APPLIED COMPUTER SCIENCE (ACS)

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Chair: J. Bautista; **Professors:** Y. Chen, S. Ramanna; **Associate Professors:** S. Camorlinga; **Assistant Professors:** M. Adedayo, Y. Al Mtawa, M. Beck, Q. Liu, R. McFadyen, B. Rey, C. Valderrama; **Instructors:** V. Balogun, J. Deng, A. Kaur

http://www.acs.uwinnipeg.ca

DEGREES/PROGRAMS OFFERED

3-Year BA
4-Year BA
3-Year BA (Information Systems Stream)
3-Year BA (Health Informatics Stream)

3-Year BSc
4-Year BSc
3-Year BSc (Information Systems Stream)
3-Year BSc (Health Informatics Stream)
4-Year BSc (Scientific Computing Stream)
Honours BSc

Minor

Master of Science (MSc) – More information can be found in the *Graduate Studies Academic Calendar.*

INTRODUCTION

The Applied Computer Science major is designed to prepare students in the following core areas: Programming Fundamentals (object-oriented, event driven, algorithms), Information Management (database systems, data modeling, data warehousing, relational databases, query languages), Software Engineering (software requirements and design, software process, software project management), Operating Systems, Net-Centric Computing (internet programming, networks, security), Human Computer Interaction (GUI Design and Programming), Intelligent Systems (Machine Learning).

Our team-oriented courses are meant to strengthen communication skills, experience group dynamics, and foster self-confidence. The 4-year major includes the development of a team-based software project for a local IT organization. Our program will help develop analytical thinking and applied skills by blending theoretical and practical aspects of computer science.

The Applied Computer Science program can lead to a Bachelor of Science (3-year, 4-year, or Honours) or a Bachelor of Arts (3-year or 4-year). This major is focused in theories, professionalism, and fundamental computing knowledge. We recommend the four-year degree programs due to the greater depth of study. Additionally, there are three streams: Information Systems, Health Informatics, and Scientific Computing. The Applied Computer Science major is designed to provide an excellent basis for graduate studies in either computer science or applied computing.

The **Information Systems stream** leads to a Bachelor of Science (3-year) or a Bachelor of Arts (3-year). The Information Systems (IS) stream is aimed at students interested in focusing on information and business needs of IT industry. The stream is intended to prepare students in information oriented courses, and also in system and internet based technologies.

The **Health Informatics stream** leads to a Bachelor of Science (3-year) or a Bachelor of Arts (3-year). The Health Informatics (HI) stream provides students with more focused courses in Health information needs, infrastructure, standards, and jurisdiction. The HI stream complements offerings of the ACS department, and gives students flexibility of combining all three areas of IT, Business, and Health.

The **Scientific Computing stream** leads to a Bachelor of Science (4-year). The Scientific Computing stream (SC) stream provides a scientific foundation for applied science industries. The goal of this stream is to provide a mechanism for students to pursue the sciences as part of their studies in Applied Computer Science. The stream also positions students for success in computer science graduate studies.

Students pursuing a 3-year or 4-year BSc in Applied Computer Science, including the IS, HI, and SC Streams, have the opportunity to take a **Business Stream (**see the “Science with a Business Stream” section of this Course Calendar**).**

The Applied Computer Science program is designed to provide an excellent basis for graduate studies in computer science, information sciences, or interdisciplinary areas such as Biostatistics.

The Department offers a **Masters Degree in Applied Computer Science and Society.**

REQUIREMENTS FOR A 3-YEAR BA/BSc IN APPLIED COMPUTER SCIENCE

ADMISSION REQUIREMENT Pre-Calculus Mathematics 40S or Applied Mathematics 40S.

GRADUATION REQUIREMENT 90 credit hours

RESIDENCE REQUIREMENT

Degree:	Minimum 30 credit hours
Major:	Minimum 18 credit hours

GENERAL DEGREE REQUIREMENT

Humanities:	12 credit hours in Humanities
Science:	6 credit hours in Science for BA 18 credit hours in Science for BSc
Writing:	Minimum 3 credit hours of Academic Writing.
Indigenous:	3 credit hours in designated Indigenous requirement courses.
Maximum Introductory Courses:	Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level. As a result, students must take a minimum of 48 credit hours at the 2000-level or above in order to not exceed the maximum number of introductory courses.
Distribution:	Minimum three (3) credit hours from each of five (5) different subjects.

