COMPUTING CAREERS & DISCIPLINES
A QUICK GUIDE FOR PROSPECTIVE STUDENTS AND CAREER ADVISORS
RANDY CONNOLLY
JANET MILLER & FAITH-MICHAEL UZOKA

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PROF. RANDY CONNOLLY
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Mount Royal University
Mathematics & Computing
Student Counselling

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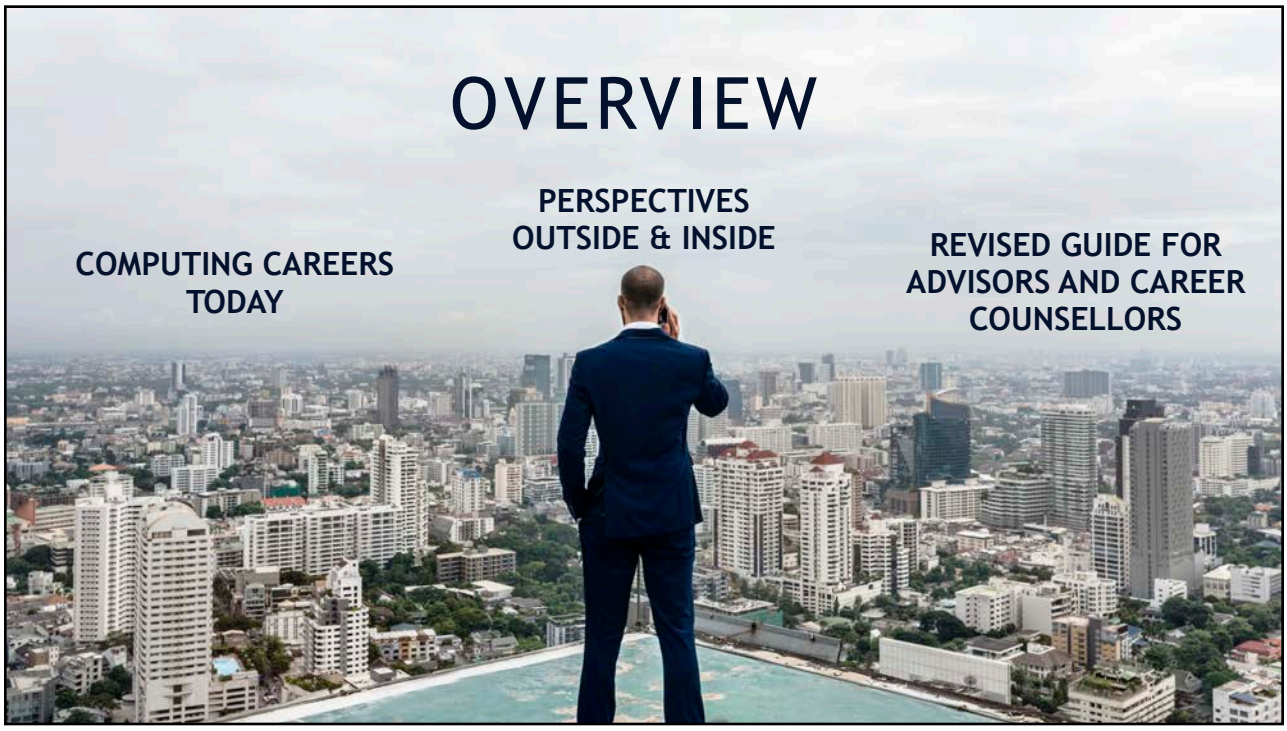
OVERVIEW
COMPUTING CAREERS TODAY
PERSPECTIVES OUTSIDE & INSIDE
REVISED GUIDE FOR ADVISORS AND CAREER COUNSELLORS

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AUDIENCE PARTICIPATION

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WHAT ROLE DO YOU HAVE?
Advisor
Counsellor
Educator
Administrator
Or work in the field of computing

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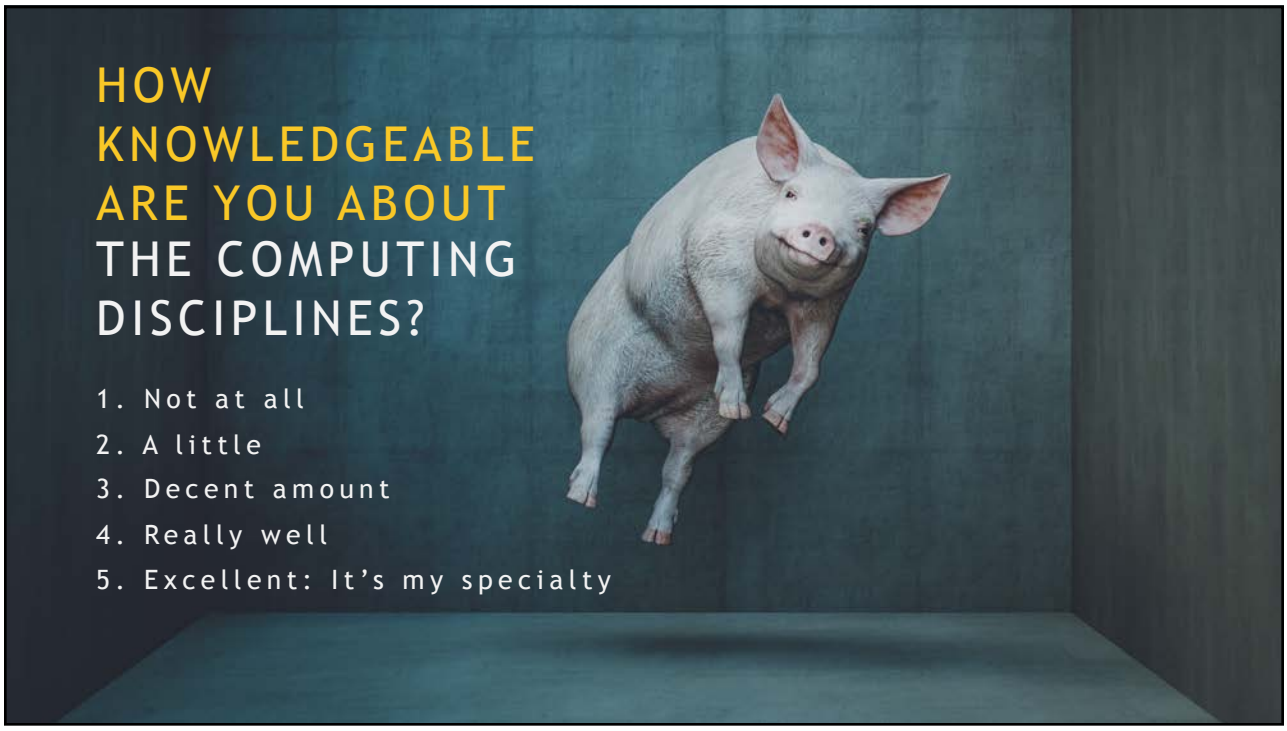
HOW KNOWLEDGEABLE ARE YOU ABOUT THE COMPUTING DISCIPLINES?
1. Not at all
2. A little
3. Decent amount
4. Really well
5. Excellent: It's my specialty

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COMPUTING

If you have a client who is interested in a career in computing, what kinds of programs and jobs do you think of?

FIRST WORDS THAT COME TO MIND?

7

Application Development Manager
Database Administrator
Analytics Consultant
Operations Research Analyst
DevOps Manager
Cloud Product Manager
Network Engineer
Web Developer
Machine Learning Specialist
Programmer
High School Computing Teacher
Software Architecture Consultant
Data Scientist
Automation Engineer
Software Engineer
Security Specialist
Data Mining Specialist
Systems Analyst
SEO Consultant
Business Analyst
Game Developer
Disaster Recovery Specialist
ITS Manager
UX Designer
Project Manager
Computer Operations Manager
Network Administrator
Quality Assurance Specialist

