COMP 2804
Exam Study Session - Winter 2026

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Study Session Format:

- Go over possible topics on the exam
- List tips and tricks to succeed (based on intuition and past experience)
- Go over ~11 practice questions, mix of short answer and multiple choice across all relevant chapters from the course
    - Counting
    - Recursion
    - Probability
    - Random Variables
    - Probabilistic Method
- Open Q & A

DISCLAIMER:

- The material presented in this slides and during the study session will not influence what is on the final exam in one way or another - this is not the definitive content of the final.
- This is not a comprehensive study guide - it is more intended to complement your studies.
- Please review the content from the professor and the textbook as well.

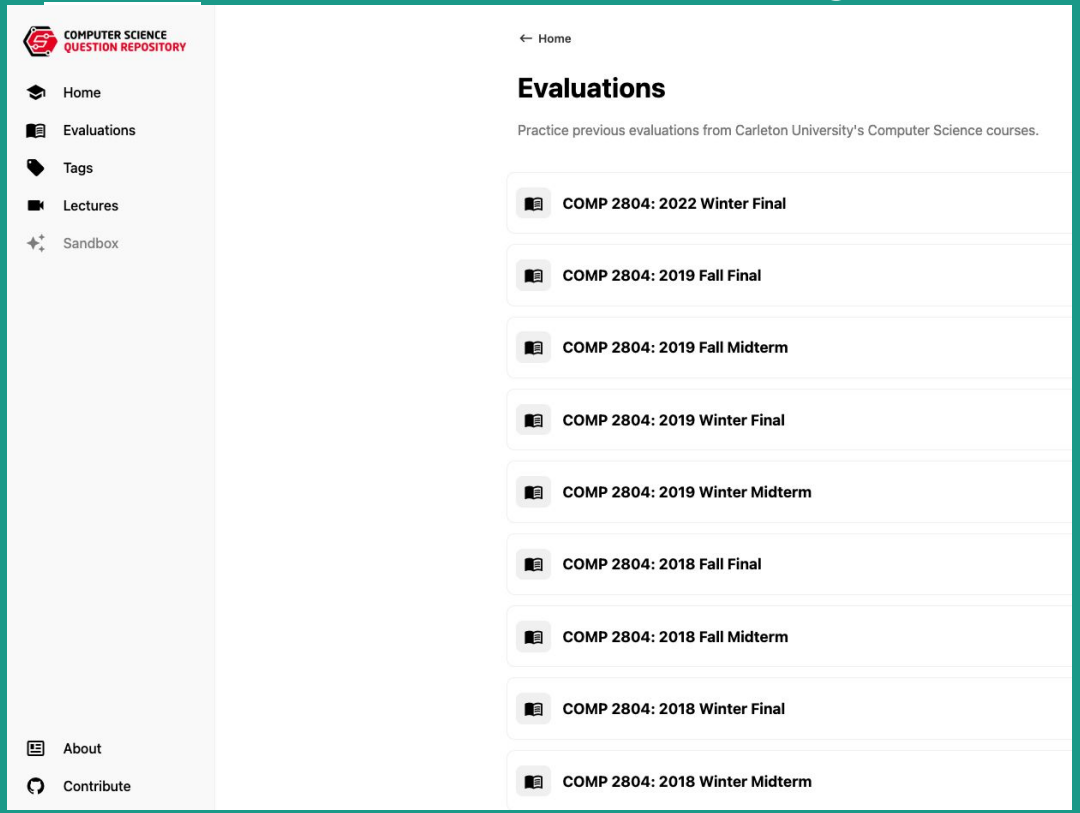
Tips and Tricks For Exam:

