Unit 12 - Week 9

Assignment 9

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-04-01, 23:59 IST.

This assignment covers description language $\mathcal{ALC}$ and inheritance networks

1) What do you recall about the description language $\mathcal{ALC}$? *1 point*

- [ ] $\mathcal{ALC}$ stands for Atributive Language with Complement
- [ ] The syntactic elements are punctuations, concept-forming operators, statement-forming operators, concepts, roles, and constants (aka individuals or objects)
- [ ] Concept-forming operators $\neg$ $\sqcap$ $\sqcup$ $\exists$ and $\forall$ are used for describing domain concepts
- [ ] Statement-forming operators $\sqsubseteq$ and $\equiv$ are used for describing domain knowledge
- [ ] Provides variable free notation for writing concept descriptions (expressions)
- [ ] An $\mathcal{ALC}$ concept denotes a set of individuals
- [ ] An $\mathcal{ALC}$ role is a binary relation that relates individuals to other individuals

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\mathcal{ALC}$ stands for Atributive Language with Complement
The syntactic elements are punctuations, concept-forming operators, statement-forming operators, concepts, roles, and constants (aka individuals or objects)
Concept-forming operators $\neg$ $\sqcap$ $\sqcup$ $\exists$ and $\forall$ are used for describing domain concepts
Statement-forming operators $\sqsubseteq$ and $\equiv$ are used for describing domain knowledge
Provides variable free notation for writing concept descriptions (expressions)
An $\mathcal{ALC}$ concept denotes a set of individuals
An $\mathcal{ALC}$ role is a binary relation that relates individuals to other individuals

2) Select the formulas that denote $\mathcal{ALC}$ concepts (not statements or axioms). *1 point*

- [ ] $\top$ (top symbol)
- [ ] Car
- [ ] Car $\sqcup$ Van
- [ ] Person $\sqcap$ Rich
- [ ] $\exists$Owns.$\top$
- [ ] $\exists$Owns.$\neg$Car
- [ ] $\neg\forall$Owns.Car
- [ ] $\bot$ (bottom symbol)
- [ ] SportsCar $\sqsubseteq$ Car
- [ ] Coronavirus(covid19)

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\top$ (top symbol)
Car
Car $\sqcup$ Van
Person $\sqcap$ Rich
$\exists$Owns.$\top$
$\exists$Owns.$\neg$Car
$\neg\forall$Owns.Car
$\bot$ (bottom symbol)

3) Between $\mathcal{DL}$ and $\mathcal{ALC}$: *1 point*

- [ ] "Thing" corresponds to $\top$ (top concept)
- [ ] $\mathcal{DL}$ does not support $\bot$ (bottom concept or empty concept)
- [ ] "[**AND** C D]" corresponds to "C $\sqcap$ D"
- [ ] "[**ALL** :R C]" corresponds to "$\forall$R.C"
- [ ] "[**EXISTS** 1 :R]" corresponds to "$\exists$R.$\top$"
- [ ] "A $\doteq$ C" corresponds to "A $\equiv$ C"
- [ ] "c $\longrightarrow$ D" corresponds to "D(c)"

No, the answer is incorrect.
Score: 0
Accepted Answers:
"Thing" corresponds to $\top$ (top concept)
$\mathcal{DL}$ does not support $\bot$ (bottom concept or empty concept)
*"[**AND** C D]" corresponds to "C $\sqcap$ D"*
*"[**ALL** :R C]" corresponds to "$\forall$R.C"*
*"[**EXISTS** 1 :R]" corresponds to "$\exists$R.$\top$"*
"A $\doteq$ C" corresponds to "A $\equiv$ C"
"c $\longrightarrow$ D" corresponds to "D(c)"

BEGIN GROUP (1)

Express the descriptions listed below as $\mathcal{ALC}$ concepts and axioms respectively.

A. Set of all elements (aka individuals, aka objects) in a domain.
B. Individuals who are happy.
C. Rich people.
D. Rich people are happy.
E. Happy people are rich.
F. People who own something.
G. Individuals who owns a car that is not a sports car.
H. Individuals who neither own a car nor own a van.
I. Individuals who do not own a car.
J. Individuals who own things that a not cars.
K. covid19 is a Coronavirus.
L. Individuals infected with Coronavirus are under quarantine.

Match each of the $\mathcal{ALC}$ expressions in the questions below to a description listed above. Fill in the blanks with the item label (one of A, B, C, ..., L) of the matching description or else type the word NONE if there is no matching description.

