CS161 Homework 5

1.

(a) Neither

|  |  |  |
| --- | --- | --- |
| Smoke | Fire |  |
| F | F | T |
| F | T | F |
| T | F | T |
| T | T | T |

(b) Neither

|  |  |  |  |
| --- | --- | --- | --- |
| Smoke | Fire | Heat |  |
| F | F | F | T |
| F | F | T | F |
| F | T | F | T |
| T | F | F | T |
| F | T | T | T |
| T | F | T | T |
| T | T | F | T |
| T | T | T | T |

(c) Valid

|  |  |  |  |
| --- | --- | --- | --- |
| Smoke | Fire | Heat |  |
| F | F | F | T |
| F | F | T | T |
| F | T | F | T |
| T | F | F | T |
| F | T | T | T |
| T | F | T | T |
| T | T | F | T |
| T | T | T | T |

2.

(a)

Knowledge Base

P1:

P2:

P3:

P4:

(b)

P1:

P2:

P3:

P4:

(c)

Given the KB, we are not able to prove the unicorn is mythical. However, we are able to prove the unicorn is magical (and also horned).

Proof that unicorn is magical, horned

|  |  |
| --- | --- |
| P5: | Extracted from P2 |
| P6: | Extracted from P2 |
| P7: | Extracted from P3 |
| P8: | Extracted from P3 |
| P9: | Resolve P4 and P8 |
| P10: | Resolve P4 and P7 |
| P11: | Resolve P5 and P10 |
| P12: | Resolve P6 and P8 |
| P13: | Resolve P1 and P6 |
| P14: | Resolve P1 and P7 |
| P15: Horned | Resolve P12 and P14 |
| P16: Magical | Resolve P4 and P15 |

3.

(a)

{x/A, y/B, z/B}

(b)

No general unifier exists because A cannot be unified with B

(c)

{y/John, x/John}

(d)

No general unifier exists (i.e. we can do {x/Father(y)}, but then Father(y) cannot be unified with y

4.

(a)

First-Order Logic Formulations

P1: A x, Food(x) => Likes(John, x)

P2: Food(Apples)

P3: Food(Chicken)

P4: A x, y, Eats(x, y) & -Killed(x, y) => Food(y)

P5: A x (E y, Killed(x, y)) => -Alive(x)

P6: Eats(Bill, Peanuts) & Alive(Bill)

P7: A x, Eats(Bill, x) => Eats(Sue, x)

(b)

FOL in CNF

P1: -Food(x) | Likes(John, x)

P2: Food(Apples)

P3: Food(Chicken)

P4: -Eats(x, y) | Killed(x, y) | Food(y)

P5: -Killed(x, y) | -Alive(x)

P6: Eats(Bill, Peanuts)

P7: Alive(Bill)

P8: -Eats(Bill, x) | Eats(Sue, x)

(c)

Proof that John likes peanuts

|  |  |
| --- | --- |
| P9: -Likes(John, Peanuts) | Proof by contradiction |
| P10: -Food(Peanuts) | Resolve P1 and P9 w/ substitution {x/Peanuts} |
| P11: -Eats(x, Peanuts) | Killed(x, Peanuts) | Resolve P4 and P10 w/ substitution {y/Peanuts} |
| P12: -Eats(x, Peanuts) | -Alive(x) | Resolve P5 and P11 w/ substitution {y/Peanuts} |
| P13: -Eats(Bill, Peanuts) | Resolve P7 and P12 w/ substitution {x/Bill} |
| P14: Empty clause (i.e. John likes Peanuts) | Resolve P6 and P13 |

(d)

What food does Sue eat?

First-Order Logic Formulation: E x, Food(x) & Eats(Sue, x)

|  |  |
| --- | --- |
| P9: -Food(x) | -Eats(Sue, x) | Formulation in CNF |
| P10: -Eats(Bill, x) | -Food(x) | Resolve S8 and S9 |
| P11: -Food(Peanuts) | Resolve S6 and S10 w/ substitution {x/Peanuts} |

Then the same proof follows from (c) starting w/ P10 in (c) (i.e. Sue eats Peanuts)

(e)

First-Order Logic Formulations

P1: A x, Food(x) => Likes(John, x)

P2: Food(Apples)

P3: Food(Chicken)

P4: A x, y, Eats(x, y) & -Killed(x, y) => Food(y)

P5: A x (E y, Killed(x, y)) => -Alive(x)

P6: A x, y, -Eats(x, y) => Die(x)

P7: A x, Die(x) => -Alive(x)

P8: Alive(Bill)

P9: A x, Eats(Bill, x) => Eats(Sue, x)

FOL in CNF

P1: -Food(x) | Likes(John, x)

P2: Food(Apples)

P3: Food(Chicken)

P4: -Eats(x, y) | Killed(x, y) | Food(y)

P5: -Killed(x, y) | -Alive(x)

P6: Eats(x, y) | Die(x)

P7: -Die(x) | -Alive(x)

P8: Alive(Bill)

P9: -Eats(Bill, x) | Eats(Sue, x)

What food does Sue eat?

First-Order Logic Formulation: E z, Food(z) & Eats(Sue, z)

|  |  |
| --- | --- |
| P10: -Food(z) | -Eats(Sue, z) | Formulation in CNF |
| P11: -Eats(Bill, z) | -Food(z) | Resolve P9 and P10 w/ substitution {x/z} |
| P12: Die(Bill) | -Food(z) | Resolve P6 and P11 w/ substitution {x/Bill, y/z} |
| P13: -Alive(Bill) | -Food(z) | Resolve P7 and P12 w/ substitution {x/Bill} |
| P14: -Food(z) | Resolve P8 and P13 |
| P15: -Eats(x, y) | Killed(x, y) | Resolve P4 and P14 w/ substitution {z/y} |
| P16: -Eats(x, y) | -Alive(x) | Resolve P5 and P15 |
| P17: -Eats(Bill, y) | Resolve P8 and P16 w/ substitution {x/Bill} |
| P18: Die(Bill) | Resolve P6 and P17 w/ substitution {x/Bill} |
| P19: -Alive(Bill) | Resolve P7 and P18 w/ substitution {x/Bill} |
| P20: Empty clause (i.e. Sue eats everything Bill eats) | Resolve P8 and P19 |

Sue eats everything Bill eats