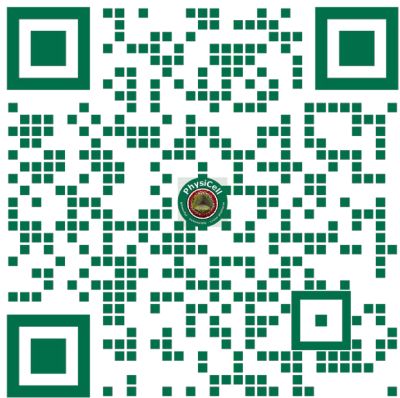


Slides, videos, links and more:

<https://github.com/physicell-training/ws2022>

Setting up PhysiCell on Windows



Furkan Kurtoglu & Aneequa Sundus



[@PhysiCell](https://twitter.com/PhysiCell)

PhysiCell Project

July 2022



LUDDY

SCHOOL OF INFORMATICS, COMPUTING, AND ENGINEERING

PhysiCell Project

PhysiCell.org

[@PhysiCell](https://twitter.com/PhysiCell)

Overview

This installation guide is prepared for installing PhysiCell to new fresh Windows. If you installed previous PhysiCell version in your PC, please uninstall MSYS 1 (previous version) and remove related directories from environmental variables.

- PhysiCell
- MSYS 2
- Adding them to path
- Anaconda
- Test modules “biorobots” and “ode-energy-sample”

Minimal
setup

-
- ImageMagick
 - COPASI
 - PhysiCell Model Builder

Traditional*
setup

*Traditional setup includes optional tools that helps for pre-simulation edits and pro-simulation analysis

Youtube video

- Here is the video link for the recording of installation on Windows:

<https://www.youtube.com/watch?v=Jp3ZOMt761M>



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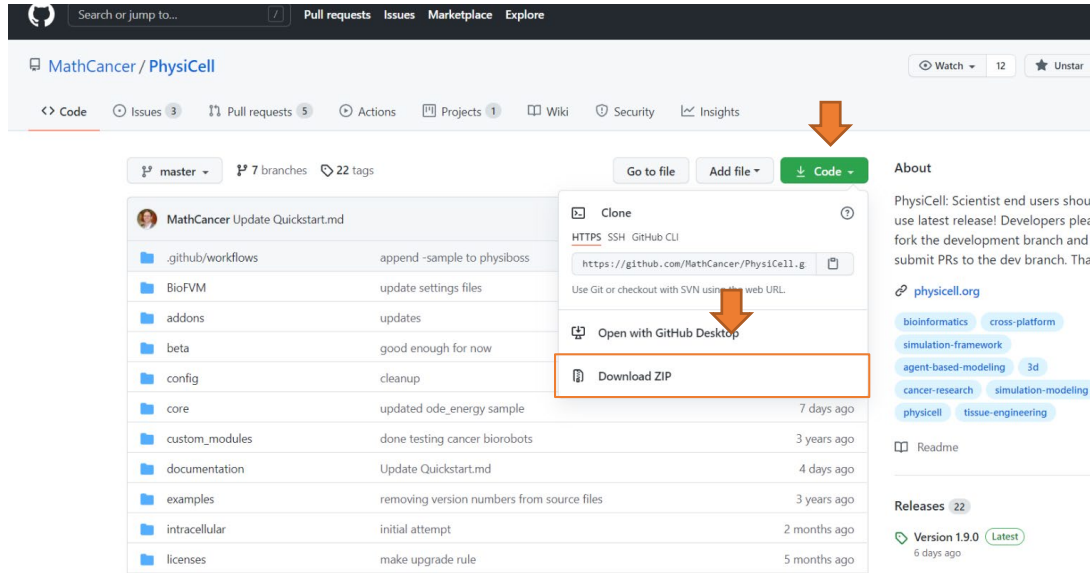
PhysiCell Project

PhysiCell.org

 @PhysiCell

PhysiCell

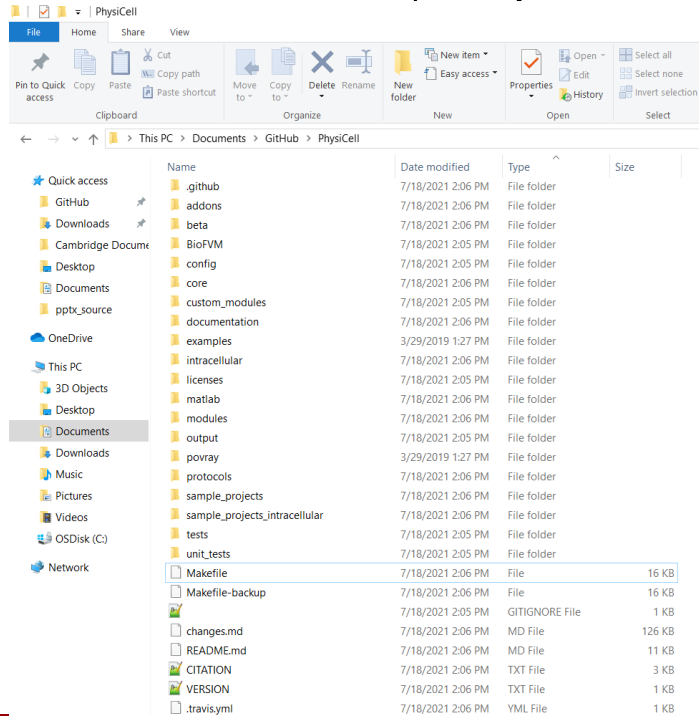
- To download PhysiCell please proceed following link:
<https://github.com/MathCancer/PhysiCell>



- Please, click green “Code” button at right.
- Then, download as “ZIP”.
- Extract to the desired directory.

PhysiCell

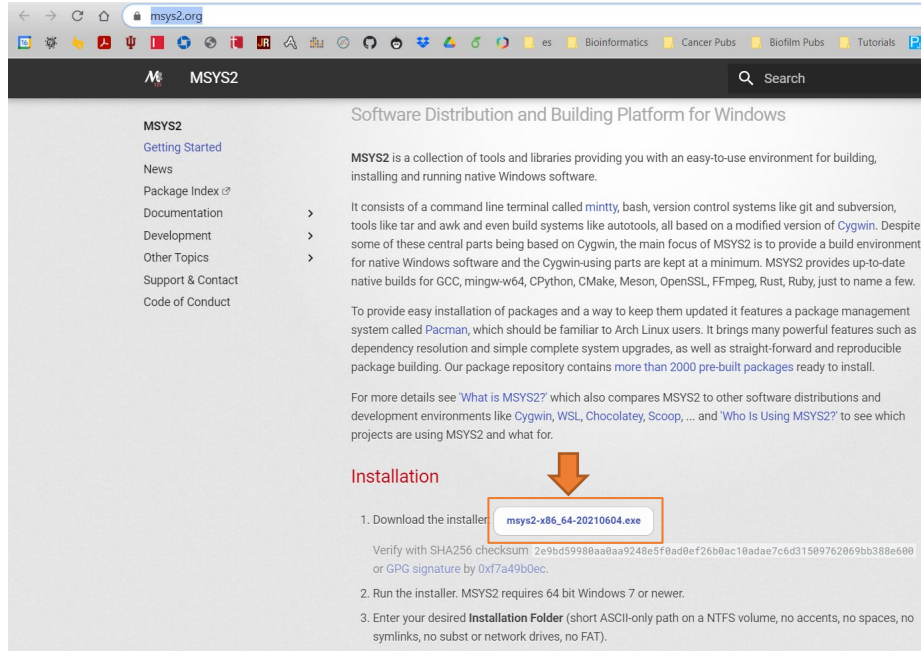
- After the extraction, PhysiCell folder should look like this:



MSYS 2

- Please proceed following link:

<https://www.msys2.org/>



The screenshot shows the msys2.org website. The header includes the MSYS2 logo and a search bar. The left sidebar contains links: MSYS2, Getting Started, News, Package Index, Documentation, Development, Other Topics, Support & Contact, and Code of Conduct. The main content area is titled "Software Distribution and Building Platform for Windows". It describes MSYS2 as a collection of tools and libraries for building and running native Windows software. It mentions that it consists of a command line terminal called mintty, bash, version control systems like git and subversion, and tools like tar and awk. It also states that MSYS2 provides up-to-date native builds for GCC, mingw-w64, CPython, CMake, Meson, OpenSSL, FFmpeg, Rust, Ruby, etc. An orange arrow points to the "Installation" section. Under "Installation", step 1 is "Download the installer" with a button labeled "msys2-x86_64-20210604.exe". Below this, it provides SHA256 and GPG checksums. Step 2 is "Run the installer" and step 3 is "Enter your desired Installation Folder".

