CS6210: PA1

Abhishek Yadav

February 28, 2015

1 Question

Graph is created from co-authorship records available at `http://dblp.uni-trier.de/db/`. Other steps regarding the structure of the graph have been followed as given on moodle. And to extract the data in correct format to create the graph, I wrote scripts attached with the code. Final output of the script is of the form **'researcher1 researcher2' and so on..** which is written to a file. Final graph contains 1273 nodes and 1354 edges.

2 Question

(a) there are 4 connected components in the graph, each with nodes:
component1: 'John Augustine'
component2: 'V. Krishna Nandivada'
component3: 'Chester Rebeiro'
component4: 'S. V. Raghavan', 'Sukhendu Das', 'Sayan Ranu', 'C. Pandu Rangan', 'Deepak Khemani', 'Shankar Balachandran', 'C. Chandra Sekhar', 'B. V. Raghavendra Rao', 'P. Sreenivasa Kumar', 'Anurag Mittal', 'N. S. Narayanaswamy', 'T. A. Gonsalves', 'Rajsekar Manokaran', 'Jayalal Sarma', 'C. Siva Ram Murthy', 'Krishna M. Sivalingam', 'Hema A. Murthy', 'Sutanu Chakraborti', 'B. Ravindran', 'Rupesh Nasre', 'Madhu Mutyam', 'V. Kamakoti', 'Meghana Nasre', 'D. Janakiram'

(b) Diameters of the connected components are: 2 2 2 8

(c) Closeness Centrality of top 10% nodes are:
(C. Pandu Rangan, 0.340069), (V. Kamakoti, 0.338043), (B. Ravindran, 0.302644), (Kamala Krithivasan, 0.292384), (C. Siva Ram Murthy, 0.288395), (N. S. Narayanaswamy, 0.285341), (N. S. Janaki Latha, 0.281541), (K. Srinathan, 0.281541), (Thomas Graf, 0.281541), (P. Jagan Mohan, 0.281541), (K. Arvind, 0.281541), (Sukhendu Das, 0.278991), (Sriram Raghavan, 0.276061), (Arpita Patra, 0.270655), (Deepak Khemani, 0.265391), (Anand Kumar, 0.261973), (Ramesh Govindan, 0.261148), (R. Manimegalai, 0.260454), (Venkatesh Raman, 0.259889), (D. Bhatia, 0.258023), (E. Siva Soumya,

0.258023), (V. Muralidharan, 0.258023), (Esha Ghosh, 0.257039), (Sathi Mahesh, 0.256977), (G. Venkatesan, 0.256977), (Saptarshi Mahesh, 0.256977), (Shyamnath Gollakota, 0.256977), (V. R. Devanathan, 0.255515), (A. Pavan Kumar, 0.255273), (Madhu Mutyam, 0.254791), (Karthik Srinivasan, 0.254490), (N. Sudha, 0.252938), (Shankar Balachandran, 0.251874), (Satyanarayana V. Lokam, 0.251462), (Venkatesan Guruswami, 0.250586), (Prasad Raghavendra, 0.250586), (S. Sudarshan, 0.250237), (Narayanan Vijaykrishnan, 0.249542), (Vishal Gupta, 0.249542), (P. Subrahmanya, 0.249542), (K. Najeeb, 0.249542), (Seetal Potluri, 0.249195), (Nitin Chandrachoodan, 0.249195), (Ch. Sobhan Babu, 0.249195), (Satya Trinadh, 0.249195), (K. R. Parthasarathy, 0.248392), (Vinod Vaikuntanathan, 0.248392), (S. V. Raghavan, 0.247821), (V. Ganesh, 0.247309), (Sk. Noor Mahammad, 0.247309), (Hema A. Murthy, 0.241654), (Sutanu Chakraborti, 0.241006), (V. K. Panchal, 0.233996), (Lalit Gupta, 0.233996), (Pinaki Roychowdhury, 0.233996), (Aakanksha Gagrani, 0.233996), (V. Srinivasa Chakravarthy, 0.232432), (Susan Elias, 0.232382), (Debarun Kar, 0.232082), (I. Murugeswari, 0.231583), (R. Sriram, 0.230002), (S. Selvakumar, 0.230002), (Arun K. Somani, 0.229512), (G. Manimaran, 0.229512), (Vikas C. Raykar, 0.227815), (Munu Sairamesh, 0.227815), (Jeffrey Xu Yu, 0.227815), (Bayya Yegnanarayana, 0.224869), (C. Chandra Sekhar, 0.224447), (Variganti Saritha, 0.223748), (Mary Joseph Minu, 0.223748), (Sayan Ranu, 0.222364), (C. E. Veni Madhavan, 0.221268), (Deepak P, 0.220996), (Saket Saurabh, 0.220725), (Bodo Manthey, 0.220725), (Daniel Lokshtanov, 0.220725), (A. Antony Franklin, 0.219645), (Kandasamy Selvaradjou, 0.219645), (Kanthi K. Sarpatwar, 0.218754), (Krishna M. Sivalingam, 0.218090), (Anurag Mittal, 0.216557), (T. A. Gonsalves, 0.215389), (Himanshu Prakash Jain, 0.215346), (Anbumani Subramanian, 0.215346), (Stewart Massie, 0.212334), (Robert Lothian, 0.212334), (M. A. Raghunandan, 0.212334), (Shubhranshu Shekhar, 0.212334), (Ulises Cervi, 0.212334), (Nirmalie Wiratunga, 0.212334), (P. Sreenivasa Kumar, 0.209081), (P. Kiran, 0.207551), (K. Prasanna, 0.207551), (R. Anitha, 0.206794), (B. V. Raghavendra Rao, 0.205847), (D. Janakiram, 0.205298), (Jayalal Sarma, 0.201123), (Sajin Koroth, 0.200413), (C. J. Janraj, 0.199596), (Rajsekar Manokaran, 0.198384), (Rupesh Nasre, 0.197874), (Venkata Ramana Rao Gadde, 0.196253), (S. Rajendran, 0.196253), (V. Bharathi Harishankar, 0.192607), (Sanasam Ranbir Singh, 0.192607), (Archana Ghode, 0.192607), (Ashok Jhunjhunwala, 0.192607), (Dinil Mon Divakaran, 0.192607), (Maryma Scotlin, 0.192607), (Alankar Bandyopadhyay, 0.192607), (Lakshmi Narayana Panuku, 0.180482), (Meghana Nasre, 0.177306), (Kalyani Bogineni, 0.176349), (Muthukumar Radhakrishnan, 0.176349), (Abhinav Gupta, 0.175345), (Ramachandran Madanagopal, 0.174578), (Nutan Limaye, 0.169181), (Maurice J. Jansen, 0.169181), (Meena Mahajan, 0.169181), (John Augustine, 0.033019), (V. Krishna Nandivada, 0.025157), (Chester Rebeiro, 0.018868), (Anisur Rahaman Molla, 0.016708), (Jos, 0.012778), (Sylvain Guilley, 0.009635), (Huaxiong Wang, 0.009635),

