CollaborateR:
extract a collaboration graph from a version control system log

eRum 2020 – Parallel session 3 - Applications

3:00 PM - 3:15 PM

Wed June 17th, 2020

Leen Jooken

Joint work with Mathijs Creemers, Mieke Jans, Benoît Depaire and Gert Janssenswillen

UHASSELT

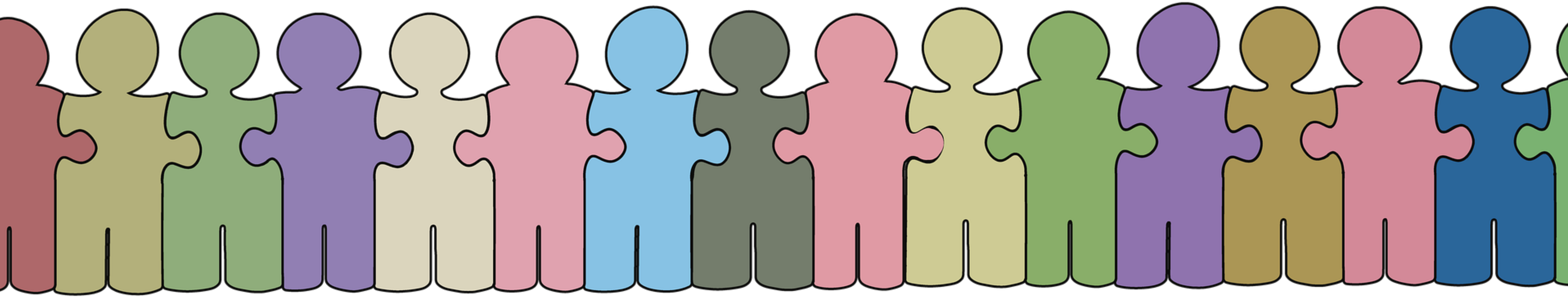
CollaborateR

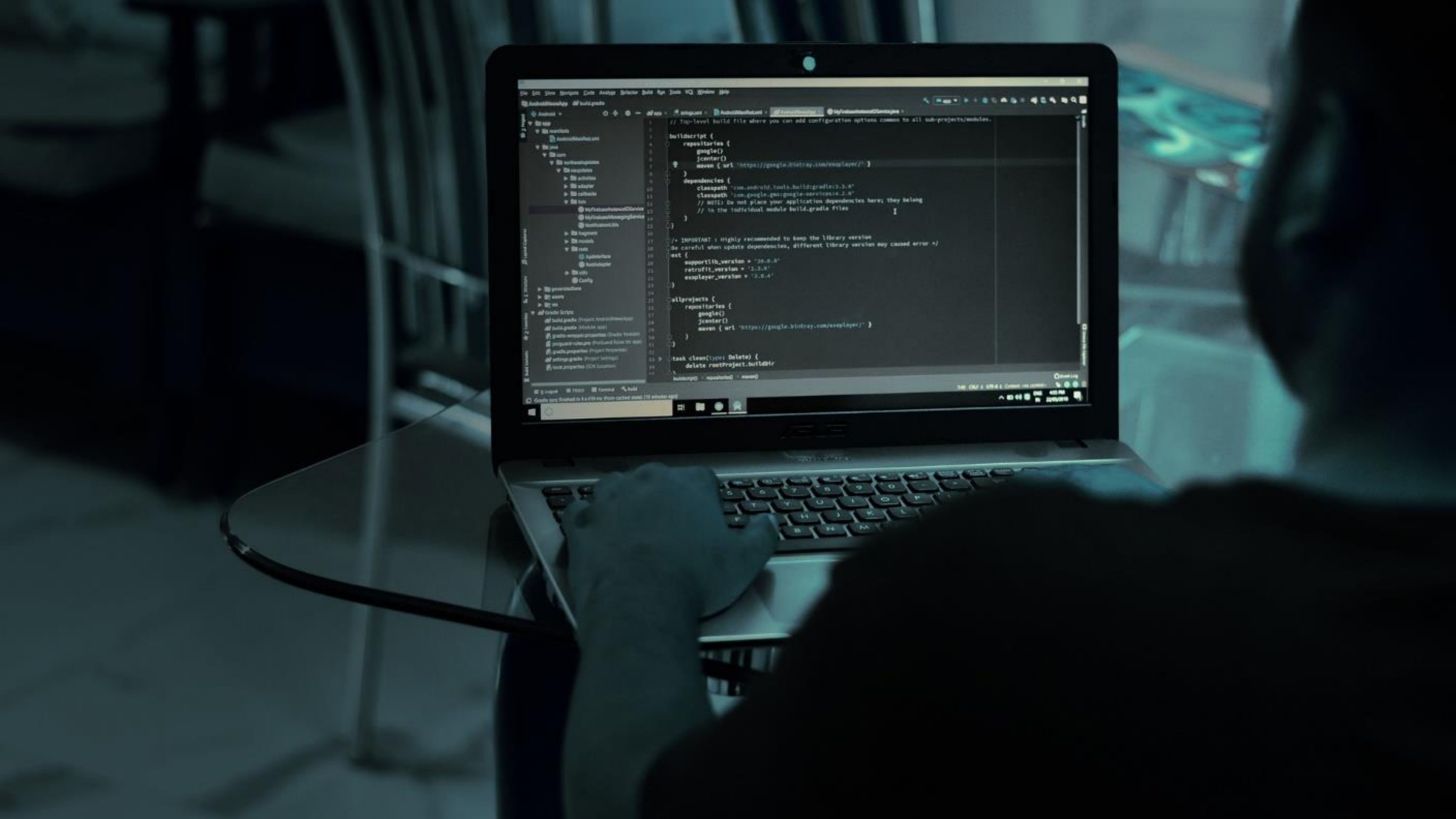
- Support knowledge management for software engineering environments
- Constructs collaboration graph

The Idea

The Idea

KNOWLEDGE MANAGEMENT
in software engineering environments




// Top-level build file where you can add configuration options common to all sub-projects/modules.
buildscript {
repositories {
google()
jcenter()
maven { url 'https://google.bintray.com/exoplayer/' }
dependencies {
// NOTE: Do not place your application dependencies here; they belong
// in the individual module build.gradle files
/* IMPORTANT : Highly recommended to keep the library version
Be careful when update dependencies, different library version may caused error */
allprojects {
task clean(type: Delete) {
delete rootProject.buildDir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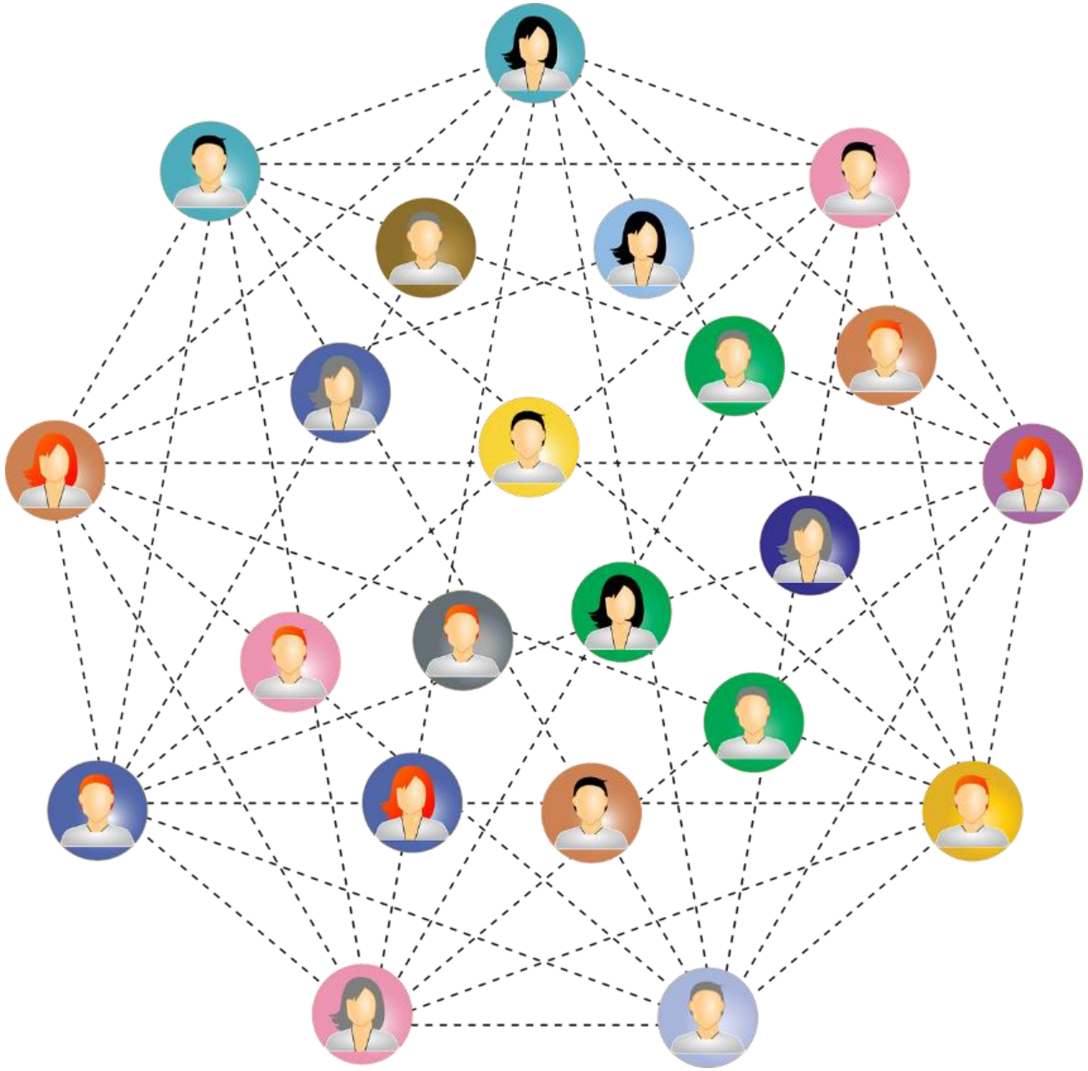
The Idea



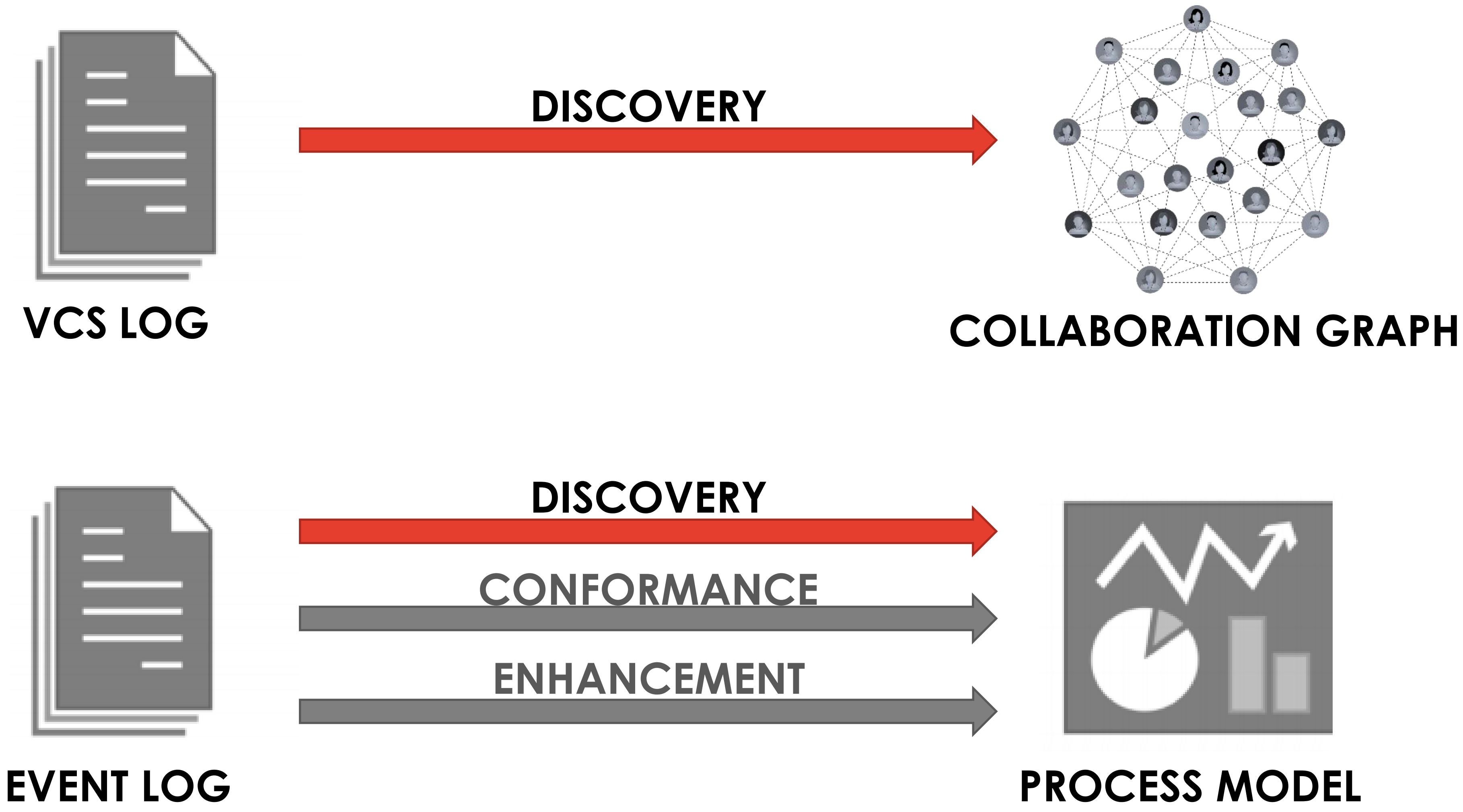
- Knowledge preservation
- General structure of collaboration
- Crucial Resources

