TNT vers. 1.6

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For all operating systems, we now provide easy-to-use installers that should take care of all the settings (☺). Check below further instructions for your operating system:

If the installer doesn't work in your computer, you will have to follow the instructions for manual installation (☹), also included below for each operating system.

The package includes a folder with documentation and example datasets (TNT-Docs_n_Datasets), as well as the binary files and materials needed for installation.

B I N A R Y F I L E S

L I N U X / M A C	W I N D O W S	C Y G W I N
"gTNT" the binary with the graphic interface; a front end you can install anywhere you like **"tnt"** a command-driven version, needed for running in parallel. It can work as a stand-alone command-line version of TNT, on its own, or as parallel engine for gTNT. **"pvmd3"** the PVM daemon. gTNT and tnt use the daemon to interconnect TNT processes (this is version 3.4.7, courtesy of James Kohl of the PVM team; the PVM web site, at https://netlib.org/pvm3/, still has version 3.4.6). **"pvm"** the PVM console, that can be used to control the PVM daemon (and the virtual machine in general). **"mpitnt"** (Linux only) a version of TNT that runs in parallel using MPI (requires installation of OpenMPI, see TNT web site)	**"tnt.exe"** the command-driven binary, can run on any Windows machine. You can use this for automating processes, and time-consuming analyses. This binary includes a C-interpreter (absent from the version with graphical interface). **"wTNT.exe"** windowed binary with a full menu interface. It can also run with commands and interpret scripts (but includes no C-interpreter). *NOTE! Versions for Windows are 32-bit versions, so they can access only limited amounts of RAM. If you have a memory demanding dataset, use the 64-bit Cygwin version, which runs under Windows*	**"tnt.exe"** the command-driven binary, which can run in parallel using PVM (provided, precompiled) **"gTNT.exe"** version with GTK graphic interface; requires installation of additional packages from the Cygwin manager (see below). **"mpitnt.exe"** a binary to run in parallel, using the MPI system (you must install Open MPI yourself). This can only run under Cygwin. **"pvmd3.exe"** the PVM daemon. gTNT and tnt use the daemon to interconnect TNT processes (this is a slight modification of version 3.4.7, which still has problems to compile under Cygwin; the fixed code is available on request). The PVM console is included as well, as it may help manage the daemon manually (see below)

WINDOWS:

The programs work just "out of the box". The only thing you need to install is the font Tred, used for drawing nicer trees. You do this by copying the file **Tred.ttf** (in the **TNT-Docs_n_Datasets** folder) to the appropriate system directory in your computer (most likely, **C:\Windows\Fonts**). You can also install by doing a right mouse click on the extracted **Tred.ttf**, and selecting "Install".

LINUX/MAC:

With TNT installer:

You extract the contents of the TNT zip package to a folder of its own. In Linux, you need to open a terminal, move to the folder where you extracted, then type **./ TNT_installer.sh** <enter>. In Macs, the file is called **TNT_installer.command**; you can open it in the same way as for Linux, or you can just double-click on the icon of **TNT_installer**.

N.B. you may need to make the TNT_installer file itself executable (e.g. in a terminal, typing **chmod a+x TNT_installer.sh** or **chmod a+x TNT_installer.command**).

The installer also creates aliases (**runTNT**, **runtnt**, and **PVM**) for easily accessing the TNT binary files and the PVM system. Calling TNT via these aliases automatically loads the PVM daemon, if needed, so as to facilitate running analyses in parallel.

Manual Installation for Mac and Linux:

Manual installation is more complicated; we recommend using it only if the TNT installer fails. The setup we recommend below mimics (at least partly) the one done by the installer, so that with some luck, the installer will work when doing updates.

Note: steps 2-5 are needed only if you intend to run in parallel.

1 - First, you need to install GTK 3 (https://www.gtk.org/) in your machine. In Linux, use your usual installation manager (e.g. apt, synaptic). In Mac, installing GTK 3 can be facilitated if you install Brew first, and then type at a terminal console:

```
brew install gtk+3
```

In Macs, you may also need to

```
brew install gtk+3 adwaita-icon-theme
```

for a better display of the menus.

