CSE103: Introduction to Probability and Statistics

Prof. Yoav Freund

Flipping two dice

- 1 dice-What is the probability that it will land on 6 ? Or on 5 ?
- G,R dice. What is the probability of green=6 and red=5
- R,R dice. What is the probability of red=5 and red=6?
- R,R dice. What is the probability of red=5 and red=5 ?
- The difference is because dice of the same color are **indistinguishable**

Indistinguishability / Exchangeability

- Two object are indistinguishable if exchanging them makes not difference.
- What makes two objects indistinguishable?
- Mathematical objects (points, lines) are indistinguishable
  - Physical objects are distinguishable (we can mark them)
- Poker cards are indistinguishable, unless marked (illegal)
- iPhones (of the same model) are indistinguishable
  - iPhone covers make the iPhones distinguishable.
- Dollars are indistinguishable – that is what makes the economy work (compare that to bartering).
- Are fruit indistinguishable? (same DNA)
- Are animals of a species distinguishable?
- Are people distinguishable?

Probabilities regarding people

- Which of the following is more correct?
  - Each of us is unique, we have our own free will.
  - We belong to groups, our opinions are the opinions of the group.
- When the number of people is large, a very effective way to reason is to think of people as interchangeable:
  - How many children in this district have special needs?
  - How many voters in this county are likely to vote republican?
  - What is the lowest price for a life insurance policy that will not bankrupt the insurance company?
- Are we all the same or are we all different?

We are individuals – The life of Brian

Can Amazon read consumers' minds?

By Gary Robbins 4:31 P.M. JAN. 27, 2014

RECOMMENDED | TRENDING

SDSU's Toledo: 'I'm Monday morning QB t…
Smash and grab robber at Shell station ge…
Brandon Flowers added to injury report
Pace of home price appreciation in San Di…
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The power of predictive analytics