The Data

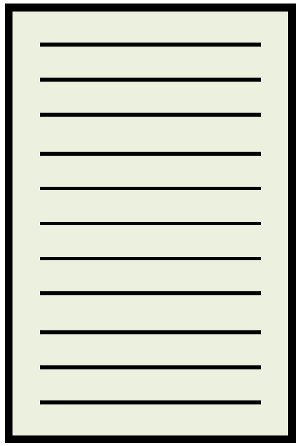
The Data

Inspiration

Inspiration



Inspiration



Inspiration

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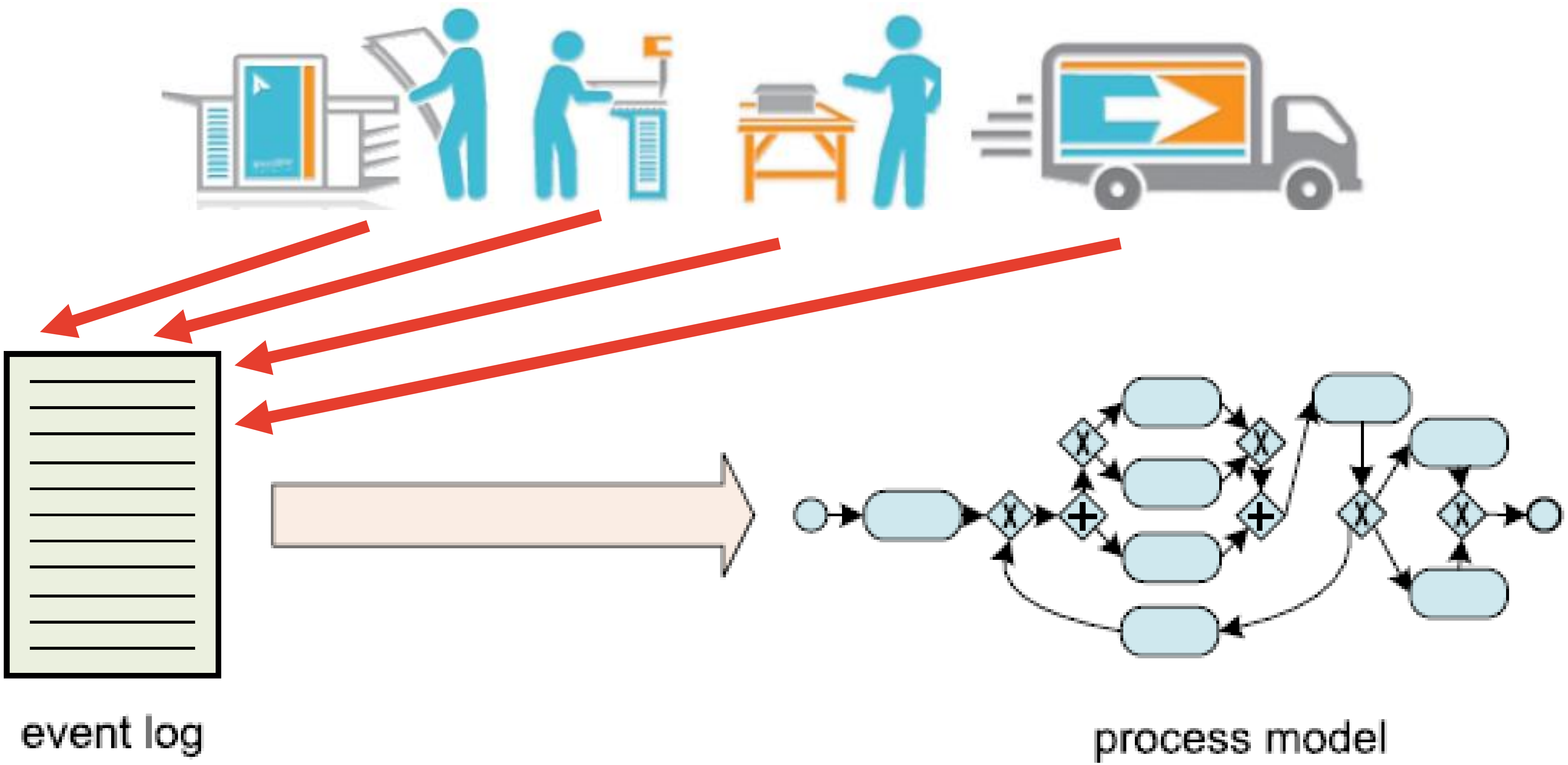

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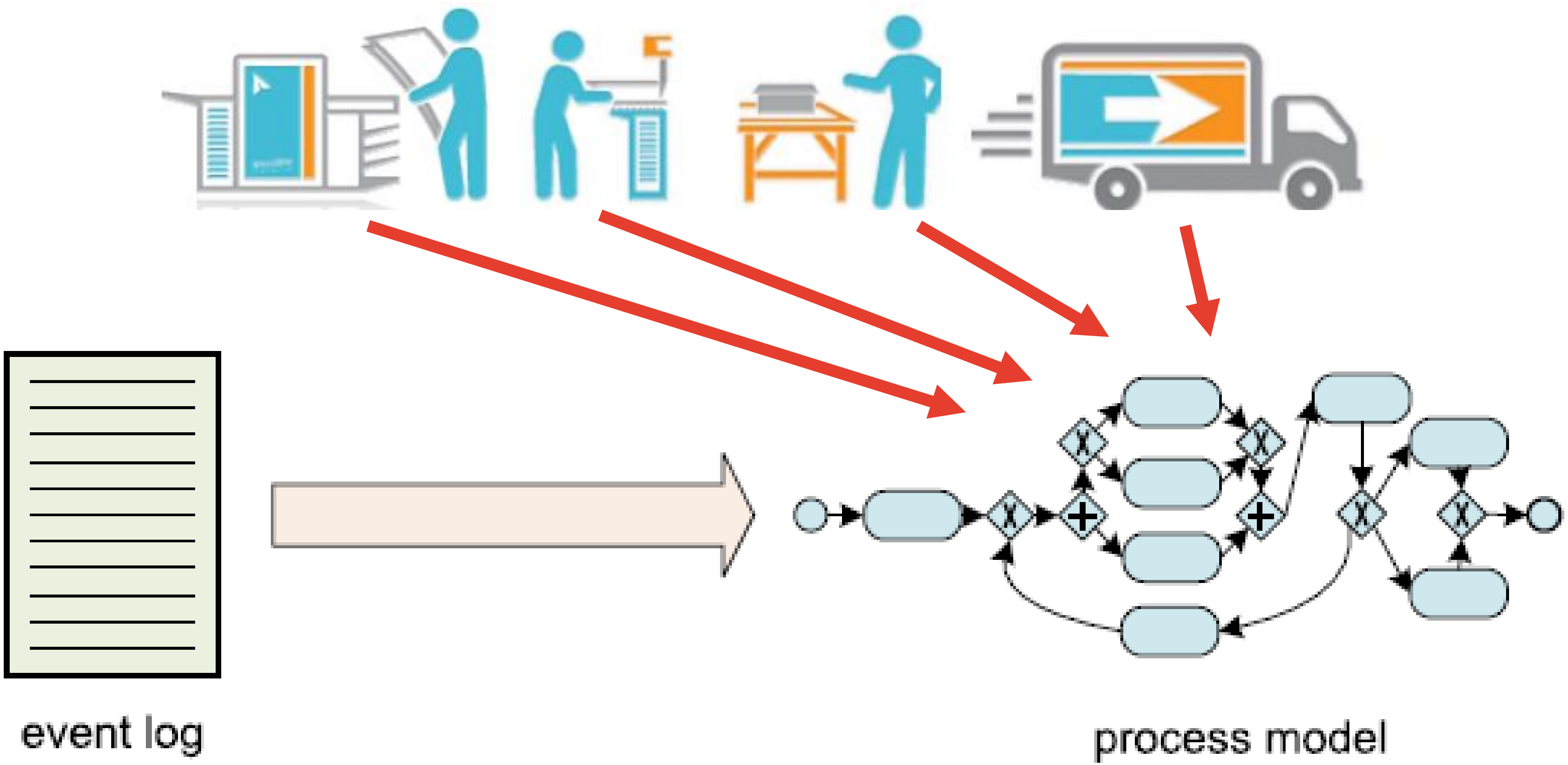

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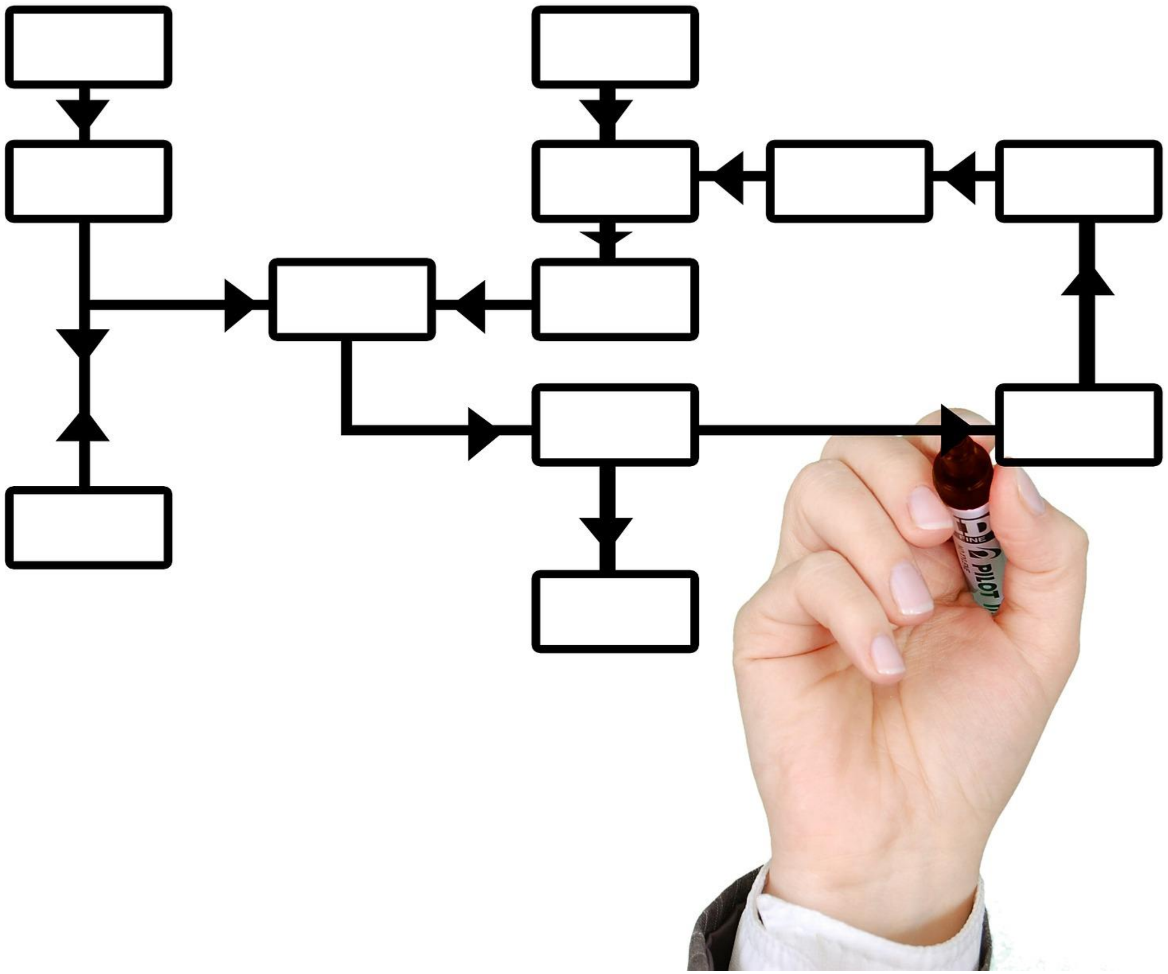
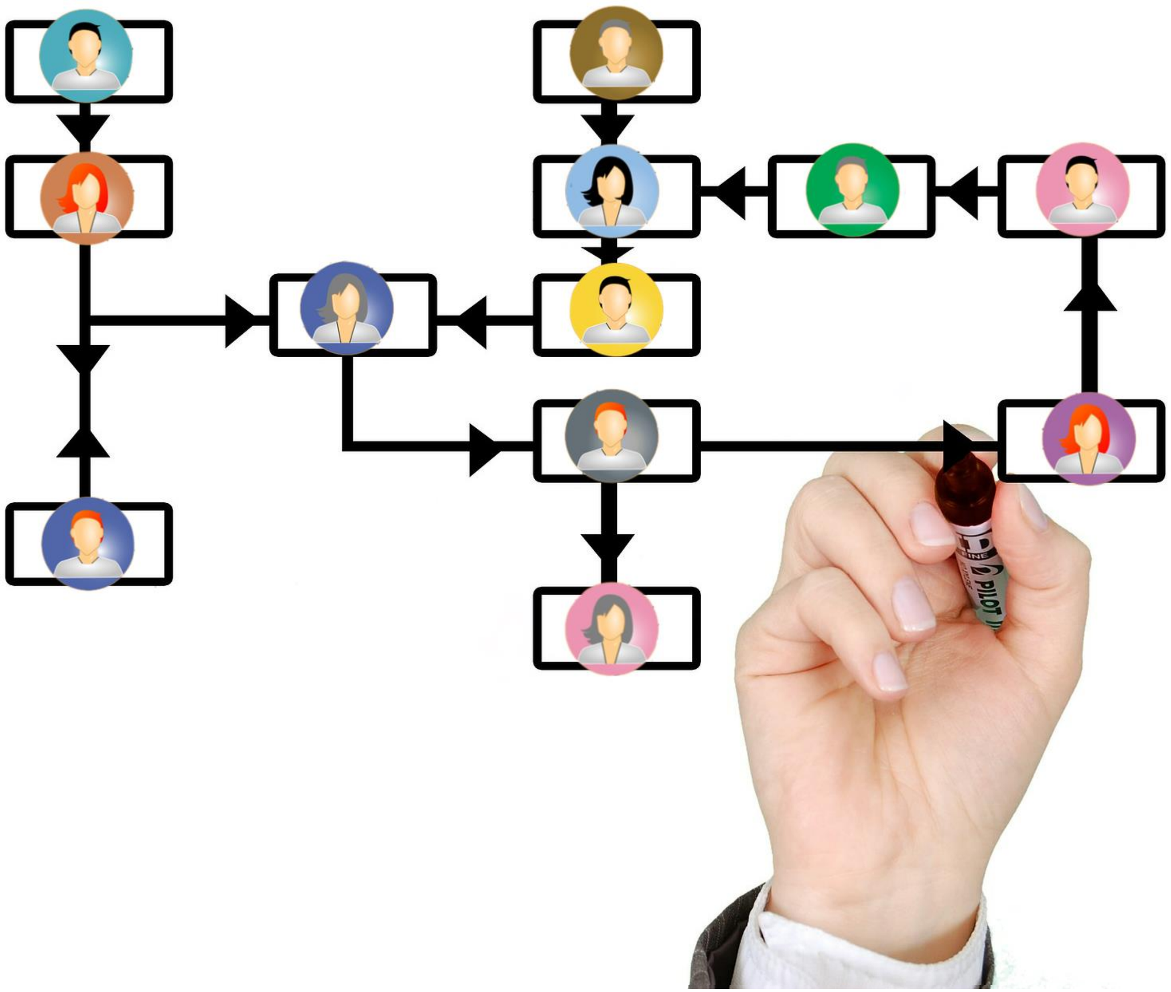


