Instructions for the Workshop

This workshop will be held in three 90-minute sessions, each focussing on modeling and solving different types of optimization problems. Techniques will be described briefly so that more time is devoted to modeling and solving problems on a computer. Participants will be expected to install and run various solvers on a computer. Basic knowledge of linear optimization and familiarity with modeling linear programs, mathematical models, linux and C++ or object oriented programming is assumed. Session specific instructions are given after the following general instructions.

Reaching the Venue

The workshop will take place in BITS lab at the ground floor of the new computing center (CC) building next to School of Management (SOM). All participants should first report at the conference venue (VMCC, IIT Bombay), register at the conference desk, have lunch and assemble near the registration desk at 2:15pm. If you are late, you should still report at the registration desk first. You will be guided to the venue from there.

Bringing your own Computer

Bringing your own laptop is optional. If you plan to bring your laptop, make sure the software described below is installed and wifi is working. The venue is equipped with Ubuntu Desktops which we will use for all three sessions.

To use the network, connect to IITB-Guest
Username: orsi2018.wifi
Password: $ERU#vJv

Instructions for Session-1
Linear and nonlinear optimization using FOSSEE Optimization Toolbox (FOT) on Scilab

Prerequisites if you work on your own laptop:
FOT runs on Scilab 5.5.2, on Ubuntu (16.04 to 17.10), and Windows (7 to 10) 64-bit operating systems.

1. Laptop with 64-bit Ubuntu (16.04 to 17.10) OR Windows (7/8/10) 64-bit operating systems.
2. Your laptop should be capable of connecting to a WiFi network.
3. Scilab 5.5.2 (64-bit) should be installed. See instructions below for details.

4. It is **mandatory** for the participants to know the basics of Scilab. To learn, refer to Tutorials 3 to 9 at https://spoken-tutorial.org/tutorial-search/?search_foss=Scilab&search_language=English
5. FOT should be installed and verified. See instructions below for details.

Note: This toolbox will NOT work on 32 bit systems, or on any other version of Scilab/OS. Please note that it will not work on Macintosh machines.

Instructions for Scilab installation:

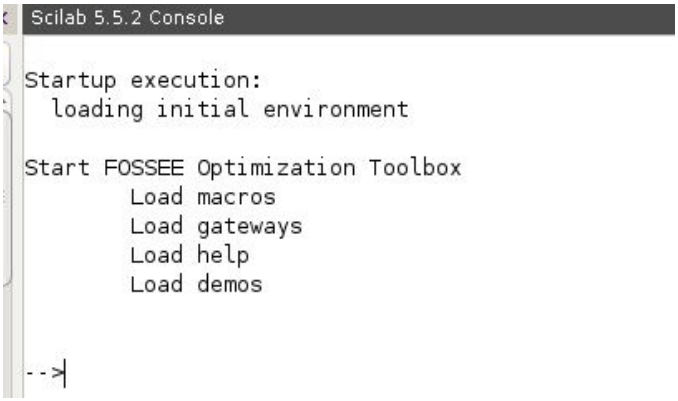
- To install scilab on Windows, please do the following:
  - Go to http://www.scilab.org/en/download/previous
  - Download the correct version of Scilab 5.5.2 installer for your OS.
  - Run the downloaded installer and follow the Installation wizard.

- To install Scilab on Ubuntu Linux OS, do the following:
  - Connect to a network
  - Open the Terminal using Ctrl+Alt+T
  - Execute *sudo apt-get install scilab*. You will need root privileges to do this.

- If the above steps for installing Scilab on Linux did not work, please do the following:
  - Go to http://www.scilab.org/en/download/previous
  - Download the correct version of Scilab 5.5.2 installer for your OS.
  - Extract the file in the directory of your choice.
  - Open the Terminal using Ctrl+Alt+T
  - Execute *cd<space>path-to-scilab-5.5.2/bin*
  - Execute *bash scilab*
  - Scilab will launch without needing any installation.