MSYS2

Software Distribution and Building Platform for Windows

MSYS2 is a collection of tools and libraries providing you with an easy-to-use environment for building, installing and running native Windows software.

It consists of a command line terminal called `mintty`, bash, version control systems like git and subversion, tools like tar and awk and even build systems like autotools, all based on a modified version of `Cygwin`. Despite some of these central parts being based on `Cygwin`, the main focus of MSYS2 is to provide a build environment for native Windows software and the `Cygwin`-using parts are kept at a minimum. MSYS2 provides up-to-date native builds for GCC, mingw-w64, CPython, CMake, Meson, OpenSSL, FFmpeg, Rust, Ruby, just to name a few.

To provide easy installation of packages and a way to keep them updated it features a package management system called `Pacman`, which should be familiar to Arch Linux users. It brings many powerful features such as dependency resolution and simple complete system upgrades, as well as straight-forward and reproducible package building. Our package repository contains more than 2000 pre-built packages ready to install.

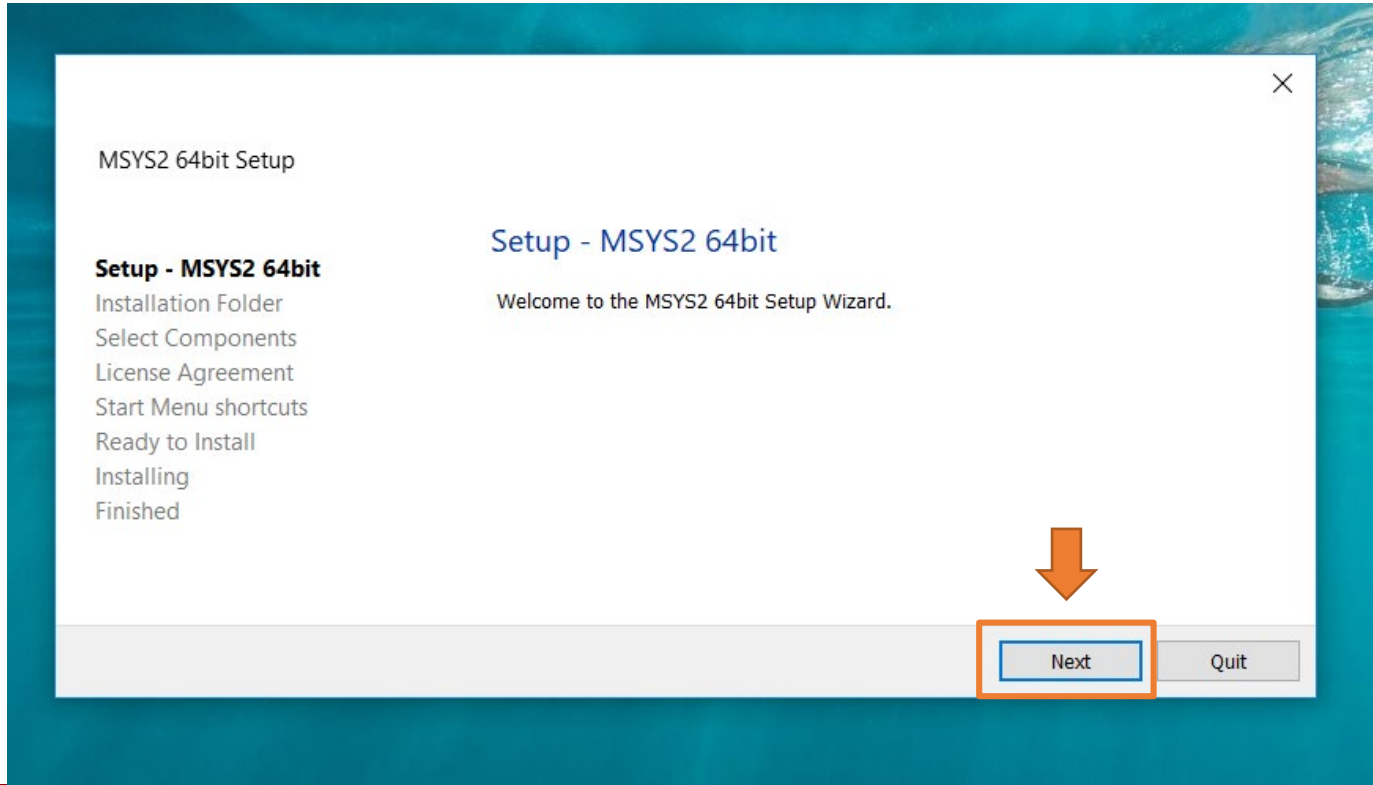
For more details see ["What is MSYS2?"](#) which also compares MSYS2 to other software distributions and development environments like `Cygwin`, `WSL`, `Chocolatey`, `Scoop`, ... and ["Who is Using MSYS2?"](#) to see which projects are using MSYS2 and what for.

Installation

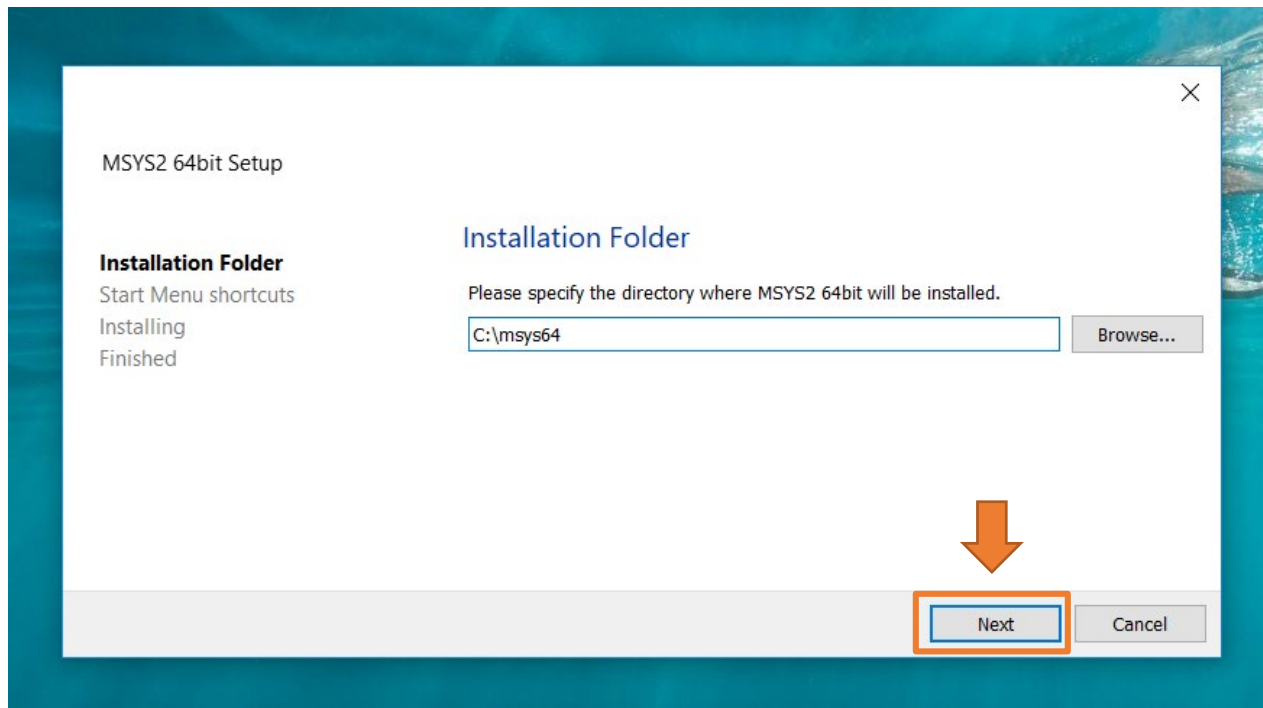
1. Download the installer [msys2-x86_64-20210604.exe](#)
Verify with SHA256 checksum `2e9bd59980aa0a9248e5f8ad0ef26b0ac10adae7c6d31509762069bb388e600` or GPG signature by `0xf7a49b0ec`.
2. Run the installer. MSYS2 requires 64 bit Windows 7 or newer.
3. Enter your desired **Installation Folder** (short ASCII-only path on a NTFS volume, no accents, no spaces, no symlinks, no subst or network drives, no FAT).

- Please, click “msys-x64_64-202XXX.exe” button at bottom.
- It should download installer.
- Open it with double-clicking the installer.

