



Case Study  
Intel® Multi-Core  
Curriculum Initiative

# More than 240 Indian Technology Institutes Add Multi-Core Processing Curriculum Through Intel Partnership

Recent developments in computer technology have vastly changed the skills required of software developers. As a result, universities around the globe are realizing that course offerings require updating to adequately prepare students to compete and perform in the job market. To help address this need, Intel collaborates with universities worldwide to share and develop curriculum in multi-core processing, and provide access to the state-of-the-art technology students need in order to gain hands-on experience in multi-core processing. Currently, Intel is working with top computer science programs in India to institute a multi-core curriculum. Faculty at these universities, in turn, are training personnel at other Indian universities in an effort to improve technology education for all.

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## Challenge

- As a result of industry-wide adaptation of multi-core technology, universities must update curricula in record time to ensure that students graduate with skills applicable to the job market.

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## Approach

- Through collaboration with Intel, faculty at Indian universities are gaining multi-core tools, training, and expertise which enable them to update curriculum, engage in state-of-the-art research, and promote technology advancement.

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## Benefit

- As a result of the Intel® Multi-core Curriculum Initiative, graduating students will have the required skills to compete and perform in the IT industry.

## Intel Multi-Core University Program: A Case Study

With the advent of multi-core technology, the skill set required to work in the IT industry has changed significantly in recent years. As a result, universities with computer science departments have found their programs lagging behind industry needs in the area of multi-core architecture. So when Indian universities were given the opportunity to participate in the Intel Multi-Core Curriculum Initiative and develop state-of-the-art multi-core processing curriculum for their computer science programs, many jumped at the chance.



Ten universities—including the Indian Institute of Technology (IIT) Kanpur, IIT Madras, Uttar Pradesh Technical University (UPTU) Lucknow, and Visvesvaraya Technological University (VTU) Belgaum—were selected as “first tier” participants in the program. Of Indian computer science programs, these are considered the premier training grounds for budding technologists.

Participating in the Intel program simply made sense, explains Kamakoti Veezhinathan, Associate Professor in the computer science department at IIT Madras. “The kids may not see a single-core system when they graduate from our institute. So the knowledge of multi-core and related issues is extremely important.”

Nandini Sidnal agrees. The professor at VTU Belgaum says, “We need to prepare our students for parallel programming to make efficient usage of the fast-growing hardware and meet the current applications.”

Early in 2006, Intel reached out to faculty at 206 Indian technical institutes through national conferences in Bangalore, Jaipur, Mumbai, and Chennai. At these forums, Intel technologists shared with faculty recent trends in the IT industry and encouraged them to update their computer architecture curriculum to include multi-core technologies. Many of the institutions in attendance submitted proposals to participate in Intel’s Multi-Core Curriculum Initiative.

Along with other first tier faculty members, Veezhinathan and Sidnal participated in Intel multi-core processing training where they were presented with a sample multi-core processing curriculum, as well as an overview of important topics to be addressed in instruction.

The objective of such a curriculum is to equip university students and future software engineers with a thorough understanding of multi-core processor architectures and the increasing importance of parallelism for maximizing system operation and performance. Because developers cannot design good parallel programs without knowledge of how parallel machines are built (and vice versa), the curriculum addresses both multi-threaded hardware and software design, as well as their impact on each other.

As program participants explored the new curriculum, they had the opportunity to work with some of the industry’s top technologists and explore the latest Intel® multi-core tools and technologies. Additionally, Intel provided them with PCs powered by Intel® Core™2 Duo processors, software licenses for use in the classroom, and access to forums and technical support.

In the fall of 2006, IIT-Madras and VTU, Belgaum offered their first multi-core courses at the graduate level, delivering the curriculum through lectures, hands-on programming assignments, semester-long lab projects, and examinations. Enrollment is high in the new courses, reports faculty at both universities.

Sidnal says the new VTU course has been “proactively welcomed,” as students get excited about “parallel programming and the importance of threading concepts.” The result? “Good applications development,” says the professor.

At IIT-Madras, “the reaction is good in terms of interest generated,” reports Veezhinathan, adding that students have opportunities to apply their new multi-core processing skills in other



coursework. The students are learning “the fundamentals of multi-core architecture and issues related to efficient usage of the system,” says the instructor. “The students now should learn how more than one CPU shall collectively solve a problem in contrast to a single CPU—exploiting the parallelism in solutions or devising new parallel algorithms for solving problems. They shall also understand hardware/architecture supported to concurrency that includes Symmetric Multiprocessing, Multi-Threading, Hyper-Threading, and Instruction Level Parallelism. This is crucial as these are the machines they are going to work with when they graduate.”

As a result of such state-of-the-art training, Indian computer science students will soon graduate with the ability to write or modify applications for the new hardware architecture. These skills will not only help young graduates land better jobs and make immediate contributions, but enable them to participate in cutting edge research and perhaps—as one industry expert puts it—lead to the opportunity to develop the next “killer app.”

