

# CS 303

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CS 303 Discrete Structures and Computing Theory is taken by CS majors after CS 151.

This page contains the syllabus for CS 303 and is used to keep track of assignments, etc. as well for the most recent offering (fall 2022). For announcements, click the link in the table of contents.

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## General Information

**Course website** - [https://cs.indstate.edu/wiki/index.php/CS\\_303](https://cs.indstate.edu/wiki/index.php/CS_303)

### Your Instructor

Jeff Kinne (<https://kinnejeff.com>), [jkinne@cs.indstate.edu](mailto:jkinne@cs.indstate.edu) (<http://mailto:jkinne@cs.indstate.edu>)

*Office:* Root Hall A-142 and in Microsoft Teams, phone 812-237-2126

*Instructor Office Hours:* MWF 10am-1pm, MTWRF 2-3pm

### Lecture, Exam

*Lecture:* MW 1-1:50 and TR 12:30-1:20 in Root Hall A-019, over Zoom (link in Canvas, see below), and recorded

*Mid-term exam:* TBA

*Final exam:* Wednesday, Dec 7, 1-2:50am and/or Tuesday, Dec 6 1-2:50pm

*Asynchronous students:* For students who will be mostly participating asynchronously even though the course is being offered synchronously, you should pick a regular time each week to check in with the instructor. Make an appointment with the instructor during the first 2 weeks at this time to make sure you are on track. Each week at this time, write an email or Teams message to the instructor to let them know how things are going and if you have any questions.

**Prerequisites** - C or higher in CS 151.

**CRN numbers** - 53200 for the 001 face to face section, 52021 for the 301 online section

### Required text

- We will use selections from the following free online sources.
- **Primary text for the beginning of the course - Building Blocks for Theoretical Computer Science** (<https://mfleck.cs.illinois.edu/building-blocks/index-sp2020.html>) by Margaret M. Fleck
- Mathematics for Computer Science (<https://courses.csail.mit.edu/6.042/spring18/mcs.pdf>) by Eric Lehman, F Thomson Leighton, and Albert R Meyer
- Introduction to Theory of Computation (<https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf>) by Anil Maheshwari and Michiel Smid
- Additional sources - as needed.

**Class notes** - Notes during class will mostly be kept in the **CS 303 OneNote notebook** ([https://sycamoresindstate-my.sharepoint.com/:o:/g/personal/jeffrey\\_kinne\\_indstate\\_edu/EiORjIshxhLLmcwB-qhatPUBGDxtwXxc40\\_-nVKPHoKrOw?e=yQKG51](https://sycamoresindstate-my.sharepoint.com/:o:/g/personal/jeffrey_kinne_indstate_edu/EiORjIshxhLLmcwB-qhatPUBGDxtwXxc40_-nVKPHoKrOw?e=yQKG51)) and might be made available later as a PDF. Note that you will need to authenticate with your ISU account to view the notebook.

# Announcements/Assignments/Quizzes

This section will be kept up to date with announcements of assigned reading, assignments, quizzes, etc. This will be kept as a "stack" with the most recent at the top of the list.

## Assignments

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- Puzzle/Challenge problems 1 - Mathematics for Computer Science (<https://courses.csail.mit.edu/6.042/spring18/mcs.pdf>) problems 1.2, 1.6, 1.8
- **Truth table proofs, Proofs of irrationality, Applying euclid's algorithm for gcd.** Due Sep 2 (but use the weekend/Monday if you need it).
- Quiz on "math notation" and "math and bases". The "Assignment" section at the bottom of **Math for CS Review** has a link where you can take the quizzes for practice. When you are ready, take the quizzes in Canvas. Due Aug 29.
- Hello unix lab. Follow instructions in **Hello Unix Lab**. Due Aug 24.