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MOST DON'T KNOW EXACTLY
WHAT THEY'RE GETTING INTO

9

BUT THEY DO HAVE AN IDEA OF
WHY THEY WANT TO BE IN COMPUTING

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IS IT FOR THIS?
JOBS
PARTLY

11

EMPLOYMENT GROWTH IN COMPUTING SECTOR WILL LIKELY STAY STRONG

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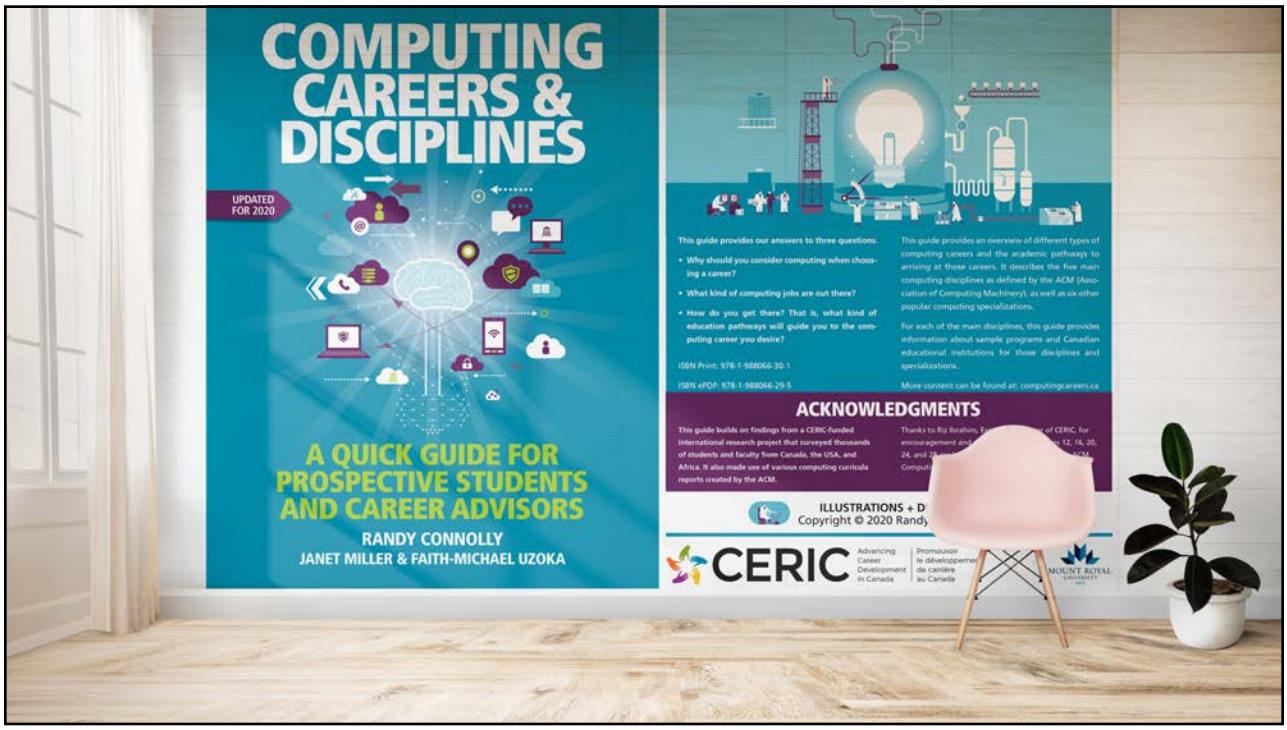
COMPUTING CAREERS & DISCIPLINES
UPDATED FOR 2020
A QUICK GUIDE FOR PROSPECTIVE STUDENTS AND CAREER ADVISORS
RANDY CONNOLLY
JANET MILLER & FAITH-MICHAEL UZOKA
This guide provides our answers to three questions.
• Why should you consider computing when choosing a career?
• What kind of computing jobs are out there?
• How do you get there? That is, what kind of education pathways will guide you to the computing career you desire?
This guide provides an overview of different types of computing careers and the academic pathways to arriving at those careers. It describes the five main computing disciplines as defined by the ACM (Association of Computing Machinery), as well as six other popular computing specializations.
For each of the main disciplines, this guide provides information about sample programs and Canadian educational institutions for those disciplines and specializations.
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ILLUSTRATIONS + D
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Advancing Career Development in Canada
Promouvoir le développement de carrière au Canada
MOUNT ROYAL UNIVERSITY

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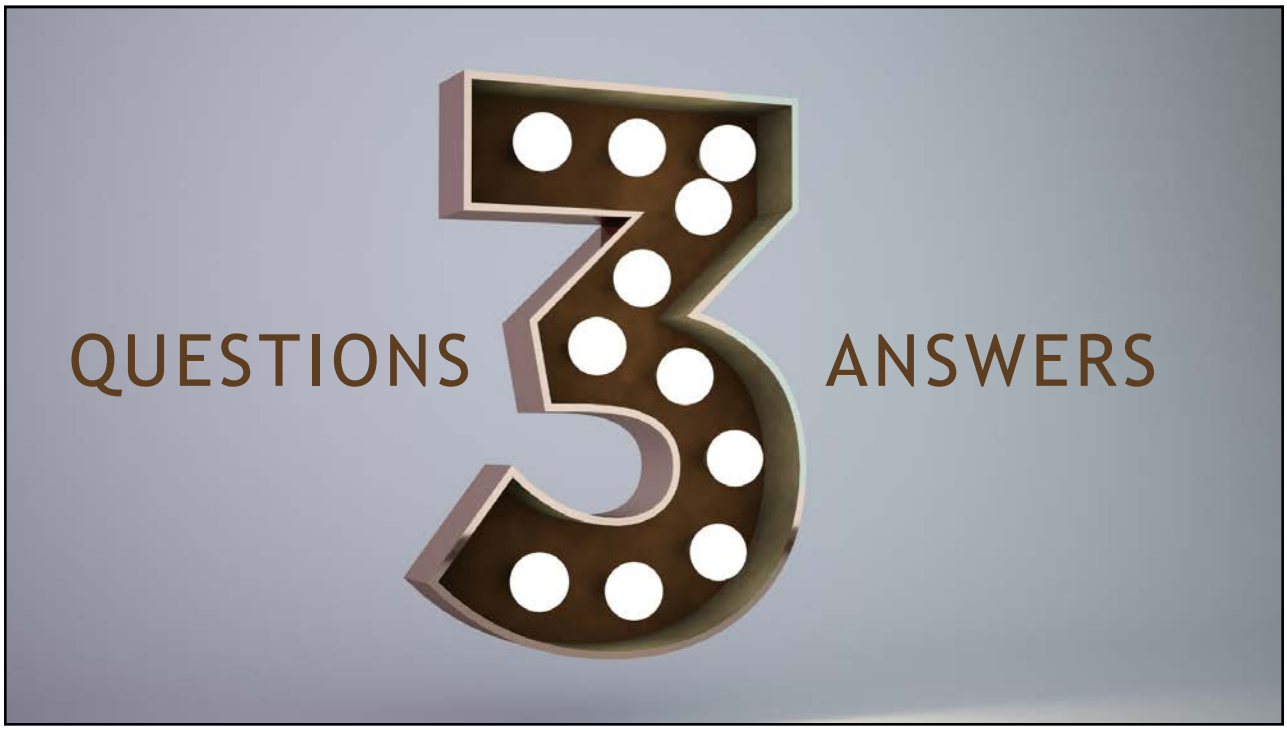
QUESTIONS
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ANSWERS

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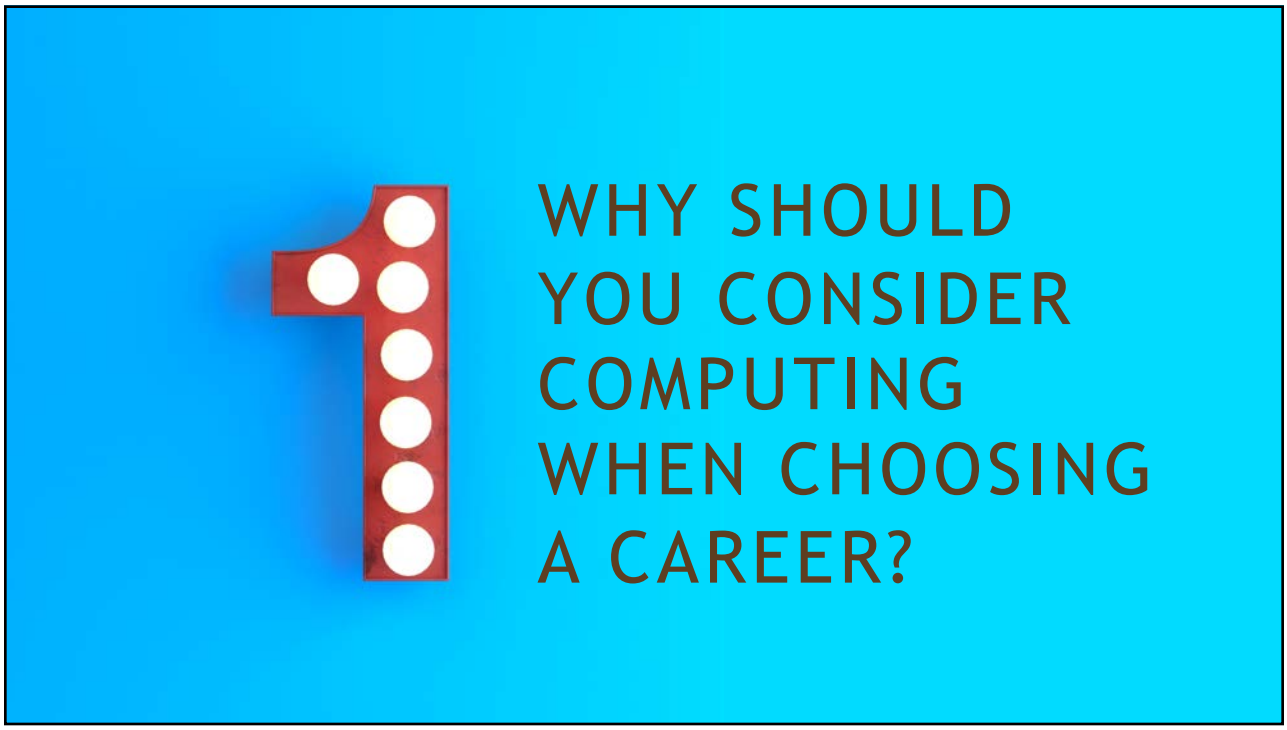
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WHY SHOULD YOU CONSIDER COMPUTING WHEN CHOOSING A CAREER?