Instructions for Toolbox installation:

- To install the FOSSEE Optimization Toolbox, go to the Scilab Console and type *atomsInstall("FOT").* If no error message appears, then the toolbox is installed.
- Restart Scilab. You should see the toolbox getting loaded at startup. The following is how your Scilab console should look like:



- If you could not install FOT using the above steps, do the following:
  - Go to http://atoms.scilab.org/toolboxes/FOT/
  - Download the correct toolbox zip file for your OS.
  - Extract the file.
  - Navigate to the toolbox directory in Scilab.
  - On the Scilab Console, type *exec loader.sce;*
- If that doesn't work, please email us at toolbox@scilab.in with the relevant screenshots.

- If the toolbox installation is successful, do the following to **verify** it:
  - Type *[xopt,fopt] = linprog([2.5],[],[],[3],[5],[0],[6])*
  - Press Enter
  - Your console should display the following as the result:
    - Optimal Solution.

```
 fopt  =

   4.1666667
 xopt  =
   1.6666667
```

Instructions for Session-2
Mixed-Integer Nonlinear Optimization

Prerequisites if you bring your own laptop:

- Laptop with a working WiFi device
- Laptop with a 64-bit linux distribution.

To compile MINOTAUR:

1. Install the following (prerequisite) software: open a terminal (Ctrl+Alt+T) and type the command as mentioned in the second column of the following table, if the package is not present on your system. To check the installation, type the command in the third column.

   Alternatively, multiple packages can be installed at the same time by naming them separated by spaces., like:

   ```
   sudo apt install cmake pkg-config g++ gfortran libblas-dev liblapack-dev git
   ```

Software	Command	To check
CMake	`sudo apt install cmake`	`dpkg -s cmake`
pkg-config	`sudo apt install pkg-config`	`dpkg -s pkg-config`
g++	`sudo apt install g++`	`dpkg -s g++`
gfortran	`sudo apt install gfortran`	`dpkg -s gfortran`
blas and lapack	`sudo apt install libblas-dev`	`dpkg -s libblas-dev`
lapack	`sudo apt install liblapack-dev`	`dpkg -s liblapack-dev`
git	`sudo apt install git`	`dpkg -s git`

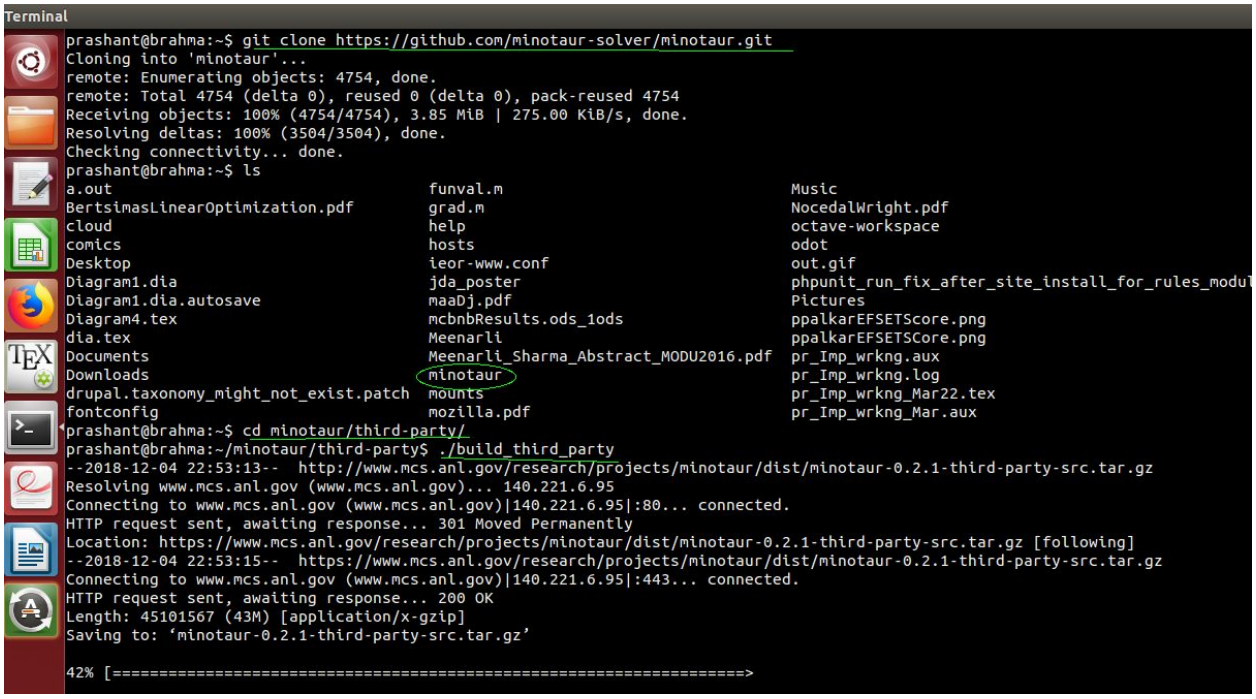
2. Open a terminal and type:

