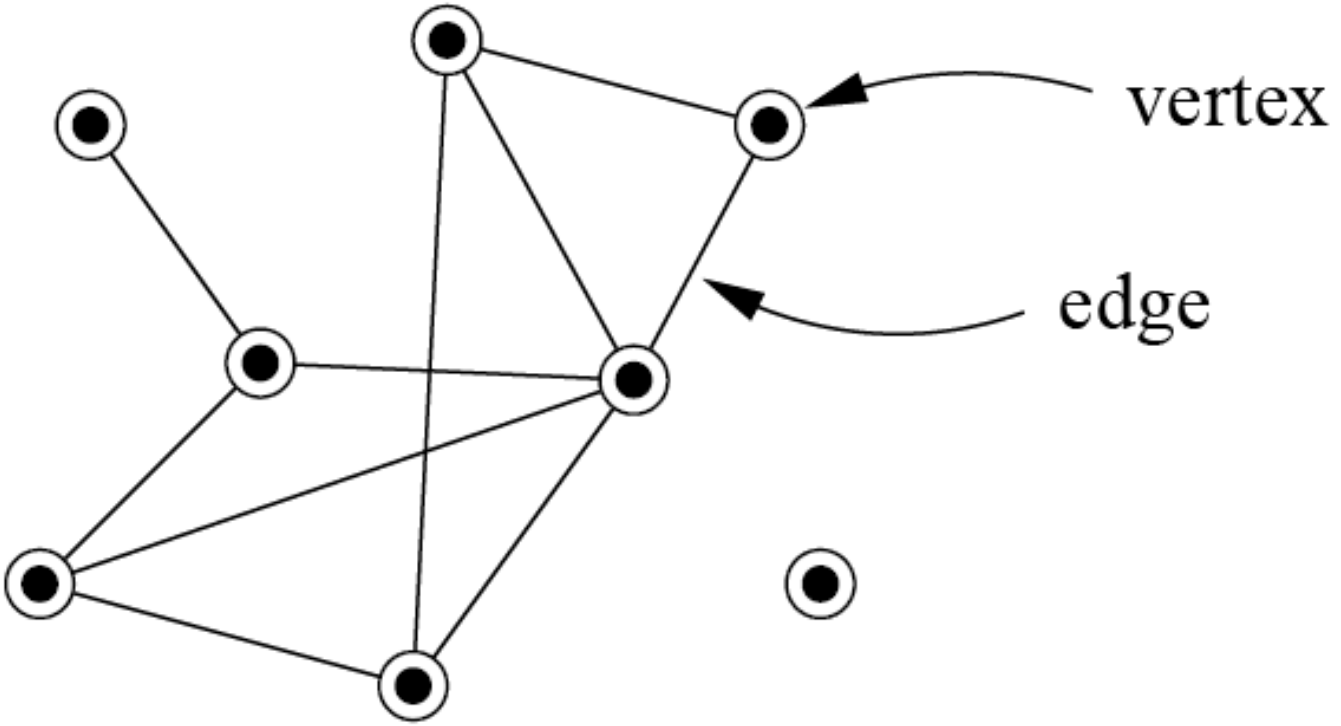
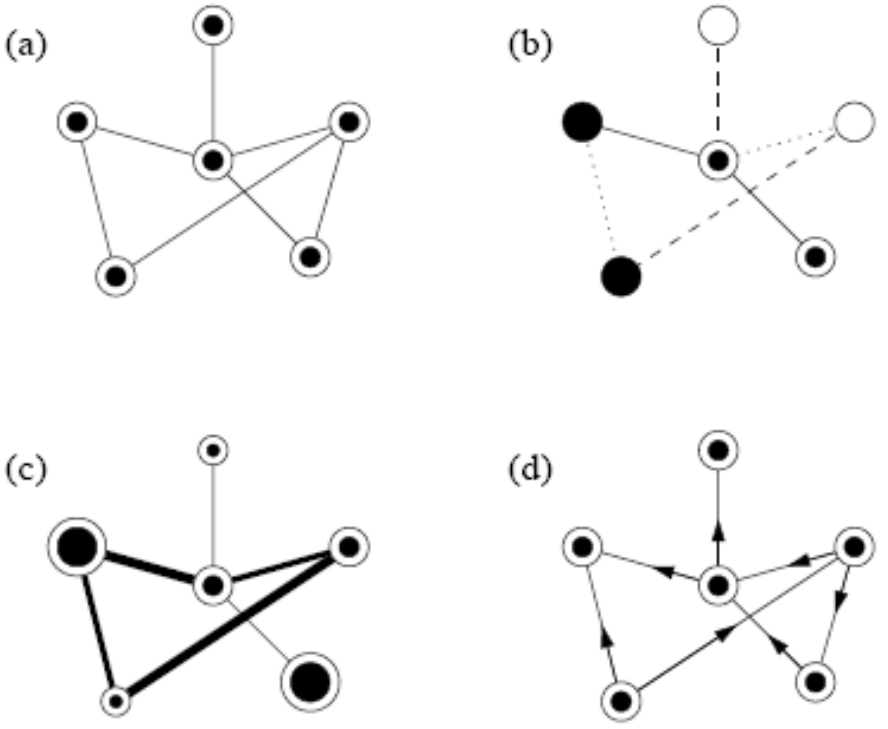
Lecture 1:
Graphs (Networks) Overview