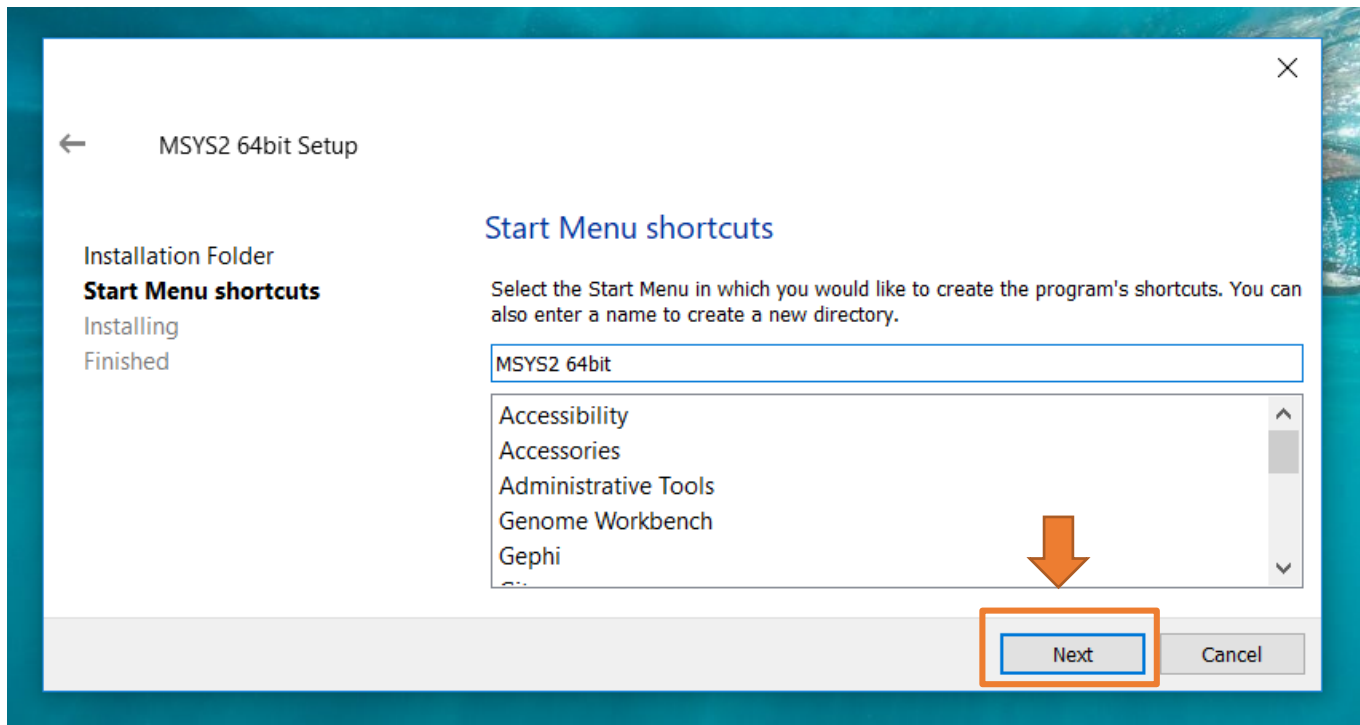
MSYS 2



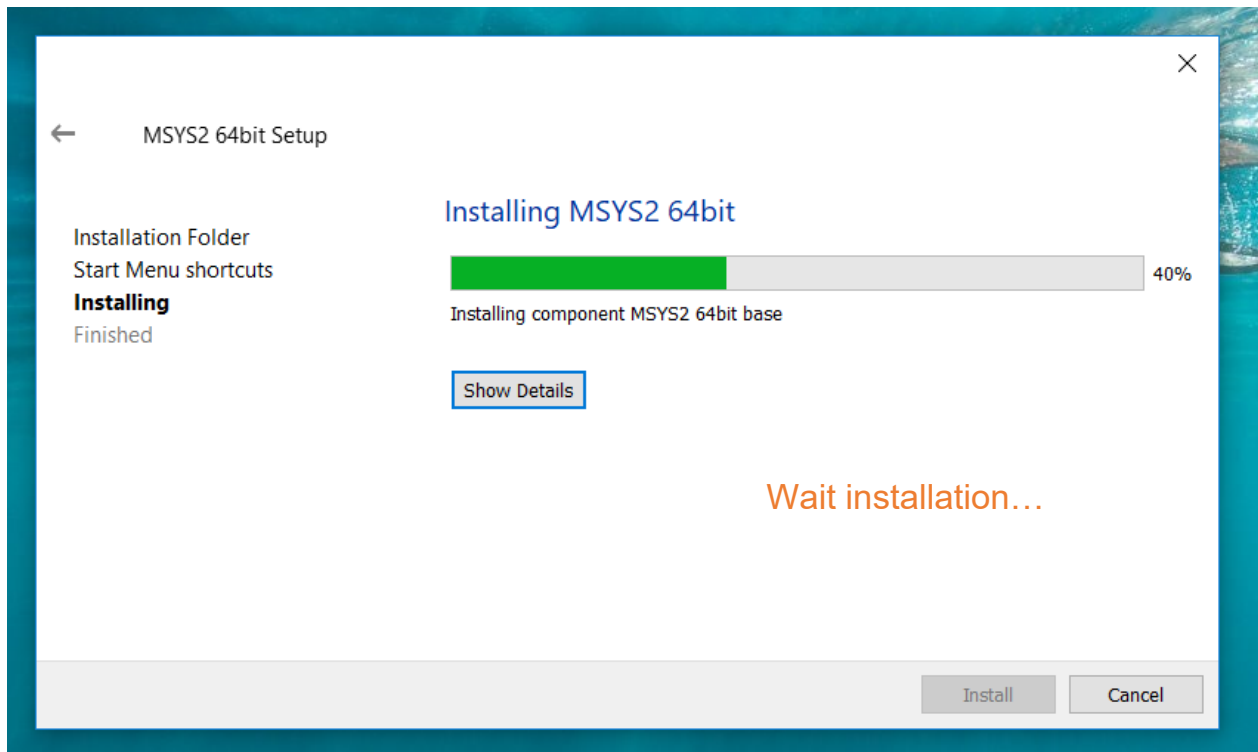
MSYS 2



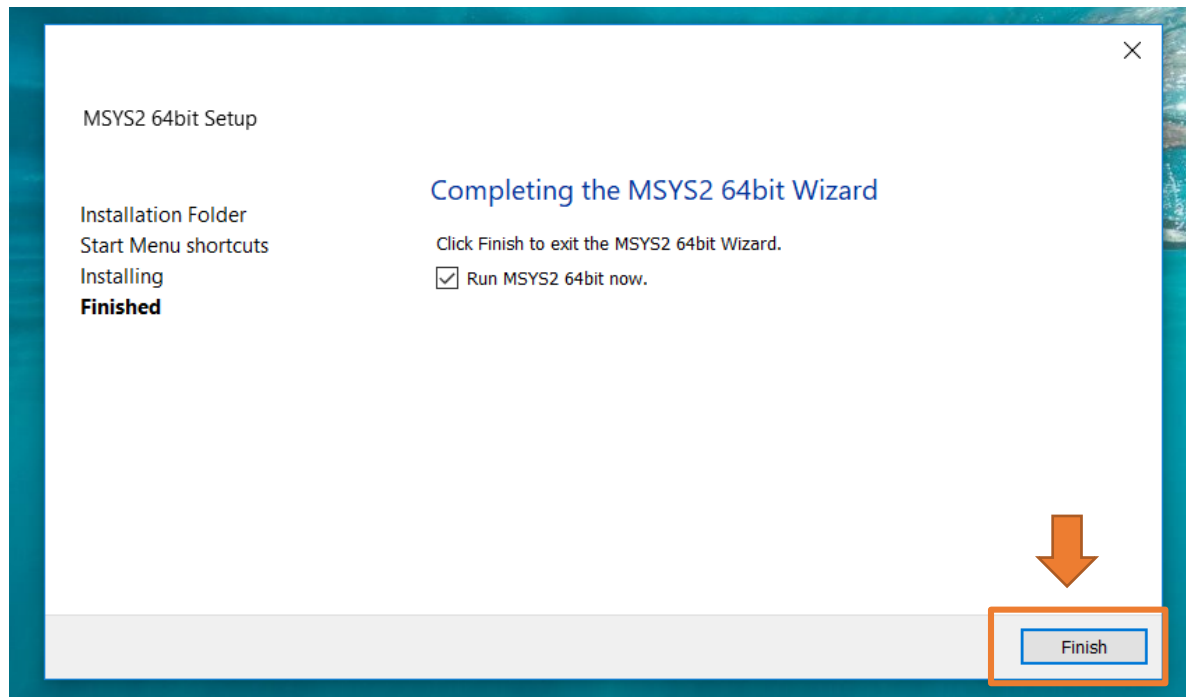
MSYS 2



MSYS 2



MSYS 2

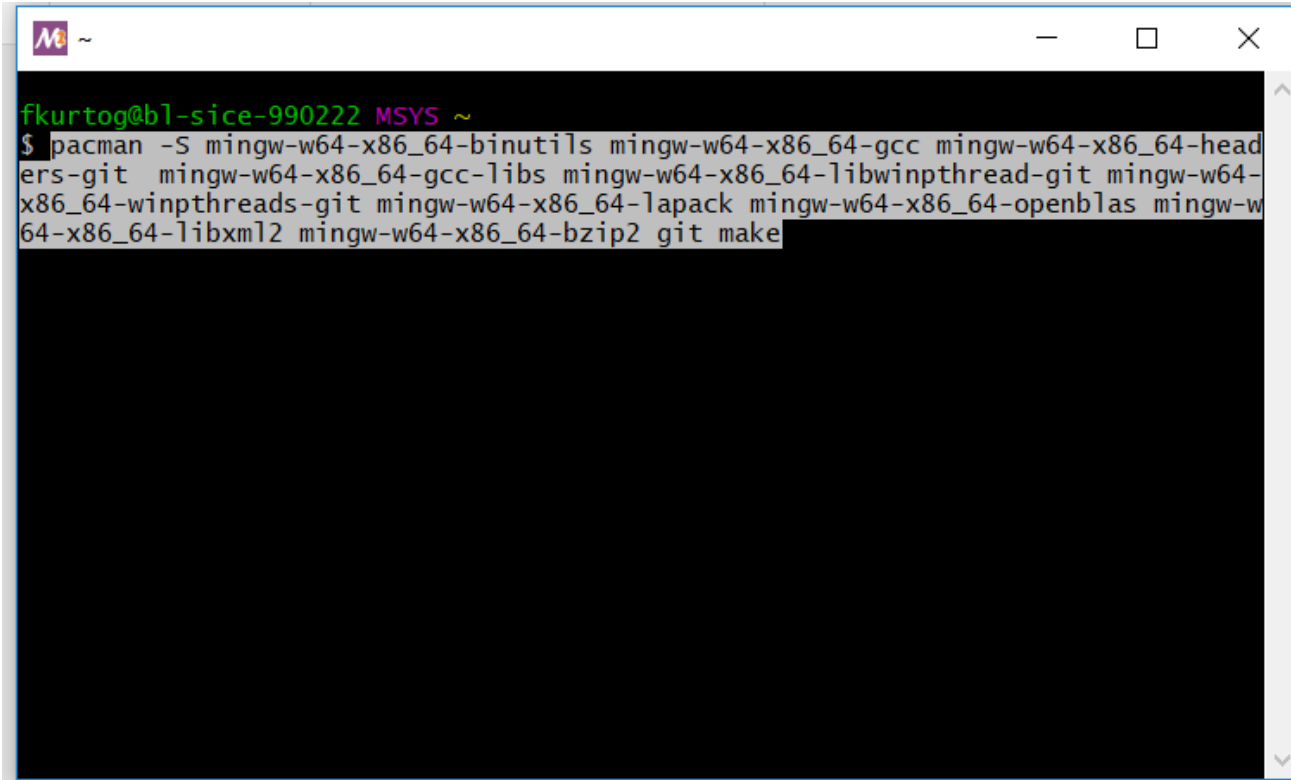


MSYS 2

- After MSYS2 command prompt is opened, please copy and paste following line. Then, press enter.

```
pacman -S mingw-w64-x86_64-binutils mingw-w64-x86_64-gcc mingw-w64-x86_64-headers-  
git mingw-w64-x86_64-gcc-libs mingw-w64-x86_64-libwinpthread-git mingw-w64-  
x86_64-winpthreads-git mingw-w64-x86_64-lapack mingw-w64-x86_64-openblas mingw-  
w64-x86_64-libxml2 mingw-w64-x86_64-bzip2 git make
```

MSYS 2



```
fkurtog@bl-sice-990222 MSYS ~  
$ pacman -S mingw-w64-x86_64-binutils mingw-w64-x86_64-gcc mingw-w64-x86_64-head  
ers-git mingw-w64-x86_64-gcc-libs mingw-w64-x86_64-libwinpthread-git mingw-w64-  
x86_64-winpthreads-git mingw-w64-x86_64-lapack mingw-w64-x86_64-openblas mingw-w  
64-x86_64-libxml2 mingw-w64-x86_64-bzip2 git make
```



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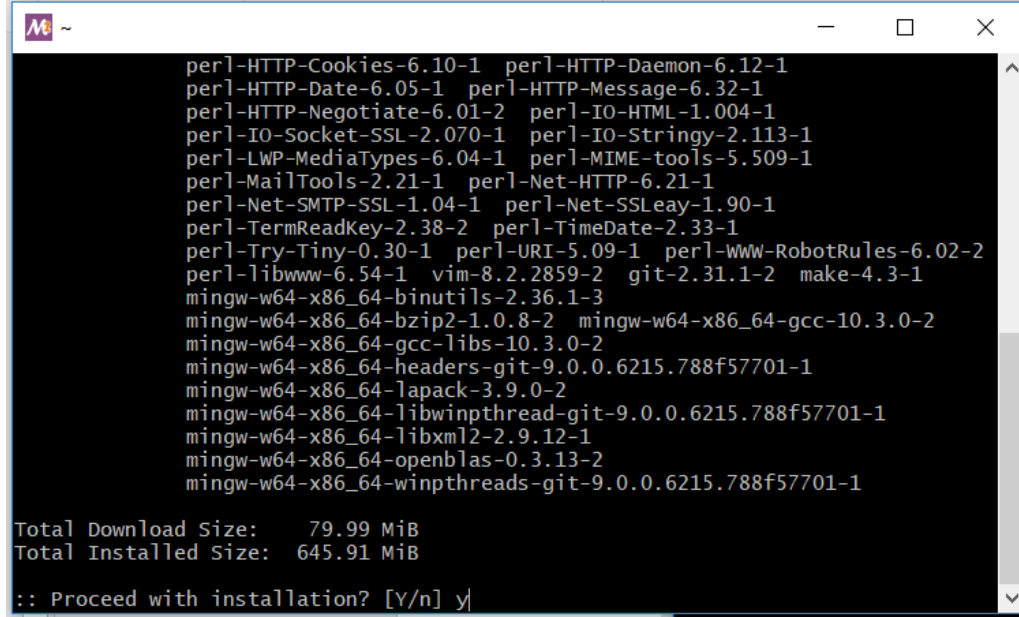
PhysiCell Project

PhysiCell.org

