Intro and Hypothesis

The world wide web contains a network of web pages that are interconnected in many different ways. Wikipedia itself is its own network of a vast collection of different topics, ideas, and other entries. Our goal was to find an interesting hypothesis to analyze that dealt with this network of pages within Wikipedia. An initial path of thought was that almost all Wikipedia pages are connected in some way. This means that if each Wikipedia page was a node on a graph, almost the graph would be connected if the edges between nodes were links from one Wikipedia page to another. An even more specific idea was that all pages on Wikipedia formed a connected graph if one just uses edges only for the first accessible in-text link on each Wikipedia page.

After some further searching, we discovered a hypothesis centered around the idea that the Philosophy page is reachable by almost any given starting Wikipedia page by only traversing through pages by clicking the first in-text link on each page. It seems intuitive that the Philosophy page could potentially be reached by almost any starting page from any link on the page, but only accessing the first link to do the same does not seem as easily possible. When researching this further we came up with the following hypothesis: In Wikipedia it is theoretically possible to reach the Philosophy page by just clicking on the first link on every page from **97%** of all Wikipedia pages. We also found estimates suggesting that it takes a **median of 23 clicks** to get from a starting page to the Philosophy page. We decided to test this hypothesis by going through a representative sample of the (approximately) 29 million English Wikipedia pages and storing their paths to Philosophy in graph form. We then wanted to check the median path size after starting at a random selection of pages. We also wanted to look at what we have designated as “funnels”, which are nodes that more than one inward edge passing through them towards Philosophy.

We decided to further develop this project in the implementation side by building a basic UI that would allow users to choose any exit node (Philosophy in our study) and then find paths from any source node to this exit node as well as path lengths. The UI would also let users find funnels after running multiple paths and also generate a graph (with visuals) of all paths generated. A final feature of the UI would be the ability for a user to generate a random graph in a similar way to the analysis we were performing for this project.

Implementation

In order to run the analysis, we first developed a “Graph” class which uses nodes from a “Node” class to represent a graph of nodes in an adjacency list form. We then built a “Scraper” class which would go through each Wikipedia page starting from a source node. At each page the scraper finds the first link to another Wikipedia page that is in the text body on the page (not the sidebar information). The scraper then accesses the next page through that link and adds it to the graph as a new node. This process continues until reaching the Philosophy page and the graph is populated with all the nodes found along the path from the source node to Philosophy. We also incorporated checks to stop when cycles are found if a source does not lead to Philosophy. We also wanted to be able to see the graphs produced by our analysis, so we implemented a graph visualization tool using a Java library called GraphStream. A feature was also included that would allow us to output the adjacency list representation of the graph, as well as the list of funnels, as a text file. Another thing we wanted to implement was a way to find distances between any node and philosophy, not just source nodes from created paths. To achieve this we implemented a BFS algorithm that would work with our graph.

For the UI implementation we first created a window where users could specify the end node by providing a link to a Wikipedia page. Then, the user is able to submit queries of source Wikipedia page links. When running the tool, the user UI will display all previous queries as well as the length of their respective paths to the end node. During each query, the entire path is displayed until the next query is run. We also implemented a way for the user to find the "funnels" after running as many queries as desired by opening a new window that displays the funnels and the number of inward edges each funnel has. The graph display feature was also added that will display a visual of the graph containing the paths from all queries to the exit node. The random graph button on the UI was implemented to mimic our analysis that we conducted by generating a random graph from a random selection of Wikipedia pages. This was achieved by accessing the built in Wikipedia link on the website that redirects to a random page.

Analysis Setup

We ran some early trial runs with the code we implemented to make sure everything was working the way we wanted. Initially, we found that every page was following the same path to Philosophy with each path length around 28-29 nodes traversed. After further investigation we realized that every page was getting directed through a path that contained a language of origin such as Greek, Latin, or French. This was not ideal for our analysis as each source node ended up having essentially the same path through a page like "Greek" or "Ancient Greek Language". This problem made sense because we were using only pages that contained English words, and most words from the English language have an origin in languages like Greek or Latin. This problem was further emphasized by the Wikipedia page structure in which any pages with terms that were not proper nouns had the language of origin for the word or terms in parentheses at the beginning of the text body. Due to the prominence of this issue and how it made the analysis uninteresting, we decided to ignore these links for languages of origin and they were removed from our scraper. This meant the scraper would instead go to the next link outside of the initial parentheses containing language of origin in each Wikipedia page.

As stated above, we utilized the Wikipedia feature of a random page redirect link to find random pages to use as source nodes. We decided to run 10 tests of 50 pages each that would create a new graph each time. This gave us 500 randomized source node samples and also made sure the program would not take too long to run or send too many requests in a short period of time to Wikipedia, also ensuring that Wikipedia would not block our computers from accessing the website.

Analysis

After running the analysis as specified above, the data was put into an excel file (see attached "analysis data" excel file). First, we took a look at all the distances from the source node to Philosophy and found that some had distances of zero. These Wikipedia links were checked to verify that these zeros were not due to errors. Nodes with distances of less than 5 were also checked at their respective Wikipedia links and verified, changed to zero, or removed. After cleaning the distance data, only 2 source pages were removed, resulting in a total of 498 samples. The funnel data is recorded in a different tab in the same excel sheet. Each of the 10 graphs produced a list of funnels as well as their number of inward edges towards Philosophy. The 10 graphs from the analysis trials are included at the end of the report.

The final analysis results had a mean distance of about 17 nodes, **median distance of 17 nodes**, a max distance of 41, standard deviation of around 6.2, and a resulting **97.8%** of source nodes having a successful path to Philosophy.

Discussion

When looking at the pages with zero distances, it was interesting to note that they usually fell into two categories: surnames or some type of list. Both of these types of pages are represented on Wikipedia in such a way that the initial paragraph of text that we counted for the first link either does not really exist or does not have any links contained in it. The other pages that followed this result for a zero distance usually were names of people that had short pages with little to no text in the initial paragraph. One of the more interesting sources with a zero distance was the page of Billie Jean King's career statistics (https://en.wikipedia.org/wiki/Billie_Jean_King_career_statistics) which ended up producing a cycle given our method of taking the first link. The reason this happens is that Billie Jean King's page leads to the world number one women's tennis rankings page, leading to the Women's Tennis Association page. Coincidentally enough, Billie Jean King happens to be the founder of the Women's Tennis Association where the first link on the page redirects back to Billie Jean King, creating the cycle. This was the only cycle we found in our data, indicating that these such cycles are rare (estimated at about 1/500 or around 0.2% given our data).

The next point of interest are the funnels found in each graph. The trend in the funnels are usually general words of subject such as Science, Mathematics, Physics, Knowledge, etc. This makes sense because pages that would have common paths would have a higher chance of being similar if they had similar general underlying concepts, such as Basketball leading to Game Theory, Probability or Math, and something like Financial Markets also leading to Probability or Math. There are a few more specific funnels that appeared, such as Sport, Association Football, Rock Music, and Canada, but these are not as important as they are due to the random page search producing two very similar pages in the same category. These funnels also tend to exist much farther apart from the rest of the funnels and also farther from Philosophy when looking at the graphs. What is most significant is that Physics, Science, Psychology, Language, Linguistics, and Knowledge are in almost every graph as a funnel. The explanation behind this is intuitive, as eventual any source page will get to some sort of topic that boils down to a these general topics that are pillars of subject matter. These funnels are also more concentrated together in each graph and tend to appear closer to Philosophy, indicating that they are more significant than the other funnels.

Something that is noticeable in almost every graph is that there is a path through Philosophy that doesn't usually contain any paths branching away. On every graph, Philosophy appears to partition the graph into two distinct parts if it were removed. A further look reveals that one of the parts is consistently much larger than the other. If you path is traversed outward from Philosophy towards the larger part, you always end up at the Knowledge funnel. This means that Knowledge could also be used as an exit node in an analysis and would most likely produce similar results to using Philosophy as the exit node, although it may be slightly less successful if the source nodes cut off from removing Philosophy would not have a path to Knowledge. Knowledge being an important node/funnel also is plausible in this graph given that the subjects of Knowledge and Philosophy are both closely related.

