IT'S A SMALL WORLD!

Manhattan School of Music

Upon the recommendation of the Faculty and by the authority of the

Board of Trustees, this Institution has conferred upon

Devon Carlisle Estes

the degree of

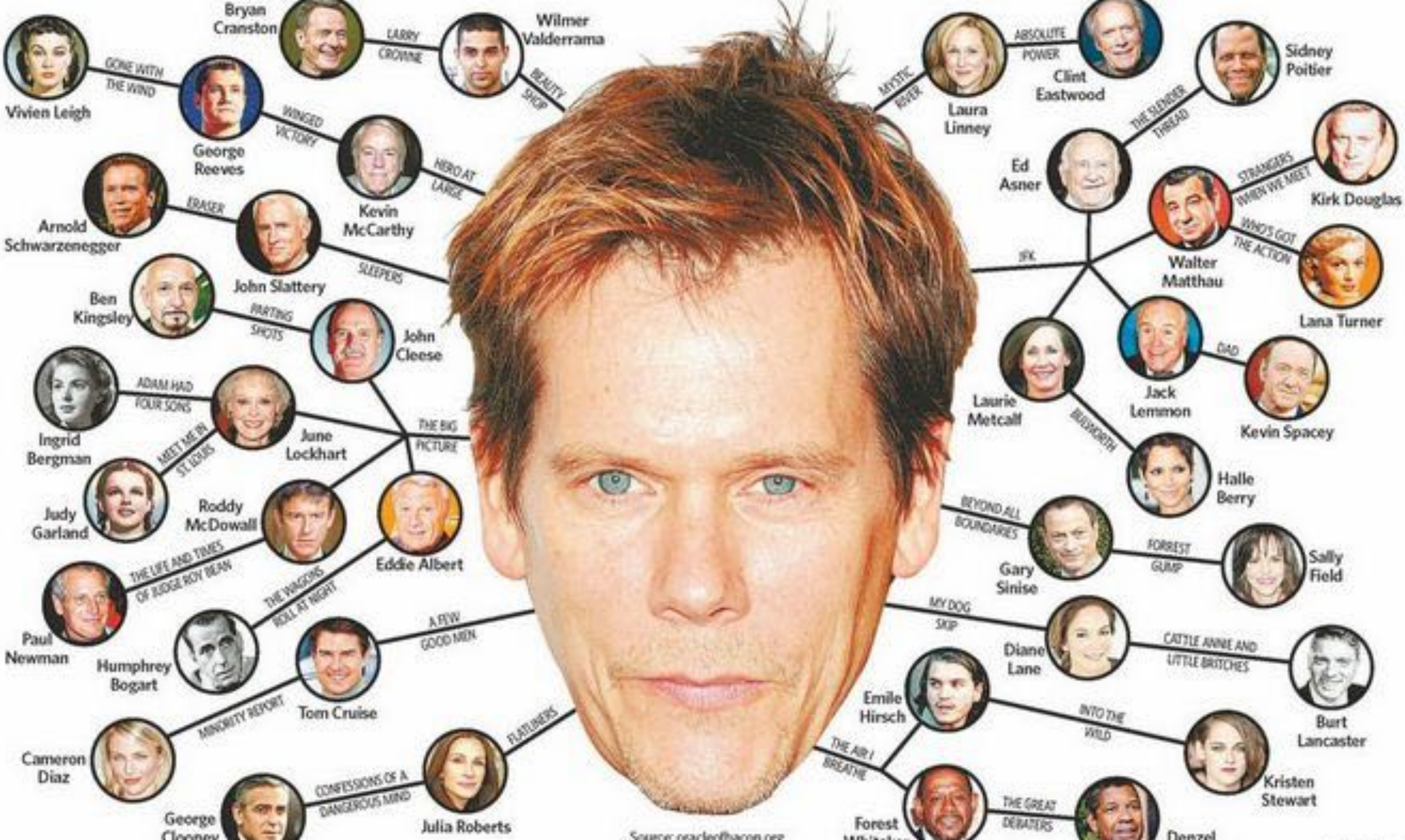
Master of Music

with all the rights, privileges and honors thereunto appertaining.

In witness whereof, the authorities of the Manhattan School of Music have affixed their signatures

this thirty-first day of May, two thousand and nine.

o2-de
12:48
74 %
Six Degrees
UNDISCOVERED
0:08
-32:29
UNDISCOVERED
30
30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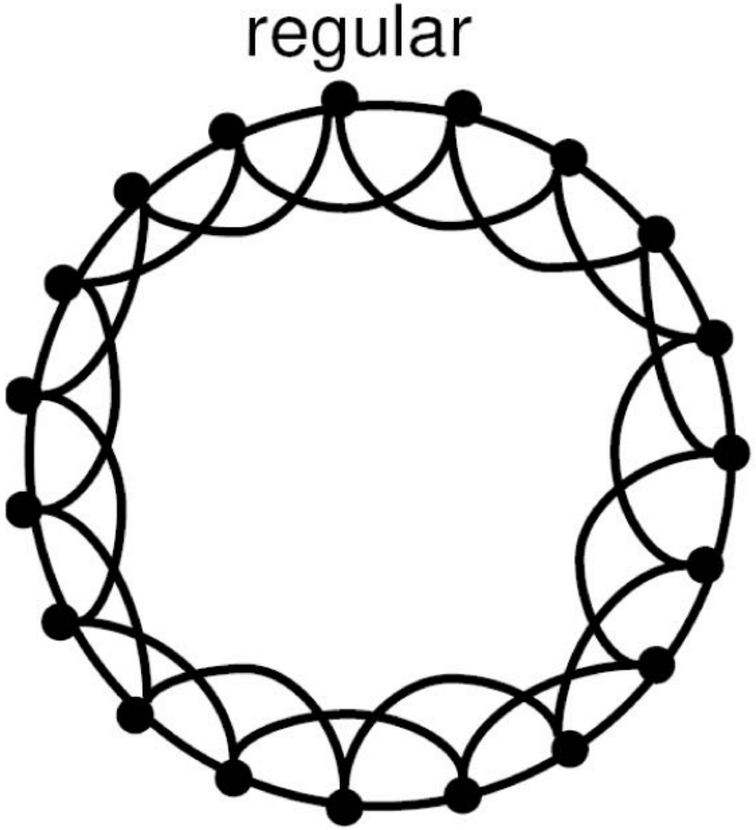
LARRY CROWNE
Wilmer Valderrama
BEAUTY SHOP
Vivien Leigh
GONE WITH THE WIND
George Reeves
WINGED VICTORY
Kevin McCarthy
HERO AT LARGE
Arnold Schwarzenegger
ERASER
John Slattery
SLEEPERS
Ben Kingsley
PARTING SHOTS
John Cleese
Ingrid Bergman
ADAM HAD FOUR SONS
June Lockhart
MEET ME IN ST. LOUIS
Judy Garland
THE BIG PICTURE
Roddy McDowall
Eddie Albert
THE LIFE AND TIMES OF JUDGE ROY BEAN
Paul Newman
THE WAGONS ROLL AT NIGHT
Humphrey Bogart
A FEW GOOD MEN
Tom Cruise
MINORITY REPORT
Cameron Diaz
CONFESSIONS OF A DANGEROUS MIND
George Clooney
FLATLINERS
Julia Roberts
MYSTIC RIVER
Laura Linney
ABSOLUTE POWER
Clint Eastwood
Sidney Poitier
THE SLENDER THREAD
Ed Asner
STRANGERS WHEN WE MEET
Kirk Douglas
JFK
Walter Matthau
WHO'S GOT THE ACTION
Lana Turner
Laurie Metcalf
Jack Lemmon
DAD
Kevin Spacey
BREWSTER
Halle Berry
BEYOND ALL BOUNDARIES
Gary Sinise
FORREST GUMP
Sally Field
MY DOG SKIP
Diane Lane
CATTLE ANNIE AND LITTLE BRITCHES
Burt Lancaster
Emile Hirsch
INTO THE WILD
Kristen Stewart
THE AIR I BREATHE
Forest
THE GREAT DEBATERS
Denzel
Source: oracleofbacon.org

Duncan Watts

Steven Strogatz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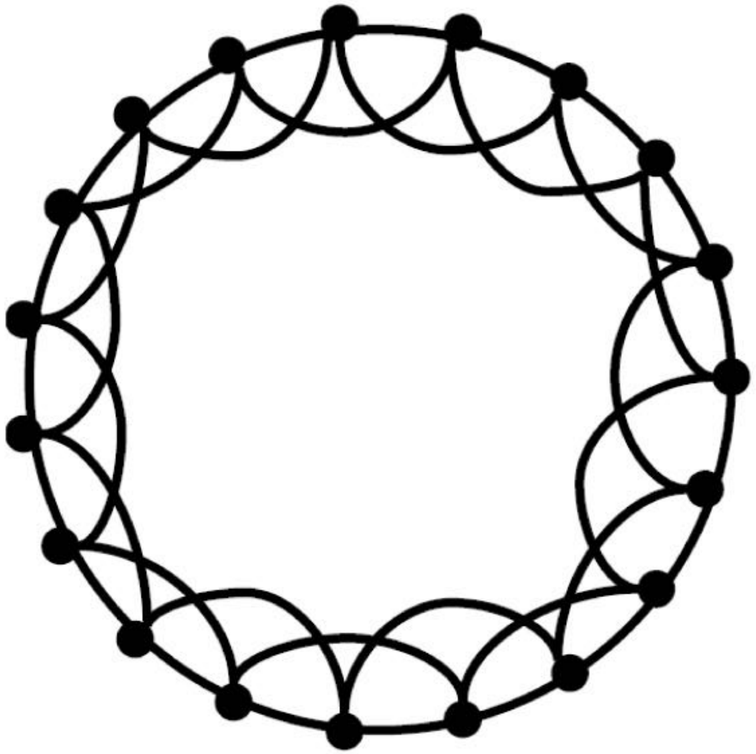
regular



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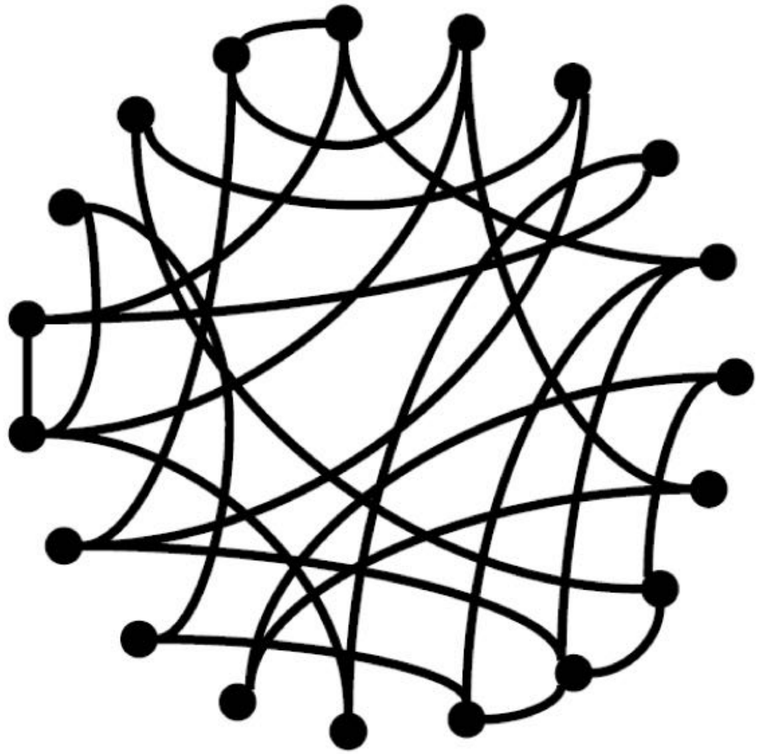

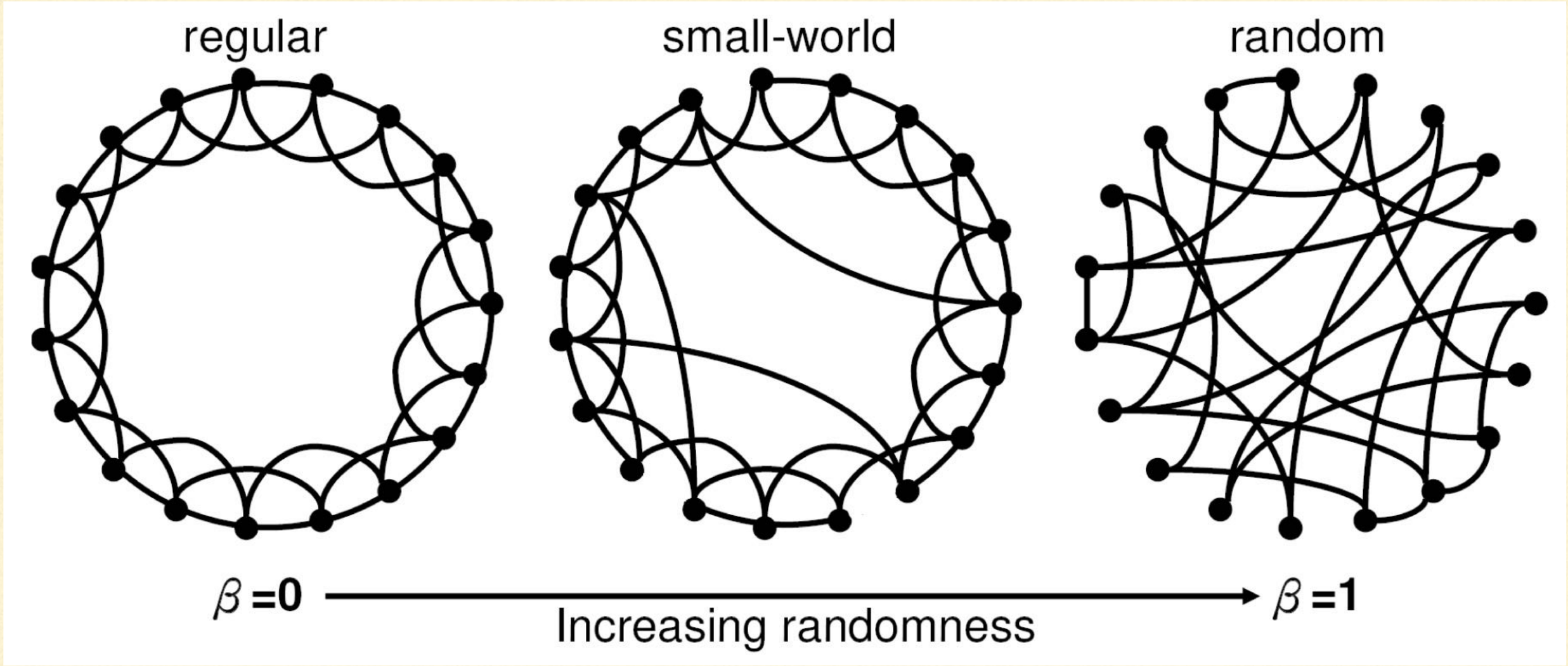
regular
small-world
random
β =0
β =1
Increasing randomness

CALCULATING A CLUSTERING COEFFICIENT

CALCULATING A CLUSTERING COEFFICIENT

$$C_i = \frac{2|\{e_{jk} : v_j, v_k \in N_i, e_{jk} \in E\}|}{k_i(k_i - 1)}.$$

CALCULATING A CLUSTERING COEFFICIENT

$$C_i = \frac{2|\{e_{jk} : v_j, v_k \in N_i, e_{jk} \in E\}|}{k_i(k_i - 1)}.$$

$$\bar{C} = \frac{1}{n}\sum_{i=1}^{n} C_i.$$

CALCULATING A CLUSTERING COEFFICIENT

$$C_i = \frac{2|\{e_{jk} : v_j, v_k \in N_i, e_{jk} \in E\}|}{k_i(k_i - 1)}.$$

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CALCULATING A CLUSTERING COEFFICIENT

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- For a single node:

CALCULATING A CLUSTERING COEFFICIENT

- For a single node:
  - How many neighbors do I have?

CALCULATING A CLUSTERING COEFFICIENT

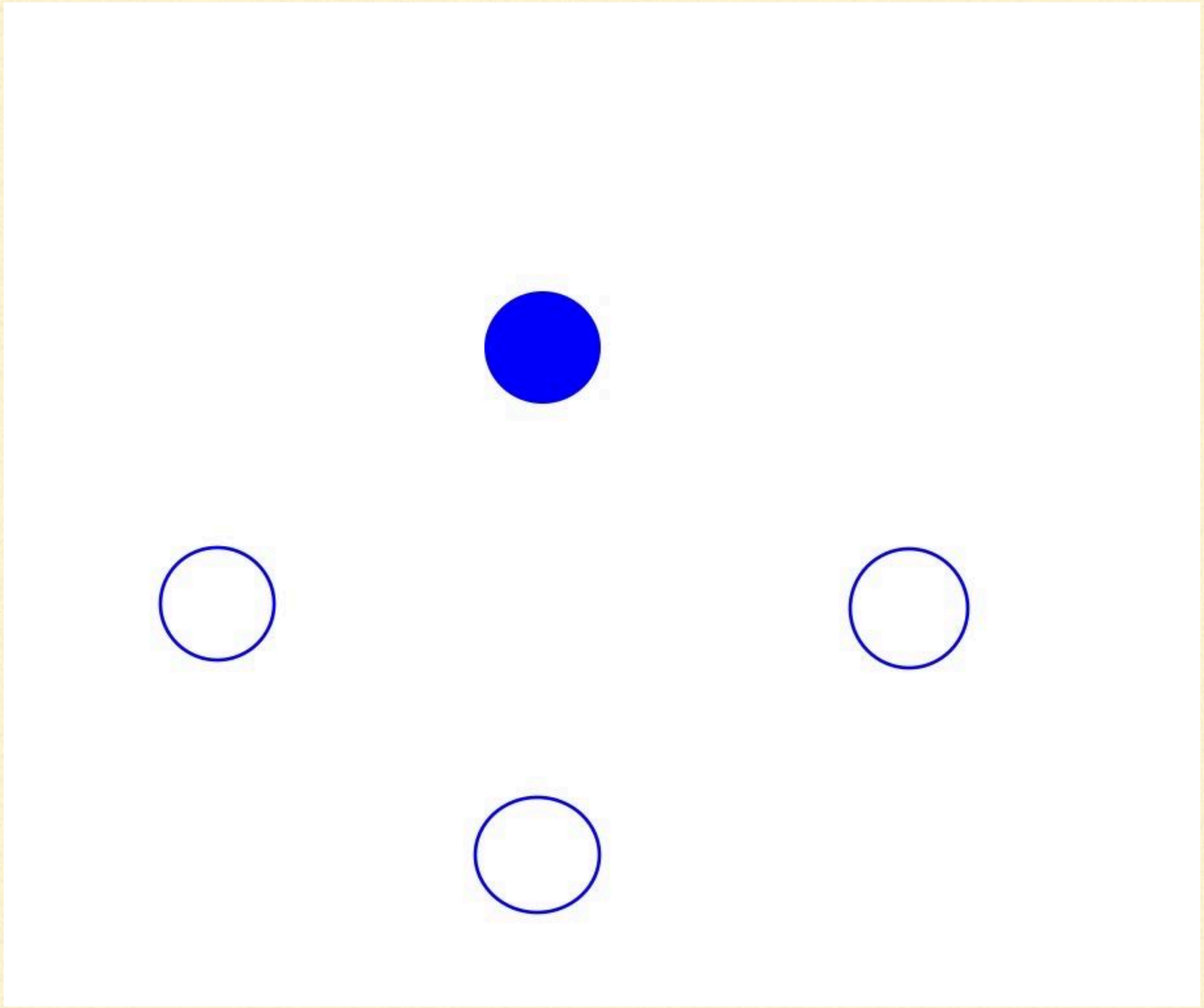
- For a single node:
  - How many neighbors do I have?
  - How many possible connections are there between my neighbors?

