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CRASH COURSE

Social Networks: Description and Visualization

FEBRUARY 2023

Agenda

Why do we study social networks?

What are social networks?

How do we visualize networks in R?

Where can I go for more?

Learning outcomes

- When we're done, you should be able to:
  - **Describe social networks** using formal language
  - **Construct network data** for analysis and visualization
  - Use the **iGraph** library in R to draw and manipulate basic networks
    - Know where to go for other options

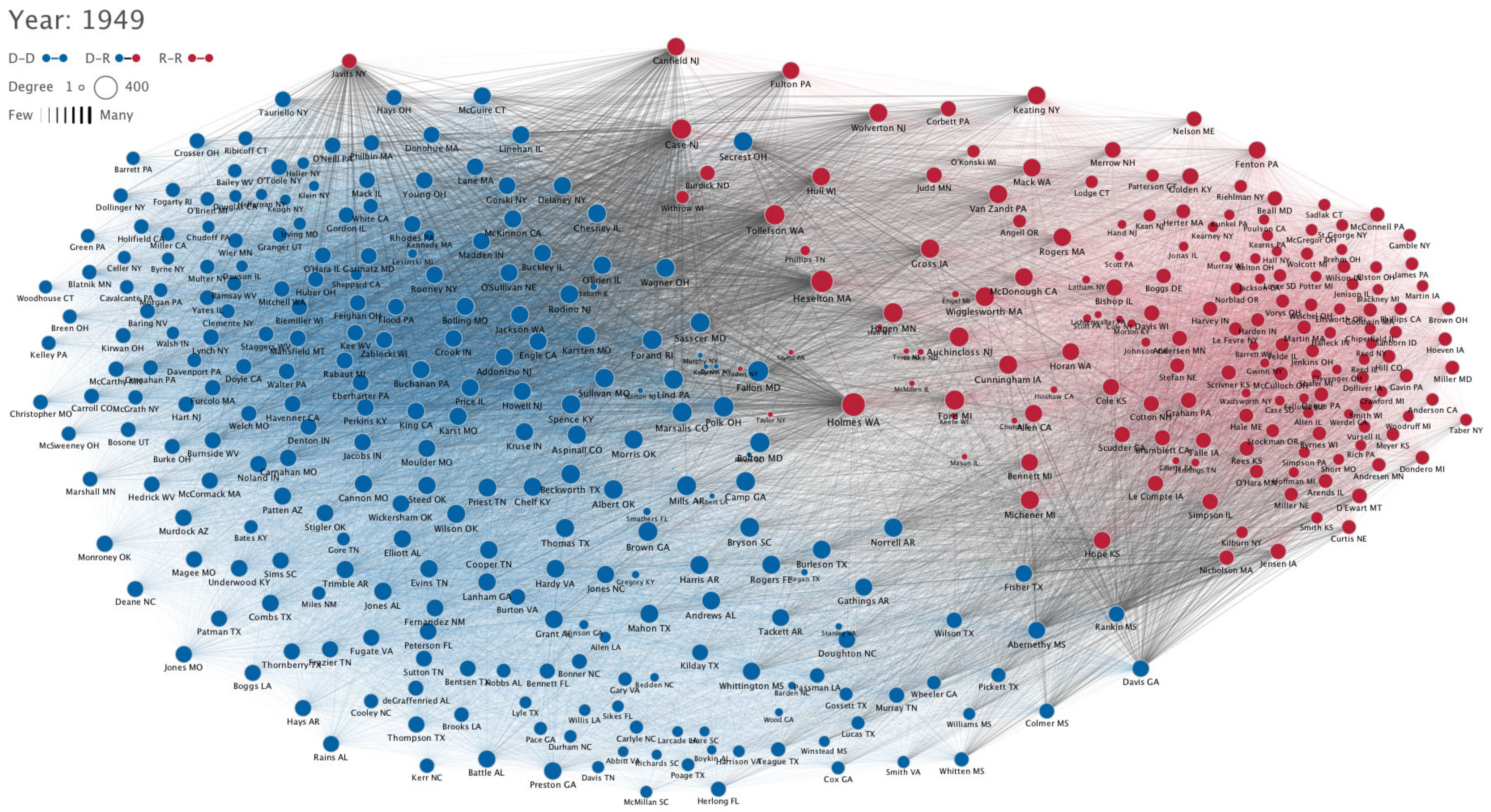
Part One

Why do we study social networks?

A contemporary story: Polarization

- Specifically, polarization in the United States House of Representatives
  - Based on roll call data, we can see how often different pairs (or “dyads”) of legislators agree
  - For all pairs of legislators:
    - Votes in common (both “aye” or both “nay”) increased the agreement score
    - Votes not in common (one “aye” and one “nay”) decreased the agreement score
- What does it look like? And does it change?

Andris C, Lee D, Hamilton MJ, Martino M, Gunning CE, Selden JA (2015) The Rise of Partisanship and Super-Cooperators in the U.S. House of Representatives. PLoS ONE 10(4): e0123507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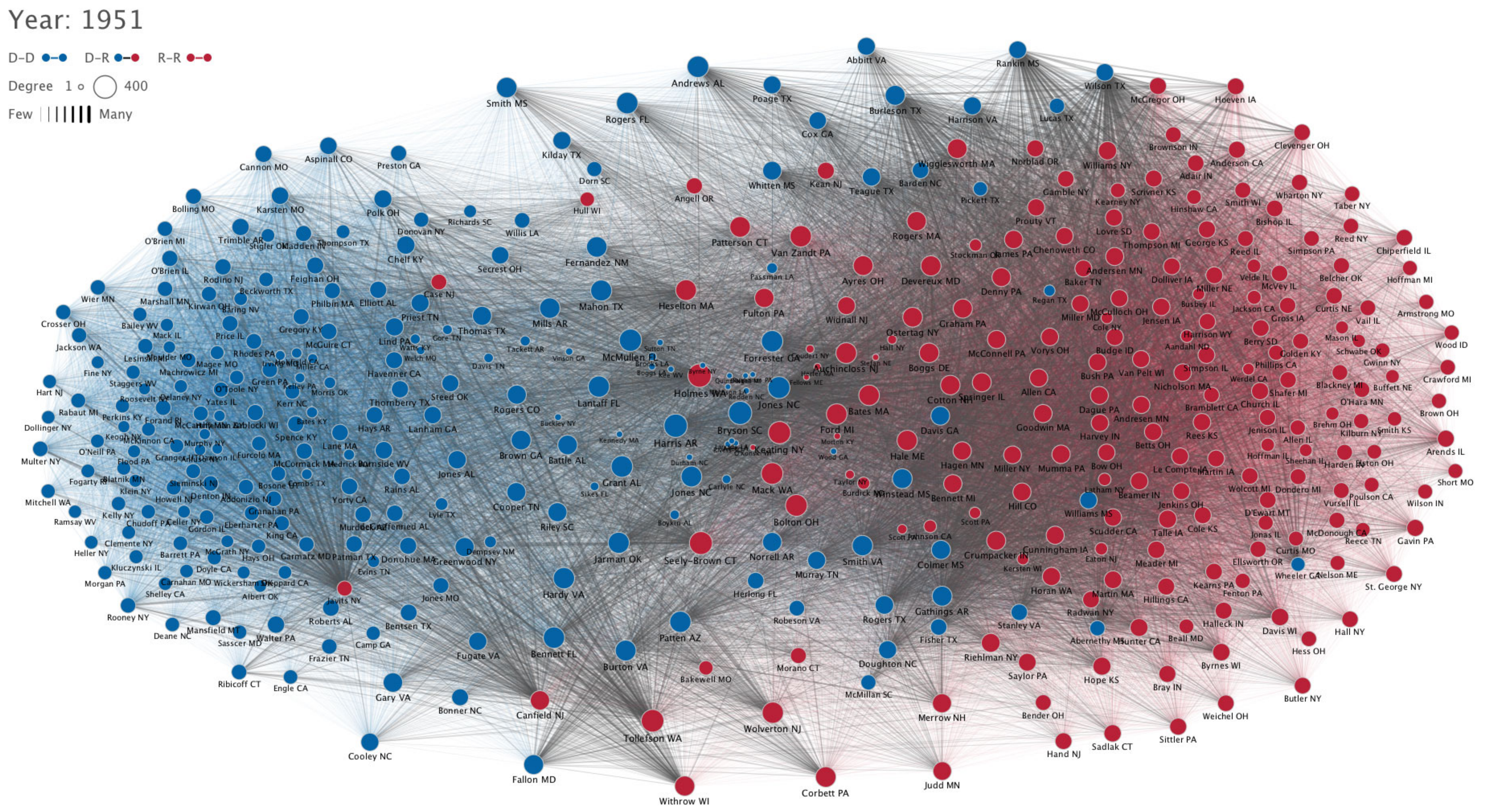

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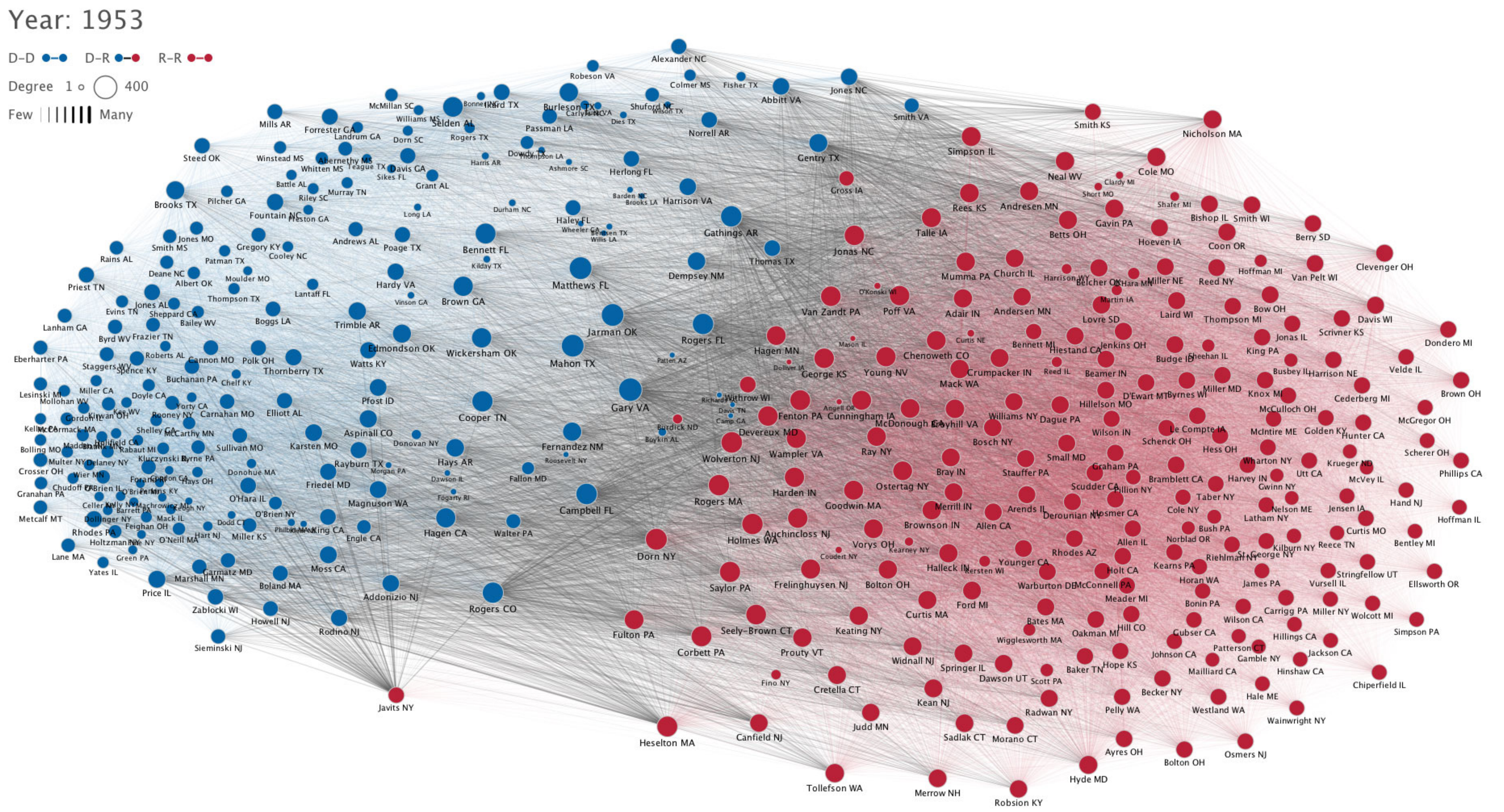
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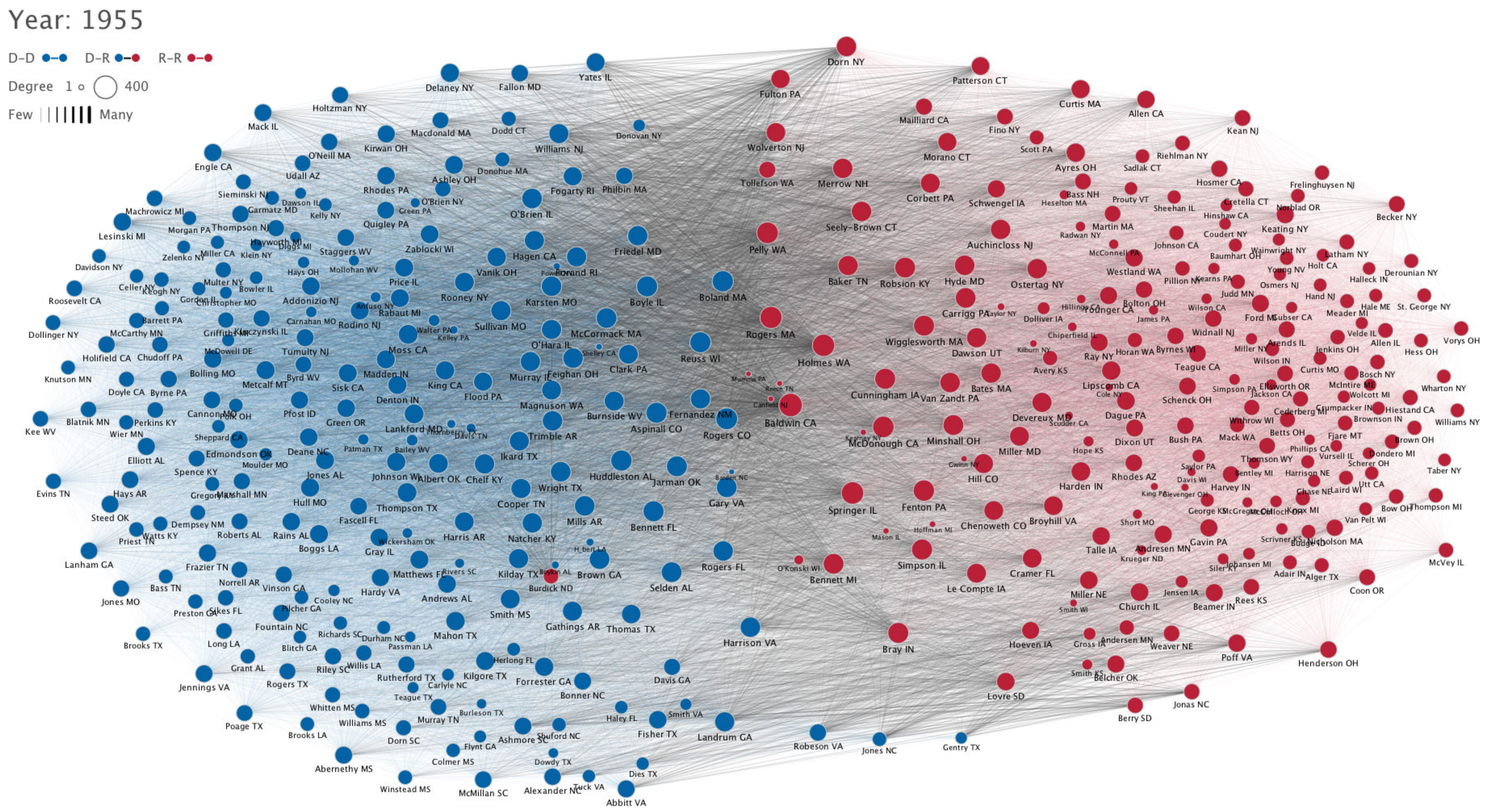
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Chelf KY
Huddleston AL
Jarman OK
Bardeen NC
Gwinn NY
Hill CO
Harden IN
Rhodes AZ
Saylor PA
Thomson WY
Bentley MI
Harrison NE
Scherer OH
Taber NY
Evins TN
Hays AR
Gregory KY
Marshall MN
Hull MO
Wright TX
Davis WI
Harvey IN
Chase NE
Laird WI
Utt CA
King PA
Clevenger OH
Cooper TN
Gary VA
Springer IL
Fenton PA
Steed OK
Thompson TX
Fascell FL
Mills AR
Broyhill VA
George KS
McGregor OH
McCulloch OH
Knox MI
Bow OH
Thompson MI
Dempsey NM
Watts KY
Roberts AL
Rains AL
Harris AR
Bennett FL
Chenoweth CO
Short MO
Van Pelt WI
Priest TN
Boggs LA
Wickersham OK
Natcher KY
Mason IL
Hoffman MI
Talle IA
Andresen MN
Gavin PA
Scrivner KS
Budge ID
Nicholson MA
Lanham GA
Frazier TN
Gray IL
H_bert LA
Simpson IL
Krueger ND
McVey IL
Norrell AR
Matthews FL
Rivers SC
Kilday TX
Boykin AL
Burdick ND
Brown GA
Selden AL
Rogers FL
O'Konski WI
Bennett MI
Le Compte IA
Cramer FL
Siler KY
Johansen MI
Adair IN
Alger TX
Coon OR
Bass TN
Jones MO
Vinson GA
Hardy VA
Andrews AL
Miller NE
Jensen IA
Preston GA
Sikes FL
Cooley NC
Pilcher GA
Smith MS
Gathings AR
Thomas TX
Smith WI
Church IL
Beamer IN
Rees KS
Fountain NC
Richards SC
Durham NC
Mahon TX
Harrison VA
Brooks TX
Long LA
Blitch GA
Passman LA
Bray IN
Hoeven IA
Gross IA
Andersen MN
Weaver NE
Poff VA
Henderson OH
Grant AL
Willis LA
Herlong FL
Riley SC
Rutherford TX
Kilgore TX
Forrester GA
Davis GA
Smith KS
Belcher OK
Jennings VA
Rogers TX
Carlyle NC
Bonner NC
Lovre SD
Jonas NC
Teague TX
Whitten MS
Burleson TX
Haley FL
Smith VA
Berry SD
Poage TX
Williams MS
Murray TN
Fisher TX
Landrum GA
Brooks LA
Dorn SC
Ashmore SC
Shuford NC
Robeson VA
Jones NC
Gentry TX
Flynt GA
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Colmer MS
Dowdy TX
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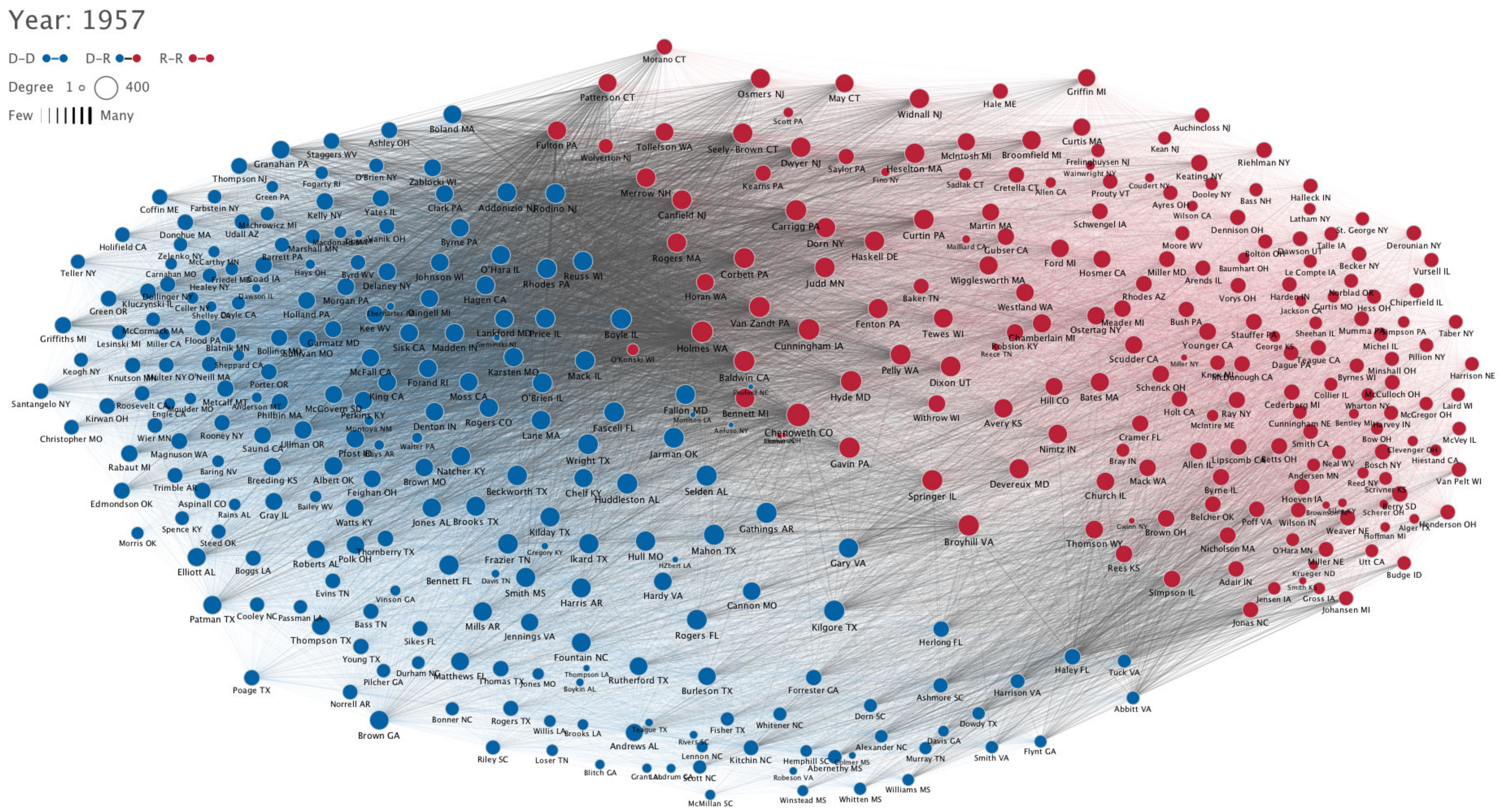
Winstead MS
McMillan SC
Alexander NC
Tuck VA
Abbitt VA



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D–D
D–R
R–R
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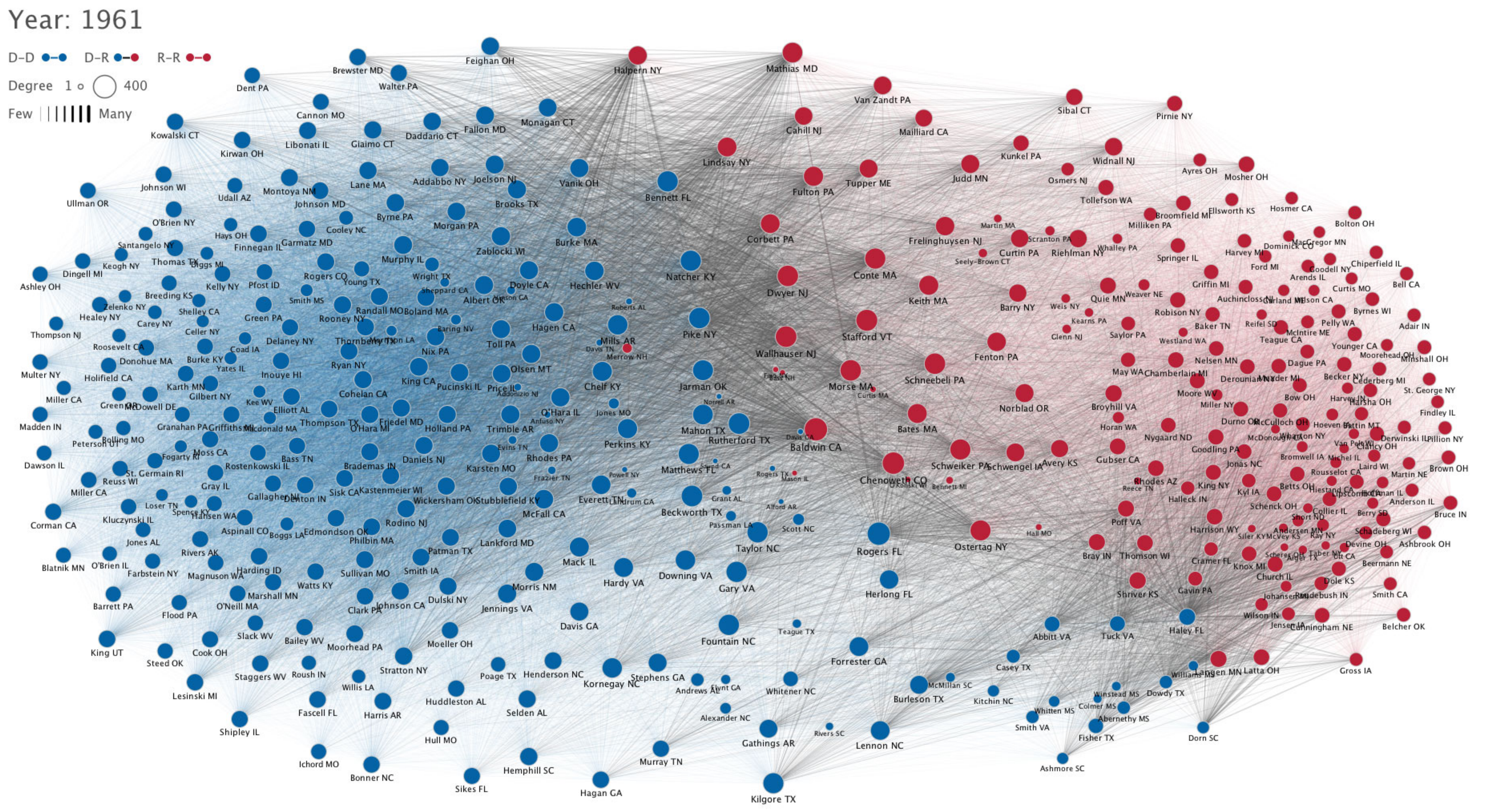
Few
Many
Morano CT
Patterson CT
Osmers NJ
May CT
Widnall NJ
Hale ME
Griffin MI
Scott PA
Auchincloss NJ
Boland MA
Ashley OH
Fulton PA
Tollefson WA
Seely-Brown CT
Wolverton NJ
Dwyer NJ
Saylor PA
Heselton MA
McIntosh MI
Broomfield MI
Curtis MA
Kean NJ
Riehlman NY
Staggers WV
Granahan PA
Thompson NJ
Fogarty RI
O'Brien NY
Zablocki WI
Merrow NH
Kearns PA
Fino NY
Sadlak CT
Cretella CT
Allen CA
Frelinghuysen NJ
Wainwright NY
Prouty VT
Coudert NY
Keating NY
Dooley NY
Bass NH
Halleck IN
Coffin ME
Farbstein NY
Green PA
Kelly NY
Yates IL
Clark PA
Addonizio NJ
Rodino NJ
Canfield NJ
Carrigg PA
Curtin PA
Martin MA
Schwengel IA
Ayres OH
Wilson CA
Latham NY
Donohue MA
Udall AZ
Machrowicz MI
Vanik OH
Byrne PA
Dorn NY
Haskell DE
Gubser CA
Dennison OH
St. George NY
Holifield CA
Zelenko NY
Barrett PA
Marshall MN
Rogers MA
Moore WV
Bolton OH
Dawson UT
Talle IA
Derounian NY
Teller NY
Carnahan MO
McCarthy MN
Hays OH
Byrd WV
O'Hara IL
Johnson WI
Reuss WI
Corbett PA
Judd MN
Ford MI
Hosmer CA
Miller MD
Baumhart OH
Le Compte IA
Becker NY
Vursell IL
Friedel MD
Coad IA
Healey NY
Delaney NY
Rhodes PA
Horan WA
Baker TN
Wigglesworth MA
Arends IL
Vorys OH
Harden IN
Norblad OR
Dollinger NY
Dawson IL
Morgan PA
Hagen CA
Rhodes AZ
Jackson CA
Curtis MO
Hess OH
Chipperfield IL
Green OR
Kluczynski IL
Celler NY
Shelley CA
Doyle CA
Holland PA
Dingell MI
Kee WV
Van Zandt PA
Fenton PA
Westland WA
Bush PA
Griffiths MI
McCormack MA
Lesinski MI
Miller CA
Flood PA
Carmatz MD
Lankford MD
Price IL
Boyle IL
Tewes WI
Chamberlain MI
Ostertag NY
Meader MI
Stauffer PA
Sheehan IL
Mumma PA
Simpson PA
Taber NY
Blatnik MN
Bolling MO
Sullivan MO
Sisk CA
Madden IN
Holmes WA
Cunningham IA
Robsion KY
Reece TN
Younger CA
George KS
Michel IL
Keogh NY
Sheppard CA
McFall CA
Karsten MO
O'Konski WI
Pelly WA
Scudder CA
Teague CA
Pillion NY
Knutson MN
Multer NY
O'Neill MA
Forand RI
Mack IL
Baldwin CA
Dixon UT
Dague PA
Minshall OH
Porter OR
King CA
Moss CA
O'Brien IL
Hyde MD
Hill CO
Bates MA
Schenck OH
McDonough CA
Byrnes WI
Harrison NE
Santangelo NY
Roosevelt CA
Metcalf MT
Anderson MT
Engle CA
Moulder MO
Philbin MA
McGovern SD
Perkins KY
Fallon MD
Bennett MI
Withrow WI
Avery KS
Holt CA
Collier IL
McCulloch OH
Laird WI
Kirwan OH
Rooney NY
Montoya NM
Denton IN
Rogers CO
Lane MA
Fascell FL
Morrison LA
Anfuso NY
Chenoweth CO
McIntire ME
Ray NY
Cederberg MI
Wharton NY
McGregor OH
Christopher MO
Wier MN
Saund CA
Ullman OR
Pfost ID
Hays AR
Walter PA
Wright TX
Jarman OK
Gavin PA
Nimtz IN
Cramer FL
Cunningham NE
Bentley MI
Harvey IN
McVey IL
Rabaut MI
Magnuson WA
Baring NV
Natcher KY
Lipscomb CA
Smith CA
Bow OH
Clevenger OH
Hiestand CA
Breeding KS
Albert OK
Brown MO
Bray IN
Allen IL
Betts OH
Neal WV
Bosch NY
Trimble AR
Feighan OH
Beckworth TX
Chelf KY
Huddleston AL
Selden AL
Springer IL
Devereux MD
Mack WA
Church IL
Andersen MN
Reed NY
Van Pelt WI
Edmondson OK
Aspinall CO
Rains AL
Gray IL
Bailey WV
Watts KY
Jones AL
Brooks TX
Byrne IL
Hoeven IA
Scrivner KS
Berry SD
Spence KY
Kilday TX
Gathings AR
Broyhill VA
Gwinn NY
Belcher OK
Poff VA
Wilson IN
Scherer OH
Henderson OH
Morris OK
Steed OK
Thornberry TX
Ikard TX
Hull MO
Mahon TX
Thomson WY
Brown OH
Nicholson MA
Weaver NE
Hoffman MI
Alger TX
Elliott AL
Boggs LA
Roberts AL
Polk OH
Frazier TN
Gregory KY
Gary VA
Rees KS
O'Hara MN
Miller NE
Utt CA
Budge ID
Bennett FL
Davis TN
Smith MS
Harris AR
Hardy VA
Simpson IL
Adair IN
Krueger ND
Smith KS
Evins TN
Vinson GA
Cannon MO
Jensen IA
Gross IA
Johansen MI
Patman TX
Cooley NC
Passman LA
Bass TN
Mills AR
Jennings VA
Rogers FL
Kilgore TX
Jonas NC
Thompson TX
Sikes FL
Herlong FL
Young TX
Fountain NC
Durham NC
Matthews FL
Thomas TX
Jones MO
Thompson LA
Rutherford TX
Boykin AL
Haley FL
Tuck VA
Poage TX
Pilcher GA
Burleson TX
Forrester GA
Ashmore SC
Harrison VA
Norrell AR
Abbitt VA
Bonner NC
Rogers TX
Fisher TX
Whitener NC
Dorn SC
Dowdy TX
Brown GA
Willis LA
Brooks LA
Teague TX
Davis GA
Andrews AL
Rivers SC
Alexander NC
Riley SC
Loser TN
Lennon NC
Kitchin NC
Hemphill SC
Colmer MS
Murray TN
Smith VA
Flynt GA
Blitch GA
Grant AL
Landrum GA
Scott NC
Abernethy MS
Robeson VA
Williams MS
McMillan SC
Winstead MS
Whitten MS


Year: 1959
D-D
D-R
R-R
Degree 1
400
Few
Many
Hemphill SC
Whitener NC
Lennon NC
Harris AR
Forrester GA
Kitchin NC
Jennings VA
Passman LA
Dorn SC
Everett TN
Fountain NC
Patman TX
Bass TN
Selden AL
Brown GA
Abbitt VA
Smith MS
Vinson GA
Ashmore SC
Tuck VA
Jones AL
Rains AL
Roberts AL
Young TX
Mills AR
Casey TX
Brooks LA
Downing VA
Haley FL
Murray TN
Harrison VA
Jensen IA
Elliott AL
Thomas TX
Gathings AR
Gary VA
Smith VA
Poff VA
Morris NM
Evins TN
Chelf KY
Thompson TX
Matthews FL
Hull MO
Herlong FL
Jonas NC
Budge ID
Frazier TN
Brooks TX
Harmon IN
Hargis KS
Boggs LA
Hogan IN
Roush IN
Ikard TX
Trimble AR
McGinley NE
Huddleston AL
Hardy VA
Cannon MO
Mahon TX
Beckworth TX
Coffin ME
Avery KS
Langen MN
Spence KY
Moulder MO
Wampler IN
Pfost ID
Watts KY
Stubblefield KY
Bennett FL
Rogers FL
Morris OK
Aspinall CO
Bailey WV
Shipley IL
Marshall MN
Albert OK
Wright TX
Fascell FL
Kilgore TX
Bray IN
Edmondson OK
Denton IN
Johnson CA
Perkins KY
George KS
Breeding KS
Gavin PA
McGovern SD
Doyle CA
Brown MO
Ullman OR
Gray IL
McCormack MA
Natcher KY
Bennett MI
Horan WA
Montoya NM
Baring NV
Sisk CA
Rivers AK
Johnson WI
Steed OK
Rogers CO
O'Konski WI
Levering OH
Thornberry TX
Kilday TX
Springer IL
Norblad OR
Saund CA
Mack IL
Wolf IA
Libonati IL
Karsten MO
Smith IA
Burke KY
Wier MN
Kasem CA
Kee WV
King CA
Anderson MT
Moore WV
Chenoweth CO
May WA
Johnson CO
Coad IA
Randall MO
Shepard CA
Slack WV
O'Brien IL
McFall CA
O'Hara IL
Hechler WV
King UT
Stratton NY
Dixon UT
Hays OH
Carnahan MO
Murphy IL
Lankford MD
Blatnik MN
Kirwan OH
Prokop PA
Moss CA
Price IL
Flood PA
Baker TN
Baldwin CA
Fenton PA
Milliken PA
Metcalf MT
Lesinski MI
Porter OR
McDowell DE
Miller CA
Sullivan MO
Griffiths MI
Barr IN
Pucinski IL
Johnson MD
Judd MN
Dawson IL
Granahan PA
Morgan PA
Zablocki WI
Walter PA
Santangelo NY
Dingell MI
Friedel MD
Curtin PA
Chamberlain MI
Meyer VT
Roosevelt CA
Flynn WI
Kowalski CT
O'Hara MI
Toll PA
Moorhead PA
Holland PA
Fallon MD
Burke MA
Saylor PA
Bowles CT
Bolling MO
Shelley CA
Udall AZ
Cohelan CA
Karth MN
Hagen CA
Foley MD
Lane MA
Conte MA
Barrett PA
Madden IN
Staggers WV
Byrne PA
Brademas IN
Kelly NY
Rostenkowski IL
Holifield CA
Reuss WI
Kastenmeier WI
Cook OH
Irwin CT
Corbett PA
Wallhauser NJ
Tollefson WA
Multer NY
Dent PA
Rabaut MI
Feighan OH
Daniels NJ
Van Zandt PA
Mailliard CA
Broomfield MI
Nix PA
Healey NY
Gallagher NJ
Delaney NY
Kearns PA
Kluczynski IL
Zelenko NY
Philbin MA
Fogarty RI
Moeller OH
Fulton PA
Dwyer NJ
Green OR
Miller CA
Ashley OH
Clark PA
Addonizio NJ
Monagan CT
Merrow NH
Rogers MA
Magnuson WA
Diggs MI
Garmatz MD
Quigley PA
Yates IL
Lindsay NY
O'Neill MA
Brewster MD
Rhodes PA
Teller NY
Machrowicz MI
Rooney NY
Rodino NJ
Boland MA
Fino NY
Dorn NY
O'Brien NY
Macdonald MA
Giaimo CT
Green PA
Thompson NJ
Donohue MA
Halpern NY
Oliver ME
Farbstein NY
Dulski NY
Holtzman NY
Daddario CT
Vanik OH



Year: 1961
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D-R
R-R
Degree 1
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Few
Many
Feighan OH
Halpern NY
Mathias MD
Brewster MD
Walter PA
Dent PA
Van Zandt PA
Sibal CT
Pirnie NY
Cannon MO
Fallon MD
Monagan CT
Cahill NJ
Mailliard CA
Kowalski CT
Libonati IL
Giaimo CT
Daddario CT
Kirwan OH
Lindsay NY
Kunkel PA
Widnall NJ
Ayres OH
Mosher OH
Johnson WI
Montoya NM
Lane MA
Addabbo NY
Joelson NJ
Vanik OH
Bennett FL
Fulton PA
Tupper ME
Judd MN
Osmers NJ
Ullman OR
Udall AZ
Johnson MD
Brooks TX
Tollefson WA
Hosmer CA
Byrne PA
Morgan PA
Ellsworth KS
Bolton OH
O'Brien NY
Cooley NC
Broomfield MI
Milliken PA
Hays OH
Finnegan IL
Garmatz MD
Zablocki WI
Burke MA
Corbett PA
Frelinghuysen NJ
Curtin PA
Riehlman NY
Santangelo NY
Murphy IL
Martin MA
Scranton PA
Springer IL
Harvey MI
Thomas TX
Keogh NY
Natcher KY
Conte MA
Seely-Brown CT
Whalley PA
Chiperfield IL
Dingell MI
Rogers CO
Wright TX
Doyle CA
Hechler WV
Dwyer NJ
Ford MI
Ashley OH
Kelly NY
Pfost ID
Young TX
Albert OK
Keith MA
Barry NY
Quie MN
Griffin MI
Curtis MO
Bell CA
Breeding KS
Smith MS
Randall MO
Boland MA
Sheppard CA
Weaver NE
Auchincloss NJ
Zelenko NY
Shelley CA
Roberts AL
Weis NY
Robison NY
Byrnes WI
Healey NY
Carey NY
Green PA
Rooney NY
Hagen CA
Pike NY
Stafford VT
Kearns PA
Baker TN
Reifel SD
Pelly WA
Adair IN
Thompson NJ
Celler NY
Delaney NY
Baring NV
Toll PA
Mills AR
Glenn NJ
Saylor PA
Teague CA
Mcintire ME
Roosevelt CA
Coad IA
Thornberry TX
Nix PA
Davis TN
Merrow NH
Wallhauser NJ
Fenton PA
Westland WA
Younger CA
Minshall OH
Burke KY
Ryan NY
Olsen MT
Multer NY
Donohue MA
Yates IL
Inouye HI
King CA
Chelf KY
Jarman OK
Morse MA
Schneebeli PA
May WA
Chamberlain MI
Nelsen MN
Dague PA
Moorehead OH
Holifield CA
Karth MN
Cohelan CA
Pucinski IL
Price IL
Becker NY
Cederberg MI
Miller CA
Gilbert NY
Addonizio NJ
Curtis MA
Norblad OR
Broyhill VA
Moore WV
Bow OH
St. George NY
Kee WV
Elliott AL
Norrell AR
Miller NY
Harsha OH
Green OR
McDowell DE
Jones MO
Durno OR
McCulloch OH
Findley IL
Madden IN
Thompson TX
O'Hara IL
Holland PA
Trimble AR
Anfuso NY
Mahon TX
Bates MA
Horan WA
Hoeven IA
Battin MT
Granahan PA
Griffiths MI
Macdonald MA
Friedel MD
O'Hara MI
Perkins KY
Rutherford TX
Baldwin CA
Davis CA
Nygaard ND
McDonough CA
Wharton NY
Derwinski IL
Pillion NY
Bolling MO
Peterson UT
Moss CA
Bass TN
Evins TN
Rhodes PA
Gubser CA
Goodling PA
Clancy OH
Fogarty RI
Daniels NJ
Karsten MO
Schweiker PA
Schwengel IA
Avery KS
Bromwell IA
Michel IL
Dawson IL
Rostenkowski IL
Brademas IN
Matthews FL
Sisk CA
Chenoweth CO
Jonas NC
Laird WI
Brown OH
St. Germain RI
Reuss WI
Gray IL
Frazier TN
Powell NY
Rogers TX
Mason IL
O'Konski WI
Bennett MI
Rousselot CA
Martin NE
Miller CA
Gallagher NJ
Denton IN
Kastenmeier WI
Wickersham OK
Stubblefield KY
Everett TN
Landrum GA
Grant AL
Rhodes AZ
Reece TN
King NY
Kyl IA
Betts OH
Hiestand CA
Lipscomb CA
Hoffman IL
Loser TN
Spence KY
Hansen WA
McFall CA
Beckworth TX
Alford AR
Halleck IN
Schenck OH
Collier IL
Berry SD
Anderson IL
Corman CA
Kluczynski IL
Aspinall CO
Boggs LA
Edmondson OK
Rodino NJ
Passman LA
Scott NC
Hall MO
Poff VA
Harrison WY
Short ND
Bruce IN
Jones AL
Philbin MA
Lankford MD
Taylor NC
Rogers FL
Ostertag NY
Siler KY
McVey KS
Ray NY
Schadeberg WI
Rivers AK
Patman TX
Mack IL
Bray IN
Thomson WI
Scherer OH
Taber NY
Utt CA
Devine OH
Ashbrook OH
Blatnik MN
O'Brien IL
Harding ID
Smith IA
Cramer FL
Alger TX
Knox MI
Beermann NE
Farbstein NY
Magnuson WA
Watts KY
Sullivan MO
Morris NM
Hardy VA
Downing VA
Gary VA
Herlong FL
Church IL
Dole KS
Barrett PA
Marshall MN
Dulski NY
Shriver KS
Gavin PA
Smith CA
Flood PA
O'Neill MA
Clark PA
Johnson CA
Jennings VA
Johansen MI
Roudebush IN
Davis GA
Wilson IN
Jensen IA
Slack WV
Bailey WV
Moorhead PA
Moeller OH
Fountain NC
Teague TX
Abbitt VA
Tuck VA
Haley FL
Cunningham NE
Belcher OK
King UT
Steed OK
Cook OH
Forrester GA
Stratton NY
Casey TX
Staggers WV
Roush IN
Poage TX
Henderson NC
Langen MN
Latta OH
Gross IA
Kornegay NC
Stephens GA
Williams MS
Lesinski MI
Willis LA
Whitener NC
McMillan SC
Andrews AL
Flynt GA
Burleson TX
Winstead MS
Dowdy TX
Fascell FL
Harris AR
Huddleston AL
Selden AL
Kitchin NC
Colmer MS
Whitten MS
Abernethy MS
Shipley IL
Alexander NC
Smith VA
Hull MO
Gathings AR
Rivers SC
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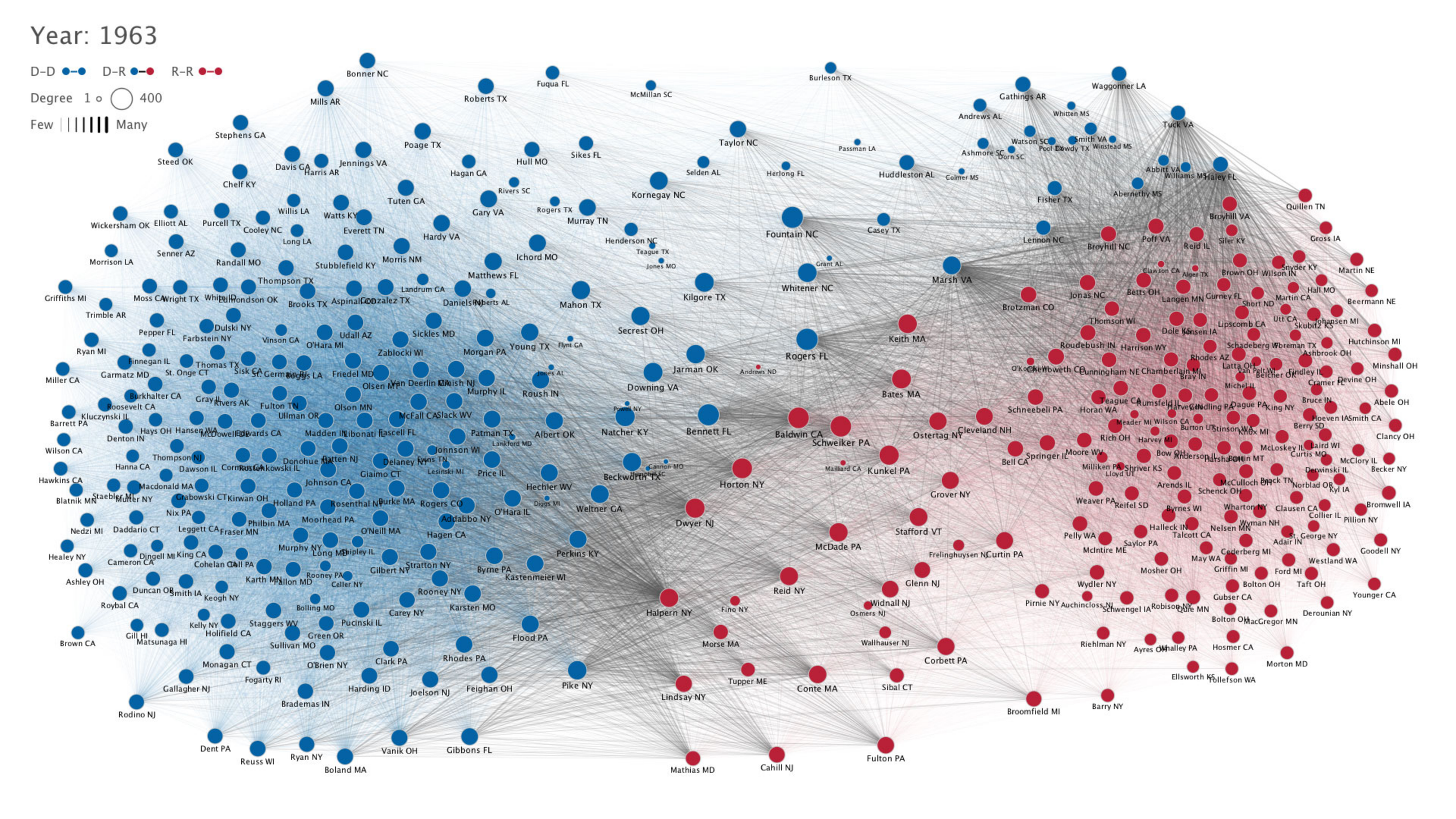
Ashmore SC
Bonner NC
Hemphill SC
Sikes FL
Hagan GA
Kilgore TX


