Package ‘Rcsdp’

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Version 0.1.57.2

Title R Interface to the CSDP Semidefinite Programming Library

Description R interface to the CSDP semidefinite programming library. Installs version 6.1.1 of CSDP from the COIN-OR website if required. An existing installation of CSDP may be used by passing the proper configure arguments to the installation command. See the INSTALL file for further details.

LazyLoad yes

Imports methods

Enhances Matrix

License CPL-1.0

URL https://projects.coin-or.org/Csdp/

RoxygenNote 7.0.2

BugReports https://github.com/hcorrada/rcsdp/issues

NeedsCompilation yes

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R topics documented:

csdp *Solve semidefinite program with CSDP*

Description

Interface to CSDP semidefinite programming library. The general statement of the primal problem is

$$\max\ \mathrm{tr}(CX)$$

$$\text{s.t. } A(X) = b$$

$$X \succeq 0$$

with $A(X)_i = \mathrm{tr}(A_i X)$ where $X \succeq 0$ means X is positive semidefinite, C and all A_i are symmetric matrices of the same size and b is a vector of length m.

The dual of the problem is

$$\min\ b'y$$

$$\text{s.t. } A'(y) - C = Z$$

$$Z \succeq 0$$

where $A'(y) = \sum_{i=1}^{m} y_i A_i$.

Matrices C and A_i are assumed to be block diagonal structured, and must be specified that way (see Details).

Usage

```
csdp(C, A, b, K,control=csdp.control())
```

Arguments

`C`	A list defining the block diagonal cost matrix C.
`A`	A list of length m containing block diagonal constraint matrices A_i. Each constraint matrix A_i is specified by a list of blocks as explained in the Details section.
`b`	A numeric vector of length m containing the right hand side of the constraints.
`K`	Describes the domain of each block of the sdp problem. It is a list with the following elements: **type:** A character vector with entries `"s"` or `"l"` indicating the type of each block. If the `j`th entry is `"s"`, then the `j`th block is a positive semidefinite matrix. otherwise, it is a vector with non-negative entries. **size:** A vector of integers indicating the dimension of each block.
`control`	Control parameters passed to csdp. See CSDP documentation.

Details

All problem matrices are assumed to be of block diagonal structure, and must be specified as follows:

1. If there are `nblocks` blocks specified by `K`, then the matrix must be a list with `nblocks` components.
2. If `K$type == "s"` then the `j`th element of the list must define a symmetric matrix of size `K$size`. It can be an object of class `"matrix"`, `"simple_triplet_sym_matrix"`, or a valid class from the class hierarchy in the `"Matrix"` package.
3. If `K$type == "l"` then the `j`th element of the list must be a numeric vector of length `K$size`.

This function checks that the blocks in arguments `C` and `A` agree with the sizes given in argument `K`. It also checks that the lengths of arguments `b` and `A` are equal. It does not check for symmetry in the problem data.

`csdp_minimal` is a minimal wrapper to the C code underlying `csdp`. It assumes that the arguments `sum.block.sizes`, `nconstraints`, `nblocks`, `block.types`, and `block.sizes` are provided as if they were created by `Rcsdp:::prob.info` and that the arguments `C`, `A`, and `b` are provided as if they were created by `Rcsdp:::prepare.data`. This function may be useful when calling the csdp functionality iteratively and most of the optimization details stays the same. For example, when the control file created by `Rcsdp:::write.control.file` stays the same across iterations, but it would be recreated on each iteration by `csdp`.

Value

`X`	Optimal primal solution X. A list containing blocks in the same structure as explained above. Each element is of class `"matrix"` or a numeric vector as appropriate.
`Z`	Optimal dual solution Z. A list containing blocks in the same structure as explained above. Each element is of class `"matrix"` or a numeric vector as appropriate.
`y`	Optimal dual solution y. A vector of the same length as argument `b`
`pobj`	Optimal primal objective value
`dobj`	Optimal dual objective value
`status`	Status of returned solution.

