

This document contains everything that teachers and students need to know to download, install, and run the software that is required to teach the 2021-22 *Engineer Your World: Computing* curriculum (formerly called EYW2 or ECS) on Windows PCs running Windows 10. We do not recommend using Windows 7.

For Macs, please see the document ‘EYW-Computing_Software_for_Macs_2021-22’. While the curriculum can be run on both PCs and Macs, if you have the choice between the two, we recommend using PCs because they tend to have fewer issues with software installation and OS updates that affect the functionality of the necessary software. Also, many of the lessons show screenshot examples from PCs.

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What software do we need, when do we need it, and why do we need it?

Needed on all student and teacher computers before the year begins:

- **Python 3** – The programming language that students will use to write programs throughout the year. We recommend using Python 3.6. Note that Python 3.7 and 3.8 will NOT work for the opening *Electronic Music* unit as explained at the beginning of the Python 3 installation instructions below.
- **Thonny** - An Integrated Development Environment (IDE) for Python that is designed for beginners. This is where students will compose their Python code throughout the year. Thonny offers both ease of use and consistency across the year, since this is the IDE that students will use to code on the Raspberry Pis in the spring semester.
- **Pysine Library** - A library that contains useful functions for playing sound through the computer's internal speaker. It is needed in the *Electronic Music* unit.
- **OpenCV (Open Source Computer Vision) Library** - A library that contains copious functions for analyzing and manipulating digital images. It is needed for the *Images* and *Motion Capture* units.
- **Numpy Library** - A library that adds support for multidimensional arrays (*e.g.*, digital images) with a collection of mathematical functions to operate on these arrays. NumPy automatically comes installed with the OpenCV library (above). It is needed for the *Images* and *Motion Capture* units.
- **Logitech Webcam App** - An app that offers extra functionality for controlling the C170 and C270 webcams that are provided in the course equipment kit. It is needed for the *Motion Capture* unit.

Needed only on the teacher's and/or IT person's computer (not students'), sometime in the fall:

- **Etcher** - An app that allows you to format and install a disk image onto a microSD card. This is used to load the Raspberry Pis with the *EYW*-provided disk image, a task that must be completed before starting the *Mechatronics* unit. Since the disk image install process can take several hours, we recommend starting that process sometime in the Fall semester.

Needed on all student and teacher computers before the spring semester begins:

- **VNC Viewer** - An app that allows you to control a Raspberry Pi remotely and wirelessly using your PC's monitor, keyboard, and mouse. It is needed for the *Mechatronics* and *CamChair* units in the spring semester.
- **WinSCP** - An app that allows you to transfer files between your PC and the Raspberry Pi. It is needed for the *Mechatronics* and *CamChair* units.

Software Installation – Fall Semester

Install the following software on the teacher’s computer and on all student computers prior to the beginning of the year. (These need to be on the teacher computers before the summer PD).

Installing Python 3.6

Why aren’t we using the latest version of Python?

We strongly recommend using Python 3.6 for this course because the opening *Electronic Music* unit cannot be completed on machines running Python 3.7 or 3.8. (One of the deep background libraries – PortAudio, which supports the Pysine library and is needed to play sound through the laptop’s speakers – doesn’t install properly with the newer versions of Python.) If your computers already have Python 3.7 or 3.8 installed, then you have two options.

- **Replace the current version of Python with Python 3.6 (preferred).** In this case, you must be careful to uninstall and delete every piece of Python from your machines before installing Python 3.6. You cannot simply “repair” the old version. (It is, however, fine to keep any .py files [*i.e.*, Python code] that you have created.)
- **Keep the current version of Python installed on the computers (requires curriculum modification).** If you **must** use Python 3.7 or 3.8 for some reason (*e.g.*, if your student computers are shared by another class that must use a newer version of Python), then your students will not be able to complete the *Electronic Music* challenge. In this case, you will need to introduce them to Python using a simple online Python 3 tutorial such as the one offered by Codecademy.

Once your computers are ready for the Python 3.6 install, follow these steps.

1. Go to <https://www.python.org/downloads/windows/>

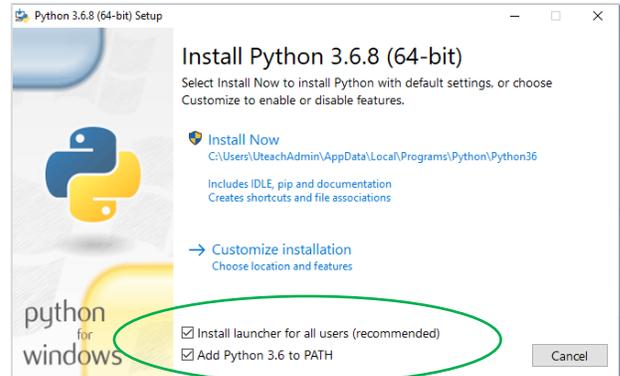
2. Find the downloadable file for the Python **3.6** newest stable release (in left column). You will need to scroll down for a while to find it. *As of the writing of these instructions in May 2021, 3.6.8 is the newest option with downloadable files (3.6.9 through 3.6.13 do not).*

* Download the “executable installer” for your system. Almost all modern computers have 64-bit operating

systems, so you will likely want to get the executable installer that has a -64 in the name. (*For this document’s example we will choose Windows x86-64 executable installer for 3.6.8.*) If you want to doublecheck what type of system you have, in Windows 10, go to Windows Start Button → Settings → System → About and look at “System Type”.

