Ipopt Installation Guide

Elisha Pager

June 15, 2023

1 Requirements

- make executable (CLT)
- pkg-config executable (homebrew)
- C++ compiler for standard C++11 (i.e., g++ executable) (CLT)
- Fortran compiler (i.e., gfortran executable) (homebrew)
- IPOPT software (curently using version 3.12.13) (coin-or)
- cmake executable (required for building CGPOPS) (homebrew)

2 Get System Packages

First the following packages and compilers need to be installed.

1. Make sure Xcode is installed on your mac
2. Install the Xcode Command Line Tools

```
$ xcode-select --install
```

3. Install gcc package through homebrew to obtain gfortran

```
$ brew update
$ brew install bash gcc
$ brew link --overwrite gcc
```

4. Install pkg-config through homebrew

```
$ brew install pkg-config
```

5. Install cmake through homebrew

```
$ brew install cmake
```

3 Get Third–Party Dependencies

You will need to request and obtain an academic license of the HSL (Harwell Subroutines Library) library.

1. Go to https://www.hsl.rl.ac.uk/ipopt/
2. In the Academic License box, click "CODE DOWNLOAD"
3. Select "I want a: Personal Academic License" and follow instructions

4 Build and Install IPOPT

You will need to obtain the Ipopt source code from https://www.coin-or.org/download/source/Ipopt/. Download the zip file for version 3.12.13: Ipopt-3.12.13.zip. Unzip the Ipopt source code in the same directory as CGPOPS.

Next, third–party libraries need to be installed before compiling Ipopt. In the Ipopt-3.12.13 directory:

1. Navigate to the ThirdParty directory

```
$ cd ThirdParty
```

2. Repeat the following steps in the following directories: Blas, Lapack, Metis, Mumps

```
$ cd Blas
$ ./get.Blas
$ ./configure
$ cd ..
$ cd Lapack
$ ./get.Lapack
$ ./configure
$ cd ..
$ cd Metis
$ ./get.Metis
$ ./configure CFLAGS=-Wno-error-implicit-function-declaration
   FCFLAGS=-fallow-argument-mismatch FFLAGS=-fallow-argument-mismatch
$ cd ..
$ cd Mumps
$ ./get.Mumps
$ ./configure CFLAGS=-Wno-error-implicit-function-declaration
   FCFLAGS=-fallow-argument-mismatch FFLAGS=-fallow-argument-mismatch
```

3. Navigate to the HSL ThirdParty directory and run the following commands:
   Note: the HSL download from Section 3 needs to be unzipped and renamed to "coinhsl" and copied into the ThirdParty/HSL directory

```
$ cd ~/Ipopt-3.12.13/ThirdParty/HSL
$ cp /path/to/coinhsl
$ ./configure
```

Now Ipopt is ready to be installed. Compile and install Ipopt using the following commands in terminal within the Ipopt installation directory (i.e, /Ipopt-3.12.13/):

```
$ ./configure CFLAGS=-Wno-error-implicit-function-declaration
   FCFLAGS=-fallow-argument-mismatch FFLAGS=-fallow-argument-mismatch
$ make -j
$ make install
$ make test
```

- Ipopt libraries and header files will be installed in lib/ and include/ directories, respectively, withing Ipopt installation directory (i.e., /Iopt-3.12.13/lib and /Ipopt-3.12.13/include).
- If pkg-config is used, .pc files for installed Ipopt librariews will be located in lib/pkgconfig/ directory within Ipopt installation directory (i.e., /Iopt-3.12.13/lib/pkgconfig).

To make sure Ipopt is installed correctly, run the following example. Within the Ipopt-3.12.13 directory:

```
$ cd Ipopt/examples/hs071_cpp
$ make
$ ./hs071_cpp
```

If this runs and Ipopt successfully finds a solution, you should be ready to use your Ipopt installation with CGPOPS.

5 Installation of CGPOPS for use with Ipopt

Instructions for compiling and installing CGPOPS can be found in the CGPOPS Quick Reference Guide located in the CGPOPS_release repository on SVN. Specifically, follow the instructions in Section 2.6 in the reference guide, but for simplicity it is also included below. Note CGPOPS should be installed in the same directory as Ipopt.

5.1 CMake Build Process

A CMake build process for compiling a libcgpops binary and all examples is available for CMake versions 3.13 and newer. The following commands in the CGPOPS installation directory are typically sufficient:

```
$ mkdir build && cd build
$ cmake ..
$ cmake --build .
$ cmake --install .
```

Executables binaries are installed in **~/build/bin**. Library binaries are installed in **~/build/lib**. Header files are installed in **~/build/include**.

NOTE: The IPOPT installation directory is assumed to be installed in the same directory as CGPOPS or in a **~/cgpops/thirdparty** directory under the name **Ipopt-3.12.13**, **ipopt-3.12.13**, **Ipopt**, or **ipopt**.

Examples of assumed directory tree structure:

```
Software
|___ cgpops
|      |___ build
|      |      |___ bin
|      |      |___ include
|      |      |___ lib
|      |___ ... (other files/folders)
|___ Ipopt-3.12.13
|      |___ include
|      |___ lib
|      |___ ... (other files/folders)
```

```
Software
|___ cgpops
|      |___ build
|      |      |___ bin
|      |      |___ include
|      |      |___ lib
|      |___ ... (other files/folders)
|      |___ thirdparty
|      |      |___ ipopt
|      |      |      |___ build
|      |      |      |      |___ include
|      |      |      |      |___ lib
|      |      |___ ... (other files/folders)
```

If IPOPT is not installed under one of the assumed names or locations, add the following define during the CMake compilation and generation step:

```
$ cmake .. -DIPOPT_DIR=/path/to/Ipopt/installation/directory
```