 **@PhysiCell**

MSYS 2

- Give “y” (yes) answer to the msys2. Press enter...



```
perl-HTTP-Cookies-6.10-1 perl-HTTP-Daemon-6.12-1
perl-HTTP-Date-6.05-1 perl-HTTP-Message-6.32-1
perl-HTTP-Negotiate-6.01-2 perl-IO-HTML-1.004-1
perl-IO-Socket-SSL-2.070-1 perl-IO-Stringy-2.113-1
perl-LWP-MediaTypes-6.04-1 perl-MIME-tools-5.509-1
perl-MailTools-2.21-1 perl-Net-HTTP-6.21-1
perl-Net-SMTP-SSL-1.04-1 perl-Net-SSLey-1.90-1
perl-TermReadKey-2.38-2 perl-TimeDate-2.33-1
perl-Try-Tiny-0.30-1 perl-URI-5.09-1 perl-www-RobotRules-6.02-2
perl-libwww-6.54-1 vim-8.2.2859-2 git-2.31.1-2 make-4.3-1
mingw-w64-x86_64-binutils-2.36.1-3
mingw-w64-x86_64-bzip2-1.0.8-2 mingw-w64-x86_64-gcc-10.3.0-2
mingw-w64-x86_64-gcc-libs-10.3.0-2
mingw-w64-x86_64-headers-git-9.0.0.6215.788f57701-1
mingw-w64-x86_64-lapack-3.9.0-2
mingw-w64-x86_64-libwinpthread-git-9.0.0.6215.788f57701-1
mingw-w64-x86_64-libxml2-2.9.12-1
mingw-w64-x86_64-openblas-0.3.13-2
mingw-w64-x86_64-winthreads-git-9.0.0.6215.788f57701-1

Total Download Size: 79.99 MiB
Total Installed Size: 645.91 MiB

:: Proceed with installation? [Y/n] y
```