## Announcements

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- 2022-09-15 - coming up - Building Blocks graphs, some new assignments, some new challenge problems.
- 2022-09-14 - puzzle challenge problems 1. Aside - **RSA cryptosystem** ([https://en.wikipedia.org/wiki/RSA\\_\(cryptosystem\)](https://en.wikipedia.org/wiki/RSA_(cryptosystem))) - examples now, proofs some time later, read the wikipedia page. Go to the job/career fair.
- 2022-09-13 - puzzle challenge problems 1. You will present solutions to:  $2=1$  (Lexy), irrational powers (JF),  $\log_7(n)$  (.). The other one is still a bit up in the air. How will they count? About 1/3 of the class got one correct.
- 2022-09-13 - letter grades - will be based on getting pass rating on things, will be revisiting before interim grades.

- 2022-09-13 - notes on grading for truth table proofs, proofs of irrationality, and running the Euclidean algorithm...
  - Scoring on each problem: 2 is pass, 1.5 is pass-. A pass should be required, right? One option is to revisit items that haven't been passed yet at the midterm (which will include an interview component).
  - I was hoping people would resubmit and fix problems. Some did, some didn't.
  - When I assign different numbers to different people, part of the reason is to ensure everyone is doing their own work. If you submit a solution for a problem that was not yours, that is suspicious (and extra work for me to have to decide on).
  - When it is required to visit the lab to demo your solution, then you need to do it.
  - Don't say things that are not true - check your proofs carefully.
  - A few people gave a proof of irrationality for a number that was not assigned to them, and looked like it was based off of an online resource. If you use something and don't cite it, that is plagiarism - you get a 0 on the assignment for the first offence, then F for the course on the second. And you created extra work for me. ;(
- 2022-09-12 - no class/lecture today
- 2022-09-08 - will continue to keep moving through Building Blocks, and also doing problems from MCS (in class, and probably also assignments). Will make up your next assignment after the current ones are graded (likely Monday).
- 2022-09-07 - "challenge" problems from the end of today's lecture - our start is in the OneNote notebook under Proofs and then Problems.
- 2022-09-07 - aside - examples/problems from MCS (Mathematics for Computer Science, link above in General Info).
- 2022-09-07 - reading assignment Building Blocks chapters 6 (relations), 7 and 8 (functions).
- 2022-09-06 - for the proofs assignments, please resubmit by 9/7 midnight.
- 2022-09-06 - grading for the two proofs. Most people need to do edits to fix the truth table proof and irrationality proof. Check the rules of writing good proofs - Proofs. For the proof of irrationality, note that things are a tiny bit different for doing a proof with a composite number (check the wiki assignment link again for an example). For the gcd question, same thing - say what you are solving, and indicate what the answer is when you get to it. Also, you need to visit the help lab to have them sign off that you can explain/demonstrate your solutions. Also, remember that I am grading mostly "pass/fail", so you should revise and resubmit (partial credit won't be good enough for these).
- 2022-08-29 - try finishing the last proof we were in the middle of.
- 2022-08-29 - **reminder to take quizzes today. new assignments due Friday**, which include a check-in with the help lab - if you use the weekend to work on this class, that's okay too.
- 2022-08-29 - reading assignment - Building Blocks chapter 5 (sets)
- 2022-08-29 - FYI in terms of when I tend to reply to messages - starting some time around 7am depending on the day, up until about 4pm (with gaps for classes, meetings, etc.), then again roughly 8-10pm. Weekends I will often have longer periods of not checking messages but try to at least a few times per day.
- 2022-08-24 - reading assignment - Building Blocks chapter 4 (number theory - integers)
- 2022-08-22 - fyi, will use OneNote in the browser from now on (spacing wasn't looking right going back and forth between application and browser)
- 2022-08-22 - reminder of the Hello Unix Lab assignment
- 2022-08-18 - ungraded self-check - think about what the first DeMorgan's law should be, and verify or disprove with truth tables. Another question: is not (p and q) equivalent to  $p \rightarrow q$  ?
- 2022-08-18 - reading assignment - Building Blocks chapter 3 (proofs)
- 2022-08-18 - reading assignment - Building Blocks chapter 2 (logic)
- 2022-08-17 - reading assignment - Building Blocks (<https://mfleck.cs.illinois.edu/building-blocks/index-sp2020.html>) chapter 1 (math review)
- 2022-08-10 - to start off we will be following along from the beginning of *Building Blocks for Theoretical Computer Science*, so if you want to do some reading you can start taking a look at that.
- 2022-08-09 - creation of this site, including the preliminary list of topics, outcomes, achievements, etc.

