**COSC 407 / 507 -101**

**Introduction to Parallel Computing**

**W2020 – T-2**

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**Instructor:** Abdallah Mohamed, PhD

## **Class time/location:** Tue / Thu 11:00 - 12:30 LIB 317

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| --- | --- | --- | --- | --- | --- | --- |
| **Lab time/location:** | L01 | Mon | 14:30 | 16:30 | SCI-234 | TA: [Chaoping Guo](mailto:chaoping.guo@alumni.ubc.ca) |
|  | L02 | Tue | 19:00 | 21:00 | SCI-234 | TA: [Chaoping Guo](mailto:chaoping.guo@alumni.ubc.ca) |
|  | L03 | Thu | 12:30 | 14:30 | SCI-234 | TA: [Khandoker Ayman](mailto:khandokermd.ayman@ubc.ca) |
|  | L04 | Wed | 19:00 | 21:00 | SCI-234 | TA: [Khandoker Ayman](mailto:khandokermd.ayman@ubc.ca) |

**Office hours/location: Mon**: 10:30-11:20, **Tue**: 12:30-14:00, **Thu**: 14:30-15:20, or by appointment at **SCI 108 E-mail:** *Instructor***:** [abdallah.mohamed@ubc.ca](mailto:abdallah.mohamed@ubc.ca) **(preferred contact method)**

*TAs:* use the hyperlinks above.

**Phone:** (250) 807-8247

**Course Website:** - Canvas

- https://people.ok.ubc.ca/abdalmoh/teaching/407

**Calendar Course Description**

**COSC 407 (3) Introduction to Parallel Computing**

Design and implementation of parallel programs including theoretical computer models, parallel architectures (distributed, multicore, GPU), and standard parallel libraries. Credit will be granted for only one of COSC 407 or COSC 507. [3-2-0]  
***Prerequisite:*** Either (a) COSC 111 or (b) APSC 177. Third-year standing is required.

**COSC 507  Parallel Computing**

Design and implementation of parallel programs including theoretical computer models, parallel architectures, and standard parallel libraries. Performance analysis of parallel programs. Credit will be granted for only one of COSC 407 or COSC 507.

***Specific description***: The course will provide 3rd and 4th year students with an introduction to parallel computing. Upon completion of the course students will be able to understand parallel computing architectures and their limitations, create and implement parallel programs using various standard libraries, explain the limitation of the IEEE 754 floating point model, determine whether an undesirable output is due to floating point errors, and write parallel code.

**Prerequisites** 3rd year standing and either COSC-111 or APSC-177 and Third Year Standing.

Please note that students who lack the prerequisites should not be registered for this course and will receive a failing grade if they remain in it. Any exceptions must be brought to the attention of the instructor immediately.

# Assessment

## Lab Assignments 20 %

* **In-class Quizzes** 10 % (using **clickers**. Full mark for correctly answering 75% of all questions)
* **Two Midterm Exams** 10 % - 30 % (75 minutes each, in-class)
* **Final Exam** 40 % - 60 % (cumulative, three hours)

Midterms are used to improve your mark, not to penalize. There is 70% of the course grade for all exams. The exams mark is calculated based on the **best** of the following options:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Option 1 | Option 2 | Option 3 | Option 4 |
| Midterm 1 | 15 % | 15 % | 5 % | 5 % |
| Midterm 2 | 15 % | 5 % | 15 % | 5 % |
| Final | 40 % | 50 % | 50 % | 60 % |

**In order to pass the course, a student must receive: (1) an overall course grade of at least 50%, and (2) a combined grade of at least 50% on the exams (midterms and final). Otherwise, the student will be assigned a maximum mark of 45.** All exams (midterms and final) are paper-based, closed-book exams. No course materials, calculators, cell phones, or other electronic devices are allowed during the exam time.

Final grades will be based on the evaluations listed above and the final grade will be assigned according to the standardized grading system outlined in the UBC Okanagan Calendar.

Note: Any requests for changes to final exams must be sent to the office of the Associate Dean of Students ([bsasdeansoffice.ubco@ubc.ca](mailto:bsasdeansoffice.ubco@ubc.ca)).

## Students will not be able to receive a passing grade if they are not registered to the required lab section.

If you have any complaint related to this course, e.g., you feel your mark was unfair or incorrectly recorded, please ensure that I am aware of the problem as soon as possible. All complaints about marks, except about that of the final exam, must be registered with me before the scheduled date of the final examination. **If any complaint is not resolved to your satisfaction, you should go the unit Head.**

# Missed Exams and Late Assignments

**Missed exams:** If you miss an exam without acceptable excuse according the UBC Okanagan's policy on excused absences from examinations, the mark received will be zero. If an acceptable excuse is provided to the instructor, then for:

* Midterm exams, the grade will be combined with the marks of the final exam so that the exams are still worth 70 % of the total grade.
* Final exams, the student may retake a make-up final exam with the permission of the Dean’s office. Note that a make-up exam may have a question format different from the regular exam.

