pblas_wrapper

NAME

pblas_wrapper - a frovedis module provides user-friendly interfaces for commonly used pblas routines in scientific applications like machine learning algorithms.

SYNOPSIS

import com.nec.frovedis.matrix.PBLAS

Public Member Functions

```
Unit PBLAS.swap (FrovedisBlockcyclicMatrix v1, FrovedisBlockcyclicMatrix v2)
Unit PBLAS.copy (FrovedisBlockcyclicMatrix v1, FrovedisBlockcyclicMatrix v2)
Unit PBLAS.scal (FrovedisBlockcyclicMatrix v, Double al)
Unit PBLAS.axpy (FrovedisBlockcyclicMatrix v1,
           FrovedisBlockcyclicMatrix v2, Double al = 1.0)
Double PBLAS.dot (FrovedisBlockcyclicMatrix v1, FrovedisBlockcyclicMatrix v2)
Double PBLAS.nrm2 (FrovedisBlockcyclicMatrix v)
Unit PBLAS.gemv (FrovedisBlockcyclicMatrix m, FrovedisBlockcyclicMatrix v1,
           FrovedisBlockcyclicMatrix v2, Boolean trans = false,
           Double al = 1.0, Double be = 0.0)
Unit PBLAS.ger (FrovedisBlockcyclicMatrix v1, FrovedisBlockcyclicMatrix v2,
          FrovedisBlockcyclicMatrix m, Double al = 1.0)
Unit PBLAS.gemm (FrovedisBlockcyclicMatrix m1, FrovedisBlockcyclicMatrix m2,
           FrovedisBlockcyclicMatrix m3, Boolean trans_m1 = false,
           Boolean trans_m2 = false, Double al = 1.0, Double be = 0.0)
Unit PBLAS.geadd (FrovedisBlockcyclicMatrix m1, FrovedisBlockcyclicMatrix m2,
           Boolean trans = false, Double al = 1.0, Double be = 1.0)
```

DESCRIPTION

PBLAS is a high-performance scientific library written in Fortran language. It provides rich set of functionalities on vectors and matrices. The computation loads of these functionalities are parallelized over the available processes in a system and the user interfaces of this library is very detailed and complex in nature. It requires a strong understanding on each of the input parameters, along with some distribution concepts.

Frovedis provides a wrapper module for some commonly used PBLAS subroutines in scientific applications like machine learning algorithms. These wrapper interfaces are very simple and user needs not to consider all the detailed distribution parameters. Only specifying the target vectors or matrices with some other parameters (depending upon need) are fine. At the same time, all the use cases of a PBLAS routine can also be performed using Frovedis PBLAS wrapper of that routine.

This scala module implements a client-server application, where the spark client can send the spark matrix data to frovedis server side in order to create blockcyclic matrix at frovedis server and then spark client can request frovedis server for any of the supported PBLAS operation on that matrix. When required, spark client can request frovedis server to send back the resultant matrix and it can then create equivalent spark data (Vector, Matrix, RowMatrix etc., see manuals for FrovedisBlockcyclicMatrix to spark data conversion).

The individual detailed descriptions can be found in the subsequent sections. Please note that the term "inout", used in the below section indicates a function argument as both "input" and "output".

Detailed Description

swap (v1, v2)

Parameters
v1: A FrovedisBlockcyclicMatrix with single column (inout)
v2: A FrovedisBlockcyclicMatrix with single column (inout)

Purpose
It will swap the contents of v1 and v2, if they are semantically valid and are of same length.

Return Value
On success, it returns nothing. If any error occurs, it throws an exception.

copy (v1, v2)

Parameters
v1: A FrovedisBlockcyclicMatrix with single column (input)
v2: A FrovedisBlockcyclicMatrix with single column (output)

Purpose
It will copy the contents of v1 in v2 (v2 = v1), if they are semantically valid and are of same length.