# Course Description and Content

## Course Description

The catalog description for this course is: "Mathematics content that is foundational to and useful for computer science. Topics include axioms and proofs, induction, graph theory, probability, finite automata, regular expressions, Turing machines, and the Church-Turing thesis." The two main goals are (a) being able to reason about computation (mathematical objects and algorithms), (b) familiarity with the topics listed in the description which are important in later courses.

## Course Outline

- We will start the course by following along in the order of *Building Blocks for Theoretical Computer Science*, see link above.

## Learning Outcomes

- Basic math - ability to use basic algebra, properties of numbers, rules of exponents and logarithms
- Proofs - understanding of what a proof is, ability to use the following methods of proof as needed - direct proof / by construction, by contradiction, by induction, by decomposition
- Logic - ability to use the rules of logic (truth tables, DeMorgan's laws, etc.) in arguments
- Integers - can use the properties of the integers to write algorithms and reason about their correctness
- Sets, relations, functions - can apply the definitions of these concepts in proofs
- Graphs, trees - understanding of standard definitions related to graphs and trees, able to argue basic properties
- Asymptotic resource analysis (big-O) - can apply the definitions of big-O notation to compare different running time formulae, to simplify expressions, and to determine the big-O running time of algorithms
- Complexity theory - understanding of definitions of basic complexity classes (L, P, NP, PSPACE, EXP), understanding of canonical problems in each class, can reason about these complexity classes
- Notions of infinity - understanding of difference between countably and uncountably infinite, can use these in proofs
- Probability - knowledge of basic definitions and properties of discrete probability, can apply to the analysis of randomized algorithms and processes
- Regular languages - understanding of DFAs, NFAs, regular expressions and ability to produce models for commonly encountered languages
- General models of computation - understanding of Turing-complete models of computation (Turing machine, circuits, programming languages) and implications
- Computability - can give arguments whether a given problem is computable or not (e.g., the halting problem)
- Notation - proper use of math notation (sets, logic, functions, summations, proofs, etc.)

# Grading and Assignments

We will be trying out what I am calling "achievements-based" grading. There are a series of skills, knowledge, and experiences that I want you to achieve. Your final letter grades will be based strictly on which of these you have completed. For each achievement, you can achieve the rating of incomplete, pass-, pass, pass+. The following will be our starting point for how letter grades will be assigned. I will reevaluate this throughout the term to make sure we are on track. I will also be setting the standards for pass-, pass, and pass+ for each of the achievements as we get to them in the course.

## D

- Pass or higher achievement for *all* of the following
- Math notation
- Truth table proofs, proof that a number is irrational, able to correctly run the Euclidean algorithm
- *We will be filling in the minimum standards here as we begin the course and start having assignments and quizzes.*

## C

- In addition to the above...
- *We will be filling in the minimum standards here as we begin the course and start having assignments and quizzes.*

## B

- In addition to the above...
- *We will be filling in the minimum standards here as we begin the course and start having assignments and quizzes.*

## A

- In addition to the above...
- Pass+ rating on most of the above
- Pass or higher achievement for *all* of the following
- *We will be filling in the minimum standards here as we begin the course and start having assignments and quizzes.*

Achievements can be earned based on quizzes, assignments, in-class work, and exams. Rather than having numerical scores for these, I will use them to mark off your achievements. Note that achievements can be "lost" if you demonstrate a skill early in the term and then demonstrate a lack of the skill later in the term. I expect this will not normally be the case, but I will continue to evaluate you based on all of the skills throughout the term.

**Late Work** - Assignments will generally be available to still handin for around a week after their due date. Once the solutions are posted and discussed, late submissions will no longer be graded. Quizzes will normally need to be taken on the day they are due, or perhaps within a few days of when they are due. Solutions will normally be discussed or posted within a week of their due date. Not accepting late work that is more than about a week old is in part because it takes much longer to grade quizzes/assignments that are no longer super fresh in the instructor's head, and in part to try to keep everyone in the class working on the same material.