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OUTCOME EXPECTANCY

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WHY COMPUTING?
JOBS
The job market for computing graduates is very strong, and according to government estimates, demand will continue to be high well into the future.
SOCIAL
Contrary to stereotypes, computing work is often highly social, involving frequent interaction with others and rewarding communication and social skills.
MOBILITY
Demand for computing exists world-wide. A career in computing offers unparalleled mobility, allowing you to work abroad or work while travelling.
INNOVATIVE
The world of computing work can be full of innovation and creativity. The world of tomorrow is being created by computing graduates today.
FLEXIBLE
Computing work supports flexible lifestyles. You can work full-time in an office, part-time as a parent at home, or take advantage of world-wide demand for short-term computing contracts.
VARIETY
Computing work is extremely varied, from development, to design, to management. This means less chance of boredom, as your work often changes measurably from year to year.

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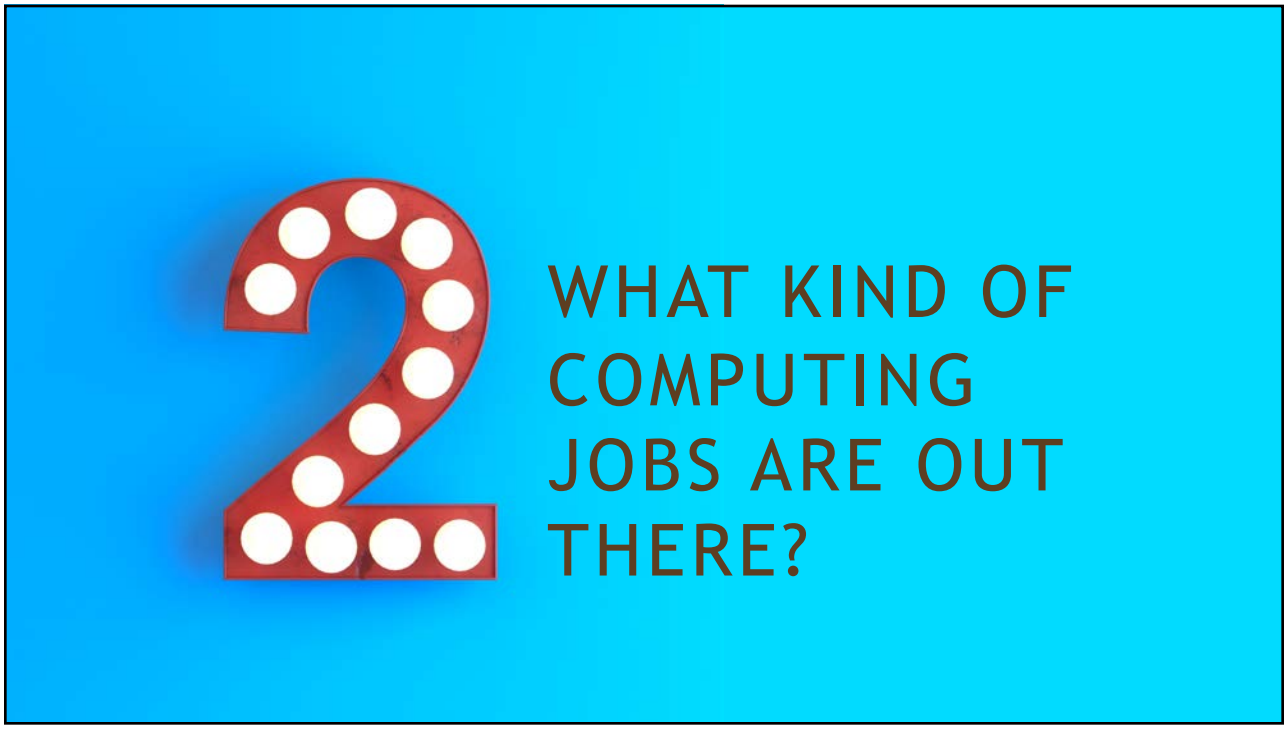
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HOW DO YOU GET THERE? WHAT EDUCATIONAL PATHWAYS TO TAKE?

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HOW DO I GET THERE?

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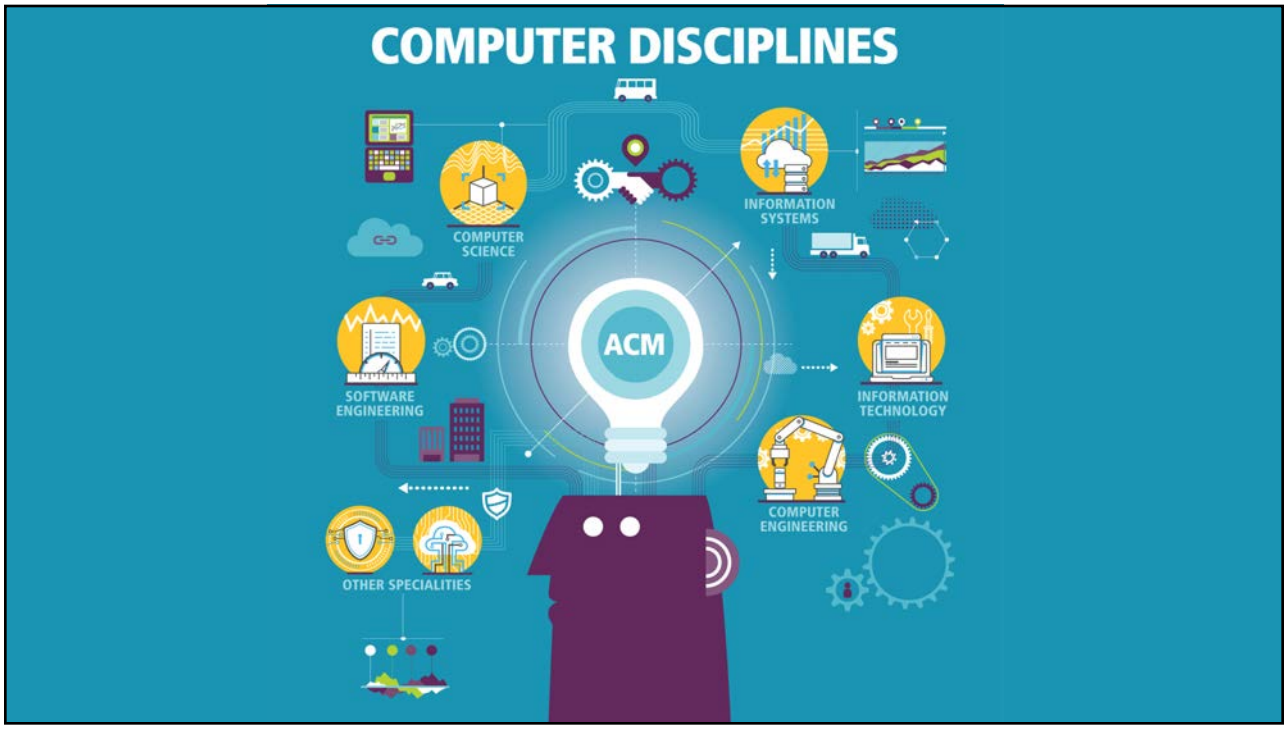

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DO STUDENTS
UNDERSTAND
THESE
DISTINCTIONS?

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OUR CLIENTS NEED HELP
IN FINDING THEIR BEST
PATH TO COMPUTING

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COMPUTER ENGINEERING
COMPUTER SCIENCE
INFORMATION SYSTEMS
INFORMATION TECHNOLOGY
SOFTWARE ENGINEERING

