



A Novel Method for Ranking the Quality of Cardiology Literature

Benjamin M.Althouse¹, Carl T. Bergstrom², Jevin D.West*

University of Washington, Information School, Seattle, WA

*email: jevinw@uw.edu, url: <http://www.eigenfactor.org>

Introduction

The scholarly literature forms a vast network of academic papers connected to one another by citations in bibliographies and footnotes [1].The structure of this network reflects millions of decisions by individual scholars about which papers are important and relevant to their own work.

Therefore within the structure of this network is a wealth of information about the relative influence of individual journals, and also about the patterns of relations among academic disciplines.We present a novel method, similar to Google's PageRank [2], to quantify the influence of scientific literature.Whereas Google uses hyperlinks to assess quality, we use scholarly citations.

Methods

The Eigenfactor metric is an eigenvector centrality measure which measures the amount of time a random walker would spend at any given journal in a citation network. Imagine entering a library, choosing a journal at random, an article from that journal at random, and a citation from that article at random and then going to that cited journal and beginning the process again, periodically dropping everything and “teleporting” to a completely new journal. If one repeats this ad infinitum, the percentage of the amount of time spent at a given journal is the journal's Eigenfactor Score.

The mathematical details of the algorithm can be found on the web (<http://www.eigenfactor.org>).The Eigenfactor score is calculated from the leading eigenvector of a stochastic matrix, P.

$$P = \alpha H' + (1 - \alpha) a.e^T$$

Matrix representing the random walk over citations *Probability of not teleporting* *Cross-citation Matrix dictating the structure of the citation network* *Probability of teleporting to completely new journal weighted by the number of articles in that journal*

The Eigenfactor Score E_i of journal i is defined as the percentage of the total weighted citations (defined by the leading eigenvector of P) that journal i receives from our 7611 journals listed in Thomson Reuters Journal Citation Reports [3].

The Eigenfactor score is a measure of the total influence that a journal provides, to measure a per-article influence we simply divide the journal's influence (the Eigenfactor score) by the number of articles published by that journal.We call the measure the Article Influence score.