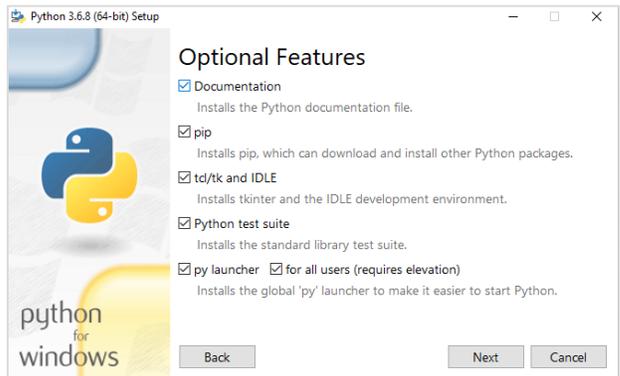


3. Save the file, then run it.
4. On the first window, check both of the boxes at the bottom:
 - ✓ Install launcher for all users (recommended)
 - ✓ Add Python 3.6 to PATH



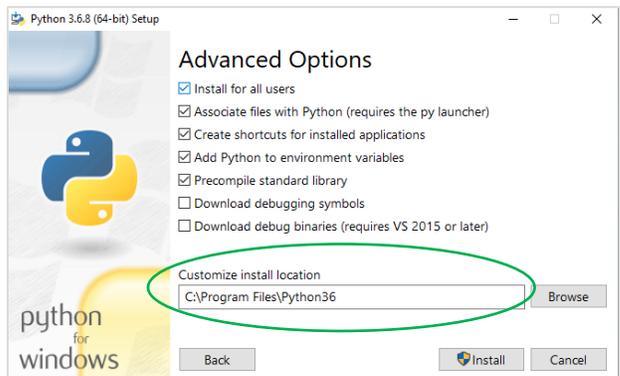
5. Click 'Customize installation'.
(Note that we are about to show you how to make the Python installation as easy as possible for future use, which involves putting Python in an easier-to-find folder that all users can access. Your school might have restrictions on student computers that don't allow this. Please contact your IT person if you have any concerns. If you choose to install Python in a special location (other than C:\Program Files\Python36), then make a note of where you put it.)

6. Check all of the boxes for "Optional Features" and click 'Next'.



7. In "Advanced Options", check the boxes for the following options:

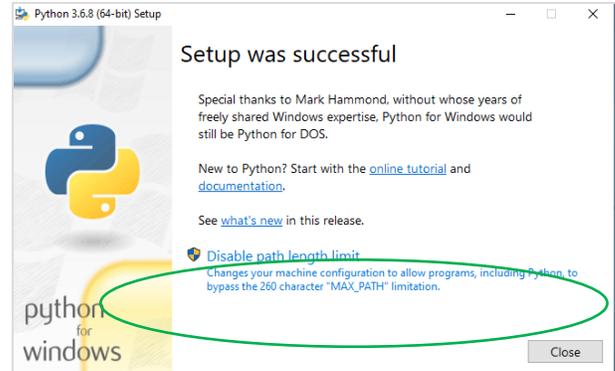
- Install for all users.
 This will likely change the install location to C:\Program Files\Python36, which is what we want (see note below if you need to install Python in another location).
- Associate files with Python (requires the py launcher)
- Create shortcuts for installed applications
- Add Python to environment variables
- Precompile standard library



Make sure that the custom installation location is C:\Program Files\Python36
Note: If you need to install Python 3.6 anywhere other than C:\Program Files\Python36, make a note of the entire path (folder location) where you put it. You will need to know this path when you install Thonny (below).

Click 'Install'.
 (Enter your admin info, or if you get a prompt to allow this app to make changes, click 'Yes'.)

- Once it is finished, you should see a page that says "Setup was successful". Near the bottom of this page you may or may not see the option to "Disable path length limit". If you do see it, click on it (and choose 'Yes' if prompted to allow this).

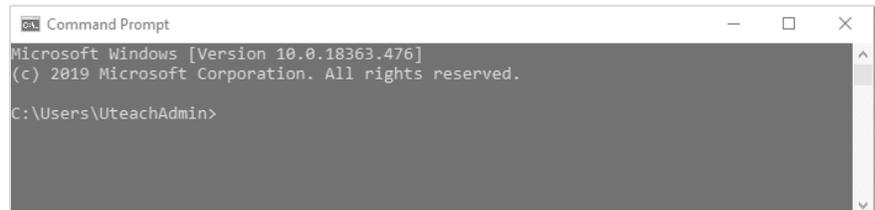


- Click 'Close'. Python 3.6 is now installed.

