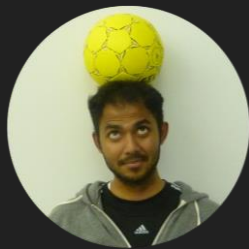


Graphiti: **Interactive Specification of Attribute-based Edges** for Network Modeling and Visualization



Arjun Srinivasan



Hyunwoo Park



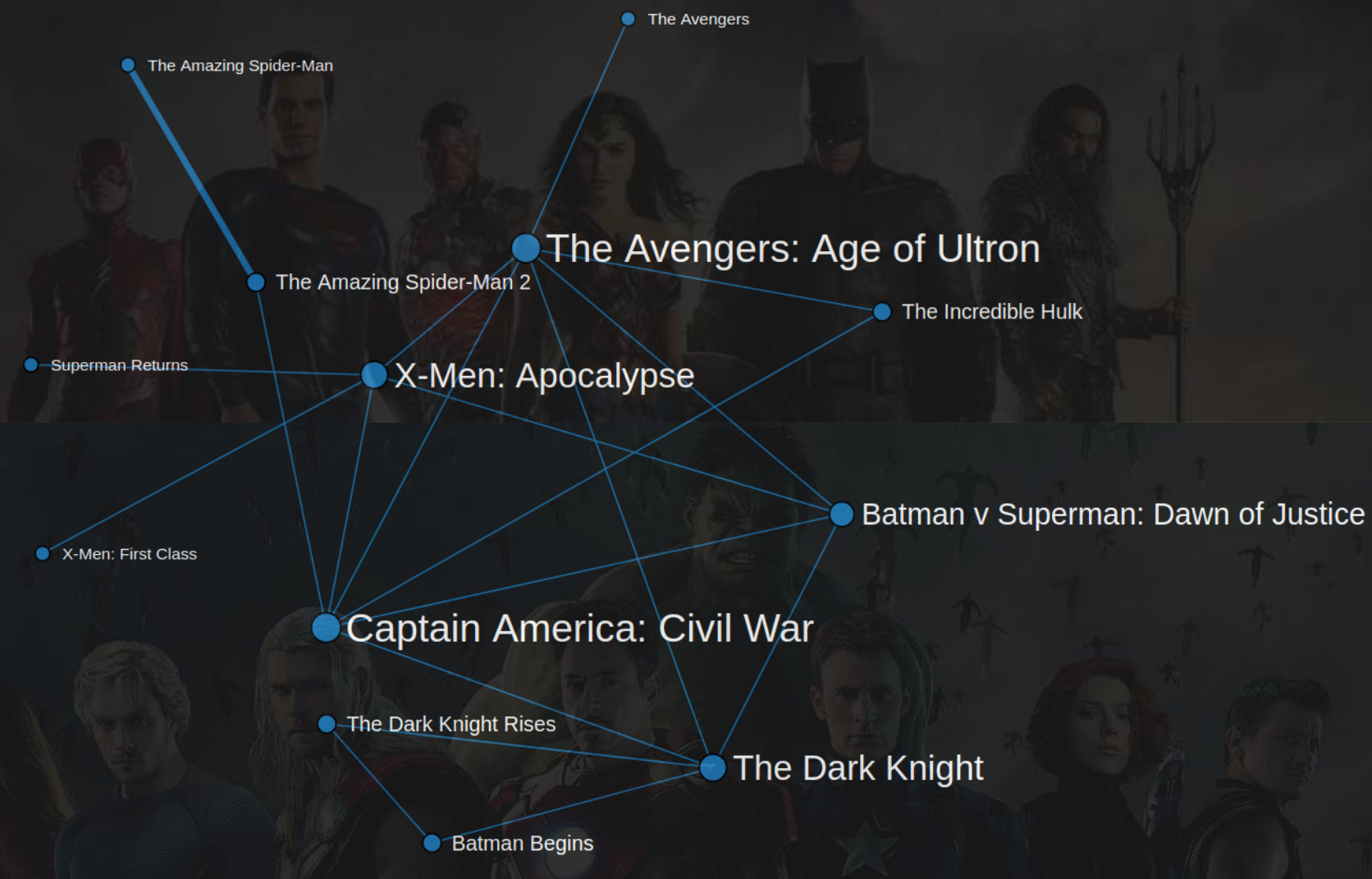
Alex Endert



Rahul C. Basole









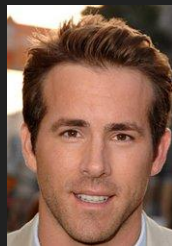
Green Lantern



Deadpool



Green Lantern



Common actor



Deadpool



Captain America: Civil War



Batman vs Superman: Dawn of Justice



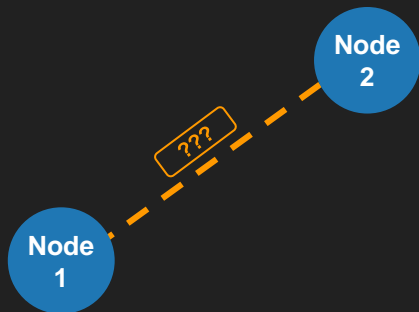
Captain America: Civil War

lead_actor
genres
duration
plot_summary
budget
gross

???

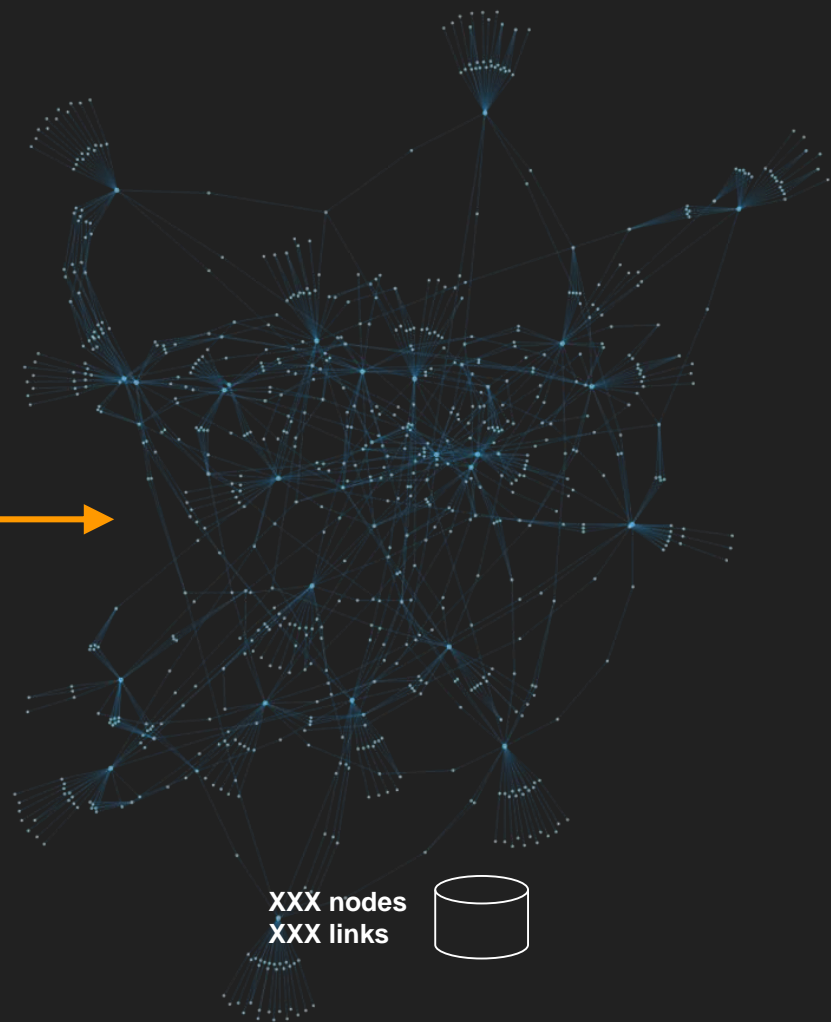


Batman vs Superman: Dawn of Justice



2 nodes
1 link

— **This talk** →



XXX nodes
XXX links



movie_title	director_name	genres	lead_actor	budget	content_rating	plot_summary
Avatar	James Cameron	Action Adventure Fantasy Sci-Fi	CCH Pounder	760505847	PG-13	By 2154, humans have depleted Earth's natural resources, leading to a severe ...
Batman v Superman: Dawn of Justice	Zack Snyder	Action Adventure Sci-Fi	Henry Cavill	330249062	PG-13	Eighteen months after the destructive battle with General Zod ...
Spectre	Sam Mendes	Action Adventure Thriller	Christoph Waltz	200074175	PG-13	Following Gareth Mallory's promotion to M, James Bond ...
Captain America: Civil War	Anthony Russo	Action Adventure Sci-Fi	Robert Downey Jr.	407197282	PG-13	In 1991, the brainwashed super-soldier James "Bucky" Barnes is dispatched ...
Tangled	Nathan Greno	Adventure Animation Comedy Family Fantasy Musical Romance	Brad Garrett	200807262	PG	Long ago, a drop of sunlight became a golden flower capable of healing ...