**Missed clicker questions:** no answers will be accepted except those provided during the lecture time (don’t forget that, anyways, you will get the full mark if you correctly answer 75% of all questions)

**Late assignments:** Except for extreme situations (e.g., illness, childbirth, or bereavement supported by a written proof such as a doctor’s note), the following policy is applied to late assignments:

* **0 to 24 hours** late: 25% mark deduction (e.g., if an assignment is worth 20 marks, then 5 marks will be deducted regardless of the mark you get in the assignment; no negative marks will be given).
* **24 to 48 hours late**: 50% mark deduction
* **More than 48 hours**: no mark.

# Expectations

**It is my best day when all my students pass the course, receive good grades, and feel the course was useful. For that to happen, help me by putting enough effort for the course.** I expect that you will attend **all classes** and participate in class discussions, read the lecture notes **before** the lecture, attend **all labs**, finish all your assignments on time, and practice on the course materials. I also expect that you will spend (in average) at least six hours per week in out-of-class relevant activities (homework, preparation, practicing).

# Textbook and Reference Materials

* Course website and discussion forum on Canvas**,** Lecture Notes (available electronically).

### *Recommended Textbooks*:

* + Pacheco, P. S. An introduction to Parallel Programming, 1st Ed., Morgan Kaufmann, 2011.
  + Kirk, D. B. & Hwu, W.-m. W. Programming Massively Parallel Processors: A Hands-on Approach, 3rd Ed., Morgan Kaufmann Publishers Inc., 2016 (*older editions are also ok*)

### *More references*:

* + Rauber, T. & Rünger, G., Parallel Programming: for Multicore and Cluster Systems, Springer Publishing Company Inc. , 2015, ISBN: 3642438067
  + Cheng, J, Grossman, M, &McKercher, T, Professional CUDA C Programming, Wrox, 2014.
  + Sanders, J. & Kandrot, E. CUDA by Example: An Introduction to General-Purpose GPU Programming, Addison-Wesley Professional, 2010, ISBN: 0131387685.
  + Eijkhout, V., Intro to High-Performance Scientific Computing, 2015, ISBN: 9781257992546.
* **A clicker is required.**

# Course Discussion Forum

# The course discussion forum is used for exchanging ideas, asking questions, and receiving answers related to the course from other students. If you don’t understand something, you may ask on the forum so that everyone can benefit from the answer. If you are not clear about an answer that was given, don’t create a new thread. Just add a reply to the original thread asking for clarification.

In all cases, respectful and academic atmosphere must be maintained. You should not post private information on the discussion forum. You must not share answers to assignments with anyone, on the forum or anywhere else.

# Class time

# Lectures will involve, besides explaining course materials, working on design examples and in class exercises. Class attendance and taking notes are expected, and students are responsible for all material covered in class. You are also expected to respect the other members of the class as well as the instructor. Inappropriate class behavior is not allowed (e.g., talking on cell phones, engaging in non-class activities, sleeping, using disrespectful language, etc.).

# Communication

# Email is the best way of communication; you can use my email above. You can also see me outside the office hours if my door is open and I have time to meet with you. However, to guarantee I can spend time with you, see me during an office hour or email for an appointment. For a prompt response, put your course number in the subject line of the email (i.e., COSC211: subject) and your name and ID at the end of the email.

**Grading Practices**

Faculties, departments, and schools reserve the right to scale grades in order to maintain equity among sections

and conformity to University, faculty, department, or school norms. Students should therefore note that an

unofficial grade given by an instructor might be changed by the faculty, department, or school. Grades are not

official until they appear on a student's academic record.

<http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,41,90,1014>

**Final Examinations**

The examination period for **W2020 T-2 is April 12 – 27, 2021**.  Except in the case of examination clashes and hardships (three or more formal examinations scheduled within a 24-hour period) or unforeseen events, students will be permitted to apply for out-of-time final examinations only if they are representing the University, the province, or the country in a competition or performance; serving in the Canadian military; observing a religious rite; working to support themselves or their family; or caring for a family member.  Unforeseen events include (but may not be limited to) the following: ill health or other personal challenges that arise during a term and changes in the requirements of an ongoing job.

Further information on **Academic Concession** can be found under **Policies and Regulation in the *Okanagan Academic Calendar***<http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,48,0,0>

**Academic Integrity**

The academic enterprise is founded on honesty, civility, and integrity.  As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity.  At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required.  This also means you should not cheat, copy, or mislead others about what is your work.  Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed.  For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President’s Advisory Committee on Student Discipline.  Careful records are kept in order to monitor and prevent recurrences.

