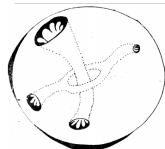
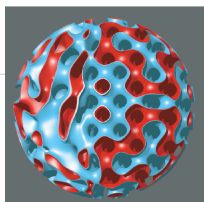


These slides, as well as all the information about the course, can be found at:  
(shortcut: Google "Moiras Chas")

<http://www.math.stonybrook.edu/~moira/courses/mat364-fall18/>

## MAT 364 Topology and Geometry

Images by Carlo Sequin



8. Sphere with two holes bored through it, and one of the holes threaded through a hole in the other hole.

Image from "An Introduction to Topology" by E. C. Zeeman



Image by Mithra Muthukrishnan

## About your instructor and this course



## Space, cyberspace and time coordinates of your instructor

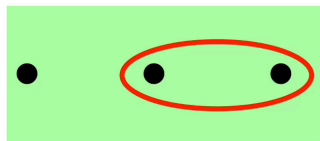


- ❖ Moira Chas, Associate professor
- ❖ Best way to contact me:
  - ❖ moira.chas at stonybrook.edu
- ❖ Website: <http://www.math.sunysb.edu/~moira/>
- ❖ Office: 3-119 Math Tower
- ❖ How to address me? Professor Chas is OK

I ♥  
Math

### Office hours:

- ❖ Mo 1:30pm to 3:30pm in 3-119 Math Tower.
- ❖ We 11am to 12pm in P-143 Math Tower,
- ❖ and/or by appointment (email me!).



## Online Syllabus



### Welcome to MAT 364 Topology and Geometry Fall 2018 - Syllabus

Instructor, grader, book...

**Instructor:** Moira Chas, office 3-119 Math Tower, e-mail: moira.chas@stonybrook.edu

**Instructor's Office hours:** Monday 11:00-1:00 (in 3-119, Math Tower), Wednesday 11:00-12:00, or by appointment.

**Class meetings:** MWF 10:00am-10:53am Earth&Space 183

**Grader:** "at" stonybrook.edu

**Grader's office hours:** Tuesday 10-11am in his office 2-115 Math Tower  
Wednesday 10:30-12:30 in MLC

**Textbook:** Topology of Surfaces, L. Christine Kinsey

**Course Materials** (slides, notes, etc) are [here](#) (Including the slides of the first day which are also part of the syllabus).

## More about this course

*The more times any of us practice remembering something we are trying to learn, the more firmly we lodge it in our memories for the long term. James Lang*

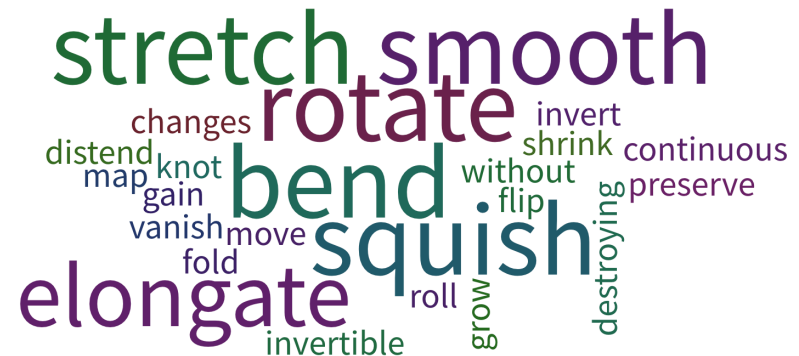
- ❖ In the first the last few minutes of some classes, we are going to work on a summary of the what already learned and/or what we are about to learn.
- ❖ Make groups of 3, 4 students.
  - ❖ Exchange ways of communication (email, phone number, smoke signals, whatever you are comfortable with).
  - ❖ Write down two or three sentences explaining what do you think a continuous transformation from a space to itself can and cannot do

1. Find all the classmates whose letter admits a continuous function with yours
2. Find all the classmates whose letter admits a homeomorphism with yours



## What a cont. map do ?

🔒 Poll locked. Responses not accepted.