pictures taken from Mark Newman: The structure and function of complex networks

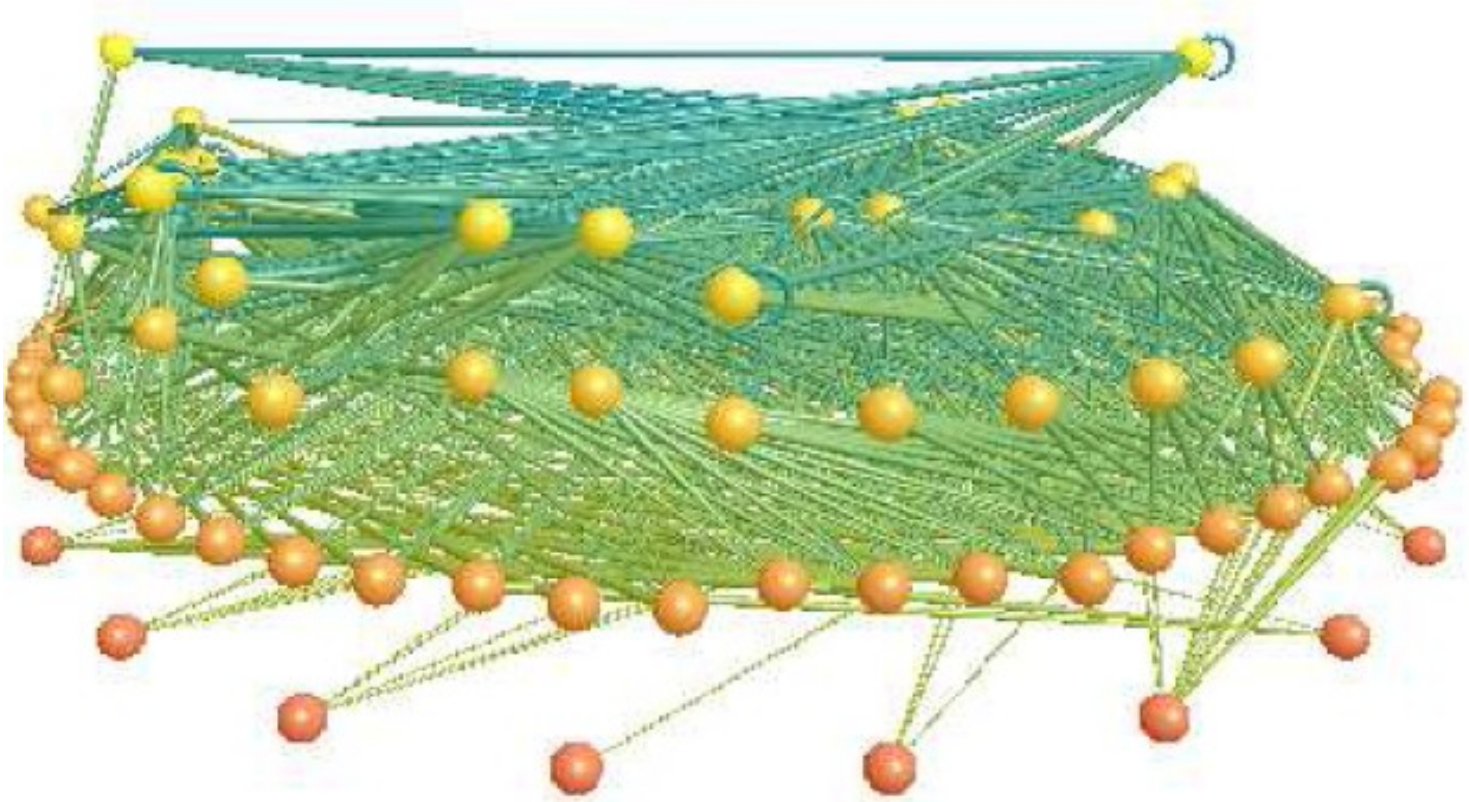
Graphs: Frequented Terms

- vertex (site, node, actor)
- edge (bond, link, tie)
  - directed/undirected
  - loops, multiple edges
- degree
  - in, out
- component

