NEST Desktop

Contents

NEST Desktop

Hello there!

NEST Desktop is a web-based GUI application for NEST Simulator, an advanced simulation tool for the computational neuroscience.

The app enables the rapid construction, parametrization, and instrumentation of neuronal network models.

It's so great that you want to use NEST Desktop.

Let's get started.

1.1 How the documentation is organized

The documentation is organized into three sections. Select the appropriate section that fits your needs.

Abstract

NEST Desktop: A web-based GUI for NEST Simulator

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In the past few years, we have developed a web-based graphical user interface (GUI) for the NEST simulation code: NEST Desktop[1]. This GUI enables the rapid construction, parametrization, and instrumentation of neuronal network models typically used in computational neuroscience. The primary objective was to create a tool of classroom strength that allows users to rapidly explore neuroscience concepts without the need to learn a simulator control language at the same time.

Currently, NEST Desktop requires a full NEST installation on the user's machine, limiting uptake by a non-expert audience, and limiting the networks studied to such that can be simulated on a laptop or desktop machine. To ease the use of the app and the range of simulations possible with NEST Desktop, we want to separate the GUI from the simulation kernel, rendering the GUI in the web browser of the user, while the simulation kernel is running on a centrally maintained server.

NEST Desktop has a high potential to be successful as a widely used GUI for the NEST Simulator. To achieve this goal, in a first step all tools have to agree on a communication scheme and data format (using JSON) used to interact with a server-side running NEST instance in a session management, e.g. Docker or Singularity containers. Next, previously developed tools, namely the NEST Instrumentation App[2] and VIOLA[3], will be integrated as a plugin into the app to extend visual modeling and analysis functionalities. In the course of this work, the use of an in situ pipeline[4]

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[1] NEST Desktop https://github.com/babsey/nest-desktop

[2] NEST InstrumentationApp https://github.com/compneuronmbu/NESTInstrumentationApp

[3] Senk J, et al. (2018) VIOLA—A Multi-Purpose and Web-Based Visualization Tool for Neuronal-Network Simulation Output. Front. Neuroinform. doi: 10.3389/fninf.2018.00075

[4] Oehrl et al. (2018) Streaming Live Neuronal Simulation Data into Visualization and Analysis. Conference Paper doi: 10.1007/978-3-030-02465-9_18

developed for neuronal network simulators will be considered to also enable the app to receive larger data sets from NEST during a running simulation, enhancing the interactivity of the app also for large simulations on HPC facilities.

We plan to develop and maintain NEST desktop sustainably. Therefore, we intend to integrate NEST desktop into the HBP infrastructure. Additionally, the open-source code of NEST Desktop will be published as a standalone distribution for teaching and training.

2.1 Acknowledgements

2.2 References

Recent events

3.1 2019

18 - 20 September Poster/Live presentation at Bernstein Conference, Berlin, Germany.

22 July Talk and Tutorial/Hand-on session at [INM-6], Julich, Germany.

18 July NESTML/NEST-desktop integration workshop, [BCF], Freiburg, Germany.

24 - 25 June Talk and Tutorial/Hand-on session "NEST Desktop" at NEST Conference at [NMBU], As, Norway.

16 April Kick-Off workshop at [HCI], Trier, Germany.

25 - 31 March Tutorial workshop for IICCSSS at [BCF], Freiburg, Germany.

11 - 22 February BSc course "Simple Neuron Models" at [BCF], Freiburg, Germany.

3.2 2018

26 - 27 September Poster/Live presentation NEST Desktop at Bernstein Conference, Berlin, Germany.

27 - 28 August Technical meeting at [BCF], Freiburg, Germany.

25 - 26 June Talk "NEST Web API" at NEST Conference at [NMBU], As, Norway.

23 - 27 April MSc course "Biophysics of Neurons and Networks" at [BCF], Freiburg, Germany.

12 - 23 February BSc course "Simple Neuron Models" at [BCF], Freiburg, Germany.

3.3 2017

19 - 20 December Talk "NEST Desktop" at NEST Conference, Jülich, Germany.

20 - 22 November Live presentation with Ad Aertsen at Neural networks mini school, Strasbourg, France.

02 - 05 May MSc course "Biophysics of Neurons and Networks" at [BCF], Freiburg, Germany.

24 January Talk (Informal Seminar) "NEST Desktop" at [BCF], Freiburg, Germany.

3.4 2016

December

- NEST Desktop is born in Freiburg.

CHAPTER 4

How to use NEST Desktop

This is the user documentation, providing more detail on how to use NEST Desktop.

