Genealogical Tree

Find all the descendant on any level of ancestry

0.0.1_45452a0

Generated:
Wed Jul 8 2015 02:42:14 on user@Andress-MacBook-Pro.local

Git Commit Hash:
45452a0

Git Details:
45452a0 (HEAD, origin/master, origin/develop, origin/HEAD, master, develop) Doc and Src own CMakeLists.txt files

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Chapter 1

Genealogical Tree

Summary

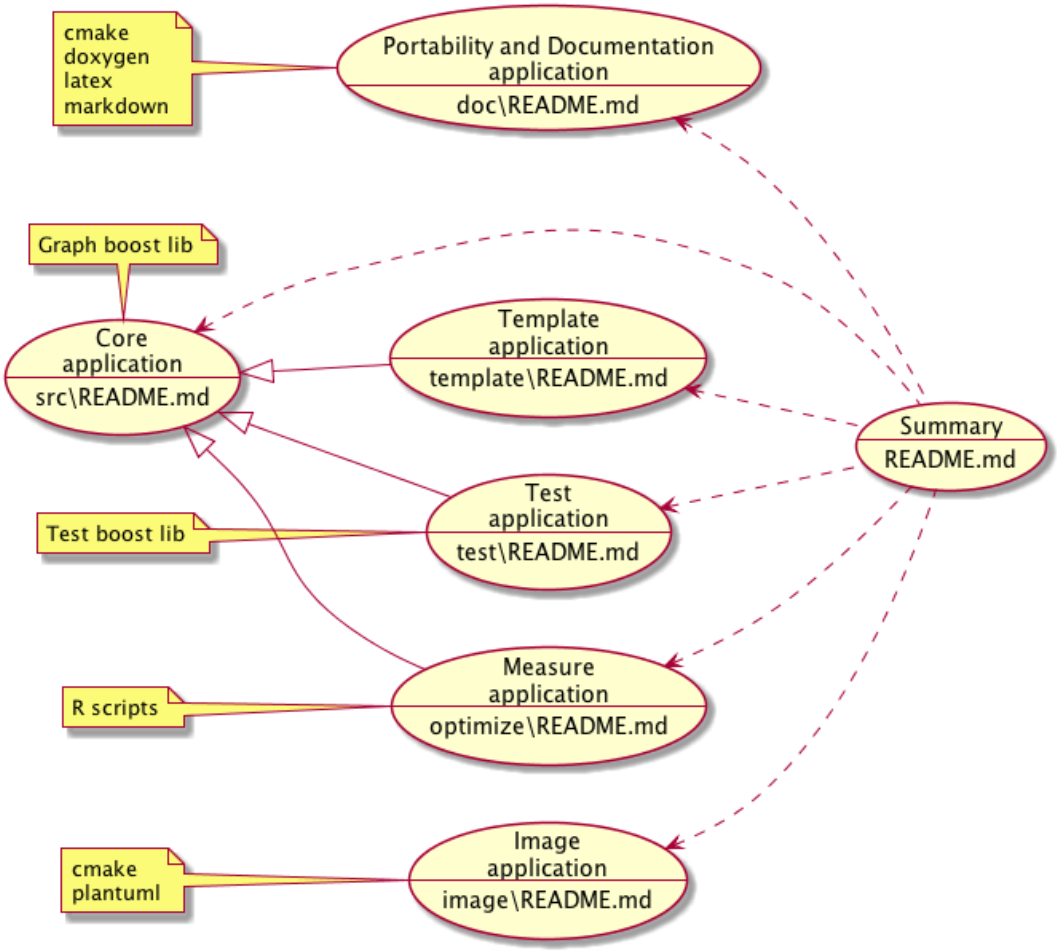
Program should be able to **find all the descendant with name Bob for all the ascendants with name Will on any level of ancestry**. In order to present the capabilities of your app:

- implement the application to optimize the initialization time.
- application should have built in data about genealogical tree of people living in particular country.
- please generate a representative data that has sample people an relationships between them. Use all varieties of names (can be also generated) but also put two test names (Bob and Will) and connect them in different relationships.
- the application should posses tests that are checking possible edge cases and ensure the stability of the application.
- the designed data structure should ensure optimized search time on following fields: name, last name, date of birth and location.

Approach

Instead of starting directly with the problem core, don't test thoroughly edge cases, leaping into too early optimization, don't document your results/decisions/mistakes and ending with an app that only run partially on your development environment, the **aproach** will be the opposite one.

