5.52 big_valley

DESCRIPTION LINKS AUTOMATON

Origin Derived from valley.

Constraint big_valley(N, VARIABLES, TOLERANCE)

Arguments

N	:	dvar
VARIABLES	:	collection(var−dvar)
TOLERANCE	:	int

Restrictions

$\texttt{N} \geq 0$
$2 * \texttt{N} \leq \texttt{max}(|\texttt{VARIABLES}| - 1, 0)$
required(VARIABLES, var)
$\texttt{TOLERANCE} \geq 0$

Purpose

A variable V_v $(1 < k < m)$ is a *valley* if and only if there exists an i $(1 < i \leq v)$ such that $V_{i-1} > V_i$ and $V_i = V_{i+1} = \cdots = V_v$ and $V_v < V_{v+1}$. Similarly a variable V_p $(1 < p < m)$ of the sequence of variables $\texttt{VARIABLES} = V_1, \ldots, V_m$ is a *peak* if and only if there exists an i $(1 < i \leq p)$ such that $V_{i-1} < V_i$ and $V_i = V_{i+1} = \cdots = V_p$ and $V_p > V_{p+1}$. A valley variable V_v $(1 < v < m)$ is a *potential big valley* wrt a non-negative integer TOLERANCE if and only if:

1. V_v is a valley,
2. $\exists i, j \in [1, m] \mid i < v < j$, V_i is a peak (or $i = 1$ if there is no peak before position p), V_j is a peak (or $i = m$ if there is no peak after position p), $V_i - V_v > \texttt{TOLERANCE}$, and $V_j - V_v > \texttt{TOLERANCE}$.

Let i_v and j_v be the largest i and the smallest j satisfying condition 2. Now a potential big valley V_v $(1 < v < m)$ is a *big valley* if and only if the interval $[i, j]$ does not contain any potential big valley that is strictly less than V_v. The constraint big_valley holds if and only if N is the total number of big valleys of the sequence of variables VARIABLES.

Example

$(7, \langle 9, 11, 11, 9, 10, 5, 7, 6, 6, 4, 8, 7, 10, 1, 1, 7, 7, 5, 9, 8, 12\rangle, 0)$
$(4, \langle 9, 11, 11, 9, 10, 5, 7, 6, 6, 4, 8, 7, 10, 1, 1, 7, 7, 5, 9, 8, 12\rangle, 1)$

As shown part Part (A) of Figure 5.118, the first big_valley constraint holds since the sequence 9 11 11 9 10 5 7 6 6 4 8 7 10 1 1 7 7 5 9 8 12 contains seven big valleys wrt a tolerance of 0 (i.e., we consider standard valleys).

As shown part Part (B) of Figure 5.118, the second big_valley constraint holds since the same sequence 9 11 11 9 10 5 7 6 6 4 8 7 10 1 1 7 7 5 9 8 12 contains only four big valleys wrt a tolerance of 1.

Typical

$\texttt{N} \geq 1$
$|\texttt{VARIABLES}| > 6$
$\texttt{range}(\texttt{VARIABLES.var}) > 1$
$\texttt{TOLERANCE} > 1$

Symmetries

- Items of VARIABLES can be reversed.
- One and the same constant can be added to the var attribute of all items of VARIABLES.

Arg. properties

- Functional dependency: N determined by VARIABLES and TOLERANCE.
- Contractible wrt. VARIABLES when $\mathtt{N} = 0$ and $\mathtt{TOLERANCE} = 0$.

Usage

Useful for constraining the number of *big valleys* of a sequence of domain variables, by ignoring too small peaks that artificially create small valleys wrt TOLERANCE.

See also

specialisation: valley *(the tolerance is set to* 0 *and removed).*

Keywords

characteristic of a constraint: automaton, automaton with counters.

combinatorial object: sequence.

constraint arguments: pure functional dependency.

modelling: functional dependency.

