

Supplemental Document #2

Fitness Functions Description

In this supplemental document, the fitness functions used in the research are described.

No.	Fitness Function	Description
1.	Average internal degree	The average internal degree of the community set. Publication: Radicchi, F., Castellano, C., Cecconi, F., Loreto, V., & Parisi, D. (2004). Defining and identifying communities in networks. <i>Proceedings of the National Academy of Sciences</i>, 101(9), 2658-2663.
2.	Edges inside	Number of edges internal to the community. Publication: Radicchi, F., Castellano, C., Cecconi, F., Loreto, V., & Parisi, D. (2004). Defining and identifying communities in networks. <i>Proceedings of the National Academy of Sciences</i>, 101(9), 2658-2663.
3.	Expansion	Number of edges per community node that point another community's nodes. Publication: Radicchi, F., Castellano, C., Cecconi, F., Loreto, V., & Parisi, D. (2004). Defining and identifying communities in networks. <i>Proceedings of the National Academy of Sciences</i>, 101(9), 2658-2663.
4.	Internal edge density	The internal density of the community set. Publication: Radicchi, F., Castellano, C., Cecconi, F., Loreto, V., & Parisi, D. (2004). Defining and identifying communities in networks. <i>Proceedings of the National Academy of Sciences</i>, 101(9), 2658-2663.
5.	Conductance	Fraction of total edge volume that points another community's nodes.

		Publication: Shi, J., Malik, J.: Normalized cuts and image segmentation. Departmental Papers (CIS), 107 (2000).
6.	Normalized cut	Normalized variant of cut-ratio. Publication: Shi, J., Malik, J.: Normalized cuts and image segmentation. Departmental Papers (CIS), 107 (2000).
7.	Cut ratio	Fraction of existing edges leaving the community. Publication: Fortunato, S.: Community detection in graphs. Physics reports 486(3-5), 75–174 (2010).
8.	Fraction over median degree	Fraction of community nodes that having higher internal degree than the median of community's nodes degree. Publlication: Yang, J., Leskovec, J.: Defining and evaluating network communities based on ground-truth. Knowledge and Information Systems 42(1), 181–213 (2015).
9.	Triangle participation ratio	Fraction of community nodes that belong to a triad. Publication: Yang, J., Leskovec, J.: Defining and evaluating network communities based on ground-truth. Knowledge and Information Systems 42(1), 181–213 (2015).
10.	Max Out-degree Fraction (Max ODF)	Maximum fraction of edges of a node of a community that point another community's nodes. Publication: Flake, G.W., Lawrence, S., Giles, C.L., et al.: Efficient identification of web communities. In: KDD, vol. 2000, pp. 150–160 (2000).
11.	Average Out-degree Fraction (Average ODF)	Average fraction of edges of a node of a community that point another community's nodes. Publication:

		Flake, G.W., Lawrence, S., Giles, C.L., et al.: Efficient identification of web communities. In: KDD, vol. 2000, pp. 150–160 (2000).
12.	Flake Out-degree Fraction (Flake ODF)	Fraction of nodes in a community that have fewer edges pointing inside than to the outside of the community. Publication: Flake, G.W., Lawrence, S., Giles, C.L., et al.: Efficient identification of web communities. In: KDD, vol. 2000, pp. 150–160 (2000).
13.	Average embeddedness	Average embeddedness of nodes within the community. Publication: Rossetti, G., Milli, L., Cazabet, R.: Cdlib: a python library to extract, compare and evaluate communities from complex networks. Applied Network Science 4, 1–26 (2019) https://doi.org/10.1007/S41109-019-0165-9/TABLES/5.
14.	Average transitivity	Average clustering coefficient of its nodes with respect to their connection within the community itself. Publication: Rossetti, G., Milli, L., Cazabet, R.: Cdlib: a python library to extract, compare and evaluate communities from complex networks. Applied Network Science 4, 1–26 (2019) https://doi.org/10.1007/S41109-019-0165-9/TABLES/5.
15.	Scaled density	Ratio of the community density with respect to the complete graph density. Publication: Rossetti, G., Milli, L., Cazabet, R.: Cdlib: a python library to extract, compare and evaluate communities from complex networks. Applied Network Science 4, 1–26 (2019) https://doi.org/10.1007/S41109-019-0165-9/TABLES/5.
16.	Size	Number of nodes in the community. Publication:

		Rossetti, G., Milli, L., Cazabet, R.: Cdlib: a python library to extract, compare and evaluate communities from complex networks. Applied Network Science 4, 1–26 (2019) https://doi.org/10.1007/S41109-019-0165-9/TABLES/5.
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