Installing Thonny

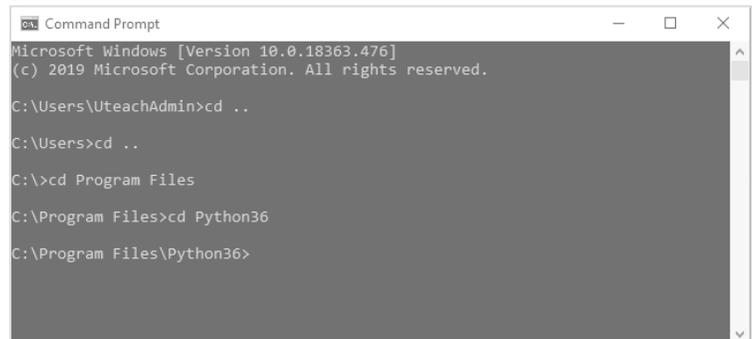
To avoid an unwanted combined install with Python 3.7, you will need to **install Thonny using pip install in Python 3.6 and NOT from the Thonny website**. Here is how to do that:

- Open a Command Prompt window. You find this by searching for "cmd" in the bottom search bar on Windows.



- First, navigate to your Python36 folder. In our example, the Python36 folder is at C:\Program Files\Python36; if you installed Python in a different location, you'll need to navigate there instead of where we show in the examples below.

To navigate to the Python36 folder, you will need to use DOS command **cd** (change directory). The command prompt will likely start you inside a directory that you need to back out of (such as \Users\UTeachAdmin in the example here).

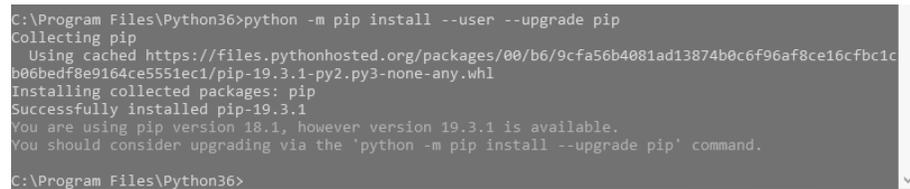


- Type the following and press enter:
`cd ..`
(note the space before the first period) to go back out (up) one directory.
- Type `cd ..` again. Do this until you get to the root directory (C:\ in this example)
- If you installed Python 36 at C:\Program Files\Python36
 - * Type `cd Program Files` to go into (down in) the "Program Files" directory.
 - * Type `cd Python36` to go into the "Python36" directory.

If you installed Python36 anywhere else, navigate to that location by typing `cd` followed by a space and the file path that you noted in step 7 of installing Python 3.6 above. If you have trouble entering the correct file path, it is useful to know that typing `dir` will show you a list of all of the contents inside the current directory.

3. Once you have navigated into the proper directory, you should update the package installer for Python, called pip. Type in the following line (including all of the spaces and dashes) and press enter:

```
python -m pip install --user --upgrade pip
```



```
C:\Program Files\Python36>python -m pip install --user --upgrade pip
Collecting pip
  Using cached https://files.pythonhosted.org/packages/00/b6/9cfa56b4081ad13874b0c6f96af8ce16c1c
b06bedf8e9164ce5551ec1/pip-19.3.1-py2.py3-none-any.whl
Installing collected packages: pip
Successfully installed pip-19.3.1
You are using pip version 18.1, however version 19.3.1 is available.
You should consider upgrading via the 'python -m pip install --upgrade pip' command.
C:\Program Files\Python36>
```

The newest version of pip will be installed. Ignore any warnings about .exe files not being on PATH. If you get a seemingly contradictory report about different versions of pip, simply run the same command above again; it should tell you that the requirement is already satisfied.

4. Now you can install Thonny with the following command:

```
python -m pip install --user thonnyapp
```

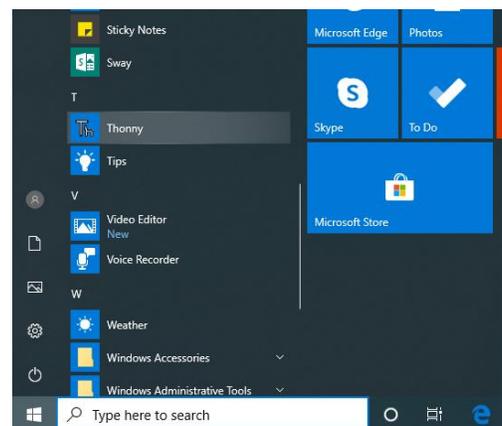
This may take a minute to complete. When it is done you will be back at the original command prompt (e.g., C:\Program Files\Python36 >). Again, ignore any warnings about .exe files not being on PATH.

Close the Command Prompt window.

5. Next you'll need connect the Thonny icon in the Applications folder to the actual Thonny app (which lives deep in a folder).

- a. Go to the Windows icon on the bottom left of the screen, scroll down in the available applications, and click on the Thonny icon.
- b. Now click on any blank space on the desktop to shrink the Windows menu back into the corner (it's hiding a new window that you want to see).

You should see a pop-up window in the middle that says "Missing Shortcut". Click 'Browse'. (Sometimes another pop-up might interject and offer a path to the thonny.exe file. If this happens, make sure that the path looks similar to the one below in step c. If so, click 'Fix it' and skip to step d.)