(d) Betweenness centrality of top 10% nodes are:
(C. Pandu Rangan: 0.444786), (C. Siva Ram Murthy: 0.202849), (Krishna M. Sivalingam: 0.143905), (B. Ravindran: 0.210908), (V. Kamakoti: 0.356955), (D. Janakiram: 0.096967), (Hema A. Murthy: 0.081544), (N. S. Narayanaswamy: 0.125870), (C. Chandra Sekhar: 0.062971), (S. V. Raghavan: 0.066634), (Madhu Mutyam: 0.054265), (Sukhendu Das: 0.106952), (John Augustine: 0.001065), (T. A. Gonsalves: 0.047829), (P. Sreenivasa Kumar: 0.051461), (Deepak Khemani: 0.096691), (V. Krishna Nandivada: 0.000614), (Anurag Mittal: 0.038646), (Sutanu Chakraborti: 0.031896), (Chester Rebeiro: 0.000341), (Jayalal Sarma: 0.025388), (Rajsekar Manokaran: 0.025864), (B. V. Raghavendra Rao: 0.019361), (Shankar Balachandran: 0.022076), (Rupesh Nasre: 0.021581), (Sayan Ranu: 0.015047), (Meghana Nasre: 0.012982), (Sriram Raghavan: 0.073968), (Kamala Krithivasan: 0.043808), (Anand Kumar: 0.016275), (R. Manimegalai: 0.004089), (Bayya Yegnanarayana: 0.020764), (Deepak P: 0.003073), (Venkatesh Raman: 0.013959), (Anbumani Subramanian: 0.000000), (Satya Trinadh: 0.000000), (Satyanarayana V. Lokam: 0.018173), (G. Manimaran: 0.018394), (Kanthi K. Sarpatwar: 0.014362), (V. Bharathi Harishankar: 0.000000), (N. Sudha: 0.032882), (Arun K. Somani: 0.018394), (Mary Joseph Minu: 0.000000), (R. Sriram: 0.005558), (S. Selvakumar: 0.005558), (C. E. Veni Madhavan: 0.012331), (Maryma Scotlin: 0.000000), (Susan Elias: 0.007242), (Aakanksha Gagrani: 0.000000), (N. S. Janaki Latha: 0.000000), (Meena Mahajan: 0.000000), (Venkatesan Guruswami: 0.013527), (V. Muralidharan: 0.000000), (Ch. Sobhan Babu: 0.000000), (K. Najeeb: 0.000000), (V. R. Devanathan: 0.095342), (K. Arvind: 0.000000), (E. Siva Soumya: 0.000000), (Himanshu Prakash Jain: 0.000000), (Bodo Manthey: 0.002035), (S. Sudarshan: 0.022861), (G. Venkatesan: 0.000000), (P. Kiran: 0.000000), (Lalit Gupta: 0.000000), (Nutan Limaye: 0.000000), (V. K. Panchal: 0.000000), (P. Jagan Mohan: 0.000000), (Ashok Jhunjhunwala: 0.000000), (I. Murugeswari: 0.000000), (Ramesh Govindan: 0.101419), (Arpita Patra: 0.016116), (Sathi Mahesh: 0.000000), (P. Subrahmanya: 0.000000), (Sajin Koroth: 0.005646), (A. Pavan Kumar: 0.000000), (Shyamnath Gollakota: 0.000000), (Nirmalie Wiratunga: 0.000000), (Venkata Ramana Rao Gadde: 0.001499), (Karthik Srinivasan: 0.030024), (Maurice J. Jansen: 0.000000), (Narayanan Vijaykrishnan: 0.000000), (V. Srinivasa Chakravarthy: 0.008391), (Thomas Graf: 0.000000), (S. Rajendran: 0.001499), (Dinil Mon Divakaran: 0.000000), (Debarun Kar: 0.000000), (Seetal Potluri: 0.000000), (Sanasam Ranbir Singh: 0.000000), (R. Anitha: 0.007524), (Alankar Bandyopadhyay: 0.000000), (Nitin Chandrachoodan: 0.000000), (Daniel Lokshtanov: 0.002035), (K. Prasanna: 0.000000), (Saptarshi Mahesh: 0.000000), (Pinaki Roychowdhury: 0.000000), (Variganti Saritha: 0.000000), (Ulises Cervi: 0.000000), (Vishal Gupta: 0.000000), (Shubhranshu Shekhar: 0.000000), (M. A. Raghunandan: 0.000000), (D. Bhatia: 0.000000), (Robert Lothian: 0.000000), (K. Srinathan: 0.000000), (Prasad Raghavendra: 0.013527), (Archana Ghode: 0.000000), (Saket Saurabh: 0.002035), (Stewart Massie: 0.000000), (Esha Ghosh: 0.000000),

