



MAPK Signaling Pathway Analysis

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Presentation by:

Gergana Bounova, Michael Hanowsky and Nandan Sudarsanam

Faculty: Chris Magee



Agenda

- Introduction
- Network Description and Interpretation
- Preliminary Model and Analysis
- Future Directions and Scope



The MAPK Signaling Pathway

- **Biological Network**
 - Signaling pathways are used to respond to external stimuli and regulate cellular activities
 - MAPK's (Mitogen Activated Protein Kinase) – Transfer information through chemical reactions.
- **Signaling Pathway**
 - Data Sources: The KEGG Database
 - System boundaries: Inputs and Outputs
 - Compounds and enzymes
 - Activation and Inhibition



MAPK Pathway (Directed)

Image removed for copyright reasons.
See: http://www.genome.jp/dbget-bin/get_pathway?org_name=ko_hsa&mapno=04010



Network Description and Interpretation

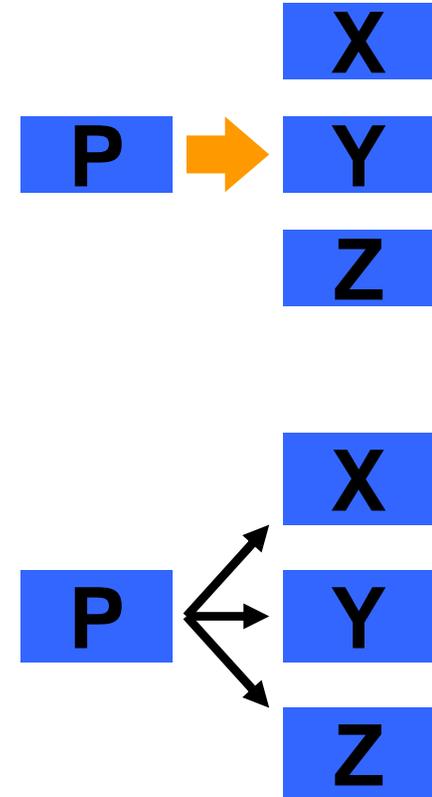
- Nodes
 - Proteins and metabolites
 - Exist at different levels of activity
- Edges
 - Are the paths along which information flows
 - Express the relationship between different proteins
 - Activation and Inhibition
 - Actions are directed



Preliminary Model – Adjacency Matrix

- The key challenge is to identify the relationships between specific nodes
 - All relationships are bi-directional
 - Nodes are de-aggregated
 - All relationship types are equivalent

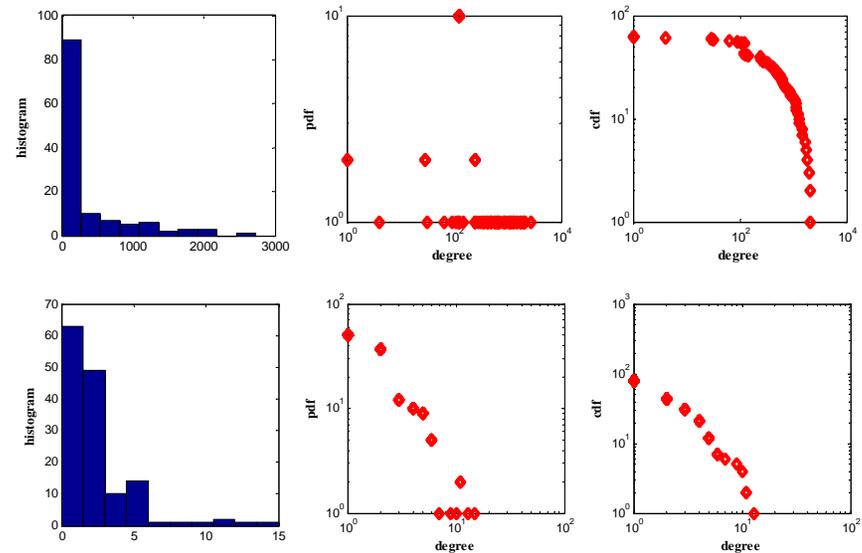
	1	2	3	4	5	6	7	8	9	10	11
	AKT	Alzheimer's d	anti-apoptos	Apoptosis	ARRB	ASK1	ASK2	ATF-2	BDNF	Ca2+	CACN
1 AKT						1					
2 Alzheimer's d											
3 anti-apoptos											
4 Apoptosis											
5 ARRB											
6 ASK1	1										
7 ASK2											
8 ATF-2											
9 BDNF											
10 Ca2+											1
11 CACN										1	





Statistics for MAPK Reference Pathway

- Adjacency matrix – 143x143
- Giant component – 126 nodes
- 15 disconnected components
- Stats
 - Network diameter: 16
 - Mean path length: 6.2
 - Deg corr: -0.338
 - Clust Coeff: 0.0082
(GC: 0.0094)



Distributions: betweenness (top), degrees (bottom)



MAPK Reference Pathway - Pajek



Open Future Directions, Project Scope

- Calculate network statistics and compare to statistic tables for other (biological) systems
- Identify network structure, functional modules (motifs-recurring patterns)
- Compare statistics and structural properties for pathway in different evolving species
- Suggestions?