Technical guidelines

Prerequisite: Windows 10, 64 bit, 8 GB RAM.

You need three pieces of software to successfully accomplish the experimental task:

1. Tracker
2. ffmpeg
3. RMPh22

One further tool that might be very useful, although not completely necessary, is Microsoft Office or Libre Office. In addition, you are allowed to use any alternative graphing/data analysis tool that you are comfortable with and that is already installed on your computer (Python, Jupyter, Matlab, Origin, etc.), as well as the associated documentation.

The archive you received contains the installer for Tracker, as well as ready-to-use executable files for ffmped and RMPh22. You will use Tracker and RMPh22 directly. ffmpeg is only a prerequisite for RMPh22.

We recommend that you perform the installation procedure in advance of the competition, to avoid delays on the exam day.
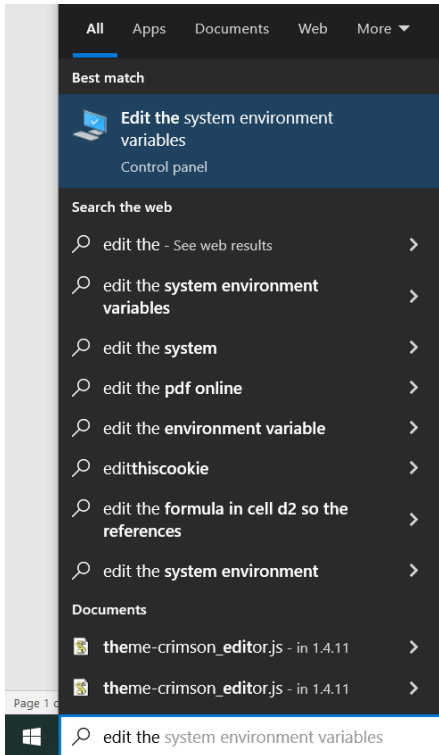
Begin by unzipping the archive at a known location.

Tracker installation

Run the installer and follow the on-screen instructions. Troubleshooting is also available online.
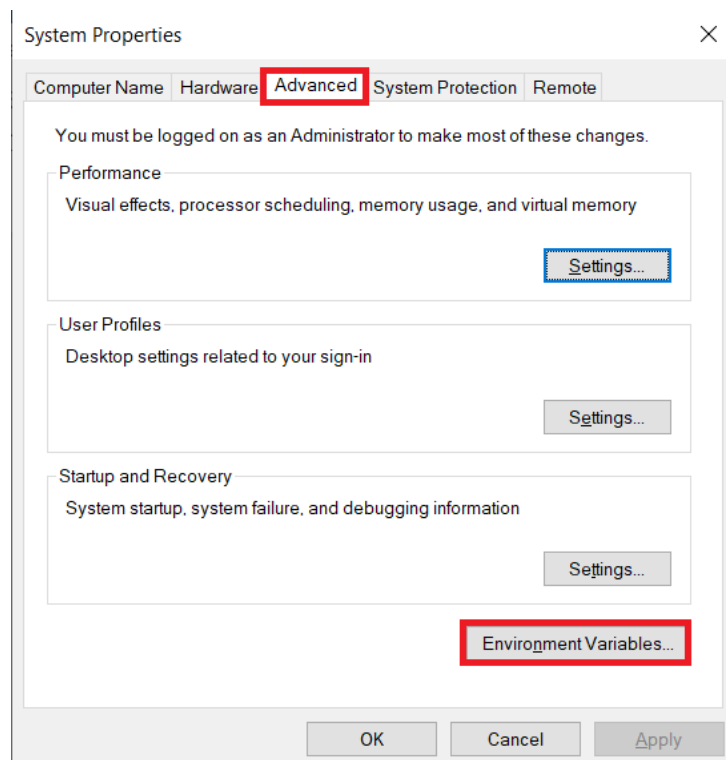
ffmpeg setup

No installation needed for ffmpeg, but you need to add it to the environment path variable.

- In the start menu search bar, look for *Edit the system environment variables*.

- Open it and go to the *Advanced* tab. Click on *Environment variables*.

- In the window that opens, click on *New* in the upper half. Then type *Path* in the *Variable name* field and the ffmpeg binary path in the *Variable value*