Note: Owns and InfectedWith are roles, covid19 is an element in the domain and other names indicate concepts, and treat person and people as synonyms.

4) Coronavirus(covid19)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) K

1 point

5) $\exists$InfectedWith.Coronavirus $\sqsubseteq$ Quarantine

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) L

1 point

6) $\bot$ (top concept)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) A

1 point

7) Happy

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) B

1 point

8) Person $\sqcap$ Rich

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) C

1 point

9) ($\neg\exists$Owns.Car) $\sqcap$ ($\neg\exists$Owns.Van)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) H

1 point

10) $\forall$Owns.$\neg$(Car $\sqcup$ Van)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) H

1 point

11) Person $\sqcap$ Rich $\sqsubseteq$ Happy

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) D

1 point

12) Person $\sqcap$ Happy $\sqsubseteq$ Rich

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) E

1 point

13) Person $\sqcap$ $\exists$Owns.$\top$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) F

1 point

14) $\exists$Owns.(Car $\sqcap$ $\neg$SportsCar)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) G

1 point

15) $\neg\exists$Owns.Car

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) I

1 point

16) $\exists$Owns.$\neg$Car

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) J

1 point

END GROUP (1)

17) $\forall$Owns Car is a concept that: *1 point*

- [ ] includes individuals that own only cars
- [ ] includes individuals that own at least one car
- [ ] includes individuals who do not own anything
- [ ] includes individuals that own only sports cars, where SportsCar $\sqsubseteq$ Car
- [ ] translates to a set $\{ x \in \Delta \mid \forall y\ (\text{Owns}(x, y) \supset \text{Car}(y)) \}$ in FOL

No, the answer is incorrect.
Score: 0
Accepted Answers:
includes individuals that own only cars
includes individuals who do not own anything
includes individuals that own only sports cars, where SportsCar $\sqsubseteq$ Car
translates to a set $\{ x \in \Delta \mid \forall y\ (\text{Owns}(x, y) \supset \text{Car}(y)) \}$ in FOL

18) $\exists$Owns Car is a concept that: *1 point*

- [ ] includes individuals that own only cars
- [ ] includes individuals that own at least one car
- [ ] includes individuals who do not own anything
- [ ] includes individuals that own at least one sports car, where SportsCar $\sqsubseteq$ Car
- [ ] translates to a set $\{ x \in \Delta \mid \exists y\ (\text{Owns}(x, y) \wedge \text{Car}(y)) \}$ in FOL

No, the answer is incorrect.
Score: 0
Accepted Answers:
includes individuals that own at least one car
includes individuals that own at least one sports car, where SportsCar $\sqsubseteq$ Car
translates to a set $\{ x \in \Delta \mid \exists y\ (\text{Owns}(x, y) \wedge \text{Car}(y)) \}$ in FOL

19) The negation normal form (NNF) of $\neg[(\forall R.\neg C) \sqcup \exists R.C]$ is: *1 point*

- ( ) $(\exists R.C) \sqcup \forall R.\neg C$
- ( ) $(\exists R.C) \sqcap \forall R.\neg C$
- ( ) $(\exists R.\neg\neg C) \sqcap \forall R.\neg C$
- ( ) $(\neg\exists R.C) \sqcap \neg\exists R.C$
- ( ) None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
$(\exists R.C) \sqcap \forall R.\neg C$

