National University of Computer & Emerging Sciences

(Karachi Campus)

Midterm Examination II – Spring 2016

Artificial Intelligence (CS401)-Sol

Time Allowed: 60 Min. Max. Points: 50

Dated: March 31, 2016

Instructions: Attempt all questions. Be to the point, there is a penalty for wild guesses. Draw neat and clean diagram/code where necessary.

Question No. 1	[5x3=15 Points] [Time: 15 Min.]

A cricket guru says

"A player who is in Form (F) is selectable (S) if he is competent (C) and has Performed (P) and not selectable if he is not competent."

a. One of the CS student has encoded the facts given in the above statement as below, answer whether it is correct or not. Explain in English what does it mean? [5]

1. F => (S <=> C Λ P)

The logical proposition correctly encodes the given statement, it is TRUE.
The logical statement encodes the fact " if a player is in form only then he can be selected if and only if he is competent and performed."

2. F => C Λ P

The logical proposition correctly encodes the given statement, it is TRUE. The logical statement encodes the fact " If a player is in form, he will be competent and will performed"

b. Express each as a set of clauses-Given in part(a), in conjunctive normal form(CNF) (e.g., a set of sentences where each is a disjunction of positive or negative atoms). [5]

1. F => (S <=> C Λ P)
   F => {(S => C Λ P) Λ ((C ΛP) => S) } ' eliminating bi-directional implication
   F => { (~S V (C Λ P)) Λ (~(C ΛP) V S)} ' eliminating inner implications
   F => { (~S V (C Λ P)) Λ (~C V~P V S)} ' eliminating inner implications
   F => { ((~S V C) Λ(~S V P)) Λ (~C V~P V S)} ' distribution
   ~F V [{ ((~S V C) Λ(~S V P)) Λ (~C V~P V S)}] ' eliminating implies
   (~F V ~S V C) Λ(~F V ~S V P) Λ (~F V S V ~C v ~P)

2. F => C Λ P
   ~F V (C ΛP) ' eliminating implies.
   (~F V C) Λ (~F V P) ' distribution of Or over And
   Required CNF.

c. Express whether or not C Λ P => F is true. [5]

Consider the given KB, we have F => C Λ P, we can clearly see that it is not TRUE.

C	**F**	**P**	**F => C Λ P**
T	T	T	T
T	T	F	F
T	*F*	*T*	*T*
T	F	F	T
F	T	T	F
F	T	F	F
F	F	T	T
F	F	F	T

C	**F**	**P**	**C Λ P => F**
T	T	T	T
T	T	F	T
T	*F*	*T*	*F*
T	F	F	T
F	T	T	T
F	T	F	T
F	F	T	T
F	F	F	T

Question No. 2	[20 Points] [Time: 30 Min.]

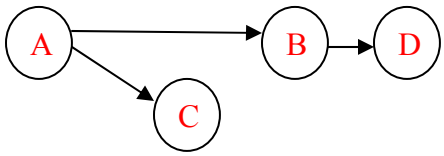
You are planning to go to a famous restaurant in Karachi for dinner with your friends. The restaurant offers a variety of items for each of the four courses, appetizer (A), beverage (B), main course (C), and dessert (D) and you have to narrow down the choices by considering the preferences of your friends as follows:

A: vegetable fritters (v) or golgappay (g)
B: water (w), fresh lime with 7up (f), or pomegranate juice (p)
C: lamb pasanday (l), mutton chops (m), or chicken broast (c)
D: rice flour pudding (r), ice cream (i), or gulabjamuns (gu)

Each friend gets the same menu consisting of one item in each course. Preferences of your friends imply the following constraints:

i. The appetizer must be vegetable fritters or the main course must be chicken broast or lamb pasanday.
ii. If you serve golgappay, the beverage must be water.
iii. You must serve at least one of pomegranate juice, ice cream or gulabjamuns.

