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The Instructors
- Announcement: Although this class was created and developed by Nathan Albin and Pietro Poggi-Corradini, this semester please refer all questions, inquiries, requests for
appointments, etc, to Pietro Poggi-Corradini.

- **Name:** Nathan Albin and Pietro Poggi-Corradini
- **Department:** Mathematics
- **Email:** albin@math.ksu.edu (Nathan), pietro@math.ksu.edu (Pietro)

**Contacting the Instructors**

- If you email with a question more suitable for the Common Room (see below), we may ask you to post your question there before we respond to it. Keep in mind that conversations through email and discussion boards are much slower than in-person conversations and will frequently require a few back-and-forth interactions to answer your question. So don't wait until the last minute to ask your questions. Begin each assignment as soon as it is posted and ask questions early and often.
- For other communications, please post to the Canvas discussion titled "Common Room". Whether your question is about mathematics (What's the difference between definitions X and Y?), programming (Why did my code do X when I wanted it to do Y?), or procedural (How am I supposed to complete task X for the course?), there is a good chance that another participant will have a similar question or will know the answer. Think of posting to the Common Room as the online equivalent of being able to raise your hand and ask or answer questions in class. If we all commit to spending time each day reading and responding in the Common Room, all of us will feel more engaged and will gain more from this course.

**Response Time for Communication**

- In general, if you contact us by email or discussion board during regular business hours, we will usually see your message and respond within a few hours, depending on our meeting and teaching schedules. In order to facilitate the digital communications process, we will also hold "virtual office hours" during which time we will check email and discussion boards frequently and respond as quickly as possible. This would also be a good time to arrange a voice call or video conference to discuss your questions. Our virtual office hours are posted below. If you contact us outside the posted times, please allow for up to 24 hours for a response (though we'll do our best to respond more quickly).

**Virtual Office Hours**

Unless announced otherwise, we will be checking and responding to your communications during the following times.

- **Pietro:** MWF 9:30-10:30am
- **Nathan:** MWF 10:30-11:30am

Please keep in mind that if you have technical questions it is best to call IT services at 785-532-7722.

**A Little About Us**

The homepage for Nathan Albin ([https://www.math.ksu.edu/~albin/](https://www.math.ksu.edu/~albin/)) and for Pietro Poggi-Corradini ([https://www.math.ksu.edu/~pietro/](https://www.math.ksu.edu/~pietro/)) provide more information about our background. More importantly, we are running the NODE group, which is an interdisciplinary research group which includes Professor Caterina Scoglio in Electrical and Computer Engineering. Our group does research in Network Science and applications. For more information see the homepage for the NODE group ([https://node.math.ksu.edu/](https://node.math.ksu.edu/)).
The Course

Course Overview

In practice, data often comes interconnected with a network structure, and other times a natural network structure can be superimposed on a raw data-set. The goal in this class is to explain the mathematics behind the use of data and networks in applied sciences such as Engineering, Biology, Ecology, Political Science and beyond. We will review the necessary matrix theory, mathematical probability, and graph theory, as the need arises.

Course Goals and Learning Outcomes

The main goals of the course is to provide students with the necessary tools, skills, vocabulary, and techniques, that will allow them to become life-long self-learners in network and data analytics.

Through their participation in this course, the students will have the opportunity to:

1. Develop a "big picture" perspective of the main themes and topics that arise when studying data and networks.
2. Acquire a solid mathematical foundation of the matrix theory, probability theory, and graph theory necessary for the analysis of data and networks.
3. Use standard Python software libraries to explore and process data.
5. Use Jupyter notebooks to create effective structured presentations on network and data analytics.
6. Read, interpret and summarize journal articles in network and data science.

Course Prerequisites

Applied Matrix Theory (Math 551), Calculus III (Math 222)

Required Reading

*Networks: An Introduction*, by M. E. J. Newman

Coding Platform

Students will have to create an online account on CoCalc ([https://cocalc.com/](https://cocalc.com/)) and provide us with the exact email address associated with that account. We will then add these accounts to the corresponding course on CoCalc. **Every student will be required to purchase a $14 one-time upgrade** that will move their project from trial servers to members-only computers, enable full internet access, and last four months.