AMAZON PATENTED AN ANTICIPATORY SHIPPING SYSTEM THAT PREDICTS ORDERS

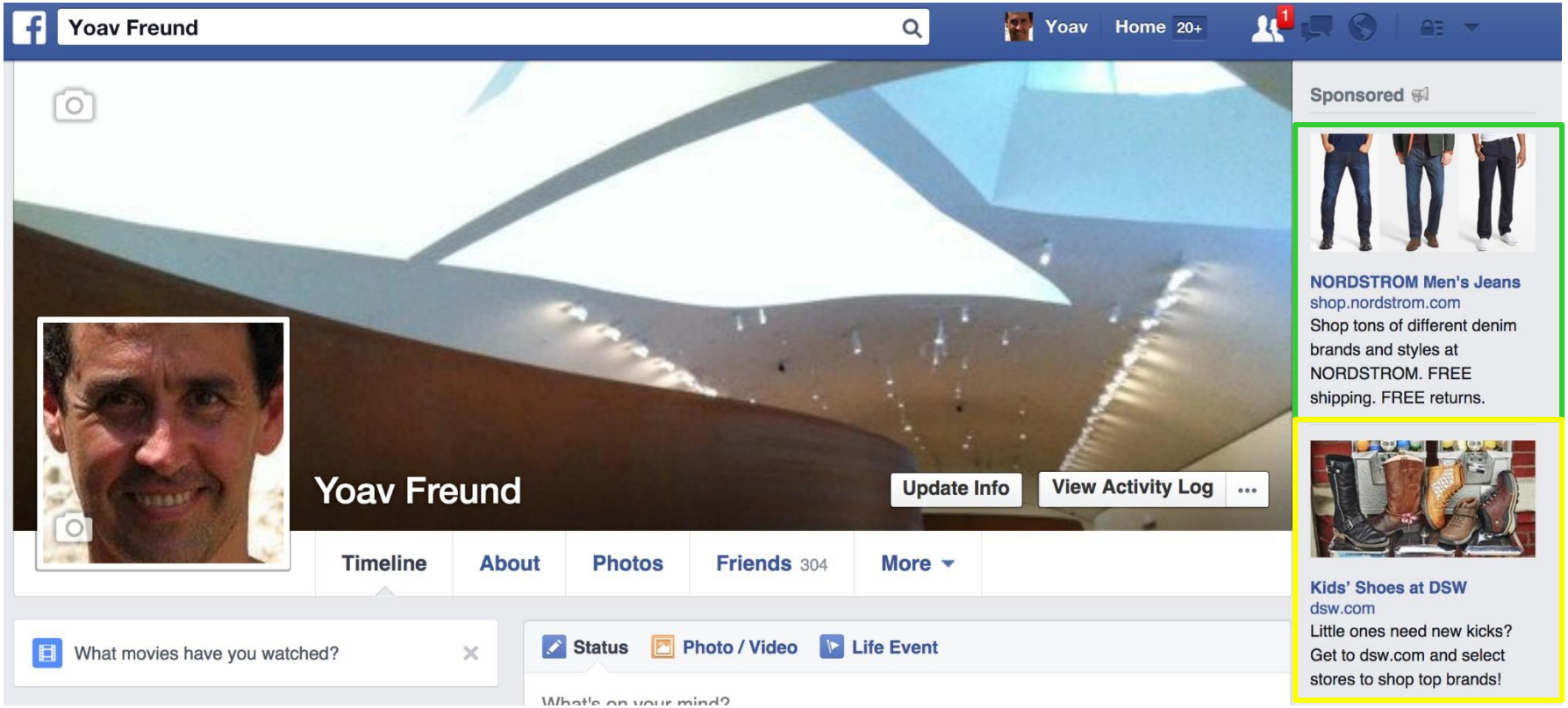
By **Mike Flacy** — January 18, 2014

Noticed by the Wall Street Journal, Amazon recently patented a new system that will help the retailer create predictive models to accurately forecast where an item will need to ship. Calling the system “anticipatory shipping,” Amazon will collectively compile data such as product searches, page visits, wish list items, order history, overall time on page, items left in the shopping cart and return history to pre-ship items to closer warehouse locations or even directly to the eventual recipient. Amazon even plans to measure the length of time that a user’s mouse cursor hovers over an item in order to predict an upcoming purchase.

What is going on?

- Actual patent: shipping a package without a final destination.
- How does this work:
  - Amazon predicts that >100 people in san diego will order the new iPad on Dec 24 with same-day delivery.
  - Mail 100 iPad's to san diego on dec 20, using UPS ground, with no final address (special agreement with UPS)
  - Fulfill last minute orders by assigning the address while package is in transit.
- This method works well when there are many identical orders from one location/city.
- Supply chain management is a long standing practice, amazon is bringing it to the next level.
- Statistics used to predict how many orders we will have of item X from location Y.

Ads on my Facebook Page



click-through

- A "click-through" occurs when
  - Surfer reaches a web page.
  - Surfer clicks on an ad – sent to a new page.
  - Advertiser pays web-host company 1 cent.
- Web host wants to place ads that are more likely to get a click through.
- Many factors to consider, but we'll keep things simple:
  - There are two alternative ads: a and b
  - The (unknown) probabilities of click through are Pa and Pb
  - If Pa > Pb -> always display a
  - If Pa < Pb -> always display b
- But we don't know!
  - To estimate Pa and Pb We alternate a,b,a,b,a,b,a,….

The law of large numbers

- If we repeat displaying ad a forever, the fraction of times that a click-through occurs converges to the true probability Pa
- Same for ad b
- By repeating a,b,a,b,a,b,a,… forever we will find out which of the two is better.
- Forever is too long – we will never get to use this knowledge.
- In this class we will study the rate at which we approach the limit.
- For now, a few figures.

The sequence of running averages

1=click through, 0=no click through

Focus on a sequence with one of the two ads:

$X_1, X_2, X_3, \ldots = 0, 0, 1, 0, 0, 0, 0, 1, \ldots$

The running average is:

$$X_1, \frac{X_1 + X_2}{2}, \frac{X_1 + X_2 + X_3}{3}, \ldots, \frac{1}{t}\sum_{i=1}^{t} X_i, \ldots$$

For the sequence above it the running average is:

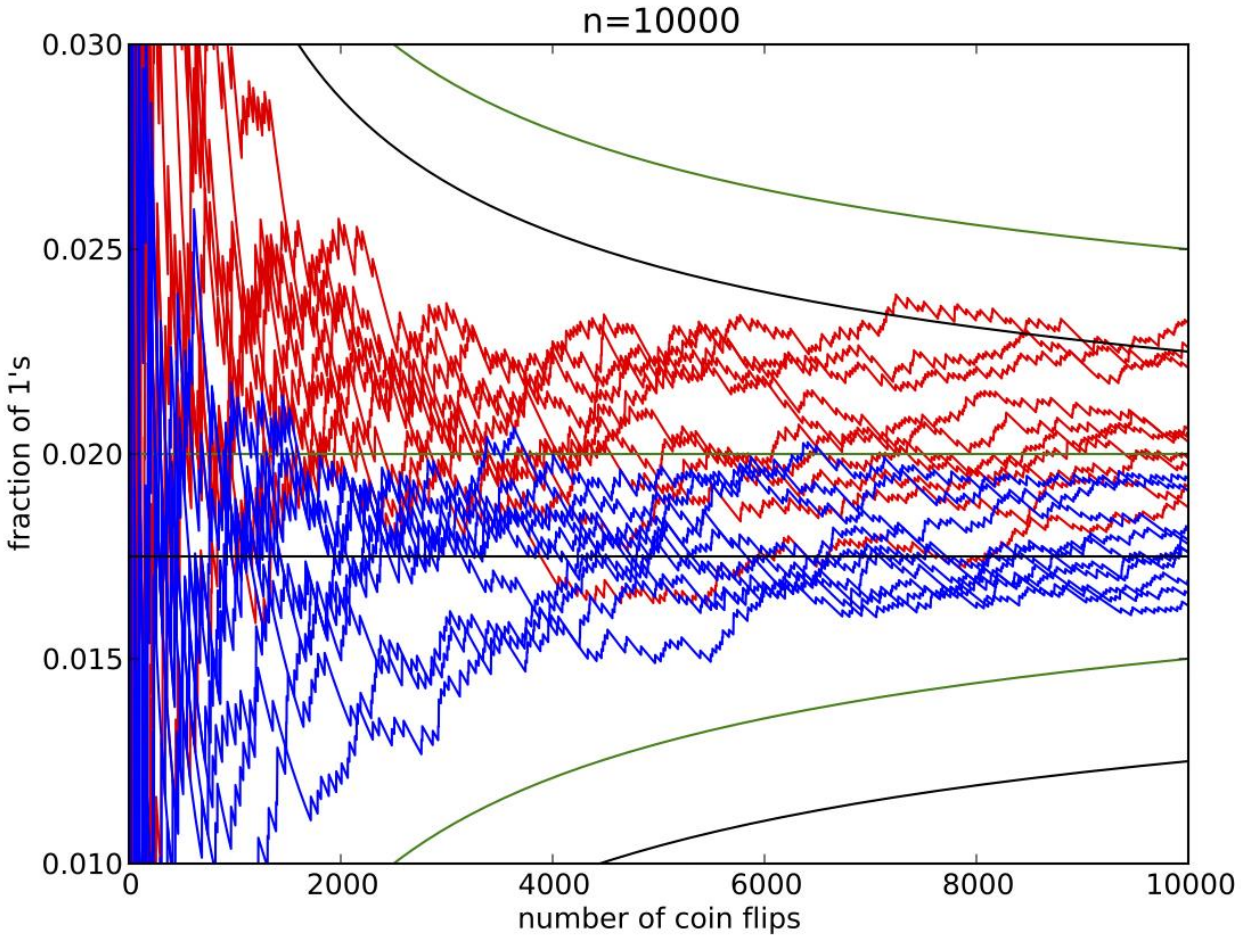
$$0, 0, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}, \frac{1}{7}, \frac{2}{8}, \ldots$$

From the law of large numbers we know that the sequence converges to the true probability. The question is how fast?