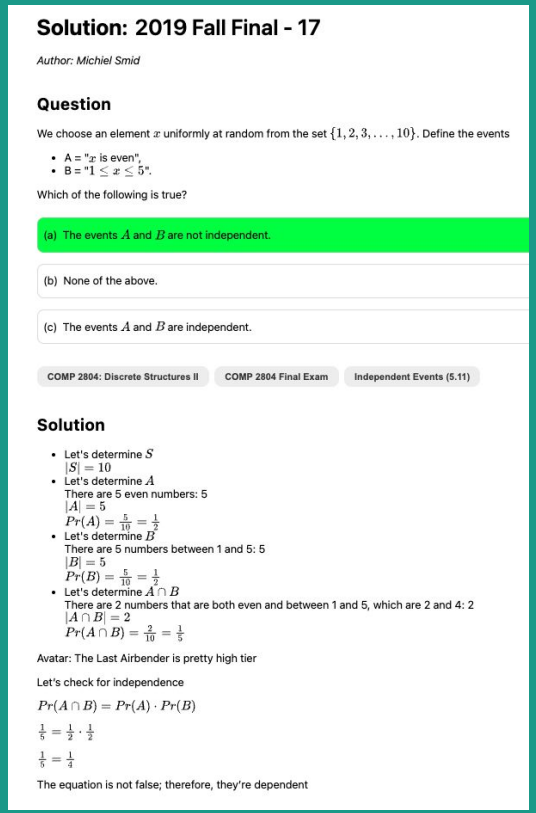
1. No cheat sheet, so memorize common formulas (ex. Linearity of Expectation, Independent Events)

2. Test on small examples (especially useful if the question is not computational or the question is recursive)

3. Study past exams over past assignments or textbook questions
    a. I would be careful with textbook questions since there aren't any known accepted solutions

Shoutout: Carleton Computer Science Questions Repository





Sample/Practice Questions

- 11 Questions
  - 1 Counting Question
  - 2 Recursion Question
  - 2 Probability Questions
  - 5 Random Variables and Expectation Questions
  - 1 Probabilistic Method Question

Question 1

A flip in a bitstring is a pair of adjacent bits that are not equal. For example, the bitstring `010011` has three flips: The first two bits form a flip, the second and third bits form a flip, and the fourth and fifth bits form a flip.

- Determine the number of bitstrings of length 7 that have exactly 3 flips at the following positions: The second and third bits form a flip, the third and fourth bits form a flip, and the fifth and sixth bits form a flip.
- Let $n \geq 2$ and k be integers with $0 \leq k \leq n-1$. Determine the number of bitstrings of length n that have exactly k flips.

Question 2

9 Question 9: Recurrence for Strings with No aa or bb

Question

Let S_n count the number of length-n strings over $\{a, b, c\}$ containing no aa or bb. Which recurrence holds for $n \geq 1$?

Choices

(a) $S_n = S_{n-1} + \sum_{i=0}^{n-2} S_i$

(b) $S_n = S_{n-1} + \sum_{i=0}^{n-2} 2S_i$

(c) $S_n = S_{n-1} + \sum_{i=1}^{n} 2S_{n-i}$

(d) $S_n = S_{n-1} + 4S_{n-2}$

(e) $S_n = S_{n-1} + 2S_{n-2}$

Question 3

10 Question 10: Solving a Linear Recurrence

Question

The function T is defined by

$$T(n) = \begin{cases} 3, & n = 0, \\ 2T(n-1) + 3, & n \geq 1. \end{cases}$$

Which is true?

Choices

(a) $T(n) = 3^{n+1}$

(b) $T(n) = 3n$

(c) $T(n) = 2(3^{n+1} - 1)$

(d) $T(n) = 3(2^{n+1} - 1)$

(e) $T(n) = 2^{n+1} + 1$

Question 4

11 Question 11: $\Pr(D \bmod 4 = 0)$

Question

Let D be a fair roll of a 6-sided die. What is $\Pr(D \bmod 4 = 0)$?

Choices

(a) 1/2

(b) 1/5

(c) 1/3

(d) 1/6

(e) 1/4

Question 5

14 Question 14: Number of Sums Equal to 5

Question

Roll a die $2n$ times to form the sequence

$$S = \{(D_1 + D_2), (D_3 + D_4), \ldots, (D_{2n-1} + D_{2n})\},$$

whose entries are all in $\{2, \ldots, 12\}$. What is the probability that exactly k entries equal 5?

