

The Limits of Computation & The Computation of Limits: Towards New Computational Architectures

An Intensive Program Proposal for Spring/Summer of 2012

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The Aim & Rationale

To disseminate the acculated information and knowledge on the limits of the science of computation in such a compact and organized way that no any single discipline and/or department offers in their standard undergrad or graduate curriculums.

While the department of Physics evaluate the limits of computation in terms of the relative speed of electrons, resistance coefficient of the propagation IC and whether such an activity takes place in a Newtonian domain or in Quantum domain with the Planck measures, It is the assumptions of Leibnitz and Gödel's incompleteness theorem or even Kolmogorov complexity along with Chaitin for the department of Mathematics. On the other hand, while the department Computer Science would like to find out, whether it is possible to find an algorithm to compute the shortest path in between two nodes of a lattice before the end of the universe, the departments of both Software Engineering and Computer Engineering is on the job of actually creating a Turing machine with an appropriate operating system; which will be executing that long without rolling off to the pitfalls of indefinite loops and/or of indefinite postponements in its process & memory management routines while having multicore architectures doing parallel execution.

All the problems, stemming from the limits withstanding, the new three and possibly more dimensional topological paradigms to the architectures of both hardware and software sound very promising and therefore worth closely examining.

As aforementioned already, since all those topics would not be bundled within one department, it is the aim of this Intensive Program to bring them together and thus to provide an opportunity for

higher undergrads as well as graduates of those disciplines for getting themselves well acquainted with such very important concepts under the multinational, multicultural learning environment.

Contents (to be detailed later on)

- Physical Limits
 - Thermodynamics – entropy etc
 - Quantum physics

- Mathematical, Logical Limits
 - Discreteness vs. Continuousness
 - Finiteness, topological spaces & discrete topology

- Information Theoretical Limits
 - Syntactical Analysis
 - Shannon's Measures
 - Semantical Analysis

- Computational Limits
 - Complexity Measures
 - Space Complexity, Omega Measure & Chaitin
 - Turing & time complexity

- Architectural Limits
 - Multicore Approach
 - Load & cache management
 - Operating Systems for Multicore Architectures

- Software Limits
 - A different approach for Operating Systems
 - Non Turing Machine based Compiler design

- New Architectural Paradigms
 - Digital topology – digital manifolds
 - Information and Life
 - Quantum computers, nanoscale computing

Target Audience

Graduate as well as the senior undergraduate students of the departments of Mathematics, Physics, Computer Science, Computer Engineering, Software Engineering and of Electric & Electronics Engineering.

Capacity

We, the Computer Engineering department of the School of Engineering of Yaşar University, would like to host 50 students for this Intensive Program.