MSYS 2

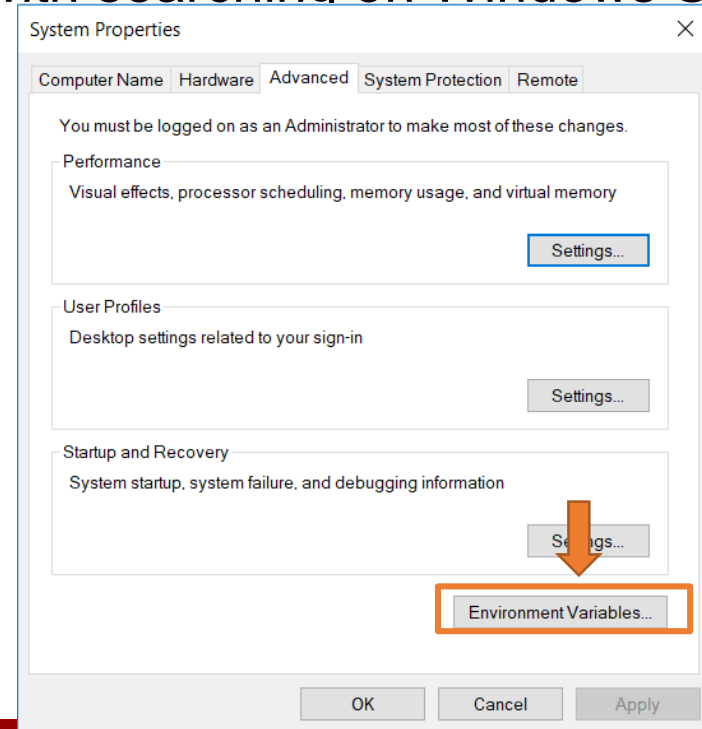
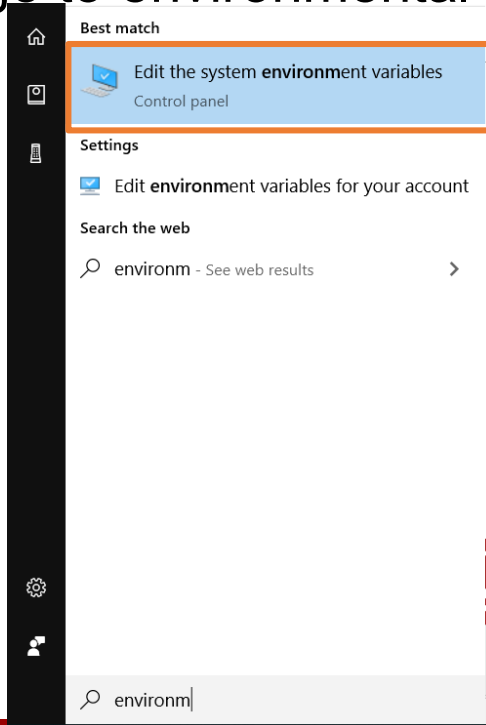
- It will take some time to install all required libraries. But in the end, you should not see any errors.

```
M ~
(45/57) installing perl-Try-Tiny [#####] 100%
(46/57) installing perl-libwww [#####] 100%
Optional dependencies for perl-libwww
perl-LWP-Protocol-https: for https:// url schemes
(47/57) installing perl-TimeDate [#####] 100%
(48/57) installing perl-MailTools [#####] 100%
(49/57) installing perl-IO-Stringy [#####] 100%
(50/57) installing perl-Convert-BinHex [#####] 100%
module test... pass.
(51/57) installing perl-MIME-tools [#####] 100%
(52/57) installing perl-Net-SSLeay [#####] 100%
(53/57) installing perl-IO-Socket-SSL [#####] 100%
(54/57) installing perl-Net-SMTP-SSL [#####] 100%
(55/57) installing perl-TermReadKey [#####] 100%
(56/57) installing git [#####] 100%
Optional dependencies for git
python: various helper scripts
subversion: git svn
(57/57) installing make [#####] 100%
:: Running post-transaction hooks...
(1/1) Updating the info directory file...

fkurtog@bl-sice-990222 MSYS ~
$ |
```

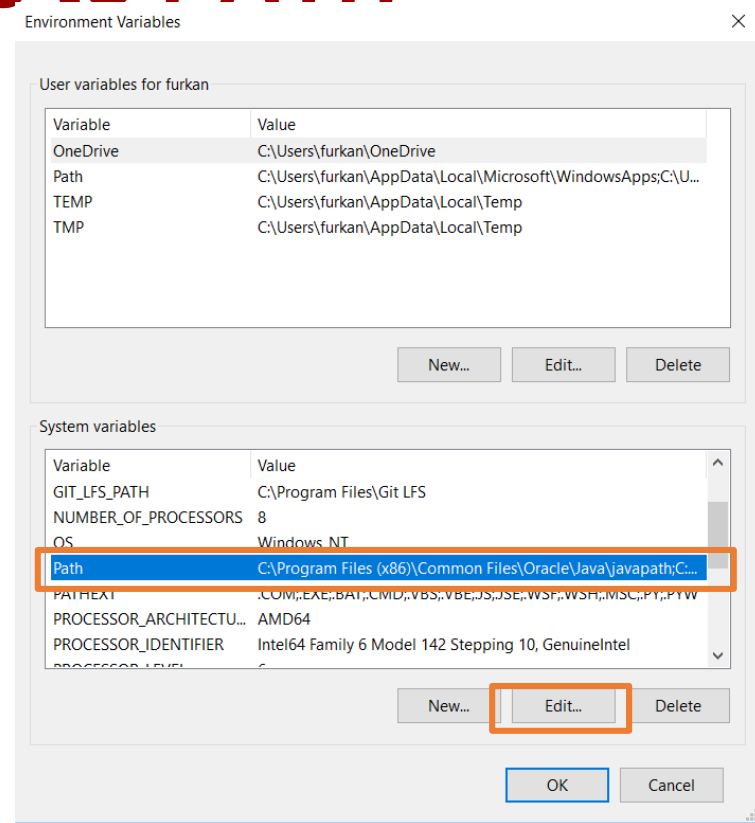
Adding directories to PATH

- Please go to environmental variables with searching on Windows Start Menu.



Adding directories to PATH

- Please select to SYSTEM PATH and press “Edit...”



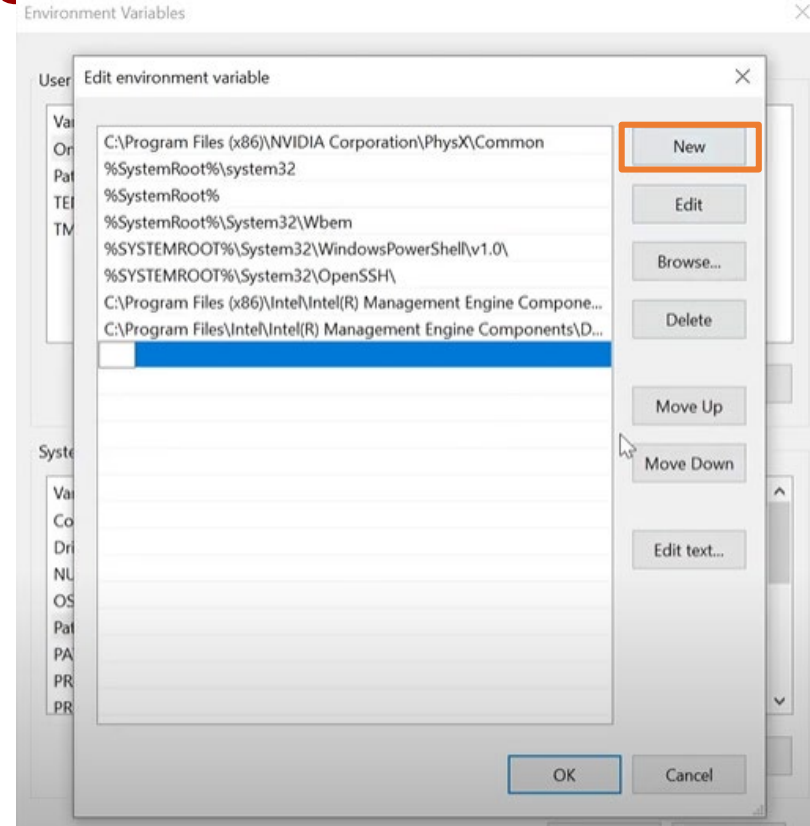
Adding directories to PATH

- Please press “New”. And add following paths to there:

C:\msys64\mingw64\bin

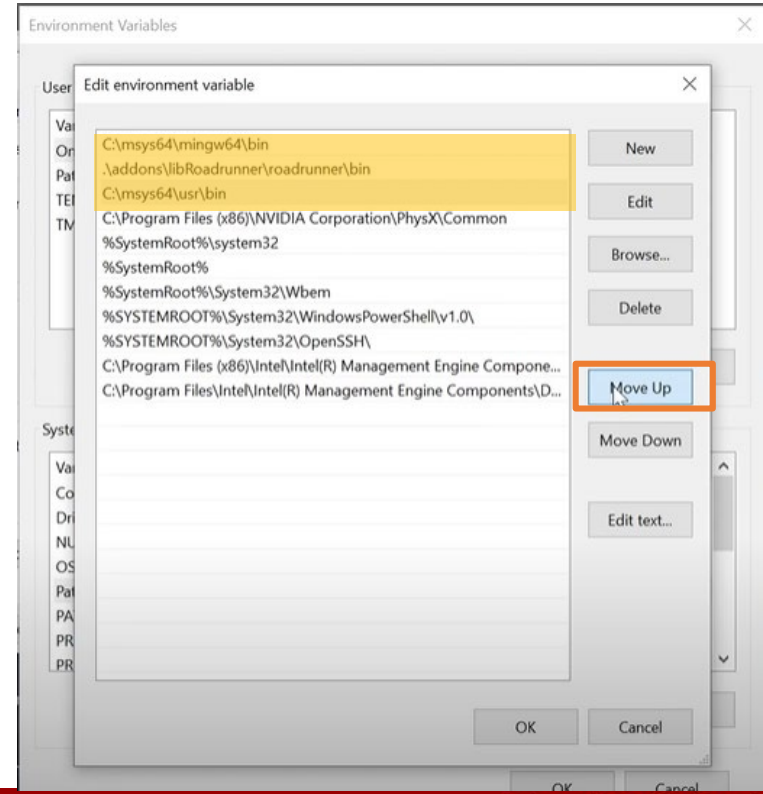
C:\msys64\usr\bin

.\addons\libRoadrunner\roadrunner\bin



Adding directories to PATH

- Then please “MOVE UP”, newly added three paths.
- The list should like the following image.



Anaconda

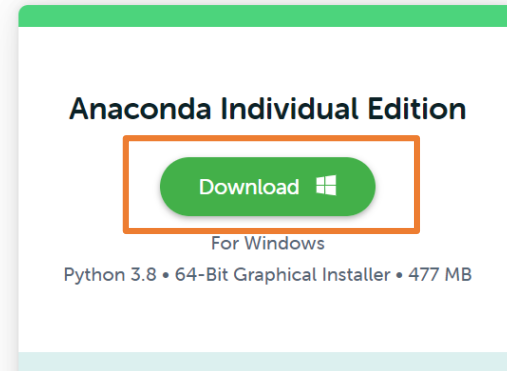
- Please proceed following link:
<https://www.anaconda.com/products/individual>



Individual Edition

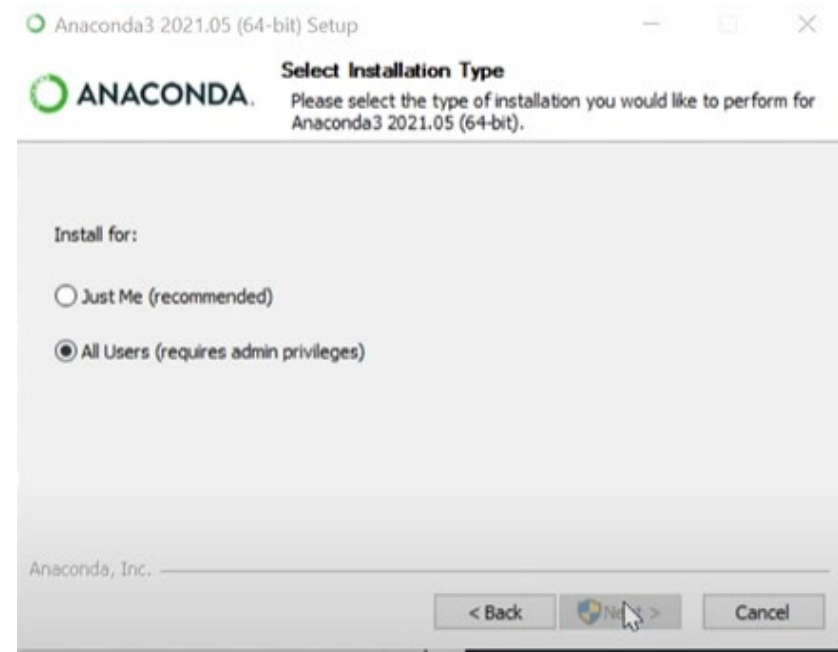
Your data science toolkit

With over 25 million users worldwide, the open-source Individual Edition (Distribution) is the easiest way to perform Python/R data science and machine learning on a single machine. Developed for



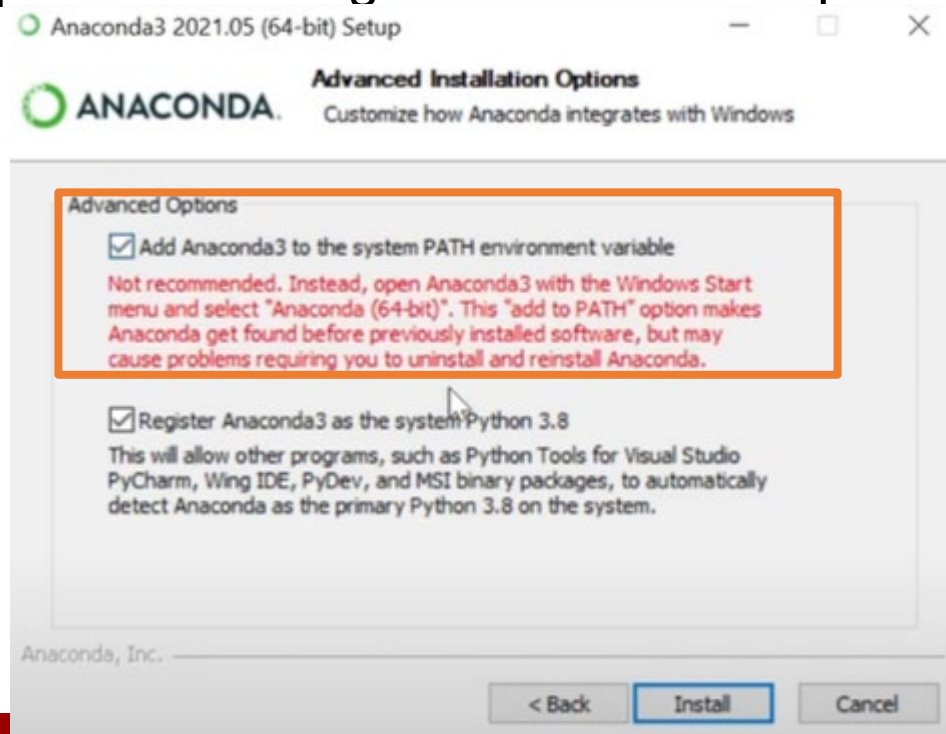
Anaconda

- Please install for all users. (This step is required for msys2 path priorities)
- If you cannot install for all users. Please add msys2 paths for current user in the environmental variables. (Instead of systems variables, please use upper user variables)



