

# MAT 327 Introduction to Topology

@[Dror Bar-Natan](http://www.math.toronto.edu/~drorbn/) [↗](http://www.math.toronto.edu/~drorbn/) (<http://www.math.toronto.edu/~drorbn/>) @Classes [↗](http://www.math.toronto.edu/~drorbn/classes/) (<http://www.math.toronto.edu/~drorbn/classes/>) @2024-25 [↗](http://www.math.toronto.edu/~drorbn/classes/#2425) (<http://www.math.toronto.edu/~drorbn/classes/#2425>)

**Agenda.** Understand "continuity" in the most abstract!

**Instructor.** [Dror Bar-Natan](http://www.math.toronto.edu/~drorbn/) [↗](http://www.math.toronto.edu/~drorbn/) (<http://www.math.toronto.edu/~drorbn/>), [drorbn@math.toronto.edu](mailto:drorbn@math.toronto.edu) (<mailto:drorbn@math.toronto.edu>) (for course administration matters only; math on email is slow and prone to misunderstandings, so I generally avoid it). Office: Bahen 6178.

**Teaching Assistants.** Brinda Venkataramani ([brinda.venkataramani@mail.utoronto.ca](mailto:brinda.venkataramani@mail.utoronto.ca) (<mailto:brinda.venkataramani@mail.utoronto.ca>)) and Kai Shaikh ([kai.j.shaikh@gmail.com](mailto:kai.j.shaikh@gmail.com) (<mailto:kai.j.shaikh@gmail.com>)).



**Classes.** Tuesdays 3-4pm and Thursdays 2-4pm at GB248.

**Office Hours.** With Dror on Tuesdays 9:30-10:30 at BA6178 and at <http://drorbn.net/vchat> [↗](http://drorbn.net/vchat) (<http://drorbn.net/vchat>).

**Tutorials.** Mondays at 1pm-2pm at OI4422 with Kai, at 2pm-3pm at OI4422 with Brinda until October 7 and then with Kai, and at 5pm-6pm at OI8214 with Brinda.

**Text.** James Munkres' [Topology](https://www.pearson.com/en-ca/subject-catalog/p/topology-classic-version/P200000006299/9780137848669) (<https://www.pearson.com/en-ca/subject-catalog/p/topology-classic-version/P200000006299/9780137848669>) (see [Errata](http://drorbn.net/index.php?title=10-327/Errata_to_Munkres%27_Book) [↗](http://drorbn.net/index.php?title=10-327/Errata_to_Munkres%27_Book) ([http://drorbn.net/index.php?title=10-327/Errata\\_to\\_Munkres%27\\_Book](http://drorbn.net/index.php?title=10-327/Errata_to_Munkres%27_Book))) (required reading!). The topology texts by Dugundji and Massey are also recommended, and many other texts are also available.


**Piazza Link.** <https://piazza.com/utoronto.ca/fall2024/mat327>, [↗](https://piazza.com/utoronto.ca/fall2024/mat327) (<https://piazza.com/utoronto.ca/fall2024/mat327>), access code 0k9rwtzm2wj.


**Blackboard Shots.** See <https://drorbn.net/bbs/show.php?prefix=24-327> [↗](https://drorbn.net/bbs/show.php?prefix=24-327) (<https://drorbn.net/bbs/show.php?prefix=24-327>).

## Course Calendar

#	Week of ...	
1	September 2-6	UofT classes begin on Tuesday September 3. Tutorials will only start next week. Handout: <a href="https://q.utoronto.ca/courses/355484/pages/about-this-class">About This Class</a> ( <a href="https://q.utoronto.ca/courses/355484/pages/about-this-class">https://q.utoronto.ca/courses/355484/pages/about-this-class</a> ).

