

Ignorant Curricula Recommendations

memo by Reiner Hartenstein, August 2005

The U.S. are losing lead in science and engineering-study [1.]. More than half a century of U.S. dominance in science and engineering may be slipping as America's share of graduates in these fields falls relative to Europe and developing nations such as China and India, a study released on Friday says [1.]. One reason is the declining enrolment in CS-related university programs. Young people find molecular biology much more fascinating and *have the feeling, that that CS-related curricula are obsolete.*

web pages found by Search Engines				
keyword	Google	MSN	TEOMA	Yahoo
FPGA	1,580,000	782,016	1,290,000	3,648,000
Reconfigurable Computing	85,500	28,009	170,000	35,400
Configware	4.920	6,211	787	6,870
Anti Machine	4.700	1,460	1,890	8,040
Morphware	585	929	299	2,030

Fig. 1. Much more than 3 million times found by Yahoo.

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

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, 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 (RC) 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“ up to 170,000 times (Fig. 1.). RC goes into every application area, which is also demonstrated by Google and Yahoo (Fig. 2.). However, *most of our typical CS graduates have no idea, what FPGA could mean.*

..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
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 ^a	13,600	14,500

Our CS departments are obsolete. In a speech at a summit meeting of US state 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 hold for our universities !*

a).High Performance Computing

Fig. 2. Going to every application area.

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-configware¹ migration* for Reconfigurable Computing (RC) is an extremely important alternative method,

1. Configware, not instruction-stream-based, is the programming source for Reconfigurable Computing platforms.

Reconfigurable Computing and computational biology make CS more fascinating, not only for students.

where similar speed-up factors can be obtained as known from hardwired accelerators. Compared to classical 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 problems due to *the software / configware chasm*, even more drastic than by the well-known hardware / software chasm, which is the traditional old qualification problem in software-to-hardware migration.

(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. It is the common model of the mainframe era. To-day, much more than 50% of all program code is implemented for embedded systems, and, for the year 2010, more than 90% has been predicted. Embedded systems are dominated by a new basic machine 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.

key word	Google	Yahoo	ACM/IEEE curriculum ^a recommendations 2004
FPGA	1,840,000	3,648,000	0
reconfigurable	652,000	1,390,000	0
Reconfigurable Computing	89,600	172,000	0
reconfigurable logic	27,900	60,500	0
configware	4,590	6,870	0

a). search thru all recommendation documents [2.] by „find and replace“ tool

Fig. 3. Illustrating the ignorance of curricula recommendations.

Going into Every Application Area (Fig. 2.). Many years ago the use of reconfigurable platforms went from niche technology to mainstream. DaimlerChrysler, for instance, has a contract with Xilinx, the largest FPGA¹ 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 emerging Configware Industry. Using software is RAM-based, which is the secret of success of the software industry (and of the wealth of Bill Gates). The RAM provides the flexibility. Now we have *a second RAM-based source: 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.*

Ignored by our curricula. All this is dramatically ignored even by newer high-ranked CS-related curricula recommendations [2.], where the number of encounters of extremely important keywords is zero (Fig. 3.). There is an urgent need to use an new roadmap for curricula. We need a dual-paradigm² teaching methodology, going throughout all stages of programs: from freshmen to graduates. As a side effect of this bridging the software / configware gap *would also close the old software / hardware gap.*

Literature

1. N.N.: U.S. losing lead in science and engineering; Reuters, Washington, DC, July 8, 2005
2. N.N.: Computing Curricula 2004; Joint Task Force for Computing Curricula 2004, 22 November 2004, etc.

1. FPGA stands for „Field-Programmable Gate Array“, a term, preferred by some FPGA vendors
2. A co-education with a symbiosis of vN and anti machine paradigm