Further Recommended Reading

- *Markov Chains and Mixing Times*, by D. Levin, E. Wilmer, and Y. Peres.

Technology Requirements
K-State has technology recommendations (http://www.k-state.edu/its/buying/) for success in online learning. You can also visit the K-State Global Campus website to make sure your technology (http://global.k-state.edu/students/services/technology) is up to date. Canvas will work best in the Google Chrome browser. If you choose to use another browser, please make sure your course materials function within that system. You may need to confirm that your browser, java, flash, and pdf reader are all updated to the latest version.

In addition, students will have to familiarize themselves with the following tools:

- **CoCalc**: CoCalc is a web-based platform that supports Python computing using Jupyter notebooks.
- **LaTeX**: LaTeX is a document preparation system used to typeset mathematical and scientific documents. The CoCalc platform supports LaTeX file processing, probably the simplest option for students with little or no LaTeX experience. Students desiring a local LaTeX installation on their own computers can find installation files and instructions at https://www.latex-project.org/get/.

**Technical Difficulties**

The K-State IT Help Desk is there to assist you with questions regarding the technology used for your course.

- **Phone**: 785-532-7722 or toll free 1-800-865-6143
- **Email**: helpdesk@k-state.edu

If you have issues with your technology, please contact them first, they are the technology experts. If you continue to have problems, please post in the "Common Room" discussion thread so that other students can indicate if they are also having problems. If you miss a deadline due to technological difficulties, make sure it is documented through communication with the IT Help Desk, then exceptions may be made on a case-by-case basis.

**Expectations**

**What you can expect of your instructors**

- We will communicate with you primarily through the tools within this Canvas course.
- If you have a question that you feel may help other students as well, please post your question in the "Common Room" discussion thread.
- If you have a personal concern or question you would like to talk about, please send us an email directly. During the work week, we will respond to personal emails or your posts directed to us within 24 hours. We will review communication over the weekend, but we will respond on Monday to most situations. If you need to reach us by email, please use the subject line: Your Name, Course Name/Number, Topic. Please allow a full 24 hours before emailing us again about the same question or issue, and on Monday for inquiries sent over the weekend.
- We will work to foster community through discussion boards, chat sessions, group projects, etc.
- We will post grades within 5 days of the final due date of the assignment, unless otherwise stated.

**What we expect of you**
• Expect to spend between 5 and 10 hours a week with this course.
• It is necessary for you to log in frequently, if not daily.
• It is important to log in early in the week so that you understand what is expected and have
time to ask questions.
• We expect you to ask questions if something is unclear.

Netiquette

Rules of style or Netiquette (network etiquette) are expected by communicating through class e-
mail lists, message boards and discussion rooms. These are the guidelines set forth by K-State
Global Campus.

Stick to the topic of discussion and its purpose

• Use the subject line to announce your topic. Often, busy people will only open messages that
have creative subject lines.
• Use only one topic per message.
• Get to the point. A limit of one page (screen) per message is ideal.
• Don’t post advertisements (called spamming) or chain letters to the class discussion.

Use courtesy and common sense in all electronic communications

• Consider what you write, as it’s a permanent record and can be retrieved easily.
• Class discussions are confidential. Do not share or forward others’ email without permission.
• When responding to a message, don’t quote back an entire message. Delete the excess
(snip) and make your comments at the very top before starting the quotes.
• DON’T TYPE IN ALL CAPS. This is hard to read and is considered shouting.
• Avoid sarcasm, as it is easily misunderstood.
• Avoid correcting others’ grammar, punctuation and spelling unless it is necessary to clarify
discussion.
• Avoid flaming. A flame is an abusive, harassing or bigoted message that attacks an author of
a message.
• Respect the opinions of others and be sensitive to the diverse nature of people in the class.
Keep in mind that although you cannot see other members on the list, you can show respect
for individual differences. Diversity issues may include the following and others: race,
ethnicity, religion, disabilities, gender, sexual orientation, age, social class, marital status,
urban vs. rural dwellers. (See K-State’s Notice of Nondiscrimination).

