

Artificial Intelligence

Exercise Sheet 4

November 16, 2021

Task 1 - DPLL

$$(B \vee \overline{D}) \wedge (\overline{A} \vee \overline{C}) \wedge (C \vee B \vee A) \wedge \overline{A} \wedge (\overline{B} \vee D) \wedge (A \vee B \vee D) \wedge (\overline{B} \vee \overline{D})$$

Task 1 - DPLL

$$(B \vee \overline{D}) \wedge (\overline{A} \vee \overline{C}) \wedge (C \vee B \vee A) \wedge \overline{A} \wedge (\overline{B} \vee D) \wedge (A \vee B \vee D) \wedge (\overline{B} \vee \overline{D})$$

Unit-Clause \overline{A}

Task 1 - DPLL

$$(B \vee \overline{D}) \wedge (\overline{A} \vee \overline{C}) \wedge (C \vee B \vee A) \wedge \overline{A} \wedge (\overline{B} \vee D) \wedge (A \vee B \vee D) \wedge (\overline{B} \vee \overline{D})$$

Unit-Clause $\overline{A} \ (B \vee \overline{D}) \wedge (C \vee B) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

Task 1 - DPLL

$$(B \vee \overline{D}) \wedge (\overline{A} \vee \overline{C}) \wedge (C \vee B \vee A) \wedge \overline{A} \wedge (\overline{B} \vee D) \wedge (A \vee B \vee D) \wedge (\overline{B} \vee \overline{D})$$

Unit-Clause $\overline{A} \ (B \vee \overline{D}) \wedge (C \vee B) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

Pure-Symbol C

Task 1 - DPLL

$$(B \vee \overline{D}) \wedge (\overline{A} \vee \overline{C}) \wedge (C \vee B \vee A) \wedge \overline{A} \wedge (\overline{B} \vee D) \wedge (A \vee B \vee D) \wedge (\overline{B} \vee \overline{D})$$

Unit-Clause $\overline{A} \ (B \vee \overline{D}) \wedge (C \vee B) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

Pure-Symbol $C \ (B \vee \overline{D}) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

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$$(B \vee \overline{D}) \wedge (\overline{A} \vee \overline{C}) \wedge (C \vee B \vee A) \wedge \overline{A} \wedge (\overline{B} \vee D) \wedge (A \vee B \vee D) \wedge (\overline{B} \vee \overline{D})$$

Unit-Clause $\overline{A} \ (B \vee \overline{D}) \wedge (C \vee B) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

Pure-Symbol $C \ (B \vee \overline{D}) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

Guess: $B1 = B, B2 = \overline{B}$

B1:

$$D \wedge \overline{D}$$

Task 1 - DPLL

$$(B \vee \overline{D}) \wedge (\overline{A} \vee \overline{C}) \wedge (C \vee B \vee A) \wedge \overline{A} \wedge (\overline{B} \vee D) \wedge (A \vee B \vee D) \wedge (\overline{B} \vee \overline{D})$$

Unit-Clause $\overline{A} \ (B \vee \overline{D}) \wedge (C \vee B) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

Pure-Symbol $C \ (B \vee \overline{D}) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

Guess: $B1 = B, B2 = \overline{B}$

B1:

$$D \wedge \overline{D}$$

Unit-Clause D

Task 1 - DPLL

$$(B \vee \overline{D}) \wedge (\overline{A} \vee \overline{C}) \wedge (C \vee B \vee A) \wedge \overline{A} \wedge (\overline{B} \vee D) \wedge (A \vee B \vee D) \wedge (\overline{B} \vee \overline{D})$$

Unit-Clause $\overline{A} \ (B \vee \overline{D}) \wedge (C \vee B) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

Pure-Symbol $C \ (B \vee \overline{D}) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

Guess: $B1 = B, B2 = \overline{B}$

B1:

$$D \wedge \overline{D}$$

Unit-Clause D

Unsolvable, backtracking

Task 1 - DPLL

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Unit-Clause $\overline{A} \ (B \vee \overline{D}) \wedge (C \vee B) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

Pure-Symbol $C \ (B \vee \overline{D}) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

