

Version  
1.0

pbdR Core Team

# Setting up a pbdR Environment

*Installing MPI, R, and pbdR*

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Installing MPI, R, and **pbdR**

Version 1.0

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# Contents

<b>1</b>	<b>Quick Introduction</b>	<b>1</b>
1.1	Installing R . . . . .	1
1.2	Installing MPI . . . . .	1
1.3	Installing pbdR Packages . . . . .	1
<b>2</b>	<b>Windows</b>	<b>2</b>
2.1	R . . . . .	2
2.2	Rtools . . . . .	5
2.3	MPICH2 . . . . .	8
2.4	pbdR . . . . .	12
<b>3</b>	<b>Mac OS X</b>	<b>14</b>
3.1	Installing R . . . . .	14
3.1.1	Installing from a Binary Package . . . . .	14
3.1.2	Compiling from Source . . . . .	14
3.2	Installing MPI . . . . .	14
3.2.1	Installing from a Package Repository . . . . .	14
3.2.2	Compiling from Source . . . . .	14
3.3	Installing pbdR . . . . .	14
3.3.1	Installing from CRAN . . . . .	14
3.3.2	Installing from the Shell . . . . .	15
3.3.3	Installing from Github . . . . .	15
<b>4</b>	<b>Linux and FreeBSD</b>	<b>15</b>
4.1	Installing R . . . . .	15
4.1.1	Installing from a Package Repository . . . . .	15
4.1.2	Compiling from Source . . . . .	16
4.2	Installing MPI . . . . .	16
4.2.1	Installing from a Package Repository . . . . .	16
4.2.2	Compiling from Source . . . . .	16
4.3	Installing pbdR . . . . .	16
4.3.1	Installing from CRAN . . . . .	16
4.3.2	Installing from the Shell . . . . .	17
4.3.3	Installing from Github . . . . .	17
<b>5</b>	<b>Installation Problems</b>	<b>17</b>
5.1	R and MPI . . . . .	17
5.2	pbdR . . . . .	18
<b>6</b>	<b>Running pbdR Scripts</b>	<b>18</b>

# 1 Quick Introduction

In this guide, we will detail the necessary steps for how to set up a pbdR environment. What follows in the remaining sections is a very lengthy list of installation instructions; however, most users should find the process fairly straight-forward, and may not need (or want) all of the details we will provide unless something goes wrong. In any case, the short version for setting up a pbdR environment is to:

1. install R (and Rtools for Windows); see <http://cran.r-project.org/>
2. install an MPI library; <http://www.open-mpi.org/>, or <http://www.mpich.org/> for Windows
3. install the pbdR packages; see <http://r-pbd.org/>

Items 1 and 2 are interchangeable, and so if you already have R (and additionally Rtools for Windows) and/or an MPI library installed, then merely skip this/these step(s); there is no need to reinstall anything.

## 1.1 Installing R

This should be fairly painless. R has binary packages for every operating system you have heard of (and some you haven't), and the install should go fine. Of course, since R is open source, you are free to compile it yourself, should have have reason or need to do so. You can find both the source as well as binaries at the R project's main site: <http://cran.r-project.org/>.

Additionally, you may wish to customize your R build by compiling from source. For example, you may wish to link R with a high performance linear algebra library, such as MKL. See the *R Installation and Administration Manual* at <http://cran.r-project.org/doc/manuals/R-admin.html> for full details.

## 1.2 Installing MPI

For Linux and Mac users, we recommend installing OpenMPI, which is available from <http://www.open-mpi.org/> in both binary and source formats. Windows users should install MPICH2, available from <http://www.mpich.org/>.

## 1.3 Installing pbdR Packages

All released pbdR packages are available from <http://cran.r-project.org/> which is the Comprehensive R Archive Network (CRAN). This is similar to the CPAN for perl or CTAN for L<sup>A</sup>T<sub>E</sub>X, although with many improvements and benefits over its competitors.

It is also possible to link pbdR with high performance linear algebra libraries, such as MKL. Figure 1

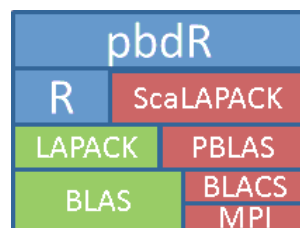


Figure 1: pbdR Relationships to Libraries

offers some insight into the package organization. See the pbdSLAP vignette for more details.

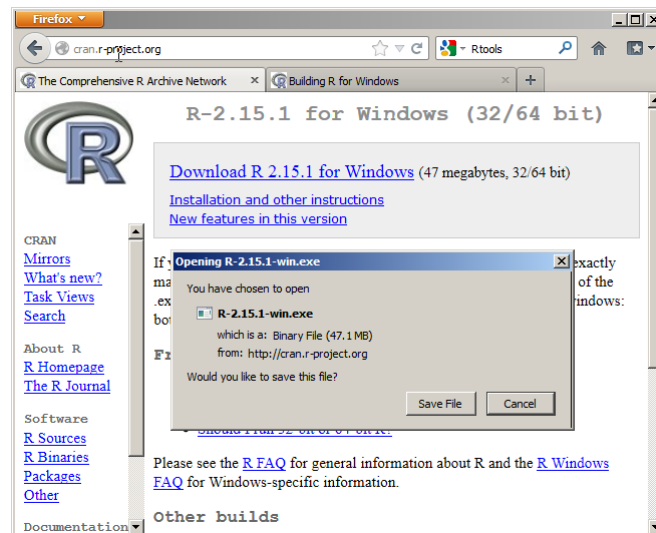
## 2 Windows

Officially, the pbdR team does not support gaming consoles. However, it is possible to install pbdR packages on Windows.

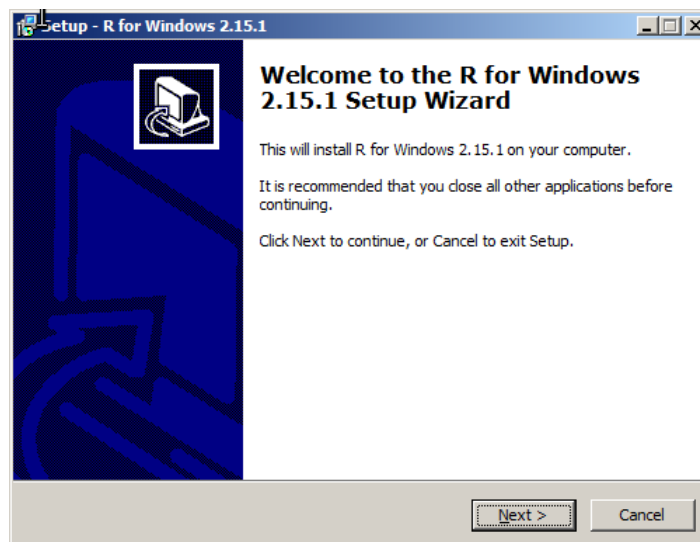
The instructions and screenshots for this document are for version 2.15.1 of R, but later versions should be very similar, if not identical.