2 - You need to create a pvm3 directory that will contain the PVM console and daemon. The easiest is copying both "pvm" and "pvmd3" to the folder $HOME/pvm3/lib/LINUX64/ (in Linux) or $HOME/pvm3/lib/DARWIN/ (in Mac).

3 - Copy the "tnt" binary to $HOME/pvm3/bin/LINUX64/ or $HOME/pvm3/bin/DARWIN/ (depending on OS; see above). Note this is "bin" instead of "lib".

4 - Define (as an environment variable) the root of the PVM directory, by inserting the line:

```
export PVM_ROOT=$HOME/pvm3
```

into your ".bashrc" or ".profile" file (Linux or Macs that run bash), or ".zprofile" (in Macs that run zsh). You can find out which shell your run by opening a terminal and typing "echo $SHELL". The files .bashrc or .zprofile should be located in your home directory.

5 - If you intend to run the MPI version, install openMPI (see detailed instructions on installing and setting MPI at https://www.lillo.org.ar/phylogeny/tnt/MPI_instructions.htm)

6 - Copy the font Tred (included in the TNT-Docs_n_Datasets folder) to the corresponding system folder (probably /usr/share/fonts/ in Linux, or /Library/Fonts/ in MacOS). This is strictly needed only for the graphic interface, but if using the command-line version, and setting to Western ISO the text (font) encoding of the terminal where you run, you can draw nicer trees on the command-line version as well (with the lintrees- option of TNT).

How to run in parallel with PVM if installer did not work, LINUX/MAC:

- You need to load the PVM daemon in memory. If you have followed all the instructions above, you do this by going either to $PVM_ROOT/lib/LINUX64, or $PVM_ROOT/lib/DARWIN, and then typing "pvm <enter>". This starts the daemon. You can now quit the PVM console, with "quit <enter>". gTNT is ready to run in parallel. You can rename the "gTNT" binary if you wish, but not the "tnt" binary.

- You stop the PVM daemon by going to the console and typing "halt". You cannot run in parallel after having done this; you need to reload the daemon. Typing "reset" at the PVM console, any "tnt" process left over (e.g. by a run that froze; this should never happen on normal termination) are eliminated. You can check every once in a while to make sure no rogue "tnt" processes are still running, either with "ps" or "top" (or similar facilities). Just in case.

- If you have several machines in a cluster, they need to be accessible via passwordless ssh. You can list the machines on a host file, e.g. "myhostfile". Then, typing "pvm myhostfile <enter>" should start the virtual

machine with all the hosts loaded. At its simplest, a host file is a list of the aliases of the hosts (as defined in /etc/hosts). See the documentation at https://netlib.org/pvm3 for details on the possible info to include in the host file.

CYGWIN:

Cygwin is installed by downloading a special installer from https://www.cygwin.com/. You need to install Cygwin *before* installing TNT. The Cygwin installer also acts as package manager.

Installation with installer (install-TNT.bat):

Once you have Cygwin installed, you can run the TNT installer. You do this from Windows, not from Cygwin. Go to the folder where you extracted the file **tnt-cygwin.zip**, double click on the **install-TNT** icon and follow instructions. If unsure of how the installer works, you can watch a short video on how to use it, at https://www.lillo.org.ar/phylogeny/tnt/files/cyginstallvid.mp4. If installer doesn't work, you will have to follow the instructions for manual installation.

Manual Installation for Cygwin:

If you have installed Tred in the Windows system (as instructed above), you can use it for the Cygwin console (set encoding to Western ISO), together with the lintrees- option of TNT, to draw nicer-looking trees.

Standard version (tnt.exe).- It should run as is, without any further installation in Cygwin. To use the parallel options, you need to:

1 - Make sure you have **libtirpc.dll.a** in **/usr/lib**; install **libtirpc3** with the Cygwin package manager otherwise.

