



# CST8102

## Operating System Fundamentals (GNU/Linux)

### Course Outline

2022-2023

Pre-requisite(s)	CST8101 and CST8116
Co-requisite(s)	N/A
Prepared by	Stanley Pieda
Approved by	Sandra Brancatelli, M.Eng., P.Eng., Chair, ICT - Applications & Programming
Normative hours	70.00
Grading system	A+ Through F
Experiential Learning	No

Applicable Program(s)	Level	Core/Elective
Multiple Programs	Multiple Levels	Multiple Core/Elective

### Course Description

Operating systems form the backbone of information technology systems coordinating the interaction between hardware and software. Students explore the basic concepts and components of Operating Systems (OS), and how they function and interact with hardware and software components. Students examine the details of operating system structures, process management, storage management, installation, configuration, and administration both in theory and through practical assignments based on the GNU/Linux operating system. Lab work is designed to implement the theory by developing skills using the powerful GNU/Linux command-line tools and utilities.

### Vocational Learning Outcomes

This course provides the opportunity for you to achieve the following outcomes:

#### 0006X01FWO - Computer Eng. Technology - Comp. Science

- VLO 1** Identify, analyze, design, develop, implement, verify and document the requirements for a computing environment. (T, A)
- VLO 2** Diagnose, troubleshoot, document and monitor technical problems using appropriate methodologies and tools. (T, A)
- VLO 3** Analyze, design, implement and maintain secure computing environments. (T, A)
- VLO 6** Select and apply strategies for personal and professional development to enhance work performance. (T, A)
- VLO 8** Adhere to ethical, social media, legal, regulatory and economic requirements and/or principles in the development and management of the computing solutions and systems. (T, A)
- VLO 10** Integrate multiple software and hardware components using appropriate systems, methodologies, and connection protocols. (T, A)
- VLO 11** Analyze, plan, design, develop, test, and implement computing devices and networked systems (software or hardware) in accordance with appropriate functional requirements and standards. (T, A)
- VLO 16** Identify and apply discipline-specific practices that contribute to the local and global community through social responsibility, economic commitment and environmental stewardship. (T)

#### 0006X03FWO - Computer Eng. Technology - Comp. Science

- VLO 1** Identify, analyze, design, develop, implement, verify and document the requirements for a computing environment. (T, A)
- VLO 2** Diagnose, troubleshoot, document and monitor technical problems using appropriate methodologies and tools. (T, A)
- VLO 3** Analyze, design, implement and maintain secure computing environments. (T, A)
- VLO 6** Select and apply strategies for personal and professional development to enhance work performance. (T, A)
- VLO 8** Adhere to ethical, social media, legal, regulatory and economic requirements and/or principles in the development and management of the computing solutions and systems. (T, A)
- VLO 10** Integrate multiple software and hardware components using appropriate systems, methodologies, and connection protocols. (T, A)
- VLO 11** Analyze, plan, design, develop, test, and implement computing devices and networked systems (software or hardware) in accordance with appropriate functional requirements and standards. (T, A)
- VLO 16** Identify and apply discipline-specific practices that contribute to the local and global community through social responsibility, economic commitment and environmental stewardship. (T)

#### 0336X01FWO - Computer Programming

- VLO 1** Identify, analyze, develop, implement, verify and document the requirements for a computing environment. (T)
- VLO 2** Contribute to the diagnostics, troubleshooting, documenting and monitoring of technical problems using appropriate methodologies and tools. (T, A)
- VLO 3** Implement and maintain secure computing environments. (T)
- VLO 4** Implement robust computing system solutions through validation testing that aligns with industry best practices. (T)
- VLO 9** Identify and apply discipline-specific practices that contribute to the local and global community through social responsibility, economic commitment and environmental stewardship. (T)

## 0336X03FWO - Computer Programming

- VLO 1** Identify, analyze, develop, implement, verify and document the requirements for a computing environment. (T)
- VLO 2** Contribute to the diagnostics, troubleshooting, documenting and monitoring of technical problems using appropriate methodologies and tools. (T, A)
- VLO 3** Implement and maintain secure computing environments. (T)
- VLO 4** Implement robust computing system solutions through validation testing that aligns with industry best practices. (T)
- VLO 9** Identify and apply discipline-specific practices that contribute to the local and global community through social responsibility, economic commitment and environmental stewardship. (T)