- *Quick start to NEST Desktop*

Detailed guides

- *How to setup NEST Desktop*
- *How to use NEST Desktop*
- *Command API*
- *Troubleshooting*

Guides for the infrastructure

- *Use NEST Desktop on the Human Brain Project (HBP) resources*

Quick Start

This guide provides a quick start documentation of NEST Desktop.

- *Getting started*
- *First steps*
- *Conctruct a network*

5.1 Getting started

```
docker run -i -p 5000:5000 -p 8000:8000 -t babsey/nest-desktop
```

If the image is not exists, it pulls from docker hub. Then, NEST Desktop is serving at `http://localhost:8000.`

5.2 First steps

This video provides a quick start in NEST-Desktop.

5.3 Conctruct a network

This video demonstrates how to construct a network from scratch.

Setup Guide

This guide provides a detailed documentation on how to install NEST Desktop.

You can read the installation instructions by clicking one of these logos below:

6.1 Via Python Package

1. Both NEST Desktop and NEST Server require NEST Simulator supporting only in Linux systems.

Note: For more information read the full installing docs of NEST Simulator here.

2. NEST Desktop is distributed on PyPI and can be installed with pip:

```
pip3 install nest-desktop [--user] [--upgrade]
```

It installs NEST Server (`nest-server`) automatically. For more information read the full installing docs *here*.

3. Before you start the frontend NEST Desktop, you have to run NEST Server as a backend.

Start NEST Server:

```
nest-server start
```

NEST Server is now serving at `http://localhost:5000`.

4. Start NEST Desktop (in other terminal session):

```
nest-desktop start
```

NEST Desktop is now serving at `http://localhost:8000`.

For more information read the full documentation of command API *here*.

6.2 Via Docker
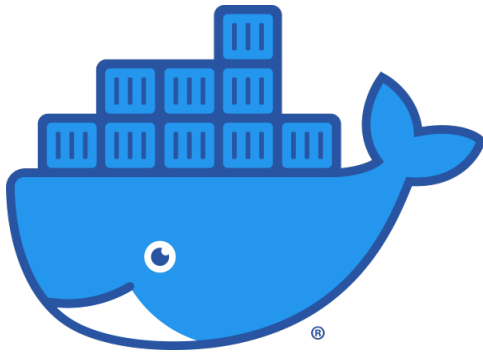
Docker is a virtualization software packaging applications and its dependencies in a virtual container that can run on any Linux server. It is available for a variety of operating systems, e.g. Linux, Mac and Windows. For more information here.

1. Pull the image from docker hub:

```
docker pull babsey/nest-desktop
```

2. Start the docker container:

```
docker run -i -p 5000:5000 -p 8000:8000 -t babsey/nest-desktop
```

Note: In Docker container NEST Desktop is serving at port 8000 and NEST Server at port 5000. So, we need to bind ports (5000 and 8000) of host and container.

NEST Desktop and NEST Server are now serving at `http://localhost:8000` and `http://localhost:5000`, respectively.

Arguments

You can find help text of docker arguments by `docker run --help`.

-p	Publish a container's port(s) to the host
-i	Keep STDIN open even if not attached
-t	Allocate a pseudo-TTY

6.3 Via Singularity

Singularity is an application container for Linux systems. For more information read the full documentation here.

1. Clone working copy from respository:

```
git clone https://github.com/babsey/nest-desktop
```

2. Go to Singularity folder of NEST Desktop:

```
cd nest-desktop/singularity
```

3. Build singularity container (with sudo):

```
singularity build nest-desktop.sif nest-desktop.def
```

4. Start singularity container

```
singularity run nest-desktop.sif
```

NEST Desktop and NEST Server are now serving at `http://localhost:8000` and `http://localhost:5000`, respectively.

Usage Guide

This guides provides detailed documentation for the Graphical User Interface (GUI) of NEST Desktop.

- *Get Started*
- *Concept of the Layout*
    - *Navigation*
    - *Content and controller*
- *Modules*
    - *The Model Module*
    - *The Network Module*
    - *The Simulation Module*
    - *The Visualization Module*
    - *The Setting Module*

7.1 Get Started

Once you start NEST Desktop, you will see the start page a image of a laptop with NEST logo. At the bottom it shows a short description of NEST Desktop (left) and some useful links and the current version (right)

It checks the compatibility of settings and databases with the application. When the server responds, the server icon is colored to green.

Note: If you think something is broken, you can reload the page. You may want to save a protocol. Go the `Settings > Simulation` and enter protocol details under *protocol database*.

