NORTHERN ARIZONA UNIVERSITY

School of Informatics, Computing, and Cyber Systems

CS499 **Network Analysis & Characterization** Syllabus

Term	Class No.	Section	Units	Days & Times	Room	Mode
Spring 2020	5194	002	3	W 5:30-8:00pm	090-102	Face-to-face

Enrollment Requirements

Pre-requisite or Corequisite: CS249

Course Website

http://bblearn.nau.edu

Instructor(s)

Dr. Morgan Vigil-Hayes
Email: morgan.vigil-hayes@nau.edu
Office Hours: W 9:00-11:00am Room 090-306 (or by appointment)

Course Purpose

Network Analysis and Characterization is an elective course in the BSCS, BSACS, and Computer Science minor. In this course students explore fundamental topics related to network science including graph theory, network modeling, network evolution, spreading effects, and community detection.

Course Student Learning Outcomes

Upon successful completion of this course, students will be able to demonstrate the following competencies:

LO1. Describe and explain foundational concepts in network science;

LO2. Generate network structures using common network models;

LO3. Identify network structures that exist in various data sets and domains;
LO4. Characterize network structures under different conditions using standard network science tools; and

LO5. Model common network phenomena using standard network science tools.

Assignments / Assessments of Course Student Learning Outcomes

Learning outcomes are assessed through a variety of means:

- Quizzes and exams assess student ability to describe and explain foundational concepts in computer networks (LO1). Quizzes will be incorporated throughout the course as well to assess LO1 competencies.
- Labs will be used to assess student ability to generate network structures, identify latent network structures that exist in data sets, characterize network structures, and model common network phenomena (LO2, LO3, LO4, & LO5). Labs will require students to engage with network science tools used by data scientists in academia and industry. Some labs will also require students to implement basic network scientific algorithms to calculate basic network characteristics.
- Discussions in class and on Slack will be used to assess student understanding of how policy, architecture, performance, and availability interact with each other.

Grading System

A weighted sum of assessment components is used to determine your final grade in the course:

- Participation (attendance, surveys, iClicker): **5%**
- Labs (at least 3): **40%**
- Quizzes (at least 5): **5%**
- Exams (3): **50%**

Grades will be assigned using the weighted sum described above using this scale:
A ≥ 90%, **B** ≥ 80%, **C** ≥ 70%, **D** ≥ 60%, **F** < 60%.

There is no "curve". Each student's grade is based on their own outcomes assessments and not affected by the grades of other students. Extra credit opportunities *may* present themselves throughout the semester and will be announced during class meetings. Mistakes in grading are liable to happen, and students are encouraged to discuss such concerns with the instructor during office hours.

Readings and Materials

We will be using *Network Science* by Albert-László Barabási.

You may purchase this book, but we will be using the online version, which you can access here: http://networksciencebook.com/

I have also posted this link under Course Content on our BbLearn page.

We will be using Jupyter Notebook and NetworkX. It is your responsibility to ensure you have access to a computer that is capable of running Jupyter and NetworkX Python packages.

Class Outline and Tentative Schedule

The course topics and a tentative schedule serve as an outline for the class:

		Wednesday	Reading	Due
Week 1	**1/15**	Introduction to Network Science and class logistics Representing networks Start Lab00	Ch. 1 Ch.2.1-2.3	Syllabus Quiz Quiz00
Week 2	**1/22**	Paths and distances Continue Lab00	Ch. 2.4-2.7	Quiz01 Lab00
Week 3	**1/29**	Connectedness and clustering coefficient Continue Lab00	Ch. 2.8-2.10	Quiz02
Week 4	**2/5**	**Midterm Exam I** Start Lab01		Quiz03 Lab00
Week 5	**2/12**	Random networks Small world networks	Ch. 3.1-3.10	Quiz04
Week 6	**2/19**	Scale-free networks Continue Lab01	Ch. 4.1-4.9	Quiz05
Week 7	**2/26**	Barabasi-Albert networks Continue Lab01	Ch. 5.1-5.10	Quiz06
Week 8	**3/4**	Putting together random, small world, scale-free, Barabasi-Albert networks	Ch. 1-5 (review)	Quiz07 Lab01
Week 9	**3/11**	**Midterm Exam II**		Quiz08
Week 10	**3/18**	**SPRING BREAK** **NO CLASS**		Quiz09
Week 11	**3/25**	Evolving networks Start Lab02	Ch. 6.1-6.5	Quiz10
Week 12	**4/1**	Community detection Continue Lab02	Ch. 9.1-9.4	Quiz11
Week 13	**4/8**	Community detection Continue Lab02	Ch. 9.5-9.7	Quiz12 Lab02
Week 14	**4/15**	Network robustness Start Lab03	Ch. 8.1-8.7	Quiz13
Week 15	**4/22**	Spreading phenomena Continue Lab03	Ch. 10.1-10.7	Quiz14 Lab03
Week 16	**4/29**	Grad student project presentations Review for Final Exam	Ch. 6, 8-10 (review)	Quiz15
Week 17	**5/6**	**FINAL EXAM 5/6 @ 5:30pm**		

Due dates for quizzes and labs are posted on BBLearn. Please check BBLearn frequently for updates.

