

# Math 454, Section 02 (Combinatorics) Fall 2020 (Rutgers University)

[http://sites.math.rutgers.edu/~zeilberg/math454\\_20.html](http://sites.math.rutgers.edu/~zeilberg/math454_20.html)

Last Update: Dec. 11, 2020.

Note: This webpage is specific for Section 02.

[CLASS POLICY](#),

*TEXTS:*

- [Notes on Introductory Combinatorics](#), by George Polya, Robert Tarjan, and Donald Wood
- [Combinatorics Through Guided Discovery](#) by Kenneth Bogart
- [Enumerative and Algebraic Combinatorics](#) by Dr. Z.

**NOTE: I AM NOT USING CANVAS OR SAKAI, ALL COMMUNICATION WITH STUDENTS IS VIA EMAIL AND THIS WEB-PAGE**

## Instructor

[Dr. Doron ZEILBERGER \("Dr. Z"\)](#)

OFFICIAL Rutgers email: zeilberg at math dot rutgeres dot edu

E-mail for this class: ShaloshBEkhad@gmail.com

## Grader

Mr. Christopher Taglieri

## Times

While this class is Asynchronous remote, if it is at all possible, you should attend the live RECITATIONS. Invitations were sent. ALL RECITATIONS ARE RECORDED.

- **OPTIONAL BUT HIGHLY RECOMMENDED RECITATIONS: MTh 6:40-8:00pm Rutgers time.**

[They are all recorded, except that there is no Recitation 1]

[Homework assignments](#)

## On-Line Office Hours

- **MTh: 10:30-11:30am** and by appointment. Invitations were sent.

## Grading algorithm

- Homework (30%)
- Final Project (30%)
- Take Home Final (24 hours) (40%)  
[followed by a scheduled 10 minute oral exam (via WebEx) to make sure that you did it all by yourself]

[Rutgers Virtual Computer Labs](#) [where you can access Maple]

## How to submit Homework

See [Homework assignments](#)

## Teach yourself Maple

Teach yourself the basics of Maple by reading Frank Garvan's golden-oldie [part 1](#), [part 2](#)

Note: a few commands are no longer valid in today's Maple. The most important one is that " has been replaced by %.

For more details, see Frank Garvan's [2002 masterpiece](#).

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Added Oct. 24, 2020: Pick a [class project](#)

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## RECORDED LECTURES and RECITATIONS

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- [Lecture 0](#) [Aug. 22, 2020]
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- [Lecture 1 \(Part I\)](#) [Lecture 1 \(Part II\)](#) [Sept. 3, 2020]

## [Maple Code for Lecture 1](#)

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- No Class on Sept. 7 [Labor Day]
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- [Lecture 2](#) [Please watch by 9/9]. Discussed in live [Recitation 2](#), delivered **Sept. 10, 6:40-8:00pm**

## [Maple Code for Lecture 2](#)

[Empty attendance quiz](#) (rename this file p2FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Sept. 11, 8:00pm)

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- [Lecture 3](#) [Please watch by 9/13]. Discussed in live [Recitation 3](#) delivered **Sept. 14, 6:40-8:00pm**.

## [Maple Code for Lecture 3](#)

[Empty attendance quiz](#) (rename this file p3FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Sept. 15, 8:00pm)

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- [Lecture 4](#) [ Please watch by 9/16]. Discussed in live [Recitation 4](#) delivered **Sept. 17, 6:40-8:00pm**

## [Maple Code for Lecture 4](#)

[Empty attendance quiz](#) (rename this file p4FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Sept. 17, 8:00pm)

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- [Lecture 5](#) [ Please watch by 9/20]. discussed in live [Recitation 5](#) delivered **Sept. 21, 6:40-8:00pm**

[\[Maple code discussed in Recitation 5\]](#)

## [Maple Code for Lectures 5 and 6](#)

[Empty attendance quiz](#) (rename this file p5FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Sept. 21, 8:00pm)

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- [Lecture 6](#) [ Please watch by 9/23]. discussed in live [Recitation 6](#) delivered **Sept. 24, 6:40-8:00pm**

### [Maple Code for Lecture 6](#)

[Empty attendance quiz](#) (rename this file p6FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Sept. 24, 8:00pm)

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- [Lecture 7](#) [ Please watch by 9/27]. Discussed in **pre-recorded** [due to Yom Kippur] [Recitation 7](#) in lieu of the live recitation of **Sept. 28, 6:40-8:00pm**.