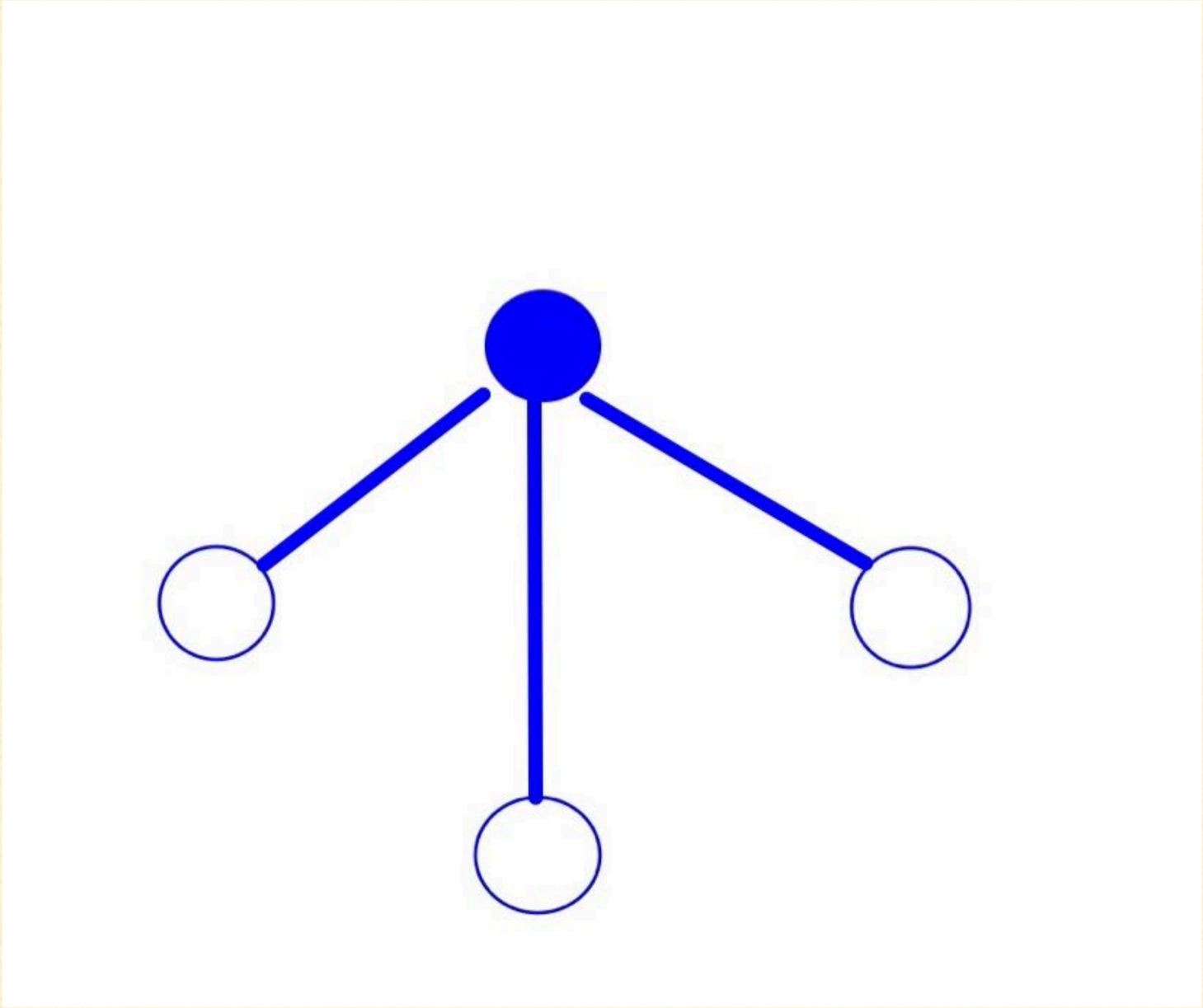
CALCULATING A CLUSTERING COEFFICIENT

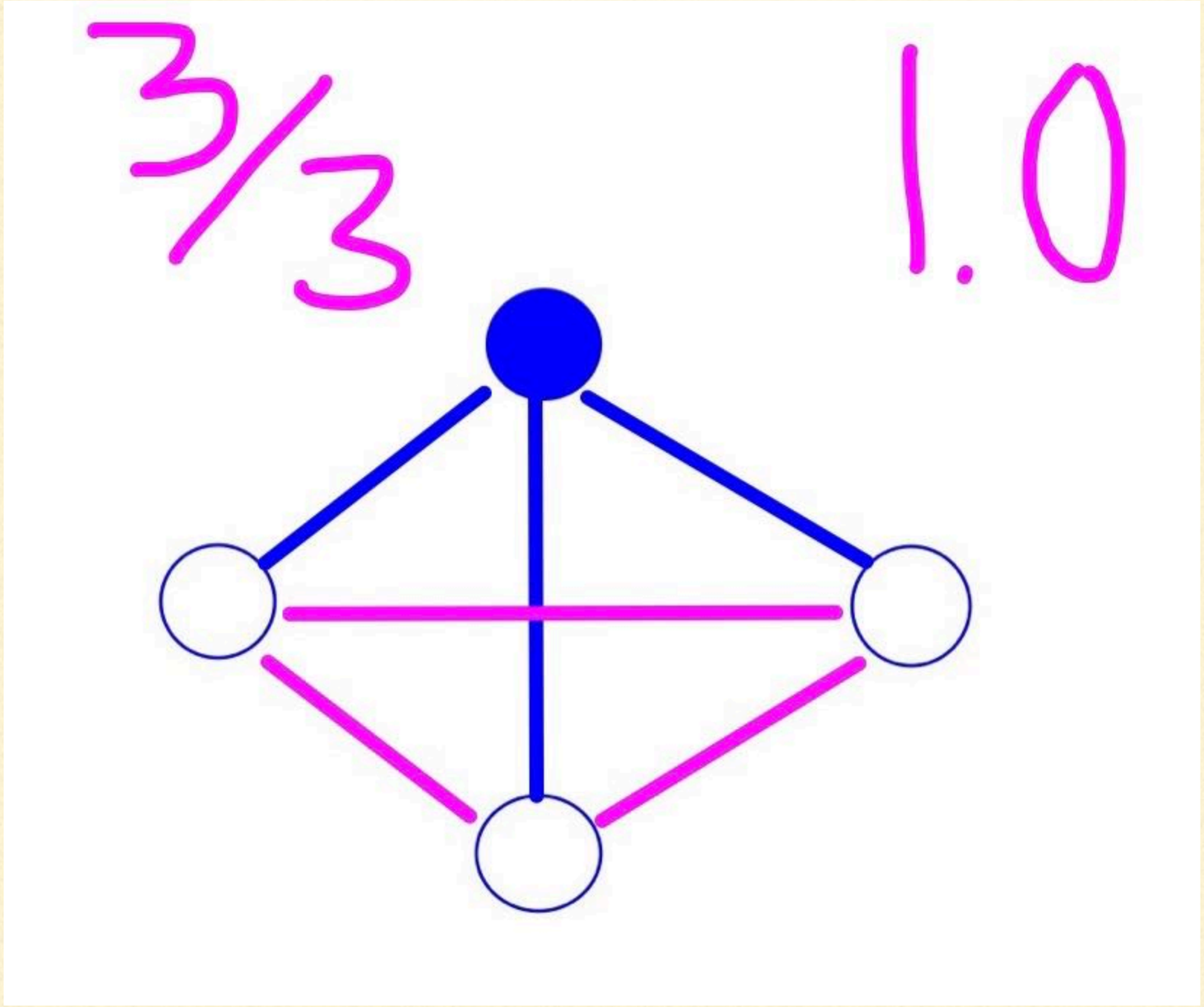
- For a single node:
  - How many neighbors do I have?
  - How many possible connections are there between my neighbors?
  - How many actual connections are there between my neighbors?

CALCULATING A CLUSTERING COEFFICIENT

- For a single node:
  - How many neighbors do I have?
  - How many possible connections are there between my neighbors?
  - How many actual connections are there between my neighbors?
  - Clustering coefficient = Actual connections / Possible connections



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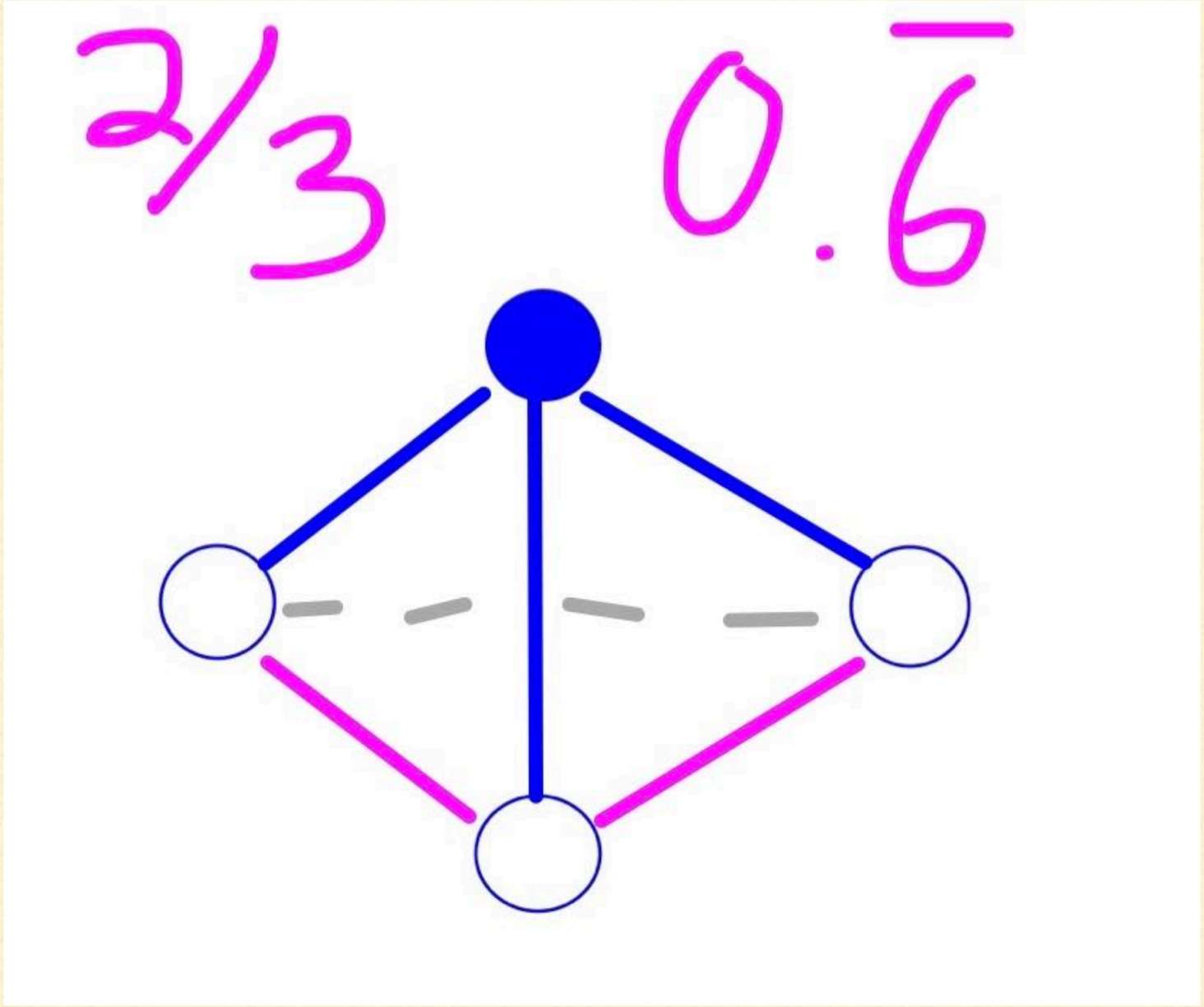
1.0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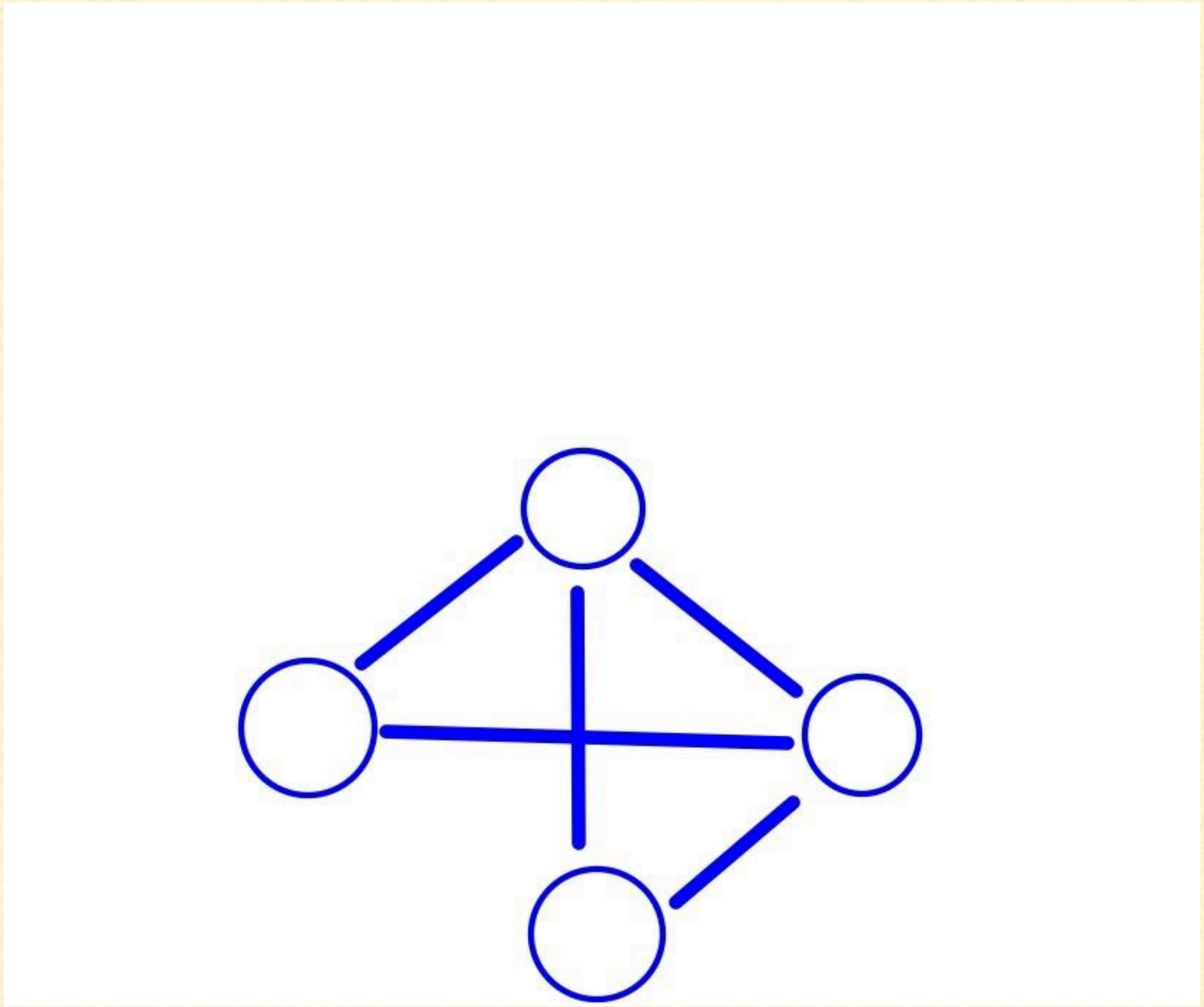