Inspiration



How To Use

How To Use

The input

How To Use

The input

FILE ID	ACTIVITY TYPE	TIMESTAMP	RESOURCE	REVISION	MODIFIER STATUS
1	Commit	25/03/2020 12:03:03	Jack Smidth	233	Modified
4	Commit	03/04/2020 16:37:12	Andy Joseph	234	Deleted
…	…	…	…	…	…

How To Use

The input

Business Process Analysis

bupaR

https://www.bupar.net

How To Use

The output:

```
#read the log
log <- read_vcs_eventlog(filePath)

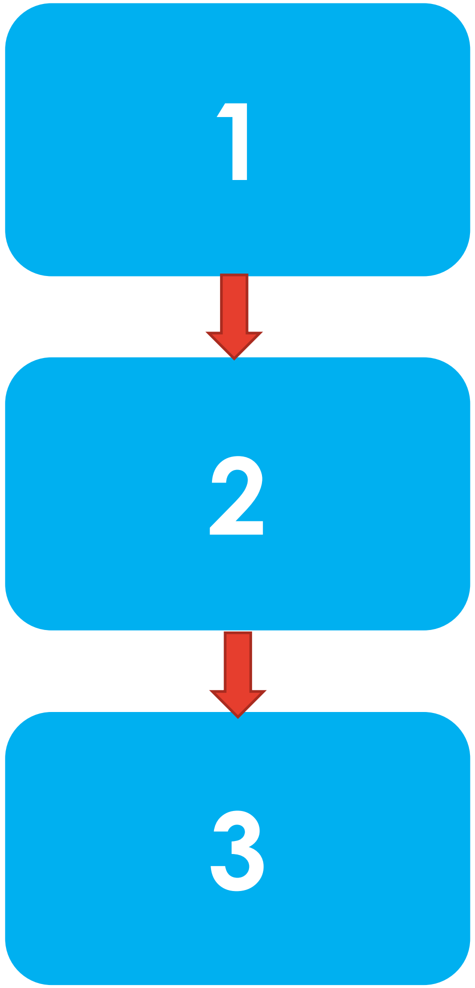
#build the graph
g <- build_graph(log, ... optional_parameters)
g$nodes
g$edges


#write graph to csv
writeGraphToCSV(g)

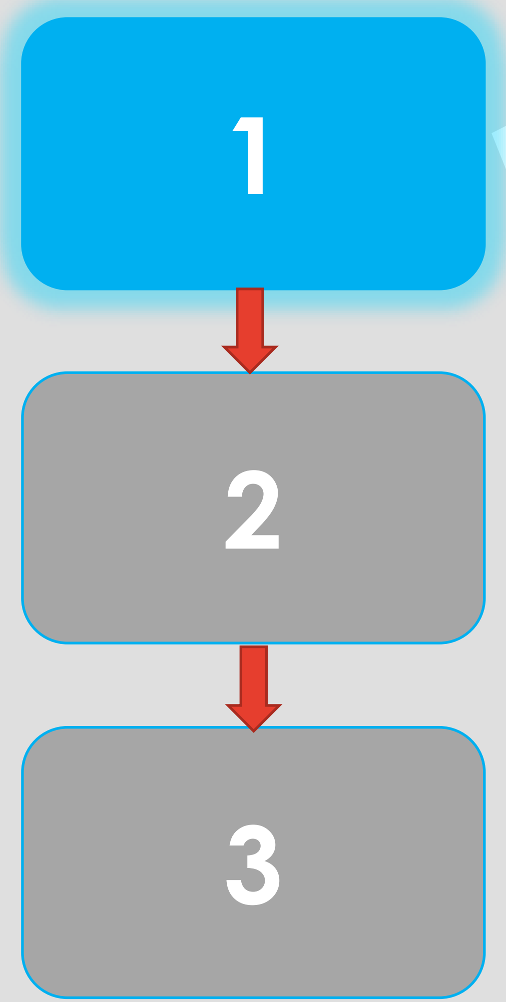
#visualize graph
visualizeGraph(g)
```

The Algorithm

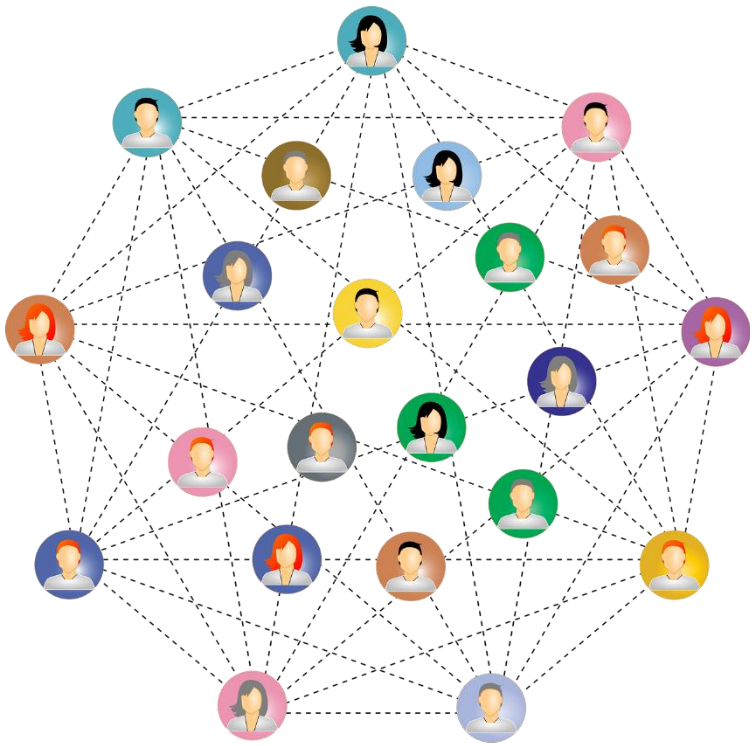
The Algorithm



Step 1: Building the Base Graph



- Include every programmer
- Add edge if file in common



Step 2: Calculating the Weights

2

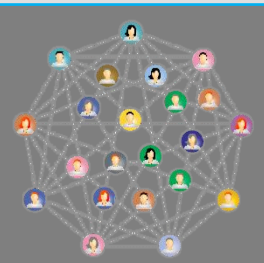
3

Purpose

1. Emphasis in the visualization

2. Simplification of the graph

Step 2: Calculating the Weights



2

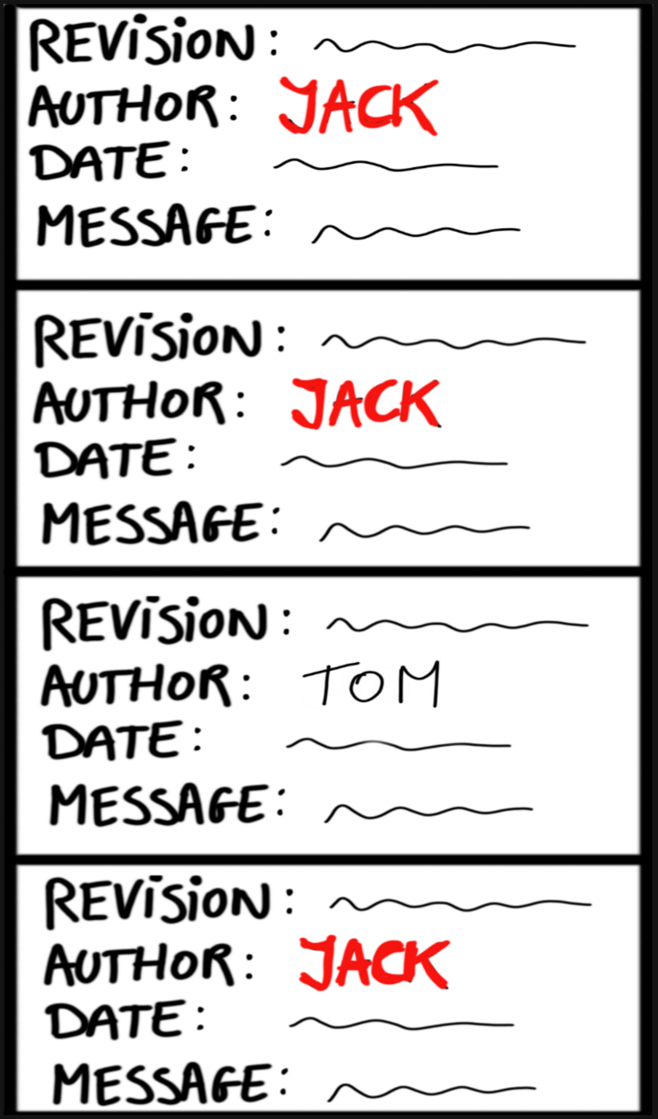
3

Importance of Programmer

$$\sum_{j=1}^{n} w_j \begin{cases} \text{Unary Frequency Significance} \\ \text{Betweenness Centrality} \\ \text{Eigenvector Centrality} \\ \text{Degree Centrality} \end{cases}$$

- Unary Frequency Significance
- Betweenness Centrality
- Eigenvector Centrality
- Degree Centrality

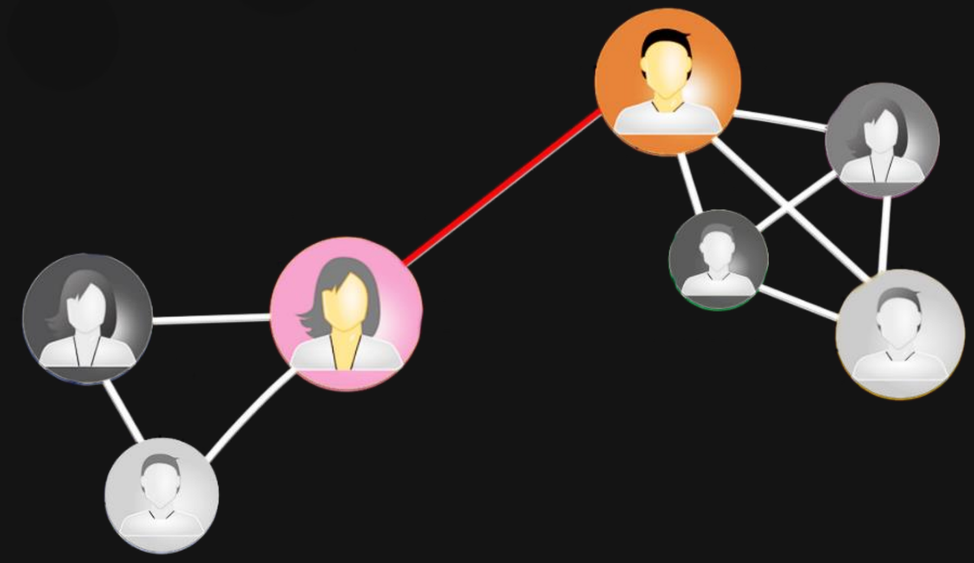
Step 2: Calculating the Weights



Unary Frequency Significance

The more often a programmer appears in the log, the more significant he is.

Step 2: Calculating the Weights



Betweenness Centrality

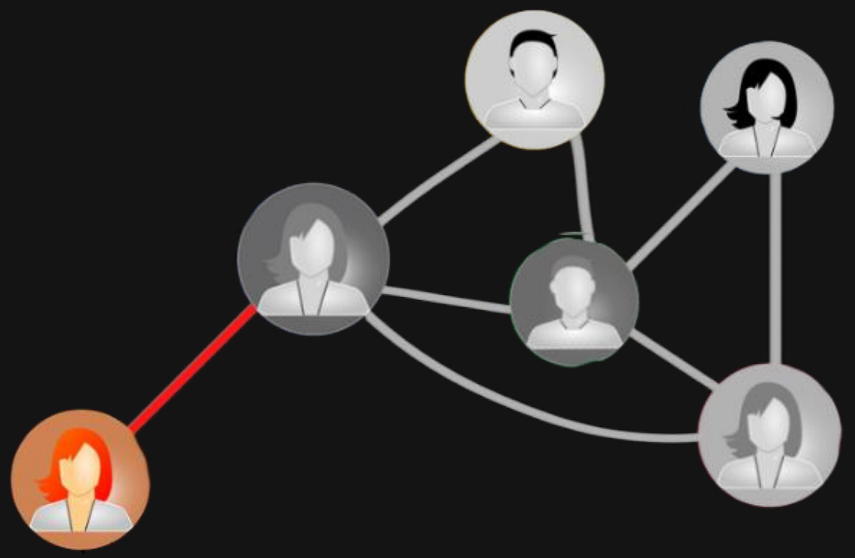
Handle programmers that are a part of several different teams.

Step 2: Calculating the Weights

Eigenvector Centrality

A node is highly important
if many other
highly important nodes link to it.

