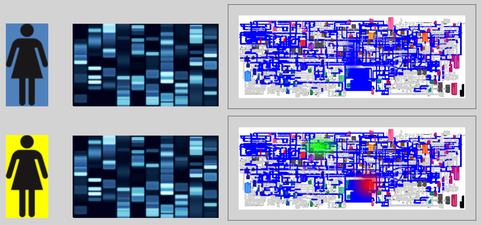
# Finding dense subgraphs in relational graphs

Vinay Jethava, Niko Beerenwinkel
vinay.jethava@bsse.ethz.ch, niko.beerenwinkel@bsse.ethz.ch

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

## Coherent sub-networks in genome-scale metabolic models

patient mutations metabolic model



http://www.metabolicatlas.org/

- 917 patients
- $|V| \sim 4000$
- $|E| \sim 15000$

Aim Find **dense common subgraphs** in patients with specific markers e.g. $mutbrca = 1$ and $mutp53 = 1$

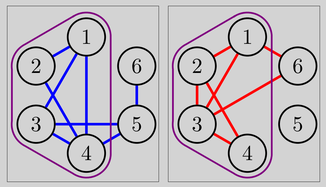
Existing methods do not scale [**jiang2009mining**; **li2011integrative** ]

## Dense Common Subgraph (DCS) problem

DCS Given relational graph set $G^{(1)} = (V, E^{(1)})$, $G^{(2)} = (V, E^{(2)}), \ldots,$

$$\delta_{DCS} = \max_{S \subseteq V} \min_{G^{(m)}} \frac{\#\{\text{edges induced by } S \text{ in } G^{(m)}\}}{|S|}$$

Example




| $S$ | $\delta^{(1)}$ | $\delta^{(2)}$ | $\delta^{\min}$ |
|---|---|---|---|
| 123456 | 1.33 | 1.17 | 1.17 |
| 12345 | 1.4 | 1.0 | 1.0 |
| 12346 | 1.0 | 1.4 | 1.0 |
| 1234 | 1.25 | 1.25 | **1.25** |
| ⋮ | ⋮ | ⋮ | ⋮ |

$\delta_{DCS} = 1.25$

## References


- **GoldbergG84**
- **charikar2000greedy**
- **jiang2009mining**
- **li2011integrative**