   `git clone https://github.com/minotaur-solver/minotaur.git`

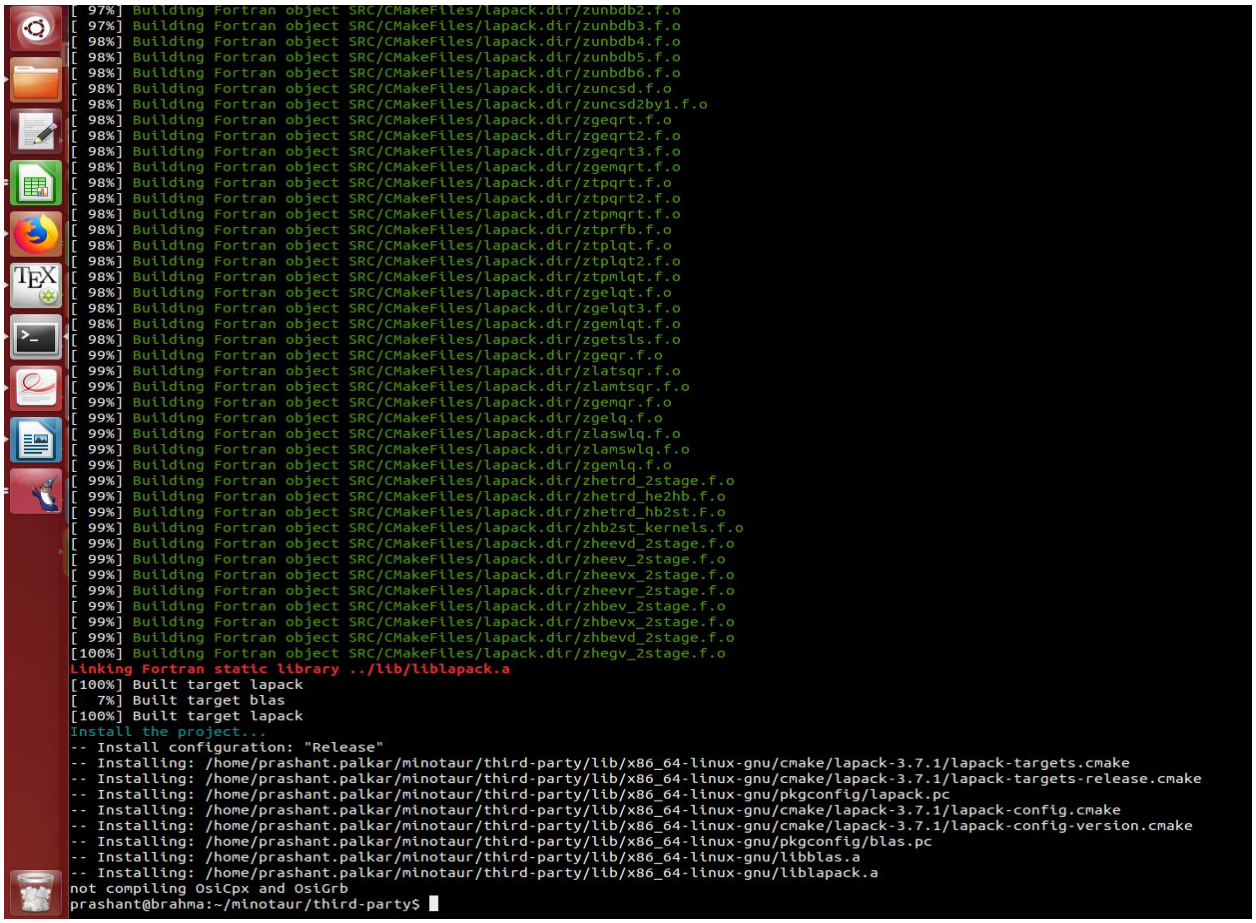
3. You must see a directory named *minotaur*. To compile third-party libraries, type the below commands on the terminal:

   `cd minotaur/third-party`
   `./build_third_party`

   See the below image to get an idea of how steps 2 and 3 written on a terminal look like. Look at the green underlined parts.



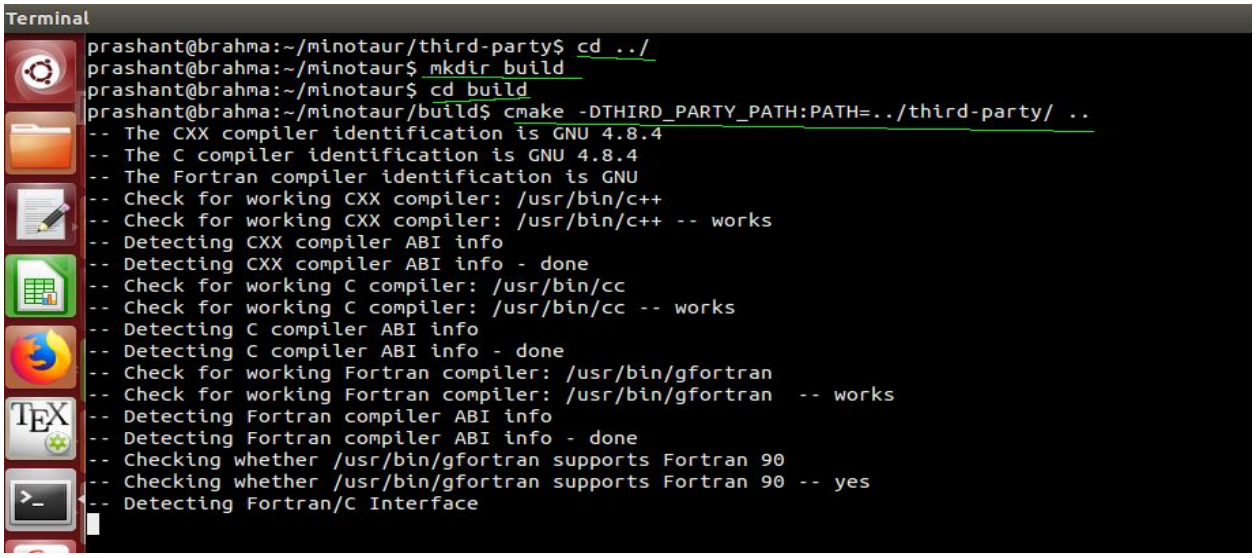
Completion of step 3 will look as in following picture



4. To start compiling MINOTAUR, type the following commands:

```
cd ..
cd minotaur
mkdir build
cd build
cmake -DTHIRD_PARTY_PATH:PATH=../third-party/ ..
```

