International Journal of Management and Humanities (IJMH)
ISSN: 2394-0913 (Online), Volume-4 Issue-8, April 2020

Collaboration Graph on Abel's Prize Winners

G.K.Yogambiga, N.Srinivasan

Abstract: ***Graph theory plays significant role in various fields. Collaboration graph is the one of the important area in Graph theory. Here, we constructed a collaboration graph centered at Paul Erdős for Abel's Prize Winners. Though the number of the prize winners as on 2019 is 20, the collaboration graph has 47 vertices and 87edges and gives some properties. Finally ,we have analyzed different parameters of the graph like k-neighbors, closest vertices and etc.***

Keywords : Graph theory ,Collaboration graph , Abel's Prize Winners , k-neighbors, closest vertices, Paul Erdős.

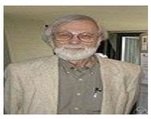
I. INTRODUCTION

The collaboration graph is a graph model where the vertices are researchers (dead or alive) from all academic disciplines and where 2 distinct researches are joined by an edge whenever they published a article or book. The distance between two vertices u and v denoted d(u,v), is the number of edges in the shortest path between u and v in case if such a path exists and ∞ otherwise. Clearly d(u,u) = 0. We now consider the collaboration sub graph centered at Paul Erdős (1913-1996). For a researcher v, the number d(Erdős ,v) is called the Erdős number of v. That is, Paul Erdős himself has Erdős number 0 and his coauthors have Erdős number 1. People not having Erdős number 0 or 1 but who has published with someone with Erdős number 1 have Erdős number 2, and so on. Those who are not linked in this way to Paul Erdős have Erdős number ∞. 511 people have Erdős number 1, and over 11000 have Erdős number 2. For more details see [1,5,6,8].

1.ABOUT ABEL'S PRIZE (AP)

The Abel Prize was established on 1 January 2002. The purpose is to award the Abel Prize for outstanding scientific work in the field of mathematics. The prize amount is 7.5 million Norwegian Kroner and was awarded for the first time on 3 June 2003. For more details refer[7.8,9].

DETAILS ABOUT ABEL'S PRIZE WINNERS

S.NO	Year	Name	Image	Erdos Number
1	2003	Jean-Pierre Serre		2
2	2004	Michael Atiyah		3
3		Isadore Singer		3
4	2005	Peter Lax		3
5	2006	Lennart Carleson		2
6	2007	S. R. Srinivasa Varadhan		2
7	2008	John G. Thompson		2
8		Jacques Tits		3
9	2009	Mikhail Gromov		2
10	2010	John Tate		2
11	2011	John Milnor		3

Revised Manuscript Received on April 15, 2020.
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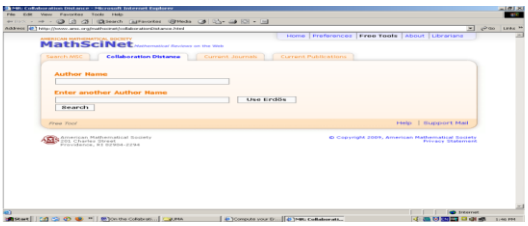
12	2012	Endre Szemerédi		1
13	2013	Pierre Deligne		3
14	2014	Yakov Sinai		3
15	2015	John F. Nash Jr.		3
16		Louis Nirenberg		3
17	2016	Andrew Wiles		3
18	2017	Yves Meyer		2
19	2018	Robert Langlands		2
20	2019	Karen Uhlenbeck		3

II. CONSTRUCTION OF THE GRAPH

Construction of Abel's prize winners collaboration graph (APWCG) is given below:

Step 1: Click on the link: https:// mathscinet.ams.org/ mathscinet/freeTools.html?version=2. Then click collaboration Distance icon. We get the following screen:



Step 2: Enter the Author 's name from the Abel's prize winners list(for ex.: Michael Francis Atiyah) and click on use Erdős icon. You will get the following screen:

If you need to verify the more details of joint work of these authors, click on respective MR number. For ex., if we click on MR1254073 then you will get the following screen:

Continuing this procedure, we can get all 20 APWCG's collaboration details one by one. Suppose that if there is no result in step 2 , then we can conclude that "There is no path between the corresponding coauthors". After that we checked every coauthor with remaining coauthors. We have completely checked all possible combinations. From step 2 details, we can get APWCG's coauthors with Erdős number 1, Erdős number 2 and Erdős number 3. At level 1 (ie) Erdős number 1, we have 16 coauthors and at level 2 (ie) Erdős number 2, we have 19 coauthors and at level 3 (ie) Erdős number 3, we have 11 coauthors. Hence we can form a list of vertices .Here that is 47 vertices. If there is a coauthor relationship between any 2 coauthors , then there is a path between that between that 2 co-authors. The vertex v1 is the Paul Erdős with Erdős number 0.Out of 511 direct coauthors of Paul Erdős with Erdős number 1,here only 16 members (V_2-V_{17}) are connected by path of length 1(ie Erdős number 1) in APWCG, Erdős number 2 members are V_{18}- V_{36}, the remaining members with Erdős number 3 namely V_{37}- V_{47}. For details refer[1-5]. Therefore, G has forty- seven vertices and eighty- seven edges. $V(G)=\{v_1, v_2 \dots v_{47}\}$ where v_1 = Paul Erdős, v_2 = Sarvadaman Chowla ,v_3 = FanChung , v_4 = Irving Kaplansky ,v_5 = Vilmos Totik ,v_6 = Kai Lai Chung, v_7= Béla Bollobás ,v_8 = Harold Davenport, v_9 = János Pach,v_{10} = Hugh L. Montgomery, v_{11} = Noga Alon ,v_{12} = Endre Szemerédi, v_{13} = Peter C. Fishburn, v_{14}= Alan J. Hoffman, v_{15} = AndrewM.Odlyzko , v_{16} = Stanisław Hartman ,v_{17}=László Babai,v_{18}= Jean-Pierre Serre ,v_{19}= Armand Borel,v_{20}= Shlomo sternberg,v_{21}=Richard Friederich Arens, v_{22}=Lennart Axel Edvard Carleson,v_{23}=Srinivasa R S. Varadhan,v_{24}= John Griggs Thompson,v_{25}= Enrico Bombieri ,v_{26}= Mikhael Gromov ,v_{27}= John Torrence Tate,v_{28}= Shmuel Friedland,v_{29}= Daniel S.Freed, v_{30}= Jean Bourgain,v_{31}= Harold W. Kuhn ,v_{32} = Christopher M. Skinner , v_{33}= Yves F. Meyer,v_{34} = Robert P. Langlands ,v_{35}= Micha Sharir ,v_{36}= William M. Kantor,v_{37}= Michael Francis Atiyah ,v_{38}= Isadore Manuel Singer,v_{39}= Peter David Lax ,v_{40} = Jacques Tits,v_{41}= John Willard Milnor,v_{42} = Pierre Deligne, v_{43}=Yakov Grigor′evich Sinaĭ, v_{44}=Louis Nirenberg , v_{45}= Andrew J. Wiles , v_{46}= John Forbes Nash Jr.,V_{47}= Karen Keskulla Uhlenbeck.

Retrieval Number: H0823044820/2020©BEIESP
DOI: 10.35940/ijmh.H0823.044820
Journal Website: www.ijmh.org