## About this course

*The more times any of us practice remembering something we are trying to learn, the more firmly we lodge it in our memories for the long term. James Lang*

- ❖ In the first the last few minutes of some classes, we are going to work on a summary of the what already learned and/or what we are about to learn.
- ❖ Make groups of 3, 4 students.
  - ❖ Exchange ways of communication (email, phone number, smoke signals, whatever you are comfortable with).
  - ❖ Write down two or three sentences explaining what do you think topology is

Inspired in an article by  
Ignacio Salduendo

## Why math?

- ❖ Math is useful: without math we wouldn't have GPS, subway, medicines...
- ❖ Math is beautiful and interesting (says me, the mathematician)
- ❖ Logical structure: It is developed from few initial concepts and clear arguments.
- ❖ Math keeps us honest.
- ❖ Math teaches us patience and grit
- ❖ "Education is what remains after one has forgotten what one has learned in school.." Einstein

411,296 views | Nov 12, 2014, 11:43am

## Why math?

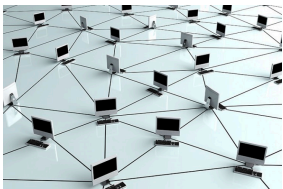
### The 10 Skills Employers Most Want In 2015 Graduates



Susan Adams Forbes Staff  
I'm a senior editor in charge of Forbes' education coverage.

1. Ability to work in a team structure
2. Ability to make decisions and solve problems
3. Ability to communicate verbally with people inside and outside an organization
4. Ability to plan, organize and prioritize work
5. Ability to obtain and process information
6. Ability to analyze quantitative data
7. Technical knowledge related to the job
8. Proficiency with computer software programs
9. Ability to create and/or edit written reports
10. Ability to sell and influence others

## Why topology?



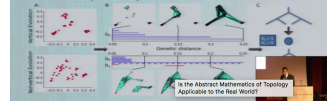
Besides many applications to different areas of mathematics, top is applied in many models of the real world.

Studying the Shape of Data Using  
Topology



Persistent Homology with Genomic data

- We can represent evolutionary relationships of a (large) set of genomes by a persistence complex:
  - vertices represent genomes,
  - complexes related by a filtration value that represents the evolutionary relationships.



## Tips to succeed in this course

Dedicate around 6-8 hours /wk to this course (outside the classroom). During these hours, your goal should be to **understand** the material. To do so,

- ❖ Work on written **HOMEWORK**
- ❖ **READ** the assigned sections of the textbook beforehand (**with paper and pencil handy**).

Every topic will be covered in class but some details will not be explained. You must must must **READ** the book

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## Tips to succeed in this course

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- ❖ Do not leave the homework for the last minutes before the deadline.
- ❖ Attend the lectures, and when you do, *be completely* in the class. (This implies no use of electronics. Note: cell-phone is electronic)
- ❖ Come ready to work in class
- ❖ Get help if you need it, as soon as you need it (office hours, MLC)

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## Tips to succeed in this course

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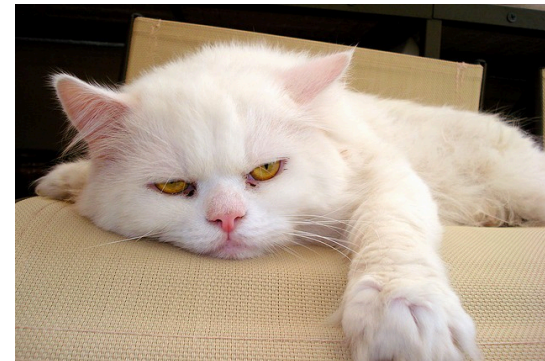
- ❖ Office hours: you do not need a concrete question, any confusion or uncertainty is justification.
- ❖ Get out of your comfort zone (in a productive way). Remember that most of us have been there: where not understanding a topic almost hurts... But if you work hard this changes.
- ❖ Ask questions (for instance What do you mean by a “blah”?)
- ❖ Answer questions
- ❖ The process of learning involves making mistakes. In other words, expect to make mistakes and do not judge yourself or others for them.

Constructive feedback is welcome by me, your instructor.

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## Administrative stuff

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## Homework Assignments

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- ❖ HW 0: It is required!!
- ❖ You cannot learn math without working on problems.
- ❖ Expect to spend a few hours a week working on homework.
- ❖ Each graded problem is worth 5 points.
- ❖ **Grader:** Siqing Zhang, siqing.zhang“at”stonybrook.edu

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## Written Homework must contain

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- ❖ The statement of the problem
- ❖ An answer that is emphasized, if appropriate.
- ❖ In most problems if there is no work shown, there is no credit. In other words, an answer with no justification is not admissible (even if it is the correct answer!)

Homework should be legible and written in complete English sentences.

10

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## Is it allowed to work in teams?

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- ❖ You may discuss the assignments in this course with classmates, before working in the write-up.
- ❖ Each student's submission must be his or her own work.
- ❖ It is not allowed to browse the Internet for solutions.

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## ACADEMIC DISHONESTY

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- All work you submit for homework, final, or exams **MUST** be your own work.
- If you cheat or aid someone in cheating, you will automatically fail this course and be brought up on charges of academic dishonesty without warning.
- Cheat includes: presenting work of other as your own, copying other student work, facilitate that other student copies your work, use of notes, calculators and/or electronic devices during examinations.

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## Online Resources

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✦ Course Website:

✦ <http://www.math.stonybrook.edu/~moira/courses/mat211-fall18/>

✦ Syllabus, homework schedule, exams dates, announcements.

✦ <http://www.math.stonybrook.edu/~moira/courses/mat211-fall18/Material/>

✦ Slides, and other materials (including the one you are reading)

✦ Blackboard:

✦ Grades

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## Email communications

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- During the semester, I will send a few emails. Please make sure that you check the Stony Brook email account regularly.
- Messages should be written in complete English sentences.
- I check my email about once a day, so expect my answer accordingly. I cannot answer complicated math question by email. This is office hours are for.

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## Book

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**Textbook:** :Topology of Surfaces, L. Christine Kinsey

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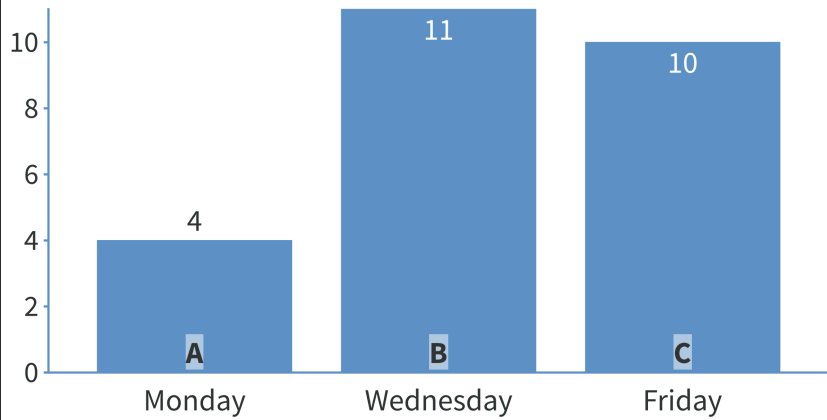
## Course Policies