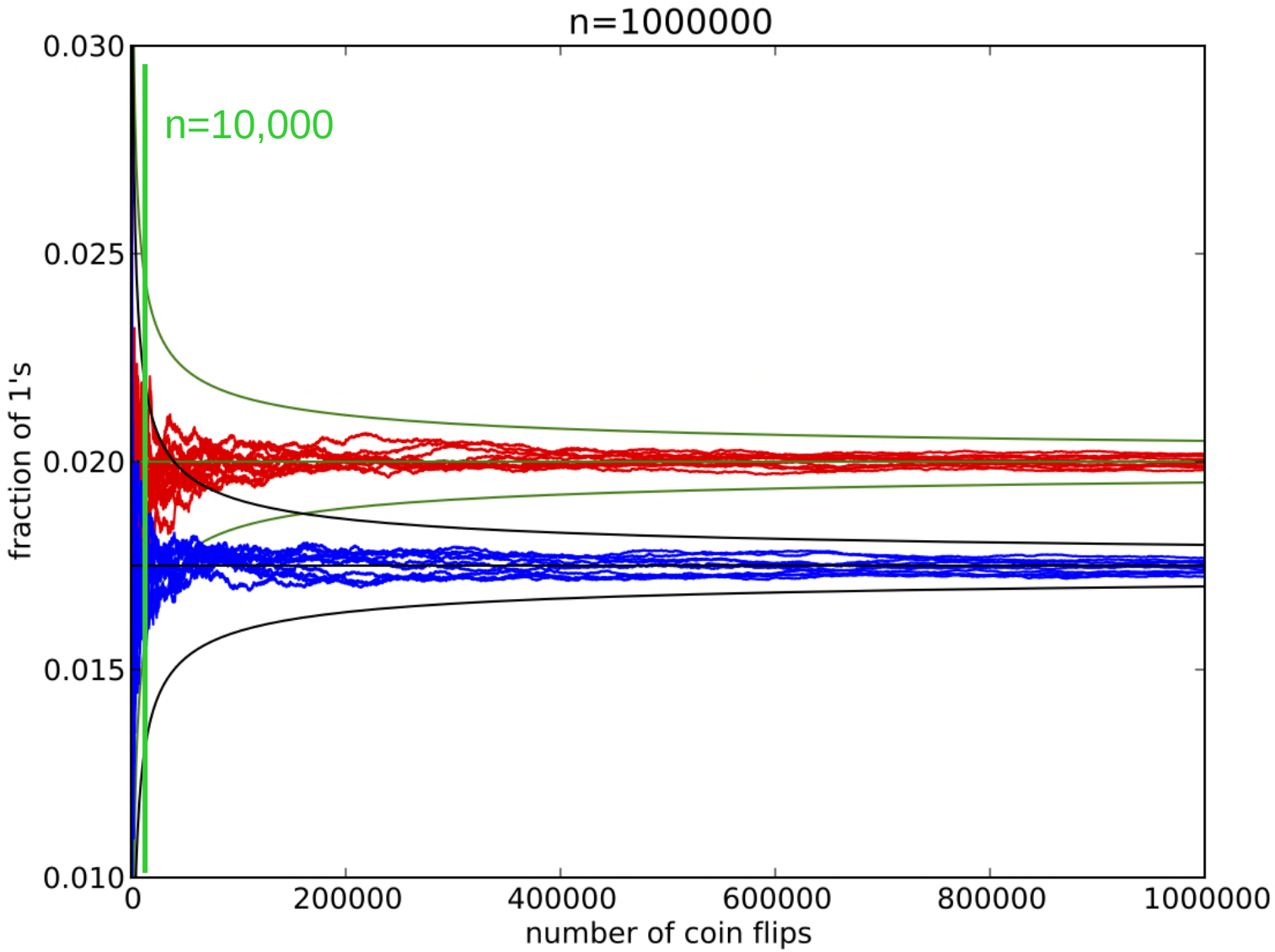
Running averages after 10,000 trials

Each jagged line is the running average for one sequence

The smooth green and black curves define the “envelope” of likely sequences



Running average after 1,000,000 trials



Class web site: http://cse103.github.io

Instruction Staff

			Office hours	Office Location	E-mail address
Instructor:	Yoav Freund		Tuesday 10AM - Noon.	Office #4126, CSE building	
Teaching Assistant:	Akshay Balsubramani		Monday 4PM-5PM, Thursday 10AM-11AM	Office #4142, CSE building	abalsubr@ucsd.edu
Teaching Assistant:	Ibrahim Awwal		Tuesday 12PM-1PM, Friday 10AM-11AM	Office #4223, CSE building	iawwal@ucsd.edu
Teaching Assistant:	Sanjeev Rao		Wednesday 11AM-12PM, Friday 11AM-12PM	Office #4223, CSE building	sjrao@ucsd.edu
Tutor:	Janet Zhen Zhai		Monday 10AM-11AM, Wednesday 10AM-11AM	Office #4223, CSE building	zzhai@ucsd.edu

To contact the teaching staff send a private message through Piazza.

