

# NERCMS TEST

## 17级计科-康楷晨

文档说明：在一边尝试一边记录的过程中，我对下面三个问题编写的格式都是——过程+结论——的形式，如果只要看结论的话，每个问题最后一点说明就是该问题我所得出的结论。

### 1. LAS文件中 *POINT DATA RECORD FORMAT 0* 和 *POINT DATA RECORD FORMAT 2* 间的差异

1. 对于这个问题，首先了解了LIDAR系统以及LAS格式的基本信息，LAS标准问题阅读的是[LAS Specification 1.4 - R15](#)说明书[在这个过程中我阅读的是0-20页，后来看到20页发现这个问题的答案只有一句话.....]
2. *POINT DATA RECORD FORMAT 0* 和 *POINT DATA RECORD FORMAT 2*最大的区别就是格式2里面增加了表示RGB的三个颜色通道位，用于显示点的着色，各占2 Bytes位

### 2. Ubuntu 18.04环境下配置libLAS，并确定你配置的 libLAS 头文件 liblas.hpp 的路径

配置环境这里使用的是Ubuntu18.04（当时加入小组群较晚，直接在自己的已有系统上进行配置了），下面对出现的一小部分问题以及最终结果进行记录

1. cmake
  - 在配置过程中没有使用make而使用cmake，由于在解压了libLAS-1.8.1之后看到里面并不是用makefile作为代码组织和编译方式的，而是采用了CMakeList.txt进行组织的，故使用cmake进行，通过对cmake进行简单阅读后看到了cmake较于makefile的优势，更加自动化、可跨平台而且上层。
  - 安装cmake，当时系统里面是没有安装cmake的[大致看了一下liaLAS的CMakeList.txt，发现最低cmake版本为2.6.0]

```

活动 窗口 终端
星期三 11:51
joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1/build$ sudo apt install cmake
正在读取软件包列表... 完成
正在分析软件包的依赖关系树
正在读取状态信息... 完成
下列软件包是自动安装的并且现在不需要了:
  dh-python python-all
使用'sudo apt autoremove'来卸载它(它们)。
将会同时安装下列软件:
  cmake-data libcurl4 libjsoncpp1 librhash0 libuv1
建议安装:
  cmake-doc ninja-build
下列 [新] 软件包将被安装:
  cmake cmake-data libcurl4 libjsoncpp1 librhash0 libuv1
升级了 0 个软件包, 新安装了 6 个软件包, 要卸载 0 个软件包, 有 215 个软件包未被升级。
需要下载 4,914 kB 的归档。
解压缩后会消耗 25.5 MB 的额外空间。
您希望继续执行吗? [Y/n] y
获取:1 http://mirrors.tuna.tsinghua.edu.cn/ubuntu bionic-updates/main amd64 cmake-data all 3.10.2-1ubuntu2.18.04.1 [1,332 kB]
获取:2 http://mirrors.tuna.tsinghua.edu.cn/ubuntu bionic-updates/main amd64 libcurl4 amd64 7.58.0-2ubuntu3.8 [214 kB]
获取:3 http://mirrors.tuna.tsinghua.edu.cn/ubuntu bionic/main amd64 libjsoncpp1 amd64 1.7.4-3 [73.6 kB]
获取:4 http://mirrors.tuna.tsinghua.edu.cn/ubuntu bionic/main amd64 librhash0 amd64 1.3.6-2 [78.1 kB]
获取:5 http://mirrors.tuna.tsinghua.edu.cn/ubuntu bionic/main amd64 libuv1 amd64 1.18.0-3 [64.4 kB]
获取:6 http://mirrors.tuna.tsinghua.edu.cn/ubuntu bionic-updates/main amd64 cmake amd64 3.10.2-1ubuntu2.18.04.1 [3,152 kB]
已下载 4,914 kB, 耗时 2分 11秒 (37.5 kB/s)
正在读取未选择的软件包 cmake-data...
(正在读取数据库... 系统当前共安装有 149242 个文件和目录。)
正准备解包 .../0-cmake-data_3.10.2-1ubuntu2.18.04.1_all.deb ...
正在解包 cmake-data (3.10.2-1ubuntu2.18.04.1) ...
正在选中未选择的软件包 libcurl4:amd64。
正准备解包 .../1-libcurl4_7.58.0-2ubuntu3.8_amd64.deb ...
正在解包 libcurl4:amd64 (7.58.0-2ubuntu3.8) ...
正在选中未选择的软件包 libjsoncpp1:amd64。
正准备解包 .../2-libjsoncpp1_1.7.4-3_amd64.deb ...
正在解包 libjsoncpp1:amd64 (1.7.4-3) ...
正在选中未选择的软件包 librhash0:amd64。
正准备解包 .../3-librhash0_1.3.6-2_amd64.deb ...
正在解包 librhash0:amd64 (1.3.6-2) ...
正在选中未选择的软件包 libuv1:amd64。
正准备解包 .../4-libuv1_1.18.0-3_amd64.deb ...
正在解包 libuv1:amd64 (1.18.0-3) ...
正在选中未选择的软件包 cmake。
正准备解包 .../5-cmake_3.10.2-1ubuntu2.18.04.1_amd64.deb ...
正在解包 cmake (3.10.2-1ubuntu2.18.04.1) ...
正在设置 libuv1:amd64 (1.18.0-3) ...
正在设置 libcurl4:amd64 (7.58.0-2ubuntu3.8) ...
正在设置 cmake-data (3.10.2-1ubuntu2.18.04.1)

