



**BIOINFORMATICS 2016 SPRING SEMINAR SERIES**

Hosted by: Department of Computer and Information Sciences,  
Department of Electrical and Computer Engineering &  
Center for Bioinformatics and Computational Biology  
<http://bioinformatics.udel.edu/Seminars/Current>

**MONDAY, April 18, 2016**  
**3:30pm**  
**DBI Room 102**

**Biological Switches and Modularity  
in Theory and Practice**

***Ashok Prasad***

***Assistant Professor, Chemical & Biological Engineering  
Colorado State University***

**ABSTRACT:** Biological switches are biochemical subnetworks whose protein outputs can exist in two states, colloquially termed ON and OFF, depending on the inputs provided. These switches encode cellular decisions, which is why they are so ubiquitous in biological networks, and form an important component of gene regulatory networks. Since switches are such important control elements, it is no surprise that one of the first synthetic genetic networks constructed was a switch. My talk will consist of two stories about switches. In the first part of the talk, I will discuss our attempts, with collaborators, to build the first synthetic genetic toggle switch in a plant. Here the challenge was to develop a method of rapid quantitative testing of synthetic genetic parts for plants, so as to computationally predict switch properties. Mathematical modeling along with careful experiments helped us reach that goal, which helps bring plant synthetic biology for practical purposes within reach. In the second part of my talk I will discuss modularity of biological switches, using theoretical approaches. I will show that switches based both on positive as well as on negative feedback are quite sensitive to downstream connections. Under fairly plausible assumptions it is even possible to completely abrogate switch-like behavior just by incorporating protein outputs of the switch in downstream processes. This property begs the question: how can switches work robustly in nature in the face of this sensitivity? I will offer a few speculations in response.