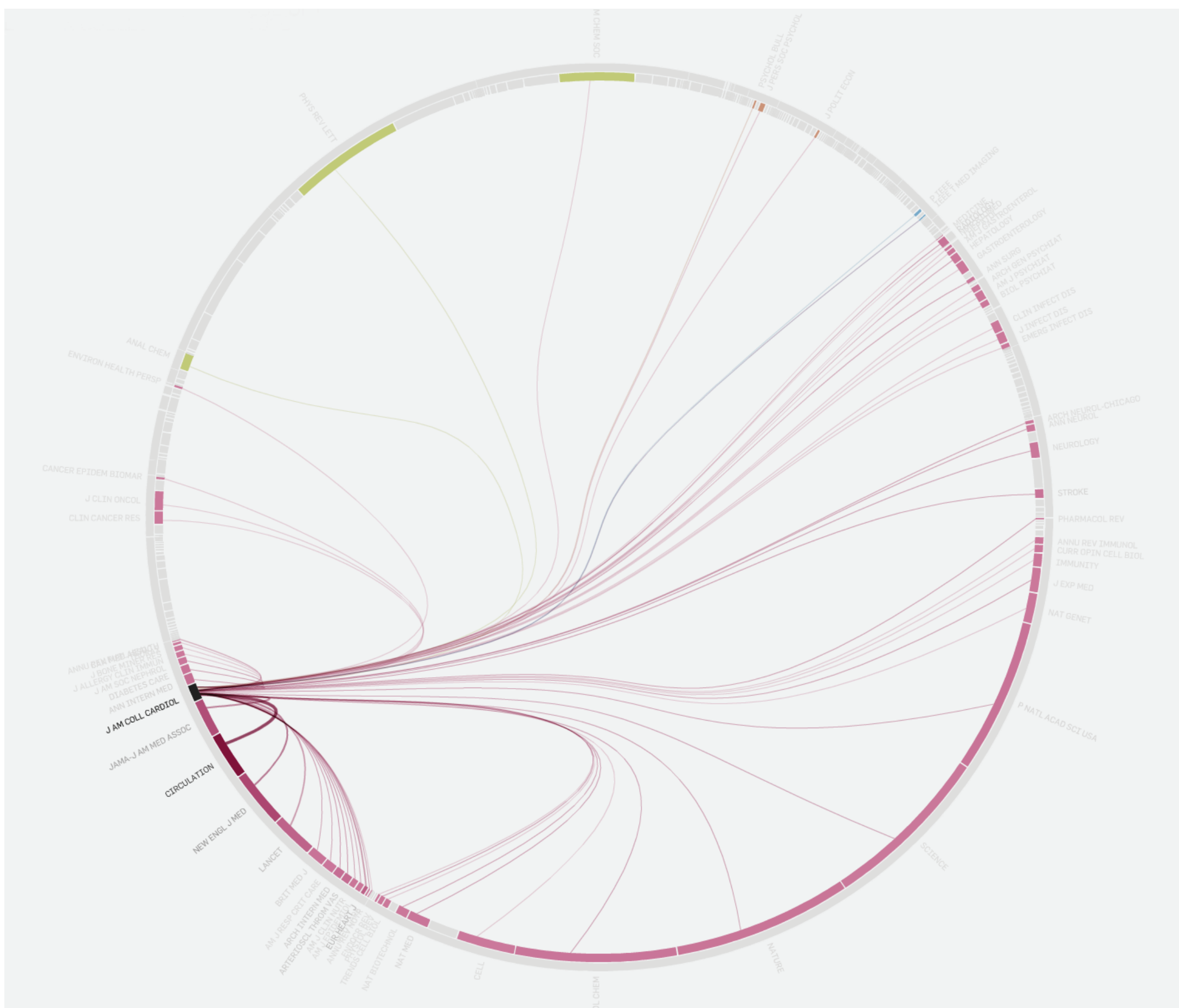
Results

Figure 1 present a visualization of the amount of citations from a) the Journal of the American College of Cardiology and b) the New England Journal of Medicine to the top 1000 journals in science and the total citation flow in c) the field of Medicine (as defined by [4]) and d) the top 1000 journals in science. Darker lines indicate larger amounts of citation flow.

