Technische Universiteit Eindhoven
University of Technology

Department of Mathematics and Computer Science

Den Dolech 2, 5612 AZ Eindhoven
P.O. Box 513, 5600 MB Eindhoven
The Netherlands

Author
Michiel Fortuin
Leo ....

Date
December 2, 2015

Version
1.0

Part 1

2IMF25: Automated reasoning

Where innovation starts

Technische Universiteit
Eindhoven
University of Technology

Table of contents

Title
Part 1

1 Assignment 1

The first problem is solvable with yices. This can be expressed as an SMT problem with linear integer equations. In these linear equations N_i refers to the pallets of nuzzles on truck i, P_i refers to the pallets of prittles on truck i, S_i refers to the pallets of skipples on truck i, C_i refers to the pallets of crottles on truck i and D_i refers to the pallets of dupples on truck i.

The result of the assignment has to be subject too the following equations:

$\sum_{i=0}^{6} N_i = 4$	4 nuzzles
$\sum_{i=0}^{6} S_i = 8$	8 skipples
$\sum_{i=0}^{6} C_i = 10$	10 crottles
$\sum_{i=0}^{6} D_i = 5$	5 dupples
$\forall_{1 \leq i \leq 6}\ 7800 \geq 700N_i + 800P_i + 1000S_i + 1500C_i + 100D_i$	max weight on trucks
$\forall_{1 \leq i \leq 6}\ \neg(P_i > 0 \wedge C_i > 0)$	no prittles and crottles together
$\forall_{1 \leq i \leq 6}\ D_i \leq 2$	maximum of 2 dupples
$\forall_{3 \leq i \leq 6}\ S_i = 0$	in truck 3 through 6 no skipples

And maximization the following equation:

$$\sum_{i=0}^{6} P_i$$

Also implicit all variables has to be greater than zero, because it's impossible to load less then 0 crates.

This is possible as input for yices, except for the maximize function. The maximal value of maximization function has to be found by trial and error. The maximum number of prittles that can be added is 25. The resulting load of the trucks can be found in table 1.1.

Table 1.1: Pallets on the trucks

Truck	Nittles	Prittles	Skipples	Crottles	Dupples	Weight on Truck	Max Weight
1	0	7	2	0	1	7700	7800
2	0	2	6	0	2	7800	7800
3	2	8	0	0	0	7800	7800
4	0	0	0	5	0	7500	7800
5	0	0	0	5	2	7700	7800
6	2	8	0	0	0	7800	7800
Total	4	25	8	10	5		
Unit weight	700	800	1000	1500	100		

2 Assignment 2

Assignment 2

3 Assignment 3

The first problem is solvable with yices. This can be expressed as an SMT problem with linear integer equations. In these linear equations S_i refers to the start of job i with length i.

To express this problem in an SMT problem, 2 general predicate are defined. The first predicate makes sure that job a is after job b. This can be expressed as follows: $S_a \geq S_b + b$. This predicate is called $precedence(a, b)$. The second predicate is that 2 jobs, namely a and b, do not overlap. This is called $dont\_overlap(a, b)$ and can be expressed as follows:

$$\begin{aligned} &\neg(S_a \geq S_b \wedge S_a < S_b + b) \\ \wedge&\neg(S_a + a > S_b \wedge S_a + a \leq S_b + b) \\ \wedge&\neg(S_b \geq S_a \wedge S_b < S_a + a) \\ \wedge&\neg(S_b + b > S_a \wedge S_b + b \leq S_a + a) \end{aligned}$$

Then the resulting problem becomes quite easy. We assume there is a list P with all the precedences. Also a list C with all the jobs that can not run concurrently.

$$\begin{aligned} \forall_{<a,b>\in P}\ & precedence(a, b) \\ \forall_{<a,b>\in C}\ & dont\_overlap(a, b) \\ \forall_{1\leq i\leq 12}\ & S_i \geq 0 \end{aligned}$$

The total resulting span of the jobs is 36. The resulting plan is plotted in 3.1.

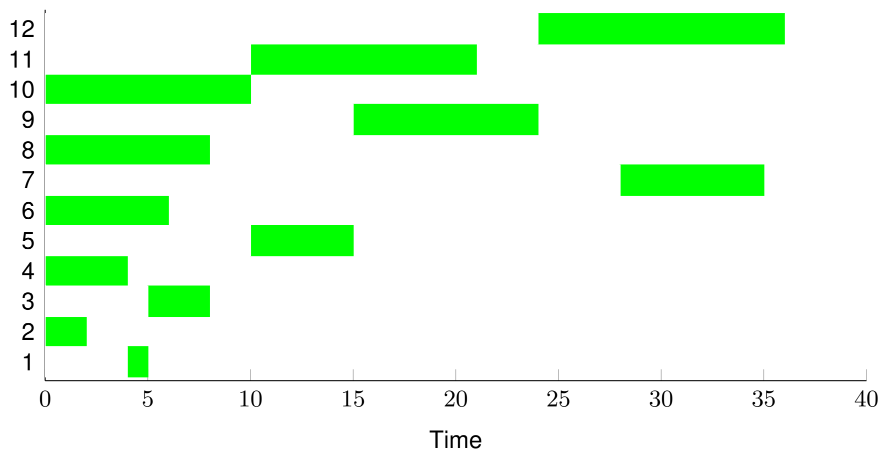

Figure 3.1: Planning results

4 Assignment 4

Assignment 4