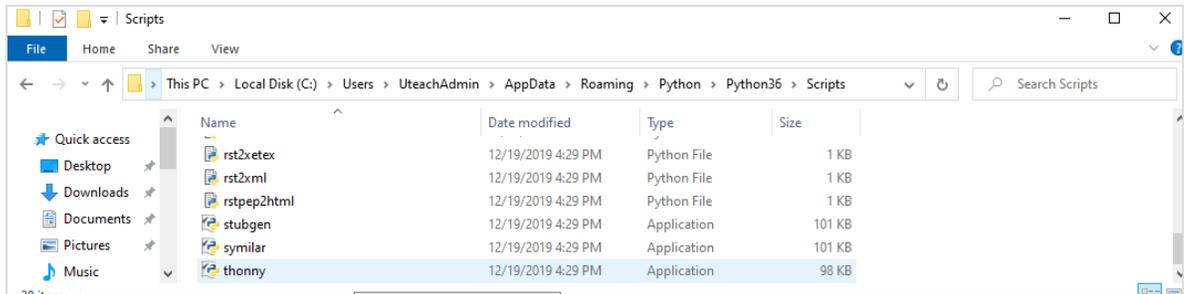


Navigate to the **thonny.exe** file located deep in your user folder. Some of the folders in your path (the ones highlighted in grey below) will have different names than those in this example:

C:/Users/UTeach/AppData/Roaming/Python/Python36/Scripts

The goal is to go to your current user folder and then the AppData folder and beyond should look the same.

(If you don't see the AppData folder, click View and check the box for 'Hidden items', or right-click in the window and go to Properties → General and check the "Hidden" box at the bottom)



6. Open the Thonny application (if it doesn't open automatically). You should see the following:



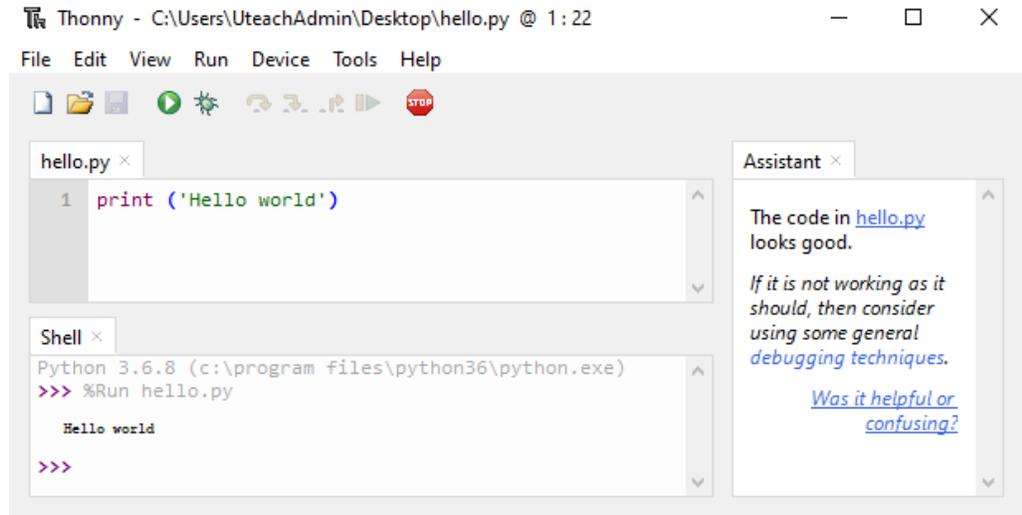
Choose the "standard" initial settings and click 'Let's go!'

You should see the Thonny app window appear; it will likely have two inset windows: <untitled> and Shell.

7. Test to see if everything works by writing a short program:
 - a. In the upper <untitled> window type the following:

```
print ('Hello world')
```

- b. Click the Run icon or press the F5 key. 
- c. It will prompt you to name the file and choose its location. Choose anything you like (such as hello.py on the Desktop) and click Enter. Note that python code is saved with the extension .py. If you do not add this extension to your file name, Thonny will do it automatically for you. In the lower Shell window you should see a report that looks something like this (don't worry if you don't see the Assistant window on the right):

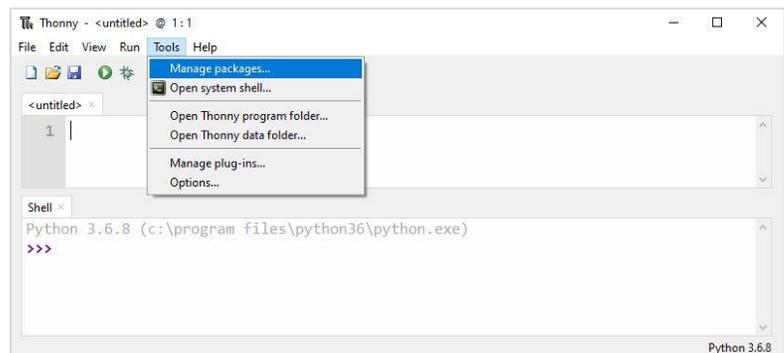


You just used Thonny to program in Python 3.6!