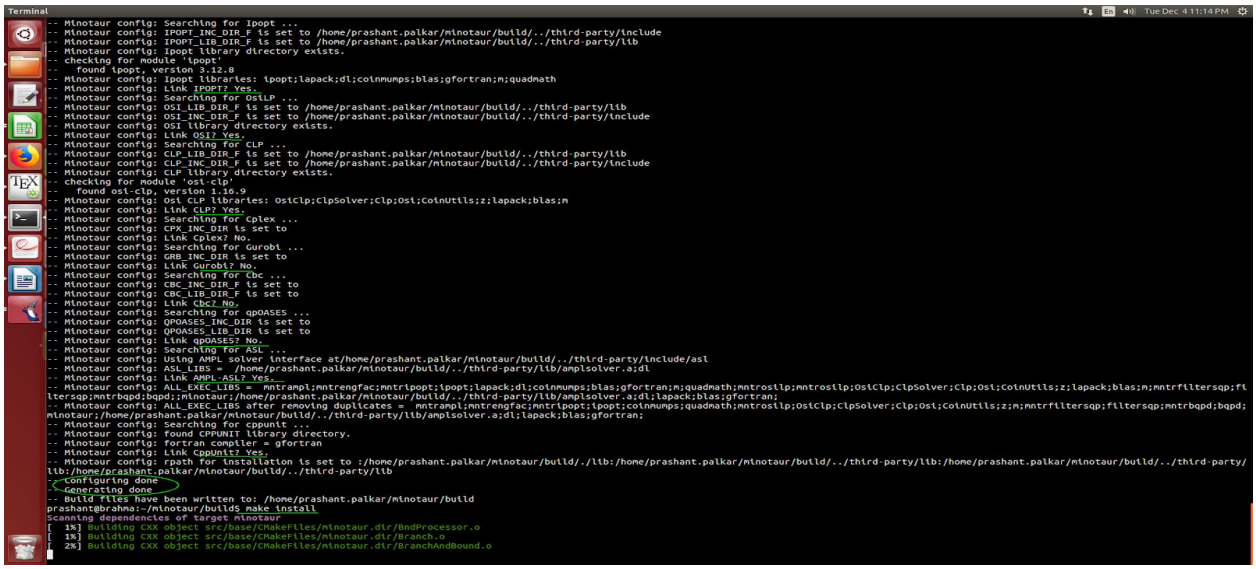
Commands in Step 4 should appear as in the following picture.