Finally, the hypothesis. Based on the results of our analysis the hypothesis is supported. We found a slightly higher percentage than the hypothesis for the amount of pages that would have a successful path. The median is also actually lower, which is actually better than the hypothesis, so it is safe to say the median from the hypothesis is at least supported in the worst case. While we only ran this with 500 samples, we would expect running our analysis on more pages would also support the hypothesis.

Conclusion

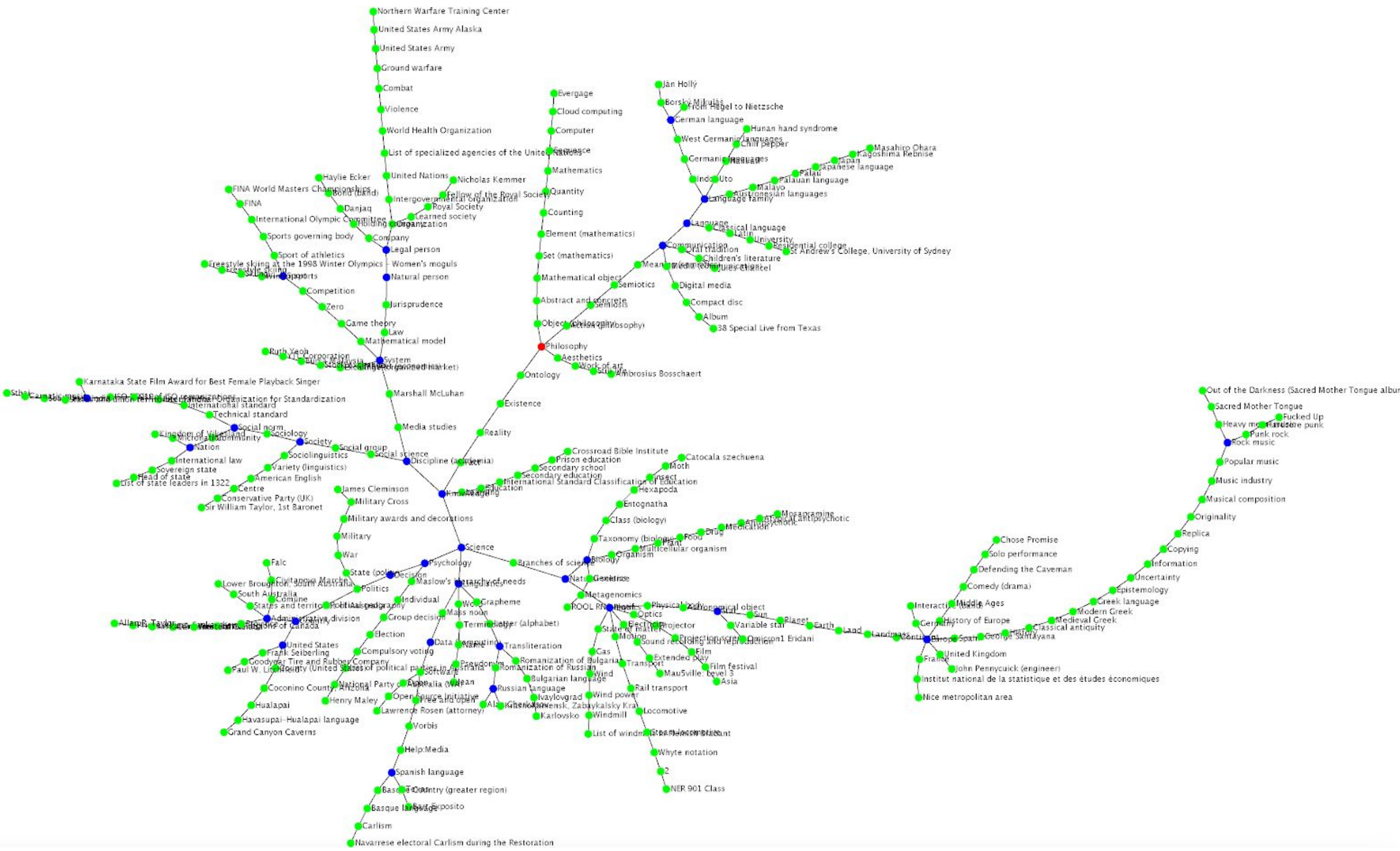
We conclude that our original hypothesis of 97% of Wikipedia pages having a path to Philosophy by clicking the first link, with a median path length of 23 clicks, is supported (actually better in the case of median clicks equal to 17). It is interesting that nearly all pages have some path to Philosophy in Wikipedia following these rules, and that there are similar pages that could produce the same effect, like Knowledge. We also built a simplified UI that will allow users to run our analysis on random Wikipedia pages, as well as test this concept out on any page the choose, even for different exit nodes.

Graphs from Analysis

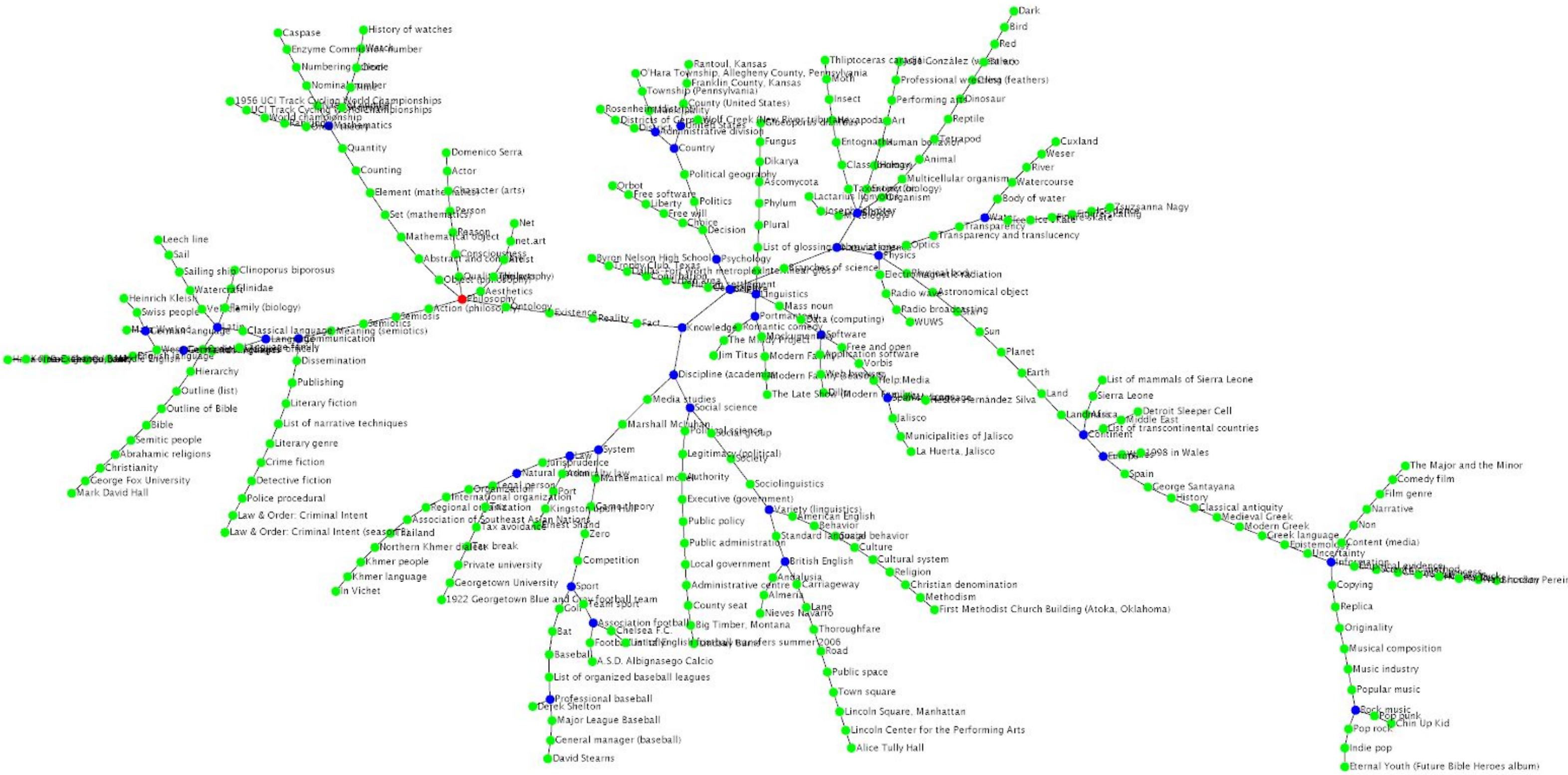
(Red Node is Philosophy, Blue Nodes are Funnels)