### 2.1 R

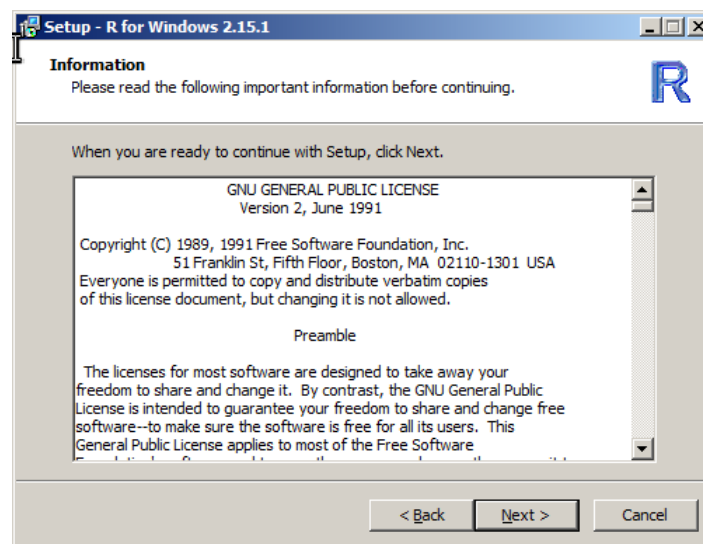
1. Download R: <http://cran.r-project.org/bin/windows/base/>



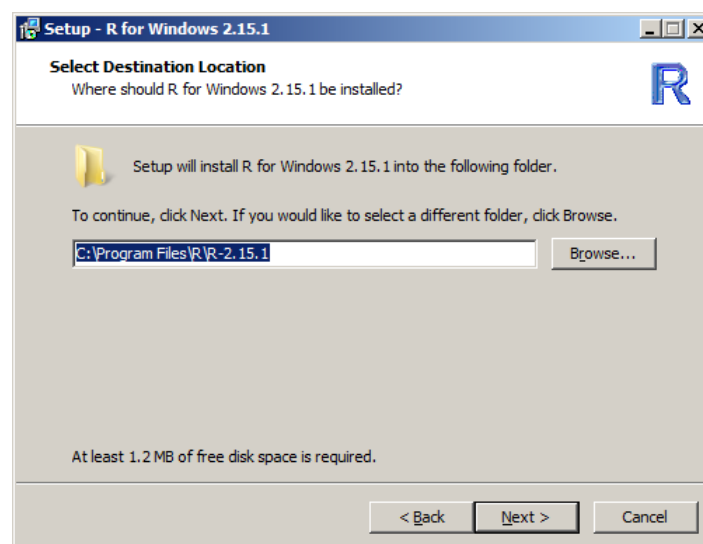
2. Open the saved file from 1 above to begin the installation. At the first setup screen, click 'Next' to continue.



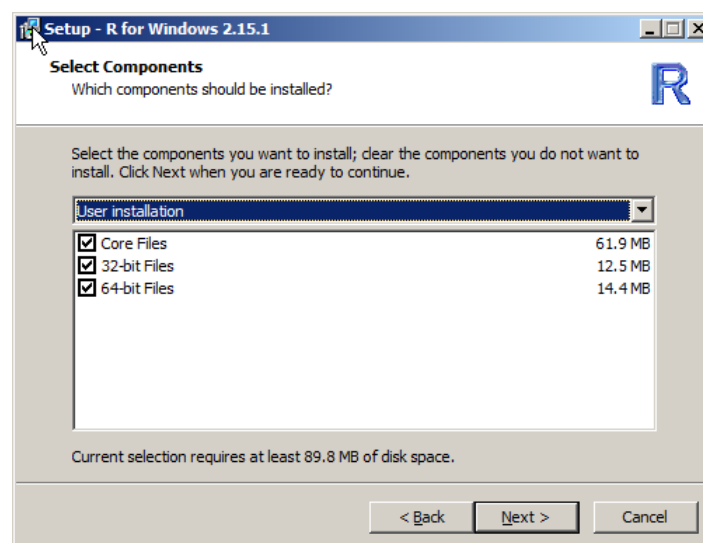
3. When prompted with the license, click 'Next' to continue.



4. When prompted for the location to install R, we strongly encourage you to use the default. When you have made your decision, click 'Next'.

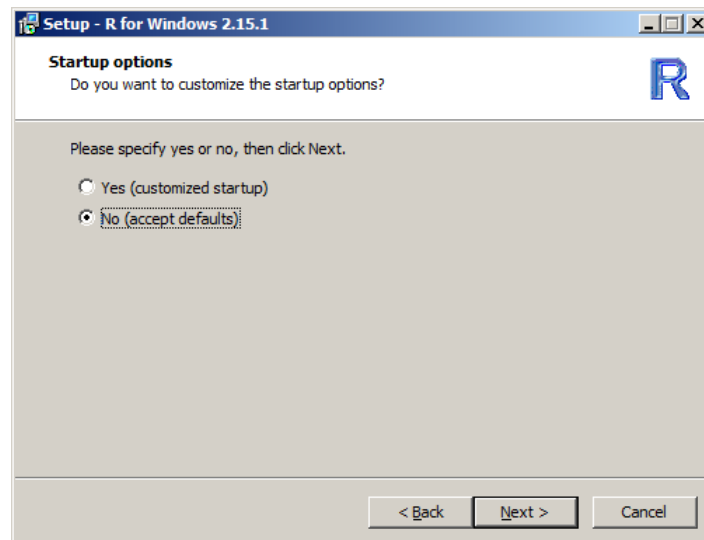


5. When prompted with the components to install, you should select a 'User installation'. Then click 'Next'.

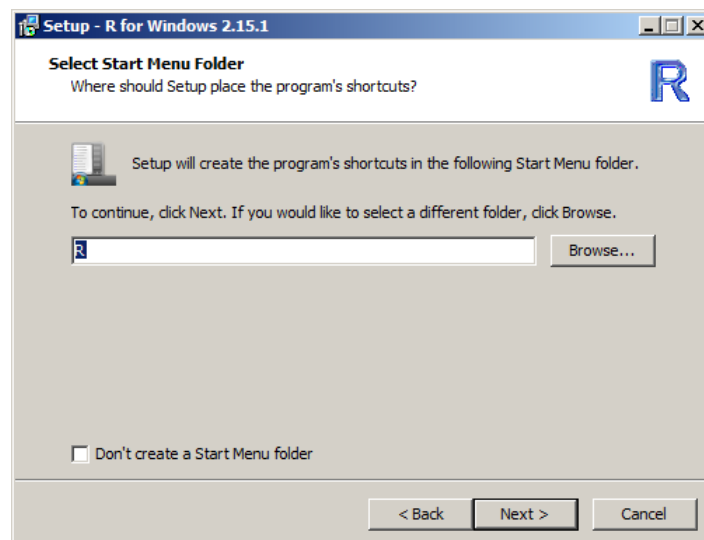


6. When prompted with the option to alter the startup options, we suggest selecting No (accept

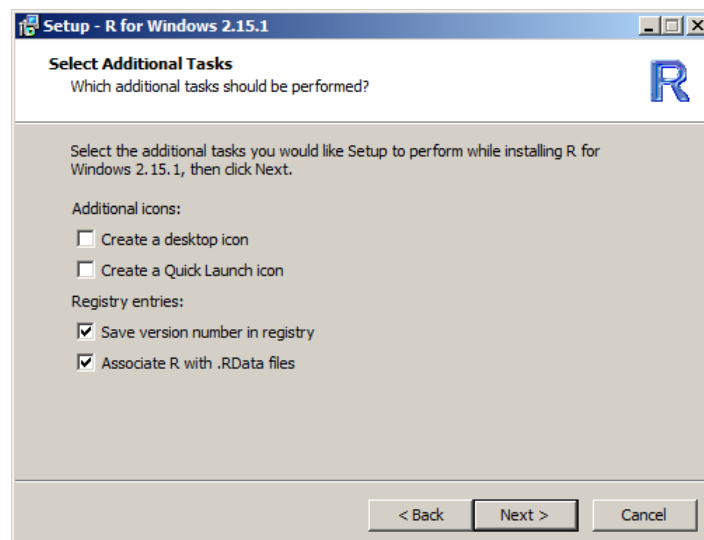
defaults). When you have made your decision, click 'Next'.



