Project-3

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PART-1 and PART-3

PART 1:

2(a)

In terms of CTL formula, I found the formula is formulated in CTL. If you combined the formula with the path formulas then the formula is hold in CTL grammar.

2(f)

In terms of CTL formula, there is no relationship between State formula and Path formula (*AEFr*). So, the formula doesn`t hold in CTL formulas.

2(g)

In terms of CTL formula, the formula is not in CTL. Since the formula doesn`t hold in CTL grammar.

6(b)

(I)

Since the initial state (*s0)* listed *r*, so *M*, s0 $\models \neg p \rightarrow r$ hold.

(III)

Since the initial state (*s0)* listed *r* and *M*, s0 $\models r$ while it happens in infinite path of r in state (*s0).* So, *M*, s0 $\models EGr$. We infer *M*, s0 $\not\models \neg EGr$.

(IV)

Since the state (*s2)* is in infinite path of state (*s2 and s1).* We infer *M*, *s2* $\not\models E(t\ U\ q)$.

(VI)

Since the state (*s2*) listed *q* and *M*, *s2* |= *q*. So, *M*, *s2* |= *EFq*.

(VII)

Since the initial state (*s0*) listed *r* and *M*, s0 |= *r* while it happens in infinite path of r in state (*s0*). So, *M*, s0 |= *EGr*. We infer *M*, s0 |= *EGr*.

9.

The respective CTL connective operators are given below:

new AG φ: AX (AG φ)

new EG φ: EX (AG φ)

new AF φ: AX (AF φ)

new EG φ: EX (EG φ)

new AU: φ ∧ AX (A[φ1 U φ2])

new EU: φ ∧ EX (E[φ1 U φ2])

10 (b).

Firstly, assume that s |= EF *φ ∨ EF Ψ.* Then, without loss of generality, we may assume that s |= EF *φ*. This means that there is a future state Sn, reachable from s, such that sn |= *φ* and *sn* |= *φ ∨ Ψ.* Thus *s* |= *EF (φ ∨ Ψ).*

Secondly, assume that *s* |= *EF (φ ∨ Ψ).* Then there is a state *sm,* reachable from *s*, such that *sm* |= *φ ∨ Ψ.* But we can conclude that *s /= EF ,* as *sm* is reachable from *s*. There for we have s |= EF *φ ∨ EF Ψ.*

10 (c).

While we have s |= (AF *φ ∨ AF Ψ)* implies *s* |= AF (*φ ∨ Ψ),* the converse is not true. Therefore, the formulas (AF *φ ∨ AF Ψ)* and AF (*φ ∨ Ψ),* is not equivalent.

10 (e).

This is not an equivalence formula. Consider the model from item 1c. We have $s \models EF\ \neg p$ since we have an initial path segment s → t → …. But we don't have $s \models AF\ \neg p$, for the present is part of the future in CTL.

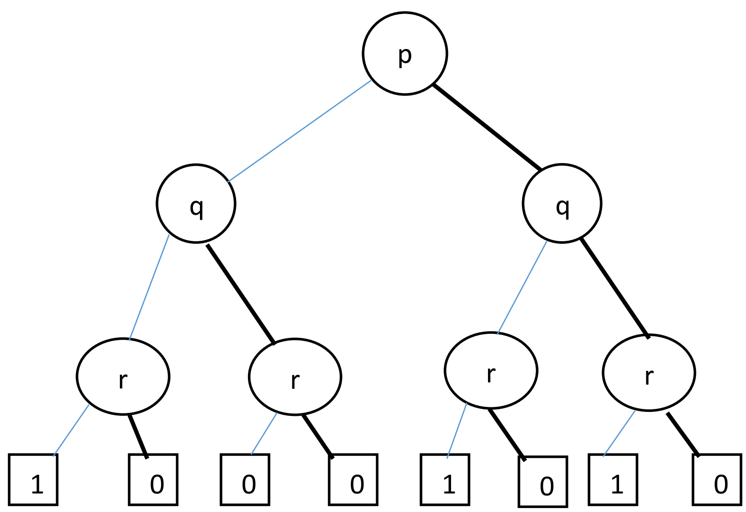
10 (h).

Saying that a CTL formula φ is equivalent to T is just paraphrasing that φ is true at all states in all models. But this is not the case for $FG\ \varphi \rightarrow AG\ \varphi$. Consider the model of item 1c. Clearly, we have $s \models EG\ p$, but we certainly don't have $s \models AG\ p$.

PART 3

6.2.2

According to the truth table, binary decision tree given below:



Here, we choose the order *p, q r* to construct the binary decision tree.

6.3.2(a)

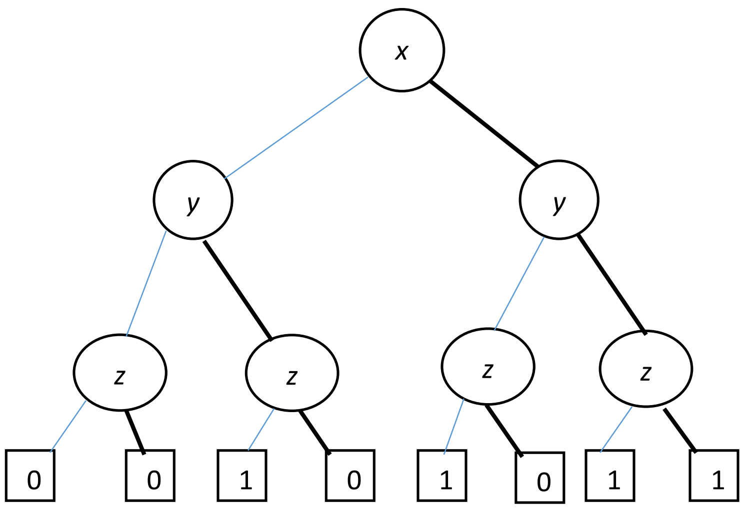
The truth table is given below:

X	*y*	*z*	*f(x, y)*
1	1	1	1
1	0	1	1
1	1	0	1
1	0	0	0
0	1	1	1

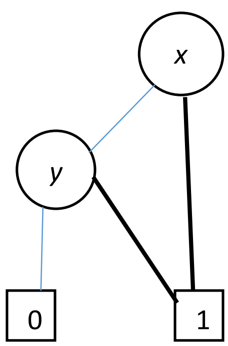
0	0	1	0
0	1	0	1
0	0	0	0

6.4.3

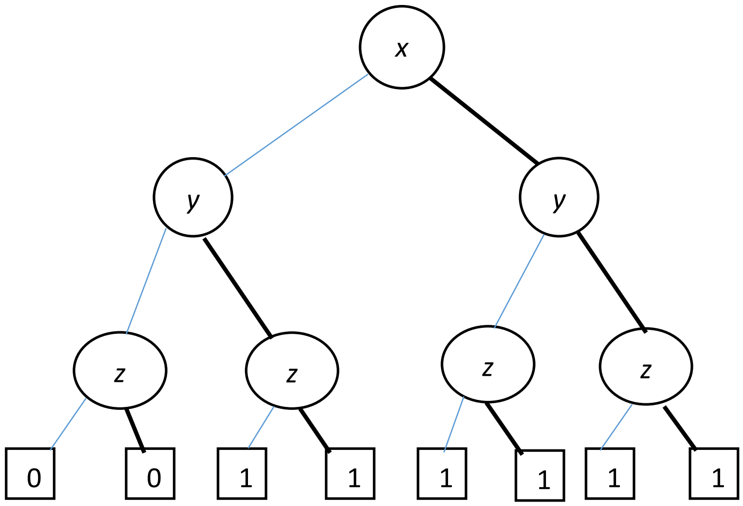
(a). The binary decision tree of ***f(x, y) def= x . y*** with respect to the order of [***x, y, z***] is



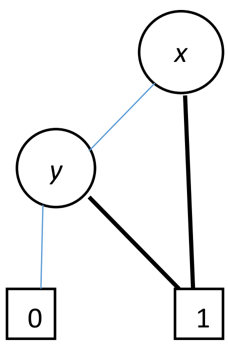
The removal of redundancy is given below:



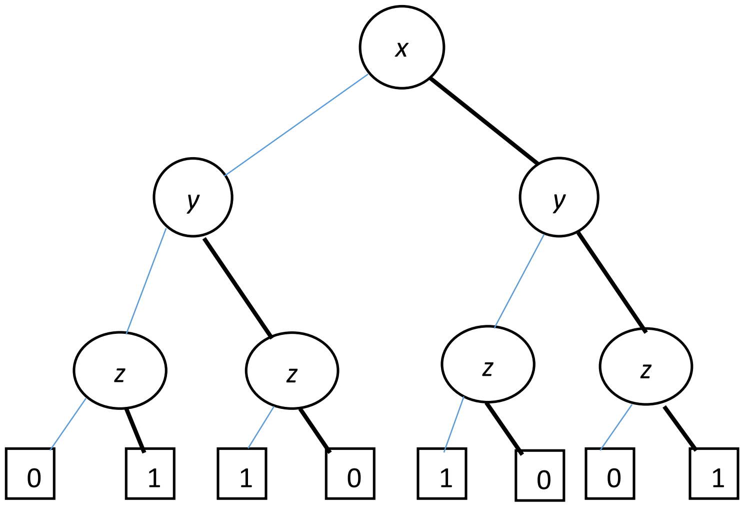
(b). The binary decision tree of ***f(x, y) def= x + y*** with respect to the order of [***x, y, z***] is



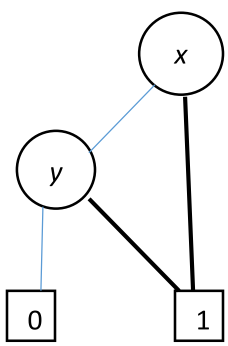
The removal of redundancy is given below:



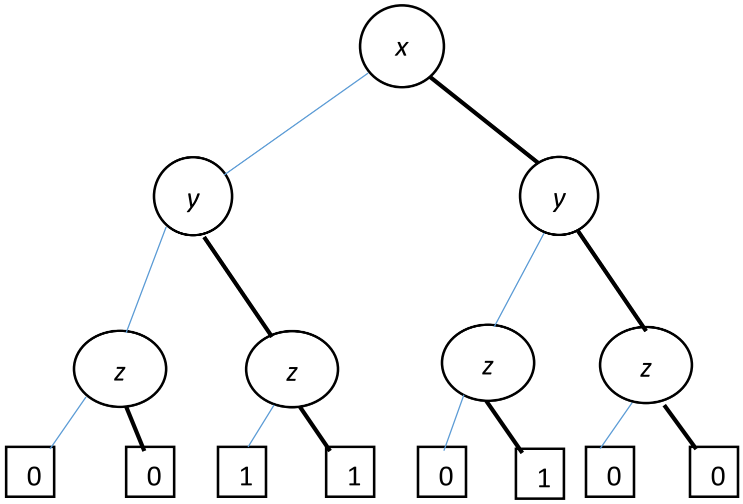
(c). The binary decision tree of ***f(x, y) def= x⊕y*** with respect to the order of [***x, y, z***] is



The removal of redundancy is given below:



(d). The binary decision tree of ***f(x, y, z) def = (x ⊕ y) · (x + z)*** with respect to the order of [***x, y, z***] is



The removal of redundancy is given below: