CSCE 222-199 Discrete Structures for Computing – Summer 2020
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Problem Set 1

Due dates: Electronic submission of *yourLastName-yourFirstName-hw1.tex* and *yourLastName-yourFirstName-hw1.pdf* files of this homework is due on **Monday, 6/1/2020 11:00 p.m.** on `https://ecampus.tamu.edu`. You will see two separate links to turn in the .tex file and the .pdf file separately. Please do not archive or compress the files. **If any of the two files are missing, you will receive zero points for this homework.**

Name: [redacted] **UIN:** [redacted]

Resources. For all parts of this question, I utilized the text from Perusall and any notes I took from the videos provided during the week. I also used some youtube tutorials to help me navigate through Latex.

On my honor, as an Aggie, I have neither given nor received any unauthorized aid on any portion of the academic work included in this assignment. Furthermore, I have disclosed all resources (people, books, web sites, etc.) that have been used to prepare this homework.

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Total 100 points.

Problem 1. (15 points) Section 1.1, Exercise 1.2

Solution. The goal of a knight's tour is to ensure that all squares are visited and no square is visited more than once, this being an open knight tour. However, if a knight tour exists and its a knight circuit, meaning it ends up back in the starting location, then it can be considered as a closed knight tour. Consider an example solution of a 3x4 knight tour. This solution, (a2,c3,d1,b2,d3,c1,b3,a1,c2,a3,b1,d2), quickly shows that a 3x4 chessboard doesn't lead to a knight circuit. The player could continue testing and manipulating positions and create new combinations that will never end up to be a knight circuit. Even a backtracking approach will never lead to a knight's circuit. Taking the hint given in the questions, the 3x4 chessboard is marked with x's on columns a and b and in o's for columns b and c demonstrates that after a move the position will end up being either on a x or o, in most cases, which makes it unlikely for it to reach the same position in both the start and the end. We know that there are no open knight tours for boards that go from 3x1,2,3,5, or 6, and we also know that there are no knight circuits for boards that range from 3x1-9, hence concluding that any solution for a 3x4 board will not lead to a closed knight tour.

Problem 2. (15 points) Section 2.1, Exercise 2.1

Solution. A statement is defined as a sentence that is either true or false.
a) The given sentence is false since π is not the smallest irrational real number.

Hence, since the sentence can determine true/false it is a mathematical statement.
b)π is an irrational number. Hence, since the sentence is true, it is a mathematical statement.
c) The given sentence is false because the roots of the equation are integers. Hence, since the sentence can determine true/false it is a mathematical statement.
d) This statement is false because 123-100=23 not 123-100¿23. Hence, since the sentence can determine true/false it is a mathematical statement.
e) We don't know the value of x and hence can't determine if its a prime number or not. Hence,the sentence is not a statement since we can't determine if its True/False.

Problem 3. (10 points) Section 2.2, Exercise 2.3

Solution. The reason Peter's question is useless, because without any reasoning he will not be able to get the real answer to his questions with simply are yes or no. We know that knaves always lie and knights always tell the truth. If the answer is no, it could be either a knight or a knave because knights would always tell the truth, or knaves always lying. On the other hand, if the answer is yes, then he can determine neither, because knights tell the truth hence it won't be a knave, and knaves always lie, making it impossible to determine knight or knave.

Problem 4. (10 points) Section 2.2, Exercise 2.4. Use a truth table to show your reasoning.

Solution.

A	B	$\neg A$	$\neg A \vee B$	$(A \leftrightarrow (\neg A \vee B))$
T	T	F	T	T
T	F	F	F	F
F	T	T	T	F
F	F	T	T	F

Given the statement, A says 'I am a knave or B is a knight" and if A is a knave then the statement is false, and B is also a knave. However if A is a knight, then the statement is true and B is a knight. This leads to A being a knight and B being a knight. Therefore, assuming that A is a knight and B is a knight, as the truth table shows, both A and B are knights, and can never be one or the other.

Problem 5. (10 points) Section 2.3, Exercise 2.10

Solution. Truth Table:

A	B	$A \to B$	$B \to A$
T	T	T	T
T	F	F	T
F	T	T	F
F	F	T	T

This shows that $A \to B \not\equiv B \to A$ because the truth values in the last two columns differ.

Problem 6. (10 points) Section 2.3, Exercise 2.11

Solution. Truth Table:

A	B	$A \to B$	$B \to A$	$((A \to B) \wedge (B \to A))$	$A \leftrightarrow B$
T	T	T	T	T	T
T	F	F	T	F	F
F	T	T	F	F	F
F	F	T	T	T	T

This shows that $(A \to B) \wedge (B \to A) \equiv A \leftrightarrow B$ because the truth values in the last two columns are the same.

Problem 7. (10 points) Section 2.3, Exercise 2.12. Use a truth table.

Solution. Truth Table:

A	B	$A \to B$	$(A \wedge (A \to B))$	$(A \wedge (A \to B)) \to B$
T	T	T	T	T
T	F	F	F	T
F	T	T	F	T
F	F	T	F	T

A tautology is when all valuations are true. In the column $(A \wedge (A \to B)) \to B$ are all True, hence this is a tautology.

Problem 8. (Two subproblems $\times$ 10 points each = 20 points) Section 2.3, Exercise 2.18 (b) and (c).

Solution. b) Proposition: $A \vee (A \wedge B)$ =A
Double Negation- $\neg\neg A \vee (A \wedge B)$=$\neg(\neg A \vee (\neg(A \wedge B)))$
De-Morgan's law-$\neg(\neg A \vee (\neg(A \wedge B)))$
Absorption law-$\neg\neg A$
=A
c) Proposition: $A \vee (A \wedge B)$ =A
Identity Law-$((A \wedge T) \vee (A \wedge B)$
Distributive Law-$(A \wedge (T \vee B))$
Identity Law- $(A \wedge T)$
Identity Law- A

Checklist:
☐ Did you type in your name and UIN?
☐ Did you disclose all resources that you have used?
(This includes all people, books, websites, etc. that you have consulted.)
☐ Did you sign that you followed the Aggie honor code?
☐ Did you solve all problems?
☐ Did you submit the .tex and .pdf files of your homework to the correct link on eCampus?