Neo4j

But first..

What is the problem we are trying to solve?

Download More Graphics - www.psdgraphics.com

"Web 2.0" actually used to be a meaningful term..

"Every user is a producer", leading to write-heavy load.

Users create messy, semi structured, data.

They create lots of it.

The average salary in this room is not enough
I want to know who will most likely buy me a beer

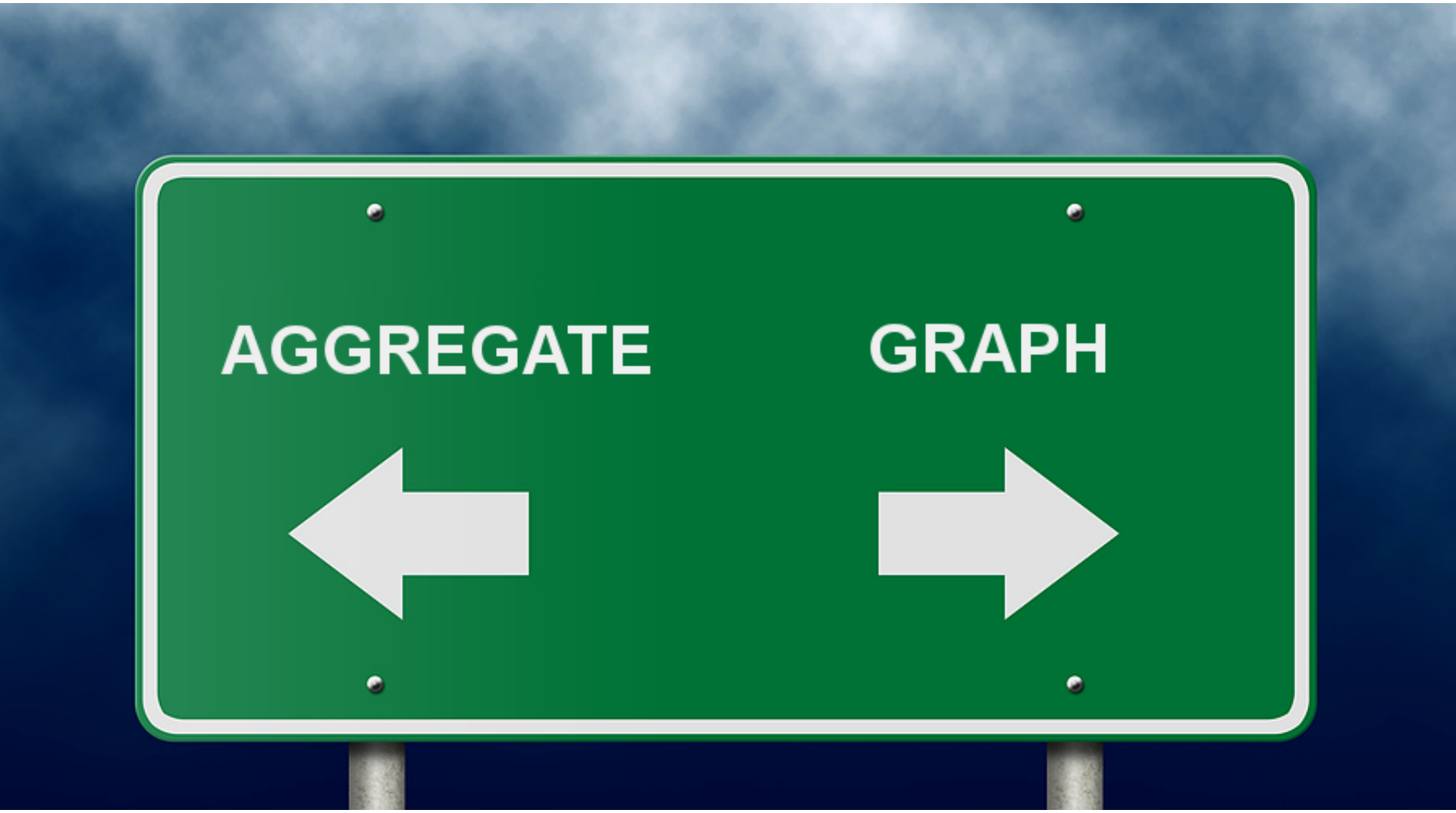
Waterfall is now a curse word in the IT sector

The database schema needs to evolve with my continuously deployed applications.

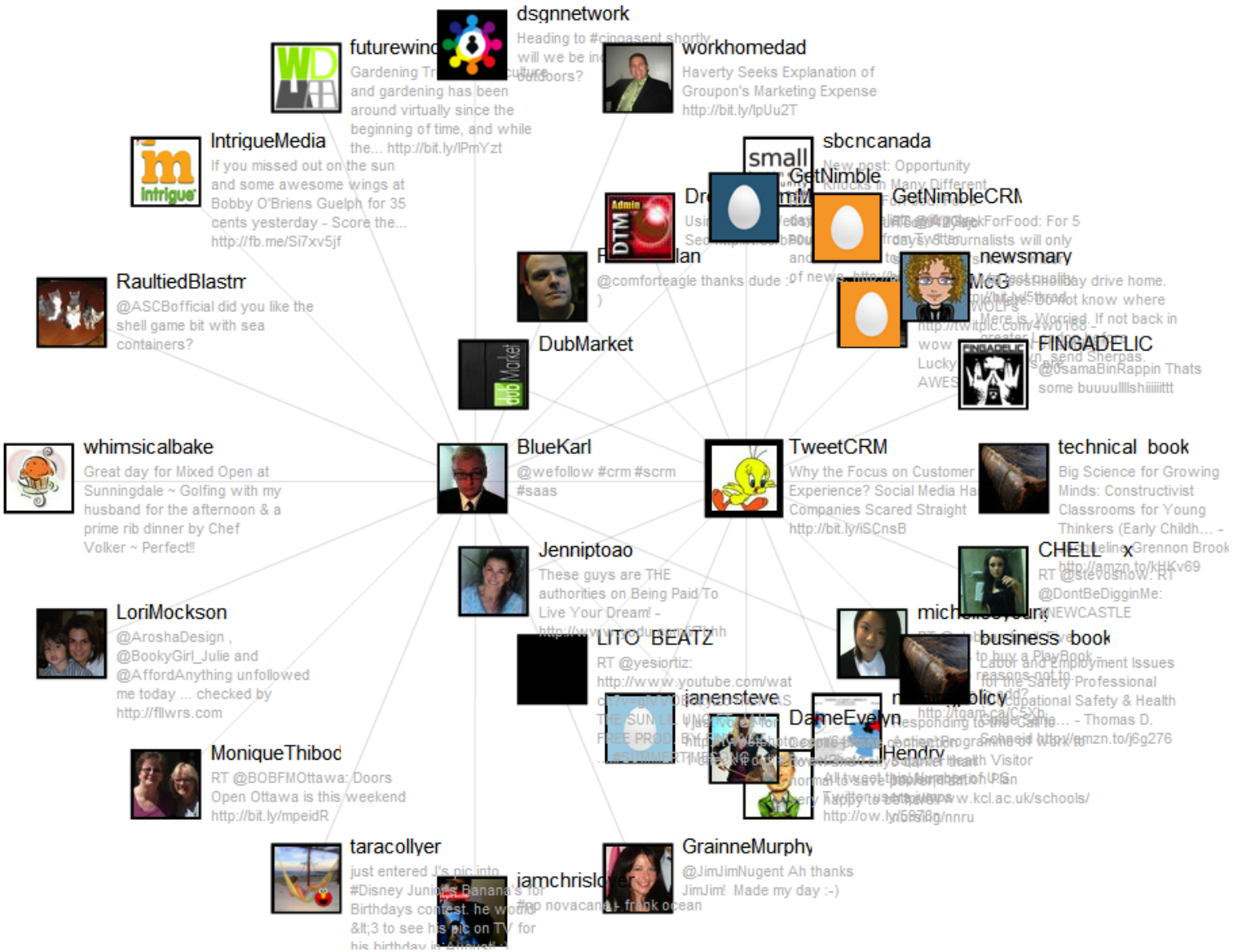
```
def complexity(size, semi_structure, connectedness):
```

```
def complexity(size, semi_structure, connectedness):
```

We've handled this by de-normalizing, aggregating information.


AGGREGATE
GRAPH

Follow the white rabbit,
into the world of graphs.


dsgnnetwork
Heading to #cingasent shortly
will we be in
outdoors?
futurewind
Gardening Tr
culture
and gardening has been
around virtually since the
beginning of time, and while
the... http://bit.ly/lPmYzt
workhomedad
Haverty Seeks Explanation of
Groupon's Marketing Expense
http://bit.ly/lpUu2T
IntrigueMedia
If you missed out on the sun
and some awesome wings at
Bobby O'Briens Guelph for 35
cents yesterday - Score the...
http://fb.me/Si7xv5jf
sbcncanada
New post: Opportunity
Knocks in Many Different
GetNimble
GetNimbleCRM
Dr
Usi
Sec
and
of news
FreeFoodForJournalists will only
days
RaultiedBlastm
@ASCBofficial did you like the
shell game bit with sea
containers?
@comfortteagle thanks dude :
)
newsmary
McG
Mere is. Worried. If not back in
wow
Lucky
AWES
DubMarket
FINGADELIC
send Sherpas.
@OsamaBinRappin Thats
some buuuulllshiiiiittt
whimsicalbake
Great day for Mixed Open at
Sunningdale ~ Golfing with my
husband for the afternoon & a
prime rib dinner by Chef
Volker ~ Perfect!!
BlueKarl
@wefollow #crm #scrm
#saas
TweetCRM
Why the Focus on Customer
Experience? Social Media Ha
Companies Scared Straight
http://bit.ly/iSCnsB
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Big Science for Growing
Minds: Constructivist
Classrooms for Young
Thinkers (Early Childh... -
Jenniptoao
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@DontBeDigginMe:
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LoriMockson
@AroshaDesign ,
@BookyGirl_Julie and
@AffordAnything unfollowed
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RT @yesiortiz:
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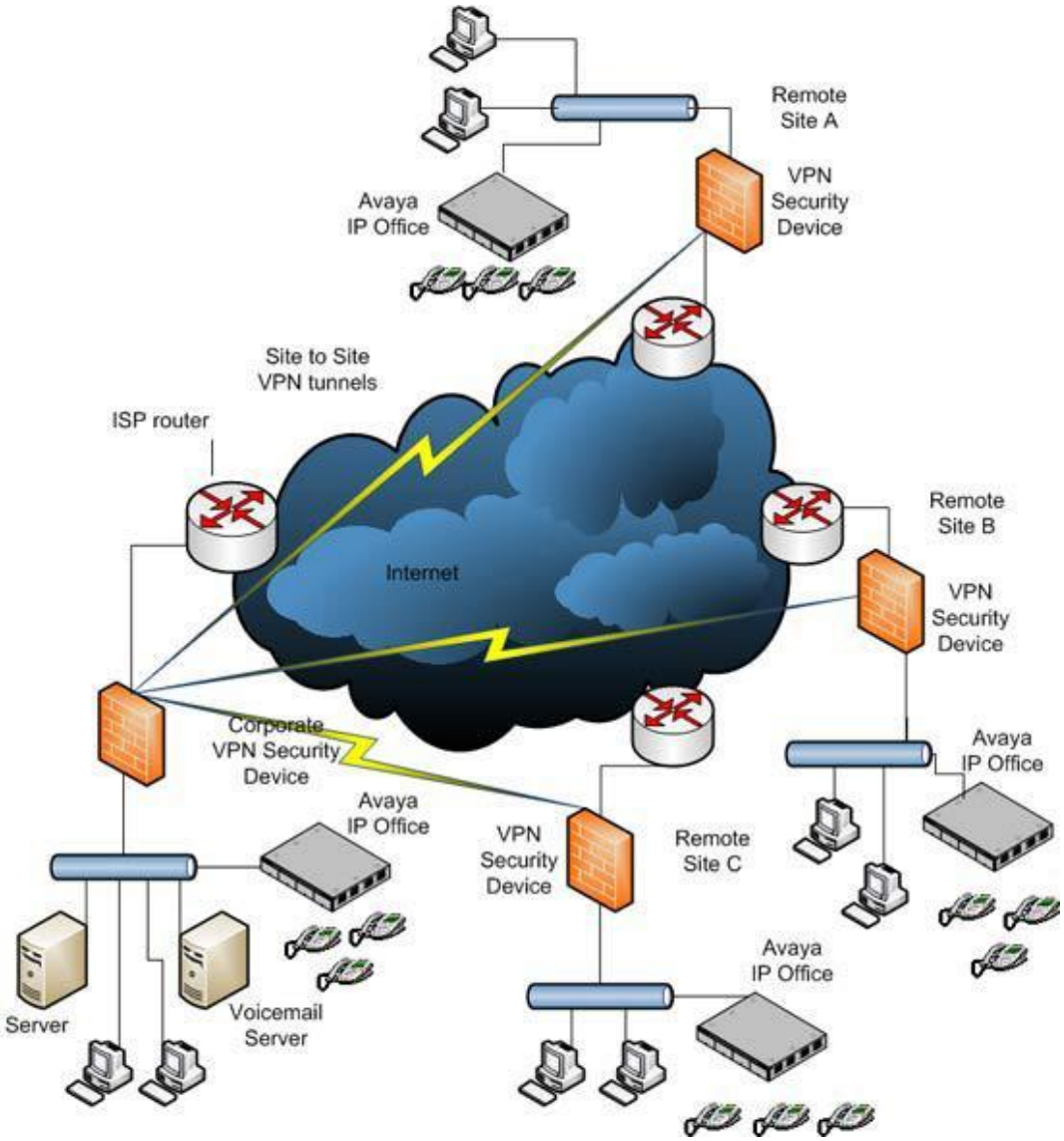
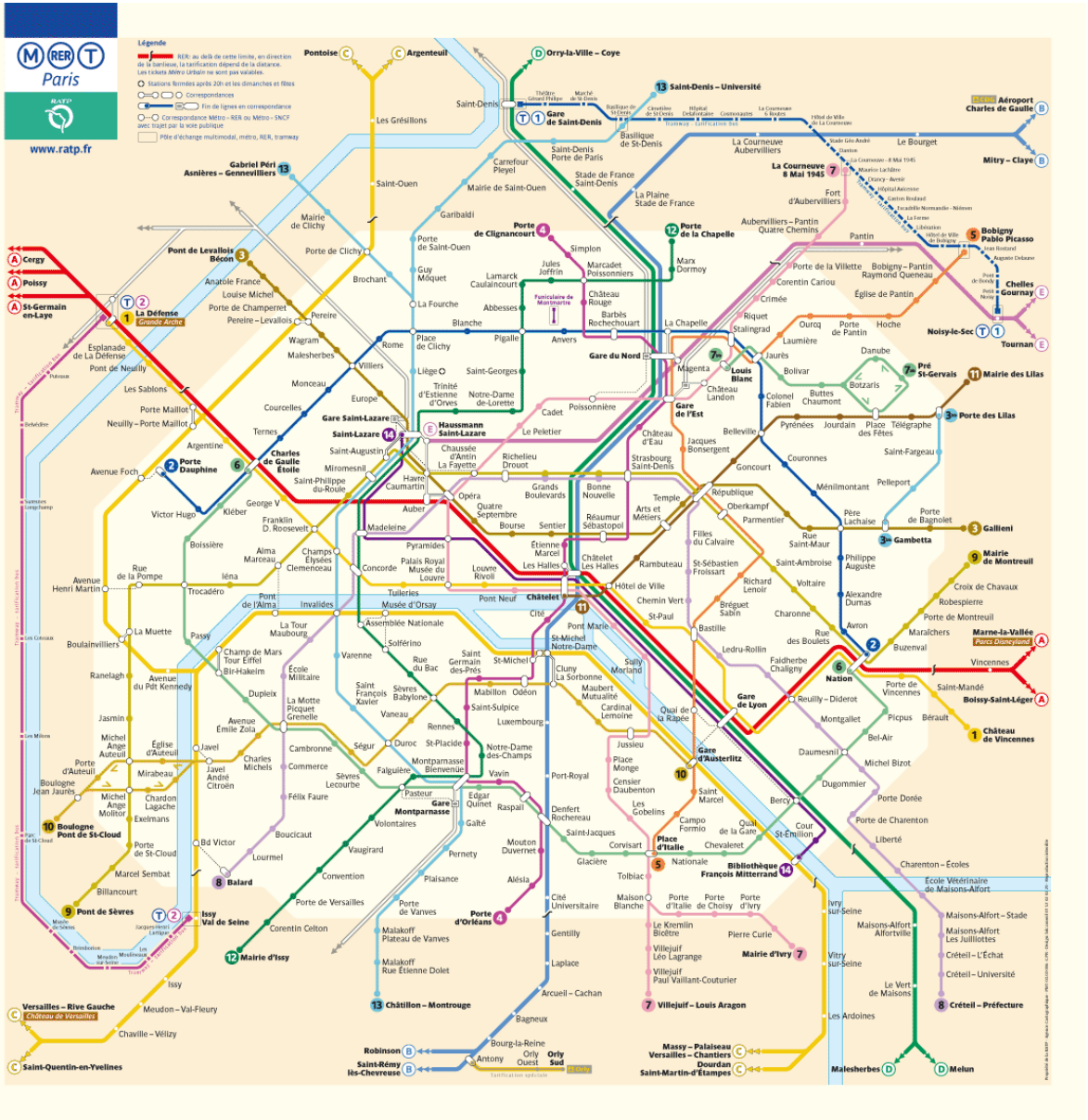
business_book
Labor and Employment Issues
reasons not to
for the Safety Professional
Occupational Safety & Health
http://tqam.ca/C5Xh
Sohaeil http://amzn.to/j6g276
janensteve
DameEvelyn
Hendry
Visitor
http://ow.ly/58738/nnru
MoniqueThibod
RT @BOBFMOttawa: Doors
Open Ottawa is this weekend
http://bit.ly/mpeidR
taracollyer
just entered J's pic into
#Disney Junior's Bananas for
Birthdays contest. he would
<3 to see his pic on TV for
jamchrislo
#np novacaine + frank ocean
GrainneMurphy
@JimJimNugent Ah thanks
JimJim! Made my day :-)


