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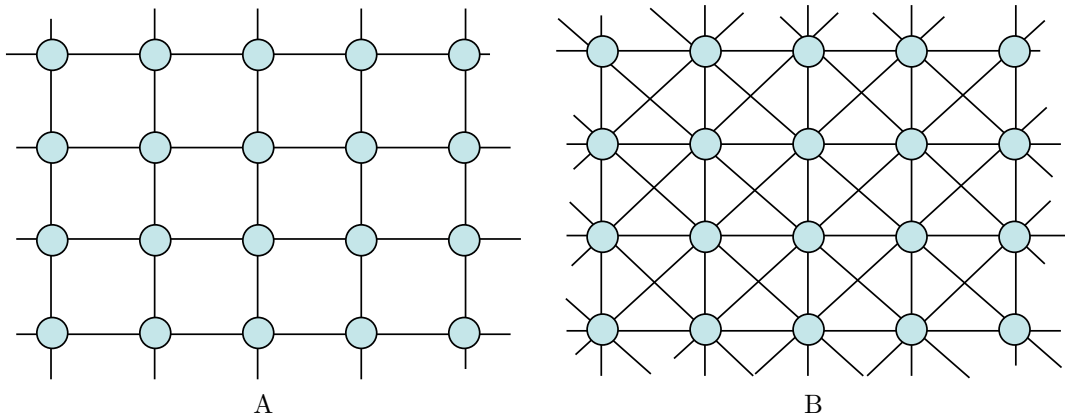
# Midterm

SI 508

NAME \_\_\_\_\_

**This exam is open book, open cTools, open web. But it is not open-human. You are to work on this entirely on your own without the help of others. The exam is worth 25% of your final grade. Good luck!**

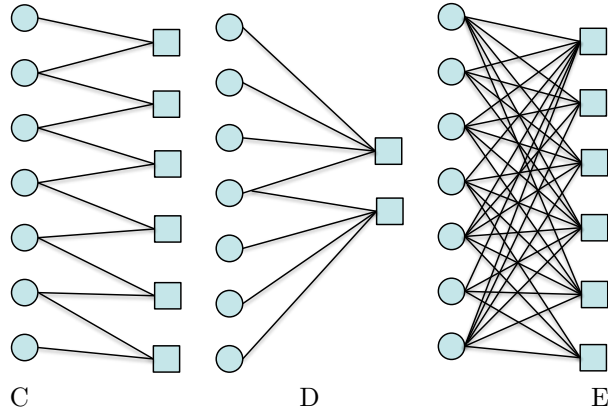
1. (10pts) Compute the Watts-Strogatz clustering coefficient for each of the following two infinite lattices. In the first, each node is connected to its 4 closest neighbors, and in the second, to its 8 closest neighbors.



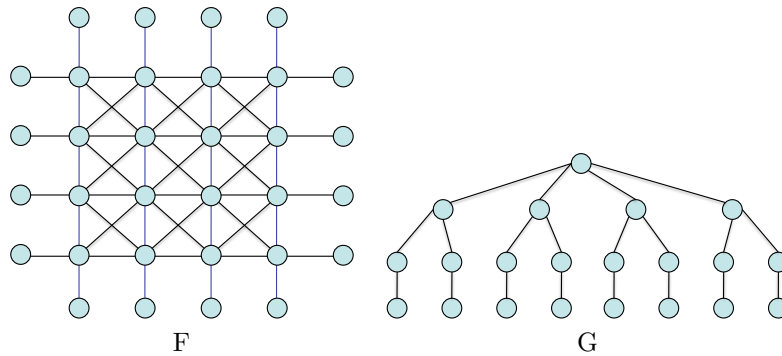
**lattice A:**

**lattice B:**

(5pts) Consider the following 3 bipartite networks. Consider their 1 mode projections into networks of circles. Which of the following will have the strongest community structure using the modularity criterion? Just pick one, no need to explain \_\_\_\_.



