

**Algorithms for Big Data**

Fall Semester 2019

**Exercise Set 13****Exercise 1:**

Show that  $k$ -spanner of a graph is in fact  $k$ -coreset for distance queries. That is, if  $G'$  is  $k$ -spanner of  $G$ , then for any  $H$  and any  $u, v$  there is  $d_{G \cup H} \leq d_{G' \cup H}(u, v) \leq k \cdot d_{G \cup H}(u, v)$ .

**Exercise 2:**

Show that  $k$ -spanners have disjoint-merge property.

**Exercise 3:**

Show construction of  $2t$ -spanner of size  $\mathcal{O}(n^{1+\frac{2}{t-1}} \log W)$  for weighted graphs with integer edge weights from  $\{1, \dots, W\}$ .

**Exercise 4:**

Show a graph-certificate for 2-edge connectivity. ( $G$  is 2-edge connected if any pair of vertices are connected by at least two edge-disjoint paths.)

**Exercise 5:**

(No sparse directed spanners)

Show that in a directed case, for some digraphs it is impossible to construct better than  $\Omega(n^2)$ -size directed spanners.