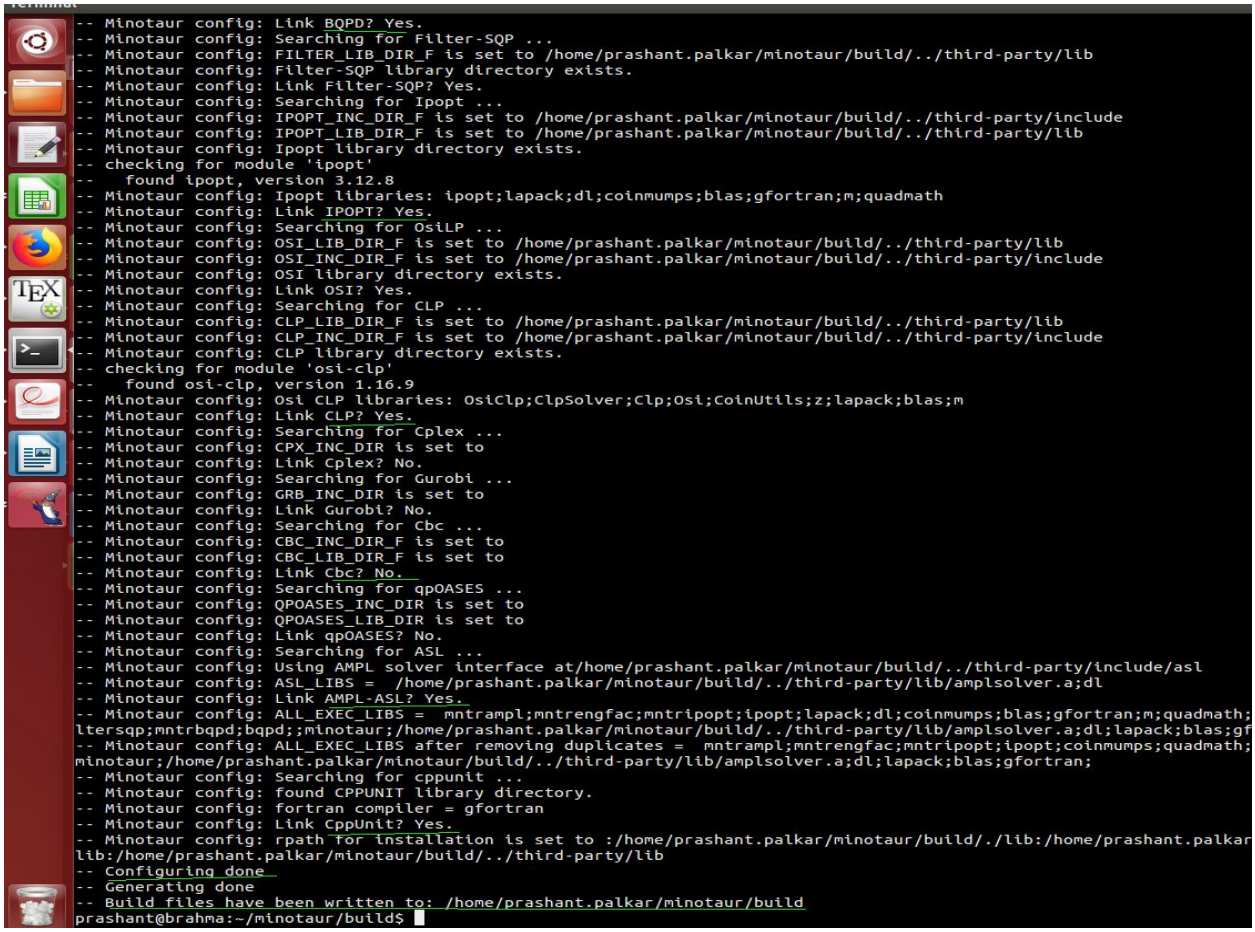
5. Last step of the compilation is:

```
make install
```

Completion of the last command in Step 4 and beginning of command in Step 5 appear as follows.

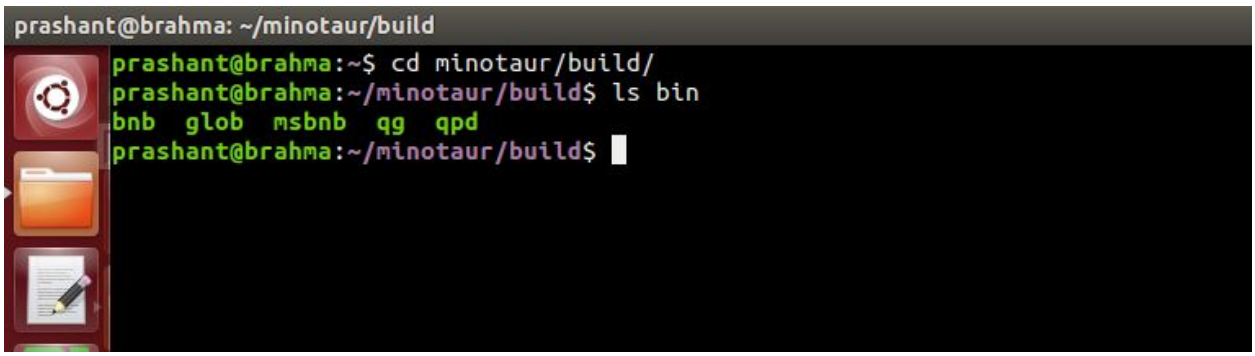


Completion of Step 5 appears as in the below image.