a) Draw the constraint graph associated with this problem. (Just show a graph with four nodes (one for each variable) labeled A, B, C and D and arcs connecting appropriate pairs of nodes that are involved in a joint constraint.) [4]



b) Show the initial domains of each of the four variables. [4]

Variables ={ A, B,C,D}
Domain of A={ v,g}
Domain of B={ w,f,p}
Domain of C= {l,m,c}
Domain of D={ r,i,gu}

c) Suppose we decide to have the appetizer be golgappay, i.e., A=g. What are the domains of all the variables after applying the forwarding checking algorithm? [4]

If we set A=g, we apply forward checking and will get the following values left for the variables.

A	B	C	D
g	w	l,m,c	r,i,gu

d) Instead of using forward checking, as in (c), say we initially set A=g and then apply the arc consistency algorithm (AC-3). What are the domains of all the variables after it finishes? [4]

If we set A=g, we apply AC-3 and will get the following values left for the variables.

A	B	C	D
g	w	l,c	i,gu

e) Give one possible final solution to this CSP or say why none exists. [4]

A	B	C	D
g	w	l	gu
g	w	l	i
g	w	c	gu
g	w	c	i

Question No. 3	[15 Points] [Time: 15 Min.]

a. What is Intelligent backtracking? Explain.[3]

Conventional Backtracking corresponds to depth first search, it is a kind of brute-force approach. Performance of brute force backtracking can be improved by using a number of techniques such as variable ordering, value ordering, back jumping, and forward checking. This performance improvement as a whole is called "Intelligent Backtracking". In this when an impasse is reached, instead of simply undoing the last decision made, the decision that actually caused the failure should be modified or avoided.

b. Suppose you use resolution to prove that KB |= α. Does is mean that α is valid? [3]

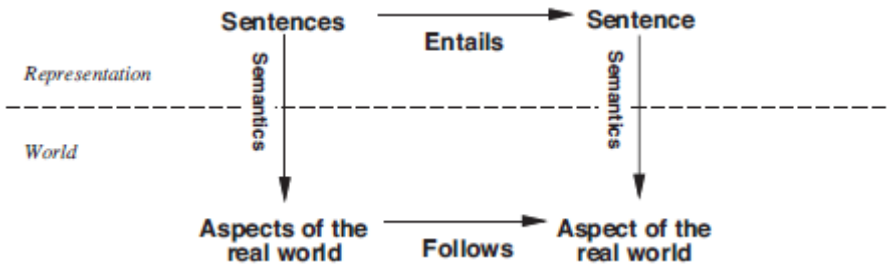
A valid sentence is one that is true in all models. If KB |= α, then we know that is true in all models for which the KB is true. However, this does not include all models, so no, this does not mean that α is valid.

c. Why factored representation of state(s) are important for applying CSP for solution? [3]

The factored representation for each state generally represents by a set of constituent variables, each of which has a value, under constraining . In CSP, the solution of the problem is to find a state-representation in which each variable has a value from its respective domain that satisfy all constraints. Hence factored representation is essential for applying CSP for solution.

d. Explain the importance of "Grounding" in applying logic to the real world problems. [3]

Grounding refers to the mapping of representation of logical knowledge from the real world problem to the computer internal representation(memory) so that the change in the real world easily integrated into the memory. In order to solve any real world problem a close, consistent and configurable map should be define first. Hence "Grounding" is very important aspect of real world problem solving by computers.



e. What do we mean by model checking in logical agent? Explain. [3]

In logical agent there is a knowledge base through which agent's keep tracks of changing environment. The knowledge base contains logical sentences about the problem background, interaction and environment. The model checking refers to finding possible worlds (state of the agent) on which KB is consistent. It is to consult a true interpretation of the real world through KB sentences. This is to say when an agent wants to entail α , he need to check all sentences in KB that still TRUE after adding α in the KB. Model checking is the activity to decide the possible set of TRUE sentences.

<Best of Luck>