### [Maple Code for Lecture 7](#)

[Empty attendance quiz](#) (rename this file p7FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Sept. 28, 8:00pm)

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- [Lecture 8](#) [ Please watch by 9/30]. discussed during live [Recitation 8](#) delivered **Oct. 1, 6:40-8:00pm**.

### [Maple Code for Lecture 8](#)

[Empty attendance quiz](#) (rename this file p8FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Oct. 1, 8:00pm)

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- [Lecture 9](#) [ Please watch by 10/4] .

Instead of live Recitation 9 that was scheduled to be delivered **Oct. 5, 6:40-8:00pm** there would be 5 minute private chats with all the students. Emails were sent regarding the exact time for each student.

### [Maple Code for Lecture 9](#)

[Empty attendance quiz](#) (rename this file p9FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Oct. 6, 8:00pm)

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- [Lecture 10](#) [ Please watch by 10/7] . discussed during live [Recitation 10](#) delivered **Oct. 8, 6:40-8:00pm**.

### [Maple Code for Lecture 10](#)

[Empty attendance quiz](#) (rename this file p10FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Oct. 9, 8:00pm)

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- [Lecture 11](#) [ Please watch by 10/11] .

Please stop watching after time 1:13 (one hour 13 minutes). I stupidly forgot to share the screen after that. I will review this material later

discussed during live [Recitation 11](#) delivered **Oct. 12, 6:40-8:00pm**.

[Maple Code for Lecture 11](#)

[Empty attendance quiz](#) (rename this file p11FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Oct. 13, 8:00pm)

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- [Lecture 12](#) [ Please watch by 10/14] . discussed during live [Recitation 12](#) delivered **Oct. 15, 6:40-8:00pm**.

[Maple Code for Lecture 12](#)

[Empty attendance quiz](#) (rename this file p12FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Oct. 16, 8:00pm)

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- [Lecture 13](#) [ Please watch by 10/18] .

discussed during live [Recitation 13](#) delivered **Oct. 19, 6:40-8:00pm**.

[Maple Code for Lecture 13](#)

[Empty attendance quiz](#) (rename this file p13FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Oct. 20, 8:00pm)

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- [Lecture 14](#) [ Please watch by 10/21]

discussed during live [Recitation 14](#) delivered **Oct. 22, 6:40-8:00pm**.

[Maple Code for Lecture 14](#)

[Empty attendance quiz](#) (rename this file p14FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Oct. 23, 8:00pm)

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- [Lecture 15](#) [ Please watch by 10/25]

discussed during live [Recitation 15](#) delivered **Oct. 26, 6:40-8:00pm**.

The Maple code for Lectures 15 and 16 consists of the seven suggested projects in [Suggested class projects](#)

[Empty attendance quiz](#) (rename this file p15FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Oct. 27, 8:00pm)

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- [Lecture 16 Part 1](#) [Lecture 16 Part 2](#) [ Please watch by 10/28]

discussed during live recitation 16 [Recitation 16](#) delivered **Oct. 29, 6:40-8:00pm**

The Maple code for Lectures 15 and 16 consists of the seven suggested projects in [Suggested class projects](#)

[Empty attendance quiz](#) (rename this file p16FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Oct. 30, 8:00pm)

**Due Nov. 1, 2020:** Return [this form](#), renamed: ProjectChoiceFirstLast.txt, to ShaloshBEkhad@gmail.com by Nov. 1, 2020, 8:00pm)

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- 11/2: [Lecture 17](#) [ Please watch by 11/1]

discussed during live recitation 17 [Recitation 17](#) delivered **Nov. 2, 6:40-8:00pm**

The Maple code for Lectures 15, 16 and 17 consists of the seven suggested projects in [Suggested class projects](#)

[Empty attendance quiz](#) (rename this file p17FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Nov. 3, 8:00pm)

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- 11/5: [Live Lecture 17a](#) (=Recitation 17a) [People who did not attend it should watch it by Nov. 7]

It discusses and simulates the combinatorics (and probability) of the complicated American Electoral College system.

