Last algorithmic assessment: composition about the algorithms presented in [Li, Thai, Wang, Yi, Wan, and Du. *Wireless Communications and Mobile Computing*, 2005].

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1 Last algorithmic assessment

The overall goal is to report a dissertation about the greedy approach proposed by Li et al. in [Li, Thai, Wang, Yi, Wan, and Du. *Wireless Communications and Mobile Computing*, 2005].

The following points should be observed :

- problem definition and the data structured to be used.
- recall with a theoretical presentation and analysis of the algorithms presented by Li et al..
- concise arguments for every claimed appreciation, improvement, or criticism w.r.t. these algorithms.
- explicit presentation of implemented algorithms (if any).
- how the datasets for testing was obtained (if any). N.B. : datasets must be used for any experimental comparison, whether about the same algorithm (between different datasets), or about different algorithms running on the same dataset(s).
- performance test : it is better to present charts, bar-charts (mean + standard deviation) and histograms, rather than showing endless columns of numbers ...
- a discussion arguing your opinion about Li et al. algorithm.
- one can inspire from survey articles, such as :
  – [Yu et al. Connected dominating sets in wireless ad hoc and sensor networks – A comprehensive survey, 2013]
  – [Vijayasharmila et al. A Survey on Connected Dominating Sets (CDS) Both in the Wireless Sensor Networks and Wireless Ad Hoc Networks, 2015]
  – [Vinayagam. A Survey of Connected Dominating Set Algorithms for Virtual Backbone Construction in Ad Hoc Networks, 2016]
- conclusion and perspectives on the connected dominant set problem in geometric graphs.

It is safer to handle back between 10 and 12 pages for this kind of report, 12 being the recommended number. The formal limitation for this report is 12 pages. This limitation is mandatory : pages 13+ will not be read.

In order to have some inspiration for writing the composition, we can draw inspiration from the exercises given in the appendix of this document.

Constraints :

- Individual work.
- Compress the final package in one unique file, including : composition under PDF format ($\approx$ 10-12 pages) ; commented code source ; a Makefile (or Apache Ant / Maven if Java), one or two test instances (not your entire datasets ! !) ; as well as all necessary materials for the examiner. However, the final compressed file must not exceed 10-ish Mo.

— Email the compressed file to `buixuan@lip6.fr`, maximum 3 emails per student. **Warning :** only a compressed file via email is accepted ; in particular, the use of online hosting services is prohibited (such as Google drive, WeTransfer, etc). Please use the following naming format for the compressed file : daar-projet-cDomSet-SURNAME.piki, where piki could belong to $\{tgz, zip, rar, 7z, etc\}$. This naming convention is important for an automatic classification of your files on the PC of the poor person who will have to assess 70+ student projects. (There should be a penalty applied to every project team not using the naming convention...).

— Deadline : 19 December 2021, 23h59, by mail server timestamp. Late report penalty : penalty of $0,1 * 2^k$ points for k minutes late.

APPENDIX :

Geometric graph : A geometric graph in a 2D plane is defined by a set of points in the plane called vertices, and a threshold on the distance between the points : there is an edge between two vertices if and only if the Euclidean distance between the two vertices is smaller than this threshold.

Connected Dominating Set : Given a graph $G = (V, E)$, the minimum Connected Dominating Set (MinCDomSet) problem consists in computing a minimum sized subset of vertices $D \subseteq V$ such that every vertex $v \in V$ either belong to D or is a neighbour of a vertex in D, and such that the subgraph $G[D]$ induced by D is connected.

2 Greedy algorithm

Li et al. [Li, Thai, Wang, Yi, Wan, and Du. *Wireless Communications and Mobile Computing*, 2005] propose a rather singular method of greedy heuristics to the Connected Dominant Set problem based on the following remarks.

Independent Set : Given a graph $G = (V, E)$, the maxim<u>al</u> Independent Set (MaximalIS) problem consists in computing a subset of vertices $I \subseteq V$ such that the subgraph $G[I]$ induced by I is edgeless, and such that the subset I is maximal by inclusion.

Remark : A maximal independent set is a dominating set. This set is not necessarily the minimum sized among all dominating sets. MaximalIS can easily be solved by any greedy algorithm.

Steiner Tree : Given a graph $G = (V, E)$ and a subset $T \subseteq V$ of vertices called terminals, the minimum Steiner tree (MinSteinerTree) problem consists in computing a partial subgraph of G which is a tree, which contains all vertices of T, and whose total number of vertices is minimum.

Remark : Deciding whether a graph contain either a dominating set, an independent set, or a Steiner tree of a given size is NP-complete.

In order to solve MinCDomSet (Minimum Connected Dominant Set), Li et al. propose to find a maximal independent set $I \subseteq V$, then, to use this set as input terminals to the MinSteinerTree problem. The result is then a connected dominating set which they prove to be not far from the optimal minimum Connected Dominating Set.

Implement this method in the canvas file available on the website of DAAR.