MAJOR REQUIREMENT

Single Major:	Minimum 36credit hours/Maximum 48 credit hours in the Major subject.
Double Major:	36 credit hours in ACS, plus number of credit hours specified by other Major subject or program

Required courses:

MATH-xxxx(3) 3 credit hours from Mathematics
Except:

- MATH-2902 Math Prior to 1640
- MATH-2901 History of Calculus
- MATH-2903 Math for Early/Middle Years Teachers I
- MATH-2904 Math for Early/Middle Years Teachers II

STAT-xxxx(3) 3 credit hours from Statistics

6 credit hours: a) or b) below:

a)
ACS-1903(3) Programming Fundamentals I **and**
ACS-1904(3) Programming Fundamentals II

b)
ACS-1905(3) Programming Fundamentals **and** one of the courses at 2000 level or above from the electives listed below.

ACS-2906(3) Computer Architecture and System Software
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design
ACS-2814(3) Applications of Database Systems
ACS-3909(3) Advanced Internet Programming
ACS-2947(3) Data Structures and Algorithms
ACS-3902(3) Database Systems
ACS-3913(3) Software Design and Architecture
ACS-3953(3) Introduction to Artificial Intelligence

One of the following two courses:
ACS-3911(3) Computer Networks
ACS-3931(3) Principles of Operating Systems

Electives: Students wishing to take further courses towards the General degree with the Applied Computer Science Major should take up to 12 credit hours from the following:

ACS-1803(3)	Introduction to Information Systems
ACS-1805(3)	Introduction to Programming
ACS-2102(3)	Scientific Computing
ACS-2103(3)	Numeric and Symbolic Computing
ACS-2112(3)	Scientific Computing with Python
ACS-2803(3)	Physical Computing
ACS-2816(3)	Health Information Systems
ACS-2916(3)	Business Application Systems
ACS-2941(3)	Unix
ACS-3901(3)	Principles of Software Project Management
ACS-3907(3)	eCommerce
ACS-3916(3)	Human Computer Interaction
ACS-3921(3) / 4921(3)	Computer Security and Privacy
ACS-3922(3)	Introduction to Game Development
ACS-3923(3)	Technical Communication in ICT Professions
ACS-3930(3)	Topics in Applied Computer Science
ACS-3941(3)	Implementation Issues in Object Oriented Languages
ACS-3947(3)	Algorithm Design
ACS-4306(3)	Applied Parallel Programming
ACS-4902(3)	Advanced Database Systems
ACS-4904(3)	Data Warehousing
ACS-4906(3)	Conceptual Modelling
ACS-4953(3)	Introduction to Machine Learning
ACS-4954(3)	Introduction to Distributed Systems
BUS-2002(3)	Introduction to Financial Accounting

Combined Major: Minimum 48 credit hours from two (2) different majors with not less than 18 credit hours from each major subject.

Required courses:

ACS-1903(3)	Programming Fundamentals I
ACS-1904(3)	Programming Fundamentals II

ACS-2814(3) Application of Database Systems
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design

Additional Information:
Students are strongly advised to take more than 42 credit hours in Applied Computer Science.
Students who wish to strengthen their business background are advised to take courses in the Department of Business and Administration.

RRC Polytech

The Department of Applied Computer Science welcomes the transfer of RRC Polytech students into the 3-Year Applied Computer Science program. The University of Winnipeg will grant a total of 30 credit hours in transfer credits to RRC Polytech students who have successfully completed the Computer Analyst/Programmer (CAP) or the Information Systems Technology (IST) 2-year Diploma programs with an average of C+ (2.5 GPA) or better. These credits can be applied to either a Science or an Arts degree. Further details regarding the transfer of credits and course requirements are available from the Department of Applied Computer Science or from Student Services at the University of Winnipeg. Those who wish to pursue a 4-year major need to consult the Chair of the department.

REQUIREMENTS FOR A 3-YEAR BA/BSc (INFORMATION SYSTEMS STREAM)

ADMISSION REQUIREMENT	Essential/Consumer Math, Pre-Calculus Math 40s or Applied Math 40s.
GRADUATION REQUIREMENT	90 credit hours
RESIDENCE REQUIREMENT	
Degree:	Minimum 30 credit hours
Major:	Minimum 18 credit hours
GENERAL DEGREE REQUIREMENT	
Humanities:	12 credit hours in Humanities
Science:	6 credit hours in Science for BA 18 credit hours in Science for BSc
Writing:	Minimum 3 credit hours of Academic Writing.
Indigenous:	3 credit hours in designated Indigenous requirement courses.
Maximum Introductory Courses:	Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level. As a result, students must take a minimum of 48 credit hours at the 2000-level or above in order to not exceed the maximum number of introductory courses.
Distribution:	Minimum three (3) credit hours from each of five (5) different subjects.
MAJOR REQUIREMENT	
Single Major:	Minimum 36 credit hours/Maximum 48 credit hours in the Major subject.
Double Major:	30 or 36 credit hours in each Major subject or program, as specified.