Graph 1

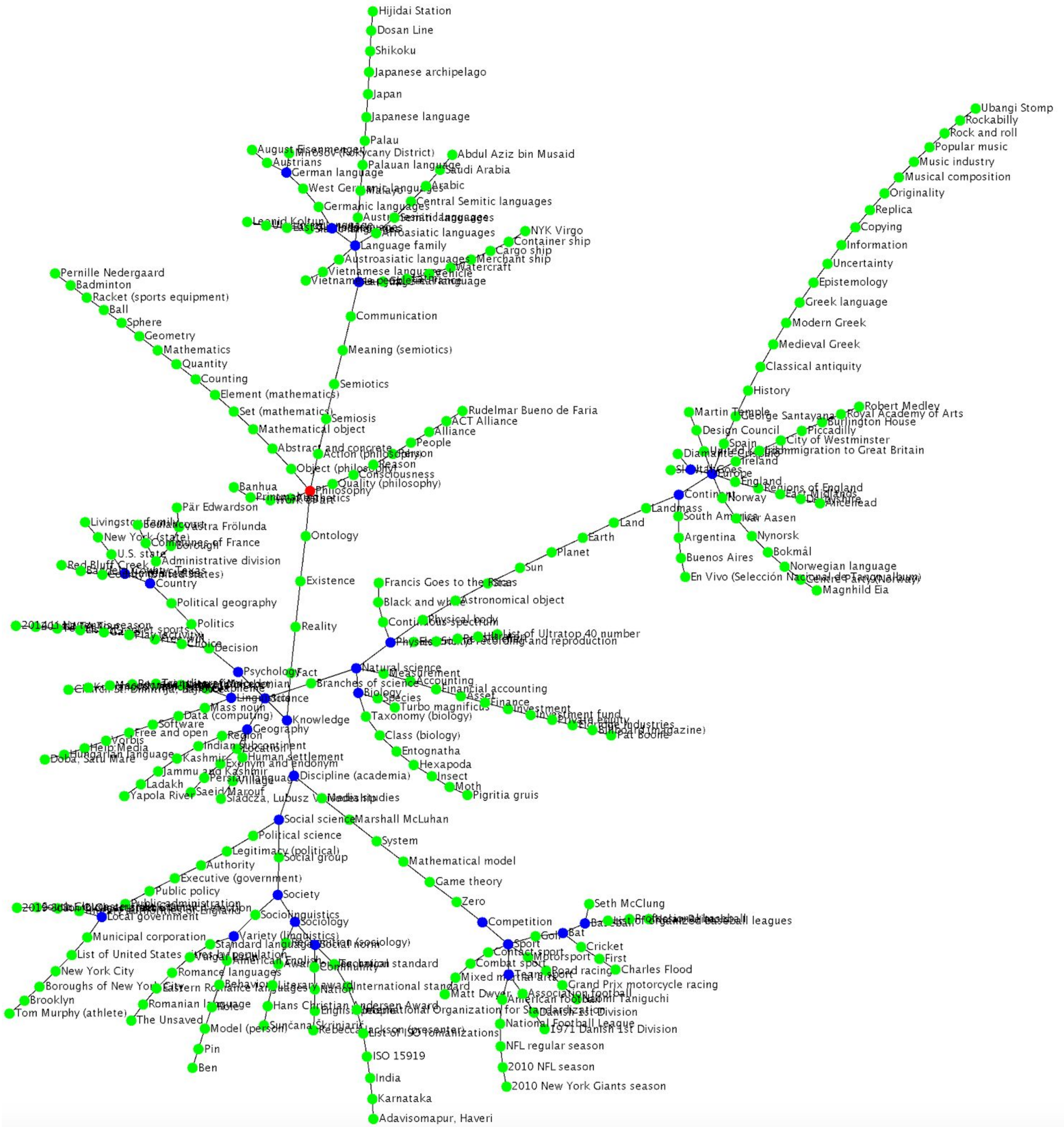
Graph 2


Northern Warfare Training Center
United States Army Alaska
United States Army
Ground warfare
Combat
Violence
World Health Organization
List of specialized agencies of the United Nations
United Nations
Intergovernmental organization
Nicholas Kemmer
Fellow of the Royal Society
Royal Society
Learned society
Haylie Ecker
FINA World Masters Championships
FINA
International Olympic Committee
Sports governing body
Sport of athletics
Danjaq
Company
Legal person
Natural person
Jurisprudence
Law
Competition
Zero
Game theory
Mathematical model
System
Ruth Yeoh
Corporation
Marshall McLuhan
Media studies
Karnataka State Film Award for Best Female Playback Singer
International Organization for Standardization
International standard
Technical standard
Social norm
Sociology
Society
Social group
Social science
Kingdom of Vikesland
Nation
International law
Sovereign state
Head of state
List of state leaders in 1322
Sociolinguistics
Variety (linguistics)
American English
Centre
Conservative Party (UK)
Sir William Taylor, 1st Baronet
Discipline (academia)
Knowledge
Evergage
Cloud computing
Computer
Mathematics
Quantity
Counting
Element (mathematics)
Set (mathematics)
Mathematical object
Abstract and concrete
Object (philosophy)
Action (philosophy)
Philosophy
Aesthetics
Work of art
Ambrosius Bosschaert
Ontology
Existence
Reality
Ján Hollý
Borský Mikuláš
From Hegel to Nietzsche
German language
West Germanic languages
Germanic languages
Hunan hand syndrome
Chili pepper
Masahiro Ohara
Kagoshima Rebnise
Japan
Japanese language
Palau
Palauan language
Malayo
Austronesian languages
Language family
Language
Classical language
Latin
University
Residential college
St Andrew's College, University of Sydney
Communication
Oral tradition
Children's literature
Semiotics
Digital media
Compact disc
Album
38 Special Live from Texas
Crossroad Bible Institute
Prison education
Secondary school
Secondary education
International Standard Classification of Education
Catocala szechuena
Moth
Insect
Hexapoda
Entognatha
Class (biology)
Taxonomy (biology)
Plant
Food
Drug
Medication
Typical antipsychotic
Mosapramine
Organism
Multicellular organism
Biology
Genetics
Metagenomics
Natural science
Branches of science
Science
James Cleminson
Military Cross
Military awards and decorations
Military
War
State (polity)
Decision
Psychology
Maslow's hierarchy of needs
Linguistics
Falc
Politics
Lower Broughton, South Australia
South Australia
Commune
States and territories of Australia
Political geography
Administrative division
Individual
Group decision
Grapheme
Letter (alphabet)
Mass noun
Terminology
Election
Compulsory voting
Data
Transliteration
Romanization of Bulgarian
Romanization of Russian
Bulgarian language
Russian language
Ivaylovgrad
Krasnokamensk, Zabaykalsky Krai
Karlovsko
United States
Frank Seiberling
Goodyear Tire and Rubber Company
Paul W. Litchfield
Coconino County, Arizona
Hualapai
Havasupai–Hualapai language
Grand Canyon Caverns
National Party of Australia
Henry Maley
Open Source Initiative
Free and open
Lawrence Rosen (attorney)
Vorbis
Help:Media
Spanish language
Basque Country (greater region)
Basque language
Carlism
Navarrese electoral Carlism during the Restoration
ROOL RNA
Physical body
Optics
Astronomical object
Variable star
Sun
Planet
Earth
Land
Landmass
State of matter
Projector
Sound recording and reproduction
Gas
Motion
Extended play
Film
Film festival
Transport
MauSville, Level 3
Asia
Wind
Wind power
Windmill
Rail transport
Locomotive
Whyte notation
NER 901 Class
Out of the Darkness (Sacred Mother Tongue album)
Sacred Mother Tongue
Heavy metal music
Hardcore punk
Punk rock
Rock music
Popular music
Music industry
Musical composition
Originality
Replica
Copying
Information
Uncertainty
Epistemology
Greek language
Modern Greek
Medieval Greek
Classical antiquity
George Santayana
Chose Promise
Solo performance
Defending the Caveman
Comedy (drama)
Middle Ages
History of Europe
Germany
Europe
Spain
France
United Kingdom
John Pennycuick (engineer)
Institut national de la statistique et des études économiques
Nice metropolitan area