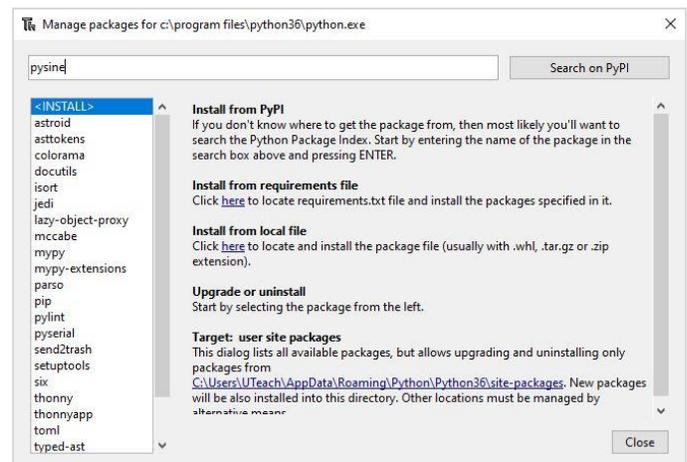
Installing the Pysine Library

This library is needed in the opening *Electronic Music* unit. It allows Python programs to play sound through the computer’s internal speaker. This is the only library that won’t work with Python 3.7.

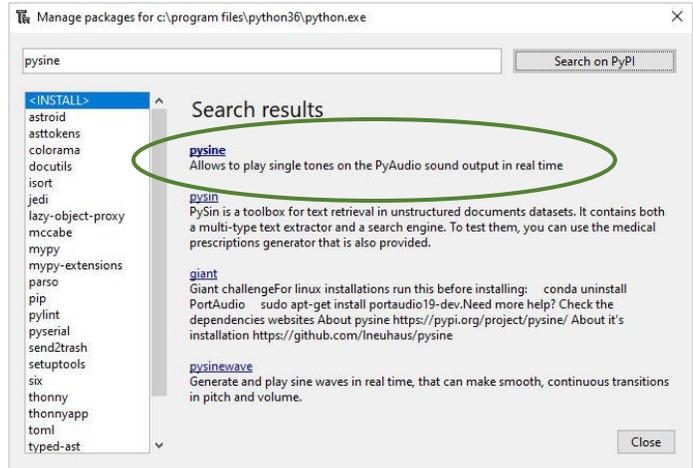
1. Open Thonny (if it’s not already open).
2. Go to ‘Tools’ in the top menu and then click on ‘Manage Packages...’



3. In the top search bar, type in “pysine” and then click ‘Search on PyPI’.



- Thonny will find some relevant packages. Click on the top one: **pysine**.

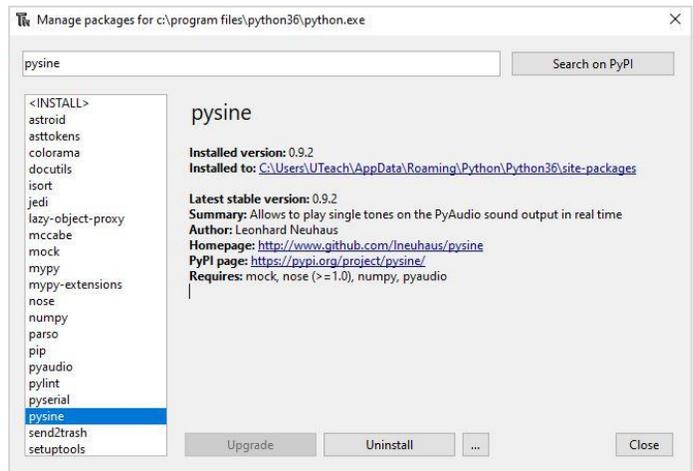


- On the next screen (not shown here) click 'Install'.

- The process will take a few seconds. Once it is done close the window.

- Note that this might automatically install a few other libraries that Pysine depends on to work. Numpy might be one of these, which is great. You want these libraries so please allow them.

If you get any errors saying "microsoft visual c++ 14.0 is required" or "portaudio.h: no such file for directory", it very likely means that you have the wrong version of Python installed. You cannot get past these errors in any simple or quick process, if at all. Please uninstall your Python and Thonny and start over with Python 3.6 following the steps above.



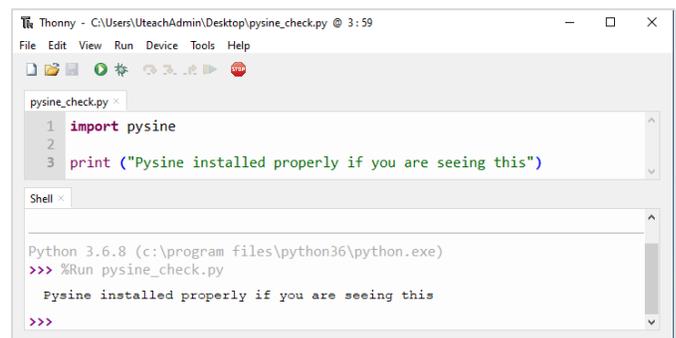
- Test to see if Pysine is properly installed

- Write a new program with the following:

```
import pysine
print ("Pysine installed properly if you are seeing this")
```

- Save and run the program (name it whatever you like). You should see the following:

If you got an error, then something went wrong in the Pysine install process. Please try it again.

