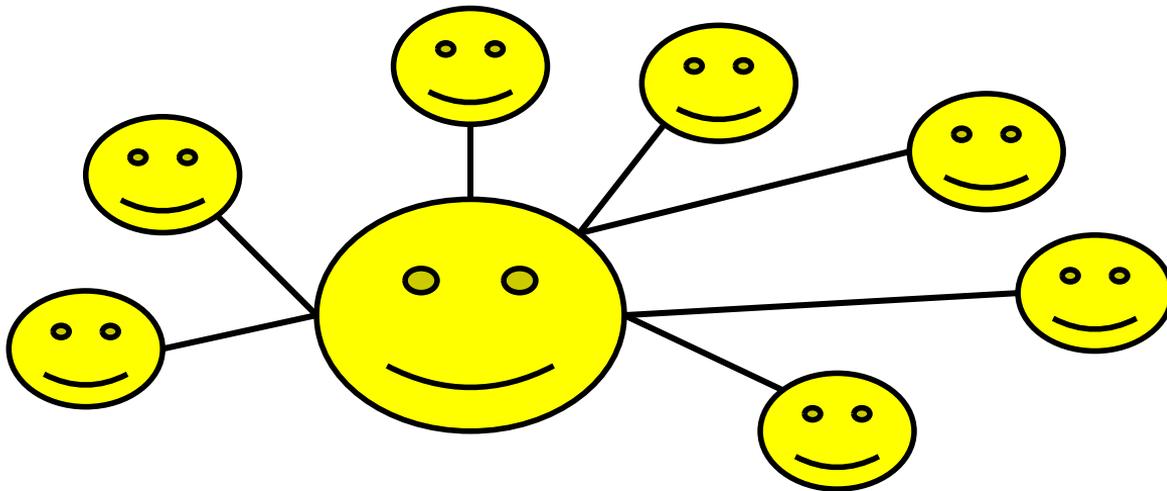




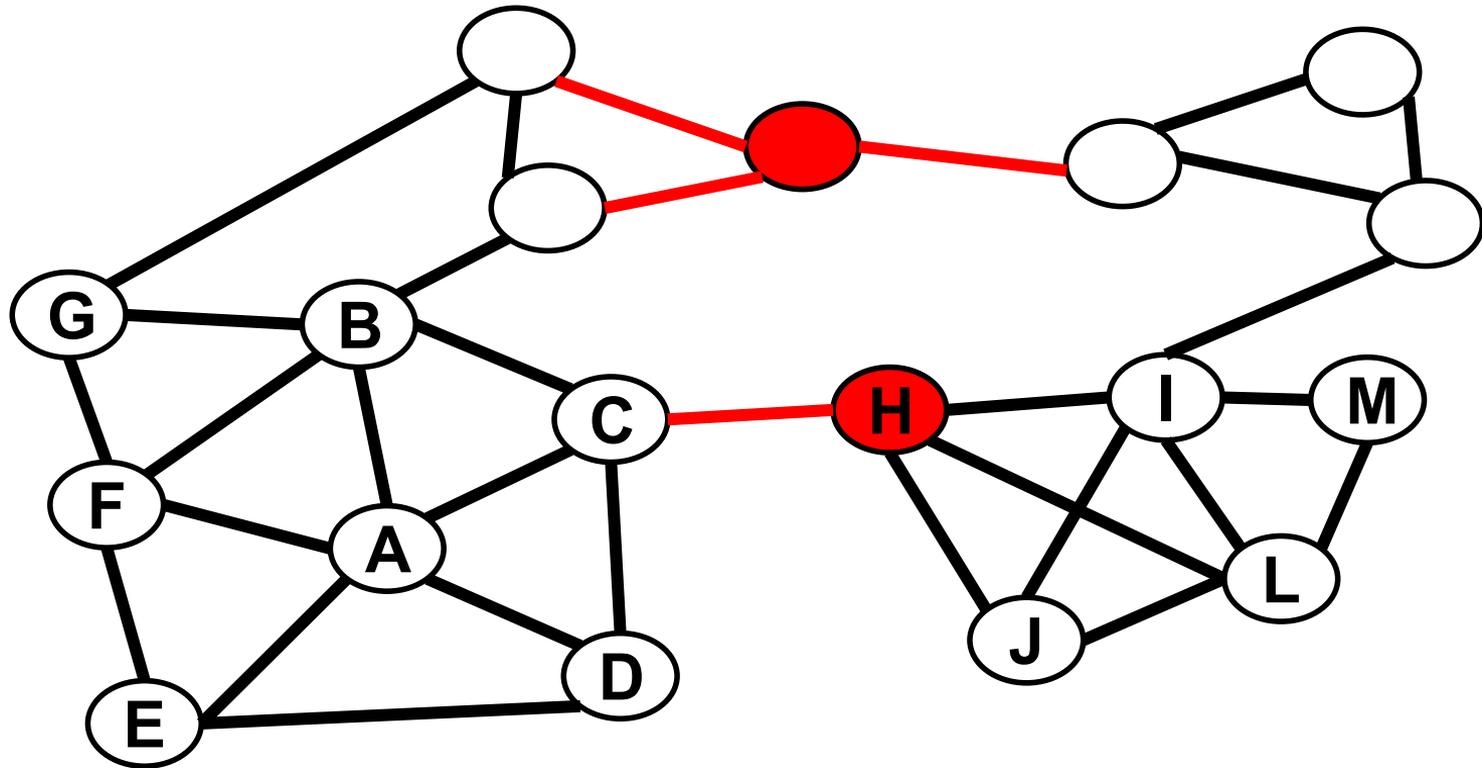
Universidade Federal do ABC



CENTRALIDADE

Prof. Fabrício Olivetti de França

Importância dos nós



Importância dos nós



Importância dos nós



Centralidade

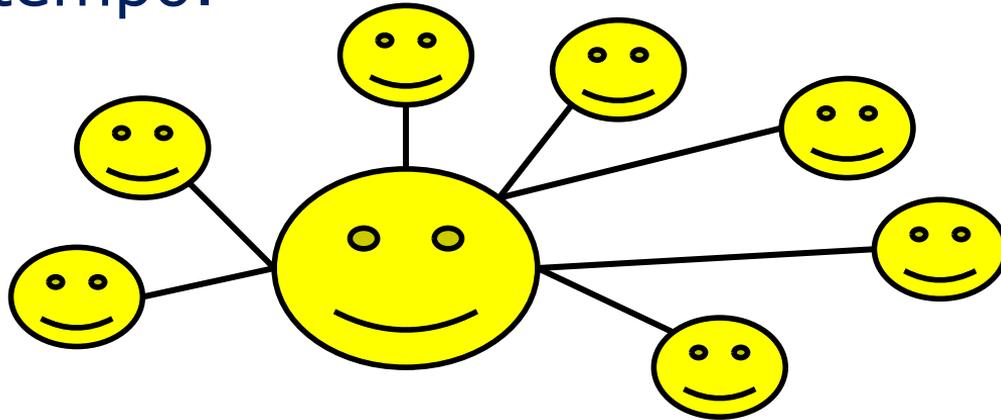
CENTRALIDADE indica:

- ❑ Influência de uma pessoa
- ❑ Importância de certas avenidas
- ❑ Ordem nos resultados de busca



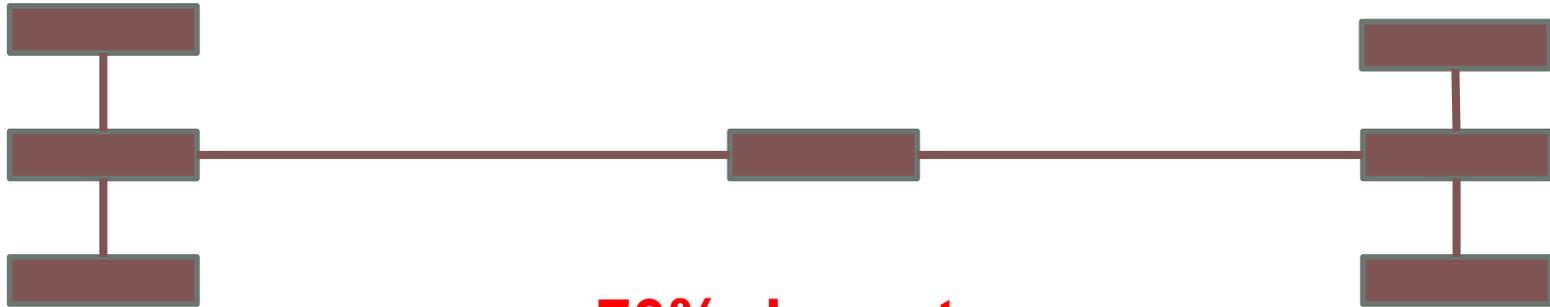
Exemplos

Em uma **rede social** o nó central é aquele que tem mais conexões, pois influencia mais pessoas ao mesmo tempo.



Exemplos

Rede de transporte: quanto mais pessoas passam por certo ponto.