field. Typically, you will obtain this path by adding *\ffmpeg\bin* to the path where you extracted the files. For example, if you extracted the files in the folder *C:\RMPh22*, the *Variable value* will be *C:\RMPh22\ffmpeg\bin*.
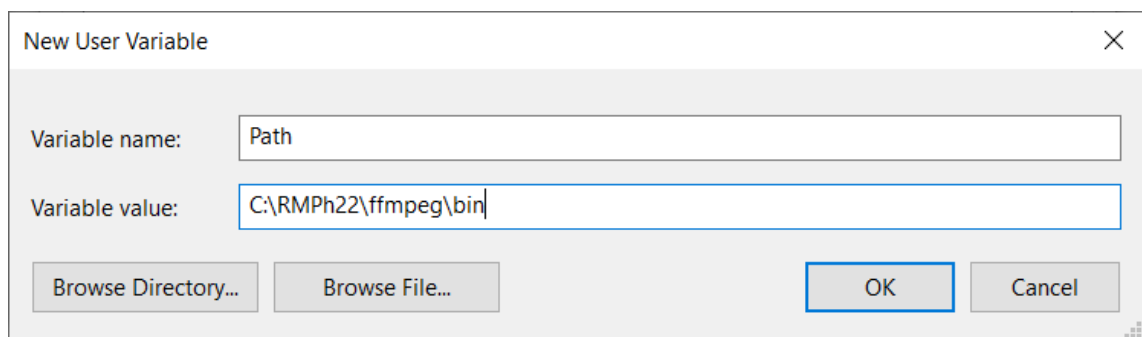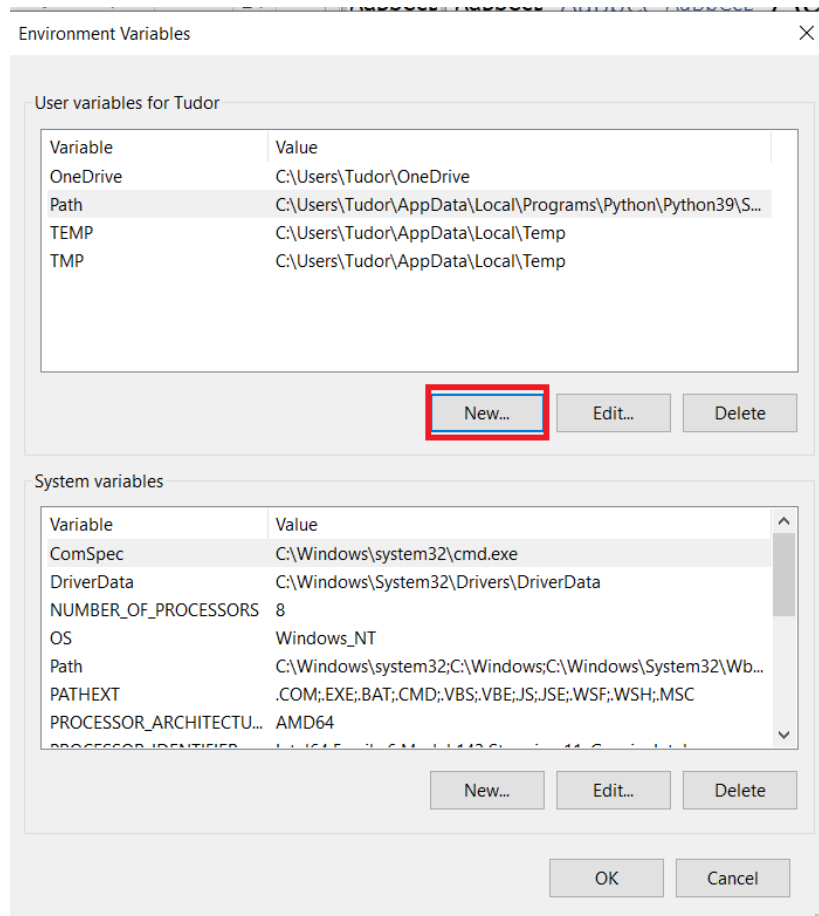
- Click on *OK* on all windows to save the changes.

How to use Tracker

You are allowed access to the full documentation of Tracker. Here we briefly present the main features that might be useful during the exam. First, you need to open the video file that you want to track with Tracker.

- Clicking the button highlighted with the red square will allow you to set a *calibration stick*. This calibration stick will be used as a reference for length measurements. You can manually set the two ends of the calibration stick, as well as give the numerical value of its length.
- Clicking the button highlighted with the blue square will allow you to move the origin and the coordinate axes of the coordinate system that will be used.
- The green square shows the button that will open the tracking interface. In the pop-up window that opens, click on *New*, then select *Point mass*. Press *Ctrl+Shift*, then click on the object whose movement you want to track. In the new pop-up Window that opens, click on *Search*.
- A data table will show up. To export the data table, click on File->Export->Data. We recommend that you select comma as a separator for the data. You can then change the extension of the output file to *.csv* and open it using Excel/Libre Office to continue your analysis.

You will also need to open some images and take some measurements on them.

- Clicking the button highlighted with purple allows you to use measuring tools. From here you can choose to insert rules or protractors. As practical advice, we recommend you to right click on the inserted tool and change its color or bold it, if it is not clearly visible on the screen. For example, certain tones of green are very easy to discern. You can also enlarge the instrument as much as you need.

How to use RMPh22

- Run the program. A black terminal window will open. Wait for a few seconds until one more window opens.
- The window will ask for a password. Input the password mentioned in the exam question and click on *OK*.
- Input the desired experiment parameters and continue.
- Wait until the terminal window closes (*this might take a few minutes!*). Then open your video in Tracker to analyze it.