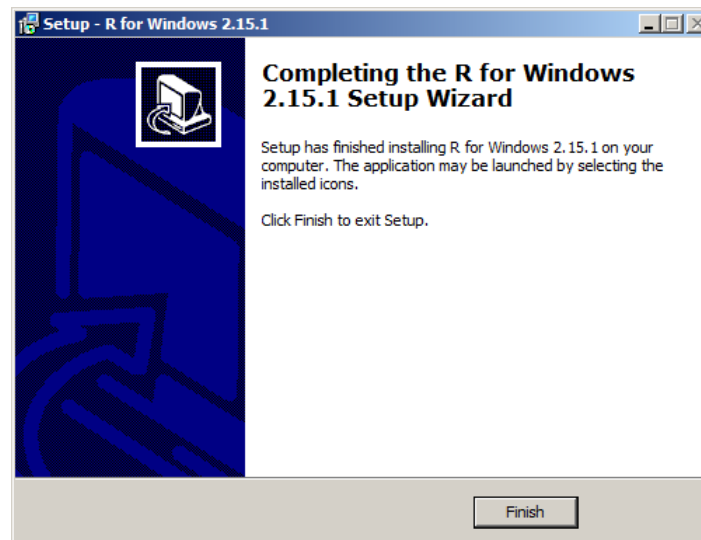
7. When prompted with the start menu folder options, make your choice and then click 'Next'.



8. When prompted with the additional tasks options, we suggest making sure that **Save version number in registry** and **Associate R with .RData files** are both **checked**. When you have made your decisions, click 'Next'.



- To complete the R installation, select 'Finish'.

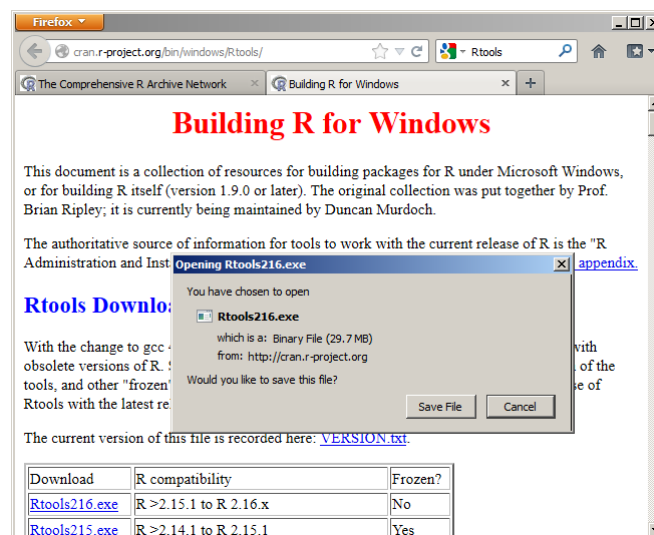


Once R is finished installing, you need to install the [rlecuyer](#) package. To install it from an interactive R session, simply start an R session and issue the command

```
1 install.packages("rlecuyer")
```

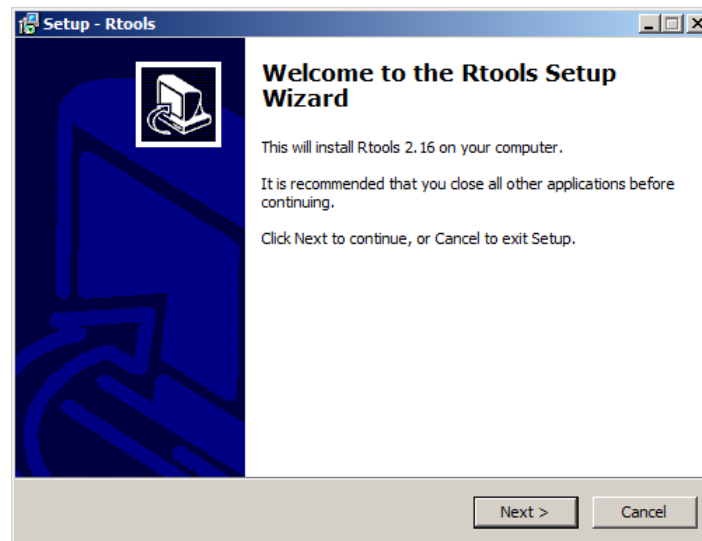
## 2.2 Rtools

- Download Rtools: <http://cran.r-project.org/bin/windows/base/>

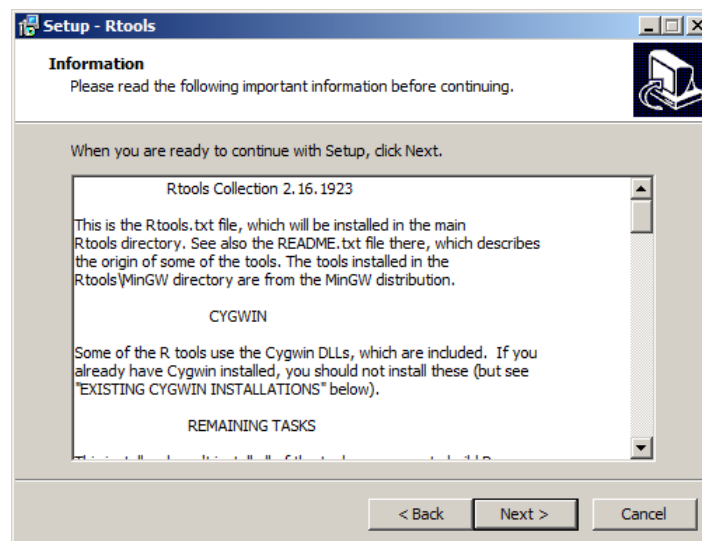


- Open the saved file from 1 above to begin the installation. At the first setup screen, click 'Next' to continue.

