CISC-221 Computer Architecture 2018

Course Syllabus

Revised Aug. 12, 2018

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Quick Reference

Course title: Computer Architecture

Course number: CISC_221

Course dates: Thursday, September 6, 2018 through Friday, November 30, 2018

Lecture Location: Ellis Hall 321

Meeting day(s): Tuesday 6:30 p.m. – 8:00 p.m., Thursday 6:30 p.m. – 8 p.m.

TA Location and hours: TAs will be located in Goodwin 248. Days and times TBD

Prerequisite(s): CISC-124 or equivalent, CISC-220 is recommended

Instructor Information

- **Name:** Dave Dove
- **Email:** dove@cs.queensu.ca
- **Office location:** Goodwin Hall Room 753
- **Office hours:** Wednesday, Thursday 4 p.m.. – 5:30 p.m.
- **Phone:** 533-6053

Teaching Assistants: TBD

Lab Assignment/TA hours : Location: Goodwin 248

TA contact information and TA times to be determined.

Textbook: Computer Systems, A Programmer's Perspective (Third Edition)
Bryant, O'Hallaron
Prentice Hall ISBN 978-0-13-409266-X

The second edition is also acceptable: ISBN 978-0-13-610804-7

Note: Readings, Labs, Quizzes, and in-class activities are based largely on material presented in this text. There is also extensive online material.

Course Computing Resources

The computing platform studied this course and used in all of the assignments is the ARM 32-bit architecture of the Raspberry Pi microcomputer board running the Raspian (Linux) OS. There is a stack of these boards in my office (one for each team) and accessible to the students via the Unix "ssh" command. This will give you command-line access to a Raspberry Pi reserved for the exclusive use by members of your team.

login: pi<yourteam#>.caslab.queensu.ca
password: yourCaslabPassword

Note: at the start of term, make sure you can login to CASLAB by logging in to one of the computers in Goodwin 248 or WalterLight 312. If you try to login to a raspberry pi repeatedly using the wrong password, you will be locked out and you must email the instructor to fix this. This lockout does not happen if you try to login to one of our CASLAB computers.

Intended Student Learning Outcomes:

As a result of this course, I hope that a year later, students will still be able to ...

Foundation Knowledge

- Apply your knowledge and understanding of how data is represented, manipulated and stored in a computer system to create data structures that make the most effective use of a computer's resources.
- Identify and explain bottlenecks in a program's performance in terms of the interaction of programming choices, the computer's architecture, and the Operating System using your understanding of computer's architecture concepts and software tools.

Application

- Analyze program segments at the assembly language level, focusing on the performance differences of alternative programming choices that are affected by a computer’s architecture.

Integration

- Apply and justify programming choices that exploit specific hardware and Operating System interactions that make the most efficient use of a computer's memory hierarchy.

Communication Skills

- Demonstrate your ability to articulate a technical position and support it with scholarly arguments.
- Demonstrate interpersonal and team interaction skills.

It is also hoped that students will...

Human Dimension

- embrace difficulty and be persistent in solving problems.
- share their own ideas and understandings with others and recognize the value of alternative and conflicting ideas.

Caring

- develop an appreciation of self-reflection and self-learning and the part they play in enhancing their own self-confidence and personal growth.

- be excited about the possibilities that embedded systems can bring to everyday life, now and in the future.

Learning How to Learn

- develop a systematic, inquiry-based approach to learning that involves formulating good questions and using them as a path to resolve complex problems.
- understand the critical importance of and practice frequent and regular reflection on their learning.

I will make an extra effort to make these six learning goals visible to students in every component readings, lab assignments, in-class activities, projects, and quizzes) of the course. In order for significant learning to occur, students need to reflect on their learning in every activity that they undertake relating to the course.
* reference: Creating Significant Learning Experiences, *L. Dee Fink 2013*

Student Assessment: (see the Appendix for Grading Scales)

There is no Mid-Term or Final Exam in this course.