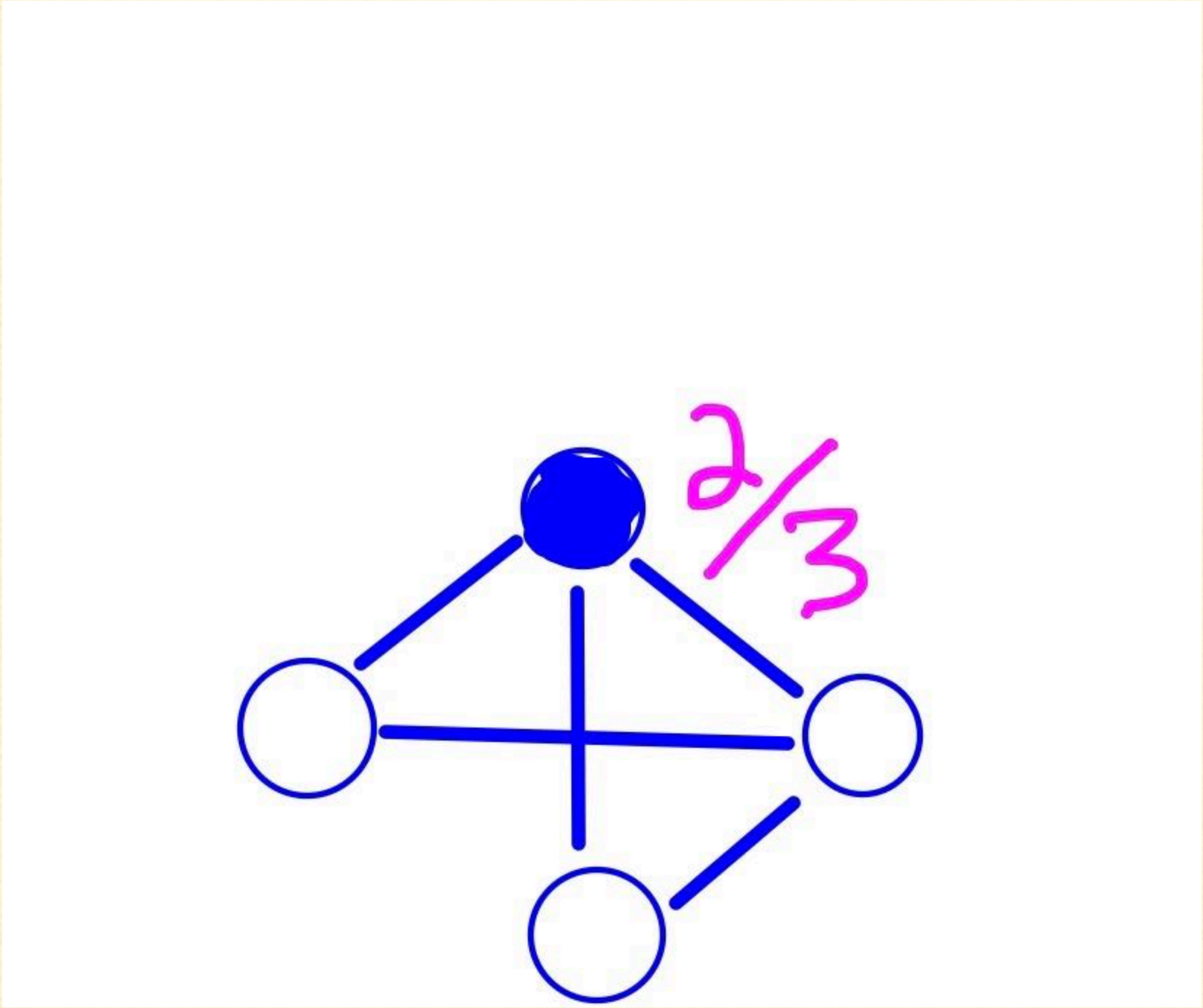
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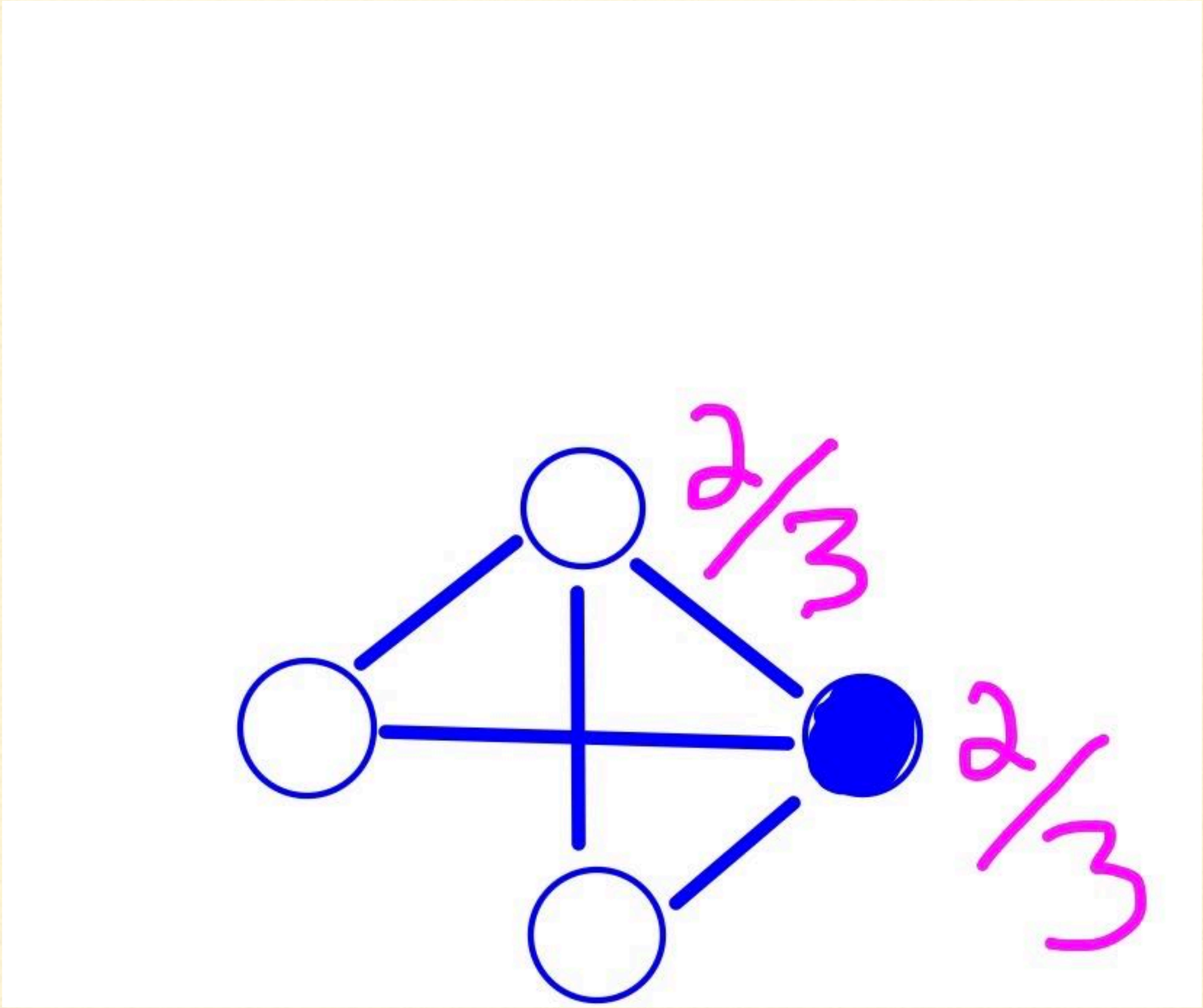
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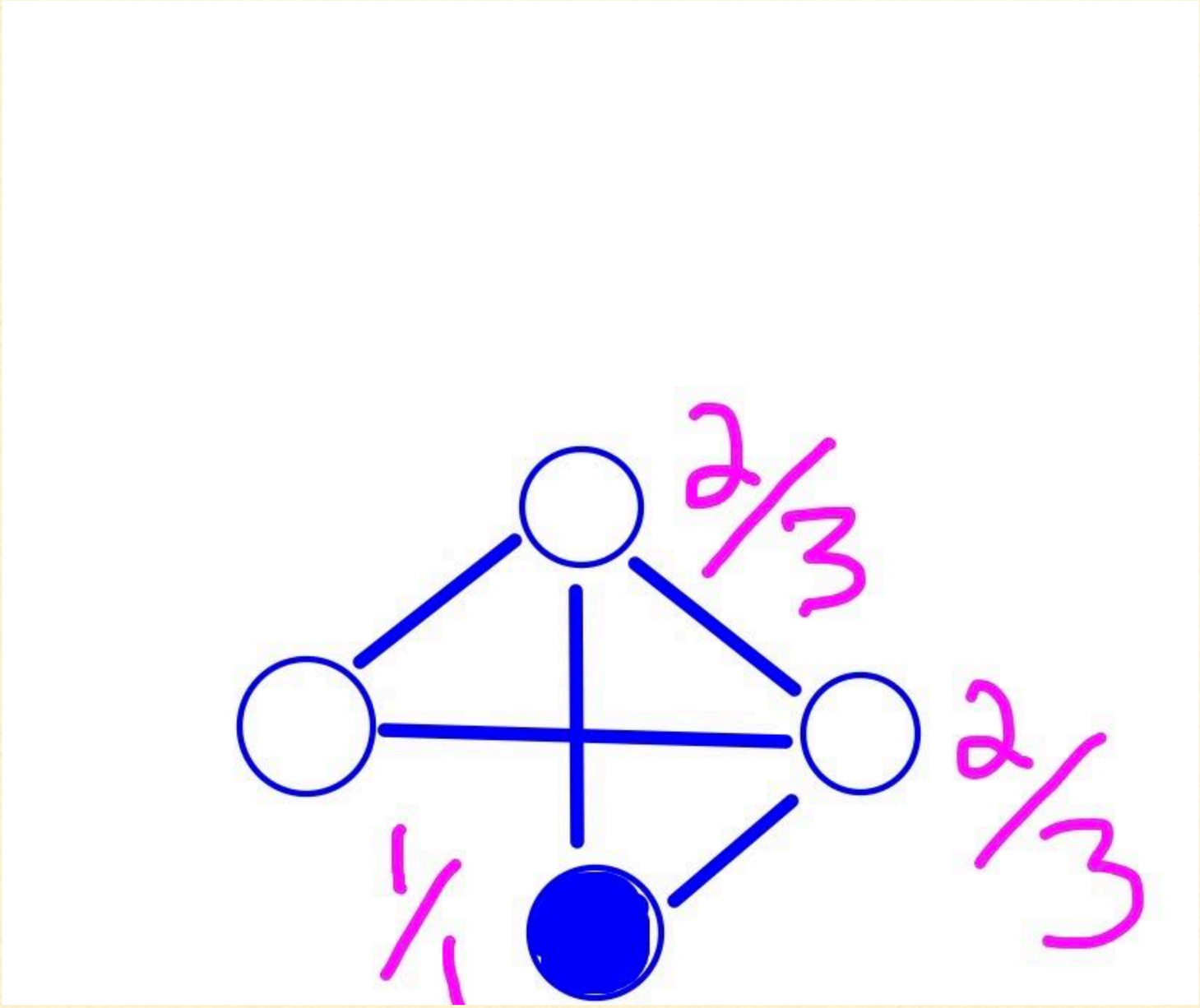
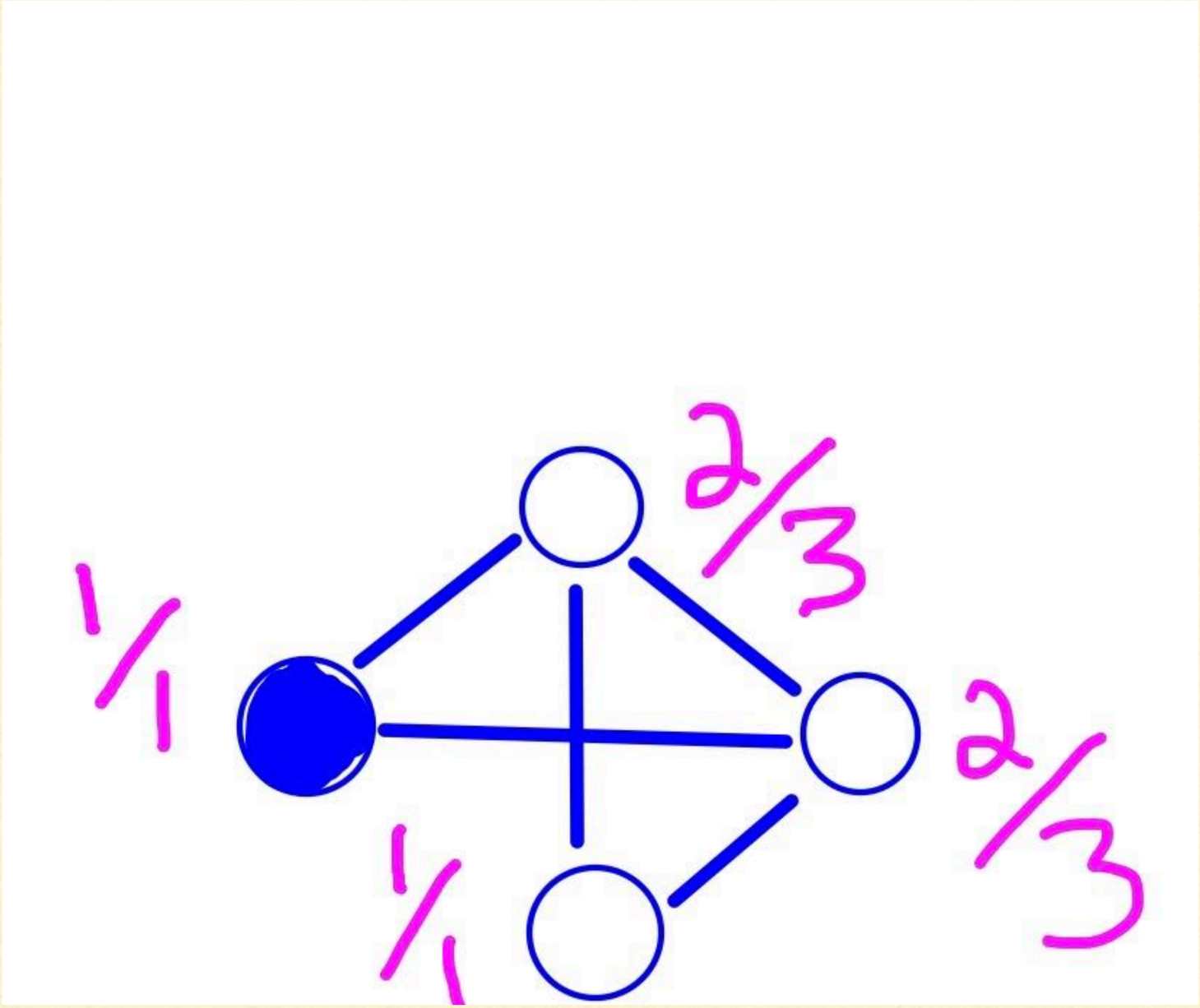
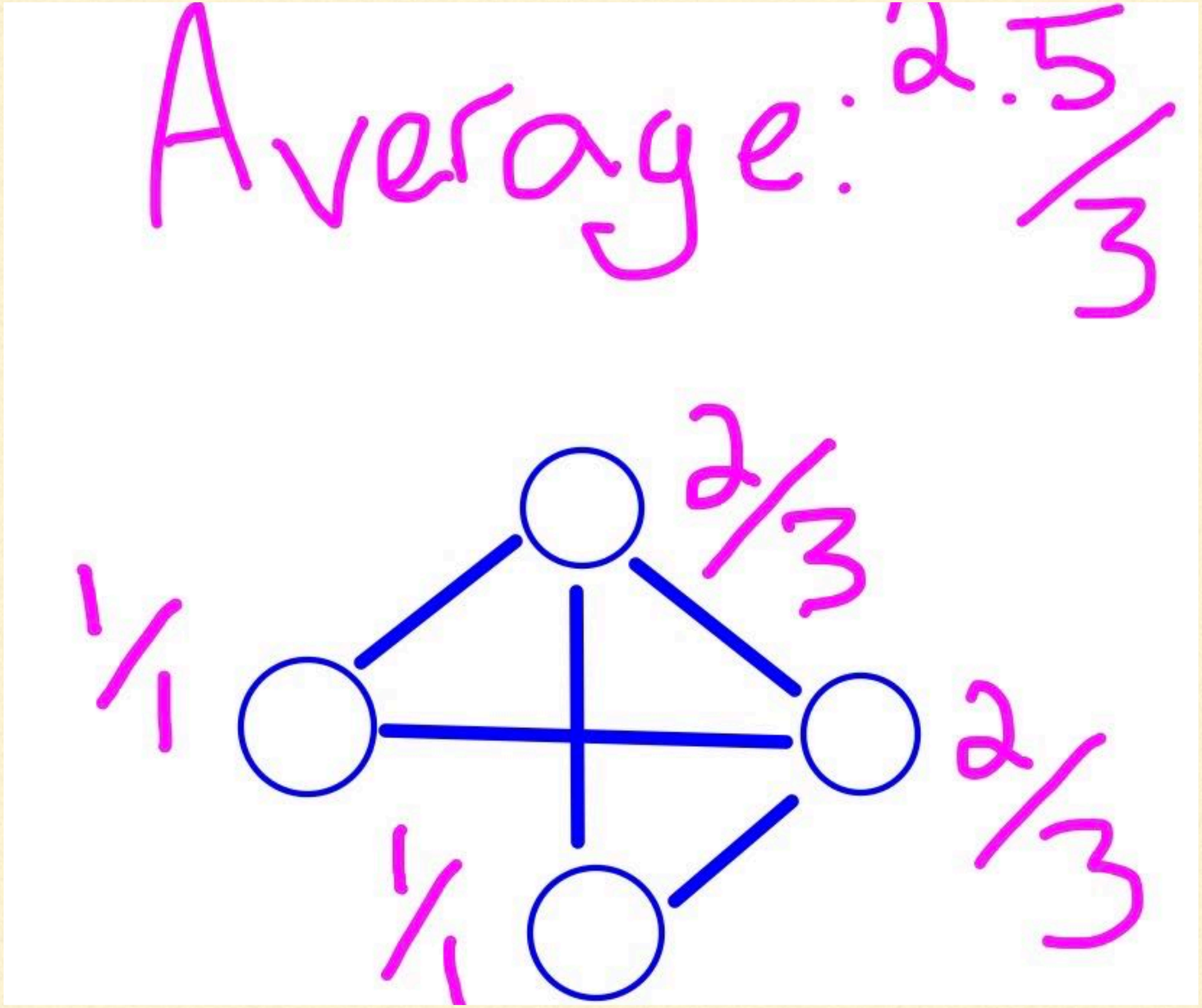
2/3


2/3
2/3
1/1


2/3
1/1
2/3
1/1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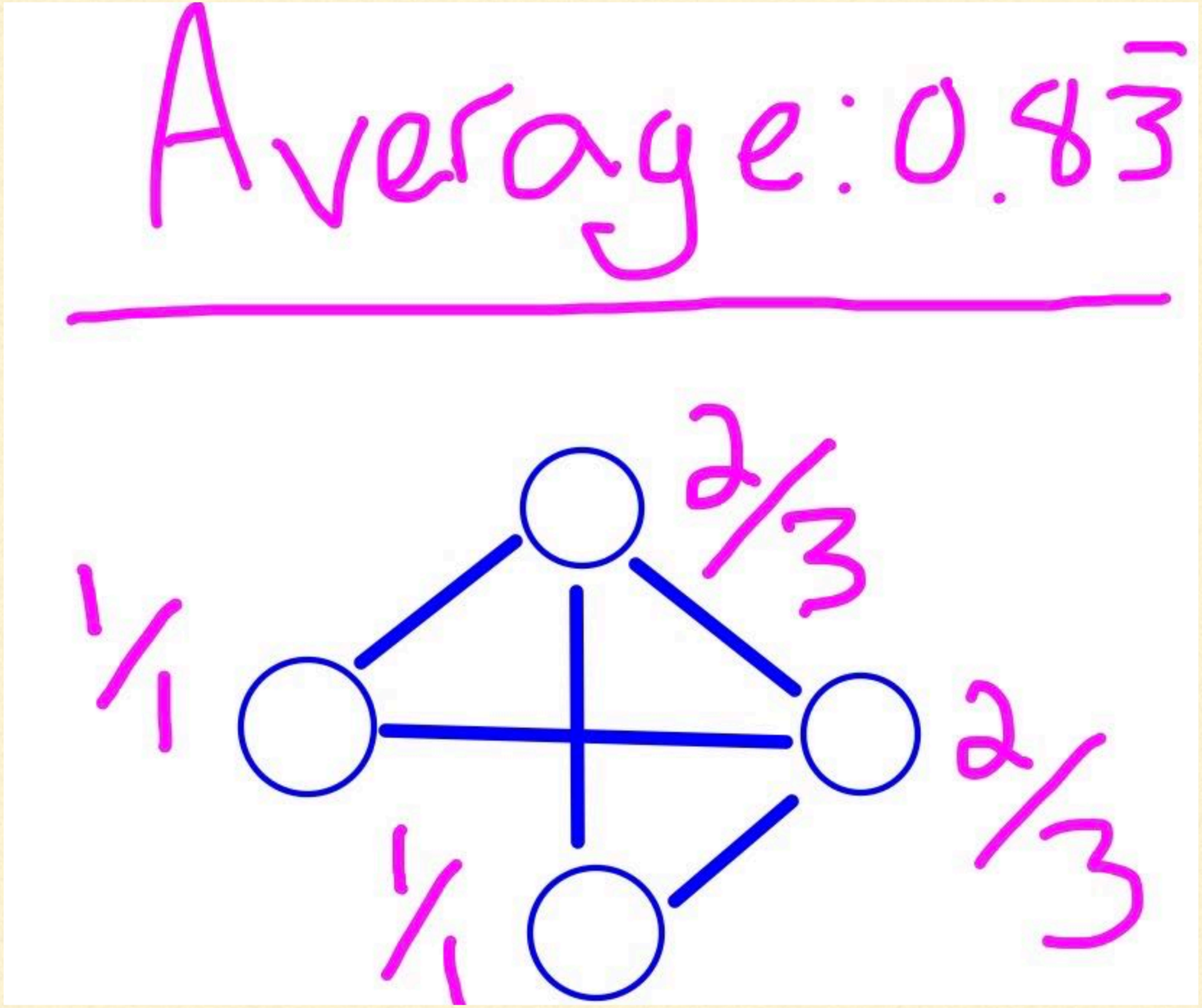
2/3
1/1
2/3
1/1