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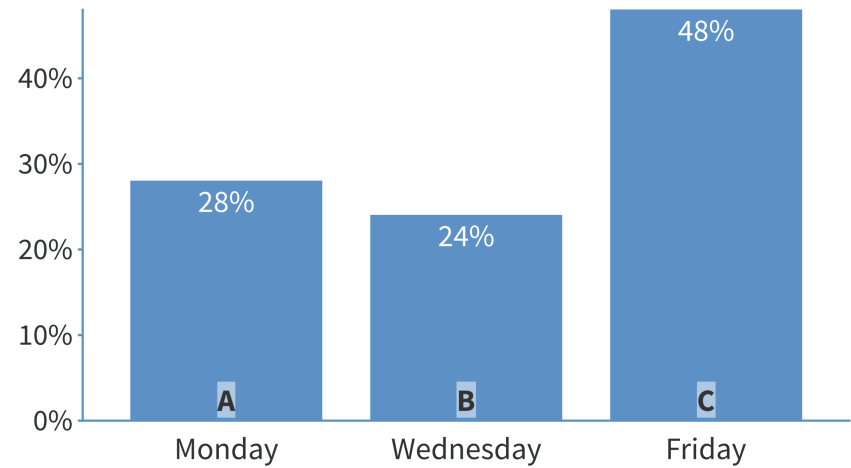
### Day of the week of the midterm 1 (on the week that starts of Oct 1st)

Respond at [PollEv.com/moirachas098](https://poll-ev.com/moirachas098)  
Text **MOIRACHAS098** to **37607** once to join, then **A, B, or C**



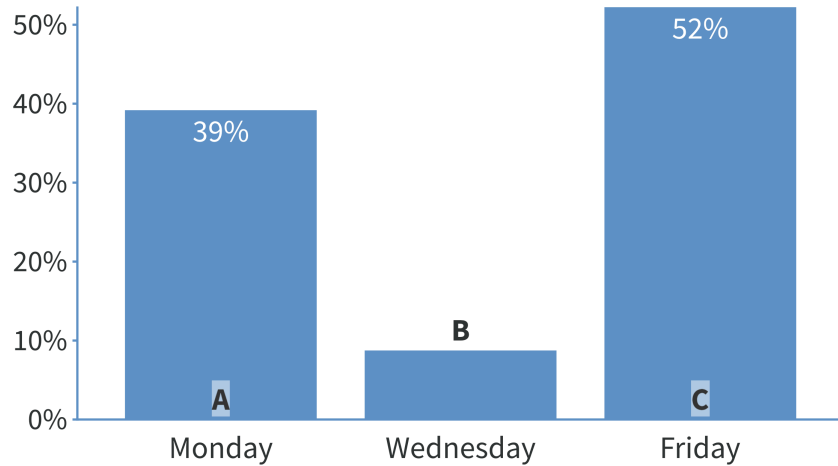
### Day of the week of midterm 2 (week of Nov 12)

Respond at [PollEv.com/moirachas098](https://poll-ev.com/moirachas098)  
Text **MOIRACHAS098** to **37607** once to join, then **A, B, or C**



### Day of the week to submit homework

Respond at [PollEv.com/moirachas098](https://poll-ev.com/moirachas098)  
Text **MOIRACHAS098** to **37607** once to join, then **A, B, or C**



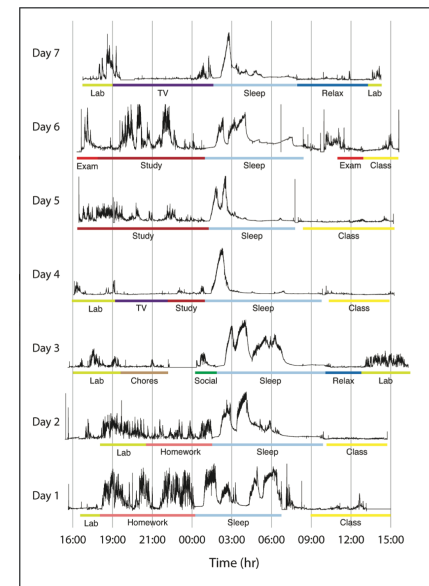
There are no dumb questions

A quotation (sometimes attributed to Mark Twain)

*“Lecturing is that mysterious process by means of which the contents of the note-book of the professor are transferred to the note-book of the student without passing through the mind of either.”*

Table by Eric Mazur

Let's make brain waves in this lecture.