*Note: The portion of your final course mark allotted to each of Individual Assessment, Team Assessment and Peer Assessment will be as follows:

Individual Assessment: 75%
Team Assessment: 15%
Peer Assessment: 10%

Individual Assessment

- Lab Assignments: 15%
- Quiz 1: 15%
- Quiz 2: 15%
- Quiz 3: 15%
- Quiz4: 15%

Dates are tentative. Consult the course web site for current information. Quizzes are 60 minutes in length and take place in the normally scheduled lecture period. Quizzes are closed book.

Team Assessment

- Team Readiness Assessment Tests (tRATs): 15%
- In-Class Activities: not assessed for marks

Caution: It's important to understand that although the Team Assessment portion of your course mark is only 20%, the work that you do as a team member may significantly affect your mark on individual Quizzes and also may affect your Peer Assessment mark.

Peer Assessment

Assessment of your own team performance and the performance of your team members will be done at mid-term, and again at the end of the term. You must submit an assessment of your team members to receive a peer assessment mark. The mark you receive will be the average of the marks given to you by your team members (including yourself).

The assessment is submitted via a web form. The form will require you to include comments that will be collated and sent to team members anonymously. Peer assessments have a rigid due date and time and submissions are not allowed after that.

Mid-term Peer Assessment	5%
End-of-term Peer Assessment	5%

Course Topics

1. Data Representation
    - Binary representation of numeric and non-numeric data
    - Bit level manipulation and computer arithmetic
2. Machine-Level Representation of Programs
    - Basic instruction set requirements, operand specification.
    - Machine architecture – ARM, IA-32, others
    - Assembly Language Programming:
        - Assembly language program structure, linkers, loaders
        - Mapping of high level languages to machine language instructions.
3. Digital Logic
    - Combinational networks, truth tables, Boolean algebra, sequential networks
4. Enhancing performance
    - pipelining, caches
    - instruction-level parallelism
    - superscalar processors, multiprocessors and clusters
5. The Memory Hierarchy
    - Virtual Memory
6. Exceptions, Devices, Interrupts
    - I/O, role of operating systems, interrupts and traps
    - Interrupt service routines, event driven programming.

Why Study Computer Architecture in Computing Science?

1. An understanding of computer architecture will help you write computer programs that are faster, smaller, and less prone to error
2. An understanding of computer architecture enables you to appreciate the relative performance cost of software operations and the effect of the programming choices that you will make.
3. An understanding of computer architecture will help you debug your programs when problems arise.
4. An understanding of computer architecture will give you a better understanding of the resources needed to run your programs effectively.
5. Computer architecture fundamentals are not directed toward any specific class of application or computer language. The fundamentals learned in this course are timeless. What you learn will assist you every day for the rest of your computing career!
6. The assembly language skills acquired in this course can be listed directly on your CV. this skill may be judged as important by your future employer, not only as a specific skill, but also as a reflection of your general understanding of how computers work.
7. If you ever program an embedded system (including mobile devices, gaming platforms and real-time data acquisition systems), you will need to understand the platform's computer architecture because resources will be limited.
8. Technology changes rapidly making past choices often obsolete. An understanding of computer

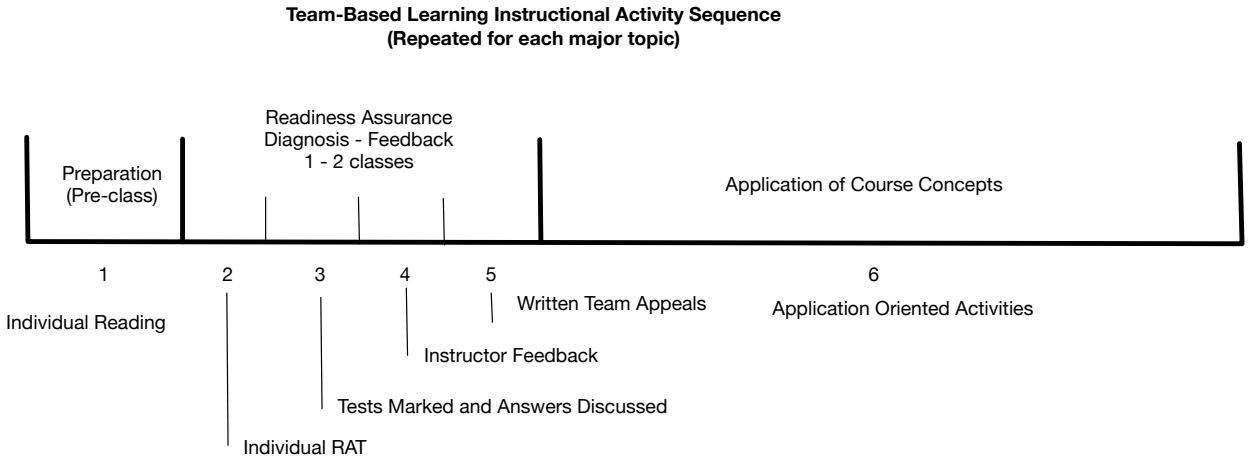
architecture will help you understand the effects that technological advances will have on your programs – past, present, and future.