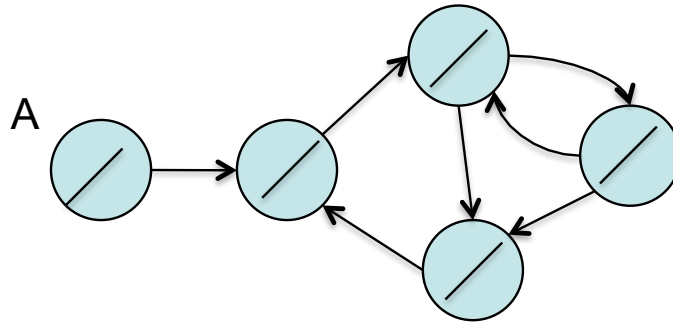
2. Consider the networks F and G. Answer the following, and explain your answer.



(5pt) In which of the networks would you expect there to be the *greater* (positive) correspondence between closeness and betweenness?

(5pt) In which of the networks would you expect there to be the *lesser* (positive) correspondence between degree and betweenness?

3. (10pts) Do a depth-first traversal of the following graph starting with vertex A. Write the start and finish times of each vertex and label the edges as tree (T), back (B), forward (F), or cross (C).



4. (20pts) Consider the following 3 graph traversal methods:

- (i) BFS (breadth first search)
- (ii) DFS (depth first search)
- (iii) random walk

Answer how you would do the following tasks, taking into account that you may need additional actions before (e.g. making the graph undirected), during or after the traversal. No need to explain your choice.

(5pts) To find the weakly connected components, you could use \_\_\_\_\_.

- (A) only (i)   (B) only (ii)   (C) both (i) and (ii) would work   (D) all three would work

(5pts) To find the strongly connected components, you could use \_\_\_\_\_.

- (A) only (i)   (B) only (ii)   (C) both (i) and (ii) would work   (D) all three would work

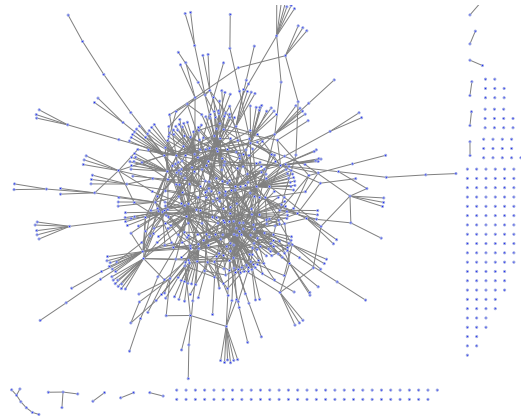
(5 pts) To find the betweenness of each vertex, you could use \_\_\_\_\_.

- (A) only (i)   (B) only (ii)   (C) both (i) and (ii) would work   (D) all three would work

(5 pts) To find the average shortest path, you could use \_\_\_\_\_.

- (A) only (i)   (B) only (ii)   (C) both (i) and (ii) would work   (D) all three would work

5. (30pts) Consider the gnutella network you've become familiar with over the course of the semester. For each of the following models in a few words express what features of the real world gnutella network are captured by the model and in which respects the model falls short.



**random graph**

features captured:

features not captured:

**Watts-Strogatz**

features captured:

features not captured:

**Barabasi-Albert**

features captured:

features not captured:

6. (10pts) Imagine you're working in an organization where being the source of gossip is rewarded through different perks: people will like you, do favors for you, etc., all in exchange for gossip. You want to achieve three things. First, you'd like to hear as much gossip as possible, so that you can pass it on. Second you want to be the person spreading the gossip (if one of your contacts has already heard the gossip, you get no credit for spreading it). Third, you want to be close to the sources of gossip because the gossip gets less accurate or stops altogether with each additional step it has to make. Explain which *two* of the following centrality measures you would try to maximize in positioning yourself in the network by forming contacts (assume contacts are bidirectional, that is if you share gossip with a person, they reciprocate by sharing gossip with you). Your options are: clustering coefficient, degree, closeness, betweenness, proximity prestige, constraint. Explain your rationale for choosing the measures you did and not the others.