

# Ignorant Curriculum Recommendations

memo by Reiner Hartenstein, v.3, September 2005

The U.S. are losing lead in science and engineering. Half a century of U.S. dominance may be slipping as America's share of graduates in these fields falls relative to Europe, China and India, a study released on Friday says [1]. We are aware also of years of declining enrolment in CS and related university programs. Many young people find molecular biology more fascinating and *believe, that CS-related curricula are obsolete.*

**Typical CS graduates are not qualified** for the contemporary labor market because CS-related curricula are obsolete and ignore labor market requirements, where 99% of all microprocessors are used within embedded systems. The code for embedded software doubles every 10 months.

**Most programmers write embedded applications.**

Most programmers write embedded applications. *Unable to understand FPGA<sup>1</sup> application and to decide software / configware / hardware partitioning most CS graduates are unqualified.*

**In embedded systems.** reconfigurable computing (RC) and reconfigurable platforms have become mainstream already years ago for accelerator use, flexibility, low cost, and, low power dissipation. Since about 2 years RC also goes rapidly into Supercomputing [2], and other forms of HPC (High Performance Computing) to obtain massively higher performance by the fundamental paradigm shift coming along with RC. Ignoring Reconfigurable Computing by our curricula is the completely wrong road map. RC is found practically everywhere which is illustrated by the reply of Google, Yahoo, and other search engines to the main keywords. For instance, „FPGA“ is found more than 3 million times, and „Reconfigurable Computing“ more than 170,000 times<sup>2</sup> (Fig. 1.). RC goes into every application area, which is also demonstrated by Google and Yahoo (Fig. 2.)<sup>2</sup>. However, *most of our typical CS graduates have no idea, what FPGA could mean.*

**Years ago, reconfigurable platforms went mainstream in embedded systems.**

**Our CS departments are obsolete.** In a speech at a summit meeting of US governors Bill Gates said: "American high schools are obsolete. Our high schools - even working exactly as designed - cannot teach our kids what they need to know today. The high schools of today teach kids about today's computers like on a 50-year-old mainframe. Our high schools were designed 50 years ago to meet the needs of another age. Without re-design for the needs of the 21st century, we will keep limiting - even ruining - the lives of millions of Americans every year." *These statements by Bill Gates also mainly hold for most of our universities !*

**Reconfigurable Computing (and computational biology) make CS more fascinating — not only for students.**

**The Role of Accelerators.** Hardwired accelerators, the result of software-to-hardware migration, are found everywhere for speed-up by avoiding the problems given by the sequential nature of instruction-stream-based traditional computing. For instance, a PC cannot maintain its own display without support by an accelerator (graphics chip or board). Because of skyrocketing mask cost, design cost, and design time, *software-to-configware<sup>3</sup> migration* for Reconfigurable Computing (RC) is an extremely important alternative method, where similar speed-up factors can be obtained as known from hardwired accelerators. Compared to classical

**HPC and Supercomputing are going reconfigurable.**

1.) FPGA stands for „Field-Programmable Gate Array“  
 2.) All numbers obtained from Google and Yahoo search around mid of August 2005  
 3.) Configware, not instruction-stream-based, is the programming source for Reconfigurable Computing platforms.

found by Search Engines		
keyword	Google	Yahoo
FPGA	1,840,000	3,648,000
Reconfigurable Computing	86,100	173,000
Configware	4,920	6,870
Anti Machine	4,700	8,040
Morphware	585	2,030

Fig. 1. found more than 3 million times

..found by Google and Yahoo		
FPGA and ...	Google	Yahoo
... automotive	167,000	321,000
... medical	149,000	323,000
... bio	45,000	74,500
... physics	89,300	166,000
... defense	78,900	156,000
... oil and gas	14,900	2,520
... chemistry	32,400	65,000
... chemical	91,900	134,000
... molecular	38,900	55,100
n body problem	27,900	24
supercomputing	25,500	35,500
... HPC <sup>a</sup>	13,600	14,500

a).High Performance Computing

Fig. 2. Going to every application area.

instruction-stream-based computing, such *RC is based on a different common model* and a fundamentally different mind set, which is often stalled by massive educational deficits: *the software / configware chasm*, even more drastic than the old hardware / software chasm, e. g. affecting software-to-hardware migration.

