Bachelor of Science in Computational Systems

Computational Systems provide the scientific foundations for making sense of natural, human-mediated, and social phenomena through analytics, computational methods, and modeling. In an age of ubiquitous - and often overwhelming - data, the ability to harness that data to reflect, reach out and make better decisions is increasingly crucial. The Computational Systems program prepares students for the future of technological innovation and life in the information age. Students use logic and data analysis to make informed decisions and solve complex problems. Students will employ the techniques of artificial intelligence, machine learning, and software engineering in the service of innovation, data-driven decision making, and technological innovation. It will support the critical needs of the technology sector by preparing graduates ready to embark upon careers such as Data Scientist, Data Analyst, Big Data Developer, Business Intelligence Developer, AI Developer, Intelligence Analyst, AI Research Scientist, Data Security Analysts, Blockchain Engineer, Incident Analyst.

In the Computational Systems program, students will take courses that provide in-depth disciplinary knowledge and skills, as well as electives from courses offered in other programs. In addition, they will complete an internship and an independent Capstone project.

Program Goals

To provide organizations with computational systems professionals skilled in cutting edge technologies in machine intelligence, applied data science, and digital security, enabling them to deliver competitive products that leverage artificial intelligence to meet customers' needs, data science for decision making support, and security to protect the society in the digital age.

Program Learning Outcomes

Upon successful completion of this program, students will be able to:

1. **Computational Solutions**: Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.
   (Level 7 of QFE: Knowledge, Skills, Autonomy and responsibility)
2. **Computational Design**: Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
   (Level 7 of QFE: Skills, Autonomy and responsibility)
3. **Communication**: Communicate effectively in a variety of professional contexts.
   (Level 7 of QFE: Skills, Autonomy and responsibility, Role in context)
4. **Professional Practice**: Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
   (Level 7 of QFE: Self-development)
5. **Working in Teams**: Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
   (Level 7 of QFE: Role in context, Self-development)

Concentration in Applied Data Science

This concentration will focus on the scientific methods, processes, algorithms and systems to extract knowledge and insights from structured and unstructured data, in addition to systems architectures and implementations for handling large scale data intensive environments.

Students will acquire the skills necessary to analyze, interpret, and exploit large amounts of data. Through the lenses of statistics, machine learning, and stochastic modeling, students learn how to draw strong inferences about the world around us.Concentration Learning Outcomes

1. Construct analytical models for processing raw data into knowledge, discovering business insights, and creating value using descriptive, predictive, and prescriptive analytics.
   (Level 7 of QFE: Knowledge, Skills, Autonomy and responsibility)
2. Deploy data-driven solutions to real-world environments and understand their ethical and social implications.
   (Level 7 of QFE: Skills, Autonomy and responsibility, Self-development)
3. Design compelling data narratives and visual representations to expose insights derived from analytics and communicate it to a diverse set of stakeholders.
   (Level 7 of QFE: Autonomy and responsibility, Role in context)

Concentration in Machine Intelligence

Machine Intelligence has created a paradigm shift in technology affecting all facets of businesses, governments, and society due to advances in AI and the exponential growth of data. The Machine Intelligence concentration provides students with the technical knowledge and analytical methods that will prepare them for the next generation of innovation. In this concentration, students will learn the latest trends in Machine Learning such as Neural Networks and Deep Learning to Computer Vision and Natural Language Processing to build and validate models to all kinds of data within organizations to gain insights and drive business intelligence.

Concentration Learning Outcomes

1. Apply machine learning and Artificial Intelligence technologies to solve computational and quantitative problems.
   (Level 7 of QFE: Knowledge, Skills, Autonomy and responsibility)
2. Synthesize and validate AI models to create industry-ready solutions for prediction, classification, and business insights.
   (Level 7 of QFE: Skills, Autonomy and responsibility, Role in context)
3. Explain the technical, ethical, and societal implications and limitations of AI models.
   (Level 7 of QFE: Skills, Self-development)

Concentration in Digital Security

The global trend of digitization has exposed society to borderless threats and attacks from local and global actors. Ranging from digital humanity, digital society, to digital economy, dimensions of threats present myriads of challenges that require urgent remediation. Security in this digitized world is therefore an immensely important issue that requires the knowledge of the underlying technology, principle, and theories. The digital security concentration provides balance between the growing technological advances, the practical implementation of protective principles, and the underlying theory of security.

The students will acquire the versatile skills set to protect computer systems, data, and networks from malicious cyberattacks. They will utilize cybersecurity tools and techniques to find system vulnerabilities while building security solutions to prevent malicious attacks and the threat intelligence knowledge to show how attacks have occurred and identify their origins.

