

CSC 462/562: Computer Architecture Spring 2019

Professor:	Richard Fox	Phone:	(859) 572-5334
Class Meeting Time:	MWF 1:00 – 1:50 pm	Office:	ST 314
Class Meeting Place:	GH 250	Email:	foxr@nku.edu
Office Hours:	MWF 9:00 – 9:50 am, MWF 12:00 – 12:50 pm, and by appointment	Web:	//www.nku.edu/~foxr/

Textbook and Materials:

Computer Architecture: A Quantitative Approach, Hennessy and Patterson, 5th edition, ISBN 978-0-12-811905-1, Morgan Kaufmann Publishers.

Prerequisites and Credits:

This is a 3 credit-hour course. Prerequisites for 462: C- or better in CSC 362. Prerequisites for 562: Regular admission to MCSC program. CSC 462 is to be taken by undergraduate students only. CSC 562 is to be taken by graduate students only.

Course Description:

Implementation of control unit and arithmetic-logic unit, microprocessor organization and design, main memory and cache organizations, I/O subsystem; RISC vs. CISC instruction sets, pipelining, parallel processing; mechanisms for evaluating computer architectures and microprocessor performance.

Student Learning Outcomes:

By the end of the course, the student will have learned to:

- describe and explain RISC-based architectural features including pipelines, superscalars, dynamic issue architectures, and branch prediction mechanisms
- apply quantitative mechanisms to evaluate computer architectures
- identify hazards in executing code on pipeline and superscalar processors
- describe and explain the impact that floating point operations have on processor performance
- describe and explain compiler-based strategies to improve performance such as compiler scheduling
- read and write RISC-V-based assembly language code
- describe and explain cache and virtual memory layouts, identify problems and evaluate improvements

Students will view a variety of architectural features from several different architectures including RISC-V, MIPS R4000, x86 and Pentium processors, ARM Cortex, iCore 7, IA-64, CDC 6600, RV64V SIMD and NVIDIA GPU architectures, parallel and multicore processors.

Student Assessment and Grading:

Student assessment will be based on submission of numerous homework assignments, each of which will test the student's understanding of concepts presented in the course including the ability to apply quantitative mechanisms to evaluate architectural innovations. There will be approximately 12-14 homework assignments. In place of a final exam, there will be a homework which will count as two homework assignments. Each homework assignment will have a number of questions. Graduate students will be asked to answer all questions while undergraduates will be asked to complete a subset of questions. Graduate students will also have a term paper assignment. Grading will be based on the following:

Undergraduate:	homework assignments (100%)
Graduate:	homework assignments (90%), term paper (10%)

Grading Scale: A: 93-100 A-: 90-90 B+: 87-89 B: 83-86 B-: 80-82
 C+: 77-79 C: 73-76 C-: 70-72 D+: 65-69 D: 60-64 F: 0-59

NOTE: Graduate students who earn below a 70 will receive an F. The grading scale is subject to curve as necessary.

Mid-term grades (for undergraduate students only) will be posted to myNKU by Tuesday, March 19. The grade is *not a predictor of your final grade* but merely your grade at that point of the semester. **The last date to drop with a grade of W is Monday, March 25.**

Course Materials:

Lectures notes, assignment, answer keys and all other handouts will be made available through the instructor's course web site at <http://www.nku.edu/~foxr/CSC462>. Keep an eye on this website throughout the semester.

Homework Policies:

Due dates for all assignments will be provided when each assignment is provided to the class. All assignments are due at the **beginning** of the class period of the due date. Late assignments will be accepted with a penalty of 10% per day late but a homework assignment **will not be accepted once the answer key for that homework has been provided** to the students. All homework assignment submissions **must be** word processed. Submit your assignments as hardcopies (not email) in person if possible. Email submissions will be accepted but you will receive no written feedback for such assignments. All homework assignments are **individual assignments** meaning that students should work alone at all times except when seeking clarification. If the instructor suspects students of copying off of each other or working together, the instructor will give a grade of 0 on those assignments and warn the students. A second offense will cause disciplinary action.