#	Week of ...	
		<p>Tuesday: Course introduction and continuity in terms of open sets.</p> <p>HW1 is on Crowdmark, with a PDF copy <a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW01.pdf">here</a> (<a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW01.pdf">https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW01.pdf</a>). It was due on Tuesday September 10 at 11:59PM. Solutions sets (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">warning</a> (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">https://q.utoronto.ca/courses/355484/pages/solution-sets-warning</a>)): <a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW01Sol1.pdf">HW01Sol1</a>, (<a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW01Sol1.pdf">http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW01Sol1.pdf</a>) <a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW01Sol2.pdf">HW01Sol2</a> (<a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW01Sol2.pdf">http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW01Sol2.pdf</a>).</p> <p>Thursday: The definition of "topological spaces", reading the "<a href="https://q.utoronto.ca/courses/355484/pages/about-this-class">About This Class</a> (<a href="https://q.utoronto.ca/courses/355484/pages/about-this-class">https://q.utoronto.ca/courses/355484/pages/about-this-class</a>)" handout.</p>
2	September 9-13	<p>Monday: Tutorials.</p> <p>Tuesday: Comparing topologies, bases for a topology.</p> <p>HW2 is on Crowdmark, with a PDF copy <a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW02.pdf">here</a> (<a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW02.pdf">https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW02.pdf</a>). It was due on Tuesday September 17 at 11:59PM. Solutions sets (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">warning</a> (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">https://q.utoronto.ca/courses/355484/pages/solution-sets-warning</a>)): <a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW02Sol1.pdf">HW02Sol1</a> (<a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW02Sol1.pdf">http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW02Sol1.pdf</a>).</p> <p>Thursday: Bases, the order topology, product topologies.</p>
3	September 16-20	<p>Monday: Tutorials.</p> <p>Tuesday: The subspace topology, compatibilities.</p> <p>HW3 is on Crowdmark, with a PDF copy <a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW03.pdf">here</a> (<a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW03.pdf">https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW03.pdf</a>). It was due on Tuesday September 24 at 11:59PM. Solutions sets (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">warning</a> (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">https://q.utoronto.ca/courses/355484/pages/solution-sets-warning</a>)): <a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW03Sol1.pdf">HW03Sol1</a> (<a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW03Sol1.pdf">http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW03Sol1.pdf</a>), <a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW03Q2Sol2.png">HW03Q2Sol2</a> (<a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW03Q2Sol2.png">http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW03Q2Sol2.png</a>).</p> <p>Thursday: Closed sets.</p>
4	September 23-27	<p>Monday: Tutorials.</p> <p>Tuesday: Limit points, <math>T_1</math> and <math>T_2</math> spaces.</p>

#	Week of ...	
		<p>HW4 is on Crowdmark, with a PDF copy <a href="#">here</a> (<a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW04.pdf">https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW04.pdf</a>). It was due on Tuesday October 1 at 11:59PM. Solutions sets (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">warning</a> (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">https://q.utoronto.ca/courses/355484/pages/solution-sets-warning</a>)): <a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW04Sol1.pdf">HW04Sol1</a> (<a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW04Sol1.pdf">http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW04Sol1.pdf</a>).</p> <p>Thursday: More on continuity, the product topology.</p>
5	September 30 - October 4	<p>Monday: Tutorials.</p> <p>Tuesday: More on product topologies, metric spaces.</p> <p>HW5 is on Crowdmark, with a PDF copy <a href="#">here</a> (<a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW05.pdf">https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW05.pdf</a>). It was due on Tuesday October 8 at 11:59PM. Solutions sets (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">warning</a> (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">https://q.utoronto.ca/courses/355484/pages/solution-sets-warning</a>)): <a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW05Sol1.pdf">HW05Sol1</a> (<a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW05Sol1.pdf">http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW05Sol1.pdf</a>), <a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW05Q3Sol2.png">HW05Q3Sol2</a> (<a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW05Q3Sol2.png">http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW05Q3Sol2.png</a>).</p> <p>Thursday: Metrizable, sequential closures, and products.</p>
6	October 7-11	<p>Monday: Tutorials.</p> <p>Tuesday: Metrizable and products, quotient spaces.</p> <p>Thursday: Quotient spaces, connectivity.</p> <p>Friday: Pre Term Test office hours with Brinda at Bahen 2179 at 2-4pm.</p>
7	October 14-18	<p>Monday is Thanksgiving, no tutorials.</p> <p>Tuesday: Pre Term Test office hours with Dror at SU 432 at 9:30-11:30am (replaces the regular office hours!)</p> <p>Tuesday: Connected spaces.</p> <p>Tuesday: Pre Term Test office hours with Dror at AB 114 at 5-7pm.</p> <p>Wednesday: Pre Term Test office hours with Kai at SS 2112 at 2-4pm and then at BA 6180 at 4:10-5pm.</p> <p>Our Term Test took place on Wednesday at 7-9pm at Bahen 1180 and Bahen 1220. The class average was 79, the median was 87, and <a href="#">here's the PDF</a> </p>

