User Manual

for

Automated CPN Model Generation

Version 1.0

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Created on: 19.01.2021

Revision History

Name	Date	Reason For Changes	Version
User_Manual_Automated_CPN_Model_ Generation	19.01.2021	First version	1.0

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1. Software Description

1.1 Description

The Automated CPN Model Generation Tool creates a process model based on an event log which is enriched with performance information such as mean and standard deviation of the transitions, the resource capacity of the transitions, probability information for each of the decision points and the average arrival rate for the process model. Finally, the enriched process mode can be exported to a CPN Model which can be simulated in CPN tools software.

1.2 Benefits and Value

The project has many benefits from all perspectives, namely, theoretical foundations, tool support, and practical applications. Traditionally, the simulation models were created manually but with the advent of process mining techniques, it is a lot faster to arrive at a simulation model. As an instance, simulation can help to estimate the benefit of an expected process redesign or to predict flow times for an increasing number of incoming cases. It is also regarded as a useful tool to gain insights into the operation of systems. In addition to this, generating simulated logs from a CPN model can be very useful to evaluate the performance of process mining algorithms. This project is expected to have an overall positive impact on the people working in the process mining domain.

1.3 Platform Requirements

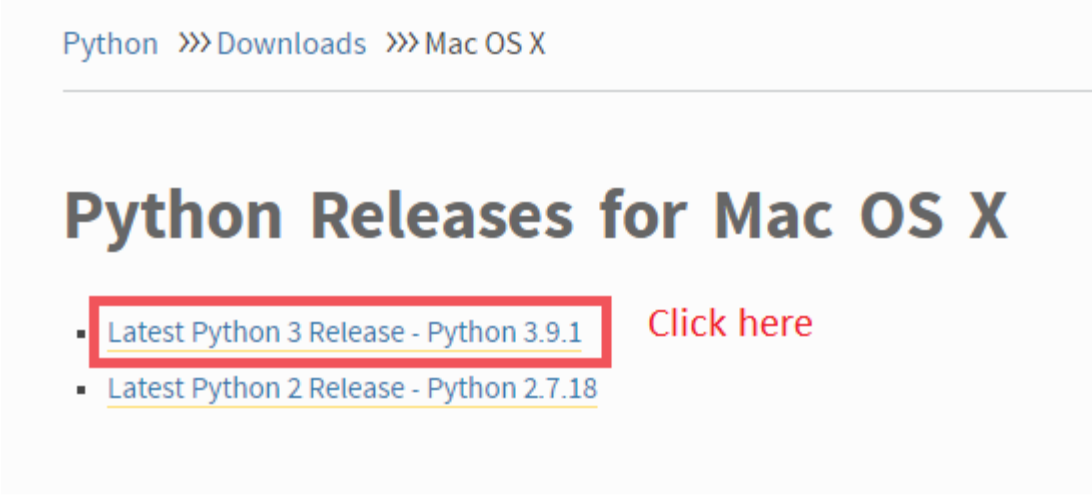
- Windows 10 64-bit: Pro, Enterprise, or Education.
- 64 bit processor.
- 4GB system RAM.

2. Installing the Software

2.1 Python

- **Install python on Windows**:
  - Download a version of Python that is 3.8 or higher here: https://www.python.org/downloads/

- **Install python on MacOS**:
  - Download a version of Python that is 3.8 or higher here: https://www.python.org/downloads/mac-osx/

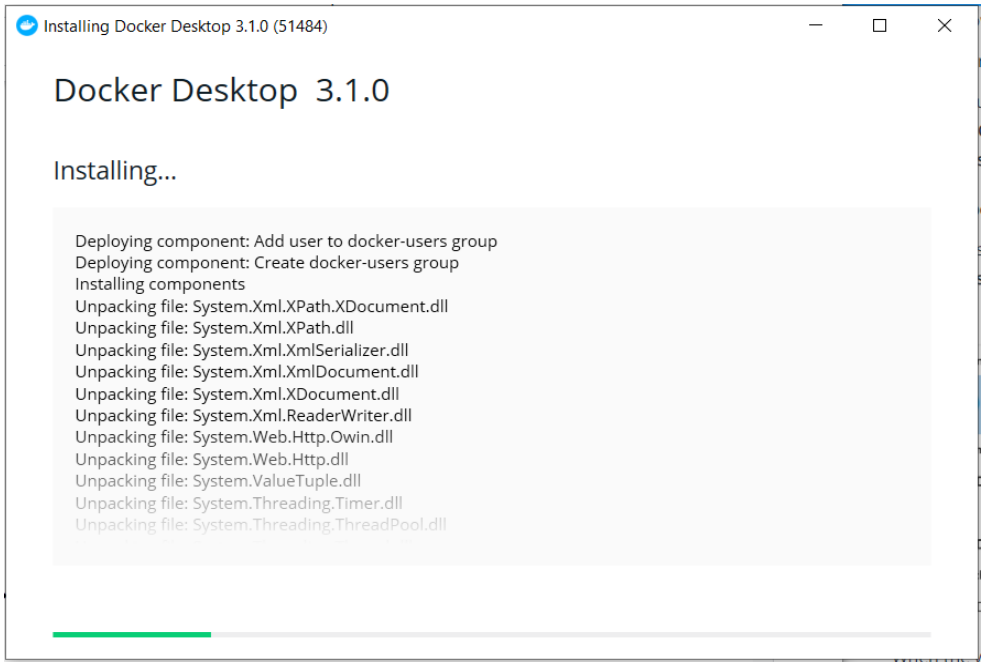


2.2 Docker Desktop

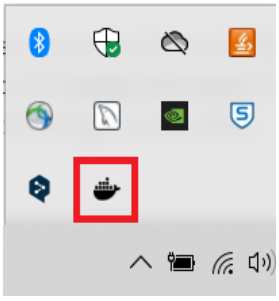
❖ Install Docker Desktop on Windows

➢ Download the Docker Desktop installer for Windows here: https://hub.docker.com/editions/community/docker-ce-desktop-windows/

➢ Double-click **Docker Desktop Installer.exe** to run the installer.
➢ If a pop-up to select Windows Features appears, ensure that **Enable Hyper-V Windows Features** option is selected on the Configuration page.
➢ Keep following the instructions on the wizard and proceed with the install.

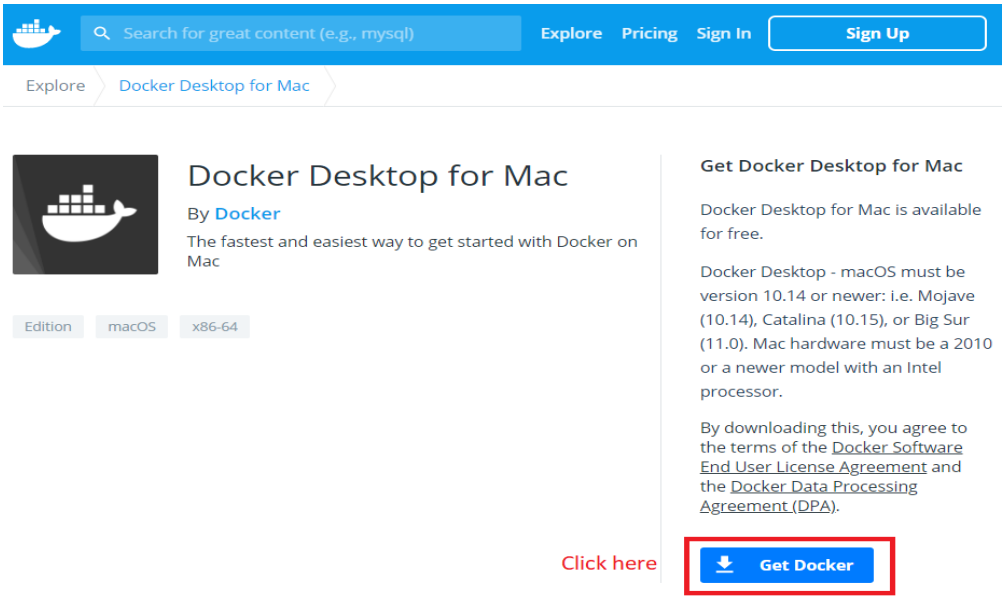


- ➢ When the installation is successful, click **Close** to complete the installation process.
- ➢ To start Docker Desktop, search for Docker and select **Docker Desktop** in the search results.
- ➢ When the whale icon in the status bar stays steady, Docker Desktop is up-and-running. If the whale icon is hidden in the Notifications area, click on the up arrow on the taskbar to show it.



❖ Install Docker Desktop on Mac

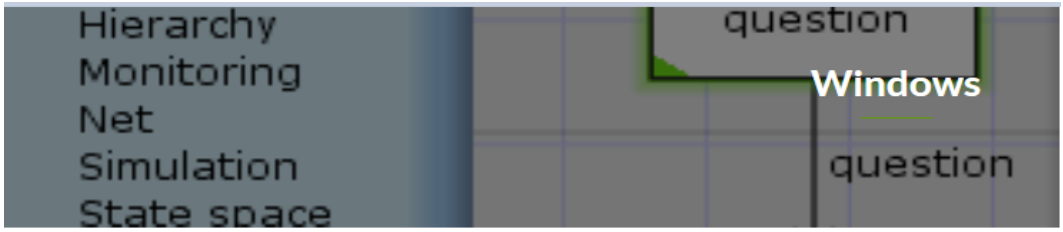
- ➢ Download the Docker Desktop installer for Mac here: https://hub.docker.com/editions/community/docker-ce-desktop-mac/

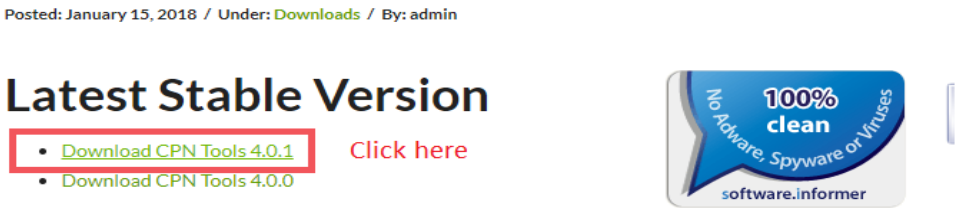


- ➢ Double-click **Docker.dmg** to open the installer, then drag the Docker icon to the Application Folder.
- ➢ Double-click Docker.app in the Application folder to start Docker.
- ➢ The Docker menu in the top status bar indicates that Docker Desktop is running, and accessible from a terminal.

2.3 CPN Tools

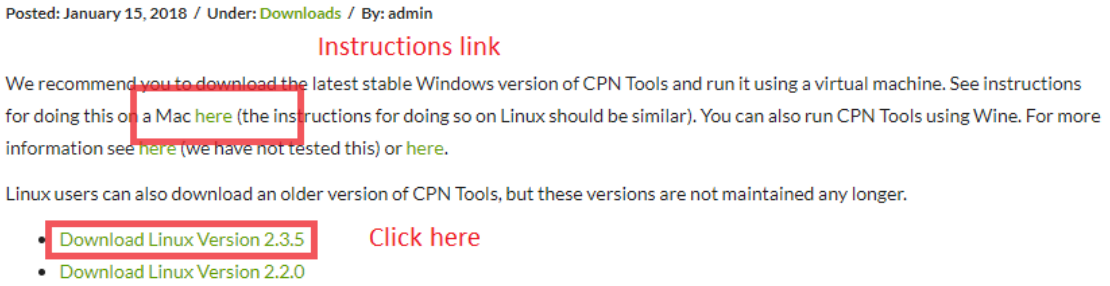
- **Install CPN Tools on Windows**:
  - Download the CPN Tools installer here:
    http://cpntools.org/2018/01/15/windows/





  - Double-click **cpntools_4.0.1.exe** to run the installer.
  - Keep following the instructions on the wizard and proceed with the install.
  - When the installation is successful, click **Close** to complete the installation process.

- **Install CPN Tools on MacOS:**
  - Download the CPN Tools installer here:
    http://cpntools.org/2018/01/15/linux-mac-os-x/

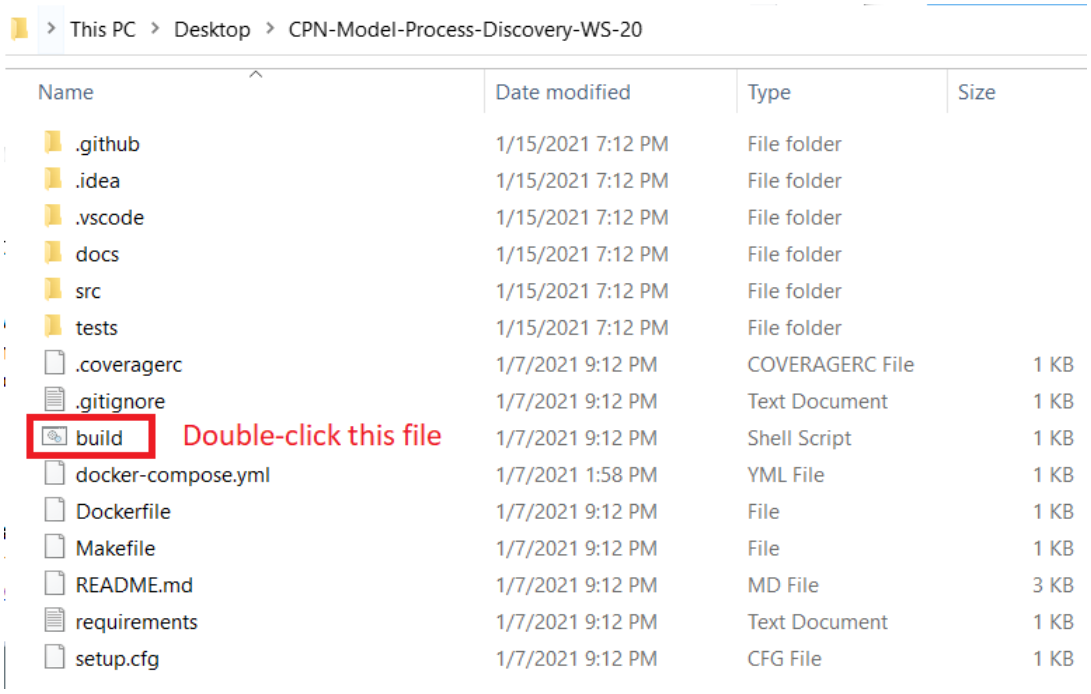


  - Follow the instructions given on this link.

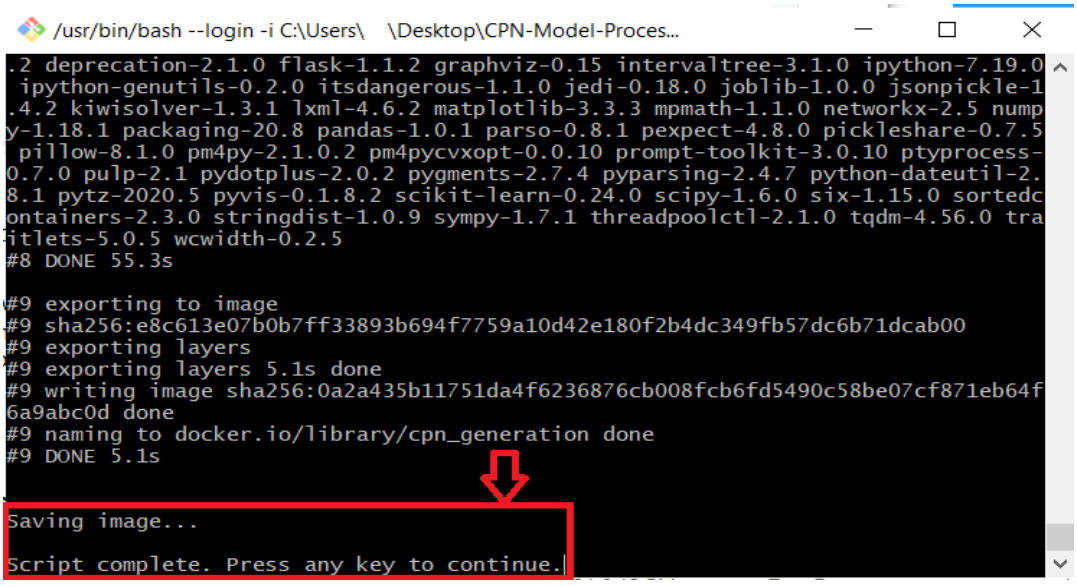
3. Process Workflow

3.1 Deployment on Docker

❖ Go to the project repository and double-click on the file "**build.sh**".

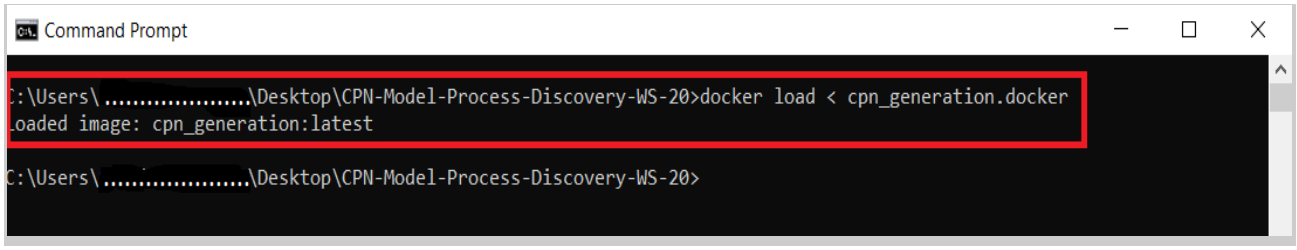


❖ Let the build script run. It will take several minutes to execute. Close the window once you get the following message, highlighted in red.