Step 2: Calculating the Weights

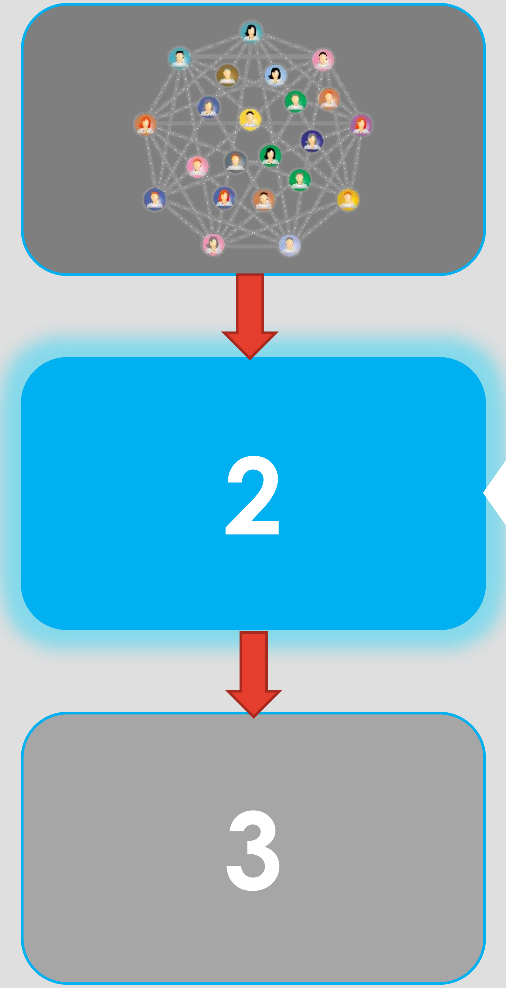


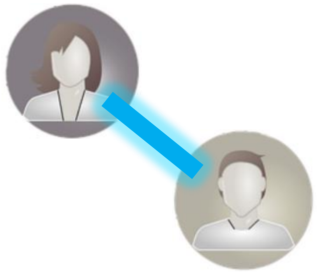
Degree Centrality

Number of edges incident upon the node.

→ *Identify isolated nodes*

Step 2: Calculating the Weights

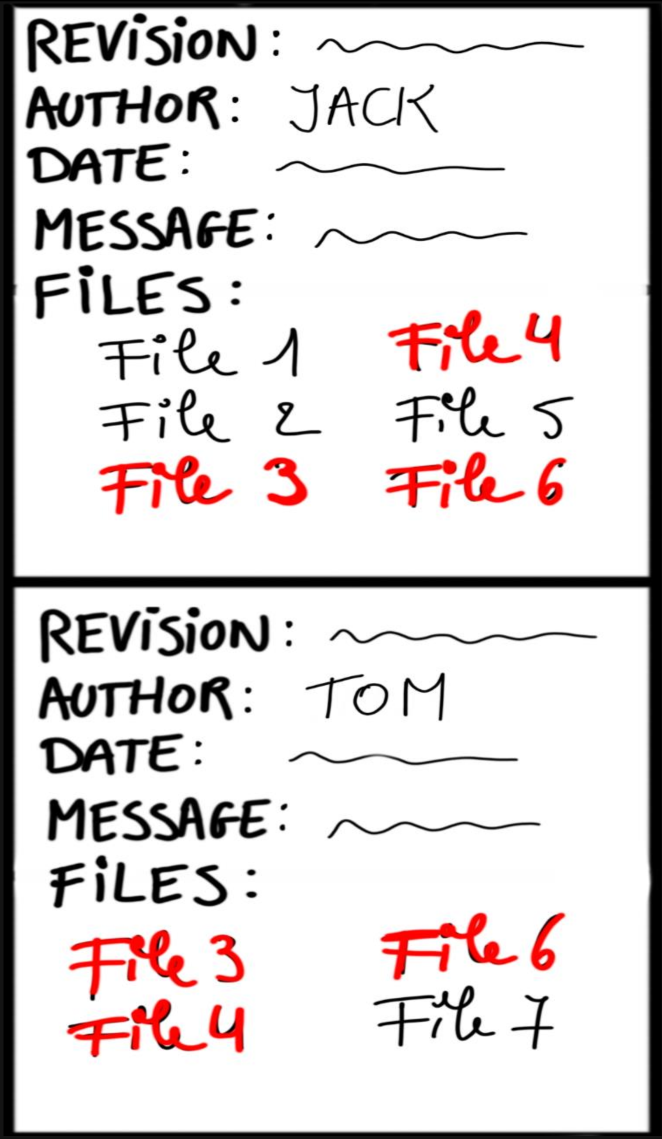




Importance of Collaboration

$$\sum_{j=1}^{n} w_j \begin{cases} \bullet \quad \text{Binary Frequency Significance} \\ \bullet \quad \text{Proximity Correlation} \end{cases}$$

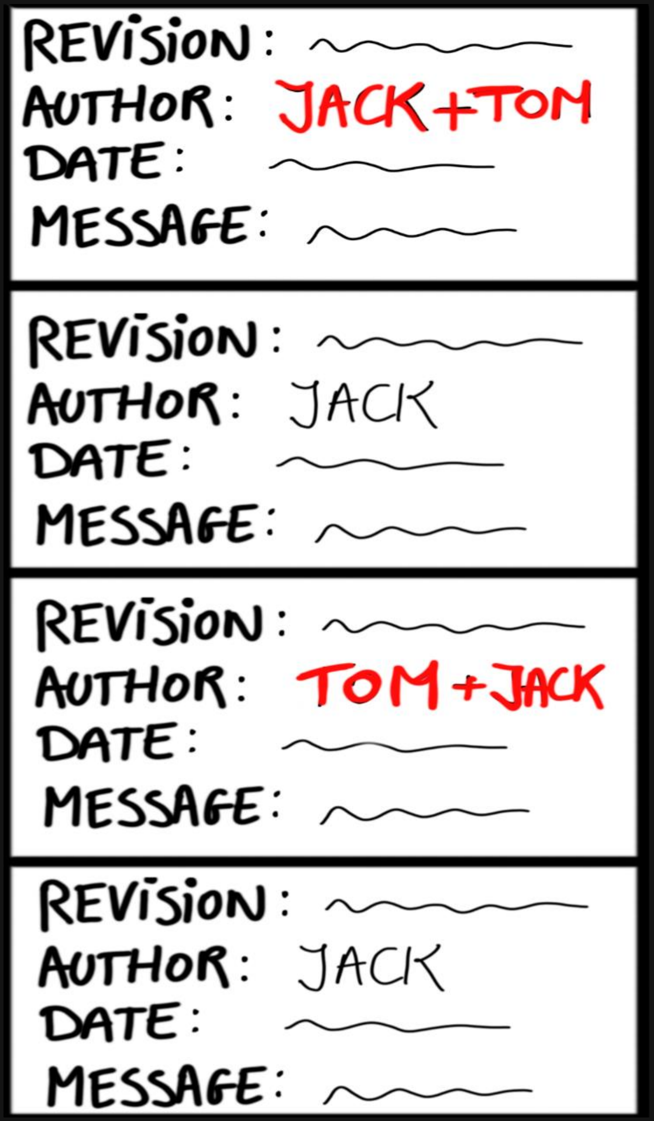
Step 2: Calculating the Weights



Binary Frequency Significance

The more files are worked on together, the stronger the relationship.

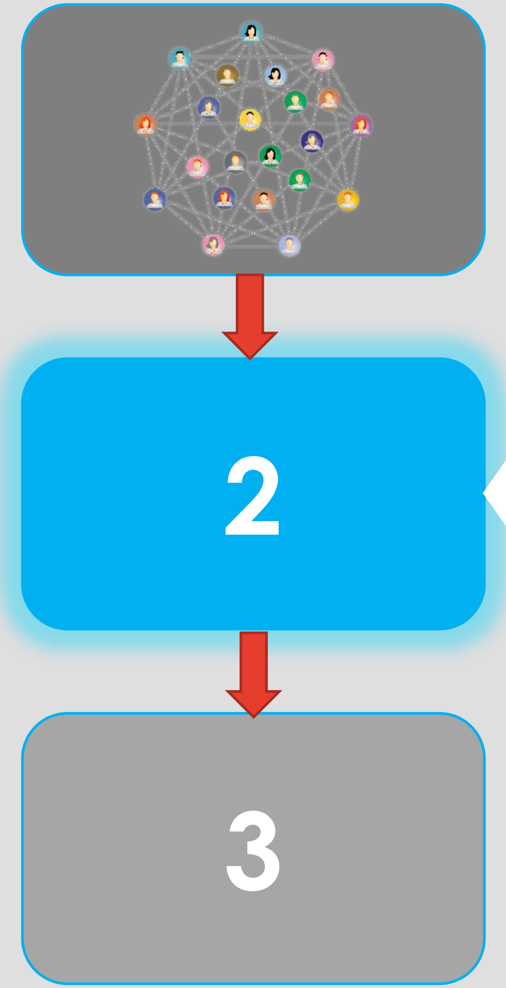
Step 2: Calculating the Weights

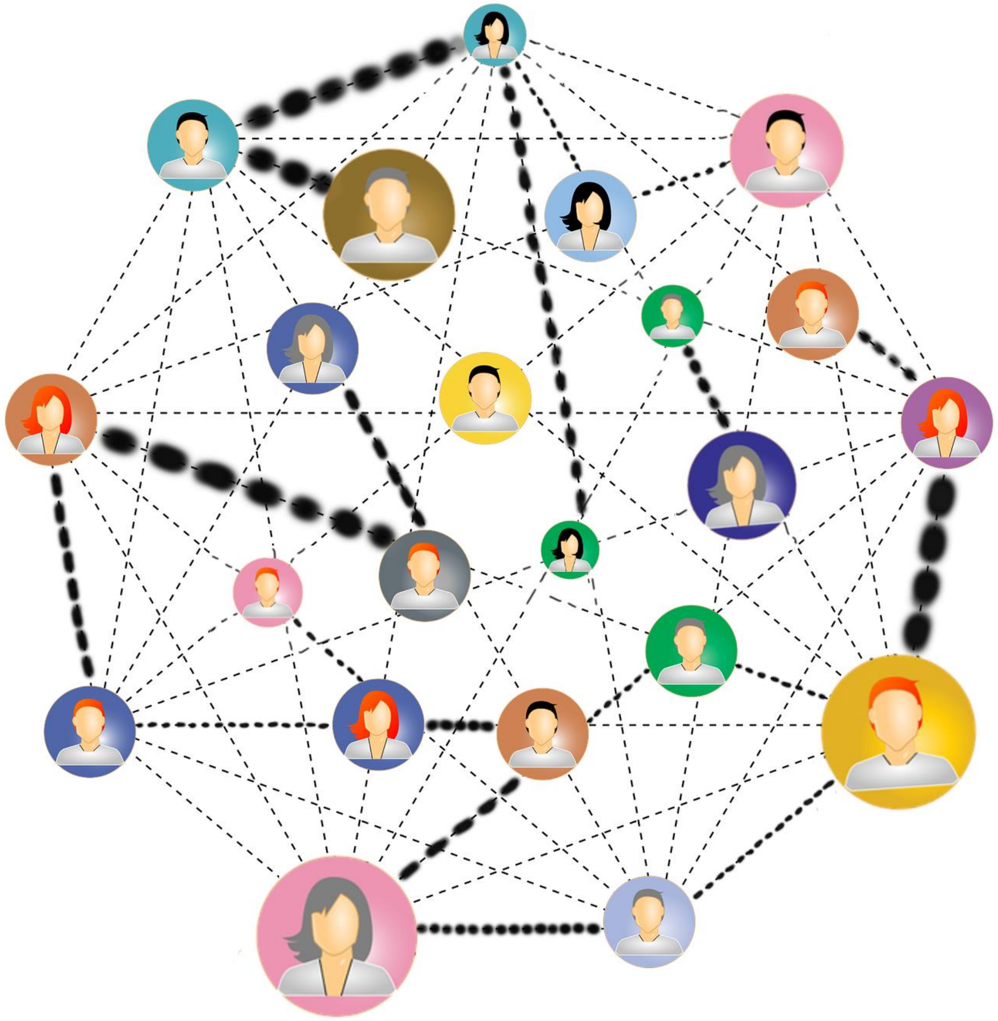


Proximity Correlation

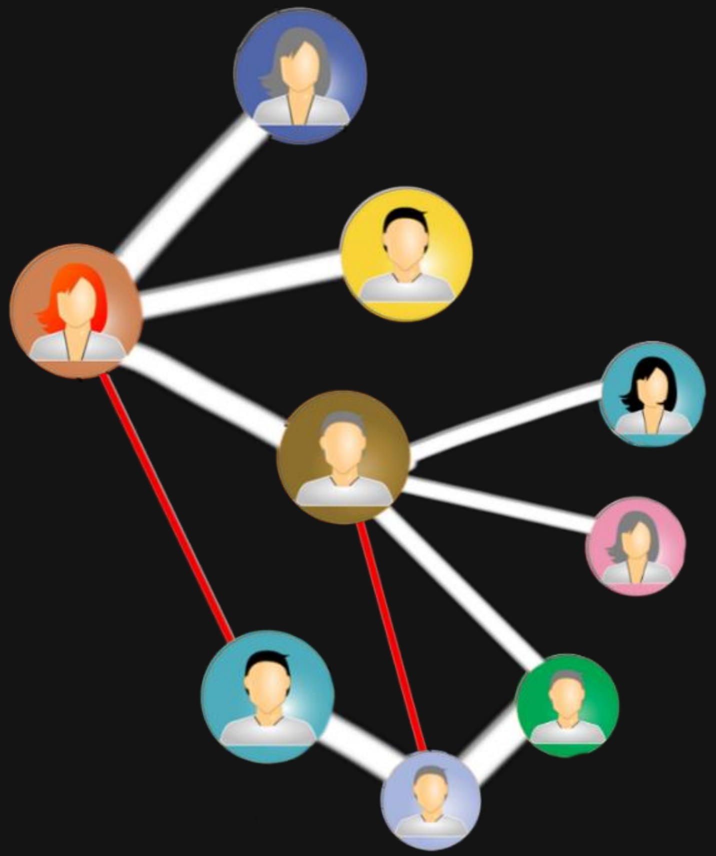
Pair programming
as a closer collaboration