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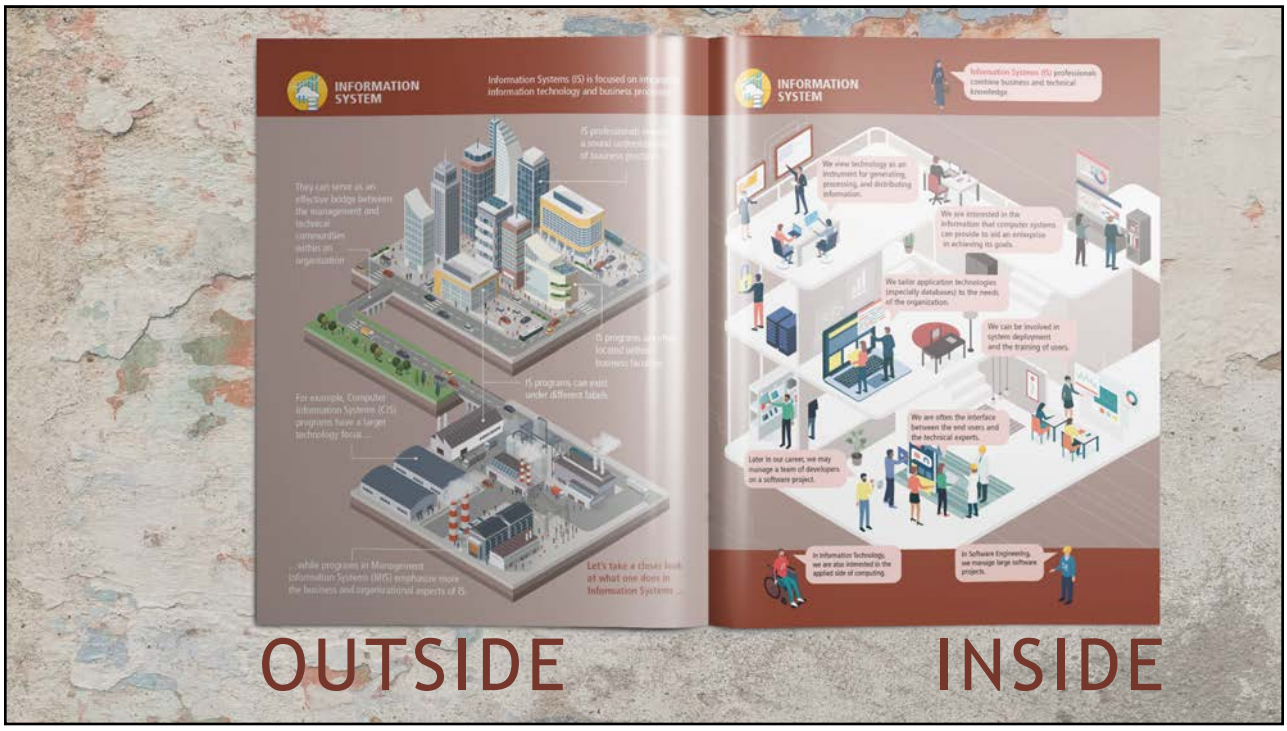
INFORMATION SYSTEM
Information Systems (IS) is focused on
information technology and business
They can serve as an effective bridge between the management and technical communities within an organization
IS programs can exist under different labels
For example, Computer Information Systems (CIS) programs have a larger technology focus
... while programs in Management Information Systems (MIS) emphasize more the business and organizational aspects of IS
Let's take a closer look at what one does in Information Systems ...
INFORMATION SYSTEM
Information Systems (IS) professionals combine business and technical knowledge
We view technology as an instrument for generating, processing, and distributing information.
We are interested in the information that computer systems can provide to aid an enterprise in achieving its goals.
We tailor application technologies (especially databases) to the needs of the organization.
We can be involved in system deployment and the training of users.
We are often the interface between the end users and the technical experts.
Later in our career, we may manage a team of developers on a software project.
In Information Technology, we are also interested in the applied side of computing.
In Software Engineering, we manage large software projects.
OUTSIDE
INSIDE

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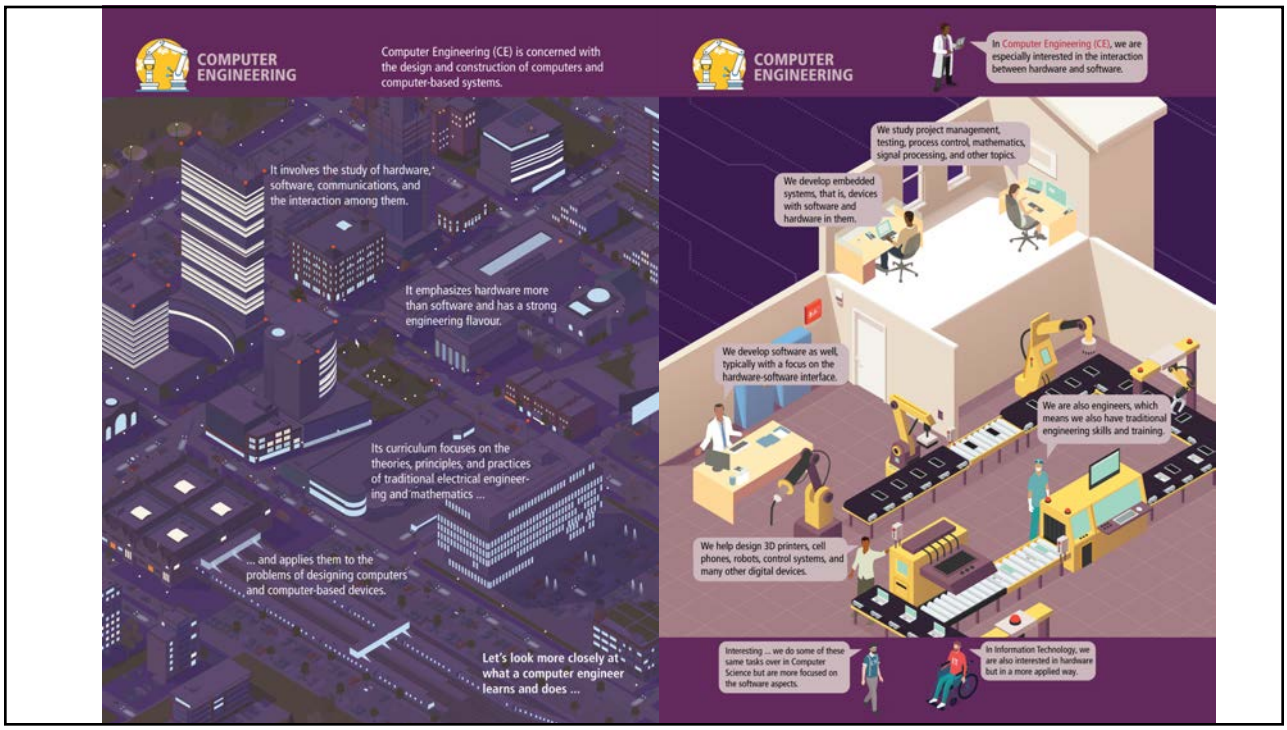
COMPUTER ENGINEERING
Computer Engineering (CE) is concerned with the design and construction of computers and computer-based systems.
It involves the study of hardware, software, communications, and the interaction among them.
It emphasizes hardware more than software and has a strong engineering flavour.
Its curriculum focuses on the theories, principles, and practices of traditional electrical engineering and mathematics ...
... and applies them to the problems of designing computers and computer-based devices.
Let's look more closely at what a computer engineer learns and does ...
COMPUTER ENGINEERING
In Computer Engineering (CE), we are especially interested in the interaction between hardware and software.
We study project management, testing, process control, mathematics, signal processing, and other topics.
We develop embedded systems, that is, devices with software and hardware in them.
We develop software as well, typically with a focus on the hardware-software interface.
We are also engineers, which means we also have traditional engineering skills and training.
We help design 3D printers, cell phones, robots, control systems, and many other digital devices.
Interesting ... we do some of these same tasks over in Computer Science but are more focused on the software aspects.
In Information Technology, we are also interested in hardware but in a more applied way.

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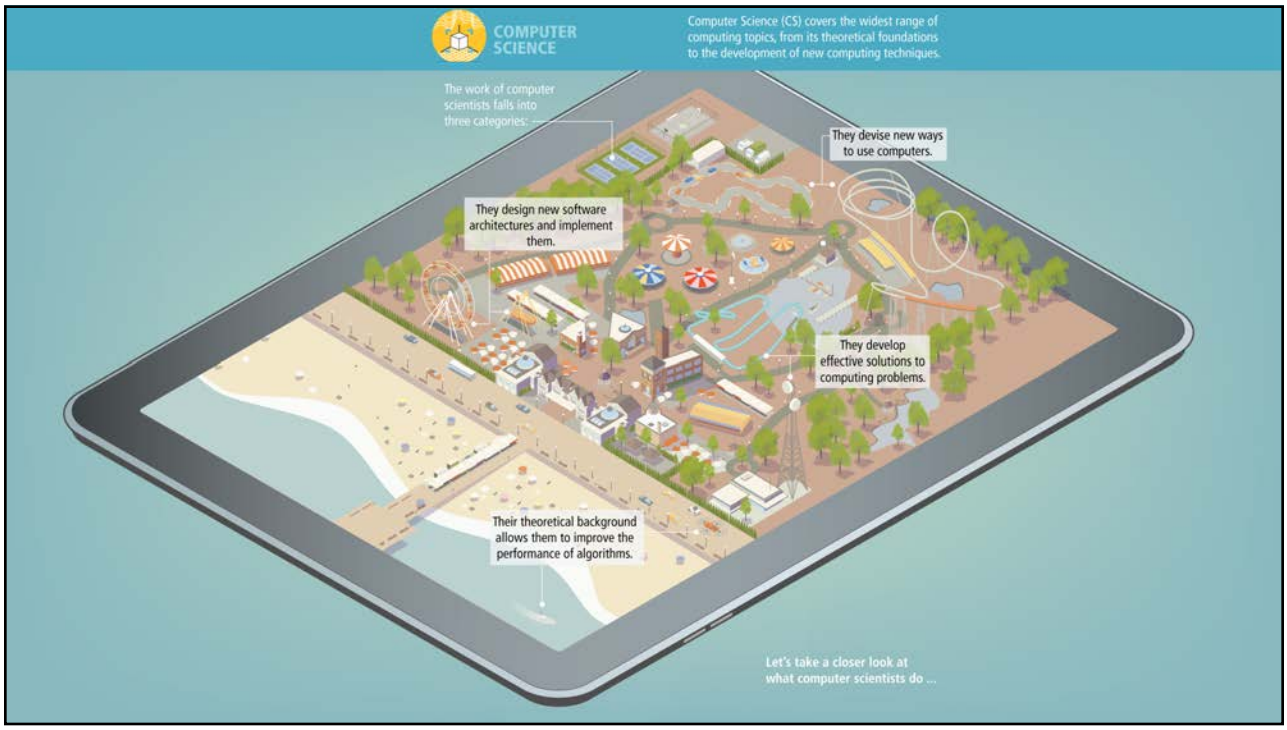
COMPUTER SCIENCE
Computer Science (CS) covers the widest range of computing topics, from its theoretical foundations to the development of new computing techniques.
The work of computer scientists falls into three categories:
They devise new ways to use computers.
They design new software architectures and implement them.
They develop effective solutions to computing problems.
Their theoretical background allows them to improve the performance of algorithms.
Let's take a closer look at what computer scientists do ...