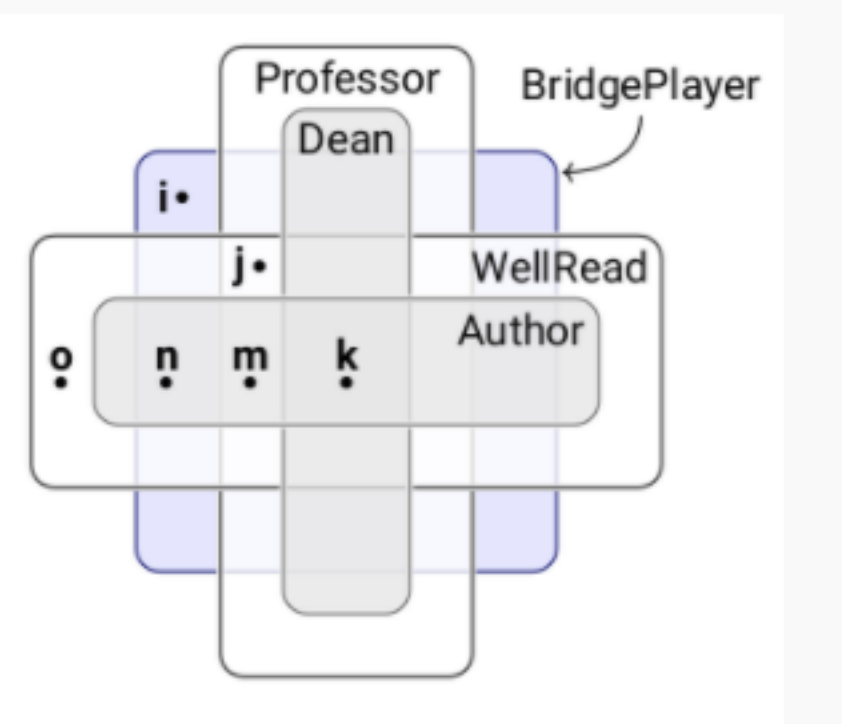
20) In $\mathcal{ALC}$, to show KB $\models \alpha$ we apply tableau on KB $\cup \{\neg\alpha\}$. As $\mathcal{ALC}$ tableau executes: *1 point*

- [ ] It maintains a graph of nodes that are connected by roles
- [ ] Each node in the graph is either a constant or a variable (placeholder for constants)
- [ ] Each node has a label which contains a set of concepts that are satisfied by that node
- [ ] ALC tableau for KB $\cup \{\neg\alpha\}$ always terminates with a contradiction if KB $\models \alpha$
- [ ] If a tableau path terminates without a contradiction then it proves that KB $\models \neg\alpha$
- [ ] Occasionally, ALC tableau runs forever when KB $\not\models \alpha$

No, the answer is incorrect.
Score: 0
Accepted Answers:
It maintains a graph of nodes that are connected by roles
Each node in the graph is either a constant or a variable (placeholder for constants)
Each node has a label which contains a set of concepts that are satisfied by that node
ALC tableau for KB $\cup \{\neg\alpha\}$ always terminates with a contradiction if KB $\models \alpha$
If a tableau path terminates without a contradiction then it proves that KB $\models \neg\alpha$

21) An $\mathcal{ALC}$ knowledge base KB1 and its interpretation-domain (figure) which has ONLY six individuals is shown below. *1 point*

KB1: {
Dean $\sqsubseteq$ Professor,
Author $\sqsubseteq$ WellRead,
(Professor $\sqcap$ WellRead) $\sqsubseteq$ BridgePlayer
}



What is true about the individuals shown in KB1?

- [ ] All six individuals can be fully described in $\mathcal{DL}$
- [ ] Only **k** can be fully described in $\mathcal{DL}$
- [ ] All six individuals can be fully described in $\mathcal{ALC}$
- [ ] There is only one bridge player and that is individual **i**
- [ ] All of the above

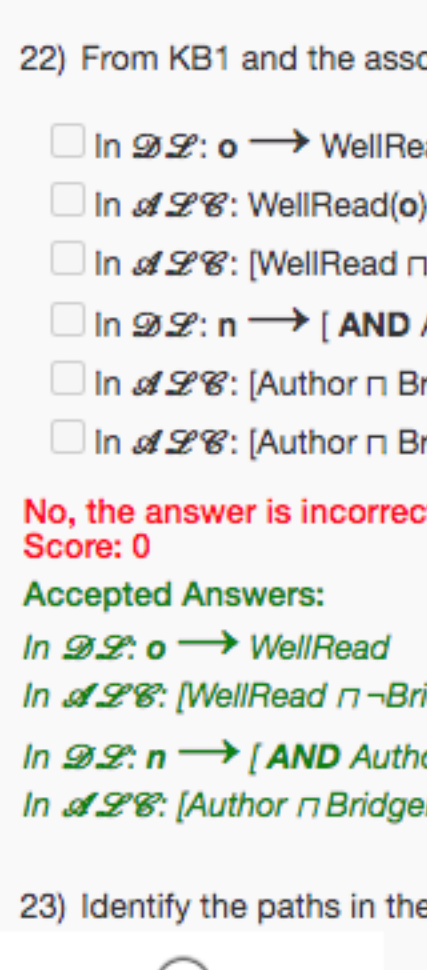
No, the answer is incorrect.
Score: 0
Accepted Answers:
*Only **k** can be fully described in $\mathcal{DL}$*
All six individuals can be fully described in $\mathcal{ALC}$

