Installation of *esys-escript* for the use via Jupyter notebooks

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There are three easy ways to use *esys-escript* via a Jupyter notebook server:

- esys-escript cloud service
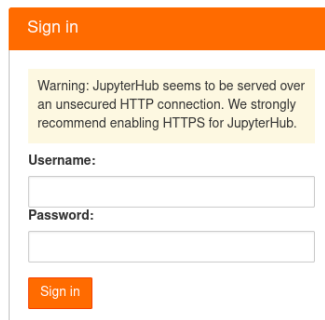- Docker container
- Anaconda3 distribution

For the latter, you can use a local installation of the anaconda python distribution via www.anaconda.com and install *esys-escript* via conda. The two other methods are described in this document:

A) esys-escript cloud service

To access the server, open your internet browser and then connect to the esys-escript webpage https://esys-escript.github.io/. Once the page loads, click on the Juypter icon.

This will take you to a Jupyter cloud server to which you can log in via the following prompt.

You can log on using any username and password of your choice (if nobody else has already taken the username). When you first log on, take care to ensure that your chosen password is spelled correctly as there is no way to recover your password once it has been set.
Once you have logged in, the server will spawn a new instance of Jupyter which may take a few moments. If the server fails to spawn wait a few moments and then try again. You will then be greeted by a screen showing a directory of files:
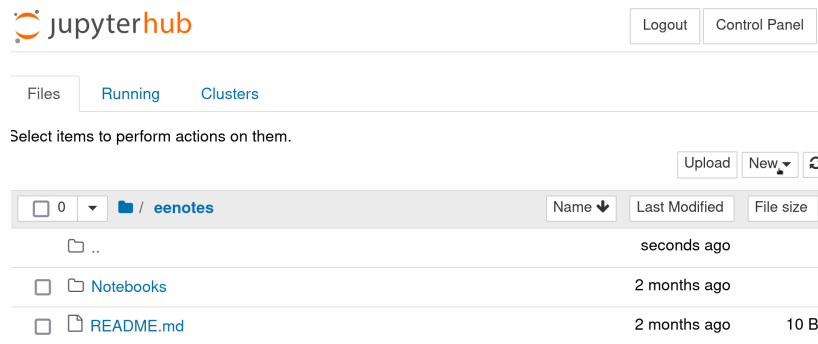
You can upload a notebook via a the 'Upload' button or clock the subfolder `Notebooks` to get started with some examples.

B) Setting up a local Jupyter server with *esys.escript* using Docker.

You can install a local copy of the cloud service as described above using a Docker container running on your local computer.

B.1 Introduction

Docker is a computer program that allows a user to run software on operating systems other than the ones they were designed for. You could use Docker, for example, to run a Windows program on a Mac or to run a Linux program on Windows.

All the information that Docker needs to run a program is packaged into an *image* file. Each image file contains everything needed to run an application: the code, system libraries, settings, &c. as well as information about the operating system that is being emulated on the host machine. Docker uses the *image* file to create a *container* that simulates the operating system in which the software is run.

This tutorial will instruct you how to install Docker and a Docker image containing *esys-escript* on a computer running Windows (or other any other OS) as well as how to launch a container running a Jupyter Notebooks server.

B.2 Installation of Docker Runtime Environment

Begin by starting an internet browser and log onto the Docker website (www.docker.com).

In order to download the Docker installation executable, you must first set up an account on their website. Doing so is free but requires an email address.