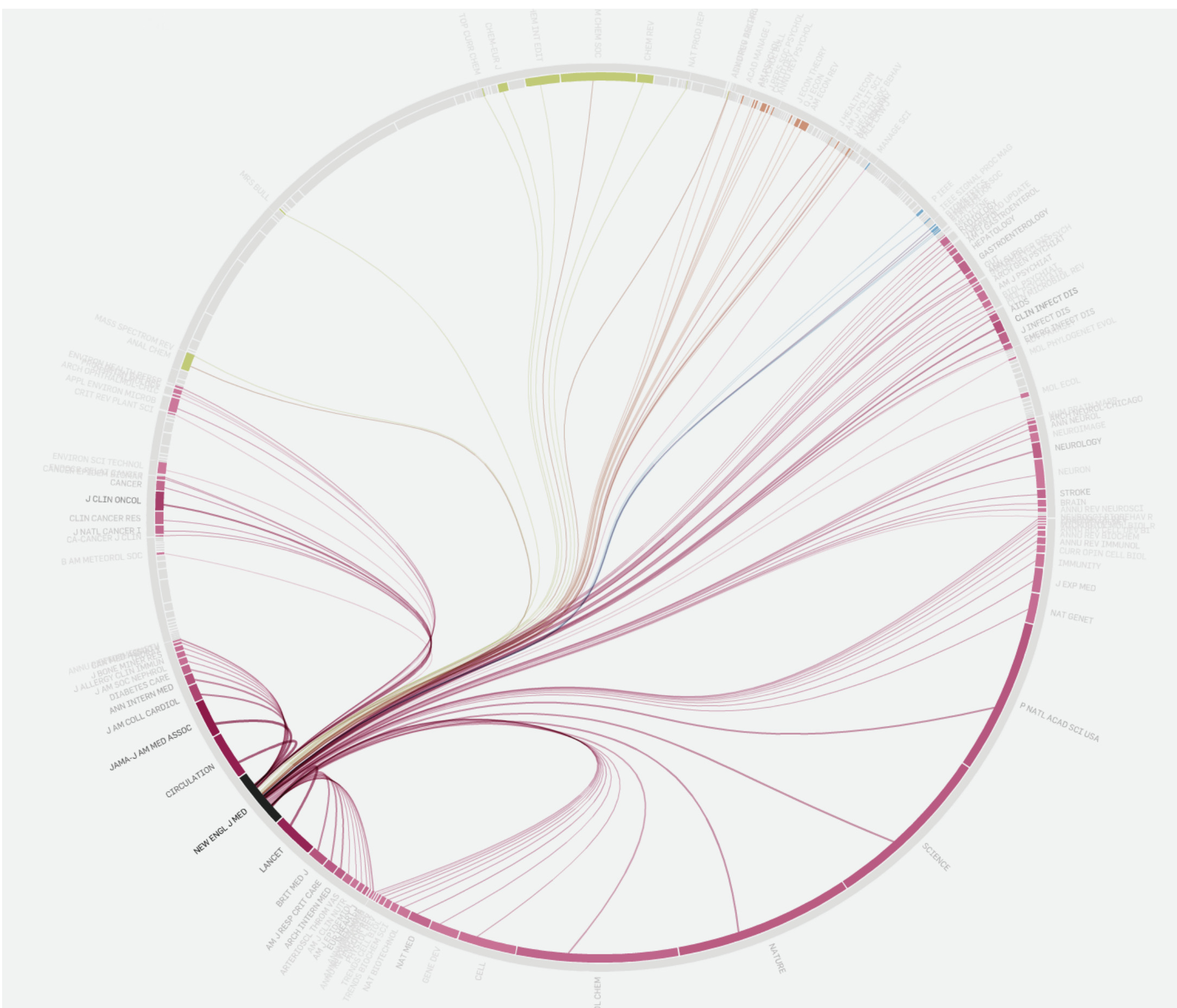
List I lists the top ten journals ranked by Eigenfactor score in a) JCR categories Cardiac & Cardiovascular Systems and Peripheral Vascular Disease, b) all of Medicine and c) all of science. Lists 2 & 3 display the differences in relative rankings between Impact Factor score and Article Influence score for the top 75 journals in all of medicine and for the top 75 journals in Cardiac & Cardiovascular Systems and Peripheral Vascular Disease.

The searchable full list of rankings is available online at <http://www.eigenfactor.org> as well as interactive visualizations at <http://well-formed.eigenfactor.org>.