Average: 0.8̄
2/3
1/1
2/3
1/1

CALCULATING AVERAGE SHORTEST PATH

CALCULATING AVERAGE SHORTEST PATH

- Take all possible pairs of nodes in a graph

CALCULATING AVERAGE SHORTEST PATH

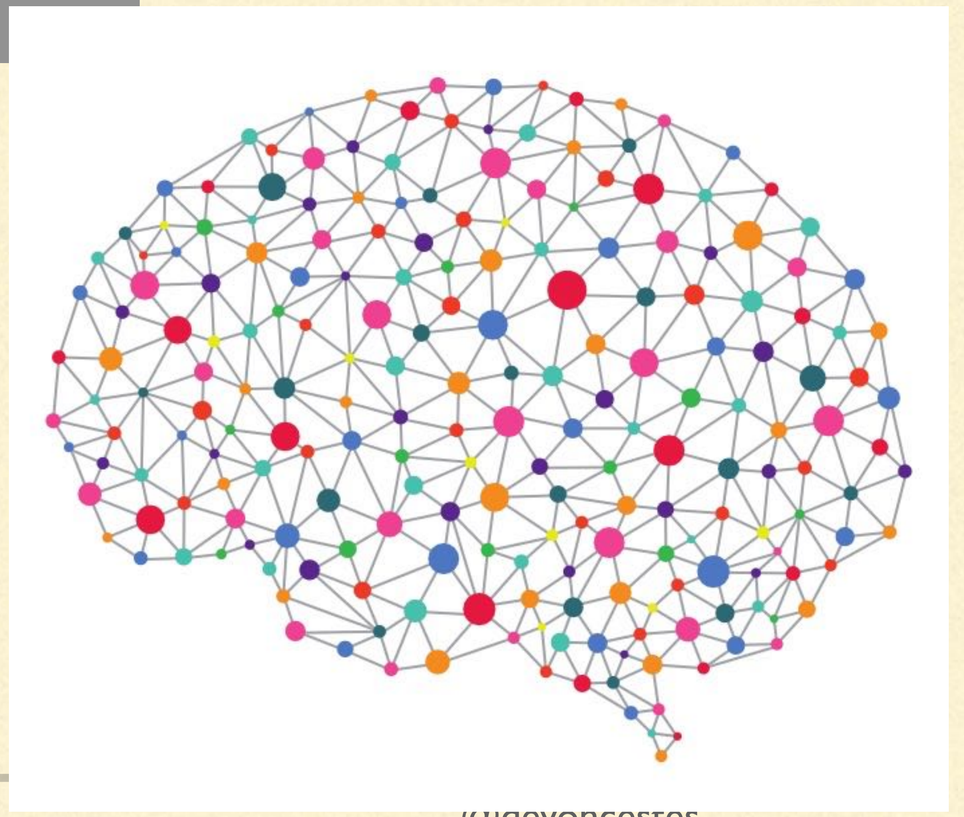
- Take all possible pairs of nodes in a graph
- For each pair, find the shortest path length

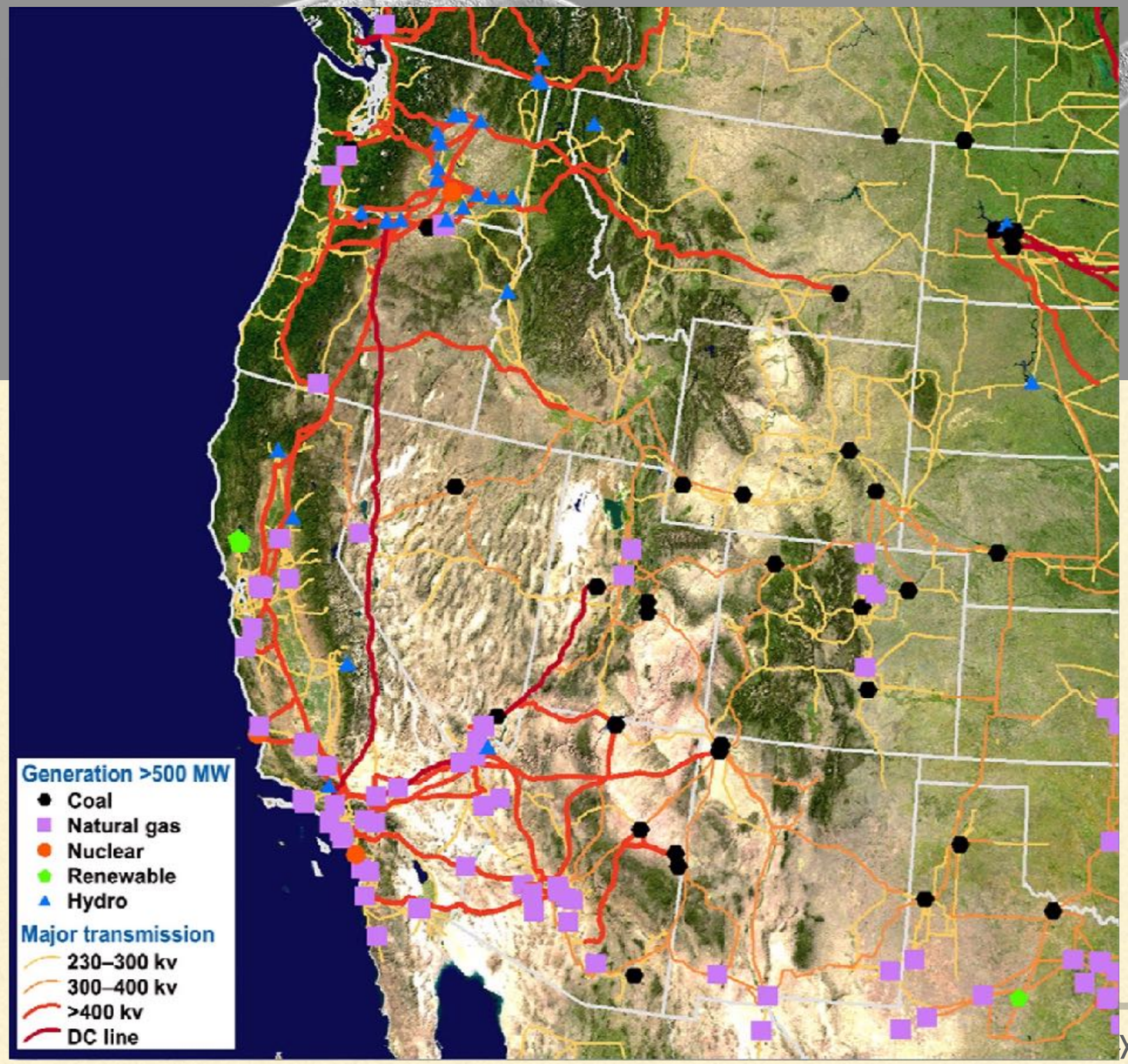
CALCULATING AVERAGE SHORTEST PATH

- Take all possible pairs of nodes in a graph
- For each pair, find the shortest path length
- Average all shortest path lengths

"Models of dynamical systems with small-world coupling display enhanced signal-propagation speed, computational power, and synchronizability."

– "Collective dynamics of 'small-world' networks" by Duncan J. Watts & Steven H. Strogatz

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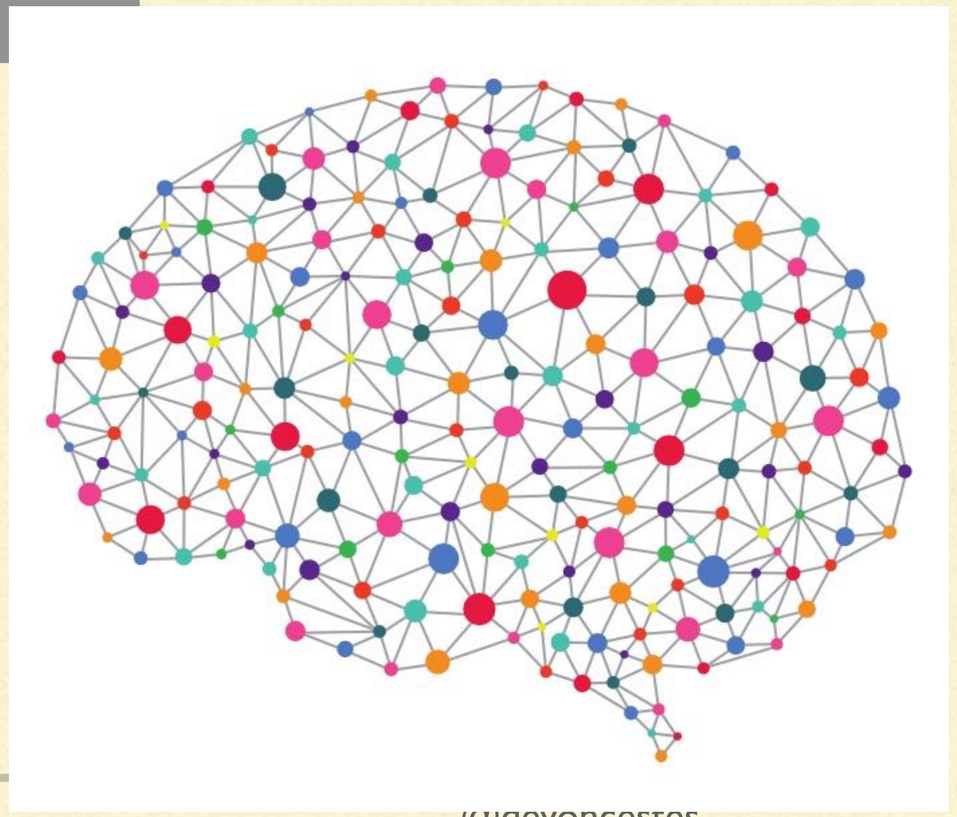
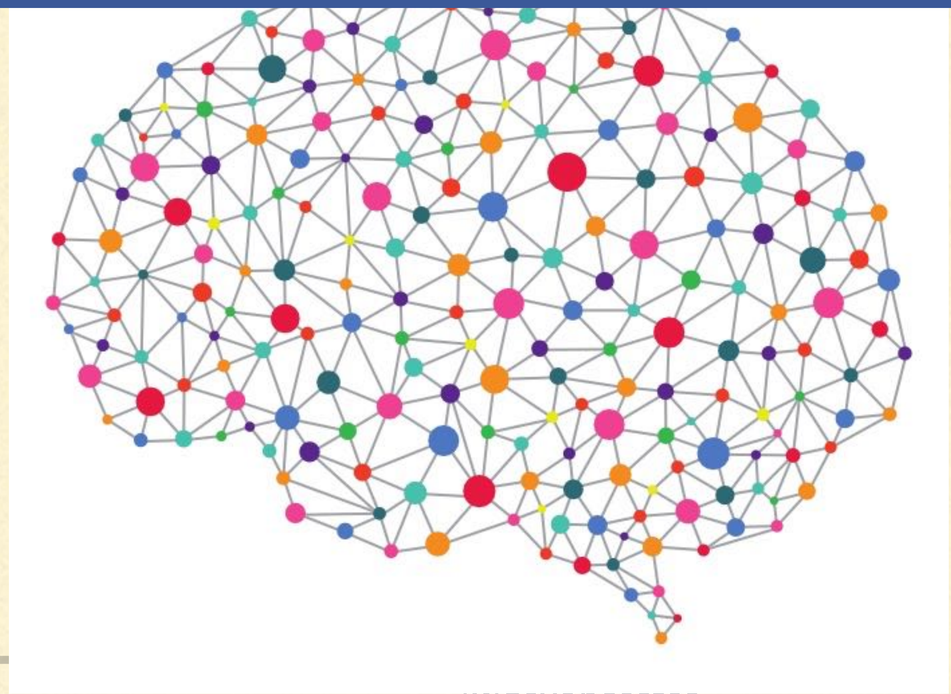
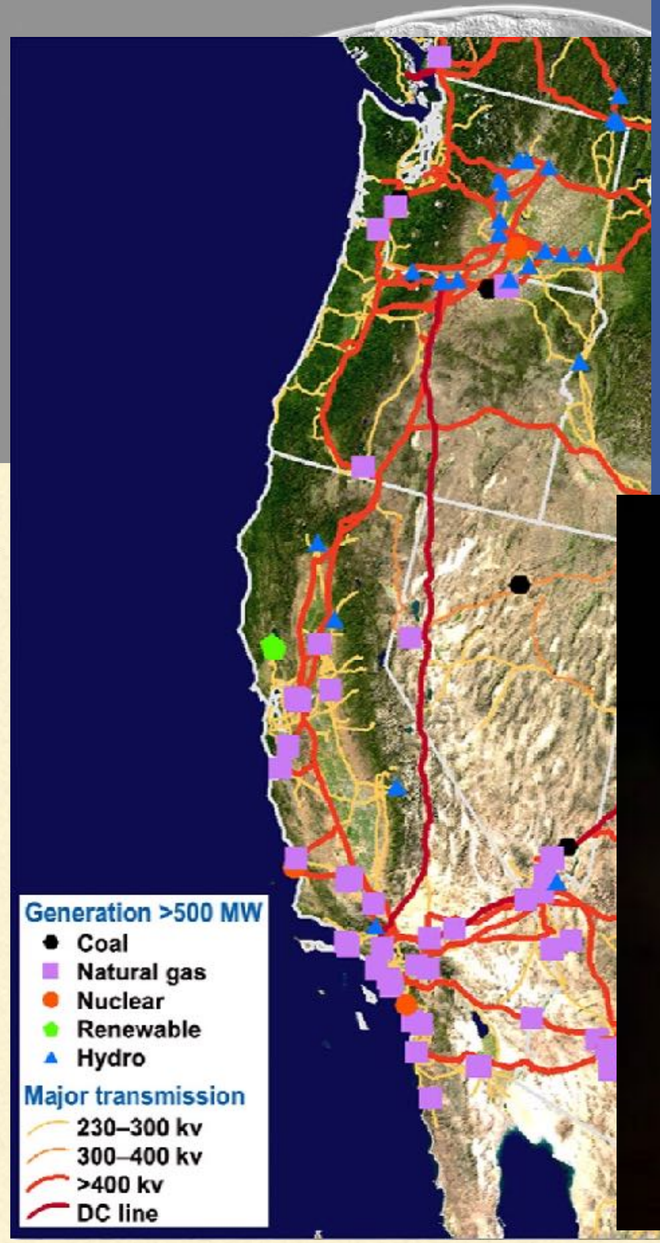
Coal
Natural gas
Nuclear
Renewable
Hydro
Major transmission
230–300 kv
300–400 kv
>400 kv
DC line



facebook

Generation >500 MW
Coal
Natural gas
Nuclear
Renewable
Hydro
Major transmission
230–300 kv
300–400 kv
>400 kv
DC line




Generation >500 MW
Coal
Natural gas
Nuclear
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Major transmission
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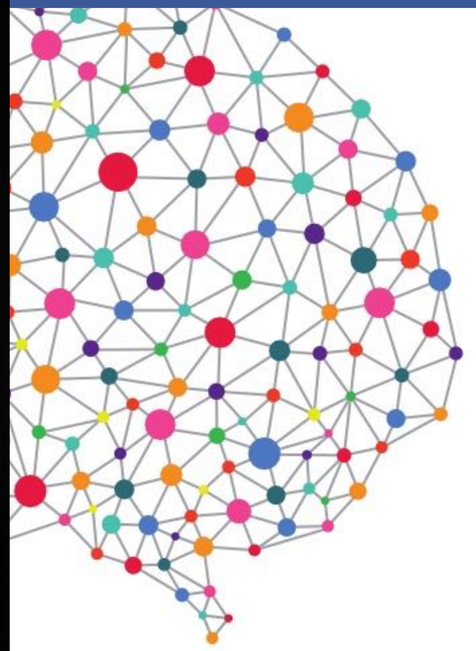
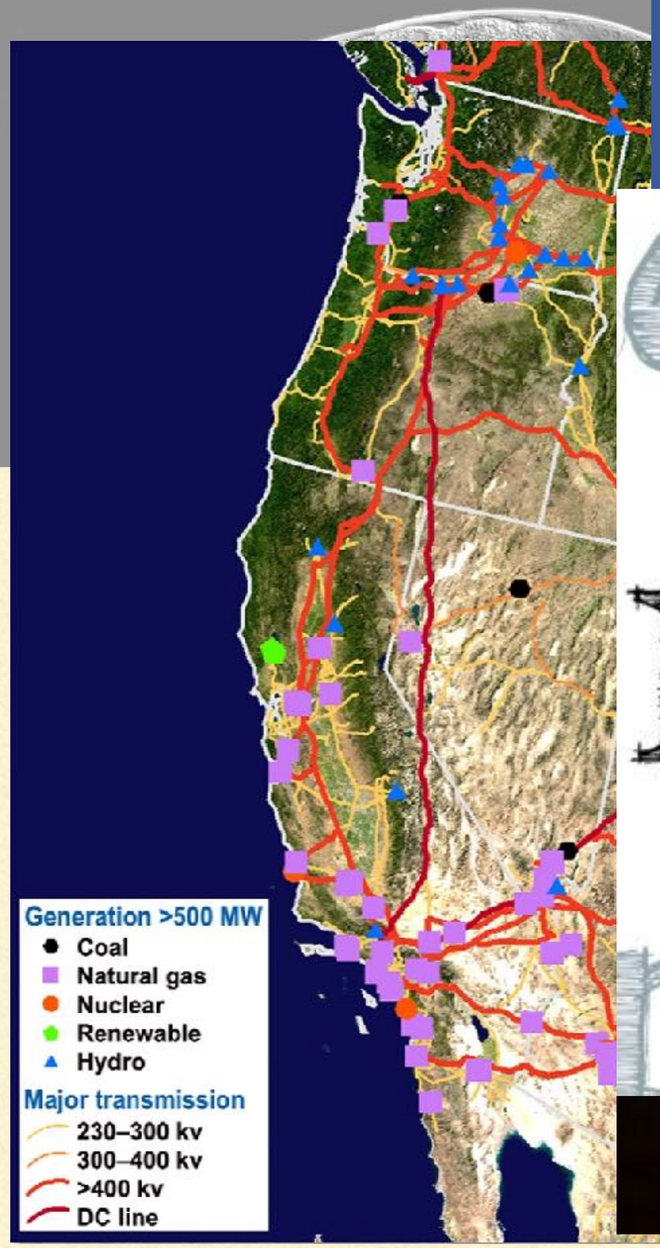
facebook