**70% das rotas
passam por aqui!!**



Centralidade

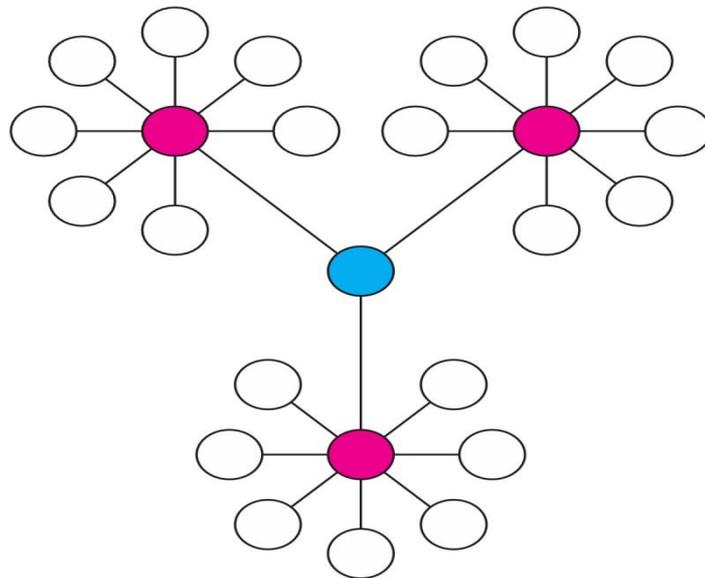
Origem em estudos de sociologia.

- ❑ Grau
- ❑ Proximidade
- ❑ Betweenness
- ❑ Pagerank (utilizado pelo Google)





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Grau

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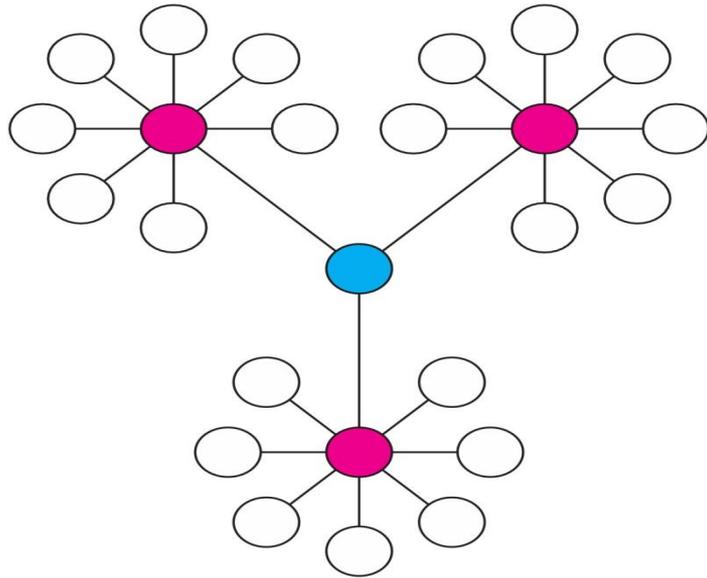
Centralidade de Grau

A ideia mais simples de um nó central é aquele que está **mais conectado que os demais**, ou seja, aquele que tem um maior grau.

$$C_g(v_i) = \frac{g(v_i)}{|V| - 1}$$



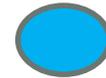
Centralidade de Grau



$C_g = 0,042$



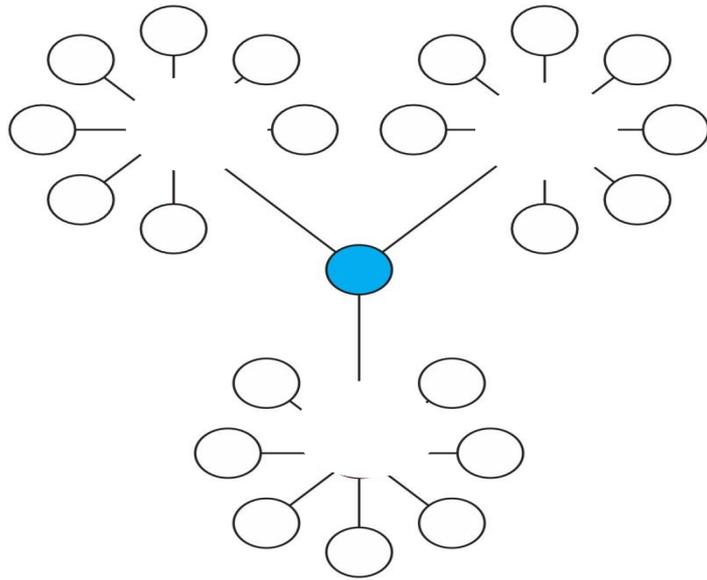
$C_g = 0,333$



$C_g = 0,125$



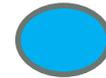
Centralidade de Grau



$$C_g = 0,042$$



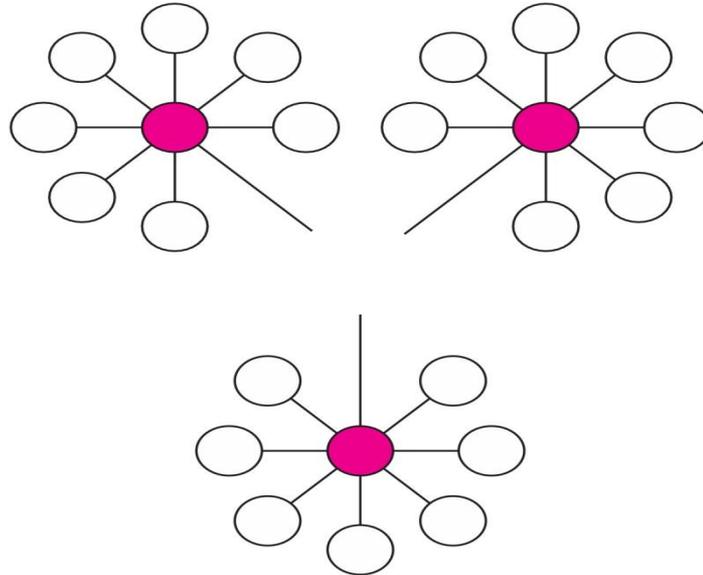
$$C_g = 0,333$$



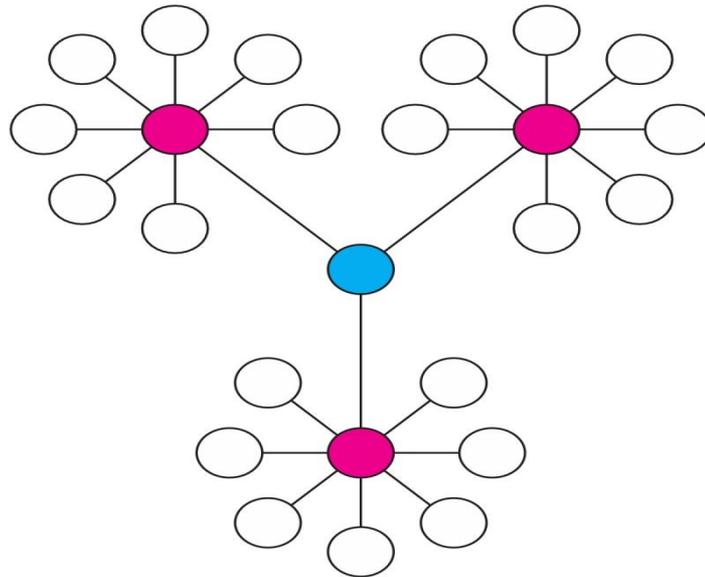
$$C_g = 0,125$$



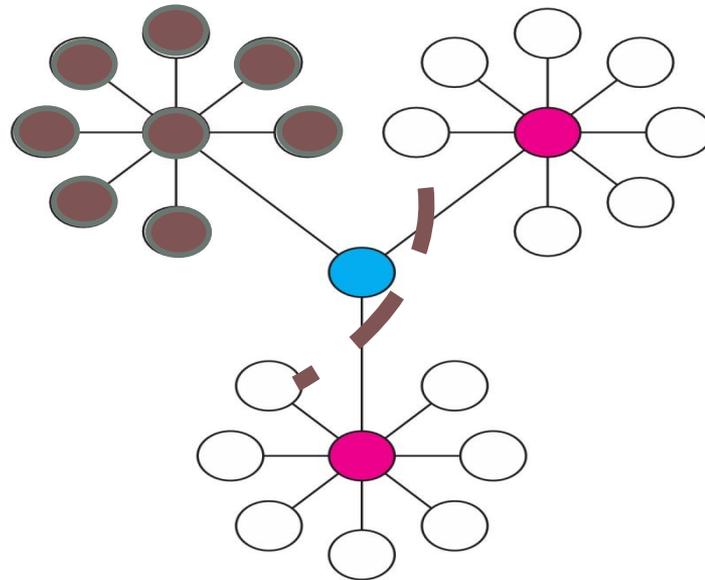
Considere Isso!