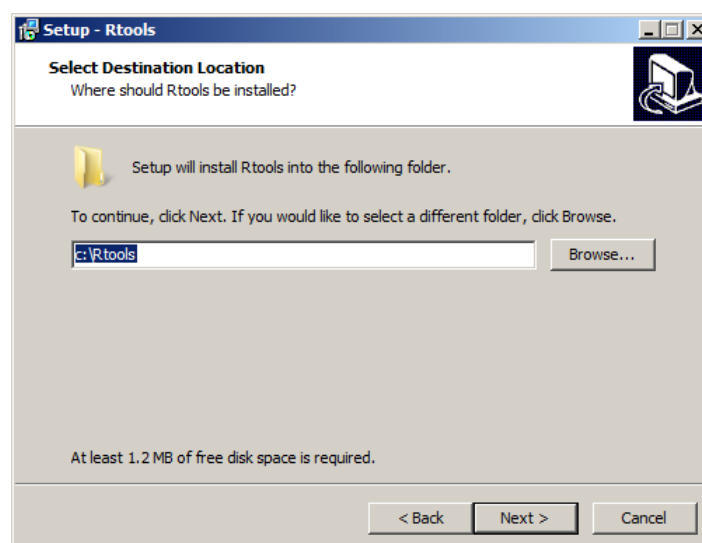




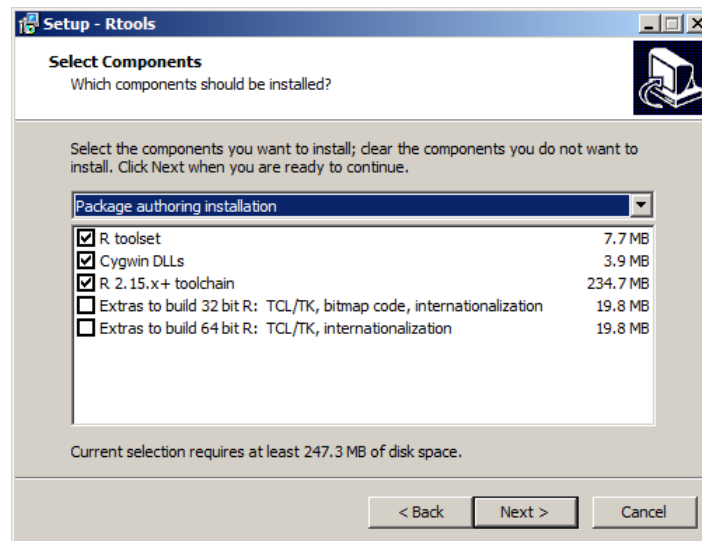
3. When prompted with the license, click 'Next' to continue.



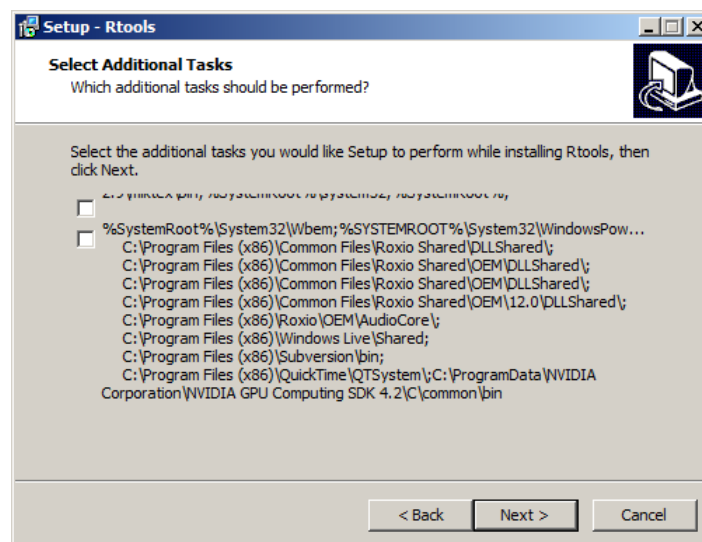
4. When prompted for the location to install R, we strongly encourage you to use the default. When you have made your decision, click 'Next'.



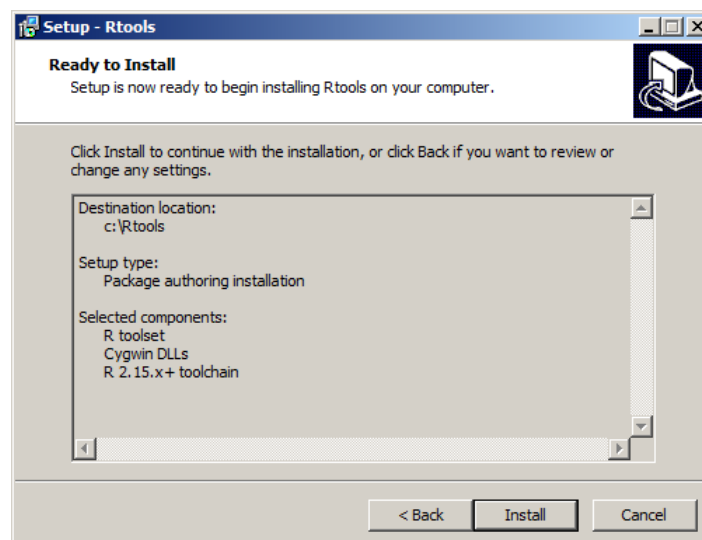
5. When prompted with the components to install, you should select a 'User installation'. Then click 'Next'.



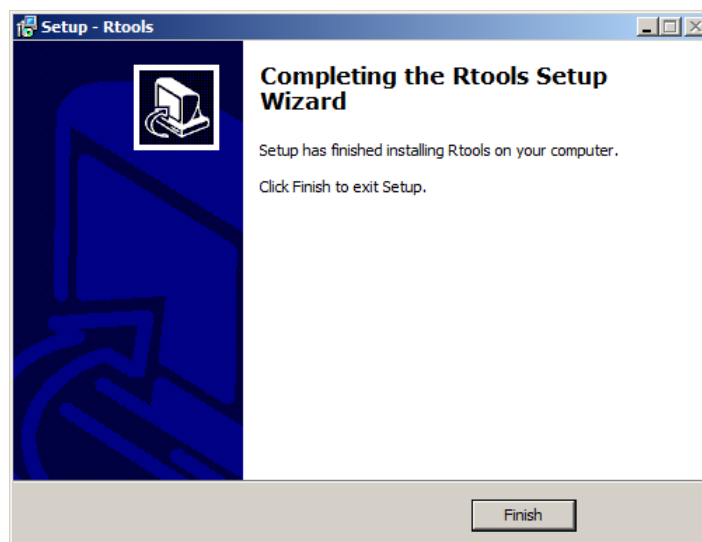
6. When prompted with the option to alter the startup options, we suggest selecting No (accept defaults). When you have made your decision, click 'Next'.



7. When prompted with the start menu folder options, make your choice and then click 'Next'.



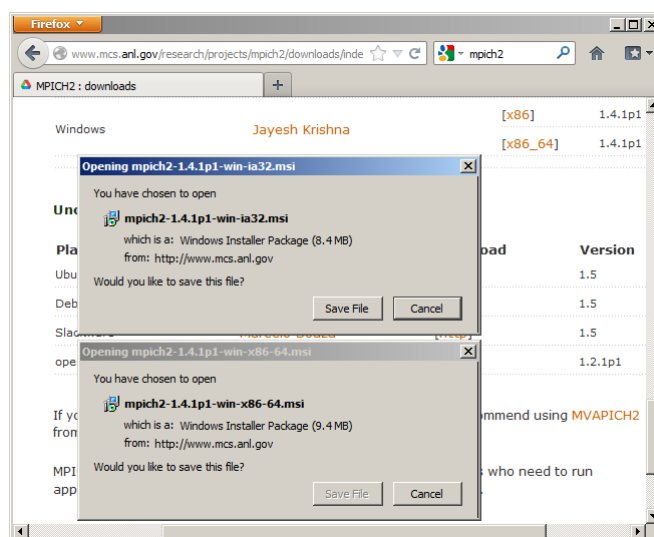
8. To complete the Rtools installation, select 'Finish'.