```

- 进行这个库的编译工作，在此需要注意的是：通过阅读，我了解到如果直接在该目录下进行编译，那么会将所有生成的中间文件和源代码混在一起，而且cmake生成的makefile无法跟踪所有的中间文件，即无法使用“make distclean”命令将所有的中间文件删除。**所以我在内部建立了build文件夹，在该目录下进行编译的工作。**

```

joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1/build$ cd ..
joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1$ ls
apps  bin  buildout  CMakeLists.txt  csharp  doc  INSTALL  NEWS  rpm  test
AUTHORS  build  cmake  COPYING  csharp-new  include  LICENSE.txt  python  src
joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1$ 

```

- 编译项目到build文件夹下：**cmake ..**

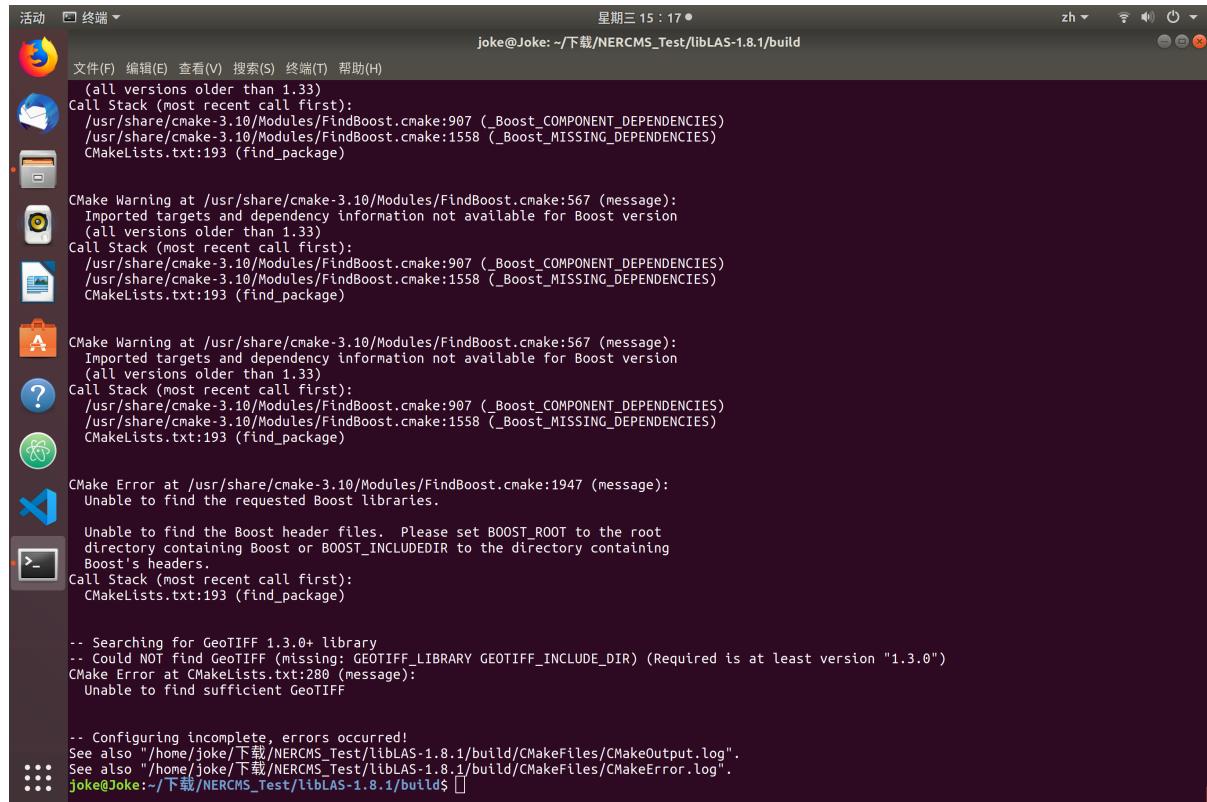
```

活动 窗口 终端
星期三 15:16
joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1/build$ cmake ..
-- The C compiler identification is GNU 7.4.0
-- The CXX compiler identification is GNU 7.4.0
-- Check for working C compiler: /usr/bin/cc
-- Check for working C compiler: /usr/bin/cc -- works
-- Detecting C compiler ABI info
-- Detecting C compiler ABI info - done
-- Detecting C compile features
-- Detecting C compile features - done
-- Check for working CXX compiler: /usr/bin/c++
-- Check for working CXX compiler: /usr/bin/c++ -- works
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler ABI info - done
-- Detecting CXX compile features
-- Detecting CXX compile features - done
-- Setting libLAS build type - Release
-- Searching for Boost 1.38+ - done
-- Looking for pthread.h
-- Looking for pthread.h - found
-- Looking for pthread_create
-- Looking for pthread_create - not found
-- Looking for pthread_create in pthreads
-- Looking for pthread_create in pthreads - not found
-- Looking for pthread_create in pthread
-- Looking for pthread_create in pthread - found
-- Found Threads: TRUE
CMake Warning at /usr/share/cmake-3.10/Modules/FindBoost.cmake:567 (message):
  Imported targets and dependency information not available for Boost version
  (all versions older than 1.33)
Call Stack (most recent call first):
  /usr/share/cmake-3.10/Modules/FindBoost.cmake:907 (_Boost_COMPONENT_DEPENDENCIES)
  /usr/share/cmake-3.10/Modules/FindBoost.cmake:1558 (_Boost_MISSING_DEPENDENCIES)
  CMakeLists.txt:193 (find_package)

CMake Warning at /usr/share/cmake-3.10/Modules/FindBoost.cmake:567 (message):
  Imported targets and dependency information not available for Boost version
  (all versions older than 1.33)
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  /usr/share/cmake-3.10/Modules/FindBoost.cmake:1558 (_Boost_MISSING_DEPENDENCIES)
  CMakeLists.txt:193 (find_package)