Remote
Site A
VPN
Security
Device
Avaya
IP Office
Site to Site
VPN tunnels
ISP router
Internet
Remote
Site B
VPN
Security
Device
Corporate
VPN Security
Device
Avaya
IP Office
Avaya
IP Office
VPN
Security
Device
Remote
Site C
Avaya
IP Office
Server
Voicemail
Server


Paris
www.ratp.fr
Légende
RER: au delà de cette limite, en direction de la banlieue, la tarification dépend de la distance. Les tickets Métro Urbain ne sont pas valables.
Stations fermées après 20h et les dimanches et fêtes
Correspondances
Fin de lignes en correspondance
Correspondance Métro – RER ou Métro – SNCF avec trajet par la voie publique
Pôle d'échange multimodal, métro, RER, tramway
Pontoise
Argenteuil
Orry-la-Ville – Coye
Saint-Denis – Université
Gare de Saint-Denis
Aéroport Charles de Gaulle
Mitry – Claye
Gabriel Péri Asnières – Gennevilliers
Les Grésillons
Saint-Ouen
Saint-Denis
Saint-Denis Porte de Paris
Basilique de Saint-Denis
La Courneuve Aubervilliers
La Courneuve 8 Mai 1945
Le Bourget
Stade de France Saint-Denis
Carrefour Pleyel
Mairie de Saint-Ouen
La Plaine Stade de France
Fort d'Aubervilliers
Aubervilliers – Pantin Quatre Chemins
Pantin
Bobigny Pablo Picasso
Chelles Gournay
Noisy-le-Sec
Tournan
Cergy
Poissy
St-Germain en-Laye
La Défense Grande Arche
Pont de Levallois Bécon
Mairie de Clichy
Porte de Clichy
Brochant
Porte de Saint-Ouen
Garibaldi
Porte de Clignancourt
Simplon
Marcadet Poissonniers
Jules Joffrin
Lamarck Caulaincourt
Abbesses
Funiculaire de Montmartre
Château Rouge
Barbès Rochechouart
Anatole France
Louise Michel
Porte de Champerret
Pereire – Levallois
Pereire
Wagram
Malesherbes
Villiers
Monceau
Europe
Courcelles
Rome
La Fourche
Blanche
Place de Clichy
Pigalle
Anvers
Gare du Nord
La Chapelle
Marx Dormoy
Porte de la Chapelle
Porte de la Villette
Corentin Cariou
Crimée
Riquet
Stalingrad
Laumière
Jaurès
Bolivar
Ourcq
Porte de Pantin
Hoche
Église de Pantin
Bobigny – Pantin Raymond Queneau
Danube
Botzaris
Pré St-Gervais
Mairie des Lilas
Porte des Lilas
Esplanade de La Défense
Pont de Neuilly
Les Sablons
Porte Maillot
Neuilly – Porte Maillot
Argentine
Ternes
Charles de Gaulle Étoile
Porte Dauphine
Avenue Foch
Victor Hugo
George V
Kléber
Franklin D. Roosevelt
Boissière
Alma Marceau
Champs Élysées Clemenceau
Iéna
Trocadéro
Rue de la Pompe
Avenue Henri Martin
Pont de l'Alma
Invalides
La Tour Maubourg
Varenne
Solférino
Rue du Bac
Saint Germain des-Prés
Saint-Michel
Mabillon
Odéon
Saint-Sulpice
Luxembourg
Rennes
Notre-Dame des-Champs
Vavin
Port-Royal
Denfert Rochereau
Saint-Jacques
Glacière
Tolbiac
Maison Blanche
Porte d'Italie
Porte de Choisy
Porte d'Ivry
Le Kremlin Bicêtre
Villejuif Léo Lagrange
Villejuif Paul Vaillant-Couturier
Pierre Curie
Mairie d'Ivry
Villejuif – Louis Aragon
Massy – Palaiseau
Versailles – Chantiers
Dourdan
Saint-Martin-d'Étampes
Malesherbes
Melun
Versailles – Rive Gauche
Château de Versailles
Saint-Quentin-en-Yvelines
Meudon – Val-Fleury
Chaville – Vélizy
Issy
Issy Val de Seine
Mairie d'Issy
Boulogne Pont de St-Cloud
Pont de Sèvres
Balard
Porte de Versailles
Corentin Celton
Porte de Vanves
Malakoff Plateau de Vanves
Malakoff Rue Étienne Dolet
Châtillon – Montrouge
Porte d'Orléans
Robinson
Saint-Rémy lès-Chevreuse
Antony
Orly Ouest
Orly Sud
Bagneux
Bourg-la-Reine
Arcueil – Cachan
Gentilly
Laplace
Cité Universitaire
Place d'Italie
Bibliothèque François Mitterrand
Gare d'Austerlitz
Gare de Lyon
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Bastille
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Faidherbe Chaligny
Reuilly – Diderot
Montgallet
Daumesnil
Bel-Air
Michel Bizot
Dugommier
Bercy
Cour St-Émilion
Porte Dorée
Porte de Charenton
Liberté
Charenton – Écoles
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Maisons-Alfort – Stade
Maisons-Alfort Les Juilliottes
Créteil – L'Échat
Créteil – Université
Créteil – Préfecture
Maisons-Alfort Alfortville
Le Vert de Maisons
Les Ardoines
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Ivry sur Seine
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Château de Vincennes
Porte de Vincennes
Saint-Mandé
Picpus
Béraut
Buzenval
Maraîchers
Porte de Montreuil
Robespierre
Croix de Chavaux
Mairie de Montreuil
Porte de Bagnolet
Gallieni
Gambetta
Père Lachaise
Philippe Auguste
Alexandre Dumas
Avron
Rue des Boulets
Charonne
Voltaire
Richard Lenoir
Bréguet Sabin
Saint-Ambroise
Rue Saint-Maur
Couronnes
Ménilmontant
Pelleport
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Pyrénées
Jourdain
Place des Fêtes
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Belleville
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Colonel Fabien
Buttes Chaumont
Jacques Bonsergent
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Oberkampf
Parmentier
Filles du Calvaire
St-Sébastien Froissart
Rambuteau
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Temple
Strasbourg Saint-Denis
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Bonne Nouvelle
Grands Boulevards
Richelieu Drouot
Opéra
Quatre Septembre
Bourse
Sentier
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Les Halles
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Hôtel de Ville
Chemin Vert
St-Paul
Pyramides
Palais Royal Musée du Louvre
Concorde
Madeleine
Auber
Havre Caumartin
Chaussée d'Antin La Fayette
Haussmann Saint-Lazare
Saint-Lazare
Gare Saint-Lazare
Saint-Augustin
Miromesnil
Saint-Philippe du-Roule
Liège
Trinité d'Estienne d'Orves
Saint-Georges
Notre-Dame de-Lorette
Cadet
Poissonnière
Le Peletier
Château d'Eau
Jaurès
Bolivar
Louis Blanc
Gare de l'Est
Magenta
Château Landon
Colonel Fabien
Belleville
Jourdain
Place des Fêtes
Télégraphe
Pyrénées
Couronnes
Ménilmontant
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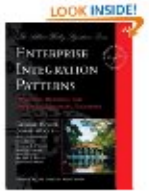

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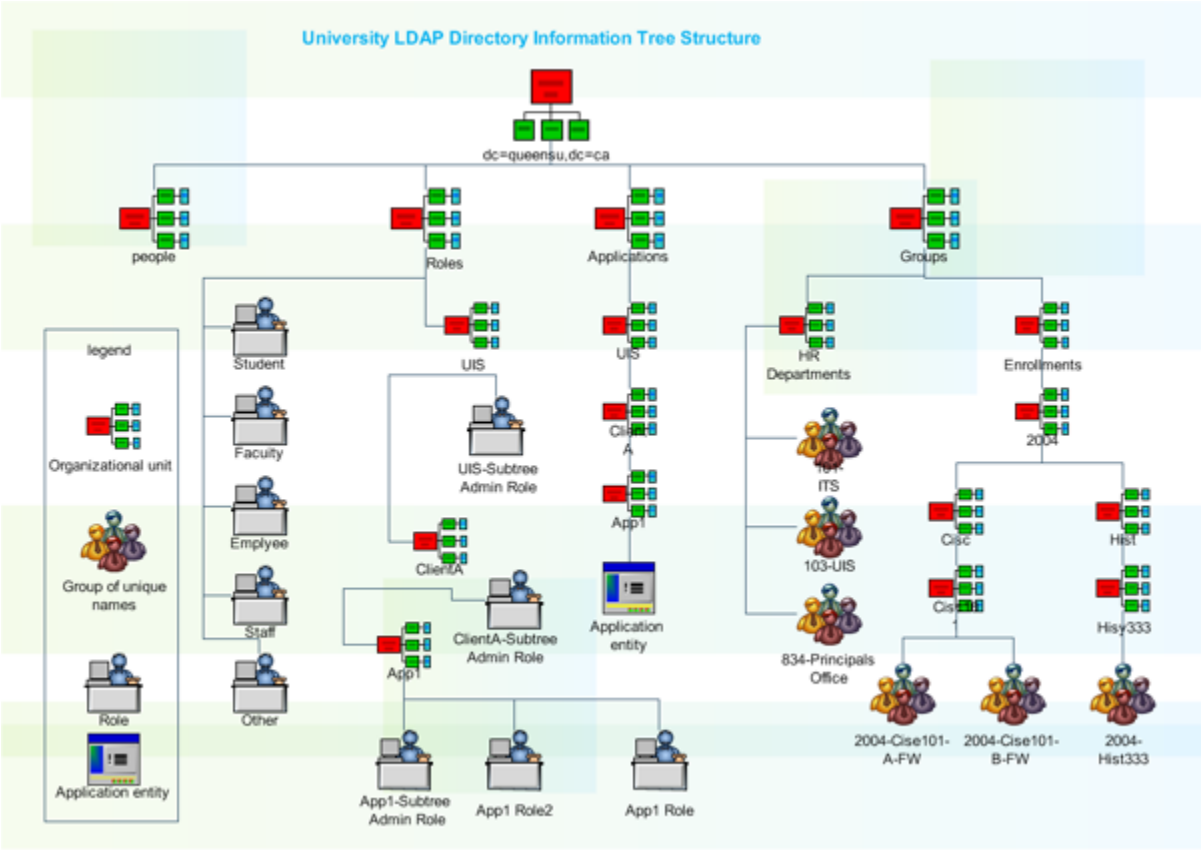
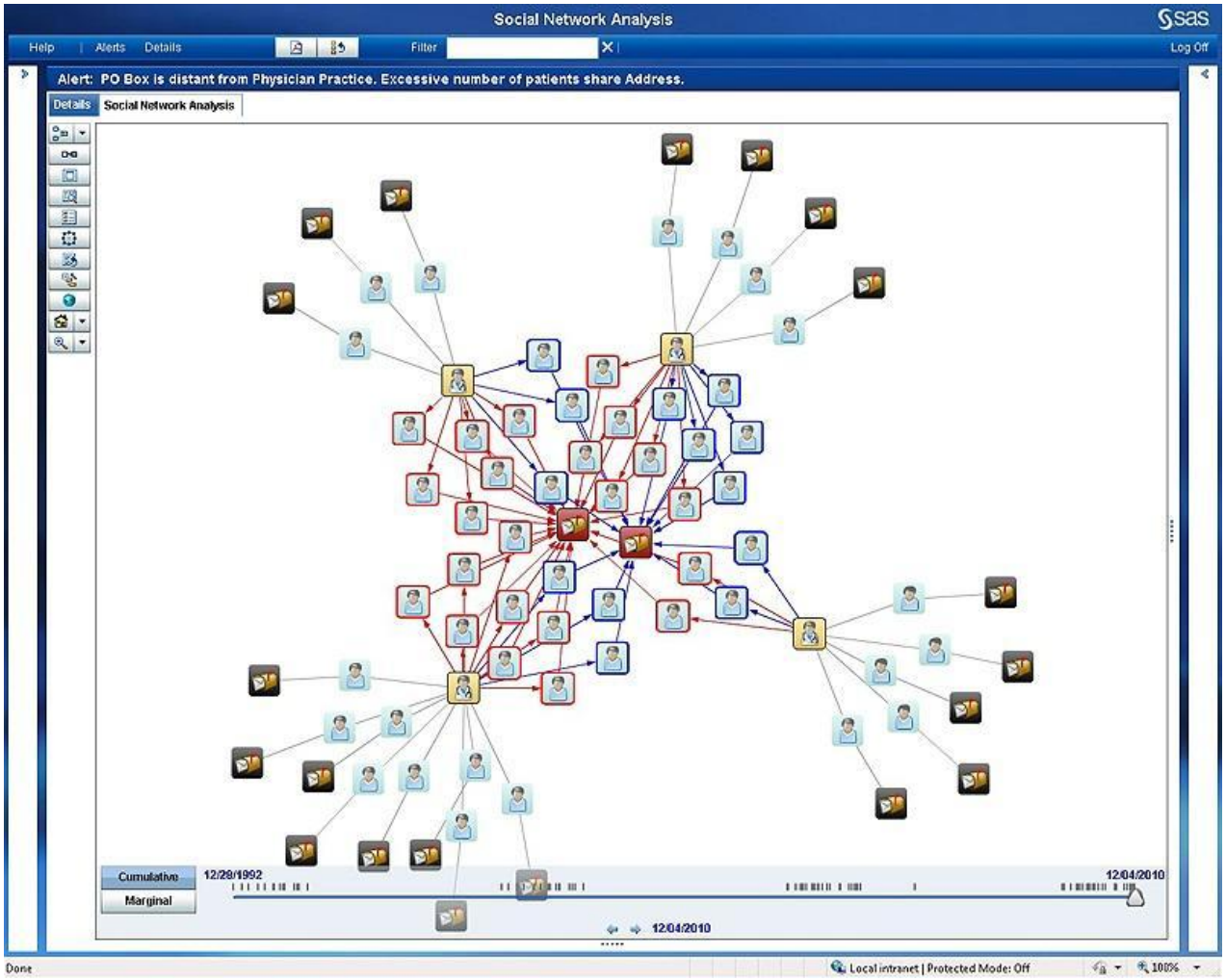
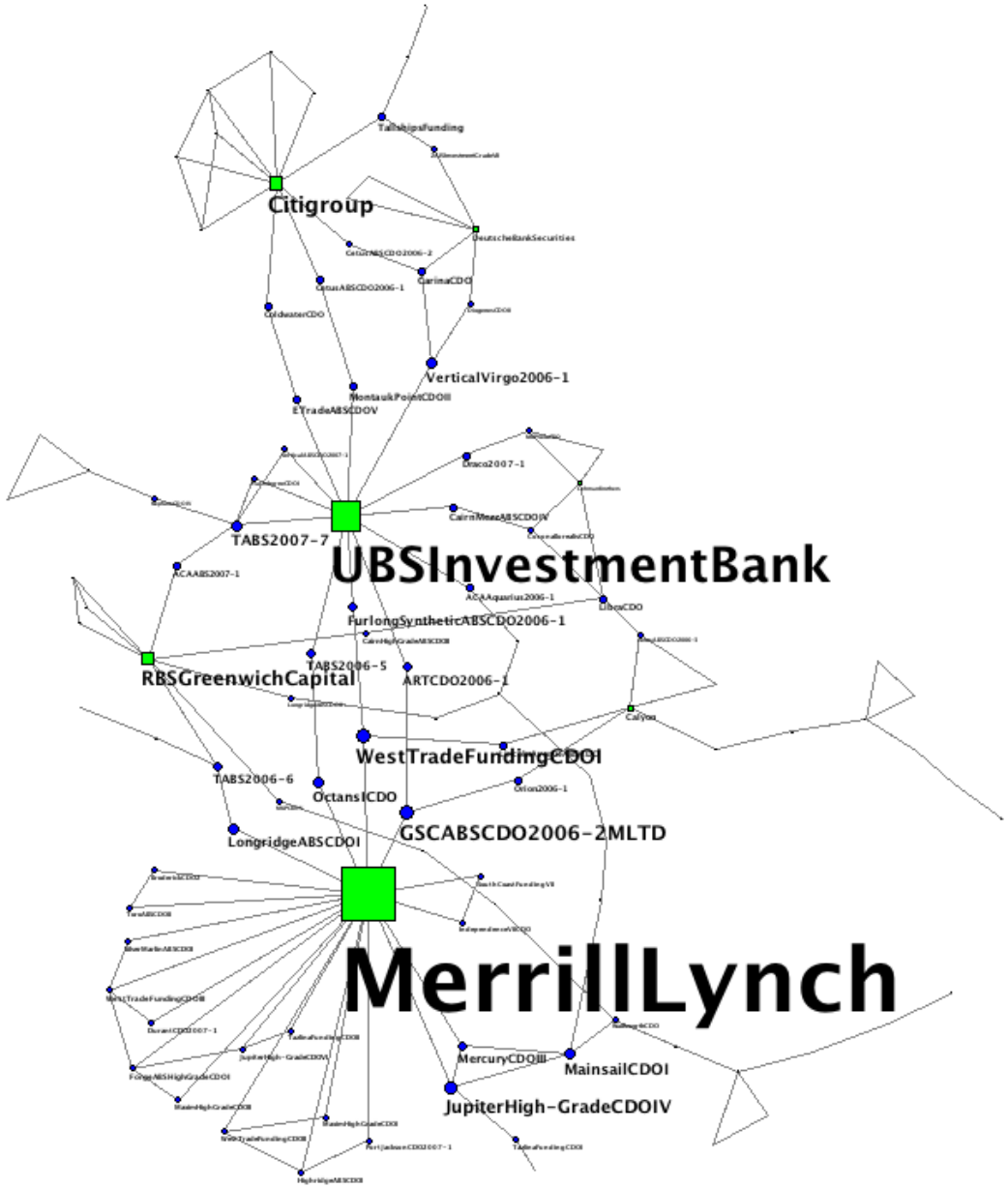
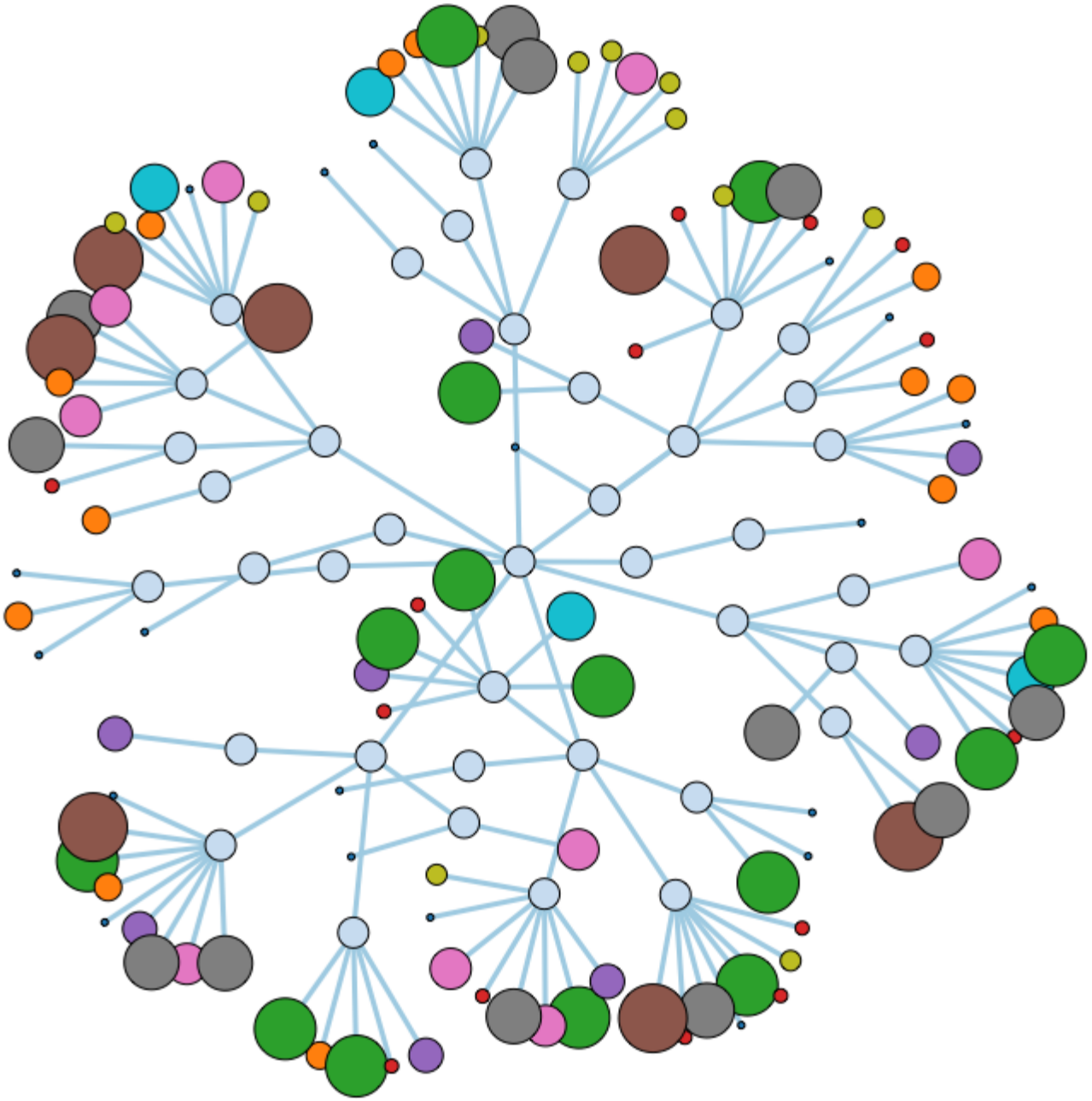