Year: 1963
D-D
D-R
R-R
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Roberts TX
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Burleson TX
Waggonner LA
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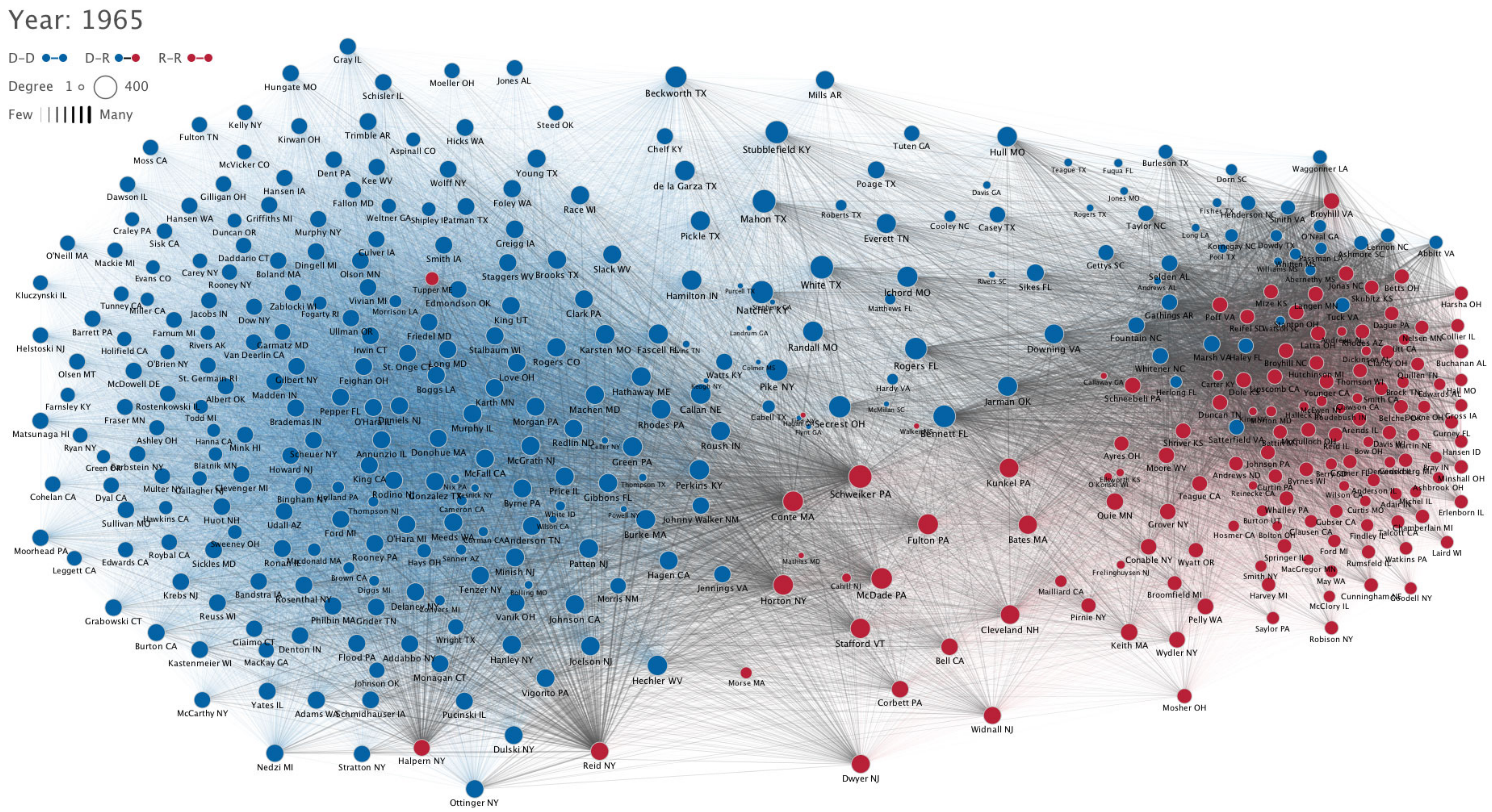
Andrews AL
Whitten MS
Tuck VA
Stephens GA
Poage TX
Taylor NC
Passman LA
Watson SC
Pool TX
Dowdy TX
Smith VA
Winstead MS
Ashmore SC
Dorn SC
Steed OK
Davis GA
Harris AR
Jennings VA
Hull MO
Sikes FL
Hagan GA
Selden AL
Herlong FL
Huddleston AL
Colmer MS
Abbitt VA
Williams MS
Haley FL
Chelf KY
Rivers SC
Kornegay NC
Fisher TX
Abernethy MS
Tuten GA
Willis LA
Watts KY
Gary VA
Rogers TX
Murray TN
Quillen TN
Broyhill VA
Wickersham OK
Elliott AL
Purcell TX
Cooley NC
Everett TN
Long LA
Hardy VA
Henderson NC
Fountain NC
Casey TX
Lennon NC
Poff VA
Reid IL
Siler KY
Gross IA
Senner AZ
Randall MO
Morris NM
Teague TX
Jones MO
Broyhill NC
Morrison LA
Stubblefield KY
Ichord MO
Grant AL
Whitener NC
Marsh VA
Thompson TX
Matthews FL
Griffiths MI
Moss CA
Wright TX
White ID
Lemmondson OK
Brooks TX
Landrum GA
Daniels NJ
Roberts AL
Kilgore TX
Jonas NC
Betts OH
Langen MN
Gurney FL
Martin CA
Hall MO
Martin NE
Trimble AR
Mahon TX
Brotzman CO
Short ND
Beermann NE
Pepper FL
Dulski NY
Farbstein NY
Vinson GA
O'Hara MI
Udall AZ
Sickles MD
Secrest OH
Thomson WI
Dole KS
Lipscomb CA
Utt CA
Johansen MI
Ryan MI
Zablocki WI
Morgan PA
Young TX
Flynt GA
Keith MA
Roudebush IN
Harrison WY
Schadeberg WI
Hutchinson MI
Finnegan IL
Thomas TX
Sisk CA
St. Germain RI
Buggs LA
Friedel MD
Rogers FL
Jarman OK
Andrews ND
Cheyenne CO
Cunningham NE
Chamberlain MI
Rhodes AZ
Ashbrook OH
Minshall OH
Miller CA
Garmatz MD
St. Onge CT
Olsen MT
Van Deerlin CA
Kazen NJ
Murphy IL
Roush IN
Downing VA
Bates MA
Devine OH
Burkhalter CA
Gray IL
Rivers AK
Fulton TN
Olson MN
Schneebeli PA
Horan WA
Rumsfeld IL
Harvey MI
Dague PA
King NY
Abele OH
Roosevelt CA
Ullman OR
McFall CA
Slack WV
Natcher KY
Bennett FL
Baldwin CA
Schweiker PA
Ostertag NY
Cleveland NH
Bruce IN
Kluczynski IL
Barrett PA
Hays OH
Hansen WA
McDowell Edwards CA
Madden IN
Libonati IL
Fascell FL
Patman TX
Albert OK
Lankford MD
Meader MI
Wilson CA
Burton UT
Stinson WA
Knox MI
Hoeven IA
Smith CA
Berry SD
Clancy OH
Denton IN
Wilson CA
Thompson NJ
Hanna CA
Dawson IL
Cornelius NC
Rostenkowski IL
Donohue MA
Ratten NJ
Delaney NY
Evins TN
Johnson WI
Lesinski MI
Price IL
Giaimo CT
Beckworth TX
Cannon MO
Thurmond SC
Horton NY
Mailliard CA
Kunkel PA
Rich OH
Harvey MI
Moore WV
Bow OH
Anderson IL
Laird WI
Curtis MO
McClory IL
Becker NY
Springer IL
Bell CA
Milliken PA
Shriver KS
Lloyd UT
Derwinski IL
Hawkins CA
Johnson CA
Hechler WV
Grover NY
Arends IL
Norblad OR
Kyl IA
Blatnik MN
Staebler MI
Macdonald MA
Mailer NY
Crabowski CT
Kirwan OH
Holland PA
Rosenthal NY
Burke MA
Rogers CO
Diggs MI
O'Hara IL
Weltner GA
Dwyer NJ
Schenck OH
Weaver PA
Reifel SD
Byrnes WI
Wharton NY
Clausen CA
Collier IL
Bromwell IA
Nix PA
Philbin MA
Moorhead PA
Addabbo NY
Stafford VT
Halleck IN
Talcott CA
Nelsen MN
Wyman NH
Pillion NY
Nedzi MI
Daddario CT
Leggett CA
Fraser MN
O'Neill MA
Hagen CA
McDade PA
Pelly WA
Saylor PA
Adair IN
St. George NY
Healey NY
Dingell MI
King CA
Cameron CA
Murphy NY
Long MD
Shipley IL
Perkins KY
Frelinghuysen NJ
Curtin PA
McIntire ME
Cederberg MI
Goodell NY
Cohelan CA
Gilbert NY
Stratton NY
Byrne PA
Kastenmeier WI
Glenn NJ
May WA
Mosher OH
Griffin MI
Ford MI
Westland WA
Ashley OH
Karth MN
Fallon MD
Rooney PA
Celler NY
Reid NY
Wydler NY
Bolton OH
Taft OH
Duncan OR
Smith IA
Keogh NY
Rooney NY
Widnall NJ
Pirnie NY
Auchincloss NJ
Schwengel IA
Robison NY
Gubser CA
Younger CA
Roybal CA
Bolling MO
Carey NY
Karsten MO
Halpern NY
Fino NY
Osmers NJ
Que MN
Derounian NY
Kelly NY
Staggers WV
Pucinski IL
Bolton OH
MacGregor MN
Gill HI
Matsunaga HI
Holifield CA
Green OR
Flood PA
Morse MA
Wallhauser NJ
Corbett PA
Riehlman NY
Ayres OH
Whalley PA
Hosmer CA
Brown CA
Sullivan MO
Monagan CT
O'Brien NY
Clark PA
Rhodes PA
Ellsworth KS
Tollefson WA
Morton MD
Fogarty RI
Tupper ME
Conte MA
Sibal CT
Gallagher NJ
Harding ID
Joelson NJ
Feighan OH
Pike NY
Lindsay NY
Broomfield MI
Barry NY
Brademas IN
Rodino NJ
Dent PA
Reuss WI
Ryan NY
Boland MA
Vanik OH
Gibbons FL
Mathias MD
Cahill NJ
Fulton PA



Year: 1965
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D–R
R–R
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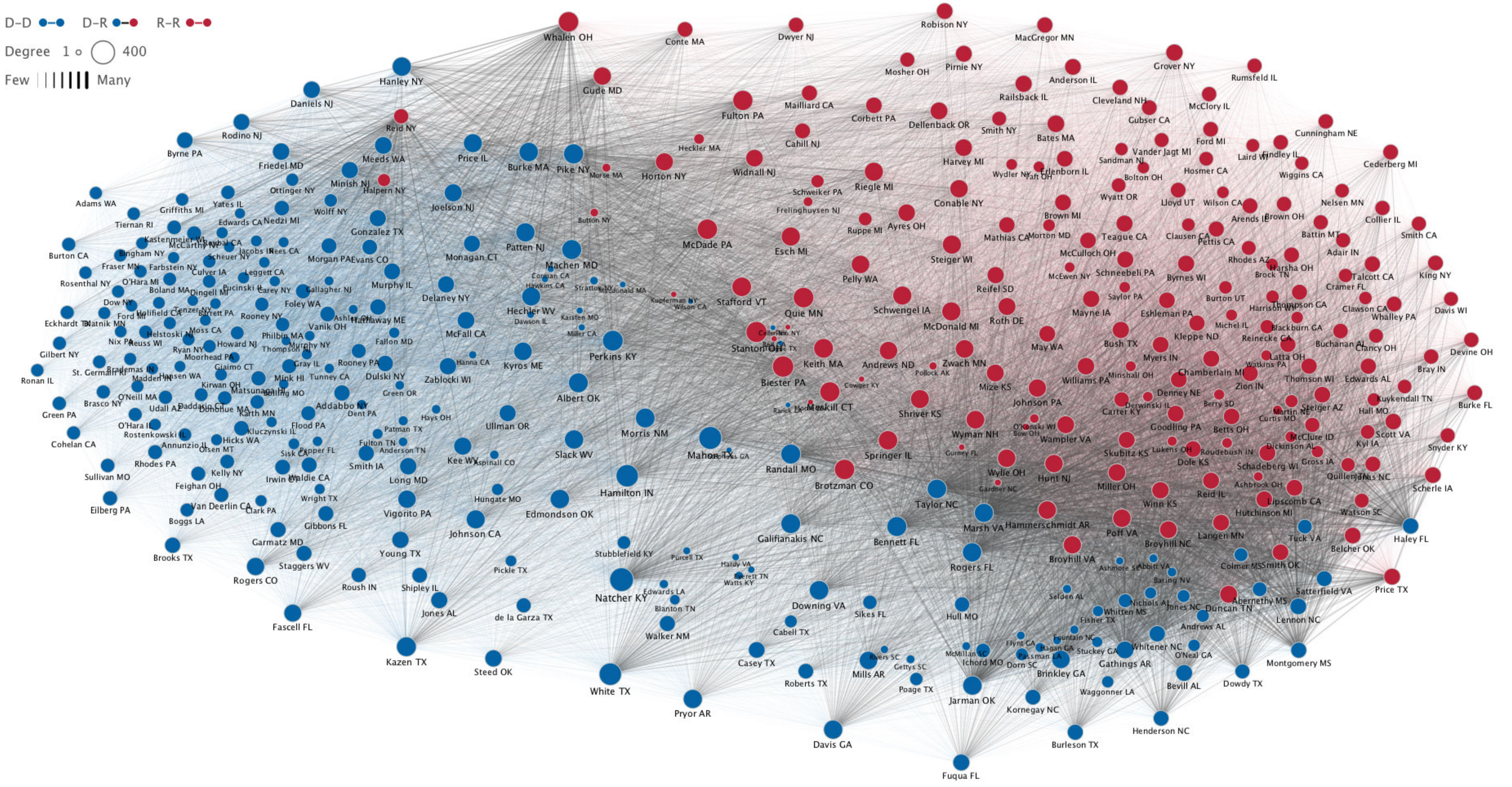
Hungate MO
Schisler IL
Moeller OH
Jones AL
Beckworth TX
Mills AR
Kelly NY
Fulton TN
Kirwan OH
Trimble AR
Hicks WA
Steed OK
Chelf KY
Stubblefield KY
Tuten GA
Hull MO
Burleson TX
Moss CA
McVicker CO
Aspinall CO
Dent PA
Kee WV
Wolff NY
Young TX
de la Garza TX
Poage TX
Waggonner LA
Dorn SC
Dawson IL
Gilligan OH
Hansen IA
Fallon MD
Foley WA
Race WI
Mahon TX
Roberts TX
Hansen WA
Griffiths MI
Murphy NY
Patman TX
Cooley NC
Casey TX
Taylor NC
Broyhill VA
Smith VA
Craley PA
Duncan OR
Greigg IA
Pickle TX
Everett TN
Sisk CA
Culver IA
Smith IA
O'Neill MA
Mackie MI
Daddario CT
Dingell MI
Evans CO
Carey NY
Boland MA
Olson MN
Staggers WV
Brooks TX
Slack WV
White TX
Gettys SC
Selden AL
Abbitt VA
Rooney NY
Tupper ME
Kluczynski IL
Tunney CA
Miller CA
Zablocki WI
Vivian MI
Edmondson OK
Hamilton IN
Natcher KY
Ichord MO
Sikes FL
Clark PA
Jacobs IN
Dow NY
King UT
Matthews FL
Gathings AR
Poff VA
Harsha OH
Barrett PA
Farnum MI
Ullman OR
Friedel MD
Karsten MO
Fascell FL
Randall MO
Downing VA
Fountain NC
Helstoski NJ
Holifield CA
Rivers AK
Carmatz MD
Irwin CT
Stalbaum WI
Rogers CO
Rogers FL
Marsh VA
Haley FL
Collier IL
Olsen MT
O'Brien NY
Van Deerlin CA
St. Onge CT
Long MD
Whitener NC
Buchanan AL
McDowell DE
St. Germain RI
Gilbert NY
Feighan OH
Love OH
Watts KY
Pike NY
Farnsley KY
Albert OK
Madden IN
Boggs LA
Hathaway ME
Hardy VA
Jarman OK
Schneebeli PA
Hall MO
Rostenkowski IL
Pepper FL
Karth MN
Machen MD
Callan NE
Matsunaga HI
Fraser MN
Todd MI
Brademas IN
O'Hara IL
Daniels NJ
Morgan PA
Secrest OH
Bennett FL
Cross IA
Ryan NY
Ashley OH
Hanna CA
Murphy IL
Rhodes PA
Gurney FL
Mink HI
Redlin ND
Roush IN
Satterfield VA
Hansen ID
Green OR
Farbstein NY
Blatnik MN
Howard NJ
Scheuer NY
Annunzio IL
Donohue MA
McGrath NJ
Green PA
Ayres OH
Moore WV
Johnson PA
Minshall OH
McFall CA
Perkins KY
Schweiker PA
Kunkel PA
Andrews ND
Cohelan CA
Dyal CA
Multer NY
Gallagher NJ
Clevenger MI
King CA
Rodino NJ
Gonzalez TX
Price IL
Gibbons FL
Teague CA
Ashbrook OH
Bingham NY
Byrne PA
Conte MA
Quie MN
Sullivan MO
Hawkins CA
Huot NH
Thompson NJ
Johnny Walker NM
Grover NY
Erlenborn IL
Udall AZ
Ford MI
Burke MA
Fulton PA
Bates MA
Chamberlain MI
Moorhead PA
Sweeney OH
O'Hara MI
Meeds WA
Anderson TN
Laird WI
Roybal CA
Leggett CA
Edwards CA
Sickles MD
Ronan IL
Rooney PA
Minish NJ
Patten NJ
Hagen CA
Conable NY
Wyatt OR
Watkins PA
Krebs NJ
Bandstra IA
Rosenthal NY
Tenzer NY
Morris NM
Jennings VA
Horton NY
McDade PA
Mailliard CA
Broomfield MI
Grabowski CT
Reuss WI
Philbin MA
Grider TN
Delaney NY
Vanik OH
Johnson CA
Pirnie NY
Pelly WA
Harvey MI
Cunningham NE
Goodell NY
Burton CA
Giaimo CT
Denton IN
Wright TX
Cleveland NH
Stafford VT
Saylor PA
Robison NY
Kastenmeier WI
MacKay CA
Flood PA
Addabbo NY
Hanley NY
Joelson NJ
Hechler WV
Bell CA
Keith MA
Wydler NY
Johnson OK
Monagan CT
Vigorito PA
Morse MA
Yates IL
Adams WA
Schmidhauser IA
Pucinski IL
Corbett PA
Widnall NJ
Mosher OH
McCarthy NY
Dulski NY
Nedzi MI
Stratton NY
Halpern NY
Reid NY
Dwyer NJ
Ottinger NY


Year: 1967
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R-R
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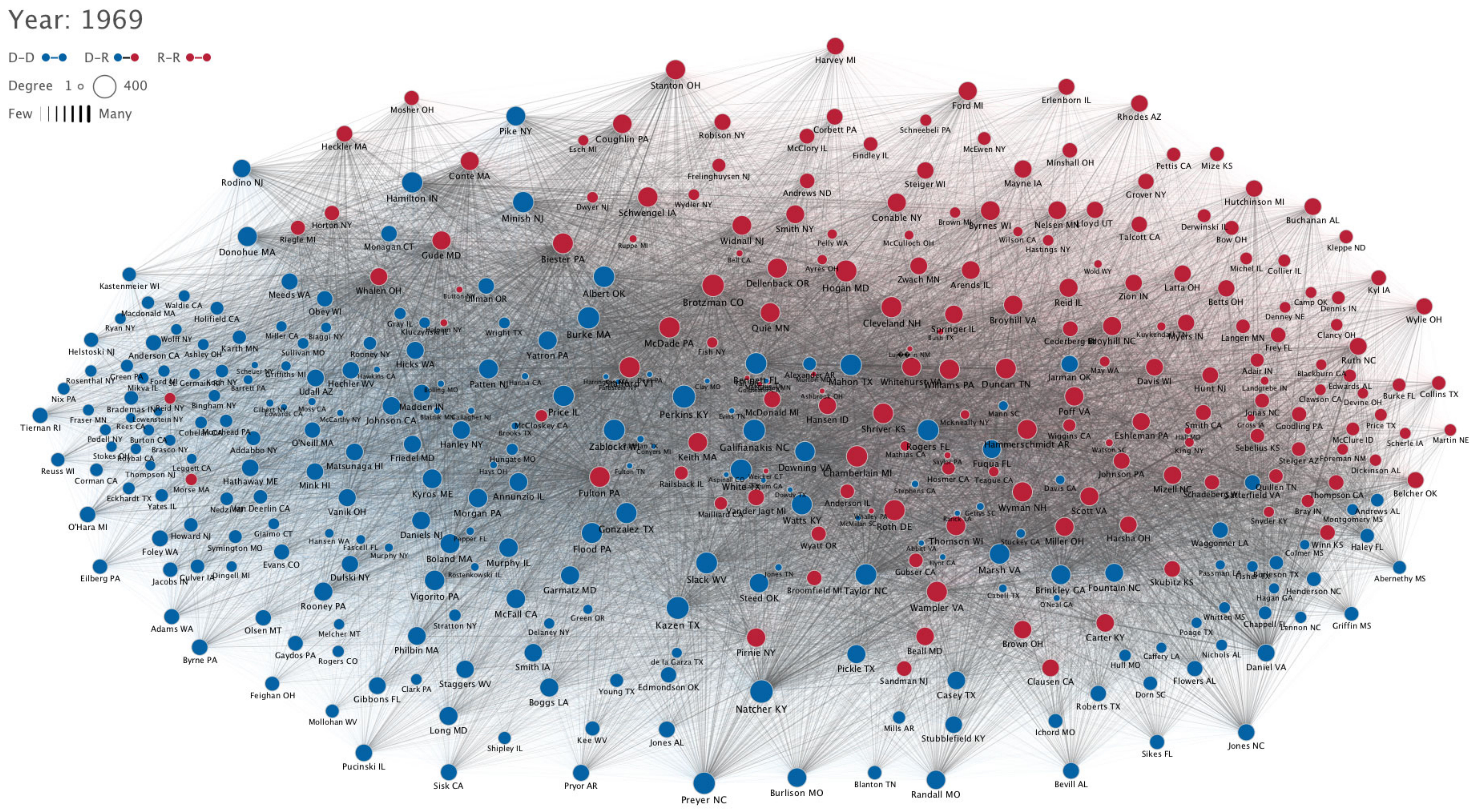
Few
Many
Whalen OH
Conte MA
Dwyer NJ
Robison NY
MacGregor MN
Mosher OH
Pirnie NY
Anderson IL
Grover NY
Rumsfeld IL
Railsback IL
Cleveland NH
McClory IL
Gubser CA
Cunningham NE
Hanley NY
Daniels NJ
Gude MD
Mailliard CA
Fulton PA
Corbett PA
Dellenback OR
Smith NY
Bates MA
Ford MI
Laird WI
Findley IL
Cederberg MI
Rodino NJ
Reid NY
Byrne PA
Meeds WA
Price IL
Burke MA
Pike NY
Morse MA
Horton NY
Heckler MA
Cahill NJ
Widnall NJ
Harvey MI
Wydler NY
Erlenborn IL
Sandman NJ
Vander Jagt MI
Hosmer CA
Wiggins CA
Friedel MD
Minish NJ
Halpern NY
Ottinger NY
Riegle MI
Schweiker PA
Frelinghuysen NJ
Conable NY
Bolton OH
Wyatt OR
Lloyd UT
Wilson CA
Nelsen MN
Adams WA
Griffiths MI
Yates IL
Edwards CA
Nedzi MI
Wolff NY
Tiernan RI
Joelson NJ
Button NY
Ruppe MI
Ayres OH
Mathias CA
Morton MD
Brown MI
Arends IL
Brown OH
Collier IL
Smith CA
Gonzalez TX
Patten NJ
McDade PA
Esch MI
Steiger WI
Teague CA
Clausen CA
Pettis CA
Battin MT
Adair IN
Burton CA
Bingham NY
Scheuer NY
Jacobs IN
Rees CA
Morgan PA
Evans CO
Monagan CT
Machen MD
Coman CA
Hawkins CA
Stratton NY
MacDonald MA
Kupferman NY
Wilson CA
Pelly WA
McCulloch OH
McEwen NY
Schneebeli PA
Rhodes AZ
Harsha OH
Brock TN
Talcott CA
King NY
Fraser MN
Farbstein NY
Culver IA
Leggett CA
Rosenthal NY
O'Hara MI
Boland MA
Dingell MI
Bucinski IL
Carey NY
Gallagher NJ
Murphy IL
Delaney NY
Reifel SD
Byrnes WI
Cramer FL
Dow NY
Foley WA
Rooney NY
Hechler WV
Dawson IL
Karsten MO
Miller CA
Stafford VT
Quie MN
Schwengel IA
Saylor PA
Mayne IA
Burton UT
Thompson CA
Clawson CA
Davis WI
Eckhardt TX
Matnik MN
Ford MI
Holifield CA
Tenzer NY
Barrett PA
Hathaway ME
Vanik OH
Ashley OH
McFall CA
McDonald MI
Roth DE
Eshleman PA
Michel IL
Harrison MS
Whalley PA
Gilbert NY
Nix PA
Reuss WI
Helstoski NJ
Howard NJ
Moss CA
Ryan NY
Moorhead PA
Fallon MD
Murphy NY
Thompson NJ
Perkins KY
Stanton OH
Keith MA
Andrews ND
Zwach MN
Pollock AK
May WA
Kleppe ND
Bush TX
Blackburn GA
Buchanan AL
Clancy OH
Devine OH
Ronan IL
St. Germain RI
Brademas IN
Madden IN
Hansen WA
Giaimo CT
Gray IL
Rooney PA
Kyros ME
Hanna CA
Zablocki WI
Dulski NY
Tunney CA
Mink HI
Kirwan OH
Matsunaga HI
Burling MO
Green OR
Biester PA
Cowger KY
Mize KS
Williams PA
Minshall OH
Myers IN
Chamberlain MI
Watkins PA
Latta OH
Bray IN
Thomson WI
Edwards AL
Green PA
Brasco NY
O'Neill MA
Udall AZ
Baddasio CT
Donohue MA
Karth MN
Addabbo NY
Dent PA
Albert OK
Meskill CT
Rarick LA
Shriver KS
Johnson PA
Denney NE
Zion IN
Berry SD
Carter KY
Derwinski IL
Martin NE
Curtis MO
Steiger AZ
Hall MO
Kuykendall TN
Burke FL
O'Hara IL
Rostenkowski IL
Cohelan CA
Annunzio IL
Olsen MT
Rhodes PA
Sullivan MO
Kelly NY
Feighan OH
Eilberg PA
Van Deerlin CA
Boggs LA
Brooks TX
Garmatz MD
Staggers WV
Rogers CO
Fascell FL
Roush IN
Shipley IL
Jones AL
Young TX
Vigorito PA
Clark PA
Gibbons FL
Wright TX
Irwin CT
Waldie CA
Flood PA
Kluczynski IL
Hicks WA
Sisk CA
Pepper FL
Smith IA
Long MD
Hays OH
Patman TX
Fulton TN
Anderson TN
Kee WV
Aspinall CO
Ullman OR
Slack WV
Morris NM
Mahon TX
Hamilton IN
Hungate MO
Edmondson OK
Johnson CA
Pickle TX
Stubblefield KY
Purcell TX
Natcher KY
Edwards LA
Blanton TN
Walker NM
de la Garza TX
Steed OK
Kazen TX
White TX
Pryor AR
Davis GA
Randall MO
Brotzman CO
Springer IL
Wylie OH
Gardner NC
Wyman NH
Gurney FL
Wampler VA
Hunt NJ
Skubitz KS
Lukens OH
Dole KS
Roudebush IN
Betts OH
Goodling PA
Schadeberg WI
Dickinson AL
McClure ID
Scott VA
Kyl IA
Snyder KY
Gross IA
Quillen TN
Jonas NC
Scherle IA
Taylor NC
Miller OH
Winn KS
Reid IL
Ashbrook OH
Lipscomb CA
Hutchinson MI
Watson SC
Galifianakis NC
Bennett FL
Marsh VA
Hammerschmidt AR
Poff VA
Broyhill NC
Langen MN
Tuck VA
Belcher OK
Haley FL
Rogers FL
Broyhill VA
Ashmore SC
Abbitt VA
Colmer MS
Smith OK
Baring NV
Satterfield VA
Price TX
Downing VA
Sikes FL
Hull MO
Selden AL
Nichols AL
Jones NC
Duncan TN
Abernethy MS
Lennon NC
Whitten MS
Fisher TX
Andrews AL
Cabell TX
Casey TX
Roberts TX
Mills AR
Rivers SC
Gettys SC
Poage TX
Flynt GA
Fountain NC
Ragan GA
Passman LA
Stuckey GA
McMillan SC
Ichord MO
Dorn SC
Brinkley GA
Whitener NC
O'Neal GA
Gathings AR
Montgomery MS
Waggonner LA
Bevill AL
Dowdy TX
Jarman OK
Kornegay NC
Henderson NC
Burleson TX
Fuqua FL


Year: 1969
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R–R
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Many
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Stanton OH
Mosher OH
Pike NY
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Robison NY
Corbett PA
Ford MI
Erlenborn IL
Rhodes AZ
Heckler MA
Conte MA
Rodino NJ
Hamilton IN
Minish NJ
Schwengel IA
Donohue MA
Gude MD
Biester PA
Widnall NJ
Smith NY
Conable NY
Mayne IA
Hutchinson MI
Buchanan AL
Albert OK
Brotzman CO
Dellenback OR
Hogan MD
Burke MA
McDade PA
Quie MN
Cleveland NH
Broyhill VA
Kyl IA
Wylie OH
Perkins KY
Mahon TX
Whitehurst VA
Williams PA
Duncan TN
Galifianakis NC
Chamberlain MI
Fulton PA
Gonzalez TX
Slack WV
Kazen TX
Taylor NC
Wampler VA
Natcher KY
Preyer NC
Burlison MO
Randall MO
Pucinski IL
Sisk CA
Pryor AR
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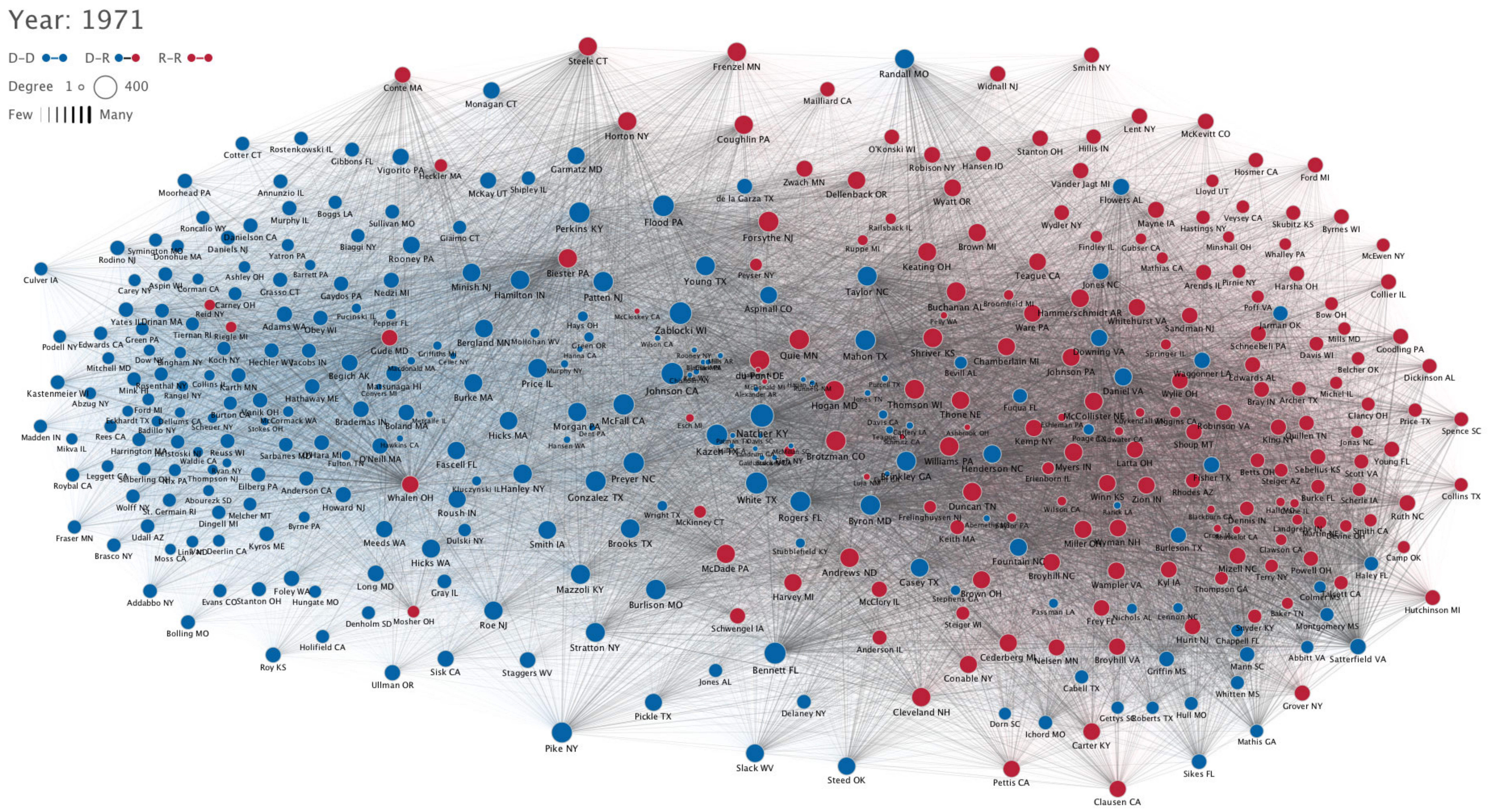
Abernethy MS
Belcher OK
Collins TX
Martin NE
Tiernan RI
Reuss WI
O'Hara MI
Eilberg PA


Year: 1971
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R–R
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Frenzel MN
Randall MO
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Widnall NJ
Monagan CT
Mailliard CA
Horton NY
Coughlin PA
Lent NY
McKevitt CO
O'Konski WI
Stanton OH
Hillis IN
Rostenkowski IL
Cotter CT
Gibbons FL
Robison NY
Hansen ID
Vigorito PA
Heckler MA
Garmatz MD
Hosmer CA
Ford MI
Moorhead PA
Annunzio IL
McKay UT
Shipley IL
Zwach MN
Dellenback OR
Vander Jagt MI
Lloyd UT
de la Garza TX
Wyatt OR
Flowers AL
Boggs LA
Roncalio WY
Murphy IL
Sullivan MO
Perkins KY
Flood PA
Railsback IL
Wydler NY
Mayne IA
Hastings NY
Vesey CA
Skubitz KS
Byrnes WI
Danielson CA
Giaimo CT
Forsythe NJ
Symington MO
Daniels NJ
Biaggi NY
Ruppe MI
Brown MI
Findley IL
Gubser CA
Minshall OH
Whalley PA
McEwen NY
Rodino NJ
Donohue MA
Yatron PA
Rooney PA
Culver IA
Ashley OH
Barrett PA
Biester PA
Peyser NY
Keating OH
Teague CA
Mathias CA
Jones NC
Arends IL
Pirnie NY
Harsha OH
Carey NY
Aspin WI
Corman CA
Grasso CT
Gaydos PA
Nedzi MI
Minish NJ
Hamilton IN
Young TX
Taylor NC
Patten NJ
Collier IL
Carney OH
Reid NY
Aspinall CO
Buchanan AL
Broomfield MI
Poff VA
Yates IL
Drinan MA
Adams WA
Obey WI
Pucinski IL
McCloskey CA
Hammerschmidt AR
Whitehurst VA
Bow OH
Pepper FL
Hays OH
Zablocki WI
Pelly WA
Ware PA
Sandman NJ
Jarman OK
Podell NY
Edwards CA
Tiernan RI
Riegle MI
Gude MD
Bergland MN
Mollohan WV
Wilson CA
Mills MD
Green PA
Griffiths MI
Green OR
Quie MN
Mahon TX
Shriver KS
Schneebeli PA
Goodling PA
Dow NY
Bingham NY
Koch NY
Hechler WV
Jacobs IN
Celler NY
Hanna CA
Rooney NY
Chamberlain MI
Downing VA
Springer IL
Davis WI
Mitchell MD
Macdonald MA
Murphy NY
Bevill AL
Johnson PA
Belcher OK
Dickinson AL
Begich AK
Price IL
Waggonner LA
Edwards AL
Kastenmeier WI
Rosenthal NY
Collins IL
Karth MN
Matsunaga HI
Johnson CA
du Pont DE
Purcell TX
Daniel VA
Wylie OH
Michel IL
Mink HI
Rangel NY
Conyers MI
Hathaway ME
Burke MA
Alexander AR
Jones TN
Hogan MD
Thomson WI
Fuqua FL
Bray IN
Archer TX
Abzug NY
Ford MI
Eckhardt TX
Dellums CA
Burton CA
Vanik OH
McCormack WA
Brademas IN
Boland MA
Metcalfe IL
Hicks MA
McFall CA
Thone NE
McCollister NE
Kuykendall TN
Wiggins CA
Clancy OH
Price TX
Spence SC
Madden IN
Badillo NY
Scheuer NY
Stokes OH
Morgan PA
Dent PA
Natcher KY
Esch MI
Davis GA
Eshleman PA
Ashbrook OH
Robinson VA
Quillen TN
Rees CA
Hansen WA
Hawkins CA
Schmitz CA
Poage TX
King NY
Jonas NC
Mikva IL
Kemp NY
Shoup MT
Harrington MA
Helstoski NJ
Reuss WI
Sarbanes MD
O'Hara MI
Fulton TN
O'Neill MA
Fascell FL
Kazen TX
Brotzman CO
Williams PA
Henderson NC
Latta OH
Young FL
Waldie CA
Myers IN
Betts OH
Sebelius KS
Leggett CA
Seiberling OH
Patman TX
Davis SC
Brinkley GA
Erlenborn IL
Fisher TX
Steiger AZ
Scott VA
Roybal CA
Nix PA
Thompson NJ
Eilberg PA
Anderson CA
Whalen OH
Kluczynski IL
Hanley NY
Preyer NC
Luja NM
Winn KS
Zion IN
Rhodes AZ
Burke FL
Scherle IA
Collins TX
Wolff NY
Abourezk SD
Howard NJ
Roush IN
Gonzalez TX
White TX
Duncan TN
Wilson CA
Rarick LA
Hall MO
St. Germain RI
Melcher MT
Wright TX
Rogers FL
Frelinghuysen NJ
Byron MD
Abernethy MS
Saylor PA
Blackburn GA
Dennis IN
Ruth NC
Dingell MI
McKinney CT
Landgrebe IN
Fraser MN
Udall AZ
Byrne PA
Dulski NY
Keith MA
Miller OH
Wyman NH
Martin NE
Devine OH
Smith CA
Kyros ME
Meeds WA
Smith IA
Brooks TX
Stubblefield KY
Burleson TX
Brasco NY
Link ND
Deerlin CA
Moss CA
Hicks WA
McDade PA
Andrews ND
Fountain NC
Clawson CA
Camp OK
Casey TX
Broyhill NC
Mizell NC
Powell OH
Haley FL
Terry NY
Long MD
Foley WA
Gray IL
Mazzoli KY
Burlison MO
Harvey MI
McClory IL
Stephens GA
Brown OH
Wampler VA
Kyl IA
Thompson GA
Colmer MS
Talcott CA
Addabbo NY
Evans CO
Stanton OH
Hungate MO
Passman LA
Frey FL
Nichols AL
Lennon NC
Baker TN
Hutchinson MI
Bolling MO
Denholm SD
Mosher OH
Roe NJ
Schwengel IA
Steiger WI
Snyder KY
Montgomery MS
Hunt NJ
Chappell FL
Holifield CA
Stratton NY
Anderson IL
Cederberg MI
Nelsen MN
Broyhill VA
Griffin MS
Abbitt VA
Satterfield VA
Roy KS
Sisk CA
Staggers WV
Bennett FL
Jones AL
Mann SC
Conable NY
Cabell TX
Ullman OR
Whitten MS
Grover NY
Pickle TX
Delaney NY
Cleveland NH
Gettys SC
Roberts TX
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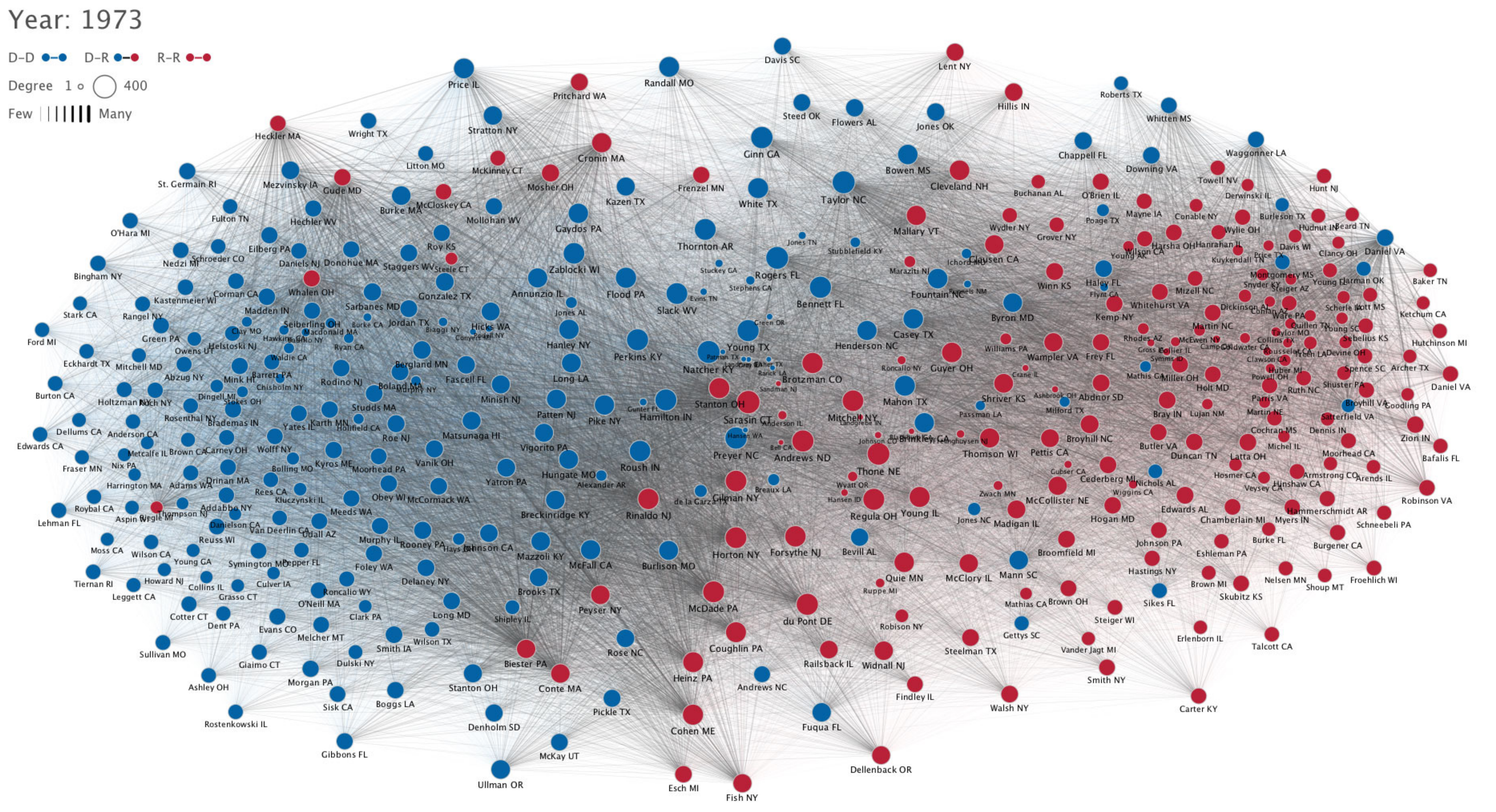
Ichord MO
Mathis GA
Pike NY
Carter KY
Slack WV
Steed OK
Pettis CA
Sikes FL
Clausen CA



