10-24 – 11-2 – Interactions between Agents

* Social ability – agents interact with other agents and possibly humans
* Connecting agents
  + Create nodes (turtles)
    - Create-turtles 5
  + Optionally give them a label
    - Ask turtle 1 [set label “James”]
  + Connect the agents
    - Ask turtle 1 [create-link-with turtle 2]
  + It helps to think of nodes as numbers, because you ask a numbered turtle to link with another numbered turtle
* What is a network?
  + A network is a set of objects connected in pairs
  + A relation can only be between 2 objects
  + A hypergraph is a set of objects of which subsets can be connected
* Edges
  + Can be of different types and that sets the type of the graph too
  + Edges can be directed when the connection isn’t always reciprocal
  + Connections aren’t always reciprocal
    - Work network, street network for cars, buyer-supplier network
  + NetLogo uses create-link-to and create-link-from for directed edges
  + Graphs with directed edges are directed graphs, or digraphs
  + Graphs with undirected edges are undirected graphs
  + If the same 2 vertices can be connected by multiple edges (also called parallel edges), you have a multigraph
    - NetLogo uses “breeds” or “categories” of edges to deal with
  + The degree d(v) of a vertex v is the number of edges that include or touch it
    - The out-degree d+(v) is the number of edges with v as origin
    - The in-degree d-(v) is the number of edges with v as destination
* Degrees in the real-world
  + The degree distribution of a graph is the number of nodes (y-axis) having a given degree (x-axis)
    - Many measured phenomena are centered around a particular value
    - There also exists numerous phenomena with a heavy tailed distribution
    - A network with power-law degree distribution is said to be scale-free
* Finding the important elements
  + Degree centrality – you are more central if the number of people you’re connected to is larger
  + Eccentricity – minimizes the maximum distance to all others
* Commonly used indices
  + Can distinguish centrality indices in three broad ways
  + Access/influence
    - From that node, is it easy to access others? To impact others?
  + Visibility/reputation
    - How likely is it that others are aware of this node?
  + Mediation/control
    - Is this node frequently used as a bridge between others?
  + We can use degrees as centrality indices
  + Degree centrality is a local measure because it only depends on direct neighbors
  + Shortest paths - the shortest sequence of edges to take from Node A to Node B
  + Distance – number of edges on the shortest path
  + Diameter – the maximum distance between two vertices and we denote it by D
  + Eccentricity centrality is the inverse of eccentricity (max distance between nodes)
    - The lower the eccentricity, the more central the node
  + Total distance is the distance from a node to the central node, closeness centrality is the inverse of the total distance
    - The lower the total, the more central the node
  + Stress centrality is the total number of shortest paths going through a node
    - Doesn’t tell how much control a node has over flow
  + Betweenness centrality is the fraction of shortest paths that go through a node
    - Captures the flow
* Selected complications
  + A 2nd measure wouldn’t be informative if its redundant with the first one, for instance by being heavily correlated
  + If they are correlates, pick the one that uses less processing power and/or the takes the least space