Step 2: Calculating the Weights





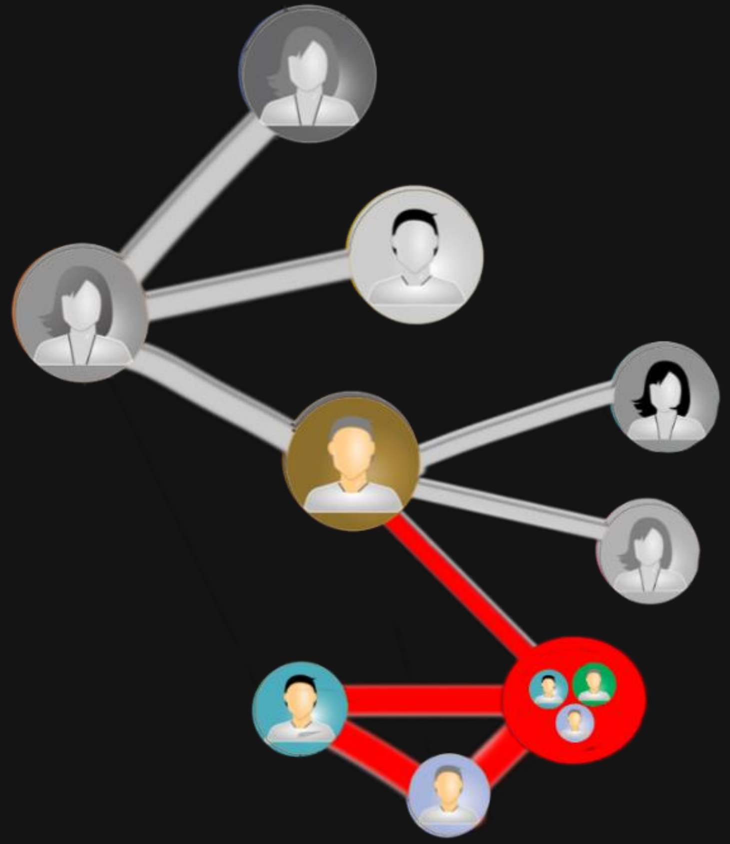
Step 3: Simplifying the Graph



Edge Filtering

Only the edges with the highest utility values are preserved

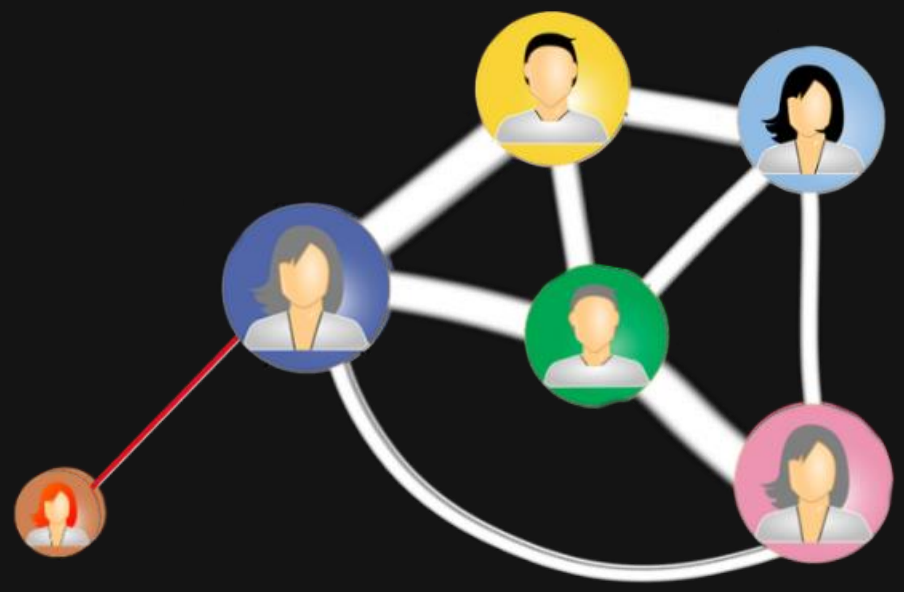
Step 3: Simplifying the Graph



Aggregation

Cluster less important but strongly connected programmers

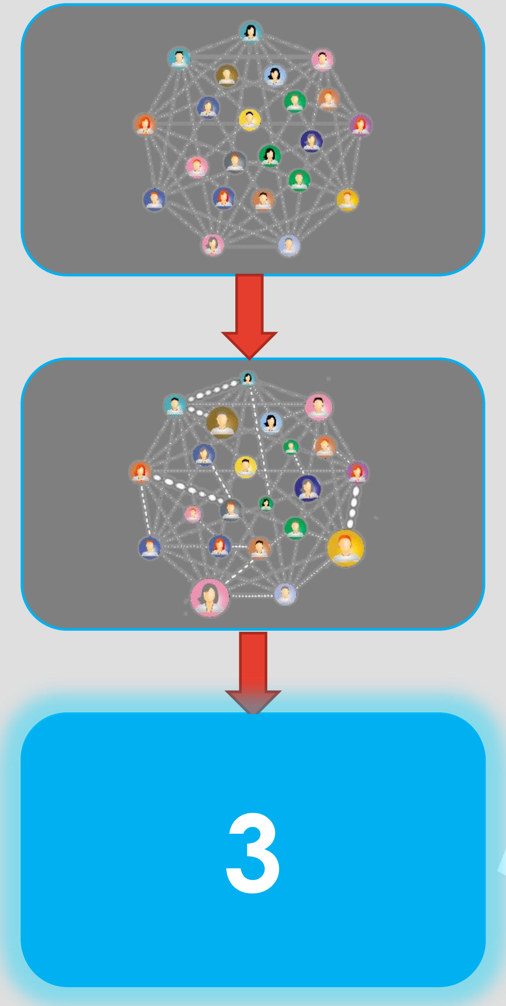
Step 3: Simplifying the Graph

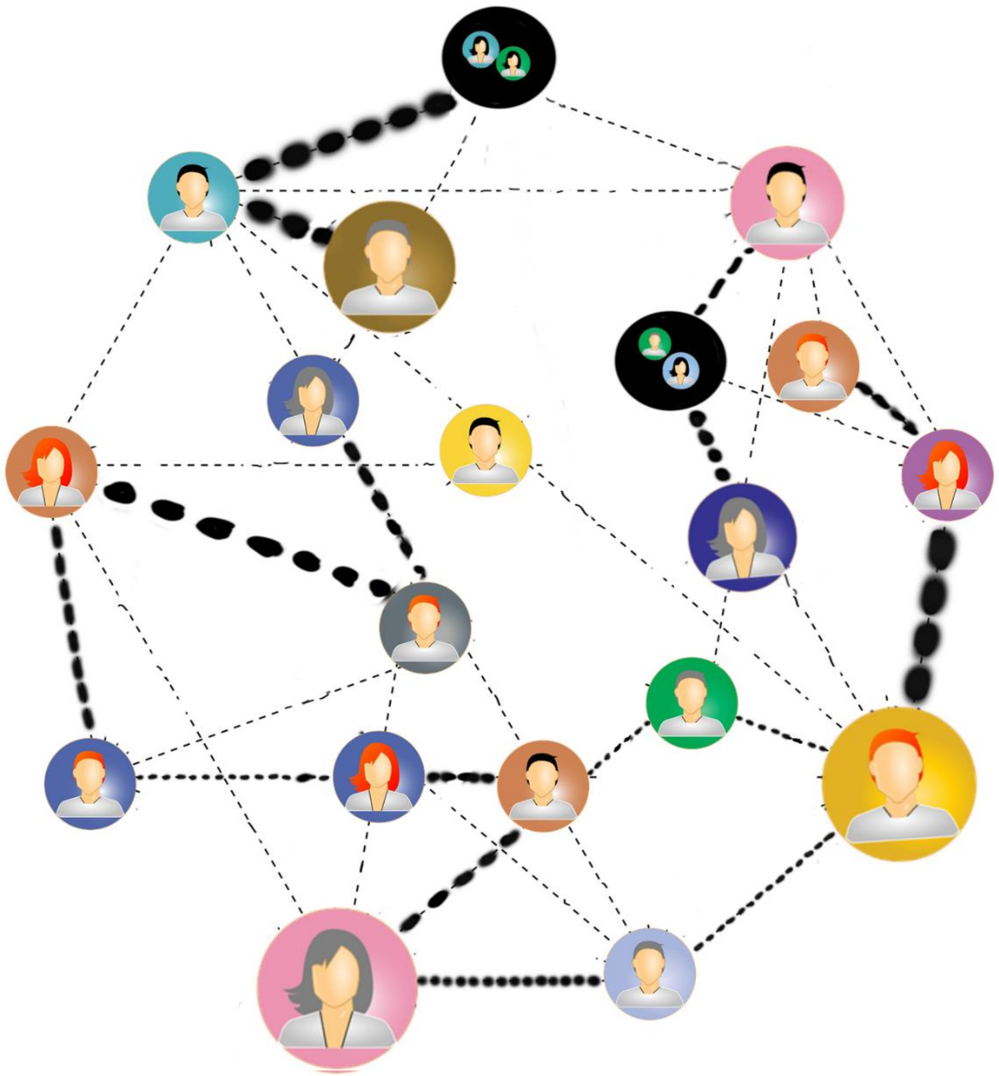


Abstraction

Abstract insignificant programmers that are weakly connected to the graph

Step 3: Simplifying the Graph





Results

Results

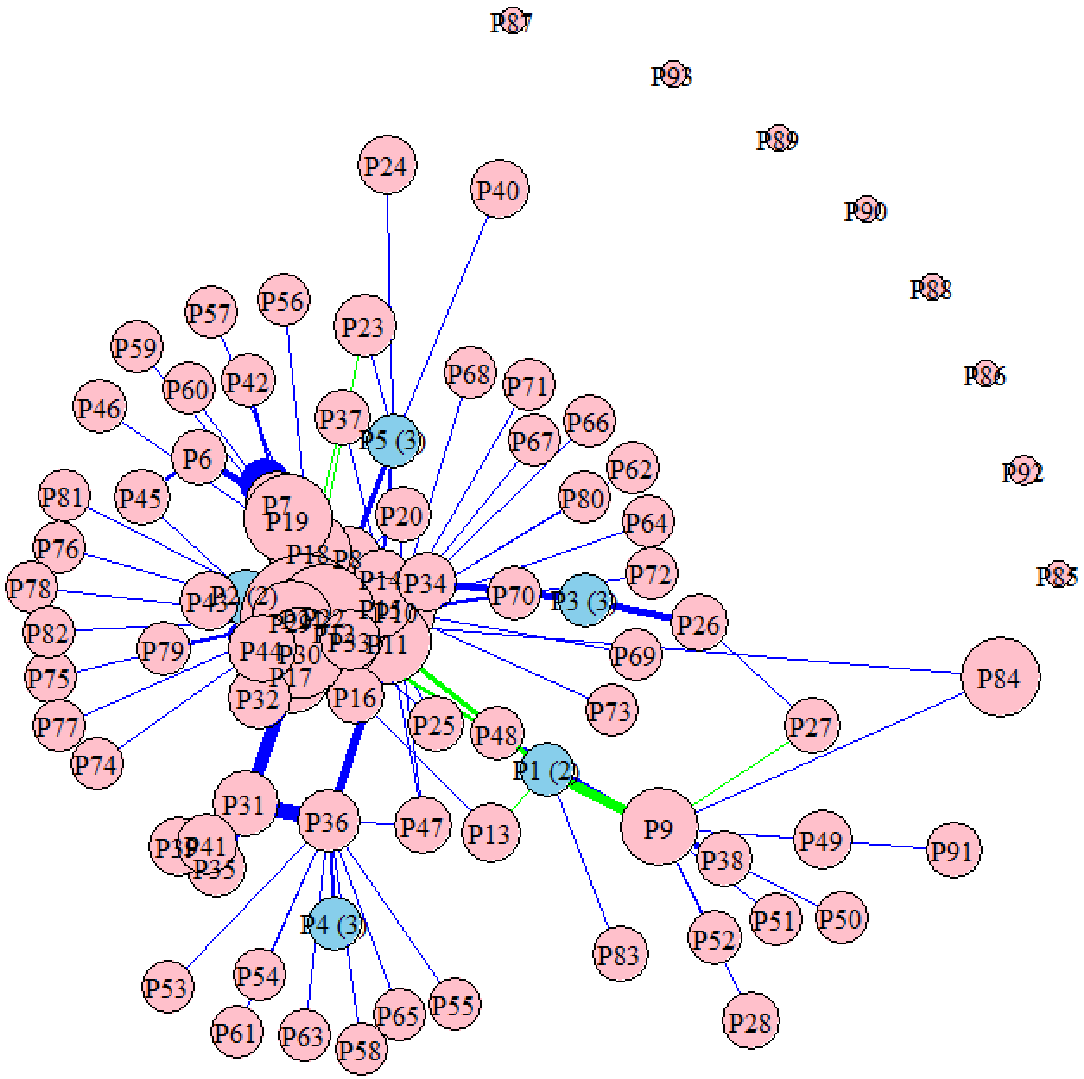
```
g <- build_graph(log)
visualizeGraph(g,anonymize = TRUE)



#direct access
g$nodes
g$edges

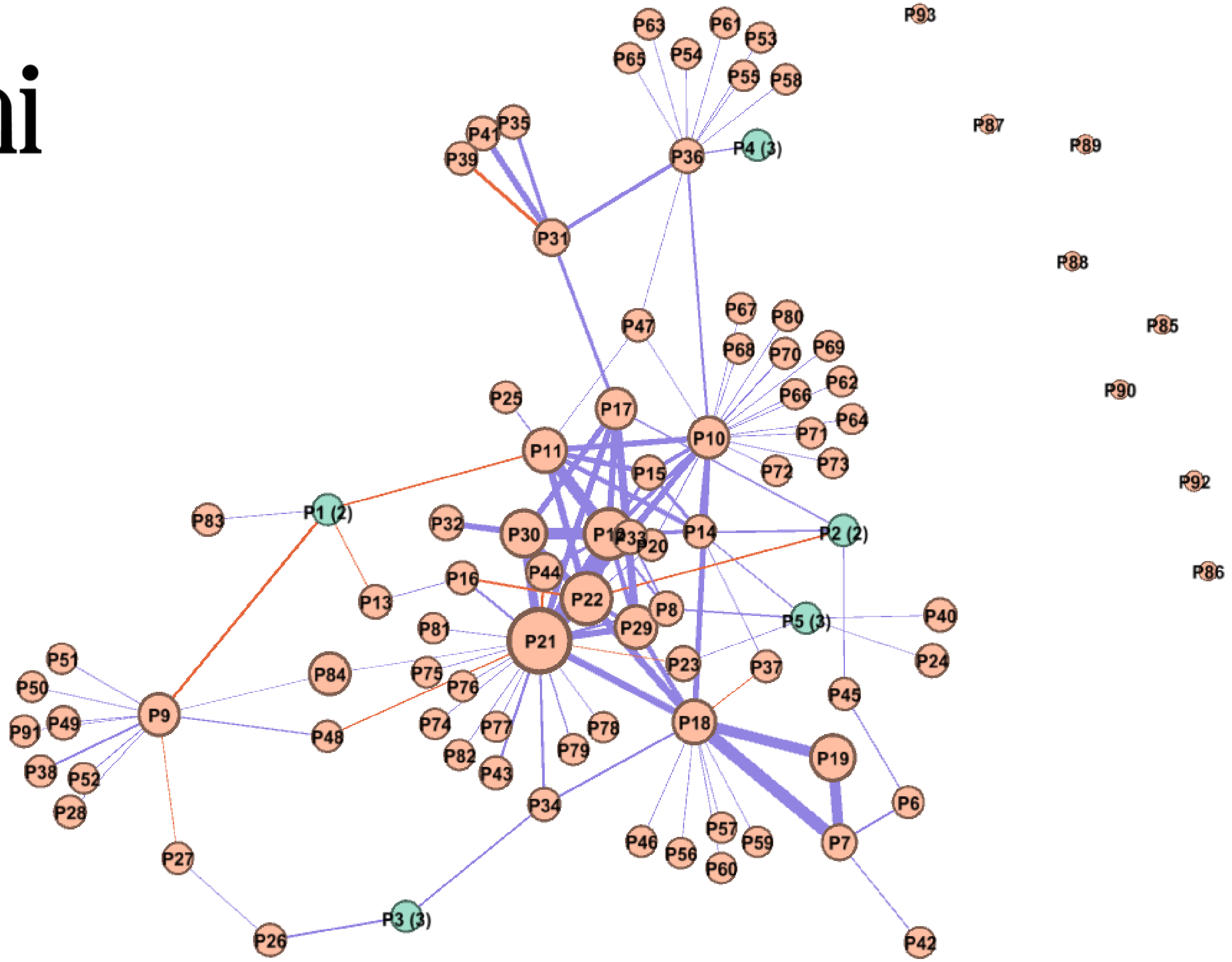
#create an igraph object
igraph <- createIGraphObject(g)

#write graph to csv
writeGraphToCSV(g)
```