6. If you have have successfully compiled MINOTAUR, you should see binaries in the *bin* directory as shown in the following picture:

   ls bin



To run an example:

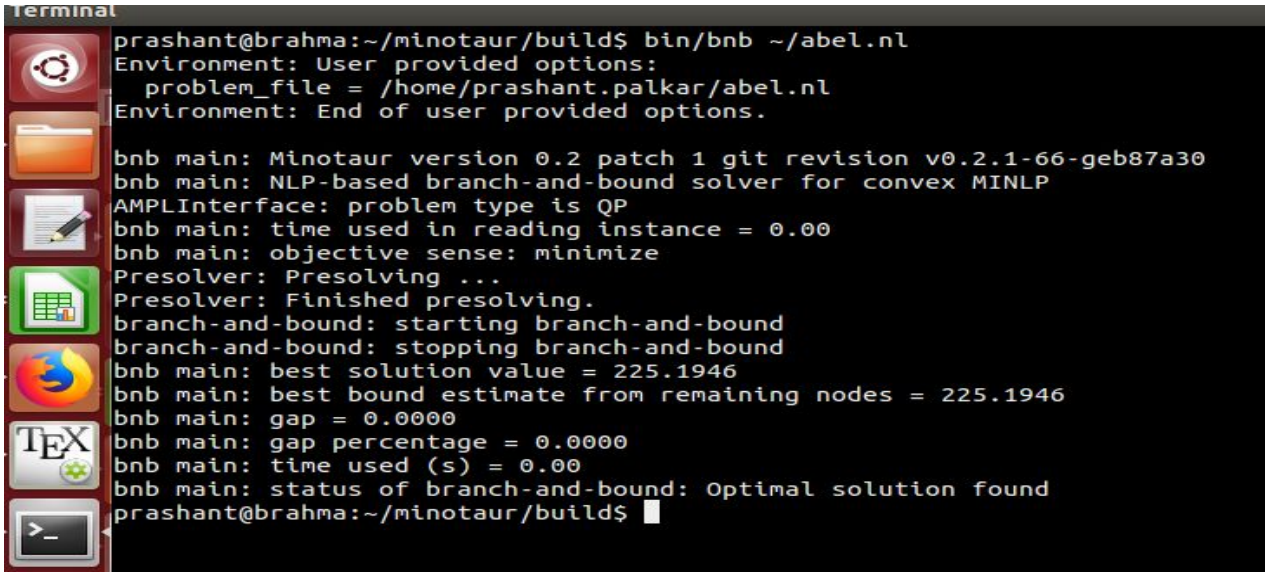
1. Download an instance (convex) using following link:

   http://www.minlplib.org/nl/abel.nl

2. Run the instance (in *.nl* format) using any of the binaries in *bin* following the path where the instance is being downloaded. For example, if the instance *abel.nl* lies in your home directory, try running the nonlinear branch-and-bound algorithm from the build directory using the following command:

   `bin/bnb ~/abel.nl`

   The following figure shows the expected output.



Instructions for Session-3
Constrained Scaled Conjugate Gradient based Direct Search (CSCG-DS)

Prerequisites if you bring your own laptop:

1. Works on linux machines only.
2. Please install lapack and blas libraries. For e.g. in debian, ubuntu, gentoo etc:
   $sudo apt-get install libblas-dev liblapack-dev
3. Download files from https://github.com/gcmouli1/CSCG-DS

This algorithm solves optimization problems without any derivative/gradient information. Written completely in C with only external dependencies of blas and lapack. To run the algorithm, do following steps:

1. Goto the directory CSCG-DS and run the following commands on command prompt.
2. **$make**
3. **$./cscgds parameters.txt**

If it reports a final optimal solution value and number of function evaluations, then the installation is complete.