Check posting guidelines

• Adequately show a “presence” in the course.
• Make sure your posts are substantive; simply replying “I agree” will not be considered a
strong contribution to the discussion.
• Check discussions frequently and respond on subject.
• Focus on one subject per post.
• Cite all quotes, references and sources.

University Expectations of "Classroom" Conduct

All student activities in the University, including this course, are governed by the Student Judicial
Conduct Code as outlined in the Student Governing Association By Laws, Article V, Section 3,
number 2. Students who engage in behavior that disrupts the learning environment may be asked
to leave the class (in an online environment, you may be restricted from accessing the course).
Assignments and Grading

Assignment Types

There are five different graded components, each worth 20% of your final grade.

Quizzes

In order to help us check your comprehension during the semester, every week there will be a short quiz in Canvas over the reading material. In general, the quizzes will be due Sunday evening at 11:59pm.

Written Homework

Frequently you will also be asked to turn in written homework assignments. You may either choose to typeset your homework in LaTeX, turning in a PDF file, or to write your solutions by hand and turn in a scanned digital copy. Homework assignments and due dates will be announced well in advance in order to allow you to seek help if necessary. Be sure to start working on these assignments as soon as they are assigned.

Journal Entries

Each week, you will also be asked to write a short journal entry describing your tasks for the week. Your journal will help you and your instructors keep track of your progress in the course. We will provide you with a LaTeX template for your journal. Journal entries will be due on Sundays at 11:59pm, but we strongly recommend that you spend some time each day reflecting on your progress.

Discussion Participation

You will be asked to participate in small group discussions each week. This activity is important in helping us and you assess your understanding of what you are learning as well as in helping you connect together the main topics of the course. Each week, you will need to significantly contribute to the assigned discussion.

Defining "significant contribution" is a little tricky since discussions are organic, developing and evolving depending upon what is said by whom. In general, posting only once is not enough to really engage in a discussion. For most discussions, we expect that you'll need to contribute around 3-6 posts throughout the week to really participate. What we expect and hope to see is a dialogue evolving, with give and take, back and forth, questions asked and ideas explored like in a face-to-face class discussion. So, as you post, be cognizant that you are engaging in a discussion. Do not post long pages of responses. A couple of paragraphs at most should suffice, sometimes a sentence or two can be effective, especially if you're asking a question. The rubric in the next section should help you understand what is expected of you.

CoCalc Notebooks

One of the course objectives is to teach the students to "use Jupyter notebooks to create effective structured presentations on network and data analytics." You will work toward that goal throughout the semester by completing Jupyter Notebook assignments on CoCalc. Early assignments will help
you get to know the software, while later assignments will actually guide you through building your final notebook project step-by-step. These weekly exercises will be due each Sunday at 11:59pm.

Unlike with Canvas, there is no "submit" button in CoCalc. Instead, your instructors will "collect" the assignments when they are due. So, if your assignment is completed and saved by the due date and time, there is nothing else you need to do. When we click the collect button, we will receive a snapshot of your work at that instant. (If you make changes after we have collected the assignment, we will not see those.)

**Rubrics**

**Quizzes**

The number of points possible for each question in a Canvas quiz is displayed during the quiz. Expect most questions to be multiple choice or true/false. The total value of each quiz will depend on the questions asked.

**Written Homework**

Written homework is expected to consist of more than a few scrawled calculations and an answer. Part of what you are practicing is technical communication. Your work should not only have a clear structure and organization, but should include an explanation of what you are doing. That means, you are expected to use sentences and paragraphs when necessary. Good written assignments are concise, clearly written, easy to read, well-organized, and explain the answer through a series of logical steps.

