

# Network Visualizations of the MARVEL Comic Universe

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## ABSTRACT

The MARVEL comic universe is an expansive and intricate system, with thousands of characters, dozens of groups, and decades of background material. How does an entity like Sony, Disney, or Fox decide which characters to greenlight films or TV shows for? Here I propose a method for determining the characters who are well-connected in the MARVEL comic universe, and find several options for future avenues of exploration for these companies to make new media.

## Introduction

Social networks are often viewed as good ways to gather large amounts of data on people as a unit whole, but they can also be used for determining specific characteristics, or targeting central individuals for dissemination of information. In Kieran Healy's "Using Metadata to Find Paul Revere"<sup>1</sup>, he describes how simple group lists of Boston clubs could be used to find important figures in the American Revolution, and proceeds to show how Paul Revere and other members of the Boston Tea Party could be found by doing simple calculations. Now, many literary universes exist, and several are extremely extensive, but none are so popular currently as the MARVEL universe, which currently has created several billion dollar films and has created many A-list stars. Could similar metadata calculations be used to determine which characters should be portrayed cinematically next?

## Methods

I manually assembled a spreadsheet of connections of Characters vs Groups in the Marvel cinematic universe using information from the open source website MARVEL Database<sup>2</sup>. This spreadsheet is a matrix representation of the bipartite network formed by the two distinctions: Characters and Groups (Figure 1).

Character	Avengers	S.H.I.E.L.D.	Guardians of Illuminati	New Avenger	Mighty Avenger	Hellfire Club	The Mighty	Defenders	Incredible Hulk	The Hand	Asgardian	Dark Avenger	Cabal	Nova Corps	Thunderbolts
3D Man	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8-Ball	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Abigail Brand	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Absorbing Man	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Abyss	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adam	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Adam Warlock	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Adolf Imposs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Aegis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agent 13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agent 22	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Agent 33	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Agent Bradley	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Agent Carter	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Agent Chester	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 1. Example set of bipartite matrix

In order to represent the information as social networks, the matrix had to be transformed into unipartite representations by matrix multiplication. If we call our normal bipartite matrix  $A$ , then the matrix created by  $AA^T$  gives us the unipartite network for Characters vs Characters (Figure 1), while the matrix created by  $A^TA$  gives us the unipartite Groups vs Groups (Figure 3).

	3D Man	8-Ball	Abigail Brand	Absorbing M	Abyss	Adam	Adam Warlo	Adolf	Imposs	Adora	Aegis	Agent 13	Agent 22	Agent 33	Agent Bradie	Agent Carsta	Agent Chees
3D Man	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0
8-Ball	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Abigail Brand	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	1	1
Absorbing M	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Abyss	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Adam	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1
Adam Warlo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adolf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aegis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agent 13	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Agent 22	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1
Agent 33	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1	1
Agent Bradie	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	1	1
Agent Carsta	0	0	1	0	0	1	0	0	0	0	0	0	1	1	1	0	1
Agent Chees	0	0	1	0	0	1	0	0	0	0	0	0	1	1	1	1	0

**Figure 2.** Sample from unipartite matrix for intercharacter relationships

	Avengers	S.H.I.E.L.D.	Guardians of Illuminati	New Avenge	Mighty Aven	Hellfire Club	The Mighty	Defenders	Incredible Hu	The Hand	Asgardian	Dark Avenge	Cabal	Nova Corps	Thunderbolts	
Avengers	0	24	7	11	15	12	4	8	22	4	7	2	8	3	1	10
S.H.I.E.L.D.	24	0	5	3	9	6	2	6	7	2	3	0	3	1	0	3
Guardians of Illuminati	7	5	0	1	3	2	1	2	2	0	0	0	0	0	0	0
New Avenge	11	3	1	0	3	3	2	3	7	1	1	0	0	1	0	0
Mighty Aven	15	9	3	3	0	3	1	7	6	0	3	0	3	0	0	3
Hellfire Club	12	6	2	3	3	0	1	3	6	1	1	0	2	1	0	1
The Mighty	4	2	1	2	1	1	0	1	3	0	2	0	0	1	0	0
Defenders	8	6	2	3	7	3	1	0	5	1	1	0	1	0	0	3
Incredible Hu	22	7	2	7	6	6	3	5	0	3	2	1	3	1	1	4
The Hand	7	3	0	1	3	1	2	1	2	1	0	0	0	0	0	0
Asgardian	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Dark Avenge	8	3	0	0	3	2	0	1	3	1	0	0	0	1	0	4
Cabal	3	1	0	1	0	1	1	0	1	0	0	0	1	0	0	2