Webwork

- Weekly Assignments run from wed-noon to wed-noon
- Assignments are 60% of the final grade
- 3 lowest grades are dropped before taking the average.
- Collaborate to understand the problem and how to solve it but be sure to solve it yourself!
- Problems are often randomized – your problem is likely slightly different than that of your friend.

Week1: Problem 3

Prev | Up | Next

This set is **visible to students.**

(1 pt) **Reorganized/Orientation/prob03.pg**

Typing in Your Answers

Here are the standard symbols that WeBWorK, along with most other computer software, uses for arithmetic operations:

Symbol	Meaning	Example
+	Addition	`3+4 = 7`
-	Subtraction	`3-4 = -1`
*	Multiplication	`3*4 = 12`
/	Division	`3/4 = .75`
^ or **	Exponentiation	`3^4 = 81` or `3**4 = 81`

Sometimes WeBWorK will insist that you calculate the value of an expression as a single number before you enter it. For example, calculate the value of $6(-3+4)-(6-5)$ and enter it in the following blank. (Here you have to enter a single integer; the question is testing whether you can do the operations correctly.)

$6(-3+4)-(6-5)=$ [ ]

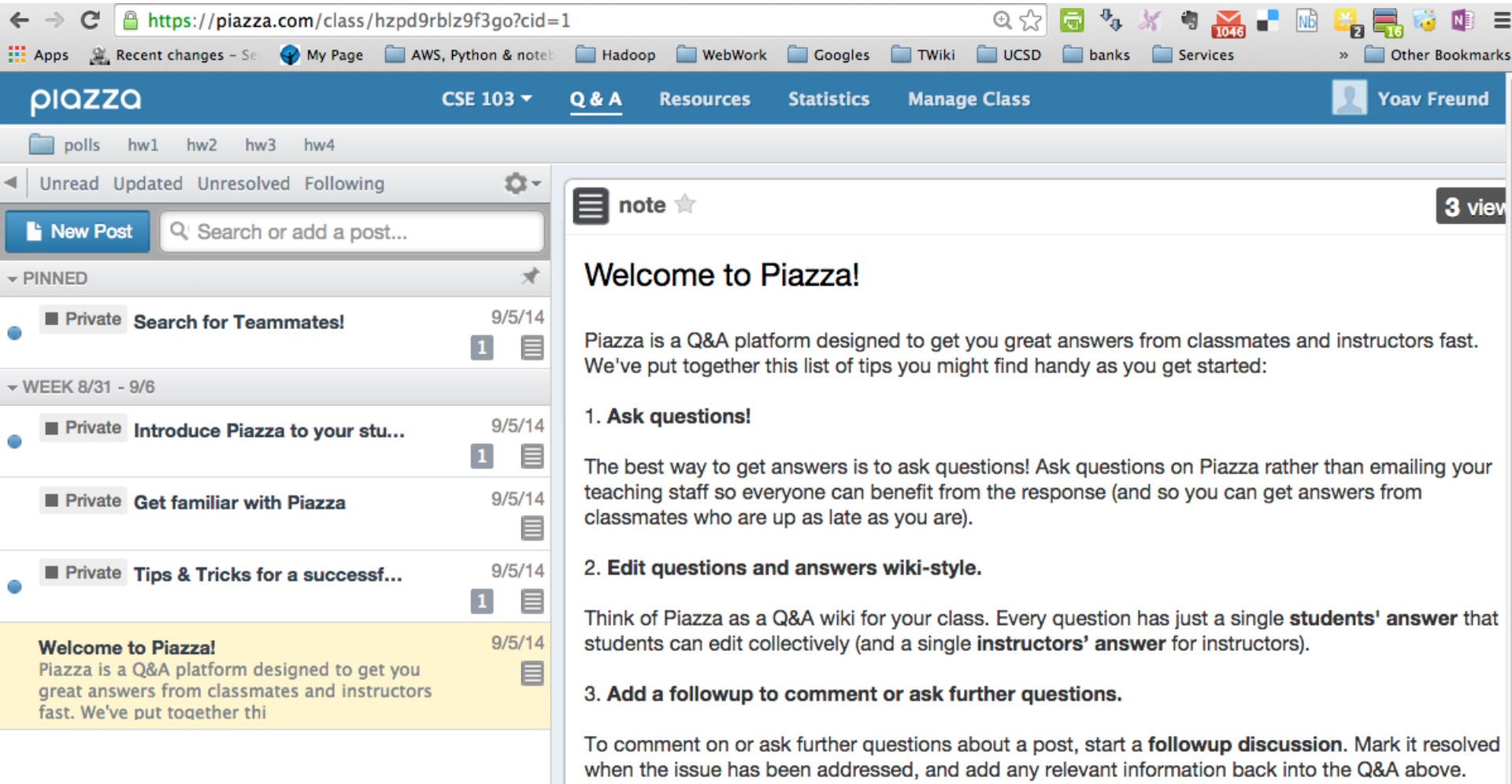
Most often you will not have to simplify your answer, but can let WeBWorK do this for you. The following blanks are all expecting the value 16. Try entering it several different ways, such as `7+9`, `18-2`, `8*2`, `32/2`, and `4^2`. Note: pressing the "Tab" key on your keyboard will move you from one answer box to the next.