Graph 3

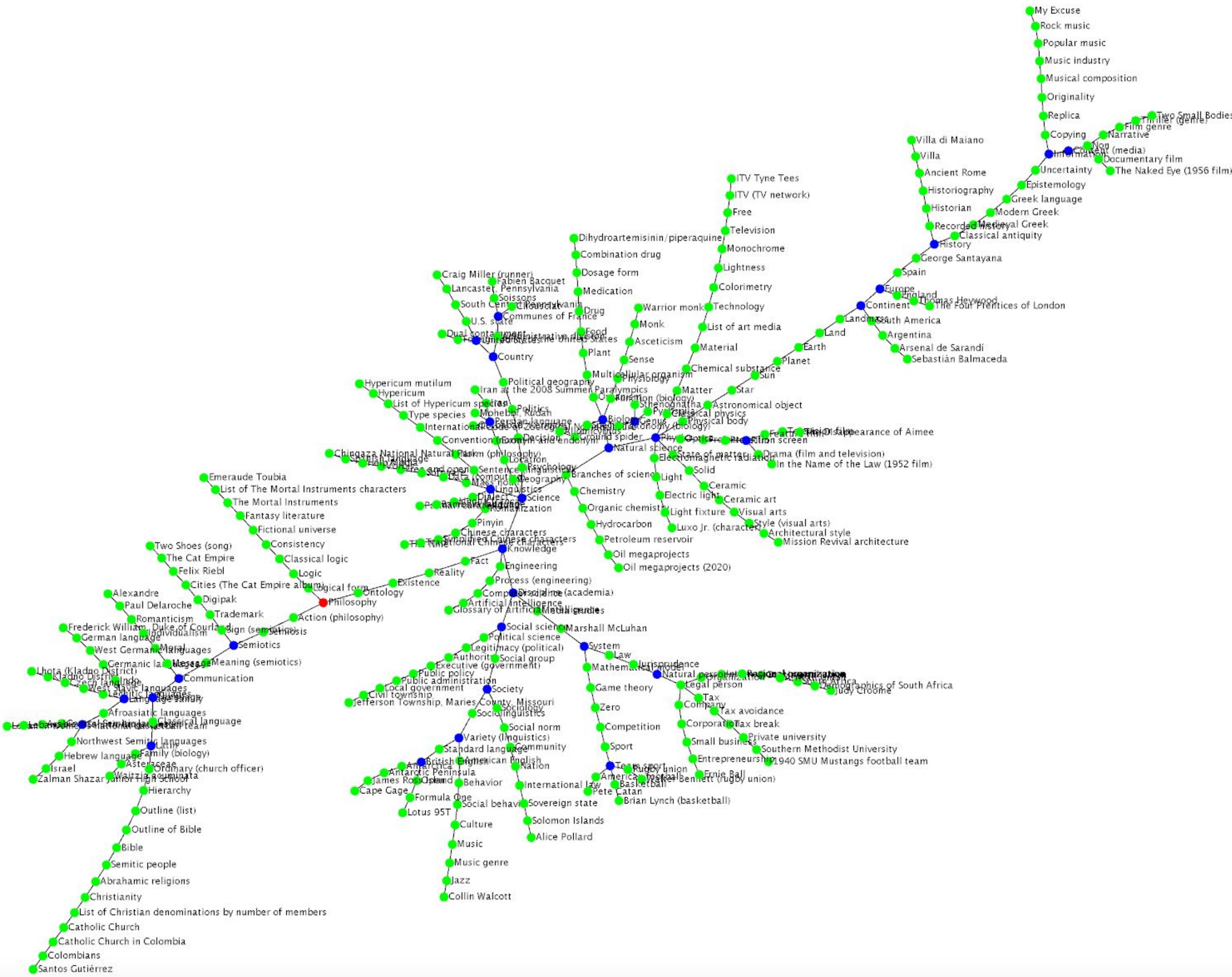


Graph 4

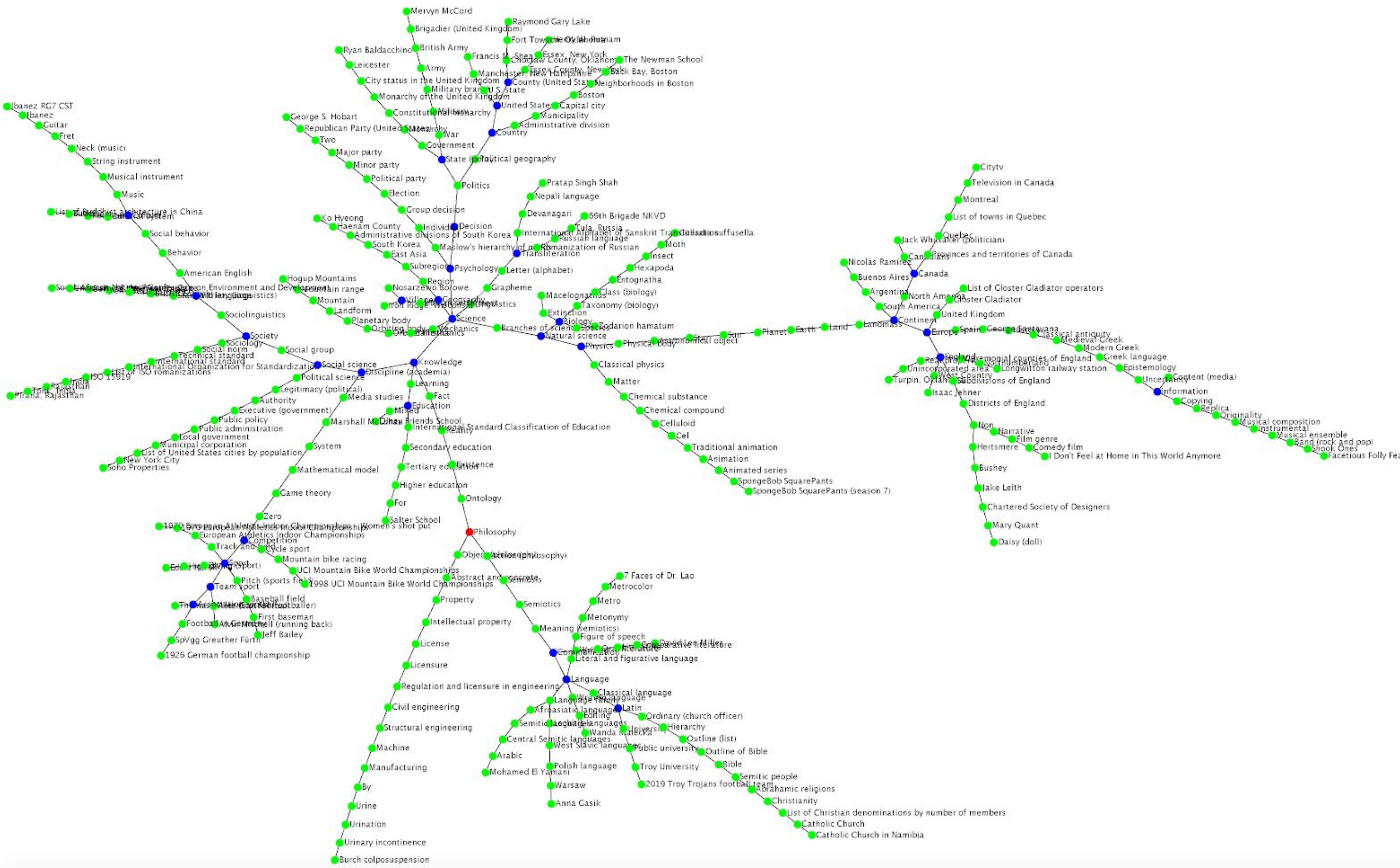


Hijidai Station
Dosan Line
Shikoku
Japanese archipelago
Japan
Japanese language
Palau
Palauan language
Abdul Aziz bin Musaid
Saudi Arabia
Arabic
Central Semitic languages
Semitic languages
Afroasiatic languages
Austrians
German language
West Germanic languages
Germanic languages
Language family
NYK Virgo
Container ship
Cargo ship
Merchant ship
Watercraft
Vehicle
Austroasiatic languages
Vietnamese language
Communication
Meaning (semiotics)
Semiotics
Semiosis
Pernille Nedergaard
Badminton
Racket (sports equipment)
Ball
Sphere
Geometry
Mathematics
Quantity
Counting
Element (mathematics)
Set (mathematics)
Mathematical object
Abstract and concrete
Object (philosophy)
Rudelmar Bueno de Faria
ACT Alliance
Alliance
People
Person
Reason
Consciousness
Quality (philosophy)
Philosophy
Banhua
Pär Edwardson
Västra Frölunda
Communes of France
New York (state)
U.S. state
Borough
Administrative division
Country
Political geography
Politics
Decision
Ontology
Existence
Reality
Fact
Psychology
Ubangi Stomp
Rockabilly
Rock and roll
Popular music
Music industry
Musical composition
Originality
Replica
Copying
Information
Uncertainty
Epistemology
Greek language
Modern Greek
Medieval Greek
Classical antiquity
History
George Santayana
Robert Medley
Royal Academy of Arts
Burlington House
Piccadilly
City of Westminster
Design Council
Spain
Immigration to Great Britain
Ireland
England
Regions of England
Norway
Landmass
Ivar Aasen
Land
Earth
Argentina
Nynorsk
Planet
Buenos Aires
Bokmål