22) From KB1 and the associated figure from previous question, pick the most specific descriptions of individuals "**o**" and "**n**" *1 point*

- [ ] In $\mathcal{DL}$: **o** $\longrightarrow$ WellRead
- [ ] In $\mathcal{ALC}$: WellRead(**o**)
- [ ] In $\mathcal{ALC}$: [WellRead $\sqcap$ $\neg$BridgePlayer $\sqcap$ $\neg$Professor $\sqcap$ $\neg$Author](**o**)
- [ ] In $\mathcal{DL}$: **n** $\longrightarrow$ [**AND** Author BridgePlayer]
- [ ] In $\mathcal{ALC}$: [Author $\sqcap$ BridgePlayer](**n**)
- [ ] In $\mathcal{ALC}$: [Author $\sqcap$ BridgePlayer $\sqcap$ $\neg$Professor](**n**)

No, the answer is incorrect.
Score: 0
Accepted Answers:
*In $\mathcal{DL}$: **o** $\longrightarrow$ WellRead*
*In $\mathcal{ALC}$: [WellRead $\sqcap$ $\neg$BridgePlayer $\sqcap$ $\neg$Professor $\sqcap$ $\neg$Author](**o**)*
*In $\mathcal{DL}$: **n** $\longrightarrow$ [**AND** Author BridgePlayer]*
*In $\mathcal{ALC}$: [Author $\sqcap$ BridgePlayer $\sqcap$ $\neg$Professor](**n**)*

23) Identify the paths in the Inheritance Network that are admissible. *1 point*



- [ ] a.B.F
- [ ] a.I.¬G
- [ ] a.I.¬G.¬H
- [ ] a.B.F.G.¬H
- [ ] a.B.C.D.E
- [ ] a.B.F.G.D.E
- [ ] a.B.F.G.C.D.E
- [ ] a.B.C.D.E.F.G.H

No, the answer is incorrect.
Score: 0
Accepted Answers:
a.B.F
a.I.¬G
a.B.F.G.¬H
a.B.C.D.E
a.B.F.G.C.D.E

BEGIN GROUP (2)

24) Given the following set of edges in an Inheritance Hierarchy Γ *1 point*
Clyde.RoyalElephant
RoyalElephant.Elephant
RoyalElephant.¬Gray
Elephant.Gray
Draw the inheritance hierarchy and identify the edges present in some credulous extension of Γ with respect to Clyde.

- [ ] Clyde.RoyalElephant
- [ ] RoyalElephant.Elephant
- [ ] RoyalElephant.¬Gray
- [ ] Elephant.Gray

No, the answer is incorrect.
Score: 0
Accepted Answers:
Clyde.RoyalElephant
RoyalElephant.Elephant
RoyalElephant.¬Gray
Elephant.Gray

25) In the inheritance hierarchy Γ given above, which of the following edges are present in the preferred credulous extension of Γ with respect to Clyde *1 point*

- [ ] Clyde.RoyalElephant
- [ ] RoyalElephant.Elephant
- [ ] RoyalElephant.¬Gray
- [ ] Elephant.Gray

No, the answer is incorrect.
Score: 0
Accepted Answers:
Clyde.RoyalElephant
RoyalElephant.Elephant
RoyalElephant.¬Gray

26) In the inheritance hierarchy Γ given above, which of the following conclusions hold in Credulous Reasoning *1 point*

- [ ] Clyde is a RoyalElephant
- [ ] Clyde is an Elephant
- [ ] Clyde is not an Elephant
- [ ] Clyde is Gray
- [ ] Clyde is not Gray

No, the answer is incorrect.
Score: 0
Accepted Answers:
Clyde is a RoyalElephant
Clyde is an Elephant
Clyde is not Gray

27) In the inheritance hierarchy Γ given above, which of the following conclusions hold in Skeptical Reasoning *1 point*

- [ ] Clyde is a RoyalElephant
- [ ] Clyde is an Elephant
- [ ] Clyde is not an Elephant
- [ ] Clyde is Gray
- [ ] Clyde is not Gray

No, the answer is incorrect.
Score: 0
Accepted Answers:
Clyde is a RoyalElephant
Clyde is an Elephant
Clyde is not Gray

END GROUP (2)