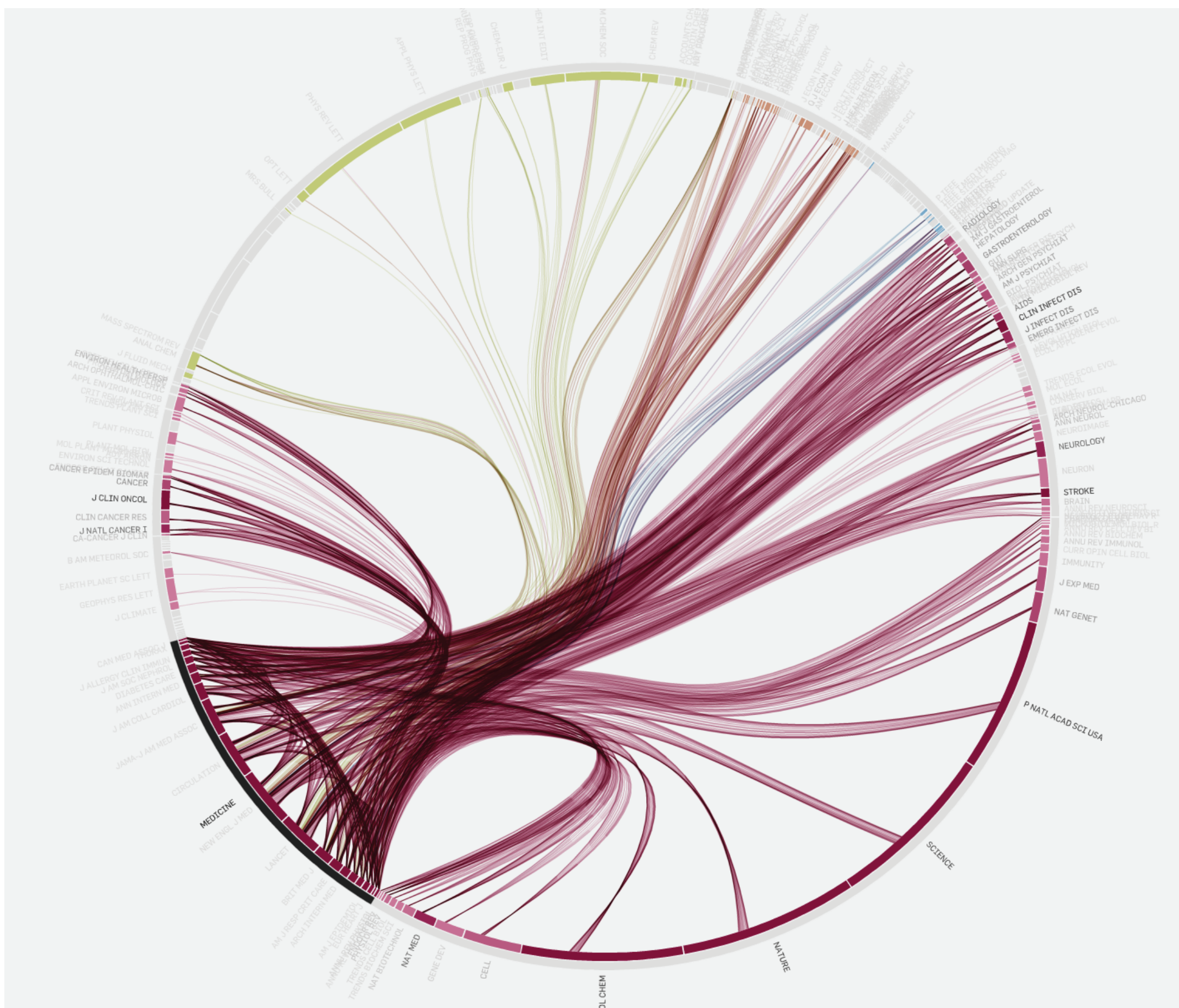
eigenfactor.org
ranking and mapping scientific knowledge