(Huaxiong Wang: 0.000000), (Sk. Noor Mahammad: 0.000000), (V. Ganesh: 0.000000), (Lakshmi Narayana Panuku: 0.000000), (Abhinav Gupta: 0.000000), (Kandasamy Selvaradjou: 0.000000), (Jeffrey Xu Yu: 0.000000), (Ramachandran Madanagopal: 0.000000), (Sylvain Guilley: 0.000000), (Kalyani Bogineni: 0.000000), (Jos: 0.000000), (Vinod Vaikuntanathan: 0.000000), (Munu Sairamesh: 0.000000), (A. Antony Franklin: 0.000000), (C. J. Janraj: 0.000000), (Vikas C. Raykar: 0.000000), (K. R. Parthasarathy: 0.000000), (Anisur Rahaman Molla: 0.000000), (Muthukumar Radhakrishnan: 0.000000),

(e) Clustering cooefficient of the top 10% nodes are:
(Sathi Mahesh: 1.000000), (V. Bharathi Harishankar: 1.000000), (V. K. Panchal: 1.000000), (Esha Ghosh: 1.000000), (Seetal Potluri: 1.000000), (Debarun Kar: 1.000000), (Stewart Massie: 1.000000), (Sanasam Ranbir Singh: 1.000000), (Nutan Limaye: 1.000000), (N. S. Janaki Latha: 1.000000), (Archana Ghode: 1.000000), (Maurice J. Jansen: 1.000000), (G. Venkatesan: 1.000000), (K. Srinathan: 1.000000), (A. Pavan Kumar: 1.000000), (Robert Lothian: 1.000000), (D. Bhatia: 1.000000), (M. A. Raghunandan: 1.000000), (Ashok Jhunjhunwala: 1.000000), (Thomas Graf: 1.000000), (P. Jagan Mohan: 1.000000), (Lalit Gupta: 1.000000), (P. Kiran: 1.000000), (I. Murugeswari: 1.000000), (Shubhranshu Shekhar: 1.000000), (Narayanan Vijaykrishnan: 1.000000), (Ulises Cervi: 1.000000), (Dinil Mon Divakaran: 1.000000), (Variganti Saritha: 1.000000), (Pinaki Roychowdhury: 1.000000), (Mary Joseph Minu: 1.000000), (Himanshu Prakash Jain: 1.000000), (E. Siva Soumya: 1.000000), (Saptarshi Mahesh: 1.000000), (Nirmalie Wiratunga: 1.000000), (Nitin Chandrachoodan: 1.000000), (Vishal Gupta: 1.000000), (K. Prasanna: 1.000000), (Shyamnath Gollakota: 1.000000), (V. Muralidharan: 1.000000), (Meena Mahajan: 1.000000), (Aakanksha Gagrani: 1.000000), (K. Arvind: 1.000000), (P. Subrahmanya: 1.000000), (Maryma Scotlin: 1.000000), (K. Najeeb: 1.000000), (Ch. Sobhan Babu: 1.000000), (Satya Trinadh: 1.000000), (Alankar Bandyopadhyay: 1.000000), (Anbumani Subramanian: 1.000000), (R. Manimegalai: 0.666667), (Anand Kumar: 0.500000), (Kamala Krithivasan: 0.333333), (Venkatesh Raman: 0.333333), (Deepak P: 0.333333), (Shankar Balachandran: 0.029412), (Sutanu Chakraborti: 0.024631), (Deepak Khemani: 0.019915), (B. V. Raghavendra Rao: 0.019608), (Jayalal Sarma: 0.012987), (Sukhendu Das: 0.011074), (T. A. Gonsalves: 0.008537), (Madhu Mutyam: 0.006061), (Hema A. Murthy: 0.005490), (Anurag Mittal: 0.004598), (V. Kamakoti: 0.004444), (N. S. Narayanaswamy: 0.003265), (P. Sreenivasa Kumar: 0.002564), (B. Ravindran: 0.002178), (C. Pandu Rangan: 0.000762), (C. Siva Ram Murthy: 0.000423), (Sayan Ranu: 0.000000), (Chester Rebeiro: 0.000000), (Arpita Patra: 0.000000), (R. Anitha: 0.000000), (John Augustine: 0.000000), (C. Chandra Sekhar: 0.000000), (Sriram Raghavan: 0.000000), (Venkatesan Guruswami: 0.000000), (Ramesh Govindan: 0.000000), (Lakshmi Narayana Panuku: 0.000000), (Krishna M. Sivalingam: 0.000000), (Saket Saurabh: 0.000000), (Meghana Nasre: 0.000000),