```



```
活动 窗口 终端
星期三 15 : 17 •
joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1/build

文件(F) 编辑(E) 查看(V) 搜索(S) 终端(T) 帮助(H)
(all versions older than 1.33)
Call Stack (most recent call first):
/usr/share/cmake-3.10/Modules/FindBoost.cmake:907 (_Boost_COMPONENT_DEPENDENCIES)
/usr/share/cmake-3.10/Modules/FindBoost.cmake:1558 (_Boost_MISSING_DEPENDENCIES)
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/usr/share/cmake-3.10/Modules/FindBoost.cmake:1558 (_Boost_MISSING_DEPENDENCIES)
CMakeLists.txt:193 (find_package)

CMake Warning at /usr/share/cmake-3.10/Modules/FindBoost.cmake:567 (message):
Imported targets and dependency information not available for Boost version
(all versions older than 1.33)
Call Stack (most recent call first):
/usr/share/cmake-3.10/Modules/FindBoost.cmake:907 (_Boost_COMPONENT_DEPENDENCIES)
/usr/share/cmake-3.10/Modules/FindBoost.cmake:1558 (_Boost_MISSING_DEPENDENCIES)
CMakeLists.txt:193 (find_package)

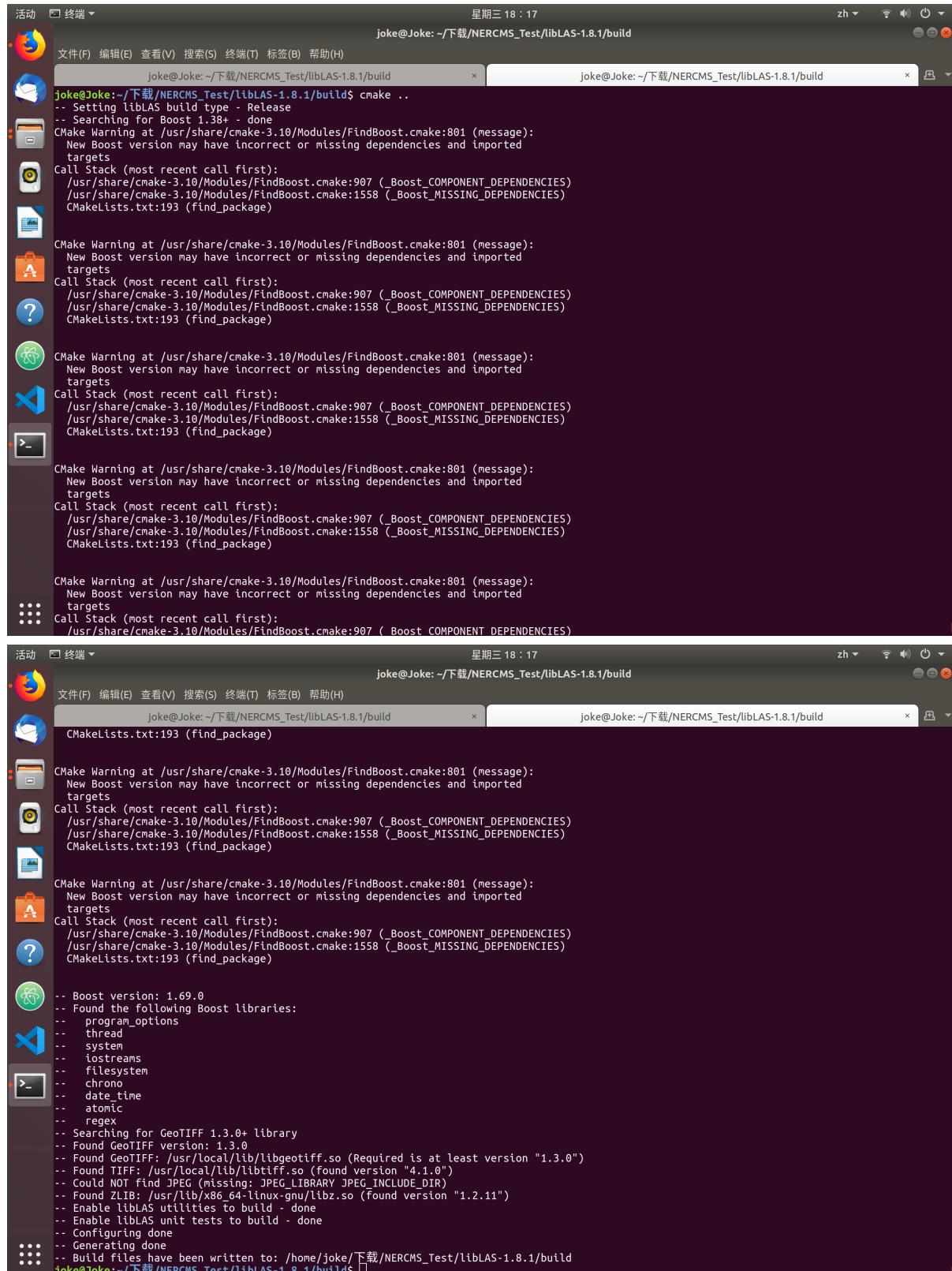
CMake Error at /usr/share/cmake-3.10/Modules/FindBoost.cmake:1947 (message):
Unable to find the requested Boost libraries.

Unable to find the Boost header files. Please set BOOST_ROOT to the root
directory containing Boost or BOOST_INCLUDEDIR to the directory containing
Boost's headers.
Call Stack (most recent call first):
CMakeLists.txt:193 (find_package)

-- Searching for GeoTIFF 1.3.0+ library
-- Could NOT find Geotiff (missing: GEOTIFF_LIBRARY GEOTIFF_INCLUDE_DIR) (Required is at least version "1.3.0")
CMake Error at CMakeLists.txt:280 (message):
  Unable to find sufficient Geotiff

-- Configuring incomplete, errors occurred!
See also "/home/joke/下载/NERCMS_Test/libLAS-1.8.1/build/CMakeFiles/CMakeOutput.log".
See also "/home/joke/下载/NERCMS_Test/libLAS-1.8.1/build/CMakeFiles/CMakeError.log".
joke@Joke:~/下载/NERCMS_Test/libLAS-1.8.1/build$ []
```

