

INTELLIGENT SYSTEM

Intelligent system is the area to develop automatic and intelligent tools which can simulate the functions of human (brain, eye, ear, etc.). The intelligent system specialization exposes students to image and audio understanding problems, and consequently students may learn the knowledge on how to extract useful features/representations from images and audio signals or texts, how to model the signals or texts, and how to predict and estimate the hidden information based on the observations. Based on the modules covered by this area, the students can develop systems to better perceive the visual and audio world, and further interact with the physical world. These systems can be widely used in scenarios including video surveillance, human robot interaction, photo/audio/video management and search, and the related graduates can expect to work in I2R or companies like Panasonic, etc.

LARGE-SCALE COMPUTING

With an unprecedented amount of data handling requirements driven by modern day applications there is an obvious need to advance the existing computing infrastructures in terms of architectural and programming aspects. The suite of modules in this Large-Scale Computing concentration attempts to cover a range of imperative issues and their solution methodologies and equip the students with adequate relevant skills to take up the challenges in modern day computer/computing industries. One of the primary issues in this domain is in handling -(Storage, Processing and Transportation) "Big Data" scaling to several tera-bytes to peta-bytes of data volumes. While modules at the earlier stages (Year 2) provide strong basis, modules at year 3 and 4 levels augment advanced concepts. Modules such as CS4223 together with CS3211 provide a concrete fundamentals and advanced concepts related to architectural and programming aspects while the essential components for an efficient database design are covered via CS2107, CS3223 and CS4224, respectively. EE4210 exposes the required issues and solutions methodologies to the underlying data transpiration layer, namely the networking aspects. The suite also covers most fundamentals and advanced concepts together with current day solutions techniques for Hi-Performance Computing (HPC) domain too. Industries in which challenging job opportunities exist pertaining to this and/or allied domains of Large-Scale Computing include, IBM, Google, Microsoft, HP research Labs, A*STAR Organizations (I2R, IHPC, DSI), Amazon, in Singapore, to quote a few, and in general with any R&D and Corporate offices that demand using big data computing resources.

SYSTEM-ON-A-CHIP DESIGN

With the continuous scaling of semiconductor technologies, all components of an embedded system can now be integrated into a single integrated circuit (IC) chip, or a System-on-Chip (SoC). A typical SoC consists of hardware blocks such as processor cores, memory blocks, timing sources, peripherals, external interfaces and so on. It also consists of the software controlling the hardware blocks. The design flow for a SoC aims to develop this hardware and software in parallel. A SoC can be implemented in the form of either an application-specific integrated circuit (ASIC) or field-programmable gate array (FPGA) chip. Students in this concentration are expected to have in-depth training of SoC hardware and software development concepts and tools, and design SoC solutions for application domains such as multimedia and communications. Career opportunities include: Digital ASIC Designer, FPGA Design Engineer, Hardware Verification Engineer, Firmware Developer and Software Developer.

From previous concentrations

EMBEDDED COMPUTING (EMBEDDED SYSTEMS)

An embedded system is a computer system consisting of both hardware and software that is designed for a dedicated purpose often with real-time constraints. Communication with the outside world occurs via sensors, actuators, and (if applicable) human interface for dedicated actions. The impressive advances in integrated circuit design (to put this in perspective, the aggregate number of transistors produced annually exceeds the number of ants on Earth) as promised by Moore's Law has fueled incredible growth in complexity, quantity, and quality of embedded systems. As a result embedded systems define and govern our world and our society today. Pacemakers, RFID tags, cellular phones, digital camera, home appliances, automobiles, aircraft are among myriad possible hosts of an embedded system.

However, going forward, International Technology Roadmap for Semiconductors has identified reliable and robust embedded software/hardware design as one of the most critical challenges. In particular, as embedded devices dictate tremendous growth in performance and complexity with constant battery life and shorter lifecycle, we are experiencing significant shortage of systems designers with understanding of both hardware and software issues of such complex computing systems. The "Embedded Systems" track under the computer engineering program will prepare a graduate with such multidisciplinary skills for a challenging career. As embedded systems are ubiquitous, a graduate can engage himself/herself in a diverse range of industries and make a difference to our society.

