

1 Explanation Generation

Algorithm 1: EXPLAINCSP(\mathcal{C}, U, f)

```

// Hyp: f
1  $E \leftarrow \langle \rangle$ 
2  $I_{end} \leftarrow \text{OPTIMALPROPAGATE}(\mathcal{C}, U)$  // assignment on variables of U
3 bart: What's a better way to get the initial interpr.?
4  $I \leftarrow \{i \in I_{end} \mid f(-i) = \text{inf}\}$  // contains the indicator literals and the initial assignment
5 while  $I \neq I_{end}$  do
6    $X \leftarrow \text{BESTSTEP}(\mathcal{C}, f, I_{end}, I)$ 
7    $I_{best} \leftarrow I \cap X$ 
8    $N_{best} \leftarrow \{I_{end} \setminus I\} \cap \text{OPTIMALPROPAGATE}(\mathcal{C} \cup I_{best}, U)$ 
9   add  $\{I_{best} \implies N_{best}\}$  to  $E$ 
10   $I \leftarrow I \cup N_{best}$ 
11 end
12 return  $E$ 

```

Algorithm 2: BESTSTEP-C-OUS($\mathcal{C}, f, I_{end}, I$)

```

1  $A \leftarrow I \cup (\overline{I_{end}} \setminus \bar{I})$  // Optimal US is subset of A
2 set  $p$  such that exactly one of  $\overline{I_{end}}$  in the hitting set
3 return C-OUS( $\mathcal{C}, f, p, A$ )

```

Algorithm 3: C-OUS(\mathcal{C}, f, p, A)

```

// Hyp:  $\mathcal{C} \cup A$  is unsatisfiable
1  $\mathcal{H} \leftarrow \emptyset$ 
2 while true do
3    $A' \leftarrow \text{CONDOPTHITTINGSET}(f, p, A, \mathcal{H})$ 
4   if  $\neg \text{SAT}(\mathcal{C} \cup A')$  then
5     return  $A'$ 
6   end
7    $A'' \leftarrow \text{GROW}(A', A)$ 
8    $\mathcal{H} \leftarrow \mathcal{H} \cup \{A \setminus A''\}$  // We can reuse the H across diff call to alg 1 was  $H \cup \{F \setminus F''\}$ 
9 end

```

Algorithm 4: OPTIMALPROPAGATE(\mathcal{C}, \mathcal{U})

```

1  $\text{sat?}, \mu \leftarrow \text{SAT}(\mathcal{C})$ 
2  $\mu \leftarrow \mu \cap \mathcal{U}$ 
3 Should I add the blocking variables  $b_i$  to the newly added clause ?
4 while true do
5    $\mathcal{C} \leftarrow \mathcal{C} \wedge (\bigvee_{1 \leq i \leq |\mu|} \neg x_i)$ 
6   or  $\mathcal{C} \leftarrow \mathcal{C} \wedge (\bigvee_{1 \leq i \leq |\mu|} \neg x_i)$ 
7   or  $\mathcal{C} \leftarrow \mathcal{C} \wedge (\neg x_1 \dots \vee \neg x_{|\mu|})$ 
8   or  $\mathcal{C} \leftarrow \mathcal{C} \wedge (\neg b_i \bigvee_{1 \leq i \leq |\mu|} \neg x_i)$ 
9   or  $\mathcal{C} \leftarrow \mathcal{C} \wedge (\neg b_i \vee \neg x_1 \dots \vee \neg x_{|\mu|})$ 
10   $\text{sat?}, \mu' \leftarrow \text{SAT}(\mathcal{C})$ 
11  if  $\neg \text{sat?}$  then
12    return  $\mu$ 
13  end
14   $\mu \leftarrow \mu \cap \mu' \cap \mathcal{U}$ 
15 end

```

2 OUS Algorithm

Algorithm 5: BESTSTEP-OUS($\mathcal{C}, f, I, I_{end}$)

```

1  $X_{best} \leftarrow \{\mathcal{C} \wedge I \wedge \overline{I_{end}}\}$ 
2 for  $l \in \{I_{end} \setminus I\}$  do
3    $X \leftarrow \text{OUS}(\mathcal{C} \wedge I \wedge \neg l, f)$ 
4   if  $f(X) < f(X_{best})$  then
5      $X_{best} \leftarrow X$ 
6   end
7 end
8 return  $X_{best}$ 

```

Algorithm 6: OUS-INC(\mathcal{F}, f)

```

1 SSoF  $\leftarrow \emptyset$ 
2 for  $S \in \text{SSs}$  do
3    $S_{\mathcal{F}} \leftarrow S \cap \mathcal{F}$ 
4   if  $\neg \exists S' \in \text{SSoF} : S_{\mathcal{F}} \subseteq S'$  then
5      $S_{\mathcal{F}} \leftarrow \text{GROW}(S_{\mathcal{F}}, \mathcal{F})$ 
6      $\mathcal{H} \leftarrow \mathcal{H} \cup \{\mathcal{F} \setminus S_{\mathcal{F}}\}$ 
7     SSoF  $\leftarrow \text{SSoF} \cup \{S_{\mathcal{F}}\}$ 
8   end
9 end
10 while true do
11    $\mathcal{F}' \leftarrow \text{OPTHITTINGSET}(\mathcal{H}, f)$ 
12   if  $\neg \text{SAT}(\mathcal{F}')$  then
13     return  $\mathcal{F}'$ 
14   end
15    $\mathcal{F}'' \leftarrow \text{GROW}(\mathcal{F}', \mathcal{F})$ 
16    $\mathcal{H} \leftarrow \mathcal{H} \cup \{\mathcal{F} \setminus \mathcal{F}''\}$ 
17   SSs  $\leftarrow \text{SSs} \cup \{(\mathcal{F}'', M)\}$ 
18 end

```

Algorithm 7: Postponing hitting set optimization for OUS (to be inserted before of)

```

1 while true do
2   while  $|\mathcal{H}| > 0$  do
3      $\mathcal{F}' \leftarrow \mathcal{F}' + \min_f \text{ element of last MCS in } \mathcal{H};$ 
4     if  $\neg \text{SAT}(\mathcal{F}')$  then
5       break
6     end
7      $\mathcal{H} \leftarrow \mathcal{H} \cup \{\mathcal{F} \setminus \text{GROW}(\mathcal{F}', \mathcal{F})\};$ 
8   end
9    $\mathcal{F}' \leftarrow \text{GREEDYHITTINGSET}(\mathcal{H}, f);$ 
10  if  $\neg \text{SAT}(\mathcal{F}')$  then
11    break
12  end
13   $\mathcal{H} \leftarrow \mathcal{H} \cup \{\mathcal{F} \setminus \text{GROW}(\mathcal{F}', \mathcal{F})\};$ 
14 end

```