Year: 1973
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Randall MO
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Roberts TX
Hillis IN
Steed OK
Flowers AL
Jones OK
Whitten MS
Heckler MA
Wright TX
Stratton NY
Cronin MA
Ginn GA
Bowen MS
Chappell FL
Waggonner LA
Litton MO
McKinney CT
Downing VA
St. Germain RI
Mezvinsky IA
Gude MD
Mosher OH
Frenzel MN
Kazen TX
White TX
Taylor NC
Cleveland NH
Buchanan AL
O'Brien IL
Towell NV
Hunt NJ
Burke MA
McCloskey CA
Mollohan WV
Derwinski IL
Fulton TN
Hechler WV
Gaydos PA
Mallary VT
Wydler NY
Mayne IA
Conable NY
Burleson TX
O'Hara MI
Thornton AR
Grover NY
Poage TX
Wylie OH
Hudnut IN
Beard TN
Eilberg PA
Roy KS
Harsha OH
Davis WI
Daniel VA
Nedzi MI
Schroeder CO
Daniels NJ
Donohue MA
Staggers WV
Steele CT
Zablocki WI
Clausen CA
Clancy OH
Bingham NY
Whalen OH
Rogers FL
Maraziti NJ
Baker TN
Corman CA
Annunzio IL
Flood PA
Winn KS
Mizell NC
Stark CA
Kastenmeier WI
Madden IN
Gonzalez TX
Slack WV
Bennett FL
Fountain NC
Whitehurst VA
Sarbanes MD
Byron MD
Kemp NY
Rangel NY
Seiberling OH
Jordan TX
Hicks WA
Dickinson AL
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Casey TX
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Hutchinson MI
Eckhardt TX
Owens UT
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Fascell FL
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Archer TX
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Minish NJ
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Daniel VA
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Koch NY
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Pike NY
Hamilton IN
Sarasin CT
Mitchell NY
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Lujan NM
Parris VA
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Dellums CA
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Karth MN
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Pettis CA
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Butler VA
Duncan TN
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Vigorito PA
Preyer NC
Andrews ND
Thone NE
Moorhead CA
Bafalis FL
Fraser MN
Nix PA
Kyros ME
Moorhead PA
Vanik OH
Hungate MO
Roush IN
Cederberg MI
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Hosmer CA
Armstrong CO
Arends IL
Harrington MA
Adams WA
Drinan MA
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Widnall NJ
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Morgan PA
Heinz PA
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Findley IL
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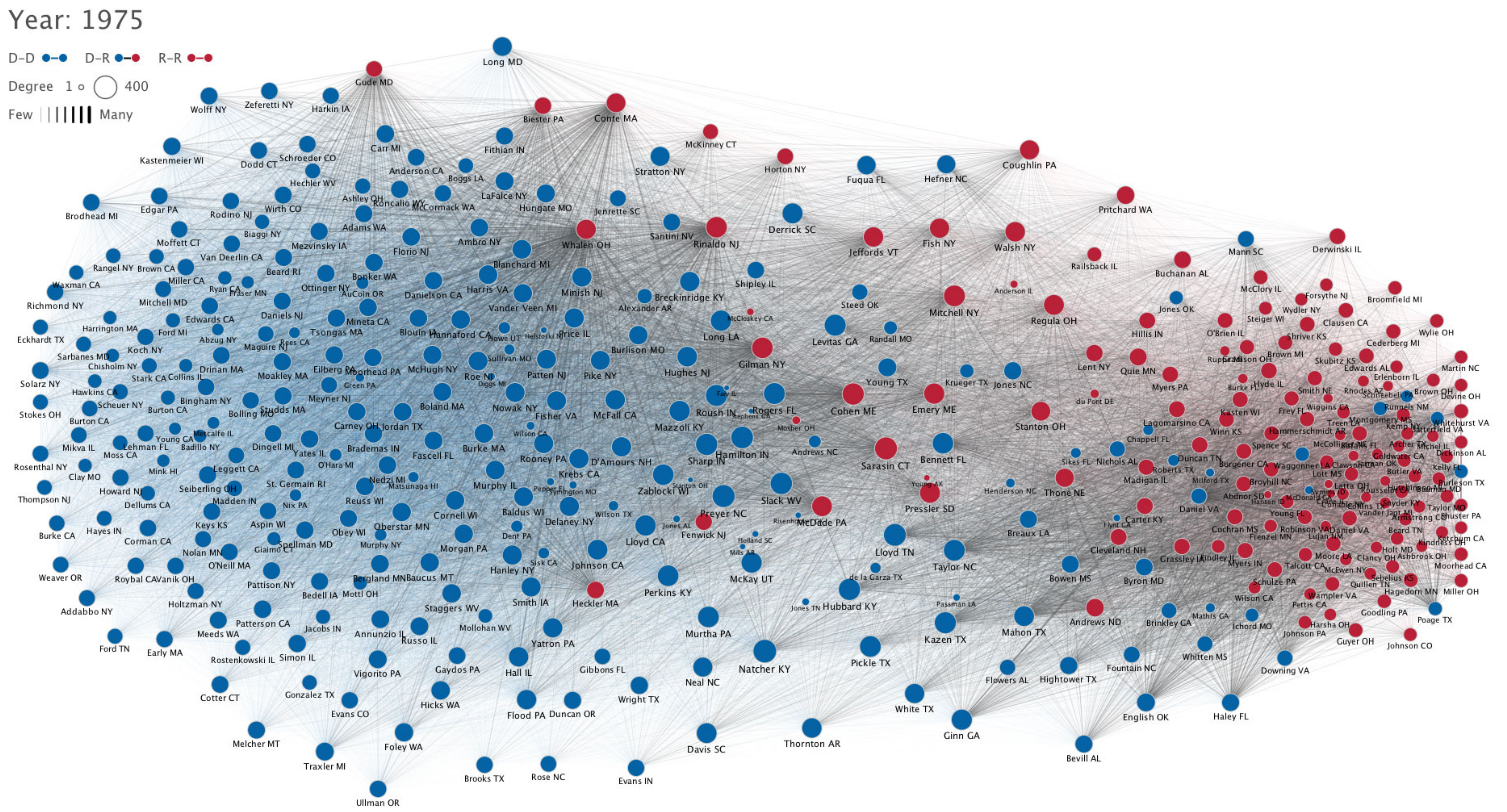
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Brodhead MI
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Rodino NJ
Wirth CO
Roncalio WY
McCormack WA
Adams WA
Whalen OH
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Rinaldo NJ
Derrick SC
Jeffords VT
Fish NY
Walsh NY
Mann SC
Derwinski IL
Moffett CT
Biaggi NY
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Railsback IL
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Miller CA
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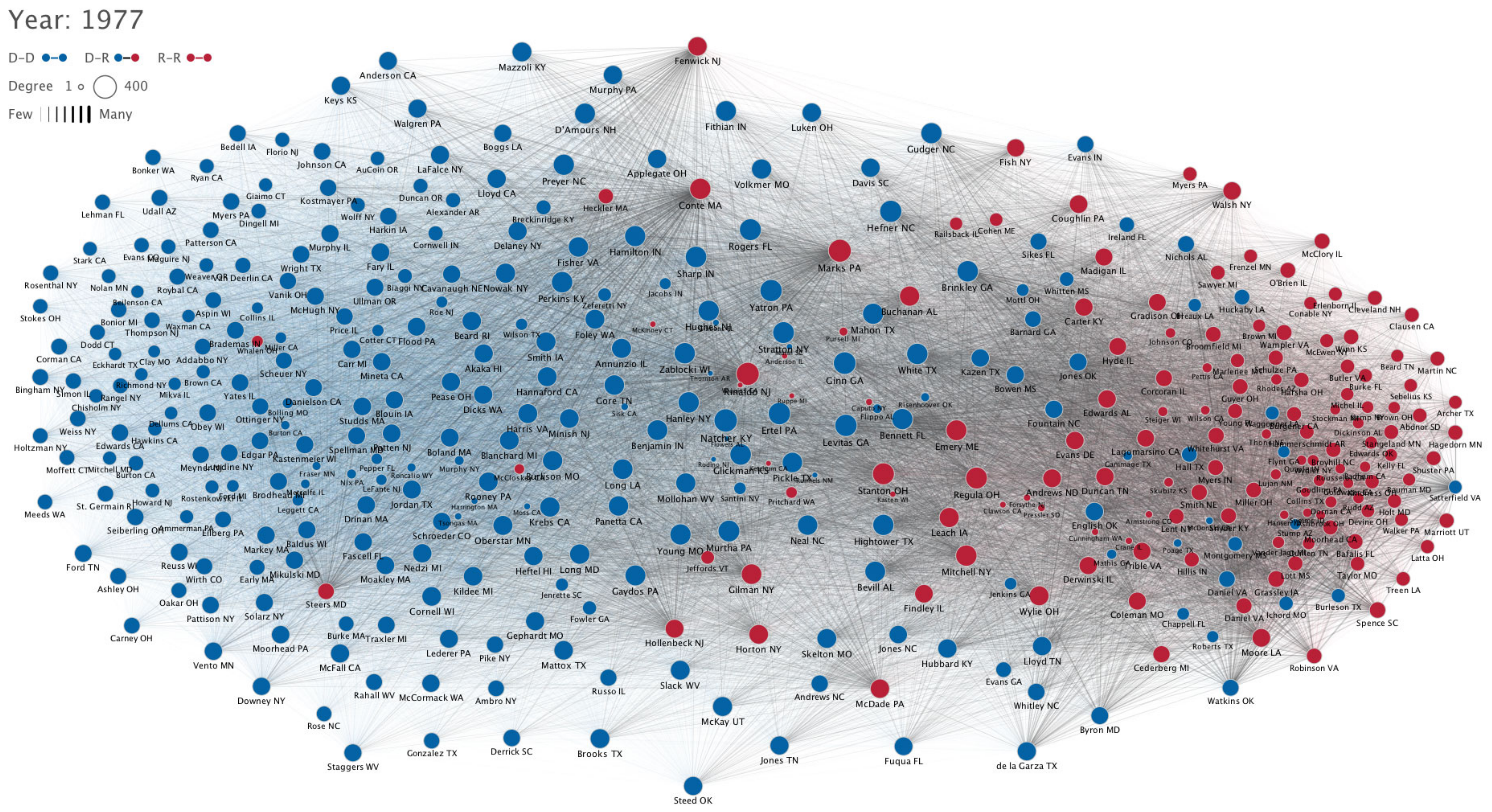
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Murphy IL
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Sikes FL
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McClory IL
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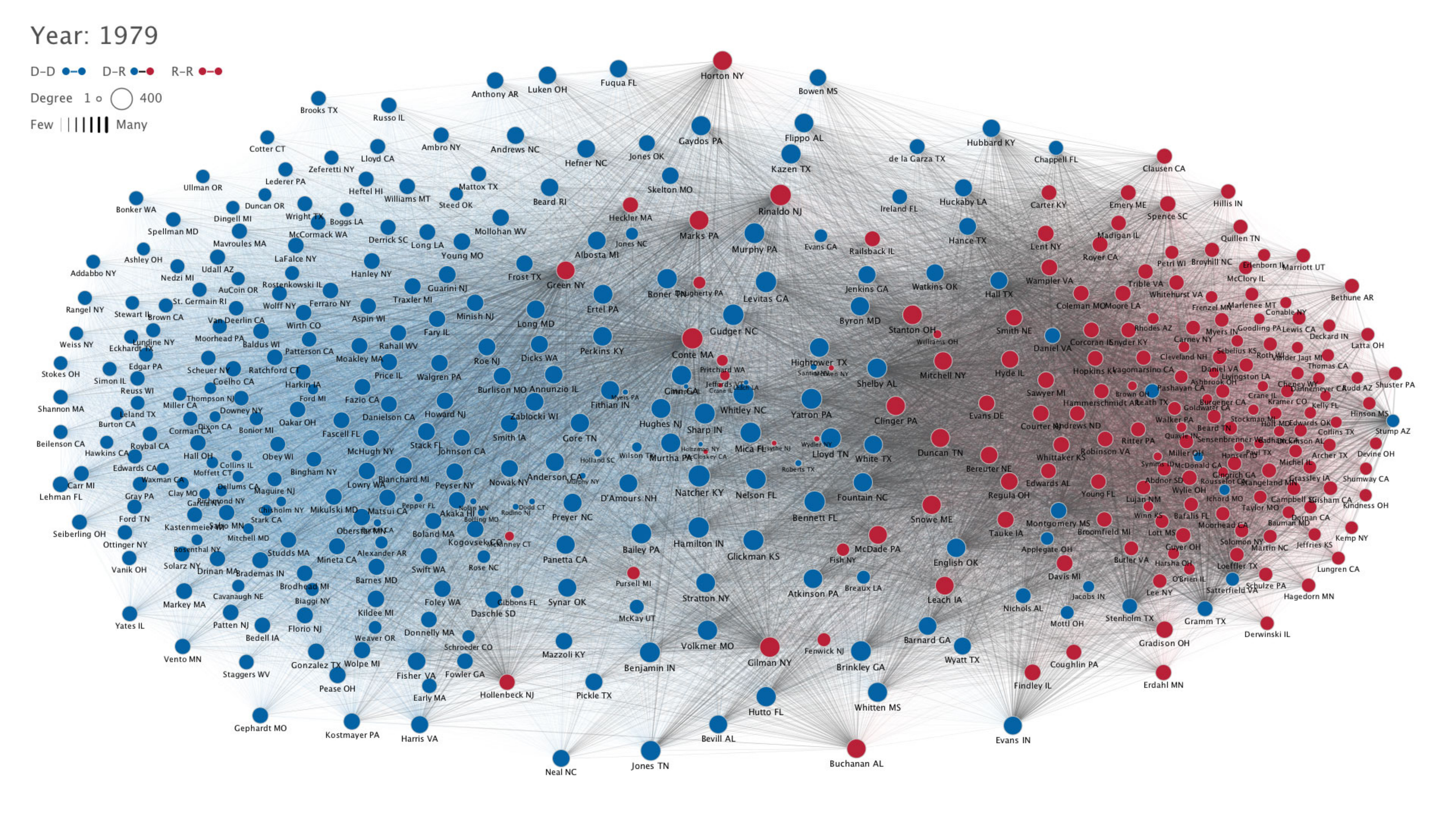
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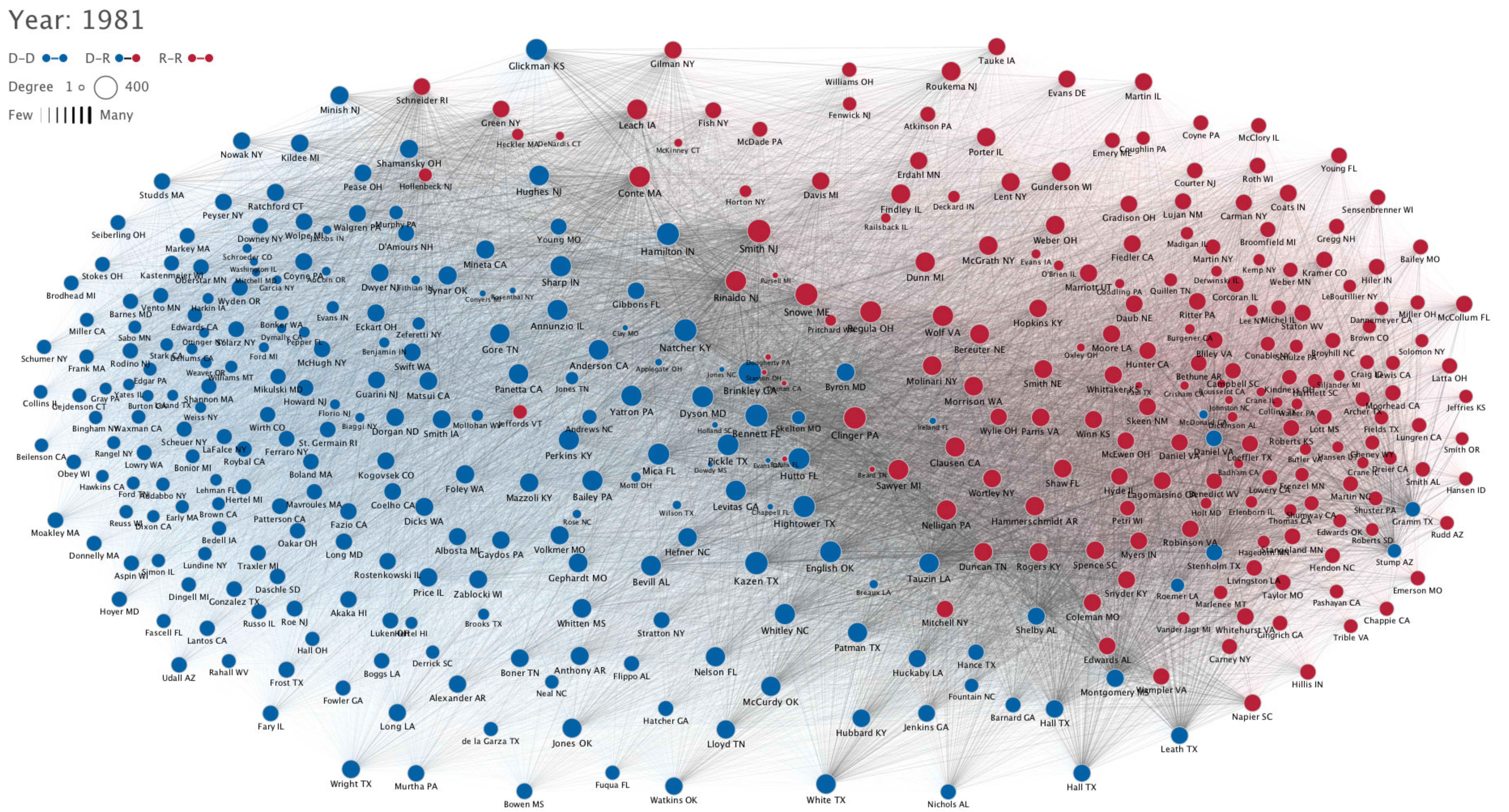
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Gradison OH
Lujan NM
Carman NY
Coats IN
Sensenbrenner WI
Seiberling OH
Walgren PA
Murphy PA
Downey NY
Wolpe MI
Jacobs IN
D'Amours NH
Young MO
Hamilton IN
Smith NJ
Weber OH
Madigan IL
Broomfield MI
Gregg NH
Markey MA
Mineta CA
McGrath NY
Evans IA
Fiedler CA
Martin NY
Bailey MO
Schroeder CO
Washington IL
Dunn MI
O'Brien IL
Kemp NY
Kramer CO
Stokes OH
Kastenmeier WI
Oberstar MN
Mitchell MD
Coyne PA
AuCoin OR
Garcia NY
Dwyer NJ
Fithian IN
Synar OK
Sharp IN
Purcell MI
Rinaldo NJ
Marriott UT
Goodling PA
Quillen TN
Derwinski IL
Weber MN
Hiler IN
Brodhead MI
Wyden OR
Conyers MI
Rosenthal NY
Gibbons FL
Corcoran IL
LeBoutillier NY
Vento MN
Harkin IA
Annunzio IL
Snowe ME
Daub NE
Ritter PA
Miller OH
McCollum FL
Barnes MD
Evans IN
Eckart OH
Pritchard WA
Regula OH
Wolf VA
Hopkins KY
Lee NY
Michel IL
Dannemeyer CA
Miller CA
Edwards CA
Bonker WA
Zeferetti NY
Clay MO
Staton WV
Sabo MN
Dymally CA
Pepper FL
Gore TN
Natcher KY
Bereuter NE
Burgener CA
Brown CO
Ottinger NY
Solarz NY
Benjamin IN
Moore LA
Oxley OH
Bliley VA
Conable NY
Schulze PA
Solomon NY
Schumer NY
Stark CA
Dellums CA
Ford MI
McHugh NY
Anderson CA
Dougherty PA
Broyhill NC
Frank MA
Rodino NJ
Swift WA
Applegate OH
Molinari NY
Hunter CA
Latta OH
Weaver OR
Williams MT
Jones NC
Stanton OH
Smith NE
Bethune AR
Craig ID
Lewis CA
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Panetta CA
Jones TN
Brinkley GA
Byron MD
Morrison WA
Whittaker KS
Campbell SC
Kindness OH
Siljander MI
Collins IL
Gejdenson CT
Yates IL
Gray PA
Mikulski MD
Shannon MA
Guarini NJ
Matsui CA
Grisham CA
Rousselot CA
Hartnett SC
Moorhead CA
Jeffries KS
Burton CA
Leland TX
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Crane IL
Johnston NC
Collins TX
Walker PA
Archer TX
Weiss NY
Florio NJ
Yatron PA
Dyson MD
Ireland FL
Wylie OH
Parris VA
Winn KS
Skeen NM
McDonald GA
Dickinson AL
Lott MS
Fields TX
Lungren CA
Bingham NY
Waxman CA
Wirth CO
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Dorgan ND
Smith IA
Mollohan WV
Jeffords VT
Andrews NC
Holland SC
Bennett FL
Skelton MO
Clinger PA
Scheuer NY
St. Germain RI
Perkins KY
Daniel VA
Loeffler TX
Roberts KS
Smith OR
Beilenson CA
Rangel NY
LaFalce NY
Ferraro NY
Pickle TX
McEwen OH
Daniel VA
Butler VA
Hansen UT
Cheney WY
Lowry WA
Roybal CA
Evans GA
Ellis FL
Clausen CA
Badham CA
Dreier CA
Obey WI
Bonior MI
Boland MA
Kogovsek CO
Mica FL
Dowdy MS
Hutto FL
Beard TN
Sawyer MI
Shaw FL
Crane IL
Smith AL
Hansen ID
Hawkins CA
Lehman FL
Foley WA
Mazzoli KY
Mottl OH
Hyde IL
Frenzel MN
Ford TN
Addabbo NY
Hertel MI
Mavroules MA
Coelho CA
Bailey PA
Wortley NY
Lagomarsino CA
Benedict WV
Lowery CA
Martin NC
Reuss WI
Early MA
Brown CA
Wilson TX
Levitas GA
Chappell FL
Holt MD
Erlenborn IL
Shuster PA
Dixon CA
Patterson CA
Fazio CA
Dicks WA
Rose NC
Hightower TX
Nelligan PA
Hammerschmidt AR
Petri WI
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Moakley MA
Bedell IA
Oakar OH
Rudd AZ
Edwards OK
Albosta MI
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Volkmer MO
Hefner NC
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Roberts SD
Donnelly MA
Long MD
Myers IN
Hagedorn MN
Stangeland MN
Lundine NY
Traxler MI
English OK
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Rogers KY
Spence SC
Stenholm TX
Stump AZ
Aspin WI
Simon IL
Rostenkowski IL
Gephardt MO
Kazen TX
Tauzin LA
Hendon NC
Bevill AL
Livingston LA
Dingell MI
Daschle SD
Price IL
Zablocki WI
Breaux LA
Snyder KY
Roemer LA
Taylor MO
Emerson MO
Gonzalez TX
Pashayan CA
Hoyer MD
Akaka HI
Marlenee MT
Whitten MS
Coleman MO
Russo IL
Roe NJ
Brooks TX
Stratton NY
Mitchell NY
Vander Jagt MI
Whitehurst VA
Chappie CA
Fascell FL
Luken OH
Heftel HI
Whitley NC
Shelby AL
Gingrich GA
Lantos CA
Tribble VA
Hall OH
Patman TX
Derrick SC
Hance TX
Edwards AL
Carney NY
Udall AZ
Rahall WV
Boggs LA
Boner TN
Anthony AR
Huckaby LA
Hillis IN
Flippo AL
Nelson FL
Montgomery MS
Wampler VA
Frost TX
Neal NC
Fountain NC
Fowler GA
Alexander AR
McCurdy OK
Barnard GA
Hall TX
Napier SC
Hatcher GA
Fary IL
Long LA
Hubbard KY
Jenkins GA
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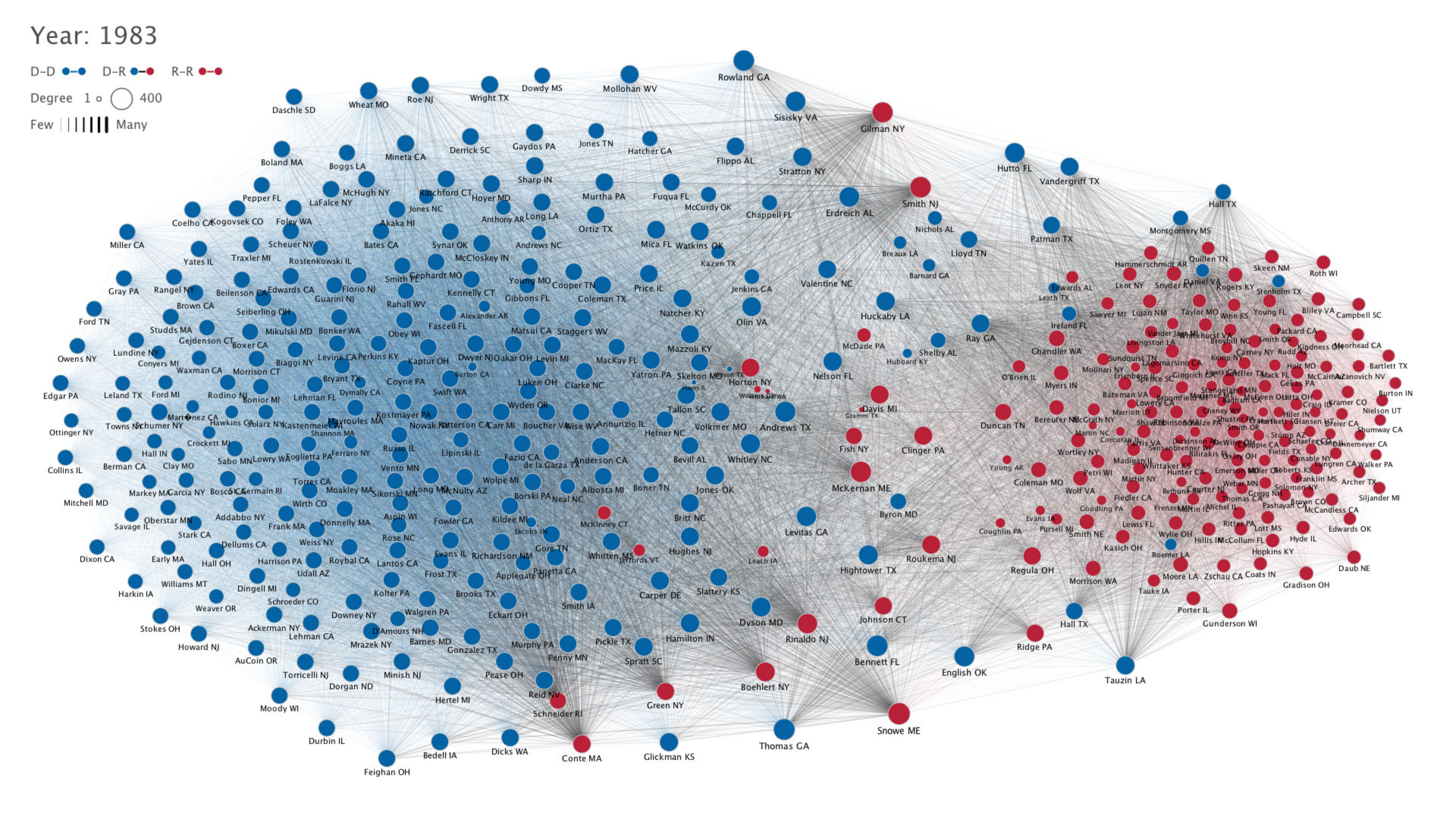
White TX
Bowen MS
Nichols AL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Daschle SD
Sisisky VA
Gilman NY
Gaydos PA
Jones TN
Hatcher GA
Derrick SC
Mineta CA
Boggs LA
Boland MA
Flippo AL
Stratton NY
Sharp IN
Hutto FL
Vandergriff TX
Pepper FL
LaFalce NY
McHugh NY
Ratchford CT
Hoyer MD
Murtha PA
Fuqua FL
McCurdy OK
Chappell FL
Erdreich AL
Smith NJ
Hall TX
Coelho CA
Kogovsek CO
Foley WA
Jones NC
Anthony AR
Long LA
Ortiz TX
Akaka HI
Nichols AL
Patman TX
Montgomery MS
Miller CA
Scheuer NY
Bates CA
Synar OK
Andrews NC
Mica FL
Watkins OK
Breaux LA
Lloyd TN
Yates IL
Traxler MI
Rostenkowski IL
McCloskey IN
Kazen TX
Barnard GA
Hammerschmidt AR
Quillen TN
Skeen NM
Roth WI
Gray PA
Rangel NY
Beilenson CA
Edwards CA
Florio NJ
Guarini NJ
Smith FL
Cephardt MO
Young MO
Cooper TN
Price IL
Jenkins GA
Valentine NC
Edwards AL
Leath TX
Lent NY
Snyder KY
Daniel VA
Rogers KY
Stenholm TX
Brown CA
Kennelly CT
Gibbons FL
Coleman TX
Rahall WV
Natcher KY
Olin VA
Huckaby LA
Ireland FL
Sawyer MI
Lujan NM
Taylor MO
Winn KS
Young FL
Bliley VA
Campbell SC
Ford TN
Seiberling OH
Alexander AR
Fascell FL
Matsui CA
Staggers WV
Obey WI
Bonker WA
Mikulski MD
Boxer CA
Studds MA
Gejdenson CT
Ray GA
Chandler WA
Vander Jagt MI
Whitehurst VA
Broyhill NC
Smith OR
Packard CA
Kindness OH
Moorhead CA
Owens NY
Lundine NY
Conyers MI
Waxman CA
Levine CA
Perkins KY
Kaptur OH
Dwyer NJ
Oakar OH
Levin MI
MacKay FL
Mazzoli KY
McDade PA
Hubbard KY
Shelby AL
Livingston LA
Lagomarsino CA
Kemp NY
Carney NY
Rudd AZ
Bartlett TX
Morrison CT
Biaggi NY
Burton CA
Yatron PA
Skelton MO
Horton NY
Nelson FL
Sundquist TN
Molinari NY
Erlenborn IL
Spence SC
Gingrich GA
Geffner TX
Mack FL
McCain AZ
Zanovich NV
Holt MD
Gekas PA
Edgar PA
Leland TX
Ford MI
Rodino NJ
Bonior MI
Bryant TX
Dymally CA
Lehman FL
Swift WA
Coyne PA
Luken OH
Clarke NC
Hayes IL
Williams DJ WA
O'Brien IL
Myers IN
Bateman VA
Broomfield MI
Lowery CA
Marriott UT
Cheney WY
Stangeland MN
Badham CA
McEwen OH
Latta OH
Craig ID
Kramer CO
Burton IN
Nielson UT
Towns NY
Schumer NY
Martínez CA
Hawkins CA
Solarz NY
Kastenmeier WI
Mavroules MA
Shannon MA
Kostmayer PA
Nowak NY
Patterson CA
Carr MI
Boucher VA
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Hefner NC
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Hall IN
Berman CA
Clay MO
Collins IL
Sabo MN
Lowry WA
Coglietta PA
Ferraro NY
Russo IL
Lipinski IL
Fazio CA
de la Garza TX
Anderson CA
Bevill AL
Whitley NC
Fish NY
Clinger PA
Parris VA
Sensenbrenner WI
Billirakis FL
Oxley OH
Wortley NY
Madigan IL
Whittaker KS
Hunter CA
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Roberts KS
Young AK
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Wolf VA
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Lewis FL
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Hillis IN
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Ritter PA
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Porter IL
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Garcia NY
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Torres CA
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Sikorski MN
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McNulty AZ
Wolpe MI
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Boner TN
Jones OK
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Bennett FL
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Ridge PA
English OK
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Wirth CO
Addabbo NY
Oberstar MN
Savage IL
Stark CA
Dellums CA
Dixon CA
Early MA
Hall OH
Harrison PA
Frank MA
Donnelly MA
Aspin WI
Fowler GA
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Neal NC
McKinney CT
Britt NC
Hughes NJ
Whitten MS
Jeffords VT
Leach IA
Weiss NY
Roybal CA
Udall AZ
Lantos CA
Rose NC
Evans IL
Richardson NM
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Panetta CA
Applegate OR
Frost TX
Brooks TX
Kolter PA
Carper DE
Slattery KS
Smith IA
Dyson MD
Rinaldo NJ
Harkin IA
Williams MT
Dingell MI
Schroeder CO
Weaver OR
Downey NY
Walgren PA
Eckart OH
Stokes OH
Ackerman NY
Lehman CA
D'Amours NH
Howard NJ
Mrazek NY
Barnes MD
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Murphy PA
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AuCoin OR
Penny MN
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Pease OH
Dorgan ND
Hertel MI
Reid NV
Schneider RI
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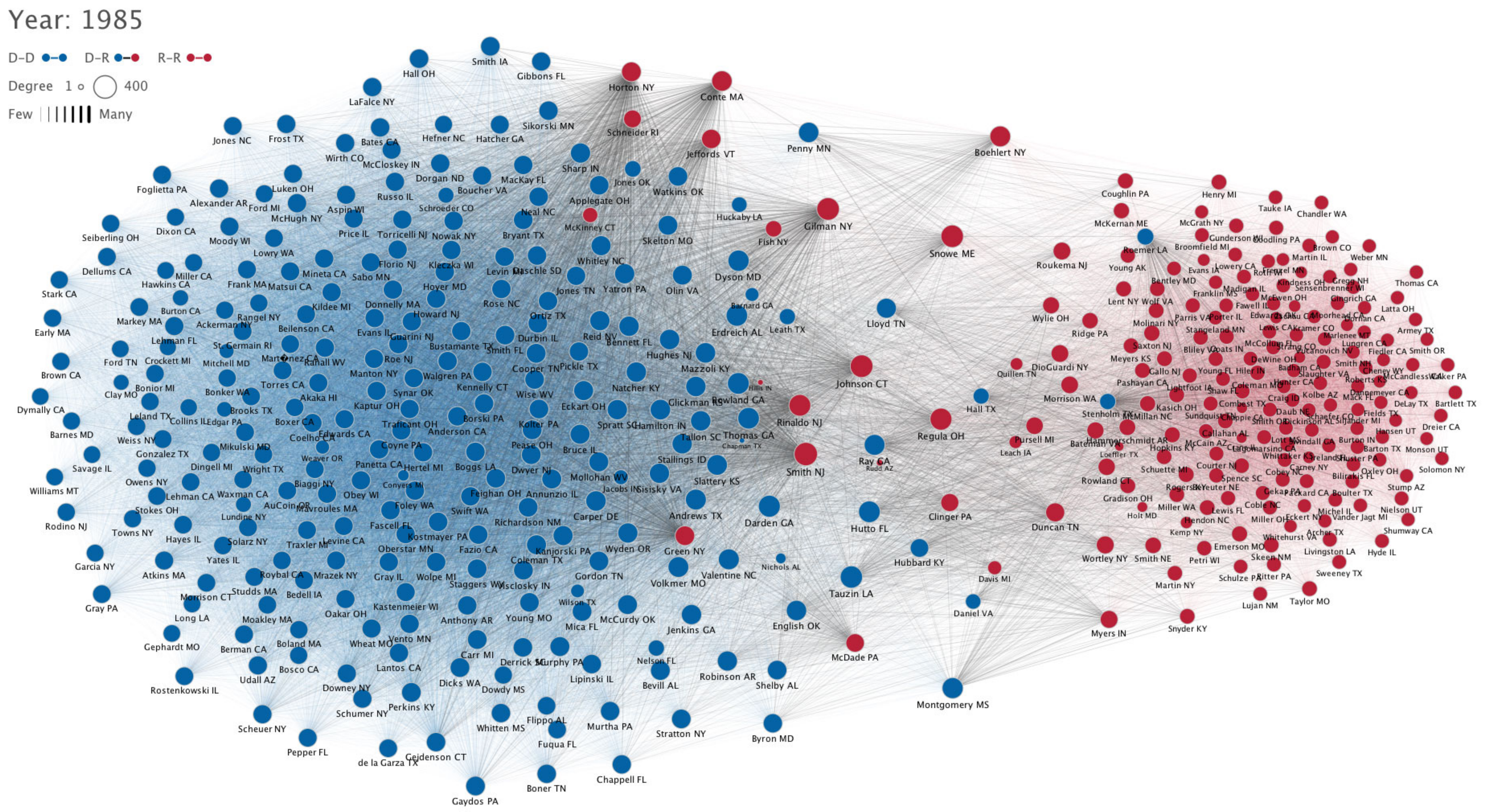
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Penny MN
Boehlert NY
Jeffords VT
Wirth CO
McCloskey IN
Sharp IN
Jones OK
Foglietta PA
Luken OH
Dorgan ND
MacKay FL
Boucher VA
Applegate OH
Watkins OK
Alexander AR
Ford MI
Russo IL
Schroeder CO
Neal NC
Coughlin PA
Henry MI
Aspin WI
McHugh NY
Huckaby LA
Tauke IA
Chandler WA
Seiberling OH
Dixon CA
Price IL
Torricelli NJ
Nowak NY
Bryant TX
McKinney CT
Gilman NY
Fish NY
McKernan ME
McGrath NY
Moody WI
Skelton MO
Snowe ME
Roemer LA
Broomfield MI
Lowry WA
Whitley NC
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Goodling PA
Dellums CA
Miller CA
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Weber MN
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Sabo MN
Hoyer MD
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Burton CA
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Ortiz TX
Lloyd TN
Wylie OH
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Guarini NJ
Bustamante TX
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Bennett FL
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Lehman FL
St. Germain RI
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Kaptur OH
Rinaldo NJ
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Boxer CA
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Conyers MI
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Lehman CA
Waxman CA
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Jacobs IN
Sisisky VA
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Mavroules MA
Foley WA
Swift WA
Gradison OH
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Lundine NY
Richardson NM
Carper DE
Andrews TX
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Towns NY
Hayes IL
Solarz NY
Traxler MI
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Fascell FL
Kostmayer PA
Fazio CA
Kanjorski PA
Wyden OR
Green NY
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Oberstar MN
Coleman TX
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Hubbard KY
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Emerson MO
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Gray IL
Wolpe MI
Gordon TN
Volkmer MO
Valentine NC
Davis MI
Livingston LA
Skeen NM
Sweeney TX
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Morrison CT
Studds MA
Bedell IA
Staggers WV
Visclosky IN
Tauzin LA
Martin NY
Schulze PA
Ritter PA
Wilson TX
Taylor MO
Kastenmeier WI
Lujan NM
Long LA
Moakley MA
Oakar OH
Anthony AR
Young MO
Mica FL
McCurdy OK
Jenkins GA
English OK
Daniel VA
Gephardt MO
Boland MA
Wheat MO
Vento MN
Myers IN
Snyder KY
Berman CA
Carr MI
McDade PA
Lantos CA
Derrick SC
Murphy PA
Nelson FL
Bosco CA
Udall AZ
Robinson AR
Rostenkowski IL
Dicks WA
Dowdy MS
Lipinski IL
Bevill AL
Shelby AL
Downey NY
Montgomery MS
Perkins KY
Schumer NY
Scheuer NY
Flippo AL
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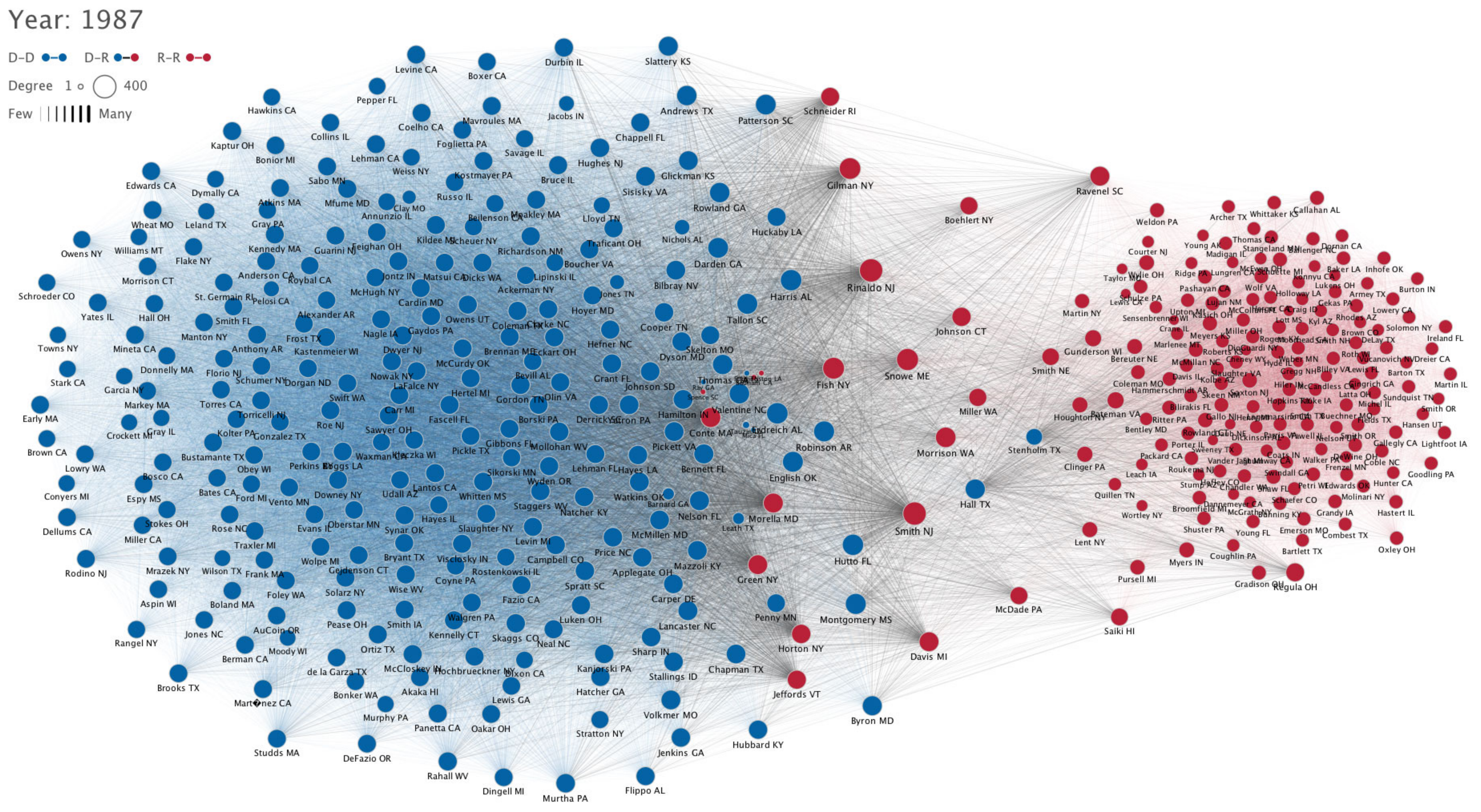
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Foglietta PA
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Bonior MI
Lehman CA
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Sabo MN
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Clay MO
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Annunzio IL
Beilenson CA
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Grant FL
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Fish NY
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Garcia NY
Schumer NY
Dorgan ND
Nowak NY
Bevill AL
Johnson SD
LaFalce NY
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Gordon TN
Olin VA
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Torres CA
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Crockett MI
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Gonzalez TX
Roe NJ
Sawyer OH
Conte MA
Erdreich AL
Brown CA
Bustamante TX
Waxman CA
Kleczka WI
Pickle TX
Gibbons FL
Mollohan WV
Pickett VA
Robinson AR
Morrison WA
Stenholm TX
Lowry WA
Perkins KY
Boggs LA
Lehman FL
Hayes LA
Bennett FL
Bosco CA
Obey WI
Sikorski MN
Wyden OR
English OK
Bates CA
Lantos CA
Conyers MI
Espy MS
Ford MI
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Price NC
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Skaggs CO
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Davis MI
McCloskey IN
de la Garza TX
Hochbrueckner NY
Dixon CA
Kanjorski PA
Chapman TX
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Brooks TX
Bonker WA
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Volkmer MO
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Panetta CA
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Studds MA
Jenkins GA
Hubbard KY
DeFazio OR
Rahall WV
Dingell MI
Flippo AL
Murtha PA
Weldon PA
Archer TX
Whittaker KS
Callahan AL
Burton IN
Inhofe OK
Martin NY
Gunderson WI
Solomon NY
Ireland FL
Dreier CA
Martin IL
Sundquist TN
Smith OR
Hansen UT
Lightfoot IA
Goodling PA
Houghton NY
Clinger PA
Quillen TN
Lent NY
Myers IN
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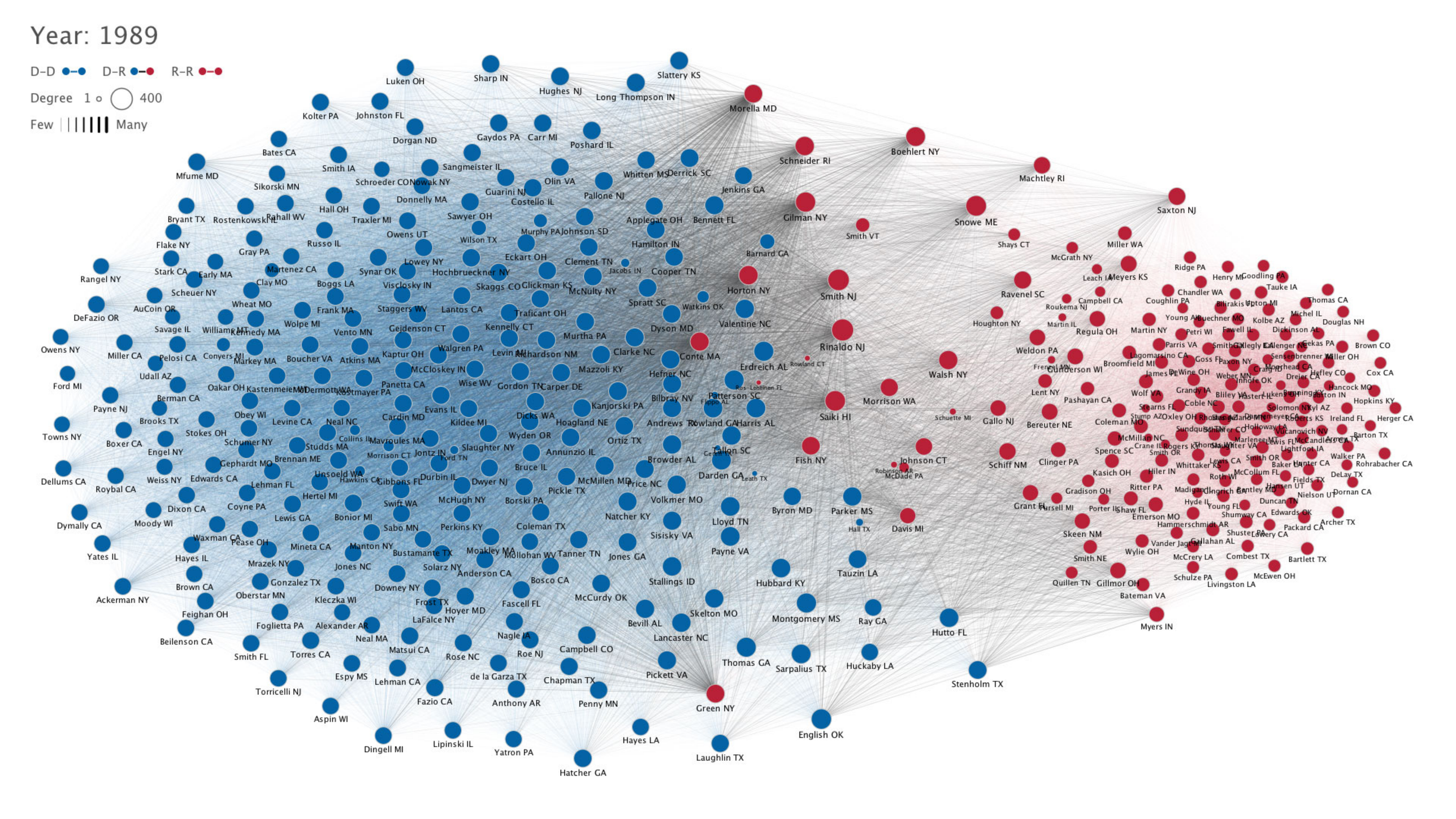
Young FL
Coughlin PA
Bartlett TX


