

An excursion through complex networks

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SUMMARY

Complex networks permeate our daily lives. We move and communicate through systems that form infrastructural networks; we feed ourselves as part of trophic networks; our lives depend on the functioning of networks of interactions between genes, proteins and metabolites; we think thanks to our neural networks in the brain. At the most abstract level networks are mathematical objects, and therefore the mathematics of complex networks plays an important role in the future development of humanity. In this talk I will introduce some basic concepts of the mathematical study of complex networks and illustrate them through practical examples. I will then emphasize how “information” flows through these networks. Using techniques from matrix functions and Euclidean distance geometry, I will show how it is possible to infer the most probable paths that information follows in a network, whether it is when navigating a city at rush hour or how two brain regions communicate with each other. I will end by illustrating with real-world examples the application of these mathematical concepts on complex networks in the detection of diseases such as Alzheimer’s or genes involved in the onset of cancer.

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