# Package 'sparsesvd'

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**Title** Sparse Truncated Singular Value Decomposition (from 'SVDLIBC')

**Version** 0.2-2

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**Description** Wrapper around the 'SVDLIBC' library for (truncated) singular value decomposition of a sparse matrix.
Currently, only sparse real matrices in Matrix package format are supported.

**Depends** R (>= 3.0)

**Imports** Matrix (>= 1.3), methods

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**URL** https://github.com/lucasmaystre/svdlibc,
http://wordspace.r-forge.r-project.org/

**NeedsCompilation** yes

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## R topics documented:

`sparsesvd` *Singular Value Decomposition of a Sparse Matrix.*

## Description

Compute the (usually truncated) singular value decomposition (SVD) of a sparse real matrix. This function is a shallow wrapper around the SVDLIBC implementation of Berry's (1992) single Lanczos algorithm.

## Usage

```
sparsesvd(M, rank=0L, tol=1e-15, kappa=1e-6)
```

## Arguments

| | |
|---|---|
| `M` | a sparse real matrix in **Matrix** package format. The preferred format is a `dgCMatrix` and other storage formats will automatically be converted if possible. |
| `rank` | an integer specifying the desired number of singular components, i.e. the rank of the truncated SVD. Specify 0 to return all singular values of magnitude larger than `tol` (default). |
| `tol` | exclude singular values whose magnitude is smaller than `tol` |
| `kappa` | accuracy parameter $\kappa$ of the SVD algorithm (with SVDLIBC default) |

## Value

The truncated SVD decomposition

$$M_r = U_r D V_r^T$$

where $M_r$ is the optimal rank $r$ approximation of $M$. Note that $r$ may be smaller than the requested number `rank` of singular components.

The returned value is a list with components

| | |
|---|---|
| `d` | a vector containing the first $r$ singular values of `M` |
| `u` | a column matrix of the first $r$ left singular vectors of `M` |
| `v` | a column matrix of the first $r$ right singular vectors of `M` |

## References

The SVDLIBC homepage `http://tedlab.mit.edu/~dr/SVDLIBC/` seems to be no longer available. A copy of the source code can be obtained from https://github.com/lucasmaystre/svdlibc.

Berry, Michael~W. (1992). Large scale sparse singular value computations. *International Journal of Supercomputer Applications*, **6**, 13–49.

## See Also

`svd`, `sparseMatrix`

## Examples

```
M <- rbind(
  c(20, 10, 15,  0,  2),
  c(10,  5,  8,  1,  0),
  c( 0,  1,  2,  6,  3),
  c( 1,  0,  0, 10,  5))
M <- Matrix::Matrix(M, sparse=TRUE)
print(M)

res <- sparsesvd(M, rank=2L) # compute first 2 singular components
print(res, digits=3)

M2 <- res$u %*% diag(res$d) %*% t(res$v) # rank-2 approximation
print(M2, digits=1)

print(as.matrix(M) - M2, digits=2) # approximation error
```

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