Required courses:

Year 1 courses: 9 credit hours
ACS-1803(3) Introduction to Information Systems
6 credit hours: a), b), or c) below:
a)
ACS-1805(3) Introduction to Programming **and**
ACS-1903(3) Programming Fundamentals I
b)
ACS-1903(3) Programming Fundamentals I **and**
ACS-1904(3) Programming Fundamentals II
c)
ACS-1905(3) Programming Fundamentals **and** one of the ACS courses at 2000 level or above

Year 2 courses: 12 credit hours
ACS-2814(3) Applications of Database Systems
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design
ACS-2916(3) Business Application Systems

Year 3 courses: 15 credit hours
ACS-3916(3) Human Computer Interaction
ACS-3907(3) eCommerce

One of the following two courses:
ACS-3801(3) Principles in Information Systems
ACS-3901(3) Principles of Software Project Management

One of the following two courses:
ACS-3909(3) Advanced Internet Programming
ACS-3911(3) Computer Networks

One of the following three courses:
ACS-3923(3) Technical Communication in ICT Professions
ACS-3830(3) Topics in Information Systems
ACS-3902(3) Database Systems

Electives: Students wishing to take further ACS courses towards the General degree with the Information Systems stream may take a maximum of 12 credit hours from the following:
ACS-2816(3) Health Information Systems
ACS-2941(3) Unix

ACS-3830(3) Topics in Information Systems
ACS-3902(3) Database Systems
ACS-3913(3) Software Design and Architecture
ACS-3922(3) Introduction to Game Development

Additional Electives: The following courses may also be of interest to students in this program:

Business and Administration
BUS-1201(3) Introduction to Business I
BUS-1202(3) Introduction to Business II
BUS-2002(3) Fundamentals of Financial Accounting
BUS-2003(3) Introduction to Managerial Accounting
BUS-2103(3) Fundamentals of Organizational Behaviour
BUS-2210(3) Fundamentals of Marketing
BUS-2501(3) Fundamentals of Production and Operational Management

Economics
ECON-1104(3) Introduction to Economic Theory

Mathematics and Statistics
MATH-1102(3) Basic Calculus
MATH-1201(3) Linear Algebra I
MATH-1401(3) Discrete Mathematics
STAT-xxxx(3) Any course in Statistics

Conflict Resolution Studies
CRS-1200(6) Introduction to Conflict Resolution Studies
CRS-2210(3) Conflict Theory and Analysis

REQUIREMENTS FOR A 3-YEAR BA/BSc (HEALTH INFORMATICS STREAM)

ADMISSION REQUIREMENT	Essential/Consumer Math, Pre-Calculus Math 40s or Applied Math 40s
GRADUATION REQUIREMENT	90 credit hours
RESIDENCE REQUIREMENT	
Degree:	Minimum 30 credit hours
Major:	Minimum 18 credit hours
GENERAL DEGREE REQUIREMENT	
Humanities:	12 credit hours in Humanities
Science:	6 credit hours in Science for BA 18 credit hours in Science for BSc
Writing:	Minimum 3 credit hours of Academic Writing.
Indigenous:	3 credit hours in designated Indigenous requirement courses.
Maximum Introductory Courses:	Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level. As a result, students must take a minimum of 48 credit hours at the 2000-level or above in order to not exceed the maximum number of introductory courses.
Distribution:	Minimum three (3) credit hours from each of five (5) different subjects.
MAJOR REQUIREMENT	
Single Major:	Minimum 36 credit hours/Maximum 48 credit hours in the Major subject.
Double Major:	30 or 36 credit hours in each Major subject or program, as specified.