9. An understanding of computer architecture will help you adapt to new technologies. It will be your task to turn advances in technology into speed, usability, and even new classes of applications that aren't even thought of yet!
10. If you ever buy a computer, how will you know what the new features are, and how do you judge their importance?

Course Delivery

This course will use a team-based, active learning approach for course delivery. In this approach, the focus is on what the learner learns rather than on what the instructor teaches. Course content is acquired by the learner under the guidance of the instructor. The instructor will give a brief overview of the topic. Students will be given a reading/research assignment that covers the topic and includes basic questions and possibly sample problems with solutions. Students will then be individually tested on basic comprehension of what they have read. Solutions will be discussed, and problem areas addressed, possibly with a short lecture from the instructor. The remainder of class time for the topic will be used to present problems and have teams develop, present, and discuss solutions. In preparation for in-class work, students may be required to complete homework assignments. This approach to learning involves active participation of the students as most of the class time is spent discussing course concepts and receiving immediate feedback on the student's level of understanding.

During the first class of the term, permanent teams of about 6 – 8 students will be formed of students with diverse qualifications. These teams will sit together in class and team membership remains static for the duration of the course.



For each Major Topic:

A multiple choice, Readiness Assurance Test (iRAT) will be given individually. Then each team has a discussion and answers the same questions once more and submits a team tRAT answer form. The

instructor will review answers to the RAT and concurrently, the individual iRATs will be marked within each team. The marked RATs are submitted to the instructor. By default, students will get their team's mark for their RAT. Students are allowed to miss or fail 2 RATs without penalty. After that, students will receive their individual iRAT mark instead of tRAT mark for any RAT that they miss or fail (<50%).

The purpose of the RATs is to ensure that students are adequately prepared for the subsequent class activities on the current topic and to identify common areas of difficulty relating to the topic which are then discussed and clarified.

Following the RAT there may be homework between classes in preparation for the subsequent in-class activities. All teams work on the same problems.

Each activity is followed by a debrief session where team solutions are compared and discussed. Any remaining questions about the material are resolved.

Students are expected to bring in their own copy of the activity to class and supplement it with their own notes for review before quizzes. Each team will submit one copy of their team's completed activity for review (not marked) by the instructor. Solutions to the activities are not posted online.

Appendix: Policy Statements

Grading Scale

All components of this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to Queen's Official Grade Conversion Scale:

Queen's Official Grade Conversion Scale

Grade	Numerical Course Average (Range)
A+	90-100
A	85-89
A-	80-84
B+	77-79
B	73-76
B-	70-72
C+	67-69
C	63-66
C-	60-62
D+	57-59
D	53-56
D-	50-52
F	49 and below

Late Policy

- Late labs, activity and project submissions will not be accepted without prior arrangement with the course instructor. Approved late submissions must be made to the course instructor or the general office in order to be accepted. Anything slipped under my door (Goodwin 753) will be disposed of.

Academic Integrity

Academic Integrity is constituted by the six core fundamental values of honesty, trust, fairness, respect, responsibility and courage (see www.academicintegrity.org). These values are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University (see the Senate Report on Principles and Priorities http://www.queensu.ca/secretariat/policies/senate/report-principles-and-priorities).