movie_title	director_name	genres	lead_actor	budget	content_rating	plot_summary
Avatar	James Cameron	Action Adventure Fantasy Sci-Fi	CCH Pounder	760505847	PG-13	By 2154, humans have depleted Earth's natural resources, leading to a severe ...
Batman v Superman: Dawn of Justice	Zack Snyder	Action Adventure Sci-Fi	Henry Cavill	330249062	PG-13	Eighteen months after the destructive battle with General Zod ...
Spectre	Sam Mendes	Action Adventure Thriller	Christoph Waltz	200074175	PG-13	Following Gareth Mallory's promotion to M, James Bond ...
Captain America: Civil War	Anthony Russo	Action Adventure Sci-Fi	Robert Downey Jr.	407197282	PG-13	In 1991, the brainwashed super-soldier James "Bucky" Barnes is dispatched ...
Tangled	Nathan Greno	Adventure Animation Comedy Family Fantasy Musical Romance	Brad Garrett	200807262	PG	Long ago, a drop of sunlight became a golden flower capable of healing ...

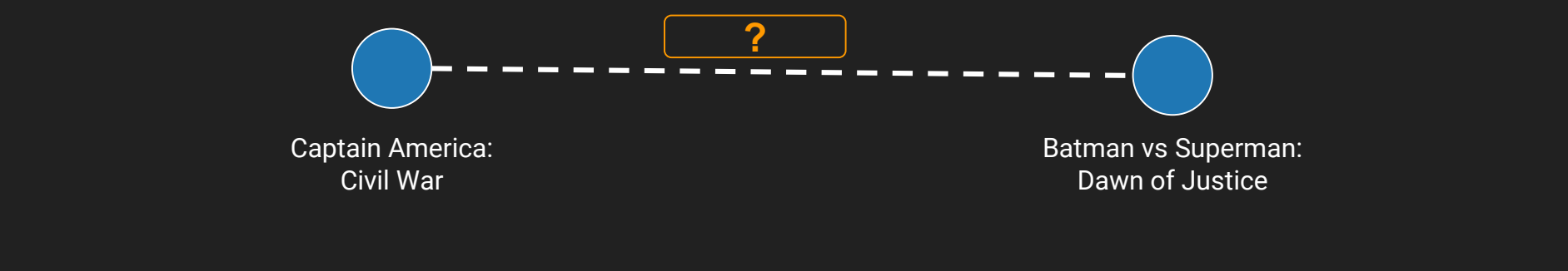


Captain America:
Civil War



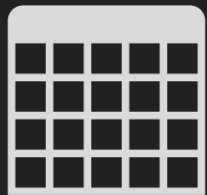
Batman vs Superman:
Dawn of Justice

movie_title	director_name	genres	lead_actor	budget	content_rating	plot_summary
Avatar	James Cameron	Action Adventure Fantasy Sci-Fi	CCH Pounder	760505847	PG-13	By 2154, humans have depleted Earth's natural resources, leading to a severe ...
Batman v Superman: Dawn of Justice	Zack Snyder	Action Adventure Sci-Fi	Henry Cavill	330249062	PG-13	Eighteen months after the destructive battle with General Zod ...
Spectre	Sam Mendes	Action Adventure Thriller	Christoph Waltz	200074175	PG-13	Following Gareth Mallory's promotion to M, James Bond ...
Captain America: Civil War	Anthony Russo	Action Adventure Sci-Fi	Robert Downey Jr.	407197282	PG-13	In 1991, the brainwashed super-soldier James "Bucky" Barnes is dispatched ...
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movie_title	director_name	genres	lead_actor	budget	content_rating	plot_summary
Avatar	James Cameron	Action Adventure Fantasy Sci-Fi	CCH Pounder	760505847	PG-13	By 2154, humans have depleted Earth's natural resources, leading to a severe ...
Batman v Superman: Dawn of Justice	Zack Snyder	Action Adventure Sci-Fi	Henry Cavill	330249062	PG-13	Eighteen months after the destructive battle with General Zod ...
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Tangled	Nathan Greno	Adventure Animation Comedy Family Fantasy Musical Romance	Brad Garrett	200807262	PG	Long ago, a drop of sunlight became a golden flower capable of healing ...

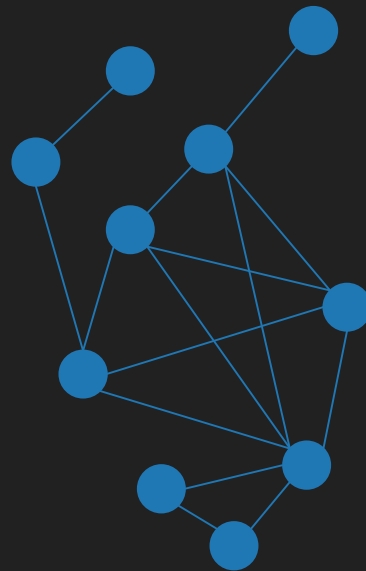




Tabular Dataset



Node &
Edge Tables



Visualization

Network Modeling

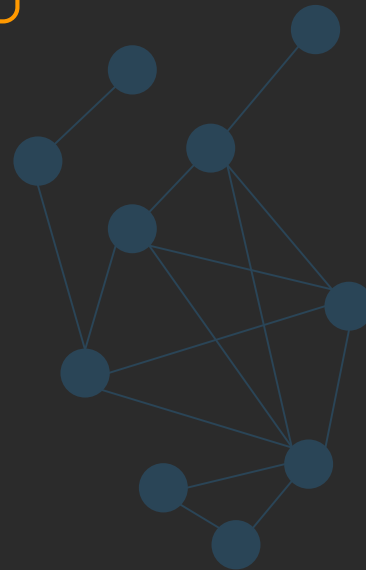
Network Exploration



Tabular Dataset



Node &
Edge Tables



Visualization

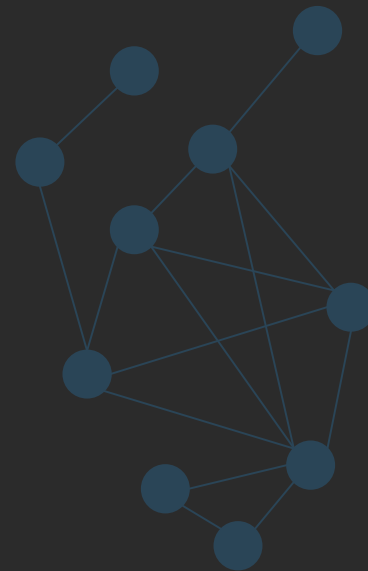


**Size & complexity
of the dataset**

Tabular Dataset



Node &
Edge Tables



Visualization

movie_title	director_name	genres	lead_actor	budget	content_rating	plot_summary
Avatar	James Cameron	Action Adventure Fantasy Sci-Fi	CCH Pounder	760505847	PG-13	By 2154, humans have depleted Earth's natural resources, leading to a severe ...
Batman v Superman: Dawn of Justice	Zack Snyder	Action Adventure Sci-Fi	Henry Cavill	330249062	PG-13	Eighteen months after the destructive battle with General Zod ...
Spectre	Sam Mendes	Action Adventure Thriller	Christoph Waltz	200074175	PG-13	Following Gareth Mallory's promotion to M, James Bond ...
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Avatar	James Cameron	Action Adventure Fantasy Sci-Fi	CCH Pounder	760505847	PG-13	By 2154, humans have depleted Earth's natural resources, leading to a severe ...
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Captain America: Civil War	Anthony Russo	Action Adventure Sci-Fi	Robert Downey Jr.	407197282	PG-13	In 1991, the brainwashed super-soldier James "Bucky" Barnes is dispatched ...
Tangled	Nathan Greno	Adventure Animation Comedy Family Fantasy Musical Romance	Brad Garrett	200607262	PG	Long ago, a drop of sunlight became a golden flower capable of healing ...