## 0336X07PAO - Computer Programming

- VLO 1** Identify, analyze, develop, implement, verify and document the requirements for a computing environment. (T)
- VLO 2** Contribute to the diagnostics, troubleshooting, documenting and monitoring of technical problems using appropriate methodologies and tools. (T, A)
- VLO 3** Implement and maintain secure computing environments. (T)
- VLO 4** Implement robust computing system solutions through validation testing that aligns with industry best practices. (T)
- VLO 9** Identify and apply discipline-specific practices that contribute to the local and global community through social responsibility, economic commitment and environmental stewardship. (T)

## 0336X09FAO - Computer Programming

- VLO 1** Identify, analyze, develop, implement, verify and document the requirements for a computing environment. (T)
- VLO 2** Contribute to the diagnostics, troubleshooting, documenting and monitoring of technical problems using appropriate methodologies and tools. (T, A)
- VLO 3** Implement and maintain secure computing environments. (T)
- VLO 4** Implement robust computing system solutions through validation testing that aligns with industry best practices. (T)
- VLO 9** Identify and apply discipline-specific practices that contribute to the local and global community through social responsibility, economic commitment and environmental stewardship. (T)

## 1561X01FWO - Computer Programming and Analysis

## 1561X03FWO - Computer Programming and Analysis

Assessment Levels —T: Taught A: Assessed CP: Culminating Performance

# Essential Employability Skills

This course contributes to your program by helping you achieve the following Essential Employability Skills:

- EES 4** Apply a systematic approach to solve problems. (T, A)
- EES 5** Use a variety of thinking skills to anticipate and solve problems. (T)
- EES 6** Locate, select, organize and document information using appropriate technology and information systems. (T)
- EES 7** Analyze, evaluate and apply relevant information from a variety of sources. (T)

Assessment Levels —T: Taught A: Assessed CP: Culminating Performance

# Course Learning Requirements / Embedded Knowledge and Skills

When you have earned credit for this course, you will have demonstrated the ability to:

1. Install and configure operating systems and applications.

- Install Linux operating system as virtual machine in VMWare. Add and remove applications in Linux
- Describe the components of an Operating System (OS).
- Maintain an OS running in a virtual machine.

2. Use commands that provide and configure system information.

- Explain how an OS manages hardware resources including processors, memory, devices and storage. CPU scheduling, process synchronization, swapping, paging.
- Explain OS components such as the kernel, Command Line Interface (CLI), device drivers, and OS services.
- State the history of Unix and Linux.
- Compare single-user and multi-user operating systems.
- Compare single-tasking and multi-tasking operating systems.
- Create and manage file systems and disk partitions.
- Explain process scheduling and Inter-Process Communication (IPC).
- Explain memory management, virtual memory, swap memory and paging.

3. Perform tasks using both GUI and/or command-line Interfaces.

- Use Linux desktop environment (GUI)
- Use the Linux command line to perform tasks such as: getting help, displaying the contents of files, using environment variables, console redirection and using pipes as Inter-process Communication (IPC).
- Display and navigate directory structures in Linux.
- Create and remove directories in Linux.
- Copy, move, delete and view files in Linux.
- Locate, display and alter files and associated file metadata in Linux.
- Use utilities to manage and monitor system processes in Linux.
- Create, delete and modify user accounts with Linux file permissions.
- Create backups of user data, applications, and personalized settings in Linux.
- Configure the Linux firewall to protect network connection from unwanted traffic.

- Perform basic system administration tasks in Linux.
- Use pipes as Inter-process Communication (IPC).

4. Create and test shell scripts in the Linux operating system.

- Use the vi editor and basic utilities to create, modify, sort, search and otherwise manipulate files in Linux.
- Create and execute basic shell scripts in Linux.
- Specify instructions to the shell to control and monitor execution of shell scripts in Linux.
- Use environment variables for pathnames to deploy an application in Linux.
- Use control and conditional structures and user interaction to write advanced shell scripts in Linux.
- Use local variables and environment variables and change variable scope.
- Display environment variables and their values.
- Run a program in the current shell or in a subshell.
- Write functions in bash with parameters and return parameters.

5. Explain the benefits of how Linux can be configured and used to reduce electricity and hardware requirements.

- Describe how Linux can extend the lifespan of older computer hardware.
- Describe how to configure a Linux installation to minimize power consumption.

# Learning Resources

This course is part of the BYOD (formerly known as Mobile Learning) program at Algonquin College. Students are required to have a functioning laptop at all lecture and lab classes. The specifications for the required laptop and additional information about the mobile program initiative can be found at <http://www.algonquincollege.com/byod/prospective/mobile2014-2015/mobile-device-better.htm> .

Software required:

- 1) As specified by the Course Professor, either  
Ubuntu 22.04 LTS - Free download at <https://releases.ubuntu.com/22.04/>  
or  
CentOS 7 - Free download at CentOS.org

- 2) VMWare Workstation - Available through Digital Resources.

Recommended Textbook: A Practical Guide to Linux. Commands, Editors and Shell Programming. Mark G. Sobell, Matthew Helmke, 4th Edition, Pearson -Addison Wesley, ISBN: 978-0-13-477460-2

# Learning Activities

**Hybrid delivery:** The course consists of 2 hours of lectures in the classroom, and 2 hours of lab per week, as well as a total of one hour per week of online activities, available through Brightspace software. It will take approximately 10 hours per week (including in-class time) to review the materials and complete the assignments.

**Lectures:** In class lectures and online materials available through Brightspace will present the theoretical material of the course. Students are expected to attend all of the lectures. Students are strongly encouraged to ask questions during lectures and to consult with the professors on topics which they do not clearly understand. Professors will inform students, at the beginning of the course, of suitable times for consultations.

**Labs:** Students are expected to perform initial analysis and design before their scheduled lab, in order to take advantage of the limited lab time. Laboratory assignments will be closely integrated with the lecture and online materials. The students' ability to successfully complete the assigned exercises will directly correlate with their level of success on tests and the final exam.

**Assignments:** Online assignments will test the student's knowledge and comprehension of lecture and reading material, as well as the ability to analyze and synthesize course material.

# Pre-defined Evaluation / Earning Credit

The following list provides evidence of this course's learning achievements and the outcomes they validate:

**Final Exam (30%)**

Validates Outcomes: CLR 2, CLR 3, CLR 4, EES 4, EES 5

**Lab Activity(ies) (30%)**

Validates Outcomes: CLR 1, CLR 2, CLR 3, CLR 4, CLR 5

**Midterm Exam(s) (30%)**

Validates Outcomes: CLR 1, CLR 2, CLR 3, CLR 4, EES 4, EES 5

**Quiz(zes)/Test(s) (10%)**

Validates Outcomes: CLR 2, CLR 3, CLR 4, CLR 5

# Prior Learning Assessment and Recognition

Students who wish to apply for Prior Learning Assessment and Recognition (PLAR) need to demonstrate competency at a post-secondary level in all outlined course learning requirements. Evidence of learning achievement for PLAR candidates includes:

- Challenge Exam
- Project/Assignment

# Other Information

# Grade Scheme

Final Grade	Mark Equivalent	Numeric Value	Final Grade	Mark Equivalent	Numeric Value
A+	90% - 100%	4.0	A	85% - 89%	3.8
A-	80% - 84%	3.6	B+	77% - 79%	3.3
B	73% - 76%	3.0	B-	70% - 72%	2.7
C+	67% - 69%	2.3	C	63% - 66%	2.0
C-	60% - 62%	1.7	D+	57% - 59%	1.4
D	53% - 56%	1.2	D-	50% - 52%	1.0
F	0% - 49%	0	FSP	0	0

# Course Related Information

Students must have a grade of at least 50% (or "D-") in each of the theory component and in the practical (i.e. lab) component in order to achieve a passing grade in the course. If you fail either the theory component or the practical component, you will not achieve a passing grade in the course, even if your combined grade exceeds 50% for the entire course,

Please refer to the Course Section Information (CSI) / weekly schedule for specific course-related information as provided by your professor.