Year: 1989
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D-R
R-R
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Carr MI
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Bates CA
Smith IA
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Nowak NY
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Olin VA
Whitten MS
Derrick SC
Schneider RI
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Machtley RI
Mfume MD
Sikorski MN
Guarini NJ
Jenkins GA
Donnelly MA
Costello IL
Pallone NJ
Hall OH
Traxler MI
Sawyer OH
Applegate OH
Bennett FL
Gilman NY
Saxton NJ
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Rostenkowski IL
Rahall WV
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Murphy PA
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Wilson TX
Hamilton IN
Smith VT
Shays CT
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Clement TN
Jacobs IN
Barnard GA
Miller WA
McGrath NY
Rangel NY
Stark CA
Early MA
Martenez CA
Synar OK
Lowey NY
Hochbrueckner NY
Cooper TN
Ridge PA
Henry MI
Goodling PA
Clay MO
Boggs LA
Visclosky IN
Skaggs CO
Glickman KS
McNulty NY
Horton NY
Smith NJ
Leach IA
Meyers KS
Ravenel SC
Scheuer NY
Staggers WV
Spratt SC
Watkins OK
Tauke IA
AuCoin OR
Frank MA
Lantos CA
Traficant OH
Campbell CA
Coughlin PA
Chandler WA
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DeFazio OR
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Regula OH
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Douglas NH
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Atkins MA
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Parris VA
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Hefner NC
Erdreich AL
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Walsh NY
Lagomarsino CA
Broomfield MI
Goss FL
Paxon NY
Sensenbrenner WI
Miller OH
Ford MI
Panetta CA
Wise WV
Gordon TN
Carper DE
Ros-Lehtinen FL
Gunderson WI
James PE
Wine OH
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Payne NJ
Berman CA
Evans IL
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Fazio AL
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Lent NY
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Wolf VA
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Bliley VA
Hancock MO
Brooks TX
Obey WI
Levine CA
Neal NC
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Hoagland NE
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Rowland GA
Harris AL
Saiki HI
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Coble NC
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Towns NY
Stokes OH
Schumer NY
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Ortiz TX
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Johnson CT
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McDade PA
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Clinger PA
Spence SC
Crane IL
Rogers KS
Smith OR
Whittaker KS
Lewis CA
Kasich OH
Hiler IN
Ireland FL
Herger CA
Boxer CA
Engel NY
Studds MA
Slaughter NY
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Darden GA
Leath TX
Gephardt MO
Brennan ME
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Ford TN
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Dellums CA
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Edwards CA
Unsoeld WA
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Dwyer NJ
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Mineta CA
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Tanner TN
Jones GA
Mrazek NY
Jones NC
Solarz NY
Anderson CA
Stallings ID
Hubbard KY
Tauzin LA
Brown CA
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Kleczka WI
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Hutto FL
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Alexander AR
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Lancaster NC
Myers IN
Beilenson CA
Neal MA
Nagle IA
Campbell CO
Smith FL
Torres CA
Matsui CA
Rose NC
Roe NJ
Thomas GA
Sarpalius TX
Huckaby LA
Espy MS
Lehman CA
de la Garza TX
Pickett VA
Stenholm TX
Torricelli NJ
Fazio CA
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Lipinski IL
Hayes LA
Yatron PA
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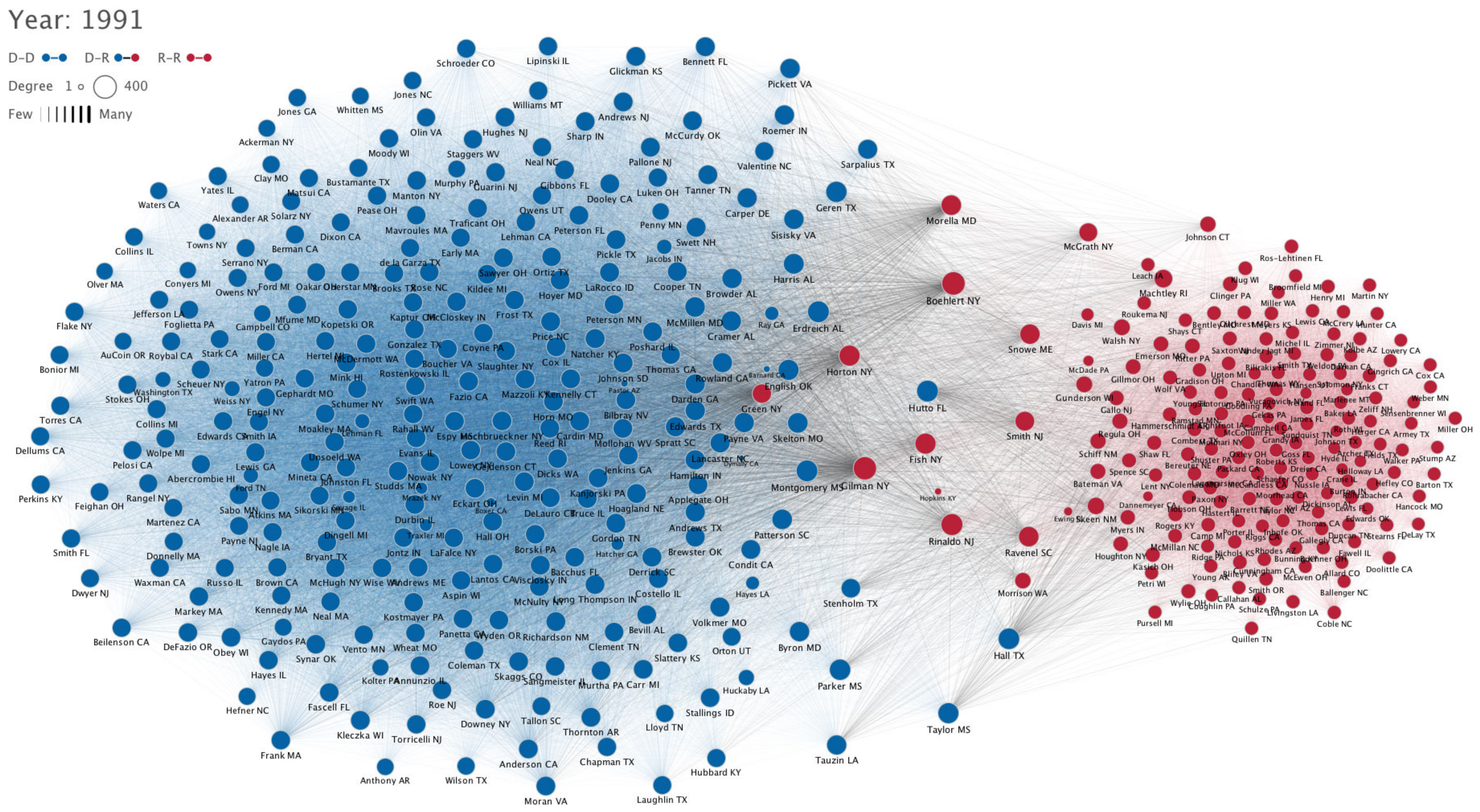
Hatcher GA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Williams MT
Jones GA
Whitten MS
Andrews NJ
Olin VA
Hughes NJ
Sharp IN
McCurdy OK
Roemer IN
Ackerman NY
Moody WI
Staggers WV
Neal NC
Pallone NJ
Valentine NC
Sarpalius TX
Clay MO
Bustamante TX
Murphy PA
Guarini NJ
Gibbons FL
Yates IL
Matsui CA
Manton NY
Dooley CA
Luken OH
Tanner TN
Geren TX
Waters CA
Alexander AR
Solarz NY
Pease OH
Owens UT
Carper DE
Traficant OH
Penny MN
Mavroules MA
Peterson FL
Sisisky VA
Towns NY
Dixon CA
Lehman CA
Swett NH
Collins IL
Berman CA
Early MA
Pickle TX
Serrano NY
de la Garza TX
Jacobs IN
Harris AL
Olver MA
Conyers MI
Sawyer OH
Ortiz TX
Owens NY
Ford MI
Oakar OH
Oberstar MN
Brooks TX
Rose NC
Kildee MI
Hoyer MD
LaRocco ID
Cooper TN
Browder AL
Jefferson LA
Flake NY
Foglietta PA
Mfume MD
Kaptur OH
McCloskey IN
Frost TX
Campbell CO
Kopetski OR
Peterson MN
McMillen MD
Ray GA
Erdreich AL
Morella MD
McGrath NY
Johnson CT
Ros-Lehtinen FL
Leach IA
Machtley RI
Klug WI
Clinger PA
Broomfield MI
Henry MI
Martin NY
Boehlert NY
Miller WA
Roukema NJ
Davis MI
Shays CT
Bentley MD
Lewis CA
McCrery LA
Hunter CA
Walsh NY
Michel IL
Zimmer NJ
Kolbe AZ
Lowery CA
AuCoin OR
Roybal CA
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Miller CA
Hertel MI
McDermott WA
Gonzalez TX
Coyne PA
Price NC
Poshard IL
Cramer AL
Snowe ME
Bonior MI
Boucher VA
Slaughter NY
Cox IL
Natcher KY
Thomas GA
Horton NY
McDade PA
Emerson MO
Ritter PA
Cox CA
Scheuer NY
Yatron PA
Mink HI
Rostenkowski IL
Johnson SD
Rowland GA
Barnard GA
English OK
Gillmor OH
Gradison OH
Upton MI
Franks CT
Washington TX
Stokes OH
Weiss NY
Gephardt MO
Fazio CA
Mazzoli KY
Kennelly CT
Pastor AZ
Darden GA
Gunderson WI
Wolf VA
Weber MN
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Collins MI
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Schumer NY
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Horn MO
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Gallo NJ
Zeliff NH
Sensenbrenner WI
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Espy MS
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Edwards TX
Skelton MO
Smith NJ
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Edwards CA
Smith IA
Reed RI
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Payne VA
Wolpe MI
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Dymally CA
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Schiff NM
Shaw FL
Stump AZ
Pelosi CA
Lewis GA
Unsoeld WA
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Mineta CA
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Dicks WA
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Montgomery MS
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Mrazek NY
Levin MI
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Applegate OH
Hopkins KY
Feighan OH
Savage IL
Eckart OH
Hoagland NE
Moorhead CA
Rohrabacher CA
Sabo MN
Atkins MA
Sikorski MN
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DeLauro CT
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Hancock MO
Martenez CA
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Ewing IL
Skeen NM
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Hastert IL
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Hall OH
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Myers IN
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Ballenger NC
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Torricelli NJ
Downey NY
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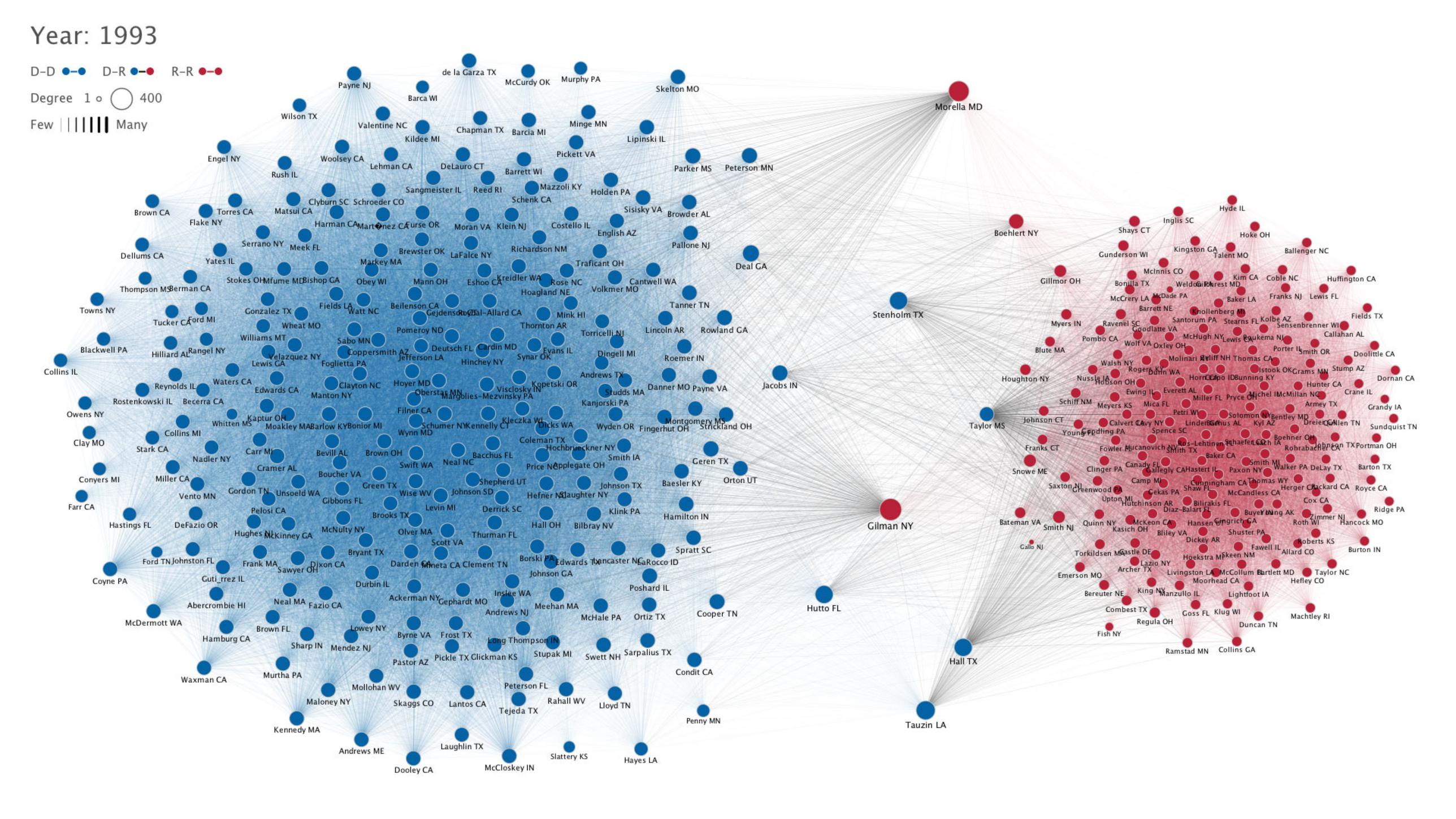
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Valentine NC
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Kildee MI
Lipinski IL
Engel NY
Woolsey CA
Lehman CA
DeLauro CT
Pickett VA
Rush IL
Barrett WI
Parker MS
Peterson MN
Sangmeister IL
Reed RI
Mazzoli KY
Holden PA
Schenk CA
Clyburn SC
Schroeder CO
Sisisky VA
Brown CA
Torres CA
Matsui CA
Browder AL
Flake NY
Harman CA
Martínez CA
Furse OR
Moran VA
Klein NJ
Costello IL
English AZ
Serrano NY
Meek FL
Pallone NJ
Dellums CA
Yates IL
Brewster OK
LaFalce NY
Richardson NM
Traficant OH
Deal GA
Markey MA
Stokes OH
Mfume MD
Bishop CA
Obey WI
Mann OH
Eshoo CA
Kreidler WA
Rose NC
Cantwell WA
Thompson MS
Berman CA
Hoagland NE
Volkmer MO
Towns NY
Gonzalez TX
Fields LA
Watt NC
Beilenson CA
Gejdenson CT
Rogal-Allard CA
Mink HI
Tanner TN
Tucker CA
Ford MI
Wheat MO
Thornton AR
Torricelli NJ
Lincoln AR
Rowland GA
Williams MT
Pomeroy ND
Sabo MN
Blackwell PA
Hilliard AL
Rangel NY
Coppersmith AZ
Deutsch FL
Cardin MD
Evans IL
Dingell MI
Velazquez NY
Jefferson LA
Synar OK
Roemer IN
Collins IL
Lewis GA
Foglietta PA
Hinchey NY
Andrews TX
Reynolds IL
Waters CA
Hoyer MD
Clayton NC
Kopetski OR
Danner MO
Payne VA
Rostenkowski IL
Becerra CA
Manton NY
Oberstar MN
Visclosky IN
Studds MA
Owens NY
Margolies-Mezvinsky PA
Kanjorski PA
Kaptur OH
Filner CA
Whitten MS
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Bonior MI
Schumer NY
Kennelly CT
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Hall OH
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Spratt SC
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Ortiz TX
Cooper TN
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Frost TX
Long Thompson IN
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Pickle TX
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Stupak MI
Swett NH
Sarpalius TX
Condit CA
Waxman CA
Murtha PA
Mollohan WV
Peterson FL
Maloney NY
Skaggs CO
Lantos CA
Rahall WV
Tejeda TX
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Penny MN
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Andrews ME
Laughlin TX
Slattery KS
Dooley CA
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Hayes LA
Morella MD
Stenholm TX
Jacobs IN
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Hutto FL
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Hall TX
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Boehlert NY
Hyde IL
Inglis SC
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Kingston GA
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Ballenger NC
Gillmor OH
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Coble NC
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Porter IL
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Molinari NY
Doolittle CA
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Dunn WA
Thomas CA
Hobson OH
Bunning KY
Istook OK
Crams MN
Stump AZ
Dornan CA
Ewing IL
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Hunter CA
Schiff NM
Miller FL
Pryce OH
Michel IL
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Crane IL
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Franks CT
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Rohrabacher CA
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Canady FL
Gallegly CA
Hastert IL
Paxon NY
Walker PA
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Barton TX
Saxton NJ
Camp MI
Cunningham CA
Thomas WY
Packard CA
Royce CA
Greenwood PA
Cekas PA
McCandless CA
Cox CA
Upton MI
Hutchinson AR
Bilirakis FL
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Bateman VA
Smith NJ
Quinn NY
McKeon CA
Kasich OH
Hansen UT
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Roth WI
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Bliley VA
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Dickey AR
Gallo NJ
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Castle DE
Fawell IL
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Burton IN
Lazio NY
Skeen NM
Allard CO
Archer TX
Livingston LA
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Bartlett MD
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Emerson MO
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Hefley CO
Bereuter NE
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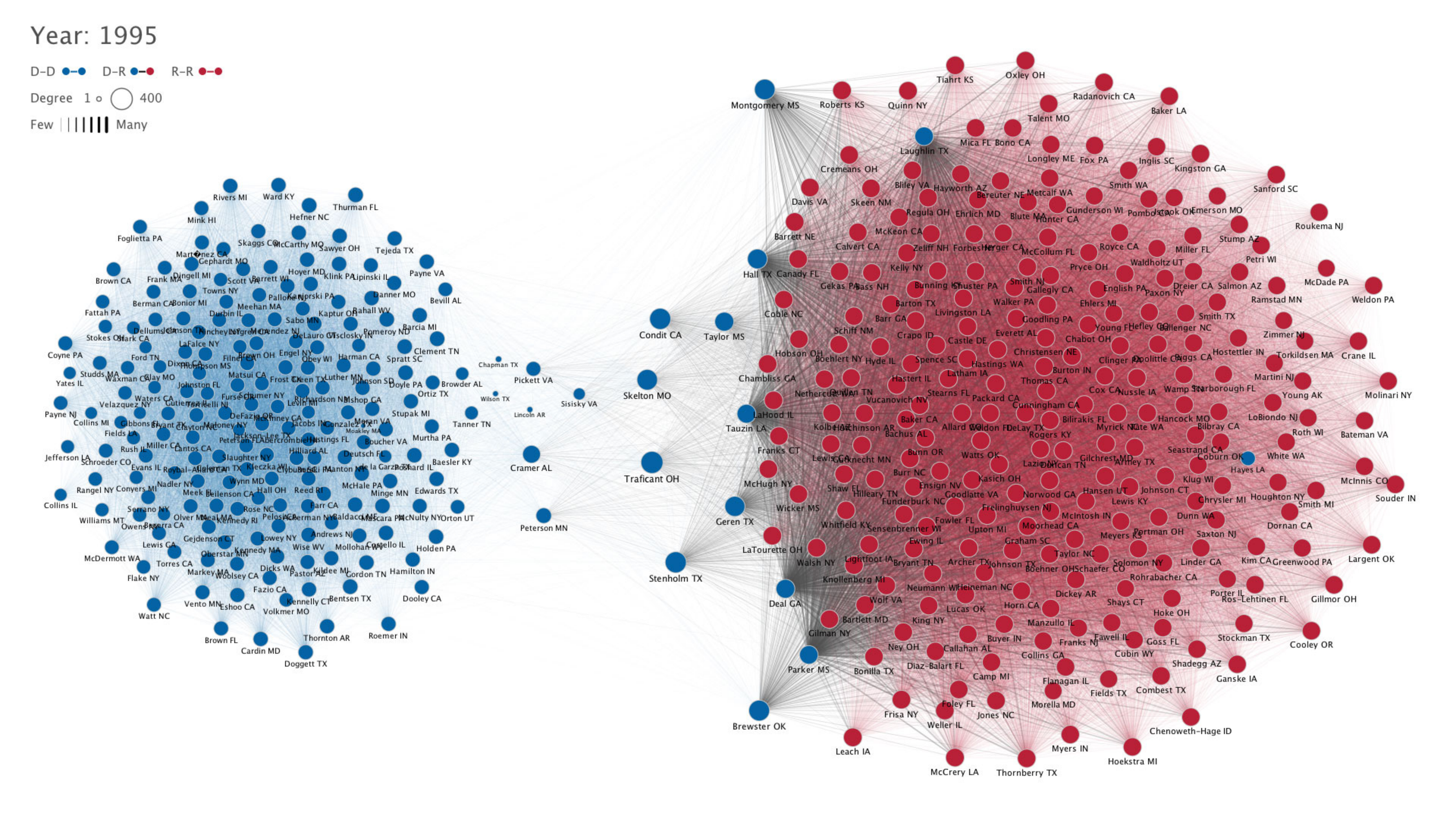
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Martinez GA
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Towns NY
Kanjorski PA
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Berman CA
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Durbin IL
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Sabo MN
Barcia MI
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Menendez NJ
DeLauro CT
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Pomeroy ND
Coyne PA
LaFalce NY
Clement TN
Ford TN
Filner CA
Brown OH
Engel NY
Obey WI
Harman CA
Spratt SC
Studds MA
Waxman CA
Clay MO
Matsui CA
Frost TX
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Yates IL
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Payne NJ
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Gibbons FL
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Maloney NY
McKinney CA
Jacobs IN
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Tanner TN
Fields LA
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Jackson Lee TX
Peterson FL
Abercrombie HI
Hastings FL
Boucher VA
Murtha PA
Jefferson LA
Rush IL
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Roybal-Allard CA
Slaughter NY
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Kennedy RI
Becerra CA
Gejdenson CT
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Andrews NJ
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Holden PA
Lewis CA
Wise WV
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Kennedy MA
Oberstar MN
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Markey MA
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Gordon TN
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Cardin MD
Doggett TX
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Skelton MO
Traficant OH
Geren TX
Stenholm TX
Montgomery MS
Roberts KS
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Tiahrt KS
Oxley OH
Radanovich CA
Baker LA
Talent MO
Laughlin TX
Mica FL
Bono CA
Longley ME
Fox PA
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Calvert CA
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Bunning KY
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King NY
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Fawell IL
Goss FL
Stockman TX
Cooley OR
Ney OH
Franks NJ
Callahan AL
Collins GA
Cubin WY
Parker MS
Diaz-Balart FL
Bonilla TX
Camp MI
Shadegg AZ
Ganske IA
Flanagan IL
Fields TX
Combest TX
Morella MD
Foley FL
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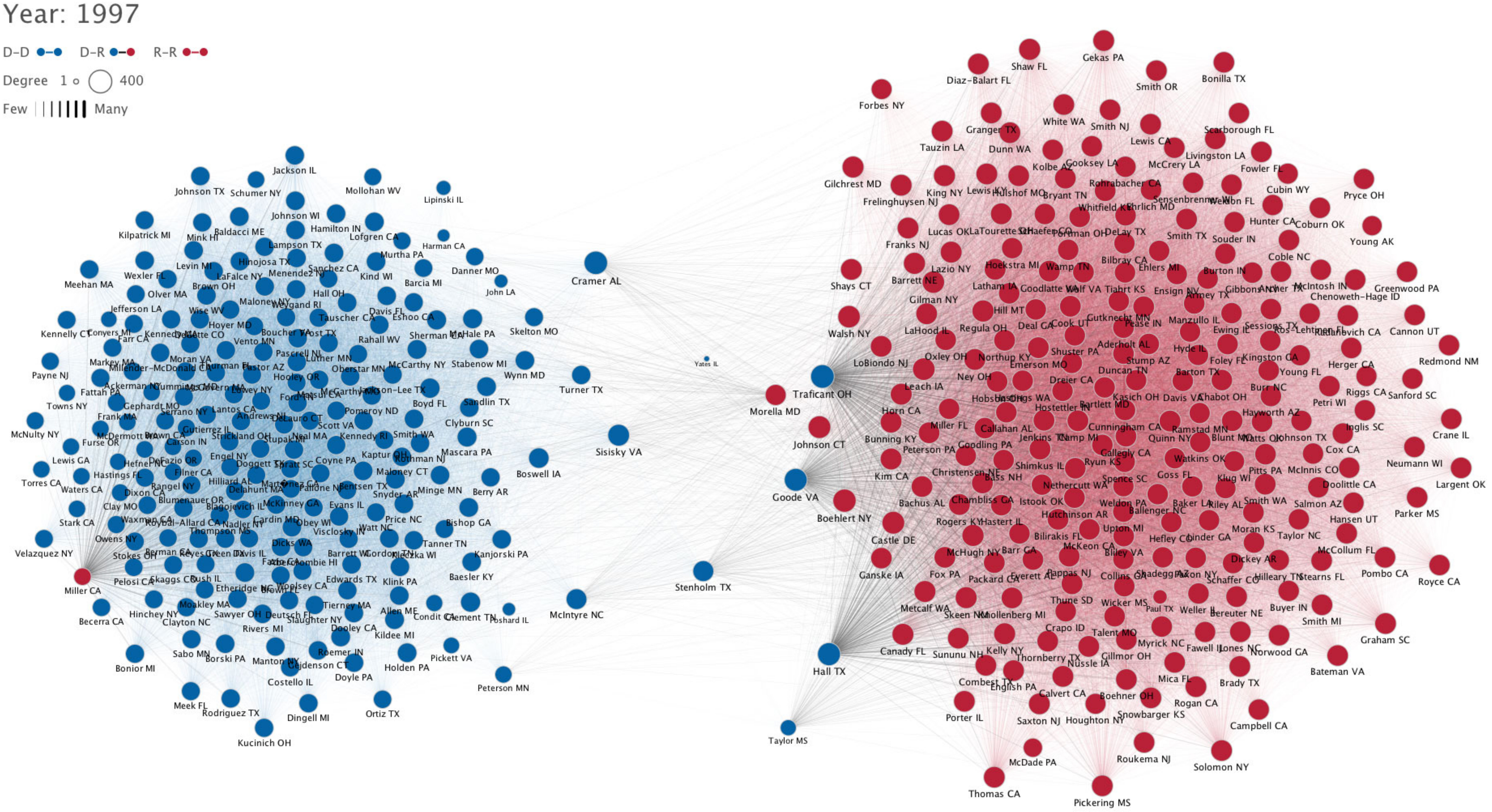
Brewster OK
Weller IL
Chenoweth-Hage ID
Leach IA
Myers IN
Hoekstra MI
McCrery LA
Thornberry TX



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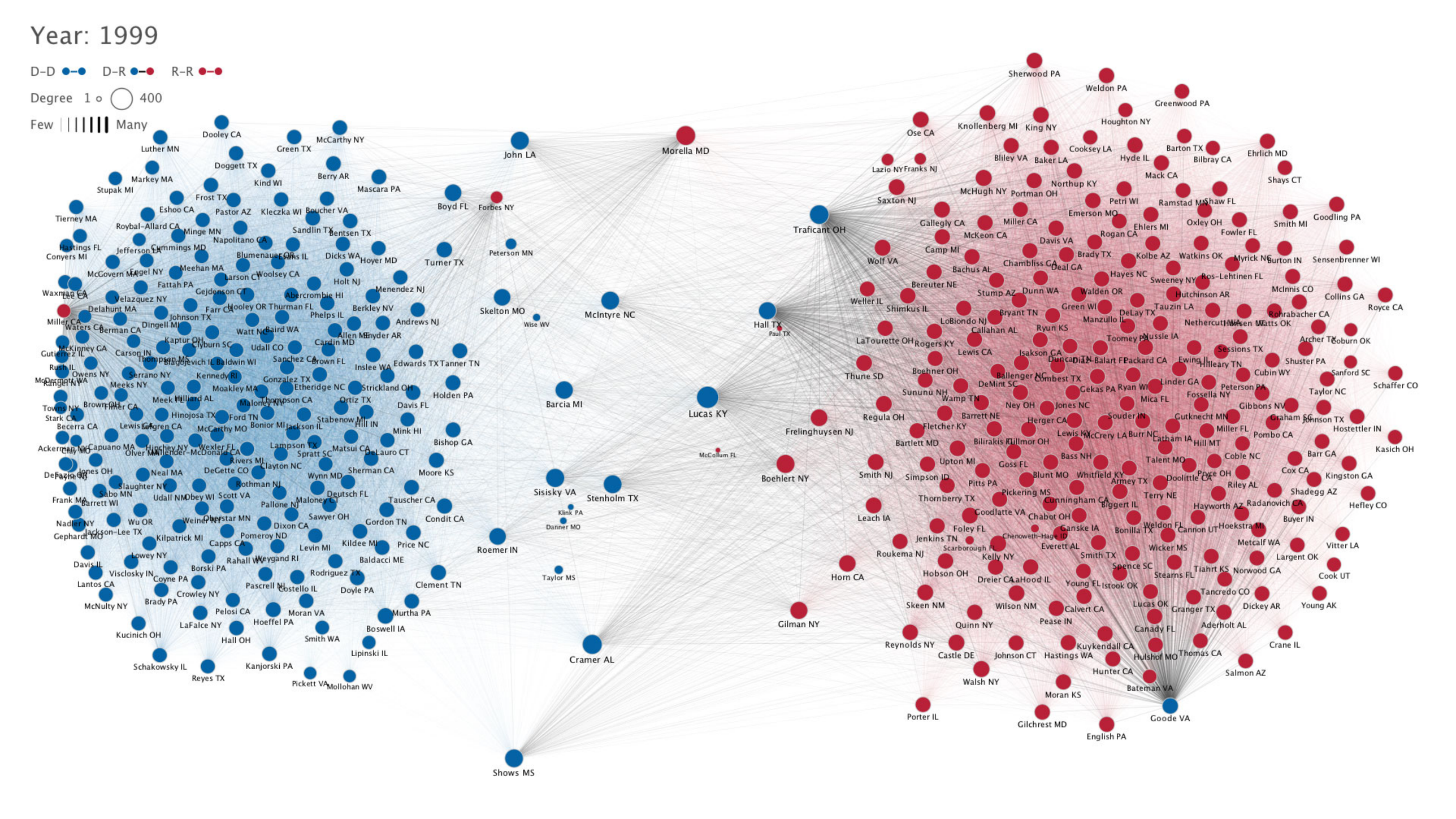
Johnson WI
Kilpatrick MI
Harman CA
Danner MO
John LA
Meehan MA
Cramer AL
Skelton MO
Kennelly CT
Payne NJ
Towns NY
McNulty NY
Wynn MD
Turner TX
Sandlin TX
Clyburn SC
Mascara PA
Sisisky VA
Boswell IA
Berry AR
Bishop GA
Kanjorski PA
Baesler KY
Yates IL
Stenholm TX
McIntyre NC
Poshard IL
Pickett VA
Peterson MN
Velazquez NY
Miller CA
Becerra CA
Bonior MI
Meek FL
Rodriguez TX
Kucinich OH
Dingell MI
Ortiz TX
Costello IL
Holden PA
Torres CA
Traficant OH
Morella MD
Johnson CT
Goode VA
Boehlert NY
Hall TX
Taylor MS
Gekas PA
Shaw FL
Diaz-Balart FL
Smith OR
Bonilla TX
Forbes NY
Gilchrest MD
Pryce OH
Young AK
Greenwood PA
Shays CT
Walsh NY
Cannon UT
Redmond NM
Sanford SC
Crane IL
Neumann WI
Largent OK
Parker MS
Royce CA
Graham SC
Bateman VA
Campbell CA
Solomon NY
Pickering MS
Thomas CA
McDade PA
Roukema NJ
Porter IL
Castle DE
Ganske IA
Canady FL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D-D
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R-R
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Dooley CA
McCarthy NY
Green TX
Luther MN
John LA
Morella MD
Doggett TX
Markey MA
Berry AR
Kind WI
Stupak MI
Mascara PA
Frost TX
Boyd FL
Forbes NY
Eshoo CA
Pastor AZ
Kleczka WI
Boucher VA
Tierney MA
Roybal-Allard CA
Minge MN
Sandlin TX
Bentsen TX
Napolitano CA
Hastings FL
Jefferson LA
Cummings MD
Conyers MI
Blumenauer OR
Evans IL
Dicks WA
Hoyer MD
Turner TX
Peterson MN
McGovern MA
Vengel NY
Meehan MA
Larson CT
Woolsey CA
Holt NJ
Fattah PA
Gejdenson CT
Menendez NJ
Waxman CA
Velazquez NY
Abercrombie HI
Lee CA
Hooley OR
Thurman FL
Berkley NV
Delahunt MA
Farr CA
Phelps IL
Skelton MO
McIntyre NC
Johnson TX
Andrews NJ
Miller CA
Dingell MI
Wise WV
Waters CA
Berman CA
Watt NC
Baird WA
Allen ME
Snyder AR
Kaptur OH
Cardin MD
McKinney GA
Clyburn SC
Udall CO
Carson IN
Thompson MS
Sanchez CA
Brown FL
Edwards TX
Tanner TN
Gutierrez IL
Blagojevich IL
Baldwin WI
Inslee WA
Rush IL
Owens NY
Serrano NY
Kennedy RI
Conyers MI
Gonzalez TX
Etheridge NC
Strickland OH
Holden PA
Meeks NY
Moakley MA
Meek FL
Hilliard AL
Thompson CA
Ortiz TX
Davis FL
Towns NY
Brown OH
Turner CA
Barcia MI
Lucas KY
Stark CA
Hinojosa TX
Ford TN
Stabenow MI
Becerra CA
Lewis GA
Lofgren CA
McCarthy MO
Bonior MI
Jackson IL
Hill IN
Mink HI
Frelinghuysen NJ
Ackerman NY
Capuano MA
Wexler FL
Lampson TX
Bishop GA
Clay MO
Oliver ME
Hinchey NY
Fullender-McDonald CA
Matsui CA
DeLauro CT
Spratt SC
Rivers MI
Clayton NC
McCollum FL
Boehlert NY
Jones OH
DeGette CO
Moore KS
Neal MA
Wynn MD
Sherman CA
Sisisky VA
Stenholm TX
Slaughter NY
Rothman NJ
Deutsch FL
Frank MA
Sabo MN
Udall NM
Obey WI
Scott VA
Tauscher CA
Barrett WI
Pallone NJ
Maloney CT
Condit CA
Klink PA
Danner MO
Nadler NY
Wu OR
Weiner NY
Sawyer OH
Gordon TN
Oberstar MN
Jackson-Lee TX
Dixon CA
Roemer IN
Gephardt MO
Kilpatrick MI
Pomeroy ND
Price NC
Capps CA
Levin MI
Kildee MI
Lowey NY
Rahall WV
Weygand RI
Baldacci ME
Davis IL
Borski PA
Taylor MS
Visclosky IN
Coyne PA
Rodriguez TX
Clement TN
Lantos CA
Crowley NY
Pascrell NJ
Costello IL
Doyle PA
McNulty NY
Brady PA
Pelosi CA
Moran VA
Murtha PA
LaFalce NY
Hoeffel PA
Boswell IA
Kucinich OH
Hall OH
Smith WA
Lipinski IL
Cramer AL
Schakowsky IL
Kanjorski PA
Reyes TX
Pickett VA
Mollohan WV
Shows MS
Sherwood PA
Weldon PA
Greenwood PA
Houghton NY
Ose CA
Knollenberg MI
King NY
Bliley VA
Baker LA
Cooksey LA
Hyde IL
Barton TX
Bilbray CA
Ehrlich MD
Lazio NY
Franks NJ
Shays CT
Mack CA
Northup KY
Saxton NJ
McHugh NY
Portman OH
Petri WI
Ramstad MN
Shaw FL
Traficant OH
Gallegly CA
Miller CA
Emerson MO
Oxley OH
Goodling PA
Ehlers MI
Smith MI
McKeon CA
Rogan CA
Fowler FL
Davis VA
Camp MI
Brady TX
Kolbe AZ
Watkins OK
Myrick NC
Burton IN
Sensenbrenner WI
Wolf VA
Chambliss GA
Deal GA
Bachus AL
Hayes NC
Sweeney NY
Ros-Lehtinen FL
Bereuter NE
Stump AZ
Dunn WA
Walden OR
Hutchinson AR
McInnis CO
Weller IL
Shimkus IL
Green WI
DeLay TX
Tauzin LA
Collins GA
Royce CA
Hall TX
Paul TX
LoBiondo NJ
Bryant TN
Manzullo IL
Rohrabacher CA
Callahan AL
Ryun KS
Nethercutt WA
Hansen UT
Watts OK
LaTourette OH
Rogers KY
Toomey PA
Hussle IA
Archer TX
Coburn OK
Lewis CA
Isakson GA
Sessions TX
Thune SD
Boehner OH
Duncan TN
Balart FL
Packard CA
Ewing IL
Hilleary TN
Shuster PA
Sanford SC
DeMint SC
Ballenger NC
Combest TX
Linder GA
Cubin WY
Schaffer CO
Sununu NH
Gekas PA
Ryan WI
Peterson PA
Taylor NC
Wamp TN
Mica FL
Fossella NY
Ney OH
Jones NC
Gibbons NV
Regula OH
Barrett NE
Souder IN
Gutknecht MN
Graham SC
Johnson TX
Fletcher KY
Herger CA
Hostettler IN
Bartlett MD
Lewis KY
McCrery LA
Burr NC
Latham IA
Pombo CA
Bilirakis FL
Gillmor OH
Hill MT
Kasich OH
Upton MI
Talent MO
Coble NC
Barr GA
Smith NJ
Goss FL
Bass NH
Cox CA
Simpson ID
Blunt MO
Whitfield KY
Pryce OH
Kingston GA
Pitts PA
Armey TX
Doolittle CA
Riley AL
Pickering MS
Terry NE
Shadegg AZ
Thornberry TX
Cunningham CA
Biggert IL
Hefley CO
Goodlatte VA
Hayworth AZ
Radanovich CA
Leach IA
Chabot OH
Buyer IN
Foley FL
Ganske IA
Weldon FL
Hoekstra MI
Jenkins TN
Chenoweth-Hage ID
Bonilla TX
Cannon UT
Metcalf WA
Roukema NJ
Scarborough FL
Everett AL
Wicker MS
Vitter LA
Kelly NY
Smith TX
Largent OK
Horn CA
Hobson OH
Spence SC
Norwood GA
Dreier CA
LaHood IL
Young FL
Istook OK
Stearns FL
Cook UT
Skeen NM
Wilson NM
Calvert CA
Lucas OK
Granger TX
Dickey AR
Young AK
Gilman NY
Quinn NY
Pease IN
Canady FL
Aderholt AL
Reynolds NY
Castle DE
Johnson CT
Hastings WA
Kuykendall CA
Hulshof MO
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Hunter CA
Salmon AZ
Moran KS
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Gilchrest MD
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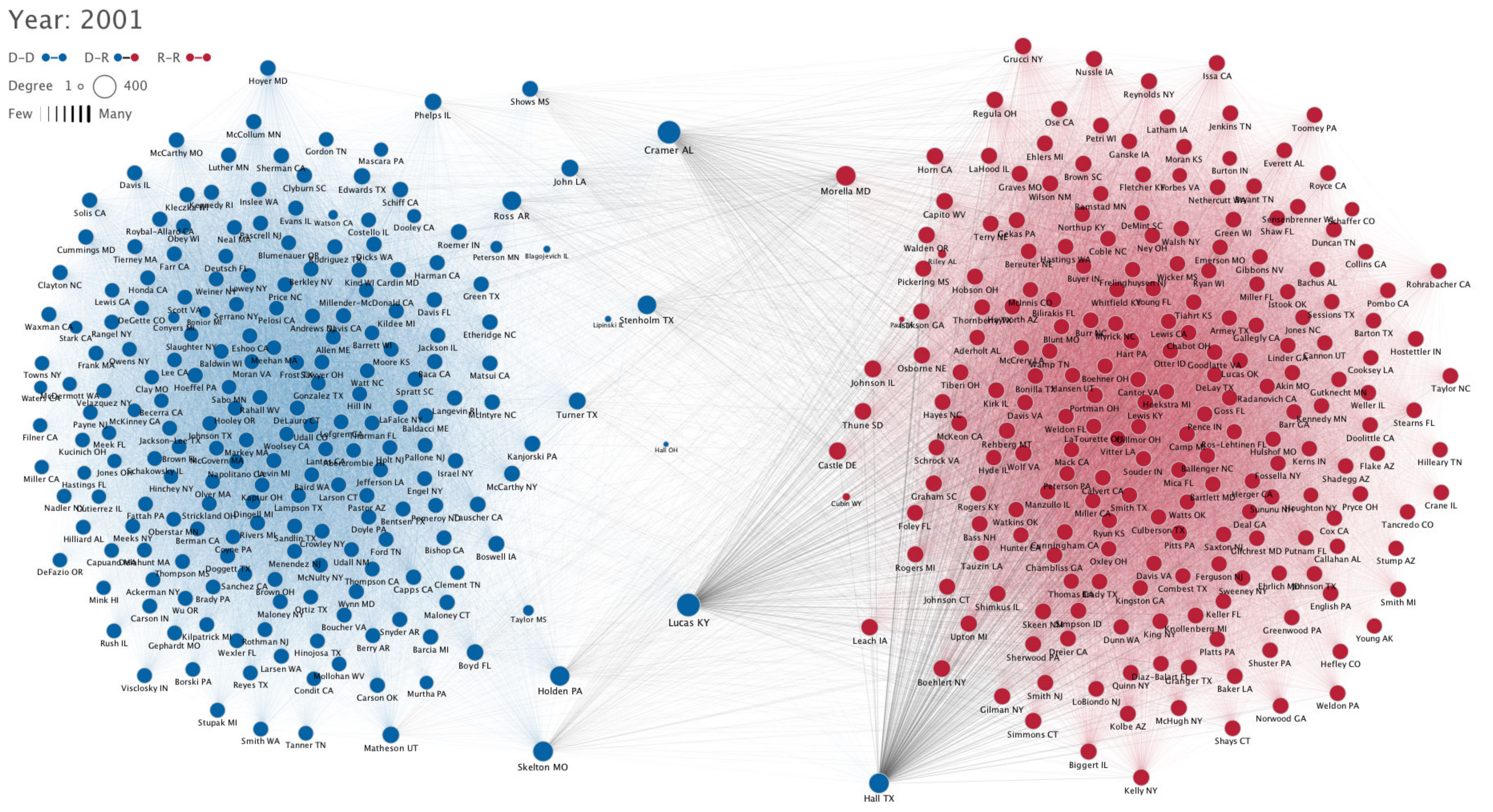
English PA