University LDAP Directory Information Tree Structure
dc=queensu,dc=ca
people
Roles
Applications
Groups
legend
Organizational unit
Group of unique names
Role
Application entity
Student
Faculty
Emplyee
Staff
Other
UIS
UIS-Subtree Admin Role
ClientA
ClientA-Subtree Admin Role
App1
App1-Subtree Admin Role
App1 Role2
App1 Role
UIS
App1
Application entity
HR Departments
ITS
103-UIS
834-Principals Office
Enrollments
2004
Cisc
Hist
Hisy333
2004-Cise101-A-FW
2004-Cise101-B-FW
2004-Hist333


Social Network Analysis
sas
Help
Alerts
Details
Filter
Log Off
Alert: PO Box is distant from Physician Practice. Excessive number of patients share Address.
Details
Social Network Analysis
Cumulative
Marginal
12/28/1992
12/04/2010
12/04/2010
Done
Local intranet | Protected Mode: Off
100%


Citigroup
DeutscheBankSecurities
CitiGrNESCDO2006-2
CitiusABSCDO2006-1
CarinaCDO
ColdwaterCDO
VerticalVirgo2006-1
MontaukPointCDOIII
ETradeABSCDOV
Draco2007-1
CairnMeadABSCDOIV
TABS2007-7
UBSInvestmentBank
ACAABS2007-1
ACAAquarius2006-1
LibraCDO
FurlongSynthetircABSCDO2006-1
TABS2006-5
ARTCDO2006-1
RBSGreenwichCapital
Calyon
WestTradeFundingCDOI
TABS2006-6
OctansICDO
Orion2006-1
GSCABSCDO2006-2MLTD
LongridgeABSCDOI
MerrillLynch
MercuryCDOIII
MainsailCDOI
JupiterHigh-GradeCDOIV



Neo4j

Neo4j uses the property graph data model (as do most modern graph databases)

Person
{ name : 'Lisa' }
KNOWS
{ since : 2009 }
Person
{ name : 'Bob' }

It is **ACID** compliant

It is really good at **connected data**

(obviously)

For instance

Lets pretend we are a social network

And we want to show a user how they know another user

Ergo:

Given two users, give me the shortest path between them.

With 1 000 users

it takes a relational db 2 000 ms
and it takes Neo4j 2 ms

(but here is the kicker)

With 1 000 000 users

it never finishes on a relational db
but it still takes Neo4j 2 ms

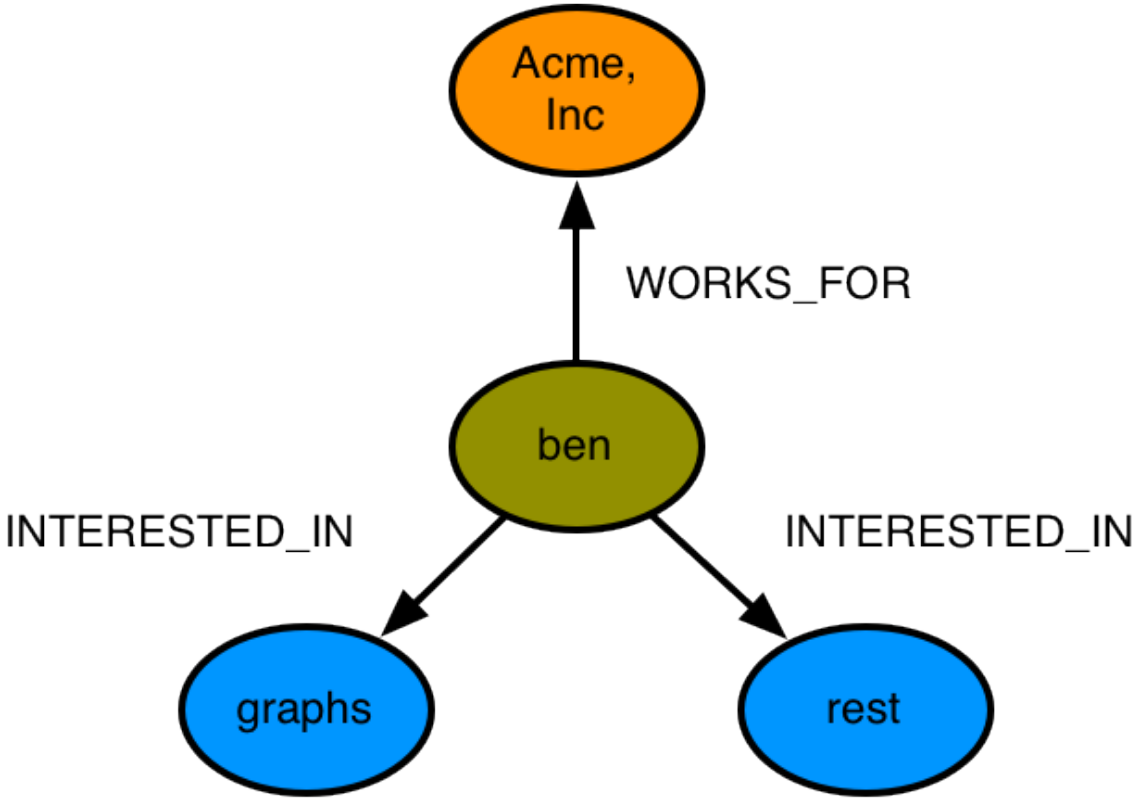
This is called index free adjacency

We don't have to use global indexes to follow relationships

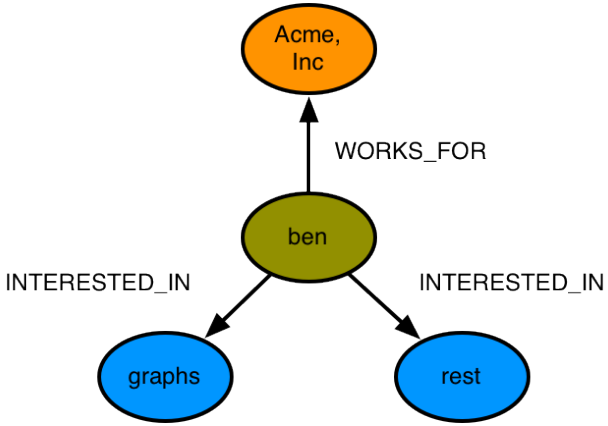
Ok, fine, but how do I

use it?

Describing Graphs



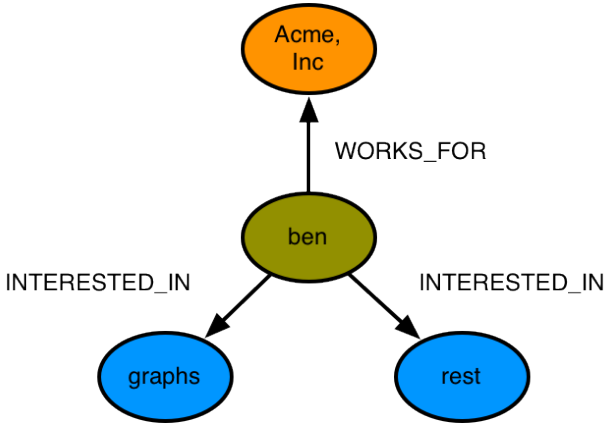
Cypher



(graphs)<-[:INTERESTED_IN]-(ben)-[:INTERESTED_IN]->(rest),

(ben)-[:WORKS_FOR]->(acme)

Cypher




```
(ben)-[:INTERESTED_IN]->(graphs),
(ben)-[:INTERESTED_IN]->(rest),
(ben)-[:WORKS_FOR]->(acme)
```

Create some data

```
CREATE ben    = { name  : 'Ben' },
       acme   = { name  : 'Acme' },
       rest   = { label : 'REST' },
       graphs = { label : 'Graphs' },
       (ben)-[:WORKS_FOR]->(acme),
       (ben)-[:INTERESTED_IN]->(rest),
       (ben)-[:INTERESTED_IN]->(graphs)
RETURN ben
```

Create nodes

```
CREATE ben    = { name  : 'Ben' },
       acme   = { name  : 'Acme' },
       rest   = { label : 'REST' },
       graphs = { label : 'Graphs' },
       (ben)-[:WORKS_FOR]->(acme),
       (ben)-[:INTERESTED_IN]->(rest),
       (ben)-[:INTERESTED_IN]->(graphs)
RETURN ben
```