Results

Gephi



Results

```
g <- build_graph(log, AgVP = 0.25, AgCP = 0.15, AbVP = 0.7, AbCP = 0.3)
```

Results

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g <- build_graph(log, AgVP = 0.25, AgCP = 0.15, AbVP = 0.7, AbCP = 0.3)
```

Clustering

- Control number of candidates
- Control strictness cluster condition

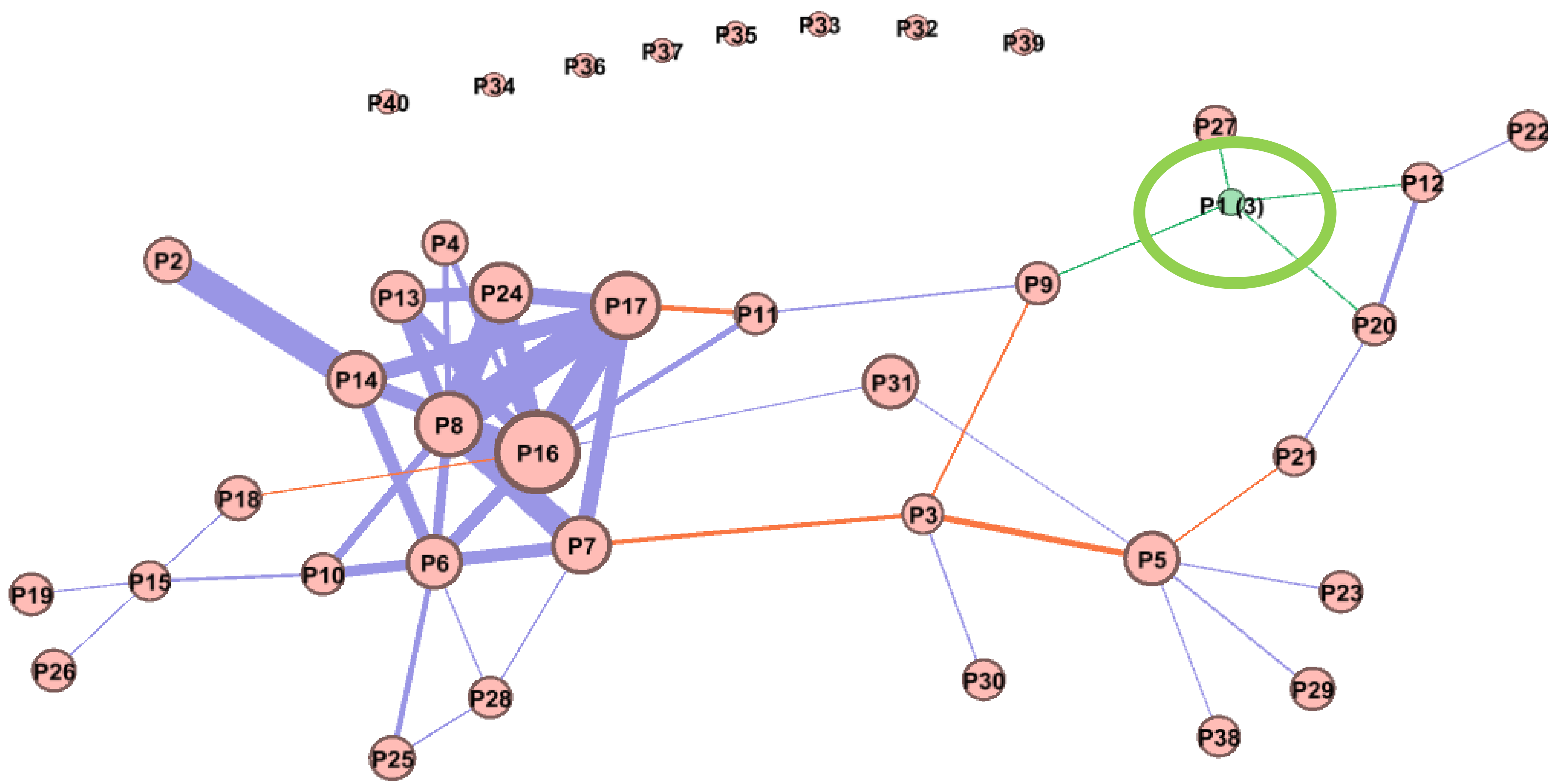
Results

```
g <- build_graph(log, AgVP = 0.25, AgCP = 0.15, AbVP = 0.7, AbCP = 0.3)
```

Abstraction

- Control number of candidates
- Control strictness abstraction condition

Results



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Results

```
g <- build_graph(log, AgVP = 0.45, AgCP = 0.25, AbVP = 0.1, AbCP = 0.4)
```

Results

```
g <- build_graph(log, AgVP = 0.45, AgCP = 0.25, AbVP = 0.1, AbCP = 0.4)
```

Clustering

- More candidates
- More strict cluster condition

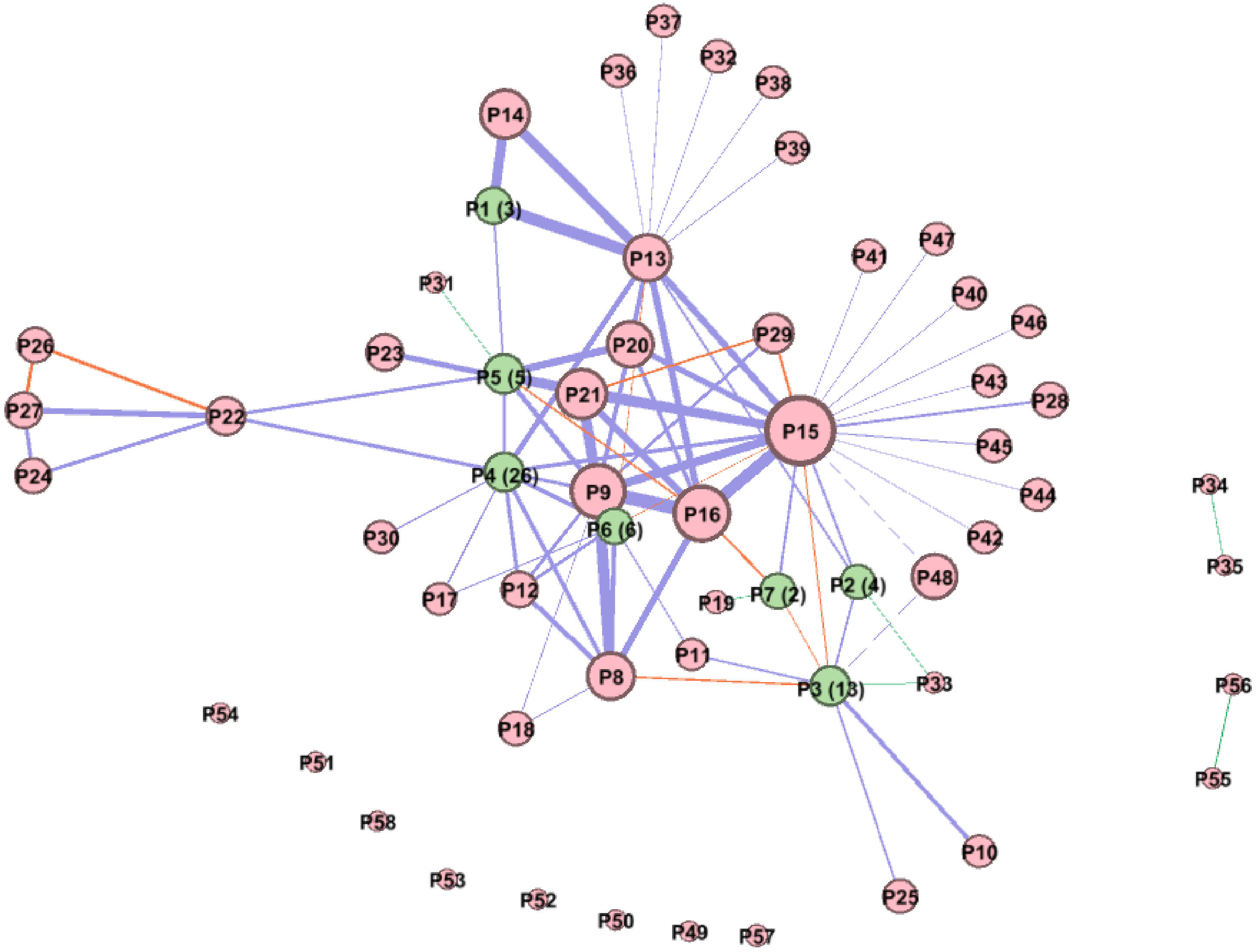
Results