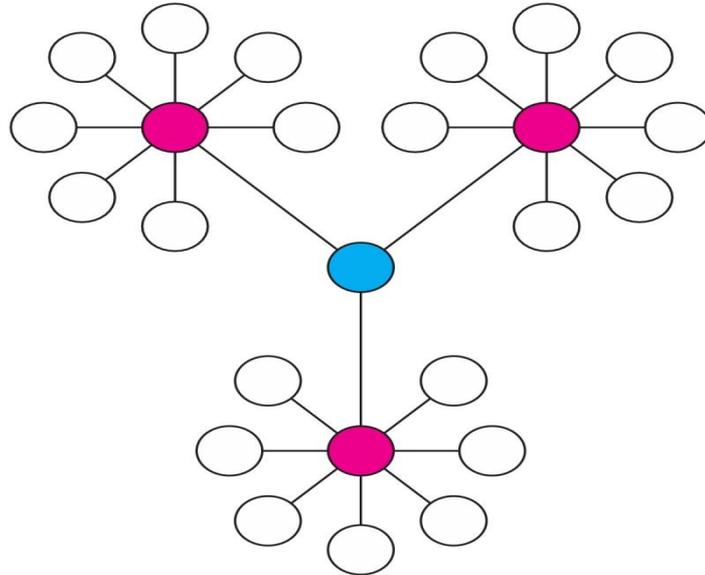
Considere Isso!



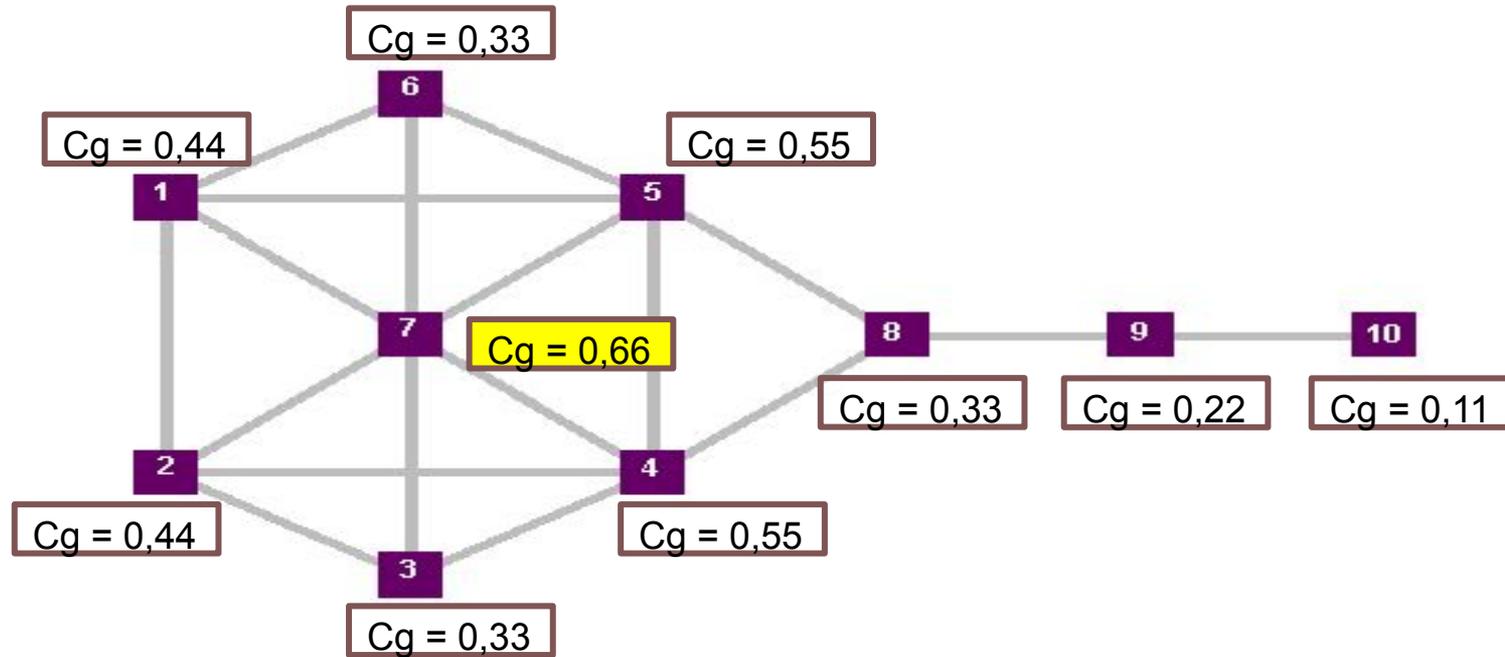
Considere Isso!



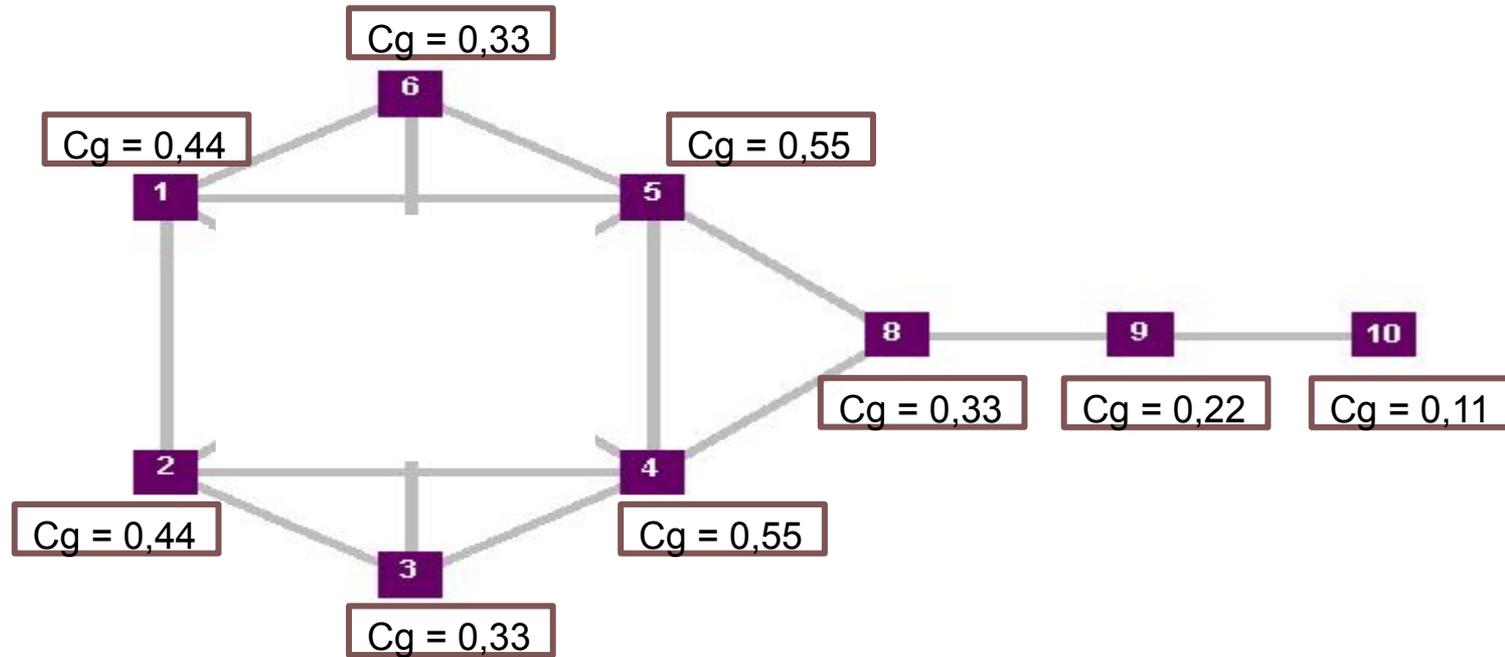
Considere Isso!