Attendance Policy

NKU students are expected to attend the first scheduled class session of each course for which they are enrolled. Faculty may report students who do not attend the first class meeting of the semester/session as non-attending if they have not contacted the faculty member. Faculty are compelled to report students who fail to attend the first two classes as non-attending if they have not contacted the faculty member. All non-attendance for the full semester must be reported by the end of the add/drop date but should be reported as soon as two classes are missed. Students who know they will be absent *must* contact their instructor(s) prior to the first class meeting to explain their absence and request to remain enrolled in the course. You will receive no further warnings! Attendance will not be taken after the first week.

It is up to the student to attend class regularly and to determine what materials were missed in the event of an absence. If an assignment is due on a date that the student is absent, it is the student's responsibility to make sure that the instructor receives the assignment prior to the beginning of class time (whether by Email or having someone reliable drop off the assignment to the instructor in his office, mailbox or classroom). If the student is to miss a class period when an exam is being given, the student **must** contact the instructor **in advance** to make arrangements for a **make-up exam**, otherwise the student will receive a 0 on that exam.

Schedule and Readings:

This will be made available separately.

Grade Appeal:

Please see the Code of Student Rights and Responsibilities Section V: Academic Policies & Processes for any final grade appeal. The specifics of the process are detailed in subsection G: Student Academic Grade Appeal. <https://inside.nku.edu/scra/information/students/rights-responsibilities.html>

Credit Hour Policy Statement:

In accordance with federal policy, NKU defines a credit hour as the amount of work represented in the achievement of student learning outcomes (verified by evidence of student achievement) that reasonably approximates one hour (50 minutes) of classroom instruction and a minimum of two hours of out-of-class student work. For every course credit hour, a typical student should expect to spend at least three hours per week of concentrated attention on course-related work including, but not limited to, class meeting time, reading, reviewing, organizing notes, studying and completing assignments. At least an equivalent amount of time is expected for other academic activities such as online courses, laboratory work, internships, practica, studio work and other academic work leading to the award of credit hours.

Estimates of the time required for a typical student to complete course expectations are as follows:

In-class: 3 hours/week * 15 weeks	45 hours/semester
Reading: 3 hours/week * 15 weeks	45 hours/semester
<u>Assignments: ~10 assignments * 6-8 hours apiece</u>	<u>60-80 hours/semester</u>
Total:	150-170 hours/semester

The amount of expected effort toward this class averages 10-11 hours per week (including 3 hours in class), so you are expected to apply some 7-8 hours outside of class. Students who do not spend an appropriate amount of time on this course will most likely obtain a poor grade and perhaps not pass the class.

Student Honor Code:

This Student Honor Code [the "Honor Code"] is a commitment by students of Northern Kentucky University, through their matriculation or continued enrollment at the University, to adhere to the highest degree of ethical integrity in academic conduct. It is a commitment individually and collectively that the students of Northern Kentucky University will not lie, cheat, or plagiarize to gain an academic advantage over fellow students or avoid academic requirements.

The purpose of the Honor Code is to establish standards of academic conduct for students at Northern Kentucky University and to provide a procedure that offers basic assurances of fundamental fairness to any person accused of violations of these rules. Each Northern Kentucky University student is bound by the provisions of the Honor Code and is presumed to be familiar with all of its provisions. Students also should aspire to conduct themselves in a manner that is consistent with the highest degree of ethical integrity in all matters, whether covered in the Honor Code or not. The success of this commitment begins in the diligence with which students uphold the letter and the spirit of the Honor Code. Students may view the complete honor code at <https://inside.nku.edu/scra.html#policies>.

Classroom Expectations:

Cellphones must be on vibrate (PLEASE!) You may leave the classroom at any time other than during exams as long as you do so quietly. If you come in late, please be quiet. During an exam, you may leave to answer your phone, use the facilities, etc, but please inform the instructor before leaving. While the instructor is lecturing, please be quiet. Do not engage other students in conversation. You may ask questions at any time during a lecture. Please do ask questions and please ask for more example problems if you feel you need them. You are encouraged to bring a laptop to class if you feel it will help you.

Student Evaluation of Instructor and Course:

Northern Kentucky University takes Instructor and Course Evaluations very seriously as an important means of gathering information for the enhancement of learning opportunities for its students. It is an important responsibility of NKU students as citizens of the University to participate in the instructor and course evaluation process. During the week prior to the final exam, you will be asked to reflect upon what you have learned in this course, the extent to which you have invested the necessary effort to maximize your learning, and the role your instructor has played in the learning process. It is very important that you complete the online evaluations with thoughtfully written comments.

