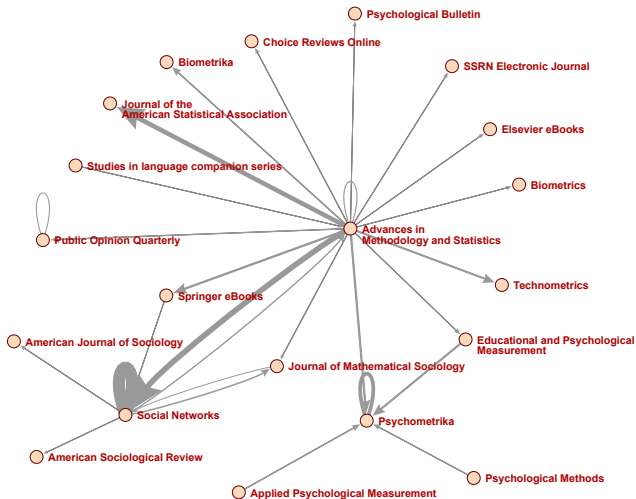
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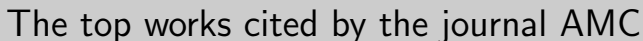
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```
> OpenAlex2PajekAll(NULL,name="AMC",listF="worksAMC.csv")
OpenAlex2Pajek / All - Start Mon May 26 06:10:05 2025
*** OpenAlex2Pajek / All - Process Mon May 26 06:10:05 2025
...
*** OpenAlex2Pajek / All - Data Collected Mon May 26 07:20:44 2025
hits: 12758 works: 137751 authors: 10849 anon: 185 sources: 1192
*** OpenAlex2Pajek / All - Stop Mon May 26 07:21:54 2025
```



	id	cdc	cby	dl	year	authors	title
1	W4395099390	2	3	7	2023	A Pasotti, JH Dinitz	A Survey of Heffter Arrays
2	W1082115497	2	16	6	2015	D Cvetković, P Rowlinson +	Graphs with least eigenvalue -2: Ten y
3	W1846554597	1	7	6	2015	A Malnič, R Požar	On the split structure of lifted group
4	W2894294252	2	40	6	2022	X Liu, S Zhou	Eigenvalues of Cayley Graphs
5	W2885665086	3	13	5	2018	JL Gross, IF Khan +	Calculating genus polynomials via stri
6	W3187989029	0	0	5	2021	FG Yin, YQ Feng +	Prime-valent Symmetric graphs with a q
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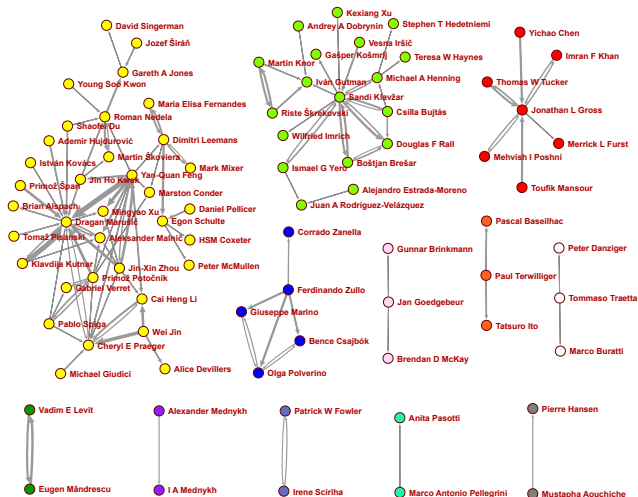
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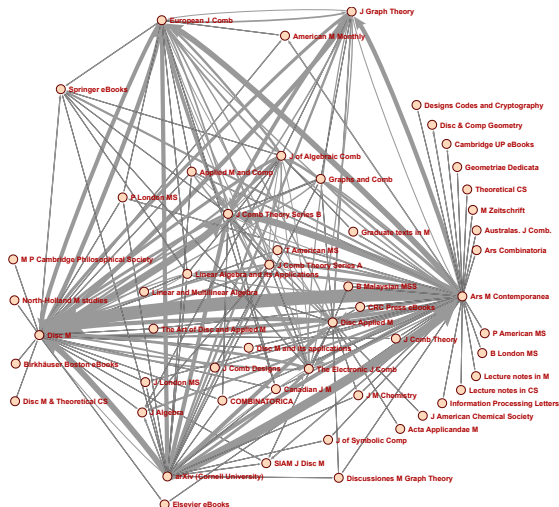
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- 1 The data in the OpenAlex database is not completely error-free. Most errors can be considered as noise – important units will float to the surface.
- 2 If the error is serious and is reflected in the final result, we correct it accordingly and repeat the analysis.
- 3 We can also contribute to the quality of the data in the OpenAlex database by informing the database maintainers about errors.



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The computational work reported in this paper was performed using the R [5] package `OpenAlex2Pajek` and the program **Pajek** for analysis of large networks [6]. The code and data are available at Github/Bavla/ **OpenAlex**.

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