4

(S. V. Raghavan: 0.000000), (Venkata Ramana Rao Gadde: 0.000000), (Bayya Yegnanarayana: 0.000000), (S. Rajendran: 0.000000), (Susan Elias: 0.000000), (Vikas C. Raykar: 0.000000), (C. E. Veni Madhavan: 0.000000), (Abhinav Gupta: 0.000000), (R. Sriram: 0.000000), (Prasad Raghavendra: 0.000000), (Bodo Manthey: 0.000000), (V. Krishna Nandivada: 0.000000), (Arun K. Somani: 0.000000), (N. Sudha: 0.000000), (Karthik Srinivasan: 0.000000), (S. Selvakumar: 0.000000), (V. Srinivasa Chakravarthy: 0.000000), (Rajsekar Manokaran: 0.000000), (A. Antony Franklin: 0.000000), (Kalyani Bogineni: 0.000000), (S. Sudarshan: 0.000000), (D. Janakiram: 0.000000), (Daniel Lokshtanov: 0.000000), (Kanthi K. Sarpatwar: 0.000000), (G. Manimaran: 0.000000), (Kandasamy Selvaradjou: 0.000000), (Sajin Koroth: 0.000000), (C. J. Janraj: 0.000000), (Ramachandran Madanagopal: 0.000000), (Satyanarayana V. Lokam: 0.000000), (V. R. Devanathan: 0.000000), (Jos: 0.000000), (K. R. Parthasarathy: 0.000000), (Anisur Rahaman Molla: 0.000000), (Munu Sairamesh: 0.000000), (Vinod Vaikuntanathan: 0.000000), (Sylvain Guilley: 0.000000), (Jeffrey Xu Yu: 0.000000), (Rupesh Nasre: 0.000000), (Muthukumar Radhakrishnan: 0.000000), (V. Ganesh: 0.000000), (Sk. Noor Mahammad: 0.000000), (Huaxiong Wang: 0.000000),

(f) Kamakoti numbers of the professors are:
'S. V. Raghavan': 2, 'Sukhendu Das': 1, 'Sayan Ranu': 3, 'Chester Rebeiro': -1, 'C. Pandu Rangan': 1, 'Deepak Khemani': 2, 'Shankar Balachandran': 1, 'John Augustine': -1, 'C. Chandra Sekhar': 2, 'V. Krishna Nandivada': -1, 'P. Sreenivasa Kumar': 3, 'Anurag Mittal': 2, 'N. S. Narayanaswamy': 2, 'T. A. Gonsalves': 2, 'Rajsekar Manokaran': 3, 'Jayalal Sarma': 3, 'B. V. Raghavendra Rao': 3, 'C. Siva Ram Murthy': 2, 'Krishna M. Sivalingam': 3, 'Hema A. Murthy': 2, 'Sutanu Chakraborti': 2, 'B. Ravindran': 1, 'Rupesh Nasre': 3, 'Madhu Mutyam': 1, 'Meghana Nasre': 4, 'D. Janakiram': 2

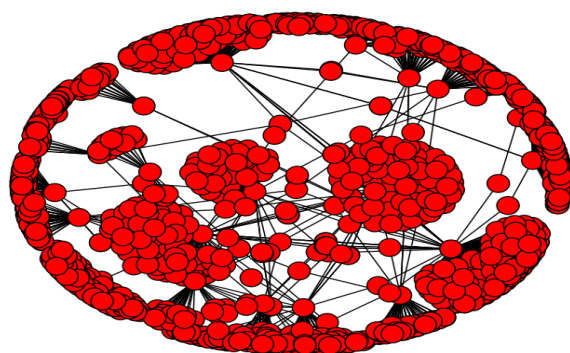(g) Yes, the graph follows powerlaw-distribution and the **powerlaw** exponent of the entire graph is: **3.23835634143**.

(h)

(i)

Figure 1: Authorship network