Common keywords
Same length
etc.



Mid-ranged values

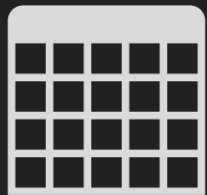
movie_title	director_name	genres	lead_actor	budget	content_rating	plot_summary	num_critic_for_reviews	duration	title_year	country	num_user_for_reviews
Avatar	James Cameron	Action Adventure Fantasy Sci-Fi	CCH Pounder	760505847	PG-13	By 2154, humans have depleted Earth's ...	723	178	2009	USA	3054
Batman v Superman: Dawn of Justice	Zack Snyder	Action Adventure Sci-Fi	Henry Cavill	330249062	PG-13	Eighteen months after the destructive ...	673	183	2016	USA	3018
Spectre	Sam Mendes	Action Adventure Thriller	Christoph Waltz	200074175	PG-13	Following Gareth Mallory's promotion to M, James Bond ...	602	148	2015	UK	994
Captain America: Civil War	Anthony Russo	Action Adventure Sci-Fi	Robert Downey Jr.	407197282	PG-13	In 1991, the brainwashed super-soldier ...	516	147	2016	USA	1022
Tangled	Nathan Greno	Adventure Animation Comedy Family Fantasy Musical Romance	Brad Garrett	200807262	PG	Long ago, a drop of sunlight ...	324	100	2010	USA	387



x10

movie_title	direct or_name	genres	lead_actor	budget	content_rating	plot_summary	num_critics_for_reviews	duration	title_year	country	num_users_for_reviews	x	x	x	x	x	x	x	x	x	x
Avatar	James Cameron	Action Adventure Sci-Fi	CCH Pounder	760505847	PG-13	By 2154, ...	723	178	2009	USA	3054	xx	xx	x	x	x	xxxx	xxx	x	x	x
Batman v Superman: Dawn of Justice	Zack Snyder	Action Adventure Sci-Fi	Henry Cavill	330249062	PG-13	Eighteen months ...	673	183	2016	USA	3018	x	x	x	x	x	x	x	x	x	xx
Spectre	Sam Mendes	Action Adventure Thriller	Christoph Waltz	200074175	PG-13	Following Gareth ...	602	148	2015	UK	994	x	x	x	x	xxxxx	xxx	xx	x	x	xxxx
Captain America: Civil War	Anthony Russo	Action Adventure Sci-Fi	Robert Downey Jr.	407197282	PG-13	In 1991, ...	516	147	2016	USA	1022	x	x	x	x	x	x	x	x	x	x
Tangled	Nathan Greno	Adventure Animation Comedy Family Fantasy Musical Romance	Brad Garrett	200807262	PG	Long ago, ...	324	100	2010	USA	387	xxx	xx	xx	xxx	xx	x	x	x	x	xxx