1. Ensure a minimum of portability on different environments.
2. Generate diagrams from codex and documentation to be able to track down all the changes.
3. Use templates to gather external information to document as much automatically as possible.
4. Write tests to cover your app and let you optimize knowing you're not breaking previous development.
5. Measure your application in order to compare improvements/regressions during the optimization stage.
6. Solve the core problem in the most simple and maintainable way at our disposal.



No doubt this approach is an overkill for a pet project but it's way more realistic for big, long C++ ones.

Chapter 2

Portability and documentation

A Modern C++ GNU compiler, g++ 4.9.2 or above, and a recent cmake, 3.1 or above, are the minimum. As well a valid *boost* library is supposed to be installed.

DEB Linux Type

Regarding to documentation, *doxygen*, *latex*, *graphviz* and *plantuml.jar* are needed. For example, if you work with ∗#Xubuntu∗∗ 15.04 or its **Docker** equivalent, the following commands might do the trick for you:

```
sudo apt-get -y install git build-essential libboost-all-dev
sudo apt-get -y install doxygen doxygen-latex openjdk-8-jdk graphviz
sudo add-apt-repository -y ppa:george-edison55/cmake-3.x
sudo apt-get -y update
sudo apt-get -y install cmake
sudo apt-get -y upgrade
sudo mkdir /opt/plantuml && sudo chmod a+wr /opt/plantuml
wget http://sourceforge.net/projects/plantuml/files/plantuml.jar/download \
     -O /opt/plantuml/plantuml.jar
```

If you want to use latest *compiler*, you can use `an extra repository`:

```
sudo add-apt-repository ppa:ubuntu-toolchan-r/test
sudo apt-get update
sudo apt-get install gcc-5 g++-5
```

But then you might want to `compile newer *boost* libraries` with that compiler.

RPM Linux type

Another typical Linux platform is **CentOS**. Their `*gcc*` and `*cmake*` are very conservative, even for *CentOS 7*, so compile newer ones from **source code** might be a possibility:

CMake:

Download *tar.gz* with latest version and *untar* its source code

```
cd <building directory>
./bootstrap --prefix=/opt/cmake --mandir=/opt/cmake/man --docdir=/opt/cmake/doc
make
sudo make install
```

Compiler

It's going to take long so try to use all the cores you got

```
mkdir ~/sourceInstallations
```

```
cd ~/sourceInstallations
svn co svn://gcc.gnu.org/svn/gcc/tags/gcc_5_1_0_release/
cd gcc_5_1_0_release/
./contrib/download_prerequisites
cd ~/sourceInstallations
mkdir gcc_5_1_0_release_build/
cd gcc_5_1_0_release_build/
../gcc_5_1_0_release/configure --enable-lenguages=c,c++ --prefix=/opt/gcc \
                               --program-suffix=-5 --disable-multilib
make -j <number of cores>
sudo make install

cd /usr/bin
sudo ln -s /opt/gcc/bin/gcc-5 gcc-5
sudo ln -s /opt/gcc/bin/g++-5 g++-5
```

Boost

A long compilation that needs to be told where to get the proper toolset.

```
cd <folder with source code>
cp tools/build/example/user-config.jam .
```

Don't forget to edit *user-config.jam* to point to **g++-5**, i.e., *using gcc : 5 : /opt/gcc/bin/g++-5*

```
using gcc : 5 : /opt/gcc/bin/g++-5
:
<dll-path>/opt/gcc/lib64:/opt/gcc/boost/lib
<harcode-dll-paths>true
<cxxflags>-std=c++14
<cxxflags>-Wl,-rpath=/opt/gcc/lib64:/opt/gcc/boost/lib
<linkflags>-rpath=/opt/gcc/lib64:/opt/gcc/boost/lib
;
```

Note: Not all the targets might be created. If some of the missing ones are required for your apps, try to hack *boost* compilation scripts.

```
./bootstrap.sh --prefix=/opt/gcc/boost --with-toolset=gcc
sudo ./b2 -j8 install toolset=gcc-5 --prefix=/opt/gcc/boost \
          threading=multi define=BOOST_SYSTEM_NO_DEPRECATED stage release
```

Note: Take into account when compile with 'g++-5' on one Linux platform that got its own previous compiler version, you should let know to the **linker** where to get 'g++-5' libraries. Try to avoid **LD_LIBRARY_PATH** and use instead **RPATH**:

```
g++-5 -pthread --std=c++14 -Wl,-rpath=/opt/gcc/lib64 <rest of options>
```

In case of your linking against *boost* generates too many *auto_ptr* deprecated warnings:

```
g++-5 -pthread -std=c++14 -Wno-deprecated -Wl,-rpath=/opt/gcc/lib64:/opt/gcc/boost/lib \
      -I/opt/gcc/boost/include -L/opt/gcc/boost/lib -lboost_program_options <rest of options.
```

Hint: If you generate those *cmake*, *gcc* and *boost* on one machine and then copy them onto another, remember that there is **soft links** involved.