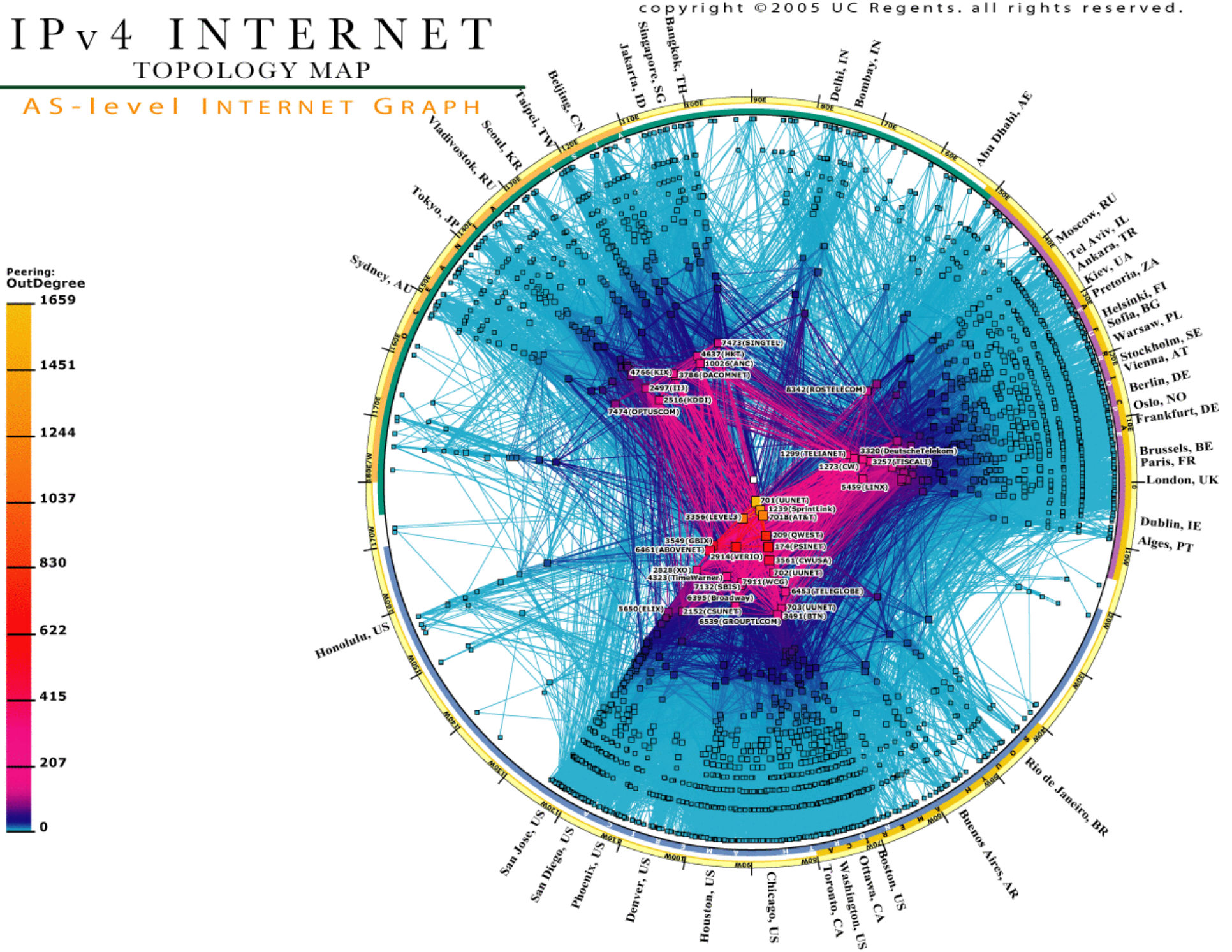


Large Networks: Basic Question

- How can I tell what this network looks like when I cannot actually look at it?



IPv4 INTERNET
TOPOLOGY MAP
AS-level INTERNET GRAPH



Networks in the Real World

- social networks
  - friendship, social influence
- information networks
  - WWW, citations, shopping carts
- technological networks
  - electric power nets, Internet
- biological networks
  - metabolic pathways

Answering the Basic Question: Properties of Networks

- Degree distribution
  - P[random vertex has degree *d*]
- Components
  - how is the network partitioned
- Transitivity
  - “a friend of my friend is also my friend”?
- Small-world'ness
  - distance grows slowly (≤*log* n) for a fixed degree
- Network resilience
  - what happens if we delete a group of vertices?