#	Week of ...	
		<p>(<a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/24-327-TT.pdf">https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/24-327-TT.pdf</a>) .</p> <p>Solutions sets (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">warning</a> (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">https://q.utoronto.ca/courses/355484/pages/solution-sets-warning</a>)): <a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/TTSol1.pdf">TTSol1</a> (<a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/TTSol1.pdf">http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/TTSol1.pdf</a>) .</p> <p>Thursday: Products of connected spaces, path connectivity.</p>
8	October 21-25	<p>Monday: Tutorials.</p> <p>Tuesday: Introduction to compactness.</p> <p>HW6 is on Crowdmark, with a PDF copy <a href="#">here</a> (<a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW06.pdf">https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW06.pdf</a>) . It was due on Tuesday November 5 at 11:59PM. Solutions sets (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">warning</a> (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">https://q.utoronto.ca/courses/355484/pages/solution-sets-warning</a>)): <a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW06Sol1.pdf">HW06Sol1</a> (<a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW06Sol1.pdf">http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW06Sol1.pdf</a>) .</p> <p>Thursday: Compactness in <math>\mathbf{R}^n</math>.</p>
R	October 28 - November 1	<p>Reading Week - no classes, no tutorials, no office hours.</p>
9	November 4-8	<p>Monday is the last date to drop this class.</p> <p>Monday: Tutorials.</p> <p>Tuesday: Uniform continuity and the Lebesgue number lemma, <a href="#">regrets</a>  (<a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/WhatWeMiss.png">https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/WhatWeMiss.png</a>) .</p> <p>HW7 is on Crowdmark, with a PDF copy <a href="#">here</a> (<a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW07.pdf">https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW07.pdf</a>) . It was due on Tuesday November 12 at 11:59PM.</p> <p>Thursday: A bit on groups and a bit on homotopies.</p>
10	November 11-15	<p>Monday: Tutorials.</p> <p>Tuesday: More on path homotopies.</p> <p>HW8 is on Crowdmark, with a PDF copy <a href="#">here</a> (<a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW08.pdf">https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW08.pdf</a>) . It was due on Tuesday November 19 at 11:59PM. Solutions sets (<a href="#">warning</a></p>

#	Week of ...	
		<p>(<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">https://q.utoronto.ca/courses/355484/pages/solution-sets-warning</a>): <a href="#">HW08Sol1</a> (<a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW08Sol1.pdf">http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW08Sol1.pdf</a>).</p> <p>Thursday: <math>\pi_1</math>, covering spaces.</p>
11	November 18-22	<p>Monday: Tutorials.</p> <p>Tuesday: Lifting properties.</p> <p>HW9 is on Crowdmark, with a PDF copy <a href="#">here</a> (<a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW09.pdf">https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW09.pdf</a>). It is due on Tuesday November 26 at 11:59PM.</p> <p>Thursday: <math>\pi_1(S^1) \simeq \mathbb{Z}</math>, categories.</p>
12	November 25-29	<p>Monday: Tutorials.</p> <p>Tuesday: Functors, retracts.</p> <p>HW10 is on Crowdmark, with a PDF copy <a href="#">here</a> (<a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW10.pdf">https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/HW10.pdf</a>). It was due on Tuesday December 3 at 11:59PM. Solutions sets (<a href="#">warning</a> (<a href="https://q.utoronto.ca/courses/355484/pages/solution-sets-warning">https://q.utoronto.ca/courses/355484/pages/solution-sets-warning</a>): <a href="#">HW10Sol1</a> (<a href="http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW10Sol1.pdf">http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/SS/HW10Sol1.pdf</a>).</p> <p>Thursday: Last class!</p>
13	December 2-6	<p>No tutorials this Monday.</p> <p>No Dror office hours on Tuesday!</p> <p>HW10 was due on Tuesday at 11:59pm.</p> <p>Fall Final Assessments begin on Friday.</p>
FF1	December 9-15	<p>Dror will hold his regular office hours on Tuesday.</p> <p>Brinda will hold pre-exam office hours on Friday and on Saturday at 10am-1pm at the graduate lounge, on the 6th floor of the Bahen Building.</p> <p>Dror will be circling between the graduate lounge, room 6180, room 6183, and his office, all on the 6th floor of the Bahen Building, on Sunday from 10am until 5pm.</p>