- 首次cmake后出现了一些问题，看了报错信息是由于在进行libLAS库的使用前，需要安装Boost和GeoTIFF依赖库，故现在需要对其进行安装。
- `wget -O boost_1_69_0.tar.gz`  
`http://sourceforge.net/projects/boost/files/boost/1.69.0/boost_1_69_0.tar.gz/`  
`download`
- `wget https://download.osgeo.org/geotiff/libgeotiff/libgeotiff-1.3.0.tar.gz`
- 配置GeoTIFF时又出现了TIFF库没有的情况，需要再次添加新的依赖库
- 之后都是简单的进行配置、编译(过程太多，编译太慢，不做叙述)，都完毕后重新cmake libLAS进行编译



```
joke@Joke:~/下载/NERCMS_Test/libLAS-1.8.1/build$ cmake ..  
-- Setting libLAS build type - Release  
-- Searching for Boost 1.38+ - done  
CMake Warning at /usr/share/cmake-3.10/Modules/FindBoost.cmake:801 (message):  
New Boost version may have incorrect or missing dependencies and imported  
targets  
Call Stack (most recent call first):  
/usr/share/cmake-3.10/Modules/FindBoost.cmake:907 (_Boost_COMPONENT_DEPENDENCIES)  
/usr/share/cmake-3.10/Modules/FindBoost.cmake:1558 (_Boost_MISSING_DEPENDENCIES)  
CMakeLists.txt:193 (find_package)  
  
CMake Warning at /usr/share/cmake-3.10/Modules/FindBoost.cmake:801 (message):  
New Boost version may have incorrect or missing dependencies and imported  
targets  
Call Stack (most recent call first):  
/usr/share/cmake-3.10/Modules/FindBoost.cmake:907 (_Boost_COMPONENT_DEPENDENCIES)  
/usr/share/cmake-3.10/Modules/FindBoost.cmake:1558 (_Boost_MISSING_DEPENDENCIES)  
CMakeLists.txt:193 (find_package)  
  
CMake Warning at /usr/share/cmake-3.10/Modules/FindBoost.cmake:801 (message):  
New Boost version may have incorrect or missing dependencies and imported  
targets  
Call Stack (most recent call first):  
/usr/share/cmake-3.10/Modules/FindBoost.cmake:907 (_Boost_COMPONENT_DEPENDENCIES)  
/usr/share/cmake-3.10/Modules/FindBoost.cmake:1558 (_Boost_MISSING_DEPENDENCIES)  
CMakeLists.txt:193 (find_package)  
  
CMake Warning at /usr/share/cmake-3.10/Modules/FindBoost.cmake:801 (message):  
New Boost version may have incorrect or missing dependencies and imported  
targets  
Call Stack (most recent call first):  
/usr/share/cmake-3.10/Modules/FindBoost.cmake:907 (_Boost_COMPONENT_DEPENDENCIES)  
/usr/share/cmake-3.10/Modules/FindBoost.cmake:1558 (_Boost_MISSING_DEPENDENCIES)  
CMakeLists.txt:193 (find_package)  
  
joke@Joke:~/下载/NERCMS_Test/libLAS-1.8.1/build$  
CMakeLists.txt:193 (find_package)  
  
CMake Warning at /usr/share/cmake-3.10/Modules/FindBoost.cmake:801 (message):  
New Boost version may have incorrect or missing dependencies and imported  
targets  
Call Stack (most recent call first):  
/usr/share/cmake-3.10/Modules/FindBoost.cmake:907 (_Boost_COMPONENT_DEPENDENCIES)  
/usr/share/cmake-3.10/Modules/FindBoost.cmake:1558 (_Boost_MISSING_DEPENDENCIES)  
CMakeLists.txt:193 (find_package)  
  
CMake Warning at /usr/share/cmake-3.10/Modules/FindBoost.cmake:801 (message):  
New Boost version may have incorrect or missing dependencies and imported  
targets  
Call Stack (most recent call first):  
/usr/share/cmake-3.10/Modules/FindBoost.cmake:907 (_Boost_COMPONENT_DEPENDENCIES)  
/usr/share/cmake-3.10/Modules/FindBoost.cmake:1558 (_Boost_MISSING_DEPENDENCIES)  
CMakeLists.txt:193 (find_package)  
  
-- Boost version: 1.69.0  
-- Found the following Boost libraries:  
--   program_options  
--   thread  
--   system  
--   iostreams  
--   filesystem  
--   chrono  
--   date_time  
--   atomic  
--   regex  
-- Searching for GeoTIFF 1.3.0+ library  
-- Found GeoTIFF version: 1.3.0  
-- Found GeoTIFF: /usr/local/lib/libgeotiff.so (Required is at least version "1.3.0")  
-- Found TIFF: /usr/local/lib/libtiff.so (found version "4.1.0")  
-- Could NOT find JPEG (missing: JPEG_LIBRARY JPEG_INCLUDE_DIR)  
-- Found ZLIB: /usr/lib/x86_64-linux-gnu/libz.so (found version "1.2.11")  
-- Enable libLAS utilities to build - done  
-- Enable libLAS unit tests to build - done  
-- Configuring done  
-- Generating done  
-- Build files have been written to: /home/joke/下载/NERCMS_Test/libLAS-1.8.1/build  
joke@Joke:~/下载/NERCMS_Test/libLAS-1.8.1/build$
```