Student evaluations of courses and instructors are regarded as strictly confidential. They are not available to the instructor until after final grades are submitted, and extensive precautions are taken to prevent your comments from being identified as coming from you. Students who complete an evaluation for a particular course (or opt out of doing so in the evaluation) will be rewarded for their participation by having access to their course grade as soon as that grade is submitted by the instructor. On the other hand, any student who does not complete the course evaluation (or opt out of doing so in the evaluation) should expect to incur a two week delay in access to his or her course grade beyond the university's official date for grade availability. To complete online evaluations go to <http://eval.nku.edu>. Click on "student login" and use the same USERNAME and PASSWORD as used on campus.

In addition, you should be aware of:

- Evaluations can affect changes in courses. Evaluations without comments are less valuable and less credible than those filled out thoughtfully. Comments that are expressed well are more effective than those that are not.
- Positive feedback is just as important as criticism. Moreover, negative evaluations without any explanation or specifics are not especially useful.
- Once grades are submitted, all evaluations are read not only by the instructor, but also by the instructor's department chairperson.
- Evaluations not only provide feedback to your instructor, but also provide information to the department chair for use in performance evaluations. This information affects reappointments, promotions, salaries, and teaching assignments.

Student Retention and Accommodations Due to Disability:

Students experiencing roadblocks to academic success may seek assistance from the Learning Assistance Programs (LAP). Financial, personal, and social concerns sometimes interfere with the dedicated focus needed to be successful in college. LAP helps students connect to academic and support services, create individual learning plans, and advance successfully towards graduation. Services including Norse Advising, student support services, testing and disability services, the math center, the writing center and tutoring. More information is available at <https://inside.nku.edu/plus.html>. Call 859 572-5475 for an appointment or stop by University Center 170. You can apply for a tutoring session through TutorTrac at <https://tutortrac.nku.edu/tracweb40/default.html>. In addition to the resources available at LAP, STEM ambassadors lead peer-study sessions every Wednesday evening in GH 230 from 7 – 9 pm.

The University is committed to making reasonable efforts to assist individuals with disabilities in their efforts to avail themselves of services and programs offered by the University. To this end, Northern Kentucky University will provide reasonable accommodations for persons with documented qualifying disabilities. If you have a disability and feel you need accommodations in this course, you must present a letter to me from the Disability Programs and Services Office (SU 303), indicating the existence of a disability and the suggested accommodations. More information can be found at <http://disability.nku.edu>.

Diversity and Conduct:

Diversity describes an inclusive community of people with varied human characteristics, ideas, and world views related, but not limited, to race, ethnicity, sexual orientation, gender, religion, color, creed, national origin, age, disability, socio-economic status, geographical region, or ancestry. Institutions that value diversity provide a supportive environment that respects those human differences. It is our responsibility as citizens of the NKU community to promote and value a campus environment and classroom climate that is safe, fair, respectful, and free from prejudice. Northern Kentucky University is committed to fostering a safe and inclusive educational and work environment free from sexual misconduct, including sexual assault, non-consensual sexual contact, non-consensual sexual intercourse, sexual exploitation, sexual harassment, dating and intimate partner violence, relationship and domestic violence, stalking and gender-based bullying. For more information please see: <https://inside.nku.edu/titleix/sexual-misconduct-policy.html>

Observation of Religious Holidays:

NKU values diverse religious perspectives and beliefs and recognizes that religious practice is for many individuals an important element of personal identity, intellectual development and psychological well-being, and, in many cases, is inseparable from cultural identity. As the diversity of our community has increased, additional religious holidays now affect a significant number of students. Consistent with our commitment to creating a diverse and inclusive community, Northern Kentucky University believes that every reasonable effort should be made to allow members of the NKU community to observe their holidays without jeopardizing the fulfillment of their academic obligations. NKU students who are unable to attend classes or participate in any examination, study or work requirement on some particular day(s) because of his or her religious belief must submit a formal request to the instructor within 3 weeks of the beginning of the semester so appropriate arrangements can be made.

Any questions? Please ask!

The instructor reserves the right to alter the syllabus if circumstances dictate.