GBOPERA
MAGAZINE
GRAPHS

Network analytics
Midterm project

Graphs

1. **Singer/singer**
   Vertices: singers
   Edges: performances

2. **Singer/opera**
   Vertices: singers, operas
   Edges: singer to opera connections
   (parties performed by the singer in the opera)

3. **Singer/role**
   Vertices: singers, opera roles
   Edges: singe to role connections
   (the roles played by the singer)

Opera graphs statistics compared with
random (ER) and preferential attachment (BA) graphs

	Singer/ Singer V: 4140 E: 40751	ER V: 4140 E: 40751	BA V: 4140 E: 40751	Singer/ Opera V: 5011 E: 9411	ER V: 5011 E: 9411	BA V: 5011 E: 9411	Singer/ Role V: 5244 E: 6973	ER V: 5244 E: 6973	BA V: 5244 E: 6973
Averaged egree	19.6865	206.8213	9.9879	3.7561	250.0032	9.99	2.6594	262.2357	9.9905
Density	0.0056	0.05	0.0024	0.007	0.0049	0.002	0.0005	0.05	0.0019
Diameter	9	3	5	12	3	5	35	3	5
Average shortest path	3.55	1.95	3.3988	4.9590	1.9501	3.4681	12.5954	1.95	3.4756

Singer/Singer, Singer/Opera, Singer/Role – giant connected component for corresponding opera graphs
ER – Erdős–Rényi model for random graph,
BA - Barabási–Albert model for preferential attachment graph
V – number of vertices,
E – number of edges

The statistics shows that real *opera graph* are better modelled by *BA* rather than *ER* model.
Also the *degree histograms* for opera graph giant connected components (see on following pages) are closer to BA degree histgrams in values and shapes (have characteristic hubs) than to ER degree histograms.

SINGER/ SINGER MULTIGRAPH

Opera singers connection graph, GBOPERA, 2008-2016
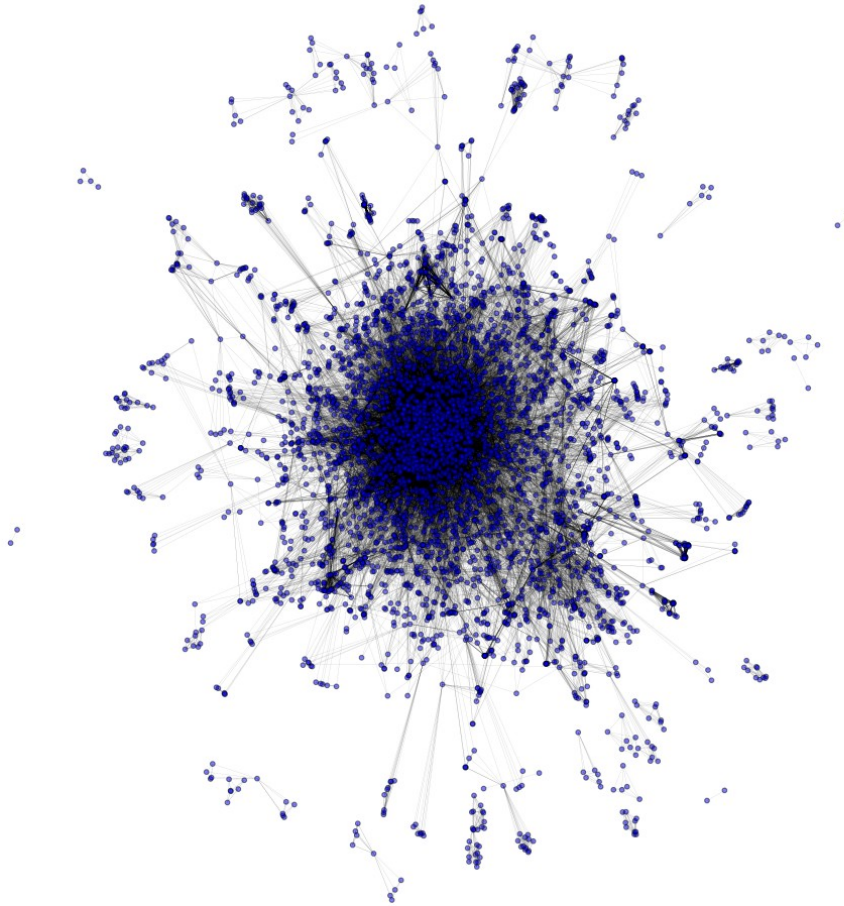
Graph properties:

Number of nodes: 4453

Number of edges: 50050

Degree:

- Avg: 22.4792
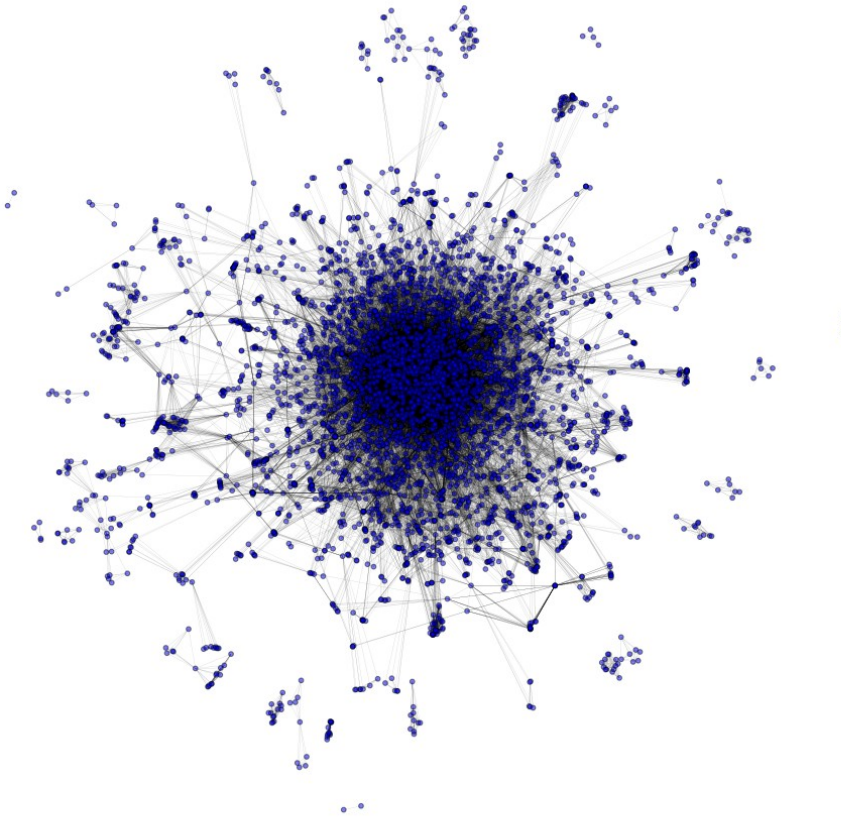- Max: 318 (LUCA CASALIN)
- Min: 1 (KARINA ORGANJAN)

Density: 0.005

Connectivity:

- Connected: False
- Number of connected components: 37

SINGER/ SINGER WEIGHTED GRAPH

Opera singers weighted connection graph, GBOPERA, 2008-2016

Graph properties:

Number of nodes: 4453

Number of edges: 42240

Degree:

- Avg: 18.9672
- Max: 197 (LUCA CASALIN)
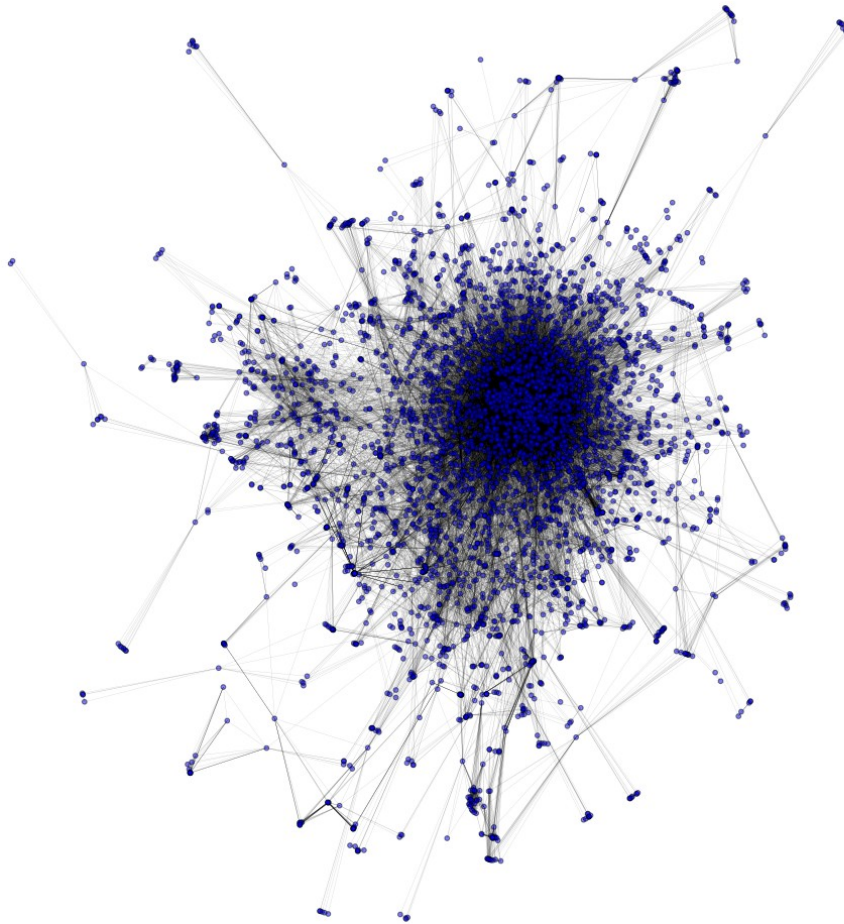- Min: 1 (ALICE BORCIANI)

Density: 0.0043

Connectivity:

- Connected: False
- Number of connected components: 37

SINGER/ SINGER WEIGHTED GRAPH
GIANT CONNECTED COMPONENT

Connected component 0 of Opera singers weighted connection graph, GBOPERA, 2008-2016

Graph properties:
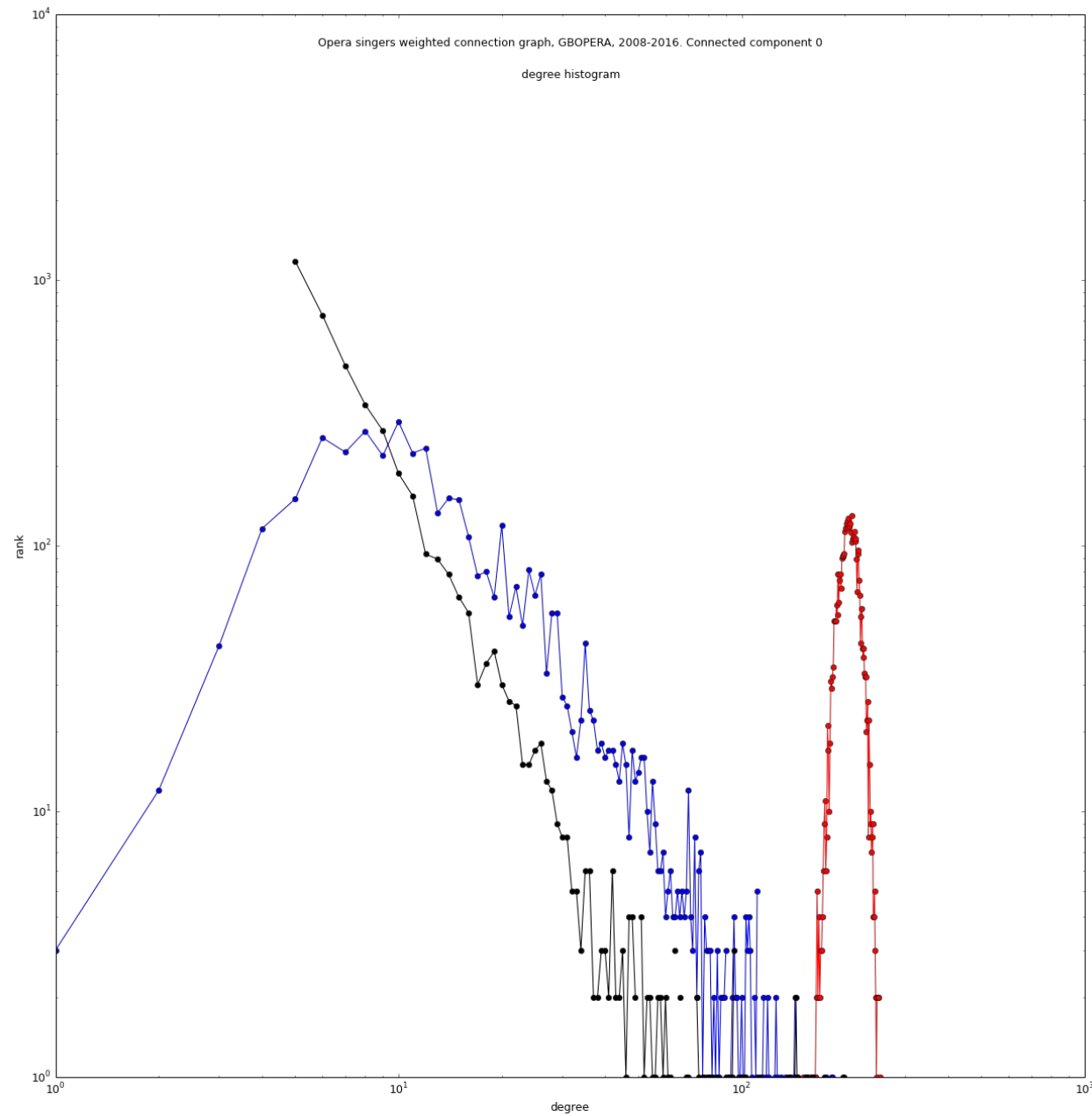
Number of nodes: 4140

Number of edges: 40751

Degree:

- Avg: 19.6865

- Max: 197 (LUCA CASALIN)

- Min: 1 (ELA REMIGIO)

