

# INTRODUCTION

There are revolutions at hand in the way we understand and implement computation, driven by an awareness of impending barriers to VLSI scaling and new understandings of the physical world. This fundamental shift in perspective allows us to contemplate engineering computational substrates at the molecular and atomic levels. To develop and exploit these new substrates will require an intimate understanding of both the physical substrates and the nature of computation, as well as the relation between them. Research and researchers whose competency spans across the disciplines will be necessary to drive progress in this area of novel computational substrates.

In this summer program we assembled a unique collection of materials intended to start identifying the fundamental background knowledge necessary to work in this area and the fundamental challenges this area presents. We invited promising, motivated students with an interest in novel computation to join researchers from Caltech and leaders from institutions across the country for an intensive, four week introduction to this exciting area. 45 undergraduate and graduate students with diverse backgrounds in computer science, electrical engineering, biology, chemistry, or physics participated in the program.

To engage the students beyond the lectures, we asked them to self-organize into small project teams to expand on issues related to or motivated by the subject matter presented in lectures. The students had roughly three weeks to focus in on a topic and put together a brief report. This volume is a collection of the student reports. Almost none of the students were “experts” in the issues they studied when they entered the program. Nonetheless, these reports show the multi-disciplinary teams they assembled were able to dig deeply into a number of interesting problems and point out some promising directions for further inquiry.

$$\frac{1}{2} \left( \left| \begin{array}{c} \text{SOURCE} \\ \text{GATE} \\ \text{DRAIN} \end{array} \right\rangle + \left| \begin{array}{c} \text{Molecular Structure} \end{array} \right\rangle + \left| \begin{array}{c} 3' \\ 5' \end{array} \right\rangle + \left| \begin{array}{c} \text{DNA} \end{array} \right\rangle \right) = \mathbf{CBS^3}$$