Required courses:

Year 1 courses: 12 credit hours
ACS-1803(3) Introduction to Information Systems
6 credit hours: a), b) or c) below:
a)
ACS-1805(3) Introduction to Programming **and**
ACS-1903(3) Programming Fundamentals I
b)
ACS-1903(3) Programming Fundamentals I **and**
ACS-1904(3) Programming Fundamentals II
c)
ACS-1905(3) Programming Fundamentals **and**
One of the ACS courses at 2000 level or above
ACS-1809(3) Web Design and Development

Year 2 courses: 12 credit hours
ACS-2814(3) Applications of Database Systems
ACS-2816(3) Health Information Systems
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design

Year 3 courses: 12 credit hours
ACS-3916(3) Human Computer Interaction

One of the following two courses:
ACS-3801(3) Principles in Information Systems (Health Centric)
ACS-3901(3) Principles of Software Project Management

One of the following two courses:
ACS-3700(3) Health Informatics Practicum
ACS-3830(3) Topics in Information Systems (Health Centric)

One of the following two courses:
ACS-3923(3) Technical Communication in ICT Professions
ACS-3902(3) Database Systems

Electives: Students wishing to take further ACS courses towards the General degree with the Health Information Systems stream may take a maximum of 12 credit hours from the following. Please note that some of these courses may have additional prerequisites.

ACS-2916(3) Business Application Systems
ACS-2941(3) UNIX
ACS-3902(3) Database Systems
ACS-3907(3) eCommerce
ACS-3909(3) Advanced Internet Programming
ACS-3911(3) Computer Networks
ACS-3913(3) Software Design and Architecture
ACS-3922(3) Introduction to Game Development

Additional Electives: The following courses may also be of interest to students in this program:

Business and Administration
BUS-2002(3) Fundamentals of Financial Accounting
BUS-2003(3) Introduction to Managerial Accounting
BUS-2103(3) Fundamentals of Organizational Behaviour
BUS-2210(3) Fundamentals of Marketing
BUS-2501(3) Fundamentals of Production and Operational Management

Economics
ECON-1104(3) Introduction to Economic Theory

Geography
GEOG-1105(3) Challenges of a Changing World: An Introduction to Human Geography
GEOG-2431(3) Population Geography
GEOG-3431(3) Health Geography

Kinesiology
KIN-2304(3) Scientific Principles of Fitness and Conditioning
KIN-1601(3) Nutrition for Health and Wellness

Psychology
PSYC-2700(3) Introduction to Clinical Psychology

Sociology
SOC-2125(3) Introduction to Research Design and Qualitative Research

Statistics
STAT-1501(3) Elementary Biological Statistics I

Conflict Resolution Studies
CRS-1200(6) Introduction to Conflict Resolution Studies
CRS-2210(3) Conflict Theory and Analysis

REQUIREMENTS FOR A 4-YEAR BA IN APPLIED COMPUTER SCIENCE

ADMISSION REQUIREMENT	Students must consult with the Department 4-Year Advisor in planning their studies. Students must have minimum 30 credit hours completed previously.
GRADUATION REQUIREMENT	120 credit hours
RESIDENCE REQUIREMENT	
Degree:	Minimum 60 credit hours
Major:	Minimum 30 credit hours
GENERAL DEGREE REQUIREMENT	
Humanities:	12 credit hours
Science:	6 credit hours
Social Science:	12 credit hours
Writing:	Minimum 3 credit hours of Academic Writing.
Indigenous:	3 credit hours in designated Indigenous requirement courses.
Maximum Introductory Courses:	Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level. As a result, students must take a minimum of 78 credit hours at the 2000-level or above in order to not exceed the maximum number of introductory courses.
Distribution:	Minimum three (3) credit hours from each of five (5) different subjects.
MAJOR REQUIREMENT	
Single Major:	Minimum 57 credit hours/Maximum 66 credit hours in the Major subject.
Cognates:	Minimum of 18 credit hours, maximum of 36 credit hours from Group III. Maximum total of cognate and major courses is 84 credit hours combined.
Required/Electives courses:	Group I. See the 4-Year BSc Requirements. Group II. See the 4-year BSc Requirements. Group III. A total of 18 credit hours must be chosen from at most three departments that offer a BA. Of these, 6 credits must be at least at the 2000 level or above. You are strongly advised to consult the Chair or the 4-Year Advisor prior to taking any Group III courses.
Combined Major:	Minimum 60 credit hours from two different majors with not less than 24 credit hours from each major subject.
Prescribed courses:	

ACS-1903(3) Programming Fundamentals I
ACS-1904(3) Programming Fundamentals II
ACS-2814(3) Applications of Database Systems
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design

REQUIREMENTS FOR A 4-YEAR BSc IN APPLIED COMPUTER SCIENCE

ADMISSION REQUIREMENT Students must consult with the Department 4-Year Advisor in planning their studies. Students must have minimum 30 credit hours completed previously.

