Status	Beendet
Begonnen	Freitag, 2. Mai 2025, 10:03
Abgeschlossen	Freitag, 2. Mai 2025, 10:21
Dauer	18 Minuten
Bewertung	**9,63** von 10,00 (**96,25**%)

Frage 1

Teilweise richtig

Erreichte Punkte 0,63 von 1,00

Assume that $d(l(h,j)) \wedge \forall i(e(m(i),o(h)) \rightarrow \forall k(n(m(i))))$ is a well-formed formula. Classify each symbol as either a function or a predicate by drag-and-dropping it to the correct location.

Important: The symbols should be specified in alphabetical order. For instance, in $a(b) \wedge c(d)$, the predicate symbols should be specified as a, c and the function symbols as b, d. Furthermore, note that constants are 0-ary functions.

- The predicate symbols are d ✓ , e ✓ , n ✓ .
- The function symbols are l ✗ , h ✗ , j ✗ , m ✓ , o ✓ .

Die richtige Antwort lautet:
Assume that $d(l(h,j)) \wedge \forall i(e(m(i),o(h)) \rightarrow \forall k(n(m(i))))$ is a well-formed formula. Classify each symbol as either a function or a predicate by drag-and-dropping it to the correct location.

Important: The symbols should be specified in alphabetical order. For instance, in $a(b) \wedge c(d)$, the predicate symbols should be specified as a, c and the function symbols as b, d. Furthermore, note that constants are 0-ary functions.

- The predicate symbols are [d],[e],[n].
- The function symbols are [h],[j],[l],[m],[o].

Frage 2

Richtig

Erreichte Punkte 1,00 von 1,00

Consider the signature $\mathcal{S}$ with $\{P\ (arity\ 2), Q\ (arity\ 2)\} \subseteq \mathcal{P}$, $\{a\ (arity\ 0), b\ (arity\ 0), f\ (arity\ 2), g\ (arity\ 1)\} \subseteq \mathcal{F}$ and $\{x, y\} \subseteq \mathcal{V}$ predicates, functions and variables, respectively. Which formulas are **not** well-formed formulas in First-Order Logic?

Important: Note that there can be more than one correct answer.

- [x] a. $(P(f(a),b) \vee Q(g(a))) \rightarrow \exists x P(f(x,b), g(f(x,b)))$ ✓
- [ ] b. $\exists x(P(a,x) \rightarrow Q(a,x)) \wedge Q(a,g(a))$
- [x] c. $\forall(x \wedge y)Q(f(x,b),g(x)) \wedge \neg(P(b,b) \wedge Q(g(a)))$ ✓
- [x] d. $(f(a,a) \vee Q(g(a))) \rightarrow \forall x P(f(x,b),g(x))$ ✓

Die richtigen Antworten sind: $(f(a,a) \vee Q(g(a))) \rightarrow \forall x P(f(x,b),g(x))$
, $(P(f(a),b) \vee Q(g(a))) \rightarrow \exists x P(f(x,b), g(f(x,b)))$
, $\forall(x \wedge y)Q(f(x,b),g(x)) \wedge \neg(P(b,b) \wedge Q(g(a)))$

Frage 3
Richtig
Erreichte Punkte 1,00 von 1,00

Consider the signature $\mathcal{S}$ with $\{P\ (arity\ 2), Q\ (arity\ 2)\} \subseteq \mathcal{P}$, $\{a\ (arity\ 0), f\ (arity\ 2)\} \subseteq \mathcal{F}$ and $\{x\} \subseteq \mathcal{V}$ predicates, functions and variables, respectively. How many **different terms** occur in the formula $P(a, f(a, a)) \vee \forall x(P(a, x) \rightarrow Q(a, x))$? Note that if a term occurs twice, it only counts as one.

Example: The formula $P(f(x), g(x), f(a))$ contains 5 unique terms - a, x, $f(x)$, $g(x)$, $f(a)$.

Antwort: 3

Die richtige Antwort ist: 3

Frage 4
Richtig
Erreichte Punkte 1,00 von 1,00

Consider the signature $\mathcal{S}$ with $\{P\ (arity\ 2), Q\ (arity\ 2)\} \subseteq \mathcal{P}$, $\{f\ (arity\ 2), g\ (arity\ 1)\} \subseteq \mathcal{F}$ and $\{x, y\} \subseteq \mathcal{V}$ predicates, functions and variables, respectively. Which variables have free occurrences in the formula $\forall x(P(f(x, x), f(x, y)) \wedge \forall x Q(f(x, y), g(x)))$? Note that variables that have both free and bound occurrences should also be listed.

