

BIOLOGICALLY INSPIRED ARCHITECTURES: AN EXPLORATION

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Technology trends towards system of systems, architectures with multiple simple cores, highly complex applications, distributed services on the web, and an ever increasing need for robust and failure tolerant systems, have rekindled interest in understanding and appreciation of biological systems and rationale behind their robust design. Improvements in technology have also led to better understanding of the systems biology and more sophisticated medical instruments, imaging, and interventions. As today's systems become more complex and more mutually dependent, focus has shifted towards the design of optimized, dependable, and adaptive subsystems, whose emergent properties can be tailored (and limited) to meet certain system needs and QOS (quality of service) metrics. Advances in technology, architecture, and software provide feasible processes to develop such complex adaptive systems. We have developed a course that uses recent literature and our experiences with a 6 year industry project on developing an integrated product development flow. The course exposes our graduate students to the multiple beneficial ways that technology, medicine, and society have intersected and interacted. The intent was to identify opportunities for further research and document the challenges that have inevitably cropped up. The course has had 8 major themes: 1. Trends in technology, architecture, and software & system design; 2. Engineering perspective of human physiology and systems biology; 3. Management perspective of culture, organization, and team work in HROs (highly reliable organizations); 4. Organic/autonomic computing: emergent behavior and self-ware; 5. Software agents and semantic web: a coordination and communication infrastructure; 6. Opportunities and benefits: application domains and domino effects; 7. Design of complex adaptive systems with dependable software: a feasible system design flow; and 8. Putting it all together: challenges, threats, and possible solutions.