Begin by clicking the **Sign In** button indicated in the image.
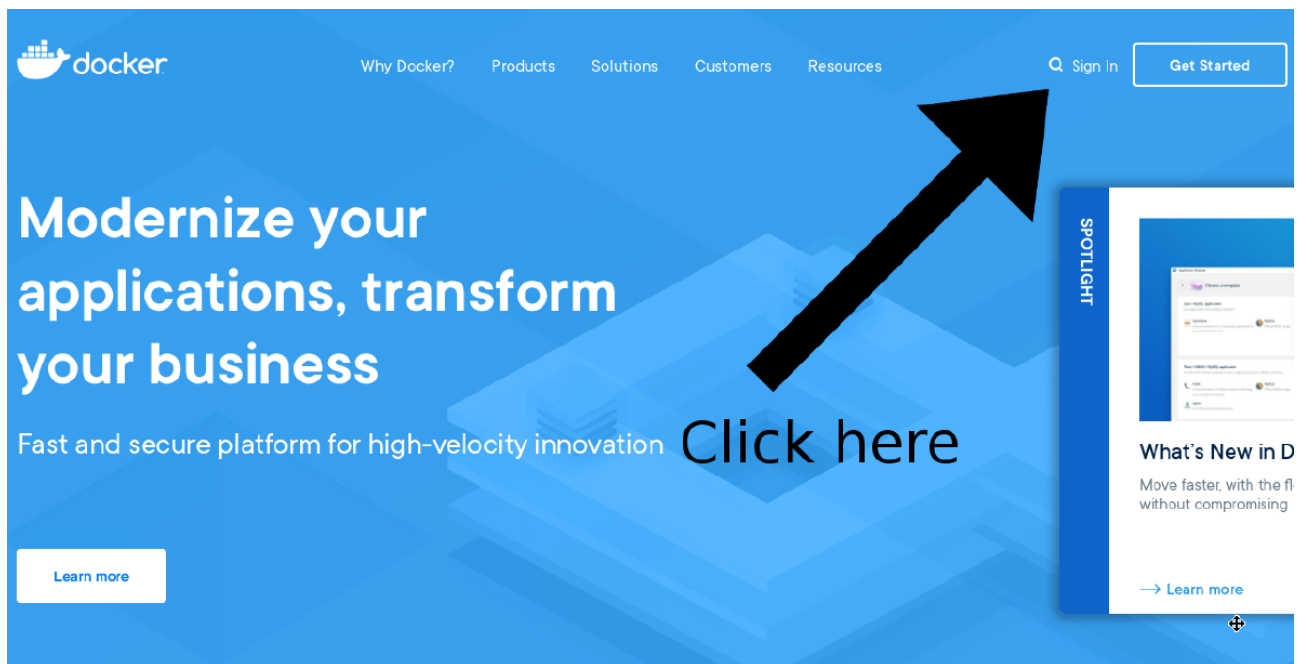
This will take you to the login section of the Docker webpage. To begin registration, click the button that says **sign up**.
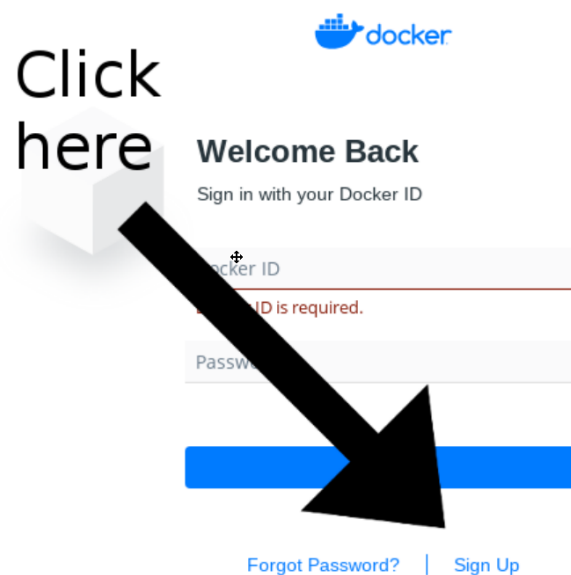
You should now see the registration screen. Fill in your details and then click **continue**.

Once your account is set up, you can install Docker. Connect to the docker website again and then log in to your account. Then click on the **Download Docker Desktop** icon on the right-hand side of the screen and follow the instructions in the installation wizard.

After the installation wizard, click on **finish** and then restart your computer.

Docker should now be installed on your machine. As part of the installation the user group 'docker-users' will be created and before you run Docker you should add yourself to this group.