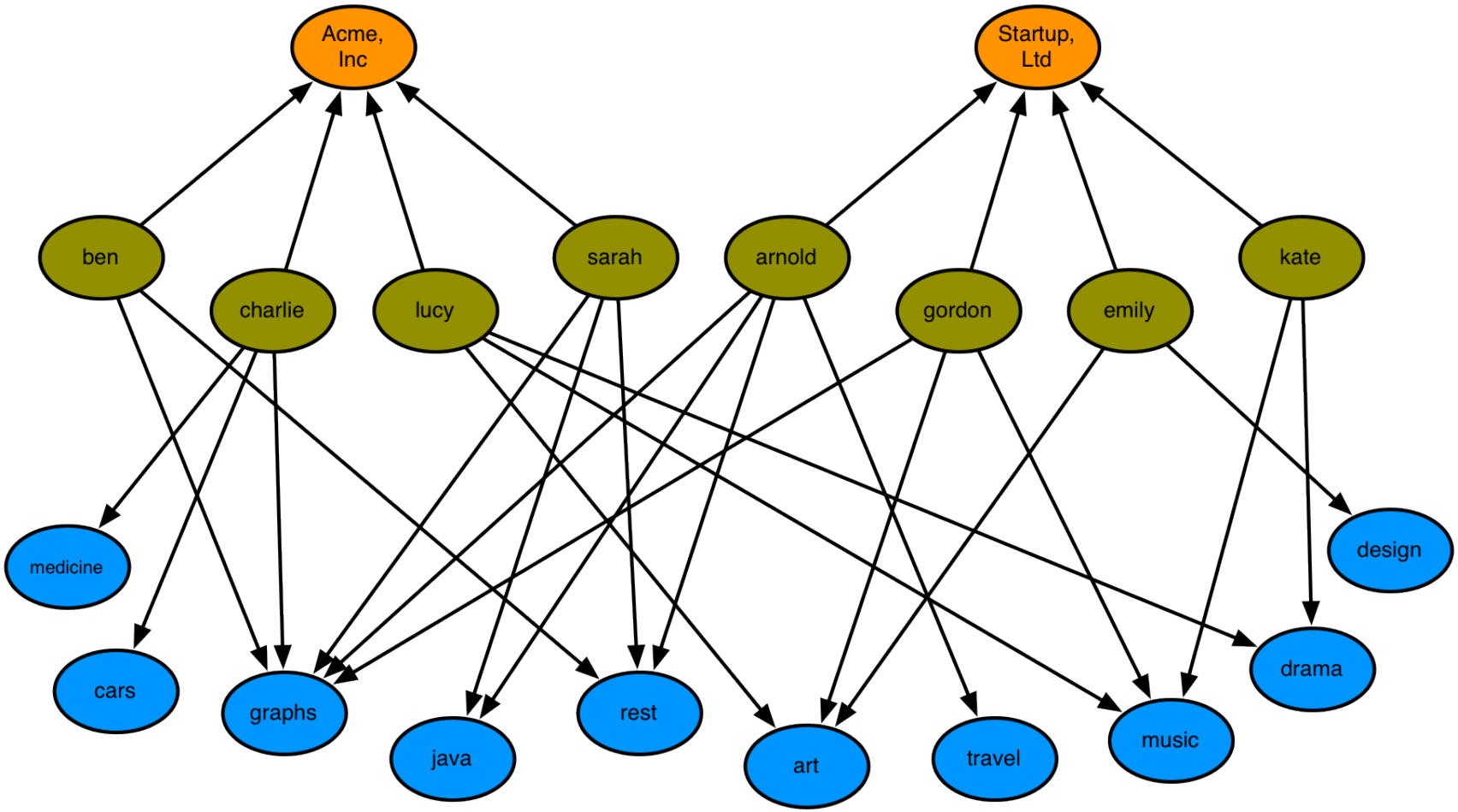
Create relationships

```
CREATE ben    = { name  : 'Ben' },
       acme   = { name  : 'Acme' },
       rest   = { label : 'REST' },
       graphs = { label : 'Graphs' },
       (ben)-[:WORKS_FOR]->(acme),
       (ben)-[:INTERESTED_IN]->(rest),
       (ben)-[:INTERESTED_IN]->(graphs)
RETURN ben
```

Return node

```
CREATE ben    = { name  : 'Ben' },
       acme   = { name  : 'Acme' },
       rest   = { label : 'REST' },
       graphs = { label : 'Graphs' },
       (ben)-[:WORKS_FOR]->(acme),
       (ben)-[:INTERESTED_IN]->(rest),
       (ben)-[:INTERESTED_IN]->(graphs)
RETURN ben
```

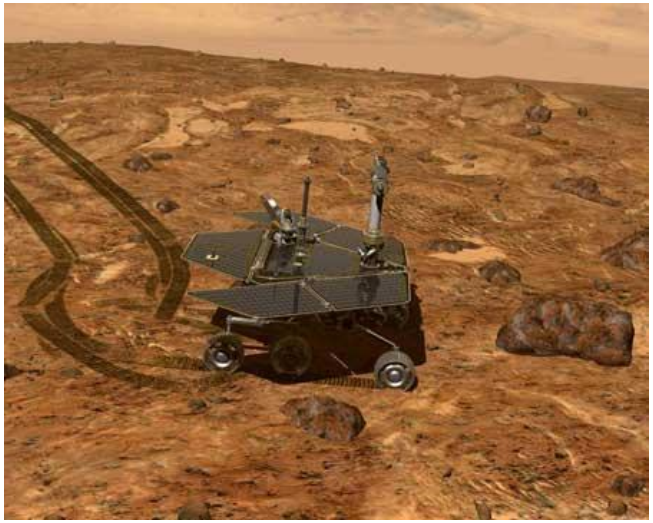
Eventually…

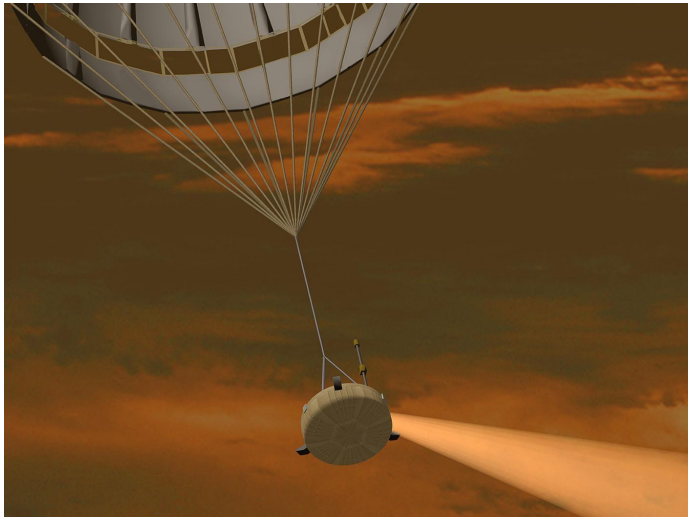

Acme, Inc
Startup, Ltd
ben
charlie
lucy
sarah
arnold
gordon
emily
kate
medicine
cars
graphs
java
rest
art
travel
music
drama
design

Querying the Graph

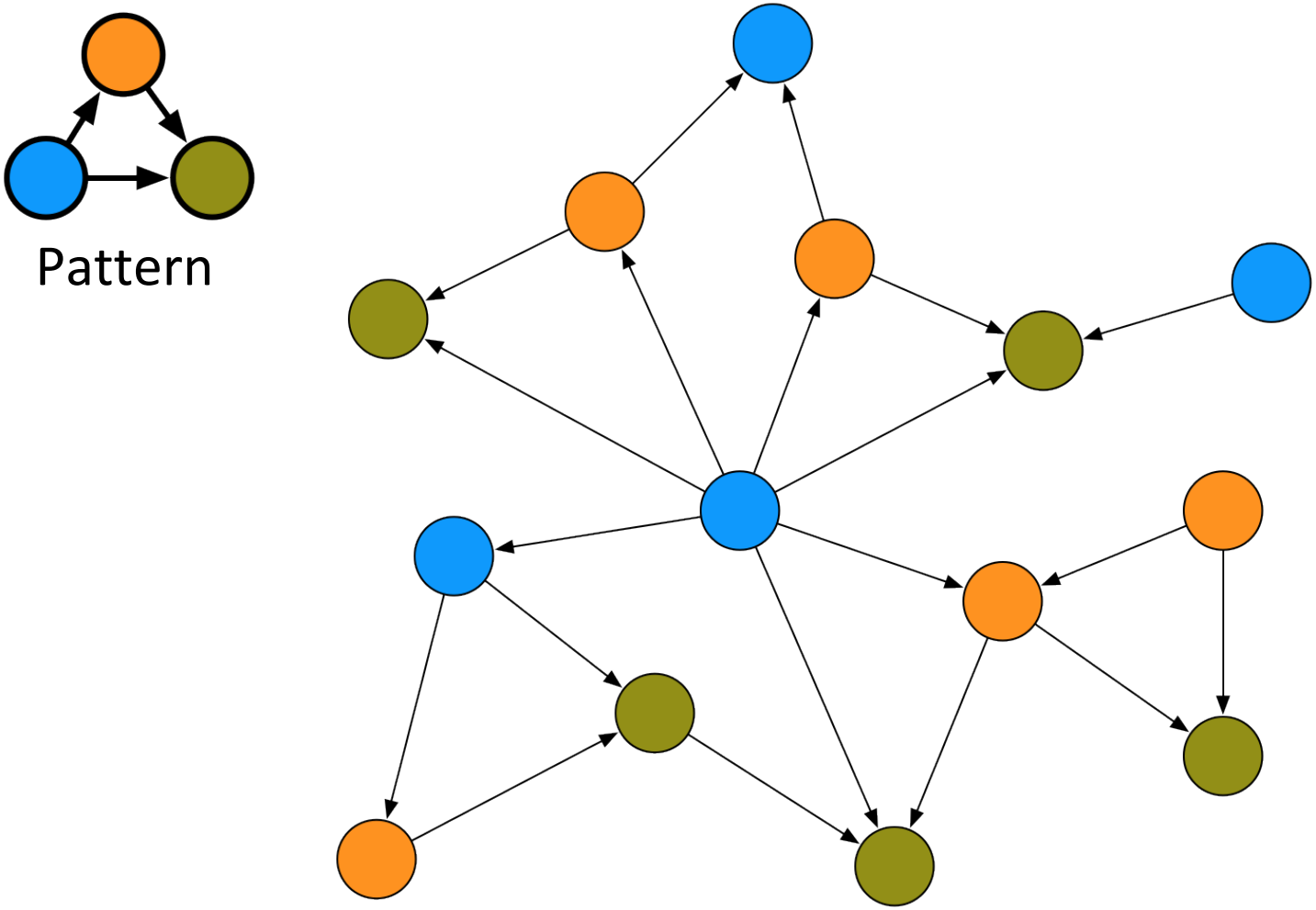
Graph local:

- **One or more start nodes**
- **Explore surrounding graph**
- **Millions of joins per second**