Concentration Learning Outcomes

1. Use digital security principles, tools, skills, and practices to safeguard computer systems, data, and applications.
   (Level 7 of QFE: Knowledge, Skills)
2. Apply machine learning and data analysis techniques to mitigate data security threats in traditional and emerging computing platforms.
   (Level 7 of QFE: Skills, Autonomy and responsibility)
3. Analyze threats and vulnerabilities to manage risks, investigate cybercrimes and communicate ethical and technical findings to appropriate stakeholders in the digital security ecosystem.
   (Level 7 of QFE: Skills, Autonomy and responsibility, Role in context, Self-development)

Degree Requirements

Required Credit Hours: 120 hours

General Education	***40 CHs***
Program Required Courses	***30 CHs***
Concentration Courses	***24 CHs***
Internship and Capstone Project	***14 CHs***
Electives	***12 CHs***

General Education		***40 CHs***
ICB101	Strategic Learning and Growth	4
ICB102	Expressive Clarity	3
IAR110 or IAR111	Arabic Lab 1 (N): Speaking to Engage & Persuade Arabic Lab 1 (NN): Arabic Language & Culture for Beginners	1
IDS101	Critique and Communication	4
IAR210 or IAR211	Arabic Lab 2 (N): Writing to Inform Arabic Lab 2 (NN): Arabic Language & Culture for Intermediate Proficiency	1
IDS102	Applied Creative and Critical Thinking	4
IDS103	Statistical Intuitions & Applications	4
IDS104	Deriving Insights from Evidence	4
IDS105	Systems and Society	4
IDS220	Fundamentals of Innovation and Entrepreneurship	3
IAH244	Ethical Systems, Moral Dilemmas	4

Program Required courses		***30 CHs***
ICS211	Single and Multivariable Calculus	4
ICS215	Mathematics For Computational Systems	3
ICS230	Information Security and Data Privacy	3
ICS221	Data Structures and Algorithms	4
ICS220	Programming Fundamentals	3
ICS214	Probability, Statistics, and the Structure of Randomness	4
ICS340	Database Systems	3
ICS360	Computer Networks Fundamentals	3
ICS350	Introduction to Artificial Intelligence	3
Internship and Capstone Project courses		***14 CHs***
IDS391	Capstone Seminar I	3
IDS493	Capstone Project I	4
IDS494	Capstone Project II	4
ICS490	Internship	3

Concentration in Applied Data Science courses		***24 CHs***
ICS351	Machine Learning	4
ICS315	Computational Bayesian Statistics	4
ICS341	Big Data Analytics	4
ICS420	Parallel Programming & Distributed Computing	4
ICS441	Data Science and Decision Making	4
ICS443	Visual and Interactive Analytics	4

Concentration in Machine Intelligence courses		***24 CHs***
ICS351	Machine Learning	4
ICS315	Computational Bayesian Statistics	4
ICS353	Perceiving the World through Computer Vision	4
ICS451	Natural Language Technologies	4
ICS450	Applied Neural Networks and Deep Learning	4
ICS453	Autonomous Systems	4

Concentration in Digital Security courses		***24 CHs***
ICS351	Machine Learning	4
ICS330	Attack and Defense in Cyberspace	4
ICS331	Applied Cryptography and Identity Management	4
ICS432	Software Security	4
ICS430	Governance, Compliance, and Risk Management	4
ICS431	Digital Forensics and Incident Response	4

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Concentration in Applied Data Science
(Recommended Sequence)

	Semester 1		Credits	Semester 2		Credits
Year 1	ICB101	Strategic Learning and Growth	4	IDS101	Critique and Communications	4
	ICB102	Expressive Clarity	3	IAR210 or IAR211	Arabic Lab 2 (N): Writing to Inform Arabic Lab 2 (NN): Arabic Language & Culture for Intermediate Proficiency	1
	IAR110 or IAR111	Arabic Lab 1 (N): Speaking to Engage & Persuade Arabic Lab 1 (NN): Arabic Language & Culture for Beginners	1	IDS103	Statistical Intuitions and Applications	4
	ICB103	Applied Algorithmic Thinking	4	IDS105	Systems and Society	4
	IDS102	Applied Creative and Critical Thinking	4	IDS220	Fundamentals of Innovation and Entrepreneurship	3
		Total	**16**		**Total**	**16**
Year 2	**Semester 3**			**Semester 4**		
	IDS204	Deriving Insights from Evidence	4	IAH244	Ethical Systems, Moral Dilemmas	4
	ICS211	Single and Multivariable Calculus	4	ICS221	Data Structures and Algorithms	4
	ICS215	Mathematics For Computational Systems	3	ICS220	Programming Fundamentals	3
	ICS230	Information Security and Data Privacy	3	ICS214	Probability, Statistics, and the Structure of Randomness	4
		Total	**14**		**Total**	**15**
Year 3	**Semester 5**			**Semester 6**		
	ICS340	Database Systems	3	IDS391	Capstone Seminar I	3
	ICS360	Computer Networks Fundamentals	3	ICS351	Machine Learning	4
	ICS350	Introduction to Artificial Intelligence	3	ICS315	Computational Bayesian Statistics	4
	Elective	Elective from other programs	3	ICS341	Big Data Analytics	4
	Elective	Elective from other programs	3			
		Total	**15**		**Total**	**15**
Year 4	**Semester 7**			**Semester 8**		
	IDS493	Capstone Project I	4	ICS490	Internship	3
	ICS420	Parallel Programming & Distributed Computing	4	IDS494	Capstone Project II	4
	ICS441	Data Science and Decision Making	4	Elective	Elective from other programs	3
	ICS443	Visual and Interactive Analytics	4	Elective	Elective from other programs	3
		Total	**16**		**Total**	**13**

