Cloud-hosted mathematical models: links between education, research, and outreach

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To address the challenges facing undergraduate research, we tested lab structure that can scalably involve undergraduates in cutting-edge mathematical biology research. Teams of two-to-four undergraduates are jointly mentored by a graduate student (or senior personnel) and the lab's principal investigator. Graduate students gain extra help and team management experience, while undergraduates gain modeling experience and co-author scientific papers. Each team is responsible for a new methodology or a new mathematical model of a specific biological problem. All teams "cross-pollinate" at weekly lab meetings that combine short progress reports, discussion, and unstructured mentoring time.

We present a case study: a team developed xml2jupyter [1] to automatically convert command-line agent-based models (written in PhysiCell [2]) to cloud-hosted, interactive models on nanoHUB [3]. This tool reduced the time to create and deploy a graphical user interface from months to hours, allowing us to expand the scope and productivity of grant-funded projects. Rapidly-developed, cloud-hosted mathematical models have enabled new approaches to education (adaptive lesson plans; student portfolio pieces), research (research papers with online model demos), and outreach (sharing interactive models on social media). With further refinement, we expect that heavy undergraduate research participation will continue to drive unexpected results that benefit education and research. For an example of a cloud-hosted mathematical model [4], see http://nanohub.org/tools/pc4cancerimmune.

References

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