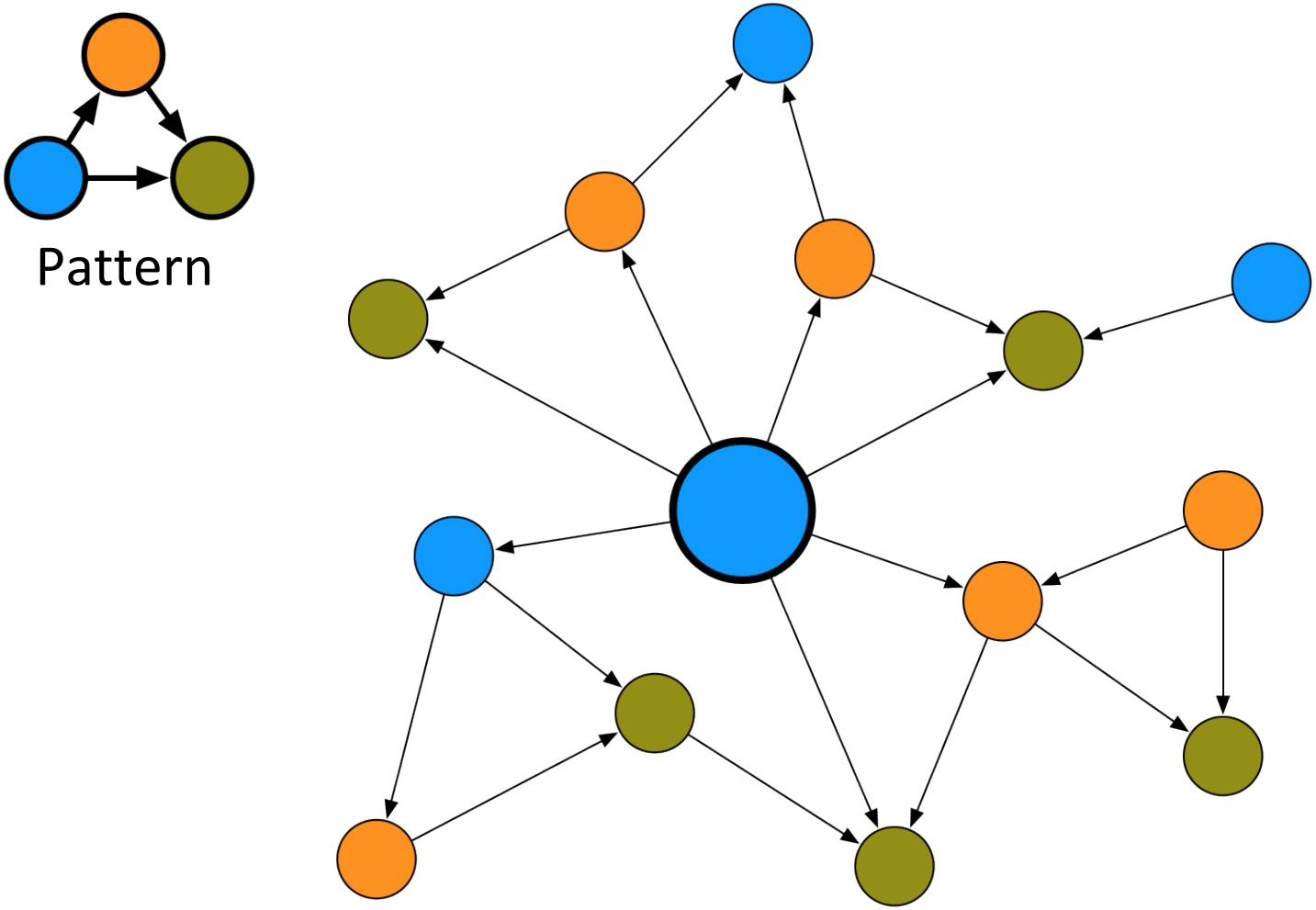




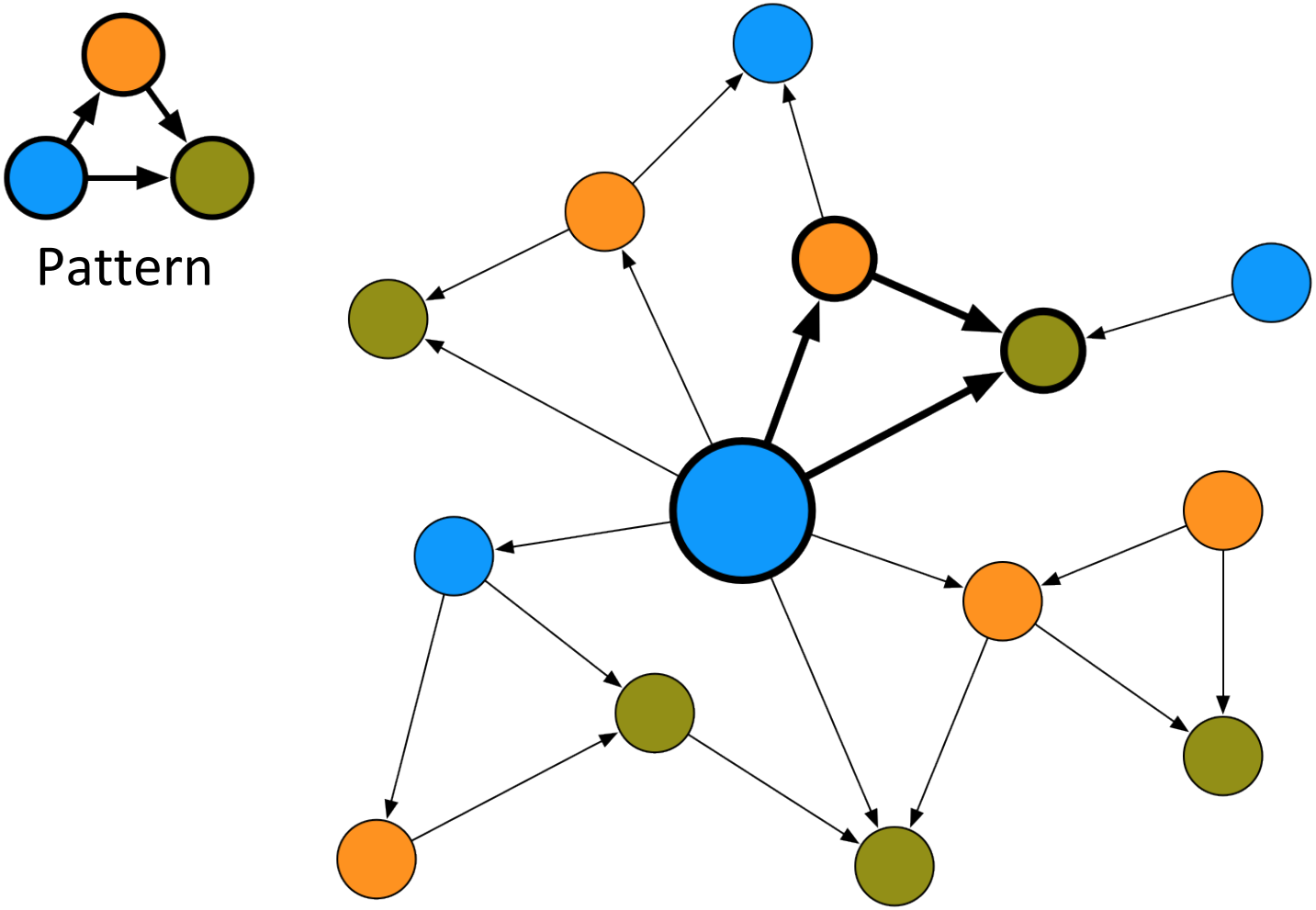
Queries: Pattern Matching



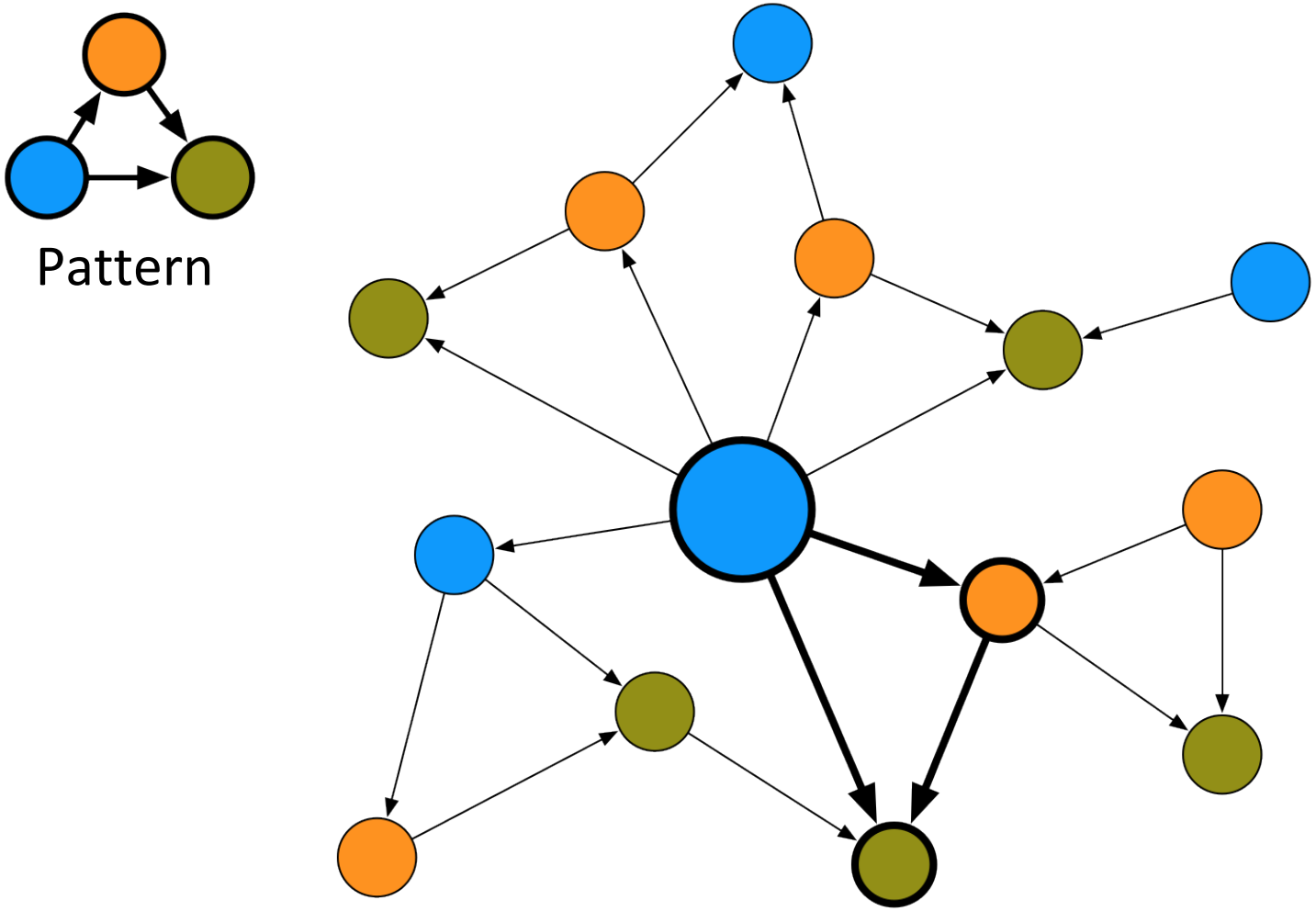
Start Node



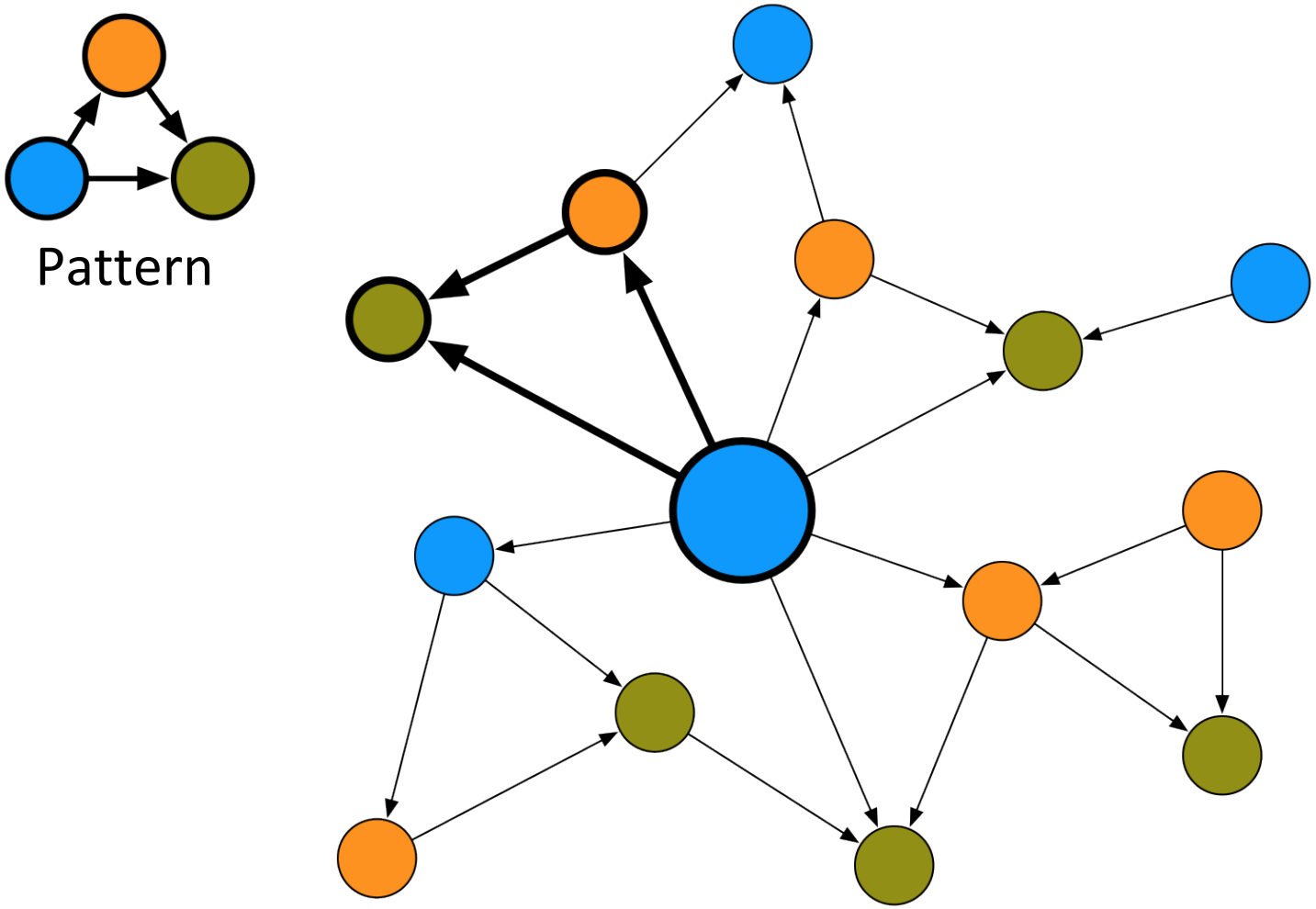
Match



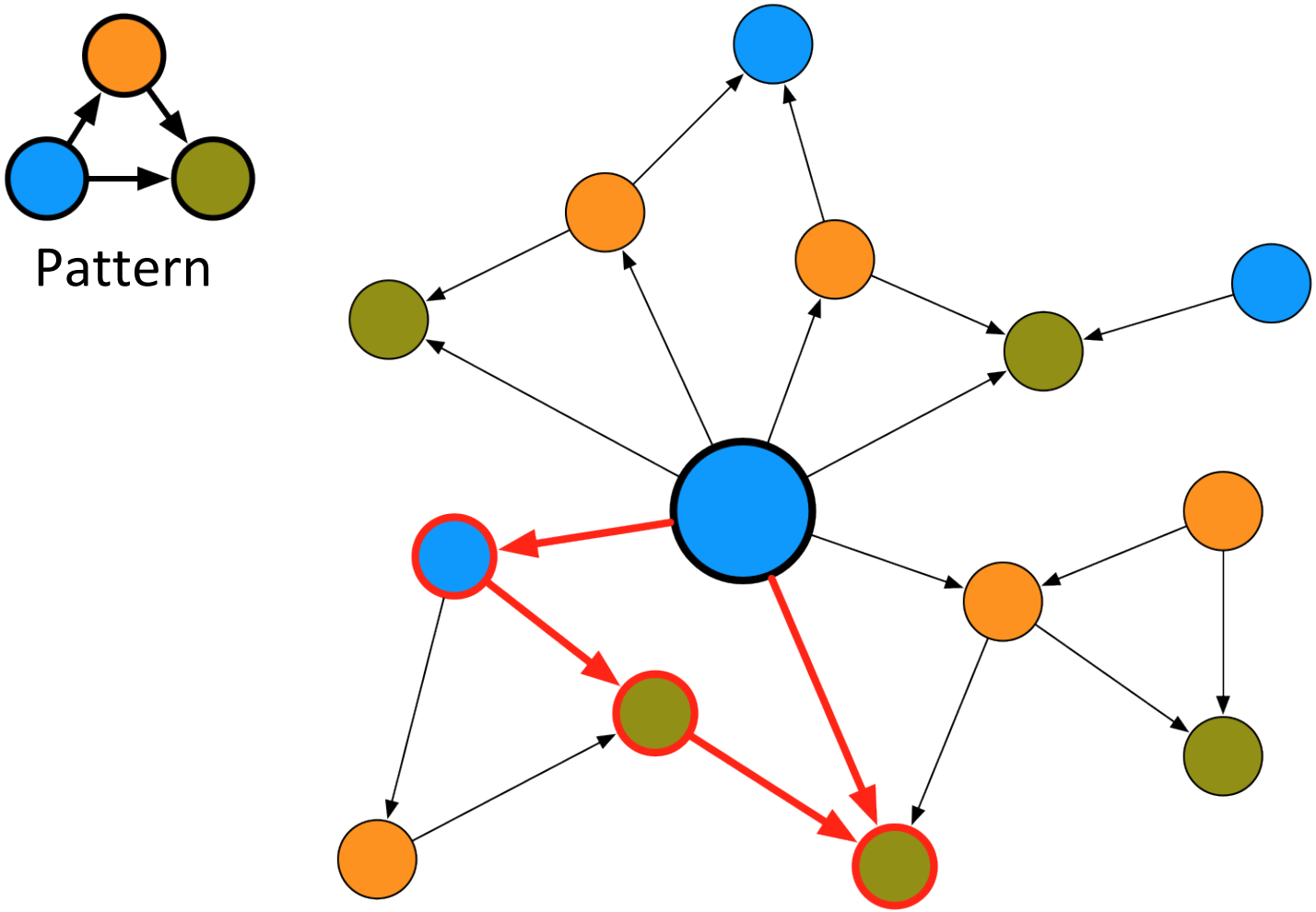
Match



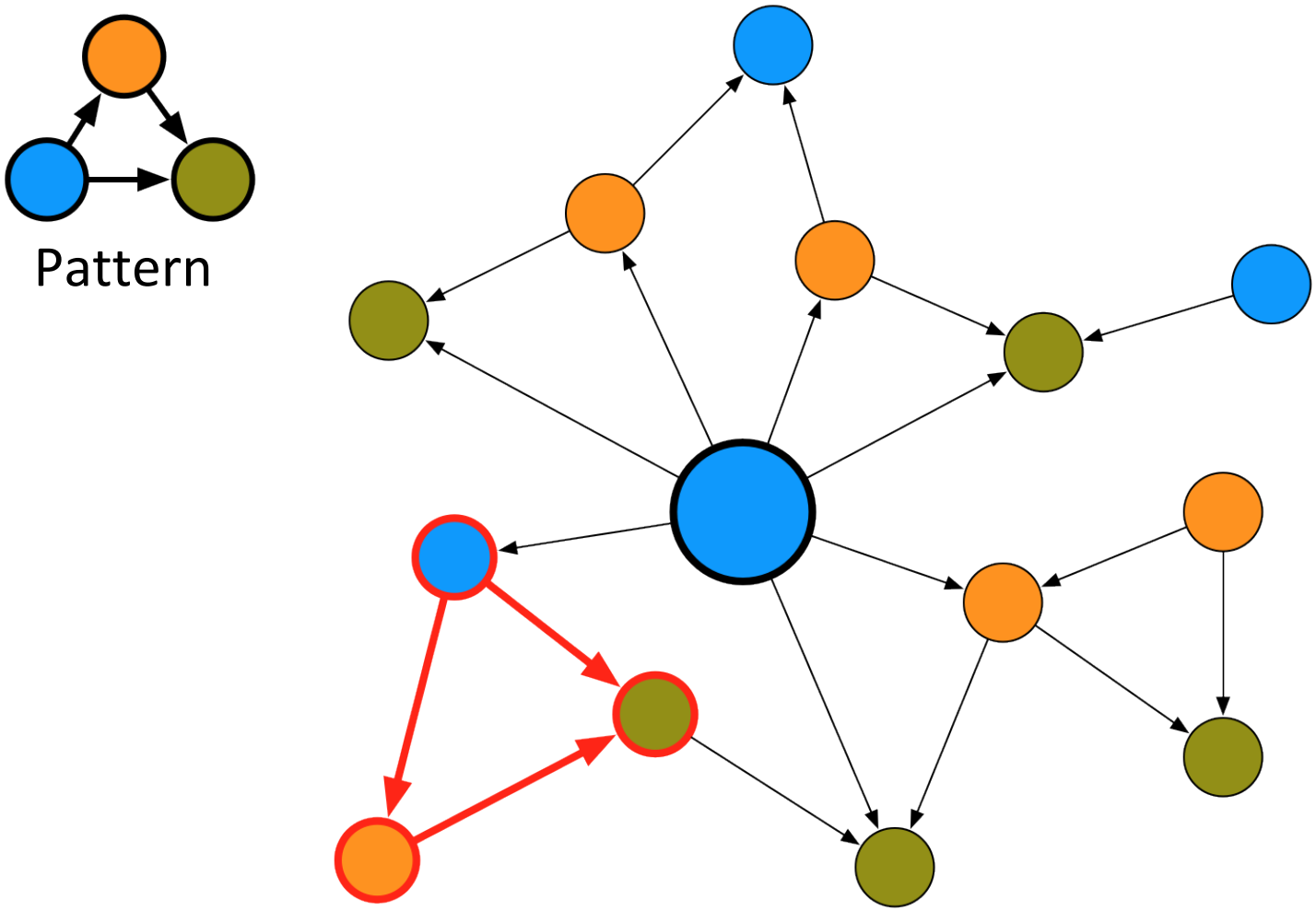
Match



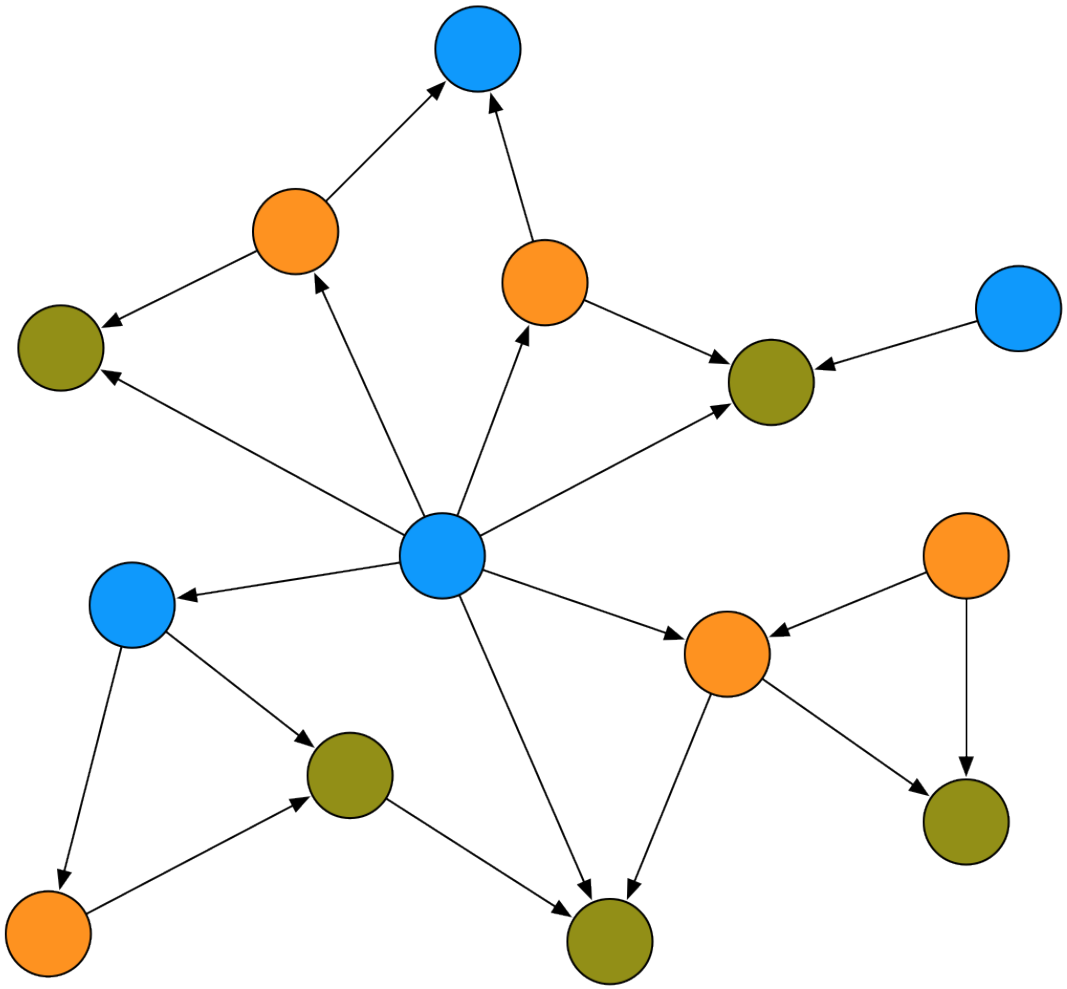
Non-Match



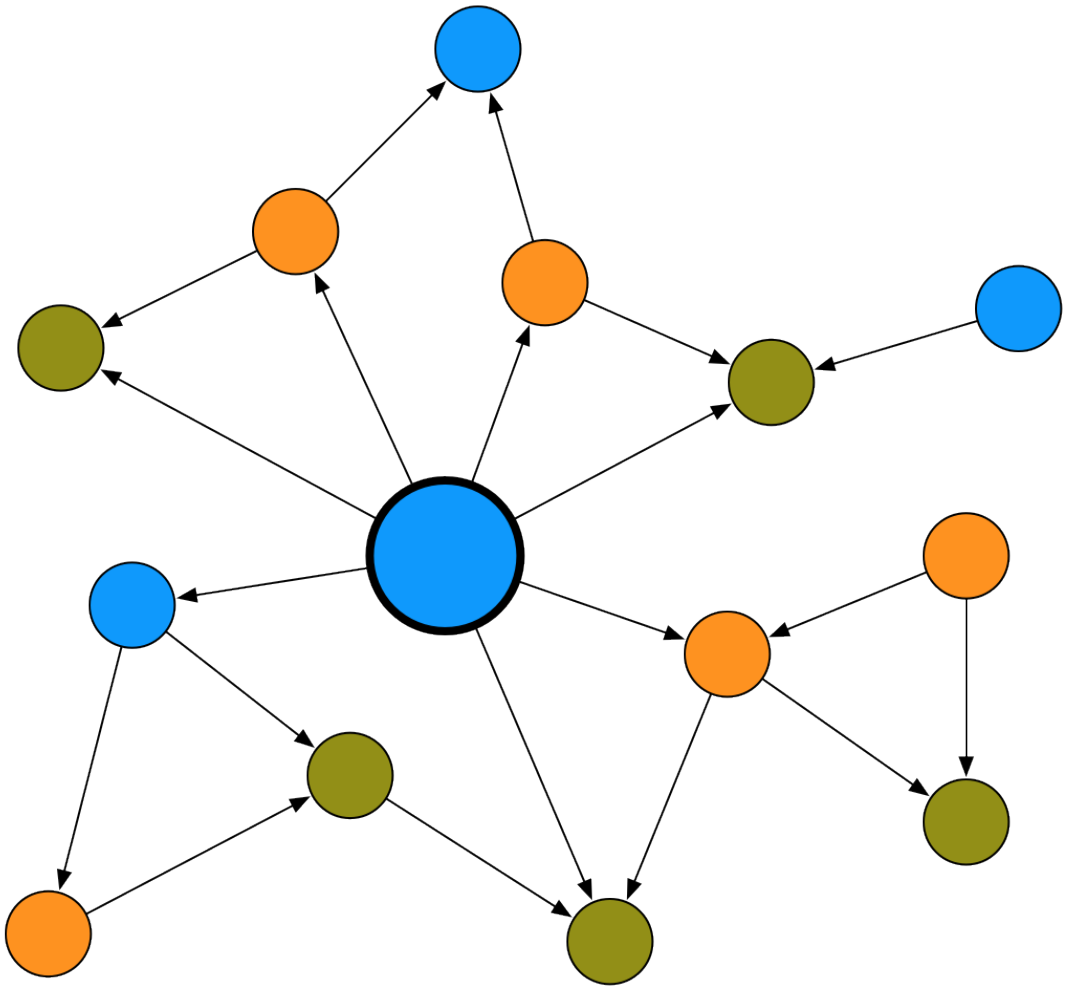
Non-Match



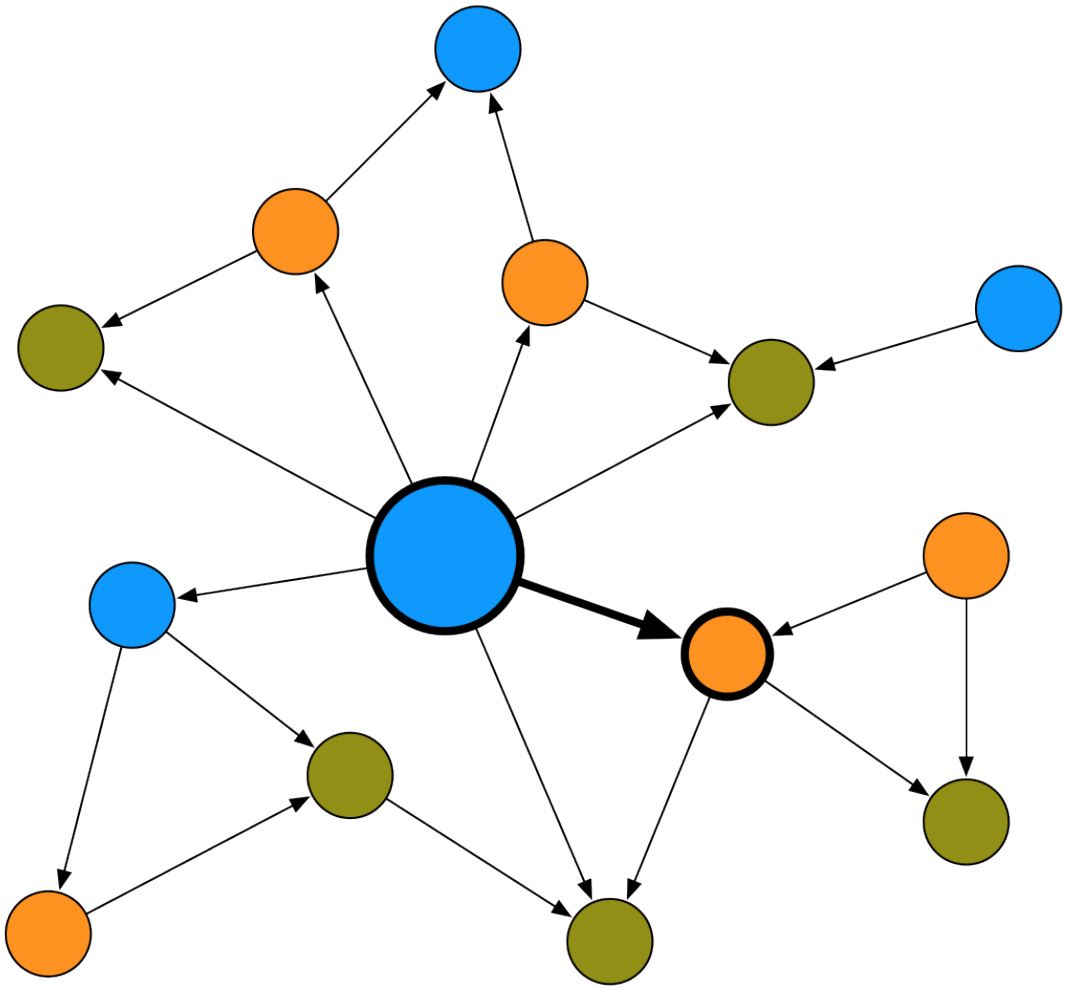
Queries: Traversing the Graph



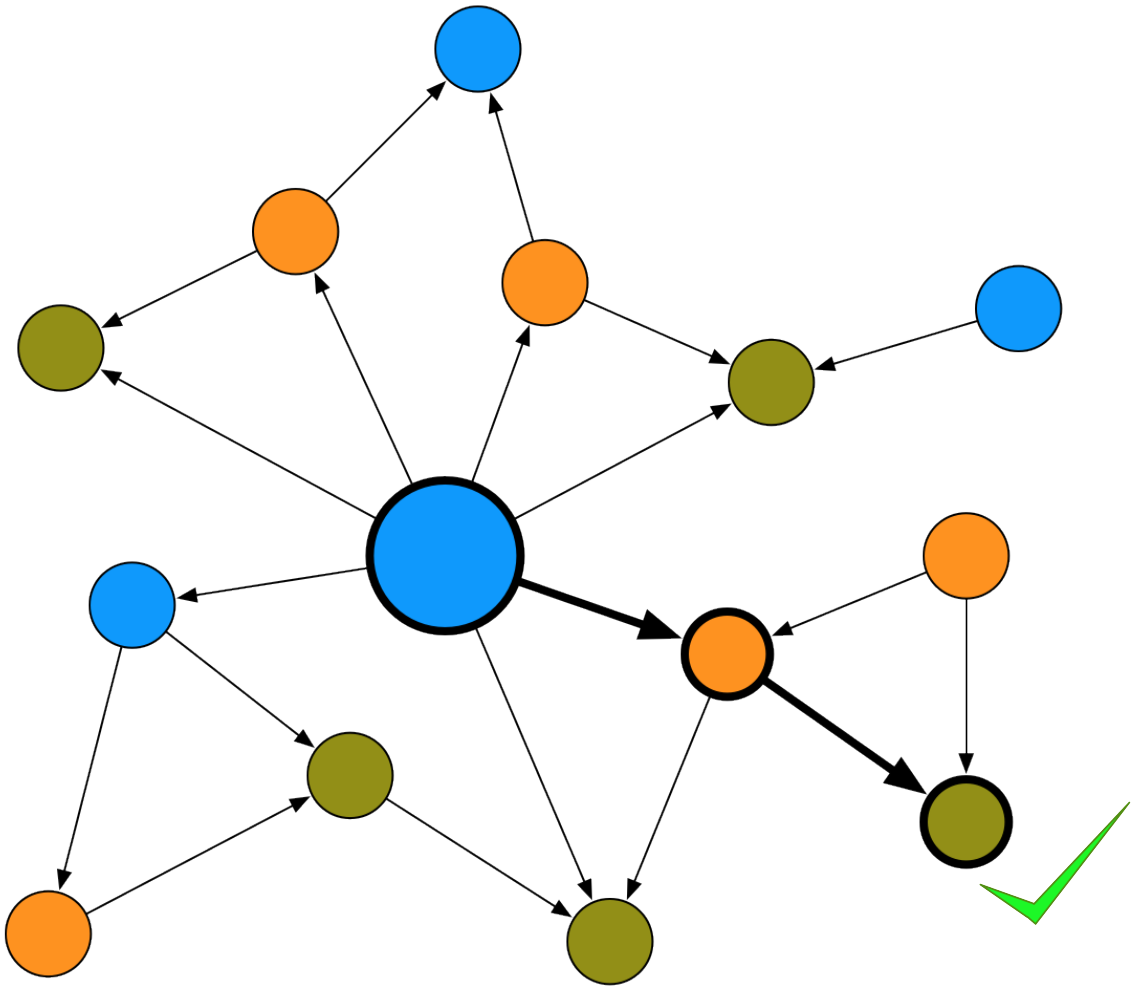
Start Node



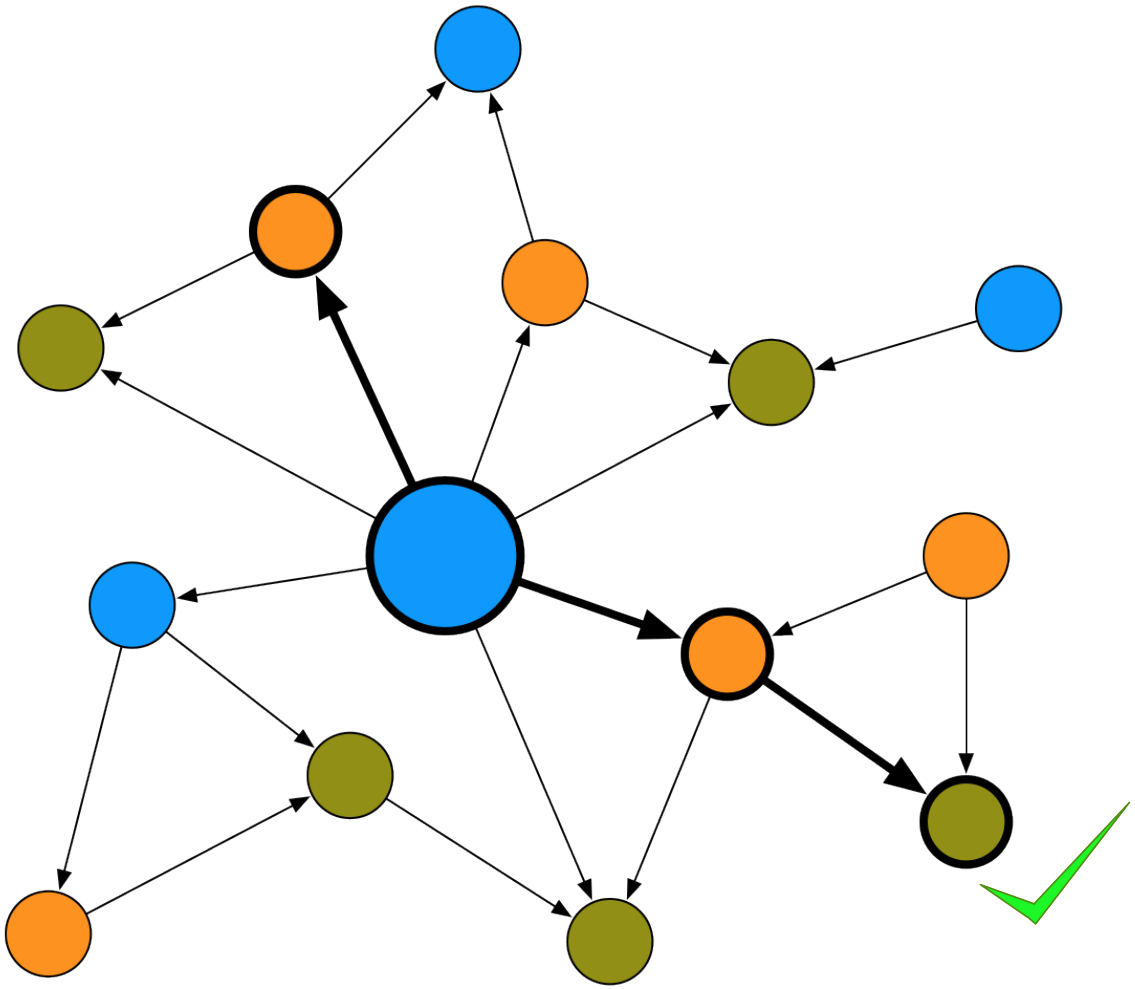
Follow Relationships