Norwegian language
Sun
Magnhild Eia
Black and white
Astronomical object
Physical body
List of Ultratop 40 number
Natural science
Measurement
Branches of science
Accounting
Financial accounting
Species
Turbo magnificus
Finance
Investment
Investment fund
Taxonomy (biology)
Class (biology)
Entognatha
Hexapoda
Insect
Moth
Pigritia gruis
Mass noun
Knowledge
Data (computing)
Software
Free and open
Geography
Region
Vorbis
Help:Media
Indian subcontinent
Human settlement
Kashmir
Exonym and endonym
Jammu and Kashmir
Ladakh
Yapola River
Saeid Marouf
Discipline (academia)
Social science
Marshall McLuhan
Political science
System
Legitimacy (political)
Social group
Authority
Mathematical model
Executive (government)
Game theory
Public policy
Zero
Society
Seth McClung
Local government
Sociolinguistics
Competition
Sociology
Bat
Municipal corporation
Variety (linguistics)
Sport
Cricket
List of United States cities by population
Contact sport
Motorsport
First
Technical standard
Combat sport
Road racing
Charles Flood
New York City
Romance languages
Grand Prix motorcycle racing
International standard
Boroughs of New York City
Literary award
Matt Dwyer
Association football
Naomi Taniguchi
Brooklyn
Behavior
Nation
American football
Hans Christian Andersen Award
Romanian language
Role
Tom Murphy (athlete)
International Organization for Standardization
Danish 1st Division
The Unsaved
National Football League
List of ISO romanizations
1971 Danish 1st Division
Model (person)
NFL regular season
Pin
ISO 15919
2010 NFL season
Ben
India
2010 New York Giants season
Karnataka
Adavisomapur, Haveri