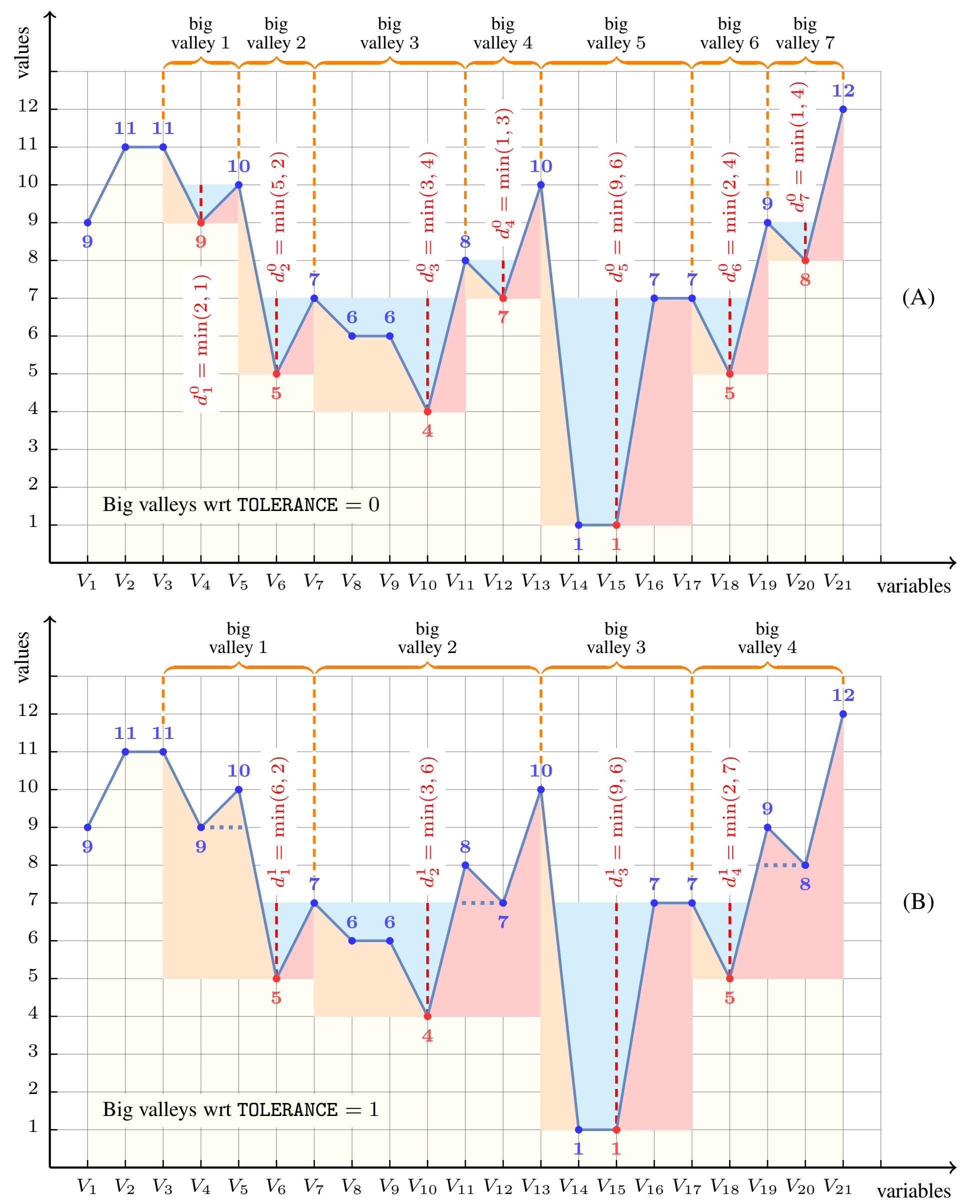

Figure 5.118: Illustration of the **Example** slot: Part (A) a sequence of 21 variables $V_1, V_2, \ldots, V_{21}$ respectively fixed to values 9, 11, 11, 9, 10, 5, 7, 6, 6, 4, 8, 7, 10, 1, 1, 7, 7, 5, 9, 8, 12 and its corresponding 7 valleys (TOLERANCE $= 0$ corresponds to standard valleys) with their respective depths $d_1^0 = 1$, $d_2^0 = 2$, $d_3^0 = 3$, $d_4^0 = 1$, $d_5^0 = 6$, $d_6^0 = 2$, $d_7^0 = 1$ (the left and right hand sides of each valley are coloured in light orange and light red) Part (B) the same sequence of variables and its 4 big valleys when TOLERANCE $= 1$ with their respective depths $d_1^1 = 2$, $d_2^1 = 3$, $d_3^1 = 6$, $d_4^1 = 2$

Automaton Figure 5.119 depicts the automaton associated with the `big_valley` constraint. To each pair of consecutive variables $(\texttt{VAR}_i, \texttt{VAR}_{i+1})$ of the collection `VARIABLES` corresponds a signature variable S_i. The following signature constraint links $\texttt{VAR}_i$, $\texttt{VAR}_{i+1}$ and S_i: $(\texttt{VAR}_i < \texttt{VAR}_{i+1} \Leftrightarrow S_i = 0) \wedge (\texttt{VAR}_i = \texttt{VAR}_{i+1} \Leftrightarrow S_i = 1) \wedge (\texttt{VAR}_i > \texttt{VAR}_{i+1} \Leftrightarrow S_i = 2)$.

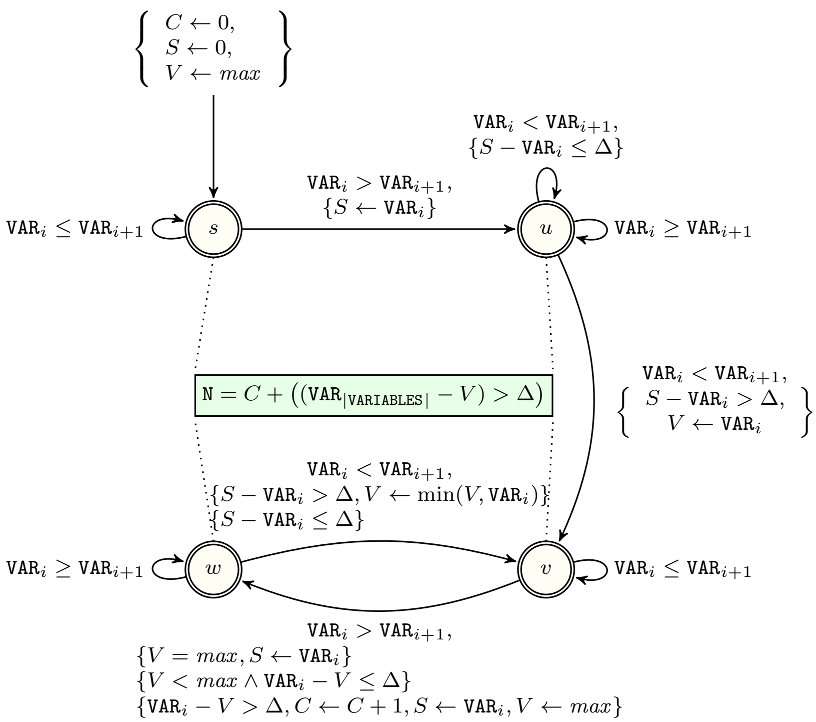

Figure 5.119: Automaton for the `big_valley` where C, S, V, max and Δ respectively stand for the number of big valleys already encountered, the altitude at the start of the current potential big valley, the altitude of the current potential big valley, the largest value that can be assigned to a variable of `VARIABLES`, the `TOLERANCE` parameter