In an effort to share multi-core technology education with universities throughout India, first tier universities involved in the initiative are now sharing their new resources with other universities. Veezhinathan has already conducted two workshops to train other instructors in the curriculum and is scheduled to conduct more. Signal will be involved in the deployment of multi-core curriculum at VTU's 118 affiliated institutes. Additionally, 111 UPTU schools are being trained in 2007 to introduce multi-core courses at the undergraduate level.

This endeavor—whereby India is partnering with Intel to bring the entire country's technology education programs to the forefront of technology development—represents the first national program of its kind in the area of multi-core architecture.

## **A Glimpse of India's IT Education Landscape**

Of India's approximately 1,570 colleges and universities, 1,076 award degrees in engineering and technology and 494 of these confer master's degrees in those subjects. Currently, approximately 400,000 students graduate each year with technical degrees, and the majority move on to careers in the IT industry. Whereas some of these workers concentrate on hardware, a sizeable number migrate to software development. Large numbers of graduates from other disciplines also migrate to IT, perhaps in response to significant opportunities in this sector, as well as the fact that the software industry also recruits professionals with knowledge in other fields of engineering. As India's population continues to grow (projected to be the world's largest by 2015<sup>1</sup>), India will be providing a large number of the IT sector's workers. Today, the IT workforce in India is estimated at 1.3 million workers; by 2010, it is predicted to be approximately three million.<sup>2</sup>

As India works to create sustainable economic development for its people, the government has identified the IT sector as an important area for development. To spur growth in this area, the Ministry of Human Resources and Development recently instituted the National Program for Human Resources Development in IT. Goals of this manpower development initiative include: improving computing facilities and connectivity, promoting technology-enhanced education, developing new curriculum, supporting professional development for faculty, encouraging interfaces between education and industry, and utilizing technology to modernize library and support services.

After conducting a variety of industry-academia meetings and roundtables, the National Association for Software Services Companies (NASSCOM) identified similar areas of focus

1. Human Development Report. See [http://hdr.undp.org/hdr2006/statistics/countries/data\\_sheets/cty\\_ds\\_IND.html](http://hdr.undp.org/hdr2006/statistics/countries/data_sheets/cty_ds_IND.html)

2. IT Task Force of the Ministry of Human Resources and Development, Government of India.

for India's IT education programs: developing faculty and dealing with shortages of talented manpower; standardizing the curriculum and its delivery process; upgrading infrastructure; conducting advanced studies and special research projects in emerging technology areas; cultivating analytical thinking, building strong fundamentals and concepts, applying knowledge; encouraging universities and institutions (especially lesser known ones) to establish linkages with recognized institutes, associations, and corporations; and improving the standards of the existing government and private educational institutes.

India's government and academic institutions, as well as industry—local and international—support these goals. Along with the Ministry of Human Resources Development, NASSCOM, TEQIP, DST, and Indo-US Science & Technology Forum are key stakeholders in developing the university ecosystem in India.

Additionally, Intel actively supports both the manpower development initiative and the goals identified by NASSCOM study through such efforts as the Multi-Core University Program, curriculum development initiatives, research and mentoring programs, and equipment grants, among others.

## Intel Multi-Core Processing Curriculum in India

Intel launched the Multi-Core Curriculum Initiative in India in 2006, offering university faculty the opportunity to collaborate on the development of multi-core curriculum for their respective institutions.

Leading universities selected to participate in the first phase worked face to face with top Intel multi-core technologists to learn about multi-core hardware and software, and used existing multi-core curriculum as a basis for developing appropriate curriculum for their programs. Topics covered included Intel® Core™ Duo architecture, Intel® Compilers, Threading, and OpenMP, among others.

To ensure that students at all Indian universities have access to multi-core education, Intel helped prepare first tier university faculty to utilize a train-the-trainer approach to educate other universities in the subject. This nationwide effort represents the first large-scale technology development program of its kind in the world, and now serves as a model for other countries interested in being at the forefront of technology development.

In the first year, ten institutes were involved in the Intel Multi-Core Curriculum Initiative. By 2009, more than 240 institutes will be delivering multi-core instruction to Indian students and bridging the industry-academia gap.

### The Intel® Education Initiative

The Intel Education Initiative is Intel's sustained commitment to prepare all students, anywhere, with the skills required to thrive in the knowledge economy by improving teaching and learning through the effective use of technology, and advancing math, science and engineering education and research. Through a sustained public-private partnership with educators and governments in more than 50 countries, Intel works with international organizations and governments at an international, national, and local level and invests approximately USD 100 million per year in education programs adapted to address the needs of each country to advocate for 21st century educational excellence through policy work and awareness efforts.

For more information, visit: [www.intel.com/education](http://www.intel.com/education).

For more information on Intel Multi-Core Processing Curriculum, visit: [www.intel.com/education/university](http://www.intel.com/education/university).

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