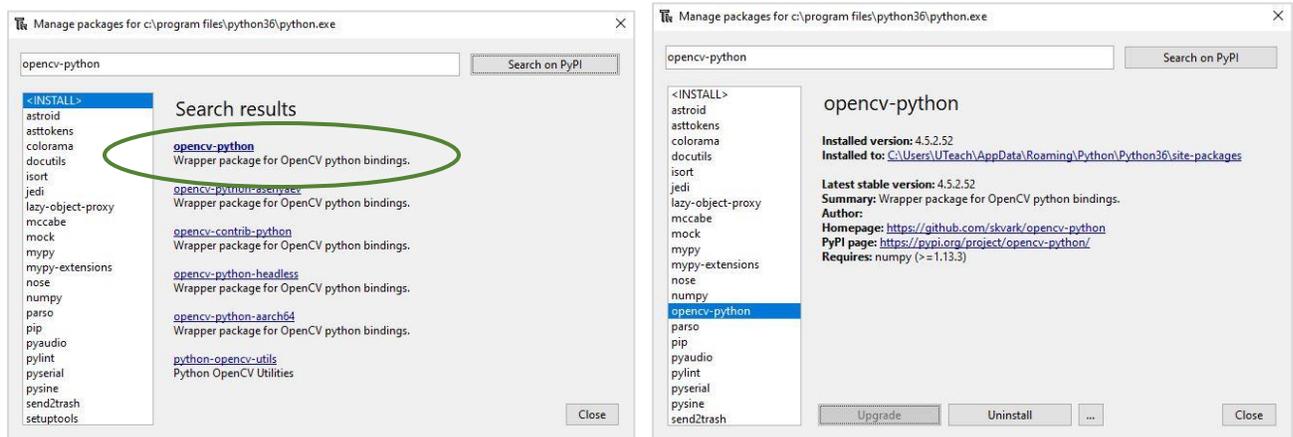


Installing the OpenCV and Numpy Libraries (combined installation)

OpenCV (Open Source Computer Vision) Library is used for programming computer vision. It supports multiple programming languages, including Python, C/C++ and MATLAB. It has a license allowing free use for both commercial and academic purposes, so many organizations use it even though there are alternatives. You can learn more about OpenCV at <http://opencv.org/about.html>.

The OpenCV software is necessary for the *Images* and *Motion Capture* units, which make up the majority of the fall semester.

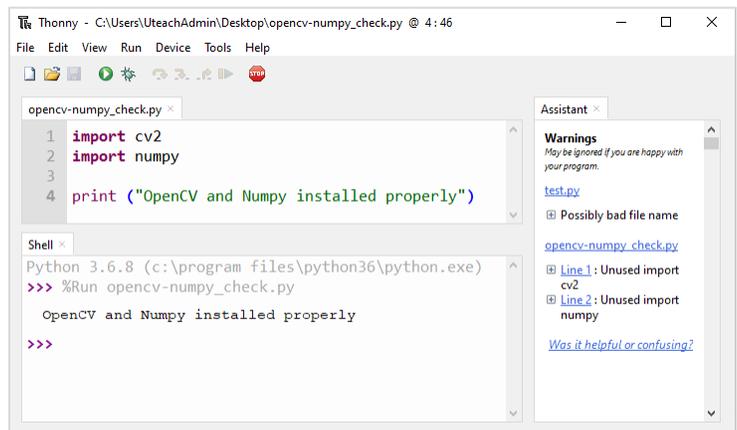
1. The install process is exactly the same as what you just did to install Pysine, except that this time you will search for “**opencv-python**” in the Manage Packages window. The Numpy library will automatically install with OpenCV (if it didn’t already come with Pysine).



2. Test to see if OpenCV and Numpy libraries are properly installed. Note that OpenCV needs to be imported as “cv2” in your python programs, as in the example below. Type, save, and run the code shown in the top window on the right:

```
import cv2
import numpy
print ("OpenCV and Numpy installed properly")
```

Verify that you see the desired message (*i.e.*, OpenCV and Numpy installed properly) in the shell window. If so, then the installation was successful. If not, redo the installation.



Installing the Logitech Webcam Application

This software is needed for the *Motion Capture* unit if you are using the recommended Logitech C170 or C270 webcams. It will be useful to have your webcam plugged in while completing this process; this can be done now or when prompted later.

Note that when a Logitech camera is plugged into a USB port on your computer, your computer will likely look for the correct drivers and install them. These automatic drivers provide minimal options and do not allow you to change important settings on the webcam. Install the full webcam software package below so that you (and your students) can turn off automatic settings that can otherwise hinder your programs.