GAME OF THRONES





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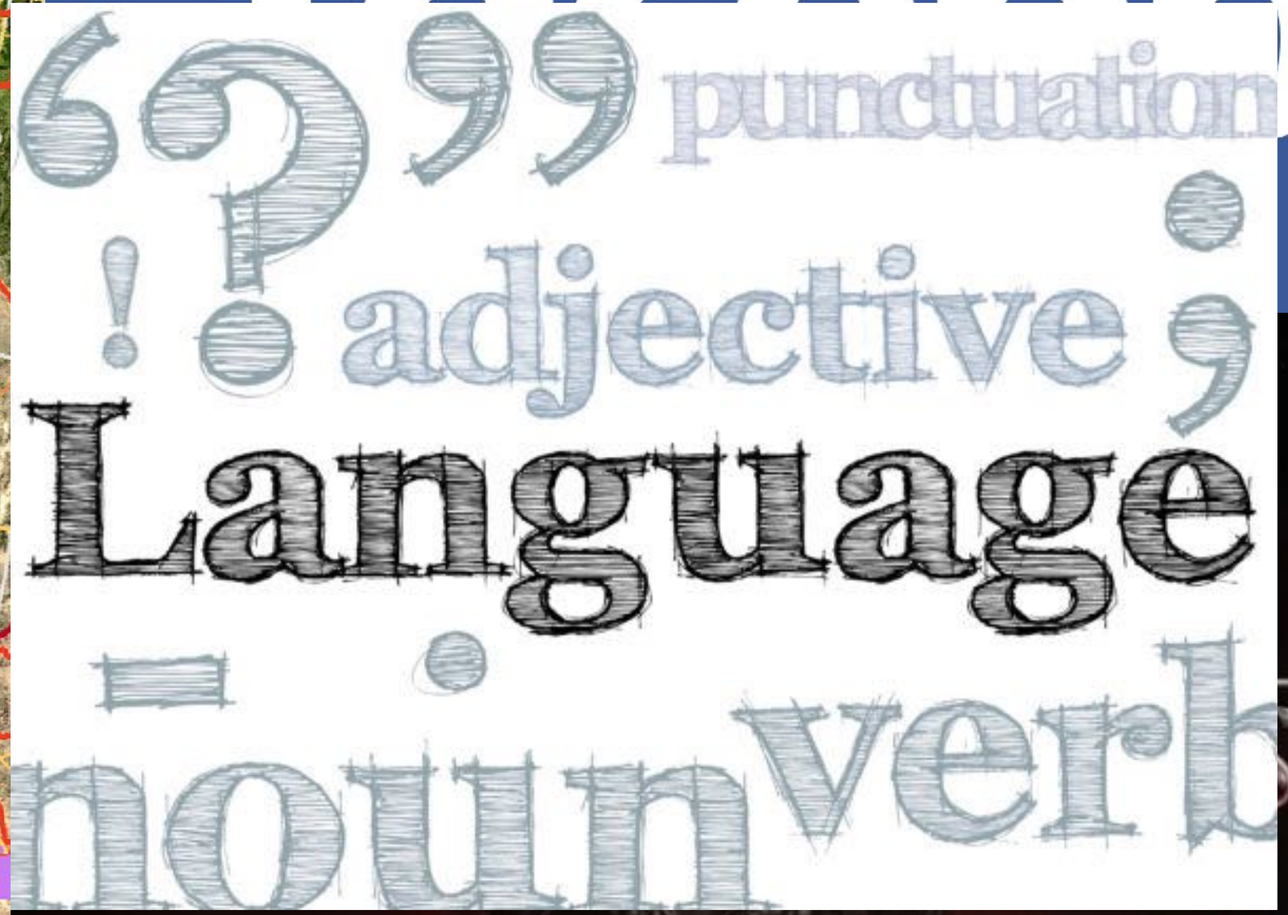
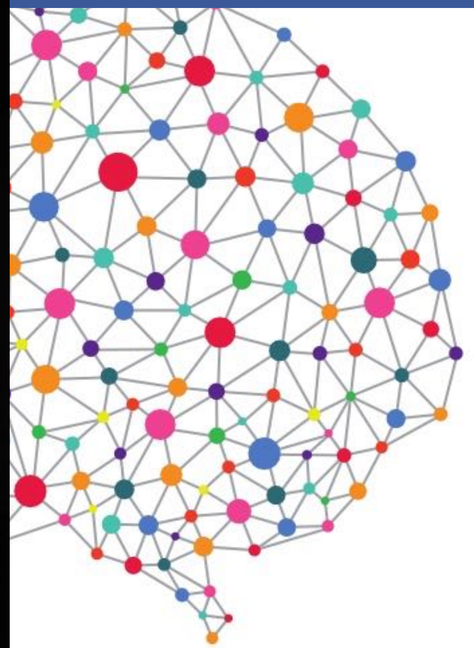




@devoncestes

ARE THEY IN OUR SOFTWARE?

ARE THEY IN OUR CODE?

devonestes / module_dependency_visualizer

Unwatch 1 Star 2 Fork 0

Code Issues 0 Pull requests 0 Projects 0 Wiki Insights Settings

Visualize the dependencies between modules in your Elixir applications

Edit

Add topics

5 commits 1 branch 0 releases 1 contributor

Branch: master New pull request Create new file Upload files Find file Clone or download

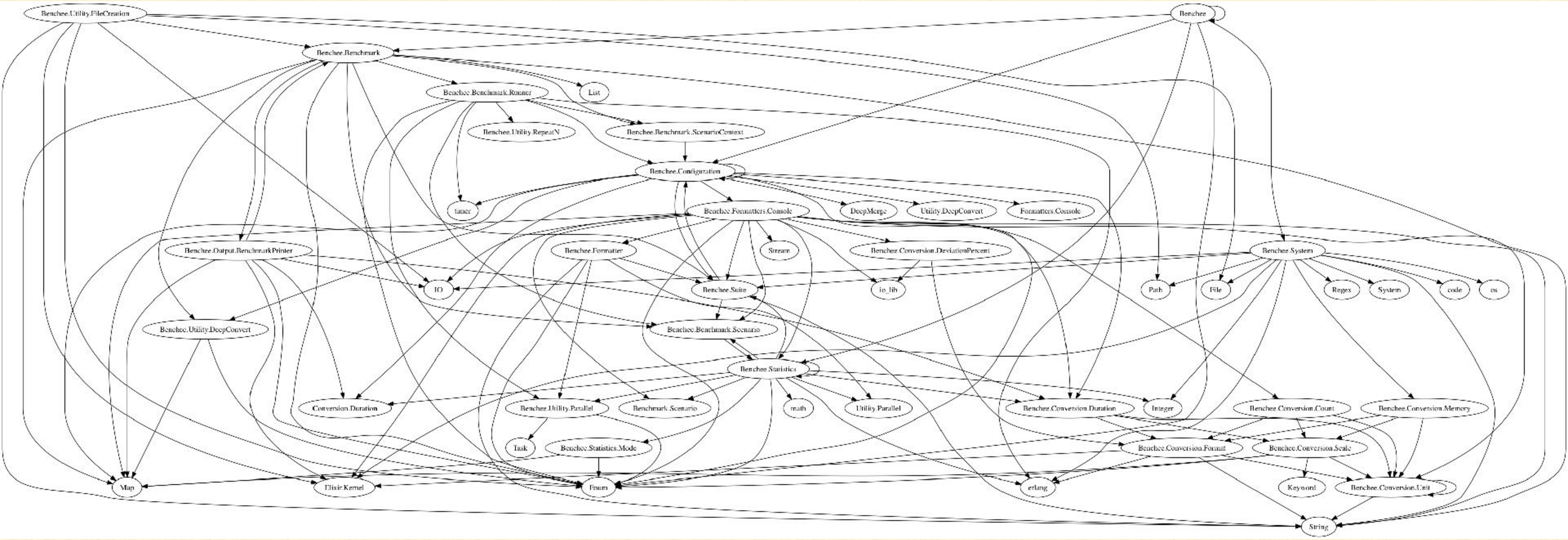
devonestes update readme Latest commit 333e2cd on Oct 31, 2017

config	Initial commit	3 months ago
lib	update readme	3 months ago
test	All tests passing!	3 months ago
.gitignore	Initial commit	3 months ago
README.md	update readme	3 months ago
mix.exs	Initial commit	3 months ago
run.exs	update readme	3 months ago

README.md

ModuleDependencyVisualizer

What is this?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Benchee.Configuration
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Benchee.Formatters.Console
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Utility.DeepConvert
Formatters.Console
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Benchee.Formatter
Stream
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File
Regex
System
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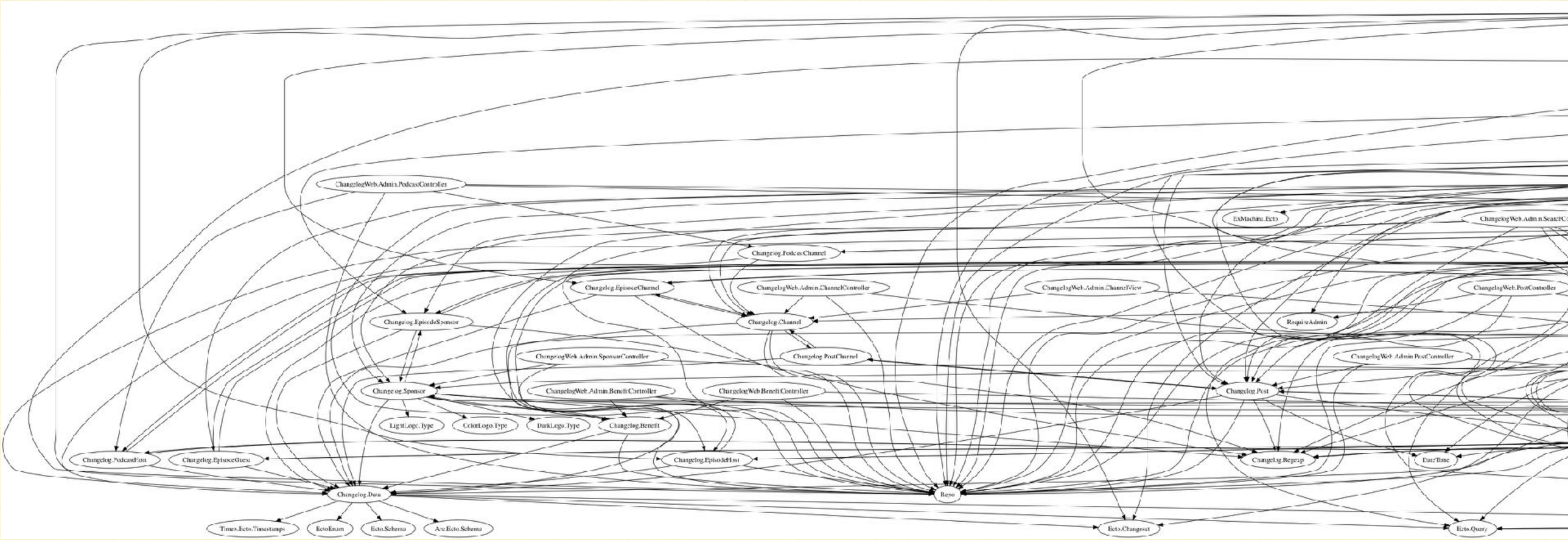
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Changelog.EpisodeChannel
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ChangelogWeb.Admin.SearchC
ChangelogWeb.PostController
Changelog.EpisodeSponsor
Changelog.Channel
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Changelog.PostChannel
ChangelogWeb.Admin.PostController
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ColorLogo.Type
DarkLogo.Type
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Ecto.Changeset
Ecto.Query

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ChangelogWeb.Admin.PersonController
ChangelogWeb.AuthController
ChangelogWeb.PersonController
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Changelog.Mailer
Ueberauth
ChangelogWeb.Email
Bamboo.Mailer
Bamboo.Phoenix
ChangelogWeb.EmailView
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Changelog.Factory
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ChangelogWeb.FeedController
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Slack.Client
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ChangelogWeb.Plug.RequireGuest
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AdminHelpers
SharedHelpers
PublicHelpers
Phoenix.Router
Phoenix.Channel
Timex
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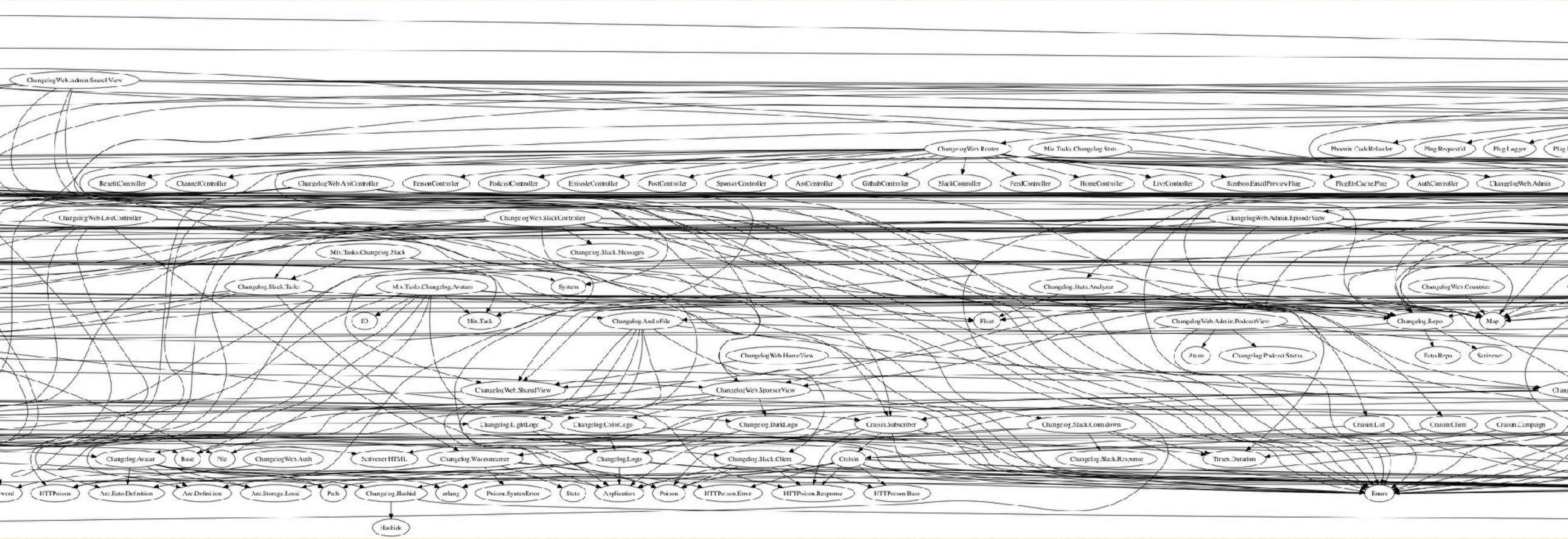
Plug.Crypto.KeyGenerator
Plug.Keys
Ecto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PersonController
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EpisodeController
PostController
SponsorController
ApiController
GithubController
SlackController
FeedController
HomeController
LiveController
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PlugEtsCache.Plug
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Item
Changelog.PodcastStats
Ecto.Repo
Scrivener
ChangelogWeb.SharedView
ChangelogWeb.SponsorView
Changelog.LightLogo
Changelog.CabinLogo
Changelog.DarkLogo
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Changelog.Slack.Countdown
Craisin.List
Craisin.Client
Craisin.Campaign
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Pile
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Changelog.Logo
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Craisin
Changelog.Slack.Response
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Arc.Definition
Arc.Storage.Local
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Poison.SyntaxError
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Poison
HTTPoison.Error
HTTPoison.Response
HTTPoison.Base
Enum
Hashids

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ChangelogWeb.Endpoint
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Plug.Head
Plug.Session
ChangelogWeb.UserSocket
Phoenix.Endpoint
Plug.Static
Phoenix.LiveReloader.Socket
Phoenix.LiveReloader
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SearchController
Mix
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Changelog.Stats
Phoenix.Transports.WebSocket
Phoenix.Socket
ChangelogWeb.FeedView
ChangelogWeb.GithubController
Timex.Interval
Task
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ChangelogWeb.Meta.Twitter
ChangelogWeb.Meta.Description
ChangelogWeb.Meta.Image
Changelog.Transcripts.Updater
ChangelogWeb.Admin.NewsletterView
ChangelogWeb.SearchView
ChangelogWeb.PageView
Scrivener
Changelog.Transcripts.Source
ChangelogWeb.NewsletterView
ChangelogWeb.Helpers.AdminHelpers
ChangelogWeb.PostView
ChangelogWeb.EpisodeView
ChangelogWeb.LayoutView
Transcripts.Source
ChangelogWeb.LiveView
AdminTitle
Image
Feeds
Twitter
Title
Description
ChangelogWeb.Meta
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Phoenix.HTML
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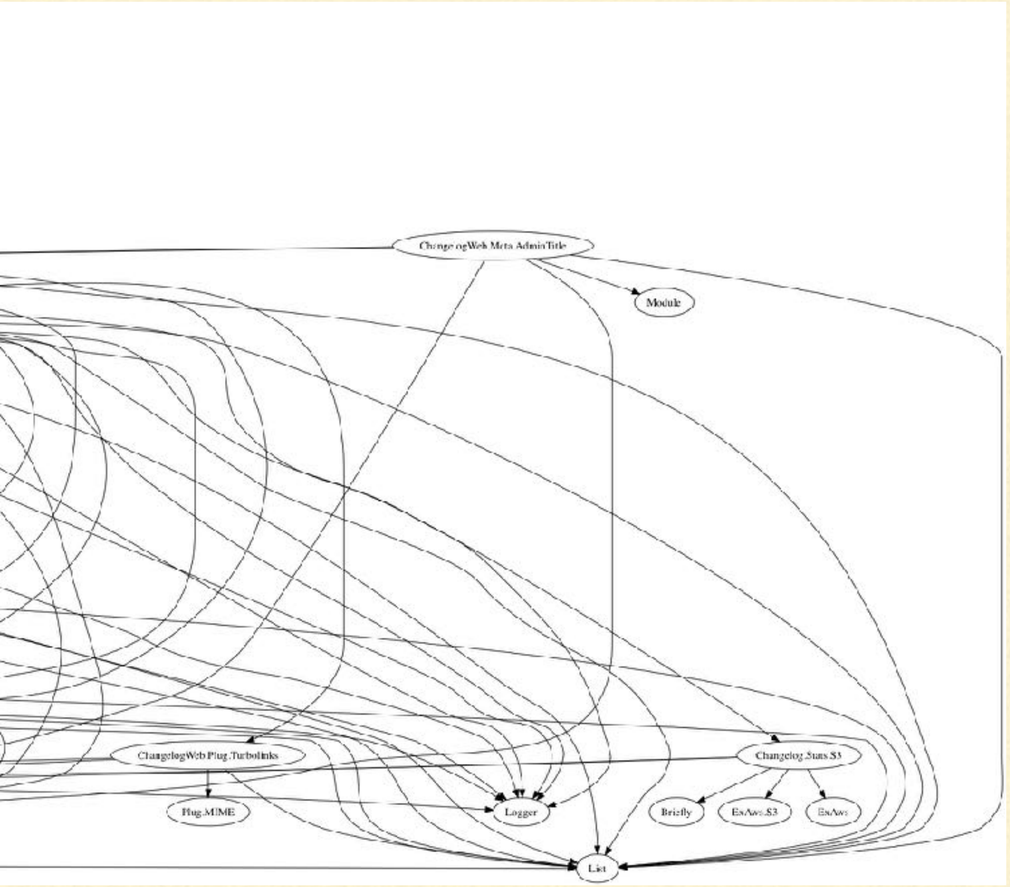
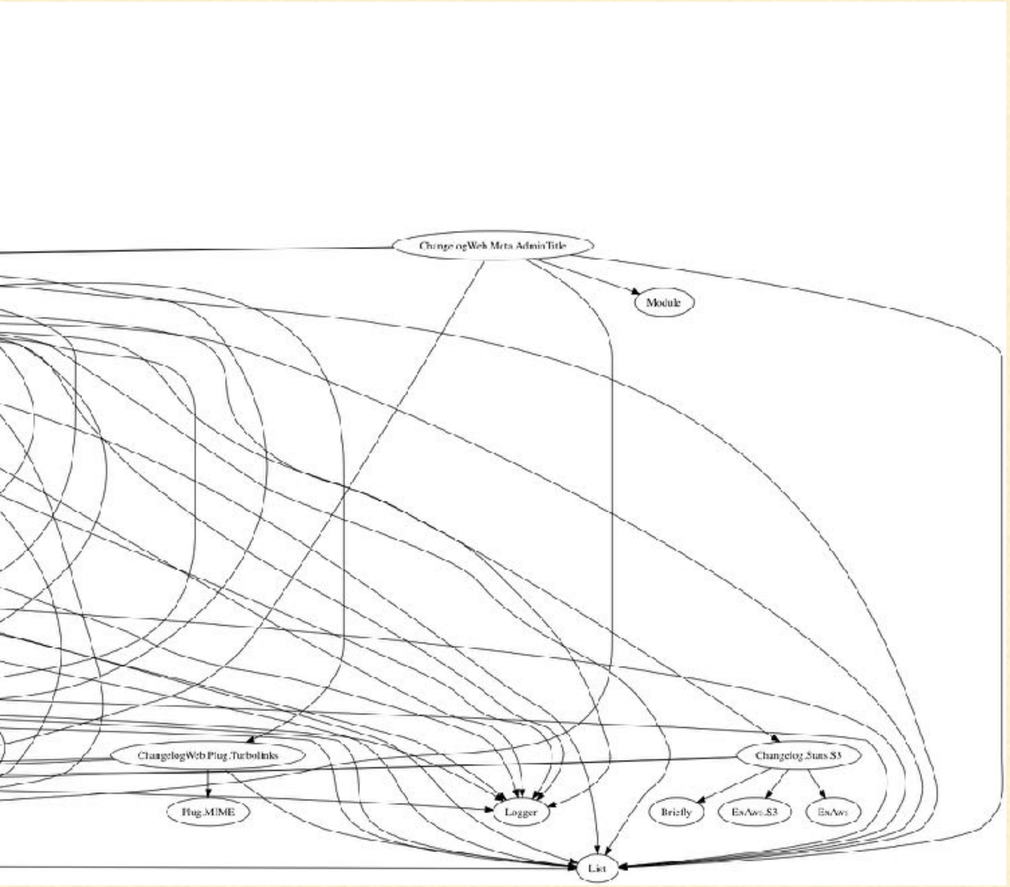
URI
Cmark
HtmlSanitizeEx
NimbleCSV.RFC4180
NimbleCSV.ParseError
Changelog.Stats.Entry
Elixir.Kernel
String