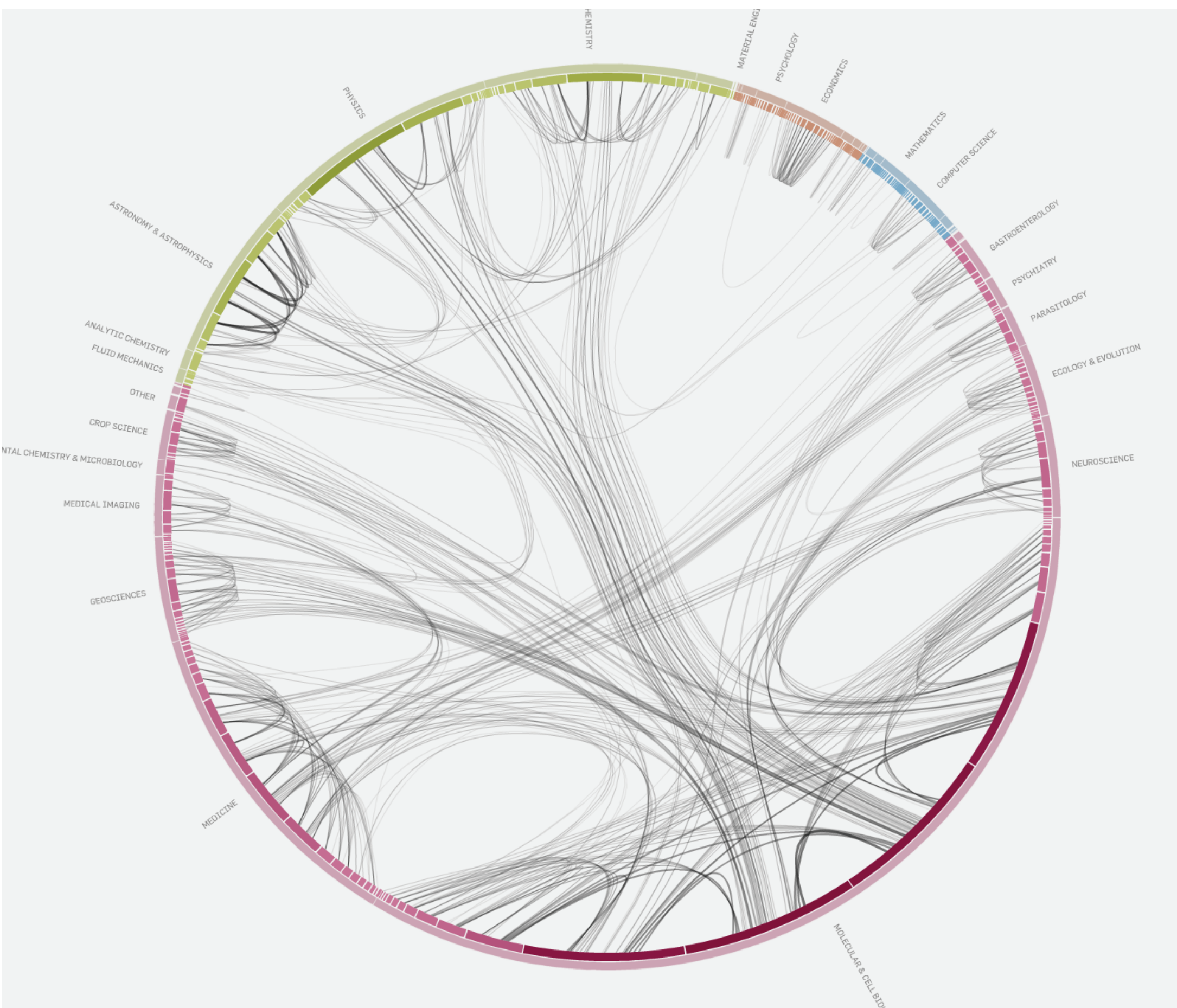
a) Journal of the ACC



b) New England Journal of Medicine



c) All of Medicine



d) All of Science

Figure 1: Radial diagrams of citation flow

List I

a) Cardiac & Cardiovasc. Sys. and Periph.Vasc. Dis.

1. Circulation
2. Journal OfThe American College of Cardiology
3. Circulation Research
4. Stroke
5. Arteriosclerosis Thrombosis and Vascular Biology
6. American Journal Of Cardiology
7. American Journal Of Physiology - Heart and Circulatory Physiology
8. Annals OfThoracic Surgery
9. Hypertension
10. European Heart Journal

b) Medicine

1. New England Journal of Medicine
2. Circulation
3. Lancet
4. Jama-Journal OfThe American Medical Association
5. Journal Of Clinical Oncology
6. Journal OfThe American College of Cardiology
7. British Medical Journal
8. Journal Of Clinical Endocrinology and Metabolism
9. Diabetes
10. Circulation Research

c) Science

1. Nature
2. Science
3. Proc. of the Nat.Acad. Sci. USA
4. Journal Of Biological Chemistry
5. Physical Review Letters
6. Journal OfThe American Chemical Society
7. Physical Review B
8. Applied Physics Letters
9. New England Journal of Medicine
10. Astrophysical Journal

List 2: Medicine Differences in Relative Ranking (2006 Data)