1. Download the necessary installation (.exe) file for your system here (you only need the one version for your particular system):

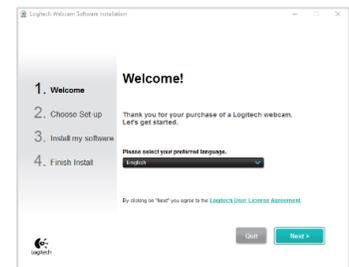
For Windows 10: <https://utexas.box.com/s/ef48nmtvogax8acca8af9jk4o9fbee7>
-this is the installer for Logitech Webcam Software version 2.80 (lws280.exe)

For Windows 7: <https://utexas.box.com/s/3hg17qxv4bbun169mt53uqwtqmyz9>
-this is the installer for Logitech Webcam Software version 2.51 (lws251.exe)

Why are these links to a UTBox location instead of the official Logitech website? Because Logitech frequently updates their recommended software and often the current recommended version does not work for our purposes. Also, Logitech does not make older (working) versions of their software easily available online, so finding those versions can be difficult. As of January 2020, they can be found [here](#). EYW has found and posted the working versions through the above UTBox links so that schools can be sure they are getting a working version regardless of ongoing changes made by Logitech.

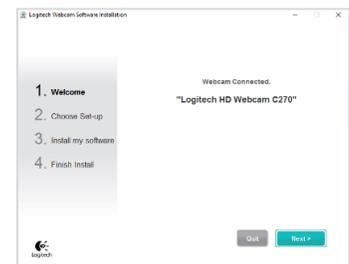
2. Run the .exe installer. (You can first save the file and check it for security threats, which is a good habit.) If you are prompted to allow the app to make changes to your device, choose 'Yes'.

3. When the first phase of the installation completes, you should see something similar to the following (although if you already have a webcam plugged in, you might see something different).

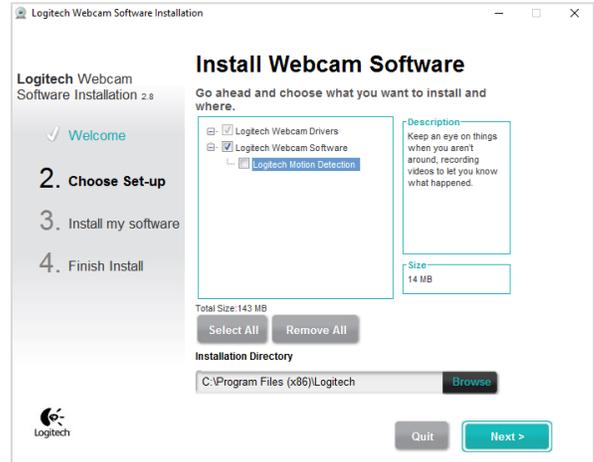


4. If you haven't already, plug in your webcam (the Logitech C170 or C270). Click 'Next >'.

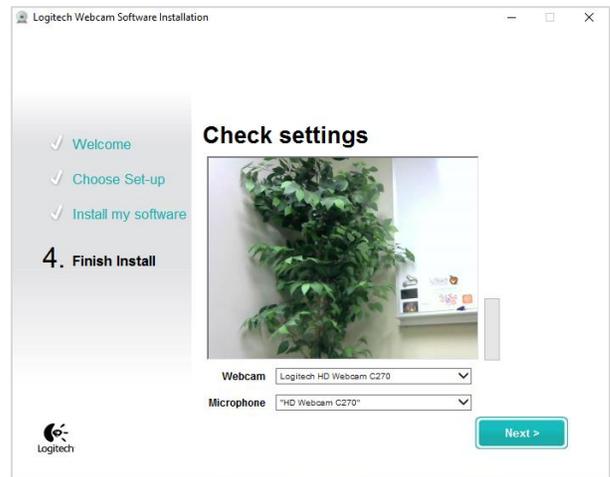
If you don't have your Logitech camera you can still proceed by clicking 'Next >'.



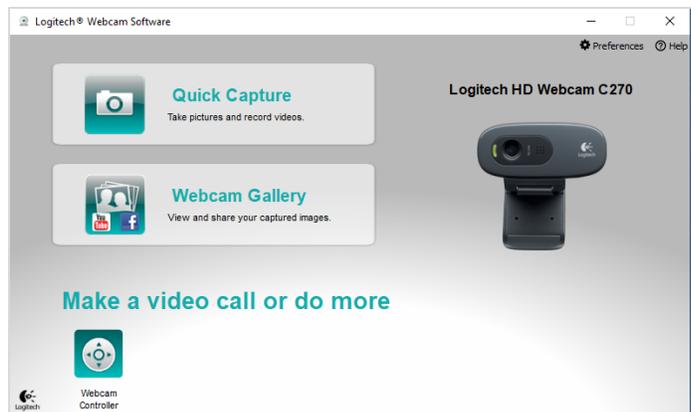
5. Uncheck the 'Logitech Motion Detection' box. We recommend using the default Installation Directory unless you have a reason to choose a different location. Click 'Next >'.



The installation process will begin, eventually giving you the following screen, which shows you a live image from your webcam:



6. Click 'Next >' to finish the install.
7. On the next screen, click on the "Check out my webcam" button and get the following output. (You can also get this screen by opening the 'Logitech Webcam Software' app that you just installed.)



Software Installation – Spring Semester

Install the following software on the teacher's computer and on all student computers prior to the spring semester. (These are not needed on the teacher's computer for the summer PD.)

Installing VNC Viewer

VNC Viewer is needed to control the Raspberry Pi wirelessly. It allows the user to port into the Pi remotely through WiFi, effectively removing the need for a wired HDMI monitor, mouse, and keyboard to control each Pi.