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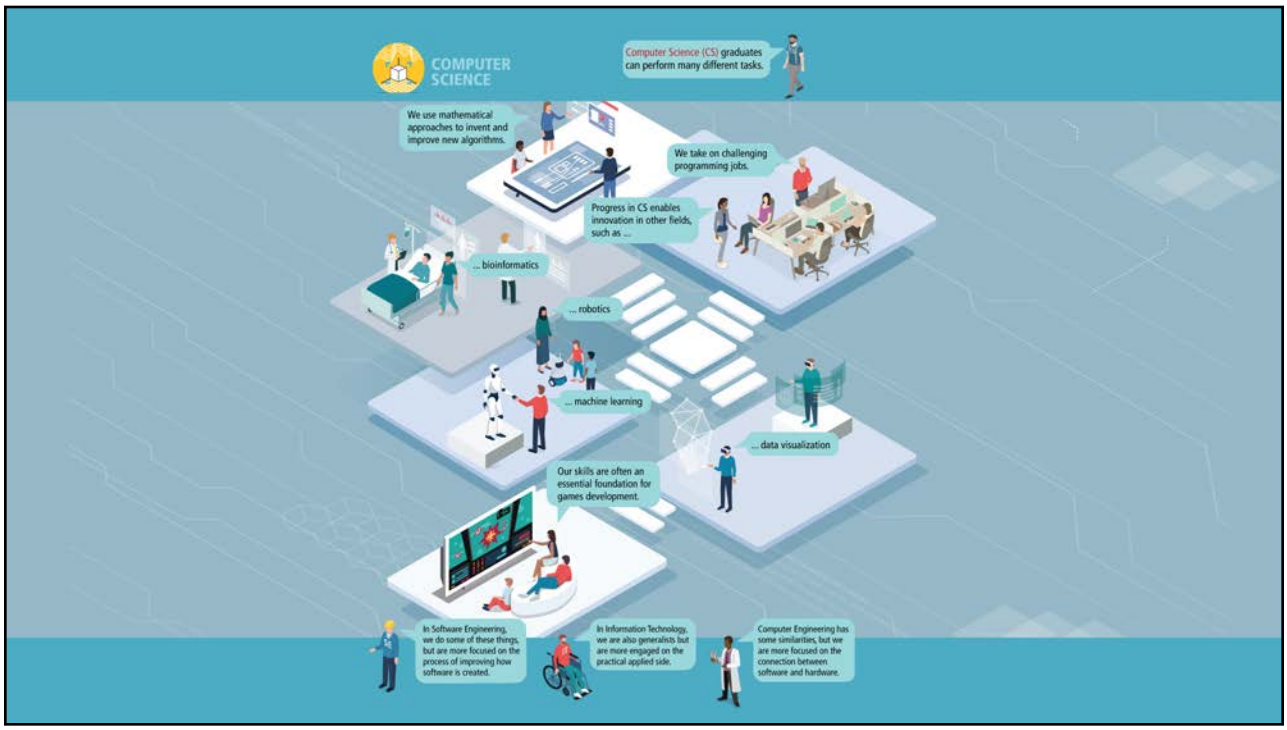
COMPUTER SCIENCE
Computer Science (CS) graduates can perform many different tasks.
We use mathematical approaches to invent and improve new algorithms.
We take on challenging programming jobs.
Progress in CS enables innovation in other fields, such as ...
... bioinformatics
... robotics
... machine learning
... data visualization
Our skills are often an essential foundation for games development.
In Software Engineering, we do some of these things, but are more focused on the process of improving how software is created.
In Information Technology, we are also generalists but are more engaged on the practical applied side.
Computer Engineering has some similarities, but we are more focused on the connection between software and hardware.

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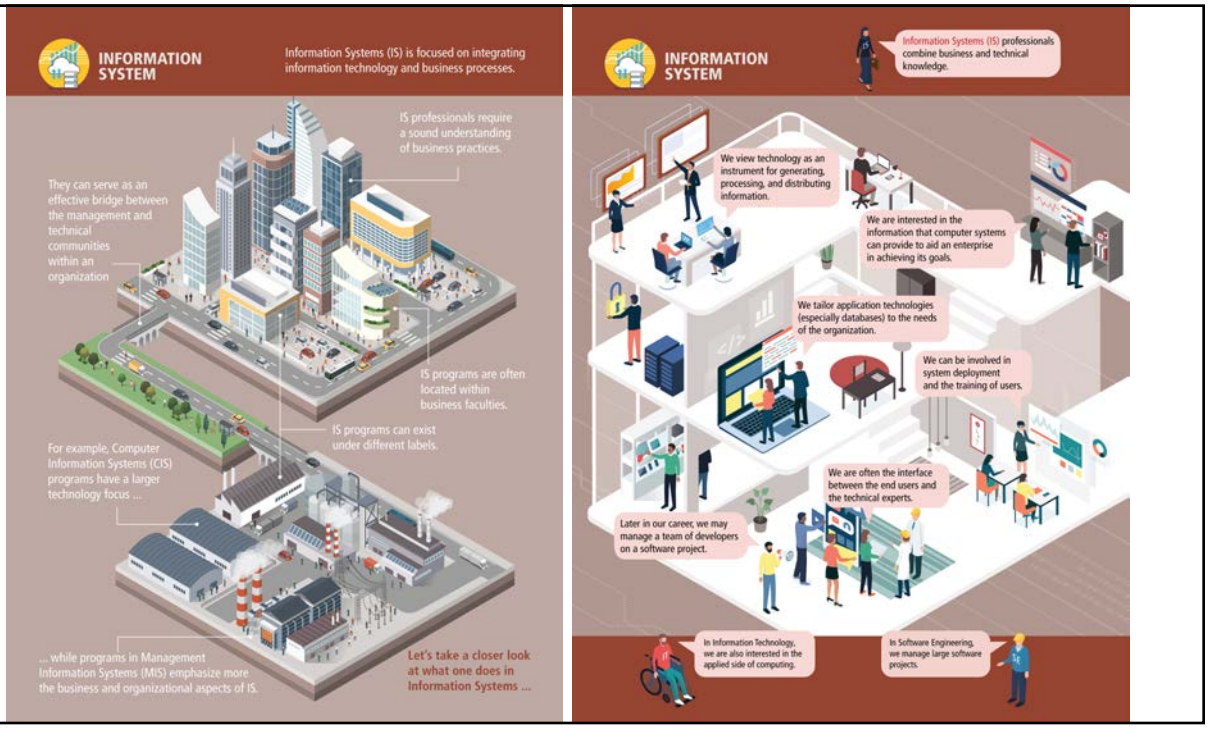
INFORMATION SYSTEM
Information Systems (IS) is focused on integrating information technology and business processes.
IS professionals require a sound understanding of business practices.
They can serve as an effective bridge between the management and technical communities within an organization
IS programs are often located within business faculties.
IS programs can exist under different labels.
For example, Computer Information Systems (CIS) programs have a larger technology focus ...
... while programs in Management Information Systems (MIS) emphasize more the business and organizational aspects of IS.
Let's take a closer look at what one does in Information Systems ...
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In Software Engineering, we manage large software projects.