**Figure 3.** Sample from unipartite matrix for intergroup relationships

Taking the unipartite matrices, we can run them through GePhi, a network mapping software, which will allow us to portray the networks, as well as calculate centralities. For this project, we utilized two centralities: betweenness centrality and eigenvector centrality. Betweenness centrality of a node v is:

$$g(v) = \sum_{s \neq v \neq t} \frac{\sigma_{st}(v)}{\sigma_{st}}$$

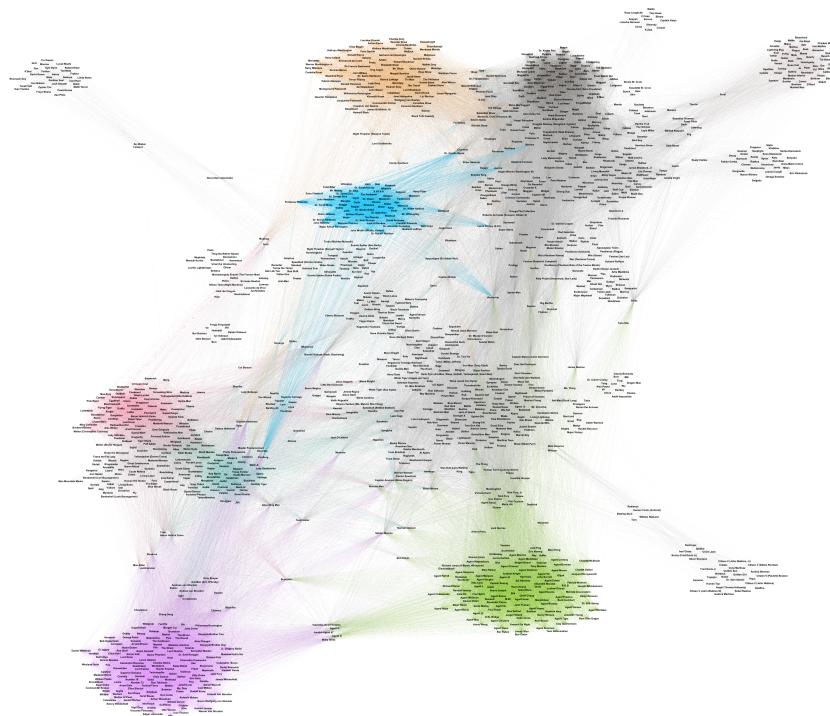
where  $\sigma_{st}$  is total number of shortest paths from node s to node t, and  $\sigma_{st}(v)$  is the number of those paths that pass through node v. Eigenvector centrality of a node v is:

$$x_v = \frac{1}{\lambda} \sum_{t \in M(v)} x_t = \frac{1}{\lambda} \sum_{t \in G} a_{v,t} x_t$$

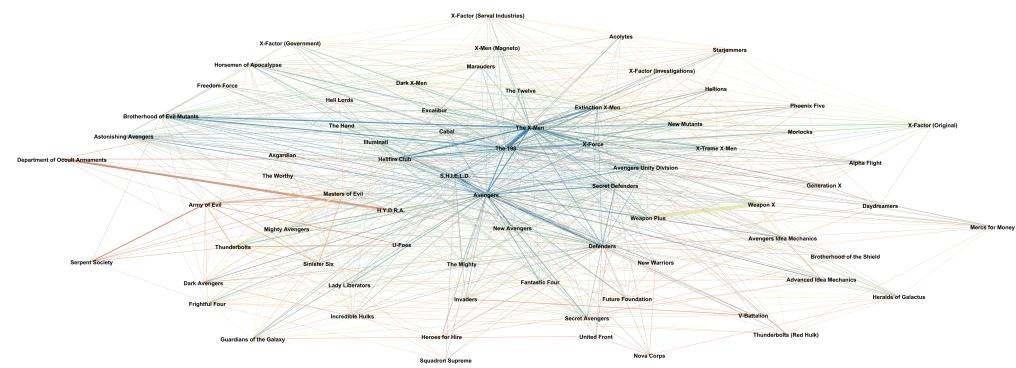
where  $a_{v,t}$  is the adjacency matrix with values of 1 if node v is linked to node t and 0 otherwise,  $M(v)$  is the set of neighbors of node v, G is the overall graph, and  $\lambda$  is a constant. In short, betweenness centrality is basic centrality, and eigenvector centrality is how central a node is relative to other central node.

Finally, sorting the centralities greatest to least to determine the most central characters by each metric.