Year: 2001
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Ross AR
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McCollum MN
McCarthy MO
Gordon TN
Mascara PA
Luther MN
Sherman CA
Davis IL
Clyburn SC
Edwards TX
Schiff CA
Solis CA
Inslee WA
Evans IL
Watson CA
Dooley CA
Costello IL
Roemer IN
Cummings MD
Neal MA
Pascrell NJ
Peterson MN
Blagojevich IL
Tierney MA
Farr CA
Deutsch FL
Blumenauer OR
Rodriguez TX
Dicks WA
Harman CA
Clayton NC
Honda CA
Weiner NY
Lowey NY
Berkley NV
Kind WI
Cardin MD
Green TX
Lewis GA
Price NC
Millender-McDonald CA
Davis FL
Waxman CA
DeGette CO
Scott VA
Serrano NY
Pelosi CA
Kildee MI
Stenholm TX
Lipinski IL
Stark CA
Rangel NY
Conyers MI
Bonior MI
Andrews NJ
Davis CA
Etheridge NC
Slaughter NY
Eshoo CA
Barrett WI
Jackson IL
Frank MA
Owens NY
Baldwin WI
Meehan MA
Allen ME
Moore KS
Towns NY
Lee CA
Moran VA
Frost TX
Sawyer OH
Baca CA
Matsui CA
Clay MO
Hoeffel PA
Watt NC
Spratt SC
McDermott WA
Sabo MN
Gonzalez TX
Turner TX
Velazquez NY
Rahall WV
Hill IN
Langevin RI
McIntyre NC
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Hooley OR
DeLauro CT
LaFalce NY
Payne NJ
McKinney GA
Johnson TX
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Lofgren CA
Norman FL
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Filner CA
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Jackson-Lee TX
Markey MA
Woolsey CA
Kucinich OH
Brown FL
McGovern MA
Lantos CA
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Pallone NJ
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Hall OH
Miller CA
Jones OH
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Baird WA
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Bentsen TX
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Oberstar MN
Rivers MI
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Meeks NY
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Sandlin TX
Coyne PA
Crowley NY
Bishop GA
Boswell IA
Capuano MA
Delahunt MA
Ford TN
DeFazio OR
Thompson MS
Doggett TX
Menendez NJ
Udall NM
Clement TN
Mink HI
Ackerman NY
Sanchez CA
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Thompson CA
Capps CA
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Brady PA
Wu OR
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Ortiz TX
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Carson IN
Taylor MS
Lucas KY
Boucher VA
Snyder AR
Rush IL
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Gephardt MO
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Berry AR
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Wexler FL
Hinojosa TX
Boyd FL
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Mollohan WV
Holden PA
Visclosky IN
Borski PA
Reyes TX
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Murtha PA
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Skelton MO
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Isakson GA
Thornberry TX
Hayworth AZ
Armey TX
Jones NC
Gallegly CA
Barton TX
Blunt MO
Burr NC
Myrick NC
Lewis CA
Chabot OH
Hostettler IN
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Linder GA
Cannon UT
McCrery LA
Wamp TN
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Otter ID
Goodlatte VA
Cooksey LA
Osborne NE
Lucas OK
Johnson IL
Boehner OH
Tiberi OH
Bonilla TX
Hansen UT
Cantor VA
DeLay TX
Akin MO
Gutknecht MN
Taylor NC
Radanovich CA
Heekstra MI
Kirk IL
Weller IL
Thune SD
Portman OH
Goss FL
Hayes NC
Davis VA
Lewis KY
Kennedy MN
Stearns FL
Barr GA
Weldon FL
Pence IN
McKeon CA
LaTourette OH
Gillmor OH
Doolittle CA
Camp MI
Ros-Lehtinen FL
Castle DE
Rehberg MT
Vitter LA
Hulshof MO
Hilleary TN
Kerns IN
Schrock VA
Flake AZ
Mack CA
Wolf VA
Hyde IL
Ballenger NC
Souder IN
Fossella NY
Shadegg AZ
Mica FL
Graham SC
Peterson PA
Calvert CA
Bartlett MD
Herger CA
Crane IL
Cubin WY
Rogers KY
Manzullo IL
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Cox CA
Culberson TX
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Cunningham CA
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Saxton NJ
Gilchrest MD
Putnam FL
Callahan AL
Stump AZ
Tauzin LA
Oxley OH
Rogers MI
Chambliss GA
Davis VA
Ferguson NJ
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Ehrlich MD
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Smith MI
Johnson CT
Thomas CA
Brady TX
Kingston GA
English PA
Shimkus IL
Keller FL
Skeen NM
Simpson ID
Greenwood PA
Leach IA
Young AK
Upton MI
Dunn WA
King NY
Knollenberg MI
Platts PA
Sherwood PA
Dreier CA
Shuster PA
Hefley CO
Boehlert NY
Diaz-Balart FL
Granger TX
Quinn NY
Baker LA
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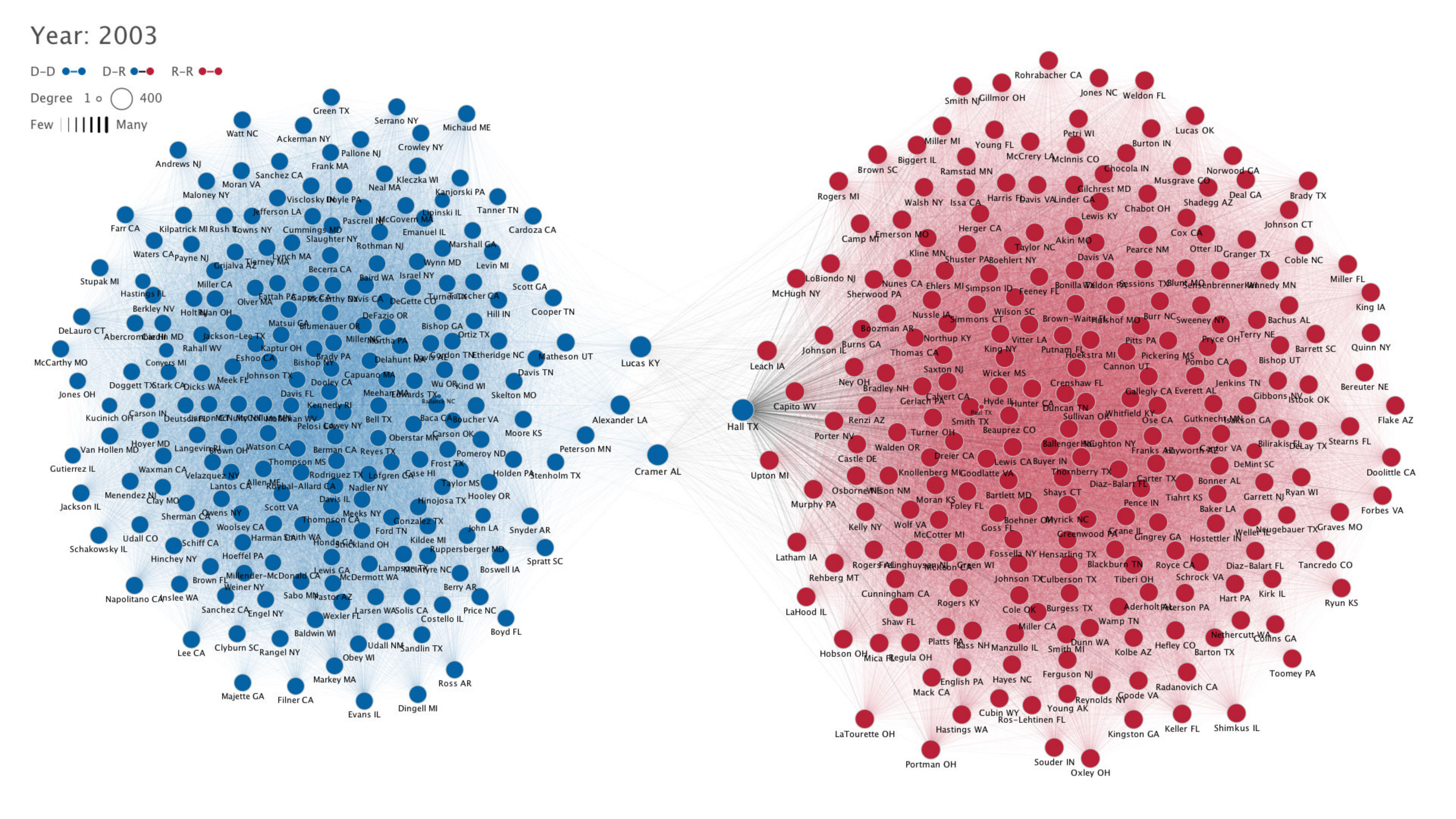
Norwood GA
Kolbe AZ
McHugh NY
Simmons CT
Shays CT
Biggert IL
Kelly NY
Hall TX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R-R
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Pallone NJ
Andrews NJ
Frank MA
Sanchez CA
Moran VA
Neal MA
Kleczka WI
Maloney NY
Visclosky DoyleDoyle PA
Kanjorski PA
Jefferson LA
Lipinski IL
Tanner TN
Farr CA
Kilpatrick MI
Towns NY
Cummings MD
Pascrell NJ
McGovern MA
Emanuel IL
Cardoza CA
Slaughter NY
Waters CA
Payne NJ
Rothman NJ
Marshall GA
Lynch MA
Tierney MA
Grijalva AZ
Becerra CA
Wynn MD
Levin MI
Stupak MI
Baird WA
Israel NY
Miller CA
Hastings FL
Scott GA
Olver MA
DeGette CO
Cooper TN
Berkley NV
Holt NJ
Ryan OH
Hill IN
DeLauro CT
Matsui CA
Blumenauer OR
Bishop GA
Ortiz TX
Jackson-Lee TX
Rahall WV
Kaptur OH
Matheson UT
McCarthy MO
Conyers MI
Eshoo CA
Brady PA
Delahunt MA
Gordon TN
Etheridge NC
Lucas KY
Johnson TX
Capuano MA
Davis TN
Jones OH
Doggett TX
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Dicks WA
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Dooley CA
Wu OR
Kind WI
Davis FL
Skelton MO
Kucinich OH
Carson IN
Kennedy RI
Alexander LA
Pelosi CA
Bell TX
Baca CA
Boucher VA
Moore KS
Oberstar MN
Carson OK
Peterson MN
Van Hollen MD
Hoyer MD
Langevin RI
Watson CA
Berman CA
Reyes TX
Pomeroy ND
Cramer AL
Gutierrez IL
Waxman CA
Thompson MS
Frost TX
Velazquez NY
Rodriguez TX
Lofgren CA
Case HI
Holden PA
Stenholm TX
Allen ME
Lantos CA
Royball-Allard CA
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Taylor MS
Menendez NJ
Clay MO
Davis IL
Hooley OR
Jackson IL
Scott VA
Hinojosa TX
Sherman CA
Owens NY
Meeks NY
Thompson CA
Gonzalez TX
Woolsey CA
Ford TN
John LA
Snyder AR
Udall CO
Harman CA
Honda CA
Kildee MI
Schakowsky IL
Schiff CA
Smith WA
Strickland OH
Ruppersberger MD
Spratt SC
Hinchey NY
Hoeffel PA
Lewis GA
Lampson TX
McIntyre NC
Boswell IA
Millender-McDonald CA
McDermott WA
Brown FL
Weiner NY
Berry AR
Napolitano CA
Inslee WA
Sabo MN
Pastor AZ
Sanchez CA
Engel NY
Larsen WA
Solis CA
Price NC
Wexler FL
Costello IL
Boyd FL
Baldwin WI
Lee CA
Clyburn SC
Rangel NY
Udall NM
Sandlin TX
Obey WI
Markey MA
Ross AR
Majette GA
Filner CA
Evans IL
Dingell MI
Hall TX
Rohrabacher CA
Smith NJ
Gillmor OH
Jones NC
Weldon FL
Petri WI
Lucas OK
Miller MI
Young FL
McCrery LA
McInnis CO
Burton IN
Biggert IL
Brown SC
Ramstad MN
Chocola IN
Norwood GA
Rogers MI
Walsh NY
Issa CA
Harris FL
Davis VA
Linder GA
Gilchrest MD
Musgrave CO
Deal GA
Brady TX
Lewis KY
Chabot OH
Shadegg AZ
Johnson CT
Camp MI
Emerson MO
Herger CA
Cox CA
Taylor NC
Akin MO
Pearce NM
Otter ID
Granger TX
Coble NC
Kline MN
Shuster PA
Boehlert NY
Davis VA
LoBiondo NJ
McHugh NY
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Simpson ID
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Sessions TX
Blunt MO
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Sherwood PA
King IA
Nussle IA
Wilson SC
Simmons CT
Brown-Waite FL
Hulshof MO
Burr NC
Sweeney NY
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Boozman AR
Northup KY
Vitter LA
Terry NE
Johnson IL
Burns GA
King NY
Putnam FL
Pitts PA
Pryce OH
Barrett SC
Quinn NY
Leach IA
Thomas CA
Hoekstra MI
Pickering MS
Bishop UT
Saxton NJ
Cannon UT
Pombo CA
Ney OH
Wicker MS
Crenshaw FL
Jenkins TN
Bereuter NE
Bradley NH
Calvert CA
Gallegly CA
Everett AL
Gibbons NV
Istook OK
Capito WV
Gerlach PA
Hyde IL
Hunter CA
Duncan TN
Whitfield KY
Flake AZ
Renzi AZ
Smith TX
Sullivan OK
Ose CA
Gutknecht MN
Isakson GA
Porter NV
Turner OH
Beauprez CO
Walden OR
Ballenger NC
Boughton NY
Franks AZ
Kingston GA
Bilirakis FL
Stearns FL
Castle DE
Dreier CA
Lewis CA
Buyer IN
DeLay TX
Taylor AZ
Upton MI
Knollenberg MI
Goodlatte VA
Thornberry TX
DeMint SC
Doolittle CA
Osborne NE
Wilson NM
Carter TX
Diaz-Balart FL
Bonner AL
Murphy PA
Moran KS
Bartlett MD
Shays CT
Tiahrt KS
Garrett NJ
Ryan WI
Foley FL
Pence IN
Forbes VA
Kelly NY
Wolf VA
Boehner OH
Myrick NC
Baker LA
Goss FL
Greenwood PA
Crane IL
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Hostettler IN
Weller IL
Neugebauer TX
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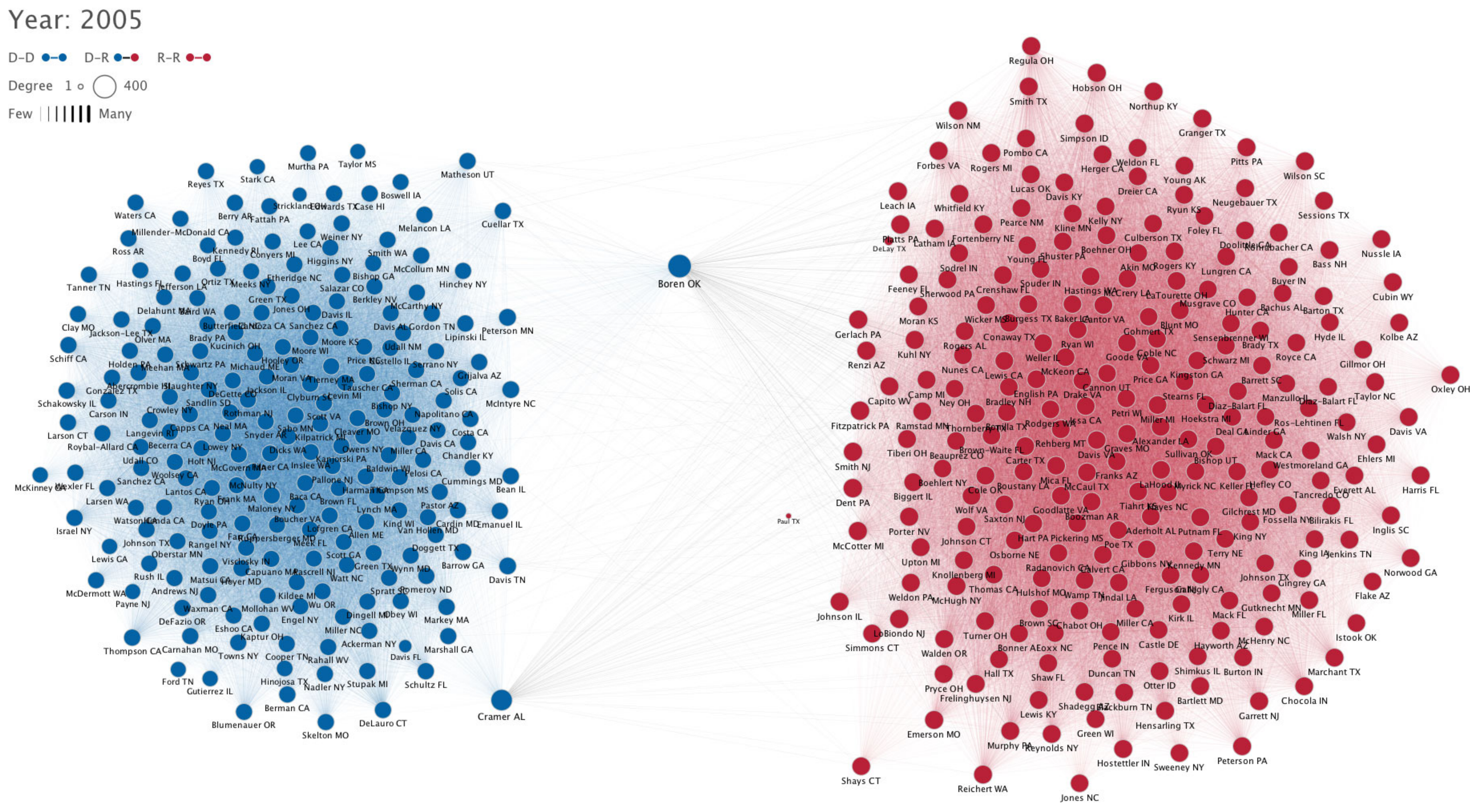
McCotter MI
Latham IA
Fossella NY
Hensarling TX
Blackburn TN
Royce CA
Diaz-Balart FL
Tancredo CO
Rehberg MT
Johnson TX
Culberson TX
Tiberi OH
Schrock VA
Kirk IL
Cunningham CA
Rogers KY
Hart PA
Ryun KS
LaHood IL
Cole OK
Burgess TX
Aderholt AL
Peterson PA
Shaw FL
Miller CA
Wamp TN
Platts PA
Bass NH
Manzullo IL
Dunn WA
Nethercutt WA
Collins GA
Hobson OH
Mica FL
Regula OH
Smith MI
Hefley CO
Kolbe AZ
Barton TX
Toomey PA
English PA
Hayes NC
Ferguson NJ
Radanovich CA
Mack CA
Goode VA
Reynolds NY
Young AK
Cubin WY
Ros-Lehtinen FL
Keller FL
Shimkus IL
LaTourette OH
Hastings WA
Portman OH
Souder IN
Oxley OH



Year: 2005
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D–R
R–R
Degree 1
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Few
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Cramer AL
Paul TX
DeLay TX
Murtha PA
Taylor MS
Matheson UT
Reyes TX
Stark CA
Boswell IA
Waters CA
Cuellar TX
Melancon LA
Ross AR
Tanner TN
Hinchey NY
Clay MO
Peterson MN
Schiff CA
Lipinski IL
Grijalva AZ
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McIntyre NC
Solis CA
Carson IN
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Costa CA
Roybal-Allard CA
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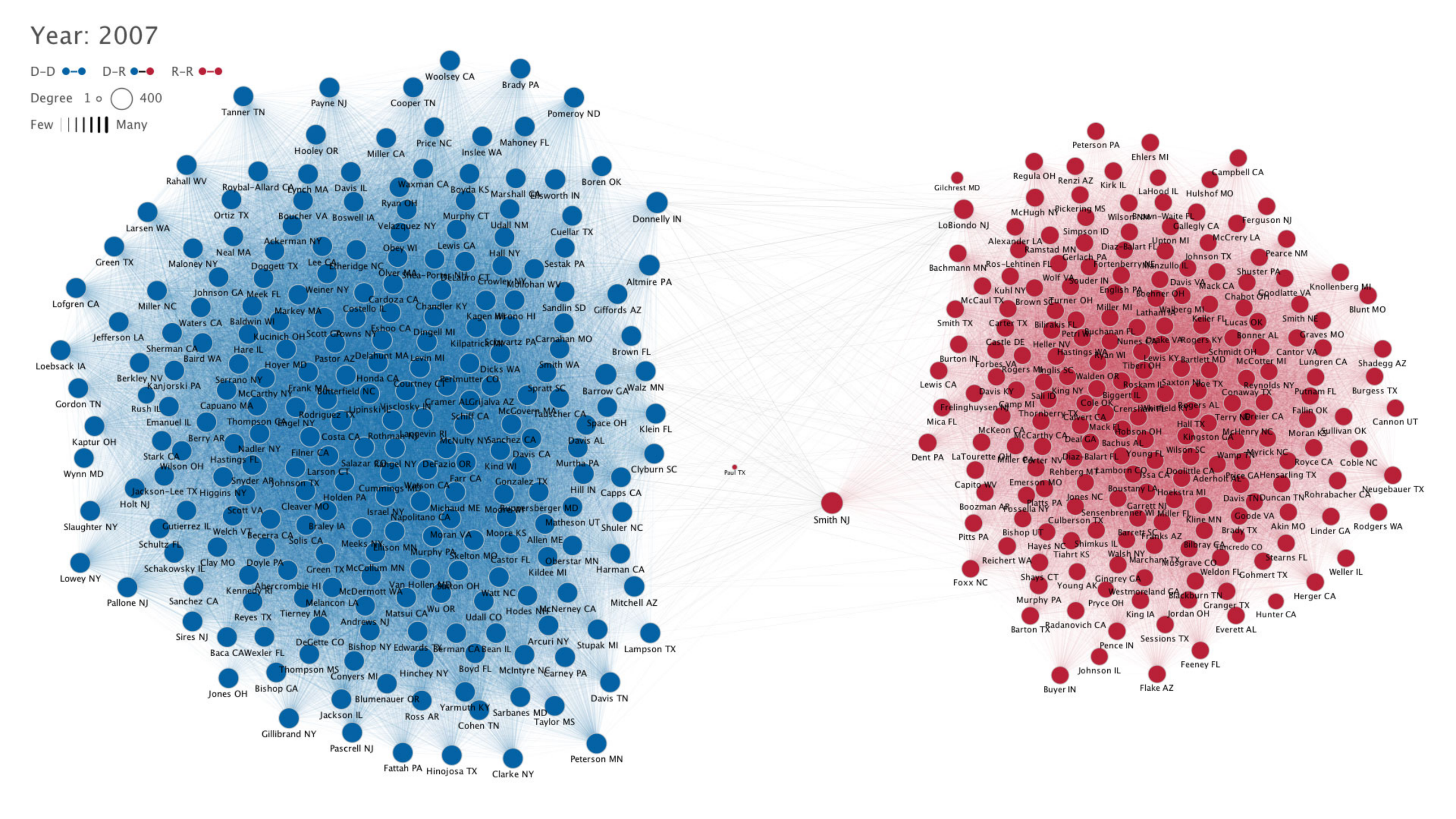
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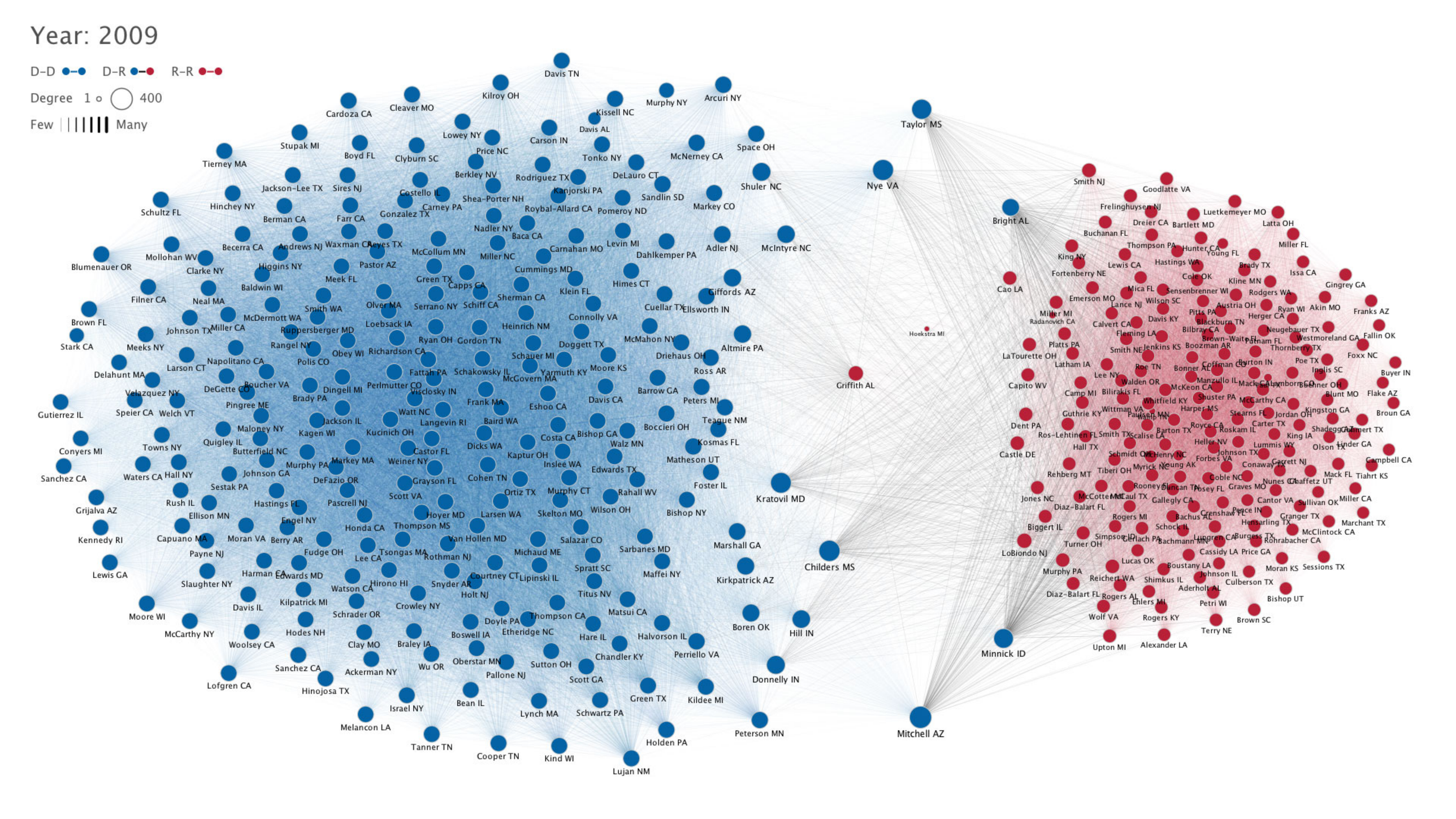
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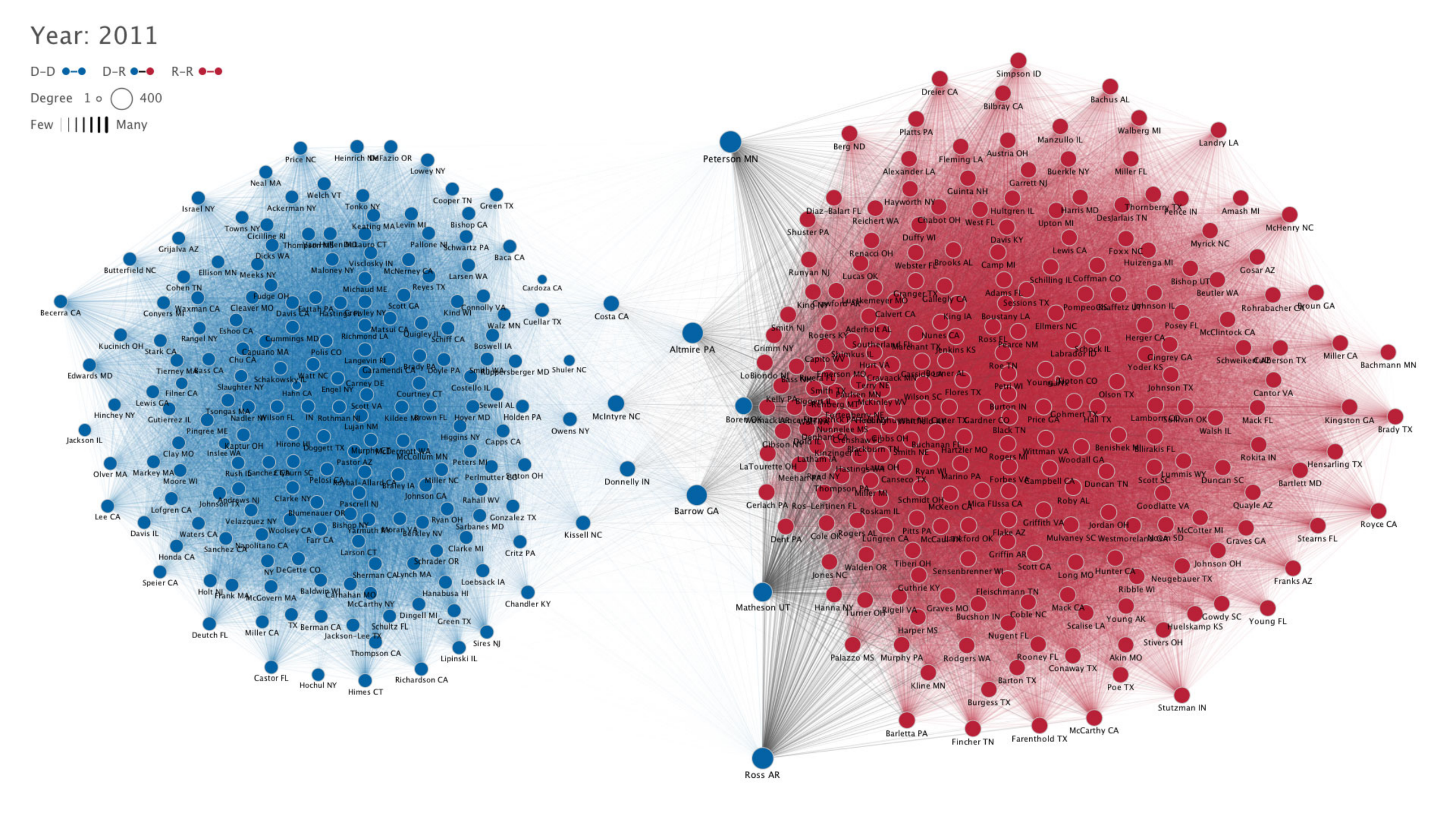
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McCarthy CA
Ross AR

Part Two

What are social networks?

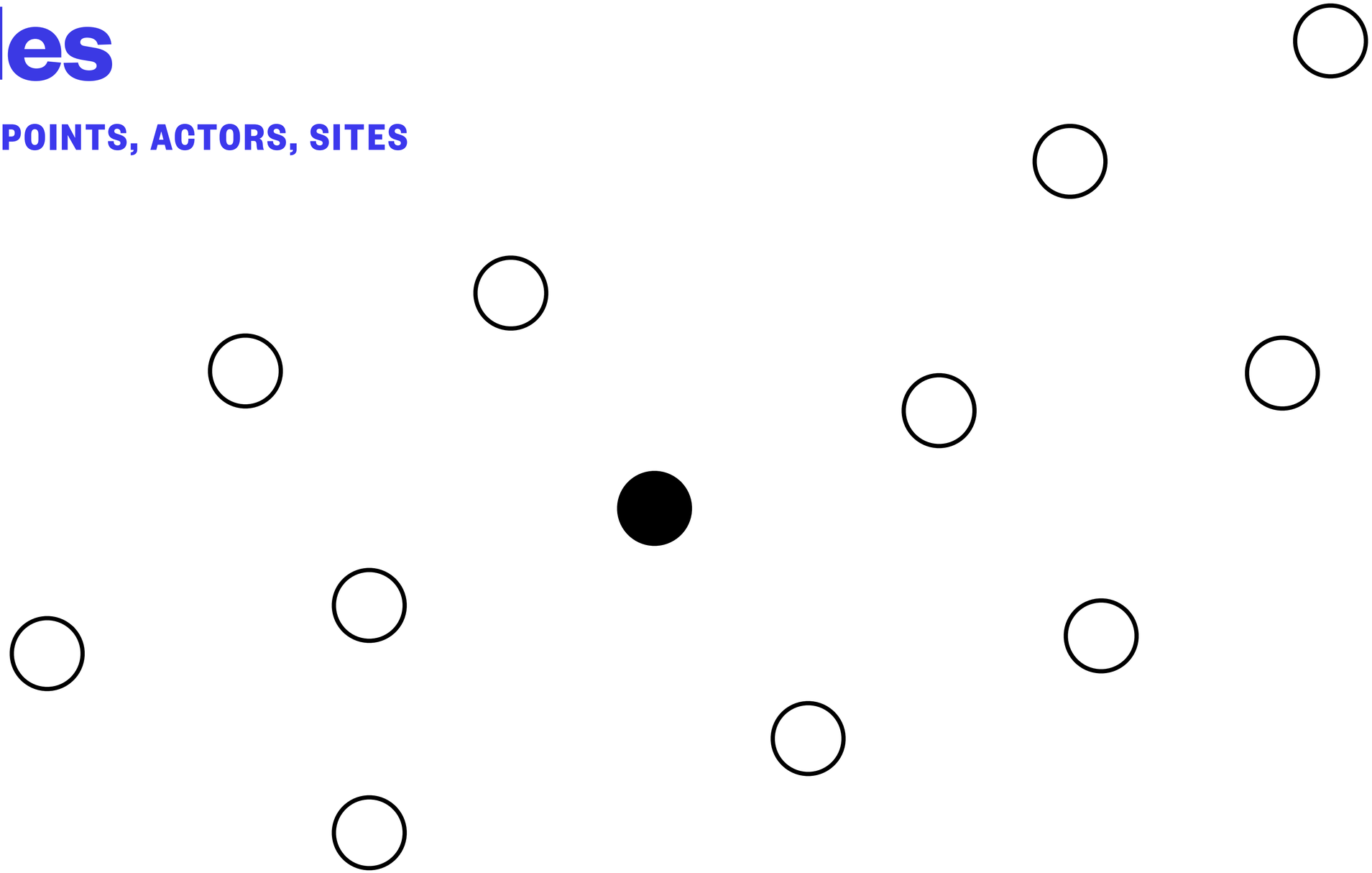
Networks have two basic elements:

Nodes & Edges

- Let’s take an imaginary ego-centric friendship network to illustrate
  - Ego-centric: A network focused on a particular individual