Graph 5

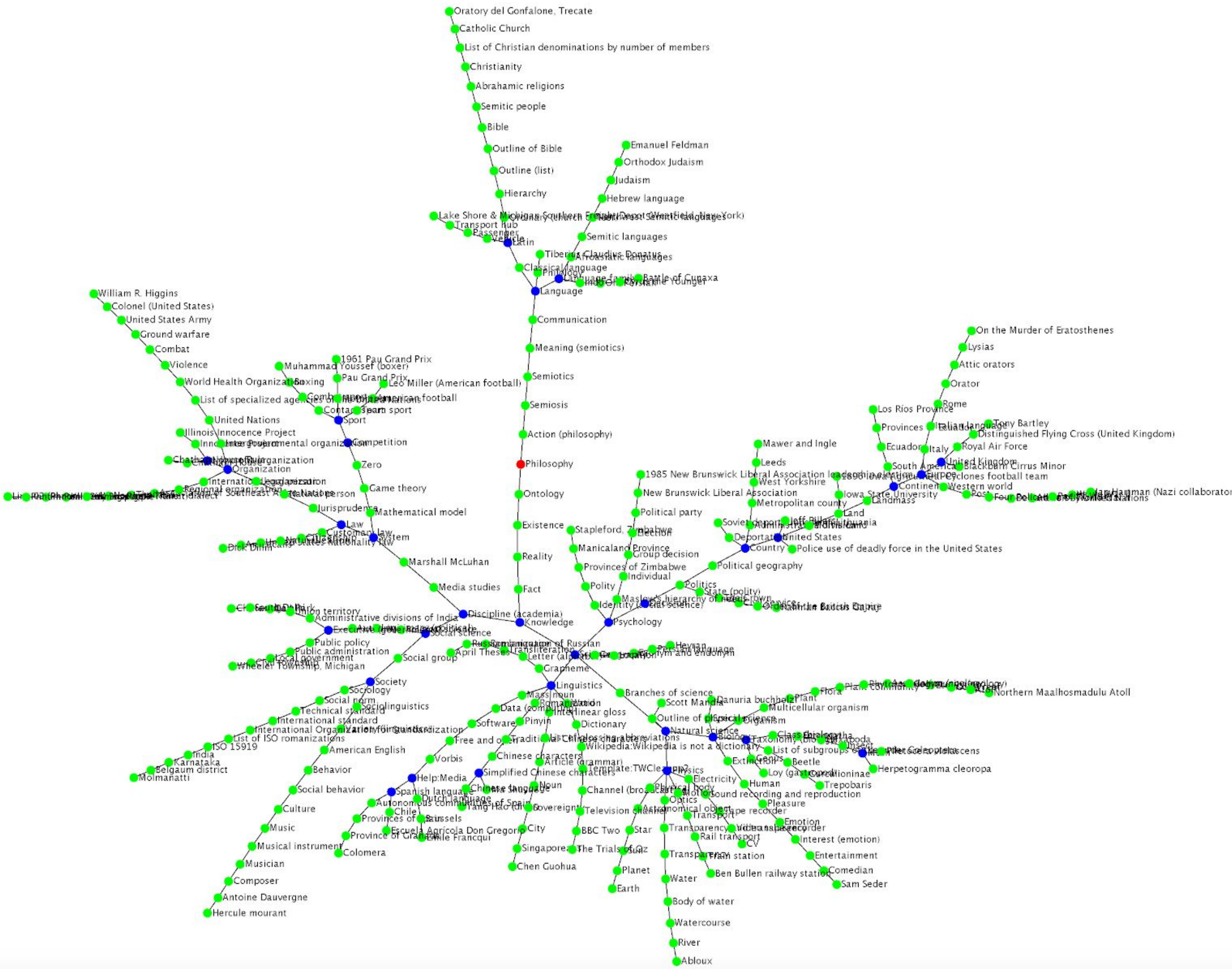

My Excuse
Rock music
Popular music
Music industry
Musical composition
Originality
Replica
Copying
Two Small Bodies
Film genre
Narrative
Documentary film
The Naked Eye (1956 film)
Uncertainty
Epistemology
Greek language
Modern Greek
Classical antiquity
Villa di Maiano
Villa
Ancient Rome
Historiography
Historian
History
George Santayana
Spain
Europe
England
The Four Prentices of London
Continent
South America
Argentina
Arsenal de Sarandí
Sebastián Balmaceda
Land
Earth
Planet
Sun
Star
Astronomical object
ITV Tyne Tees
ITV (TV network)
Free
Television
Monochrome
Lightness
Colorimetry
Technology
List of art media
Material
Chemical substance
Matter
Dihydroartemisinin/piperaquine
Combination drug
Dosage form
Medication
Drug
Food
Plant
Warrior monk
Monk
Asceticism
Sense
Physiology
Craig Miller (runner)
Fabien Bacquet
Lancaster, Pennsylvania
Soissons
Communes of France
U.S. state
Country
Political geography
Hypericum mutilum
Hypericum
List of Hypericum species
Type species
Natural science
Electromagnetic radiation
Drama (film and television)
In the Name of the Law (1952 film)
Solid
Light
Ceramic
Electric light
Ceramic art
Light fixture
Visual arts
Luxo Jr. (character)
Style (visual arts)
Architectural style
Mission Revival architecture
Branches of science
Chemistry
Organic chemistry
Hydrocarbon
Petroleum reservoir
Oil megaprojects
Oil megaprojects (2020)
Emeraude Toubia
List of The Mortal Instruments characters
The Mortal Instruments
Fantasy literature
Fictional universe
Consistency
Classical logic
Logic
Logical form
Philosophy
Action (philosophy)
Ontology
Existence
Reality
Fact
Knowledge
Engineering
Process (engineering)
Discipline (academia)
Artificial intelligence
Linguistics
Science
Pinyin
Chinese characters
Two Shoes (song)
The Cat Empire
Felix Riebl
Cities (The Cat Empire album)
Digipak
Trademark
Alexandre
Paul Delaroche
Romanticism
Individualism
German language
West Germanic languages
Semiotics
Meaning (semiotics)
Communication
Afroasiatic languages
Classical language
Northwest Semitic languages
Hebrew language
Family (biology)
Asteraceae
Ordinary (church officer)
Israel
Zalman Shazar Junior High School
Hierarchy
Outline (list)
Outline of Bible
Bible
Semitic people
Abrahamic religions
Christianity
List of Christian denominations by number of members
Catholic Church
Catholic Church in Colombia
Colombians
Santos Gutiérrez
Social science
Marshall McLuhan
Political science
Legitimacy (political)
Social group
Executive (government)
Public policy
Public administration
Local government
Civil township
Jefferson Township, Maries County, Missouri
Society
Sociolinguistics
Social norm
Variety (linguistics)
Community
Standard language
Antarctic Peninsula
Cape Cage
Formula One
Lotus 95T
Behavior
Social behavior
Culture
Music
Music genre
Jazz
Collin Walcott
International law
Sovereign state
Solomon Islands
Alice Pollard
System
Law
Jurisprudence
Natural person
Legal person
Tax
Company
Tax avoidance
Tax break
Private university
Southern Methodist University
1940 SMU Mustangs football team
Small business
Entrepreneurship
Demographics of South Africa
Judy Croome
Game theory
Zero
Competition
Sport
Team sport
Rugby union
Basketball
Pete Catan
Brian Lynch (basketball)