0: Success. Problem solved to full accuracy

1: Success. Problem is primal infeasible

2: Success. Problem is dual infeasible

3: Partial Success. Solution found but full accuracy was not achieved

4: Failure. Maximum number of iterations reached

5: Failure. Stuck at edge of primal feasibility

6: Failure. Stuch at edge of dual infeasibility

7: Failure. Lack of progress

8: Failure. X or Z (or Newton system O) is singular

9: Failure. Detected NaN or Inf values

Author(s)

Hector Corrada Bravo. CSDP written by Brian Borchers.

References

- https://projects.coin-or.org/Csdp/
- Borchers, B.:
  CSDP, A C Library for Semidefinite Programming Optimization Methods and Software 11(1):613-623, 1999
  http://euler.nmt.edu/~brian/csdppaper.pdf
- Lu, F., Lin, Y., and Wahba, G.:
  Robust Manifold Unfolding with Kernel Regularization TR 1108, October, 2005.
  http://pages.stat.wisc.edu/~wahba/ftp1/tr1108rr.pdf

Examples

```
  C <- list(matrix(c(2,1,
                     1,2),2,2,byrow=TRUE),
            matrix(c(3,0,1,
                     0,2,0,
                     1,0,3),3,3,byrow=TRUE),
            c(0,0))
A <- list(list(matrix(c(3,1,
                        1,3),2,2,byrow=TRUE),
               matrix(0,3,3),
               c(1,0)),
          list(matrix(0,2,2),
               matrix(c(3,0,1,
                        0,4,0,
                        1,0,5),3,3,byrow=TRUE),
               c(0,1)))

  b <- c(1,2)
  K <- list(type=c("s","s","l"),size=c(2,3,2))
  csdp(C,A,b,K)

# Manifold Unrolling broken stick example
# using simple triplet symmetric matrices
X <- matrix(c(-1,-1,
              0,0,
              1,-1),nc=2,byrow=TRUE);
d <- as.vector(dist(X)^2);
d <- d[-2]

C <- list(.simple_triplet_diag_sym_matrix(1,3))
A <- list(list(simple_triplet_sym_matrix(i=c(1,2,2),j=c(1,1,2),v=c(1,-1,1),n=3)),
          list(simple_triplet_sym_matrix(i=c(2,3,3),j=c(2,2,3),v=c(1,-1,1),n=3)),
          list(matrix(1,3,3)))

K <- list(type="s",size=3)
csdp(C,A,c(d,0),K)
```

csdp-sparse *Simple support for sparse matrices*

Description

Support for sparse matrices in package Rcsdp. The class simple_triplet_sym_matrix is defined to provide support for symmetric sparse matrices. It's definition is copied from the package relations by Kurt Hornik. Coercion functions from objects of class matrix and classes in the Matrix hierarchy are provided.

Usage

```
   simple_triplet_sym_matrix(i,j,v,n=max(c(i,j)),check.ind=FALSE)
   ## S3 method for class 'matrix'
as.simple_triplet_sym_matrix(x,check.sym=FALSE)
   ## S3 method for class 'simple_triplet_sym_matrix'
as.matrix(x,...)
   ## S3 method for class 'simple_triplet_sym_matrix'
as.vector(x,...)
   .simple_triplet_zero_sym_matrix(n,mode="double")
   .simple_triplet_diag_sym_matrix(x,n)
  .simple_triplet_random_sym_matrix(n,occ=.1,nnz=occ*n*(n+1)/2,rfun=rnorm,seed=NULL,...)
```

Arguments

i	Row indices of non-zero entries.
j	Column indices of non-zero entries.
v	Non-zero entries.
n	Size of matrix.
check.ind	Checks that arguments i and j indicate entries in the lower triangular part of the matrix. Default FALSE.
check.sym	Checks if matrix object is symmetric. Default FALSE.
x	Object of class matrix or simple_triplet_sym_matrix.
mode	Type of zero matrix to create. Default double.
occ	Ratio of occupancy of random sparse matrix. Default .1.
nnz	Number of non-zero entries in random sparse matrix. Default corresponds to occ=.1.
rfun	Function to generate random entries in sparse matrix. Default rnorm.
seed	Random number generator seed. Set by function set.seed before generating random sparse matrix. Default NULL.
...	Arguments passed on to casting functions.