In addition to the modules listed in this concentration, a student may choose to supplement additional modules from the following list:

CS3210 Parallel Computing
CS3221 Operating Systems Design and Pragmatics
CS4222 Wireless Computing & Sensor Networks
CS4212 Compiler Design
CS3235 Introduction to Computer Security
EE3101 Digital Signal Processing
EE3304 Digital Control Systems

COMMUNICATIONS & NETWORKING

(COMMUNICATIONS)

Communication is one of the domain specialization areas of the of the Computer Engineering programme. The word communication is certainly not new to anyone. Indeed virtually everyone of us own a mobile phone, and would have used some electronic devices to communicate with each other, everyday. In the communication specialisation, you would gain the knowledge and learn all the techniques that made such devices work. As a computer engineer, you would also have learned the knowledge and techniques behind the design of gadgets. This combined with the communication knowledge, would put you in the fore front in the actual realisation of communication devices that are so indispensable to everyday life.

(NETWORKING)

We live in an increasing connected world. The fundamental substrate that unleashed the current unprecedented connectivity is networking. From a home-based network to the Internet, wired and wireless networking has allowed users to share, connect, work, play, and socialize. The CEG specialization in networking brings together the best of networking modules in the Departments of CS and ECE. Taken together, it will give the student fundamental skills in networking that cuts across several layers of networking, ranging from signals, data communication fundamentals, protocols, Internet, and ad hoc wireless networking.

Advanced modules will also introduce the student to the development of network-centric applications. CEG graduates specializing in networking can look forward to rewarding and challenging careers in the design and delivery of hardware and software networking solutions.

In addition to the modules listed in this concentration, a student may choose to supplement additional modules from the following list.

CS3210 Parallel Computing
CS3221 Operating Systems Design and Pragmatics
CS4213 Game Development
CS4223 Parallel Computer Architecture
EE4218 Embedded Hardware System Design
EE4415 Integrated Digital Design
(EE3702 and EE4702 are not offered in AY13/14)

INTERACTIVE DIGITAL MEDIA (MULTIMEDIA PROCESSING)

Multimedia data have become ubiquitous factors in modern life and work and drive many new applications. Advances of digital technologies and interaction technologies have also significantly changed our way of communications and thus our life. The Multimedia Processing specialization exposes students to common data analysis problems as well as techniques that create novel enabling technologies for human-computer interaction.

The modules in this specialization area can be divided roughly into 2 tracks. The first track looks at common data analysis problems in sound, image, and video data such as classification, regression, and clustering, etc. Retrieval of information is also important for many applications; these include visual concepts such as car or a person identity, as well as 3d shape and surface properties, etc. Those students specializing in this track would be able to work in the intersection of multimedia processing and many other application areas in consumer, industrial, military, medical, and biological domains, making this track one of the most exciting ones in computer engineering.

In addition to the modules listed in this concentration, a student may choose to supplement additional modules from the following list:

CS3230 Design and Analysis of Algorithms
CS4345 General-Purpose Computation on GPU
CS3244 Machine Learning
CS3243 Foundations of Artificial Intelligence
MA2213 Numerical Analysis I

CEG TECHNICAL ELECTIVES IN THE 'NEW' CONCENTRATIONS
(With effect from sem 1, AY2013/14)

MA4268 Mathematics for Visual Data Processing
EE4604 Biological Perception in Digital Media

In the second track, students can learn about creating novel enabling technologies for human-computer interaction, such as innovative input devices or new media that extend the boundaries of traditional interaction such as augmented reality. Students will gain skills required to work in many emerging areas such as ubiquitous computing, digital gaming and edutainment. The modules for this track include:

CS3240 Human Computer Interaction
CS3246 Hypermedia & World Wide Web
CS3248 Design of Interactive Systems
CS3249 Elements of User Interface Design
CS4249 Design of Advanced User Interface
CS4240 Virtual Reality and 3-D Interaction
EE3701 Digital Media Technologies
CS4341 Multimedia Technologies
CS4213 Game Development (re-coded to CS3247, effective semester 2, AY12/13)
(EE3702 and EE4702 are not offered in AY13/14)

In addition to the modules listed above, a student may choose to supplement additional modules from those listed in the first track, as well as from the following list:

NM 2216 Introduction to Interactive Media
NM2217 Creating Interactive Media
NM2218 Critical Introduction to Gaming
NM 3216 Game Design I
NM3221 Interactivity and Everyday Life