#	Week of ...	
FF2	December 16-20	Our final exam will take place on Monday December 16 at 2-5pm at KC Knox (Knox Presbyterian Church, Fellowship Centre - GYM, 630 Spadina Avenue). See more <a href="https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/FEInfo.pdf">here (https://drorbn.net/AcademicPensieve/Classes/24-327-Topology/FEInfo.pdf)</a> . Fall Final Assessments end on Saturday.

### Further resources:

- The University of Toronto [Faculty of Arts & Science Calendar \(https://artsci.calendar.utoronto.ca/\)](https://artsci.calendar.utoronto.ca/).
- Academic integrity [Information for Students \(https://www.artsci.utoronto.ca/current/academic-advising-and-support/student-academic-integrity#:~:text=Academic%20Integrity%20in%20the%20Faculty,%2C%20respect%2C%20responsibility%20and%20courage.\)](https://www.artsci.utoronto.ca/current/academic-advising-and-support/student-academic-integrity#:~:text=Academic%20Integrity%20in%20the%20Faculty,%2C%20respect%2C%20responsibility%20and%20courage.).
- My personal [1982 topology](http://drorbn.net/AcademicPensieve/Classes/82-Topology/index.html) [↗](http://drorbn.net/AcademicPensieve/Classes/82-Topology/index.html) (http://drorbn.net/AcademicPensieve/Classes/82-Topology/index.html) notebook (as a student).
- My personal [1993 topology](http://drorbn.net/AcademicPensieve/Classes/93-131-Topology/) [↗](http://drorbn.net/AcademicPensieve/Classes/93-131-Topology/) (http://drorbn.net/AcademicPensieve/Classes/93-131-Topology/) notebook.
- My personal [1995-6 topology](http://drorbn.net/AcademicPensieve/Classes/9596-Topology/index.html) [↗](http://drorbn.net/AcademicPensieve/Classes/9596-Topology/index.html) (http://drorbn.net/AcademicPensieve/Classes/9596-Topology/index.html) notebook.
- My 2010 MAT327 Introduction to Topology [class website](http://drorbn.net/index.php?title=10-327) [↗](http://drorbn.net/index.php?title=10-327) (http://drorbn.net/index.php?title=10-327) and [personal notebook](http://drorbn.net/AcademicPensieve/Classes/10-327/index.html) [↗](http://drorbn.net/AcademicPensieve/Classes/10-327/index.html) (http://drorbn.net/AcademicPensieve/Classes/10-327/index.html).
- The Summer 2014 MAT327 Introduction to Topology [website](https://mikepawliuk.ca/teaching/mat-327-summer-2014/) [\(https://mikepawliuk.ca/teaching/mat-327-summer-2014/\)](https://mikepawliuk.ca/teaching/mat-327-summer-2014/), by Micheal Pawliuk.
- The Summer 2017 MAT327 Introduction to Topology [website](http://www.math.toronto.edu/ivan/mat327/) [\(http://www.math.toronto.edu/ivan/mat327/\)](http://www.math.toronto.edu/ivan/mat327/), by Ivan Khatchaturian.
- My personal [18-327-Topology](http://drorbn.net/AcademicPensieve/Classes/18-327-Topology/) [↗](http://drorbn.net/AcademicPensieve/Classes/18-327-Topology/) (http://drorbn.net/AcademicPensieve/Classes/18-327-Topology/) notebook.
- My personal [24-327-Topology](http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/) [↗](http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/) (http://drorbn.net/AcademicPensieve/Classes/24-327-Topology/) notebook.