GRADUATION REQUIREMENT 120 credit hours, that is, 90 credit hours meeting the requirements for the BA or BSc General plus 30 credit hours of additional credit hours.

RESIDENCE REQUIREMENT

Degree:	Minimum 60 credit hours
Major:	Minimum 30 credit hours

GENERAL DEGREE REQUIREMENT

Humanities:	12 credit hours
Science:	6 credit hours
Writing:	Minimum 3 credit hours of Academic Writing.
Indigenous:	3 credit hours in designated Indigenous requirement courses.
Maximum Introductory Courses:	Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level. As a result, students must take a minimum of 78 credit hours at the 2000-level or above in order to not exceed the maximum number of introductory courses.
Distribution:	Minimum three (3) credit hours from each of five (5) different subjects.

MAJOR REQUIREMENT

Single Major:	Minimum 57 credit hours/Maximum 78 credit hours in the Major subject. 18 credit hours in Group III.

Required courses:

Group I:

MATH-xxxx(3) 3 credit hours from Mathematics
Except:
- MATH-2902 Math Prior to 1640
- MATH-2901 History of Calculus
- MATH-2903 Math for Early/Middle Years Teachers I
- MATH-2904 Math for Early/Middle Years Teachers II

STAT-xxxx(3) 3 credit hours from Statistics

6 credit hours: a) or b) below:

a)
ACS-1903(3) Programming Fundamentals I **and**
ACS-1904(3) Programming Fundamentals II

b)
ACS-1905(3) Programming Fundamentals **and** one of the courses at 2000 level or above from the Group II electives.

ACS-2814(3) Applications of Database Systems
ACS-2906(3) Computer Architecture and System Software
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design
ACS-2947(3) Data Structures and Algorithms
ACS-3901(3) Principles of Software Project Management
ACS-3902(3) Database Systems
ACS-3909(3) Advanced Internet Programming
ACS-3913(3) Software Design and Architecture
ACS-3916(3) Human Computer Interaction
ACS-3953(3) Introduction to Artificial Intelligence
ACS-4901(6) Senior Systems Development Project

One of the following two courses:
ACS-3911(3) Computer Networks
ACS-3931(3) Principles of Operating Systems

Select <u>9 credits</u> from the following list:
ACS-3921(3) / 4921(3) Computer Security and Privacy
ACS-4306(3) Applied Parallel Computing
ACS-4902(3) Advanced Database Systems
ACS-4904(3) Data Warehousing
ACS-4906(3) Conceptual Modelling
ACS-4953(3) Introduction to Machine Learning
ACS-4954(3) Introduction to Distributed Systems

Group II Electives: Students wishing to take further courses towards the 4-Year Degree should take up to 21 credit hours from the following:

MATH-1201(3) Linear Algebra 1
ACS-1803(3) Introduction to Information Systems
ACS-1805(3) Introduction to Programming
ACS-2102(3) Scientific Computing
ACS-2103(3) Numeric and Symbolic Computing
ACS-2112(3) Scientific Computing with Python
ACS-2803(3) Physical Computing: Interacting with the Real World
ACS-2816(3) Health Information Systems
ACS-2916(3) Business Application Systems

ACS-2941(3) Unix
ACS-3907(3) eCommerce
ACS-3921(3) Computer Security and Privacy
ACS-3922(3) Introduction to Game Development
ACS-3923(3) Technical Communication in ICT Professions
ACS-3930(3) Topics in Applied Computer Science
ACS-3941(3) Implementation Issues in Object-Oriented Languages
ACS-3947(3) Algorithm Design
ACS-4306(3) Applied Parallel Programming
ACS-4902(3) Advanced Database Systems
ACS-4904(3) Data Warehousing
ACS-4906(3) Conceptual Modelling
ACS-4921(3) Computer Security and Privacy
ACS-4930(6) Research Project in Applied Computer Science
ACS-4931(3) Research Project in Applied Computer Science
ACS-4953(3) Introduction to Machine Learning
ACS-4954(3) Introduction to Distributed Systems

Group III Other Courses: A total of 18 credit hours must be chosen from at most three of the following departments: Business and Administration, Biology, Chemistry, Geography, Physics, Mathematics and Statistics. Of these, 6 credits must be at least at the 2000 level or above. You are strongly advised to consult the Chair or the 4-Year Advisor prior to taking any Group III courses.