Course Policies

The following policies will apply to this course:

- **Attendance**: I will **not** be taking attendance in this course. You are responsible for all material covered during the lectures whether you attend or not. If you must miss a class, be sure to get notes from another student.
- **Office Hours:** Feel free to come to my office during office hours to discuss problems or "talk shop" about almost anything else. Email me or see me after class if you need to schedule an appointment outside my office hours.
- **Late Work**: Late assignments will not be accepted and will receive a 0 grade. No exceptions.
- **Missed Exams**: If a student misses an exam, they can schedule a make-up exam if they have received permission from the instructor prior to the exam date. Exams must be scheduled within 72 hours of the original exam date. The only acceptable excuses for missing an exam without scheduling an instructor-approved make-up prior to the exam date would be extenuating circumstances, i.e., documented family emergency, documented extended illness, documented required court appearance. Please use Student Life's Classes Missed Memo system for appropriate documentation: https://nau.edu/student-life/classes-missed-memos/
- **Electronic Devices:** Electronic device usage must support learning in the class. All cell phones, PDAs, music players and other entertainment devices must be turned off (or in silent mode) during lecture, and may not be used at any time. Laptops or workstations (if present) are allowed for note-taking and activities only during lectures; no web surfing or other use is allowed. I devote 100% of my attention to providing a high-quality lecture; please respect this by devoting 100% of your attention to listening and participating.
- **Final Grades**: Grades will be entered in BBLearn but your final grade will be calculated in Excel using the grading system described above and then entered in LOUIE. Your final course grade will **not** necessarily appear in BBLearn. Please check LOUIE for your final grade.
- **Communication**:
    - Email to the instructor and teaching assistant(s) must be respectful and professional. Specifically, all emails should:
        - Contain a salutation with correct title, (for example, "Dear Dr. Vigil-Hayes")
        - Contain a closing, (for example, "Thanks, Jane Doe")
        - The body should contain complete sentences and correct grammar including correct usage of lowercase and uppercase letters. Composing emails on a mobile device is **not** an excuse for poor writing.
        - The body of your message should also be respectful and explain the full context of the query.
        - The subject should be prefixed with "CS499" so that the message can be easily identified or placed in an auto-folder. The subject should also use lower case and upper case correctly.
        - Although email will typically be answered quickly, you should allow up to three (3) business days for a response.

- If you have a question that would require a long response or you have a lot of questions, please come to office hours or schedule an appointment with the instructor.

- Visiting the instructor during office hours is encouraged! I am happy to talk about the class, careers, research, and topics related (even loosely) to this course.
- This class will use Slack as a backchannel for discussion. This is a great way to discuss content with your peers, get feedback or clarification, and (most importantly) as questions. Participation on Slack channels may be a requirement for certain assignments. **Importantly, while the instructor will monitor and interact with you on the Slack workspace, *this is not the appropriate way to ask the instructor a question that is unique to your situation and context. Please use email for these types of queries*.**

Appendix A. POLICY STATEMENTS FOR COURSE SYLLABI

ACADEMIC INTEGRITY

NAU expects every student to firmly adhere to a strong ethical code of academic integrity in all their scholarly pursuits. The primary attributes of academic integrity are honesty, trustworthiness, fairness, and responsibility. As a student, you are expected to submit original work while giving proper credit to other people's ideas or contributions. Acting with academic integrity means completing your assignments independently while truthfully acknowledging all sources of information, or collaboration with others when appropriate. When you submit your work, you are implicitly declaring that the work is your own. Academic integrity is expected not only during formal coursework, but in all your relationships or interactions that are connected to the educational enterprise. All forms of academic deceit such as plagiarism, cheating, collusion, falsification or fabrication of results or records, permitting your work to be submitted by another, or inappropriately recycling your own work from one class to another, constitute academic misconduct that may result in serious disciplinary consequences. All students and faculty members are responsible for reporting suspected instances of academic misconduct. All students are encouraged to complete NAU's online academic integrity workshop available in the E-Learning Center and should review the full academic integrity policy available at https://policy.nau.edu/policy/policy.aspx?num=100601.