ChangelogWeb.Meta.AdminTitle
Module
ChangelogWeb.Plug.Turbolinks
Changelog.Stats.S3
Plug.MIME
Logger
Brizly
ExAws.S3
ExAws
List


Changelog.Web.Meta.AdminTitle
Module
Changelog.Web.Plug.Turbolinks
Changelog.Stats.S3
Plug.MIME
Logger
Brizly
ExAws.S3
ExAws
List

The Open Graph Viz Platform

Gephi is the leading visualization and exploration software for all kinds of graphs and networks. Gephi is open-source and free.

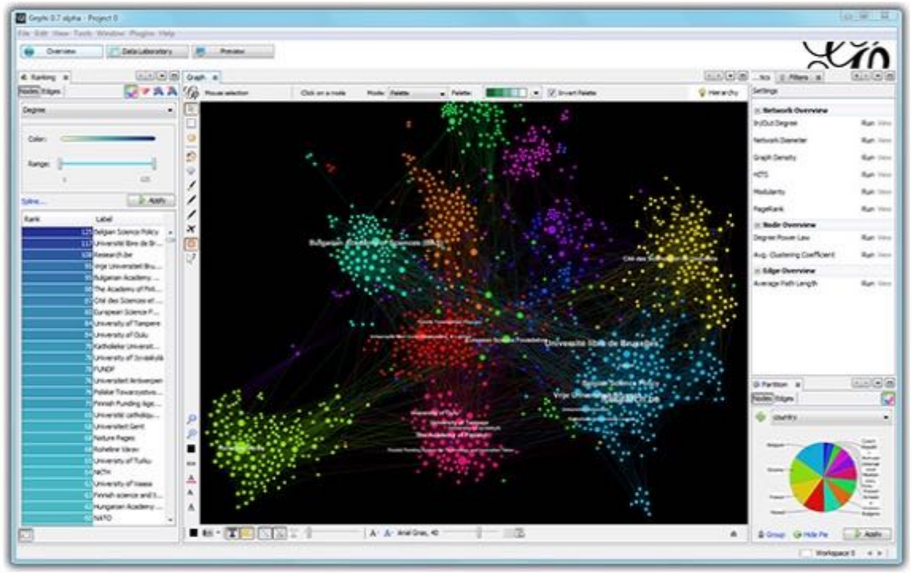
Runs on Windows, Mac OS X and Linux.

Learn More on Gephi Platform »

Download FREE
Gephi 0.9.2

Release Notes | System Requirements

- Features
- Quick start
- Screenshots
- Videos



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APPLICATIONS

- **Exploratory Data Analysis**: intuition-oriented analysis by networks manipulations in real time.
- **Link Analysis**: revealing the underlying structures of associations between objects.
- **Social Network Analysis**: easy creation of social data connectors to map community organizations and small-world networks.
- **Biological Network analysis**: representing patterns of biological data.
- **Poster creation**: scientific work promotion with hi-quality printable maps.

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METRICS READY

Like Photoshop™ for graphs.

— the Community

LATEST NEWS

- Gephi updates with 0.9.2 version
- Gephi updates with 0.9.1 version
- A close look at the Gephi user community
- Gephi 0.9 released: Play with network data again
- Gephi boosts its performance with new "GraphStore" core

See All »

Tweets by @Gephi

PAPERS

Bastian M., Heymann S., Jacomy M. (2009). *Gephi:*

14 applications

14 applications

5 Phoenix web applications

14 applications

5 Phoenix web applications

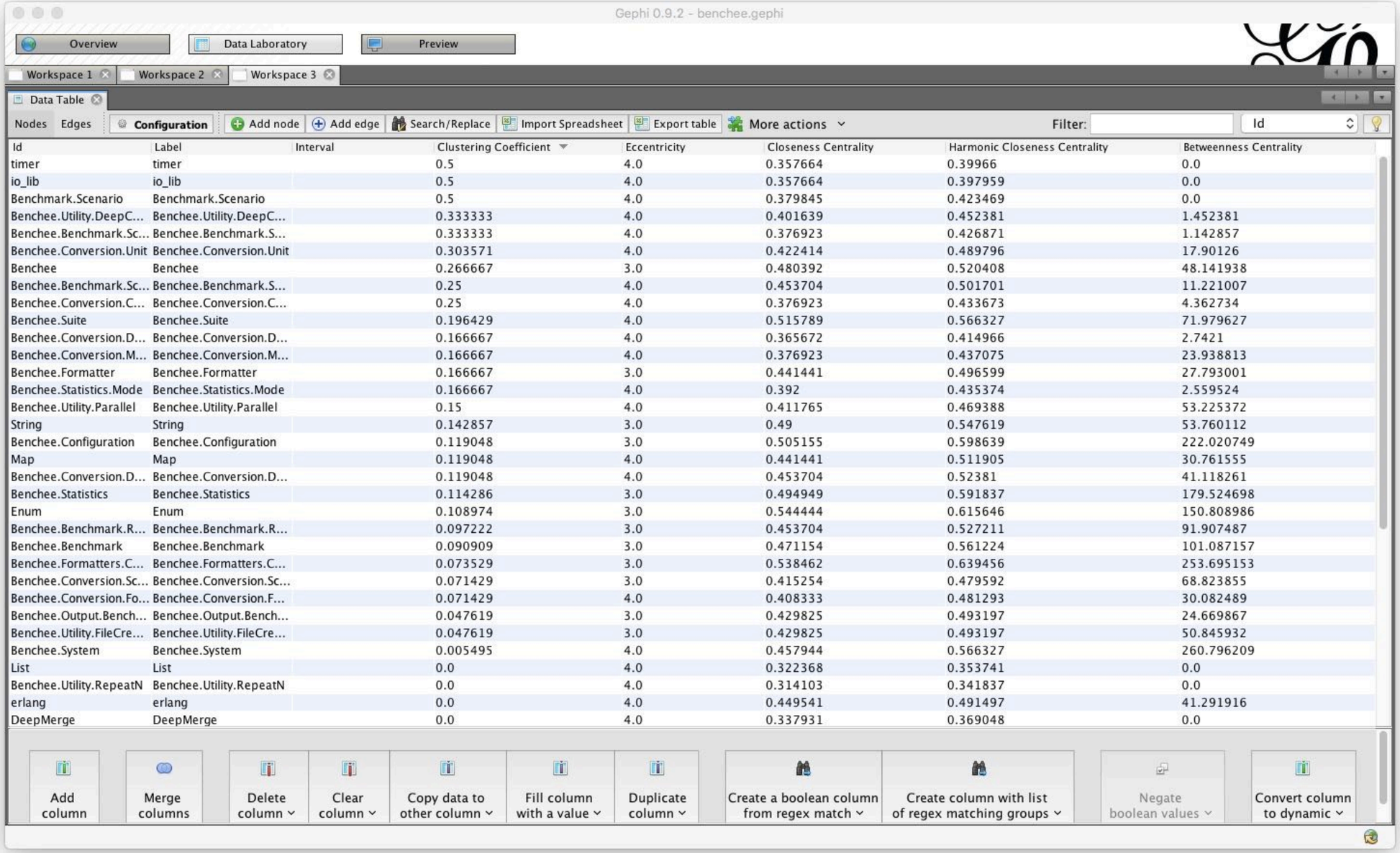
9 libraries

14 applications

5 Phoenix web applications

9 libraries

* I am not a real scientist

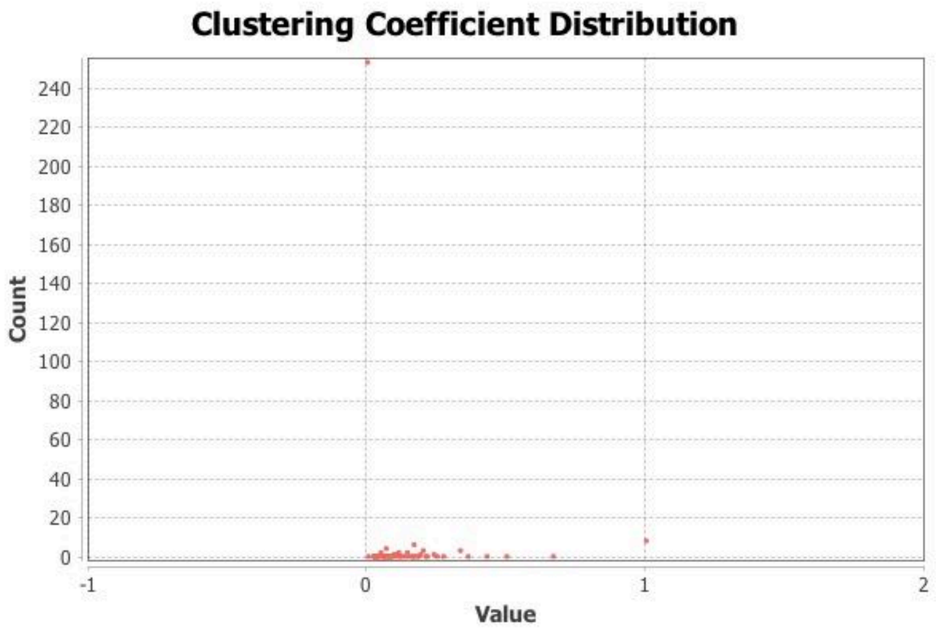

Gephi 0.9.2 - benchee.gephi
Overview
Data Laboratory
Preview
Workspace 1
Workspace 2
Workspace 3
Data Table
Nodes
Edges
Configuration
Add node
Add edge
Search/Replace
Import Spreadsheet
Export table
More actions
Filter:
Id
Id | Label | Interval | Clustering Coefficient | Eccentricity | Closeness Centrality | Harmonic Closeness Centrality | Betweenness Centrality
timer | timer | | 0.5 | 4.0 | 0.357664 | 0.39966 | 0.0
io_lib | io_lib | | 0.5 | 4.0 | 0.357664 | 0.397959 | 0.0
Benchmark.Scenario | Benchmark.Scenario | | 0.5 | 4.0 | 0.379845 | 0.423469 | 0.0
Benchee.Utility.DeepC... | Benchee.Utility.DeepC... | | 0.333333 | 4.0 | 0.401639 | 0.452381 | 1.452381
Benchee.Benchmark.Sc... | Benchee.Benchmark.S... | | 0.333333 | 4.0 | 0.376923 | 0.426871 | 1.142857
Benchee.Conversion.Unit | Benchee.Conversion.Unit | | 0.303571 | 4.0 | 0.422414 | 0.489796 | 17.90126
Benchee | Benchee | | 0.266667 | 3.0 | 0.480392 | 0.520408 | 48.141938
Benchee.Benchmark.Sc... | Benchee.Benchmark.S... | | 0.25 | 4.0 | 0.453704 | 0.501701 | 11.221007
Benchee.Conversion.C... | Benchee.Conversion.C... | | 0.25 | 4.0 | 0.376923 | 0.433673 | 4.362734
Benchee.Suite | Benchee.Suite | | 0.196429 | 4.0 | 0.515789 | 0.566327 | 71.979627
Benchee.Conversion.D... | Benchee.Conversion.D... | | 0.166667 | 4.0 | 0.365672 | 0.414966 | 2.7421
Benchee.Conversion.M... | Benchee.Conversion.M... | | 0.166667 | 4.0 | 0.376923 | 0.437075 | 23.938813
Benchee.Formatter | Benchee.Formatter | | 0.166667 | 3.0 | 0.441441 | 0.496599 | 27.793001
Benchee.Statistics.Mode | Benchee.Statistics.Mode | | 0.166667 | 4.0 | 0.392 | 0.435374 | 2.559524
Benchee.Utility.Parallel | Benchee.Utility.Parallel | | 0.15 | 4.0 | 0.411765 | 0.469388 | 53.225372
String | String | | 0.142857 | 3.0 | 0.49 | 0.547619 | 53.760112
Benchee.Configuration | Benchee.Configuration | | 0.119048 | 3.0 | 0.505155 | 0.598639 | 222.020749
Map | Map | | 0.119048 | 4.0 | 0.441441 | 0.511905 | 30.761555
Benchee.Conversion.D... | Benchee.Conversion.D... | | 0.119048 | 4.0 | 0.453704 | 0.52381 | 41.118261
Benchee.Statistics | Benchee.Statistics | | 0.114286 | 3.0 | 0.494949 | 0.591837 | 179.524698
Enum | Enum | | 0.108974 | 3.0 | 0.544444 | 0.615646 | 150.808986
Benchee.Benchmark.R... | Benchee.Benchmark.R... | | 0.097222 | 3.0 | 0.453704 | 0.527211 | 91.907487
Benchee.Benchmark | Benchee.Benchmark | | 0.090909 | 3.0 | 0.471154 | 0.561224 | 101.087157
Benchee.Formatters.C... | Benchee.Formatters.C... | | 0.073529 | 3.0 | 0.538462 | 0.639456 | 253.695153
Benchee.Conversion.Sc... | Benchee.Conversion.Sc... | | 0.071429 | 3.0 | 0.415254 | 0.479592 | 68.823855
Benchee.Conversion.Fo... | Benchee.Conversion.F... | | 0.071429 | 4.0 | 0.408333 | 0.481293 | 30.082489
Benchee.Output.Bench... | Benchee.Output.Bench... | | 0.047619 | 3.0 | 0.429825 | 0.493197 | 24.669867
Benchee.Utility.FileCre... | Benchee.Utility.FileCre... | | 0.047619 | 3.0 | 0.429825 | 0.493197 | 50.845932
Benchee.System | Benchee.System | | 0.005495 | 4.0 | 0.457944 | 0.566327 | 260.796209
List | List | | 0.0 | 4.0 | 0.322368 | 0.353741 | 0.0
Benchee.Utility.RepeatN | Benchee.Utility.RepeatN | | 0.0 | 4.0 | 0.314103 | 0.341837 | 0.0
erlang | erlang | | 0.0 | 4.0 | 0.449541 | 0.491497 | 41.291916
DeepMerge | DeepMerge | | 0.0 | 4.0 | 0.337931 | 0.369048 | 0.0
Add column
Merge columns
Delete column
Clear column
Copy data to other column
Fill column with a value
Duplicate column
Create a boolean column from regex match
Create column with list of regex matching groups
Negate boolean values
Convert column to dynamic

Parameters:

Network Interpretation: undirected

Results:

Average Clustering Coefficient: 0.104
Total triangles: 275
The Average Clustering Coefficient is the mean value of individual coefficients.



Algorithm:

Matthieu Latapy, *Main-memory Triangle Computations for Very Large (Sparse (Power-Law)) Graphs*, in Theoretical Computer Science (TCS) 407 (1-3), pages 458-473, 2008

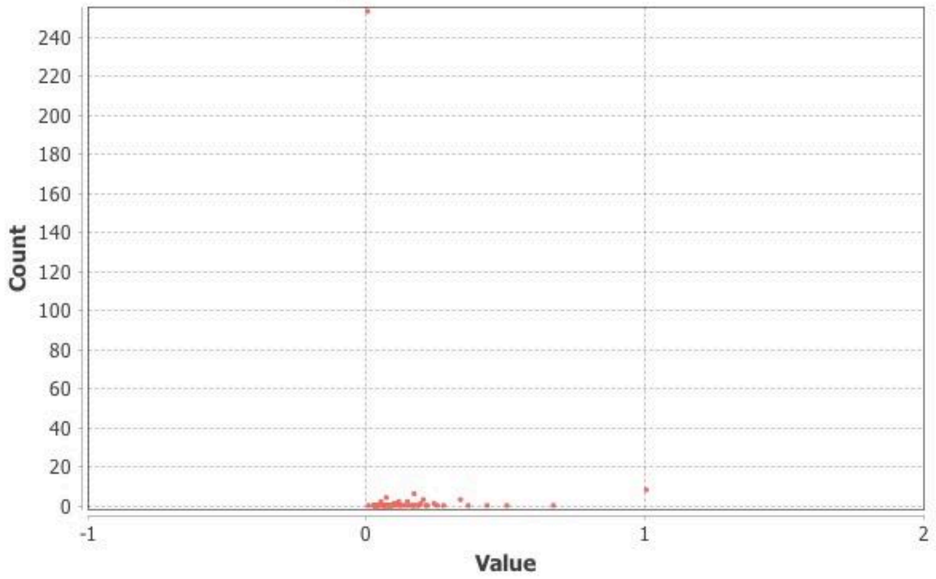
Parameters:

Network Interpretation: undirected

Results:

Average Clustering Coefficient: 0.104
Total triangles: 275
The Average Clustering Coefficient is the mean value of individual coefficients.