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$E(G)=\{ e_1, e_{2,\ldots}\ e_{87} \}$ where $e_1=(v_1,v_2)$, $e_2 =(v_1,v_3)$, $e_3 = (v_1,v_4)$, $e_4= (v_1,v_5)$, $e_5= (v_1,v_6)$, $e_6= (v_1,v_7)$, $e_7= (v_1,v_8)$, $e_8= (v_1,v_9)$, $e_9= (v_1,v_{10})$, $e_{10} = (v_1,v_{11})$, $e_{11} = (v_1,v_{12})$, $e_{12} = (v_1,v_{13})$, $e_{13} = (v_1,v_{14})$, $e_{14} = (v_1,v_{15})$, $e_{15} = (v_1,v_{16})$, $e_{16}= (v_1,v_{17})$, $e_{17} = (v_2,v_8)$, $e_{18} = (v_2,v_{18})$, $e_{19} = (v_2,v_{19})$, $e_{20} = (v_3,v_7)$, $e_{21}= (v_3,v_{11})$, $e_{22}= (v_3,v_{12})$, $e_{23}= (v_3,v_{13})$, $e_{24}= (v_3,v_{15})$, $e_{25} = (v_3,v_{17})$, $e_{26}= (v_3,v_{20})$, $e_{27} = (v_3,v_{34})$, $e_{28}= (v_4,v_{21})$, $e_{29}= (v_5,v_{22})$, $e_{30}= (v_6,v_{23})$, $e_{31}= (v_7,v_{11})$, $e_{32}= (v_7,v_{12})$, $e_{33}= (v_7,v_{24})$, $e_{34}= (v_8,v_{25})$, $e_{35}= (v_9,v_{11})$, $e_{36}= (v_9,v_{12})$, $e_{37}= (v_9,v_{26})$, $e_{38}= (v_9,v_{35})$, $e_{39}=(v_{10},v_{15})$, $e_{40} = (v_{10},v_{24})$, $e_{41}=(v_{10},v_{25})$, $e_{42}=(v_{10},v_{27})$, $e_{43} = (v_{11},v_{12})$, $e_{44}=(v_{11},v_{15})$, $e_{45}=(v_{11},v_{17})$, $e_{46}=(v_{11},v_{28})$, $e_{47} = (v_{11},v_{30})$, $e_{48} = (v_{11},v_{35})$, $e_{49} = (v_{12},v_{17})$, $e_{50}= (v_{13},v_{15})$, $e_{51}= (v_{13},v_{29})$, $e_{52}= (v_{14},v_{31})$, $e_{53}= (v_{15},v_{25})$, $e_{54} = (v_{15},v_{29})$, $e_{55}= (v_{15},v_{32})$, $e_{56}= (v_{16},v_{33})$, $e_{57}= (v_{17},v_{36})$, $e_{58}= (v_{18},v_{19})$, $e_{59}=(v_{18},v_{25})$, $e_{60}= (v_{18},v_{27})$, $e_{61} =(v_{18},v_{37})$, $e_{62} =(v_{18},v_{40})$, $e_{63} = (v_{18},v_{41})$, $e_{64} = (v_{18},v_{42})$, $e_{65}=(v_{19},v_{37})$, $e_{66}=(v_{19},v_{39})$, $e_{67}=(v_{19},v_{40})$, $e_{68}=(v_{20},v_{38})$, $e_{69} = (v_{21},v_{38})$, $e_{70}= (v_{22},v_{39})$, $e_{71}=(v_{23},v_{44})$, $e_{72}=(v_{25},v_{30})$, $e_{73}= (v_{25},v_{40})$, $e_{74}= (v_{25},v_{44})$, $e_{75}=(v_{26},v_{30})$, $e_{76}=(v_{28},v_{41})$, $e_{77}= (v_{29},v_{42})$, $e_{78}=(v_{30},v_{43})$, $e_{79}=(v_{31},v_{46})$, $e_{80}= (v_{32},v_{45})$, $e_{81}= (v_{35},v_{39})$, $e_{82}=(v_{35},v_{44})$, $e_{83}= (v_{36},v_{40})$, $e_{84}= (v_{37},v_{38})$, $e_{85},=(v_{39},v_{44})$, $e_{86}=(v_{41},v_{46})$, $e_{87} =(v_{47},v_{29})$.

III. PAJEK

Pajek is a program, for analysis and visualization of huge networks which has thousands or even millions of vertices. In Slovenian language, the meaning of pajek is spider. The latest version of Pajek is freely available, for noncommercial use, at its home page: http://vlado.fmf.uni-lj.si/pub/networks/pajek/. Pajek provide tools for analysis and visualization of such networks: collaboration networks, organic molecule in chemistry, protein-receptor interaction networks, genealogies, Internet networks, citation networks, diffusion (AIDS, news, innovations) networks, data-mining(2-modenetworks), etc. See also collection of large networks at: http://vlado.fmf.uni-lj.si/pub/networks/data/. Refer [10]

By Pajek program ,we constructed the graph APWCG. The following graph(Fig 1.) is the visualization of Abel's Prize Winners Collaboration Graph (APWCG).