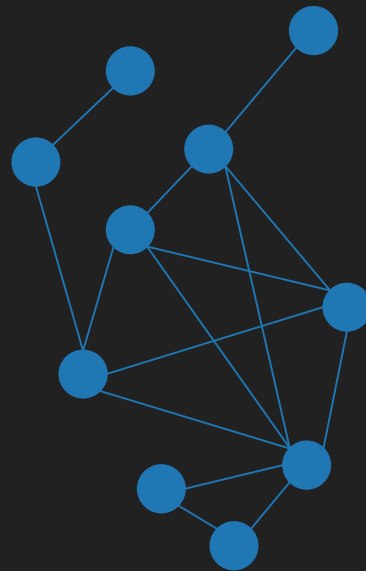


Tabular Dataset

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Node &
Edge Tables



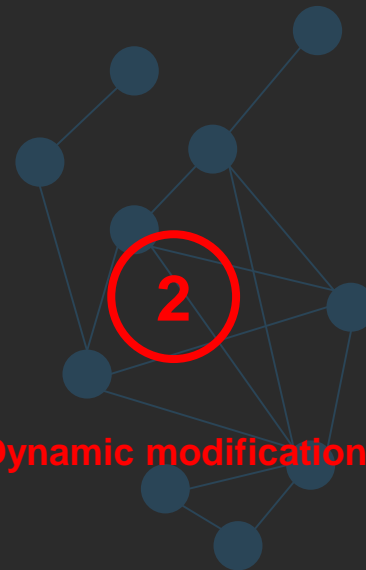
Visualization



Tabular Dataset

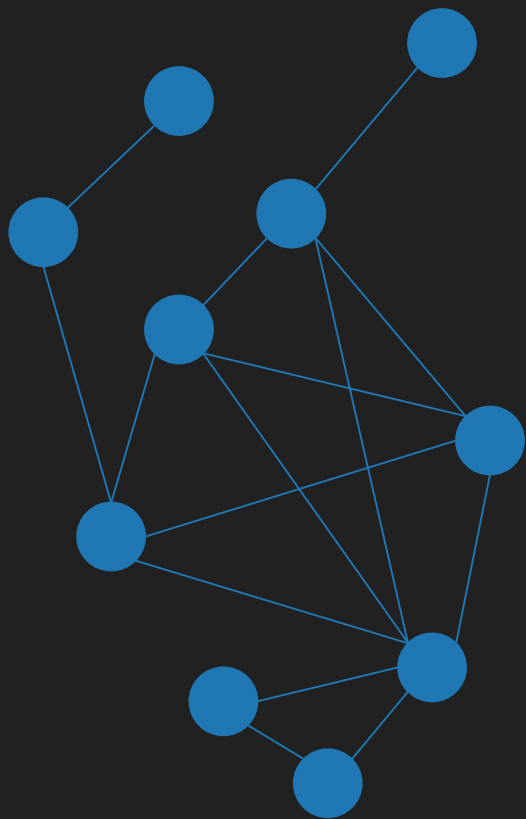


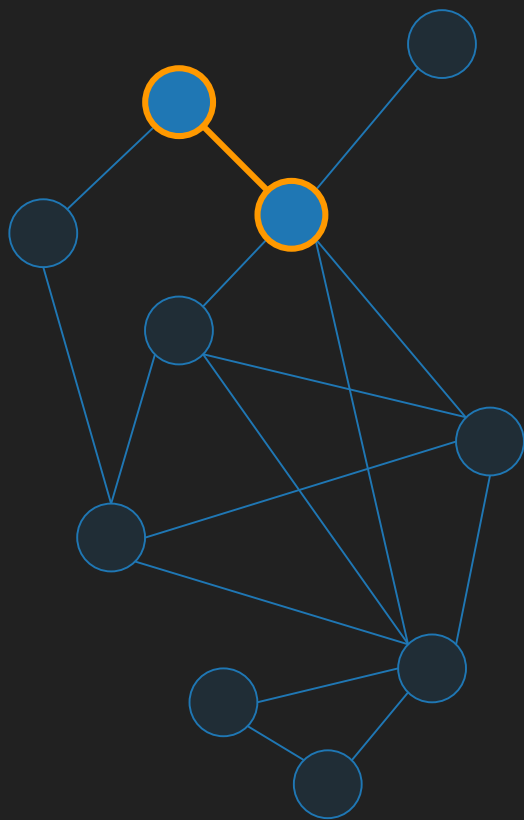
Node &
Edge Tables



Dynamic modification

Visualization



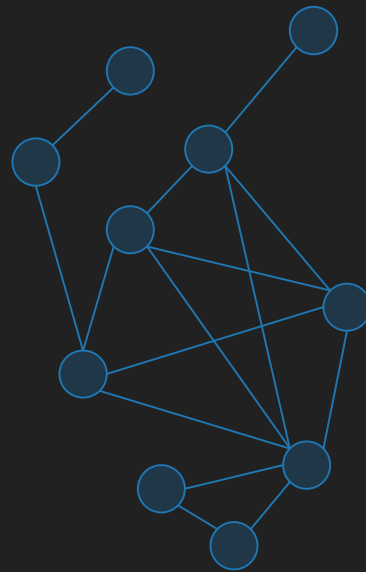




Tabular Dataset



Node &
Edge Tables



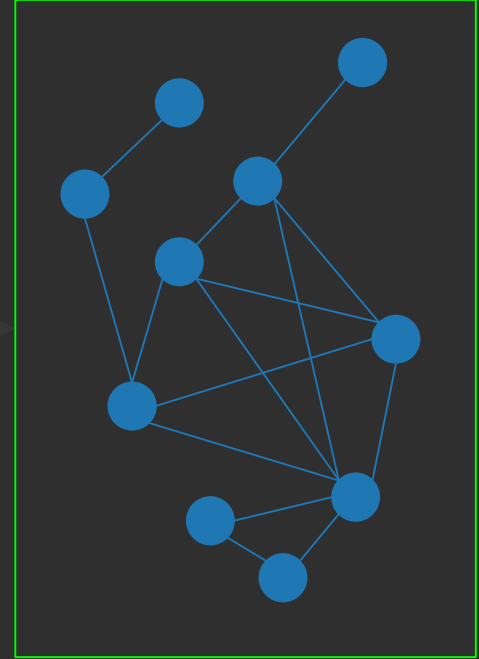
Visualization

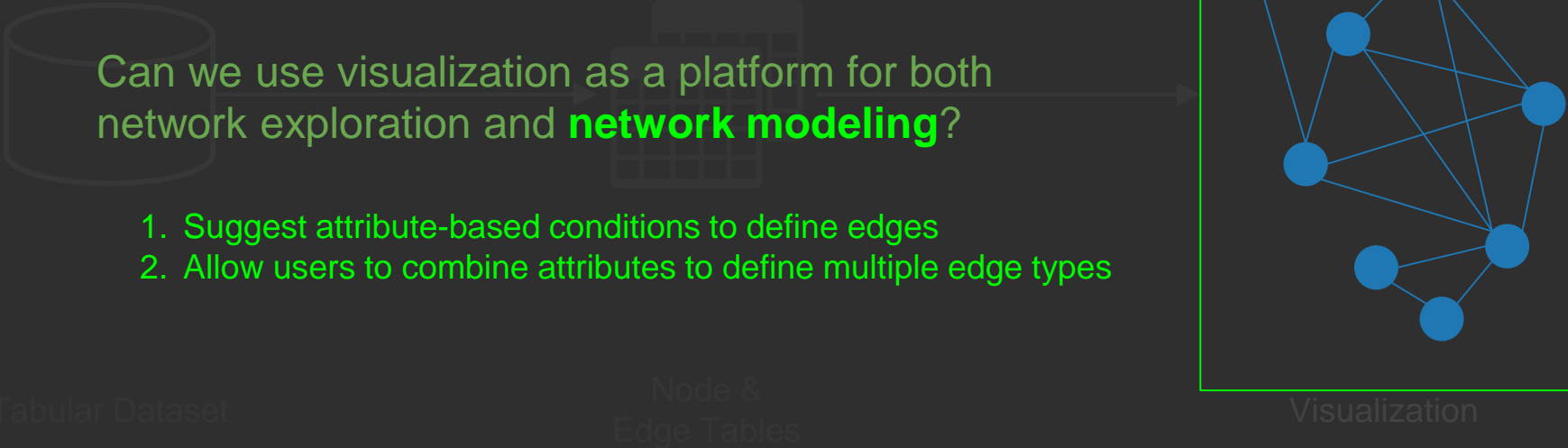
Can we use **visualization** as a platform for both **network exploration** and **network modeling**?

Tabular Dataset

Node &
Edge Tables

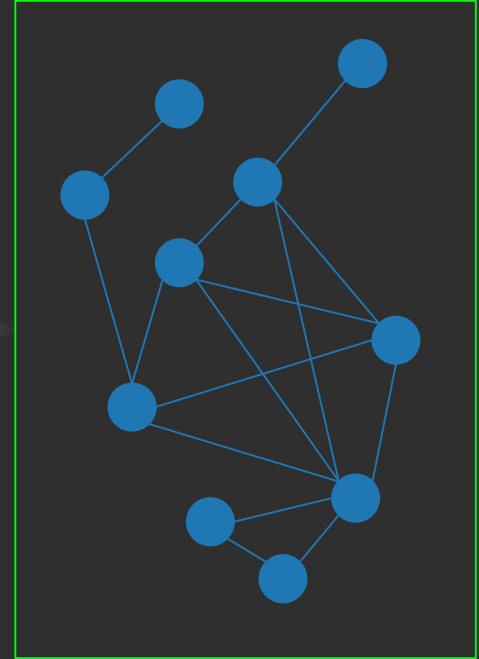
Visualization





Can we use visualization as a platform for both network exploration and **network modeling**?

1. Suggest attribute-based conditions to define edges
2. Allow users to combine attributes to define multiple edge types



Tabular Dataset

Node &
Edge Tables

Visualization

> Network Metrics

COMPUTE

> Node Details

Hover over a node.



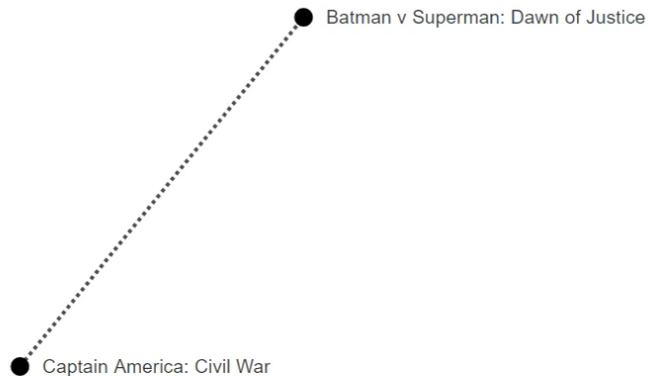
Recommendations

Demonstrate edges on the canvas to get recommendations.

Edge Types

Specify conditions to create edge types.

SPECIFY A MANUAL CONDITION



> Network Metrics

COMPUTE

> Node Details

- actor_1_name: Henry Cavill
- actor_2_name: Lauren Cohan
- actor_3_name: Alan D. Purwin
- budget: 250000000
- content_rating: PG-13
- director_name: Zack Snyder
- duration: 183
- genres: Action,Adventure,Sci-Fi
- gross: 330249062
- imdb_score: 6.9
- movie_facebook_likes: 197000
- movie_imdb_link:
http://www.imdb.com/title/tt2975590/?ref_=fn_tt_tt_1

Recommendations

Based on the link(s) drawn between Captain America: Civil War ↔ Batman v Superman: Dawn of Justice

Same value for **budget**

Value for **content_rating** is [PG-13](#)

Common values for **content_rating**

Value for **genres** is [Action, Adventure, Sci-Fi](#)

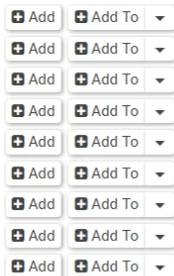
Common values for **genres**

Topics in **plot_summary** include [based on comic book, superhero](#)

Common topics in **plot_summary**

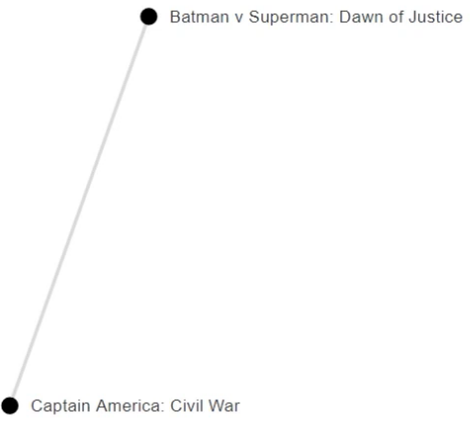
Value for **title_year** is [2016](#)