Total = 120 Credit Hours

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	Semester 1		Credits	Semester 2		Credits
Year 1	ICB101	Strategic Learning and Growth	4	IDS101	Critique and Communications	4
	ICB102	Expressive Clarity	3	IAR210 or IAR211	Arabic Lab 2 (N): Writing to Inform Arabic Lab 2 (NN): Arabic Language & Culture for Intermediate Proficiency	1
	IAR110 or IAR111	Arabic Lab 1 (N): Speaking to Engage & Persuade Arabic Lab 1 (NN): Arabic Language & Culture for Beginners	1	IDS103	Statistical Intuitions and Applications	4
	ICB103	Applied Algorithmic Thinking	4	IDS105	Systems and Society	4
	IDS102	Applied Creative and Critical Thinking	4	IDS220	Fundamentals of Innovation and Entrepreneurship	3
		Total	**16**		**Total**	**16**
Year 2	**Semester 3**			**Semester 4**		
	IDS204	Deriving Insights from Evidence	4	IAH244	Ethical Systems, Moral Dilemmas	4
	ICS211	Single and Multivariable Calculus	4	ICS221	Data Structures and Algorithms	4
	ICS215	Mathematics For Computational Systems	3	ICS220	Programming Fundamentals	3
	ICS230	Information Security and Data Privacy	3	ICS214	Probability, Statistics, and the Structure of Randomness	4
		Total	**14**		**Total**	**15**
Year 3	**Semester 5**			**Semester 6**		
	ICS340	Database Systems	3	IDS391	Capstone Seminar I	3
	ICS360	Computer Networks Fundamentals	3	ICS351	Machine Learning	4
	ICS350	Introduction to Artificial Intelligence	3	ICS315	Computational Bayesian Statistics	4
	Elective	Elective from other programs	3	ICS353	Perceiving the World through Computer Vision	4
	Elective	Elective from other programs	3			
		Total	**15**		**Total**	**15**
Year 4	**Semester 7**			**Semester 8**		
	IDS493	Capstone Project I	4	ICS490	Internship	3
	ICS451	Natural Language Technologies	4	IDS494	Capstone Project II	4
	ICS450	Applied Neural Networks and Deep Learning	4	ICS453	Autonomous Systems	4
	Elective	Elective from other programs	3	Elective	Elective from other programs	3
		Total	**15**		**Total**	**14**

Total = 120 Credit Hours

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Concentration in Digital Security
(Recommended Sequence)

	Semester 1		Credits	Semester 2		Credits
Year 1	ICB101	Strategic Learning and Growth	4	IDS101	Critique and Communications	4
	ICB102	Expressive Clarity	3	IAR210 or IAR211	Arabic Lab 2 (N): Writing to Inform Arabic Lab 2 (NN): Arabic Language & Culture for Intermediate Proficiency	1
	IAR110 or IAR111	Arabic Lab 1 (N): Speaking to Engage & Persuade Arabic Lab 1 (NN): Arabic Language & Culture for Beginners	1	IDS103	Statistical Intuitions and Applications	4
	ICB103	Applied Algorithmic Thinking	4	IDS105	Systems and Society	4
	IDS102	Applied Creative and Critical Thinking	4	IDS220	Fundamentals of Innovation and Entrepreneurship	3
		Total	**16**		**Total**	**16**
Year 2	**Semester 3**			**Semester 4**		
	IDS204	Deriving Insights from Evidence	4	IAH244	Ethical Systems, Moral Dilemmas	4
	ICS211	Single and Multivariable Calculus	4	ICS221	Data Structures and Algorithms	4
	ICS215	Mathematics For Computational Systems	3	ICS220	Programming Fundamentals	3
	ICS230	Information Security and Data Privacy	3	ICS214	Probability, Statistics, and the Structure of Randomness	4
		Total	**14**		**Total**	**15**
Year 3	**Semester 5**			**Semester 6**		
	ICS340	Database Systems	3	IDS391	Capstone Seminar I	3
	ICS360	Computer Networks Fundamentals	3	ICS351	Machine Learning	4
	ICS350	Introduction to Artificial Intelligence	3	ICS330	Attack and Defense in Cyberspace	4
	Elective	Elective from other programs	3	ICS331	Applied Cryptography and Identity Management	4
	Elective	Elective from other programs	3			
		Total	**15**		**Total**	**15**
Year 4	**Semester 7**			**Semester 8**		
	IDS493	Capstone Project I	4	ICS490	Internship	3
	ICS432	Software Security	4	IDS494	Capstone Project II	4
	ICS430	Governance, Compliance, and Risk Management	4	Elective	Elective from other programs	3
	ICS431	Digital Forensics and Incident Response	4	Elective	Elective from other programs	3
		Total	**16**		**Total**	**13**

Total = 120 Credit Hours