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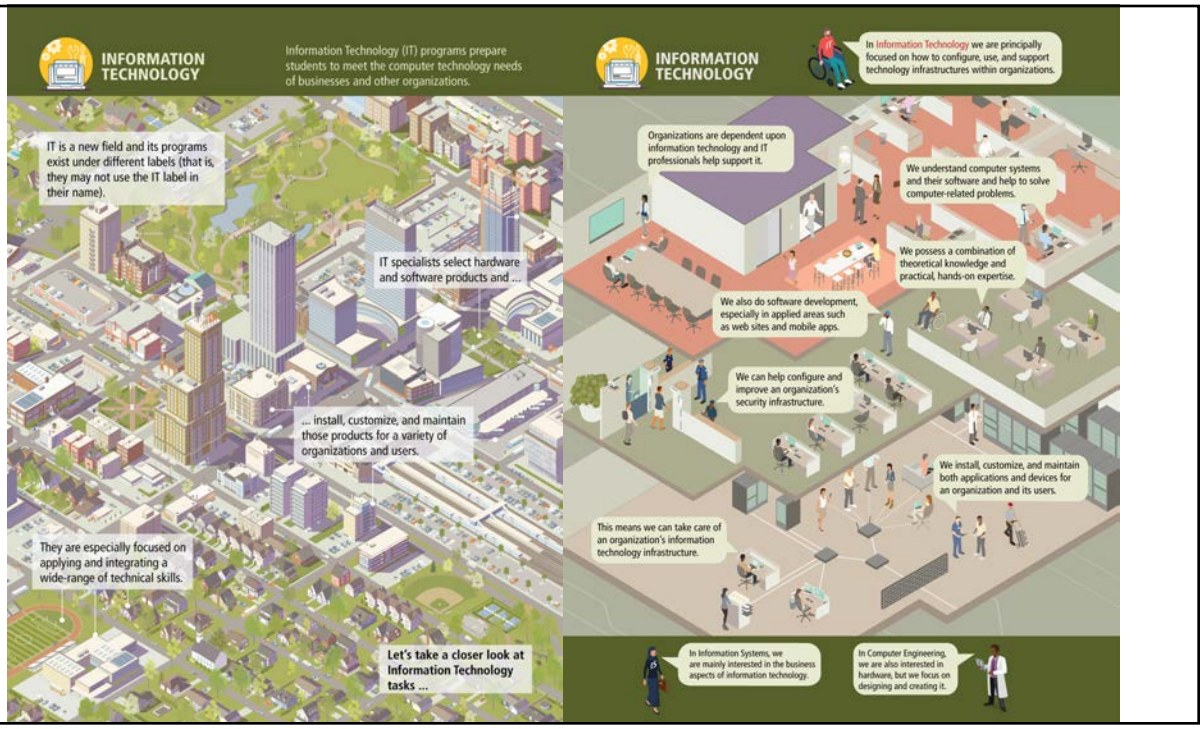
INFORMATION TECHNOLOGY
Information Technology (IT) programs prepare students to meet the computer technology needs of businesses and other organizations.
IT is a new field and its programs exist under different labels (that is, they may not use the IT label in their name).
IT specialists select hardware and software products and ...
... install, customize, and maintain those products for a variety of organizations and users.
They are especially focused on applying and integrating a wide-range of technical skills.
Let's take a closer look at Information Technology tasks ...
INFORMATION TECHNOLOGY
In Information Technology we are principally focused on how to configure, use, and support technology infrastructures within organizations.
Organizations are dependent upon information technology and IT professionals help support it.
We understand computer systems and their software and help to solve computer-related problems.
We possess a combination of theoretical knowledge and practical, hands-on expertise.
We also do software development, especially in applied areas such as web sites and mobile apps.
We can help configure and improve an organization's security infrastructure.
We install, customize, and maintain both applications and devices for an organization and its users.
This means we can take care of an organization's information technology infrastructure.
In Information Systems, we are mainly interested in the business aspects of information technology.
In Computer Engineering, we are also interested in hardware, but we focus on designing and creating it.

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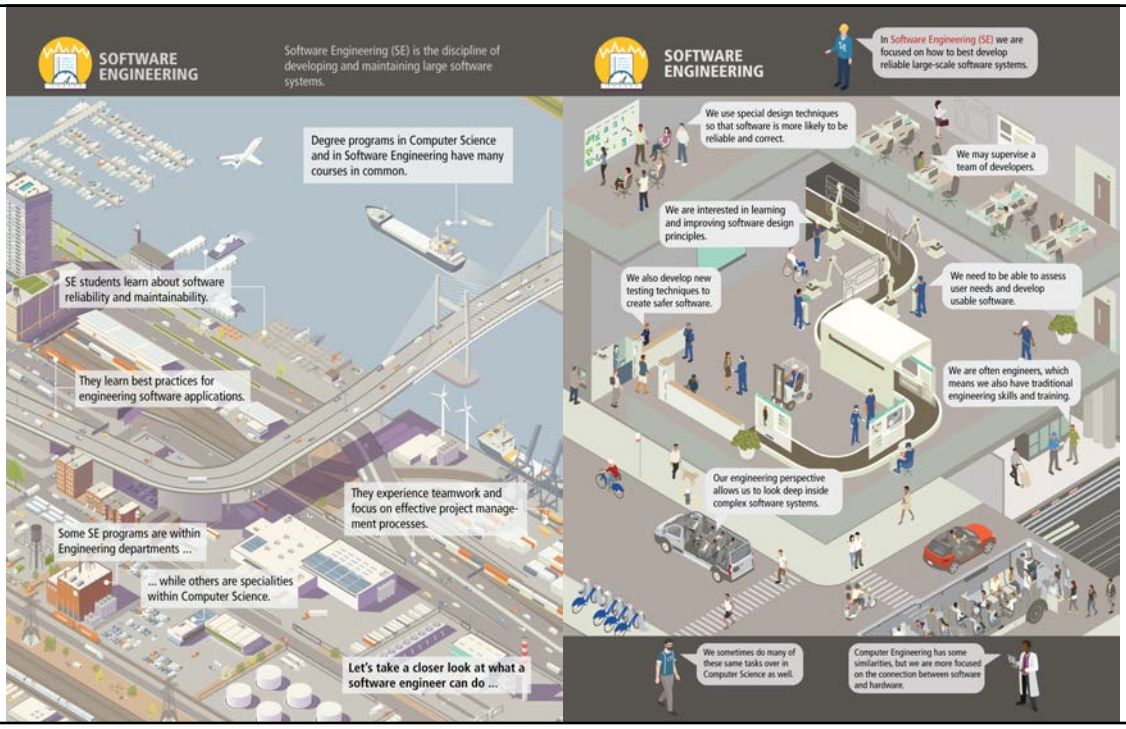
SOFTWARE ENGINEERING
Software Engineering (SE) is the discipline of developing and maintaining large software systems.
Degree programs in Computer Science and in Software Engineering have many courses in common.
SE students learn about software reliability and maintainability.
They learn best practices for engineering software applications.
They experience teamwork and focus on effective project management processes.
Some SE programs are within Engineering departments ...
... while others are specialities within Computer Science.
Let's take a closer look at what a software engineer can do ...
SOFTWARE ENGINEERING
In Software Engineering (SE) we are focused on how to best develop reliable large-scale software systems.
We use special design techniques so that software is more likely to be reliable and correct.
We may supervise a team of developers.
We are interested in learning and improving software design principles.
We also develop new testing techniques to create safer software.
We need to be able to assess user needs and develop usable software.
We are often engineers, which means we also have traditional engineering skills and training.
Our engineering perspective allows us to look deep inside complex software systems.
We sometimes do many of these same tasks over in Computer Science as well.
Computer Engineering has some similarities, but we are more focused on the connection between software and hardware.

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COMPUTER ENGINEERING
Summary
Computer Engineering is focused on computer architecture and infrastructure, from the applied to the theoretical aspects. It also has an interest in software methods (programming) insofar as it applies to the hardware side of computing.
CE
Computer Engineering
On the Job
Designs hardware to implement communication systems.
Develops hardware devices that are software-controlled, such as iPods, smart phones and gaming devices.
Focuses exclusively on hardware design, including digital electronics, with less involvement in software design.
Evaluates and improves the usability (user experience) of computing systems.
Core Courses
Circuits and Electronics
Computer Architecture and Organization
Computer Networks
Control Systems
Data and Systems Communications
Data Structure and Algorithms
Digital Design
Embedded Systems
Information Security
Internet of Things
Signal Processing
Software Design
Sample Degrees
University of Western Ontario, Bachelor of Engineering Science in Computer Engineering
University of British Columbia, Bachelor of Applied Science in Computer Engineering
University of Alberta, Bachelor of Engineering in Computer Engineering
McGill University, Bachelor of Engineering in Computer Engineering
University of New Brunswick, Bachelor of Science in Computer Engineering
University of Waterloo, Bachelor of Applied Science in Computer Engineering
University of Saskatchewan, Bachelor of Science in Engineering – Computer Engineering
St. Mary's University, Bachelor of Engineering – Electronic Systems Engineering
Ryerson University, Bachelor of Engineering in Computer Engineering
Other Pathways
Sheridan College, Computer Engineering Technician/Technology (Advanced Diploma – 3 years)
Saskatchewan Polytechnic, Computer Engineering Technology (Advanced Diploma – 3 years)
Seneca College, Computer Engineering Technology (Advanced Diploma – 3 years)
George Brown College, Computer Systems Technology, (Advanced Diploma – 3 years)
Okanagan College, Electronics Engineering Technology (Diploma
Computer Engineering Technology (Diploma – 2