Common values for **title_year**



Edge Types

+ SPECIFY A MANUAL CONDITION



> Network Metrics

COMPUTE

> Node Details

- actor_1_name: Henry Cavill
- actor_2_name: Lauren Cohan
- actor_3_name: Alan D. Purwin
- budget: 250000000
- content_rating: PG-13
- director_name: Zack Snyder
- duration: 183
- genres: Action,Adventure,Sci-Fi
- gross: 330249062
- imdb_score: 6.9
- movie_facebook_likes: 197000
- movie_imdb_link: http://www.imdb.com/title/tt2975590/?ref_=fn_tt_1
- movie_title: Batman v Superman: Dawn of Justice
- plot_keywords: based on comic book,batman,sequel to a reboot,superhero,superman
- title_year: 2016

Recommendations

Based on the link(s) drawn between Captain America: Civil War ↔ Batman v Superman: Dawn of Justice

Value for content_rating is [PG-13](#)

Common values for content_rating

Common values for genres

Topics in plot_summary include [based on comic book](#), [superhero](#)

Value for title_year is [2016](#)

Common values for title_year

Add

Add To

Add

Add To

Add

Add To

Add

Add To

Add

Add To

Add

Add To

Edge Types

SPECIFY A MANUAL CONDITION

Shown

Similar movies

Editable

Same value for budget

Value for genres is

ACTION, ADVENTURE, SCI-FI

Common topics in plot_summary

Remove

Remove

Remove

● Iron Man 2

● Rush Hour 3

● Mission: Impossible - Rogue Nation

● Mars Needs Moms

● Minority Report

● Exodus: Gods and Kings

● Bolt

> Network Metrics

COMPUTE

> Node Details

- actor_1_name: Tom Cruise
- actor_2_name: Jeremy Renner
- actor_3_name: Sean Harris
- budget: 150000000
- content_rating: PG-13
- director_name: Christopher McQuarrie
- duration: 131
- genres: Action,Adventure,Thriller
- gross: 195000874
- imdb_score: 7.4
- movie_facebook_likes: 47000
- movie_imdb_link:
http://www.imdb.com/title/tt2381249/?ref_=fn_tt_tt_1
- movie_title: Mission: Impossible - Rogue Nation
- plot_keywords: capture,computer hacker,mission,rogue agent,spy
- title_year: 2015

Recommendations

Edge Types

SPECIFY A MANUAL CONDITION

Shown Similar movies Editable

Same value for budget

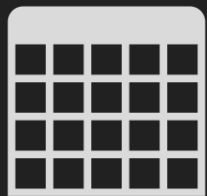
Remove

Value for genres is ACTION, ADVENTURE, SCI-FI

Remove

Common topics in plot_summary

Remove

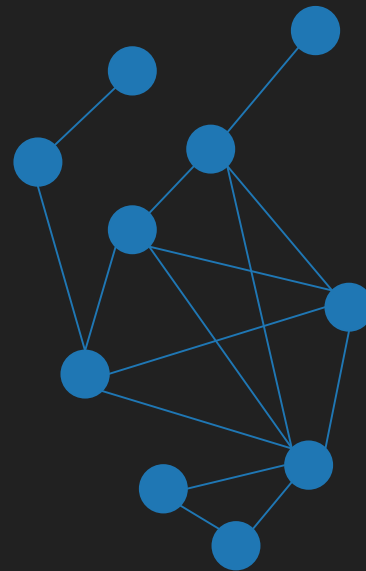


Tabular Dataset

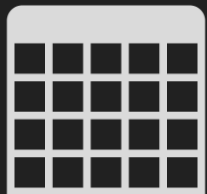
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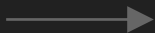


Node &
Edge Tables



Visualization

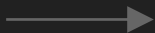




Batman v
Superman

Captain
America

Avengers



Batman v
Superman

Captain
America

Avengers



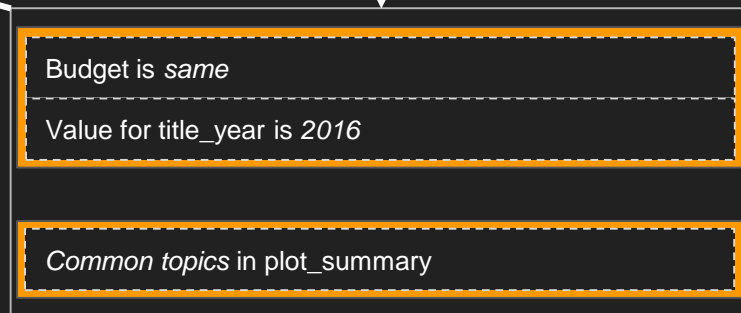
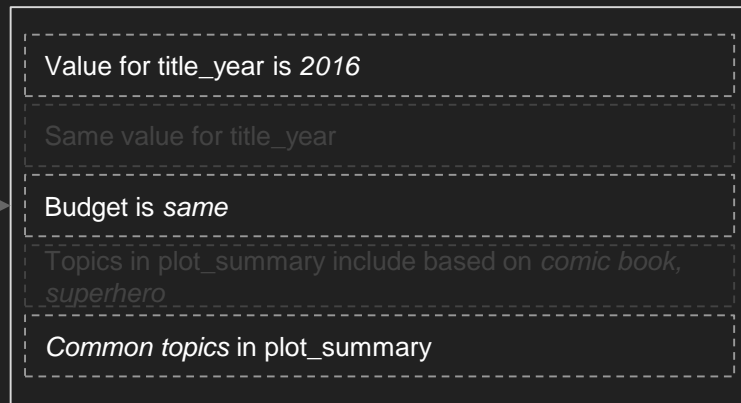
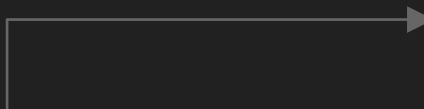
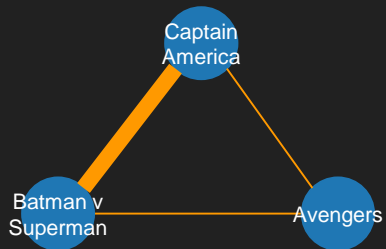
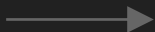
Value for **content_rating** is *PG-13*

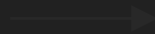
Same value for **content_rating**

Budget is *same*

Topics in **plot_summary** include based on *comic book*,
superhero

Common topics in **plot_summary**





Value for **title_year** is 2016

Same value for **title_year**

Budget is *same*

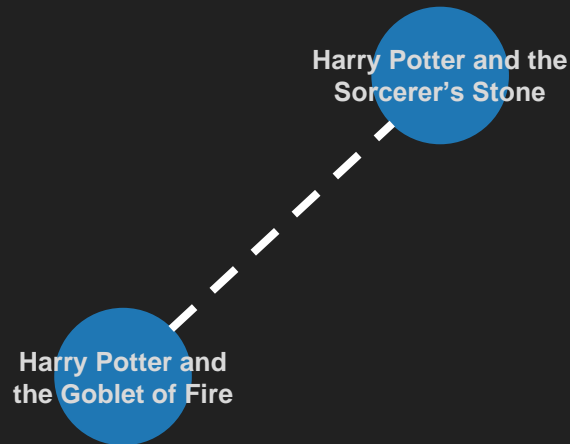
Topics in **plot_summary** include based on *comic book*, *superhero*