Graph 6



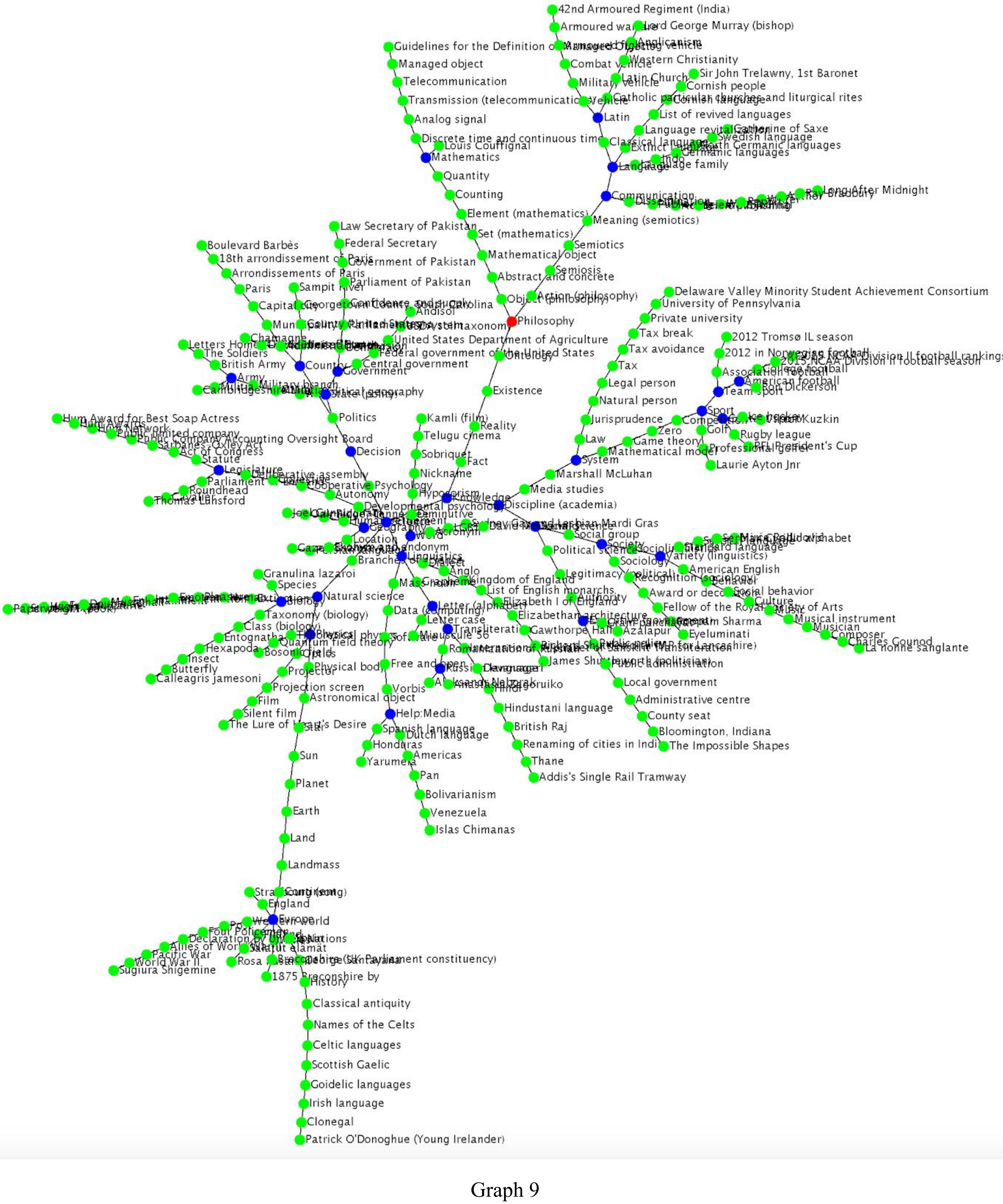
Mervyn McCord
Brigadier (United Kingdom)
British Army
Army
Raymond Gary Lake
Ryan Baldacchino
Leicester
City status in the United Kingdom
Monarchy of the United Kingdom
Constitutional monarchy
Military branch
U.S. state
United States
County (United States)
Capital city
Boston
Back Bay, Boston
Neighborhoods in Boston
The Newman School
Municipality
Administrative division
Country
State (polity)
Political geography
Government
War
Politics
George S. Hobart
Republican Party (United States)
Two
Major party
Minor party
Political party
Election
Group decision
Decision
Ibanez RG7 CST
Ibanez
Guitar
Fret
Neck (music)
String instrument
Musical instrument
Music
Social behavior
Behavior
American English
Sociolinguistics
Society
Sociology
Social norm
Social group
Technical standard
International standard
International Organization for Standardization
List of ISO romanizations
ISO 15919
Social science
Political science
Legitimacy (political)
Authority
Executive (government)
Public policy
Public administration
Local government
Municipal corporation
List of United States cities by population
New York City
Soho Properties
Ko Hyeong
Haenam County
Administrative divisions of South Korea
South Korea
East Asia
Subregion
Region
Psychology
Maslow's hierarchy of needs
Hogup Mountains
Mountain range
Mountain
Landform
Planetary body
Science
Knowledge
Discipline (academia)
Learning
Fact
Education
Media studies
Marshall McLuhan
System
Mathematical model
Game theory
Zero
Secondary education
Tertiary education
Higher education
For
Salter School
Existence
Ontology
Philosophy
International Standard Classification of Education
Pratap Singh Shah
Nepali language
Devanagari
69th Brigade NKVD
Tula, Russia
Russian language
Romanization of Russian
Transliteration
Letter (alphabet)
Grapheme
Moth
Insect
Hexapoda
Entognatha
Class (biology)
Taxonomy (biology)
Macelognathus
Extinction
Biology
Natural science
Physics
Physical body
Astronomical object
Sun
Planet
Earth
Land
Landmass
Continent
Classical physics
Matter
Chemical substance
Chemical compound
Celluloid
Cel
Traditional animation
Animation
Animated series
SpongeBob SquarePants
SpongeBob SquarePants (season 7)
Citytv
Television in Canada
Montreal
List of towns in Quebec
Quebec
Provinces and territories of Canada
Canada
Nicolás Ramírez
Buenos Aires
Argentina
North America
South America
List of Closter Gladiator operators
Closter Gladiator
United Kingdom
Europe
Spain
Classical antiquity
Medieval Greek
Modern Greek
Greek language
Epistemology
Uncertainty
Content (media)
Information
Copying
Replica
Originality
Musical composition
Instrumental
Musical ensemble
Band (rock and pop)
Shook Ones
Facetious Folly Feat
England
Unincorporated area
West Country
Turpin, Oklahoma
Subdivisions of England
Longwitton railway station
Isaac Jenner
Districts of England
Non
Narrative
Film genre
Comedy film
I Don't Feel at Home in This World Anymore
Hertsmere
Bushey
Jake Leith
Chartered Society of Designers
Mary Quant
Daisy (doll)
European Athletics Indoor Championships
Competition
Track and field
Cycle sport
Mountain bike racing
UCI Mountain Bike World Championships
1998 UCI Mountain Bike World Championships
Team sport
Pitch (sports field)
Baseball field
First baseman
Jeff Bailey
Football
SpVgg Greuther Fürth
1926 German football championship
Object (philosophy)
Abstract and concrete
Property
Intellectual property
License
Licensure
Regulation and licensure in engineering
Civil engineering
Structural engineering
Machine
Manufacturing
By
Urine
Urination
Urinary incontinence
Burch colposuspension
Semiotics
7 Faces of Dr. Lao
Metrocolor
Metro
Metonymy
Meaning (semiotics)
Figure of speech
Literal and figurative language
Language
Classical language
Latin
Afroasiatic languages
Semitic languages
Central Semitic languages
Arabic
Mohamed El Yamani
West Slavic languages
Polish language
Warsaw
Anna Gasik
Ordinary (church officer)
Hierarchy
Outline (list)
Public university
Troy University
2019 Troy Trojans football team
Outline of Bible
Bible
Semitic people
Abrahamic religions
Christianity
List of Christian denominations by number of members
Catholic Church
Catholic Church in Namibia