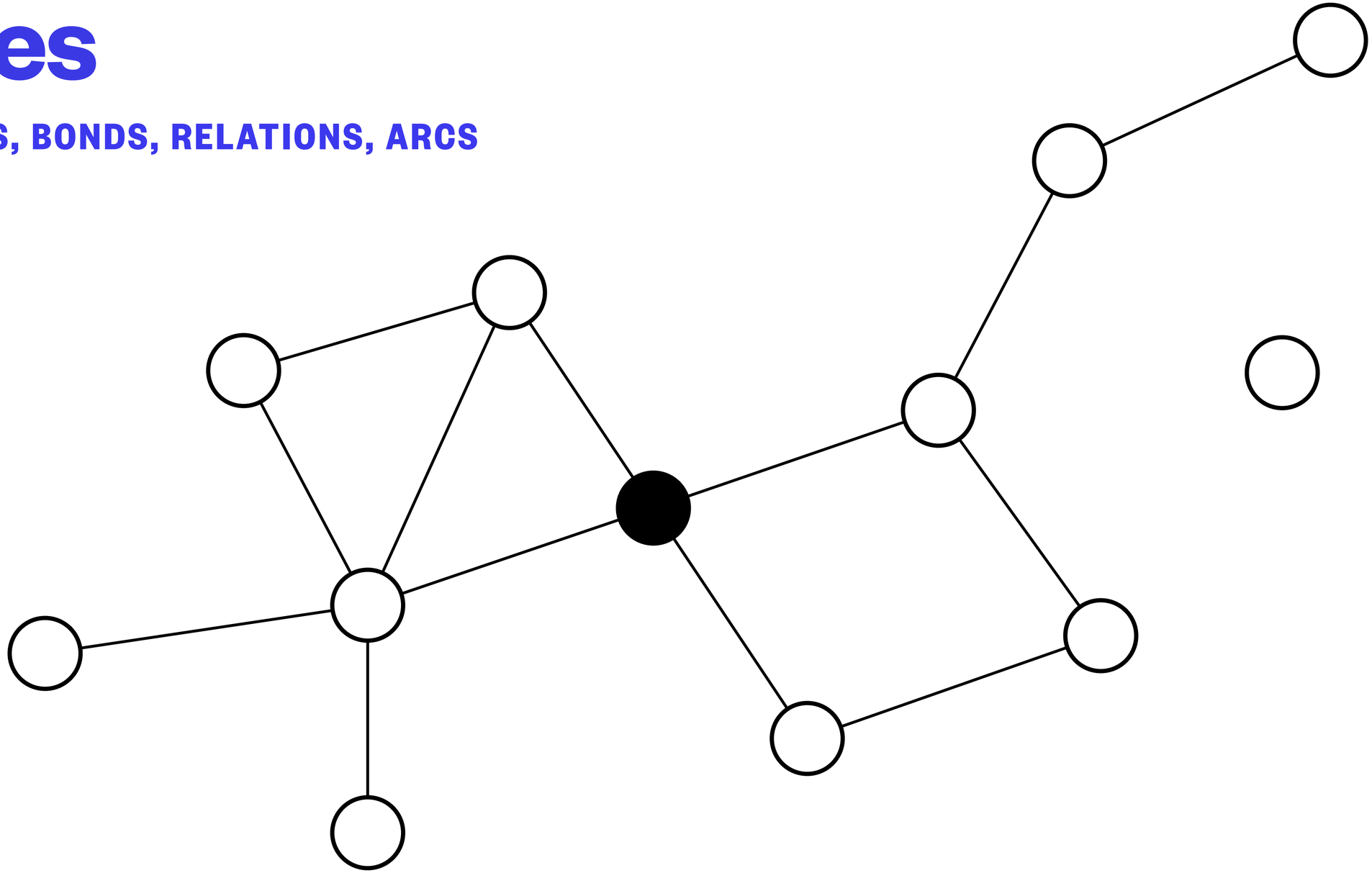
Nodes

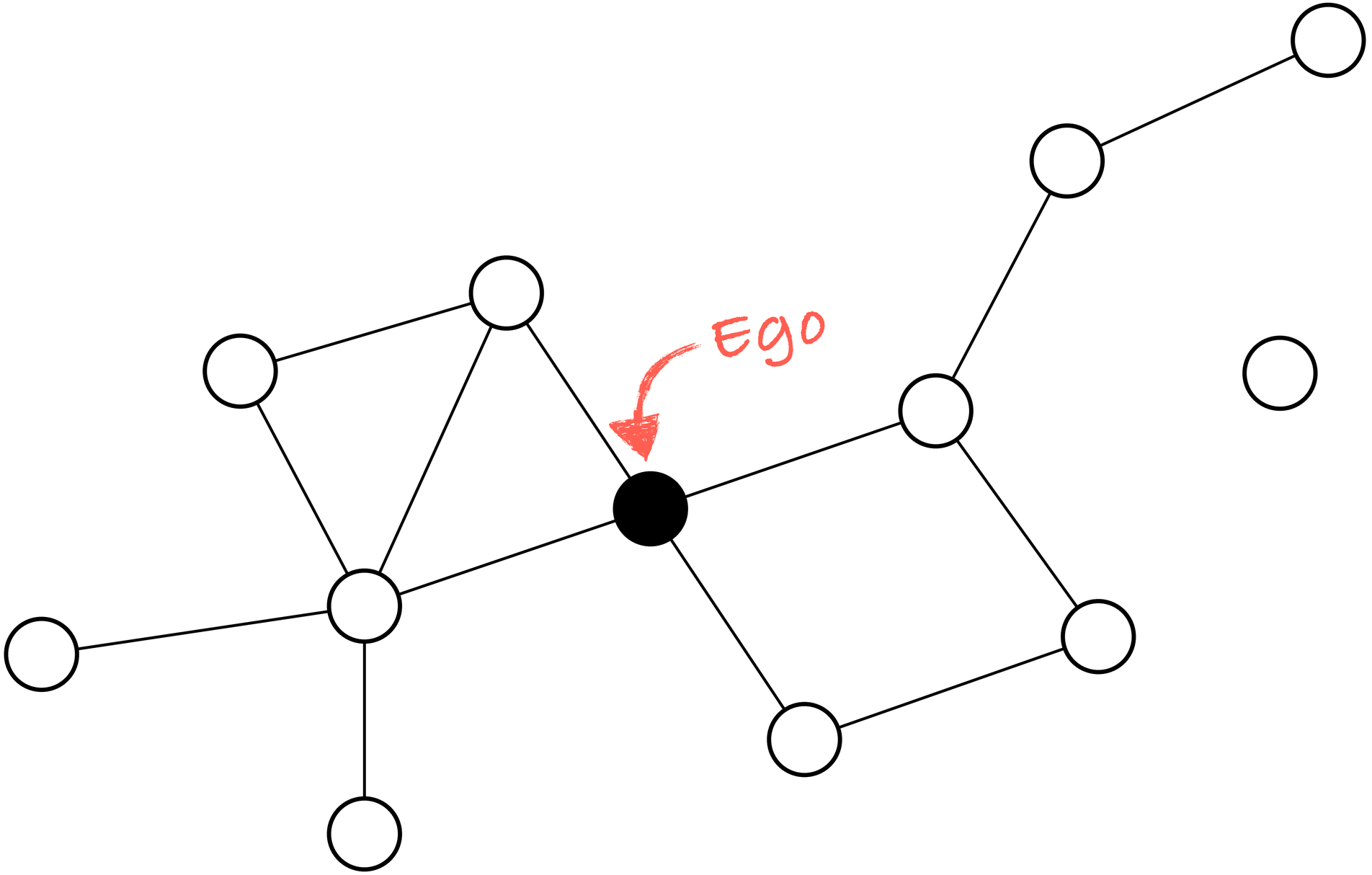
VERTICES, POINTS, ACTORS, SITES

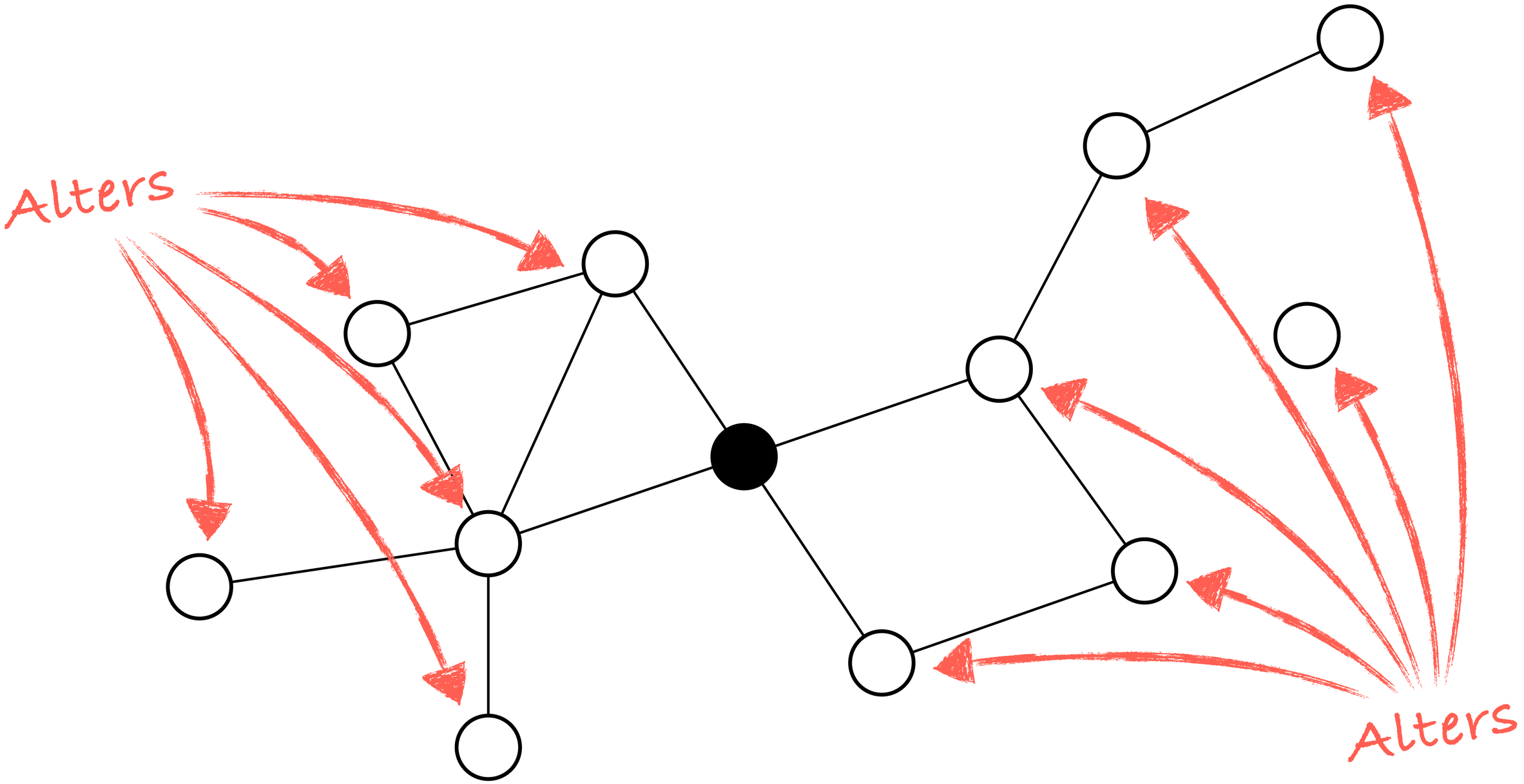


Edges

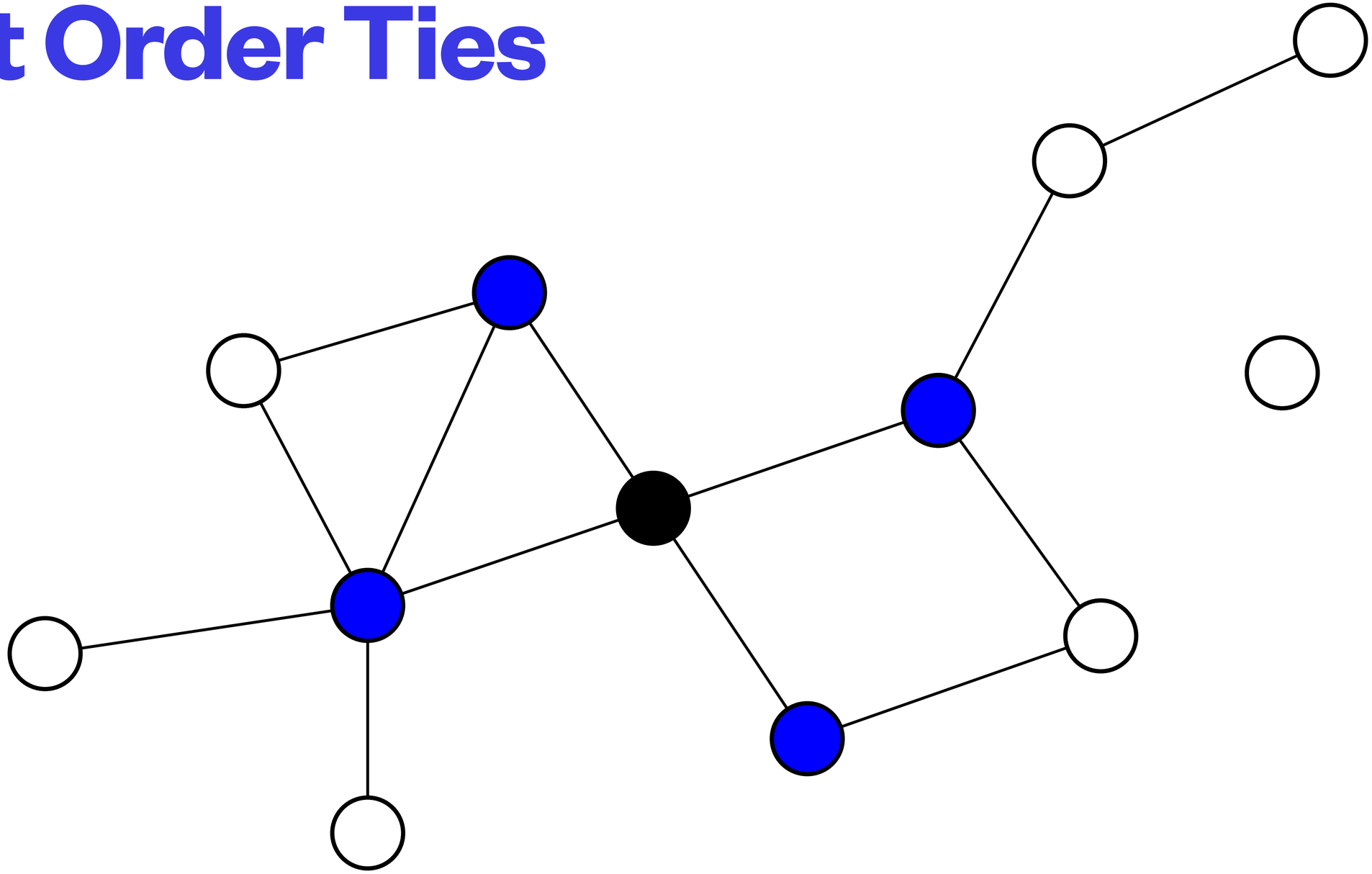
TIES, LINKS, BONDS, RELATIONS, ARCS



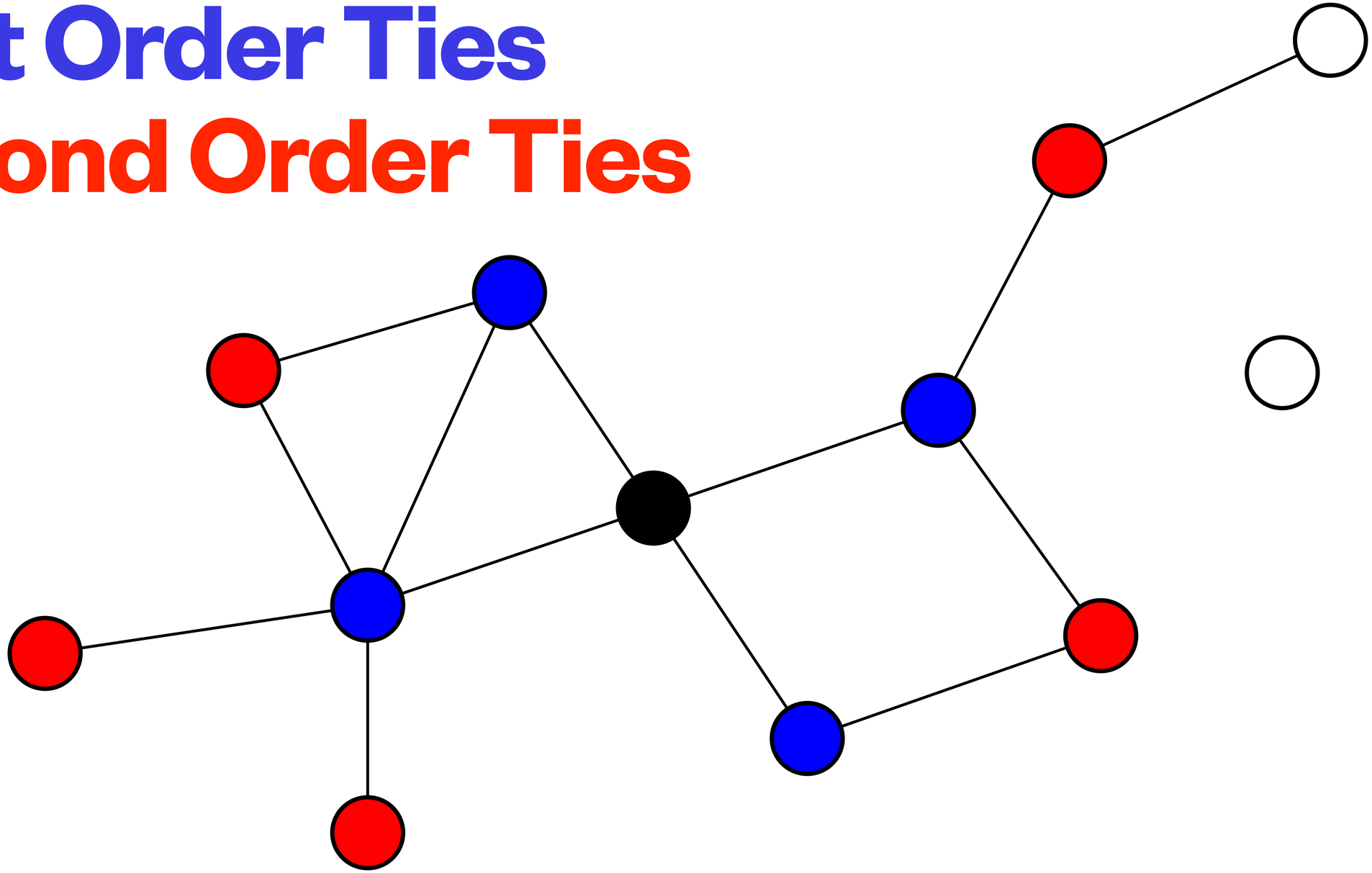

Ego


Alters
Alters

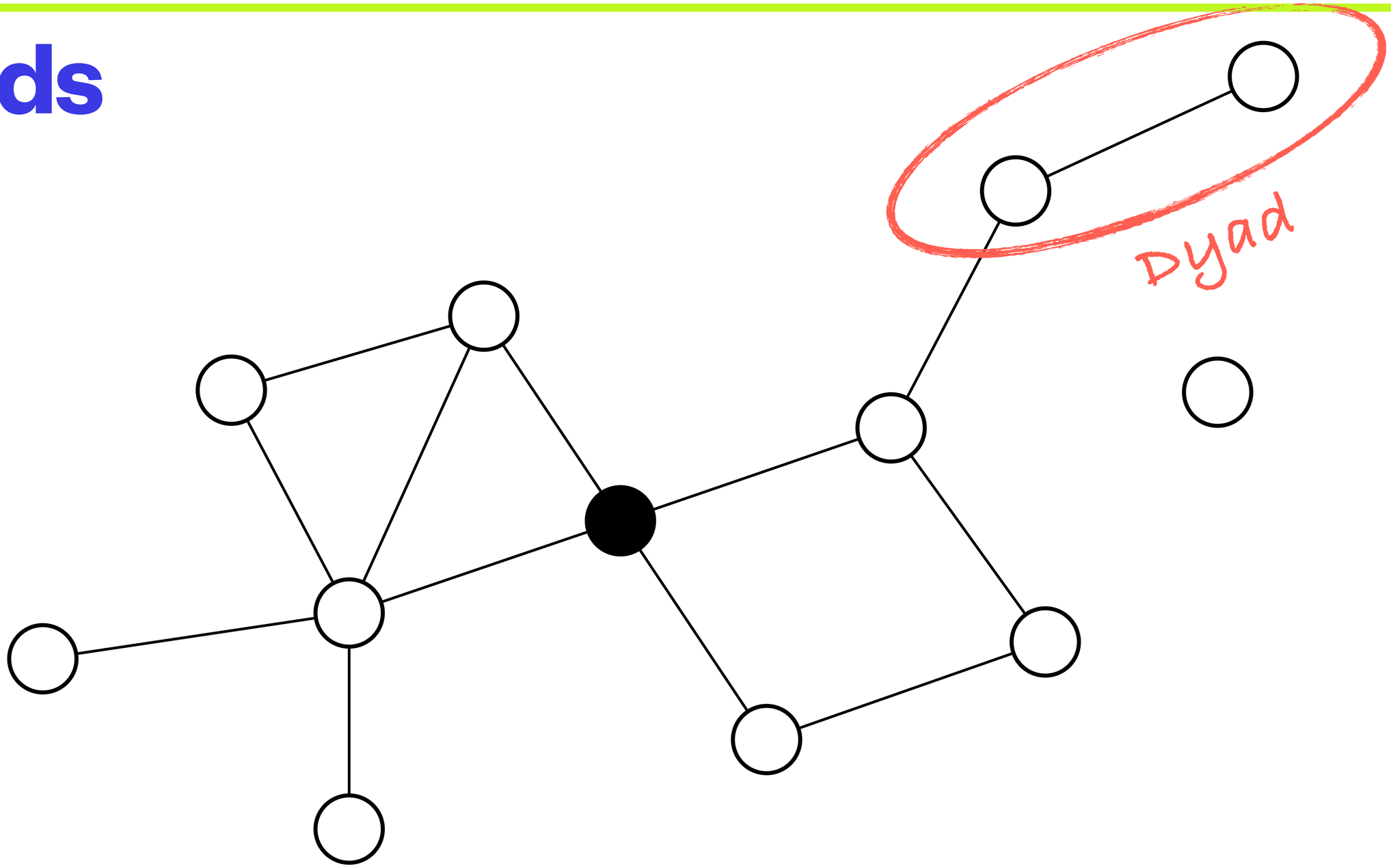
First Order Ties



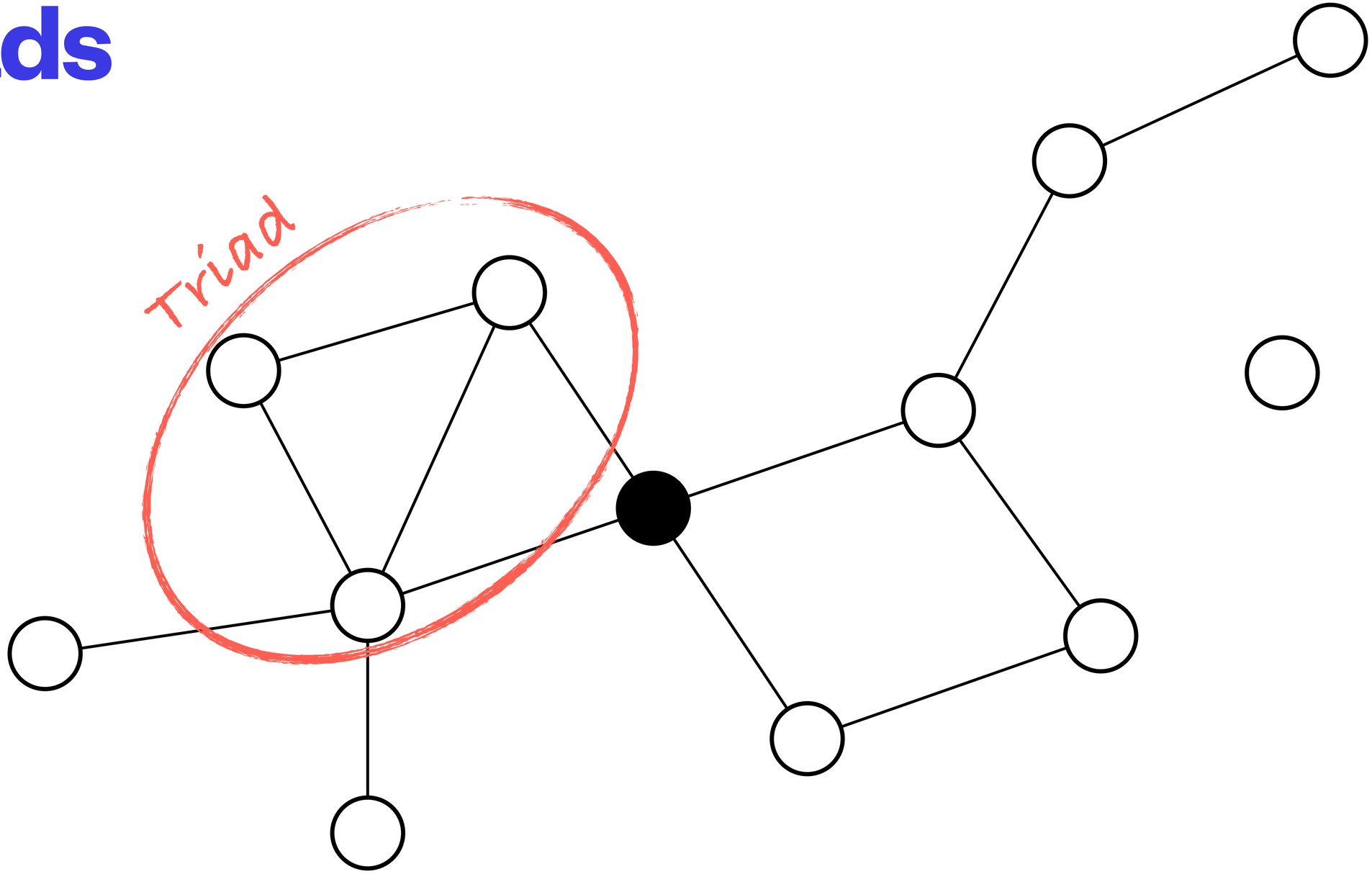
First Order Ties
Second Order Ties



Dyads

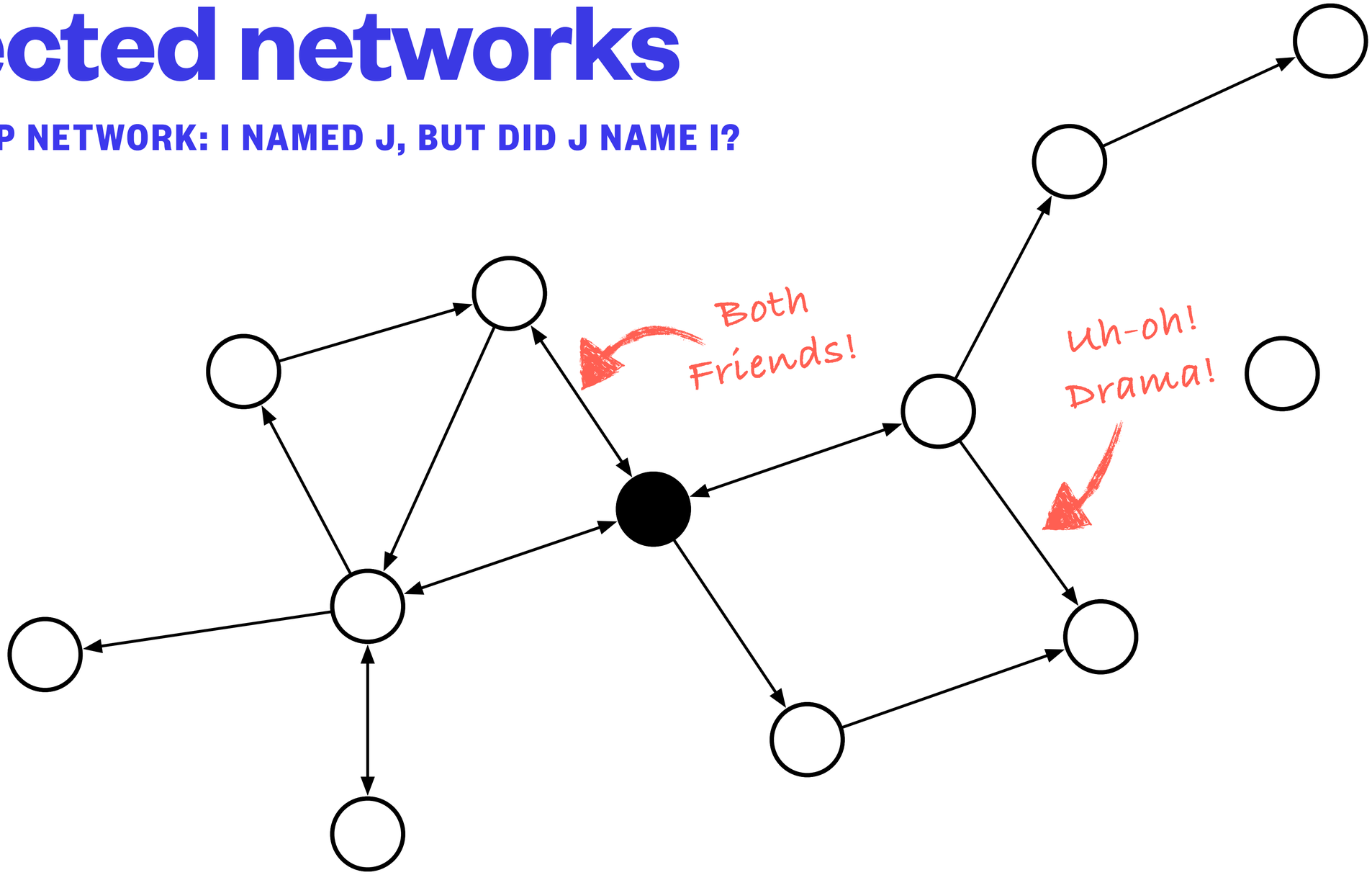


Triads



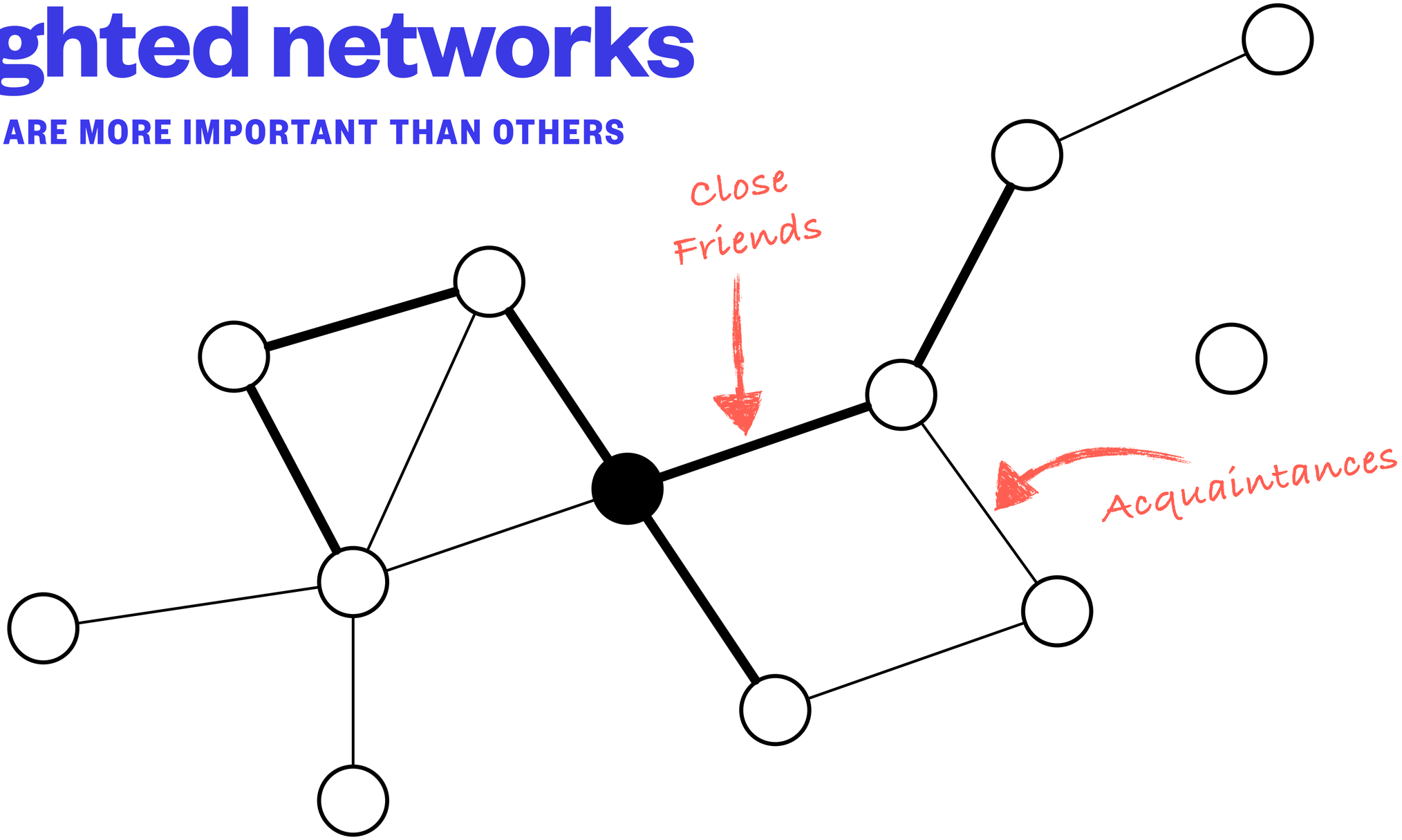
Directed networks

FRIENDSHIP NETWORK: I NAMED J, BUT DID J NAME I?



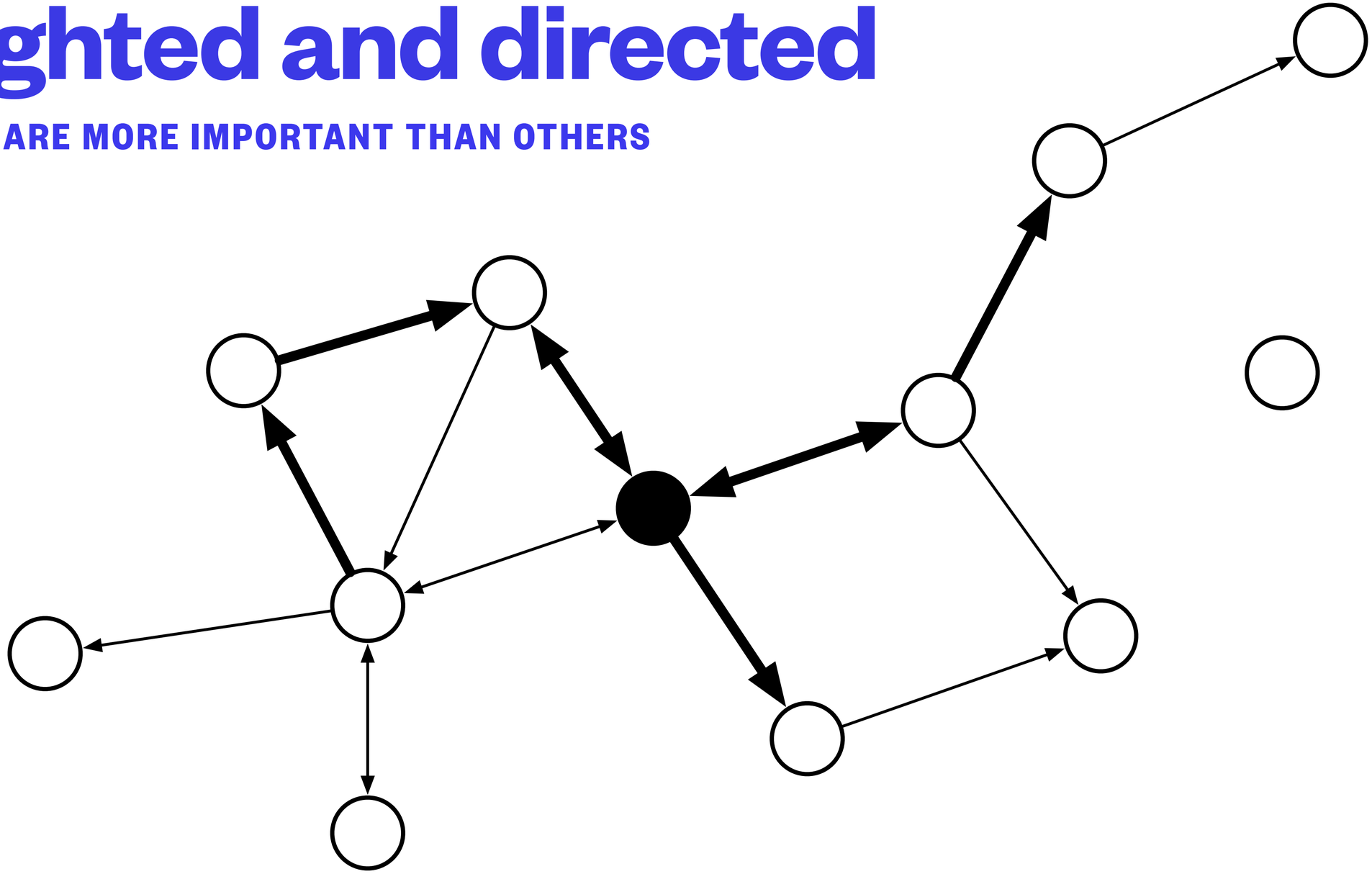
Weighted networks

SOME TIES ARE MORE IMPORTANT THAN OTHERS



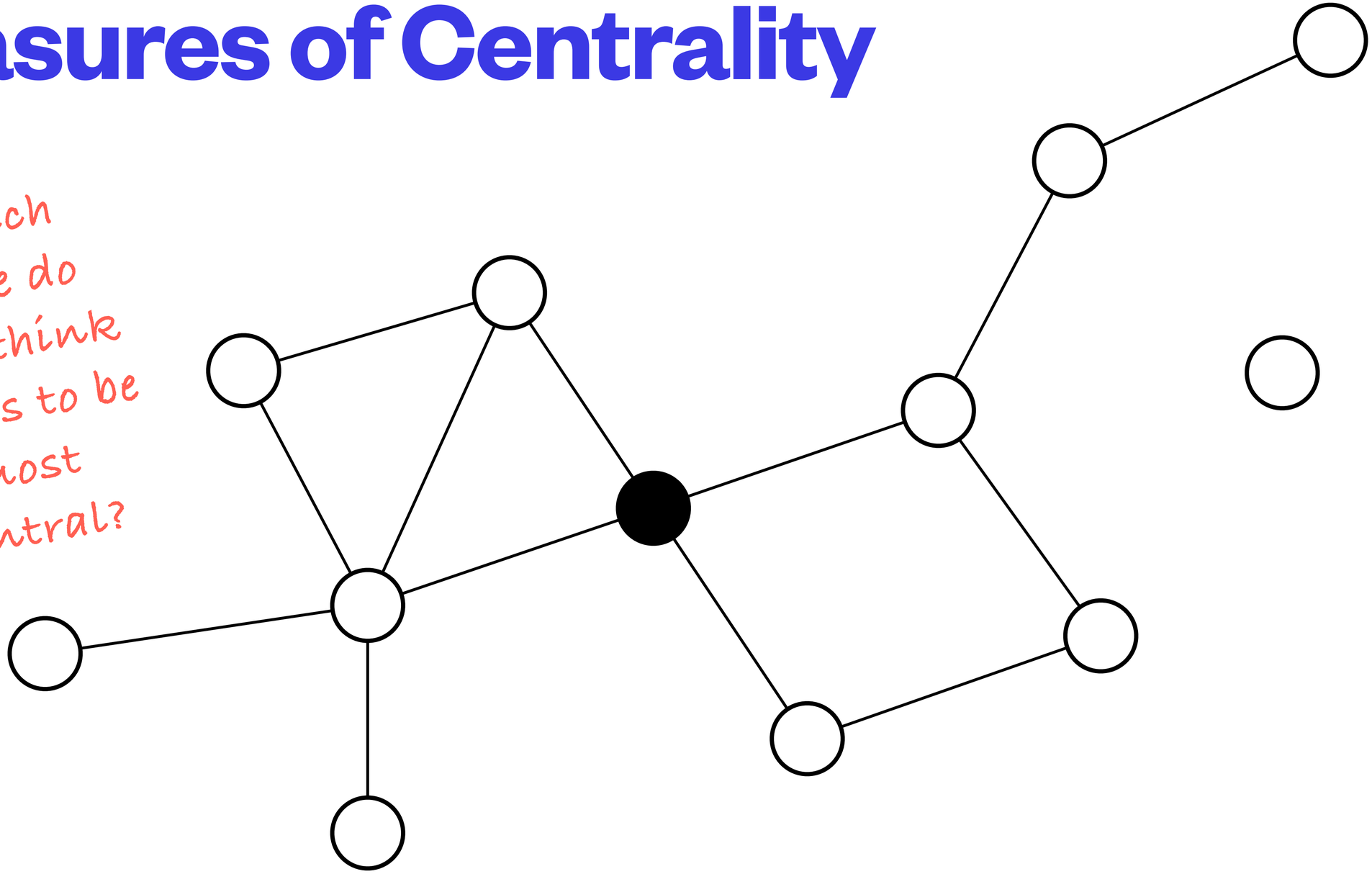
Weighted and directed

SOME TIES ARE MORE IMPORTANT THAN OTHERS



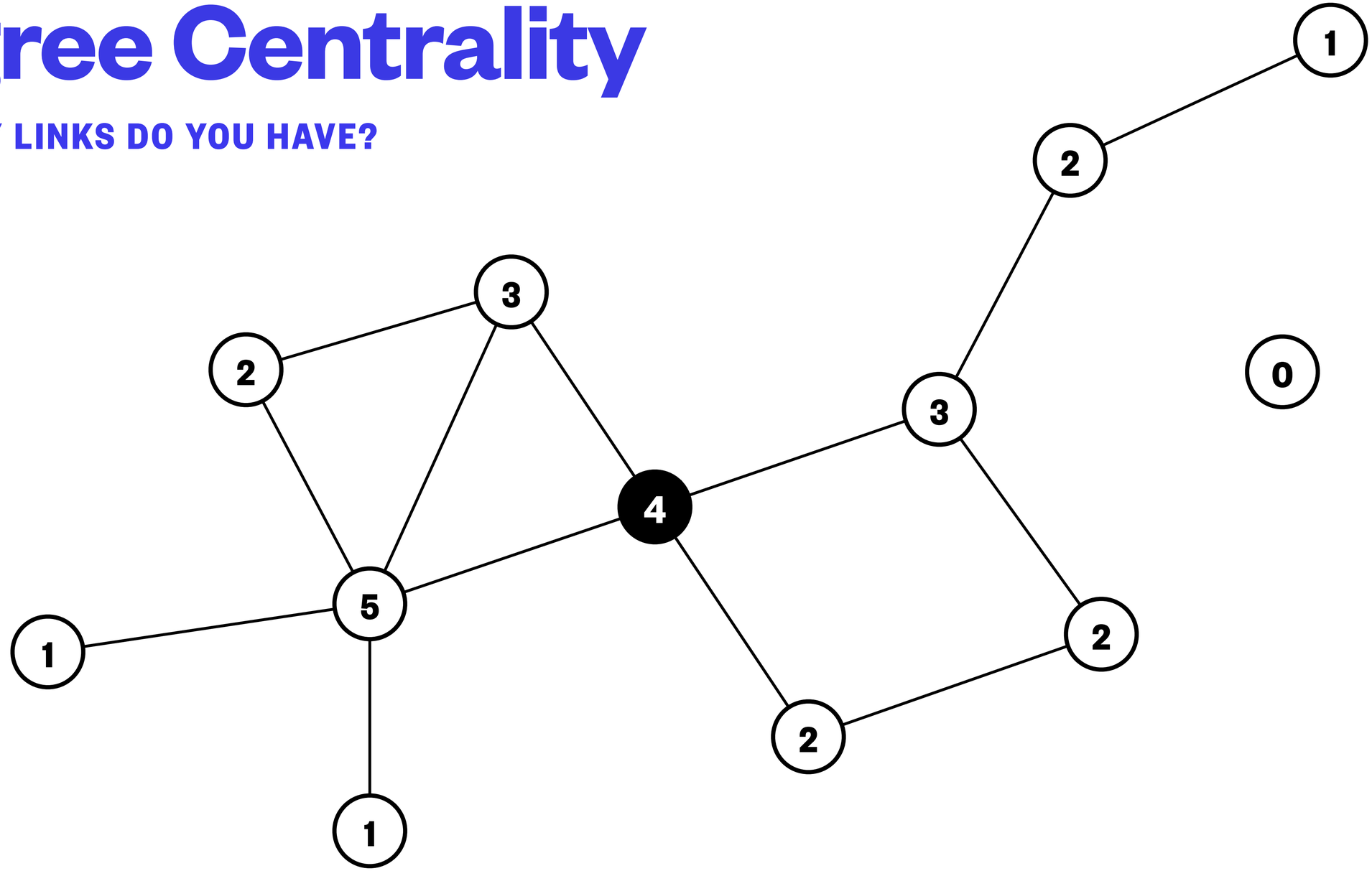
Measures of Centrality

which node do you think seems to be most central?