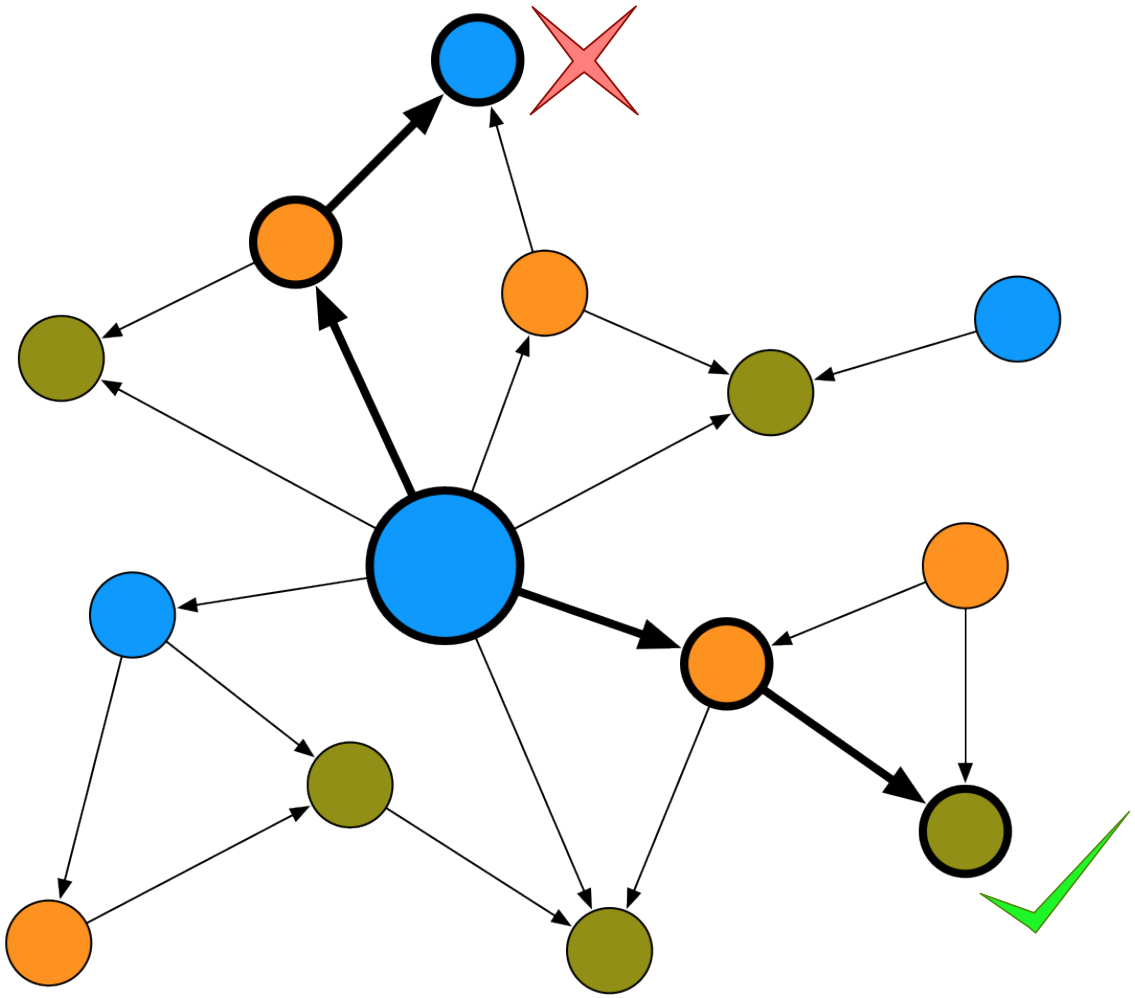
Evaluate Node



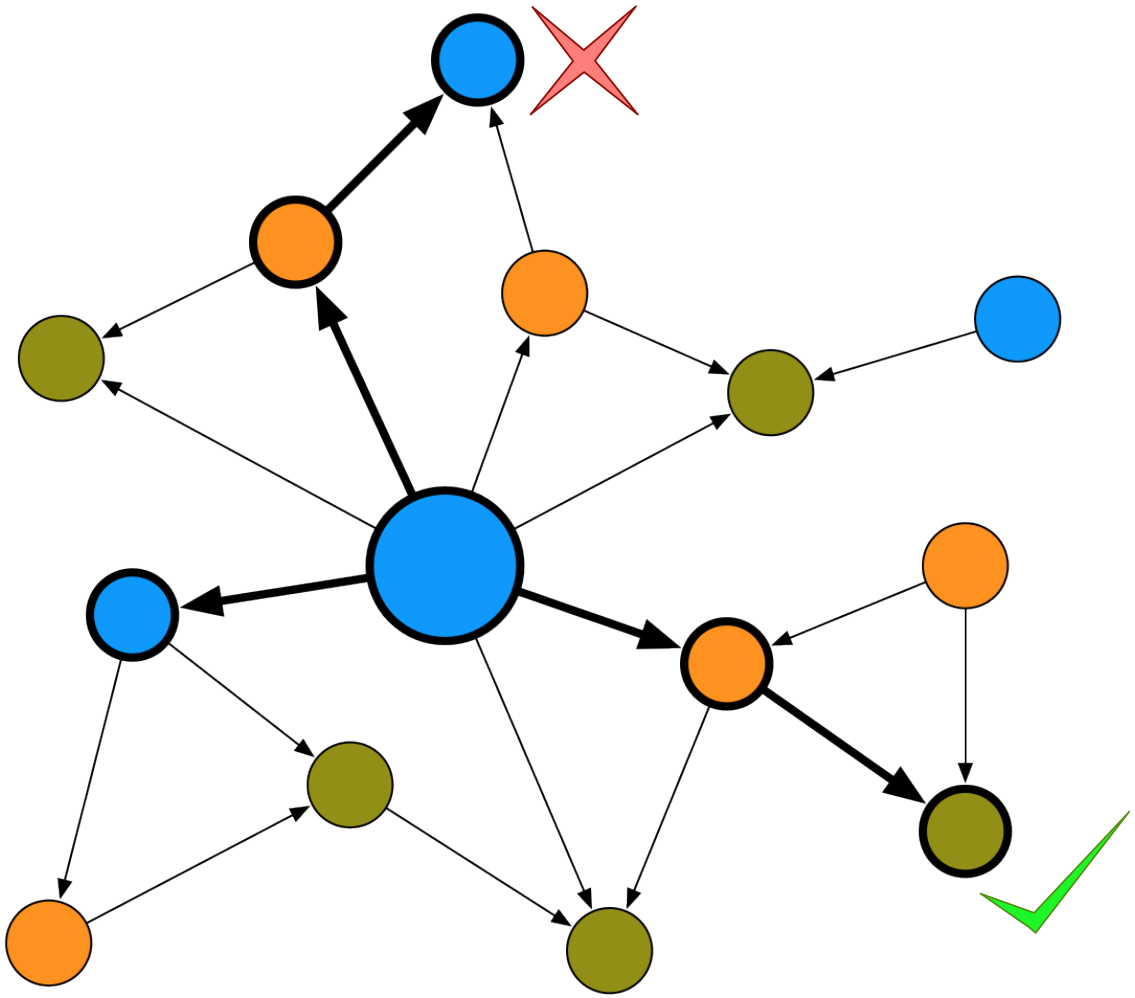
Continue Traversing



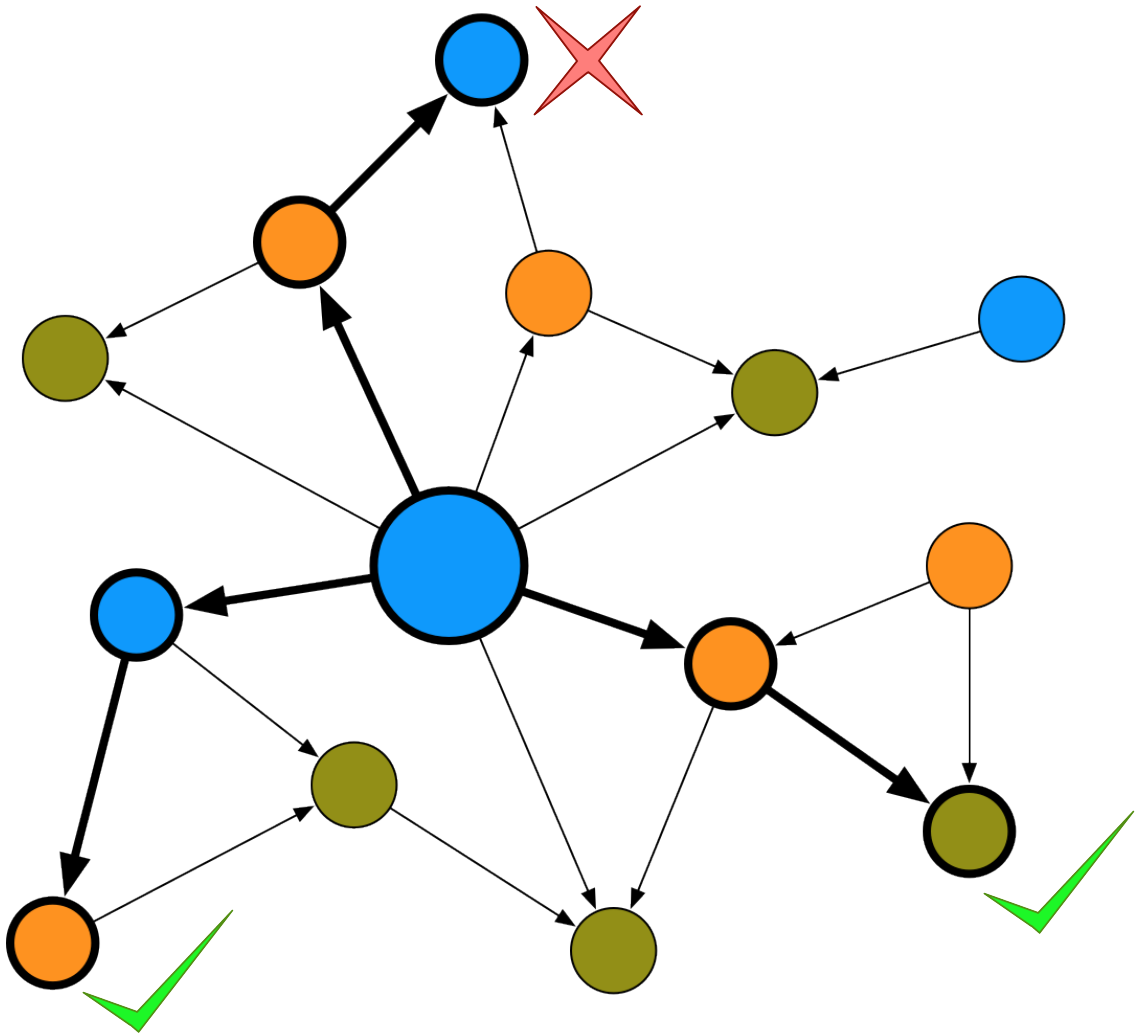
Continue Traversing



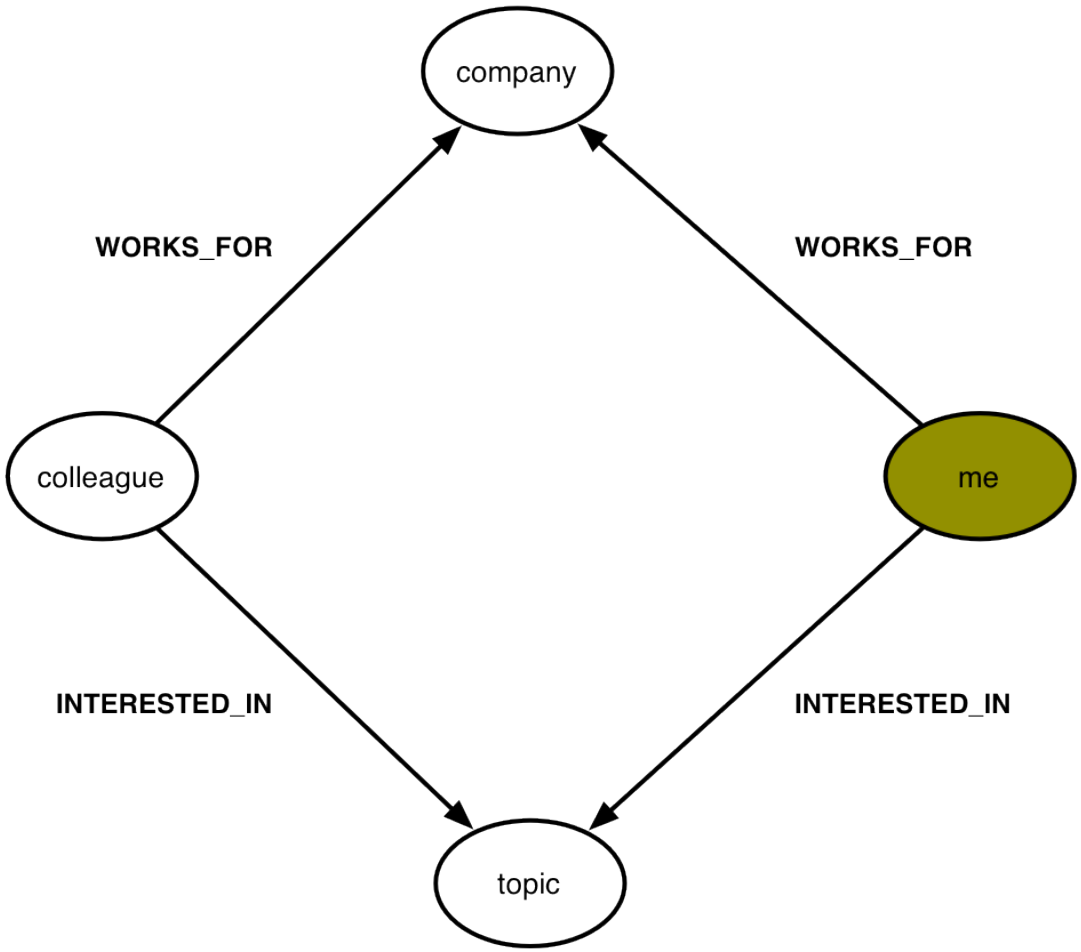
Continue Traversing



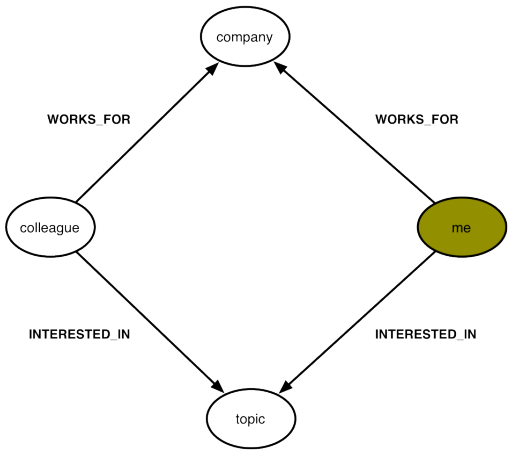
Continue Traversing



Colleagues Who Share My Interests



Cypher Pattern




```
me-[:INTERESTED_IN]->topic,
me-[:WORKS_FOR]->company,
colleague-[:INTERESTED_IN]->topic,
colleague-[:WORKS_FOR]->company
```

Find Colleagues

```
MATCH      (me:User)-[:INTERESTED_IN]->(topic),
           (me)-[:WORKS_FOR]->(company),
           (colleague)-[:INTERESTED_IN]->(topic),
           (colleague)-[:WORKS_FOR]->(company)
WHERE      me.name = "Jacob"
RETURN     colleague.name          AS name,
           count(topic)            AS score,
           collect(topic.label)    AS interests
ORDER BY   score DESC
```

Find start node

```
MATCH      (me:User)-[:INTERESTED_IN]->(topic),
           (me)-[:WORKS_FOR]->(company),
           (colleague)-[:INTERESTED_IN]->(topic),
           (colleague)-[:WORKS_FOR]->(company)
WHERE      me.name = "Jacob"
RETURN     colleague.name        AS name,
           count(topic)          AS score,
           collect(topic.label) AS interests
ORDER BY score DESC
```