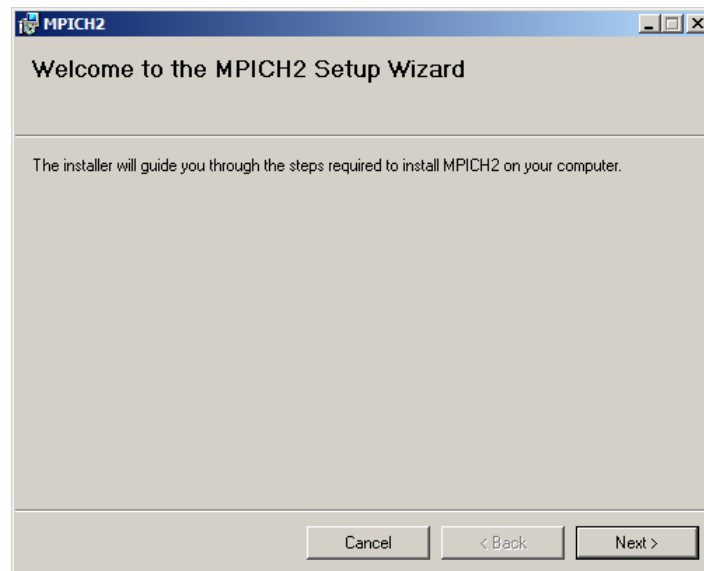
## 2.3 MPICH2

Before proceeding, please be aware that this installation requires **administrative privileges**.

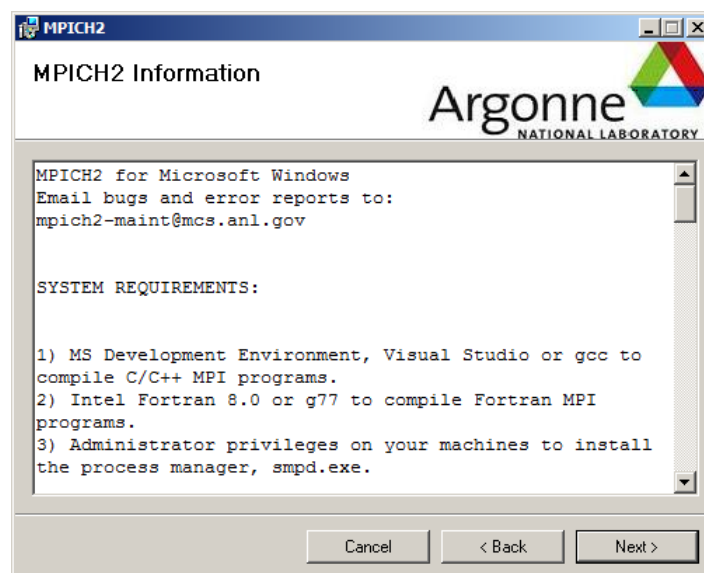
1. Download both the 32-bit [mpich2-1.4.1p1-win-ia32.msi](http://www.mpich.org/) and the 64-bit [mpich2-1.4.1p1-win-x86-64.msi](http://www.mpich.org/) installers from: <http://www.mpich.org/> .



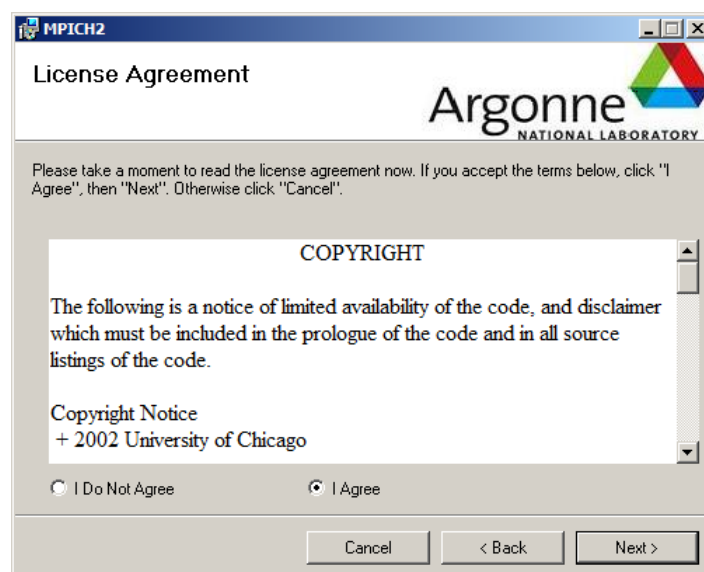
2. Open the saved file from 1 above to begin the installation. At the first setup screen, click 'Next' to continue.



3. When prompted with the system requirements, click 'Next' to continue.

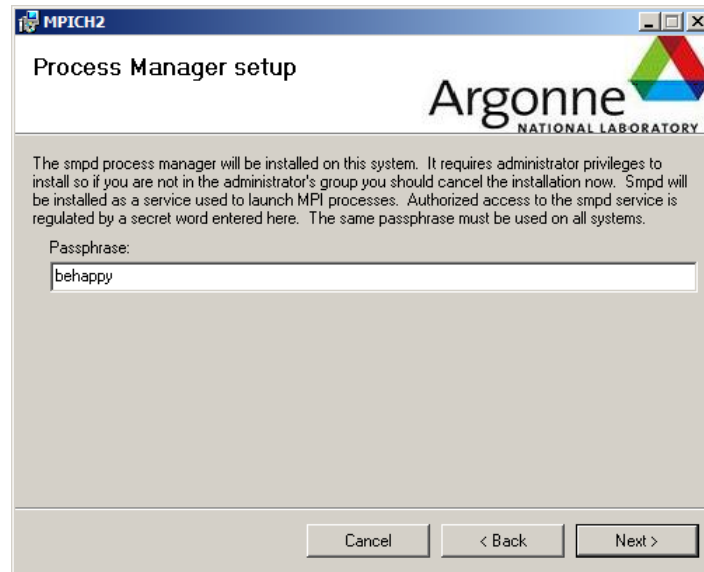


4. When prompted with the license, click "I agree" and then click 'Next' to continue.



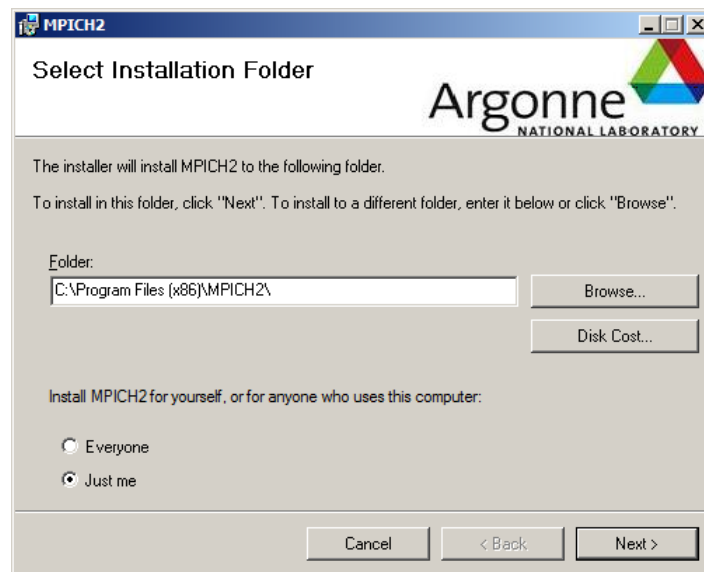
5. When prompted with the 'Process Manager setup' screen, choose a passphrase and then click

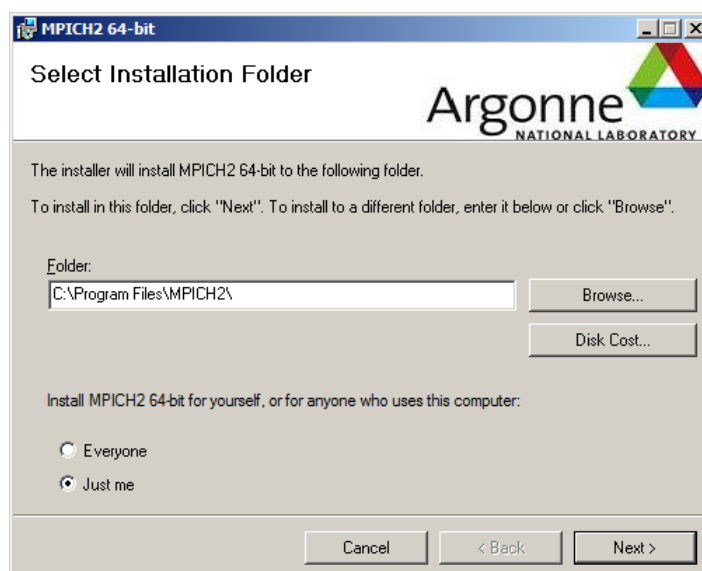
'Next' to continue.