Impact Factor	Article Influence
CA-CANCER J CLIN	NEW ENGL J MED
NEW ENGL J MED	CA-CANCER J CLIN
LANCET	JAMA-J AM MED ASSOC
JAMA-J AM MED ASSOC	LANCET
J NATL CANCER I	CLIN MICROBIOL REV
ANN INTERN MED	PLOS MED
PLOS MED	ANN INTERN MED
J CLIN ONCOL	J NATL CANCER I
ANNU REV MED	LANCET INFECT DIS
CIRCULATION	CIRCULATION
LANCET INFECT DIS	ANNU REV MED
CIRCULATION	ANNU REV NUTR
ANNU REV NUTR	CIRC RES
CIRC RES	HEALTH TECHNOL ASSES
J CLIN ONCOL	J CLIN ONCOL
J AM COLL CARDIOL	BRIT MED J
BRIT MED J	J AM COLL CARDIOL
AM J RESP CRIT CARE	BRIT MED J
ALLERGY CLIN IMMUN	ARCH INTERN MED
DIABETES	HEART RHYTHM
CLIN PHARMACOL THER	AM J RESP CRIT CARE
DIABETES	MILBANK Q
ARCH INTERN MED	ARTERIOSCL THROM VAS
DIABETES CARE	ARCH DIS CHILD-FETAL
ANN SURG	AM J EPIDEMIOL
J AM SOC NEPHROL	EUR HEART J
EUR HEART J	ANN SURG
PHARMACOGENETICS	DIABETES CARE
ARTERIOSCL THROM VAS	ANNU REV PUBL HEALTH
CAN MED ASSOC J	EPIDEMIOL REV
ANNU REV PUBL HEALTH	EMERG INFECT DIS
AM J TRANSPLANT	J AM SOC NEPHROL
MILBANK Q	AM J CLIN NUTR
HUM REPROD UPDATE	AIDS
J BONE MINER RES	J ALLERGY CLIN IMMUN
CRIT CARE MED	J BONE MINER RES
AM J CLIN NUTR	CLIN INFECT DIS
CLIN INFECT DIS	CAN MED ASSOC J
THORAX	THORAX
HYPERTENSION	HUM REPROD UPDATE
ATHEROSCLEROSIS SUPP	J INFECT DIS
CARDIOVASC RES	STROKE
J CLIN ENDOCR METAB	MED CARE
CURR OPIN LIPIDOL	CURR OPIN LIPIDOL
AIDS	INT J EPIDEMIOL
CLIN CHEM	EPIDEMIOLOGY
STROKE	AM J BIOETHICS
PHARMACOGENET GENOM	DIABETOLOGIA
J INFECT DIS	AM J PUBLIC HEALTH
ALLERGY	J CLIN ENDOCR METAB
HEALTH TECHNOL ASSES	AM J MED
DIABETOLOGIA	B WORLD HEALTH ORGAN
AM J EPIDEMIOL	J GEN INTERN MED
ONCOLOGIST	PHARMACOGENETICS
ANN ONCOL	HYPERTENSION
MEDICINE	CLIN CHEM
J THROMB HAEMOST	CLIN PHARMACOL THER
EMERG INFECT DIS	MEDICINE
EUR RESPIR J	LUNG CANCER
ANTIVIR THER	CARDIOVASC RES
J MOL CELL CARDIOL	PEDIATRICS
CURR OPIN INFECT DIS	HEALTH AFFAIR
KIDNEY INT	J MOL CELL CARDIOL
ARCH DIS CHILD-FETAL	AM J PREV MED
J INTERN MED	J GEN INTERN MED
BREAST CANCER RES TR	JAIDS JACQ HIV DEF
ANN MED	CANCER EPIDEM BIOMAR
CANCER	HIV MED
AM J MED	J THROMB HAEMOST
INT J EPIDEMIOL	ANN BEHAV MED
DRUGS	CANCER
INTENS CARE MED	HEALTH SERV RES
CANCER TREAT REV	EUR RESPIR J
EPIDEMIOLOGY	BONE
	AM J PHYSIOL-ENDOCR M
	CRIT CARE MED

List 3: Cardiac & Cardiovascular Systems and Peripheral Vascular Disease Differences in Relative Ranking (2006 Data)