Return Value
On success, it returns nothing. If any error occurs, it throws an exception.

scal (v, al)

Parameters
v: A FrovedisBlockcyclicMatrix with single column (inout)
al: A double parameter to specify the value to which the input vector needs to be scaled. (input)

Purpose
It will scale the input vector with the provided "al" value, if it is semantically valid. On success, input vector "v" would be updated (in-place scaling).

Return Value
On success, it returns nothing. If any error occurs, it throws an exception.

axpy (v1, v2, al=1.0)

Parameters
v1: A FrovedisBlockcyclicMatrix with single column (input)

v2: A FrovedisBlockcyclicMatrix with single column (inout)
al: A double parameter to specify the value to which "v1" needs to be scaled (not in-place scaling) [Default: 1.0] (input/optional)

Purpose
It will solve the expression v2 = al*v1 + v2, if the input vectors are semantically valid and are of same length. On success, "v2" will be updated with desired result, but "v1" would remain unchanged.

Return Value
On success, it returns nothing. If any error occurs, it throws an exception.

dot (v1, v2)

Parameters
v1: A FrovedisBlockcyclicMatrix with single column (input)
v2: A FrovedisBlockcyclicMatrix with single column (input)

Purpose
It will perform dot product of the input vectors, if they are semantically valid and are of same length. Input vectors would not get modified during the operation.

Return Value
On success, it returns the dot product result of the type double. If any error occurs, it throws an exception.

nrm2 (v)

Parameters
v: A FrovedisBlockcyclicMatrix with single column (input)

Purpose
It will calculate the norm of the input vector, if it is semantically valid. Input vector would not get modified during the operation.

Return Value
On success, it returns the norm value of the type double. If any error occurs, it throws an exception.

gemv (m, v1, v2, trans=false, al=1.0, be=0.0)

Parameters
m: A FrovedisBlockcyclicMatrix (input)
v1: A FrovedisBlockcyclicMatrix with single column (input)
v2: A FrovedisBlockcyclicMatrix with single column (inout)
trans: A boolean value to specify whether to transpose "m" or not [Default: false] (input/optional)
al: A double type value [Default: 1.0] (input/optional)
be: A double type value [Default: 0.0] (input/optional)

Purpose
The primary aim of this routine is to perform simple matrix-vector multiplication.
But it can also be used to perform any of the below operations:

```
(1) v2 = al*m*v1 + be*v2
(2) v2 = al*transpose(m)*v1 + be*v2
```

If trans=false, then expression (1) is solved. In that case, the size of "v1" must be at least the number of columns in "m" and the size of "v2" must be at least the number of rows in "m".

If trans=true, then expression (2) is solved. In that case, the size of “v1” must be at least the number of rows in “m” and the size of “v2” must be at least the number of columns in “m”.

Since “v2” is used as input-output both, memory must be allocated for this vector before calling this routine, even if simple matrix-vector multiplication is required. Otherwise, this routine will throw an exception.

For simple matrix-vector multiplication, no need to specify values for the input parameters “trans”, “al” and “be” (leave them at their default values).

On success, “v2” will be overwritten with the desired output. But “m” and “v1” would remain unchanged.

Return Value
On success, it returns nothing. If any error occurs, it throws an exception.

ger (v1, v2, m, al=1.0)

Parameters
v1: A FrovedisBlockcyclicMatrix with single column (input)
v2: A FrovedisBlockcyclicMatrix with single column (input)
m: A FrovedisBlockcyclicMatrix (inout)
al: A double type value [Default: 1.0] (input/optional)

Purpose
The primary aim of this routine is to perform simple vector-vector multiplication of the sizes “a” and “b” respectively to form an axb matrix. But it can also be used to perform the below operations:

```
m = al*v1*v2' + m
```

This operation can only be performed if the inputs are semantically valid and the size of “v1” is at least the number of rows in matrix “m” and the size of “v2” is at least the number of columns in matrix “m”.

Since “m” is used as input-output both, memory must be allocated for this matrix before calling this routine, even if simple vector-vector multiplication is required. Otherwise it will throw an exception.

For simple vector-vector multiplication, no need to specify the value for the input parameter “al” (leave it at its default value).