OSX type

In order to use *GNU* compiler instead of *XCode* **clang** one, there are several options. The one followed for this project was Homebrew.

Note: If you happen to work with *OSX* and *Homebrew*, don't forget to compile **boost** with the previous **gcc** compiler, not with the default *clang* one:

```
brew install gcc
brew install boost --cc=gcc-5
```

Windows type

As well there are several options to get your *GNU* chaintool ready on windows instead of *Visual Studio*. For example, Git and MinGW.

Another option might be following MSYS2 instruction:

```
pacman -Syu
pacman -S mingw-w64-x86_64-toolchain mingw-w64-x86_64-pkgconf make
pacman -S git mingw-w64-x86_64-cmake-git
```

Generate binaries & documentation

Usual commands:

```
mkdir build
cd build
cmake ..
make
make doc
```

Optionally you can invoke *make install* to install binaries or *make install_doc* / *make show* to install / preview documentation.

Note: If you happen to work with *OSX* and Homebrew, don't forget to invoke *cmake* pointing to the **GNU** compiler:

```
cmake -DCMAKE_CXX_COMPILER=/usr/local/bin/g++-5 ..
```

Note: If you happen to work with *Windows* and Git/MinGW, don't forget to invoke *cmake* pointing to the **GNU** generator:

```
cmake -G "MSYS Makefiles" ..
```

As well a script, called **show** or something similar, will be created in your *home* directory as a shortcut for generating & viewing documentation. Don't hesitate to use it as a *template* for your specific environment.

Generate only documentation

Similar commands to the previous ones, just the compiler is not required:

```
mkdir build
cd build
cmake -DONLY_DOC=TRUE ..
make doc
```

Note: If you happen to work with *Windows* and Git/MinGW, don't forget to invoke *cmake* pointing to the **GNU** generator:

```
cmake -G "MSYS Makefiles" -DONLY_DOC=TRUE ..
```

Note: If your **make** utility is not installed in the default place, define *CMAKE_BUILD_TOOL*

```
cmake -G "MSYS Makefiles" -DCMAKE_BUILD_TOOL=<your location> -DONLY_DOC=TRUE ..
```

As well, if you installed the documentation utility with **make show**, you're supposed to able to recreate and view that documentation PDF though usual *ssh* connection with enabled X11:

```
ssh -X <user>@<location> "./show"
```

Note: By default **make install_doc** or **make show** copy the documentation *PDF* with the default project name in your **home** directory. You can define that target file with:

```
cmake <rest of options> -DDOC_PDF=<your path & name, ending in .pdf> ..
```

IDE hints

To use **NetBeans** don't forget to configure a *cmake* project with *custom* **build** folder. Add at that moment any extra customization in the command line used by *cmake* instruction. For example:

- -DCMAKE_CXX_COMPILER=g++-5 for **OSX**
- -DONLY_DOC=TRUE for only documentation on **Linux**/**OSX**
- -G "MSYS Makefiles" for **Windows**
- -G "MSYS Makefiles" -DONLY_DOC=TRUE for only documentation on **Windows**

Note: If you happen to use *jVi* plugin on *OSX*, don't forget to use "-lc" instead of just "-c" for its /bin/bash flag.

Development details

In order to generate binaries & documentation, the following versions were used:

For code

Pay attention to *cmake* and *gcc* versions. A minimum is required to work on several O.S. using modern C++. Feel free to locally hack **CMakeLists.txt** to meet your needs.

Linux (Xubuntu 15.04)

- **cmake** *3.2.2*
- **gcc** *4.9.2*
- **boost** *1.55*

OSX (Yosemite 10.10.4)

- **cmake** *3.2.2*
- **gcc** *5.1*
- **boost** *1.58*

Windows (Win7 x64)

- **cmake** *3.3.0*
- **gcc** *5.1*
- **boost** *1.58*

For documentation

Environment variables to locate PlantUML *jar* and default *PDF* viewer can be defined to overwrite default values. See **CMakeLists.txt** for further information on your platform.

