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Rare events, large deviation and sampling

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In many systems exceptional events can have a crucial impact, while the routine is peaceful and with no consequences. Well known examples are the earthquakes in the Earth's lithosphere or the events of extreme weather. Predicting their magnitude or their occurrence rate is a major challenge for human security and economy. Large deviation theory is the branch of probabilities that adresses this issue. In this talk, I introduce the rate function, the central object of the theory, and study it for several dynamical models. A special focus is dedicated to the Monte Carlo approaches able to compute the rate function and designed to sample rare events. In the last part of the talk I will also discuss the issue of rare events in the context of learning. How detect exceptional rare events from examples that are almost always non relevant?

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