Density: 0.0048

Diameter: 9

SINGER/ SINGER WEIGHTED GRAPH
GIANT CONNECTED COMPONENT
DEGREE HISTOGRAM

Opera singers weighted connection graph, GBOPERA, 2008-2016. Connected component 0

degree histogram

RED   – ER graph
BLACK – BA graph
BLUE   – opera graph

SINGER/ SINGER WEIGHTED GRAPH
MAXIMAL CONNECTED COMPONENT
DIAMETER: 9

CENTER:

ALBERTO ROTA	FRANCESCO VERNA	MATTEO FERRARA	
ALESSANDRO BATTIATO	GIACOMO PRESTIA	MATTIA DENTI	
ALESSANDRO PUCCI	GIANFRANCO MONTRESOR	MICHAEL SPYRES	
ALESSANDRO SPINA	GIANLUCA TERRANOVA	MIRCO PALAZZI	
ANDREA MASTRONI	GIANNI PACI	NATASCHA PETRINSKY	
ANNETTE JAHNS	GIANNI SCHICCHI	NICOL AYROLDI	
ANNUNZIATA VESTRI	GIOVANNI BATTISTA PARODI	NICOL CERIANI	
AQUILES MACHADO	GIULIANO PELIZON	NICOLA PAMIO	
ARMANDO GABBA	GIULIO PELLIGRA	PAOLO MARIA ORECCHIA	
AUXILIADORA TOLEDANO	GIUSEPPINA BRIDELLI	ROBERTO GATTEI	
BARBARA DI CASTRI	GREGORY BONFATTI	ROMINA TOMASONI	
BRUNO TADDIA	IORIO ZENNARO	SAVERIO BAMBI	
CARLO BOSI	IRENE FAVRO	SIMONE PIAZZOLA	
CARMELA REMIGIO	IRINA LUNGU		
CLAUDIO SGURA	JESSICA PRATT		
DIMITRA THEODOSSIOU	JUAN FRANCISCO GATELL		
EKATERINA SADOVNIKOVA	JULIA GERTSEVA		
ELENA BORIN	JULIANNA DI GIACOMO		
ELIA FABBIAN	KRYSTIAN ADAM		
EMANUELE GIANNINO	LEO NUCCI		
ENEA SCALA	LEONARDO CORTELLAZZI		
ENRICO COSSUTTA	LUCA DALLAMICO		
ERIC CUTLER	LUCA SALSI		
ERNESTO PANARIELLO	LUCIANO MONTANARO		
EVA MEI	MARCO BERTI		
FRANCESCA FRANCI	MARIELLA DEVIA		
FRANCESCA SASSU	MARIO LUPERI		
FRANCESCO MELI	MARTA CALCATERRA		
FRANCESCO PICCOLI	MASSIMILIANO LUCIANI		

PERIPHERY:

PETER RENZ
LUISA FRANCESCONI
JENKINS
MARIBEL SALAZAR
MARTIN LAMB
CHRISTIANE OERTEL
EDURNE GOYARZU
CAROLINA RAMIREZ
KATHRYN RUDGE
MT GL
JENS LARSEN
ASMIK GRIGORIAN
KEVIN SKELTON
ROLAND WOOD
MARY BEVAN
LUCY SCHAUFER
MARTIN LUNA
GABRIEL LOPEZ
KATARINA MORFA
KATE VALENTINE
HUGO COLIN
DEVON GUTHRIE
FRANCESCA ASPROMONTE
AGNES ZWIERKO
IAIN PETERSON

SINGER/ SINGER WEIGHTED GRAPH CENTRALITY. SAVERIO FIORE EGO GRAPH

Connected component. Ego graph for node SAVERIO FIORE 0 of Opera singers weighted connection graph, GBOPERA, 2008-2016


CENTRALITY

SAVERIO FIORE, 0.0253
CARLO BOSI, 0.0231
GREGORY BONFATTI, 0.0222
FRANCESCO MELI, 0.0208
JOHN GRAHAM HALL, 0.0202
ALEX ESPOSITO, 0.0195
MATTEO FERRARA, 0.0195
LUCA CASALIN, 0.0184
ANNUNZIATA VESTRI, 0.0179
GIANNI SCHICCHI, 0.0174
CRISTIANO OLIVIERI, 0.0172
JESSICA PRATT, 0.0154
ANNA MARIA CHIURI, 0.0139
CARMEN ROMEU, 0.0137
ANDREA MASTRONI, 0.0137
PAOLO FANALE, 0.0129
CARMELA REMIGIO, 0.0127
LEONARDO CORTELLAZZI, 0.0124
GEZIM MYSHKETA, 0.0120
ATTILA JUN, 0.0118
GREGORY KUNDE, 0.0117
JUAN FRANCISCO GATELL, 0.0116
FRANCESCO MUSINU, 0.0116
JULIA GERTSEVA, 0.0113
ENRICO COSSUTTA, 0.0113
ANTONIO BARBAGALLO, 0.0112
DARIO GIORGELE, 0.0112
LUCA DALLAMICO, 0.0110
ALEXANDER TELIGA, 0.0108
FRANCESCO VERNA, 0.0107
ANNALISA STROPPA, 0.0103

SINGER/ OPERA MULTIGRAPH

Opera singer vs opera connection graph, GBOPERA, 2008-2016
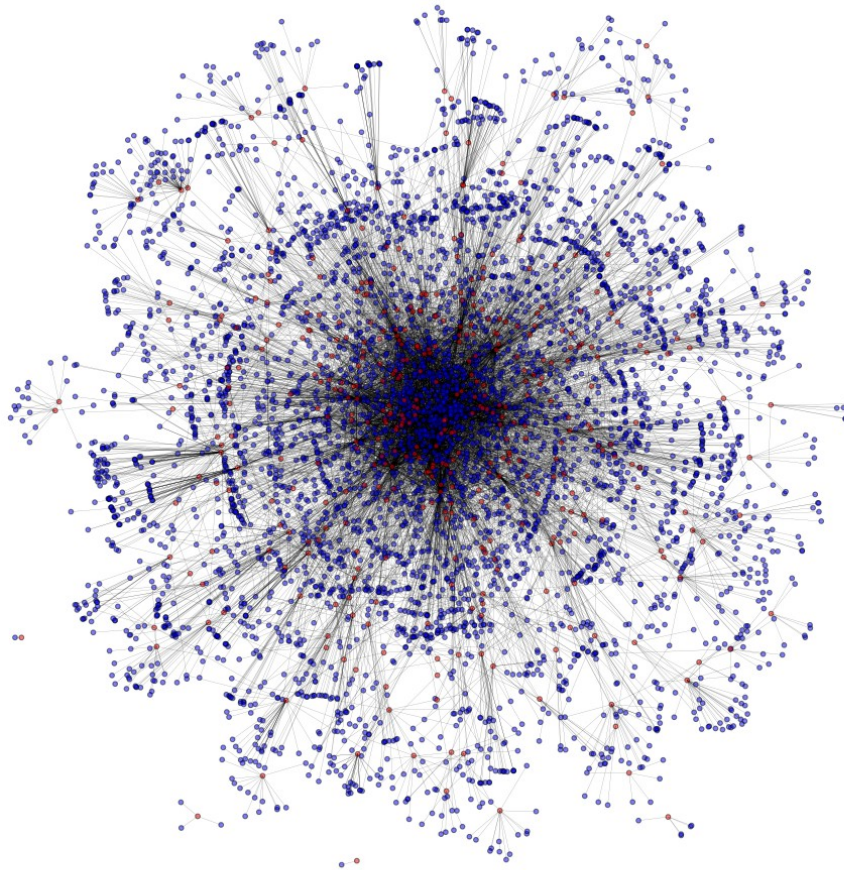
Graph properties:

Number of nodes: 5236

Number of edges: 11216

Degree:

- Avg: 4.2687

- Max: 456 (LA TRAVIATA)

- Min: 1 (LVARO VALLEJO)

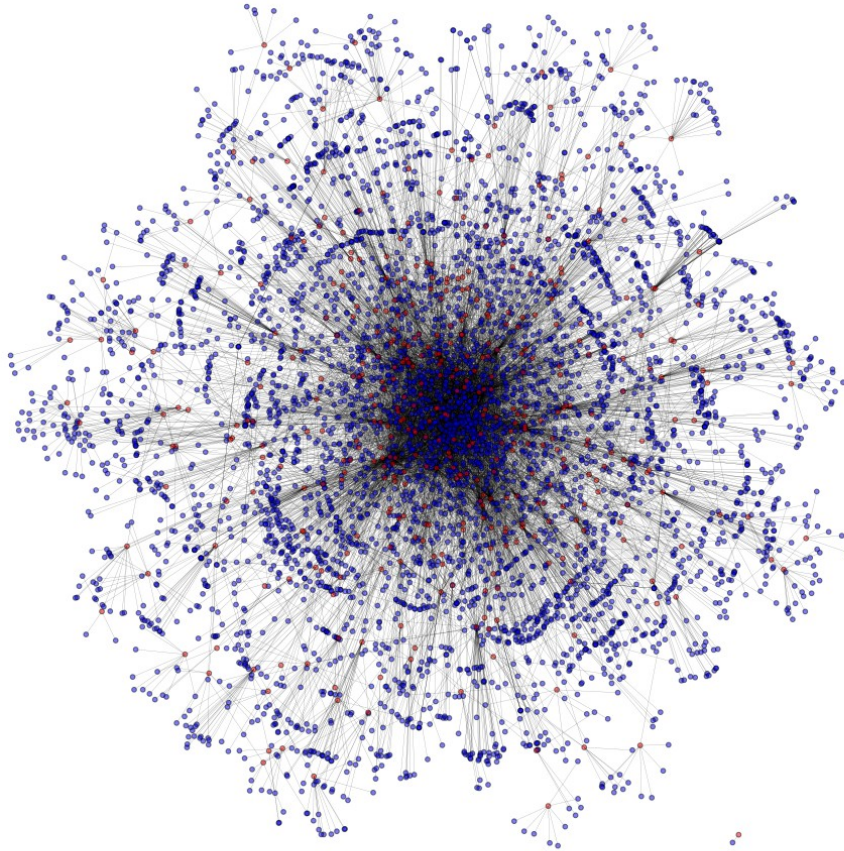Density: 0.0008

Connectivity:

- Connected: False

- Number of connected components: 22

red nodes are operas
blue nodes are singers

SINGER/ OPERA WEIGHTED GRAPH

Opera singer vs opera weighted connection graph, GBOPERA, 2008-2016

Graph properties:

Number of nodes: 5236

Number of edges: 9616

Degree:

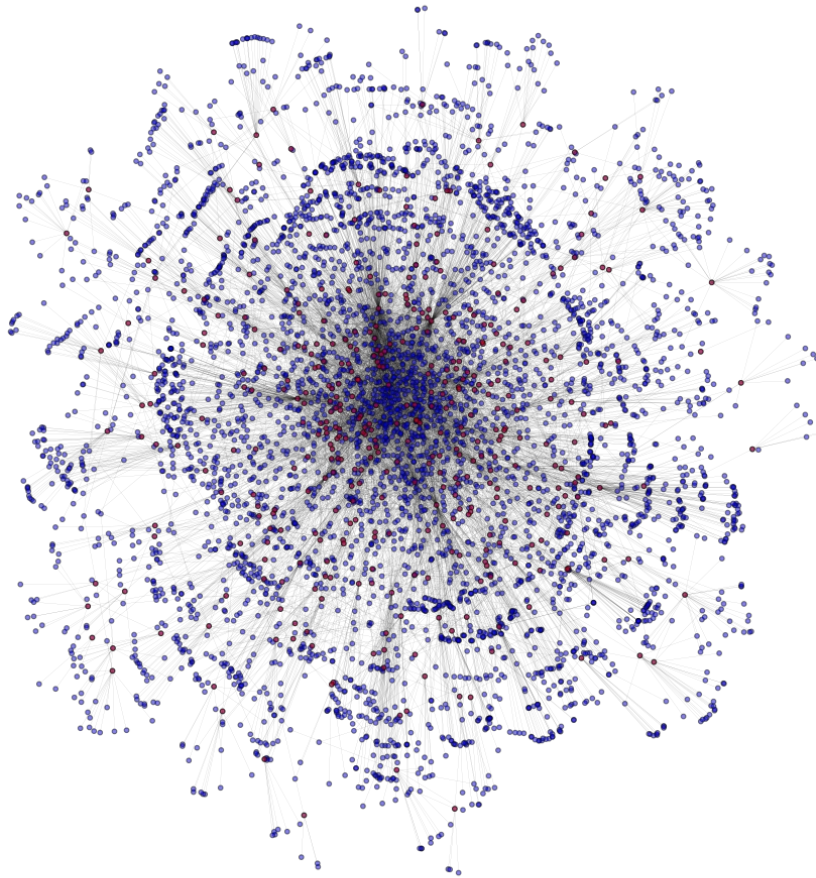- Avg: 3.673
- Max: 355 (LA TRAVIATA)
- Min: 1 (CLAUDIO OTELLI)

Density: 0.0007

Connectivity:

- Connected: False
- Number of connected components: 21

red nodes are operas
blue nodes are singers

SINGER/ OPERA WEIGHTED GRAPH
GIANT CONNECTED COMPONENT

Connected component 0 of Opera singer vs opera weighted connection graph, GBOPERA, 2008-2016

Graph properties:

Number of nodes: 5011

Number of edges: 9411

Degree:

- Avg: 3.7561

- Max: 355 (LA TRAVIATA)

- Min: 1 (MALIN BYSTRM)