7.2 Concept of the Layout

Next you will see the main page of NEST Desktop with the same concept of the layout for several components:

Left sidebar Navigation (it can be closed)

Center Main container for the content

Right sidebar Controller if provided.

7.2.1 Navigation

NEST Desktop provides three root modules (Simulation, Model, Settings) and a module can be selected by clicking on stacked, colored buttons right adjacent to navigation panel.

The navigation will be rendered according to the selected module. The navigation contains, top a navigation header with the name of the module and an icon ( ) for the context menu, and subjacent a content section with a list of items.

7.2.2 Content and controller

By clicking on an item in the navigation triggers loading the content in the main container and if provided in the controller panel.

Note: When a section provides a context menu, triggered by right mouse button, an icon of mouse-right-button-click appears in left bottom of the page.

7.3 Modules

7.3.1 The Model Module

The model module includes the description and the management of the neuron, device and synapse models.

In the left panel, it shows lists of available node and synapse models. Nodes can be stimulus devices, neurons or recorder devices. Once you select a model, the main container displays the documentation as well as a list of parameters with default values.

In the advanced mode, you can manage the models or configure the input panel of individual parameters. It will store the changes in the model database. In the input settings you can define the type of input, label, default value and the unit of the parameter. Additionally, you can adjust slider settings of the model parameters.

7.3.2 The Network Module

The network module as a part of the simulation module is where you can create and modify networks.

Network editor

When the view mode is set to 'edit', you will see a stretched area of the network sketch for the drawings. The right controller shows a network selection of created nodes. 'Selected' parameters will be visible for the parameterization in the simulation mode.

You can switch to sketch settings by clicking on 'bezier-curve' button left to the controller panel.

Network sketch

Network sketch is a graphical representation of the network. You are able to drag, draw and delete node and link elements.

Network list

It is an fixed list of nodes and links to get an overview of the network. It appears together with network sketch in simulation details.

Network selection

It is a list of nodes and links, in which you can set the visibility of node parameters. It appears together with network sketch in the network editor.

Network controller

It is a list of nodes and links in which you are able to change the parameter values. It appears together with records visualization in the simulation play.

Network summary

The network summary is appropriate view for the printing output in 'PDF' format.

Here, you find a network sketch (top) and a list of nodes and links (bottom). To improve the affiliation of the nodes and links, each node is labeled by a character and a color. Each node and link panel starts with a colored header and, if provided, a list of visible parameters.

7.3.3 The Simulation Module

In the simulation module, a list of simulations and if provided protocols are displayed in the navigation panel.

The Simulation menu

Clicking on the 3 vertical dots icon ( ) in the navigation header opens the simulation menu.

In the simulation menu you can manage protocols. For delete or download specific protocol, click on *select protocols* item. To upload protocols from file, select *upload protocols* item. To delete all protocol, it will clear Protocol database.

Note: Some simulations cannot be deleted because they are integrated in the application.

Once you select a simulation/protocol, it will load from the database and ready for the simulation. In the main container you will see the colored header toolbar and icons.

These icons switch views of the main container. NEST Desktop offers view mode according to icons:

pen icon Modify the network and visibility of the node parameters.

play icon Modify the parameter values and visualize the results of the simulation.

eye icon View network summary.

Simulation playground

When the view mode is set to 'analyze activity', you will see a controller of nodes and links with parameters. However, the main container remains empty because it does not find records. It is now ready to simulate and the simulation outcome will be rendered in the main container.

The content shows top left two icons: 'line chart' and 'braille'. The chart icon switch to chart panel in the main container. When the recorded neurons are spatial (by clicking on context menu in node header), it enables the 'braille' for switching to the animation of the records.

You can go to the controller of the network, simulation, chart, animation, and stats of the simulation outcome by clicking on the stacked buttons in the right side.

Configure the simulation

You can click on the *Simulate* button with right mouse button to display the context menu of the simulation. Here, you are able to change the settings of the simulation. For instance, check the option that runs the simulation after any change of the network automatically.

Logging

Logging component allows you to review the time protocol of the processing checkpoints. To activate it, go to `Settings -> Application` and then check the item `Log`. Once it is activated and after a successful simulation, you can see the logging list in the bottom of the navigation section.

7.3.4 The Visualization Module

Chart

The chart of the recordings is rendered by the library *Plotly.js*. The chart interface has dragging and zooming handlers. You can download a snapshot of the current chart by clicking on the camera icon in the top mode panel.

Animation

The animation of the recordings with positions of recorded neurons is rendered by the *three.js*.

7.3.5 The Setting Module

The setting module collects settings of the modules. Once you modified a setting, it will saves as JSON in local storage of the web browser.