**Start Assignments and Quiz Studying Early** - I suggest attempting an assignment the day it is given, or the day after, so that if you have a problem you can ask early. If you continue to have problems in trying to complete the assignment, you will have time to ask again. Many of the assignments require thought and problem solving, which takes "time on the calendar" not just "time on the clock". By that I mean that spending an hour on 3 consecutive days is likely to be more productive than trying to spend 3 hours at once on the assignment.

**Expected Amount of Work** - My expectation is that an average student will spend about 5-10 hours OUTSIDE of class each week (that is in addition to class time or viewing lecture videos) WORKING PRODUCTIVELY/EFFICIENTLY (not just staring at the computer) to complete their coursework for this class. Some students may spend less time than this, and some students will spend more.

This is the foundation for the rest of CS, so it definitely pays off to do your best here.

Note - please find a way to spend enough time on this class (the investment will pay off in terms of skills, being able to get a job, etc.).

**Grade Meanings** - The letter grades are intended to have the following rough meaning. The list of achievements needed for each was chosen with this in mind.

- A+/A: You understand everything and probably could teach the course yourself.
- B+/A-: You understand nearly everything, and should be all set to use this knowledge in other courses or in a job.
- C/C+/B-/B: Some things you understand very well and others you don't (more towards the former for a B and more towards the latter for a C).
- D-/D+/C-: You did put some effort in, and understand many things at a high level, but you haven't mastered the details well enough to be able to use this knowledge in the future.
- F: Normally, students that get an F simply stopped doing the required work at some point.

# CS-Specific Items

This section contains items that are generally the same for all CS courses (and in particular those taught by this instructor).

## CS Course Policies

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Note that this course follows all standard CS course policies. In particular, (a) cheating/plagiarism by graduate students results in an F in the course, (b) and there will be no makeup exams. See <http://cs.indstate.edu/info/policies.html> for details.

## Lab Help

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We have a few lab assistants who are available to help students in beginning computer science courses. Please see [https://cs.indstate.edu/wiki/index.php/Unix\\_Lab\\_and\\_Help](https://cs.indstate.edu/wiki/index.php/Unix_Lab_and_Help) for details. The lab hours are in a calendar on the CS homepage, at [http://cs.indstate.edu/info/index.php#lab\\_hours](http://cs.indstate.edu/info/index.php#lab_hours). You can join the lab when working on your programs. You can ask the lab assistants to look at your programs, and you can work with any other CS students that are there (you could use the lab as a regular meeting place to work with your classmates).

## Course Announcements

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Announcements regarding the course will be made both during class and via email to your @sycamores.indstate.edu email address. You should regularly check this email account or have it forwarded to an account that you check regularly. You can set the account to forward by logging into your indstate.edu email online (if you aren't able to find the option, try a different browser or search online for things like - outlook online forward email setting).

## Classroom conduct

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You may not use cell phones, iPods/music players, etc. during class. You should be civil and respectful to both the instructor and your classmates, and you should arrive to class a few minutes before the scheduled lecture so you are ready for lecture to begin on time. You may use your computer during class if you are using it to follow along with the examples that are being discussed. You should avoid spending time on email, Facebook, work on other courses, etc. during the lecture for this class (be fully present wherever you are, make the most of each experience).

## Academic Integrity

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Please follow these guidelines to avoid problems with academic misconduct in this course:

*Homework:* You may discuss the homework assignments, but should solve and finish them on your own. To make sure you are not violating this, if you discuss with someone, you should DESTROY any work or evidence of the discussion, go your separate ways, SPEND at least an hour doing something completely unrelated to the assignment, and then you should be able to RECREATE the program/solution on your own, then turn that in. If you cannot recreate the solution on your own, then it is not your work, and you should not turn it in.

*Note on sources:* if you use some other source, the web or whatever, you better cite it! Not doing so is plagiarism.