Density: 0.0007

Diameter: 12

red nodes are operas
blue nodes are singers

SINGER/ OPERA WEIGHTED GRAPH
GIANT CONNECTED COMPONENT
DEGREE HISTOGRAM

Opera singer vs opera weighted connection graph, GBOPERA, 2008-2016. Connected component 0

degree histogram

rank

degree

RED — ER graph
BLACK — BA graph
BLUE — opera graph
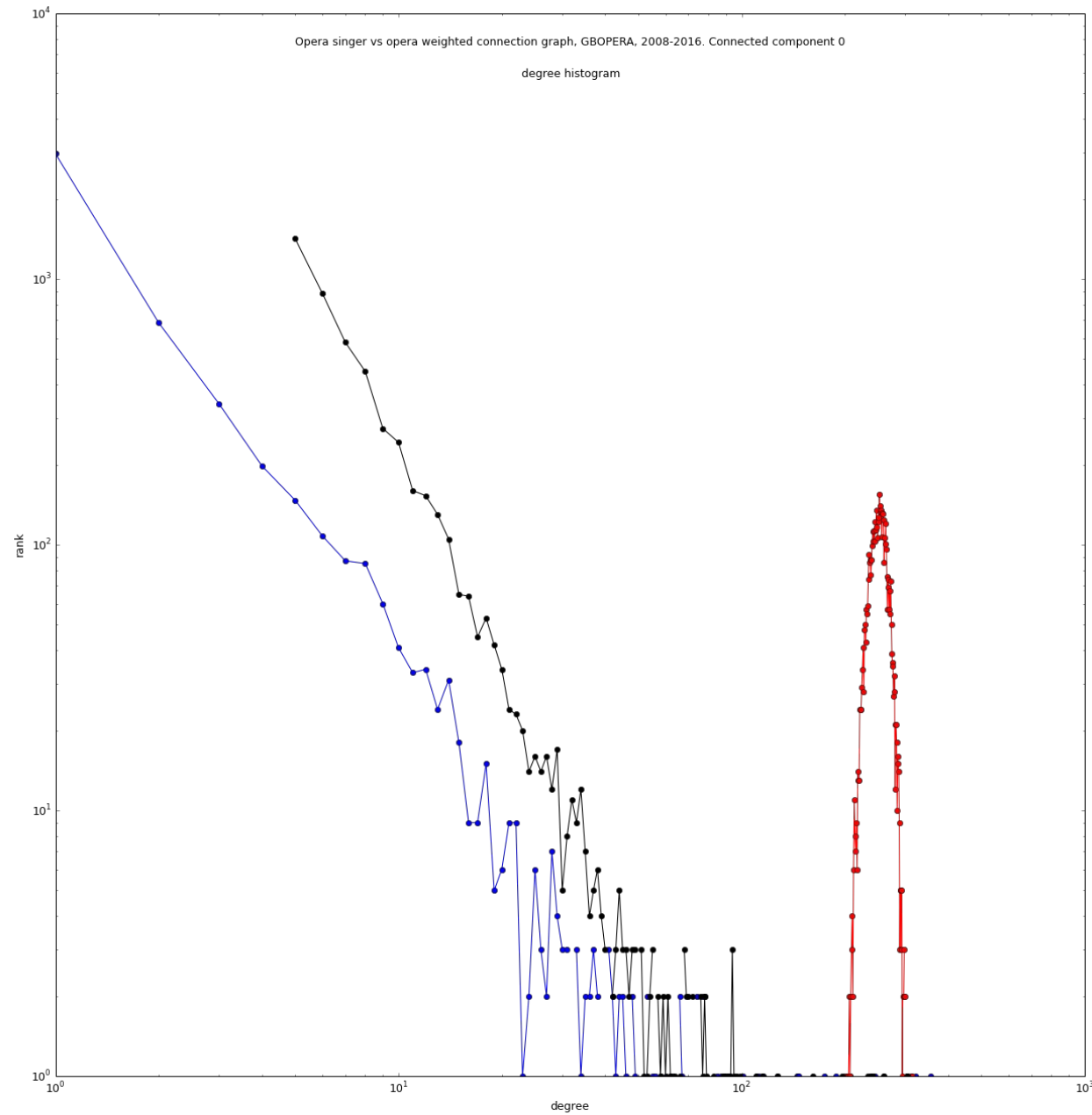
SINGER/ OPERA WEIGHTED GRAPH
MAXIMAL CONNECTED COMPONENT
DIAMETER: 12

CENTER:

AIDA

ANNA BOLENA

CANDIDE

CARMEN

COS FAN TUTTE

DIE ZAUBERFLTE

DON CARLO

DON GIOVANNI

DON PASQUALE

ELEKTRA

FALSTAFF

FAUST

GEMMA DI VERGY

GUILLAUME TELL

I LOMBARDI ALLA PRIMA
CROCIATA

I PURITANI

IDOMENEO

IL BARBIERE DI SIVIGLIA

IL CAMPIELLO

IL MATRIMONIO SEGRETO

IL TABARRO

IL TROVATORE

IL TURCO IN ITALIA

IL VIAGGIO A REIMS

LA BOHME

LA CENERENTOLA

LA FORZA DEL DESTINO

LA GAZZA LADRA

LA SCALA DI SETA

LA TRAVIATA

LA VEDOVA ALLEGRA

LE NOZZE DI FIGARO

LE TORADOR

LELISIR DAMORE

LES CONTES DHOFFMANN

LES PCHEURS DE PERLES

LES TROYENS

LITALIANA IN ALGERI

LOLIMPIADE

LUCIA DI LAMMERMOOR

LUCREZIA BORGIA

LULU

MADAMA BUTTERFLY

NORMA

OPENING GALA

OTELLO

PELLAS ET MLISANDE

RIGOLETTO

RISORGIMENTO!

ROMEO ET JULIETTE

THE RAKES PROGRESS

TOSCA

UN BALLO IN MASCHERA

UN GIORNO DI REGNO

WERTHER

ZELMIRA

PERIPHERY:

JRMIE DELVERT

CHRISTOPHER HODGES

FRANCESCO RENZONI

NEAL FERREIRA

GABRIEL PREISSER

MARIA ELENA GARC

STEFANIA TOCZYSKA

PEPE NUNEZ

FRANCESCO GHELARDINI

LINA LOPEZ

EL PUAO DE ROSAS

STEPHAN RUGAMER

JOS LUIS PATIO

ENCARNA PIEDRABUENA

MARCO BERRIEL

GUNTER PAPENDELL

NURIA RIAL

CLAUDIA MUNTEAN

CHRISTOPH SPATH

ANGELA MORTELLARO

LUIS RODARTE

DAN KEMPSON

and others (**150** singers)