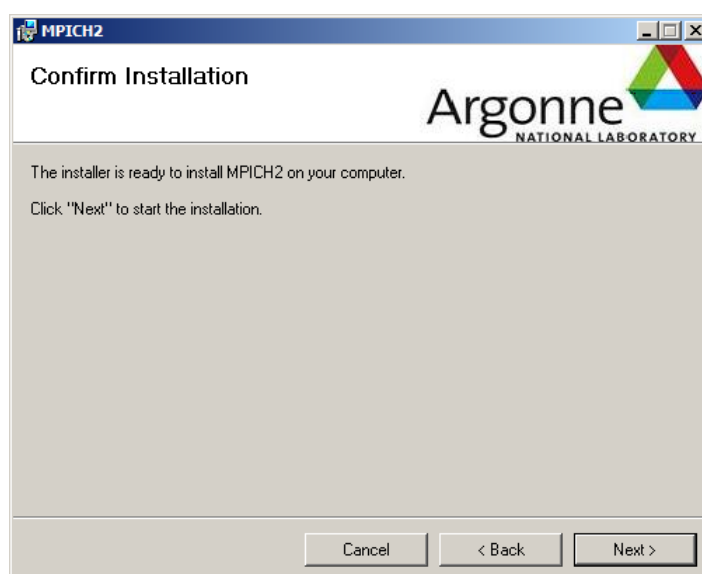
6. At the 'Select Installation Folder' screen, we recommend you keep the default folders. By default, the 32-bit application will be installed in C:\Program Files (x86)\MPICH2\ and the 64bit application will be installed in C:\Program Files\MPICH2\.

Additionally, you should make the selection for whether or not MPICH2 should be available to all users of this system or just yourself. When you are ready to proceed, click 'Next'.

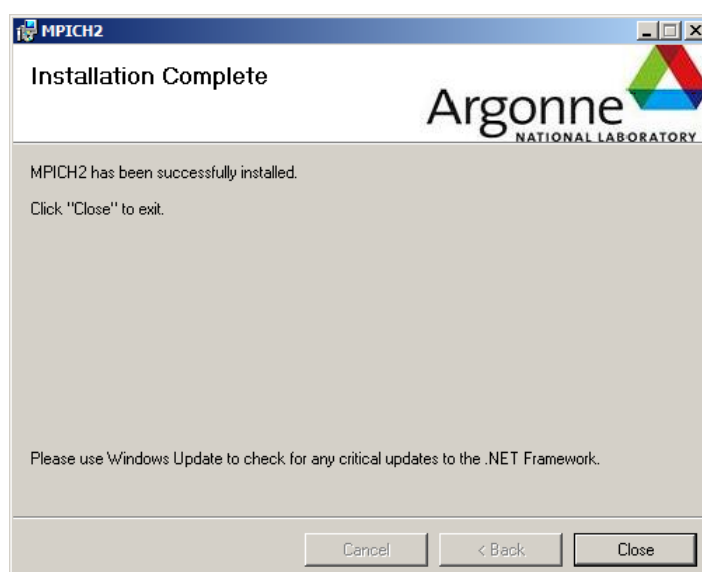




7. When prompted to confirm the installation, click 'Next' to proceed.

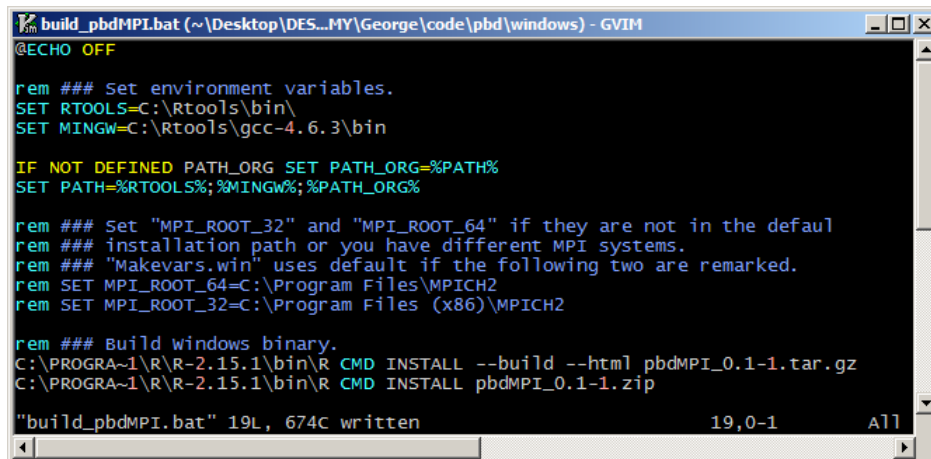


8. To complete the MPICH2 installation, select 'Close'.



## 2.4 pbdR

1. To help simplify things, we offer a simple [install script](#) which makes managing the PATH slightly simpler. By default, this is for R version 2.15.3 and **pbdMPI** version 0.1-6. If you have a different version of R or want to install a different version of **pbdMPI**, simply change lines 4 and/or 5 of the install script to match your needs.



```

build_pbdMPI.bat (~\Desktop\DES...MY\George\code\pbd\windows) - GVIM
@ECHO OFF

rem ### Set environment variables.
SET RTOOLS=C:\Rtools\bin\
SET MINGW=C:\Rtools\gcc-4.6.3\bin

IF NOT DEFINED PATH_ORG SET PATH_ORG=%PATH%
SET PATH=%RTOOLS%;%MINGW%;%PATH_ORG%

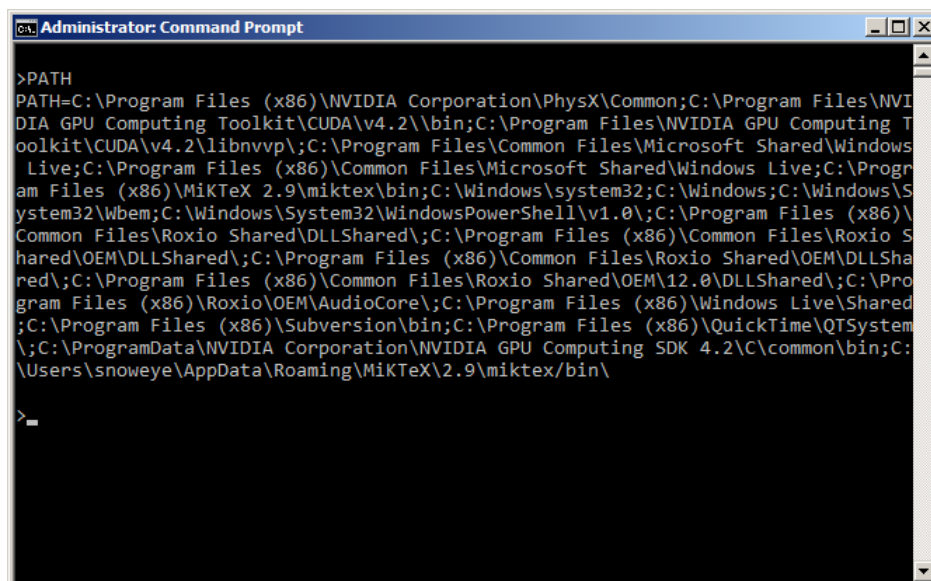
rem ### Set "MPI_ROOT_32" and "MPI_ROOT_64" if they are not in the default
rem ### installation path or you have different MPI systems.
rem ### "Makevars.win" uses default if the following two are remarked.
rem SET MPI_ROOT_64=C:\Program Files\MPICH2
rem SET MPI_ROOT_32=C:\Program Files (x86)\MPICH2

rem ### Build windows binary.
C:\PROGRA~1\R\R-2.15.1\bin\R CMD INSTALL --build --html pbdMPI_0.1-1.tar.gz
C:\PROGRA~1\R\R-2.15.1\bin\R CMD INSTALL pbdMPI_0.1-1.zip

"build_pbdMPI.bat" 19L, 674C written                      19,0-1      All

