NAME

CUTEST_ceh − CUTEst tool to evaluate the sparse Lagrangian Hessian matrix in finite element format.

SYNOPSIS

```
CALL CUTEST_ceh( status, n, m, X, Y, ne, lhe_ptr, HE_row_ptr, HE_val_ptr, lhe_row, HE_row, lhe_val,
                 HE_val, byrows )
```

For real rather than double precision arguments, instead

```
CALL CUTEST_ceh_s( ... )
```

and for quadruple precision arguments, when available,

```
CALL CUTEST_ceh_q( ... )
```

DESCRIPTION

The CUTEST_ceh subroutine evaluates the Hessian matrix of the Lagrangian function $l(x, y) = f(x) + y^T c(x)$ for the problem decoded into OUTSDIF.d at the point (x, y) = (X,Y). This Hessian matrix is stored as a sparse matrix in finite element format

$$H = \sum_{e=1}^{ne} H_{e,}$$

where each square symmetric element H_e involves a small subset of the rows of the Hessian matrix.

The problem under consideration consists in minimizing (or maximizing) an objective function $f(x)$ o ver all $x \in R^n$ subject to general equationsc $_i(x) = 0$, $(i \in 1, \ldots, m_E)$, general inequalities $c_i^l \le c_i(x) \le c_i^{u,}$ $(i \in m_E + 1, \ldots, m)$, and simple bounds $x^l \le x \le x^{u.}$ The objective function is group-partially separable and all constraint functions are partially separable.

ARGUMENTS

The arguments of CUTEST_ceh are as follows

status [out] - integer
the outputr status: 0 for a succesful call, 1 for an array allocation/deallocation error, 2 for an array bound error, 3 for an evaluation error,

n [in] - integer
the number of variables for the problem,

m [in] - integer
the total number of general constraints,

X [in] - real/double precision
an array which gives the current estimate of the solution of the problem,

Y [in] - real/double precision
an array which gives the Lagrange multipliers,

ne [out] - integer
the number, ne, of "finite-elements" used,

lhe_ptr [in] - integer
the actual declared dimensions of HE_row_ptr and HE_val_ptr,

HE_row_ptr [out] - integer
HE_row_ptr(i) points to the position in HE_row of the first row index involved with element number e: the row indices of element number e are stored in HE_row between the indices HE_row_ptr(e) and HE_row_ptr(e+1)-1. HE_row_ptr(ne+1) points to the first empty location in HE_row,

HE_val_ptr [out] - integer
HE_val_ptr(i) points to the position in HE_val of the first nonzero involved with element number i: the values involved in element number e are stored in HE_val between the indices HE_val_ptr(e) and HE_val_ptr(e+1)-1. HE_val_ptr(ne+1) points to the first empty location in HE_val,

lhe_row [in] - integer
the actual declared dimension of HE_row,

HE_row [out] - integer
an array which holds a list of the row indices involved which each element. Those for element e directly preceed those for element e+1, e = 1, ..., ne-1. Since the elements are symmetric, HE_row is also the list of column indices involved with each element.

lhe_val [in] - integer
the actual declared dimension of HE_val,

HE_val [out] - real/double precision
an array of the nonzeros in the upper triangle of H_e, evaluated at X and stored by rows, or by columns. Those for element e directly proceed those for element, e+1, i = 1, ..., ne-1. Element number e contains the values stored between

HE_val(HE_val_ptr(e)) and HE_val(HE_val_ptr(e+1)-1)

and involves the rows/columns stored between

HE_row(HE_row_ptr(e)) and HE_row(HE_row_ptr(e+1)-1).

byrows [in] - logical
must be set to .TRUE. if the upper triangle of each H_e is to be stored by rows, and to .FALSE. if it is to be stored by columns.

AUTHORS

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SEE ALSO

CUTEst: a Constrained and Unconstrained Testing Environment with safe threads,
N.I.M. Gould, D. Orban and Ph.L. Toint,
Computational Optimization and Applications **60**:3, pp.545-557, 2014.

CUTEr (and SifDec): A Constrained and Unconstrained Testing Environment, revisited,
N.I.M. Gould, D. Orban and Ph.L. Toint,
ACM TOMS, **29**:4, pp.373-394, 2003.

CUTE: Constrained and Unconstrained Testing Environment,
I. Bongartz, A.R. Conn, N.I.M. Gould and Ph.L. Toint,
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cutest_ueh(3M), sifdecoder(1).