16 = [ ] or [ ] or [ ] or [ ] or [ ]

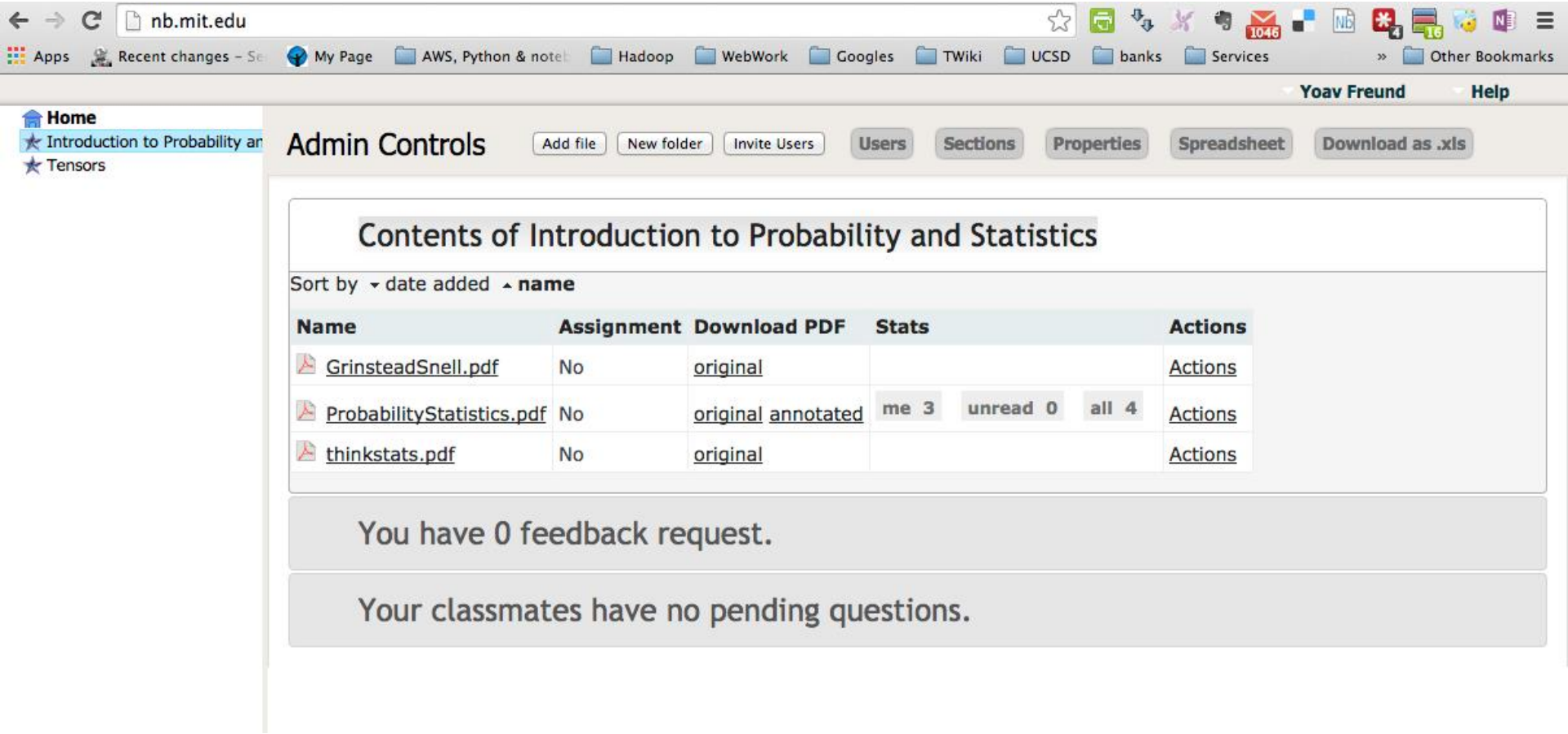
WeBWorK also understands that quantities written next to each other are supposed to be multiplied. For example, you can enter `(9)(7)` instead of `63`. Most often this is used when