A more detailed description of academic integrity, including the University’s policies and procedures, may be found in the Academic Calendar at: <http://okanagan.students.ubc.ca/calendar/index.cfm?tree=3,54,111,0>.

**Cooperation vs. Cheating**

Working with others on assignments is a good way to learn the material and we encourage it. However, there are limits to the degree of cooperation that we will permit. Any level of cooperation beyond what is permitted is considered cheating.

When working on programming assignments, you must work only with others whose understanding of the material is approximately equal to yours. In this situation, working together to find a good approach for solving a programming problem is cooperation; listening while someone dictates a solution is cheating. You must limit collaboration to a high-level discussion of solution strategies, and stop short of actually writing down a group answer. Anything that you hand in, whether it is a written problem or a computer program, must be written by you, from scratch, in your own words. If you base your solution on any other written solution, you are cheating. If you provide your solution for others to use, you are also cheating.

**Copyright Disclaimer**

Diagrams and figures included in lecture presentations adhere to Copyright Guidelines for UBC Faculty, Staff and Students <http://copyright.ubc.ca/requirements/copyright-guidelines/> and UBC Fair Dealing Requirements for Faculty and Staff <http://copyright.ubc.ca/requirements/fair-dealing/>.  Some of these figures and images are subject to copyright and will not be posted to ***Canvas.***  All material uploaded to ***Canvas*** that contain diagrams and figures are used with permission of the publisher; are in the public domain; are licensed by Creative Commons; meet the permitted terms of use of UBC’s library license agreements for electronic items; and/or adhere to the UBC Fair Dealing Requirements for Faculty and Staff. Access to the ***Canvas*** course site is limited to students currently registered in this course. Under no circumstance are students permitted to provide any other person with means to access this material. Anyone violating these restrictions may be subject to legal action. Permission to electronically record any course materials must be granted by the instructor. Distribution of this material to a third party is forbidden.

**Grievances and Complaints Procedures**

A student who has a complaint related to this course should follow the procedures summarized below:

The student should attempt to resolve the matter with the instructor first. Students may talk first to someone other than the instructor if they do not feel, for whatever reason, that they can directly approach the instructor.

If the complaint is not resolved to the student's satisfaction, the student should e-mail the Associate Head, Dr. Yves Lucet [yves.lucet@ubc.ca](mailto:yves.lucet@ubc.ca) or the Department Head, Dr. John Braun at [john.braun@ubc.ca](mailto:john.braun@ubc.ca)

# Important Dates

<http://www.calendar.ubc.ca/okanagan>

**Tentative Schedule**

The course schedule contains the most up-to-date information and important dates for m ain events such as assignments due dates and tests. These dates and topics are subject to change. Any change will be announced to students. **The due dates of each assignment is one *or* two weeks after the lab (as indicated below) at 11:59 pm.** All assignments should be done on **INDIVIDUAL** basis (NO GROUP WORK).

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| --- | --- | --- | --- | --- | --- |
| W | L | Date | | **Topics** | **Labs** |
| **1** | L1 | Tue | 7 / 1 | Introduction to the course | **No lab in the first week** |
| L2 | Thu | 9 / 1 | Intro to C (basics, arrays, functions) |
| **2** | L3 | Tue | 14 / 1 | Intro to C (pointers, struct, directives) | **A1:** Intro to C, *due* ***Jan 24*** |
| L4 | Thu | 16 / 1 | Basic Concepts of Parallelism  OpenMP (A): Intro |
| **3** | L5 | Tue | 21 / 1 | OpenMP (B, C): Mutual Exclusion, Reduction, Sync | **A2:** C-pointers, OpenMP(A), *due* ***Jan 31*** |
| L6 | Thu | 23 / 1 | OpenMP (D): Work Sharing 1 |
| **4** | L7 | Tue | 28 / 1 | OpenMP (E): Work Sharing 2 | **A3:** OpenMP (B,C,D), *due* ***Feb 7*** |
| L8 | Thu | 30 / 1 | OpenMP (F): Example Applications |
| **5** | L9 | Tue | 4 / 2 | OpenMP (G, H): Speed/Efficiency, Misc | **A4:** OpenMP (E,F), *due* ***Feb 14*** |
| L10 | Thu | 6 / 2 | **Revision** (bring your iClicker) |
| **6** | L11 | Tue | 11 / 2 | **Midterm 1** (in-class, L1 to L8) | ***Review*** |
| L12 | Thu | 13 / 2 | Midterm discussion  CUDA (A) : Introduction |
| **7** |  | **Tue** | **18 / 2** | **No class – midterm break** | **No lab –midterm break** |
|  | **Thu** | **20 / 2** |
| **8** | L13 | Tue | 25 / 2 | Continue CUDA (A) : Introduction | ***Midterm 1 discussion*** |
| L14 | Thu | 27 / 2 | CUDA(B,C): Programming model,Threads Organization |
| **9** | L15 | Tue | 3 / 3 | CUDA (C): Threads Organization, cont’d | **A5:** CUDA (A,B), *due* ***Mar 13*** |
| L16 | Thu | 5 / 3 | CUDA (D): Memories and Performance |
| **10** | L17 | Tue | 10 / 3 | CUDA (E,F): Thread Sync, Best Practices  CUDA: Practice Questions | **A6:** CUDA (C), *due* ***Mar 20*** |
| L18 | Thu | 12 / 3 | Distributed Memory Concurrency *(tentative – maybe*  *discussed after Java Concurrency)* |
| **11** | L19 | Tue | 17 / 3 | Continue Distributed Memory Concurrency | **A7:** CUDA (D,E), *due* ***Mar 27*** |
| L20 | Thu | 19 / 3 | **Revision** (bring your iClicker) |
| **12** | L21 | Tue | 24 / 3 | **Midterm 2** (in-class, L9 to L16) | **A8:** CUDA (F), *due* ***Apr 3*** |
| L22 | Thu | 26 / 3 | Midterm discussion  Floating Point (tentative) |
| **13** | L23 | Tue | 31 / 3 | Java Concurrency and Semaphores (tentative) | **A9:** Java (tentative), *due ???*  *Depends on the order of “Java Concurrency” and “Distribute Memory” topics in the schedule.* |
| L22 | Thu | 2 / 4 | Cont. Java Concurrency and Semaphores |
| **14** | L23 | Tue | 7 / 4 | **Final review** | *Review* |
|  | Thu | 9 / 4 | **No Class** |