COURSE TIME COMMITMENT

Pursuant to Arizona Board of Regents guidance (Academic Credit Policy 2-224), for every unit of credit, a student should expect, on average, to do a minimum of three hours of work per week, including but not limited to class time, preparation, homework, and studying.

DISRUPTIVE BEHAVIOR

Membership in NAU's academic community entails a special obligation to maintain class environments that are conductive to learning, whether instruction is taking place in the classroom, a laboratory or clinical setting, during course-related fieldwork, or online. Students have the obligation to engage in the educational process in a manner that does not breach the peace, interfere with normal class activities, or violate the rights of others. Instructors have the authority and responsibility to address disruptive behavior that interferes with student learning, which can include the involuntary withdrawal of a student from a course with a grade of "W". For additional information, see NAU's disruptive behavior policy at https://nau.edu/university-policy-library/disruptive-behavior.

NONDISCRIMINATION AND ANTI-HARASSMENT

NAU prohibits discrimination and harassment based on sex, gender, gender identity, race, color, age, national origin, religion, sexual orientation, disability, or veteran status. Due to potentially unethical consequences, certain consensual amorous or sexual relationships between faculty and students are also prohibited. The Equity and Access Office (EAO) responds to complaints regarding discrimination and harassment that fall under NAU's Safe Working and Learning Environment (SWALE) policy. EAO also assists with religious accommodations. For additional information about SWALE or to file a complaint, contact EAO located in Old Main (building 10),

Room 113, PO Box 4083, Flagstaff, AZ 86011, or by phone at 928-523-3312 (TTY: 928-523-1006), fax at 928-523-9977, email at equityandaccess@nau.edu, or via the EAO website at https://nau.edu/equity-and-access.

TITLE IX

Title IX is the primary federal law that prohibits discrimination on the basis of sex or gender in educational programs or activities. Sex discrimination for this purpose includes sexual harassment, sexual assault or relationship violence, and stalking (including cyber-stalking). Title IX requires that universities appoint a "Title IX Coordinator" to monitor the institution's compliance with this important civil rights law. NAU's Title IX Coordinator is Pamela Heinonen, Director of the Equity and Access Office located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011. The Title IX Coordinator is available to meet with any student to discuss any Title IX issue or concern. You may contact the Title IX Coordinator by phone at 928-523-3312 (TTY: 928-523-1006), by fax at 928-523-9977, or by email at pamela.heinonen@nau.edu. In furtherance of its Title IX obligations, NAU will promptly investigate and equitably resolve all reports of sex or gender-based discrimination, harassment, or sexual misconduct and will eliminate any hostile environment as defined by law. Additional important information about Title IX and related student resources, including how to request immediate help or confidential support following an act of sexual violence, is available at http://nau.edu/equity-and-access/title-ix.

ACCESSIBILITY

Professional disability specialists are available at Disability Resources to facilitate a range of academic support services and accommodations for students with disabilities. If you have a documented disability, you can request assistance by contacting Disability Resources at 928-523-8773 (voice), 928-523-6906 (TTY), 928-523-8747 (fax), or dr@nau.edu (e-mail). Once eligibility has been determined, students register with Disability Resources every semester to activate their approved accommodations. Although a student may request an accommodation at any time, it is best to initiate the application process at least four weeks before a student wishes to receive an accommodation. Students may begin the accommodation process by submitting a self-identification form online at https://nau.edu/disability-resources/student-eligibility-process or by contacting Disability Resources. The Director of Disability Resources, Jamie Axelrod, serves as NAU's Americans with Disabilities Act Coordinator and Section 504 Compliance Officer. He can be reached at jamie.axelrod@nau.edu.

RESPONSIBLE CONDUCT OF RESEARCH

Students who engage in research at NAU must receive appropriate Responsible Conduct of Research (RCR) training. This instruction is designed to help ensure proper awareness and application of well-established professional norms and ethical principles related to the performance of all scientific research activities. More information regarding RCR training is available at https://nau.edu/research/compliance/research-integrity.

SENSITIVE COURSE MATERIALS

University education aims to expand student understanding and awareness. Thus, it necessarily involves engagement with a wide range of information, ideas, and creative representations. In their college studies, students

can expect to encounter and to critically appraise materials that may differ from and perhaps challenge familiar understandings, ideas, and beliefs. Students are encouraged to discuss these matters with faculty.

Updated 1/6/2020