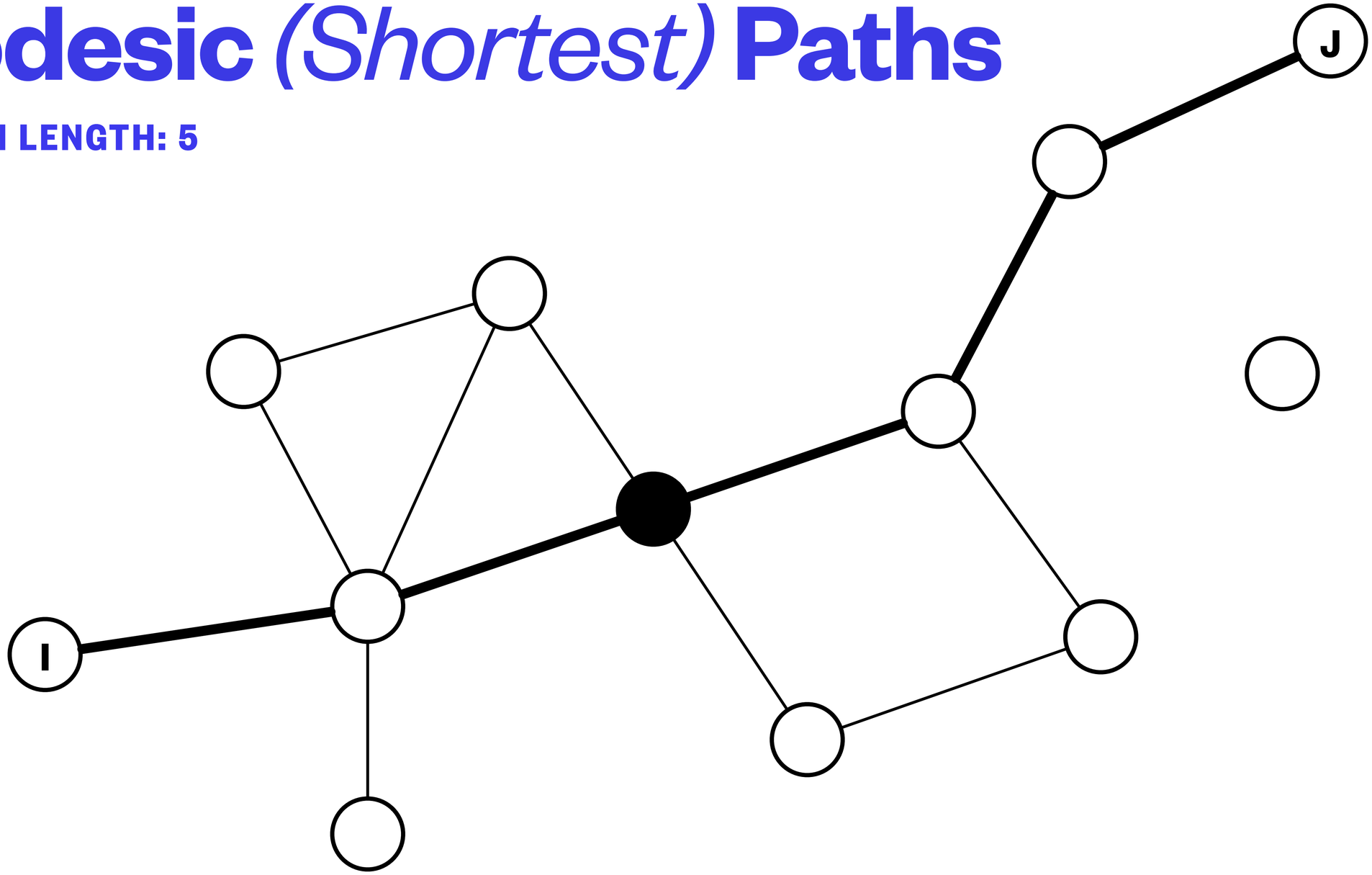
Degree Centrality

HOW MANY LINKS DO YOU HAVE?



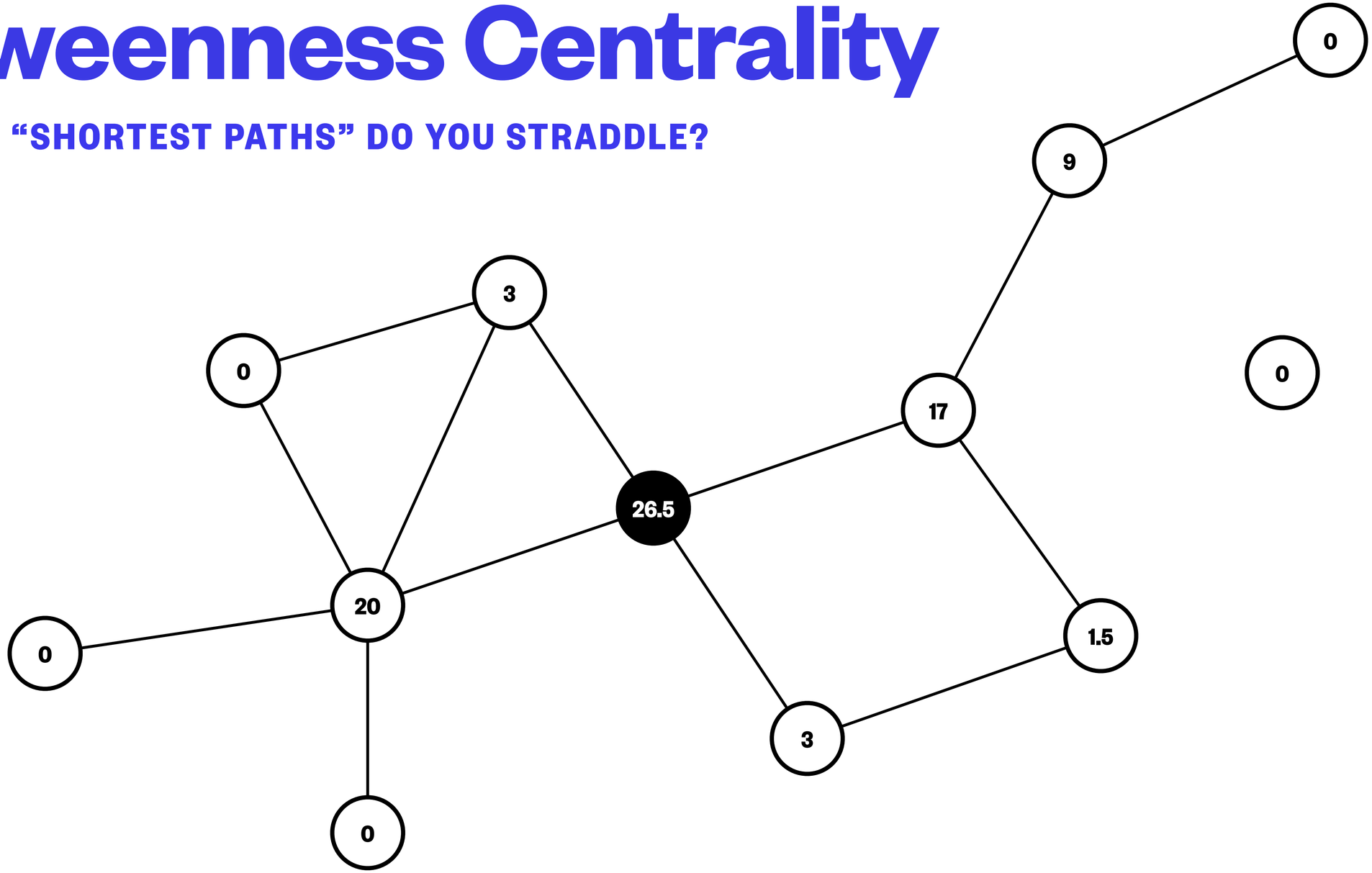
Geodesic *(Shortest)* Paths

I TO J PATH LENGTH: 5



Betweenness Centrality

HOW MANY “SHORTEST PATHS” DO YOU STRADDLE?



Networks language

- We now know how to talk about networks
  - Main elements (nodes, edges)
  - Core variations (direction, weight)
  - Descriptors of components (dyads, triads)
  - Basic statistics (degree, centrality)
- We’re ready

Part Three

How do we visualize networks?

Network Data

- The core element of a network is defining the **relationship(s) between the actors**
- Two main datasets to any network:
  - Data defining attributes of the **nodes**
  - Data defining attributes of the **edges**
- Let's motivate with a simple example: the network of agreement among members of the Supreme Court in the 2020-2021 term
  - https://harvardlawreview.org/supreme-court-statistics/

Node data: the node list

supreme_nodelist.csv

id	justice	abbrev	type	party	president	year	seniority
j01	Roberts	JR	Chief	Republican	Bush Jr	2005	16
j02	Thomas	CT	Associate	Republican	Bush Sr	1991	30
j03	Breyer	SB	Associate	Democrat	Clinton	1994	27
j04	Alito	SA	Associate	Republican	Bush Jr	2006	15
j05	Sotomayor	SS	Associate	Democrat	Obama	2009	12
j06	Kagan	EK	Associate	Democrat	Obama	2010	11
j07	Gorsuch	NG	Associate	Republican	Trump	2017	4
j08	Kavanaugh	BK	Associate	Republican	Trump	2018	3
j09	Barrett	ACB	Associate	Republican	Trump	2020	1

- A pretty ordinary looking dataset, similar to what we'd see in cross-sectional analysis
- Each row corresponds to a justice, each column corresponds to an attribute of the justice

Edge data: the edge list

supreme_edgelist.csv

from	to	type	weight
j01	j02	agreement	0.463
j01	j03	agreement	0.488
j01	j04	agreement	0.625
j01	j05	agreement	0.366
j01	j06	agreement	0.463
j01	j07	agreement	0.512
j01	j08	agreement	0.927
j01	j09	agreement	0.743
j02	j03	agreement	0.293
j02	j04	agreement	0.525
j02	j05	agreement	0.171
j02	j06	agreement	0.241

- Each row corresponds to an edge/link in the dataset
  - IDs link the node list and edge list
- Each column is an attribute of the edge
- This network is *undirected* (the agreement between j01 and j02 is the same as the agreement between j02 and j01)
  - Only a single row per relation
  - A *directed* network would have not just a j01-j02 row, but a j02-j01 row as well

More edge data: the adjacency matrix

supreme_adjacency.csv

	j01	j02	j03	j04	j05	j06	j07	j08	j09
j01	.	0.463	0.488	0.625	0.366	0.463	0.512	0.927	0.743
j02	.	.	0.293	0.525	0.171	0.341	0.707	0.488	0.600
j03	.	.	.	0.200	0.805	0.854	0.366	0.537	0.429
j04	.	.	.	.	0.125	0.175	0.600	0.600	0.588
j05	.	.	.	.	.	0.805	0.244	0.415	0.314
j06	.	.	.	.	.	.	0.415	0.512	0.486
j07	.	.	.	.	.	.	.	0.561	0.686
j08	.	.	.	.	.	.	.	.	0.800
j09	.	.	.	.	.	.	.	.	.

- Each cell corresponds to an edge/link in the dataset
  - The weight of each edge is given by the value of the cell
- This network is *undirected* (the agreement between j01 and j02 is the same as the agreement between j02 and j01)
  - Only a single cell per relation
  - A *directed* network would have not just a j01-j02 cell, but a j02-j01 cell as well
- Unlike an edge list, only one attribute per link

Using R (and iGraph) for Social Networks

- R's advantages:
  - Easily integrates with the rest of a data workflow
  - More programmatically flexible (for the programmatically inclined) than GUIs
  - Reproducible
  - Free!
- R's "disadvantages":
  - Needs to be scripted/programmed
  - Network visualization not built in; must use additional libraries, which themselves have different strengths and weaknesses
- **iGraph** vs. **Statnet**; assorted others for interactive and dynamic networks

Loading the data

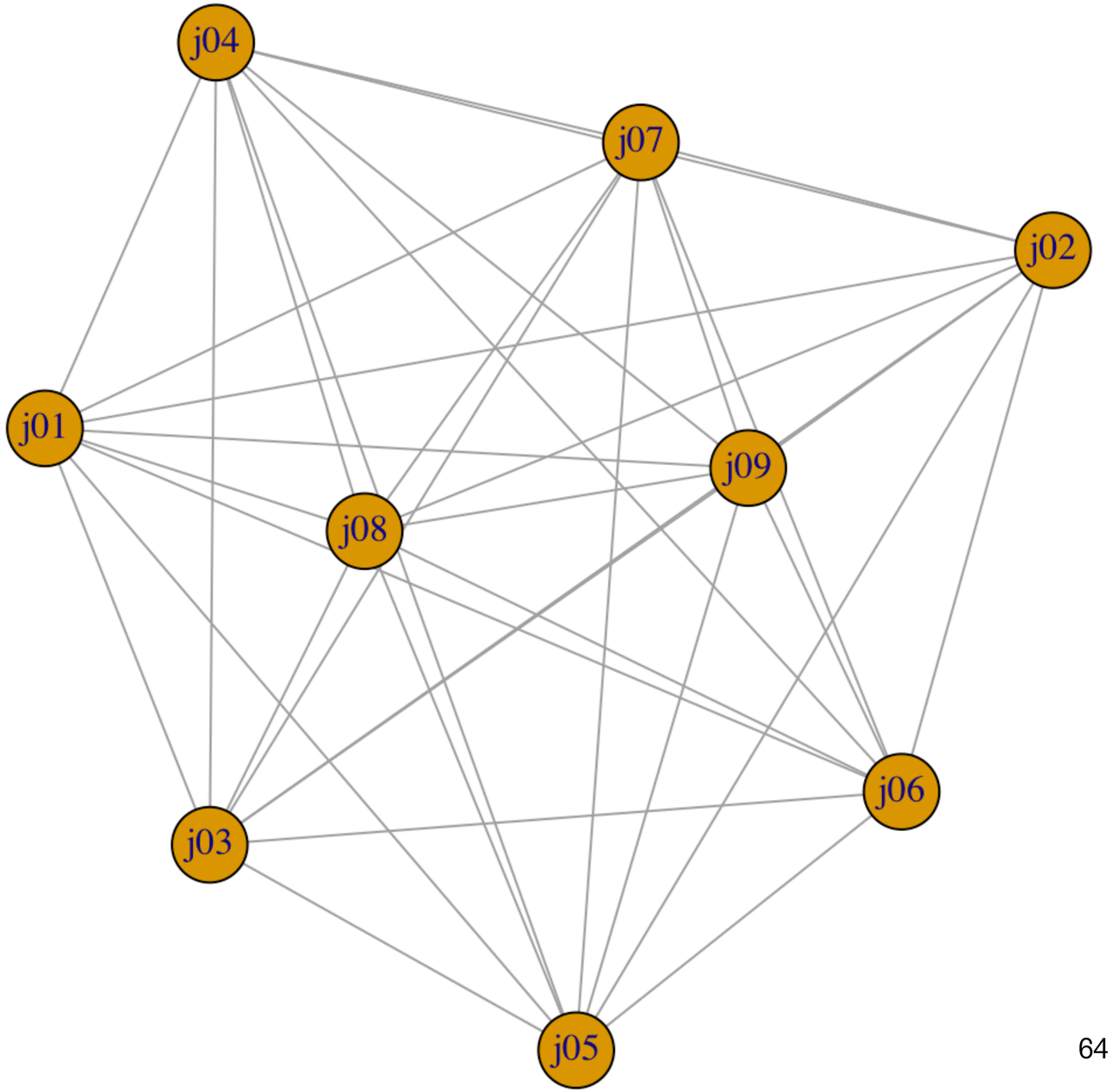
```
#Load library
library(“igraph”)

#Load nodelist and edgelist as objects
nodes <- read.csv("supreme_nodes.csv", header=T, as.is=T)
links <- read.csv("supreme_edgelist.csv", header=T, as.is=T)

#Convert to an iGraph network. “d” identifies the edgelist; “vertices” identifies the nodelist
net <- graph_from_data_frame(d=links, vertices=nodes, directed=F)

#If we want to output an adjacency matrix, we can
#(we just need to identify the attribute to encode)
adjacency<-as_adjacency_matrix(net, attr="weight")
```

Working with the data

Command	Usage
`E(net)`	Access the edges of the network
`V(net)`	Access the nodes of the network
`E(net)$weight`	Access a particular attribute (weight) of the edges of the network
`V(net)$seniority`	Access a particular attribute (seniority) of the nodes of the network
`V(net)[president==“Obama”]`	Returns all vertices with appointing president “Obama”
`E(net)[weight>.9]`	Returns all edges with weight greater than .9
`net[1,]`	Returns first row of network matrix
`net[5,7]`	Returns cell in the fifth row, seventh column
`plot.igraph(net)` ***or*** `plot(net)`	**Plots the network (!)**

plot.igraph(net)

- And . . . . ok, but, it's kind of . . .
  - uninspired
- What's wrong?
  - Links are overplotted
  - Links are undifferentiated
  - Node labels are uninspiring
  - Colors
- How should we fix it?

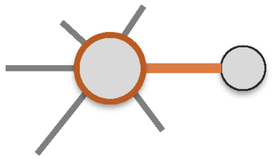


Graphics guidelines

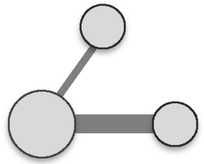
- Data does not speak for itself; visual attention must be properly drawn
- Like in regular graphics and visualization, plotting networks is a matter of taste
  - *Tastes can differ, but . . .*
- Healy (2020) identifies three common graphics challenges to consider as we set our visualization goals:
  - **Aesthetic**
  - **Substantive**
  - **Perceptual**

Network visualization goals

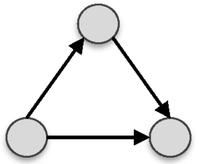
Key actors and links



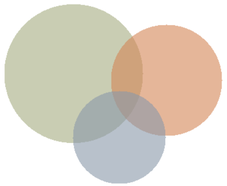
Relationship strength



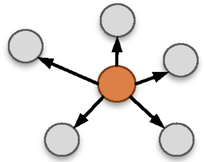
Structural properties



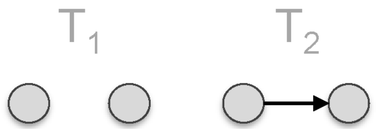
Communities



Diffusion patterns



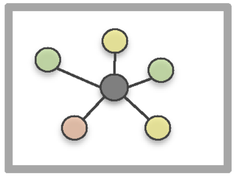
Network evolution



Networks as maps

Networks as persuasion

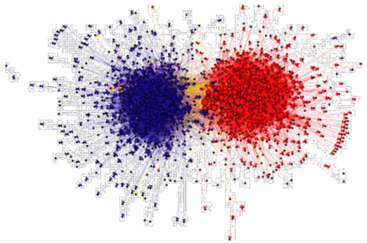
Networks as art



Ognyanova, K. (2021) Network visualization with R. Retrieved from www.kateto.net/network-visualization

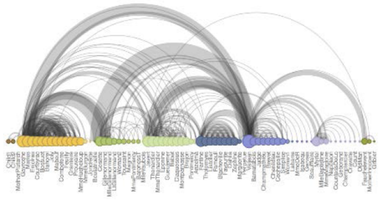
Some network visualization types

Network Maps

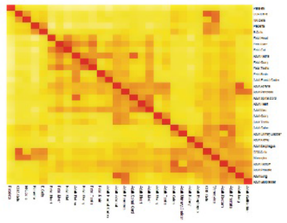


Statistical charts

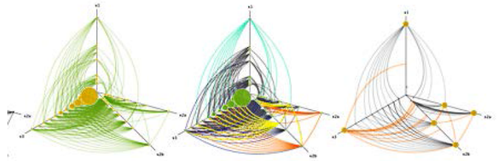
Arc diagrams



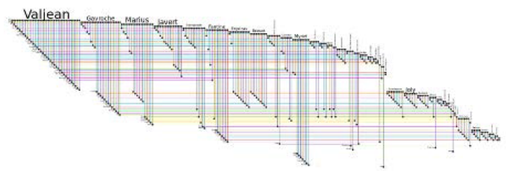
Heat maps



Hive plots

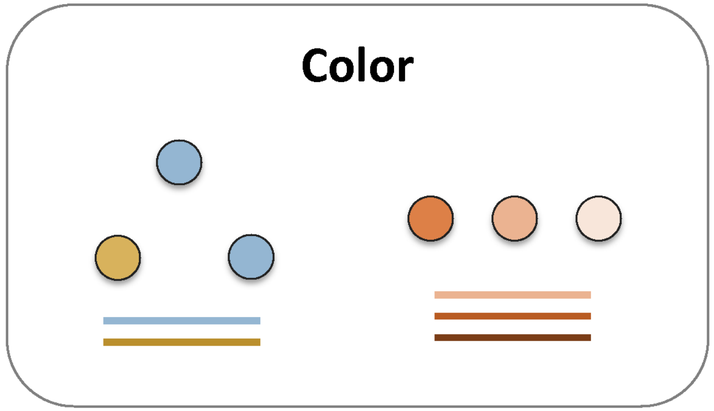


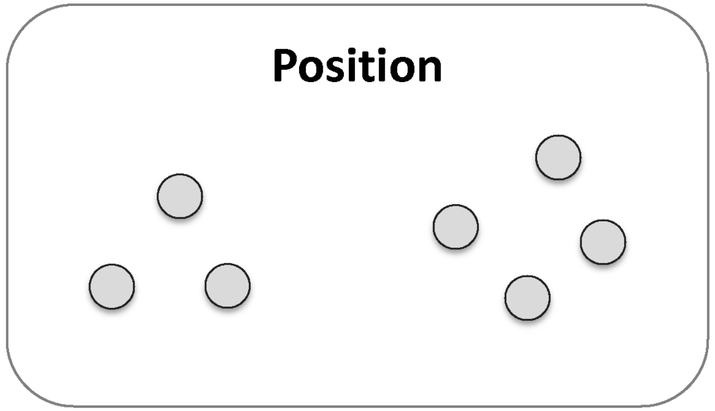
Biofabric

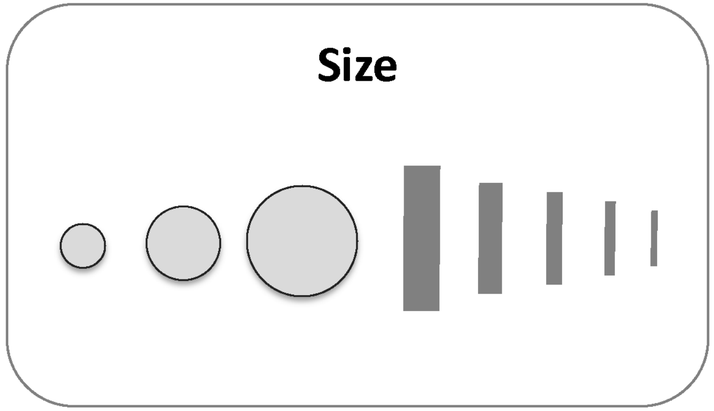


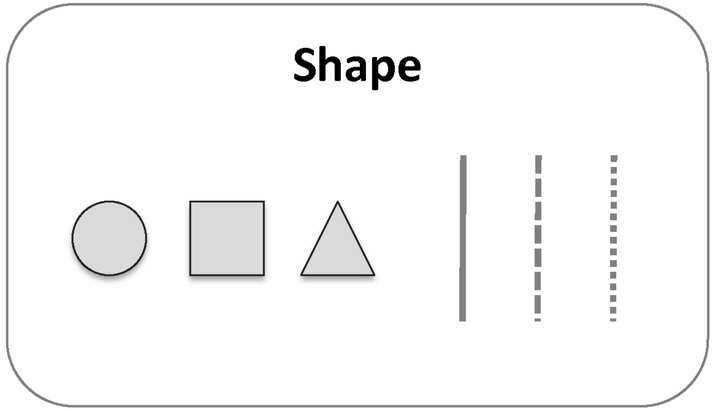
Ognyanova, K. (2021) Network visualization with R. Retrieved from www.kateto.net/network-visualization

Network visualization controls









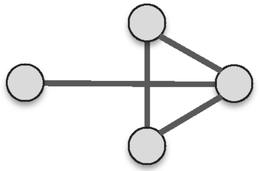
Honorable mention: arrows (direction) and labels (identification)

Ognyanova, K. (2021) Network visualization with R. Retrieved from www.kateto.net/network-visualization

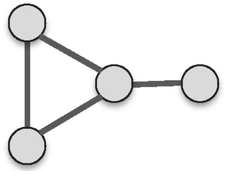
Layout aesthetics

Minimize edge crossing

No

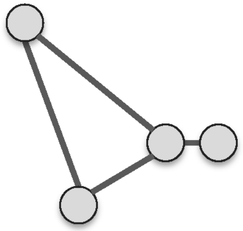


Yes

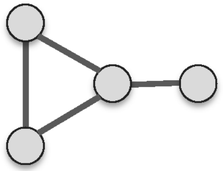


Uniform edge length

No

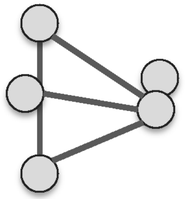


Yes

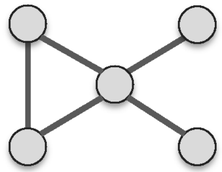


Prevent overlap

No

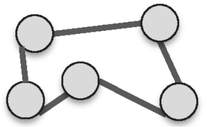


Yes

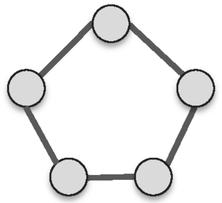


Symmetry

No



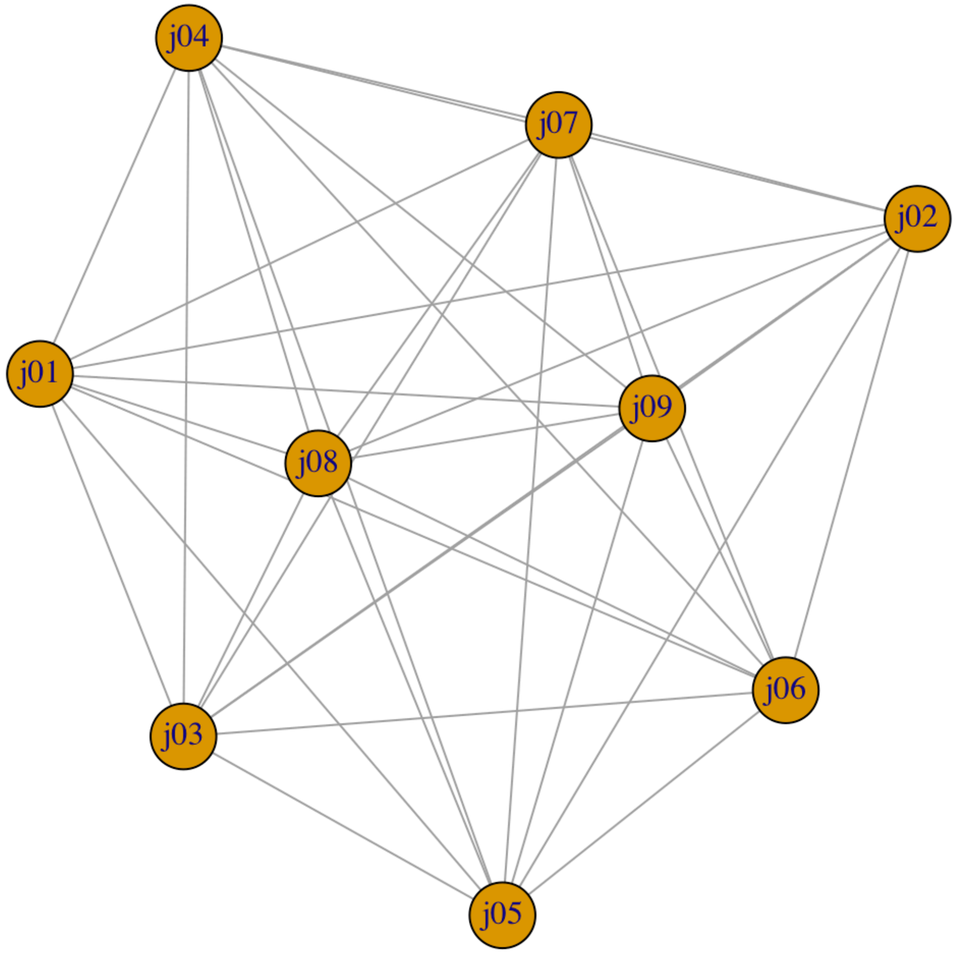
Yes



Ognyanova, K. (2021) Network visualization with R. Retrieved from www.kateto.net/network-visualization

Goals in the Supreme Court network

- Identify **who** the justices are
- Illustrate external **political factors** relevant to the Supreme Court
- Show who the most **central** (likely "decisive") justices are
- Show **agreement** and **disagreement** among the justices



Goals in the Supreme Court network

- Identify **who** the justices are → *Label the nodes*
- Illustrate external **political factors** relevant to the Supreme Court → *Color the nodes to show party of appointment*
- Show who the most **central** (likely "decisive") justices are → *Calculate centrality and illustrate it visually*
- Show **agreement** and **disagreement** among the justices → *Do something with the ties/edges - thickness and/or color*

Along the way, don't forget about other aesthetics: color, tie overlap, etc.

Controlling iGraph graphic elements

- Two ways of editing network graphs
  - Use parameters of the `plot.igraph` command
  - Write information about graphical attributes to the network object itself (that `plot.igraph` will then read)
- Command order and priority
  - Parameters of the plot.igraph command itself will overwrite information written into the network object

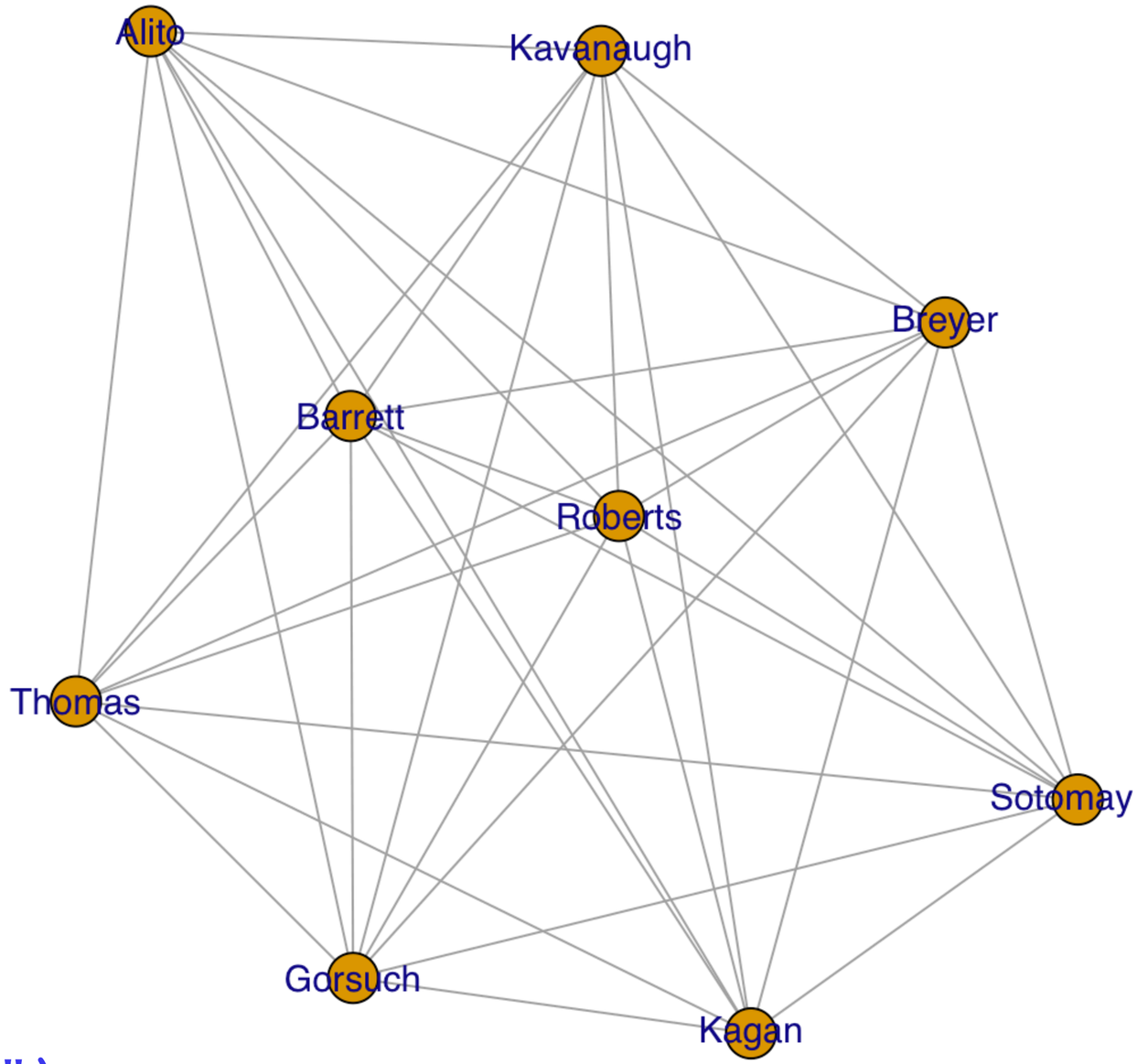
Plotting parameters

NODES	
vertex.color	Node color
vertex.frame.color	Node border color
vertex.shape	One of “none”, “circle”, “square”, “csquare”, “rectangle” “crectangle”, “vrectangle”, “pie”, “raster”, or “sphere”
vertex.size	Size of the node (default is 15)
vertex.size2	The second size of the node (e.g. for a rectangle)
vertex.label	Character vector used to label the nodes
vertex.label.family	Font family of the label (e.g.“Times”, “Helvetica”)
vertex.label.font	Font: 1 plain, 2 bold, 3, italic, 4 bold italic, 5 symbol
vertex.label.cex	Font size (multiplication factor, device-dependent)
vertex.label.dist	Distance between the label and the vertex
vertex.label.degree	The position of the label in relation to the vertex, where 0 is right, “pi” is left, “pi/2” is below, and “-pi/2” is above

Plotting parameters

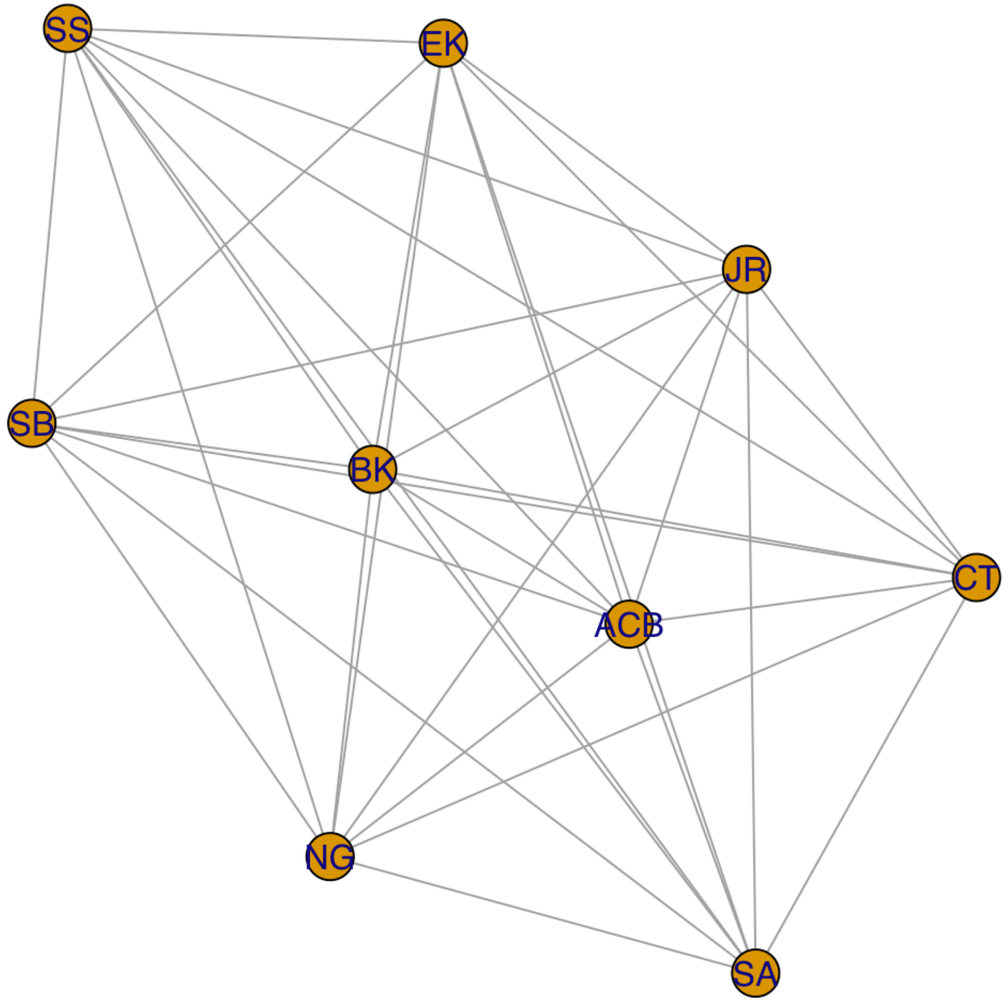
EDGES	
edge.color	Edge color
edge.width	Edge width, defaults to 1
edge.arrow.size	Arrow size, defaults to 1
edge.arrow.width	Arrow width, defaults to 1
edge.lty	Line type, could be 0 or “blank”, 1 or “solid”, 2 or “dashed”, 3 or “dotted”, 4 or “dotdash”, 5 or “longdash”, 6 or “twodash”
edge.label	Character vector used to label edges
edge.label.family	Font family of the label (e.g.“Times”, “Helvetica”)
edge.label.font	Font: 1 plain, 2 bold, 3, italic, 4 bold italic, 5 symbol
edge.label.cex	Font size for edge labels
edge.curved	Edge curvature, range 0-1 (FALSE sets it to 0, TRUE to 0.5)
arrow.mode	Vector specifying whether edges should have arrows, possible values: 0 no arrow, 1 back, 2 forward, 3 both

Label nodes



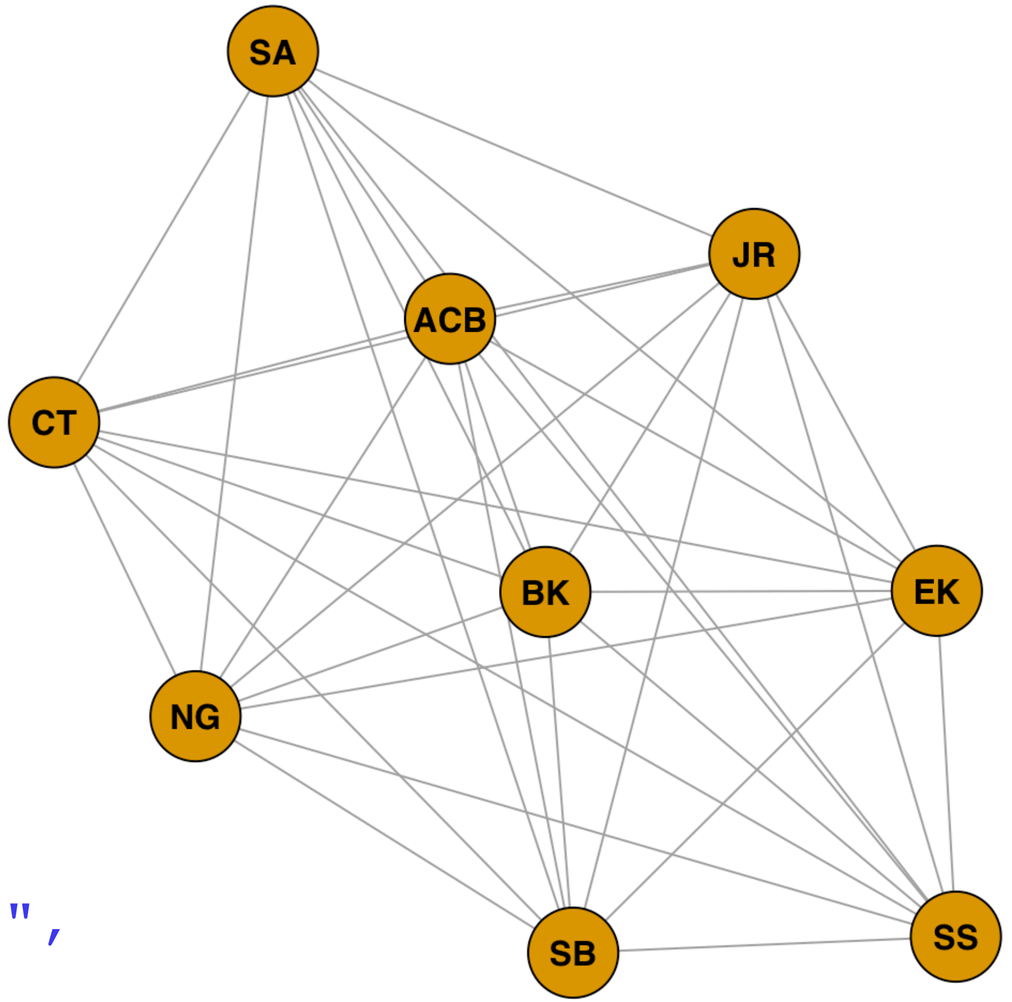

```
plot.igraph(net,
  vertex.label=V(net)$justice,
  vertex.label.family="Helvetica")
```

Label nodes



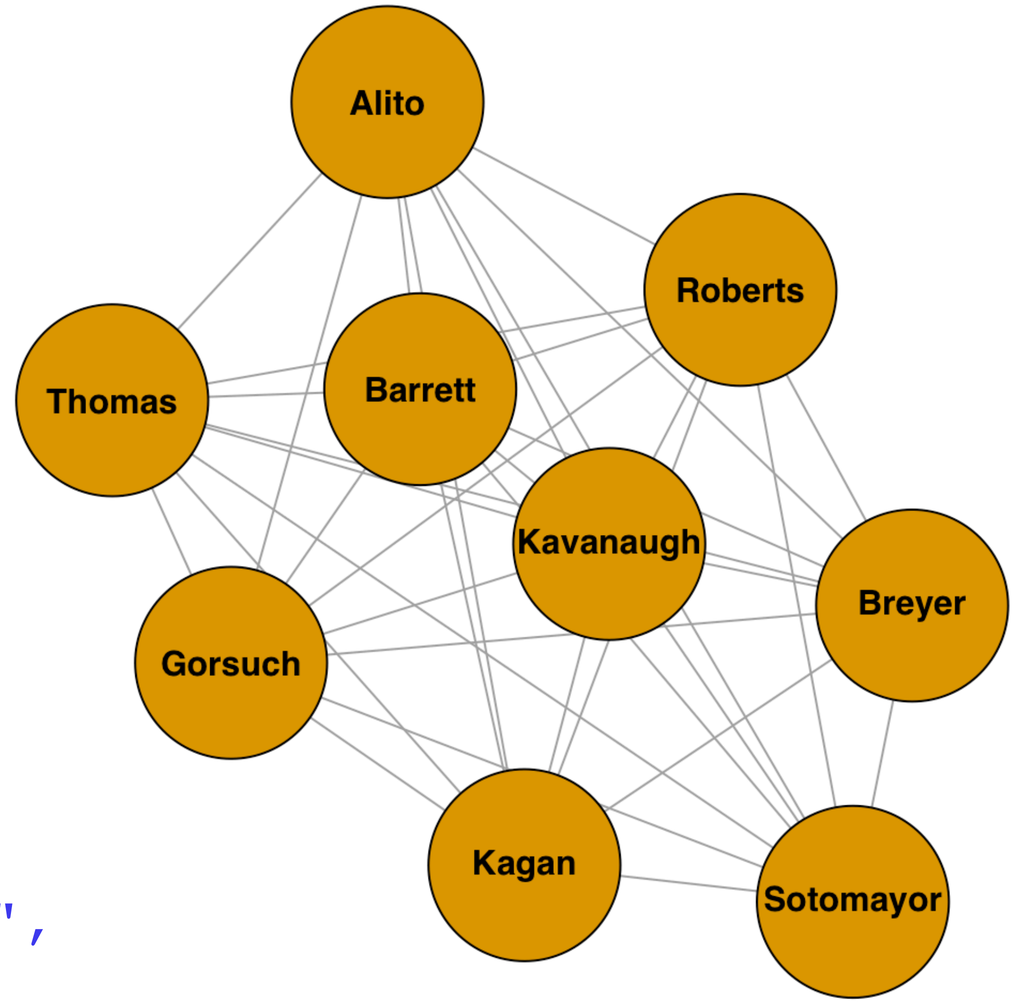

```
plot.igraph(net,
  vertex.label=V(net)$abbrev,
  vertex.label.family="Helvetica")
```

Label nodes




```
plot.igraph(net,
    vertex.label=V(net)$abbrev,
    vertex.label.family="Helvetica",
    vertex.label.font=2,
    vertex.label.color="black",
    vertex.size=20)
```