**Reconfigurable Computing now went into every application area.**

**(Structurally) Programmable Accelerators.** RC means the replacement of hardwired accelerators by (structurally) programmable platforms, which migrates the definition of wiring patterns and operator specs from before fabrication to the customer's location after delivery.

**The new common model.** The von-Neumann-like machine paradigm (vN paradigm) is obsolete: the model of the mainframe era. Embedded systems are dominated by a new basic model: the symbiosis of the vN paradigm and the *anti machine*, which is not instruction-stream-driven. Both, hardwired and programmable (reconfigurable) accelerators can be modeled by the anti machine paradigm.

key word	Google	Yahoo	ACM/IEEE 2004 [3]	ARTIST[4] consortium
FPGA	1,840,000	3,648,000	0	3
reconfigurable	652,000	1,390,000	0	1
Reconfigurable Computing	86,100	173,000	0	0
reconfigurable logic	27,900	60,700	0	0
configware	4,590	6,870	0	0

a). search in all recommendation documents by „find and replace“ too

**Going into Every Application Area.** (Fig. 2.). Many years ago the use of reconfigurable platforms went from niche technology to mainstream.

Fig. 3. Illustrating the ignorance of curriculum recommendation

DaimlerChrysler, for instance, has a contract with Xilinx, the largest FPGA vendor, for creating FPGA architectures for automotive applications. Los Alamos National Laboratory has developed a FPGA-based self-repairing computing system scheduled for being launched into orbit. Recently Cray Inc. has introduced a supercomputing module including a FPGA-based accelerator. MAPLD, a special conference serves the needs of NASA and military applications for reconfigurable platforms lists much more very active application areas of reconfigurable platforms. Also the call for papers of a very large number of other conferences list a wide variety of application areas.

**The obsolescence of the von-Neumann-only common model drastically stalls progress.**

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**The emerging Configware Industry.** Using software is RAM-based, which is the secret of success of the software industry. The RAM provides the flexibility. Now we have *a second RAM-based source:*

**Configware Engineering is the counterpart of Software Engineering.**

*configware.* Supporting reconfigurable computing and reconfigurable logic, an emerging configware industry is already growing. Not being instruction-stream-based, configware is fundamentally different from software. *Configware engineering is the counterpart of software engineering.*

**Fully ignored by our curriculum recommendations.** All this is dramatically ignored even by newer high-ranked CS-related curriculum recommendations [3], where the number of encounters of all extremely important RC-related keywords is zero ( Fig. 3.). For critics and recommendations also see „Artist FP5“ [4]

**Our curriculum recommendations fully ignore embedded systems and related important developments.**

**An update of curriculum recommendations is overdue.**

There is an urgent need to elaborate a new roadmap for CS and related curricula. We need a dual-paradigm teaching methodology<sup>1</sup>, going throughout all stages of programs: from freshmen to graduates. A side effect of this bridging the software / configware gap *would also help to bridge the old software / hardware gap.* A rich supply of literature is available for upgrading existing courses - more to change the point of view, rather than for swapping major parts of the contents.

**Literature**

[1] N.N.: U.S. losing lead in science and engineering (a study); Reuters, Washington, DC, July 8, 2005  
 [2] N.N. (News Brief): Researchers Build Reconfigurable Supercomputer; COMPUTER, August 2005  
 [3] N.N.: Computing Curricula 2004; Joint Task Force for Computing Curricula 2004, 22 November 2004, etc.  
 [4] N.N.: W2.All.Y1Guidelines for a Graduate Curriculum on Embedded Software and Systems; ARTIST Consortium, May 12, 2003, <http://www.artist-embedded.org/Education/Education.pdf>

1.)A „co-education“ based on the a symbiosis of vN and anti machine paradigm