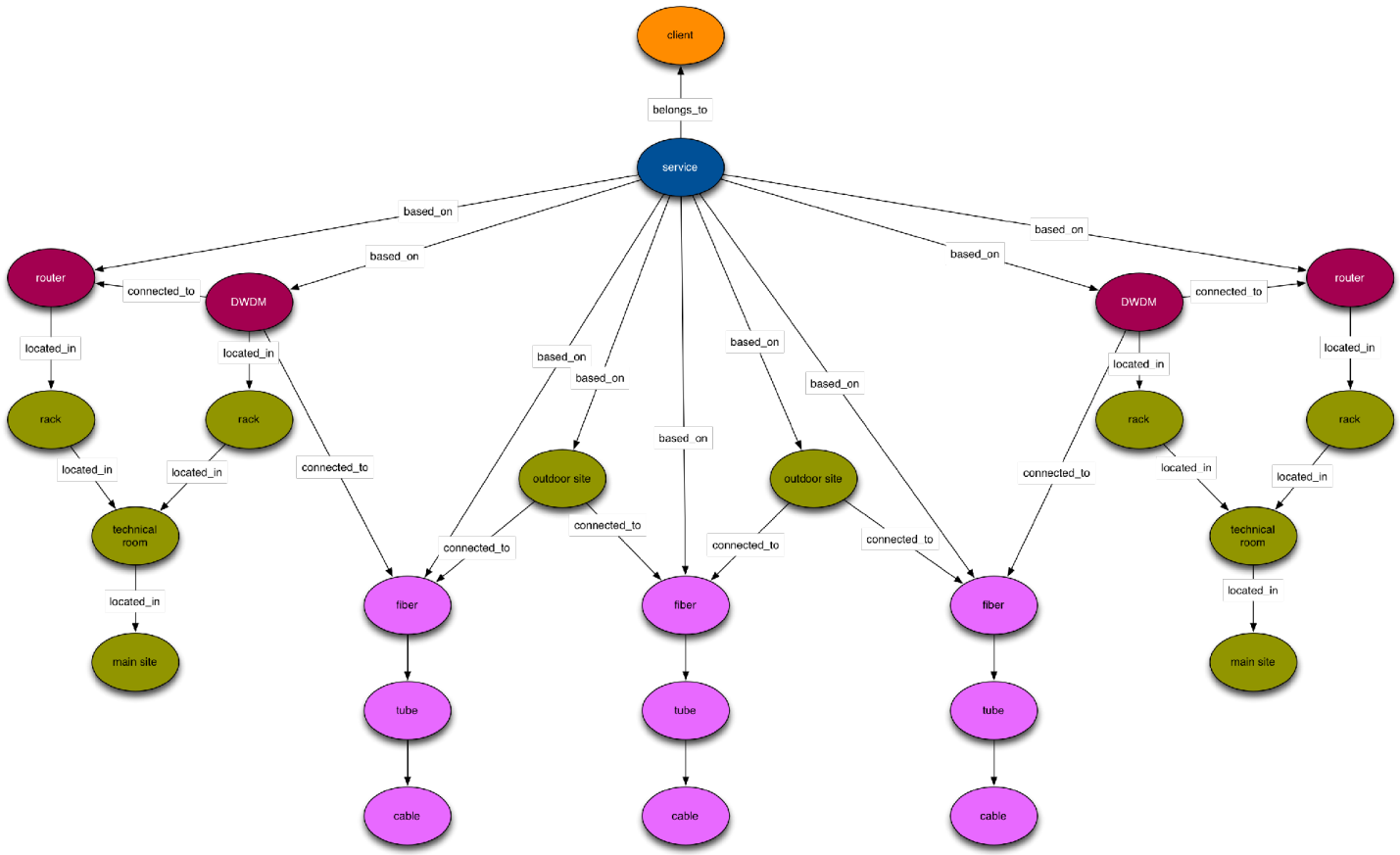
Describe pattern

```
MATCH      (me:User)-[:INTERESTED_IN]->(topic),
           (me)-[:WORKS_FOR]->(company),
           (colleague)-[:INTERESTED_IN]->(topic),
           (colleague)-[:WORKS_FOR]->(company)
WHERE      me.name = "Jacob"
RETURN     colleague.name        AS name,
           count(topic)          AS score,
           collect(topic.label) AS interests
ORDER BY score DESC
```

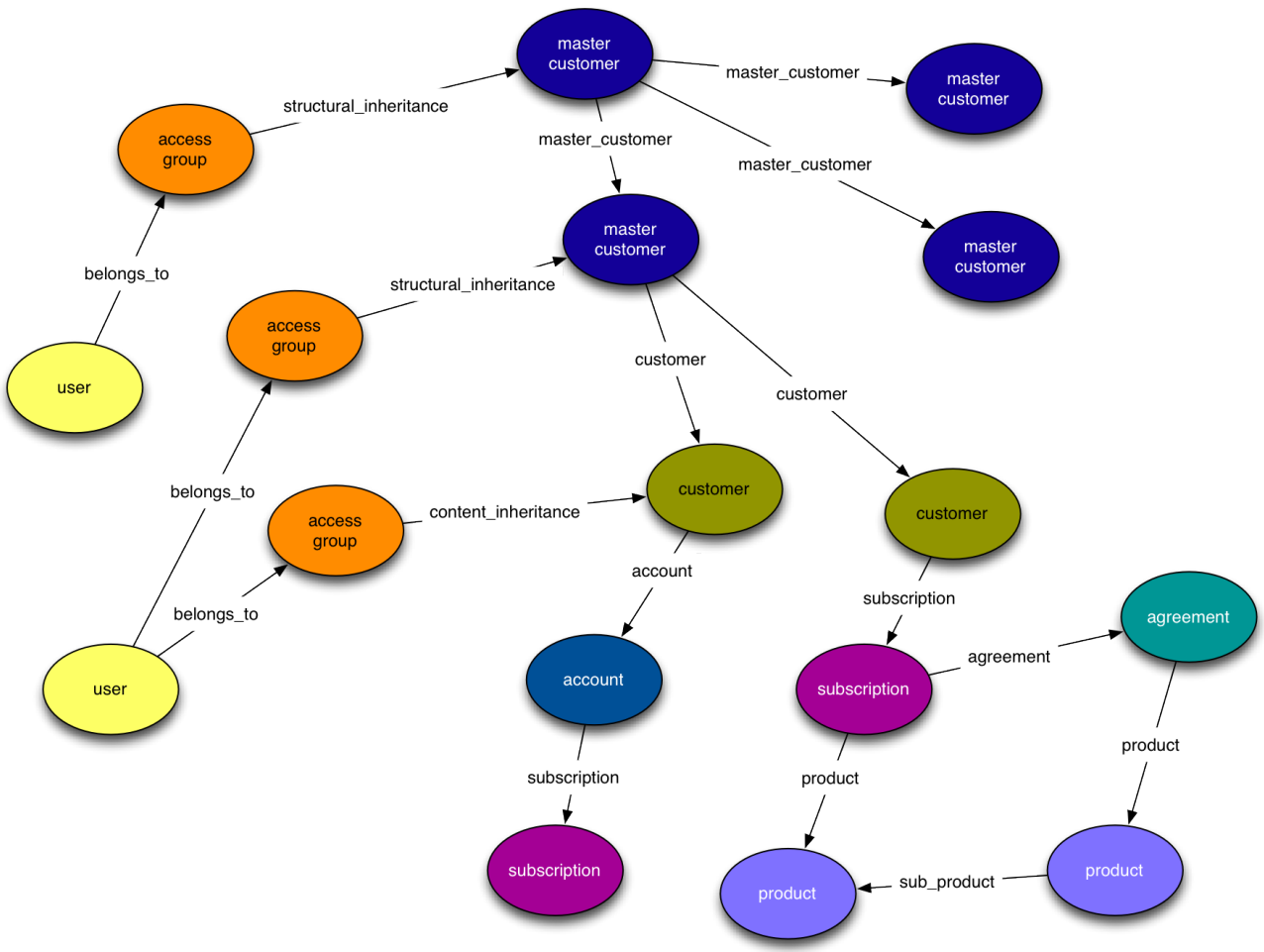
Construct result

```
MATCH      (me:User)-[:INTERESTED_IN]->(topic),
           (me)-[:WORKS_FOR]->(company),
           (colleague)-[:INTERESTED_IN]->(topic),
           (colleague)-[:WORKS_FOR]->(company)
WHERE      me.name = "Jacob"
RETURN     colleague.name          AS name,
           count(topic)            AS score,
           collect(topic.label)    AS interests
ORDER BY   score DESC
```

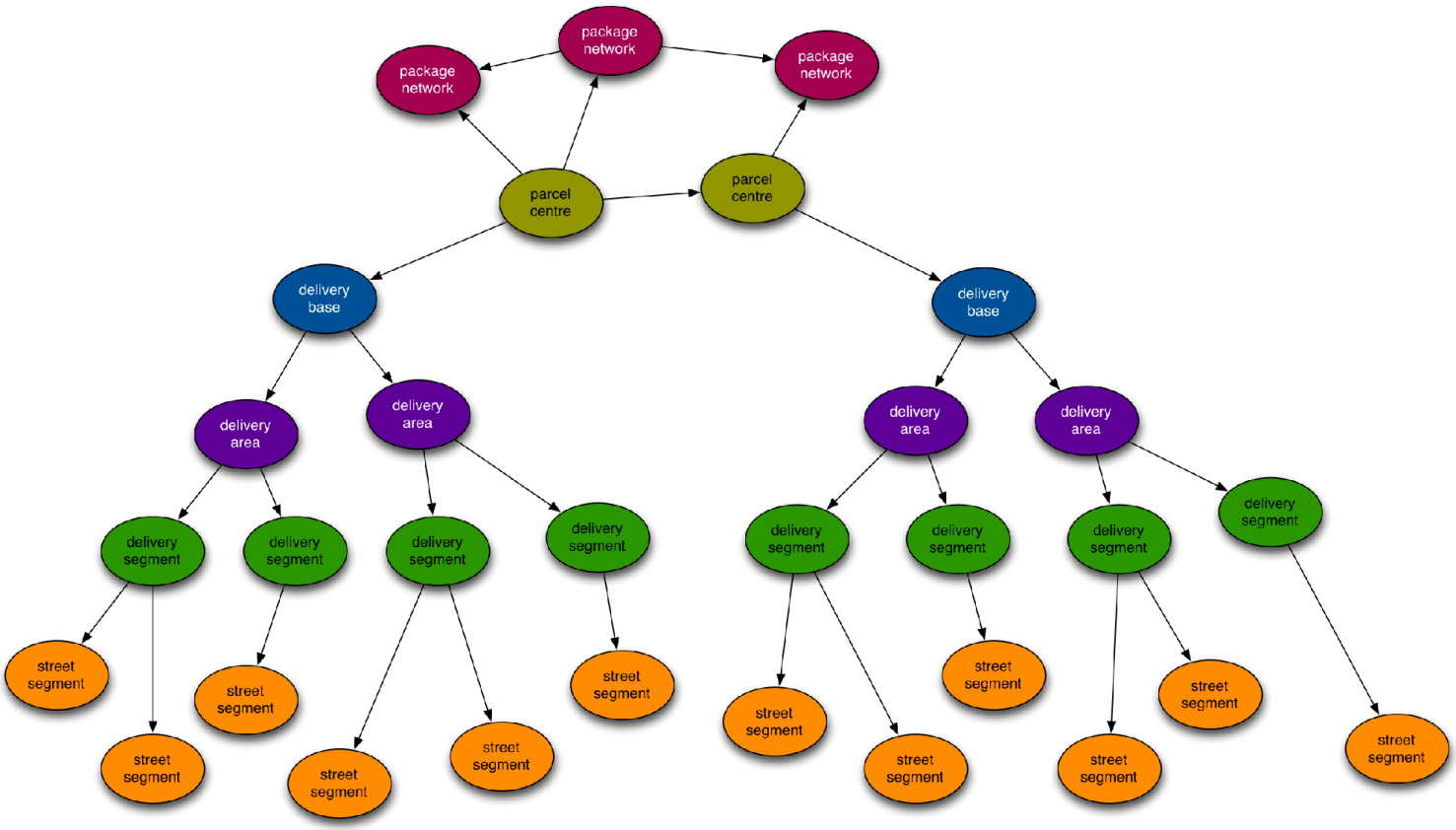
Network Impact Analysis



Asset Management & Access Control



Logistics


package network
package network
package network
parcel centre
parcel centre
delivery base
delivery base
delivery area
delivery area
delivery area
delivery area
delivery segment
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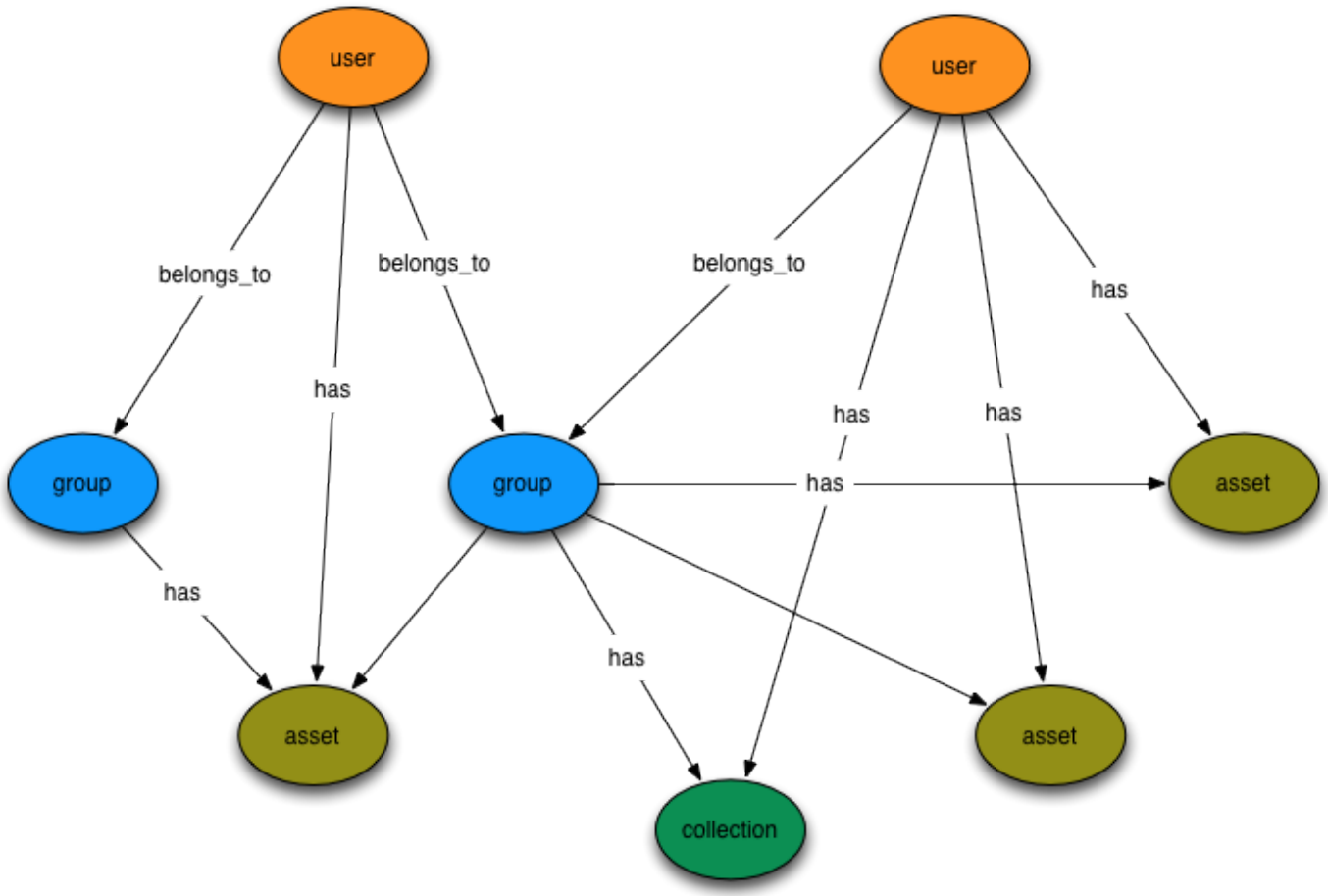
Social Network & Recommendations



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