2 - In the Cygwin console, create a **pvm3** directory, in your **$HOME**, with subdirectories as follows:

```
cd $HOME
mkdir pvm3; cd pvm3; mkdir lib; mkdir bin
cd $HOME/pvm3/lib; mkdir CYGWIN
cd $HOME/pvm3/bin; mkdir CYGWIN
```

Note you can cut-and-paste these lines onto your Cygwin console.

3 - Using the text editor of your preference, add the following lines to your **.bashrc** file (in your **$HOME** directory):

```
export PVM_ROOT=$HOME/pvm3
export PVM_ROOT_U=$HOME/pvm3
export PVM_ARCH=CYGWIN
```

The easiest way to do this is by just **echo**'ing to **.bashrc**:

```
cd $HOME
echo export PVM_ROOT=$HOME/pvm3 >> .bashrc
echo export PVM_ROOT_U=$HOME/pvm3 >> .bashrc
echo export PVM_ARCH=CYGWIN >> .bashrc
```

4 – Go to where you have unpacked TNT, and copy **tnt.exe** to **$PVM_ROOT/bin/CYGWIN**:

```
cp tnt.exe $PVM_ROOT/bin/CYGWIN
```

and then copy **pvmd3.exe** to **$PVM_ROOT/lib/CYGWIN**:

```
cp pvmd3.exe $PVM_ROOT/lib/CYGWIN
```

Note that the daemon **pvmd3** goes to **"lib"** and TNT goes to **"bin"**.

With this, you should be all set with the installation. Although simpler installations are possible (e.g. copying both tnt.exe and pvmd3.exe to /usr/local/bin), the above comes closer to what the automatic TNT installer uses, and will probably facilitate making updates if the TNT installer didn't work the first time.

Step 1–4 are done only once. For an actual run in parallel, every time you turn your machine on, you will need to start the PVM daemon manually from the Cygwin console:

```
$PVM_ROOT/lib/CYGWIN/pvmd3
```

This should answer something like "7f000001:c2f5" or similar and wait for your input; you then send the daemon to the background by typing ctrl-Z, which will reply with:

```
[1]+  Stopped                 ./pvmd3
```

Note: If you have other pending jobs (i.e. processes in the background started in the same session), the response can use numbers other than **[1]**. The daemon then needs to be awaken in the background, with:

```
bg %1
```

(use the corresponding number instead of "1", depending on whether you have other pending jobs).

The daemon creates a file, in **/tmp/pvmd.$EUID** (the **$EUID** environment variable is the number for your "effective user ID" in the system), to keep track of whether the daemon is started and how. If you turn your machine off, the daemon may not remove this file by itself, and then it cannot start again. You need to remove the file manually in the Cygwin console:

rm /tmp/pvmd.$EUID

If you're the only user in the system, then you can just use **rm /tmp/pvmd.*** and not worry about the **$EUID**. Important: do NOT ever remove the **/tmp/pvmd.$EUID** file when the PVM daemon is running; this screws up communications.

MPI version.- You only need to install OpenMPI (and only if you intend to use Mpitnt.exe), and follow the instructions given at the TNT web site, https://www.lillo.org.ar/phylogeny/tnt/MPI_instructions.htm. Note that the MPI version cannot be started (even to just do serial analyses) if you have not installed Open MPI.

GTK version (gTNT.exe).- First, you need to add the following lines to the **.bashrc** file in your Cygwin **$HOME** directory:

export DISPLAY=:0.0

You also need to copy the Tred font to **/usr/share/fonts**, e.g., in the Cygwin console, go to where you have unpacked TNT and then type:

cp Tred.ttf /usr/share/fonts

Before starting gTNT, you need to launch the X11 server (the graphic server) on the Cygwin console:

XWin :0 -clipboard -multiwindow -noprimary

Note that you will have to start the X11 server every time you turn your computer ON.

If you have installed **tnt.exe** as instructed above, then **gTNT** will also be able to run in parallel (**tnt.exe** is the parallel engine).