NAVAL POSTGRADUATE SCHOOL
Systems Engineering Department

SE4960: Network Concepts in Systems Engineering

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Fall 2013

Homework #2

Issued: 17 Oct 12
Due: 29 Oct 12

Readings: Newman, *Networks: An Introduction*, Ch.14

Note: In your submission, please put the number of hours that you spent on this homework set.

1. (*Preferred Attachment*) Create a MATLAB function which generates a network model according to the parameters for the preferred attachment method for network growth, according to the Price model described in the textbook (refer to §14.1.1, pp.495-498). Assume you are constructing an *undirected* graph.

   The definition of your function should adhere to the following specification:

   `[A_new, label_list] = preferAttachBuilder_`*`Lastname`*`( A_orig, N_add, a, c )`

   where `A_orig` is the adjacency matrix of your seed graph (i.e., must have at least two connected nodes), `N_add` is the integer number of additional nodes to add to the seed graph, and design parameters `a` and `c` represent the offset parameter and desired mean node degree, respectively.

   Your function should return `A_new`, the augmented graph, and `label_list`, the vector containing the labels of the nodes to which each edge of the graph is pointing (c.f., Figure 14.1 in *Networks*). Refer to the pseudocode below for some general guidance.

```
1: procedure PREFERATTACHBUILDER(A_orig, N_add, a, c)
2:     Construct initial label_list vector from A_orig
3:     for each vertex n to be added do
4:         Generate a uniform random number, r                    ▷ Use rand()
5:         if r < c/(c+a) then
6:             Select a random element (i.e., target vertex) from label_list    ▷ Consider randi()
7:         else
8:             Select a random vertex from the set of all vertices
9:         end if
10:        Create edge from n to the selected vertex in A_new
11:        Add newly created edge to label_list          ▷ Account for undirected edge
12:    end for
13: end procedure
```

Deliverables: Submit your MATLAB function file using Sakai's Assignment page with the following naming convention, `preferAttachBuilder_`*`Lastname`*`.m`.

(over⇝)

2. (*Real world Networks*) Using any openly available network dataset, write a MATLAB script file which ingests the dataset, parses it as necessary (e.g., to determine the adjacency matrix), and analyzes the network using your `graphSpecs` function from the previous assignment.

   In particular, you are asked to determine the node degree (probability) distribution, $p(k)$, for node degree k, and to plot this distribution using a log-log plot in MATLAB (refer to the `loglog()` command).

   The Course Wiki lists a number of pointers to repositories of network datasets, including the UF Sparse Matrix Collection. To load a dataset, you can use MATLAB functions such as `load()` or `importdata()` or `csvread()`, as illustrated in the example script below (available on the Sakai site, along with example dataset files):

```
%----
% Load from dataset
% (2) From UF Sparse Matrix Collection
%       - Ref: http://www.cise.ufl.edu/research/sparse/matrices/
% dataset = 'netscience.mat';                   % name of the dataset
% dataset = 'EPA.mat';                          % name of the dataset
dataset = 'California.mat';                   % name of the dataset
load( dataset, 'Problem');
A_sparse = getfield( Problem, 'A' );          % adjacency stored as sparse matrix
A = full(A_sparse);                           % convert to full square matrix
```

Deliverables: Submit the following files using Sakai's Assignment page:

- Your script file which you use to load, process, and analyze your selected dataset
- The dataset file you selected
- A clearly labeled log-log plot of the degree distribution of your selected dataset