Written homework assignments will be graded out of 20 points according to the following rubric.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Unacceptable (0 pts)</th>
<th>Acceptable (3 pts)</th>
<th>Good (4 pts)</th>
<th>Excellent (5 pts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correctness</td>
<td>Few or no correct answers.</td>
<td>Some of the answers are correct.</td>
<td>Most of the answers are correct.</td>
<td>All answers are correct.</td>
</tr>
<tr>
<td>Logic</td>
<td>Logical argument is missing or seriously flawed.</td>
<td>Solution strategy was poorly chosen or poorly executed.</td>
<td>A reasonable strategy was selected, but there are still some logical errors. May be missing key steps or unnecessarily complicating the problem.</td>
<td>A good strategy was selected and carried out with correct logic.</td>
</tr>
<tr>
<td>Neatness &amp; Clarity</td>
<td>Work is difficult to read or understand.</td>
<td>Work is partly understandable.</td>
<td>Work is mostly understandable but could still use improvement.</td>
<td>Work is clear and easy to understand.</td>
</tr>
<tr>
<td>Organization &amp; Exposition</td>
<td>No overall organizational structure is apparent or no</td>
<td>Some attempt at organization was made, but the structure is difficult to follow due to</td>
<td>The work is organized reasonably well, but still could be significantly</td>
<td>The work is well-organized and well-explained. The explanation provides a concise,</td>
</tr>
</tbody>
</table>
Journal Entries

Your journal is where you will track your progress in the course. Here, you will record your weekly activities, thoughts and ideas. We will provide you with a LaTeX template for your journal. You may choose to upload it to CoCalc and edit it there, or install a LaTeX distribution on your own computer for editing.

Each week, you will add an entry to your journal, reflecting your progress from the week. Your journal will be cumulative, with new entries added to the end of the document as you go. By 11:59pm on Sunday, you will need to upload a PDF version of your journal, updated for the past week, to Canvas.

Each weekly journal entry will be graded out of 5 points according the the following rubric. For journal entries, you are not being graded on correctness but on process. So don't be afraid to jot down whatever comes to your mind throughout the week; we're not going to judge your thoughts. Our goal is to help you learn to track your ideas and activities as you work. One of the trickiest parts of research is remembering what you've done and why. A good research journal will help with that. Our advice is to quickly jot down your ideas throughout the week, then spend a little time at the end of the week cleaning up and clarifying your thoughts.

<table>
<thead>
<tr>
<th>Journal Entry</th>
<th>Unacceptable (0 pts)</th>
<th>Acceptable (3 pts)</th>
<th>Good (4 pts)</th>
<th>Excellent (5 pts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No entry was provided.</td>
<td>The basic structure of the journal entry is filled in, but it is not apparent that the student is thinking deeply about the course content.</td>
<td>More than just a minimal entry is provided, but the ideas are not clearly expressed. It will probably be difficult for the student to make sense of the entry a few months down the road.</td>
<td>The journal entry is well-organized and well-written. The student's progress through the week is clearly demonstrated, and the entry is sufficiently well-written to make sense in the future.</td>
<td></td>
</tr>
</tbody>
</table>

Discussion Participation

Your weekly discussion participation will be graded out of 15 points with 5 points possible for each of 3 criteria as described in the following rubric.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Unacceptable (0 pts)</th>
<th>Acceptable (3 pts)</th>
<th>Good (4 pts)</th>
<th>Excellent (5 pts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>No participation.</td>
<td>Active participation on a single day. Posts at least twice.</td>
<td>Participates on multiple days with 2-3 posts by the end of the week.</td>
<td>Participates on most days with 4+ posts by the end of the week.</td>
</tr>
<tr>
<td><strong>Content Contribution</strong></td>
<td>Posts information that is off-topic, incorrect, or irrelevant to discussion.</td>
<td>Repeats but does not add substantive information to the discussion</td>
<td>Posts information that is factually correct, but lacks full development of concept or thought</td>
<td>Posts factually correct, reflective and substantive contribution; advances discussion.</td>
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</tr>
<tr>
<td><strong>Clarity &amp; Nettiquette</strong></td>
<td>Posts long, unorganized or rude content that may contain multiple errors or may be inappropriate.</td>
<td>Communicates in friendly, courteous and helpful manner with some errors in clarity, spelling or grammar.</td>
<td>Contributes valuable information to discussion with minor clarity, spelling or grammar errors.</td>
<td>Contributes to discussion with clear, concise comments formatted in an easy to read style that is free of grammatical or spelling errors.</td>
</tr>
</tbody>
</table>