Common topics in **plot_summary**

Budget is *same*

Value for **title_year** is 2016

Common topics in **plot_summary**



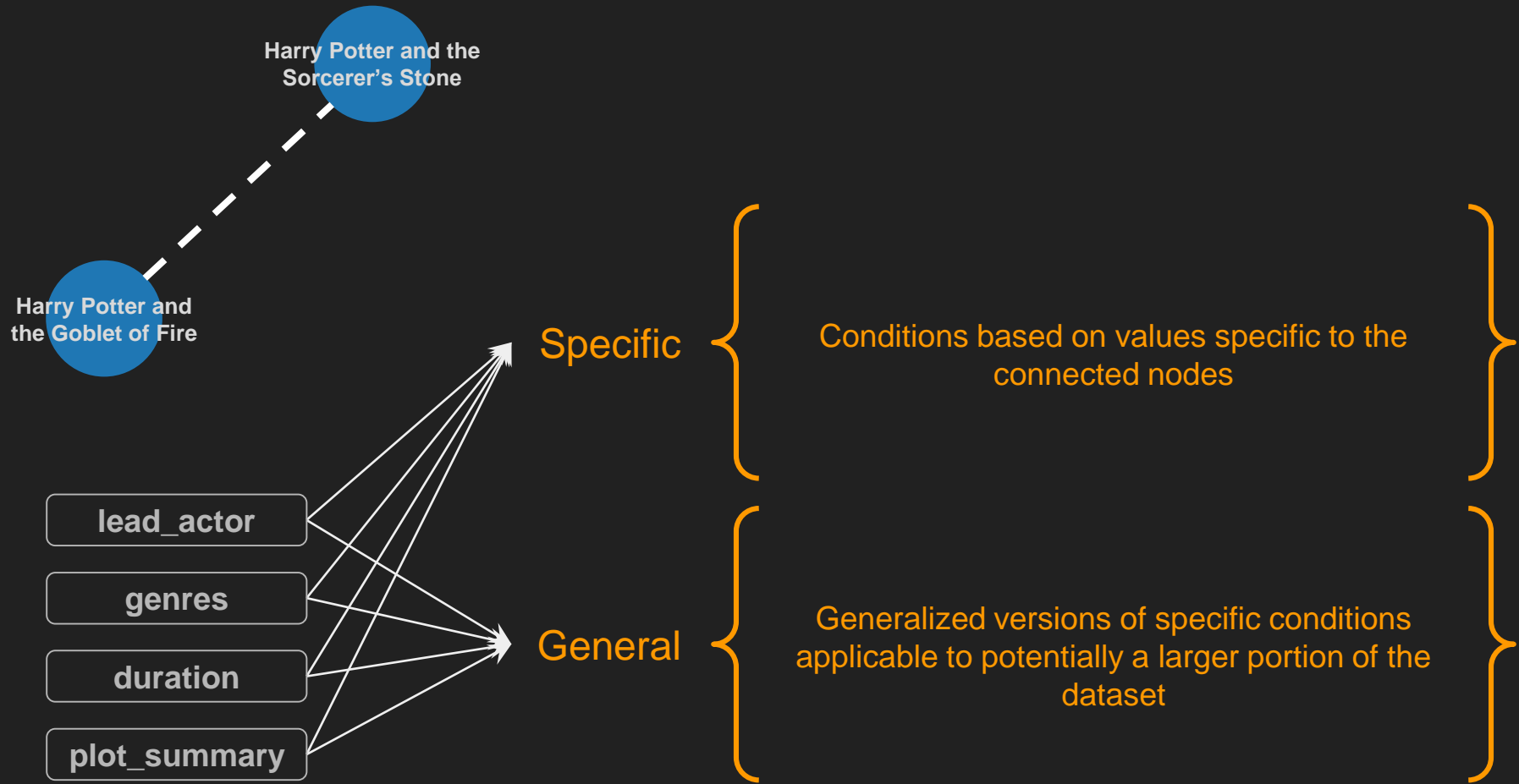
“ABC”

[“ABC”, “ABC”,...]

123

T 

movie	lead_actor	genres	duration	plot_summary
Harry Potter and the Sorcerer's Stone	Daniel Radcliffe	Adventure Family Fantasy Mystery	159	Harry Potter is an average bespectacled 11 year old boy ...
Harry Potter and the Goblet of Fire	Daniel Radcliffe	Adventure Family Fantasy	157	Harry's fourth year at Hogwarts is about to start ...



Harry Potter and
the Goblet of Fire

Harry Potter and the
Sorcerer's Stone

lead_actor

genres

duration

plot_summary

Specific

Connect **movies** if **lead_actor** is "*Daniel Radcliffe*"



General

Connect **movies** if **lead_actor** is same



Harry Potter and
the Goblet of Fire

Harry Potter and the
Sorcerer's Stone

lead_actor

genres

duration

plot_summary

Specific

Connect **movies** if genres contains [*"adventure"*, *"family"*,
"fantasy"]



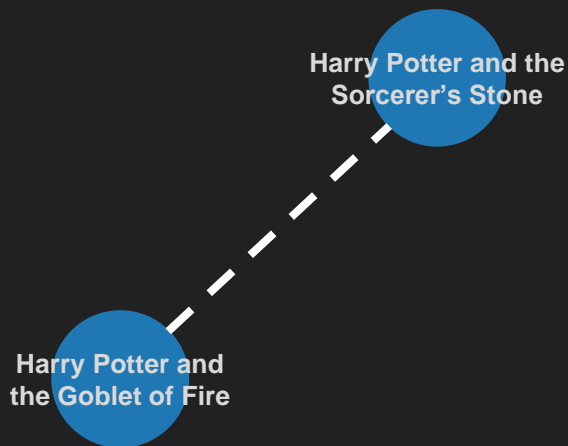
General

Connect **movies** if **genres** has common values

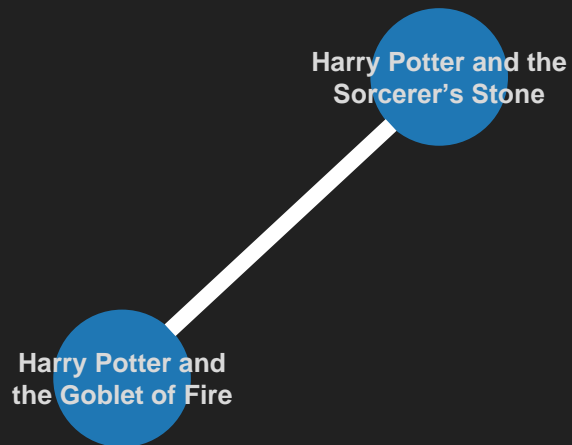


Can we use visualization as a platform for both network exploration and network modeling?

1. Suggest attribute-based conditions to define edges



lead_actor	Connect movies if lead_actor is "Daniel Radcliffe"	✓	✗
	Connect movies if lead_actor is same	✓	✗
genres	Connect movies if genres contains ["adventure", "family", "fantasy"]	✓	✗
	Connect movies if genres has common values	✓	✗
duration	Connect movies if difference between duration [=, ≤] 2	✓	✗
	Connect movies if duration is in "mid-range"	✓	✗
	Connect movies if duration is in the same range	✓	✗
plot_summary	Connect movies if plot_summary has topics ["wizard"]	✓	✗
	Connect movies if plot_summary has common topics	✓	✗