SINGER/ OPERA WEIGHTED GRAPH
CENTRALITY. RIGOLETTO EGO GRAPH

Connected component. Ego graph for node RIGOLETTO 0 of Opera singer vs opera weighted connection graph, GBOPERA, 2008-2016
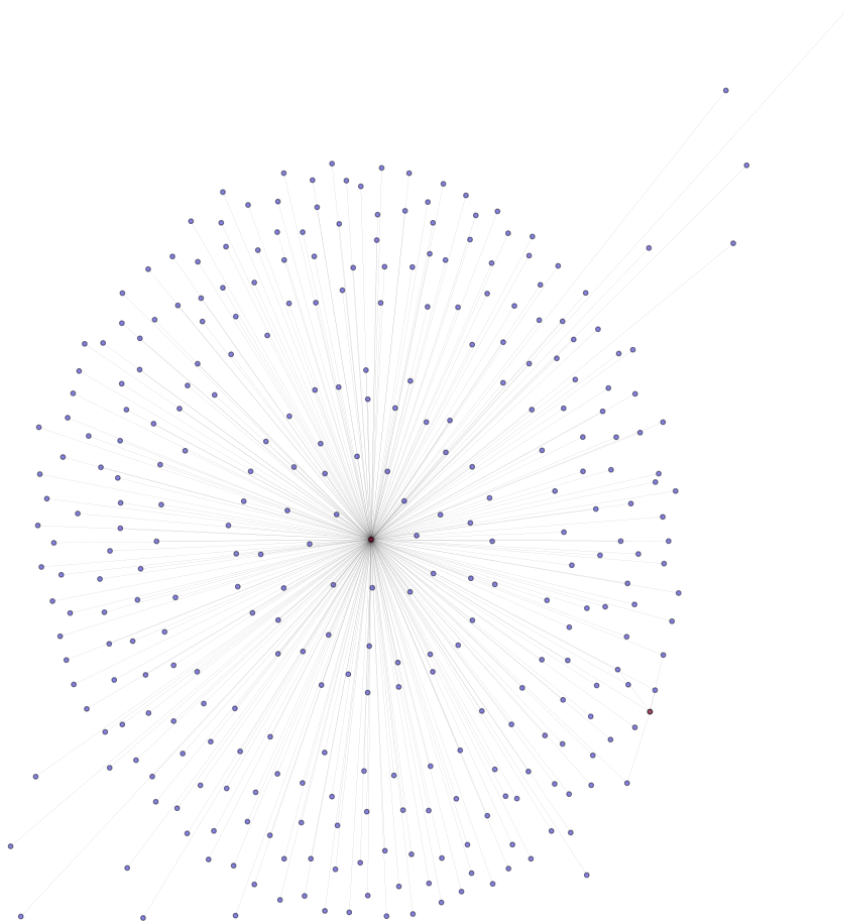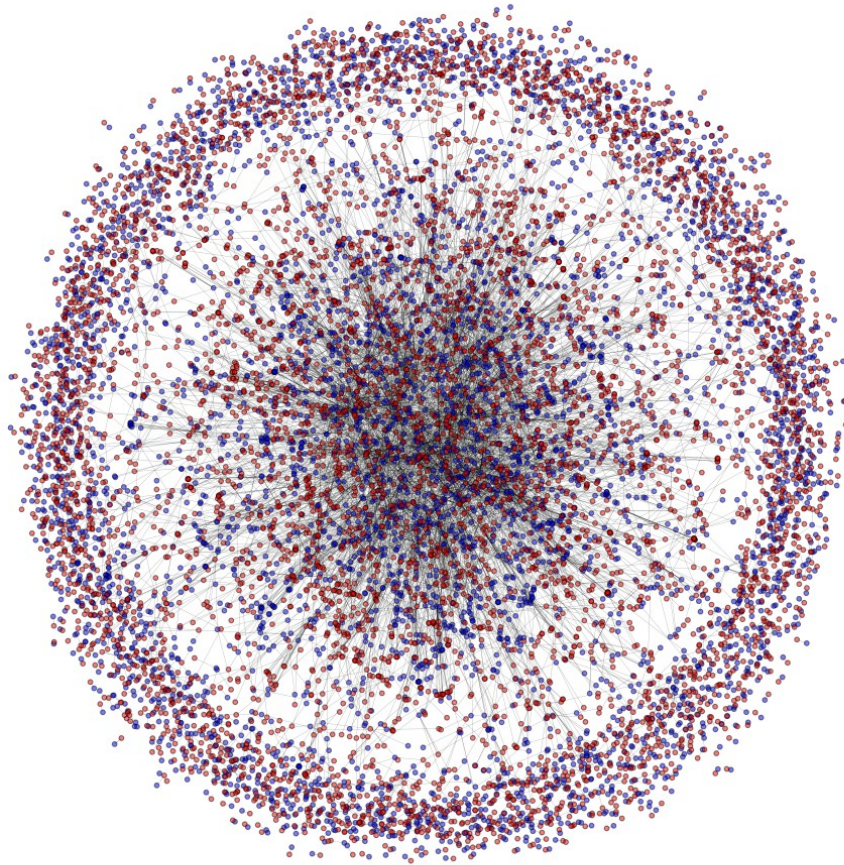

red nodes are operas
blue nodes are singers

CENTRALITY

RIGOLETTO, 0.1339
LA TRAVIATA, 0.1262
LA BOHME, 0.0813
MADAMA BUTTERFLY, 0.0713
CARMEN, 0.0711
TOSCA, 0.0649
NABUCCO, 0.0485
AIDA, 0.0461
TURANDOT, 0.0377
IL BARBIERE DI SIVIGLIA, 0.0375
DON GIOVANNI, 0.0359
LE NOZZE DI FIGARO, 0.0332
LUCIA DI LAMMERMOOR, 0.0331
DIE ZAUBERFLTE, 0.0297
IL TROVATORE, 0.0295
UN BALLO IN MASCHERA, 0.0286
OTELLO, 0.0262
ELEKTRA, 0.0241
BORIS GODUNOV, 0.0237
LES CONTES DHOFFMANN, 0.0233
FALSTAFF, 0.0229
DAS RHEINGOLD, 0.0215
MACBETH, 0.0214
CAVALLERIA RUSTICANA, 0.0205
LITALIANA IN ALGERI, 0.0203
LA VEDOVA ALLEGRA, 0.0192
DON CARLO, 0.0188
SAVERIO FIORE, 0.0187
LELISIR DAMORE, 0.0180
NORMA, 0.0168
EVGENIJ ONEGIN, 0.0153

SINGER/ ROLE MULTIGRAPH

Opera singer vs role connection graph, GBOPERA, 2008-2016

Graph properties:

Number of nodes: 10580

Number of edges: 11216

Degree:

- Avg: 2.1202

- Max: 39 (Annina|LA TRAVIATA)

- Min: 1 (LVARO VALLEJO)
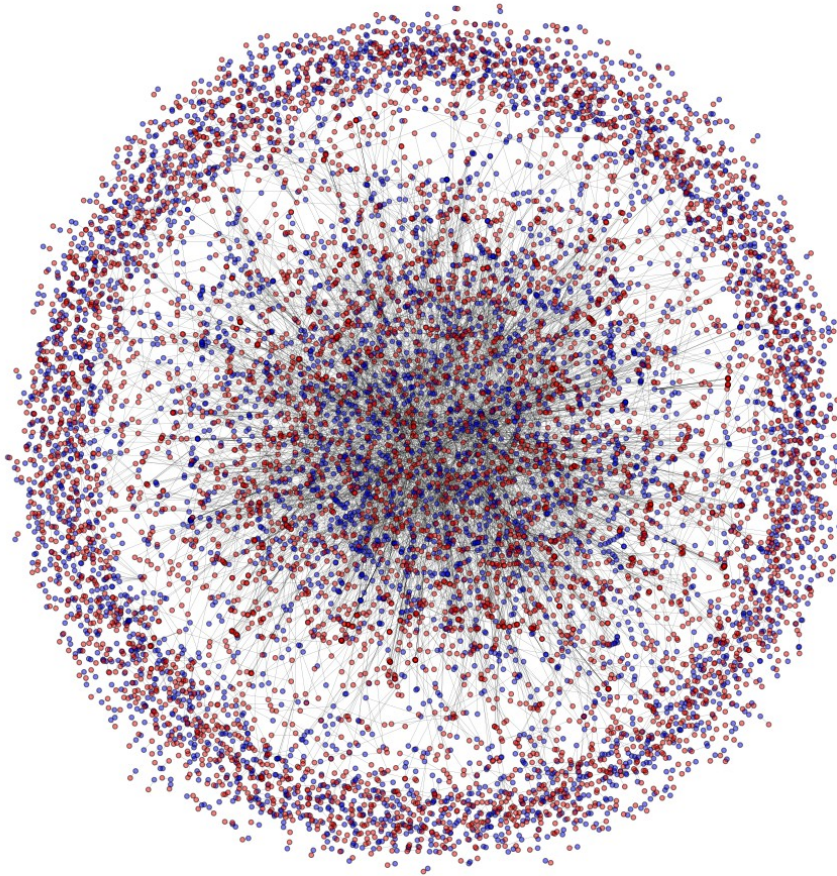
Density: 0.0002