Choices

(a) $\binom{n}{k}\left(\frac{1}{36}\right)^k\left(\frac{35}{36}\right)^{n-k}$

(b) $\binom{n}{k}\left(\frac{1}{12}\right)^k\left(\frac{11}{12}\right)^{n-k}$

(c) $\binom{n}{k}\left(\frac{1}{9}\right)^k\left(\frac{8}{9}\right)^{n-k}$

(d) $\binom{n}{k}\left(\frac{1}{11}\right)^k\left(\frac{10}{11}\right)^{n-k}$

(e) $\binom{n}{k}\left(\frac{1}{6}\right)^k\left(\frac{5}{6}\right)^{n-k}$

Question 6

18 Question 18: $E(\max(X, Y))$ for 4-Sided Dice

Question

Let X and Y be the results of rolling two 4-sided dice. Let $Z = \max(X, Y)$. What is $E(Z)$?

Choices

(a) 13/4

(b) 7/2

(c) 3

(d) 25/8

(e) 5/2

Question 7

19 Question 19: Expected Number of Shouters

Question

$n \geq 3$ friends stand in a circle and flip coins. A friend shouts "Huzzah!" if their flip differs from both neighbors. Let X be the number of shouters. What is $E(X)$?

Choices

(a) $n/2$

(b) $n/8$

(c) $n/3$

(d) None of the above

(e) $n/4$

Question 8

You go fishing in a lake. There are two types of fish (trout and pike) in the lake. Each time you cast your line, you catch a trout with probability 4/5 and you catch a pike with probability 1/5. You throw every fish you catch back in the water, so the result of each cast is independent of which types of fish you caught on previous casts. You stop fishing once you've caught at least one trout and at least one pike.

What is the expected number of casts you make before you stop fishing?

Question 9

Let D be a standard deck of cards.

For a card $c \in D$, let the value of $X(c)$ be equal to the value of the card. So 1 if the rank is A, 2 if the card is 2, ..., and 10 if the rank is in $\{J, Q, K\}$.

Assume you are dealt a standard hand of 5 cards.

Let the folllowing be random variables:

$$V = \text{The sum of the values of the cards in your hand,}$$
$$F = \text{The number of face cards (that is, } J, Q, \text{ or } K\text{) in your hand.}$$

1. What are $\mathbb{E}(V)$ and $\mathbb{E}(F)$?
2. Are V and F independent random variables?

Question 10

23 Question 23: Is $E(X^2) = (E(X))^2$ Always True?

Question

Is the following true or false? For any random variable X:

$$E(X^2) = E(X) \cdot E(X).$$

Choices

(a) Neither true nor false

(b) True

(c) False

Question 11

Question

100 students each choose one of 10 study groups, independently and uniformly at random. (So each student picks each group with probability 1/10.)

Let X be the number of study groups that end up with *no* students. What is $E(X)$?

Choices

(a) $10\left(\frac{9}{10}\right)^{100}$

(b) $10\left(\frac{1}{10}\right)^{100}$

(c) $\left(\frac{9}{10}\right)^{100}$

(d) $100\left(\frac{9}{10}\right)^{10}$

(e) $10\left(1-\left(\frac{9}{10}\right)^{100}\right)$

Resources:

Past assignments:

- https://cglab.ca/~michiel/2804/oldassignments/oldassignments.html

Past Midterms and Exams:

- https://cglab.ca/~michiel/2804/oldmidterms/oldmidterms.html
- https://cglab.ca/~michiel/2804/oldexams/oldexams.html
- https://cglab.ca/~morin/teaching/2804/oldexams.html

Interactive Version of Midterms and Exams:

- https://questions.carletoncomputerscience.ca/comp2804

Questions document:

- https://drive.google.com/file/d/1CA-mAtEkMVpMZQoXNsVU4Z8ahkptQp49/view?usp=sharing