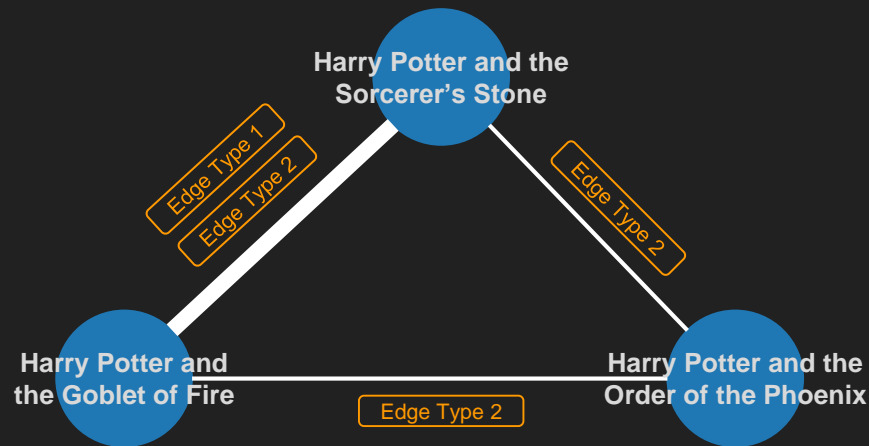
Edge Type 1

Connect **movies** if **plot_summary** has common topics

OR

Edge Type 2

Connect **movies** if difference between **duration** $[=, \leq] 2$



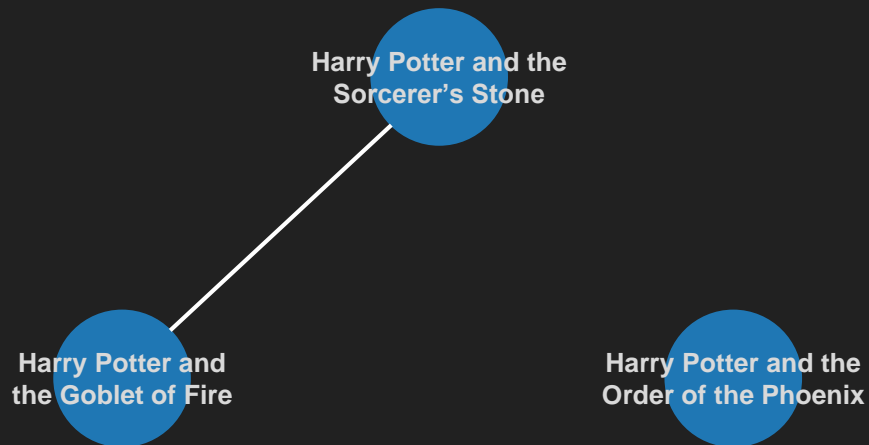
Edge Type 1

Connect **movies** if **plot_summary** has common topics

OR

Edge Type 2

Connect **movies** if difference between **duration** $[=, \leq] 2$



AND

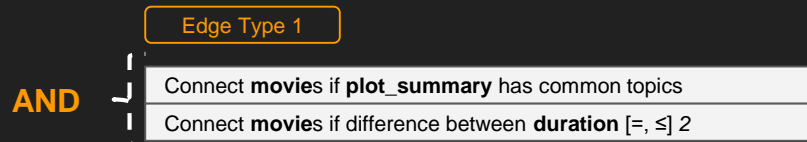
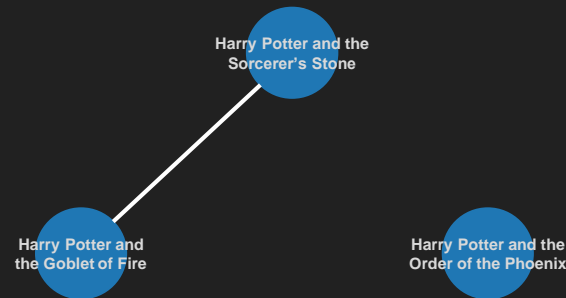
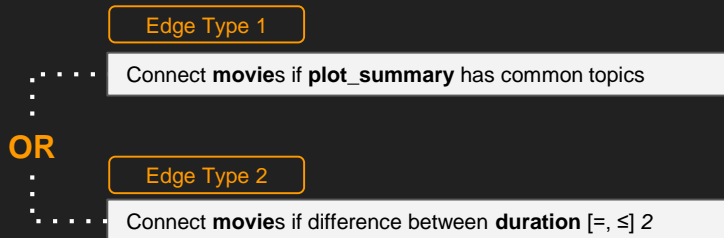
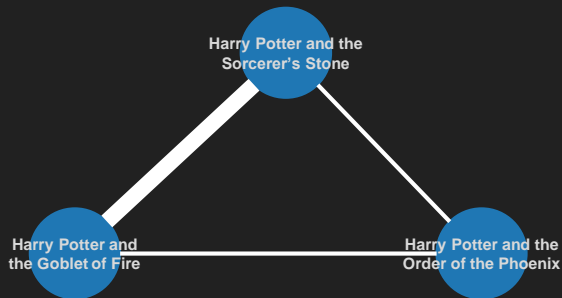
Edge Type 1

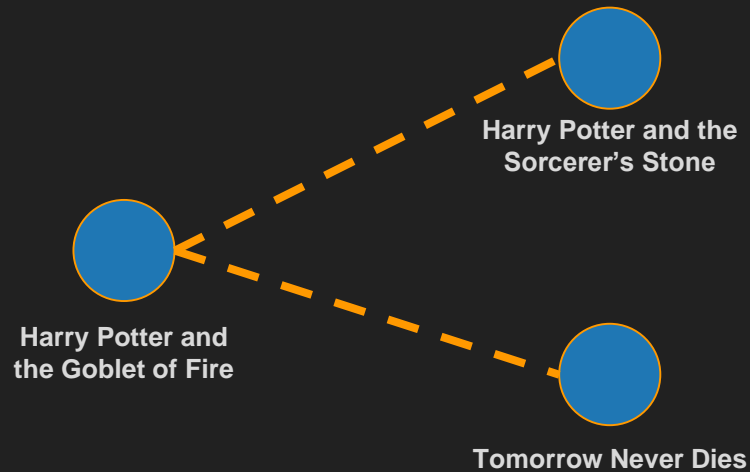
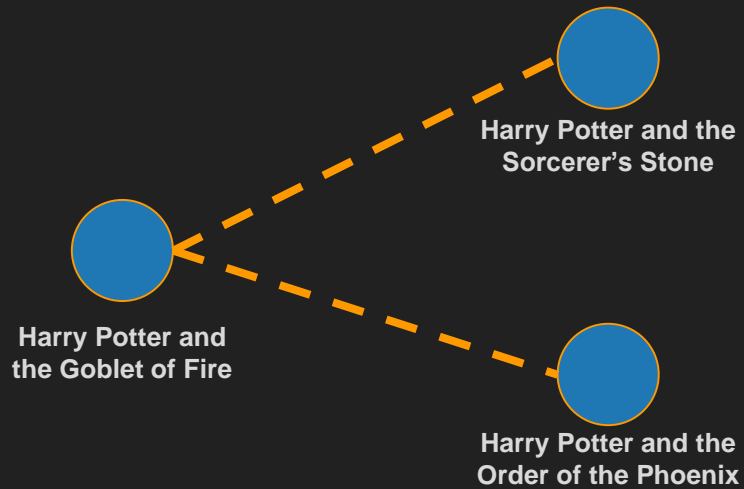
Connect **movies** if **plot_summary** has common topics

Connect **movies** if difference between **duration** [=, ≤] 2

Can we use visualization as a platform for both network exploration and network modeling?

2. Allow users to combine attributes to define multiple edge types



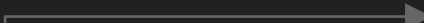
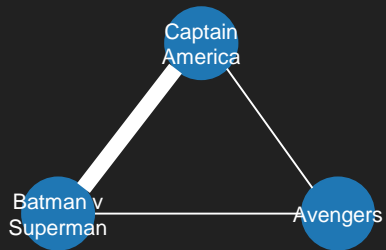
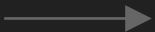
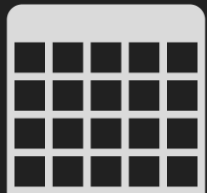


Connect **movies** if **lead_actor** is "*Daniel Radcliffe*"