Centralidade de Grau

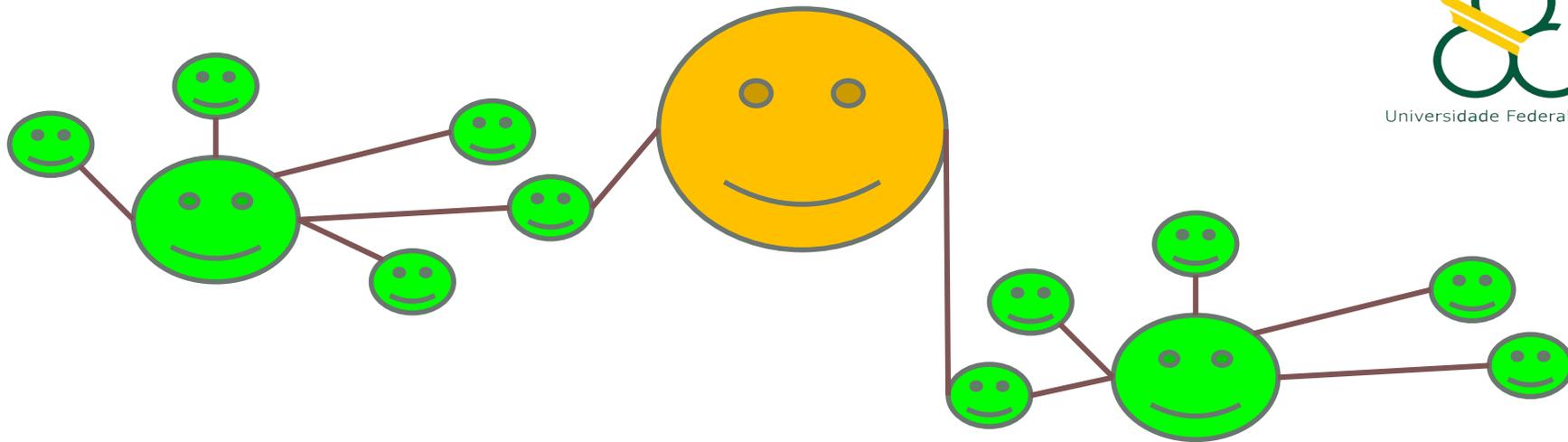


Centralidade de Grau





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Proximidade

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Centralidade de Proximidade



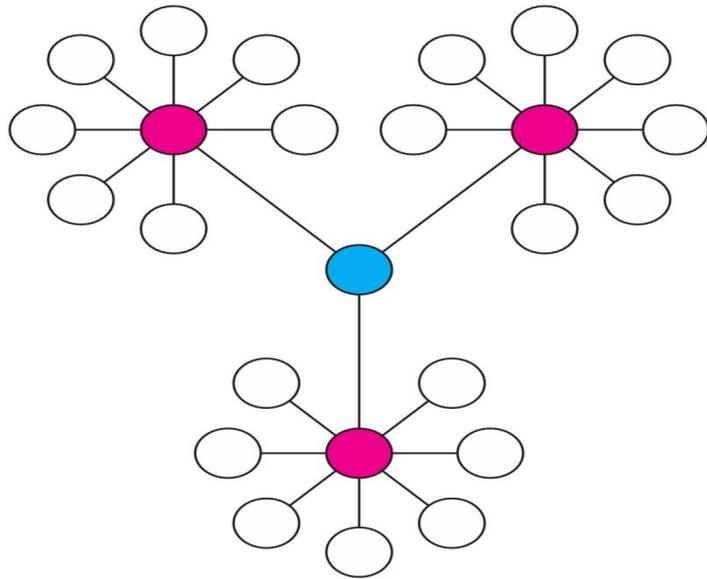
Centralidade de Proximidade

Inverso da média dos caminhos mais curtos:

$$C_p(v_i) = \frac{n - 1}{\sum_{v_j \in V/v_i} d(v_i, v_j)}$$



Centralidade de Proximidade



$C_p = 0,31$



$C_p = 0,44$

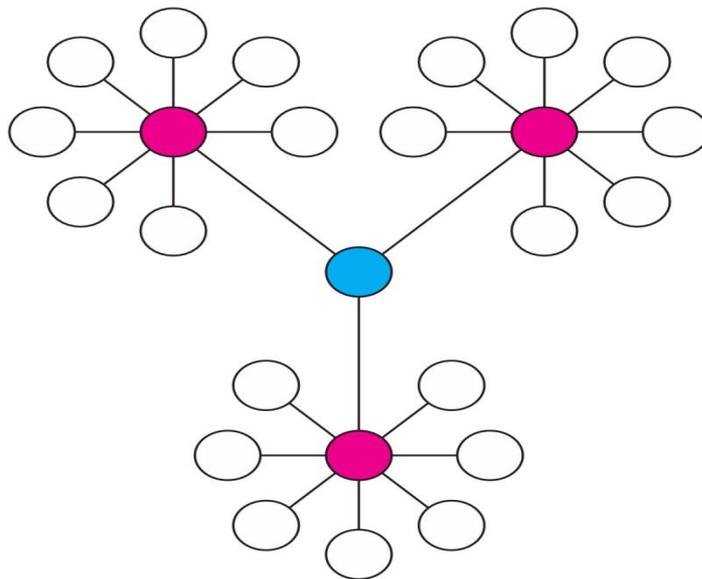


$C_p = 0,53$





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Betweenness

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Centralidade de Betweenness

Essa medida foi introduzida para verificar o controle/influência de uma pessoa para transmitir uma informação entre grupos sociais diferentes.

Freeman, Linton (1977). "A set of measures of centrality based upon betweenness". *Sociometry* **40**: 35–41.



Centralidade de Betweenness

$$C_b(v_i) = \sum_{v_j \neq v_i \neq v_k} \frac{\sigma_{v_j, v_k}(v_i)}{\sigma_{v_j, v_k}}$$



Centralidade de Betweenness

$$Cb'(v_i) = \frac{Cb(v_i)}{(n-1)(n-2)}$$

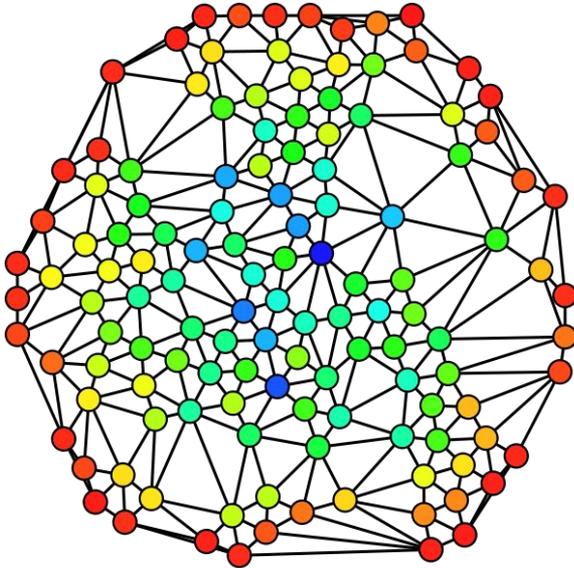
← Medida normalizada para comparação entre redes

$$(n-1)(n-2)$$

← Grau de betweenness do nó mais central em uma rede em formato estrela. Se não for direcionada, dividir por 2



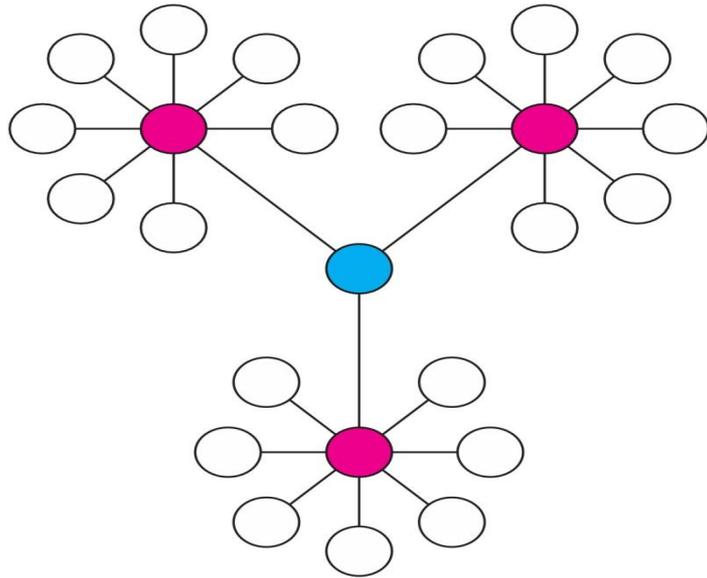
Centralidade de Betweenness



Em redes com **ORDEM** e **TAMANHO** elevados, o valor dessa centralidade é estimado utilizando uma amostragem dos caminhos.