Command API

This documentation guide provides detailed information about the commands `nest-desktop` and `nest-server`.

8.1 nest-desktop

Show usage for the command `nest-desktop`

```
nest-desktop
```

Options for `nest-desktop`

```
nest-desktop <command> -h <host> -p <port>
```

Commands

status Status of NEST Desktop

start Start NEST Desktop

stop Stop NEST Desktop

restart Stop then start

Arguments

-h Host (Default: 127.0.0.1)

-p Port (Default: 8000)

8.2 nest-server

Show usage for for the command `nest-server`

```
nest-server
```

Options for `nest-server`

```
nest-server <command> [-d] [-h <HOST>] [-p <PORT>] [-u <UID>]
```

Commands

> **log** Monitor NEST Server
>
> **status** Status of NEST Server
>
> **start** Start NEST Server
>
> **stop** Stop NEST Server
>
> **restart** Stop then start

Arguments

> **-d** Demonize the process
>
> **-h** Host (Default: 127.0.0.1)
>
> **-p** Port (Default: 5000)
>
> **-u** User ID

Troubleshooting

Having trouble getting something working? Got a question that the rest of our docs can't answer? Maybe we can help with some answers to commonly asked questions and troublesome spots.

9.1 Error messages

9.1.1 Server not found

This error has two possible sources:

- NEST Desktop has wrong URL of the server. See FAQ for *NEST Server*.
- The server is down. Enter the url of the NEST Server, e.g. `localhost:5000` in web browser. For advanced users: Check in terminal whether NEST Server is running (`curl localhost:5000`).

9.1.2 Internal server error

NEST Simulator produces value error, e.g. *The value cannot be negative.*.

9.2 Frequently asked questions (FAQ)

On this page, you'll find questions to

- *Application*
- *NEST Server*
- *Model*
- *Network*
- *Simulation*
- *Protocol*
- *Chart*
- *Animation*

9.2.1 Application

Where can I find settings? You find settings by clicking on the cog icon right to navigation side bar. The settings are stored as 'local storage' of the browser.

How can I change settings? You can change settings in the settings section by clicking on cog icon next to navigation side bar.

How can I reset settings? In the loading page you can click on menu icon of the settings section to open menu. One of the menu item is to reset settings.

How can I reset databases? In the loading page you can click on menu icon of the database section to open menu. One of the menu item is to reset databases.

Where can I find the database? The databases are stored as 'Indexed DB' of the browser.

How can I disable loading page? In the settings of the application you find the option to disable loading page.

How can I activate automatic start? In the settings of the application you find the option to activate automatic start.

How can I switch to advanced view? In the settings of the application you find an option to switch to advanced view.

9.2.2 NEST Server

How can I check NEST Server? In the loading page you can click on menu icon of the server section to open menu. One of the menu item is to check NEST Server.

How can I change the URL of the NEST Server? In the settings of the NEST Server you find the form fields for the URL of the NEST Server.

9.2.3 Model

What is terminology of this model? This model includes neuron, synapse and device models.

How can I read the documentation of a model? In the model section you find a list of models on the left side navigation. Click on one model, it request NEST Server for the documentation text of the selected model.

How can I get default values of a model? In the model section you find a list of models on the left side navigation. Click on one model, it request NEST Server for the default values of the selected model. The default values appear as a list on the right side bar.

9.2.4 Network

Where can I find network controller? You find network controller by clicking on top icon ('project diagram') left to controller. Node and link controller are part of the network controller.

Where can I find network settings? You find a 'bezier-curve' button towards network settings in the network editor. Alternatively, you find a network settings in the settings section.

How can I empty network? In network sketch you find bottom left a trash button that empties the network.

How can I create node? In network sketch you can click the right mouse button, then it appears a selector panel to select an element type of the node.

How can I create link / connect nodes? In network sketch you can select a node as a source node, move the mouse towards target node and then click the target node.

How can I keep selected node to connect other nodes? Hold pressing 'CTRL' before connecting nodes.

How can I (un)select node / link? When a node or link is selected you can press 'ESC' to unselect it or in network sketch you can click on node or link to select it. Click on background area of the network sketch or on the selected in the network controller unselect node or link. An other method to (un)select is to click on node shape or link toolbar in the network controller on the right side.

How can I colorize nodes? You find the method to color in the context menu of the node by clicking the right mouse button on node shape in network sketch or node toolbar in the controller.

How can I change the color cycle of nodes? In the network settings you find the way to change the color cycle.