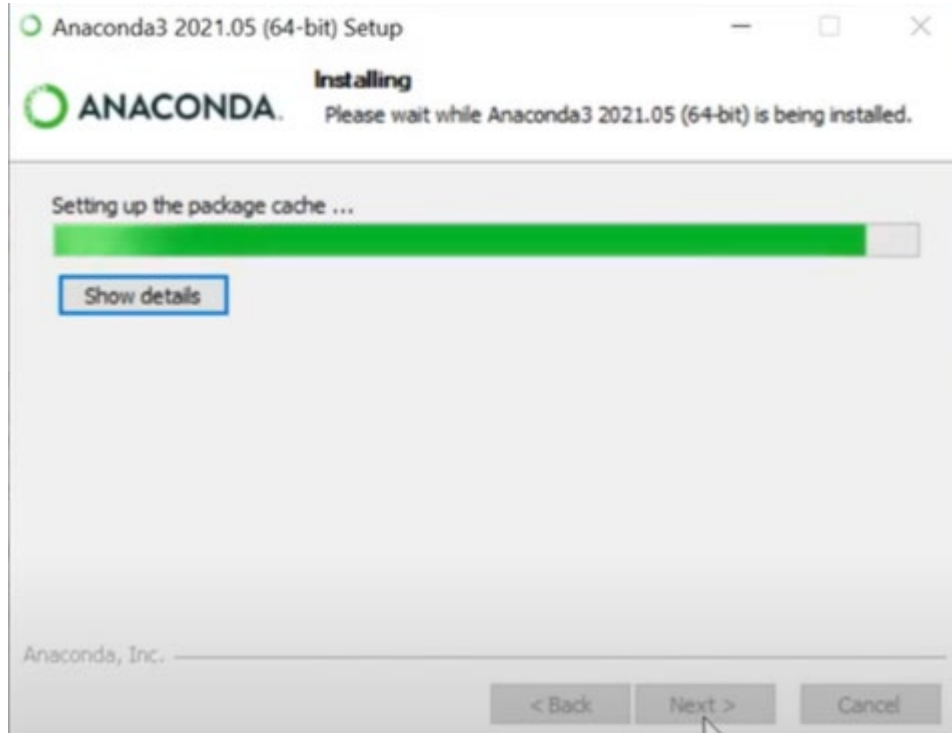
Anaconda

- Please select option for adding Anaconda to the path.



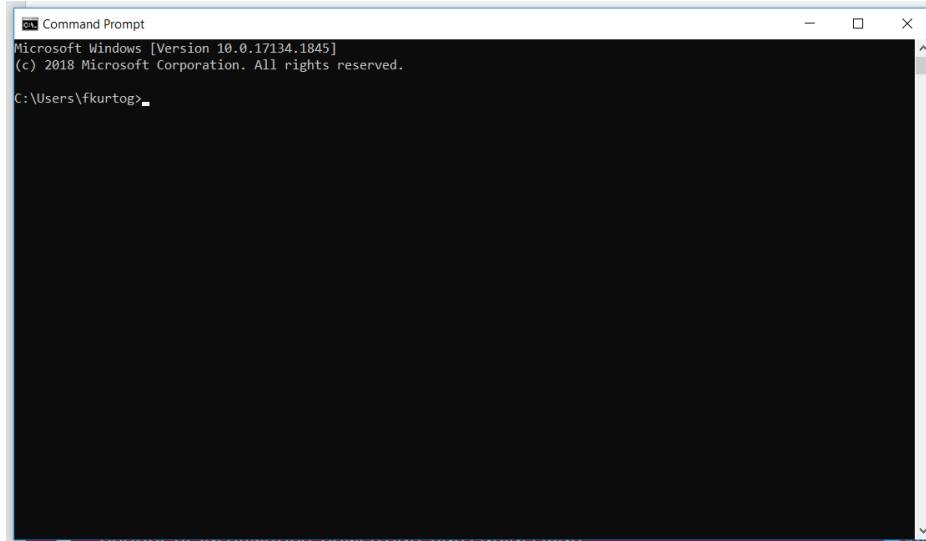
Anaconda

- Installation...



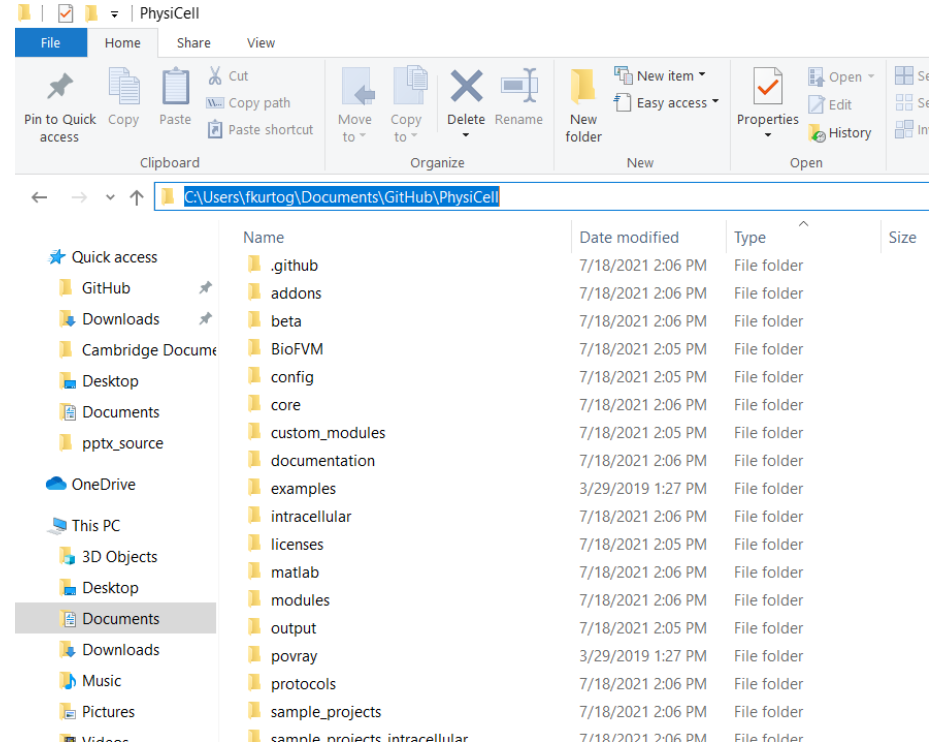
Test Module : “biorobots”

- At this moment PhysiCell is ready to work. Let’s try “biorobots”, first.
- Open command prompt from Start menu with typing “cmd”.



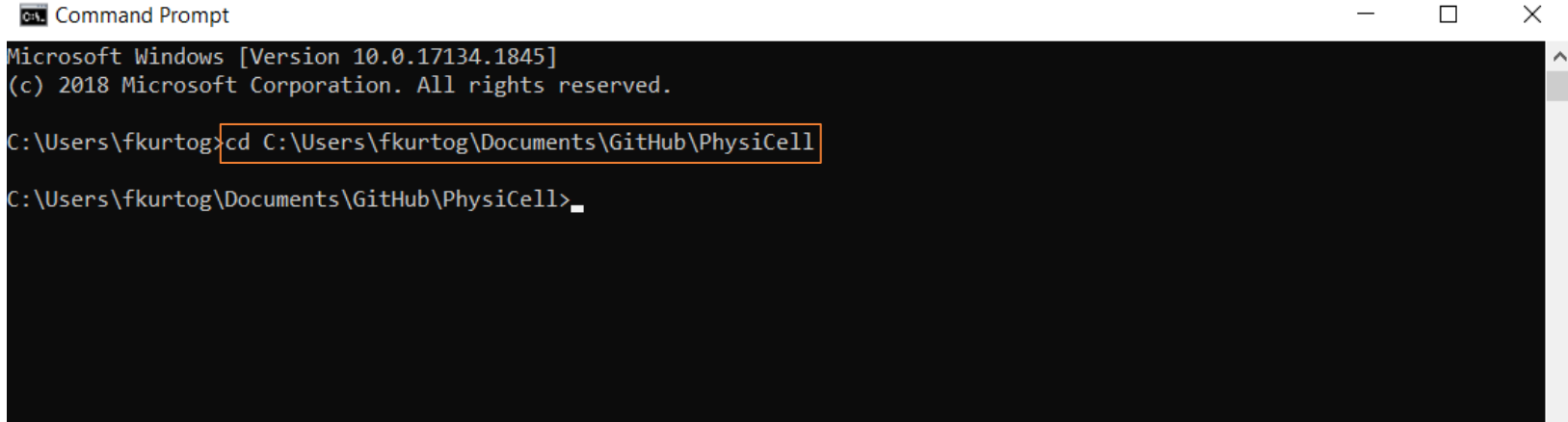
Going to PhysiCell folder

- Proceed to the PhysiCell folder at File Browser.
- Click to the directory address from top.
- Copy it



Going to PhysiCell folder

- Type “cd” and paste the copied directory with space between them.



```
Command Prompt
Microsoft Windows [Version 10.0.17134.1845]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\fkurtog>cd C:\Users\fkurtog\Documents\GitHub\PhysiCell

C:\Users\fkurtog\Documents\GitHub\PhysiCell>
```

Testing Modules (biorobots)

- Let's compile "biorobots" sample project first.
- Please run following commands in the command prompt.

```
make biorobots-sample
```

```
make
```

- This should successfully compile biorobots sample project that ready to run with following command.

```
./biorobots.exe
```