# Department Information

## STUDENT ACADEMIC RESPONSIBILITIES

- Each student is responsible for:
- Knowing the due dates for marked out-of-class assignments.
  - Attending all classes and knowing the dates of in-class marked assignments and exercises.
  - Maintaining a folder of all work done in the course during the semester for validation claims in cases of disagreement with faculty.
  - Keeping both paper and electronic copies of all assignments, marked and unmarked, in case papers are lost or go missing.
  - Regularly checking both Brightspace announcements as well as one's Algonquin e-mail account for important messages from both professors and college administration.
  - Participating in on-line and classroom exercises and activities as required.
  - Retaining course outlines for possible future use to support applications for transfer of credit to other educational institutions.

**Department Grading Policy** - For all courses that have both a theory and practical (lab) component, students must have a grade of at least 50% (or "D-") on both the theory component as well as in the practical (i.e. lab) component in order to achieve a passing grade in the course. i.e. Even if your combined grade exceeds 50% for the entire course, if you fail either the theory component or the practical component, you will not achieve a passing grade in the course.

**Lab/Practical Assessment Demonstration "Demo" Requirements** - Certain courses require students to demo their work after it has been submitted. These will be scheduled by the professor and involve 1-2 rudimentary questions to assure the professor that the work submitted by the student is their own. Demos are not graded items - the work submitted is graded. However, where demos are required, if a student does not demo their work, the work will not be graded (i.e. grade of 0 on the lab or practical assessment).

**Department Academic Dishonesty Policy** - Academic Integrity is very important to all of our faculty and administrative staff and as such, measures have been put into place to detect all forms of academic dishonesty, including plagiarism of code. If plagiarism is detected by a professor, the incident will be reported and investigated. If the findings of the investigation are that a student has submitted plagiarized work as their own, they will be subject to the following policy:

1. The first offence will result in the plagiarized assessment being assigned a grade of 0.
2. The second offence will result in the assignment of a grade of F for the course.
3. The third offence will result in removal of a student from the program of study.

**Harassment/Discrimination/Violence will not be tolerated.** Any form of harassment (sexual, racial, gender or disability-related), discrimination (direct or indirect), or violence, whether involving a professor and a student or amongst students, will not be tolerated on the college premises. Action taken will start with a formal warning and proceed to the full disciplinary actions as outlined in Algonquin College Policies - HR22 and SA07. Harassment means one or a series of vexatious comment(s) (whether done verbally or through electronic means), or conduct related to one or more of the prohibited grounds that is known or ought reasonably to be known to be unwelcome/unwanted, offensive, intimidating, derogatory or hostile. This may include, but is not limited to: gestures, remarks, jokes, taunting, innuendo, display of offensive materials, offensive graffiti, threats, verbal or physical assault, stalking, slurs, shunning or exclusion related to the prohibited grounds.

For further information, a copy of the official policy statement can be obtained from the Student Association.

## Violation of the Copyright Act

**General – The Copyright Act** makes it an offence to reproduce or distribute, in whatever format, any part of a publication without the prior written permission of the publisher. For complete details, see the Government of Canada website at <http://laws.justice.gc.ca/en/C-42> . Make sure you give it due consideration, before deciding not to purchase a textbook or material required for your course.

**Software Piracy - The Copyright Act** has been updated to include software products. Be sure to carefully read the licensing agreement of any product you purchase or download, and understand the terms and conditions covering its use, installation and distribution (where applicable). Any infringement of licensing agreement makes you liable under the law.

**Disruptive Behaviour** is any conduct, or threatened conduct, that is disruptive to the learning process or that interferes with the well being of other members of the College community. It will not be tolerated. Members of the College community, both students and staff, have the right to learn and work in a secure and productive environment. The College will make every effort to protect that right. Incidents of disruptive behaviour must be reported in writing to the departmental Chair as quickly as possible. The Chair will hold a hearing to review available information and determine any sanctions that will be imposed. Disciplinary hearings can result in penalties ranging from a written warning to expulsion.