Centralidade de Betweenness



$C_b = 0,00$



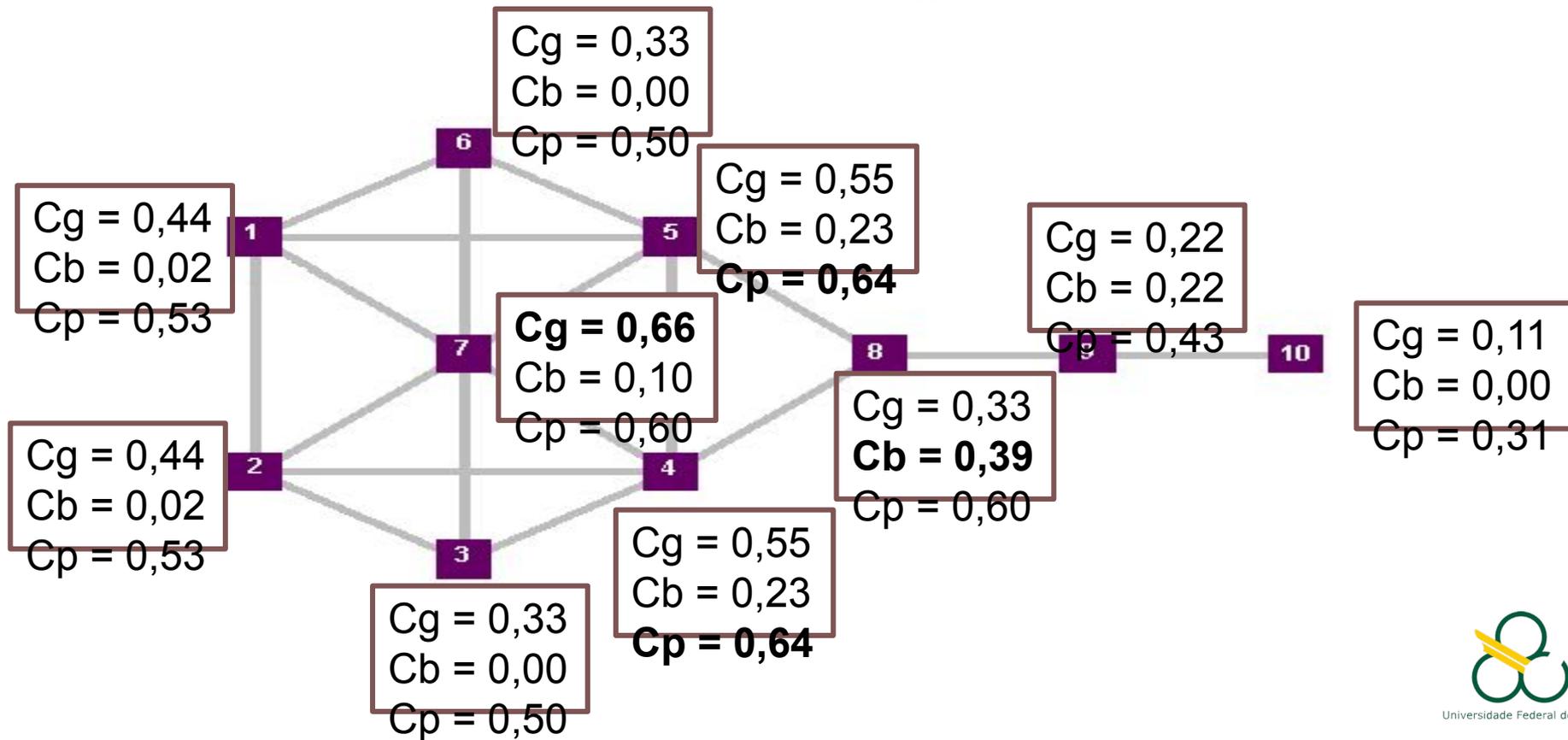
$C_b = 0,51$



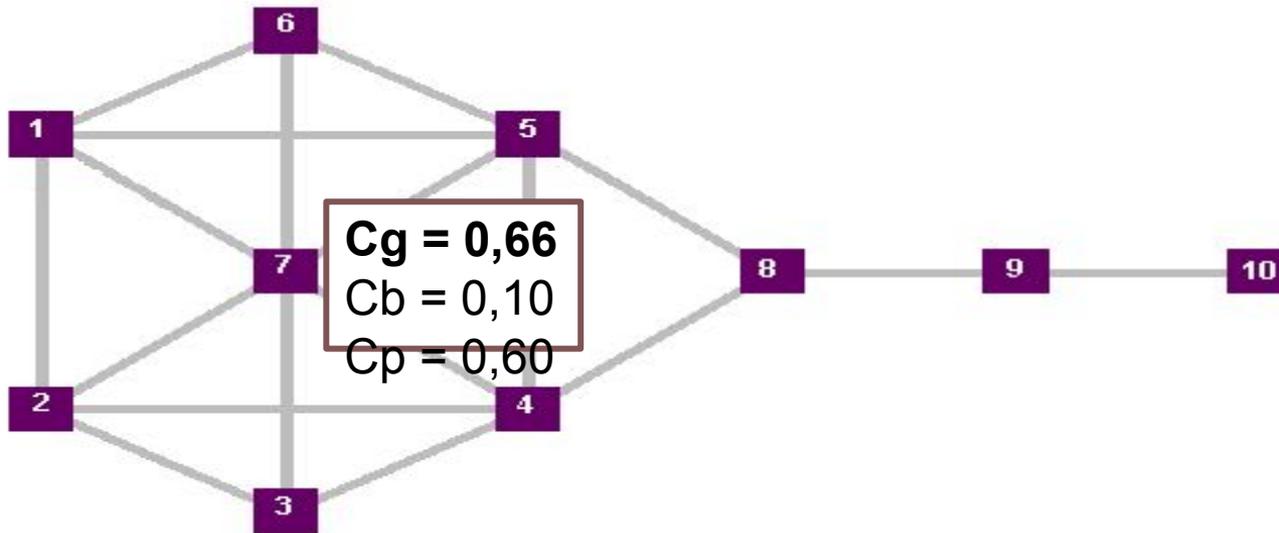
$C_b = 0,70$



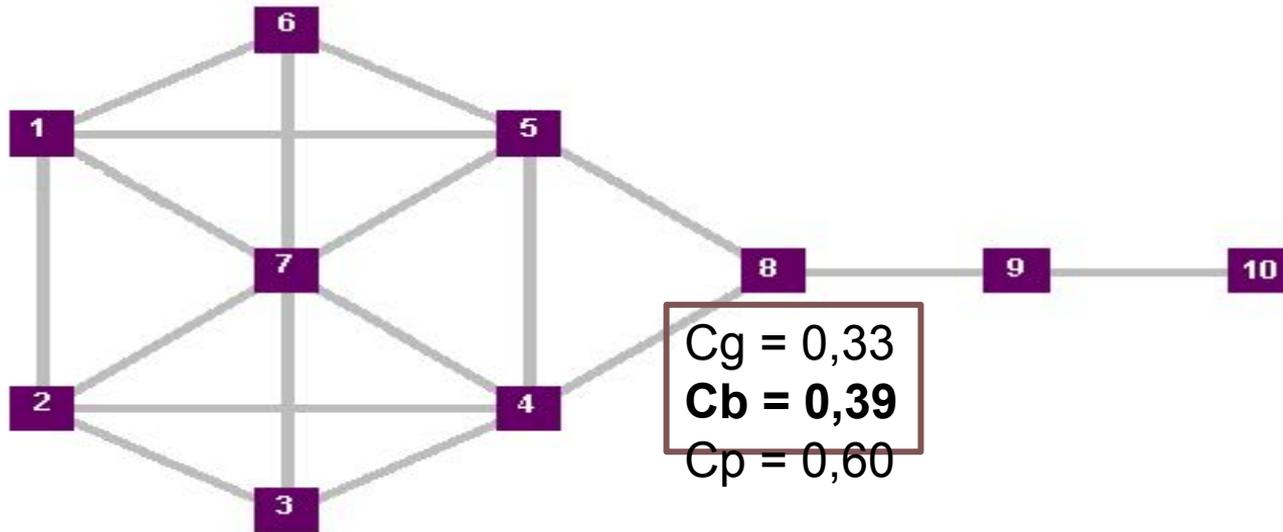
Centralidade até agora



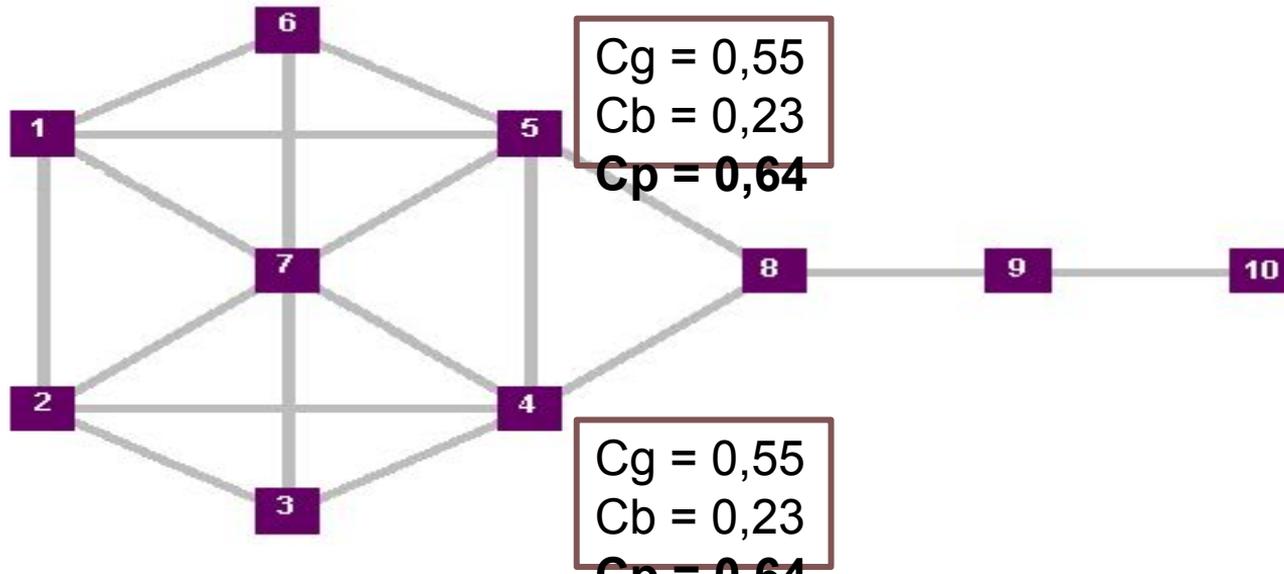
Centralidade até agora



Centralidade até agora

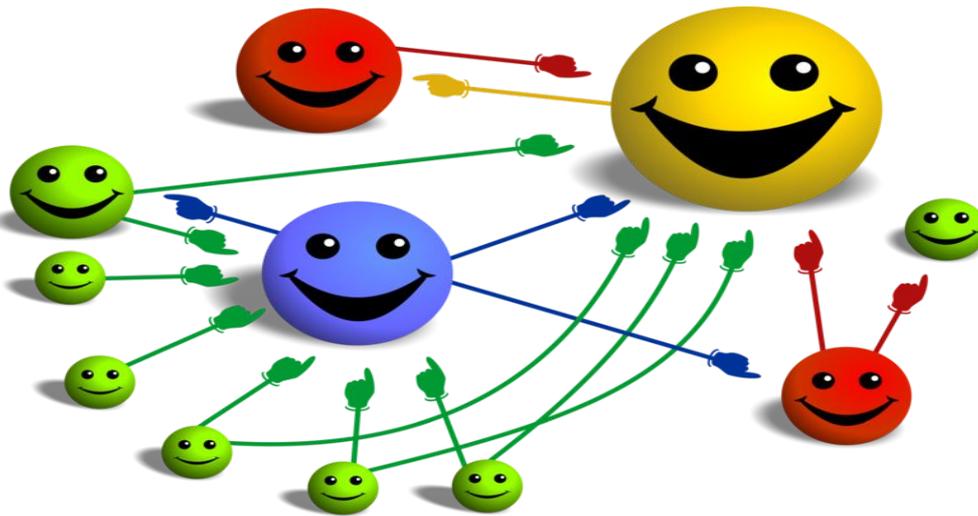


Centralidade até agora





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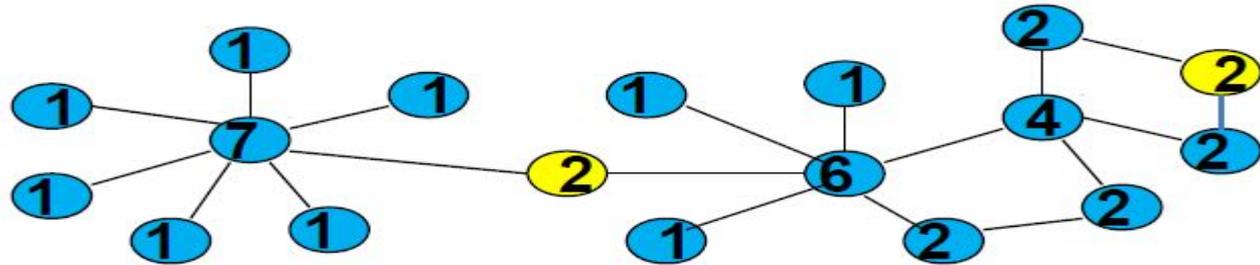


PageRank

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Centralidade de Autovetor

Porém, analisemos o seguinte caso:



Centralidade de Autovetor

$$C_i = \frac{1}{\lambda} \sum_j a_{i,j} C_j$$



Centralidade de Autovetor

$$\lambda C = \sum_i \sum_j a_{i,j} C_j = AC$$

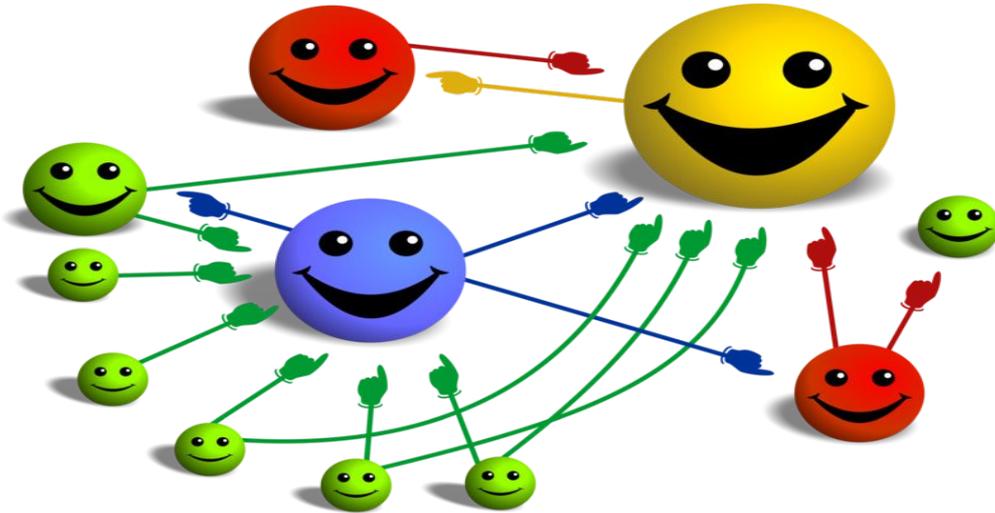


Autovalor e Autovetor

$$Ax = \lambda x$$



PageRank



PageRank

$$C_{pr}(v_i) = \sum_{v_j | (v_j, v_i) \in E} \frac{C_{pr}(v_j)}{dg_{out}(v_j)}$$

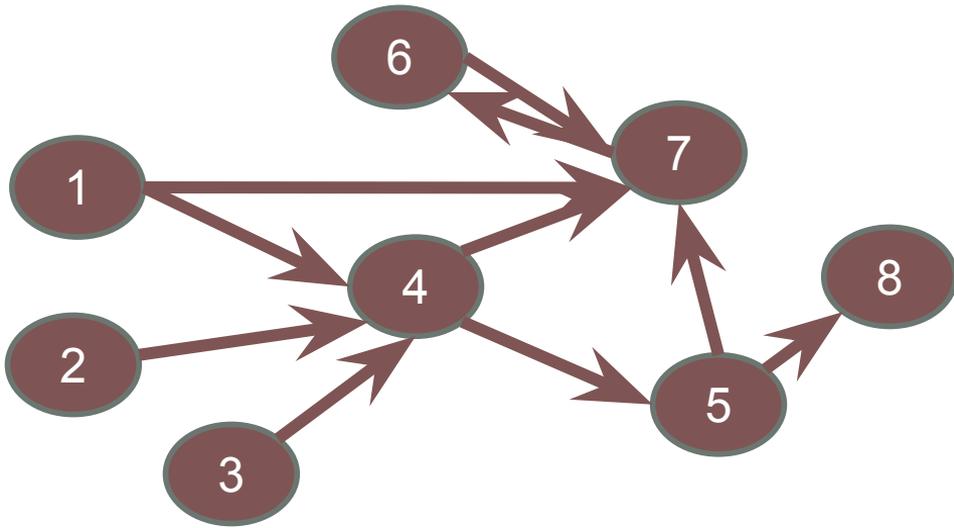


PageRank

$$C_{pr} = C_{pr}N$$



PageRank



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			1				
				0,5		0,5	
						0,5	0,5
						1	
					1		

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PageRank