```

2. Open a command prompt either from the start menu, or by entering the command Windows key then R, and then entering cmd in the “run” dialog box.



```

Administrator: Command Prompt

>PATH
PATH=C:\Program Files (x86)\NVIDIA Corporation\PhysX\Common;C:\Program Files\NVI
DIA GPU Computing Toolkit\CUDA\v4.2\bin;C:\Program Files\NVIDIA GPU Computing T
oolkit\CUDA\v4.2\libnvvp;C:\Program Files\Common Files\Microsoft Shared\Windows
Live;C:\Program Files (x86)\Common Files\Microsoft Shared\Windows Live;C:\Progr
am Files (x86)\MiKTeX 2.9\miktex\bin;C:\Windows\system32;C:\Windows;C:\Windows\S
ystem32\Wbem;C:\Windows\System32\WindowsPowerShell\v1.0\;C:\Program Files (x86)\
Common Files\Roxio Shared\DLLShared\;C:\Program Files (x86)\Common Files\Roxio S
hared\OEM\DLLShared\;C:\Program Files (x86)\Common Files\Roxio Shared\OEM\DLLSha
red\;C:\Program Files (x86)\Common Files\Roxio Shared\OEM\12.0\DLLShared\;C:\Pro
gram Files (x86)\Roxio\OEM\AudioCore\;C:\Program Files (x86)\Windows Live\Shard
;C:\Program Files (x86)\Subversion\bin;C:\Program Files (x86)\QuickTime\QTSystem
\;C:\ProgramData\NVIDIA Corporation\NVIDIA GPU Computing SDK 4.2\common\bin;C:
\Users\snoweye\AppData\Roaming\MiKTeX\2.9\miktex\bin\

>_

```

3. Before proceeding further, it is probably a good idea to test the installation of MPICH2. The following commands utilize MPICH2 to do some fairly trivial things (do not copy **SHELL>** if you are copying and pasting from the lines below):

```

SHELL> C:\PROGRA~1\MPICH2\bin\mpiexec -np 2 hostname.exe
SHELL> C:\PROGRA~1\R\R-2.15.1\bin\R --vanilla --slave -e "ls()"
SHELL> C:\PROGRA~1\R\R-2.15.1\bin\Rscript --vanilla --slave -e "ls()"

```

```

Administrator: Command Prompt

>C:\PROGRA~1\MPICH2\bin\mpiexec -np 2 hostname.exe
User credentials needed to launch processes:
account (domain\user) [WOLF_DELL\snoweye]: snoweye
password:
WOLF_DELL
WOLF_DELL

>C:\PROGRA~2\MPICH2\bin\mpiexec -np 2 hostname.exe
WOLF_DELL
WOLF_DELL

>C:\PROGRA~1\R\R-2.15.1\bin\R --vanilla --slave -e "ls()"
character(0)

>C:\PROGRA~1\R\R-2.15.1\bin\Rscript --vanilla --slave -e "ls()"
character(0)

>

```

4. Download the [source](#) for **pbdMPI** package. Put it in the same directory as your `build_pbdMPI.bat` file, and then execute `build_pbdMPI.bat` from the command prompt to install the package.

```

Administrator: Command Prompt

>dir
Volume in drive C is OSDisk
Volume Serial Number is 5AB5-15E1

Directory of C:\Users\snoweye\Desktop\DESKTOP-MY\George\code\pbd\windows

10/17/2012  04:29 PM    <DIR>          .
10/17/2012  04:29 PM    <DIR>          ..
10/17/2012  04:03 PM             704 build_pbdMPI.bat
10/17/2012  04:28 PM    <DIR>          figures
10/17/2012  03:28 PM      8,769,536 mpich2-1.4.1p1-win-ia32.msi
10/17/2012  03:28 PM      9,809,408 mpich2-1.4.1p1-win-x86-64.msi
10/02/2012  03:39 PM       337,013 pbdMPI_0.1-1.tar.gz
10/17/2012  02:26 PM     49,354,275 R-2.15.1-win.exe
10/17/2012  04:29 PM        65,018 rlecuyer_0.3-3.zip
10/17/2012  02:37 PM     31,120,628 Rtools216.exe
               7 File(s)      99,456,582 bytes
               3 Dir(s)  110,782,427,136 bytes free

>build_pbdMPI_

```

5. If the process is done without errors, you can see the binary package is installed.

```

Administrator: Command Prompt

cc_comm             html
dd_info             html
dd_prob            html
dd_wait            html
ww_get.jid          html
ww_print_cat        html
ww_seed            html
xx_g.sort           html
yy_api.apply        html
zz_internal         html
zz_spmid.internal   html
** building package indices
** installing vignettes
'pbdMPI-guide.Rnw'
** testing if installed package can be loaded
*** arch - i386
*** arch - x64
* MD5 sums
packaged installation of 'pbdMPI' as pbdMPI_0.1-1.zip

* DONE (pbdMPI)
* installing to library 'C:/Program Files/R/R-2.15.1/library'
package 'pbdMPI' successfully unpacked and MD5 sums checked

>

```



## 3 Mac OS X

Before starting, make sure you have installed XCode. You can find this in the Mac App Store.

terminal

### 3.1 Installing R

#### 3.1.1 Installing from a Binary Package

#### 3.1.2 Compiling from Source

You can find R sources from <http://cran.r-project.org/sources.html>

Generally, it should be enough to simply execute

```
./configure && make && make install
```

without problems.

### 3.2 Installing MPI

#### 3.2.1 Installing from a Package Repository

#### 3.2.2 Compiling from Source

If you want to install OpenMPI from source (I don't really recommend this unless this document is irrelevant to you in the first place), then the sources are available here: <http://www.open-mpi.org/software/mpi/v1.6/>.

### 3.3 Installing pbdR

Installing pbdR should go smoothly. The simplest way to install the packages is from an R terminal, which will manage dependencies for you much like your distro's package manager. Additionally, our packages are available in the Fedora repositories.