**CoCalc Notebooks**

CoCalc notebooks will be graded out of 10 points. Since the notebook assignments may differ significantly from week to week, writing down a simple, comprehensive rubric isn’t possible. Instead, here is a list of some general characteristics of a good notebook assignment.

- **If you were asked to write Python code…**
  - The code is clean and easy to read.
  - Variables and functions are given helpful names.
  - Comments are provided to aid in understanding.
  - There is *not* a lot of commented-out code cluttering the notebook.
  - Good use is made of existing functions and data structures. (You are not reinventing the wheel.)
  - When possible, simple algorithms and data structures are used. (You are not over-complicating the problem.)
- **If you were asked to write text (i.e., Markdown cells)…**
  - The text is written in complete sentences, with correct spelling and grammar.
  - The text aids in understanding the rest of the notebook (e.g., any Python code).
  - The text is well-organized and well-formatted.
  - Mathematical formulas are correctly typeset and fit well in the text.

**Assignment Policies**

**Late or Missing Assignment Policy**

There will be several assignments due by 11:59 PM Central time on the date listed. The purpose of these deadlines is to help you stay on track to complete all materials in a timely manner. If for any reason you are unable to complete the assignment on time, please contact us by email as soon as possible so that we can make arrangements for the completion of the work.

**Make-up Work**

Make-up work will be granted only if the issue is communicated to the instructors in a timely manner.

**Extra Credit Options**
Extra credit options will not be available in this course.

Other Topics

Student Access Center and Classroom Accommodations

Students with disabilities who need classroom accommodations, access to technology, or information about emergency building/campus evacuation processes should contact the Student Access Center and/or their instructor. Services are available to students with a wide range of disabilities including, but not limited to, physical disabilities, medical conditions, learning disabilities, attention deficit disorder, depression, and anxiety. If you are a student enrolled in campus/online courses through the Manhattan or Olathe campuses, contact the Student Access Center at accesscenter@k-state.edu, 785-532-6441; for Salina campus, contact Disability Support Services at 785-826-2984.

Academic Honesty

Kansas State University has an Honor and Integrity System based on personal integrity, which is presumed to be sufficient assurance that, in academic matters, one's work is performed honestly and without unauthorized assistance. Undergraduate and graduate students, by registration, acknowledge the jurisdiction of the Honor and Integrity System. The policies and procedures of the Honor and Integrity System apply to all full and part-time students enrolled in undergraduate and graduate courses on-campus, off-campus, and via distance learning. The Honor and Integrity System website can be reached via the following URL: http://www.k-state.edu/honor. A component vital to the Honor and Integrity System is the inclusion of the Honor Pledge which applies to all assignments, examinations, or other course work undertaken by students. The Honor Pledge is implied, whether or not it is stated: "On my honor, as a student, I have neither given nor received unauthorized aid on this academic work." A grade of XF can result from a breach of academic honesty. The F indicates failure in the course; the X indicates the reason is an Honor Pledge violation.

Copyright

Copyright is a form of legal protection that allows authors, photographers, composers, and other creators to control some reproduction and distribution of their work. Both student and professors are protected by copyright. Please visit http://www.k-state.edu/copyright/basics/ for more information.

Academic Freedom

Kansas State University is a community of students, faculty, and staff who work together to discover new knowledge, create new ideas, and share the results of their scholarly inquiry with the wider public. Although new ideas or research results may be controversial or challenge established views, the health and growth of any society requires frank intellectual exchange. Academic freedom protects this type of free exchange and is thus essential to any university's mission.