Homework 11/10 – Satisfiability Modulo Theories

(For more information, see the paper on SAT-Modulo Theories on course reserves)

1. In our discussion of theories, we extended our FOL syntax to use lambdas. A danger that is avoided in practice, but ever haunts us, is combinatorial explosion: an innocent-looking set of statements of size N which, after lambda evaluation, results in a O(2^n) (or so) size equation. Describe in your own words a situation (set of statements) where this can occur. Suggestion: provide the statements, and a first few evaluations, and then attempt to reason about the final size.

2. The theory of arithmetic we discuss include +, -, but not *(multiplication). We leave out multiplication for both arithmetic over reals as well as arithmetic over integers? Why may we want to leave out multiplication for each case?

3. What characteristics of static learning and T-backjumping/T-learning make these steps (which are applied to the “lazy” schema”) different from the "eager" schema?

4. Looking at the diagram of a T-DPLL search provided (also in the paper as Figure 26.4), can you explain what method from the T-DPLL solver resulted in the creation of clause c8?

	$\varphi =$	$\varphi^p =$
$c_1 :$	$\{\neg(2x_2 - x_3 > 2) \vee A_1\}$	$\{\neg B_1 \vee A_1\}$
$c_2 :$	$\{\neg A_2 \vee (x_1 - x_5 \leq 1)\}$	$\{\neg A_2 \vee B_2\}$
$c_3 :$	$\{(3x_1 - 2x_2 \leq 3) \vee A_2\}$	$\{B_3 \vee A_2\}$
$c_4 :$	$\{\neg(2x_3 + x_4 \geq 5) \vee \neg(3x_1 - x_3 \leq 6) \vee \neg A_1\}$	$\{\neg B_4 \vee \neg B_5 \vee \neg A_1\}$
$c_5 :$	$\{A_1 \vee (3x_1 - 2x_2 \leq 3)\}$	$\{A_1 \vee B_3\}$
$c_6 :$	$\{(x_2 - x_4 \leq 6) \vee (x_5 = 5 - 3x_4) \vee \neg A_1\}$	$\{B_6 \vee B_7 \vee \neg A_1\}$
$c_7 :$	$\{A_1 \vee (x_3 = 3x_5 + 4) \vee A_2\}$	$\{A_1 \vee B_8 \vee A_2\}$

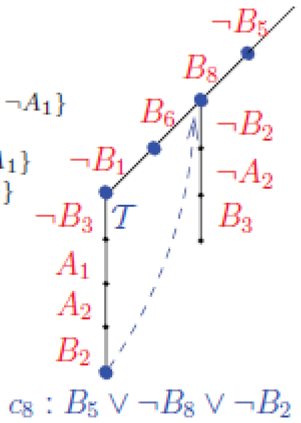

Figure 26.4. Boolean search (sub)tree in the scenario of Example 26.4.1. (A diagonal line, a vertical line and a vertical line tagged with “$\mathcal{T}$” denote literal selection, unit propagation and $\mathcal{T}$-propagation respectively; a bullet “•” denotes a call to the $\mathcal{T}$-*solver*.)