Details

TO DO

Value

TO DO

Author(s)

Hector Corrada Bravo

References

TO DO

See Also

csdp

Examples

```
#  TO DO
```

---

csdp.control *Pass control parameters to csdp solver.*

Description

Utility function to pass control parameters to csdp solver.

Usage

```
csdp.control(axtol = 1e-08,
  atytol = 1e-08,
  objtol = 1e-08,
  pinftol = 1e+08,
  dinftol = 1e+08,
  maxiter = 100,
  minstepfrac = 0.9,
  maxstepfrac = 0.97,
  minstepp = 1e-08,
  minstepd = 1e-08,
  usexzgap = 1,
  tweakgap = 0,
  affine = 0,
  printlevel = 1,
  perturbobj = 1,
  fastmode = 0)
```

Arguments

`axtol`	Tolerance for primal feasibility.
`atytol`	Tolerance for dual feasibility.
`objtol`	Tolerance for relative duality gap.
`pinftol`	Tolerance for primal infeasibility.
`dinftol`	Tolerance for dual infeasibility.
`maxiter`	Maximum number of iterations used.
`minstepfrac`	Minimum distance to edge of feasibility region for step.
`maxstepfrac`	Maximum distance to edge of feasibility region for step.
`minstepp`	Failure is declared if primal line search step size is shorter than this parameter.
`minstepd`	Failure is declared if dual line search step size is shorter that this parameter.
`usexzgap`	If 0, then use objective function duality gap.
`tweakgap`	If 1 (and `usexzgap`=0) then "fix" negative duality gaps.
`affine`	If 1, only use affine primal-dual steps and do not use barrier function.
`printlevel`	If 0, no printing, 1 normal printing, higher values result in more debug printing.
`perturbobj`	Amount of objective permutation used.
`fastmode`	If 1, csdp will be faster but also less accurate.

Details

Parameters are fully described in CSDP user guide. https://projects.coin-or.org/Csdp/

Value

A list with values for all parameters. Any parameters not passed to function are set to default.

Author(s)

Hector Corrada Bravo, CSDP by Brian Borchers

References

https://projects.coin-or.org/Csdp/

Examples

```
params <- csdp.control(axtol=1e-6)
```

readsdpa *Reading and writing semidefinite programs for SDPA format files.*

Description

Functions to read and write semidefinite program data and solutions in SDPA format.

Usage

```
readsdpa(file="",verbose=FALSE)
writesdpa(C,A,b,K,file="")
readsdpa.sol(K,C,m,file="")
writesdpa.sol(X,Z,y,K,file="")
```

Arguments

`file`	The name of the file to read from or write to.
`C`	Block structured cost matrix
`A`	List of block structured constraint matrices
`b`	RHS vector
`K`	Cone specification, as used in `csdp`
`X`	Block structured primal optimal solution matrix
`Z`	Block structured dual optimal solution matrix
`y`	Dual optimal solution vector
`verbose`	Printout information as problem is read. Passed to CSDP's readsdpa function. Default `FALSE`
`m`	Number of constraints in problem.

Details

Block structured matrices must be specified as described in `csdp`. Files read must be in SDPA format (see `http://euler.nmt.edu/~brian/sdplib/FORMAT`). However, these functions don't support comments or grouping characters (e.g. braces, parentheses) in the block sizes specification.

Value

Function `readsdpa` returns a list with elements `C,A,b,K`. Function `readsdpa.sol` returns a list with elements `X,Z,y`. All returned matrices are lists of objects of class `simple_triplet_sym_matrix`.

Author(s)

Hector Corrada Bravo

References

`http://euler.nmt.edu/~brian/sdplib/FORMAT`

See Also

csdp

Examples

```
#  TO DO
```

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