```
g <- build_graph(log, AgVP = 0.45, AgCP = 0.25, AbVP = 0.1, AbCP = 0.4)
```

Abstraction

- Less candidates
- Less strict abstraction condition

Results



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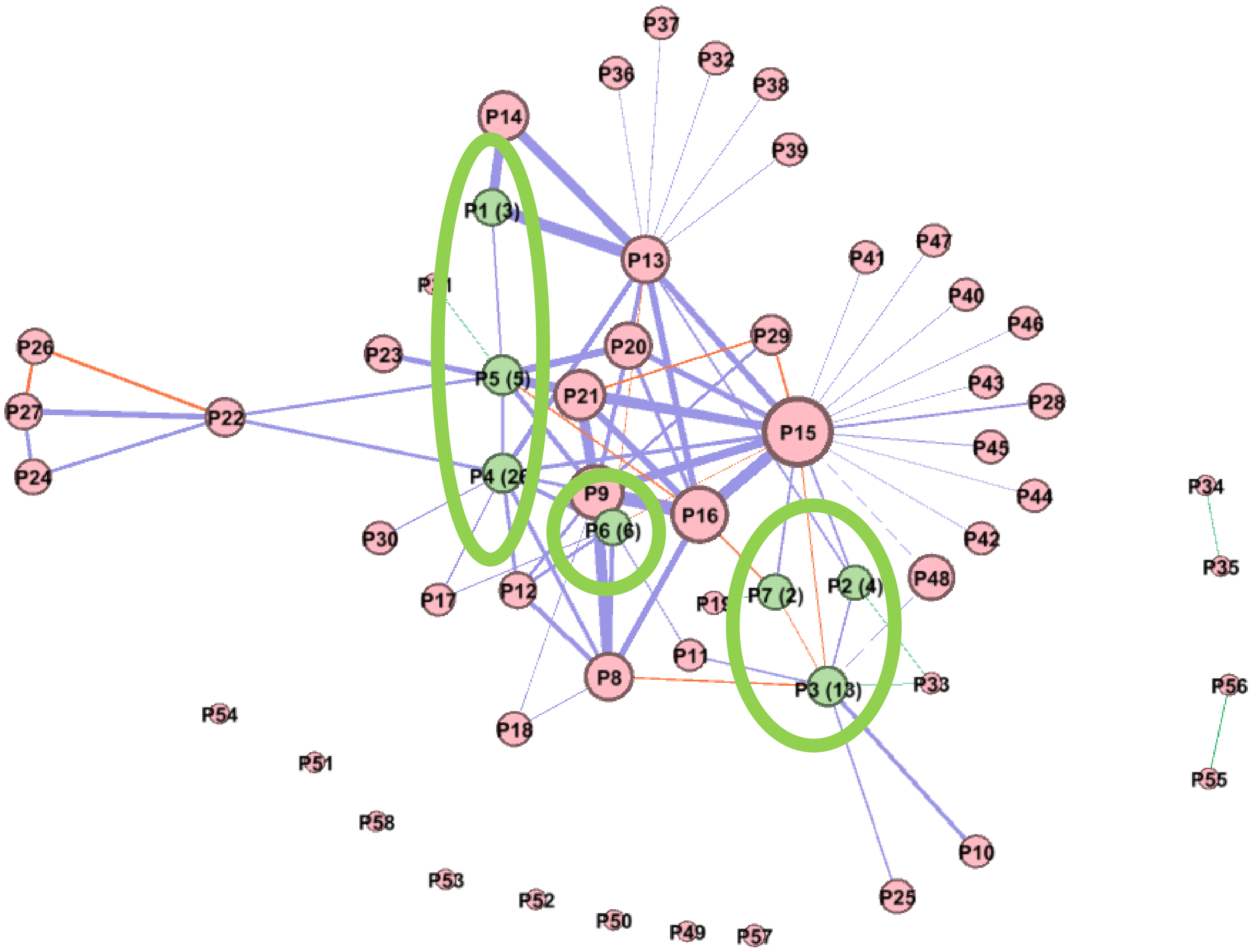
Results



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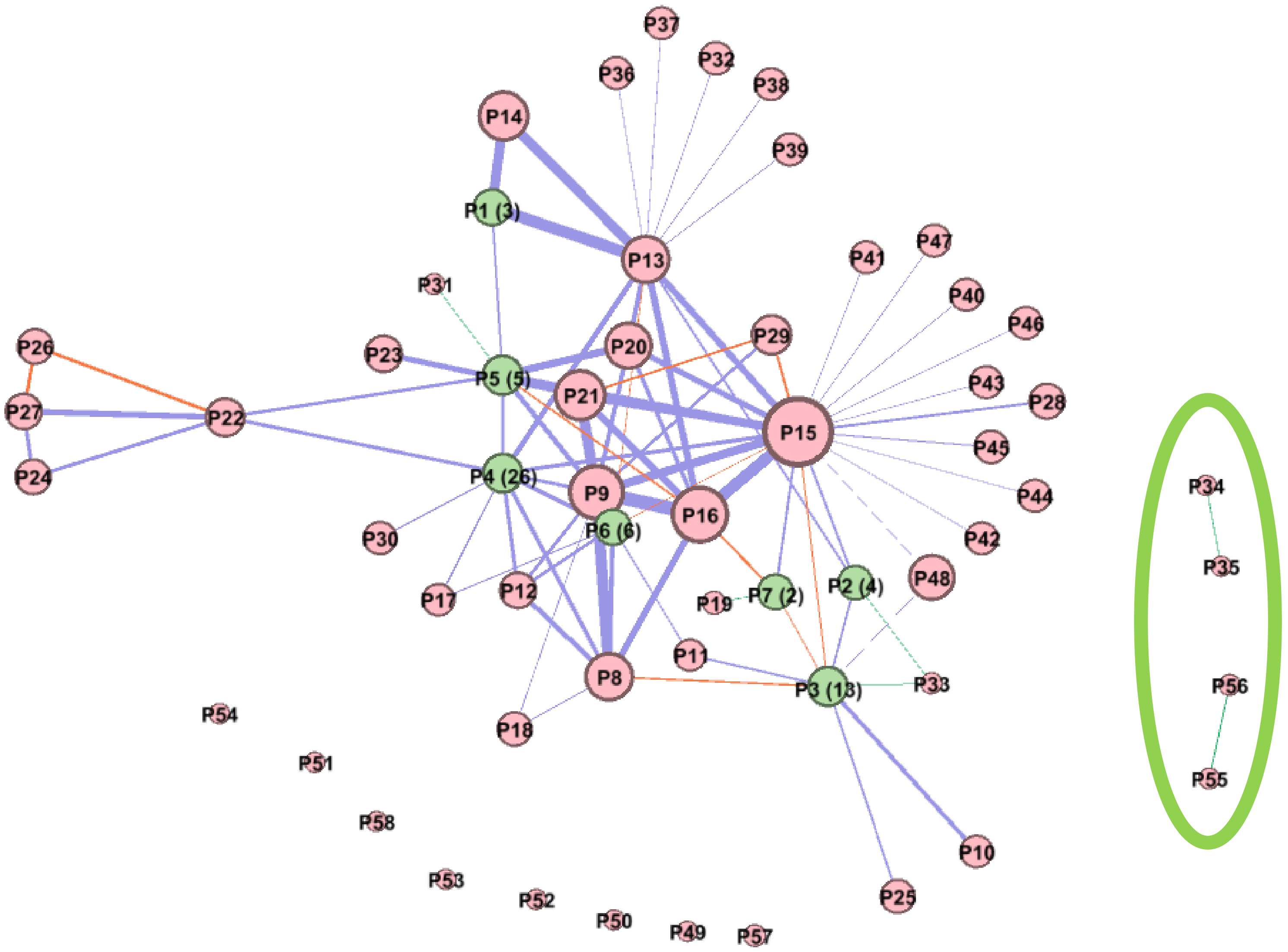
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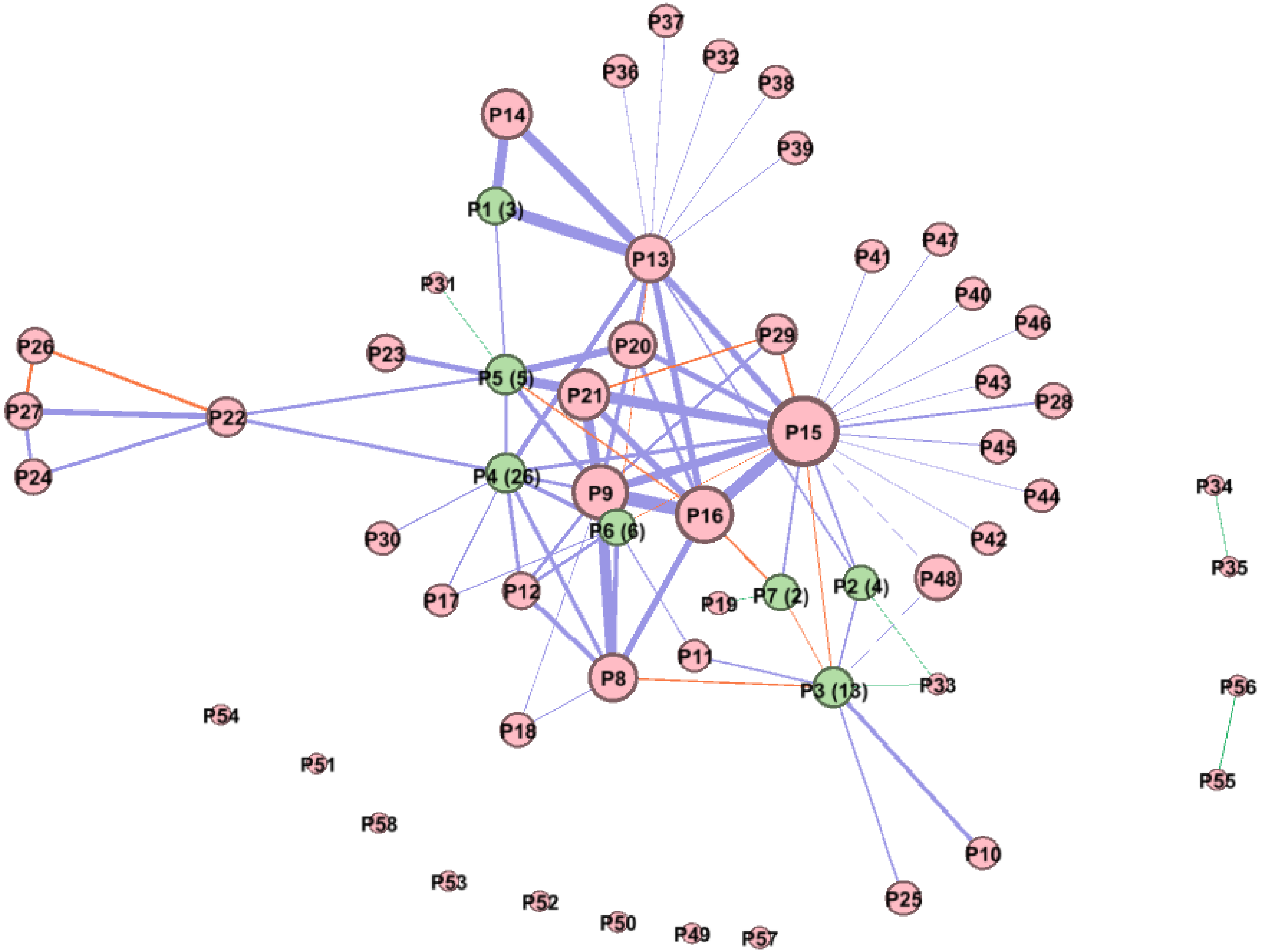
Insights

Insights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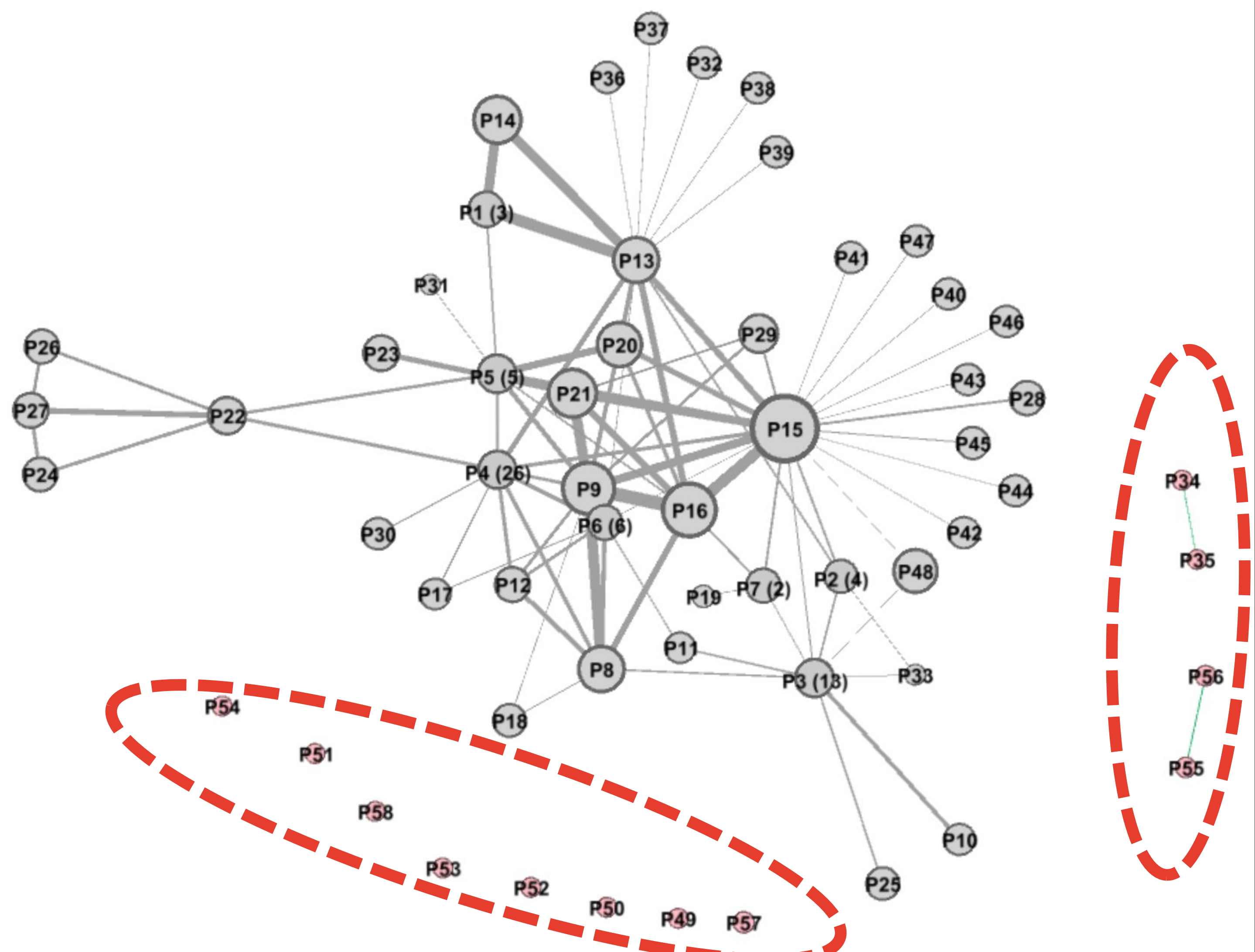
Insights

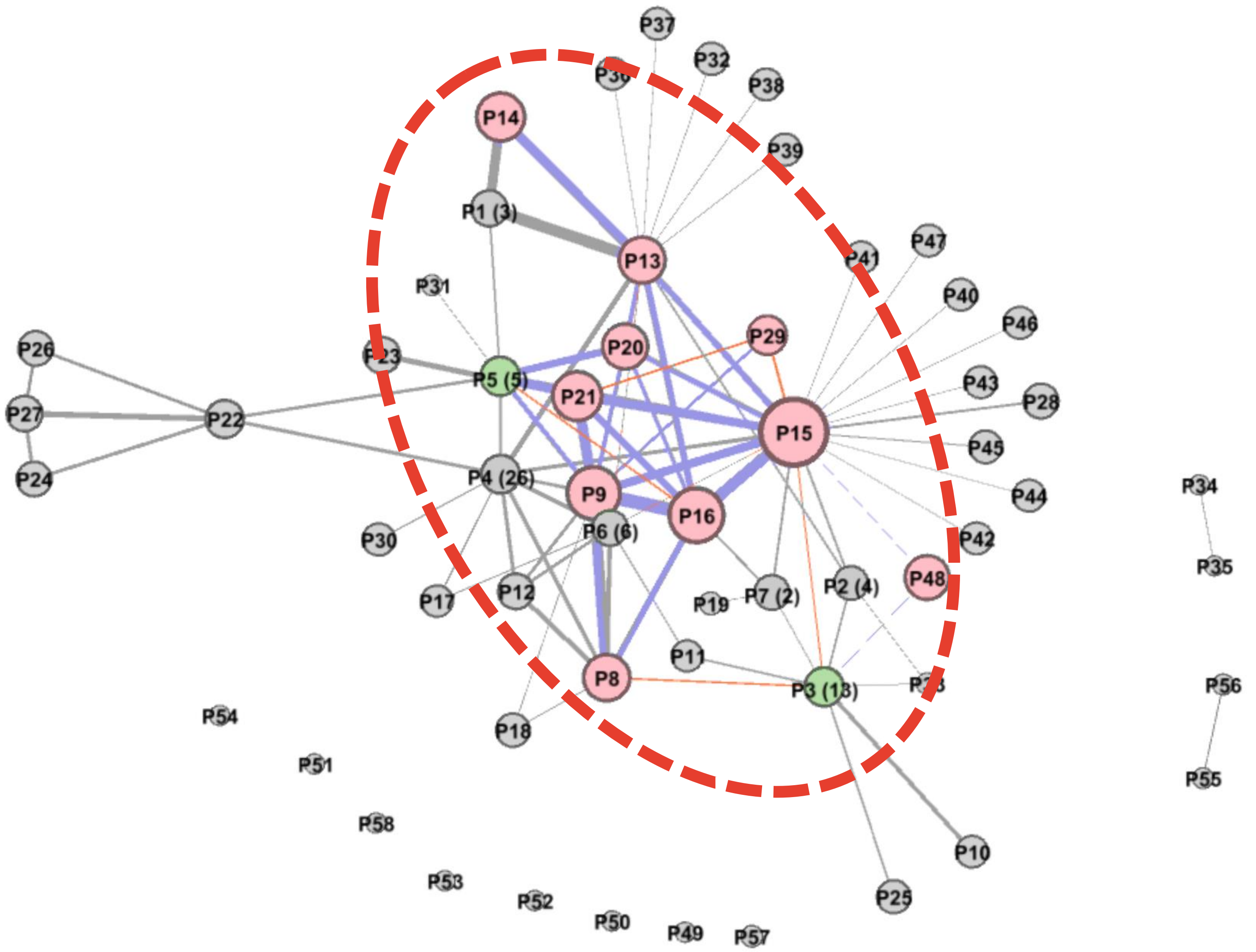