#### 3.3.1 Installing from CRAN

This is perhaps the simplest way to proceed, as R will handle any package dependency resolution for you. Simply start an R session (from the terminal<sup>1</sup>, type R then press enter) and issue the command:

```
1 install.packages(<package>)
```

So for example, to install **pbdMPI**, you might execute:

```
1 install.packages(pbdMPI)
```

---

<sup>1</sup>Do *not* use the gui. See section 5.2 for details

### 3.3.2 Installing from the Shell

If you have downloaded a pbdR (or other R) package, then installing from the shell simply amounts to issuing the command:

```
R CMD INSTALL <package>
```

So for example, to install **pbdMPI**, you might execute:

```
R CMD INSTALL pbdMPI_0.1-6.tar.gz
```

### 3.3.3 Installing from Github

CRAN policy is such that updates to packages can not be made too frequently. For this reason, the development versions of our packages will have bugfixes and new features much more quickly than CRAN versions.

## 4 Linux and FreeBSD

Before starting, make sure you have

On Linux, unless you have a specific reason not to (in which case, most of this document is probably unnecessary for you), we recommend that you install R and MPI through your distribution's package repository.

If instructions for your favorite distribution are not listed below, we would be happy to incorporate submissions/corrections.

terminal

### 4.1 Installing R

#### 4.1.1 Installing from a Package Repository

If your distribution is Debian-derived, including Debian, Ubuntu, and Mint:

```
apt-get install r-base-dev
```

If your distribution is “Redhat-ish”, including Redhat, Fedora, and CentOS:

```
yum install R-devel
```

If your distribution is OpenSUSE:

```
zypper install R-patched-devel
```

If you are using FreeBSD:

```
cd /usr/ports/math/R && make install clean
```

### 4.1.2 Compiling from Source

You can find R sources from <http://cran.r-project.org/sources.html>

Generally, it should be enough to simply execute

```
./configure && make && make install
```

without problems.

## 4.2 Installing MPI

### 4.2.1 Installing from a Package Repository

For these systems, we recommend using OpenMPI. To install OpenMPI

If your distribution is Debian-derived, including Debian, Ubuntu, and Mint:

```
apt-get install openmpi-bin libopenmpi-dev
```

If your distribution is “Redhat-ish”, including Fedora and CentOS:

```
yum install openmpi openmpi-devel
```

If your distribution is OpenSUSE:

```
zypper install openmpi-devel lam-devel
```

If you are using FreeBSD:

```
cd /usr/ports/net/openmpi && make install clean
```

### 4.2.2 Compiling from Source

If you want to install OpenMPI from source (I don’t really recommend this unless this document is irrelevant to you in the first place), then the sources are available here: <http://www.open-mpi.org/software/ompi/v1.6/>.

## 4.3 Installing pbdR

Installing pbdR should go smoothly. The simplest way to install the packages is from an R terminal, which will manage dependencies for you much like your distro’s package manager. Additionally, our packages are available in the Fedora repositories.

### 4.3.1 Installing from CRAN

This is perhaps the simplest way to proceed, as R will handle any package dependency resolution for you. Simply start an R session (from the terminal, type R then press enter) and issue the command:

```
1 install.packages(<package>)
```

So for example, to install **pbDMPI**, you might execute:

```
1 install.packages(pbdMPI)
```

### 4.3.2 Installing from the Shell

If you have downloaded a pbdR (or other R) package, then installing from the shell simply amounts to issuing the command:

```
R CMD INSTALL <package>
```

So for example, to install **pbDMPI**, you might execute:

```
R CMD INSTALL pbdMPI_0.1-6.tar.gz
```

### 4.3.3 Installing from Github

CRAN policy is such that updates to packages can not be made too frequently. For this reason, the development versions of our packages will have bugfixes and new features much more quickly than CRAN versions.

The easiest way to install from github is using Hadley Wichkam's **devtools** package (which can be installed via `install.packages(devtools)`). Assuming you have this package installed, then from an R session, then to install a pbdR package, you would issue one of the following:

```
1 install_github(repo="pbdMPI", username="snoweye")
2 install_github(repo="pbdSLAP", username="snoweye")
3 install_github(repo="pbdNCDF4", username="snoweye")
4
5 install_github(repo="pbdBASE", username="wrathematics")
6 install_github(repo="pbdDMAT", username="wrathematics")
7 install_github(repo="pbdDEMO", username="wrathematics")
```

## 5 Installation Problems

During the course of installation, you may run into unrecoverable issues. The pbdR team does not support MPI libraries or R core, so if you have problems during that portion of the installation phase, we probably can not directly help you. However, there are still many great resources at your disposal, maintained by those individual projects.

### 5.1 R and MPI

If you have problems installing or customizing R, see the *R Installation and Administration Manual* at <http://cran.r-project.org/doc/manuals/R-admin.html> for help.

If you are having trouble installing an MPI library, you should see that library's official documentation. For OpenMPI, see <http://www.open-mpi.org/community/help/> and for MPICH, see <http://www.mpich.org/documentation/guides/>.

For the remainder, we will be addressing installation issues with pbdR packages.

## 5.2 pbdR

This is a quick list of potential problems you could encounter when installing pbdR packages. For additional troubleshooting or installation options, each package has a vignette which may offer additional useful information.

- **When compiling pbdMPI from source**, you may be required to pass a configure argument at compile time. So for example, if you have OpenMPI installed and were installing from the command line, then you would issue the command:

```
R CMD INSTALL pbdMPI_0.1-6.tar.gz \
  --configure-args='--with-Rmpi-type=OPENMPI'
```

or if installing from R:

```
1 install.packages("pbdMPI", configure.args='--with-Rmpi-type=
  OPENMPI')
```

See the **pbdMPI** vignette for more details.

- **If you are installing on a cluster** where you must install on the login node which can not execute `mpirun`, then pass the install option `--no-test-load`. So for example, if installing from the command line, then you would issue the command:

```
R CMD INSTALL pbdMPI_0.1-6.tar.gz --no-test-load
```

or if installing from R:

```
1 install.packages("pbdMPI", INSTALL_opts='--no-test-load')
```

- **If you are installing binaries on MAC OS X**, do not use the gui. You can install from source using the gui, or you can install binaries (or from source) using the terminal. But you can not install binaries using the gui. So if you want to install binaries, you should open Finder, then navigate to **Applications/Utilities/** and select **Terminal**. Next, type **R** and press enter. Now try to install the packages.

## 6 Running pbdR Scripts

This information is covered in *much* more detail in the [pbdDEMO](#) vignette, and should not be considered a substitute. However, there are two key points one needs to understand in order to use pbdR tools. Namely,

- pbdR codes are written in Single Program/Multiple Data style
- pbdR codes are executed in batch

For full details, see the pbdDEMO package vignette.

Below is a simple pbdR script. This will help you know if things are installed properly or not. To understand what the script is doing, or to learn how to do much more substantial things, you should see the pbdDEMO package vignette.

```
1 library(pbdMPI, quiet = TRUE)
2 init()
3
4 x <- comm.rank()
5
6 comm.print(x, all.rank = TRUE)
7
8 finalize()
```

To run the script, you must do so in batch (i.e., non-interactively). First save its contents to the file `my_script.r`, and then open a terminal/command prompt. On Linux and Mac, you should execute the command:

```
mpirun -np 2 Rscript my_script.r
```

On Windows, you should execute the command:

```
mpiexec.exe -np 2 Rscript my_script.r
```