On success, “m” will be overwritten with the desired output. But “v1” and “v2” will remain unchanged.

Return Value
On success, it returns nothing. If any error occurs, it throws an exception.

gemm (m1, m2, m3, trans_m1=false, trans_m2=false, al=1.0, be=0.0)

Parameters
m1: A FrovedisBlockcyclicMatrix (input)
m2: A FrovedisBlockcyclicMatrix (input)
m3: A FrovedisBlockcyclicMatrix (inout)
trans_m1: A boolean value to specify whether to transpose “m1” or not [Default: false] (input/optional)
trans_m2: A boolean value to specify whether to transpose “m2” or not [Default: false] (input/optional)
al: A double type value [Default: 1.0] (input/optional)
be: A double type value [Default: 0.0] (input/optional)

Purpose
The primary aim of this routine is to perform simple matrix-matrix multiplication.
But it can also be used to perform any of the below operations:

```
(1) m3 = al*m1*m2 + be*m3
(2) m3 = al*transpose(m1)*m2 + be*m3
(3) m3 = al*m1*transpose(m2) + be*m3
(4) m3 = al*transpose(m1)*transpose(m2) + be*m3
```

(1) will be performed, if both “trans_m1” and “trans_m2” are false.

(2) will be performed, if trans_m1=true and trans_m2 = false.

(3) will be performed, if trans_m1=false and trans_m2 = true.

(4) will be performed, if both “trans_m1” and “trans_m2” are true.

If we have four variables nrowa, nrowb, ncola, ncolb defined as follows:

```
if(trans_m1) {
  nrowa = number of columns in m1
  ncola = number of rows in m1
}
else {
  nrowa = number of rows in m1
  ncola = number of columns in m1
}

if(trans_m2) {
  nrowb = number of columns in m2
  ncolb = number of rows in m2
}
else {
  nrowb = number of rows in m2
  ncolb = number of columns in m2
}
```

Then this function can be executed successfully, if the below conditions are all true:

```
(a) "ncola" is equal to "nrowb"
(b) number of rows in "m3" is equal to or greater than "nrowa"
(b) number of columns in "m3" is equal to or greater than "ncolb"
```

Since “m3” is used as input-output both, memory must be allocated for this matrix before calling this routine, even if simple matrix-matrix multiplication is required. Otherwise it will throw an exception.

For simple matrix-matrix multiplication, no need to specify the value for the input parameters “trans_m1”, “trans_m2”, “al”, “be” (leave them at their default values).

On success, “m3” will be overwritten with the desired output. But “m1” and “m2” will remain unchanged.

Return Value
On success, it returns nothing. If any error occurs, it throws an exception.

geadd (m1, m2, trans=false, al=1.0, be=1.0)

Parameters
m1: A FrovedisBlockcyclicMatrix (input)

m2: A FrovedisBlockcyclicMatrix (inout)
trans: A boolean value to specify whether to transpose “m1” or not [Default: false] (input/optional)
al: A double type value [Default: 1.0] (input/optional)
be: A double type value [Default: 1.0] (input/optional)

Purpose
The primary aim of this routine is to perform simple matrix-matrix addition. But it can also be used to perform any of the below operations:

```
(1) m2 = al*m1 + be*m2
(2) m2 = al*transpose(m1) + be*m2
```

If trans=false, then expression (1) is solved. In that case, the number of rows and the number of columns in “m1” should be equal to the number of rows and the number of columns in “m2” respectively.
If trans=true, then expression (2) is solved. In that case, the number of columns and the number of rows in “m1” should be equal to the number of rows and the number of columns in “m2” respectively.

If it is needed to scale the input matrices before the addition, corresponding “al” and “be” values can be provided. But for simple matrix-matrix addition, no need to specify values for the input parameters “trans”, “al” and “be” (leave them at their default values).

On success, “m2” will be overwritten with the desired output. But “m1” would remain unchanged.

Return Value
On success, it returns nothing. If any error occurs, it throws an exception.

SEE ALSO

scalapack_wrapper