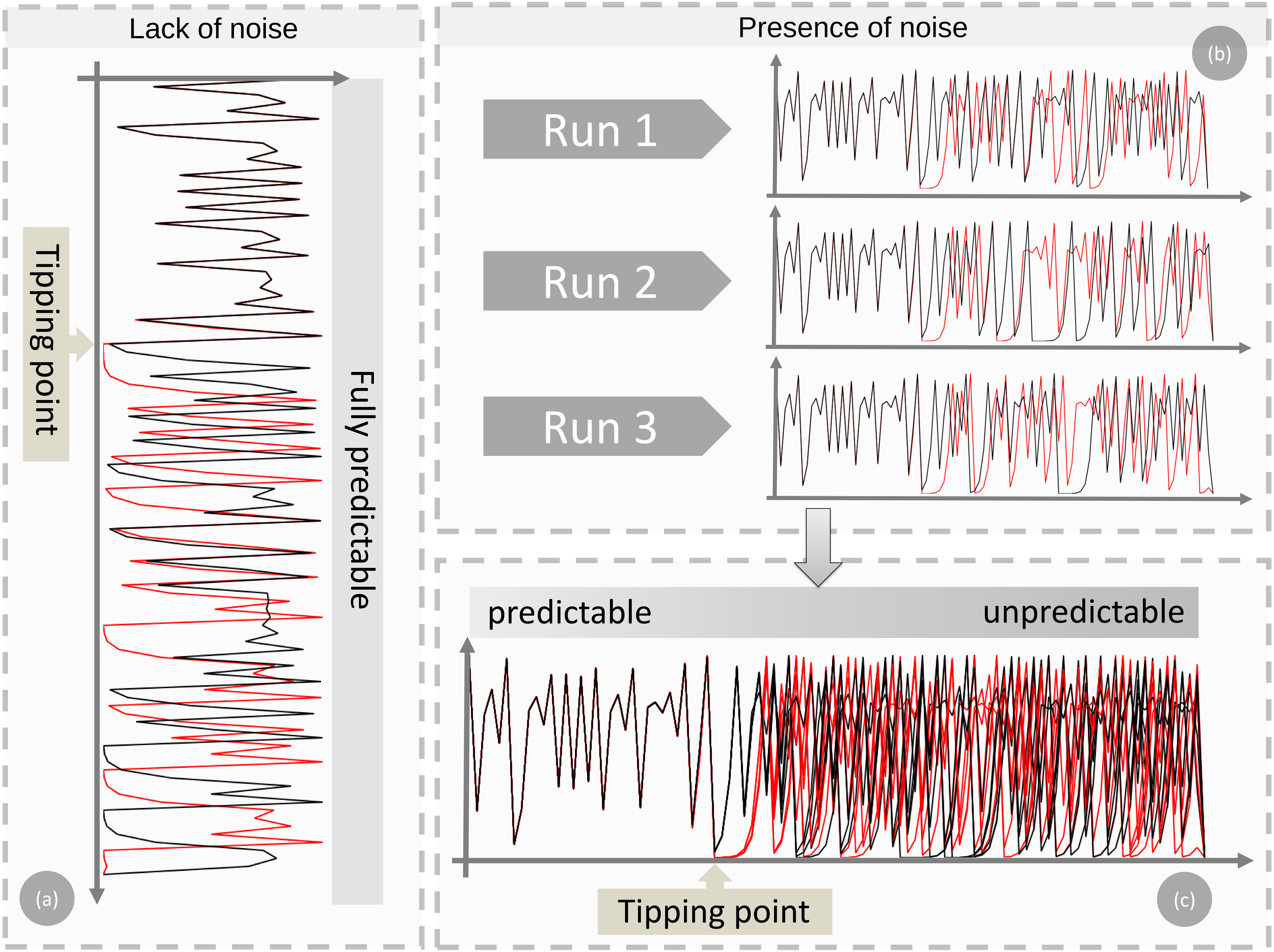
Lack of noise
Tipping point
Fully predictable
(a)
Presence of noise
(b)
Run 1
Run 2
Run 3
predictable
unpredictable
Tipping point
(c)

Limits of prediction, chaos and noise

Limits of prediction, chaos and noise. Each graph shows the evolution of the same nonlinear equation ($X_{n+1}=4\times X_n\times(1-X_n)$) starting with two almost identical values (X_0 = 0.62342375475 and X_0 = 0.62342375474). (**a**) The panel on the left shows an experiment that observes the evolution of values (*y*-axis) for 100 iterations (*x*-axis) in the absence of noise. (**b**) The panel on the right shows an experiment that displays the evolution of values (*y*-axis) for 100 iterations (*x*-axis) in presence of noise. The noise in this case is a very small value (0.00000000000001), which is randomly added or subtracted from the main result (X_{n+1}) at each iteration in both evolutions. The place where the two evolutions in a chart begin to diverge is called the tipping point. Note that each run of the experiment is unique from the tipping point onward. (**c**) Limits of prediction. It shows an overlay of several experiments with the same parameters in the presence of noise. Note that up to the tipping point the experiments in the presence of noise do not differ from experiments in the absence of noise. However, after the tipping point, in the presence of noise, each experiment is unique because although it is imperceptible, noise leads to unique evolutions at each run. Thus, the presence of noise indicates the prediction limits for any nonlinear system in our frame of reference.

Cite this work as:

Paul A. Gagniuc. *Algorithms in Bioinformatics: Theory and Implementation*. John Wiley & Sons, Hoboken, NJ, USA, 2021, ISBN: 9781119697961.