Linux

- **doxygen** *1.8.9.1*
- **latex**/**pdfTeX** *2.6-1.40.15*
- **graphviz**/**dot** *2.38.0*
- **java**/**plantuml** *1.8.0_45/8026*

OSX

- **doxygen** *1.8.9.1*
- **latex**/**pdfTeX** *2.6-1.40.15*
- **graphviz**/**dot** *2.38.0*
- **java**/**plantuml** *1.8.0_40/8026*

Windows

- **doxygen** *1.8.9.1*
- **latex**/**pdfTeX** *2.9.5496-1.40.15*
- **graphviz**/**dot** *2.38.0*
- **java**/**plantuml** *1.8.0_45/8026*

Note: Don't forget configure *Doxyfile* and *CMakeLists.txt* to use **README.md** as *Main Page* for **latex** documentation.

Chapter 3

Generate diagrams from code or documentation

Diagrams related directly to the current code are a key part of any kind of technical documentation. As well being able to track down partial changes **inside** of those images along the code itself right out off the bat it's a huge improvement.

Low level considerations

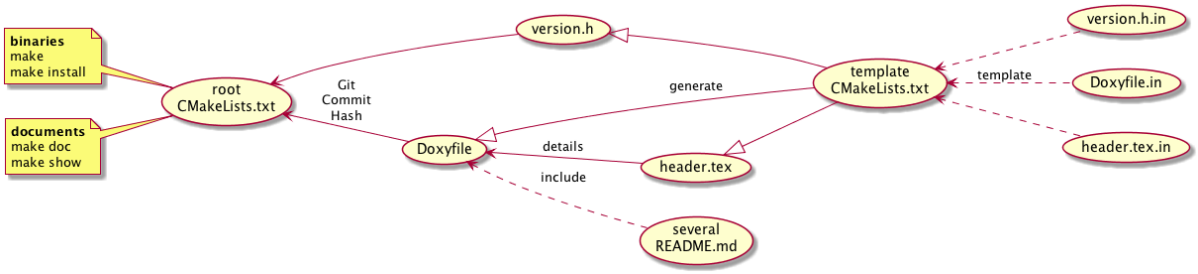
The tool is [PlantUML]http://plantuml.sourceforge.net) and the format usually used is **PNG**. The reason behind was that **metadata** information is embedded into those photos and it might be checked out images before even generating them. This way you can save a huge deal of time at big projects and avoid stesssing too much your *GIT* repositories with binaries.

That feature is not implemented at this pet project. So in order to prevent GIT from uploading too much binaries,

Chapter 4

Templates to gather external information

The basic external information to be included is **GIT COMMIT HASH**. This way *code* and *documentation* are related by this piece of information.



As well information on the machine where **cmake** was invoked is collected.

Note: Take into account that **the last commit** information will be processed; if there are new changes not yet committed, they will be included anyway. So in order to generate *final official* documentation first commit all your changes, generate the documentation and, if needed, commit that generated document.

GIT Commit Hash

In order to add the specific **git commit hash** into code & documentation, *templates* are defined in the *template* folder for **Doxyfile**, **header.tex** & **version.h** files.

In order to **speed up** local compilations and let us hardcode our locally generated files, it's possible to instruct *cmake* to use this hardcoded header instead of usual GIT one.

The parameter to pass onto **cmake** is **VERSION_HARDCODED**:

```
cmake <rest of options> -DVERSION_HARDCODED=TRUE ..
```

Chapter 5

Test your application

Taking advantage of *boost* test cases as explained at An Engineer's Guide to Unit Testing.

Chapter 6

Measure your application

Scripts to gather information on performance. Basically *statistical information* on execution time of different approaches.

Chapter 7

Application Core Code

Source folder for headears & code files directly involved with the core problem.

Limits

First of all, we should grasp a rough idea about which range of numbers to consider:

- Most Populous Country: China
  Inhabitants: around 1400000000
- Another populous country, culturally diverse: USA
  Number of first & last names: around 5200 & 152000
- Example of baptism registers: Ireland
  Roman Catholic: around 19th century
- Marriageable age: world
  Some common value: around 20
- Number of locations: India
  Number of villages: around 640000

Assumptions on numbers

This way we can assume that taking into account around 200 years of sensible information on our ascendants, around 10 generations back in time, we suppose not to deal with more than 4000000000 individuals.