Clustering Coefficient Distribution



Algorithm:

Matthieu Latapy, *Main-memory Triangle Computations for Very Large (Sparse (Power-Law)) Graphs*, in Theoretical Computer Science (TCS) 407 (1-3), pages 458-473, 2008

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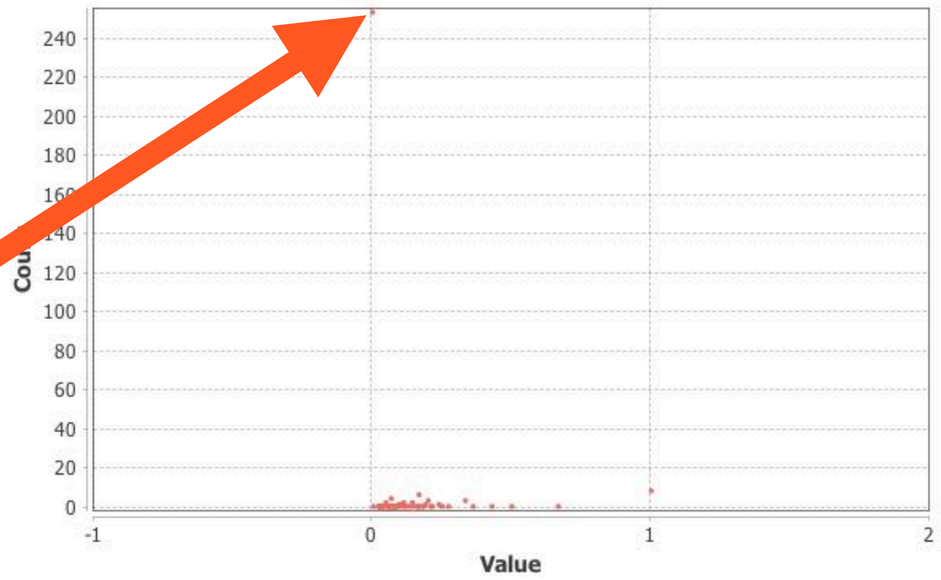


Algorithm:

Matthieu Latapy, *Main-memory Triangle Computations for Very Large (Sparse (Power-Law)) Graphs*, in Theoretical Computer Science (TCS) 407 (1-3), pages 458-473, 2008

Clustering Coefficient Metric Report

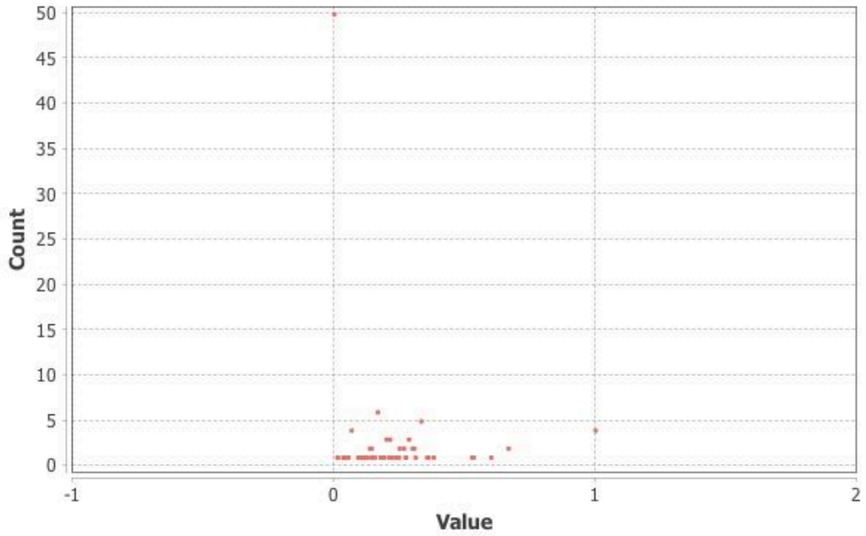
Parameters:

Network Interpretation: undirected

Results:

Average Clustering Coefficient: 0.211
Total triangles: 277
The Average Clustering Coefficient is the mean value of individual coefficients.

Clustering Coefficient Distribution



Algorithm:

Matthieu Latapy, *Main-memory Triangle Computations for Very Large (Sparse (Power-Law)) Graphs*, in Theoretical Computer Science (TCS) 407 (1-3), pages 458-473, 2008

Clustering Coefficient Metric Report

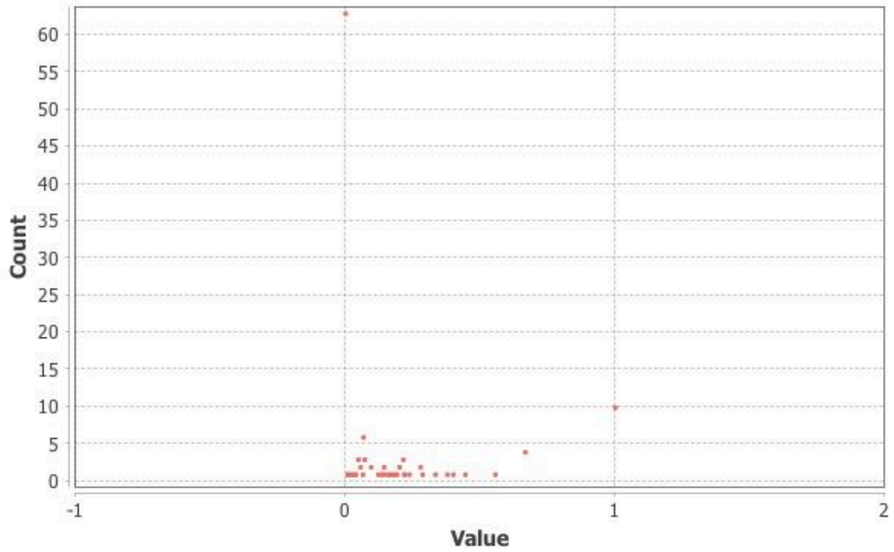
Parameters:

Network Interpretation: undirected

Results:

Average Clustering Coefficient: 0.207
Total triangles: 143
The Average Clustering Coefficient is the mean value of individual coefficients.

Clustering Coefficient Distribution



Algorithm:

Matthieu Latapy, *Main-memory Triangle Computations for Very Large (Sparse (Power-Law)) Graphs*, in Theoretical Computer Science (TCS) 407 (1-3), pages 458-473, 2008

Clustering Coefficient Metric Report

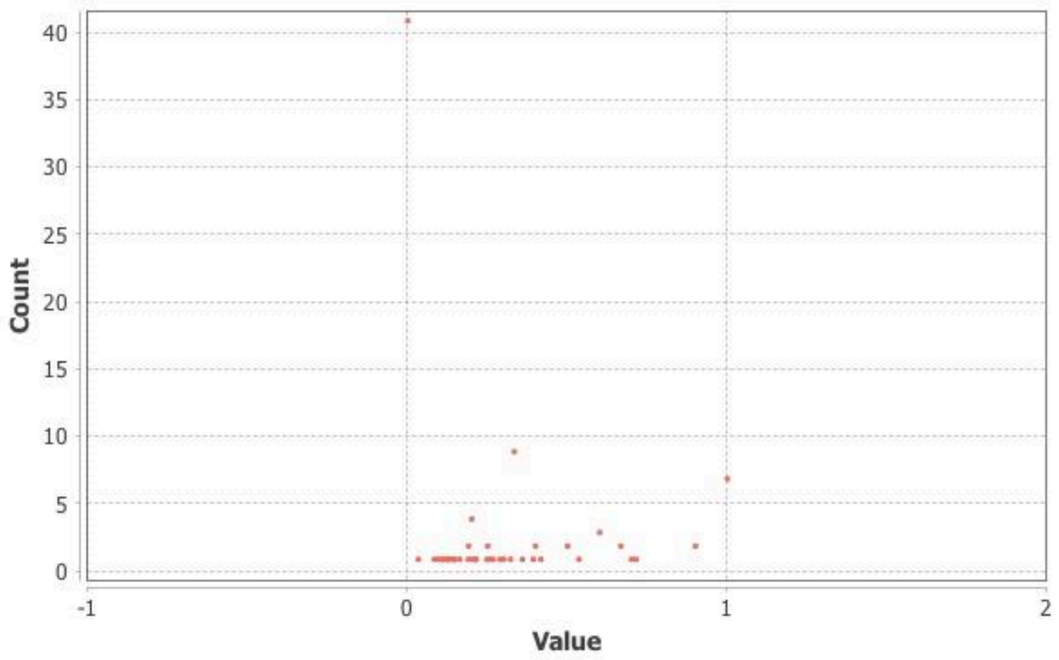
Parameters:

Network Interpretation: undirected

Results:

Average Clustering Coefficient: 0.337
Total triangles: 249
The Average Clustering Coefficient is the mean value of individual coefficients.

Clustering Coefficient Distribution



Clustering Coefficient Metric Report

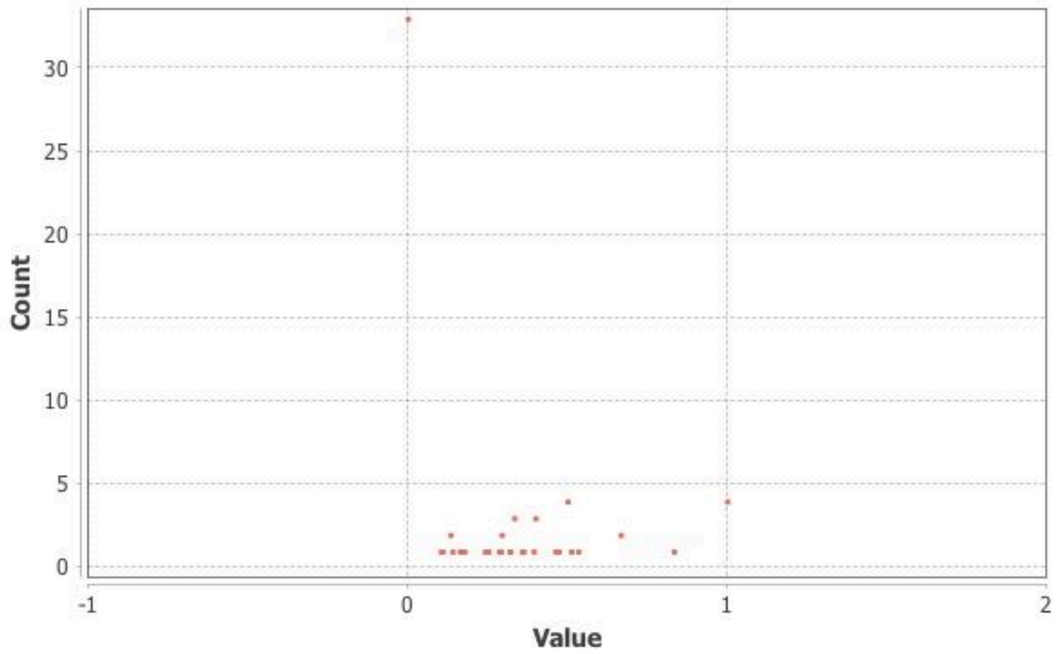
Parameters:

Network Interpretation: undirected

Results:

Average Clustering Coefficient: 0.319
Total triangles: 262
The Average Clustering Coefficient is the mean value of individual coefficients.

Clustering Coefficient Distribution



Clustering Coefficient Metric Report

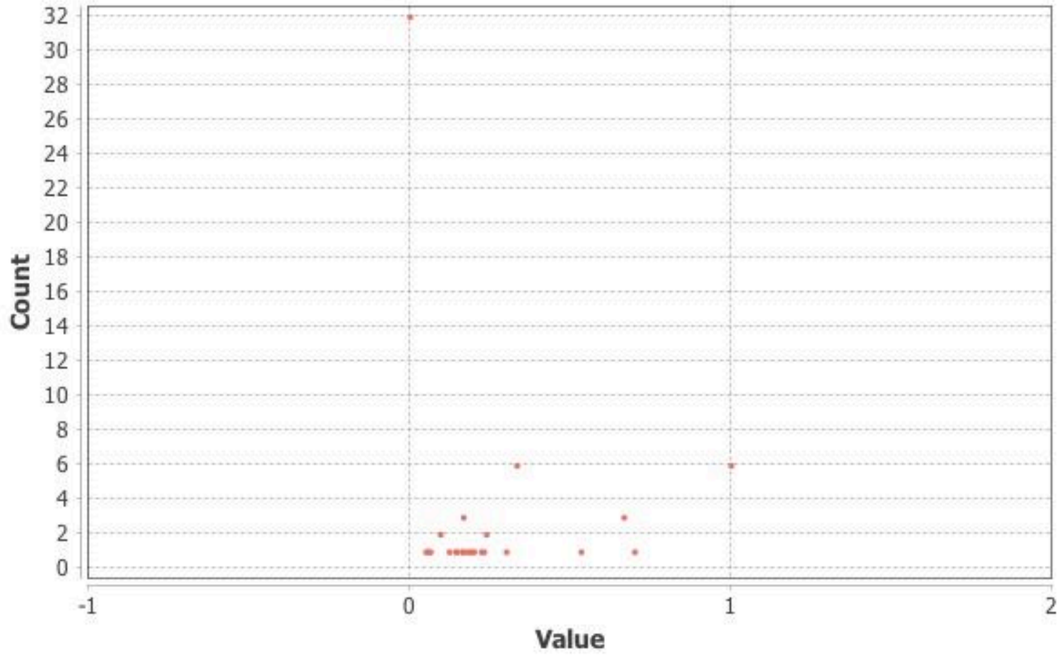
Parameters:

Network Interpretation: undirected

Results:

Average Clustering Coefficient: 0.315
Total triangles: 87
The Average Clustering Coefficient is the mean value of individual coefficients.

Clustering Coefficient Distribution



Clustering Coefficient Metric Report

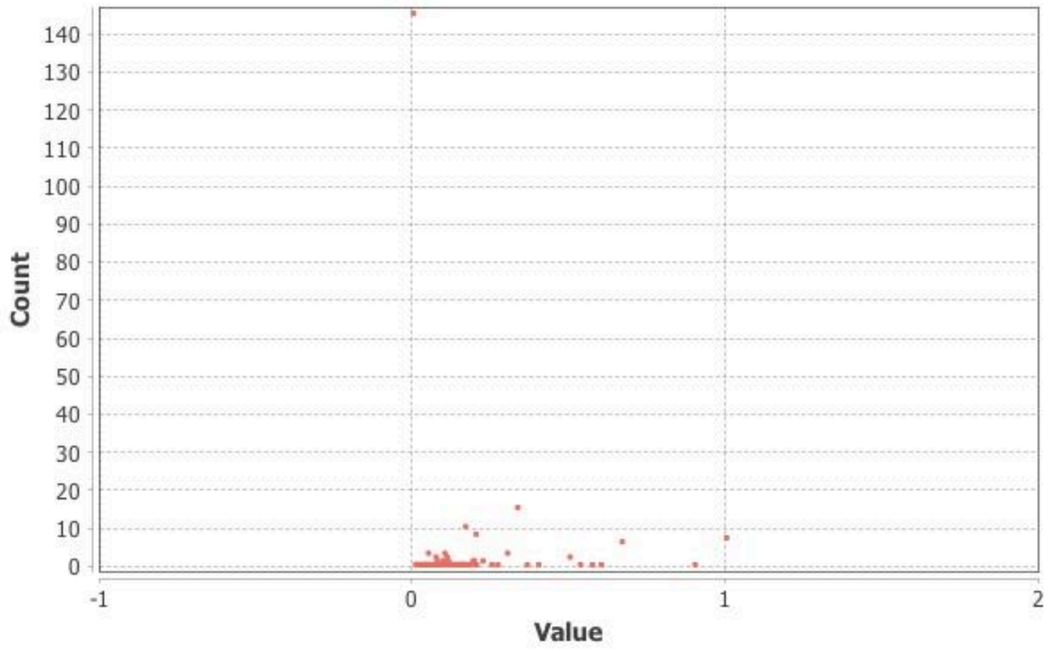
Parameters:

Network Interpretation: undirected

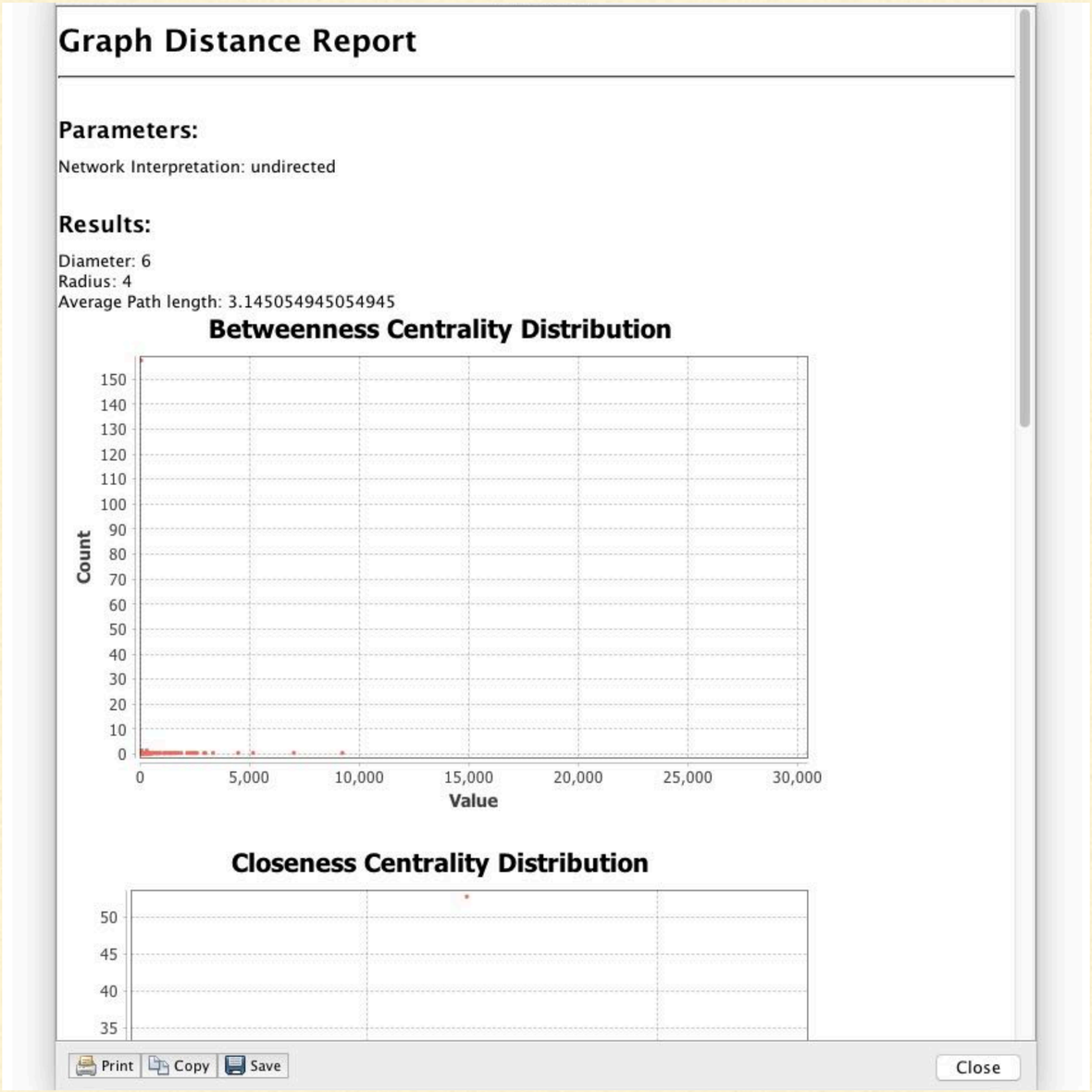
Results:

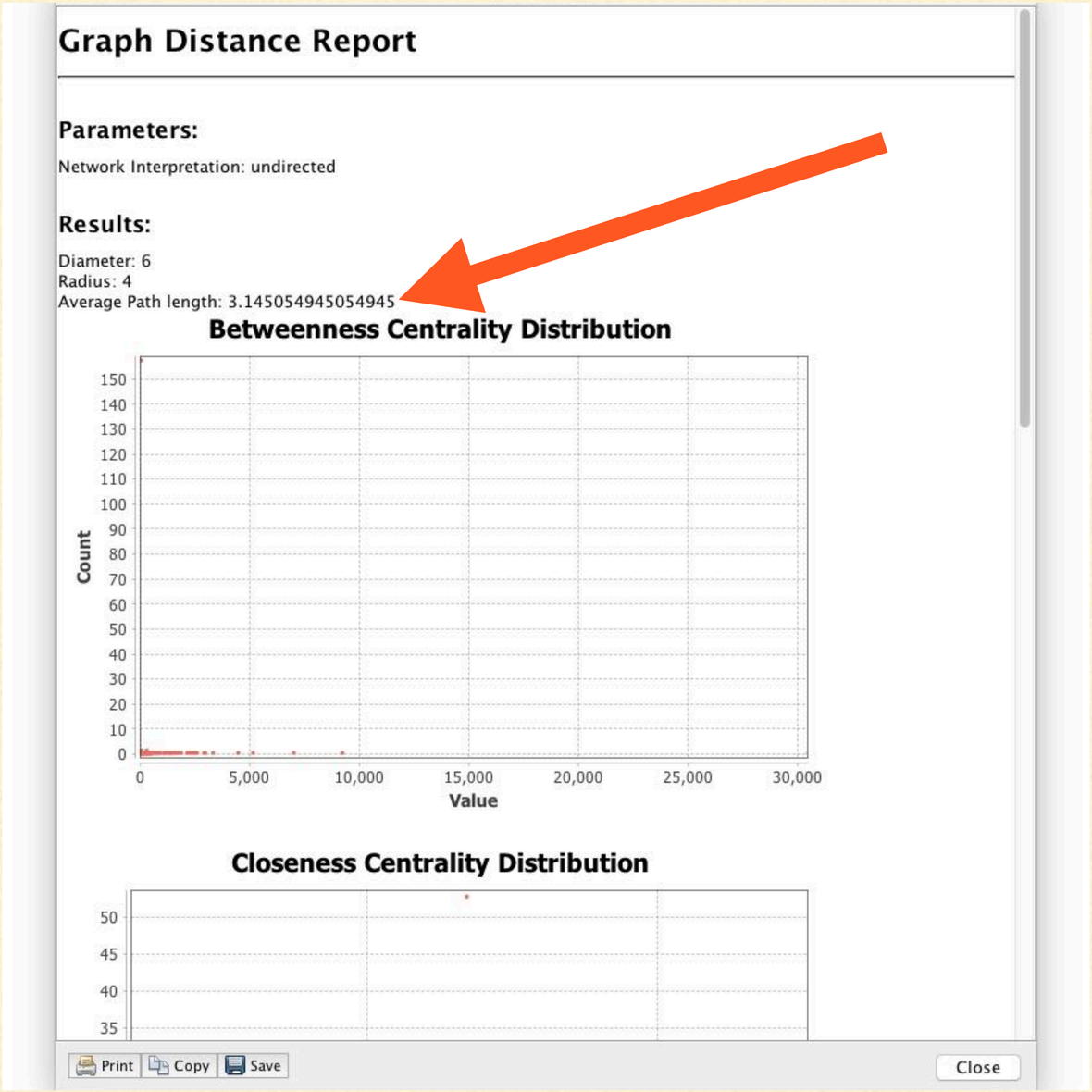
Average Clustering Coefficient: 0.207
Total triangles: 319
The Average Clustering Coefficient is the mean value of individual coefficients.

Clustering Coefficient Distribution



SMALL-WORLD NETWORK NOT FOUND 😞


Graph Distance Report
Parameters:
Network Interpretation: undirected
Results:
Diameter: 6
Radius: 4
Average Path length: 3.145054945054945
Betweenness Centrality Distribution
Count
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
5,000
10,000
15,000
20,000
25,000
30,000
Value
Closeness Centrality Distribution
50
45
40
35
Print
Copy
Save
Close

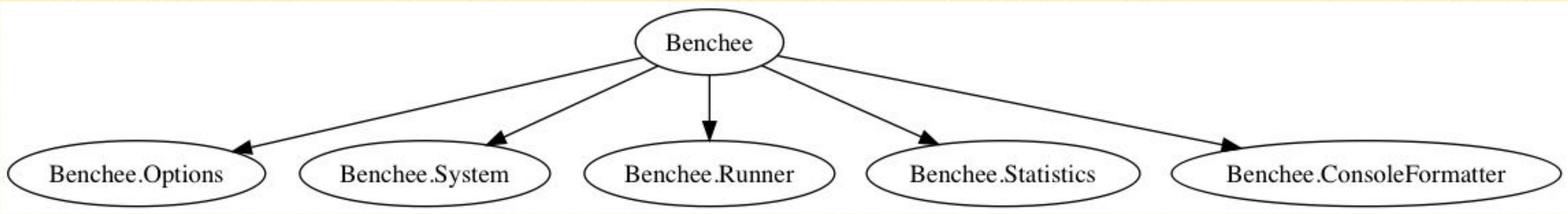

Graph Distance Report
Parameters:
Network Interpretation: undirected
Results:
Diameter: 6
Radius: 4
Average Path length: 3.145054945054945
Betweenness Centrality Distribution
Count
Value
0
5,000
10,000
15,000
20,000
25,000
30,000
Closeness Centrality Distribution
Print
Copy
Save
Close

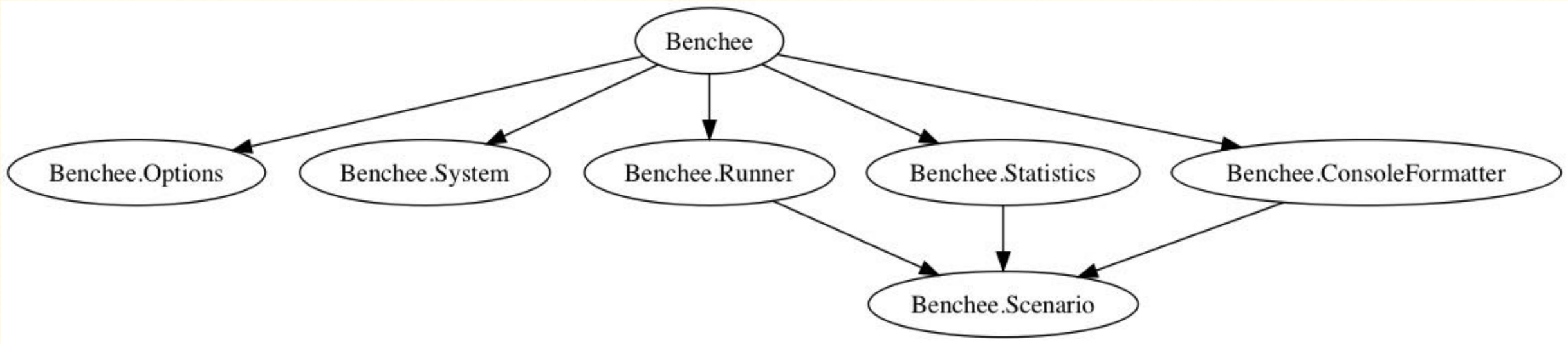
```elixir
defmodule Benchee do
  def run(jobs, config_opts) do
    # convert user config_opts into structured data
    # get information about the system on which the benchmarks are running
    # convert user given benchmarking jobs into structured data
    # take benchmarking measurements
    # calculate statistics from measurements
    # output results to terminal
  end
end
```

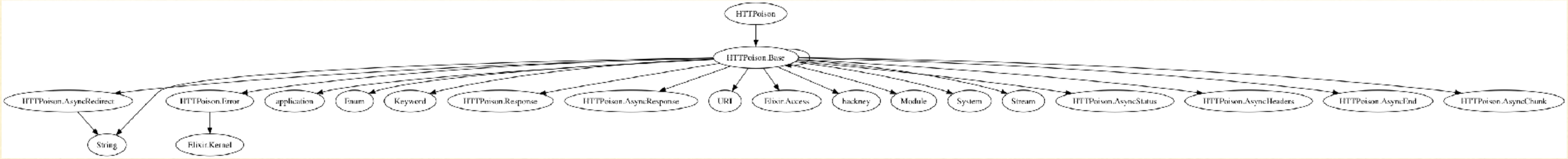
```elixir
defmodule Benchee do
  def run(jobs, config_opts) do
    config
    |> convert_user_opts()
    |> get_system_info()
    |> add_benchmarking_jobs(jobs)
    |> measure_runtimes()
    |> calculate_statistics()
    |> output_results()
  end

  def convert_user_opts(config_opts) do
    # ...
  end

  def get_system_info(benchmarking_suite) do
    # ...
  end

  # ...
end
```

```elixir
defmodule Benchee do
  # ...

  def convert_user_opts(config_opts) do
    config_opts
    |> step_1
    |> step_2
    |> step_3
    |> step_4
    |> step_5
  end

  defp step_1(data) do
    # ...
  end

  defp step_2(data) do
    # ...
  end

  # ...
end
```

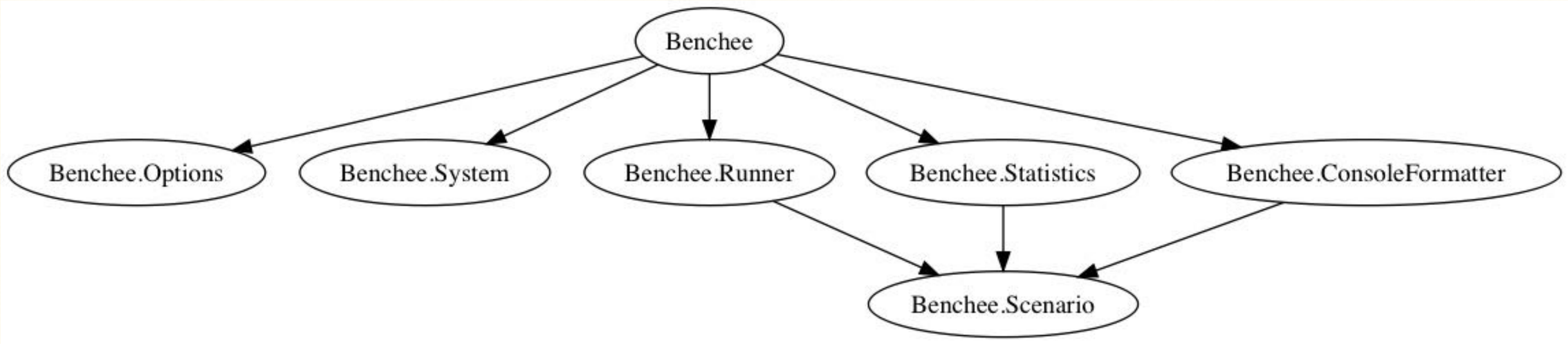
```elixir
defmodule Benchee do
  def run(jobs, config_opts) do
    config
    |> Benchee.Options.convert()
    |> Benchee.System.info()
    |> Benchee.Benchmark.add(jobs)
    |> Benchee.Runner.run()
    |> Benchee.Statistics.calculate()
    |> Benchee.ConsoleFormatter.output_results()
  end
end

defmodule Benchee.Options do
  # ...
end

defmodule Benchee.System do
  # ...
end

# ...
```

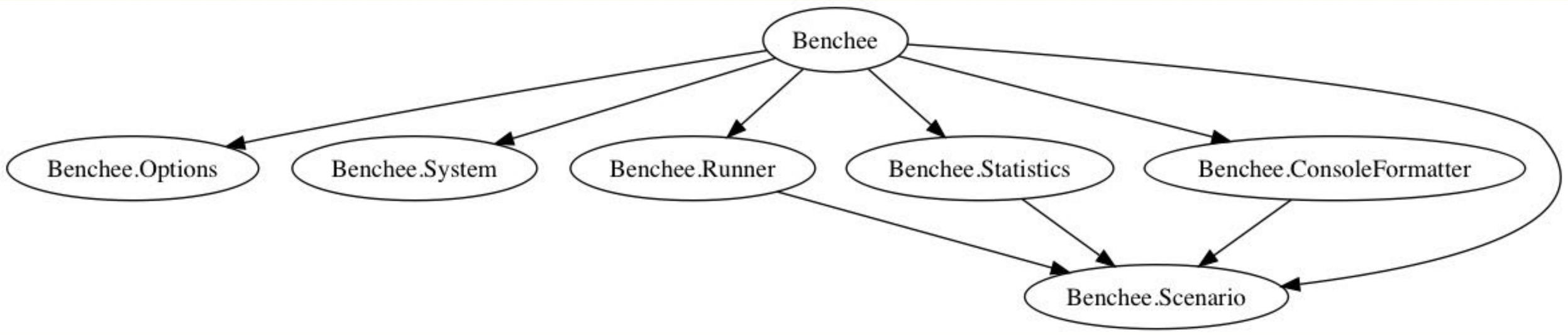

Benchee
Benchee.Options
Benchee.System
Benchee.Runner
Benchee.Statistics
Benchee.ConsoleFormatter

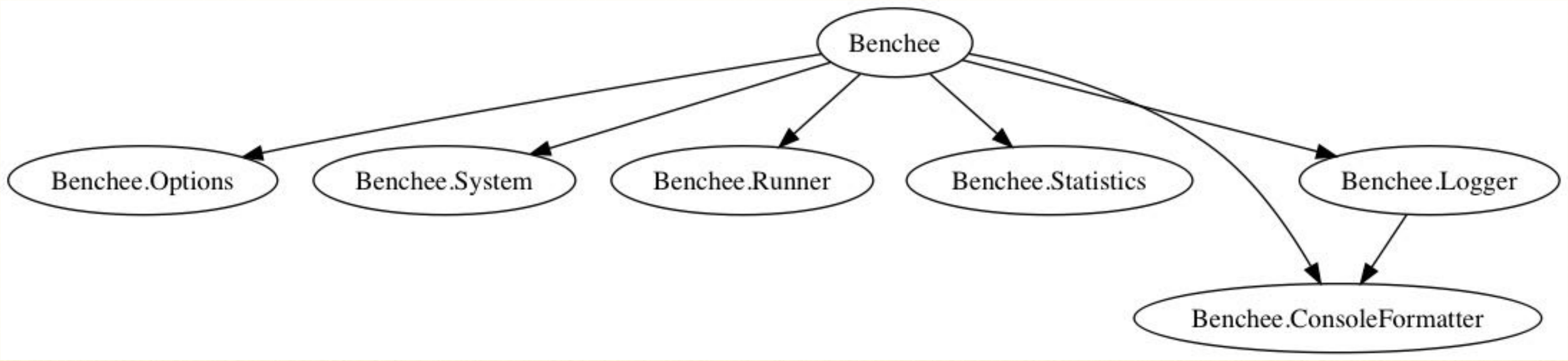

Benchee
Benchee.Options
Benchee.System
Benchee.Runner
Benchee.Statistics
Benchee.ConsoleFormatter
Benchee.Scenario

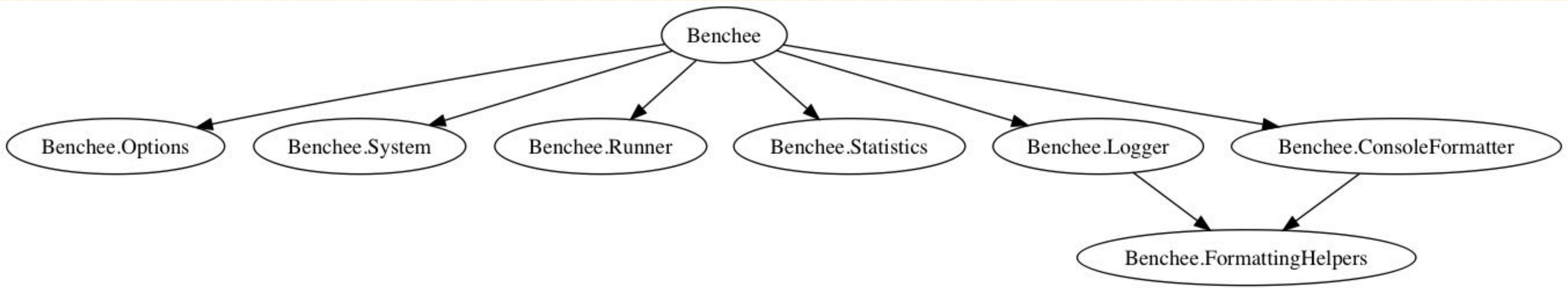

HTTPoison
HTTPoison.Base
HTTPoison.AsyncRedirect
HTTPoison.Error
application
Enum
Keyword
HTTPoison.Response
HTTPoison.AsyncResponse
URI
Elixir.Access
hackney
Module
System
Stream
HTTPoison.AsyncStatus
HTTPoison.AsyncHeaders
HTTPoison.AsyncEnd
HTTPoison.AsyncChunk
String
Elixir.Kernel

WHERE DOES CLUSTERING COME FROM?


Benchee
Benchee.Options
Benchee.System
Benchee.Runner
Benchee.Statistics
Benchee.ConsoleFormatter
Benchee.Scenario


Benchee
Benchee.Options
Benchee.System
Benchee.Runner
Benchee.Statistics
Benchee.ConsoleFormatter
Benchee.Scenario


Benchee
Benchee.Options
Benchee.System
Benchee.Runner
Benchee.Statistics
Benchee.Logger
Benchee.ConsoleFormatter


Benchee
Benchee.Options
Benchee.System
Benchee.Runner
Benchee.Statistics
Benchee.Logger
Benchee.ConsoleFormatter
Benchee.FormattingHelpers

"We hope that our work will stimulate further studies of small world networks… Although small-world architecture has not received much attention, we suggest that it will probably turn out to be widespread in biological, social and man-made systems, often with important dynamical consequences."

– *"Collective dynamics of 'small-world' networks" by Duncan J. Watts & Steven H. Strogatz*

FURTHER RESEARCH IDEAS

FURTHER RESEARCH IDEAS

- Relationships between types?

FURTHER RESEARCH IDEAS

- Relationships between types?
- Message sending in a large scale OTP application?

FURTHER RESEARCH IDEAS

- Relationships between types?
- Message sending in a large scale OTP application?
- Relationships between services in a microservice architecture?

FURTHER RESEARCH IDEAS

- Relationships between types?
- Message sending in a large scale OTP application?
- Relationships between services in a microservice architecture?
- Consensus seeking algorithms in distributed systems?

FURTHER RESEARCH IDEAS

- Relationships between types?
- Message sending in a large scale OTP application?
- Relationships between services in a microservice architecture?
- Consensus seeking algorithms in distributed systems?
- Blockchain?

THANK YOU 🇵🇱!