

Autonomous Intelligent Systems

Lab 2

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1 Exercise 1: DPLL

a) $\phi_1 = (\neg A \vee B \vee C) \wedge (\neg B \vee \neg C) \wedge (\neg A \vee \neg C \vee \neg D) \wedge (C \vee \neg D) \wedge (A \vee D) \wedge (A \vee \neg C \vee \neg D)$

$$\Delta_{\phi_1} = \{\{-A, B, C\}, \{-B, C\}, \{-A, -C, -D\}, \{C, -D\}, \{A, D\}, \{A, -C, -D\}\}$$

Splitting rule: $A \rightarrow F$
 $\{\{-B, -C\}, \{C, -D\}, \{D\}, \{-C, -D\}\}$

Unit Propagation: $D \rightarrow T$
 $\{\{-B, -C\}, \{C\}, \{-C\}\}$

Unit Propagation: $C \rightarrow T$
 $\{\{-B\}, \square\}$

Splitting rule: $A \rightarrow T$
 $\{\{B, C\}, \{-B, -C\}, \{-C, -D\}, \{C, -D\}\}$

Splitting rule: $B \rightarrow F$
 $\{\{C\}, \{-C, -D\}, \{C, -D\}\}$

Unit Propagation: $C \rightarrow T$
 $\{\{-D\}\}$

Unit Propagation: $D \rightarrow F$
 $\{\}$

\therefore Satisfiable

b) $\phi_2 = (\neg A \vee \neg B \vee C \vee \neg E) \wedge (\neg A \vee \neg B \vee C \vee E) \wedge (A \leftrightarrow B) \wedge (B \vee D) \wedge (B \vee C \vee \neg D) \wedge (\neg C)$

$$\Delta_{\phi_2} = \{\{-A, -B, C, -E\}, \{-A, -B, C, E\}, \{-A, B\}, \{A, -B\}, \{B, D\}, \{B, C, -D\}, \{-C\}\}$$

Unit Propagation: $C \rightarrow F$

$$\{\{-A, -B, -E\}, \{-A, -B, E\}, \{-A, B\}, \{A, -B\}, \{B, D\}, \{B, -D\}\}$$

Splitting rule: $A \rightarrow F$

$$\{\{B, D\}, \{B, -D\}, \{-B\}\}$$

Unit Propagation: $B \rightarrow F$

$$\{\{D\}, \{-D\}\}$$

Unit Propagation: $D \rightarrow T$

$$\{\square\}$$

Splitting rule: $A \rightarrow T$

$$\{\{-B, -E\}, \{-B, E\}, \{B, D\}, \{B, -D\}, \{B\}\}$$

Unit Propagation: $B \rightarrow T$

$$\{\{-E\}, \{E\}\}$$

Unit Propagation: $E \rightarrow T$

$$\{\square\}$$

\therefore Unsatisfiable

2 Exercise 2: DPLL + Clause Learning

$$\Delta = \{\{A, B, C, D\}, \{-A, -B\}, \{-B, -C\}, \{-A, -D\}, \{A, -D\}, \{C, -D\}, \{B, -C\}, \{-B, C\}, \{-A, C, D\}\}$$

Splitting Rule: $A \rightarrow F$ (choice literal)

$$\{\{B, C, D\}, \{-B, -C\}, \{-D\}, \{C, -D\}, \{B, -C\}, \{-B, C\}\}$$

Unit Propagation: $D \rightarrow F$ (implied literal)

$$\{\{B, C\}, \{-B, -C\}, \{B, -C\}, \{-B, C\}\}$$

Splitting Rule: $B \rightarrow T$ (choice literal)

$$\{\{-C\}, \{C\}\}$$

Unit Propagation: $C \rightarrow T$ (implied literal)

$$\{\square\}$$

$-B$ is learned (a).

$$\Delta' = \{\{B, C\}, \{-B, -C\}, \{-B, C\}, \{B, -C\}, \{-B\}\}$$

Unit Propagation: $B \rightarrow F$ (implied [learned] literal)

$$\{\{C\}, \{-C\}\}$$

Unit Propagation: $C \rightarrow T$ (implied literal)

$$\{\square\}$$

A is learned (b).

Unit Propagation: $A \rightarrow T$ (implied [learned] literal)

$$\{\{-B\}, \{-B, -C\}, \{-D\}, \{C, -D\}, \{B, -C\}, \{-B, C\}, \{C, D\}\}$$

Unit Propagation: $D \rightarrow F$ (implied literal)

$$\{\{-B\}, \{-B, -C\}, \{B, -C\}, \{-B, C\}, \{C\}\}$$

Unit Propagation: $C \rightarrow T$

$$\{\{-B\}, \{-B\}, \{B\}\}$$

Unit Propagation: $B \rightarrow F$

$$\{\square\}$$

\therefore Unsatisfiable

(Graphs on next page)

Figure 1: Implication graph(left) and conflict graph(right) (a)

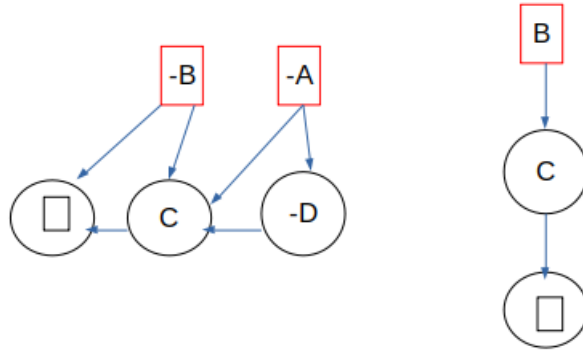


Figure 2: Implication graph (b)

