CSCE 590-1: From Data to Decisions with Open Data: A Practical Introduction to AI
Prof. Biplav Srivastava, Spring 2021

Quiz 2 / Mar 23, 2021/ Instructions

- Return answer to quiz as .pdf and GitHub link by 5:00 pm on Thursday, March 25, 2021 by posting to your shared folder (e.g., Google folder mentioned in spreadsheet) and email to biplav.s@sc.edu.
- Ask question by email. Or, office hour of Wednesday, March 24, 2021 can be used to clarify questions. Timing: 11:30am-12:30pm.
- Total points = 100, Obtained =

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GitHub link with model: https://github.com/khvedant02/Vedant-CSCE590-submission

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Question 1: Time Series
[10 + 10 + 20 = 40 points]

These questions relate to weather data for South Carolina.

South Carolina Weather Records

- Min temp - https://www.dnr.sc.gov/climate/sco/ClimateData/data/min_temp_table.php
- Precipitation records - https://www.dnr.sc.gov/climate/sco/ClimateData/data/24_hr_pcpn.php

Task 1 – Create Plot 1: Show the records for temperature on a timeline
[10 points]

Task 2 - Plot 2: Show the records for precipitation on a timeline
[10 points]

Task 3 - Plot 3: Plotting the two phenomena (records for temperature and precipitation) on the same timeline
[20 points = 1x5 + 1x15]

a) Are the locations in the counties same in the two plots? If not, what are some of the things we can do to still draw on the same timeline?

b) Task 3 – Plot on a single timeline assuming data is for the same county and disregard location.

Question 2: Intelligent Agents and Reasoning
[10 + 10 + 20 = 40 points]

Suppose you want to build an alert system which will decide how many days to close schools when the weather is inclement. You want to encode the following policy:

- One record rule: When one weather record is broken for a county (e.g., precipitation or temperature), close schools for 1 day in that county [10 points]

- Two record rule: When two weather records broken (e.g., precipitation or temperature) in a county, close schools by 2 days in that county [10 points]

- State-wide rules: When schools in 3 or more counties are closed for 2 days or more in the state, close schools in all the counties in the state [20 points]

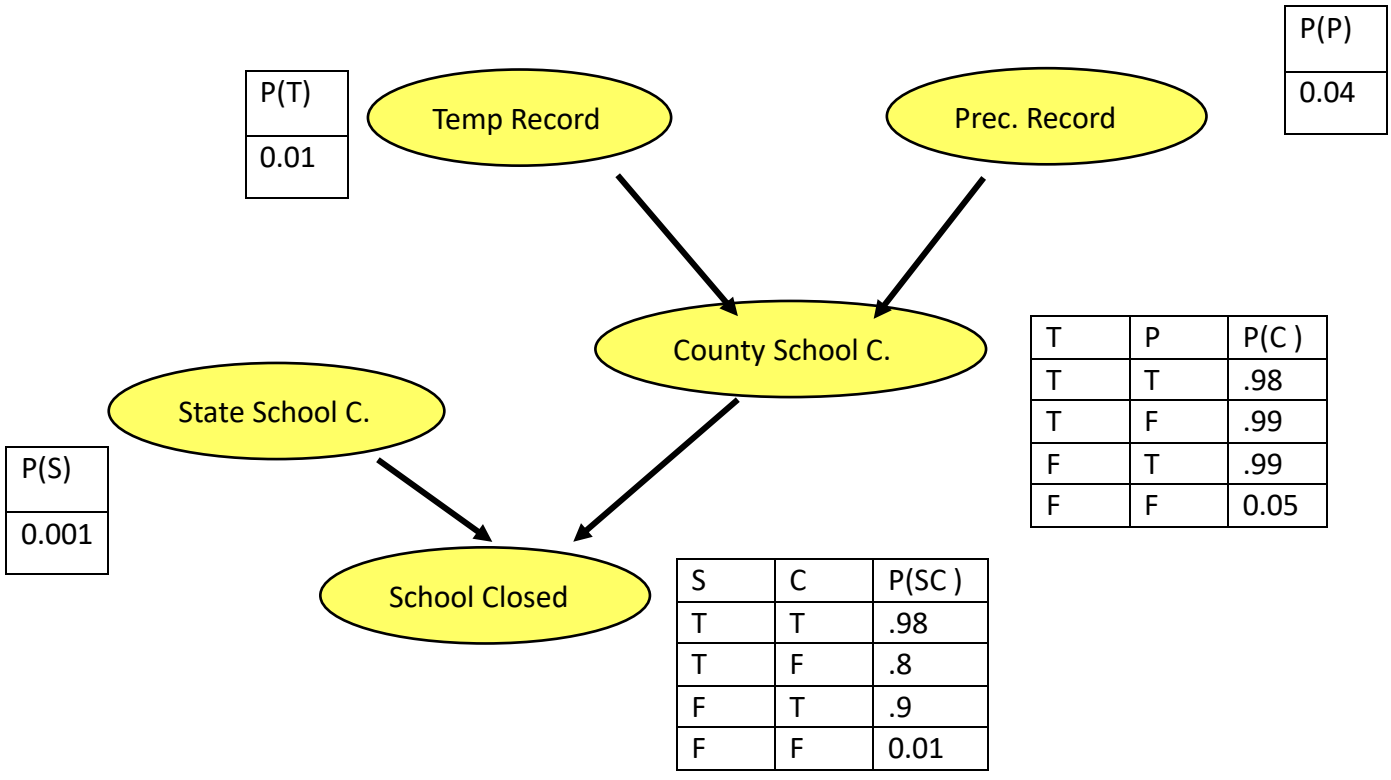
How will you write these policies/ knowledge in propositional logic? Create as many propositions as you need for facts and relations.

