

Contribution Title: HISTORY VERSUS FUNCTION: THE CASE OF PRO-
TEINS
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Some of the concepts one encounters while studying systems under (natural) selection are proper to biology. An important example is the concept of function, fundamental for the description of biological systems. Similarly, evolution is largely an historical process and many similarities between different organisms originate in their common past. Therefore, one of the challenges for future mathematical modeling of biological systems is to develop a theoretical framework for the interplay between history and function. To illustrate this point, I will describe a recent piece of work on the structure of proteins, done in collaboration with N. Halabi, O. Rivoire and R. Ranganathan. By comparing hundreds of sequences of proteins belonging to the same family (of serine proteases), we were able to separate the functional and historical correlations between protein residues. This allowed us to uncover the functional structure of these proteins, consisting of several coexisting, quasi-independent, 3-d "sectors", each associated with a different function. The detailed physical nature of the sectors needs to be elucidated.