Important: In order for your answer to be properly validated, input your variables comma-separated and with no white-spaces in between. For instance, for the formula $\forall y P(x, y) \wedge P(x, y)$ your answer should be: *x,y*

Antwort: y

Die richtige Antwort ist: y

Frage 5
Richtig
Erreichte Punkte 1,00 von 1,00

Consider the signature $\mathcal{S}$ with $\{P\ (arity\ 2)\} \subseteq \mathcal{P}$, $\{a\ (arity\ 0), f\ (arity\ 2), b\ (arity\ 0), g\ (arity\ 1)\} \subseteq \mathcal{F}$ and $\{x\} \subseteq \mathcal{V}$ predicates, functions and variables, respectively. How many **subformulas** does the formula $(\forall x P(a, f(x, b)) \rightarrow P(a, f(a, a))) \rightarrow P(a, g(a))$ have? Note that if a subformula occurs twice, it only counts as one.

Antwort: 6

Die richtige Antwort ist: 6

Frage 6
Richtig
Erreichte Punkte 1,00 von 1,00

What is the correct formalization of the natural language sentence "Some student passes the exam."?

a. $\exists x(Student(x) \rightarrow PassesExam(x))$

b. $Student \wedge StudentPassesExam$

c. $\exists x(Student(x)) \wedge \exists x(PassesExam(x))$

d. $\exists x(\mathrm{Student}(x) \wedge \mathrm{PassesExam}(x))$

Die richtige Antwort ist: \(\exists x (\mathit{Student}(x) \land \mathit{PassesExam}(x))\)

Frage 7

Richtig

Erreichte Punkte 1,00 von 1,00

Which formula is equivalent to the **negation** of $\exists x~\neg P(x)$?

- a. $\neg \forall x~P(x)$
- b. $\forall x~P(x)$
- c. $\neg \forall x~\neg P(x)$
- d. $\forall x~\neg P(x)$

Die richtige Antwort ist: $\forall x~P(x)$

Frage 8

Richtig

Erreichte Punkte 1,00 von 1,00

Which one of the following entailments holds?

- a. $\exists x (P(x) \to Q(x)), \exists x~P(x) \models \forall y~Q(y)$
- b. $\forall x (P(x) \land Q(x)), \exists y~P (y) \models P(b)$
- c. $\exists x (P(x) \lor Q(x)) \models \exists x~P(x)$
- d. $\forall x (P(x) \to Q(x)), Q(a) \models \forall x~P(x)$

Die richtige Antwort ist: $\forall x (P(x) \land Q(x)), \exists y~P (y) \models P(b)$

Frage 9

Richtig

Erreichte Punkte 1,00 von 1,00

Consider the formula $\varphi := \forall x P(x,x) \land \forall x \exists y \neg P(y,x)$. Given the structure $\mathcal{M} = (D_{\mathcal{M}}, I_{\mathcal{M}})$ with domain $D_{\mathcal{M}} = \{ a,b \}$, your task is to specify the relation $P^{\mathcal{M}}$ associated to the predicate symbol P by $I_{\mathcal{M}}$, such that the formula φ is satisfied by $\mathcal{M}$.

Note: List the tuples in $P^{\mathcal{M}}$ comma-separated, with no spaces in between. In case $P^{\mathcal{M}}$ should not contain any elements, input "empty" (without the quotes) in the field below. Furthermore, note that multiple correct answers may be possible.

Example: For $\exists xP(x,x)$ and $\mathcal{M} = (\{a,b\}, I_{\mathcal{M}})$, a possible input could be: *(a,a),(a,b)*

Antwort: (a,a),(b,b)

Die richtige Antwort ist: (a,a),(b,b)

Frage 10

Richtig

Erreichte Punkte 1,00 von 1,00

Which of the following interpretations is a model of the formula $\forall x \exists y P(x, y)$? Note that more than one answer may be correct.

- [ ] a. $\mathcal{M}=(D_\mathcal{M},I_\mathcal{M})$ with $D_\mathcal{M}=\{ a,b,c\}$ and $P^{\mathcal{M}}=\emptyset$
- [ ] b. $\mathcal{M}=(D_\mathcal{M},I_\mathcal{M})$ with $D_\mathcal{M}=\{ a,b,c\}$ and $P^{\mathcal{M}}=\{ (a,a),(a,b),(a,c) \}$
- [ ] c. $\mathcal{M}=(D_\mathcal{M},I_\mathcal{M})$ with $D_\mathcal{M}=\{ a,b,c\}$ and $P^{\mathcal{M}}=\{ (b,a), (a,b) \}$
- [x] d. $\mathcal{M}=(D_\mathcal{M},I_\mathcal{M})$ with $D_\mathcal{M}=\{ a,b,c\}$ and $P^{\mathcal{M}}=\{(a,a),(b,b),(c,c)\}$

Die richtige Antwort ist: $\mathcal{M}=(D_\mathcal{M},I_\mathcal{M})$ with $D_\mathcal{M}=\{ a,b,c\}$ and $P^{\mathcal{M}}=\{(a,a),(b,b),(c,c)\}$