Remember that for minimum temperature, a record is broken if the new temperature is below (cooler) than the current one. For precipitation, a record is broken if it is above (higher) than the current one.

Question 3: Learning to explain school closure
[2 x 10 = 20 points]

Give the three type of rules, suppose a school is closed and you have been asked to build a system to explain the closure to parents. The Bayesian Network corresponding to how the alert may have been triggered is shown below.

A school may have been closed due to county's school closure notice or state notice. The county notice depends on temperature or precipitation record being broken.



T	P	P(C)
T	T	.98
T	F	.99
F	T	.99
F	F	0.05

S	C	P(SC)
T	T	.98
T	F	.8
F	T	.9
F	F	0.01

What is:

- Probability that school is closed due to state's school closure notice?
- Probability that school is closed due to record temperature and precipitation record in its county ?

2. Given, Precipitation, temperature, schools, counties.
P T S C

P_N : New value for precipitation
P_{GT} : New value is greater than current value
T_N : New value for Temperature
T_{LT} : New value is less than current value
P_R : Precipitation Record Broken
T_R : Temperature Record Broken
S_C : Schools closed
N_1 : Number of days = 1
N_2 : Number of days = 2
N_3 : Number of days $\geq$ 2
C_n : Any n^{th} county in the state
C_A : All counties in the state

One record rule:

$$(C_n \wedge ((P_N \wedge P_{GT}) \rightarrow P_R)) \vee (C_n \wedge ((CT_N \wedge T_{LT}) \rightarrow T_R)) \rightarrow S_C \wedge N_1$$

Two record rule:

$$((C_n \wedge ((P_N \wedge P_{GT}) \rightarrow P_R)) \wedge (C_n \wedge ((CT_N \wedge T_{LT}) \rightarrow T_R)) \rightarrow S_C \wedge N_2$$

state-wide-rules:

$$((C_{Cn} \wedge (C_{PN} \wedge P_{QT}) \rightarrow P_R)) \wedge (G_n \wedge ((C_{TN} \wedge T_{LT}) \rightarrow T_R) \rightarrow S_C \wedge N_2) \wedge$$
$$((C_{Cn} \wedge (C_{PN} \wedge P_{QT}) \rightarrow P_R)) \wedge (C_{Cn} \wedge ((C_{TN} \wedge T_{LT}) \rightarrow T_R) \rightarrow S_C \wedge N_2) \wedge$$
$$((C_{Cn} \wedge (C_{PN} \wedge P_{QT}) \rightarrow P_R)) \wedge (C_{Cn} \wedge ((C_{TN} \wedge T_{LT}) \rightarrow T_R) \rightarrow S_C \wedge N_2) \vee$$
$$((C_{Cn} \wedge (C_{PN} \wedge P_{QT}) \rightarrow P_R)) \wedge (C_{Cn} \wedge ((C_{TN} \wedge T_{LT}) \rightarrow T_R) \rightarrow S_C \wedge N_2)) \rightarrow S_C \wedge C_A$$