Connect **movies** if **lead_actor** has same value





Value for title_year is 2016

Same value for title_year

Budget is *same*

Topics in plot_summary include based on *comic book*, *superhero*

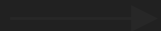
Common topics in plot_summary



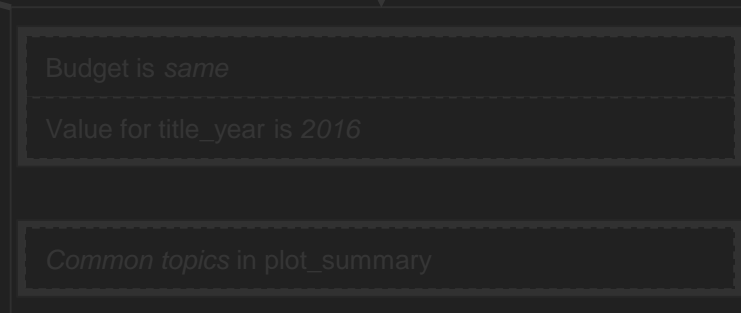
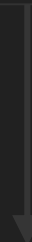
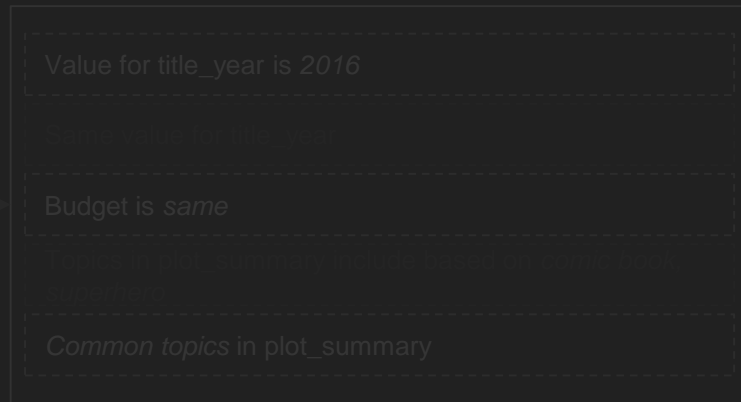
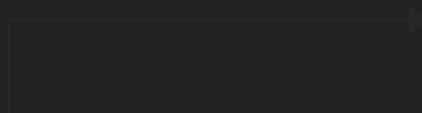
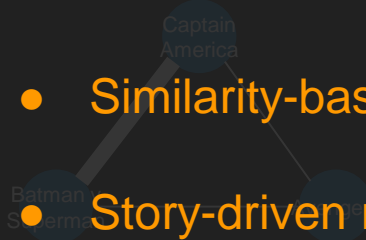
Budget is *same*

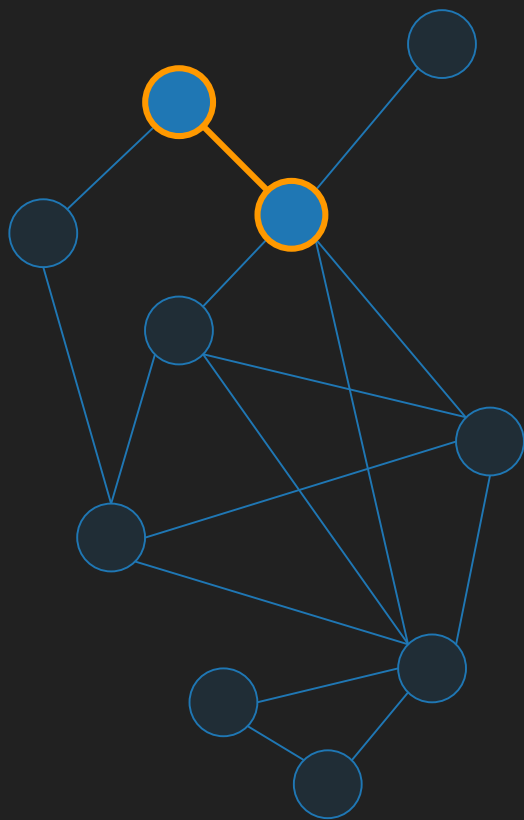
Value for title_year is 2016

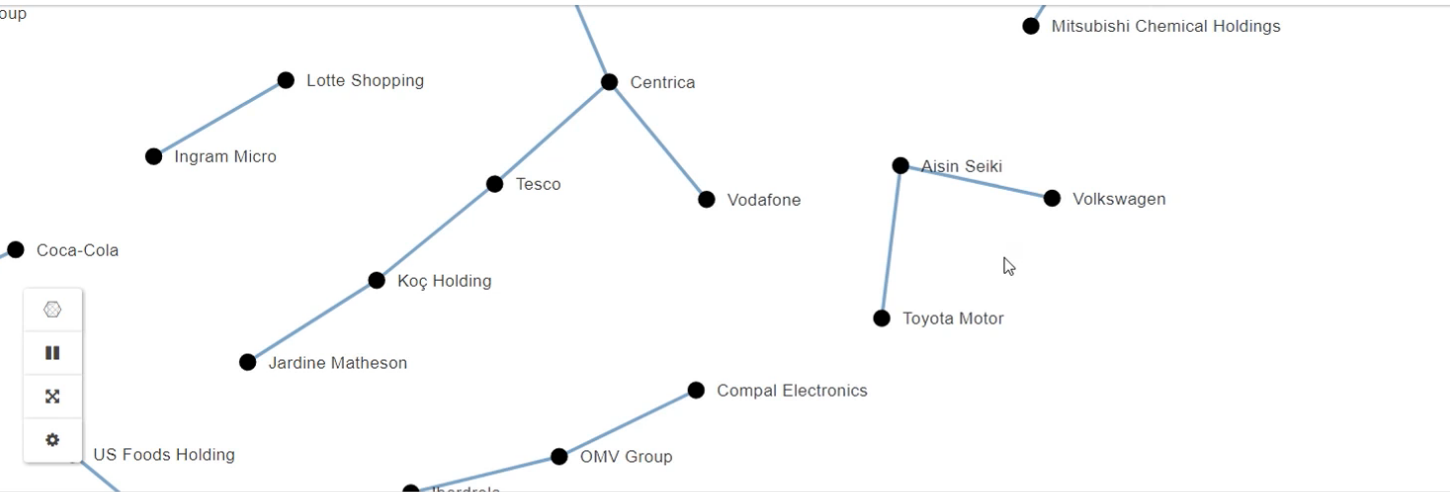
Common topics in plot_summary



- Similarity-based entity exploration
- Story-driven network construction







> Network Metrics

COMPUTE

> Node Details

- **Assets:** 192159
- **CeoTitle:** Chief Executive, Director
- **City:** Newbury
- **Country:** Britain
- **EconomicPole:** Developed
- **Employees:** 111684
- **Industry:** Telecommunications
- **MarketValue:** 0
- **Name:** Vodafone
- **Profits:** -6058.7
- **Region:** Europe
- **Revenue:** 61690
- **State:** 0
- **Ticker:** VOD

Recommendations

Demonstrate edges on the canvas to get recommendations.

Edge Types

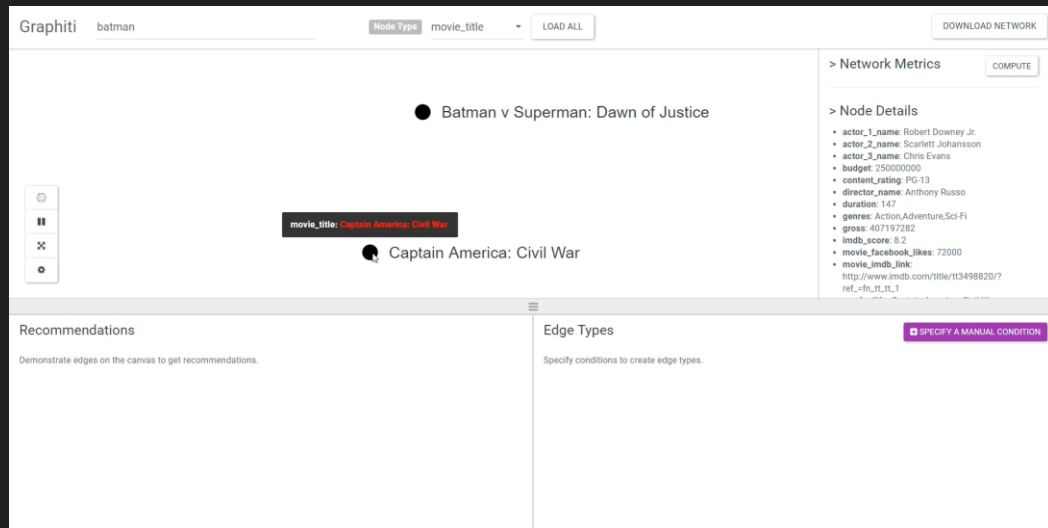
Specify conditions to create edge types.

SPECIFY A MANUAL CONDITION

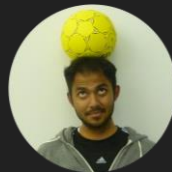
Graphiti: Interactive Specification of Attribute-based Edges for Network Modeling and Visualization

Using visualization as a platform for network exploration and modeling by:

- Suggesting attribute-based linking conditions
- Allowing users to define multiple edge types by combining conditions



Thank you



Arjun Srinivasan
<http://arjun010.github.io/>



Hyunwoo Park



Alex Endert



Rahul C. Basole