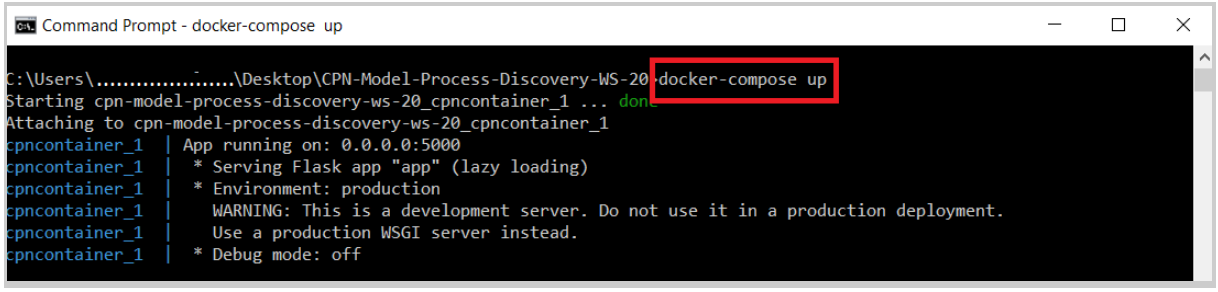


- Once the docker image “cpn_generation.docker” file is ready in the project repository. Open command prompt and go to the project repository. Run the following command:

  `docker load < cpn_generation.docker`



- Once the docker image has been loaded, start-up the application by running the following command:
  `docker-compose up`



- After the application container is up and running, go to the browser and open the below URL:

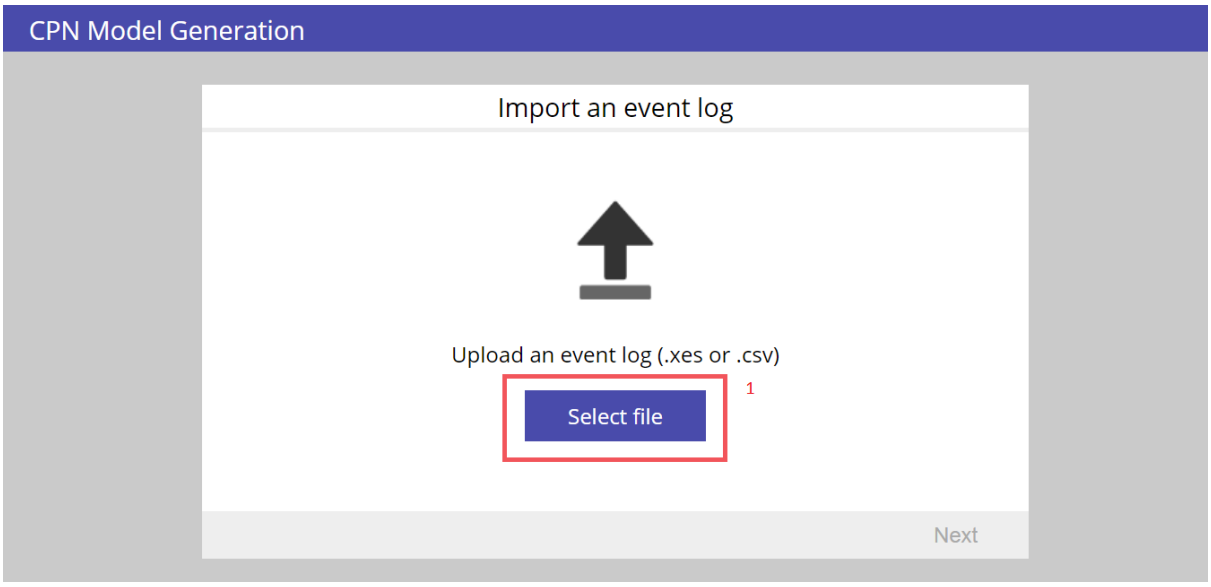
  http://127.0.0.1:5000/generate-cpn-model/

- To stop the application container, use the following command:

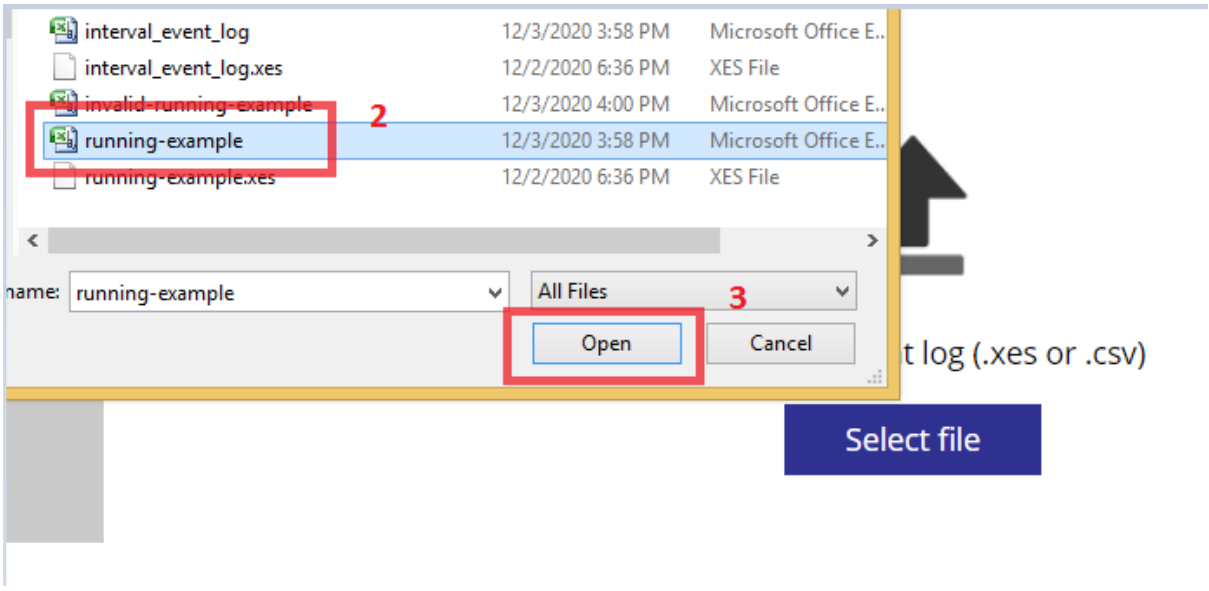
  `docker-compose down`

3.2 Import an Event Log and Discover a Process Model

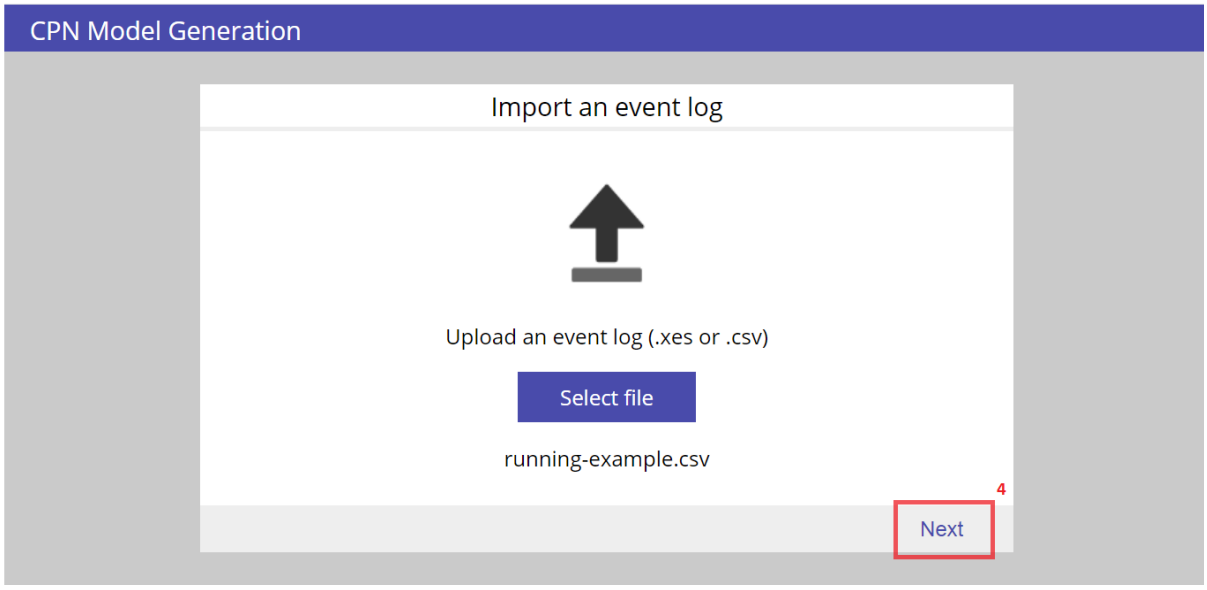
1. Click on the "**Select file**" to upload the file.



2. Go to the path in your computer from where the file needs to be uploaded and select the file (.xsv or .csv) file.
3. Click on the "**Open**" and the file is uploaded.



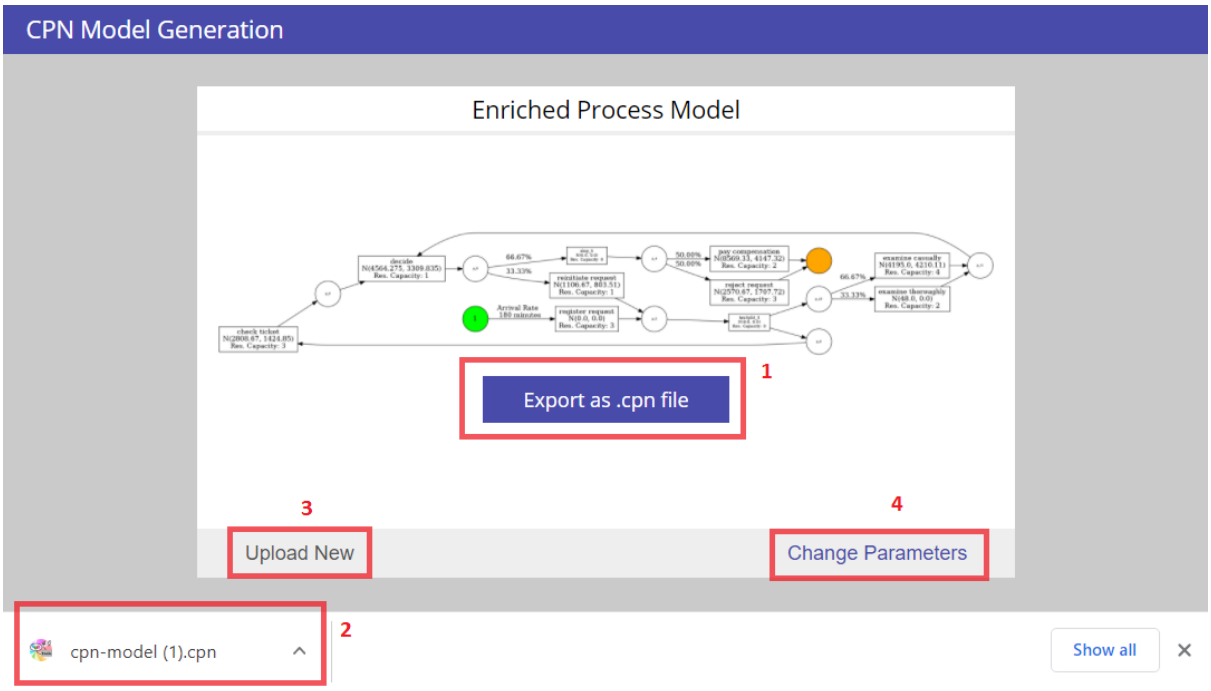
4. Once the file is uploaded, click on "**Next**"