Label nodes

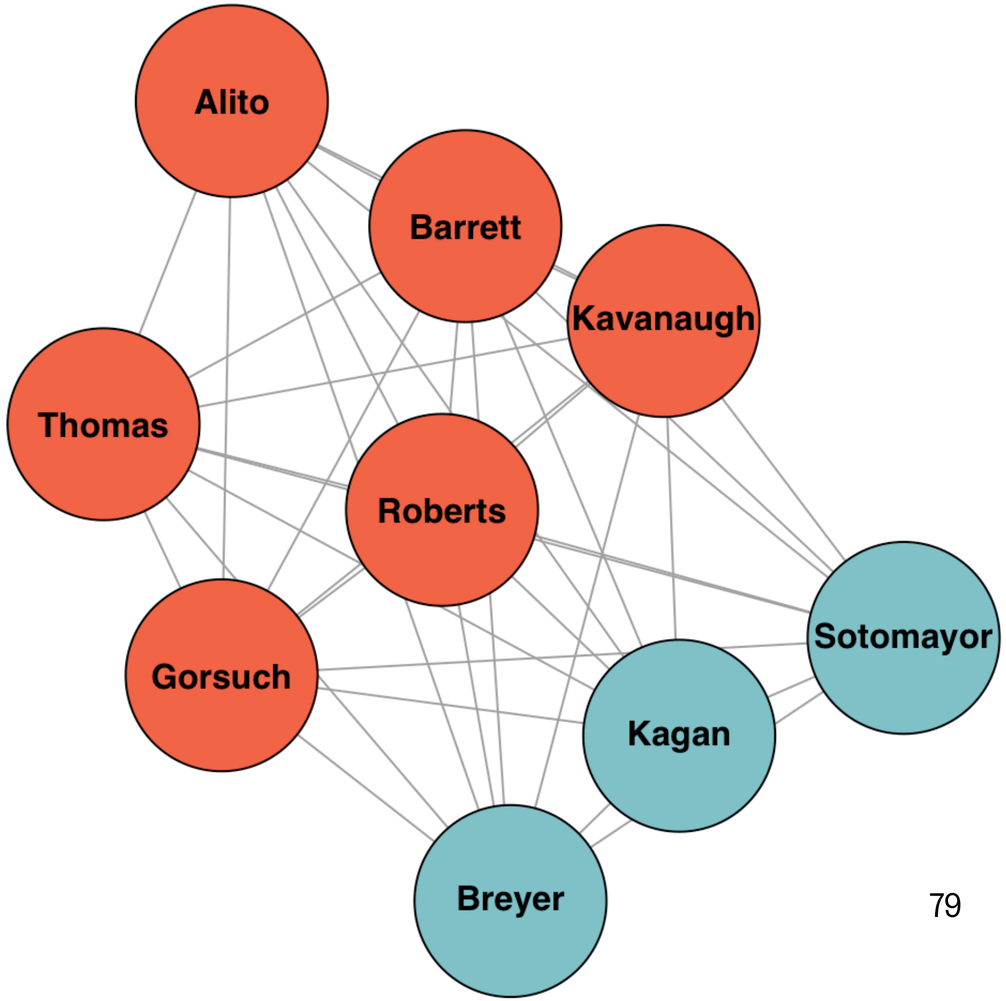



```
plot.igraph(net,
    vertex.label=V(net)$justice,
    vertex.label.family="Helvetica",
    vertex.label.font=2,
    vertex.label.color="black",
    vertex.size=48)
```

Color by appointment party

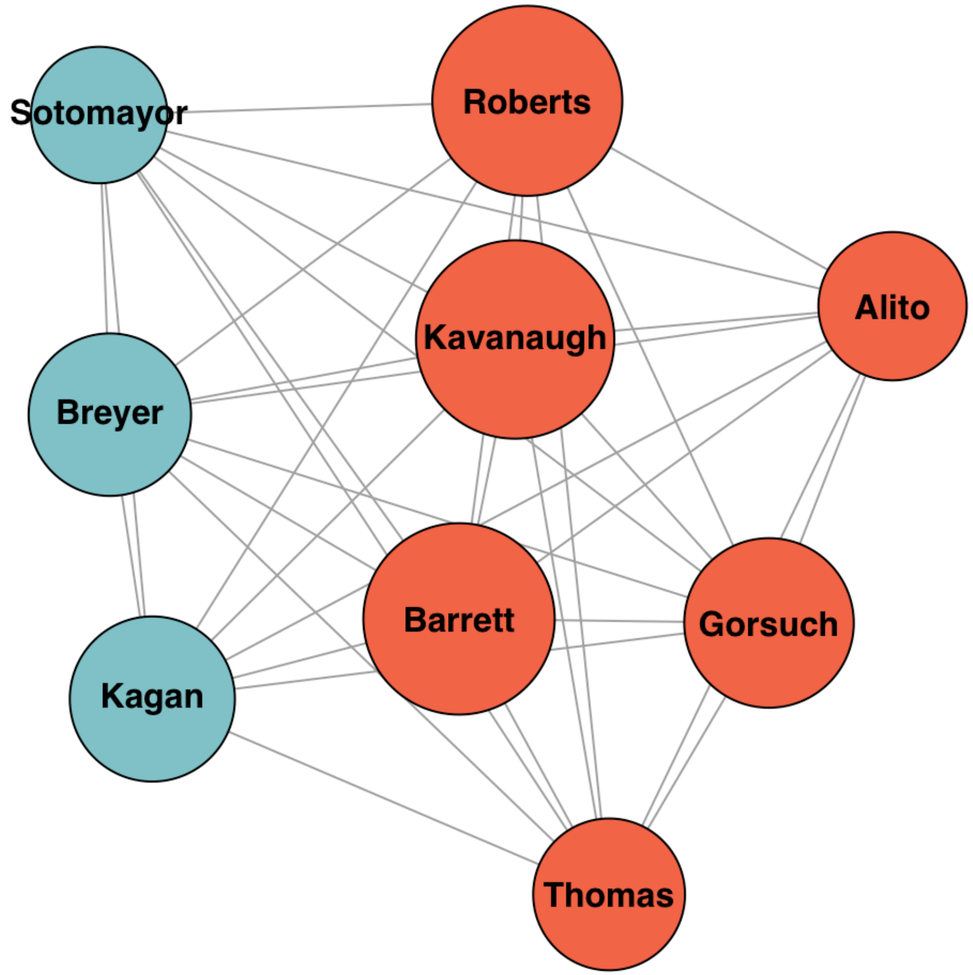
```
#Generate colors based on party and write into network:
V(net)$color <- ifelse(V(net)$party=="Republican","coral1","cadetblue3")

plot.igraph(net,
            vertex.label=V(net)$justice,
             vertex.label.family="Helvetica",
             vertex.label.font=2,
             vertex.label.color="black",
             vertex.size=48)
```

- Note that we no longer have to “keep” color in the main line of graph code, it’s “written in” to the network object itself



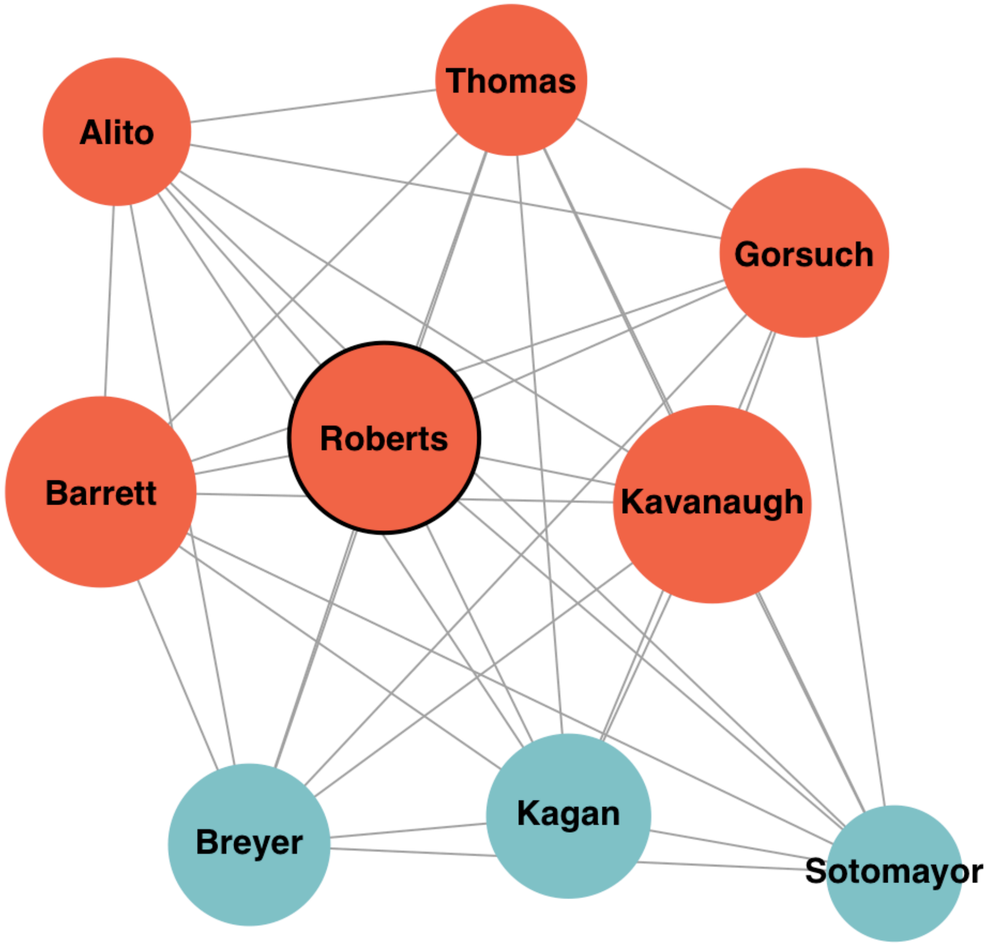
Scale nodes by centrality

```
V(net)$eigen<-evcent(net)$vector

plot.igraph(net,
  vertex.label=V(net)$justice,
  vertex.label.family="Helvetica",
  vertex.label.font=2,
  vertex.label.color="black",
  vertex.size=V(net)$eigen*50)
```



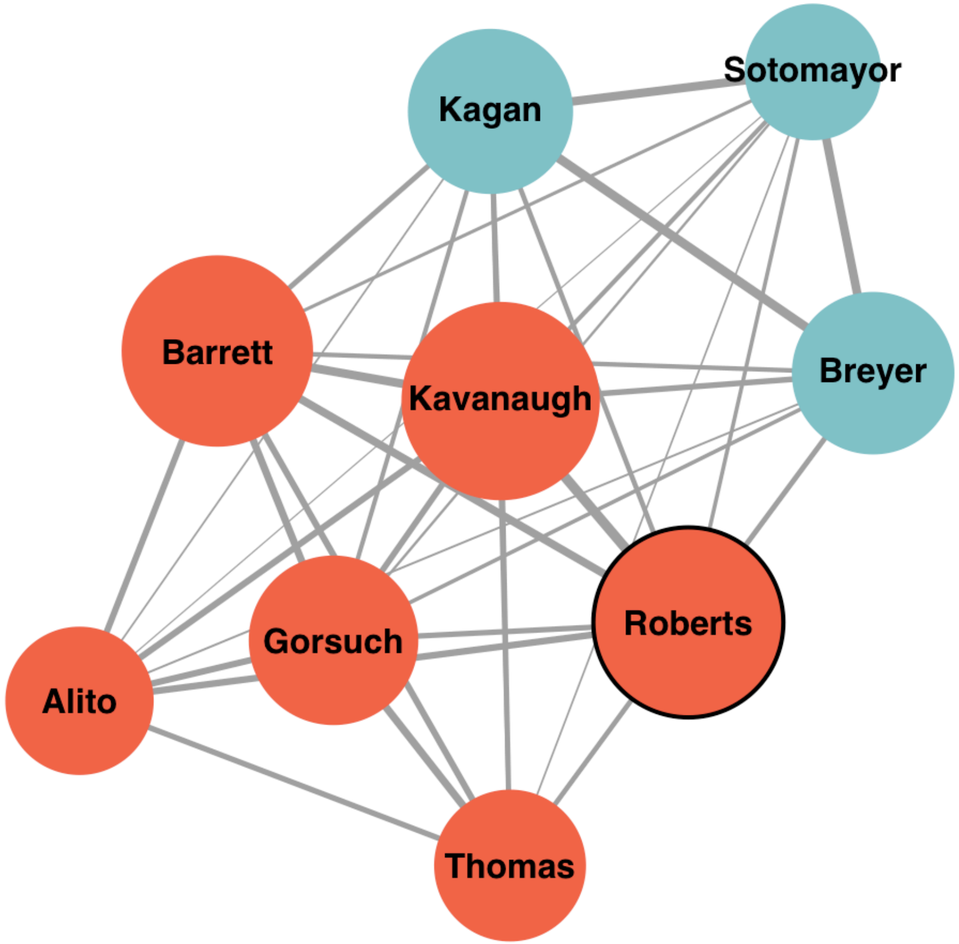
While we're at it

```
V(net)$width<-
  ifelse(V(net)$type=="Chief",2,1)

plot.igraph(net,
  vertex.label=V(net)$justice,
  vertex.label.family="Helvetica",
  vertex.label.font=2,
  vertex.label.color="black",
  vertex.size=V(net)$eigen*50,
  vertex.frame.width=V(net)$width)
```



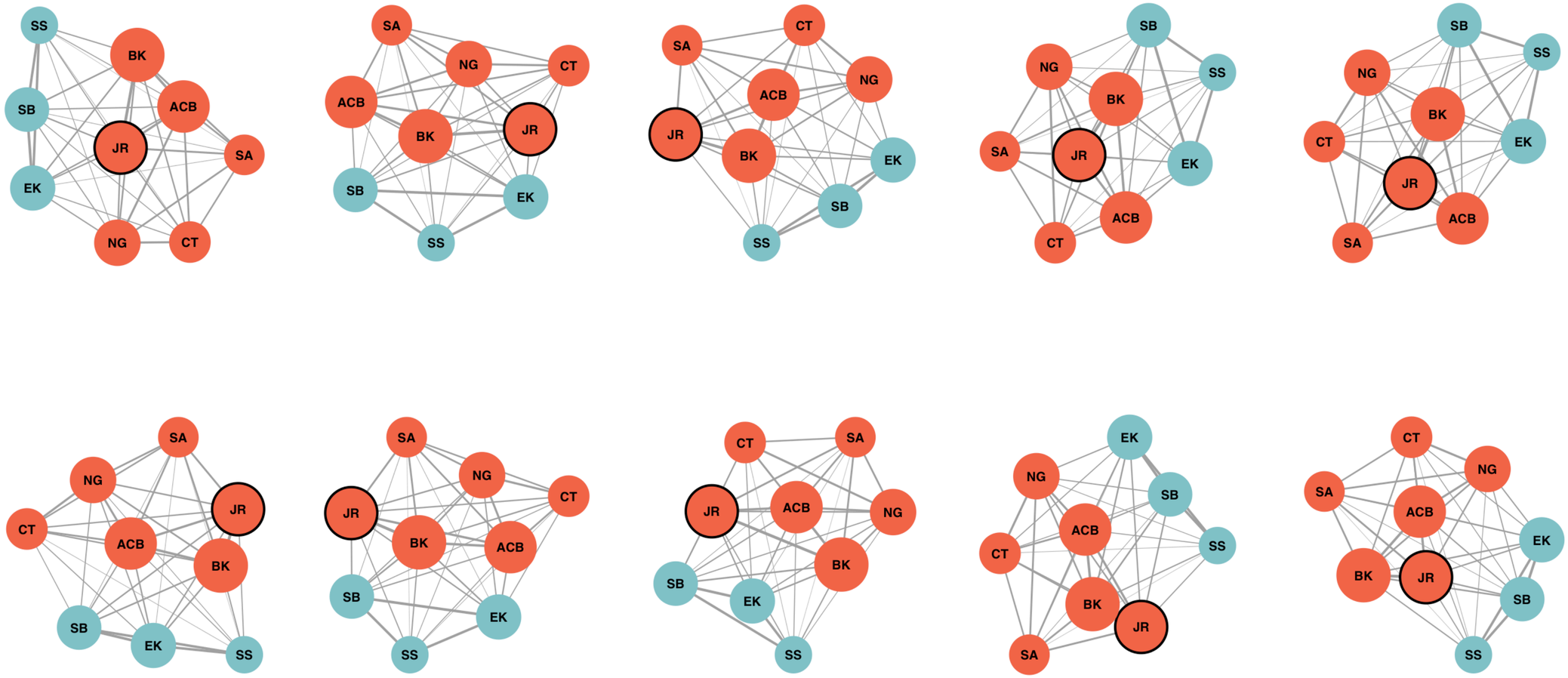
Finally: tie strength

```
plot.igraph(net,
  edge.width=E(net)$weight*5,
  vertex.label=V(net)$justice,
  vertex.label.family="Helvetica",
  vertex.label.font=2,
  vertex.label.color="black",
  vertex.size=V(net)$eigen*50,
  vertex.frame.width=V(net)$width)
```



Graph layouts

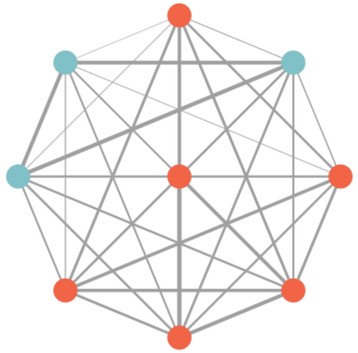
- iGraph generates layouts quasi-randomly within similar constraints; each time the network is drawn, the layout will look slightly different



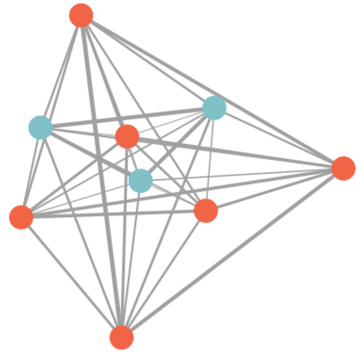
An assortment of network layouts

- We control with the **`layout`** option within **`plot.igraph`**

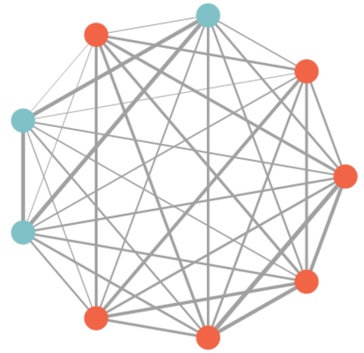
layout_as_star



layout_components



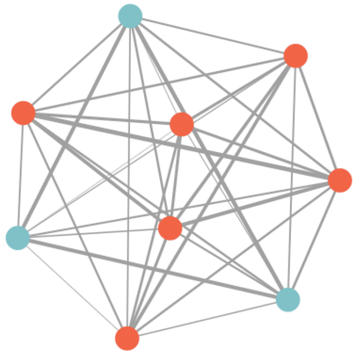
layout_in_circle



layout_with_fr

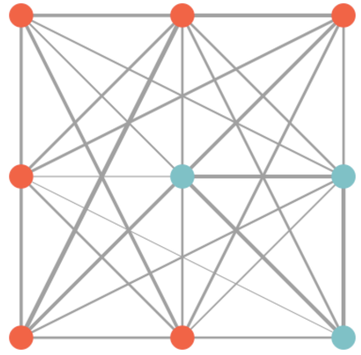
layout_with_gem

layout_with_graphopt

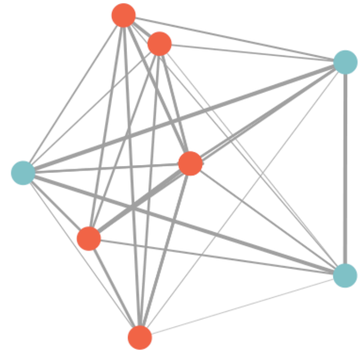


layout_nicely

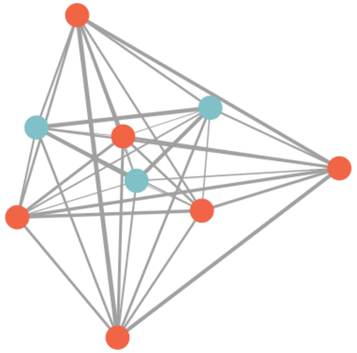
layout_on_grid



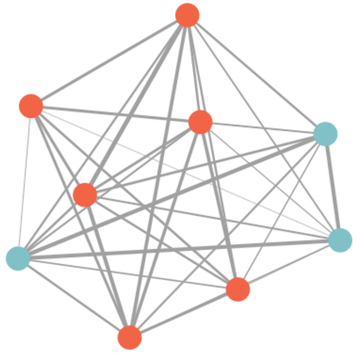
layout_on_sphere



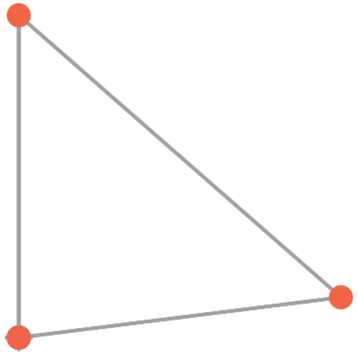
layout_with_kk



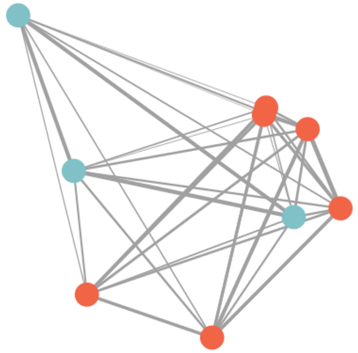
layout_with_lgl



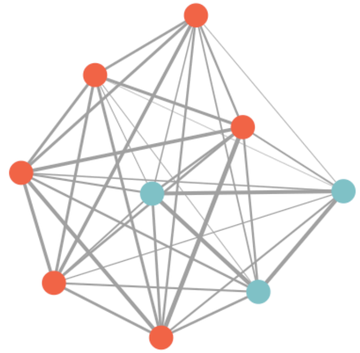
layout_with_mds



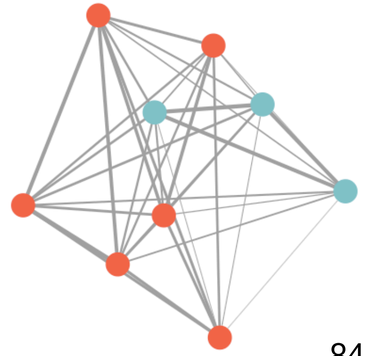
layout_randomly



layout_with_dh

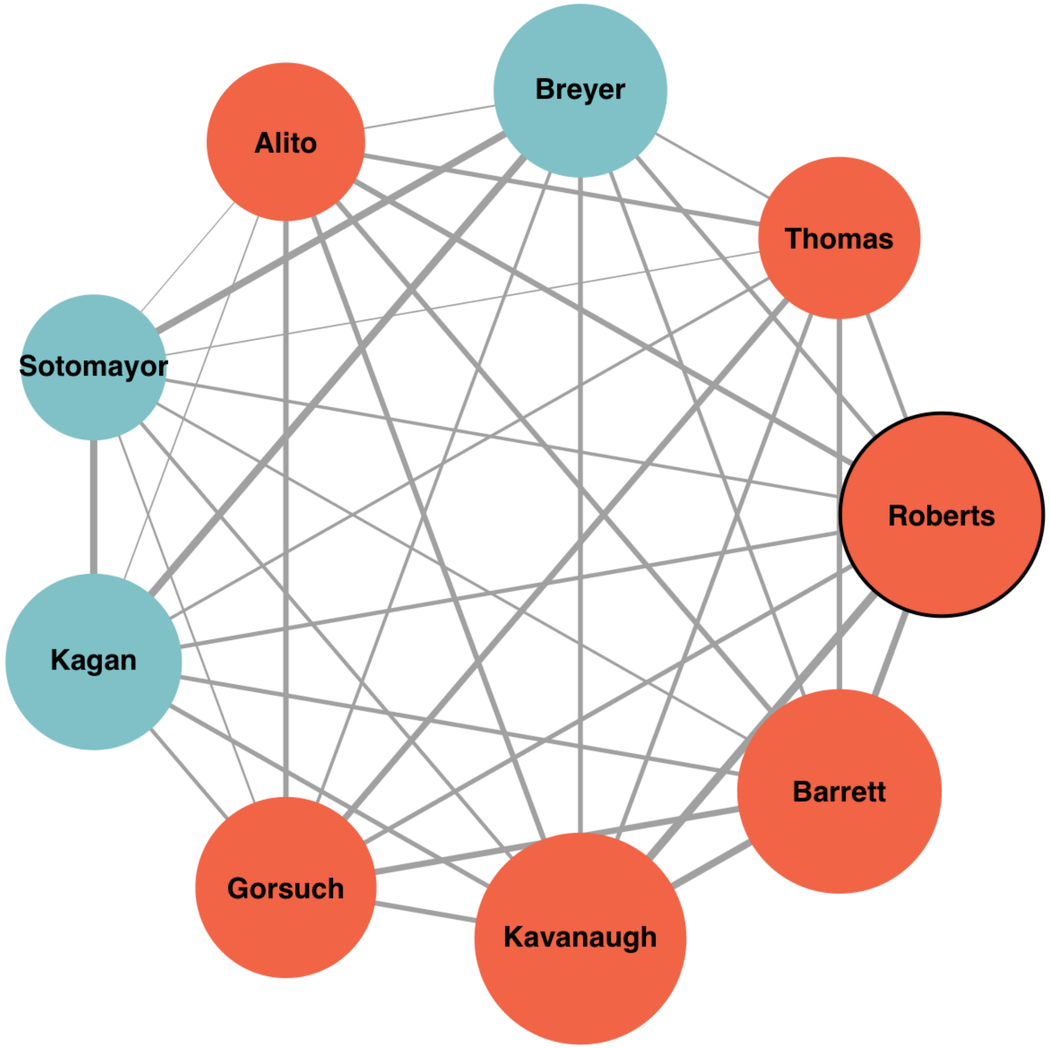


layout_with_drl



The circle layout

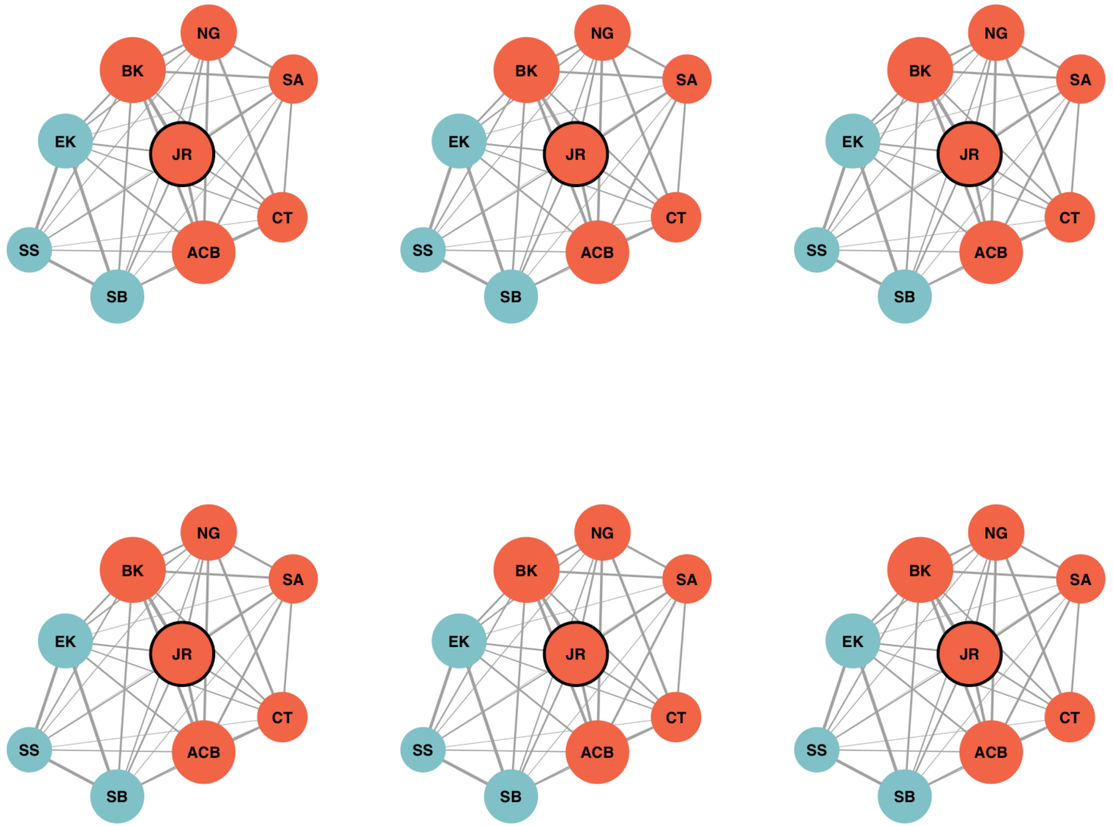
```
plot.igraph(net,
  edge.width=E(net)$weight*5,
  vertex.label=V(net)$justice,
  vertex.label.family="Helvetica",
  vertex.label.font=2,
  vertex.label.color="black",
  vertex.size=V(net)$eigen*50,
  vertex.frame.width=V(net)$width,
  layout=layout_in_circle)
```



Locking in layouts

- We can create and store a particular layout to use if we wish (in this case, a layout linked to tie strength), so that the graph appears the same every time

```
nice_layout <- layout_with_fr(net,
  weights=E(net)$weight)

plot.igraph(net,
  edge.width=E(net)$weight*5,
  vertex.label=V(net)$abbrev,
  vertex.label.family="Helvetica",
  vertex.label.font=2,
  vertex.label.color="black",
  vertex.size=V(net)$eigen*50,
  vertex.frame.width=V(net)$width,
  layout=nice_layout)
```



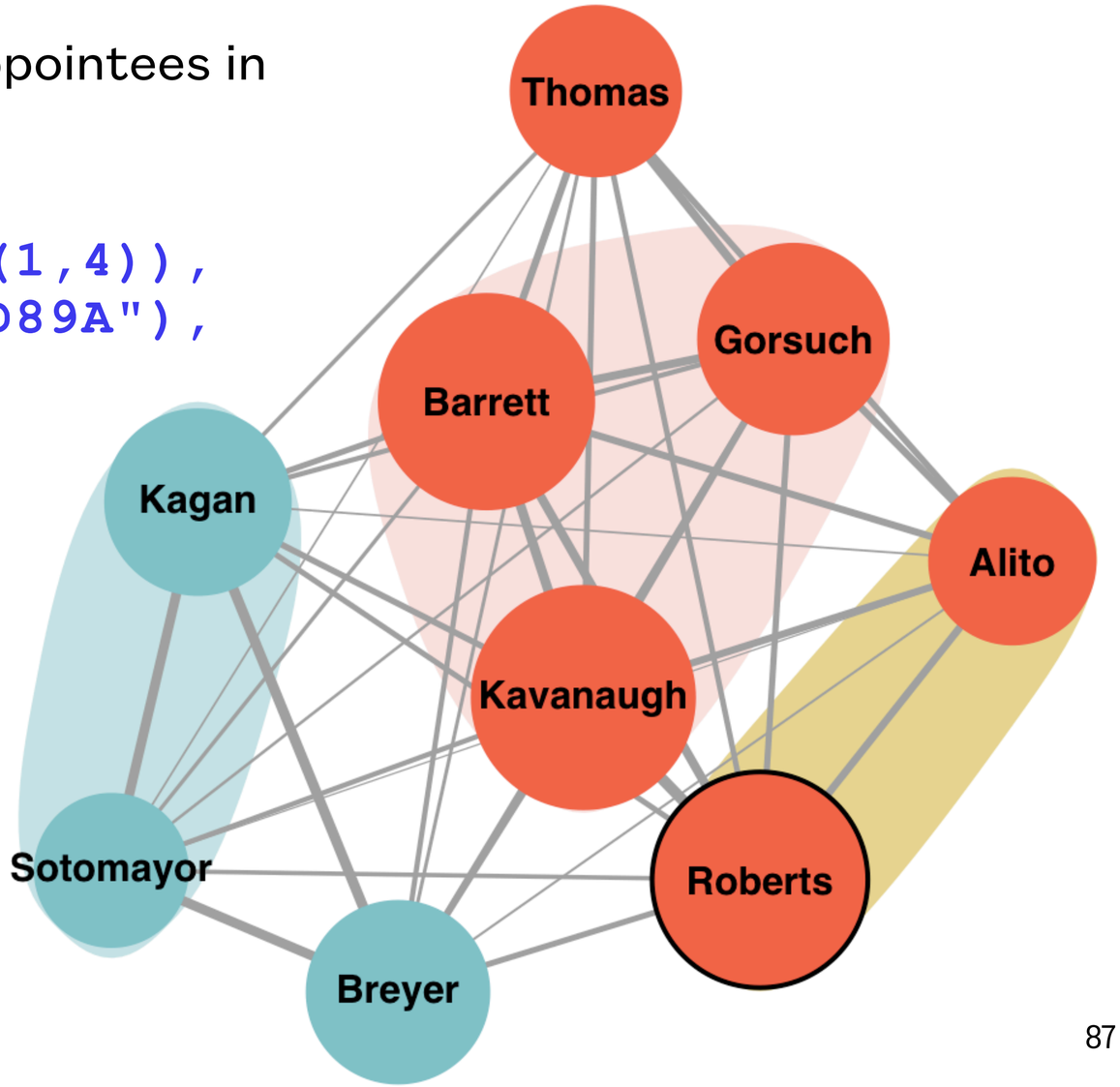
- And can store it to drive for next time

```
write.csv(nice_layout, "layout.csv")
nice_layout <- as.matrix(read.csv("layout.csv"))
```

Highlighting nodes

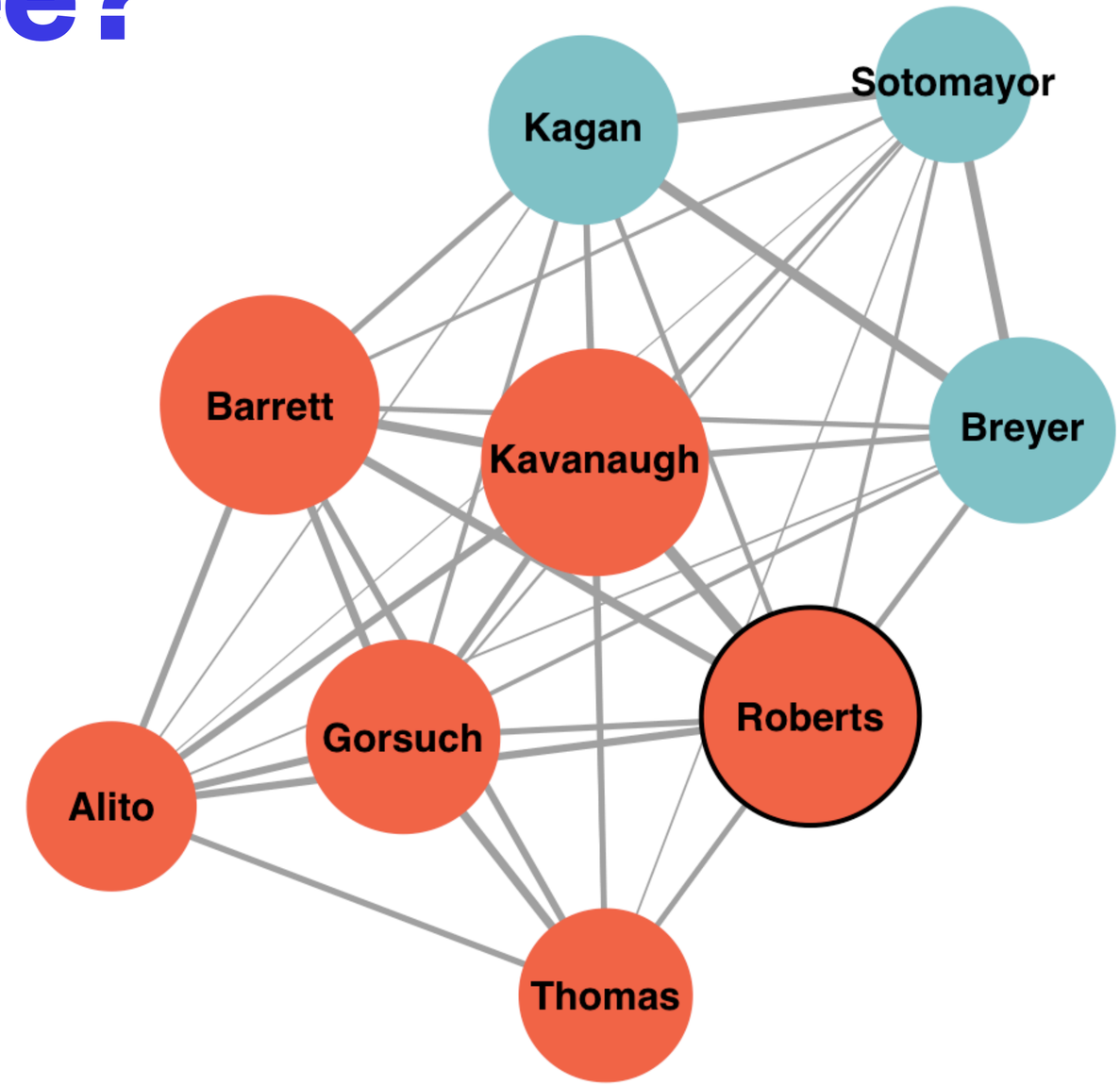
- Here, we highlight Trump, Obama, and Bush Jr. appointees in red, blue, and yellow, respectively.

```
plot.igraph(net,
  mark.groups=list(c(7,8,9), c(5,6), c(1,4)),
  mark.col=c("#FFE4E1","#C5E5E7", "#ECD89A"),
  mark.border=NA,
  edge.width=E(net)$weight*5,
  vertex.label=V(net)$justice,
  vertex.label.family="Helvetica",
  vertex.label.font=2,
  vertex.label.color="black",
  vertex.size=V(net)$eigen*50,
  vertex.frame.width=V(net)$width)
```



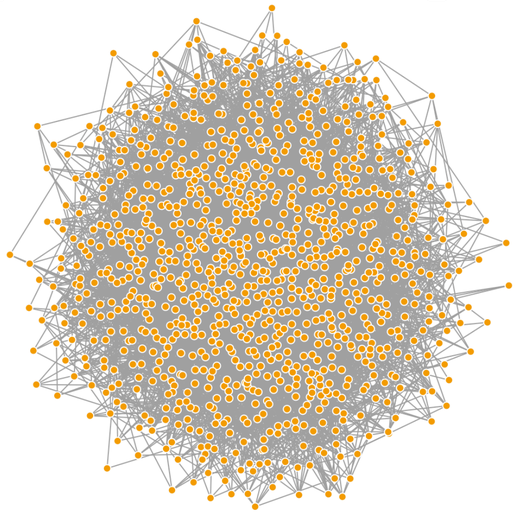
So what can we see?

- *Strong graphics present ready information quickly, at a glance*
  - *While rewarding further inspection with more detail*
- Centrality/importance (node size, graph position from layout tied to edge weights)
- Party (color)
- Tie strength (line width)
- Identities of justices



The example is just an example

- The Supreme Court is a nice (small, simple) network to begin with
- But the techniques here can be used for larger networks just as easily (albeit with things possibly slowing down as the scale and size of your network expands)
  - Larger networks bring different considerations:
    - Smaller (or no!) nodes between links
    - Focus on structure over individual elements
    - Easier to draw “hairballs”



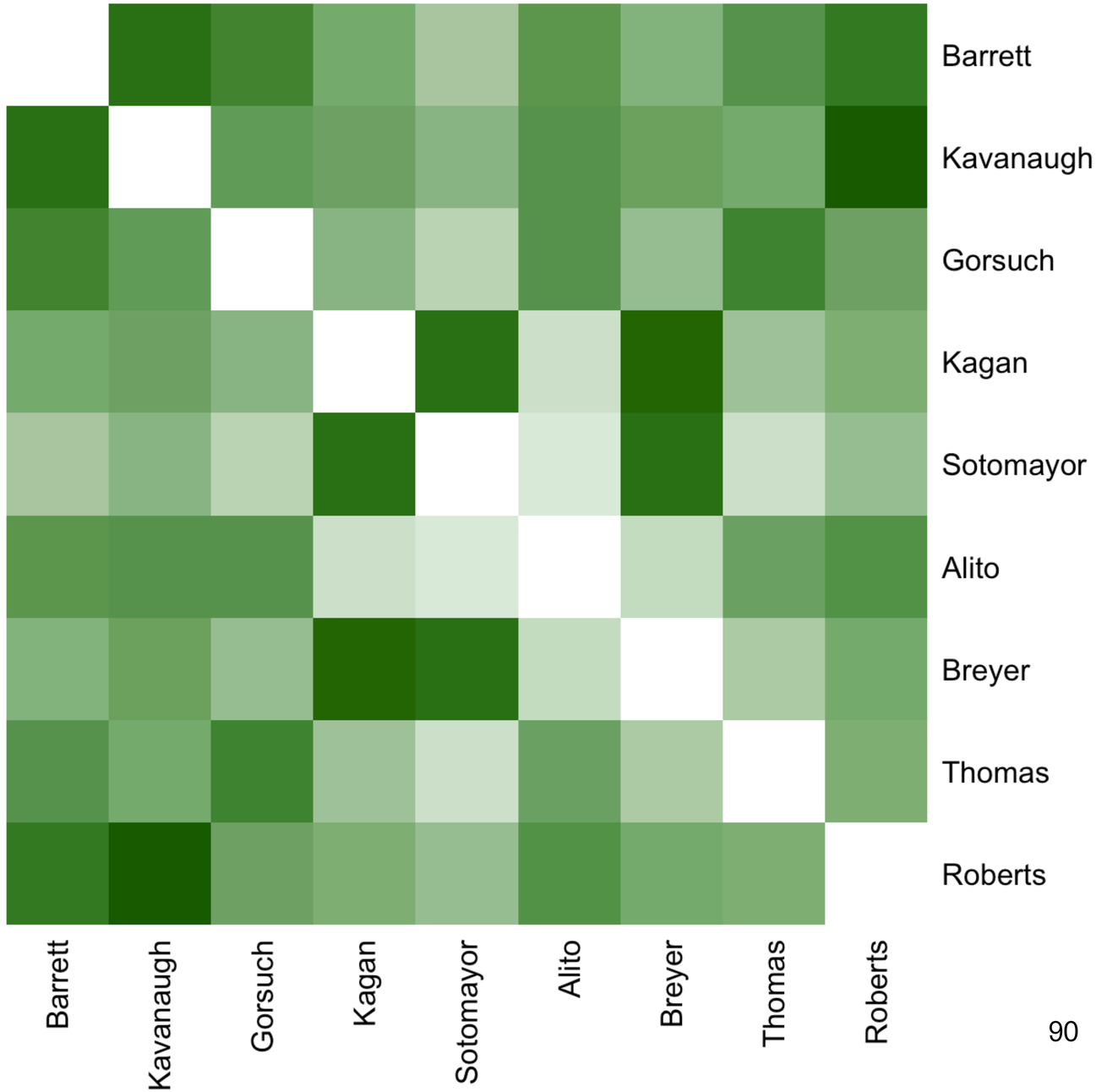
- Also, don’t let yourself be caught by thinking you *must* draw a network with network data

More than one

WAY TO VISUALIZE A NETWORK

- This is a heatmap of network agreement (note that it is symmetrical/undirected)

```
palf <-
  colorRampPalette(
  c("white", "darkgreen"))

netm <- get.adjacency(net,
  attr="weight", sparse=F)

colnames(netm) <- V(net)$justice
rownames(netm) <- V(net)$justice

heatmap(netm, Rowv = NA,
  Colv = NA, col = palf(100),
 scale="none", margins=c(10,10) )
```



Part Four

Wrapping up: where do I go from here?

Alternatives to R

- Programmatic
  - Python's **NetworkX** library (and iGraph again)
  - Julia's **JuliaGraphs** library
- GUIs
  - UCI-NET
  - SocNetV
  - Gephi
  - Cytoscape
  - Pajek
  - GraphVis

Resources

- Materials from this lecture (slides, data, code): https://jacklreilly.github.io/networkscrashcourse
- Core references in these slides
  - Ognyanova, K. (2021) Network visualization with R. Retrieved from www.kateto.net/network-visualization.
  - Healy, K. (2018) Data Visualization: A Practical Introduction. Princeton. (Also available: socviz.co.)
- Other books
  - The classic: Wasserman and Faust, 1994. *Social Network Analysis.*
  - The modern classic: Jackson, 2010. *Social and Economic Networks.*
  - For undergraduate courses: Scott, 2017. *Social Network Analysis.*
  - More formal: Menczer, Fortunato, and Davis, 2020. *A First Course in Network Analysis.*

Teaching in context

WHERE DOES THIS FIT?

- Not an exhaustive overview of networks, of course
- Placed in a course, this content would be different in a few ways
  - Interspersed with hands-on R workshops
  - In undergraduate classes, include active learning (with yarn!)
- Where would this fit in a class?
  - This is a more concentrated dose of presentations I do in my current advanced undergraduate course on social networks
  - Normally, it would be divided more (not covering data and visualization together, for one)

Teaching in context

- What would come around this?
  - Depends - social networks exists at the cross-section of methodology and substance
    - In a more substantive course, reading substantive applications goes hand-in-hand with learning core elements of network data, description, and visualization
    - In a more methodologically focused course, this would precede a deeper discussion of proper network analysis: network formation, blockmodels and community detection, contagion and influence, and eventually, models for inference (ERGMs)
    - It might be done with intro to R content at the beginning, as well

Thank you!

Materials: https://jacklreilly.github.io/networkscrashcourse

Contact: jreilly@ncf.edu

Questions?