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X

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			1				
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PageRank

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X

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			1				
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						1	
					1		

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PageRank

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 X

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			1				
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PageRank

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			1				
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PageRank

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X

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			1				
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						0,5	0,5
						1	
					1		

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PageRank

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X

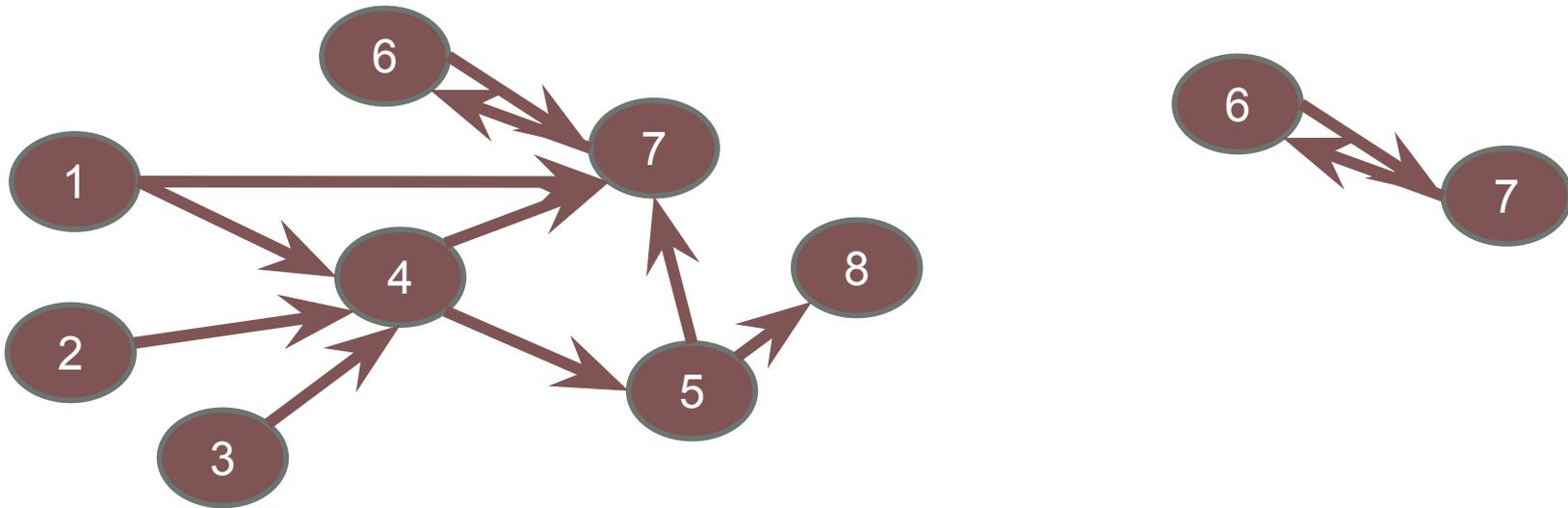
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			1				
			1				
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						0,5	0,5
						1	
					1		