Guess: $B1 = B, B2 = \overline{B}$

B1:

$$D \wedge \overline{D}$$

Unit-Clause D

Unsolvable, backtracking

B2:

$$\overline{D} \wedge D$$

Task 1 - DPLL

$$(B \vee \overline{D}) \wedge (\overline{A} \vee \overline{C}) \wedge (C \vee B \vee A) \wedge \overline{A} \wedge (\overline{B} \vee D) \wedge (A \vee B \vee D) \wedge (\overline{B} \vee \overline{D})$$

Unit-Clause $\overline{A} \ (B \vee \overline{D}) \wedge (C \vee B) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

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B1:

$$D \wedge \overline{D}$$

Unit-Clause D

Unsolvable, backtracking

B2:

$$\overline{D} \wedge D$$

Unit-Clause \overline{D}

Task 1 - DPLL

$$(B \vee \overline{D}) \wedge (\overline{A} \vee \overline{C}) \wedge (C \vee B \vee A) \wedge \overline{A} \wedge (\overline{B} \vee D) \wedge (A \vee B \vee D) \wedge (\overline{B} \vee \overline{D})$$

Unit-Clause $\overline{A} (B \vee \overline{D}) \wedge (C \vee B) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

Pure-Symbol $C (B \vee \overline{D}) \wedge (\overline{B} \vee D) \wedge (B \vee D) \wedge (\overline{B} \vee \overline{D})$

Guess: $B1 = B, B2 = \overline{B}$

B1:

$$D \wedge \overline{D}$$

Unit-Clause D

Unsolvable, backtracking

B2:

$$\overline{D} \wedge D$$

Unit-Clause \overline{D}

Unsolvable, backtracking

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Guess: $B1 = B, B2 = \overline{B}$

B1:

$$D \wedge \overline{D}$$

Unit-Clause D

Unsolvable, backtracking

B2:

$$\overline{D} \wedge D$$

Unit-Clause \overline{D}

Unsolvable, backtracking

Unsolvable

Task 2 - Unifikation

1. $\{Vater(a, Tim), Vater(Jakob, b)\}$
2. $\{Kennt(Vater(y), y), Kennt(x, x)\}$
3. $\{f(g(a, x), g(y, b)); f(z, g(v, w)); f(g(x, a), g(v, b))\}$

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► $\{a/Jakob, b/Tim\}$

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- ▶ $\{a/Jakob, b/Tim\}$
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- ▶ $\{a/Jakob, b/Tim\}$
- ▶ $\{/\}$
- ▶ $\{x/a, y/v, z/g(a, a), w/b\}$

Task 3

Formulas and CNF:

1. $\forall x \text{ Child}(x) \rightarrow \text{hasDragon}(x)$
 $\equiv \neg \text{Child}(x) \vee \text{hasDragon}(x)$
2. $\forall x (\text{Child}(x) \wedge \text{hasDragon}(x) \wedge \text{outside}(x)) \rightarrow \text{hasfun}(x)$
 $\equiv \neg \text{Child}(x) \vee \neg \text{hasDragon}(x) \vee \neg \text{outside}(x) \vee \text{hasFun}(x)$
3. $\forall x (\text{Child}(x) \wedge \neg \text{isIll}(x) \rightarrow \text{outside}(x))$
 $\equiv \neg \text{Child}(x) \vee \text{isIll}(x) \vee \text{outside}(x)$
4. $\neg \text{isIll}(\text{Alfons})$
5. $\text{Child}(\text{Alfons})$
6. **Negated Aim:** $\neg \text{hasFun}(\text{Alfons})$

Task 3

Resolution:

7. $hasDragon(Alfons)$ (from (1) and (5))
 8. $\neg hasDragon(Alfons) \vee \neg outside(Alfons) \vee hasFun(Alfons)$ (from (2) and (5))
 9. $isIll(x) \vee outside(x)$ (from (3) and (5))
 10. $outside(Alfons)$ (from (9) and (4))
 11. $\neg hasDragon(Alfons) \vee hasFun(Alfons)$ from (8) and (10)
 12. $hasFun(Alfons)$ from (7) and (11)
 13. $\{\}$ from (12) and (6)
- (Unifier is always $\sigma = \{x/Alfons\}$)