Fixed mindset	Instead of	Try thinking	Growth mindset
	I am not good at this	What am I missing?	
	I am awesome at this	I am on the right track	
	I give up	This might take longer than I expected	
	This is too hard	I'll try to use some of the strategies we learned	
	I can't make it any better	I can improve if I keep trying	
	I am not a math person	I can train my brain to do math.	
	I am upset because I made a mistake	Mistakes help me learn better	
	The problem is that X is smarter than me	I'll try to learn how X does it.	
	It is good enough	How can I improve this?	
	My strategy didn't work.	What other strategy I can try?	
	This is too easy for me	Can I understand this more deeply?	

Unknown source

**MAT 364 Topology and Geometry**  
**Fall 2018 - Schedule**

Week Starts	Sections	Topics	HW	Assignment (hand in the underlined problems)	Remarks
Aug 24th	1.1 2.1 2.2	Introduction - Administrative details (all discussed in the <a href="#">syllabus</a> ) Point set topology Open and closed sets in $\mathbb{R}^n$ . Relative neighborhoods	0	Fill <a href="#">this form</a> .	
Sept 3rd	2.3 2.4	Continuous functions. Compact sets	1	1.1 You do not need to justify your answers in this problem. This is just to sharpen your topological neurons. <u>Section 2.1 Open and closed sets in <math>\mathbb{R}^n</math>.</u> 2.1 (problems 1, 4, 5, 6, 7, 8, 9.) Justify your answers. A. <u>Determine whether the rectangle <math>(0, 2) \times (0, 1)</math> is open and/or closed in <math>\mathbb{R}^2</math>. Justify your answer.</u> 2.2 2.3 - (problems 4, 5, 6, 7, 8, 9). Justify your answers. 2.4 2.9 <u>2.12</u> <u>Section 2.2 Relative neighborhoods</u> 2.19 2.22	Sept 3rd, Labor day.

## Grades and Exams

Exam	When and where	% of Final Grade
Midterm 1	Wed Oct 3rd In class	18%
Midterm 2	Fr Nov 16 In class	18%
Final Exam	Wed, Dec 19, 2:15pm-5:00pm To be announced.	40%
Homework	Every Friday	20%
Class participation		4%

## Homework

- ❖ Written homework assignments are due every Friday.
- ❖ These assignments will be updated according to the progress of the class.
- ❖ The assignments will be posted on a Friday and due the next Friday.

## Informal description of the course - Part I

Point set topology.  $X$  is a set

- Open sets: A list of special subsets of  $X$ , with certain properties
- Topology on a set: A structure that organizes the points in a set
- Closed sets: Complement of open sets by "gluing" them
- Relative topology: A way of giving a topology to a subset  $Y$  of a topological space  $X$ , determined by the topology of  $X$ .
- Continuous functions between topological spaces: A function that "respects" some features of the topology of  $X$ . Does not break  $x$ .
- Homeomorphism: A bijective function between spaces which is continuous and has a continuous inverse.
- Compact set: A small, controllable set
- Connected set: Cannot be broken into pieces respecting the topology
- Product spaces: Endowing a product of spaces  $X, Y$  with a topology in  $X \times Y$  determined by the topology on  $X$  and the topology on  $Y$ .

## Informal description of the course - Part II

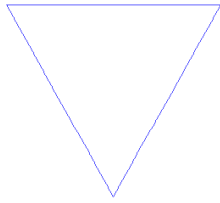
A special type of topological space: cell complexes. A topological space made of balls of  $\mathbb{R}^n$ , glued in a particular way.

Special cell complexes: Surfaces, Trees, Graphs, Three manifolds

Fundamental group and covering spaces

Euler characteristic: An integer associated to a cell complex.

Application: Maps on surfaces



Koch snowflake - Animations from Wikipedia