=

0	0	0	0	0	3,125	2,5	0
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PageRank

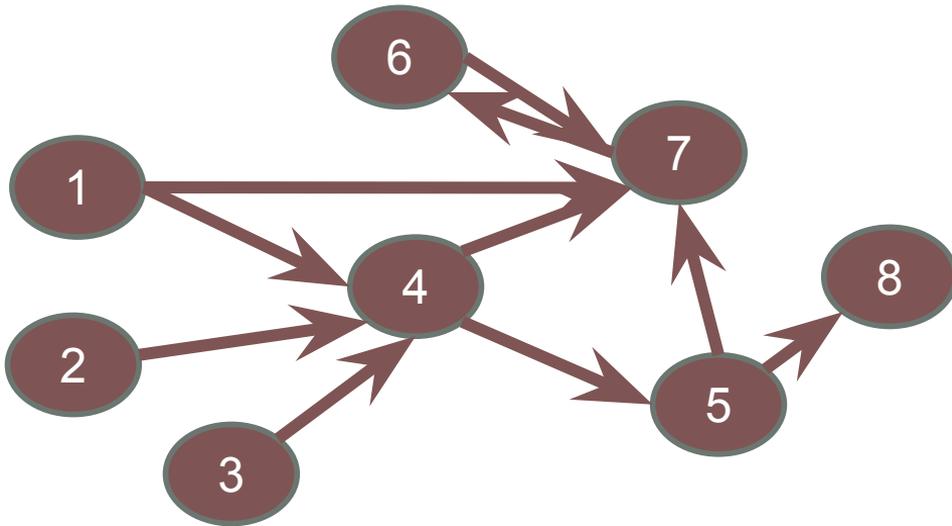


PageRank

$$P = \alpha N + (1 - \alpha)E$$



PageRank



0.02	0.02	0.02	0.44	0.02	0.02	0.44	0.02
0.02	0.02	0.02	0.87	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.87	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.44	0.02	0.44	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.44	0.44
0.02	0.02	0.02	0.02	0.02	0.02	0.87	0.02
0.02	0.02	0.02	0.02	0.02	0.87	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02



PageRank

$$C_{pr} = \frac{C_{pr}P}{\|C_{pr}P\|}$$



PageRank

0.04 0.04 0.04 0.65 0.17 0.29 0.65 0.17

0.04 0.04 0.04 0.14 0.33 0.62 0.68 0.11

0.04 0.04 0.04 0.12 0.09 0.6 0.76 0.17

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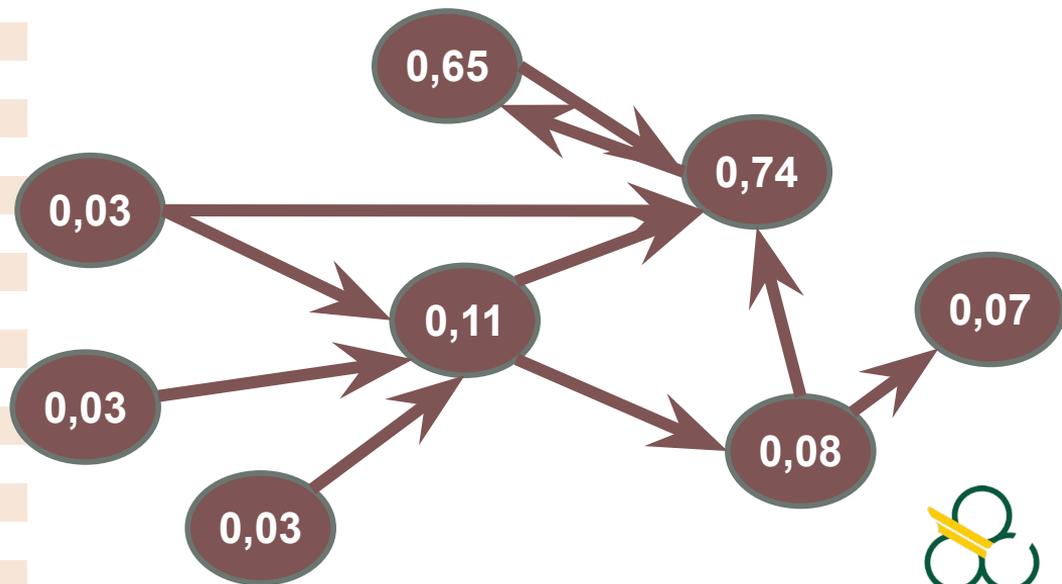
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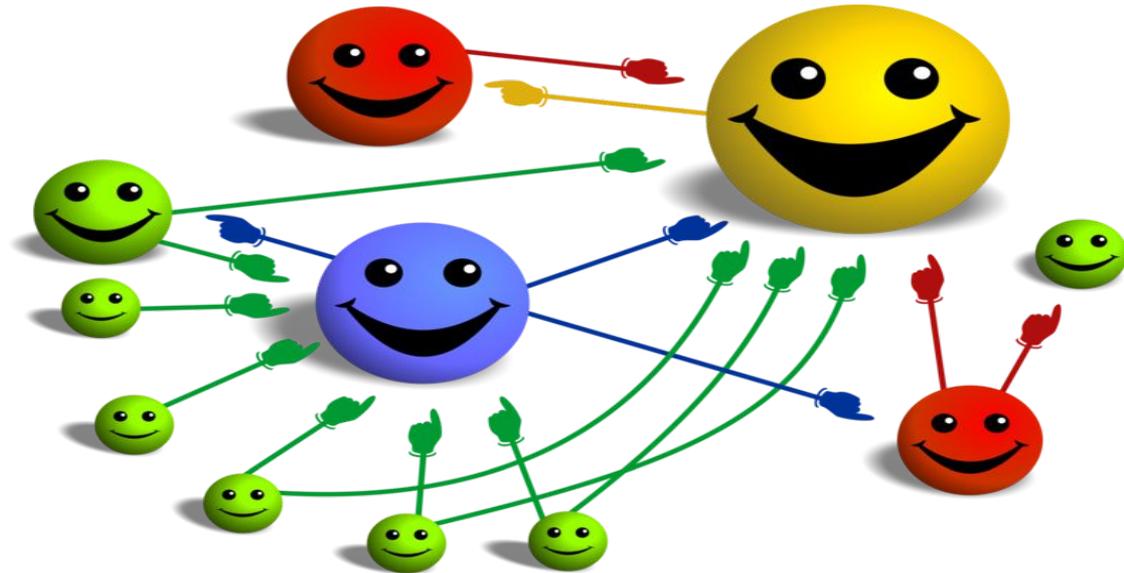
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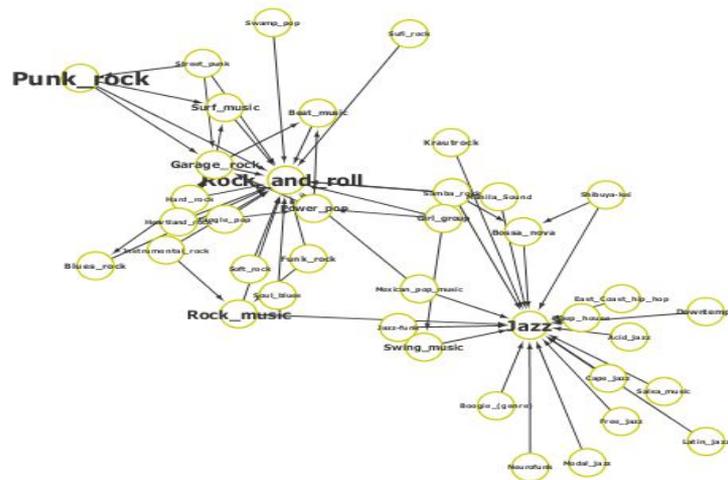
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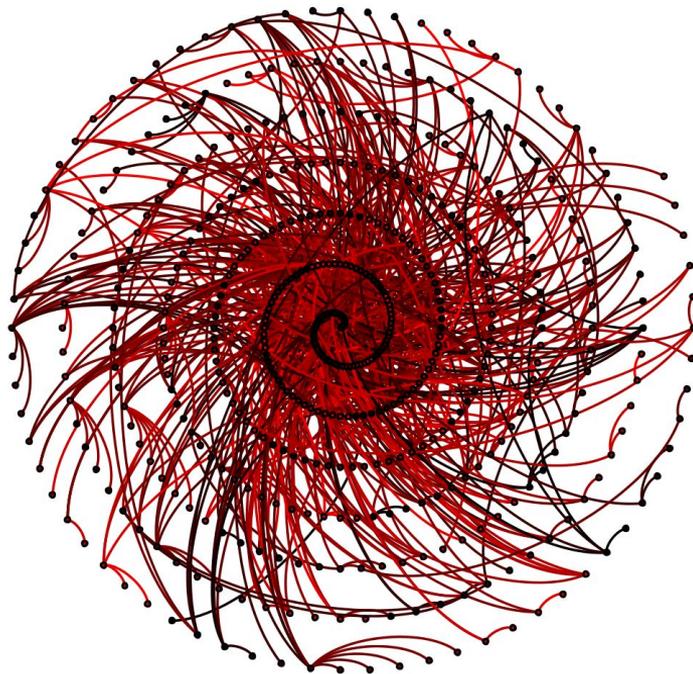