Additional Courses:

- Students wishing to take further courses towards the 4-Year degree may select additional Applied Computer Science courses not already taken from Group II listed above.
- Students are encouraged to take more than 57 credit hours in Applied Computer Science.
- Students wishing to take ACS-2916(3) Business Application Systems must complete ACS-1803(3).
- Students wishing to take ACS-4954(3) Introduction to Distributed Systems are encouraged to take ACS-2941(3) or ACS-2951(3).
- Students wishing to pursue the 4-Year degree must consult with the Chair of Applied Computer Science and complete a 4-Year declaration form before registering for their eleventh course (63rd credit hour).

Combined Major: Minimum 60 credit hours from two different majors with not less than 24 credit hours from each major subject.

Prescribed courses:

ACS-1903(3) Programming Fundamentals I
ACS-1904(3) Programming Fundamentals II
ACS-2814(3) Applications of Database Systems
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design

REQUIREMENTS FOR A 4-YEAR BSc (SCIENTIFIC COMPUTING STREAM)

ADMISSION REQUIREMENT Students must consult with the Department 4-Year Advisor in planning their studies. Students must have minimum 30 credit hours completed previously.

GRADUATION REQUIREMENT 120 credit hours, that is, 90 credit hours meeting the requirements for the BA or BSc General plus 30 credit hours of additional credit hours.

RESIDENCE REQUIREMENT

Degree: Minimum 60 credit hours
Major: Minimum 30 credit hours

GENERAL DEGREE REQUIREMENT

Humanities: 12 credit hours
Science: 6 credit hours
Writing: Minimum 3 credit hours of Academic Writing.
Indigenous: 3 credit hours in designated Indigenous requirement courses.

Maximum Introductory Courses: Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level. As a result, students must take a minimum of 78 credit hours at the 2000-level or above in order to not exceed the maximum number of introductory courses.

Distribution: Minimum three (3) credit hours from each of five (5) different subjects.

MAJOR REQUIREMENT

Single Major: Minimum 54 credit hours/Maximum 78 credit hours.
18 credit hours in Group III.

Required courses:

Group I. See the 4-year BSc in Applied Computer Science
Group II. Students wishing to take further courses towards the 4-Year Degree (Scientific Computing Stream) should take up to 21 credit hours from the following:

MATH-1103(3) Introduction to Calculus
MATH-1104(3) Introduction to Calculus II
MATH-1201(3) Linear Algebra I
MATH-1401(3) Discrete Mathematics

MATH-2102(3) Differential Equations I
MATH-2103(3) Differential Equations II
MATH-2105(3) Intermediate Calculus I
MATH-2106(3) Intermediate Calculus II
MATH-2202(3) Applied Algebra
MATH-2203(3) Linear Algebra II
MATH-3104(3) Methods in Partial Differential Equation
MATH-3401(3) Graph Theory
MATH-4401(3) Networks, Graph Theory and Combinatorial Optimization
STAT-1401(3) Statistics 1 for Economics, Business and Social Sciences
STAT-1501(3) Elementary Biological Statistics I
STAT-2001(3) Elementary Biological Statistics
STAT-3501(3) Simulation
STAT-3611(3) Mathematical Statistics I
STAT-3612(3) Mathematical Statistics II
PHIL-2302(3) Logic
PHYS-2105(3) Mathematical Physics I
PHYS-2106(3) Mathematical Physics II

Group III Other Courses:

A total of 18 credit hours (that fulfill the University's Science Requirement as listed in the Degree and Majors Requirements section of the Calendar) must be chosen from at most three departments from the Faculty of Science, not including the Applied Computer Science Department. Of these, 6 credits must be at least at the 2000 level or above. You are strongly advised to consult the Chair or the 4-Year Advisor prior to taking any Group III courses. Note, these courses provide a good opportunity to pursue a minor in another department, which typically consists of 18 credit hours.

Additional Courses. See the 4-year BSc in Applied Computer Science

Combined Major: Minimum 60 credit hours from two different majors with not less than 24 credit hours from each major subject.

