Student Name

**CS 480 Spring 2022 Written Assignment #03**

Due: **Tuesday, April 19, 11:00 PM CST**

Points: **75**

**Instructions:**

1. Use this document template to report your answers. Name the complete document as follows:

LastName\_FirstName\_CS480\_Written03.doc or pdf

1. Submit the final document to Blackboard Assignments section before the due date. No late submissions will be accepted.

**Objectives:**

1. (20 points) Demonstrate your understanding of propositional logic, its syntax, laws, and inference based on propositional logic.
2. (25 points) Demonstrate your understanding of First-Order Logic syntax.
3. (30 points) Demonstrate your understanding of Bayes’ Rule.

**Problem 1 [20 pts]:**

Use **resolution** (convert to CNF first) to show (or not) that the:

1. Sentence (p ∨ q) ∧ (¬q ∨ ¬r) ⇒ (p ∧ r) is a **tautology** **[10 pts]**

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| **Your solution (provide all steps)** |
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1. Sentence ¬(¬hasGas ∧ (hasGas ∨ ¬carCanStart) ⇒ ¬carCanStart)

is a **contradiction** **[10 pts]**

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| **Your solution (provide all steps)** |
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**Problem 2 [25 pts]:**

Convert English sentences to FOL. Write each of the following English sentences using First Order Logic. Use the following predicates and constants only.

* Occupation(p, o): Predicate. Person p has occupation o. You can also read it as p is o.
* Customer(p1, p2): Predicate. Person p1 is a customer of person p2.
* Boss(p1, p2): Predicate. Person p1 is a boss of person p2.
* Doctor, Surgeon, Lawyer, Actor: Constants denoting some occupations. This list is not comprehensive. There are also other occupations not mentioned in this list.
* Mary, John: Constants denoting some people. This list is not comprehensive. There are also other people not mentioned in this list.

1. Mary is either a lawyer or an actor **[5 pts]**.

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| **Your solution:** |
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1. John is a lawyer, but he also holds another job **[5 pts]**.

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| **Your solution:** |
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1. All surgeons are doctors **[5 pts]**.

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| **Your solution:** |
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1. John does not have a lawyer (i.e., John is not a customer of any lawyer.) **[5 pts]**.

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| **Your solution:** |
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1. Every surgeon has a lawyer **[5 pts]**.

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| **Your solution:** |
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**Problem 3 [10 pts]:**

Given the probabilities in the table below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Hard working | | Not hard working | |
|  | Low grade | High grade | Low grade | High grade |
| Get a job | 0.06 | 0.32 | 0.04 | 0.01 |
| Not get a job | 0.09 | 0.03 | 0.28 | 0.17 |

1. **[5 pts]** Obtain / calculate the following probability (include derivation):

*P(not hard working, low grade, get a job)*

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| **Your answer:** |
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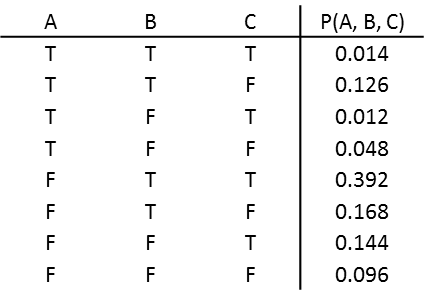
1. **[5 pts]** Obtain / calculate the following probability (include derivation):

*P(get a job | hard working)*

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| **Your answer:** |
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**Problem 4 [20 pts]:**

We are given the following joint distribution for variables A, B, and C. Please compute the requested probabilities. **Show each probability distribution as a table/vector**.



1. **P**(A, C) **[5 pts]**

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| **Your solution:** |
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1. **P**(C) – you can use your answer to part a to compute the answer to this question. **[5 pts]**

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| **Your solution:** |
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1. **P**(A|C) – you can use your answers to parts a and b to compute the answer to this question. **[5 pts]**

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| **Your solution:** |
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1. **P**(A, B | C) – you can use your answers from previous parts if they are relevant. **[5 pts]**

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| **Your solution:** |
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