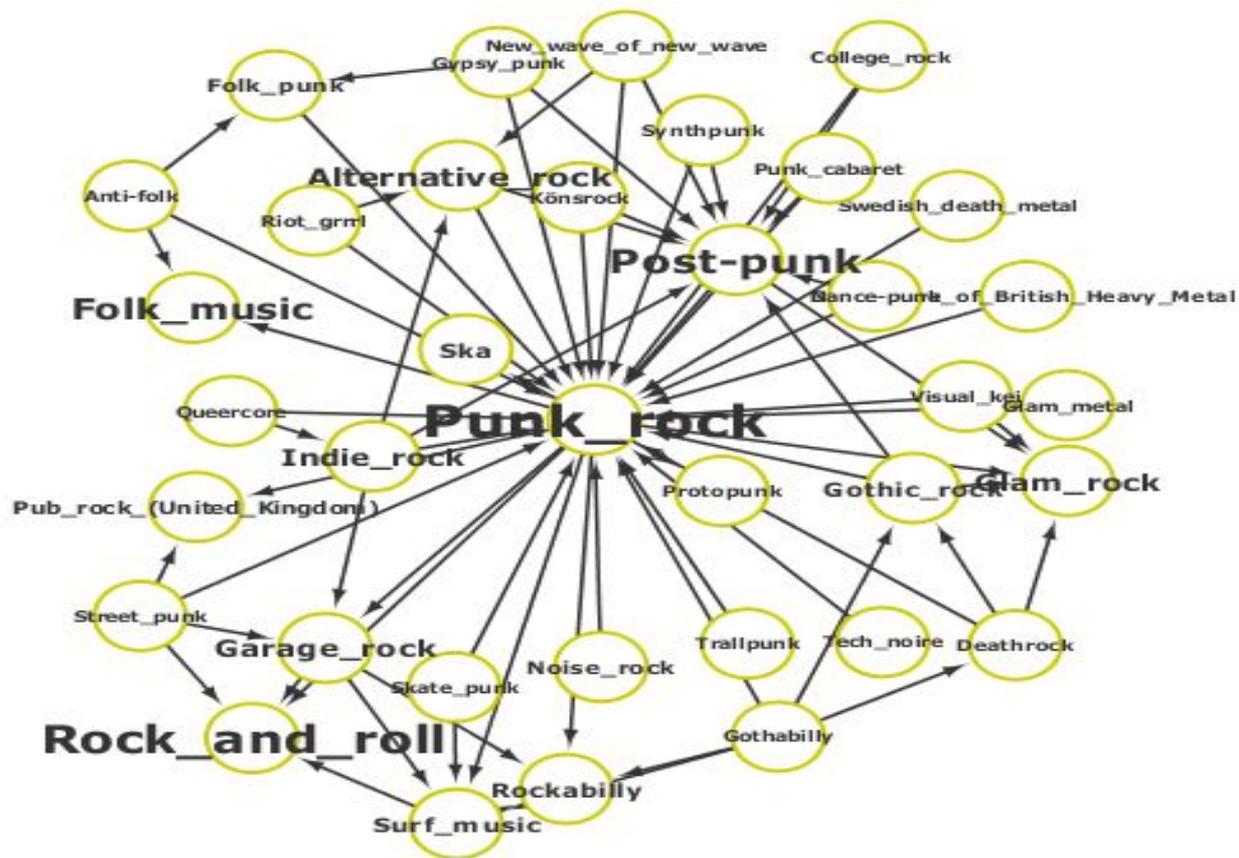
CENTRALIDADE NAS REDES REAIS

Prof. Fabrício Olivetti de França

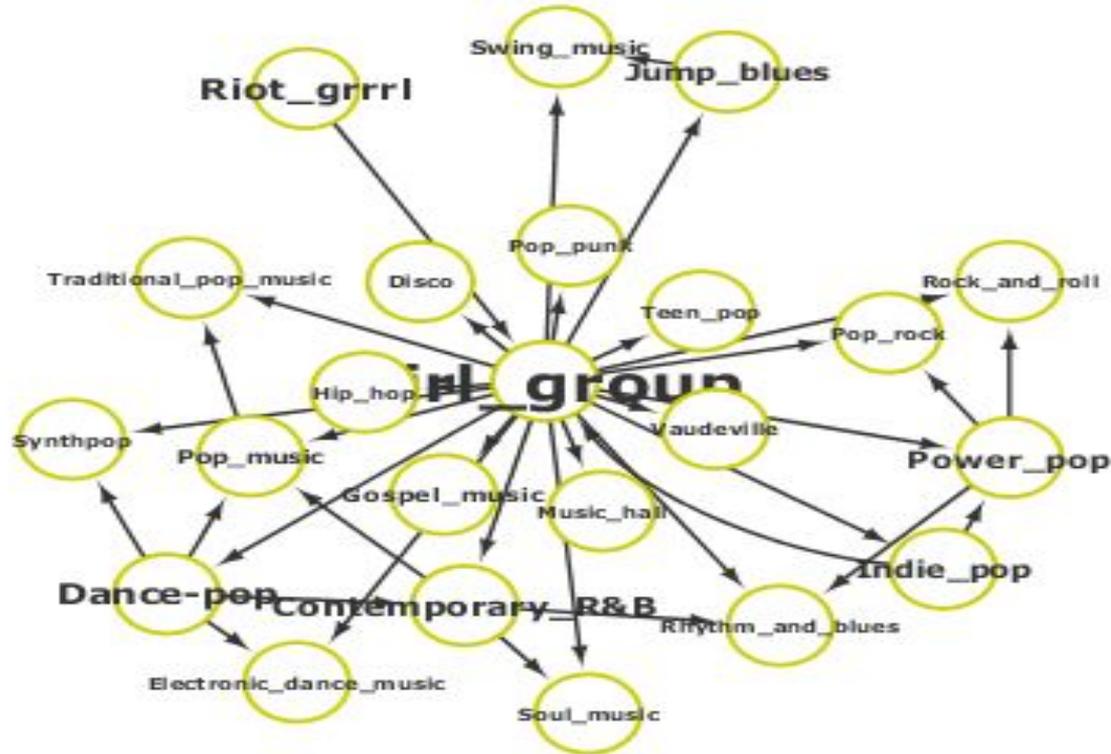
Influências Musicais



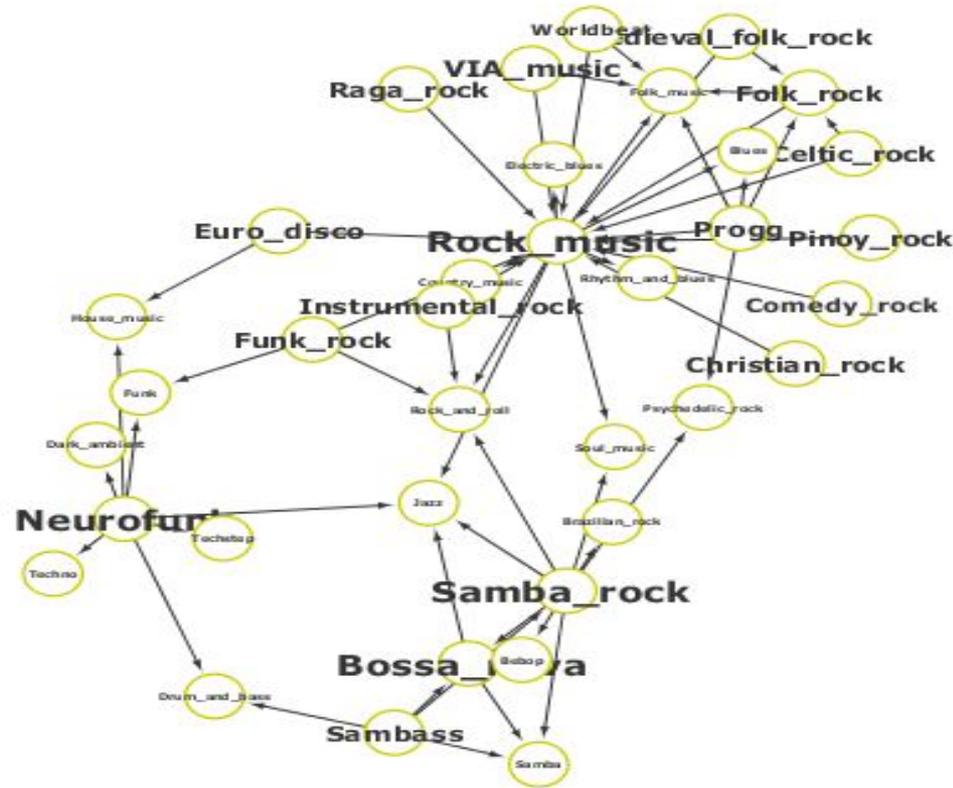
Influências Musicais – Grau Entrada



Influências Musicais – Grau Saída



Influências Musicais – Proximidade



Influências Musicais – Pagerank

