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Conclusions

This is an extremely exciting time in biology, where new discoveries happen on a daily basis and there is a vast amount of data available to researchers. In this book, we have made the argument that scientific progress in biology requires the application of more sophisticated methods for representing and analyzing the shape of data. To carry out this argument, we have walked the reader through some basic applications of algebraic topology to biological problems.

The attentive reader has no doubt observed that our efforts serve mostly to highlight the extensive work that needs to be done. On the mathematical side, there are many urgent foundational problems that need to be addressed, including further development of statistical methods attuned to biological applications, finding better ways of applying multiple filtration parameters, defining new simplicial complexes that can capture biological relationships in a natural way, and more. On the biological side, the applications we have described constitute only the tip of the iceberg of potential applications. Developing biologically meaningful metrics and Morsetype functions and accurate and meaningful topological condensed representations remains an art that needs to be systematized.

Our hope is that this book will help inspire the next wave of work in the area.