Graph 7

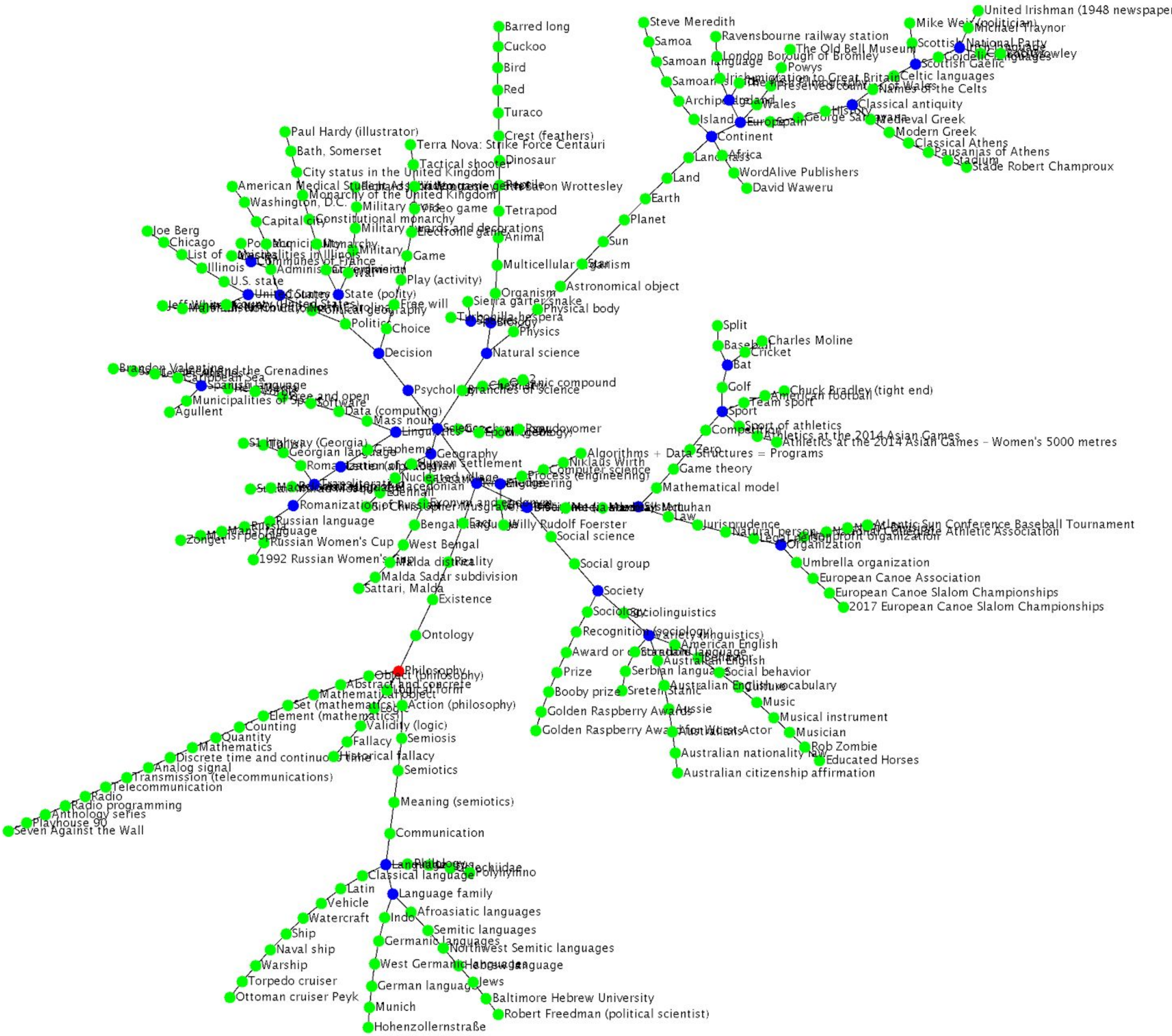


Oratory del Gonfalone, Trecate
Catholic Church
List of Christian denominations by number of members
Christianity
Abrahamic religions
Semitic people
Bible
Outline of Bible
Outline (list)
Hierarchy
Emanuel Feldman
Orthodox Judaism
Judaism
Hebrew language
Transport hub
Passenger
Latin
Semitic languages
Tiberius Claudius Donatus
Classical language
Philology
Language
Communication
Meaning (semiotics)
Semiotics
Semiosis
Action (philosophy)
Philosophy
Ontology
Existence
Reality
Fact
Knowledge
Discipline (academia)
Media studies
Marshall McLuhan
Mathematical model
Game theory
Zero
Competition
Sport
Contact sport
1961 Pau Grand Prix
Pau Grand Prix
Leo Miller (American football)
Muhammad Youssef (boxer)
Boxing
William R. Higgins
Colonel (United States)
United States Army
Ground warfare
Combat
Violence
World Health Organization
United Nations
Illinois Innocence Project
Organization
Jurisprudence
Law
System
Administrative divisions of India
Public policy
Public administration
Local government
Wheeler Township, Michigan
Social group
Social science
Society
Sociology
Social norm
Sociolinguistics
Technical standard
International standard
International Organization for Standardization
List of ISO romanizations
ISO 15919
India
Karnataka
Belgaum district
Molmanatti
American English
Behavior
Social behavior
Culture
Music
Musical instrument
Musician
Composer
Antoine Dauvergne
Hercule mourant
Help:Media
Spanish language
Autonomous communities of Spain
Provinces of Spain
Province of Granada
Colomera
Escuela Agricola Don Gregorio
Chile
Brussels
Dutch language
Vorbis
Software
Free and open
Data (computing)
Pinyin
Chinese characters
Simplified Chinese characters
Traditional Chinese characters
Singapore
Chen Guohua
City
Sovereignty
Noun
Article (grammar)
Interlinear gloss
Dictionary
Wikipedia:Wikipedia is not a dictionary
Template:TWCleanup2
Channel (broadcasting)
Television channel
BBC Two
The Trials of Oz
Star
Sun
Planet
Earth
Linguistics
Grapheme
Letter (alphabet)
Transliteration
April Theses
Romanization of Russian
Branches of science
Natural science
Outline of physical science
Physics
Electricity
Physical body
Optics
Astronomical object
Transparency
Water
Body of water
Watercourse
River
Abloux
Transport
Rail transport
Train station
Ben Bullen railway station
Sound recording and reproduction
Tape recorder
Videotape recorder
Biology
Taxonomy (biology)
Multicellular organism
Plant
Flora
Northern Maalhosmadulu Atoll
Scott Manda
Danuria buchholzi
Organism
Extinction
Human
Emotion
Pleasure
Interest (emotion)
Entertainment
Comedian
Sam Seder
Genus
Beetle
Trepobaris
Herpetogramma cleoropa
Psychology
Identity (social science)
Maslow's hierarchy of needs
Individual
Group decision
Election
Polity
Provinces of Zimbabwe
Manicaland Province
Stapleford, Zimbabwe
Politics
State (polity)
Political geography
Country
United States
Police use of deadly force in the United States
Deportation
Land
Landmass
Metropolitan county
West Yorkshire
Leeds
Mawer and Ingle
Political party
New Brunswick Liberal Association
1985 New Brunswick Liberal Association leadership election
Iowa State University
Continent
South America
Ecuador
Provinces
Los Ríos Province
Italy
Rome
Orator
Attic orators
Lysias
On the Murder of Eratosthenes
Italian language
Royal Air Force
Distinguished Flying Cross (United Kingdom)
Tony Bartley
United Kingdom
Blackburn Cirrus Minor
Cyclones football team
Western world
Post

Graph 8



Graph 9



United Irishman (1948 newspaper)
Steve Meredith
Mike Weir (politician)
Michael Traynor
Ravensbourne railway station
Barred long
Samoa
Scottish National Party
The Old Bell Museum
Cuckoo
Samoan language
London Borough of Bromley
Scottish Gaelic
Bird
Powys
Celtic languages
Red
Names of the Celts
Archipelago
Wales
Classical antiquity
Turaco
Island
Medieval Greek
Paul Hardy (illustrator)
Crest (feathers)
Continent
Modern Greek
Terra Nova: Strike Force Centauri
Bath, Somerset
Classical Athens
Dinosaur
Africa
Pausanias of Athens
Tactical shooter
Stadium
City status in the United Kingdom
Stade Robert Champroux
WordAlive Publishers
Land
Monarchy of the United Kingdom
David Waweru
Washington, D.C.
Video game
Tetrapod
Earth
Capital city
Constitutional monarchy
Planet
Joe Berg
Animal
Chicago
Monarchy
Game
Sun
Illinois
Multicellular organism
Communes of France
U.S. state
Play (activity)
Astronomical object
Organism
State (polity)
Free will
Sierra garter snake
Physical body
Choice
Physics
Split
Decision
Natural science
Charles Moline
Cricket
Bat
Golf
Chuck Bradley (tight end)
American football
Team sport
Sport
Sport of athletics
Data (computing)
Mass noun
Athletics at the 2014 Asian Games – Women's 5000 metres
Municipalities of Spain
Agullent
Algorithms + Data Structures = Programs
Niklaus Wirth
Georgian language
Geography
Game theory
Human settlement
Computer science
Process (engineering)
Mathematical model
Romanization of Russian
Willy Rudolf Foerster
Russian language
Social science
Law
Jurisprudence
Atlantic Sun Conference Baseball Tournament
Russian Women's Cup
Organization
1992 Russian Women's Cup
Bengal
West Bengal
Malda district
Umbrella organization
Malda Sadar subdivision
European Canoe Association
Social group
Sattari, Malda
European Canoe Slalom Championships
Existence
2017 European Canoe Slalom Championships
Society
Sociolinguistics
Ontology
Recognition (sociology)
Variety (linguistics)
American English
Philosophy
Australian English
Object (philosophy)
Prize
Social behavior
Abstract and concrete
Booby prize
Mathematical object
Music
Action (philosophy)
Golden Raspberry Awards
Aussie
Musical instrument
Counting
Validity (logic)
Musician
Quantity
Fallacy
Semiosis
Rob Zombie
Mathematics
Australian nationality law
Educated Horses
Discrete time and continuous time
Historical fallacy
Analog signal
Australian citizenship affirmation
Semiotics
Transmission (telecommunications)
Telecommunication
Radio
Radio programming
Meaning (semiotics)
Anthology series
Playhouse 90
Seven Against the Wall
Communication
Polyhymno
Classical language
Latin
Language family
Vehicle
Afroasiatic languages
Watercraft
Indo
Semitic languages
Ship
Germanic languages
Naval ship
Northwest Semitic languages
Warship
West Germanic languages
Hebrew language
Torpedo cruiser
German language
Jews
Ottoman cruiser Peyk
Baltimore Hebrew University
Munich
Robert Freedman (political scientist)
Hohenzollernstraße

Graph 10