3(a) $P(+sc \mid +s) = \dfrac{P(+sc, +s)}{P(+s)}$

$= \dfrac{1}{P(+s)} \sum_{T,P,C} P(+sc, +s, T, P, C)$

$= \dfrac{1}{P(+s)} \sum_{T,P,C} P(+s) P(+sc \mid +s, C) P(T) P(P) P(C \mid T, P)$

$= \dfrac{P(+s)}{P(+s)} \sum_{TPC} P(+sc \mid +s, C) P(T) P(P) \dfrac{P(C, T, P)}{P(T, P)}$

$= \sum_{TPC} P(+sc \mid +s, C) P(T) P(P) \dfrac{P(C, T, P)}{P(T) P(P)}$

$= \sum_{TPC} P(+sc \mid +s, C) P(C, T, P)$

$= P(+sc \mid +s, +c) P(+c, +T, +P) + P(+sc \mid +c, +s) P(+c, +T, -P)$
$+ P(+sc \mid +s, +c) P(+c, -T, +P) + P(+sc \mid +c, +s) P(+c, -T, -P)$
$+ P(+sc \mid +s, \bar{+}c) P(-c, +T, +P) + P(+sc \mid \bar{-}c, +s) P(-c, +T, -P)$
$+ P(+sc \mid +s, -c) P(-c, -T, +P) + P(+sc \mid -c, +s) P(-c, -T, -P)$

$\left[\because P(A, B, C) = P(A \mid B, C) \times P(B) \times P(C) \right.$
$\left. \therefore P(\pm c, \pm T, \pm P) = P(\pm c \mid \pm T, \pm P) \times P(\pm T) \times P(\pm P) \right]$

$= 0.98 \times 0.98 \times 0.01 \times 0.04 + 0.98 \times 0.99 \times 0.96 \times 0.01 +$
$0.98 \times 0.99 \times 0.99 \times 0.04 + 0.98 \times 0.05 \times 0.99 \times 0.96 +$
$0.8 \times 0.02 \times 0.01 \times 0.04 + 0.8 \times 0.01 \times 0.96 \times 0.01 +$
$0.8 \times 0.01 \times 0.99 \times 0.04 + 0.8 \times 0.95 \times 0.99 \times 0.96$

$= 0.00038416 + 0.00931392 + 0.03841992 + 0.0465696 +$
$0.0000768 + 0.0003168 + 0.722304$
0.0000064

$\therefore P(+sc/+s) = 0.81739 16$

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3(b) $P(+sc / +c, +T, +P)$ (+ refers to condition being true)

$$= \frac{P(+sc, +c, +T, +P)}{P(+c, +T, +P)}$$

$$= \frac{\sum_s P(s, +sc, +c, +T, +P)}{P(+c, +T, +P)}$$

$$= \frac{\sum_s P(s)\, P(+sc/s, +c)\, P(+T)\, P(+P)\, P(+c/+T, +P)}{P(+c, +T, +P)}$$

$$= \frac{\sum_s P(s)\, P(+sc/s, +c)\, P(+T)\, P(+P)\, \frac{P(+c, +T, +P)}{P(+T, +P)}}{P(+c, +T, +P)}$$

$$= \frac{\sum_s P(s)\, P(+sc/s, +c)\, P(+T)\, P(+P)\, \frac{(P(+c, +T, +P))}{P(+T)\, P(+P)}}{P(+c, +T, +P)}$$

$$= \frac{P(+c, +T, +P)}{P(+c, +T, +P)} \sum_s P(s)\, P(+sc/s, +c)$$

$$= \sum_s P(s)\, P(+sc/s, +c)$$

$$= P(+s)\, P(+sc/+s, +c) + P(-s)\, P(+sc/-s, +c)$$

$$= 0.001 * 0.98 + 0.999 * 0.9$$

$$= 0.00098 + 0.8991$$

$$= 0.90008$$

$\therefore P(+sc/+c, +T, +P) = 0.90008$