To do this: Go to the control panel and then select **Edit local users and groups.** This will open a new window. In this new window click on **groups** and then double click on the **docker-users** and then add yourself as a member of the group:
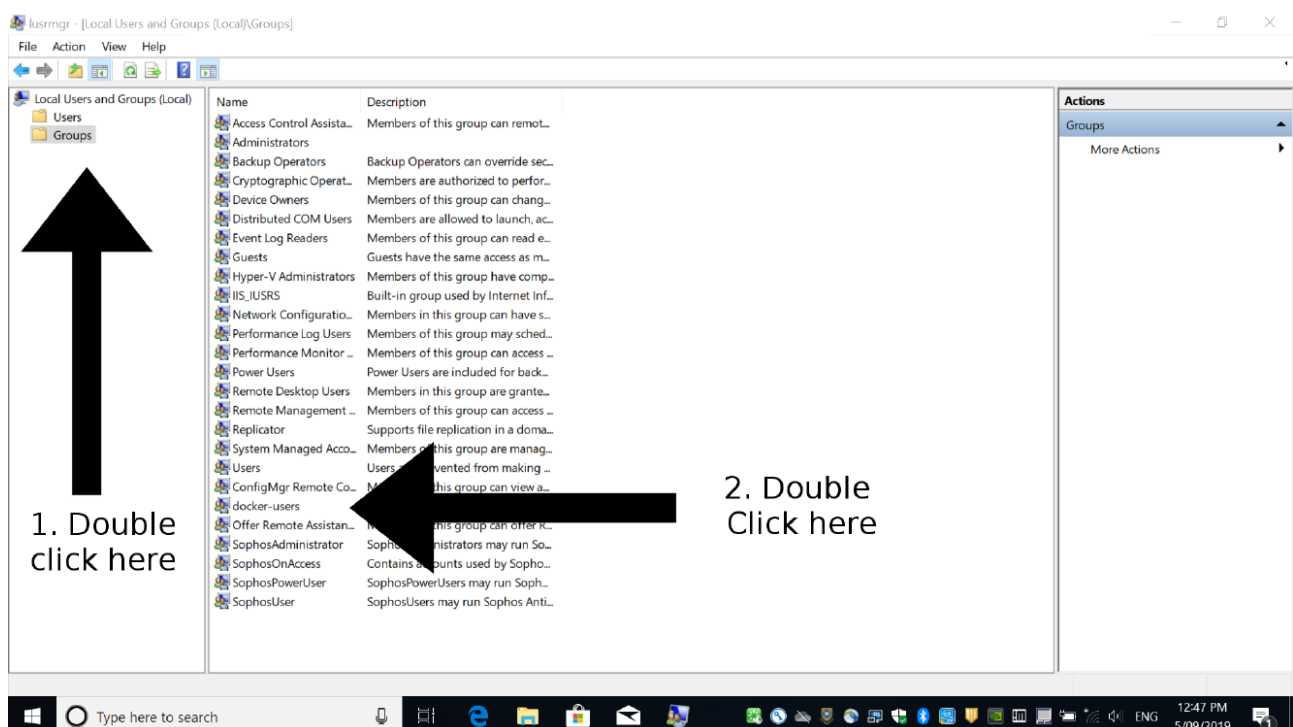
Now you can start Docker. Click on the Docker Desktop app in the start menu. If everything worked correctly, an icon depicting the Docker logo will appear in the system tray (next to the clock located on the bottom right of the screen).

To confirm that Docker is working correctly on your computer open a Windows Powershell and then run the command

```
docker run hello-world
```

If Docker is working correctly, it will download and install an image that contains a hello-world program. The program will run and print the text "hello world" to your console.

B.3 Installing the Docker esys.escript image

Now you can install the *esys.escript* image and launch a container by running the command

```
docker run -p 8888:8888 esysescript/esys-escript-jupyter start-notebook.sh
```

Once this has run it will print several URLs to the console of the form

http://127.0.0.1:8888/?token=4dbd5deadc0bc4d787b7a5f79b

To view the notebooks server, simply copy any of these urls into your web browser's address bar.

B.4 Mounting folders inside Docker

Docker programs are run inside self-contained *containers.* Each *container* simulates an operating system and a file system that is separate from the file system of the host machine. For security reasons, by default, programs that run inside the *container* can typically only access the internal file structure of the *container*. Once all the programs running inside the *container* end, the *container* self-destructs and all files within the container are lost.

If you wish to save your work, you should instruct Docker to temporarily give the container access to the host machine's file system. This can be done by running the command

```
docker run -p 8888:8888 -v [path]:/home/jovyan esysescript/esys-escript-jupyter start-notebook.sh
```

where `[path]` represents the path to the folder that you want the Docker *container* to be able to access under `/home/jovyan`.

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