The Maple code is [ComboProject8.txt](#)

[Empty attendance quiz](#) (rename this file p17aFirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Nov. 7, 8:00pm)

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- 11/9: [Lecture 18](#) [ Please watch by 11/8]

discussed during live [Recitation 18](#) delivered **Nov. 9, 6:40-8:00pm**  
[but, except for the first few minutes, it is useless, and is posted for the record]

### [Maple Code for Lecture 18](#)

[Empty attendance quiz](#) (rename this file p18FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Nov. 10, 8:00pm)

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- 11/12: [Lecture 19](#) [ Please watch by 11/11]  
The live [Recitation 19](#) delivered **Nov. 12, 6:40-8:00pm** discusses the class projects. It should be watched by everyone.

There is no Maple code for this lecture. It is all theory

[Empty attendance quiz](#) (rename this file p19FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Nov. 13, 8:00pm)

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- 11/16: [Lecture 20](#) [ Please watch by 11/15]

discussed during live [Recitation 20](#) delivered **Nov. 16, 6:40-8:00pm**

### [Maple Code for Lecture 20](#)

[Empty attendance quiz](#) (rename this file p20FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Nov. 17, 8:00pm)

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- 11/19: [Lecture 21](#) [ Please watch by 11/18] -

discussed during live recitation 21 delivered **Nov. 19, 6:40-8:00pm**

### [Maple Code for Lecture 21](#)

[Empty attendance quiz](#) (rename this file p21FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Nov. 20, 8:00pm)

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- 11/23 and 11/26: NO LECTURES OR RECITATIONS THIS WEEK. BUT It is expected that students will work hard and make progress on the Final Projects.
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- 11/30: [Lecture 22](#) [Please watch by 11/29]

discussed during live [Recitation 22](#) delivered **Nov. 30, 6:40-8:00pm**

## [Maple Code for Lecture 22](#)

[Empty attendance quiz](#) (rename this file p22FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Dec. 1, 8:00pm)

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- 12/3: [Lecture 23](#) [ Please watch by 12/2]

discussed during live [Recitation 23](#) delivered **Dec. 3, 6:40-8:00pm**

## [Maple Code for Lecture 23](#)

[Empty attendance quiz](#) (rename this file p23FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Dec. 4, 8:00pm)

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- 12/7: [Lecture 24](#) [ Please watch by 12/6]

discussed during [Recitation 24](#) delivered **Dec. 7, 6:40-8:00pm**

## [Maple Code for Lecture 24](#)

[Empty attendance quiz](#) (rename this file p24FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Dec. 8, 8:00pm)

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- 12/10: [Lecture 25](#) [ Please watch by 12/9]

discussed during live [Recitation 25](#) delivered **Dec. 10, 6:40-8:00pm**

## [Maple Code for Lecture 25](#)

[Empty attendance quiz](#) (rename this file p25FirstLast.txt, and add the answers, and email to ShaloshBEkhad@gmail.com by Dec. 11, 8:00pm)

[Dr. Z.'s paper on Sylvester's bijection](#)

[The Bressoud-Zeilberger bijective proof of Euler's recurrence for the number of partitions](#)

## [Practice Final](#)

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**Take home Final:** Dec. 15, 2020. Emailed you 9:00am and due 9:00am Dec.16. Oral exams will be scheduled.



Added Dec. 18, 2020: Here is the [24-hour Take Home exam](#) and the students' completed tests (who kindly agreed to be posted) can be found in [this directory](#).

Added Dec. 18, 2020: Look at the great

[class projects](#)

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[Dr. Z.'s teaching](#)