Prescribed courses:
ACS-1903(3) Programming Fundamentals I
ACS-1904(3) Programming Fundamentals II
ACS-2814(3) Applications of Database Systems
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design

REQUIREMENTS FOR THE BSc (HONOURS) IN APPLIED COMPUTER SCIENCE

ADMISSION REQUIREMENT
Students must consult with and have the approval of the Department Chair or Chair-designate in planning their studies.
Students must have completed 30 credit hours.

GRADUATION REQUIREMENT
120 credit hours.

GRADUATION GPA REQUIREMENT
To graduate with a BSc (Honours), students must have a minimum GPA of 3.0 in all major (Applied Computer Science) courses which will be calculated on all course attempts in the major, and a minimum GPA of 2.75 in all non-major courses which will be calculated as for the general degree.

RESIDENCE REQUIREMENT
Degree: Minimum 60 credit hours
Honours: Minimum 30 credit hours, including 18 credit hours at the upper level (3000/4000) of which a minimum of 9 credit hours are at the 4000 level.

GENERAL DEGREE REQUIREMENT
Humanities: 12 credit hours
Writing: Minimum 3 credit hours of Academic Writing.
Indigenous: 3 credit hours in designated Indigenous requirement courses.
Maximum Introductory Courses: Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level. As a result, students must take a minimum of 78 credit hours at the 2000-level or above in order to not exceed the maximum number of introductory courses.
Minimum three (3) credit hours from each of five (5) different subjects.

HONOURS REQUIREMENT
Single Honours: Minimum 57 credit hours in the Major.
Minimum 36 credit hours in the courses listed in Groups I at the upper level (3000/4000) of which a minimum of 15 credit hours must be at the 4000 level.

Required courses:
Group I:
MATH-xxxx(3) 3 credit hours from Mathematics
Except:

- MATH-2902 Math Prior to 1640
- MATH-2901 History of Calculus
- MATH-2903 Math for Early/Middle Years Teachers I
- MATH-2904 Math for Early/Middle Years Teachers II

STAT-xxxx(3) 3 credit hours from Statistics
6 credit hours: a) or b) below:
a)
ACS-1903(3) Programming Fundamentals I **and**
ACS-1904(3) Programming Fundamentals II
b)
ACS-1905(3) Programming Fundamentals **and** one of the courses at 2000 level or above from the Group II electives.

ACS-2814(3) Applications and Database Systems
ACS-2906(3) Computer Architecture and System Software
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design
ACS-2947(3) Data Structures and Algorithms

Group II Electives
MATH-1201(3) Linear Algebra 1
ACS-1803(3) Introduction to Information Systems
ACS-1805(3) Introduction to Programming
ACS-2102(3) Scientific Computing I
ACS-2103(3) Numeric and Symbolic Computing
ACS-2112(3) Scientific Computing with Python
ACS-2803(3) Physical Computing: Interacting with the Real World
ACS-2916(3) Business Application Systems
ACS-2941(3) Unix
ACS-3907(3) eCommerce
ACS-3921(3) Computer Security and Privacy
ACS-3922(3) Introduction to Game Development
ACS-3923(3) Technical Communication in ICT Professions
ACS-3930(3) Topics in Applied Computer Science
ACS-3901(3) Principles of Software Project Management
ACS-3902(3) Database Systems
ACS-3909(3) Advanced Internet Programming
ACS-3913(3) Software Design and Architecture
ACS-3916(3) Human Computer Interaction
ACS-3953(3) Introduction to Artificial Intelligence
ACS-4901(6) Senior Systems Development Project

One of the following two courses:
ACS-3911(3) Computer Networks
ACS-3931(3) Principles of Operating Systems

Minimum 9 credit hours selected from the following courses:
ACS-4902(3) Advanced Database Systems
ACS-4904(3) Data Warehousing
ACS-4906(3) Conceptual Modelling
ACS-4921(3) Computer Security and Privacy
ACS-4953(3) Introduction to Machine Learning
ACS-4954(3) Introduction to Distributed Systems
ACS-3941(3) Implementation Issues in Object-Oriented Languages
ACS-3947(3) Algorithm Design
ACS-4306(3) Applied Parallel Programming
ACS-4902(3) Advanced Database Systems
ACS-4904(3) Data Warehousing
ACS-4906(3) Conceptual Modelling
ACS-4921(3) Computer Security and Privacy
ACS-4930(6) Research Project in Applied Computer Science
ACS-4931(3) Research Project in Applied Computer Science
ACS-4953(3) Introduction to Machine Learning
ACS-4954(3) Introduction to Distributed Systems

Any additional 3 credit courses in Group I or Group II except first year courses.