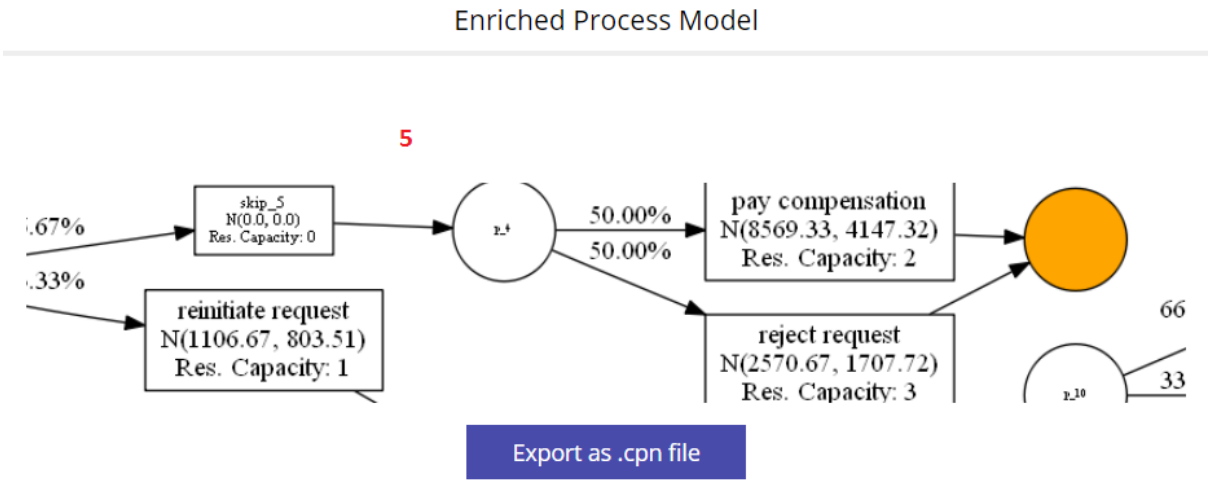
3.3 View the Process Model and Export the CPN Model

- View: A colored petri net
- Circles = Places
- Squares = Transitions
- Special Places
  - Green Place = Source
  - Orange Place = Sink
- Places with two outgoing arcs = Decision points
  - Percentages on the arcs indicate the percentage of cases that took each path.
- The Source arc has arrival rate information.
- Further Transition Information:
  - First line: transition identifier
  - Second line: Service time of the activity, represented by a Normal distribution, N(**μ**,**σ**) with mean **μ** and standard deviation **σ**.
  - Third line: Resource capacity, how many cases can the transition handle simultaneously at max.

1. Click on the "**Export as .cpn file**" button to generate the CPN file.
2. "**cpn-model.cpn**" file will be generated. The file can be opened in CPN-Tools.
3. Click on the "**Upload New**" button for uploading another .csv or .xes file.
4. To change parameters like arrival rate, mean and standard deviation of activities, activity resource capacity, click on "**Change Parameters**" button.

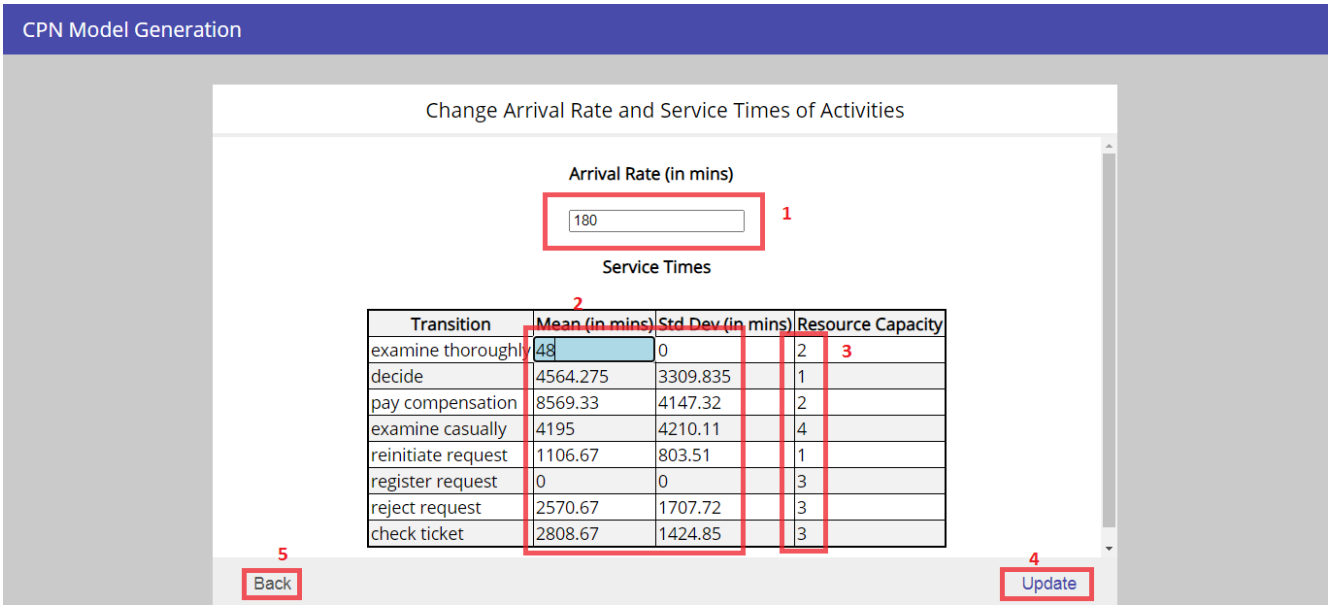


5. **Hover** over the image to see the enlarged process model.



