Warning! Original SPOT5 instances number 1401-1506 have a memory

limitation (n-ary constraint) which is ignored when translating in ds,

cp, and wcsp formats.

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---- Original README file from ftp.cert.fr/pub/lemaitre/LVCSP/Pbs/SPOT5.zip

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This README file explains the `spot5' problems and their representation.

Look at the file "8.spot" for a small example (in the same directory,

and see below).

These files represent some earth observation daily management

problems, which have been produced at the CNES (French Space Agency)

by a simulator of the future order book of the satellite SPOT5.

The management problems to be solved can be roughly described as

follows (see [1] for more details):

- given a set S of photographs which can be taken the next day from

at least one of the three instruments, w.r.t. the satellite

trajectory; given, for each photograph, a weight expressing its

importance;

- given a set of imperative constraints: non overlapping and minimal

transition time between two successive photographs on the same

instrument, limitation on the instantaneous data flow through the

satellite telemetry and on the recording capacity on board;

- find an admissible subset S' of S (imperative constraints met)

which maximizes the sum of the weights of the photographs in S'.

These problems can be casted as additive CSPs with valued variables

(where the objective is to produce a partial assignment of the problem

variables which satisfies all the imperative constraints and maximizes

the sum of the weights of the assigned variables) by:

- associating a variable v with each photograph p, and associating

with v a domain d to express the different ways of achieving p;

- translating as imperative constraints (binary and ternary) the

constraints of non overlapping and minimal transition time between two

photographs on the same instrument, and of limitation on the

instantaneous data flow;

- translating as an n-ary imperative constraint the constraint of

limitation on the recording capacity;

The files suffixed by ".spot" are the result of a preprocessing, which

computes all the variables with their associated domain and all the

binary and ternary imperative constraints with their explicitely

defined associated relation (all the forbidden tuples). Only the

n-ary constraint associated with the limitation on the recording

capacity remains implicitely defined (the sum of the memory

consumptions of the assigned variables must be less than or equal to

the memory limitation). Looking at them, you can forget what they

represent and just consider them as additive CSPs.

The used BNF-like syntax can be described as follows (something

following by an asterisk indicates zero or more of them, something in

square brackets indicates zero or one of them and curly brackets are

used for grouping):

file ::=

variables constraints

variables ::=

number-of-variables {variable}\*

number-of-variables ::= number \newline

variable ::=

variable-ident variable-weight domain-size

{value-ident memory-consumption}\* \newline

variable-ident ::= number

variable-weight ::= number

domain-size ::= number

value-ident ::= number

memory-consumption ::= number

constraints ::=

explicitly-defined-constraints [implicitly-defined-constraints]

explicitly-defined-constraints ::=

number-of-constraints {constraint}\*——大括号分组、星号 0或多个、

中括号，0或其中一个

number-of-constraints ::=

number \newline

constraint ::=

arity {variable-ident}\* {forbidden-tuple}\* \newline

arity ::= number

forbidden-tuple ::=

{value-ident}\*

implicitly-defined-constraints ::=

memory-limitation \newline

memory-limitation ::= number

For example, the file "8.spot" represents a small size problem

including 8 variables and 7 constraints, without memory limitation.

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8

0 1 3 1 0 2 0 3 0

1 1 3 1 0 2 0 3 0

2 1 3 1 0 2 0 3 0

3 1 3 1 0 2 0 3 0

4 2 1 13 0

5 2 1 13 0

6 2 1 13 0

7 2 1 13 0

7

2 1 0 3 3 2 2 1 1

2 2 0 3 3 2 2 1 1

2 3 0 3 3 2 2 1 1

2 5 4 13 13

2 5 6 13 13

2 2 1 3 3 2 2 1 1

2 3 1 3 3 2 2 1 1

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The first variable (line 2) has the following characteristics:

- its ident is 0;

- its weight is equal to 1;

- its domain size is equal to 3;

- its possible values are 1, 2 and 3, all of them without memory

consumption.

The first constraint (line 11) has the following characteristics:

- its arity is equal to 2;

- it links the variables 1 and 0;

- the forbidden pairs of values are (3 3) (2 2) (1 1) (inequality

constraint).

The following table shows the results which have been obtained on some

of these problems, using an exact Branch-and-Bound-like method, called

"Russian Doll Search" (see [2]).

pb is the problem number, n the number of variables, e the number of

constraints, v the optimal valuation (the maximum of the sum of the

weights of the assigned variables) and t the cpu time in seconds to

get this result (to get an optimal valuation assignment and to prove

its optimality). Algorithms have been written in Common Lisp and tests

have been performed with the CMUCL implementation on a Sparc 5

workstation with 32Mb of memory).

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pb & n & e & v & t

404 & 100 & 610 & 49 & 0.5

408 & 199 & 2032 & 3082 & 14

412 & 300 & 4048 & 16102 & 29

414 & 364 & 9744 & 22120 & 86

503 & 105 & 403 & 9096 & 2.5

505 & 240 & 2002 & 13100 & 15

507 & 311 & 5421 & 15137 & 55

509 & 348 & 8276 & 19125 & 106

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Note that problems number 11 and 414 are the same.

[1]: "Exact and Approximate Methods for the Daily Management of an

Earth Observation Satellite", J.C. Agnese, N. Bataille, E. Bensana,

D. Blumstein and G. Verfaillie, Proc. of the 5th ESA Workshop on

Artificial Intelligence and Knowledge Based Systems for Space,

Noordwijk, The Netherlands, 1995,

ftp://ftp.cert.fr/pub/verfaillie/estec95.ps

[2]: "Russian Doll Search for Solving Constraint Optimization

Problems", G. Verfaillie, M. Lemaitre and T. Schiex, Proc. of

AAAI-96, Portland, Oregon, USA, 1996,

ftp://ftp.cert.fr/pub/verfaillie/rds-aaai96.ps