First simulation...

```
Command Prompt - birobots.exe

Placing 15 director cells ...
Placing cargo cells ...
Placing worker cells ...
done!
Using PhysiCell version 1.9.0
Please cite DOI: 10.1371/journal.pcbi.1005991
Project website: http://PhysiCell.MathCancer.org

See ALL_CITATIONS.txt for this list.
current simulated time: 0 min (max: 2880 min)
total agents: 514
interval wall time: 0 days, 0 hours, 0 minutes, and 0.0075989 seconds
total wall time: 0 days, 0 hours, 0 minutes, and 0.0094352 seconds

Using method diffusion_decay_solver__constant_coefficients_LOD_2D (2D LOD with Thomas Algorithm) ...

Warning and FYI: Very small vectors are normalized to 0 vector

current simulated time: 2 min (max: 2880 min)
total agents: 513
interval wall time: 0 days, 0 hours, 0 minutes, and 0.163112 seconds
total wall time: 0 days, 0 hours, 0 minutes, and 0.173366 seconds

current simulated time: 4 min (max: 2880 min)
total agents: 513
interval wall time: 0 days, 0 hours, 0 minutes, and 0.139892 seconds
total wall time: 0 days, 0 hours, 0 minutes, and 0.313664 seconds
```

Testing Modules (ode-energy-sample)

- If the first test is successfully created .mat and .xml files in the output folder. Let's try “ode-sample” sample project. To do that:

```
make ode-energy-sample
```

```
make
```

- While compilation, you should see “libroadrunner” installation. After the compilation, please use following command to run simulation.

```
./ode_energy.exe
```

Second simulation... (ode-energy-sample)

```
Command Prompt - ode_energy.exe
Number of boundary species = 0
Number of compartments = 1
Floating species names:
-----
Glucose Oxygen Energy Lactate apoptosis_rate migration_speed Lac_Secretion_Rate Transition_Rate

Glucose -> 0
Oxygen -> 1
Energy -> 2
Lactate -> 3
apoptosis_rate -> 4
migration_speed -> 5
Lac_Secretion_Rate -> 6
Transition_Rate -> 7
0) 100
1) 100
2) 450
3) 0
4) 0
5) 0
6) 0
7) 0.000166667

----- start: librr_intracellular.cpp: start() called
----- start: doing: rrHandle = createRRInstance()
----- start: rrHandle = 0x1d1bb045f30
      sbml_filename = ./config/Toy_Metabolic_Model.xml
```

Overview

We have finished the minimal setup. Following slides will show traditional setup.

- PhysiCell
 - MSYS 2
 - Adding them to path
 - Anaconda
 - Test modules “biorobots” and “ode-energy-sample”
-

Minimal
setup

- ImageMagick
- COPASI
- PhysiCell Model Builder

Traditional*
setup

*Traditional setup includes optional tools that helps for pre-simulation edits and pro-simulation analysis

ImageMagick

- Please proceed the following link:
<https://imagemagick.org/script/download.php>
- And go below for “Windows Binary Release” and click there to download.

Windows Binary Release

ImageMagick runs on Windows 10 (x86 & x64), Windows 8 (x86 & x64), Windows 7 (x86 & x64), Windows Server 2012, Windows Vista (x86 & x64) with Service Pack 2, Windows Server 2008 (x86 & x64) with Service Pack 2, and Windows Server 2008 R2 (x64).

The amount of memory can be an important factor, especially if you intend to work on large images. A minimum of 512 MB of RAM is recommended, but the more RAM the better. Although ImageMagick runs well on a single core computer, it automatically runs in parallel on multi-core systems reducing run times considerably.

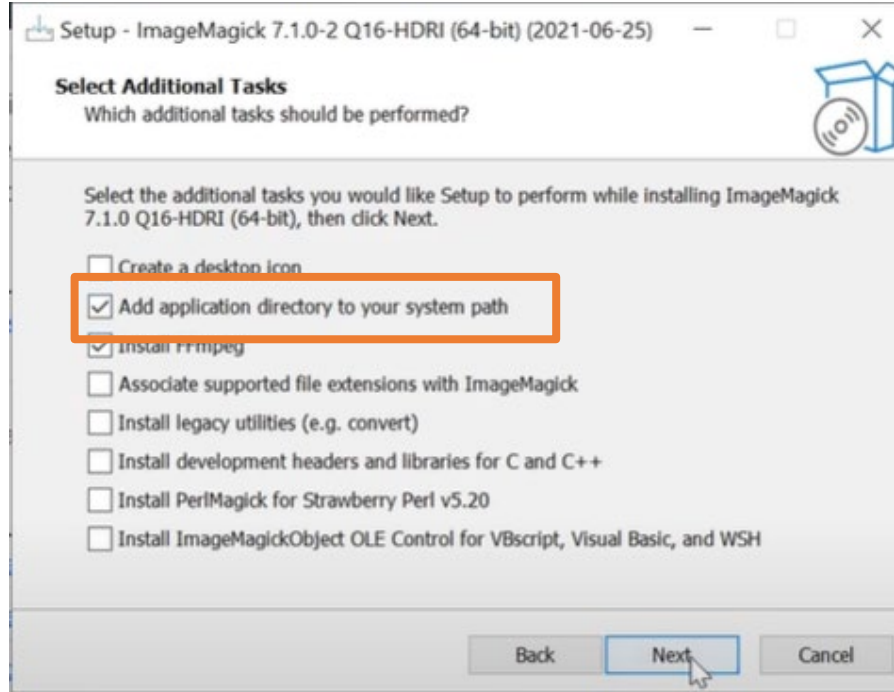
The Windows version of ImageMagick is self-installing. Simply click on the appropriate version below and it will launch itself and ask you a few installation questions. Versions with *Q8* in the name are 8 bits-per-pixel component (e.g. 8-bit red, 8-bit green, etc.), whereas, *Q16* in the filename are 16 bits-per-pixel component. A *Q16* version permits you to read or write 16-bit images without losing precision but requires twice as much resources as the *Q8* version. Versions with *dll* in the filename include ImageMagick libraries as [dynamic link libraries](#). Unless you have a Windows 32-bit OS, we recommend this version of ImageMagick for 64-bit Windows:

Version	Description
ImageMagick-7.1.0-4-Q16-HDRI-x64-dll.exe	Win64 dynamic at 16 bits-per-pixel component with High-dynamic-range imaging enabled

Or choose from these alternate Windows binary distributions:

ImageMagick

- Please be sure the option for adding directory to path is selected.



COPASI

- Please proceed following link to download COPASI

<http://copasi.org/>

- Install regularly



PhysiCell Model Builder (1)

- The Model Builder is a GUI to let you create/edit a .xml configuration file that defines (nearly all of) a PhysiCell model.

- Download the latest release at:

<https://github.com/PhysiCell-Tools/PhysiCell-model-builder/releases>

- Uncompress the .zip, change directory into it, and run it:

```
$ unzip PhysiCell-model-builder-2.5.0.zip  
$ cd PhysiCell-model-builder-2.5.0  
$ python bin/gui4xml.py
```

Note that if your setup automatically unzips files after downloading, this command will not work. INSTEAD, **skip** the unzip command and go directly to the second command

This should display the GUI (next page):

PhysiCell Model Builder (2)

The screenshot shows the 'PhysiCell Model Builder: copy_template.xml' window. It has a menu bar with 'File' and tabs for 'Config Basics', 'Microenvironment', 'Cell Types', and 'User Params'. The 'Config Basics' tab is active. The interface is divided into several sections with orange headers:

- Domain (micron):** Contains input fields for Xmin (-500), Xmax (500), Ymin (-500), Ymax (500), Zmin (-10), and Zmax (10). To the right are fields for dx (20), dy (20), and dz (20).
- ☐ Virtual walls
- Misc runtime parameters:** Contains fields for Max Time (7200 min), # threads (6), and output folder (output).
- Save data:** Includes checkboxes for SVG (checked) and Full (checked), with frequency fields set to every 60 min and every 360 min respectively.
- Initial conditions of cells (x,y,z, type):** Includes a checkbox for 'cells.csv'.

A User Guide for the Model Builder is still be written.

It is a tool that is still considered “beta”, so your feedback will be very valuable.

Funding Acknowledgements



PhysiCell Development:

- Breast Cancer Research Foundation
- Jayne Koskinas Ted Giovanis Foundation for Health and Policy
- National Cancer Institute (U01CA232137)
- National Science Foundation (1720625)

Training Materials:

- Administrative supplement to NCI U01CA232137 (Year 4)