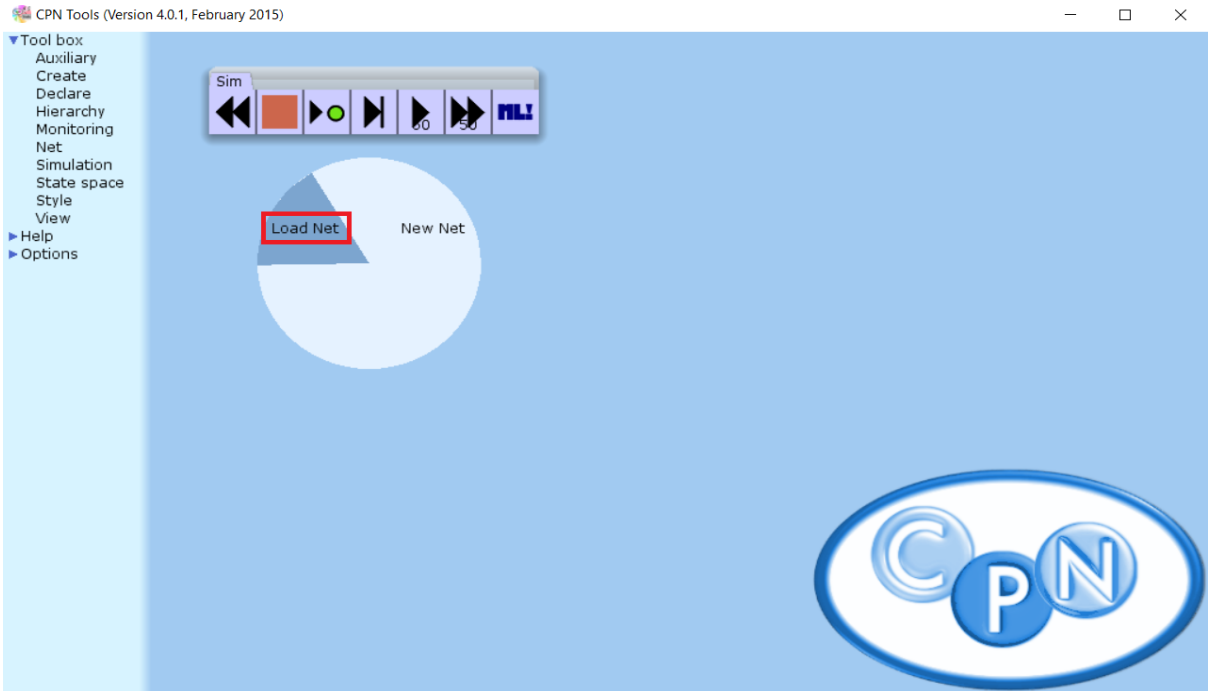
3.4 Change the Parameters of Process Model

1. **Edit** to change the **arrival rate** (in minutes). Arrival rate should be greater than 0.
2. **Edit** to change the **mean and standard deviation** (in minutes) of the activities.
3. **Edit** to change the **resource capacity** of the activities. Resource capacity should be greater than 0.
4. Click the "**Update**" button to update the process model and return to the view process model screen.
5. To discard the made changes click the "**Back**" button. You automatically return to the view process model screen.