Students must complete an Honours BSc degree form available at the department office.

REQUIREMENTS FOR A MINOR IN APPLIED COMPUTER SCIENCE

Degree: Students completing any undergraduate degree program are eligible to complete the Minor.
Minor: 18 credit hours in ACS (not including ACS-1453), with a minimum of 12 credit hours above the first-year level
Residence Requirement: Minimum 12 credit hours in ACS
Restrictions: Students cannot declare the same subject as a Major and a Minor.
Note: ACS-1453 cannot be counted towards the ACS Minor.

GENERAL INFORMATION

Prerequisites
Students are advised to pay attention to the prerequisites for each Applied Computer Science course when planning a program of study. Students can visit the department website for more guidance.

Prerequisites are waived only in the case of clearly demonstrated equivalent knowledge. Only the Department Chair has the authority to grant prerequisite waivers.

Admission to Applied Computer Science Courses
Students are advised that a priority admission procedure may be used in the event that enrolments in Applied Computer Science courses are limited. For all courses, previous overall academic performance may be considered. For 2000-, 3000-, and 4000-level courses, grades achieved in prerequisite courses may also be considered.

Priority for entry into **ACS-4901(6)** will be given to students who require the course for graduation in the 4-Year degree program. Only the Chair of the department has the authority to admit students to courses that are full.

Graduate Studies
Students planning to continue with graduate studies are advised to consult with the Department before entering Year 2 of their studies.

Course Substitutions
Applied Computer Science courses were formerly numbered in the **32(MATH).xxxx** series and **92/91(BUSC).xxxx**. All courses with **32(MATH).xxxx** and **92/91(BUSC).xxxx** numbers may be substituted for corresponding **ACS-xxxx** numbers in meeting degree requirements.

COURSE LISTINGS

Students should consult WebAdvisor or the Timetable on the website for courses to be offered in an upcoming term.

ACS-1453(3) Introduction to Computers
ACS-1803(3) Introduction to Information Systems
ACS-1805(3) Introduction to Programming
ACS-1809(3) Website Design and Development
ACS-1903(3) Programming Fundamentals I
ACS-1904(3) Programming Fundamentals II
ACS-1905(3) Programming Fundamentals
ACS/PHYS-2102(3) Scientific Computing
ACS/PHYS-2103(3) Numeric and Symbolic Computing
ACS/PHYS-2112(3) Scientific Computing with Python
ACS/PHYS-2803(3) Physical Computing: Interacting with the Real World
ACS-2814(3) Applications of Database Systems
ACS-2816(3) Health Information Systems
ACS-2821(3) Information Security in Business
ACS-2906(3) Computer Architecture and System Software
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design
ACS-2916(3) Business Application Systems
ACS-2941(3) Unix
ACS-2947(3) Data Structures and Algorithms
ACS-2951(3) System Administration and Networking
ACS-3700(3) Health Informatics Practicum
ACS-3801(3) Principles in Information Systems
ACS-3916(3) Human Computer Interaction
ACS-3830(3) Topics in Information Systems
ACS-3901(3) Principles of Software Project Management
ACS-3902(3) Database Systems
ACS-3907(3) eCommerce
ACS-3909(3) Advanced Internet Programming
ACS-3911(3) Computer Networks
ACS-3913(3) Software Design and Architecture
ACS-3921(3) / 4921(3) Computer Security and Privacy
ACS-3922(3) Introduction to Game Development
ACS-3923(3) Technical Communication in ICT Professions
ACS-3930(3) Topics in Applied Computer Science
ACS-3931(3) Principles of Operating Systems
ACS-3941(3) Implementation Issues in Object Oriented Languages
ACS-3947(3) Algorithm Design
ACS-3953(3) Introduction to Artificial Intelligence
ACS-4306(3) Applied Parallel Programming
ACS-4901(6) Senior Systems Development Project
ACS-4902(3) Advanced Database Systems
ACS-4904(3) Data Warehousing
ACS-4906(3) Conceptual Modelling
ACS-4930(6) Research Project in Applied Computer Science
ACS-4931(3) Research Project in Applied Computer Science
ACS-4953(3) Introduction to Machine Learning
ACS-4954(3) Introduction to Distributed Systems

COURSE DESCRIPTIONS

All course descriptions are available in one large PDF called “All Course Descriptions” in the Academic Calendar section of the University website: http://uwinnipeg.ca/academics/calendar/index.html