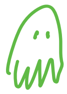
CS1800

Friday the 13th 

Agenda

1. Exam logistics

2. Practice exam

1. Exam Logistics

- Tues, 10/17
- Open 9Am - 5:30pm
- Remote (gradescope) ~ 2 hour window once started

  ~ 1h 40 min work
  20 min for tech details

  ~ (start by 3:30 to get full 2 hours)
- Upload per problem
- Show your work! !!
- Clarification? Post on piazza (private)
- Open note, textbook, Hw/Rec
- $\boxed{\text{Closed}}$ internet, people
- No discussion of exam until returned
- no recitation next week
- DRC Accommodation?
  - extra time: built in to gradescope

Kayla McLaughlin

- distraction reduced env: book room w/DRC

- circle/highlight your final answer
- partial credit

2. Practice Exam

Problem 7 Principle Inclusion/Exclusion OS
There are 2504 computer science students at a school. Of these, 1876 have taken a course in Java, 999 have taken a course in Linux, and 345 have taken a course in C. Further, 876 have taken courses in both Java and Linux, 231 have taken courses in both Linux and C, and 290 have taken courses in both Java and C. If 189 of these students have taken courses in Linux, Java, and C, how many of these 2504 students have not taken a course in any of these three programming languages?

PIE (in general)... $|A \cup B \cup C| = |A| + |B| + |C| -$
$|A \cap B| - |A \cap C| - |B \cap C| + |A \cap B \cap C|$

$|U| = 2504$ A = Java, B = Linux, C = C

$|A| = 1876$ $|A \cap B| = 876$ $|A \cap B \cap C| = 189$

$|B| = 999$ $|A \cap C| = 290$

$|C| = 345$ $|B \cap C| = 231$

$|A \cup B \cup C|$ = students who took at least one of A, B, C

$= 1876 + 999 + 345 - 876 - 290 - 231 + 189$

$= 2012$

$|U| - |A \cup B \cup C|$ = students who took none of these courses

$2504 - 2012 = \boxed{492}$

, or A and B and C

Problem 6 Counting: Assorted 1 2 3 4

A course has 4 sections. Each contains 239, 243, 87 and 49 students respectively.

i If six students from the smallest section form a study group, how many different groups could there be?

ii How many different study groups can be formed from one student from each of the four sections? (Four total students in the group).

iii One student from the second (243 student) section wishes to form a study group with two students from the first section (239 students). How many different groups can she form?

iv She is now willing to form a group with two students from either the first *or* third sections (potentially one from each), how many different groups can she form?

v She realizes that the two sections have different styles, so she now wishes to select the two students from either the first or third section, but not both, how many different groups can she form?

i. $\binom{49}{6}$

ii. $\underset{\text{sec1}}{239} \cdot \underset{\text{sec2}}{243} \cdot \underset{\text{sec3}}{87} \cdot \underset{\text{sec4}}{49}$

iii. $\binom{239}{2}$ ... or ... $243 \cdot \binom{239}{2}$

- Ask for clarification $\binom{243}{1} \cdot \binom{239}{2}$
- We'd accept either

iv. both from sec 1 or both sec 3 or one of each

$\binom{239}{2} + \binom{87}{2} + 239 \cdot 87$

(equivalently)

$\binom{239+87}{2}$

(maybe multiply by 243, dep on interpretation)

v. both from sec 1 both from sec 2

$\binom{239}{2} + \binom{87}{2}$

sel rej'd

$\binom{239+87}{2} - 239 \cdot 87$

Problem 5 Counting: Partition Method & Permutations

How many ways can we line up 5 people for picture, of 8 total, if person 2 must be directly to the right of person 1 in every picture person 2 is included in?

• order ~~or~~ matters
• no repetition
} permutation

$P(8,5) \to$ no restrictions

$4 \cdot P(6,3)$

1 2 6 5 4
6 1 2 5 4
6 5 1 2 4
6 5 4 1 2

Person 2 is in the picture
• person 1 also in
• 2 is right of 1

• can't have 2 w/o 1
• can have 1 w/o 2

$\to$ 1 6 5 4 3
6 1 5 4 3
6 5 1 4 3
6 5 4 1 3
6 5 4 3 1

$5 \cdot P(6,4)$

Person 1, not person 2
• 1 in place
• no person 2
• 6 left to arrange

• can have $\boxed{\text{no 1, no 2}}$

$P(6,5)$

three cases, can't happen together so we add

$$\boxed{P(6,5) + 5 \cdot P(6,4) + 4 \cdot P(6,3)}$$

Problem 4 Set Algebra

Simplify each of the following expressions by applying (and labelling) one law at time from logic_set_identities.pdf. Do not use the set difference operator in your simplifications. Note that the set U in the second item is the universal set, which includes all elements.

i $A \cap A$ $\longrightarrow$ A Idempotent

ii $(A^C \cap B^C)^C \cap U$

iii $(A \cup A) \cap (B \cup A^C)$

$\overline{(\bar{A} \cap \bar{B})} \cap U$

$\overline{(\bar{A} \cap \bar{B})}$ identity

$(\bar{\bar{A}} \cup \bar{\bar{B}})$ demorgan

$A \cup B$ double complement

$(A \cup A) \cap (B \cup \bar{A})$

$= A \cap (B \cup \bar{A})$ idempotent

$= (A \cap B) \cup (A \cap \bar{A})$ distributive

$= (A \cap B) \cup \{\}$ complement

ϕ

$= A \cap B$ identity

The headlights of a car turn on for either of the following two reasons:

- the manual switch is on
- the automatic switch is on and the car does not detect any light (i.e. it's dark outside)

1. Construct a truth table for H in terms of A, L, M.
   - A = 1 when automatic headlight switch is on
   - L = 1 when light detected by light sensor
   - M = 1 when manual headlight switch is on
   - H = 1 when headlights on

A, L, M inputs
H output
(1 to respect statement)

A	L	M	H
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

manual switch is on
or
(auto is on and no light detected)

2. Write an expression for H in terms of A, L, M.

$(\neg A \wedge \neg L \wedge M) \vee (\neg A \wedge L \wedge M) \vee (A \wedge \neg L \wedge \neg M) \vee$
$(A \wedge \neg L \wedge M) \vee (A \wedge L \wedge M)$

all situations where H = 1

The predicates below are applicable to any candies x, y:

`choc`(x)	candy x contains chocolate
`nut`(x)	candy x contains nuts
`pop`(x)	candy x is popular
`same_comp`(x, y)	candy x and y are made by the same company

Using the predicates above, express each english statement with logic:

i Snickers bars have chocolate, but no nuts

ii all popular candies contain nuts

iii there is no candy which is both popular and doesn't contains nuts. (Hint: use $\neg\exists$ here)

iv By negating the existential quantifier and applying DeMorgan's law, write a logically equivilent form of the statement immediately above. Note that these manipulations may be applied to the english sentence or the logical expression, if you're stuck on one try the other.

v For every candy with nuts, there is another candy made by the same manufacturer which doesn't have nuts.

i. $\text{choc}(\text{snickers}) \land \neg \text{nut}(\text{snickers})$

ii. $\forall x \ \text{pop}(x) \Rightarrow \text{nuts}(x)$

iii. $\neg(\underline{\exists x \ \text{pop}(x) \land \neg \text{nuts}(x)})$ negating 3 musketeers

iv. $\forall x \ \neg \text{pop}(x) \lor \text{nuts}(x)$

v. $\forall x \exists y \ \text{nut}(x) \Rightarrow \text{same-comp}(x, y) \land x \neq y \land \neg(\text{nuts}(y))$

$\exists x \ \text{pop}(x) \land \neg \text{nuts}(x)$ 3 musk

$\neg(\exists x \ \text{pop}(x) \land \neg \text{nuts}(x))$

$\neg(\underline{\exists x \ \text{pop}(x)})$

¬ there is a pop (candy)

$\forall x \ \neg \text{pop}(x)$

$\forall x \ \neg \text{pop}(x) \lor \text{nuts}(x)$