*Exams:* This should be clear no cheating during exams. Each instructor has different rules for what is allowed on exams in terms of notes, etc. If not noted otherwise, you should assume that a quiz or exam is closed notes, no computer, no calculator.

*Projects:* You should not copy from the Internet or anywhere else. The project should be your own work. It will be fairly obvious to me if you do copy code from the Internet, and the consequences will be at the least a 0 on the project. If cheating is observed, you will at the least receive a 0 for the assignment (and may receive an F for the course), and I will file a Notification of Academic Integrity Violation Report with Student Judicial Programs, as required by the university's policy on Academic Integrity. A student who is caught cheating twice (whether in a single course or different courses) is likely to be brought before the All University Court hearing panel, which can impose sanctions up to and including suspension/expulsion. See <http://www.indstate.edu/sjp/docs/code.pdf> and <http://www.indstate.edu/academicintegrity/> for more information.

Please ask the instructor if you have doubts about what is considered cheating in this course.

## **Office hours (using Teams)**

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Office hours will be through Microsoft Teams by default. If you would like to meet in person you should reserve an appointment using <http://cs.indstate.edu/scheduler> to reserve an in person meeting with Jeff Kinne. I am normally in my office during my listed office hours, but by making an appointment you can be more certain. For meeting through Teams, you should start Teams in your browser or start the application. You should be logged in using your ISU credentials. Once you have Teams open you can message me to ask me questions or to ask to talk. We can use Teams to message (better than emailing back and forth repeatedly if you have questions about something that you just want to write about) or to talk and share screens (e.g., to take a look at your code). I normally have Teams open on my computer all of the time, including during my office hours. During my office hours I will normally reply right away; at other times I will reply when I get a chance.

## **Canvas**

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The course has a canvas site. Click <https://indstate.instructure.com/> to go to canvas. You should see this course listed under your courses for the current term. If you don't you may need to click on the Courses icon and then click the "All courses" link. The canvas site is used for giving you your grades, for quizzes/exams, and for getting to online lectures (which are done using Zoom). Announcements will be sent through canvas and to your university email. Links and such will be kept on this website.

## **Lectures (using Zoom)**

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Here at ISU section numbers starting with the number 3 (e.g.3xx: 301, 302, etc.) are generally online sections. There are 2 types of online sections, synchronous online and asynchronous online. Sections that are synchronous should be joined at the regularly scheduled time of the course, whereas sections that are asynchronous generally keep up with the material independently without regularly scheduled meetings. In general async sections are more difficult to stay on top of, and require a great deal of self-discipline (it is much easier to think "I can watch the videos tomorrow" and just get behind). So if you are in one of these sections make sure you get off to a strong start, and ask for help sooner rather than later. If you are in an online section, check your course schedule for course meeting times; if you have a meeting time, then your section is synchronous, otherwise it is asynchronous (or there is an error in the system).

This course has a 301 section (synchronous online) and 001 section (face to face). Students in either section can participate in whatever way you need to.

For ISU's links to information on getting started with Zoom, see <https://indstate.teamdynamix.com/TDClient/1851/Portal/KB/ArticleDet?ID=107534>. You can also see the information linked at <https://www.indstate.edu/services/student-success/cfss>. You will get to the lectures for this course by going to Canvas, select this course, click Modules on the menu on the left, and click on the Zoom module. Once there you should see a schedule of lectures and be able to view recorded lectures. Note that you should install the Zoom application for your computer, and you will need to be logged into to Zoom with your ISU credentials to be able to connect. Also note that the lectures are recorded and only available to those in our class. Recorded lectures normally appear later the same day as the lecture.

Note that if you have not used Zoom with your ISU account previously, you need to go to <https://indstate-edu.zoom.us> and login with your ISU email address and password to get it setup.

## Participating online

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If you are participating online, please see the information at <https://www.indstate.edu/services/student-success/cfss> about participating in online courses. You are expected to either join lectures live through Zoom or watch the recordings once they are available. You will complete assignments, quizzes, and exams on the same schedule as the rest of the class. For quizzes and exams you will normally have a 24 hour period during which to take the quiz/exam (note that different students will have slightly different questions and any communication between students about quiz/exam content is academic misconduct).