The letter “W” in the header refers to the week number, and “L” to lecture number

**Student Service Resources**

**Disability Assistance**

The Disability Resource Centre ensures educational equity for students with disabilities, injuries or illness. If you are disabled, have an injury or illness and require academic accommodations to meet the course objectives, e-mail us or visit our website for more information.

**Web:** <http://students.ok.ubc.ca/drc/welcome.html> **E-mail** DRC at: [drc.questions@ubc.ca](mailto:drc.questions@ubc.ca)

**Equity, Human Rights, Discrimination and Harassment**

UBC Okanagan is a place where every student, staff and faculty member should be able to study and work in an environment that is free from human rights-based discrimination and harassment. If you require assistance related to an issue of equity, discrimination or harassment, please contact the Equity Office, your administrative head of unit, and/or your unit’s equity representative.

**UBC Okanagan Equity Advisor: ph. 250-807-9291**

**Web:** <https://equity.ok.ubc.ca/> **E-mail:**  [equity.ubco@ubc.ca](mailto:equity.ubco@ubc.ca)

**Health & Wellness - UNC 337**

At UBC Okanagan health services to students are provided by Health and Wellness. Nurses, physicians and counsellors provide health care and counselling related to physical health, emotional/mental health and sexual/reproductive health concerns. As well, health promotion, education and research activities are provided to the campus community. If you require assistance with your health, please contact Health and Wellness for more information or to book an appointment.

**Web:** [www.students.ok.ubc.ca/health-wellness](http://www.students.ok.ubc.ca/health-wellness) **Email:** [healthwellness.okanagan@ubc.ca](mailto:healthwellness.okanagan@ubc.ca)

**Sexual Violence Prevention and Response Office (SVPRO)**

A safe and confidential place for UBC students, staff and faculty who have experienced sexual violence regardless of when or where it took place. Just want to talk? We are here to listen and help you explore your options. We can help you find a safe place to stay, explain your reporting options (UBC or police), accompany you to the hospital, or support you with academic accommodations. You have the right to choose what happens next. We support your decision, whatever you decide. Visit [svpro.ok.ubc.ca](https://svpro.ok.ubc.ca/) or call us at 250-807-9640

**Independent Investigations Office (IIO)**

If you or someone you know has experienced sexual assault or some other form of sexual misconduct by a UBC community member and you want the Independent Investigations Office (IIO) at UBC to investigate, please contact the **IIO**. Investigations are conducted in a trauma informed, confidential and respectful manner in accordance with the principles of procedural fairness. You can report your experience directly to the **IIO by** calling 604-827-2060.

**Web:** <https://investigationsoffice.ubc.ca/> **E-mail:** [director.of.investigations@ubc.ca](mailto:director.of.investigations@ubc.ca)

**The Hub**

The Student Learning Hub (LIB 237) is your go-to resource for free math, science, writing, and language learning support. The Hub welcomes undergraduate students from all disciplines and year levels to access a range of supports that include **tutoring in math, sciences, languages, and writing, as well as help with study skills and learning strategies**. **Web:** (<https://students.ok.ubc.ca/student-learning-hub/>) **Ph:** 250-807-9185.

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**Call Safewalk at 250-807-8076**  For more information: <https://security.ok.ubc.ca/safewalk/>