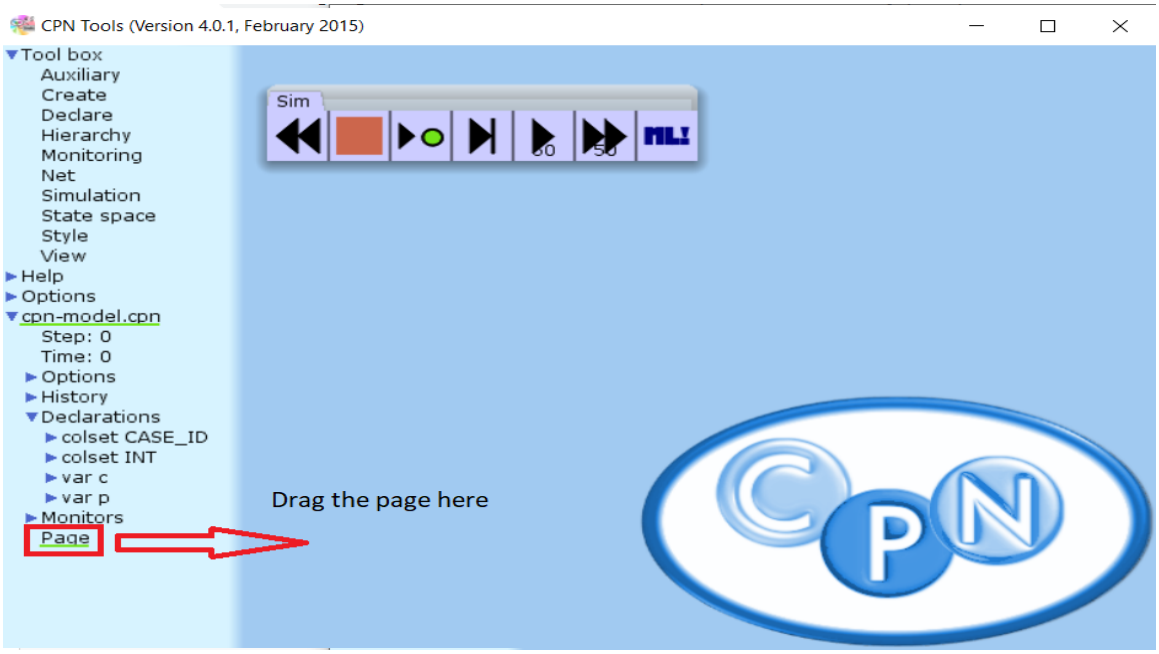


3.5 Simulate the CPN Model in CPN Tools

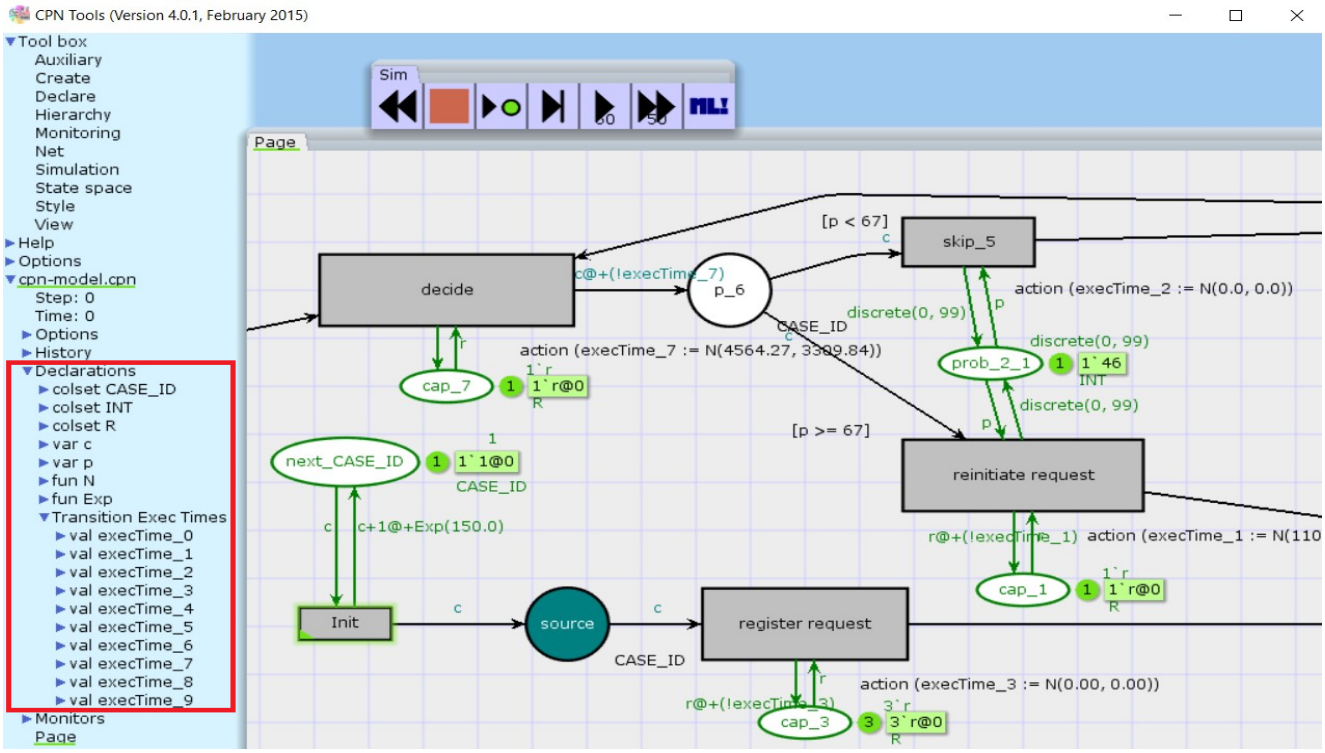
- Click on the generated CPN Model file to open the model in CPN Tools. Alternatively, open CPN Tools and load the CPN Model using the “Load Net” option.



- Once the CPN Model has been loaded, drag the “**Page**” option on the left panel to the workspace area, in order to display the CPN model.

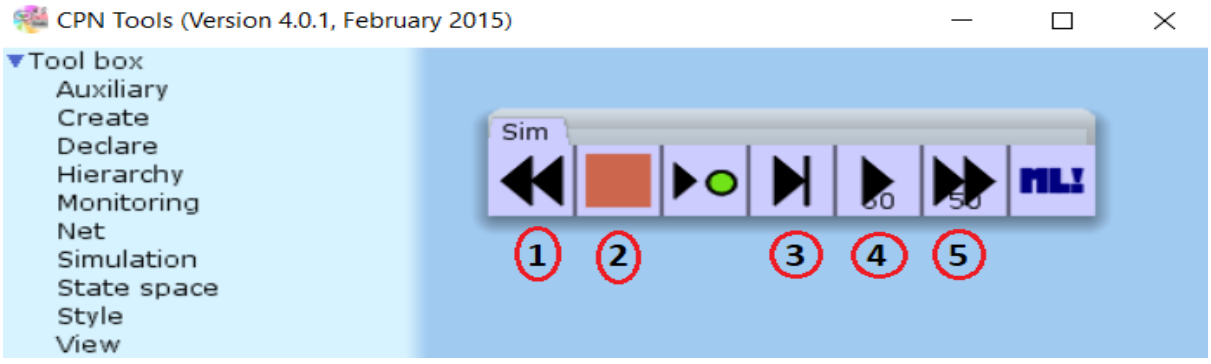


- The CPN Model will look like this with all of the transitions, places and arcs annotated with performance, probability, arrival rate and resource capacity information. On the left panel (marked in a red box), one can see all the declarations and the global variables used in the model.



- In order to perform the simulation, the buttons in the binder "**Simulation**" can be used.

1. Go to the initial state.
2. Stop an ongoing simulation.
3. Execute a particular transition.
4. Start the simulation and show the intermediate markings.
5. Fast forward the simulation and do not show the intermediate markings.



- Once the simulation is running, the intermediate markings can be seen at all places in the CPN Model as highlighted in the red boxes.