As well, we could consider that our application should only tackle around different 6000 first names or 60000 last names in our given country. Even we can take for granted that there aren't more than 60000 locations, that we might classify them in two levels; one coarse level easy to remember and another fine one more close to small places.

Translate into C++:

- First Name: unsigned short int (uint16_t)
- Last Name: unsigned short int (uint16_t)
- Year of Birth: unsigned char (unit8_t) $<$ 200 years
- Coarse Location of Birth: unsigned short int (unit8_t)
- Month of Birth: unsigned char (uint8_t)
- Day of Birth: unsigned char (unit8_t)

- Fine location of Birth: unsigned short int (uint8_t)
- More information related to a specific subject: extra indexes.

This way we can use the **first 64 bits of information** as a valid **identification** for the individuals and with the advantage of getting the relevant information to debug first: *name and generation*.

Generated Files

version.h is generated with *GIT* information by *cmake*.

But in order to **speed up** local compilations and let us hardcode our locally generated files, it's possible to instruct *cmake* to use this hardcoded header instead of usual GIT one.

The parameter to pass onto **cmake** is **VERSION_HARDCODED**:

```
cmake <rest of options> -DVERSION_HARDCODED=TRUE ..
```

Chapter 8

Class Index

8.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 9

File Index

9.1 File List

Here is a list of all documented files with brief descriptions:

Chapter 10

Class Documentation

10.1 struct_index_t Struct Reference

Public Attributes

- char **year**

The documentation for this struct was generated from the following file:

- src/id.h

10.2 union_id_t Union Reference

Public Attributes

- uint64_t **id**
- struct_index_t **index**

The documentation for this union was generated from the following file:

- src/id.h

Chapter 11

File Documentation

11.1 src/id.h File Reference

```
#include <cstdint>
#include <iostream>
```

Classes

- struct struct_index_t
- union union_id_t

Functions

- std::ostream & **operator**<< (std::ostream &os, const union_id_t &u)

Variables

- static constexpr const union_id_t **EMPTY_UNION_ID** {0}

11.1.1 Detailed Description

Define types for id's for our subjects

A first approach of getting packed id & basic information in form of indexes:

- First Name: unsigned short int (uint16_t)
- Last Name: unsigned short int (uint16_t)
- Year of Birth: unsigned char (unit8_t) < 200 years
- Coarse Location of Birth: unsigned short int (unit8_t)
- Month of Birth: unsigned char (uint8_t)
- Day of Birth: unsigned char (unit8_t)

Grouping all that indexes we got a 64 bits identification

11.2 src/main.cpp File Reference

```
#include <iostream>
#include "version.h"
#include "id.h"
```

Functions

- int main (int argc, char **argv)
  Main function.

11.2.1 Function Documentation

11.2.1.1 int main (int *argc*, char ** *argv*)

Main function.

Parameters

argc	An integer argument count of the command line arguments
argv	An argument vector of the command line arguments

Returns

an integer 0 upon exit success

11.3 src/version.h File Reference

Macros

- #define **DEFINE_VERSION_FIRST** "0"
- #define **DEFINE_VERSION_MIDDLE** "0"
- #define **DEFINE_VERSION_LAST** "1"
- #define **DEFINE_GIT_DETAILS** "45452a0 (HEAD, origin/master, origin/develop, origin/HEAD, master, develop) Doc and Src own CMakeLists.txt files"
- #define **DEFINE_GIT_COMMIT_HASH** "45452a0"
- #define **DEFINE_VERSION**

Variables

- static const char * **VERSION** = "VERSION = " DEFINE_VERSION
- static const char * **GIT_DETAILS** = "GIT_DETAILS = " DEFINE_GIT_DETAILS

11.3.1 Detailed Description

This metadata information might be located through **strings** command

- Linux/Solaris/Mac:

```
strings <binary> | grep VERSION
strings <binary> | grep GIT_DETAILS
```

- Windows (MinGW):

```
strings <binary> | findstr VERSION
strings <binary> | findstr GIT_DETAILS
```

11.3.2 Macro Definition Documentation

11.3.2.1 #define DEFINE_VERSION

Value:

```
DEFINE_VERSION_FIRST "." \
        DEFINE_VERSION_MIDDLE "." DEFINE_VERSION_LAST \
    "_" DEFINE_GIT_COMMIT_HASH
```

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