Impact Factor	Article Influence
CIRCULATION	CIRCULATION
CIRC RES	CIRC RES
J AM COLL CARDIOL	J AM COLL CARDIOL
EUR HEART J	ARTERIOSCL THROM VAS
ARTERIOSCL THROM VAS	EUR HEART J
HYPERTENSION	STROKE
ATHEROSCLEROSIS SUPP	CURR OPIN LIPIDOL
CARDIOVASC RES	HYPERTENSION
CURR OPIN LIPIDOL	CARDIOVASC RES
STROKE	J MOL CELL CARDIOL
J THROMB HAEMOST	TRENDS CARDIOVASC MED
J MOL CELL CARDIOL	J THROMB HAEMOST
TRENDS CARDIOVASC MED	J THORAC CARDIOV SUR
J THORAC CARDIOV SUR	HEART
CURR OPIN NEPHROL HY	CURR OPIN NEPHROL HY
AM J HYPERTENS	AM HEART J
CURR VASC PHARMACOL	HEART RHYTHM
ATHEROSCLEROSIS	HEART FAIL REV
BASIC RES CARDIOL	ATHEROSCLEROSIS
AM J PHYSIOL-HEART C	AM J PHYSIOL-HEART C
J HYPERTENS	J HYPERTENS
CARDIOL CLIN	CARDIOL CLIN
AM J CARDIOL	AM J CARDIOL
J CARDIOVASC MAGN R	J CARDIOVASC MAGN R
CURR PROB CARDIOLOGY	J VASC SURG
SHOCK	THROMB HAEMOSTASIS
J VASC SURG	J CARD FAIL
ATHEROSCLEROSIS SUPP	ATHEROSCLEROSIS SUPP
J CARDIOVASC ELECTR	PROG CARDIOVASC DIS
EUR J HEART FAIL	CURR OPIN NEPHROL HY
HYPERTENS RES	MICROCIRCULATION
AM J HYPERTENS	J CARDIOVASC ELECTR
AM J CARDIOL	AM J HYPERTENS
J HUM HYPERTENS	J HEART LUNG TRANSPL
J HEART LUNG TRANSPL	HEART FAIL REV
HEART FAIL REV	THROMB HAEMOSTASIS
THROMB HAEMOSTASIS	CURR VASC PHARMACOL
CURR VASC PHARMACOL	J CARD FAIL
J CARD FAIL	SEMIN THROMB HEMOST
SEMIN THROMB HEMOST	NAT CLIN PRACT CARD
NAT CLIN PRACT CARD	J VASC RES
J VASC RES	PROG CARDIOVASC DIS
PROG CARDIOVASC DIS	MICROVASC RES
MICROVASC RES	J NUCL CARDIOL
J NUCL CARDIOL	MICROCIRCULATION
MICROCIRCULATION	J VASC INTERV RADIOL
J VASC INTERV RADIOL	ENDOTHELIUM J ENDOTH
ENDOTHELIUM J ENDOTH	ANN THORAC SURG
ANN THORAC SURG	INT J CARDIOL
INT J CARDIOL	REV ESP CARDIOL
REV ESP CARDIOL	EUR J VASC ENDOVASC
EUR J VASC ENDOVASC	J ENDOVASC THER
J ENDOVASC THER	EUR J CARDIO-THORAC
EUR J CARDIO-THORAC	RESP MED
RESP MED	THROMB RES
THROMB RES	J HUM HYPERTENS
J HUM HYPERTENS	J HEART VALVE DIS
J HEART VALVE DIS	J AM SOC ECHOCARDIOG
J AM SOC ECHOCARDIOG	CATHETER CARDIO INTE
CATHETER CARDIO INTE	KIDNEY BLOOD PRESS R
KIDNEY BLOOD PRESS R	NUTR METAB CARDIOVASC
NUTR METAB CARDIOVASC	CARDIOLOGY
CARDIOLOGY	J CARDIOVASC MAGN R
J CARDIOVASC MAGN R	CARDIOVASC DRUG REV
CARDIOVASC DRUG REV	J AM SOC ECHOCARDIOG
J AM SOC ECHOCARDIOG	J CARDIOVASC PHARM
J CARDIOVASC PHARM	CATHETER CARDIO INTE
CATHETER CARDIO INTE	CORONARY ARTERY DIS
CORONARY ARTERY DIS	EUR HEART J SUPPL
EUR HEART J SUPPL	EUROPACE
EUROPACE	CARDIOL CLIN
CARDIOL CLIN	BLOOD PRESS MONIT
BLOOD PRESS MONIT	CORONARY INTER RAD
CORONARY INTER RAD	CAN J CARDIOL
CAN J CARDIOL	ANN NONINVAS ELECTRO
ANN NONINVAS ELECTRO	CURR CONTR TRIALS C
CURR CONTR TRIALS C	NUTR METAB CARDIOVAS

Conclusions

We present the Eigenfactor score and the Article Influence score as novel measures of journal influence.The Article Influence score is comperable to Thomson Reuters Impact Factor and can be used by academic physicians seeking to publish in the most influential journals.

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Acknowledgements

The authors would like to thank Moritz Stefaner for creating the radial graphs used in Figure 1.

¹Santa Fe Institute, Santa Fe, NM

²Department of Biology, University of Washington, Seattle, WA