Connectivity:

- Connected: False

- Number of connected components: 2230

red nodes are roles
blue nodes are singers

SINGER/ ROLE WEIGHTED GRAPH

Opera singers vs roles weighted graph: 2008 - 2016

Graph properties:

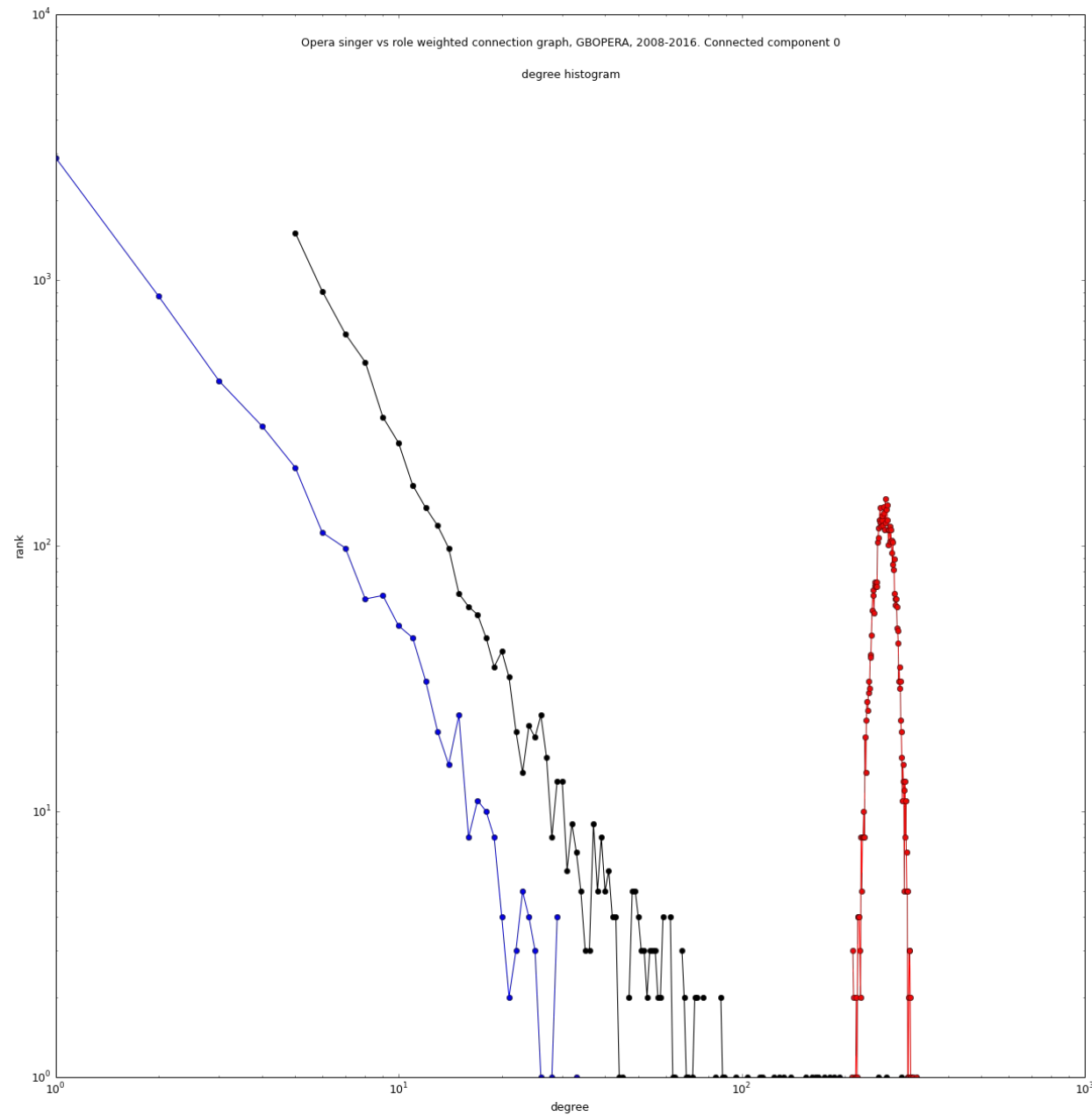Number of nodes: 10580

Number of edges: 10089

Degree:

- Avg: 1.9072

- Max: 39 (Annina|LA TRAVIATA)

- Min: 1 (LVARO VALLEJO)

Density: 0.0002

Connectivity:

- Connected: False

- Number of connected components: 2230

red nodes are roles
blue nodes are singers

SINGER/ ROLE WEIGHTED GRAPH
DEGREE HISTOGRAM

Opera singer vs role weighted connection graph, GBOPERA, 2008-2016. Connected component 0