For further details, consult the Algonquin College Policies AA32, SA07 and IT01 in your Instaguide.

# College Related Information

Algonquin College’s policies have been developed to ensure the health, safety and security of all students, faculty and staff, and the proper and fair operation of the College as an academic institution and employer. Please refer to the Algonquin College Policies website for the most current policy information available at <http://www.algonquincollege.com/policies/>.

Students are especially encouraged to be aware of the following College expectations

## Academic Integrity

Algonquin College is committed to the highest standards of academic integrity, and students are expected to uphold these standards as part of the learning process. Any academic work submitted by a student is expected to be their own work, unless designated otherwise and all sources must be attributed. All students should be familiar with the Algonquin College policy [AA48: Academic Integrity](#), which outlines student's roles and responsibilities and what represents academic dishonesty. In some courses, online proctoring may be used to prevent academic dishonesty. Additional information can be found at [Academic Integrity - Student Survival Guide - Subject Guides at Algonquin College \(libguides.com\)](#), and via [Academic Integrity Student Resources](#). Students with any questions about the course expectations regarding academic integrity are encouraged to speak to their professor and the College's academic integrity team at [acaio@algonquincollege.com](mailto:acaio@algonquincollege.com)

### **Centre for Accessible Learning.**

Students with visible and/or non-visible disabilities are encouraged to register with the [Centre for Accessible Learning \(CAL\)](#) in order to be eligible for appropriate learning supports and/or accommodations. Students are strongly encouraged to make an appointment with the Centre for Accessible Learning as early as possible when starting a program. Once your needs are identified, a Letter of Accommodation (LOA) will be issued which you can share with your professors. If you are a returning student, please ensure that professors are given a copy of your LOA each semester.

### **College Email**

Students at Algonquin College are provided with a college email account. This is the address that will be used when the College, your professors, or your fellow students communicate important information about your program or course activities. Your network credentials can be found in the [AC SIS portal](#) and you are expected to check your Algonquin email regularly and to use it to send and receive college-related email. Support is available through the college Information Technology Service (ITS) at: <https://www.algonquincollege.com/its/>

### **Retroactive Accommodations**

Students are expected to meet evaluation and completion deadlines as stated in course outline and course section information documents. In circumstances where evaluation and/or completion deadlines are missed or student performance has been affected by a temporary or permanent disability (including mental health), interim or retroactive accommodations may be considered. In such instances, please consult your course faculty member. For other situations where deferral of evaluations may be warranted, please consult Algonquin College Policy [AA21: Deferred Evaluation](#).

### **Student Course Feedback**

Algonquin College invites students to share their course experience by completing a student course feedback survey for each course they take. For further details consult Algonquin College Policy [AA25: Student Course Feedback](#).

### **Use of Mobile Devices in Class**

With the proliferation of small, personal mobile devices used for communications and data storage, Algonquin College believes there is a need to address their use during classes and examinations. During classes, the use of such devices unless authorized by your professor can be disruptive and disrespectful to others. During examinations, the use of such devices is generally prohibited unless authorized by your professor. Otherwise use is considered academic dishonesty in the form of cheating. For further details consult Algonquin College Policy [AA32: Use of Mobile Devices in Class](#).

### **Technology Requirements**

Students are required to have access to a computer and to the internet. There may also be additional technology-related resources required to participate in a course that are not included in the course materials fee, such as headphones, webcams, specialized software, etc. Details on these requirements can be found in the Course Section Information of the course outline for each course available on Brightspace.

### **Transfer of Credit**

It is the student's responsibility to retain course outlines for possible future use to support applications for transfer of credit to other educational institutions.

### **Safe Harbour**

In the event of an unexpected major event (pandemic, etc.), your course may have changes that are not reflected in the Course Outline. Should this happen, the Course Section Information document will have updated information about your course.