## Results



**Figure 4.** The unipartite network for Character vs Character (zoomable)



**Figure 5.** The unipartite network for Group vs Group (zoomable)

## Discussion

As one can see from the above networks, we have several relatively central characters and a few extremely central characters. Upon examination of the statistics of the centralities, we arrive at:

	Id	betweenesscentrality
Barnell Bohusk (Beak, Blackwing)	54142.83287	
Nova (Richard Rider)	43347.22609	
Storm	41352.55945	
Captain America (Steve Rogers)	37310.15234	
Magneto	30172.64345	
Wolverine	29457.90222	
Human Torch (Johnny Storm)	28132.96185	
Daimon Hellstrom	25565.12103	
Skids	24935.38704	
Whirlwind	20986.44505	
Deadpool	20594.82706	
Dazzler	18238.18029	
Absorbing Man	17458.05234	
Sunfire	16774.78589	
Spider-Woman	16261.45962	
Mentallo	15686.98837	
Taskmaster	14443.15768	
Viper	14174.74931	
Iron Man (Tony Stark)	13758.88892	
Roberto da Costa (Sunspot, Citizen X)	13492.82477	

(a) The top 20 betweenness centralities for Characters

	Id	eigencentrality
Wolverine	1	
Dazzler	0.964491	
Storm	0.907934	
Roberto da Costa (Sunspot, Citizen X)	0.887049	
Captain Marvel (Carol Danvers)	0.861005	
Beast	0.844897	
Sabretooth	0.841529	
Laura Kinney (X-23)	0.835503	
Rogue	0.825083	
Firestar	0.815387	
Cannonball	0.811812	
Captain America (Steve Rogers)	0.796631	
Magneto	0.781618	
Barnell Bohusk (Beak, Blackwing)	0.772323	
Kitty Pryde (Shadowcat, Star-Lady)	0.750767	
Spider-Woman	0.741335	
Sunfire	0.729288	
Namor	0.728121	
Spider-Man	0.718678	
Prodigy	0.700083	

(b) The top 20 eigenvector centralities for Characters

As we can see, there are several popular characters who are extremely central in the MARVEL Universe: Wolverine has the highest eigenvector centrality and 6th highest betweenness centrality, Storm is top 3 in both, and Captain America and Iron Man both make their positions known (this is a top 20 out of 1515 characters). But it is characters like Roberto da Costa (20th between, 4th eigen), Barnell Bohusk (1st between, 14th, eigen), Dazzler (12th between, 2nd eigen), and Spider-Woman (15th between, 16th eigen) who prove to be interesting here. They are all extremely central characters in our network, and are relatively unknown to the mass public. Could they be the starting points for new franchises? When we examine the lists for characters attached to major storylines, we see some under-utilized material. Captain Marvel (5th eigen) has already been introduced in the MARVEL Cinematic Universe, being played by Brie Larsen. Could this be an opening for others such as Nova (2nd between) to enter, as their background is already set up? Lastly, we see many central characters from both the X-Men and the Avengers. Would a crossover/continuity fix be appropriate, due to high centrality/connections with each other, or would there be problems? We may find out soon, as Fox is currently in the process of selling the X-Men franchise to Disney, who owns the Avengers half of MARVEL.

Id	betweenesscentrality
Avengers	194.934496
Defenders	168.114496
S.H.I.E.L.D.	121.70709
The 198	99.787112
Hellfire Club	97.549606
Thunderbolts	89.795637
The X-Men	88.663463
Secret Defenders	63.903553
Secret Avengers	55.715614
Brotherhood of Evil Mutants	51.628085
Avengers Unity Division	47.944217
Horsemen of Apocalypse	42.722796
Astonishing Avengers	42.25916
H.Y.D.R.A.	42.178673
X-Force	39.468385
Frightful Four	31.643174
Extinction X-Men	30.139431
Army of Evil	25.394881
Fantastic Four	24.688652

(a) The top 20 betweenness centralities for Groups

Id	eigencentrality
Avengers	1
The X-Men	0.979058
S.H.I.E.L.D.	0.953724
The 198	0.932701
Defenders	0.8879
Hellfire Club	0.840917
Secret Defenders	0.804503
X-Force	0.795563
Brotherhood of Evil Mutants	0.791188
Avengers Unity Division	0.774599
Astonishing Avengers	0.759691
Extinction X-Men	0.751204
Illuminati	0.709103
Secret Avengers	0.668267
Horsemen of Apocalypse	0.661605
X-Treme X-Men	0.643684
Lady Liberators	0.633537
Weapon Plus	0.625229
H.Y.D.R.A.	0.624439

(b) The top 20 eigenvector centralities for Groups

Again, we can see that there are several popular groups who are extremely central in the MARVEL Universe: the Avengers top both lists, S.H.I.E.L.D. is top 3 on both lists, and the X-Men are high on both lists. But rather than opening avenues for new characters, what these rankings show us is possible events that can occur because of crossover opportunity. The group "the 198" is formed by the character Scarlet Witch whispering "No more mutants" and removing the powers of more than 98% of the mutant characters in the world<sup>3</sup>. With the introduction of Scarlet Witch into the MCU (MARVEL Cinematic Universe, Disney's current franchise tag) in Avengers: Age of Ultron, and the ongoing sale of Fox to Disney, which includes the X-Men franchise, a House of M storyline would not only be potentially very profitable for Disney, but also would be relatively simple to enact, given the centrality of the involved groups/characters.

## References

1. Healy, K. Using Metadata to Find Paul Revere (2013).
2. Marvel Database (2018).
3. House of M(Event) (2018).

## Acknowledgements

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