How can I delete node/link? You find this method in the context menu of the node or link by clicking the right mouse button on node / link shape in network sketch or on node / link toolbar in the network controller.

How can I modify parameters? You find a list of parameters in network controller. If they are not visible, switch to network editor to check the visibility of the parameters.

How can I reset all parameter value? In the context menu of node or link you find the method to reset all parameters of the corresponding node / link.

How can I reset a parameter value? In the context menu of a parameter (by clicking right button on a parameter) you find the method to reset parameter. It also shows the default value of the parameter.

How can I set inhibitory connectome? You can set weights to negative value in the link controller.

How can I get distribution for parameters? In the current version you are able to activate the distribution of the parameters in kernel, weights and delay of the spatial projections.

How can I set node in spatial mode? In the context menu of the node, you can (un)set the spatial mode of the node.

How can I add mask for projection? When source and target nodes are set to spatial, then you find mask item of the spatial projections in the link controller. Click on the mask item to modify it.

How can I generate grid/free positions? When the node is set to spatial, position item will replace the population item. Click on position item to get a position panel. Modify a value will generate positions, at the end of the panel you find a button to generate positions.

How can I add positions? In the positions panel you find a text area of the positions, you can add custom positions.

How can I modify the slider? In the context menu of the parameter, you find a method to alter slider settings.

How can I generate array? In the context menu of the array parameters (e.g. spike times of spike generator) you find the method to generate array. It opens a dialog for array generation.

9.2.5 Simulation

Where can I find simulation controller? The simulation controller appears by clicking on the cog icon left to controller side bar. The kernel controller is a part of the simulation controller.

How can I start simulation? Click on the play button in top right to go to simulation play, then click the play button again to start simulation.

How can I stop simulation? The option to stop simulation is not implemented.

How can I activate simulation after change? In the context menu of the play button (by clicking on right button) you find an option to activate simulation after change.

How can I activate simulation after load? In the context menu of the play button (by clicking on right button) you find an option to activate simulation after load.

How can I activate seed randomization? In the context menu of the play button (by clicking on right button) you find an option to activate seed randomization.

How can I modify kernel of NEST Simulator? In the simulation controller you find a kernel section for the NEST Simulator.

How can I change resolution of the kernel? In the simulation controller you find a kernel section for the NEST Simulator. There you are able to change resolution.

> **Warning:** Please verify that the resolution of the recorders are larger than the resolution in the kernel.

How can I change seed? In the simulation controller you find a simulation section. There you are able to change seed value.

How can I set simulation time? In the simulation controller you find a simulation section. There you are able to change simulation time.

How can I get Python script of the simulation? When the advanced view is activated you find the Python script of the simulation in one of the tabs in the simulation details.

How can I find data for the simulation in JSON format? In one tab of the simulation details you find data for the simulation.

How can I find data for the app in JSON format? In one tab of the simulation details you find data for the app.

9.2.6 Protocol

How can I save protocol? In the top left of the page you find a floppy disc icon to save protocol.

How can I rename protocol? In the network editor you find the input field of the protocol name. There you are able to change the name of the protocol.

How can I delete a protocol? In the context menu of the protocols (by clicking on mouse right button on a protocol) you find this method to delete corresponding protocol.

How can I delete specific protocols? In the menu of the simulation in the top navigation you find an method to select protocols. Then select several protocols and then at the end you find the action to delete them.

How can I download a protocol? In the context menu of the protocols (by clicking on mouse right button on a protocol) you find this method to delete corresponding protocol.

How can I download simulation with records? In the context menu of the simulation (on play icon) you find a menu item to download data and records of the current simulation.

How can I download specific protocols? In the menu of the simulation in the top navigation you find an method to select protocols. Then select several protocols and then at the end you find the action to download them.

How can I download all protocols? In the menu of the simulation in the top navigation you find an method to download all protocols.

How can I upload protocols? In the menu of the simulation in the top navigation you find an method to upload protocols from a file.

9.2.7 Chart

Where can I find chart controller? You find animation controller by clicking on the 'chart' icon in the stacked menu left to controller.

How can I drag/zoom the chart? Select the mode in the mode bar (top). Then click on the chart for dragging or zooming.

How can I reset to default view? Click on the house icon in the mode bar (top) to reset to default view.

How can I download plot of the chart? Click on the photo icon (top) to download plot of the chart. It saves into SVG format.

How can I migrate chart to Plotly Chart Studio? Click on the text "Edit chart" (bottom) to see the chart in Plotly Chart Studio.

How can I modify bin size of the PSTH? In the chart controller you find tick slider to modify bin size.

How can I change the mode of the PSTH? In the chart controller you find options to change the mode of the PSTH.

How can I change the label of axes or the title? Click on the label of the axes or the title to change it.

How can I hide/show dots/lines? Click on the legend to alter the visibility of the dots/lines.

9.2.8 Animation

Where can I find animation controller? You find animation controller by clicking on the 'braille' icon.

How can I stop animation? Go to animation controller. You find a pause icon to stop animation.

How can I increase/decrease animation speed? In the animation controller you find forward or backward to alter animation speed.

How can I change colorscale of dots? In the animation controller you find a colormap of the current colorscale. Next below of it you find an options to select colorscale.

How can I change size of dots? In the animation controller you find slider of the dot size.

How can I add trailing for dots? It only works in the animation of the spikes.

How can I rotate camera? Hold the mouse button on the animation area and then move it to rotate the camera.

How can I activate camera motion? In the animation controller you can increase the speed of the camera motion.

Use NEST Desktop on **HBP**

Human Brain Project

Human Brain Project (HBP) is a research infrastructure for the researchers in neuroscience, computing and brain-related medicine fields.

NEST Desktop has been selected as a Partnering Project of the Human Brain Project. The main goal of the project of NEST Desktop is to develop to an advanced GUI for the NEST Simulator and to integrate into HBP infrastructure. For more information, please follow the link here.

10.1 Access to NEST Desktop

An *HBP* account is required to access NEST Desktop on *HBP*.

If you have an *HBP* account, follow the link below:

- https://nest-desktop.apps.hbp.eu.

You will see the login interface of *HBP*. Enter you account name and password, then it directs you to the main page of NEST Desktop.

10.2 Request account of *HBP*

If you have no *HBP* account, you can ask a member of *HBP* to invite you or request an account here:

- https://services.humanbrainproject.eu/oidc/login

10.3 Trouble shootings

Why cannot I find NEST Server? Sometimes the issue is resolved when you check NEST Server.

If not, the problem lies in cookies and site data for the user authentication of the *HBP*. That cookie expires after a session. This happens when you re-access to `https://nest-desktop.apps.hbp.eu` after the browser is closed.

The simple solution is to reload the page that you can re-login HBP infrastructure.

A persistent solution is to set the browser configuration that it deletes cookies and site data when the browser is closed (It works in Firefox).

How to deploy NEST Desktop

This guide provides detailed documentation on how to deploy NEST Desktop.

- *Deploy NEST Desktop in Docker engine*
- *Deploy NEST Desktop on Human Brain Project (HBP) resources*
- *Deploy NEST Desktop on bwCloud resources*

Deploy NEST Desktop in **Docker**

Docker is a virtualization software packaging applications and its dependencies in a virtual container that can run on any Linux server. It is available for a variety of the operating systems, e.g. Linux, Mac and Windows. For more information follow the link here.

12.1 Requirements

- Docker engine

12.2 Installation

The image from docker hub contains all required software (NEST Desktop, NEST Server and NEST Simulator). For more information, follow the link here.

```
docker pull babsey/nest-desktop
```

12.3 Getting started

Start docker container with arguments.

```
docker run -i -p 5000:5000 -p 8000:8000 -t babsey/nest-desktop
```

NEST Desktop and NEST Server are now serving at `http://localhost:8000` and `http://localhost:5000`, respectively.

Note: In Docker container NEST Desktop is serving at port 8000 and NEST Server at port 5000. So, we need to bind ports (5000 and 8000) of host and container.

Arguments

You can find help text of docker arguments by `docker run --help`.

-p	Publish a container's port(s) to the host
-i	Keep STDIN open even if not attached
-t	Allocate a pseudo-TTY

12.4 Acknowledgements

Thanks for the help:

- Steffen Graber (Docker hub for NEST Simulator)

Deploy NEST Desktop on **HBP**

The documentation shows how to deploy NEST Desktop from docker hub on *HBP* resources.

HBP provides two OpenShift infrastructures

- https://openshift-dev.hbp.eu for the development.

- https://openshift.hbp.eu for the production.

Note: I strongly recommend to use the development page before you push NEST Desktop on `https://openshift.hbp.eu`.

13.1 Requirements

- OC Client Tools (https://www.okd.io/download.html#oc-platforms)

13.2 Step to deploy (in development)

First configure OpenID Connect client for NEST Desktop here.

You can copy command line from the web console of `https://openshift-dev.hbp.eu`.

Login to openshift-dev.hbp.eu:

```
oc login https://openshift-dev.hbp.eu:443 --token=<token>
```

Get status of current project:

```
oc status
```

You find a configuration and a bash files for setting up NEST Desktop on *HBP*. Execute the bash script and in the end it shows the IP needed for *HBP* authentication (see below):

```
cd infrastructure/openshift-dev.hbp.eu
bash setup-nest-desktop.sh
```

13.2.1 Further usage

Scaling up the replicas (pods or nodes):

```
oc scale --replicas=2 dc nest-desktop
```

Monitor log of a pod (Get pod name: `oc get pod`):

```
oc exec <pod> -- nest-server log
```

13.3 HBP Authentication and redirecting

To access to NEST Desktop on HBP infrastructure, an authentication of *HBP* membership is requested. You find the codes on https://github.com/babsey/hbp-auth.

Here are the steps how to setup authentication and redirecting to NEST Desktop properly. Before you have to modify the environment for *HBP* authentication, i.e. OIDC_CLIENT_ID, OIDC_CLIENT_SECRET and CLUSTER_IP of NEST Desktop (which is printed after setting up NEST Desktop).

```
cd projects/nest-desktop-dev
bash setup-nest-desktop-hbp-auth.sh
```

13.4 Deploy Production

If NEST Desktop is ready for the production, meaning to deploy on apps.hbp.eu. Perform all steps same as in Development (apps-dev.hbp.eu).

13.5 Maintenance

tba

13.6 Acknowledgements

Thanks for the help to integrate NEST Desktop on HBP resources:

- Alberto Madonna (Concepting)
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- Martin Jochen Eppler (Contacting)

Deploy NEST Desktop on **bwCloud**

The guide provides step-by-step documentation on how to deploy NEST Desktop on bwCloud resources. The *bwCloud* is a cloud assigned for the universities in Baden-Württemberg, Germany. For more information, follow the link: https://www.bw-cloud.org/.

The *bwCloud* is running on OpenStack, an open source platform using pooled virtual resources to build and manage clouds. For more information, please follow the link: https://www.redhat.com/en/topics/openstack.

14.1 Requirements

- Packer (https://www.packer.io/downloads.html)
- Ansible (https://releases.ansible.com/ansible/)

14.2 Deploy NEST Desktop

1. Download Openstack RC File from the dashboard, follow the steps: "Compute" -> "Access & Security" -> "API Access" -> "Download OpenStack RC File"

2. Source the RC file:

```
source Project_<userID>-openrc_v3.sh
```

3. Modify the configurations (i.e. source image and networks for the builder) in `infrastructure/bwCloud/nest-desktop.json`.

4. Build an image on *bwCloud*

```
cd infrastructure/bwCloud
/path/to/packer build nest-desktop.json
```

14.3 Acknowledgements

How to develop NEST Desktop

This is the developer guide, providing more detail on how to develop NEST Desktop.

The concept of the interface

NEST Desktop follows a clear concept of the page layout which is overlaid by three bars. For the consistence of the page layout each bar has an unambiguous function. Left and right bars are closable and after changing the open status of a side bar the the visualization content in the center bar changes its width format.

16.1 Left bar

It is the navigation showing a list of the items which is loaded from individual modules. A stacked set of buttons (left) renders the content of the navigation and it shows list of the simulations (sketch icon), of the models (square-root icon) and of the settings (wrench icon). When the user click on an item, it loads the content of the center and right bars. The header toolbar stretches over center and right bars and it is color-coded by a loaded page: Simulation page is summergreen, model is crail and settings page is sycamore. These color palette are generated using deep learning method on the colormind websitefootnote{http://colormind.io/template/material-dashboard/}.

16.2 Center bar

It provides as router outlets showing the page content of the modules. The simulation module displays the information of the network and the graphical output of the simulation. A model module shows the detailed information of models which can be used in NEST Simulator. Finally, a settings module shows an overview of all settings for application modules.

16.3 Right bar

It is the controller which the user is able to change values. The content of the controller is tabbed by several components, e.g. in simulation playground it displays list of network elements for the network component or list of configurations for a visualization component.

Preparation

NEST Desktop is written in HTML5 but compiled by Angular, a web framework written in TypeScript. For Angular you need to install nodeJS (+ yarn).

I have prepared Singularity recipe that build an environment with required packages for the develompment. You can find the definition file in singularity/nest-desktop-dev.def for building Singularity container.

Requirements

- Python 3.4 or higher

- NEST Server, NEST Simulator (Test app)

- nodeJS, npm, yarn (Build app)

- setuptools, wheel, twine (for PyPI)

- sphinx, sphinx rth theme (for Readthedocs)

17.1 Source code

The source code of NEST desktop is hosted at `https://github.com/babsey/nest-desktop`

Clone NEST Desktop from the github repository:

```
git clone https://github.com/babsey/nest-desktop
```

17.2 Environment for development

The definition file `nest-desktop/singularity/nest-desktop-dev.def` contains an adequate environment to develop and build NEST Desktop.

Build a singularity image:

```
singularity build nest-desktop-dev.sif nest-desktop/singularity/nest-desktop-dev.def
```

Go to shell of singularity container:

```
singularity shell nest-desktop-dev.sif
```

Source code

18.1 Usage of yarn

Install node modules for NEST Desktop source code:

```
yarn install
```

Check if any node package are outdated:

```
yarn outdated
```

Upgrade outdated packages:

```
yarn upgrade
```

Serve Angular Live Development Server serving at http://localhost:4200

```
yarn start
```

18.2 Usage of npm

Install node modules for NEST Desktop source code:

```
npm install
```

Check if any node package is outdated:

```
npm out
```

Update node package:

```
npm up
```

Serve Angular Live Development Server serving at http://localhost:4200

```
npm start
```

18.3 Setup

Install NEST Desktop from source code using `pip` (where it finds `setup.py`). Best method is to install it in user home using `pip install --user`.

```
python3 -m pip install --user --no-deps -e nest-desktop
```

18.4 Getting started

You can read *Getting started* in User Documentation to start NEST Desktop. Starting NEST Desktop `nest-desktop start` equivalent to the command:

```
python3 -m nest_desktop.app
```

Python Package Index (PyPI)

To build and deploy NEST Desktop on PyPi is a cruical step for the development. With it, Docker hub can update NEST Desktop and NEST Server in babsey/nest-desktop image.

19.1 Steps to build and deploy

Current work directory: `nest-desktop`.

The Python Package Index **nest-desktop** includes an executive command `nest-desktop` and a Python library `nest_desktop`.

First update the version of nest-desktop in `src/packages.json` and in `nest_desktop/__init__.py`.

Then generate app package using yarn. It builds the folder `nest_desktop/app`:

```
yarn run build
```

Next, remove the folders:

```
rm -rf build/ dist/ nest_desktop.egg-info/
```

Then generate distribution packages of *nest-desktop* for PyPI:

```
python3 setup.py sdist bdist_wheel
```

Finally, upload *nest-desktop* to PyPI:

```
python3 -m twine upload dist/*
```

Readthedocs

20.1 Peparation

Current work directory: `nest-desktop/docs`. To install sphinx and readthedocs theme via `pip`:

```
python3 -m pip install sphinx sphinx_rtd_theme
```

20.2 Local building

Build sphinx documentation in `docs/_build` folder:

```
rm -r _build/; make html
```

20.3 Build on Readthedocs

It automatically builds docs for master when pulling commits to master. Docs for latest and stable depends on their github tags.

The semantic versioning

During the course of the development the implementation of featured into NEST Desktop are validated its compatibility. In this concept a general rule of the semantic versioning NEST Desktop was introduced that the operational capability of the application can be guaranteed. The formal convention of the version releases for specifying compatibility in NEST Desktop uses a three-part number:

21.1 A major number

It is incremented for the compatibility with the NEST Simulator. It implies that the major version of the NEST Desktop (2.x.x) has to match with the one of NEST Simulator (currently 2.x.x).

21.2 A minor number

It is a breaking feature such as a new library or a minor changes of the data structure. It means that it could cause the compatibility issue and the user need to adapt to use the same minor version of NEST Desktop as well as of NEST Server.

21.3 A patch number

It is a bugfix and non-breaking features added to the code. The user is able to work with different patch versions of NEST Desktop and NEST Server.

NEST Desktop checks the compatibility in the loading page and provides options to reset settings and databases. Otherwise, they might be incompatible.

Sources

22.1 Images

mouse-button-right-click.png https://www.hiclipart.com/free-transparent-background-png-clipart-iplqp

nest-invert.svg Modified from nest.svg

nest.svg https://nest-simulator.org/

spike-transmission-carlos.svg Carlos Toledo Suárez, a former PhD of Abigail Morrison lab, passed away in 2013)

Bibliography

[BCF]   Bernstein Center Freiburg, Faculty of Biology, University of Freiburg, Freiburg, Germany

[HCI]   Department IV - Computer Science, Human-Computer Interaction, University of Trier, Trier, Germany

[INM-6] Institute of Neuroscience and Medicine (INM-6), Jülich Research Center, Jülich, Germany

[NMBU] Norwegian University of Life Sciences, As, Norway