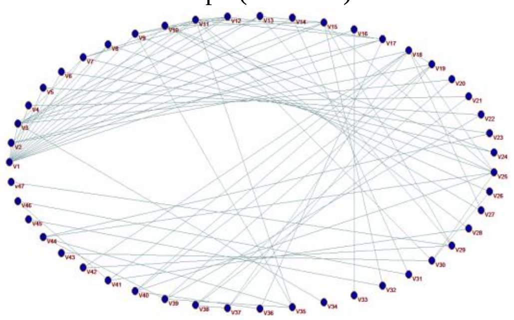

Figure.1 (Visualization of APWCG)

IV. HOW TO CLASSIFY THE COAUTHORS IN THE GRAPH APWCG?

When preparing the input file for pajek program, we have assigned specific colors for the coauthors with Erdős number i. In APWCG graph , we have assigned blue color to Paul Erdős who has Erdős number 0.Similarly the coauthors with Erdős number 1 is assigned with green color, orange color for the coauthors with Erdős number 2, yellow color for the coauthor with Erdős number 3 .The following figure 2. shows that graph.

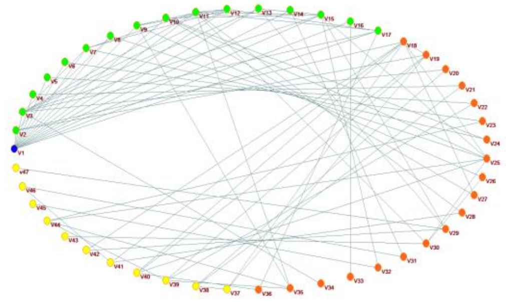

Figure 2. Visualization of APWCG with corresponding Erdős number

V. CALCULATION OF DISTINCT SPECIFICATION OF THE GRAPH

We can find some graph parameters like k-neighbors, closest vertices, shortest and longest edges and etc by using pajek . The following graphs 3 -5 shows that.

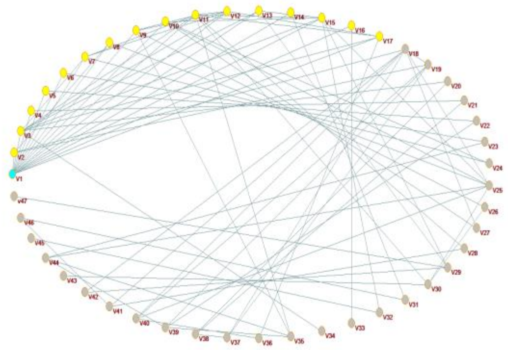

Figure 3. Visualization of APWCG with 1-neighbors of v_1

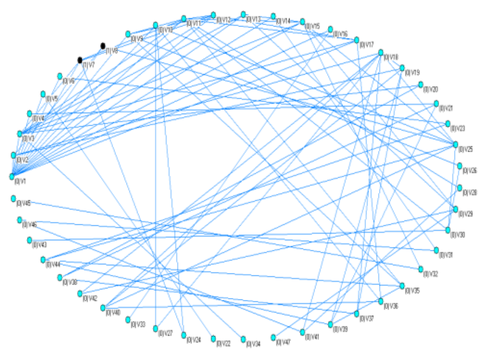

Figure 4.Visualization of Closest vertices in APWCG

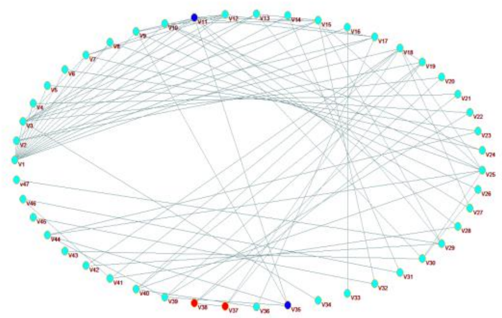

Figure 5.Visualization of shortest and longest edges in APWCG

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VI. CONCLUSION

In this paper, We constructed a collaboration graph for Abel's Prize Winners by using mathscinet database and Pajek program. Hence we have analyzed different Visualization of APWCG using Pajek. Further, we are going present some properties of the graph.

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Retrieval Number: H0823044820/2020©BEIESP
DOI: 10.35940/ijmh.H0823.044820
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