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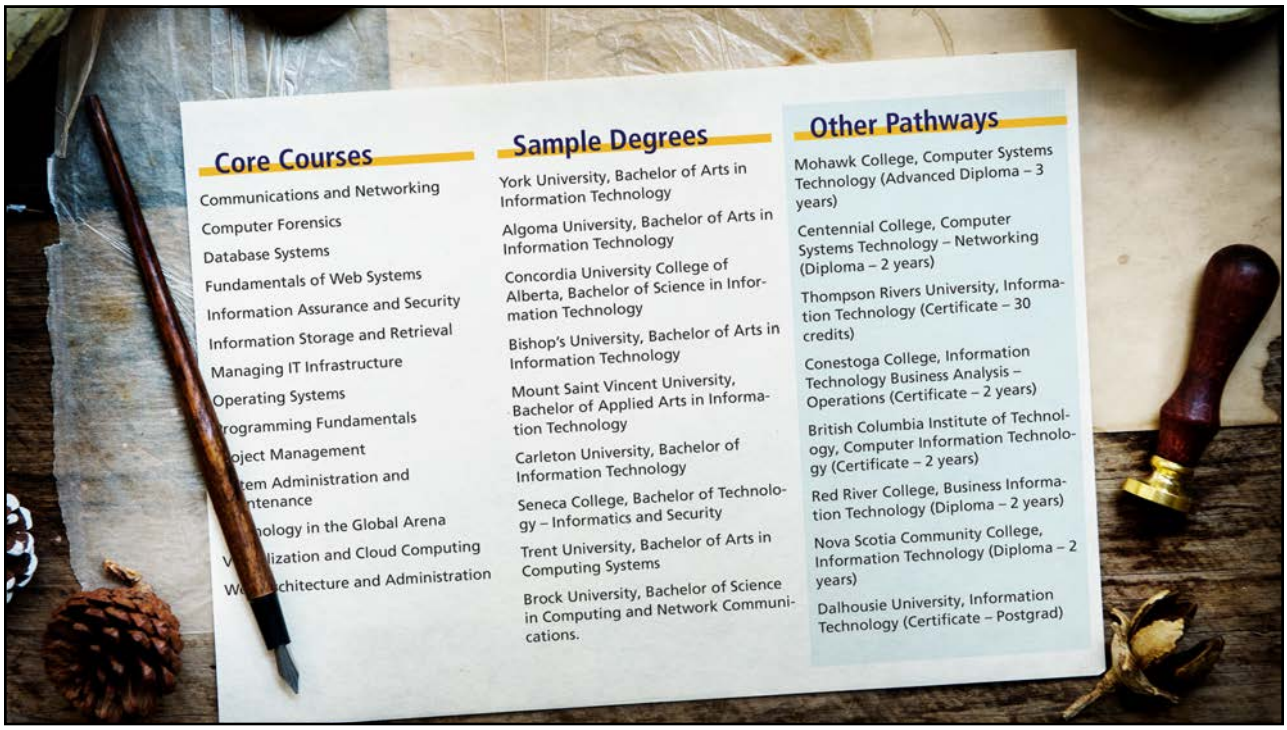
Core Courses
Communications and Networking
Computer Forensics
Database Systems
Fundamentals of Web Systems
Information Assurance and Security
Information Storage and Retrieval
Managing IT Infrastructure
Operating Systems
rogramming Fundamentals
oject Management
em Administration and
ntenance
ology in the Global Arena
lization and Cloud Computing
chitecture and Administration
Sample Degrees
York University, Bachelor of Arts in Information Technology
Algoma University, Bachelor of Arts in Information Technology
Concordia University College of Alberta, Bachelor of Science in Information Technology
Bishop's University, Bachelor of Arts in Information Technology
Mount Saint Vincent University, Bachelor of Applied Arts in Information Technology
Carleton University, Bachelor of Information Technology
Seneca College, Bachelor of Technology – Informatics and Security
Trent University, Bachelor of Arts in Computing Systems
Brock University, Bachelor of Science in Computing and Network Communications.
Other Pathways
Mohawk College, Computer Systems Technology (Advanced Diploma – 3 years)
Centennial College, Computer Systems Technology – Networking (Diploma – 2 years)
Thompson Rivers University, Information Technology (Certificate – 30 credits)
Conestoga College, Information Technology Business Analysis – Operations (Certificate – 2 years)
British Columbia Institute of Technology, Computer Information Technology (Certificate – 2 years)
Red River College, Business Information Technology (Diploma – 2 years)
Nova Scotia Community College, Information Technology (Diploma – 2 years)
Dalhousie University, Information Technology (Certificate – Postgrad)

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BIOINFORMATICS
NETWORK TECHNOLOGY
CYBERSECURITY
DATA SCIENCE
GAME DEVELOPMENT
MEDIA DESIGN + WEB DEVELOPMENT

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GAME DEVELOPMENT
Game Development focuses on the unique programming and design tasks involved in creating video games.
It can be a concentration within Computer Science ...
... or it can be a dedicated program that covers not just programming, but also design, interaction, 3D, animation, graphic formats, and testing.
Sample programs: Bachelor of Fine Arts in Game Design & Development (Wilfrid Laurier University), Advanced Diploma in Game Development (Niagara College), Graduate Certificate in Game Development (Fanshawe College).

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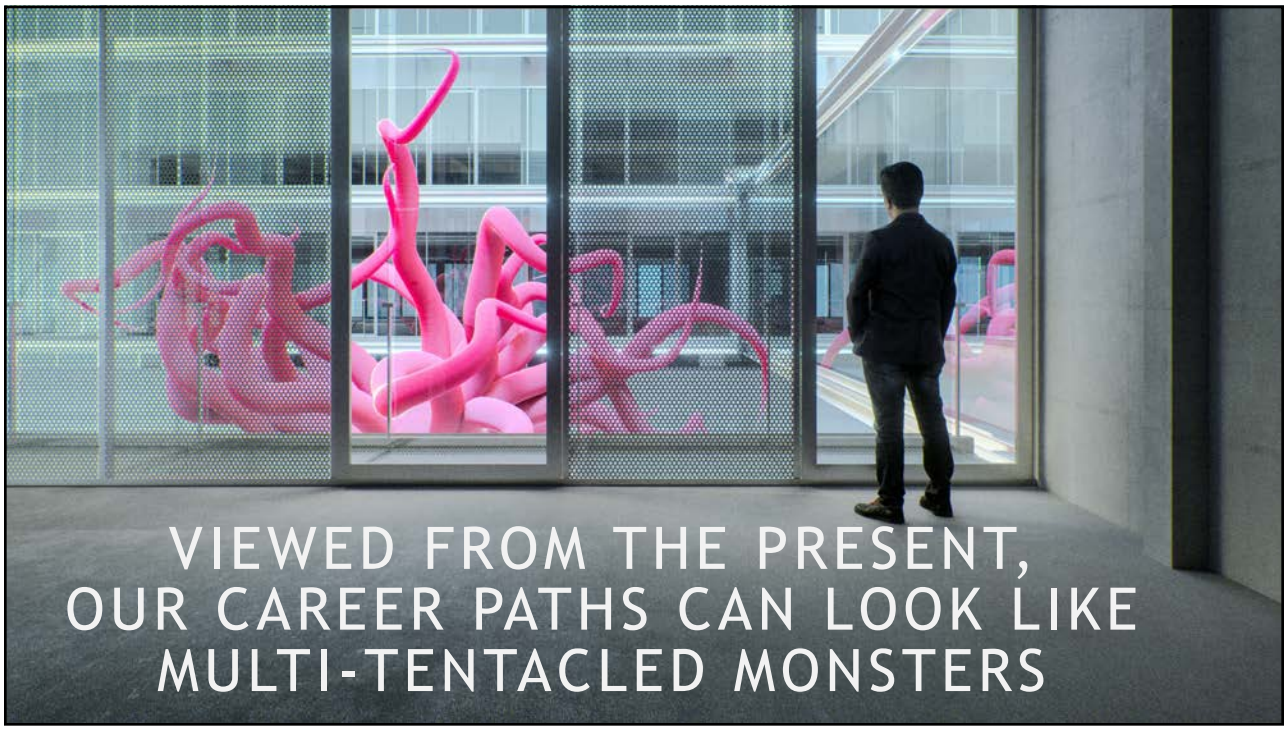
VIEWED FROM THE PRESENT,
OUR CAREER PATHS CAN LOOK LIKE
MULTI-TENTACLED MONSTERS

