

COSC-254 DATA MINING  
HOMEWORK 06 — SOCIAL NETWORKS  
Due: Wednesday, April 3, 2019, 1.59pm

**Exercise 1** Let  $\lambda \in (0, 1)$  and let  $z$  be a even natural number. Consider the following two scenarios:

1. A graph  $G_1 = (V_1, E_1)$  with  $V_1 = \{v, u_1, \dots, u_{z/2}, w_1, \dots, w_{z/2}\}$ . The vertex  $v$  has degree  $\deg(v) = z$ . The other vertices are split into two communities  $U = \{v, u_1, \dots, u_{z/2}\}$  and  $W = \{v, w_1, \dots, w_{z/2}\}$ , each containing also  $v$ , and each with density  $\lambda$ .
2. A graph  $G_2 = (V_2, E_2)$  with  $V_2 = \{v, q_1, \dots, q_z\}$ . The vertex  $v$  has degree  $\deg(v) = z$ . All vertices belong to one community  $Q = V$  with density  $\lambda$ .

Denote with  $\eta_1(v)$  the clustering coefficient of the vertex  $v$  in  $G_1$ , and with  $\eta_2(v)$  the clustering coefficient of the vertex  $v$  in  $G_2$ . Prove one of the following statements:

1. For any choice of  $\lambda$  and  $z$ , it holds  $\eta_1(v) \geq \eta_2(v)$
2. For any choice of  $\lambda$  and  $z$ , it holds  $\eta_2(v) \geq \eta_1(v)$
3. For some choices of  $\lambda$  and  $z$ , it holds  $\eta_1(v) \geq \eta_2(v)$ , for other choices the opposite holds (Give examples for each of the two cases).

## How to submit

Submit your work at <https://www.cs.amherst.edu/submit> or via `cssubmit` from `romulus` or `remus`, as a *single* archive file with name `username.ext` where `username` is your user name and `ext` is one of `.zip`, `.tar.bz2`, or `.tar.gz` (no `.rar`, please). The archive must contain a *single* directory with name `username`. This directory must contain a subdirectory with name  $X$  for each Exercise  $X$ , or a single subdirectory with name `1` in case of projects. All files (source code or otherwise) for each exercise (or project) must be in the directory for that exercise. Directories containing source code should contain a `README.txt` file explaining how to run the code in that directory. For non-code answers, please submit a `.pdf` (no `.txt`, `.rtf`, `.png`, or `.doc(x)`, please). You can find an example archive at <http://bit.ly/DM19sub>. Please post to the Moodle forum if you have problems with the submission.