# Generating graphs

## Random graphs G(n,m)

- Random graph G(n,m), n vertices, m edges
  - repeat m times
  - uniformly at random choose a pair of nodes
  - better for sparse graphs, $m \ll n(n-1)/2$

Interesting questions

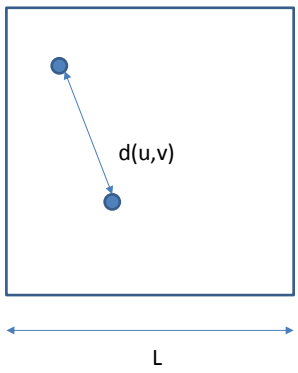
- for fixed n, number of strong components as a function of m
- for fixed n, diameter as a function of m (small worlds)

# Random graphs G(n,p)

- Random graph G(n,p), n vertices, p probability of there being and edge
  - for each pair of nodes, enter an edge with probability p
  - number of edges is p n (n-1) / 2 *on average*
  - better for dense graphs

# Waxman model

- Place n nodes in an L x L 2-dimensional grid
- For each pair of nodes *u* and *v*, there is an edge between *u* and *v* with probability $pe^{-bd(u,v)/L}$, where d(*u*,*v*) is the euclidean distance from u to v
- increase in *p* corresponds to increase in number of edges
- increase in *b* corresponds to larger ratio between long an short edges



# Preferential attachment

Start with one node
Repeat n-1 times

1. with probability p make a link from the new node i to another node, chosen uniformly at random
2. with probability 1 – p make a link to node i with probability $k_i / (\sum k_j)$ where $k_j$ is the in-degree of node j, $0 \leq j < i$

Start with one node
Repeat n-1 times

1. with probability p make a link from the new node i to another node, chosen uniformly at random
2. with probability 1 – p choose a node i uniformly at random
    1. if the chosen node is 0 link to node 0
    2. otherwise, link to the node *that i points to*