Piazza

- **Main purpose:** discussion of Webwork assignment
- Search and read previous postings before
- Use it for everything! Any problem/question/idea/complaint
- 3 lowest grades



Nota-Benne 1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Nota Benne 2

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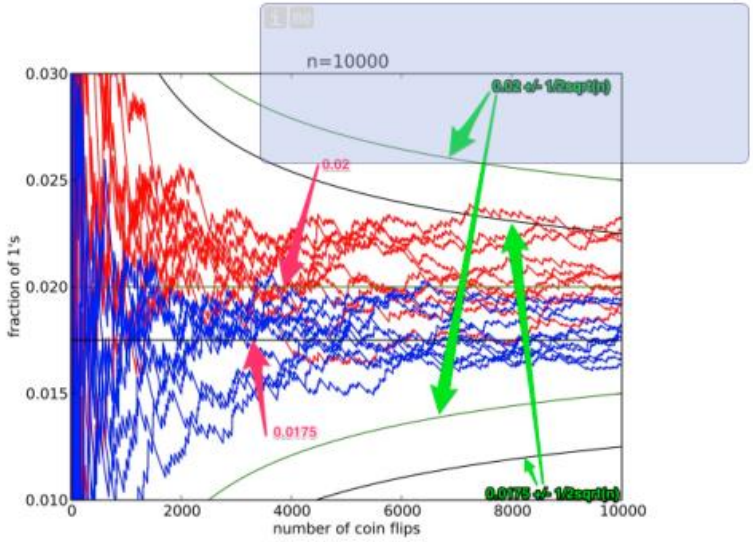
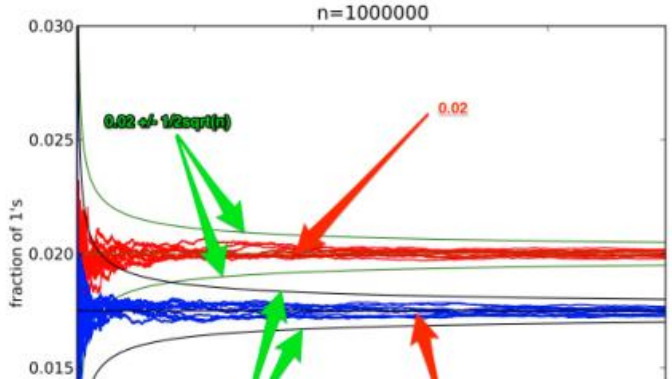
Apps | Recent changes – Se | My Page | AWS, Python & notet | Hadoop | WebWork | Googles | TWiki | UCSD | banks | Services | Other Bookmarks

Yoav Freund | Help

1.5. MONTE-CARLO SIMULATIONS 11





3 threads | me 3 | 0 | 0

1 thread on page 11

1 i me What is the diffence between the green and the red arro...

3 threads on page 29

2 i me I think you mean 3 shared, rather than 5 shared...

1 i me seen only by the player who received them. They are re...

1 i me Delete

? + 0 – replies requested

What is the diffence between the green and the red arrows?

Yoav Freund i me – 02:42PM

For Monday

- Make sure you have accounts on:
  - Webwork (ID@ucsd.edu, password=PID)
  - Piazza
  - Nota Benne
- Read chapter 1 of the class notes, comment in places that you don't understand.
- Start on webwork week1 assignment: is due next wed at noon!
- Post your questions on Piazza
- See you on Monday!