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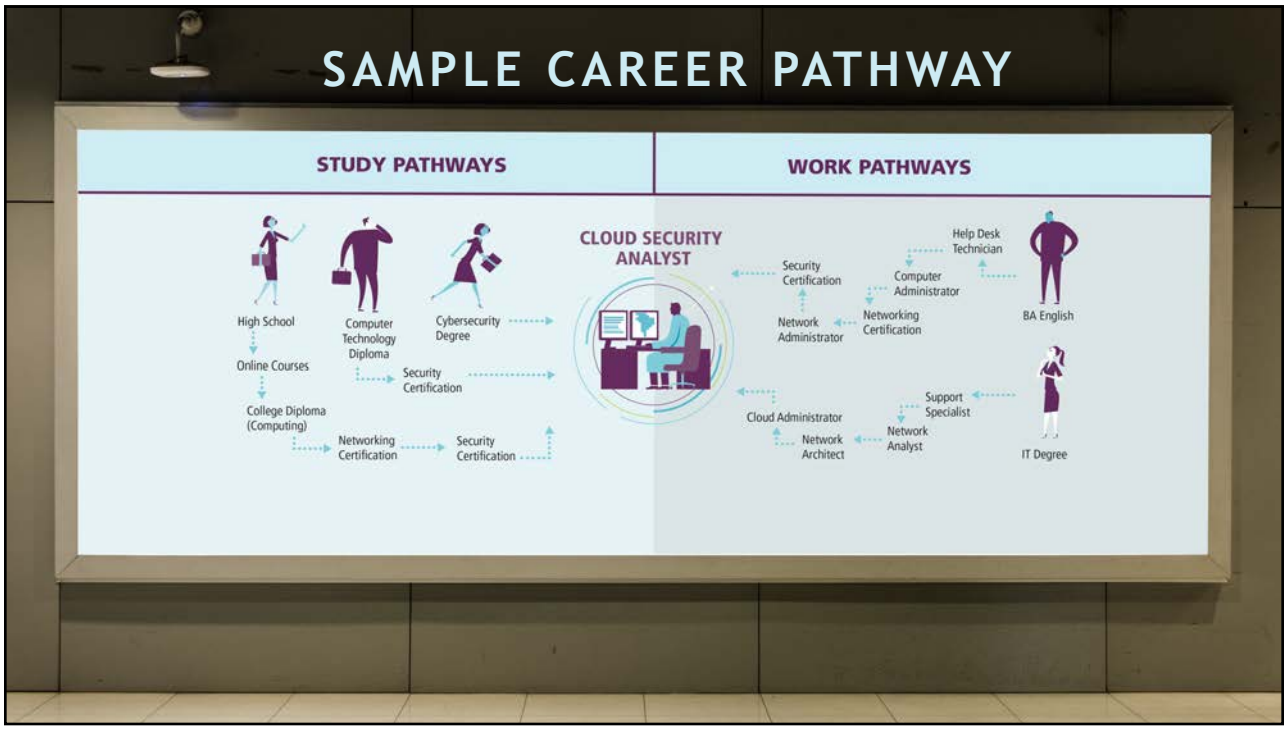

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Job Title	Computing Discipline CE	CS	IS	IT	SE	Possible Additional Training
Business System Analyst			☆		☆	Business/Commerce
Computational Scientist		☆				Mathematics, Sciences
Computer Network Support Specialist	☆			☆		
Data Analyst		☆	☆			Statistics
Database Administrator		☆	☆	☆		
Gaming & Multimedia Specialist		☆			☆	Graphic Design, Creative Writing
Hardware Engineer	☆					Electrical/Electronic Engineering
Information Security Analyst		☆	☆	☆		
IT/IS Consultant		☆	☆	☆		
Medical Computing / Bioinformatics		☆				Biology, Health Sciences, Statistics
Project Manager	☆	☆	☆	☆	☆	
Quality Assurance Specialist	☆	☆	☆	☆	☆	
Software Developer	☆	☆	☆	☆	☆	
Systems Administrator	☆			☆		

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FOR THIS REASON, WE RECOMMEND ASKING YOUR CLIENTS …

… WHAT KIND OF COMPUTING WORK ARE THEY INTERESTED IN

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ALUMNI STORIES

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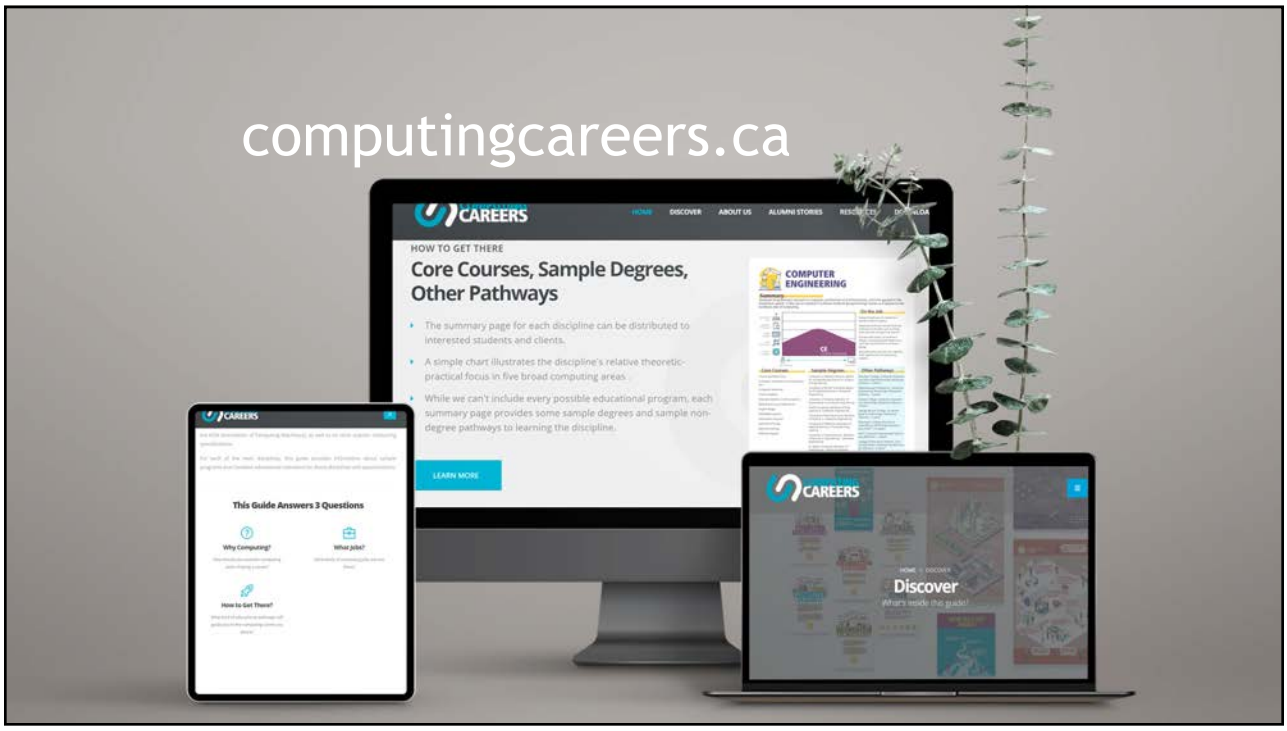
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CAREERS
HOME
DISCOVER
ABOUT US
ALUMNI STORIES
HOW TO GET THERE
Core Courses, Sample Degrees, Other Pathways
The summary page for each discipline can be distributed to interested students and clients.
A simple chart illustrates the discipline's relative theoretic-practical focus in five broad computing areas.
While we can't include every possible educational program, each summary page provides some sample degrees and sample non-degree pathways to learning the discipline.
LEARN MORE
COMPUTER ENGINEERING
This Guide Answers 3 Questions
Why Computing?
What Jobs?
How to Get There?
Discover

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acm
INROADS
PAVING THE WAY TOWARD EXCELLENCE IN COMPUTING EDUCATION
2020 JUNE
VOL. 11, NO. 2
Programming Assignments: Identifying Red Flags
Software Ecosystems: What Do We Need to Know?
A New Pedagogy to Address the Unacknowledged Failure of American Secondary CS Education
Outside and Inside Our Great City: Helping Career Advisors Understand Computing
ARTICLES
Outside and Inside Our Great City: Helping Career Advisors Understand Computing
By Randy Connolly, Mount Royal University
When you first arrive in an unfamiliar city, your attention will likely be drawn to the outside features of the notable buildings around you. But for the long-term inhabitants of that city, what matters most are the activities occurring within those buildings. This discrepancy between the outside and inside is the analogous situation facing career advisors when they endeavor to guide their clients towards a computing career. Their clients ultimately decide to pursue a computing education based on what they imagine happens inside those buildings, but the advisors generally only have the outside perspective of a tourist. We have created a handbook to help both career advisors and potential students better understand both the inside and the outside of different computing careers and disciplines.
COMPUTING CAREERS & DISCIPLINES
COMPUTER DISCIPLINES
A QUICK GUIDE FOR PROSPECTIVE STUDENTS AND CAREER ADVISORS
INTRODUCTION
How do we encourage prospective students to consider enrolling in an educational program that will prepare a student adequately for a future computing career? During the harrowing enrollment crisis of the first decade of the 2000s, the answer to this question had existential exigency for almost everyone in computing education. In this past decade, the problem has lost some of its urgency due to strong and steadily increasing application numbers within computing [15]. Yet despite these rosy trends, the answer to this question remains uncertain. For some, it's an issue wrapped up in the more generalized concern of getting more students to enroll within STEM programs for the good of the economy. For others, it's about maintaining growth within their discipline. But for career counselors and advisors, the interest in this question lies principally in their concern for how best to guide their clients onto a rewarding career path.
We know that computing can be rewarding, and that economic demand will likely remain strong for some time. But what is a computing career? How does one prepare for it? Back in 2003, Anthony noted that there was "confusion in industry as well as among students and parents in relation to what various computing programs offer and prepare students for" [2]. In the intervening 17 years, the variety within computing ed-
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WE ARE NOW READY ... FOR YOUR QUESTIONS

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Advancing Career Development in Canada
Promouvoir le développement de carrière au Canada
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