Students are responsible for familiarizing themselves with the regulations concerning academic integrity and for ensuring that their assignments conform to the principles of academic integrity. Information on academic integrity is available in the Arts and Science Calendar (see Academic Regulation 1 http://www.queensu.ca/artsci/academic-calendars/regulations/academic-regulations/regulation-1), on the Arts and Science website (see http://www.queensu.ca/artsci/academics/undergraduate/academic-integrity), and from the

instructor of this course. Departures from academic integrity include plagiarism, use of unauthorized materials, facilitation, forgery and falsification, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the university.

Calculator Policy

As noted in Academic Regulation 9.2, Calculators acceptable for use during quizzes, tests and examinations are intended to support the basic calculating functions required by most Arts and Science courses. For this purpose, the use of the **Casio 991** series calculator is permitted and is the **only approved calculator for Arts and Science students**. This calculator sells for around $25 at the Queen's Campus Bookstore, Staples and other popular suppliers of school and office supplies.

Copyright of Course Materials

The material on this website is copyrighted and is for the sole use of students registered in the course. The material on this website may be downloaded for a registered student's personal use but shall not be distributed or disseminated to anyone other than students registered in the course during the current term. Failure to abide by these conditions is a breach of copyright and may also constitute a breach of academic integrity under the University Senate's Academic Integrity Policy Statement.

Accessibility Statement

Queen's is committed to an inclusive campus community with accessible goods, services, and facilities that respect the dignity and independence of persons with disabilities. If any material in this course is not adequately accessible to you, please contact the course instructor so that remedial action can be taken.

Accommodation Statement

Queen's University is committed to achieving full accessibility for persons with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. If you are a student with a disability and think you may need accommodations, you are strongly encouraged to contact Student Wellness Services (SWS) and register as early as possible. For more information, including important deadlines, please visit the Student Wellness website at: http://www.queensu.ca/studentwellness/accessibility-services/

Academic Considerations for Students in Extenuating Circumstances

The Senate Policy on Academic Consideration for Students in Extenuating Circumstances (http://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslcwww/files/files/policies/ExtenuatingCircumstancesPolicyFinal.pdf) was approved in April, 2017. Queen's University is committed to providing academic consideration to students experiencing extenuating circumstances that are beyond their control and which have a direct and substantial impact on their ability to meet essential academic requirements. The Faculty of Arts and Science is developing a protocol to provide a consistent and

equitable approach in dealing with requests for academic consideration for students facing extenuating circumstances, which will be posted on the Faculty of Arts and Science website in Fall, 2017.

Absenteeism

In a team-based, active learning environment, it is vitally important for you to attend every class.

Individual attendance may be recorded during classes involving in-class activities. If the team and instructor was not given prior notice of an impending absence and the valid a reason for it, the absent student may not get credit for the team activity. If a student is absent a significant number of times without giving the team notice or team members have doubts about the validity of reasons for absenteeism, it may affect their peer evaluation of that student. If you will be missing a significant number of classes, you need to discuss this with an instructor to make appropriate assessment modifications.
Students who miss a Quiz must inform the instructor before or on the day of the Quiz of the reason for the absence and may be given a single opportunity to write a makeup Quiz.

Any absence that is the result of illness (up to 48 hours) will require the student to visit the self-declaration form on the Arts and Science Academic Consideration Request Portal that is here:

https://webapp.queensu.ca/artsci/acrp/

The course instructor must receive official notification before any accommodation for any missed work affecting academic performance assessment is considered.

If you are the student who is responsible for bringing in a laptop and/or parts kit for in-class activities, it is crucial that arrangements be made with another student to bring in the parts kit and an alternate laptop for in-class activities and inform the instructor of your impending absence. Otherwise your team will not be able to do any work that day and will not get any credit for it.

Other Policies and Information

- Marking of RATs, Quizzes, or Assignments may be contested by writing a scholarly appeal and submitting it to the instructors (printed or by email) in a timely manner.
- Solutions to RATs, Quizzes, Lab Assignments, and In-Class activities are not electronically published but the instructor will always be happy to review your answers and make sure that any misconceptions are resolved.