So also the General Information section at the top of this page for setting up a normal check-in time with the instructor.

## ISU Required Syllabus Items

The items in this section are required and are the same for every ISU course.

## COVID-19 Information

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Information specific to CS courses - [Start of Term Announcements](#)

*Standard ISU language required in all syllabi (read this all once, then skim for your other courses)...*

Students are expected to adhere to course attendance policies, as stated in the course syllabus. Documented COVID-related absences will be treated like any other serious medical issue. Following University policy, students with a documented, serious medical issue must contact the Office of the Dean of Students for assistance. The Office of the Dean of Students will supply documentation for faculty. Students with a documented serious medical issue should not be penalized and will be given a reasonable chance to complete exams or assignments. Once notification is made, faculty will make reasonable efforts to accommodate the student's absence and will communicate that accommodation directly to the student. Please note that faculty are not required to accommodate a serious medical issue with virtual content options, like streaming or recorded lectures. To avoid the potential of missing significant class time, students are strongly encouraged to receive the COVID vaccination that has been made available on campus. For more information about the vaccines or to find a vaccination site, go to: <https://ourshot.in.gov>. The ISU Health Center also administers COVID-19 vaccines by appointment.

Students should contact the Office of the Dean of Students with questions by calling 812-237-3829.



The information provided in this section of the syllabus is subject to modification based on guidance by public health authorities. Changes to Covid-related policies or updated information will, as always, be posted on the ISU website and communicated in multiple ways.

## **Special Needs / Disability Services**

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*Standard ISU language required in all syllabi...*

Indiana State University recognizes that students with disabilities may have special needs that must be met to give them equal access to college programs and facilities. If you need course adaptations or accommodations because of a disability, please contact us as soon as possible in a confidential setting either after class or in my office. All conversations regarding your disability will be kept in strict confidence. Indiana State University's Student Support Services (SSS) office coordinates services for students with disabilities: documentation of a disability needs to be on file in that office before any accommodations can be provided. Student Support Services is located on the lower level of Normal Hall in the Center for Student Success and can be contacted at 812-237-2700, or you can visit the ISU website under A-Z, Disability Student Services and submit a Contact Form. Appointments to discuss accommodations with SSS staff members are encouraged.

Once a faculty member is notified by Student Support Services that a student is qualified to receive academic accommodations, a faculty member is obligated to provide or allow a reasonable classroom accommodation under ADA.

## **Disclosures Regarding Sexual Misconduct**

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*Standard ISU language required in all syllabi...*

Indiana State University Policy 923 strictly prohibits discrimination on the basis of: age, disability, genetic information, national origin, pregnancy, race/color, religion, sex, gender identity or expression, sexual orientation, veteran status, or any other class protected by federal and state statutes in ISU programs and activities or that interferes with the educational or workplace environment.

Title IX of the Educational Amendments of 1972 prohibits discrimination based on sex, including sexual harassment. Sexual harassment includes quid pro quo harassment, unwelcome verbal or physical conduct, sexual assault, dating violence, domestic violence, and stalking.

If you witness or experience any forms of the above discrimination, you may report to:

*Office:* Equal Opportunity & Title IX; (812) 237-8954; Rankin Hall, Room 426

*Email:* [ISU-equalopportunity-titleix@mail.indstate.edu](mailto:ISU-equalopportunity-titleix@mail.indstate.edu)

*Online:* [https://cm.maxient.com/reportingform.php?IndianaStateUniv&layout\\_id=10](https://cm.maxient.com/reportingform.php?IndianaStateUniv&layout_id=10)

Disclosures made to the following confidential campus resources will not be reported to the Office of Equal Opportunity and Title IX:

*ISU Student Counseling Center:* (812) 237-3939; Gillum Hall, 2nd Floor

*Victim Advocate:* (812) 237-3829; HMSU 7th Floor

*UAP Clinic/ISU Health Center:* (812) 237-3883; 567 N. 5th Street

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