Isolated groups

Risky if:

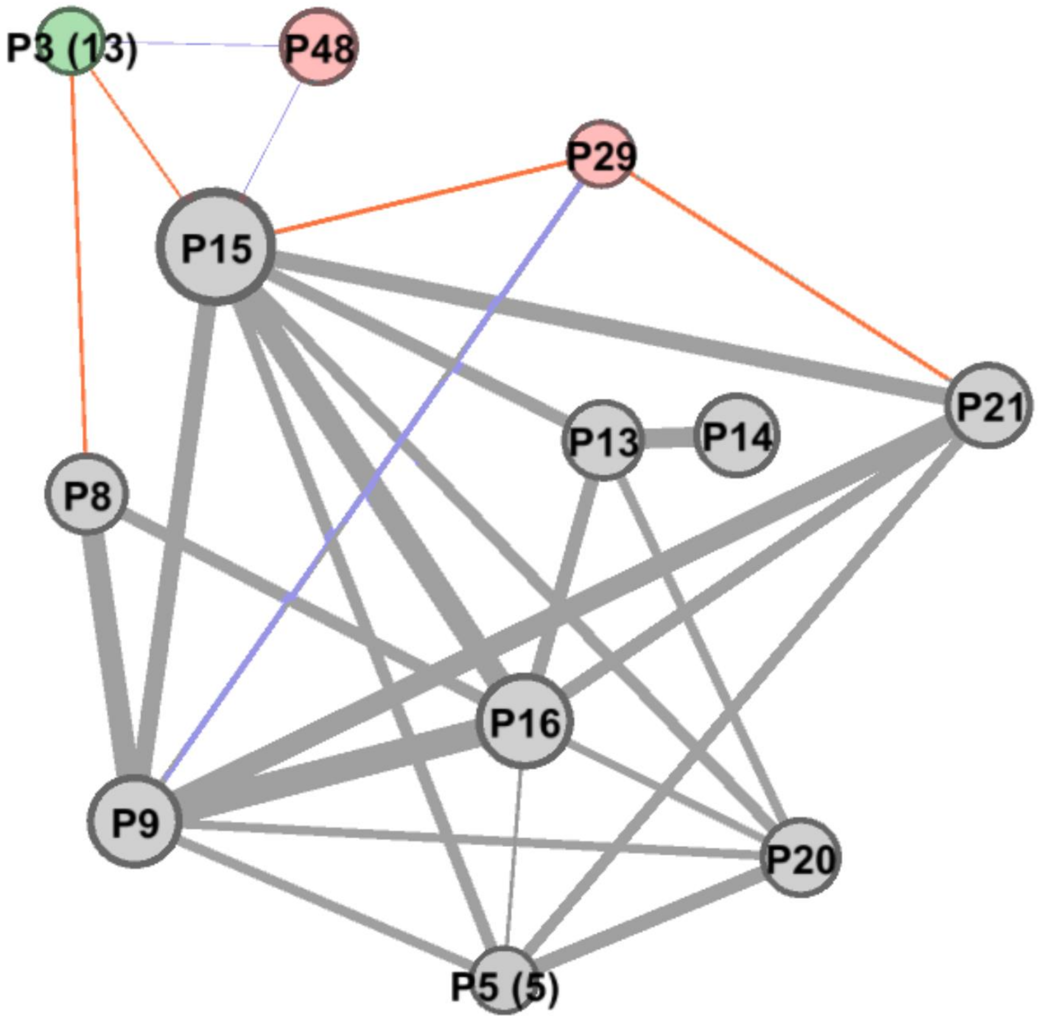
- Few members
- Members have large importance

Insights



Core developers

Insights



Core developers

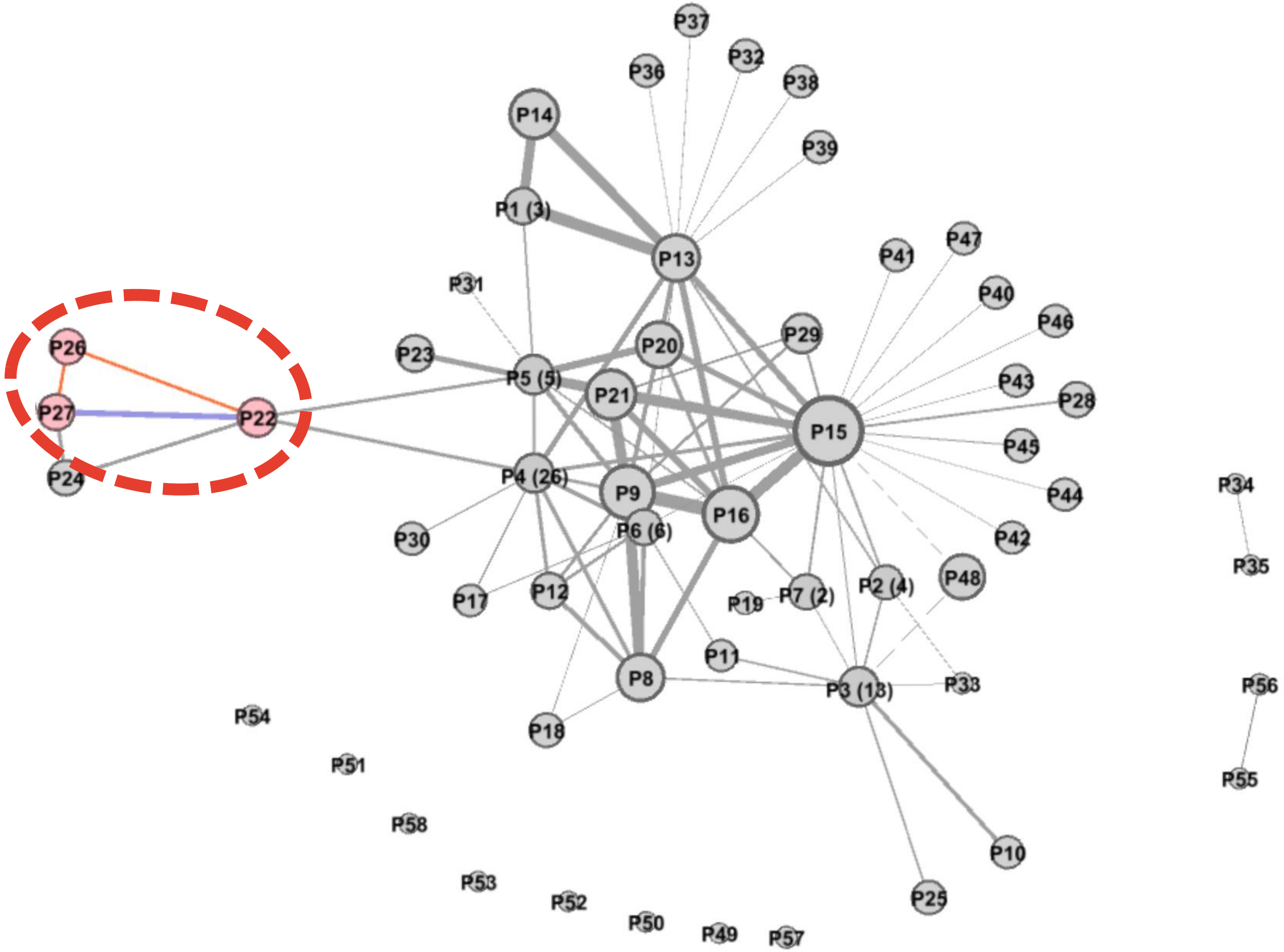
Risky because:

Important contribution

+

Weak collaboration

Insights

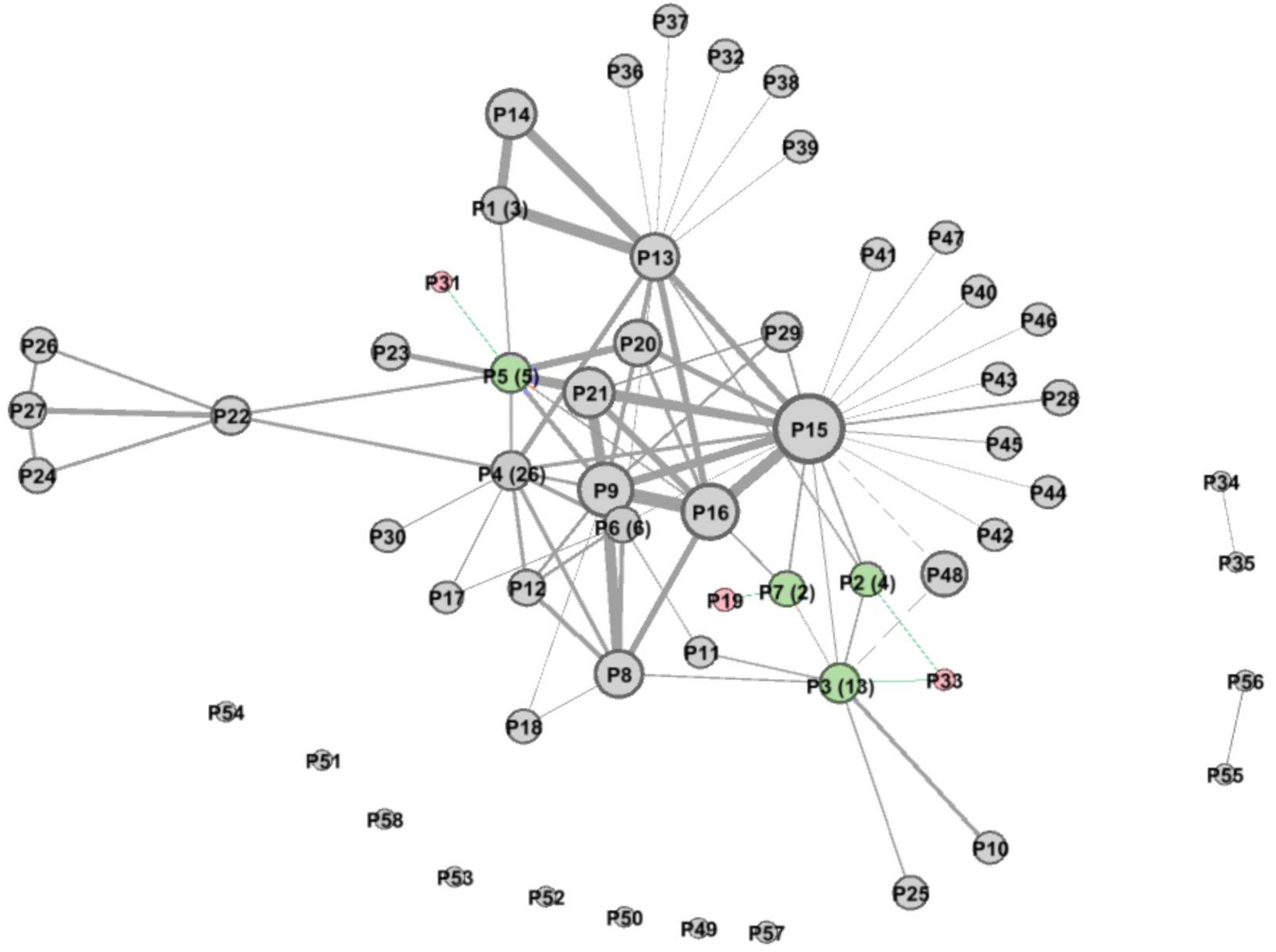


Striking relations

Strong disjunct programming relation:

The only ones working on a specific aspect of the code

Insights



Striking relations

Pair programming relation:

Teacher

+

Apprentice

Thank you

leen.jooken@uhasselt.be

https://github.com/bupaverse/collaborateR