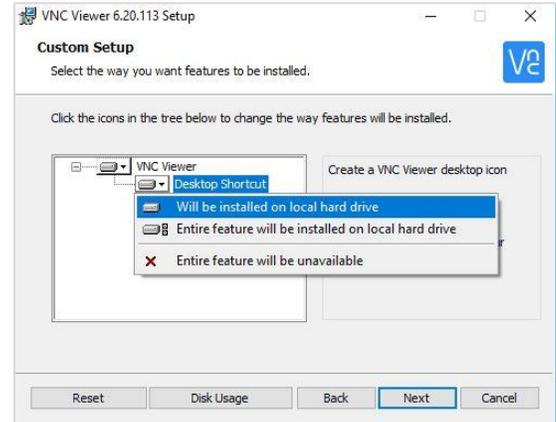
1. Go to the RealVNC website's download page for the VNC Viewer at <https://www.realvnc.com/en/connect/download/viewer/>

2. Keep the default setting from the pulldown menu ('EXE x86/x64') and click 'Download VNC Viewer'.

Note: the default version works perfectly, but if you want to save a very small amount of disk space (~1.5 MB) you can select the specific standalone version for your computer. Most likely this will be 'Standalone EXE x64'. To doublecheck what type of system you have, in Windows 10, go to Windows Start Button → Settings → System → About and look at "System Type".

3. Save and run the .exe installer.
4. Choose your language.
5. When you get a prompt to install VNC Viewer on your computer, click 'Next'.
6. Accept the terms of the License Agreement and click 'Next'. *(If instead you get prompted to change, repair, or remove the software, choose 'Remove' and enter your admin password. After it removes everything, run the installer again and go through the first couple of steps again. This should get you started fresh and lead you to the license agreement page.)*

7. In the Custom Setup page, you may be offered to create a desktop shortcut. We recommend creating this shortcut. Choose 'Will be installed on local hard drive' in the pulldown menu (*in this particular situation where there are no subfeatures, it achieves the same result as 'Entire feature will be installed on local hard drive', so either option works*). Click 'Next'.
8. If offered, click 'Install'.
9. If asked to allow the program to make changes to your device, click 'Yes'. (This may require admin privileges.)
10. Once everything is done, click 'Finish'.

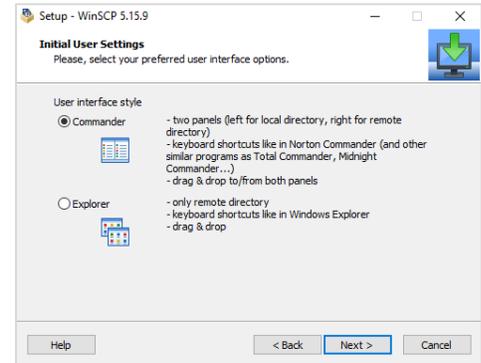


Installing WinSCP

WinSCP, which allows the user to swap files between a computer and a Raspberry Pi with intuitive “drag and drop” operations, is most often used by students to back up their programs from the Raspberry Pi to their computer or to submit programs to the teacher. Occasionally students may also move files from their computer to the Pi, although this isn't typically necessary.

1. Go to WinSCP's download page at <https://winscp.net/eng/index.php>
2. Look for the link to the WinSCP download and click it (beware of advertisements that look like download links).
3. Save and run the .exe installer.
4. If prompted, install for all users, and allow the app to make changes to your device.
5. Accept the license agreement.
6. Choose the Typical installation (recommended). This typical installation will create a desktop shortcut icon. Click 'Next >'.

7. For the Initial User Settings, we recommend the 'Commander' interface. However, either option will work just fine.
8. Click 'Install'.
9. Once everything is done, click 'Finish'.



Software Installation – Teacher or IT Staff Computer Only

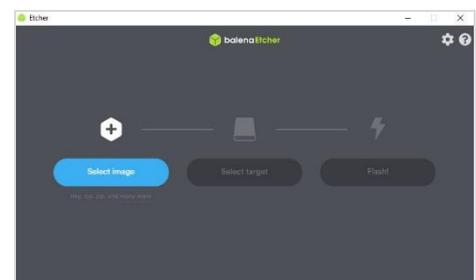
Install the following software on the teacher's or IT person's computer sometime in the fall. Use it to install the *EYW*-provided image onto the SD cards that students will use in the spring semester.

Installing Etcher

Etcher, which is used to format a microSD card (or other device) and install a disk image onto it, should be installed on the teacher and/or IT person's computer sometime during the fall semester. You will use it to load the disk image provided by *EYW* for use on the Raspberry Pis. Since the disk image install process can take hours, we recommend starting that process sometime in the Fall semester. Once you have imaged all of your microSD cards, you won't need it anymore unless a card gets damaged or corrupted.

1. Go to the Etcher download webpage:
<https://www.balena.io/etcher/>
2. Click on the link for 'Download for Windows (x86|x64)'
3. Save and run the .exe installer.
4. Agree to the license.

The install process should complete and eventually show the home screen of the Etcher app:



End of Software Installation

At this point your Windows PC has everything it needs to complete the *Engineer Your World: Engineering Applications of Computer Science* curriculum. You do not need to install anything else.