degree histogram

RED   – ER graph
BLACK – BA graph
BLUE   – opera graph

SINGER/ ROLE WEIGHTED GRAPH
GIANT CONNECTED COMPONENT

Connected component 0 of Opera singer vs role weighted connection graph, GBOPERA, 2008-2016
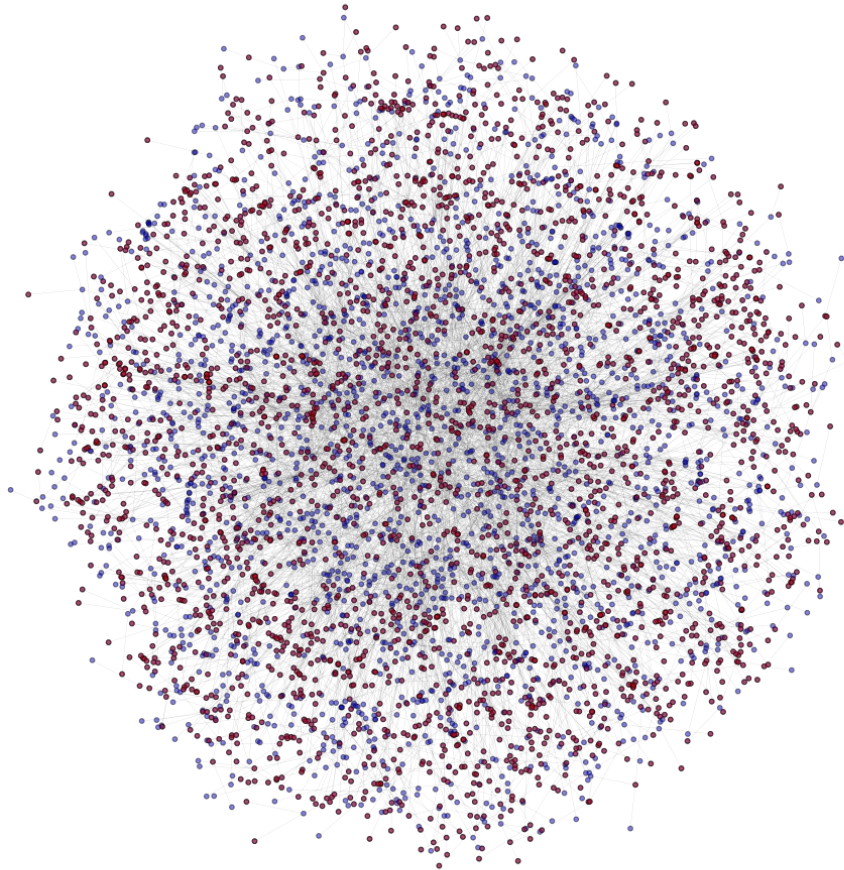
Graph properties:

Number of nodes: 5244

Number of edges: 6973

Degree:

- Avg: 2.6594

- Max: 33 (Annina|LA TRAVIATA)

- Min: 1 (GIULIA MIJ)

Density: 0.0005

Diameter: 35

red nodes are roles
blue nodes are singers

SINGER/ OPERA WEIGHTED GRAPH
CENTRALITY. KRYSTIAN ADAM EGO GRAPH

Connected component. Ego graph for node KRYSTIAN ADAM 0 of Opera singer vs role weighted connection graph, GBOPERA, 2008-2016
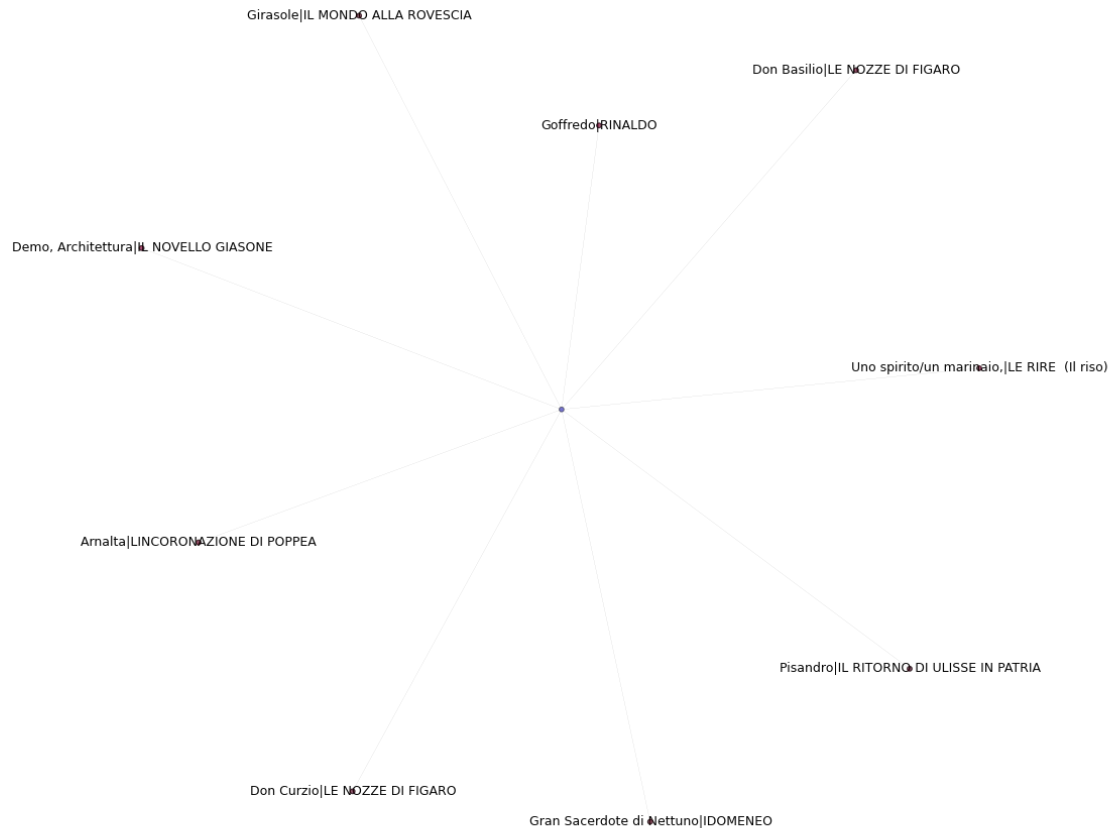
CENTRALITY

KRYSTIAN ADAM, 0.4687
Arnalta|LINCORONAZIONE DI POPPEA, 0.4669
ADRIANA DI PAOLA, 0.466833843262
Curra|LA FORZA DEL DESTINO, 0.4267
Don Curzio|LE NOZZE DI FIGARO, 0.3979
ANNUNZIATA VESTRI, 0.2285
LUCA CASALIN, 0.2198
Gastone|LA TRAVIATA, 0.1425
Flora Bervoix|LA TRAVIATA, 0.1290
Il Principe YamadoriMADAMA BUTTERFLY, 0.1267
PIETRO PICONE, 0.1192
MILENA JOSIPOVIC, 0.1077
Sacerdotessa|AIDA, 0.0999
ANTONELLA TREVISAN, 0.0951
ALFIO MARLETTA, 0.0780
BRUNO LAZZARETTI, 0.0747
Benoit|LA BOHME, 0.0743
Don Basilio|LE NOZZE DI FIGARO, 0.0739
Suzuki|MADAMA BUTTERFLY, 0.0668
FEDERICO LONGHI, 0.0662
ANTONIO FELTRACCO, 0.0630
Un notaro|DON PASQUALE, 0.0600
MATTEO MACCHIONI, 0.0598
Matteo Borsa|RIGOLETTO, 0.0593
CATERINA DI TONNO, 0.0588
SAVERIO BAMBI, 0.0586
ALESSANDRO PUCCI, 0.0555
Parpignol|LA BOHME, 0.0525
GREGORY BONFATTI, 0.0523
FRANCESCO PITTARI, 0.0518
Maddalena|RIGOLETTO, 0.0508
Annina|LA TRAVIATA, 0.04977

Girasole|IL MONDO ALLA ROVESCIA

Don Basilio|LE NOZZE DI FIGARO

Goffredo|RINALDO

Demo, Architettura|IL NOVELLO GIASONE

Uno spirito/un marinaio,|LE RIRE (Il riso)

Arnalta|LINCORONAZIONE DI POPPEA

Pisandro|IL RITORNO DI ULISSE IN PATRIA

Don Curzio|LE NOZZE DI FIGARO

Gran Sacerdote di Nettuno|IDOMENEO

red nodes are roles
blue nodes are singers