2. cmake完毕之后就生成了一般的Makefile文件，后面正常make编译、 make install安装即可（非常慢、并且还需要管理员权限）

```
joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1/build
[40%] Built target las
[43%] Built target las_c
[46%] Built target las2col
[50%] Built target txt2las
[54%] Built target ts2las
[58%] Built target las2txt
[62%] Built target lasinfo
[65%] Built target las2pg
[69%] Built target las2las
[73%] Built target lasblock
[75%] Built target bigfile_boost_iostreams_test
[78%] Built target bigfile_test
[81%] Built target lastindex_test
[100%] Built target libblas_test
Install the project...
-- Install configuration: "Release"
-- Installing: /usr/local/share/libblas/doc/AUTHORS
-- Installing: /usr/local/share/libblas/doc/COPYING
-- Installing: /usr/local/share/libblas/doc/INSTALL
-- Installing: /usr/local/share/libblas/doc/LICENSE.txt
-- Installing: /usr/local/share/libblas/doc/README.txt
-- Installing: /usr/local/lib/libblas.so.2.4.0
-- Installing: /usr/local/lib/libblas.so.3
-- Installing: /usr/local/lib/libblas.so
-- Installing: /usr/local/lib/libblas_c.so.2.4.0
-- Installing: /usr/local/lib/libblas_c.so.3
-- Installing: /usr/local/lib/libblas_c.so
-- Installing: /usr/local/include/libblas
-- Installing: /usr/local/include/libblas/error.hpp
-- Installing: /usr/local/include/libblas/header.hpp
-- Installing: /usr/local/include/libblas/export.hpp
-- Installing: /usr/local/include/libblas/compatibility.hpp
-- Installing: /usr/local/include/libblas/utility.hpp
-- Installing: /usr/local/include/libblas/iterator.hpp
-- Installing: /usr/local/include/libblas/filter.hpp
-- Installing: /usr/local/include/libblas/variablerecord.hpp
-- Installing: /usr/local/include/libblas/libblas.hpp
-- Installing: /usr/local/include/libblas/detail
-- Installing: /usr/local/include/libblas/detail/endian.hpp
-- Installing: /usr/local/include/libblas/detail/fwd.hpp
-- Installing: /usr/local/include/libblas/detail/opt_allocator.hpp
-- Installing: /usr/local/include/libblas/detail/zippoint.hpp
-- Installing: /usr/local/include/libblas/detail/private_utility.hpp
```

```
-- Installing: /usr/local/include/libblas/external/property_tree/detail/file_parser_error.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/detail/info_parser_writer_settings.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/detail/json_parser_read.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/detail/info_parser_read.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/detail/exception_implementation.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/detail/info_parser_write.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/detail/xml_parser_utils.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/detail/ptree_utils.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/detail/xml_parser_write.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/ini_parser.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/exceptions.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/json_parser.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/info_parser.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/string_path.hpp
-- Installing: /usr/local/include/libblas/external/property_tree/id_translator.hpp
-- Installing: /usr/local/include/libblas/bounds.hpp
-- Installing: /usr/local/include/libblas/version.hpp
-- Installing: /usr/local/include/libblas/dimension.hpp
-- Installing: /usr/local/include/libblas/classification.hpp
-- Installing: /usr/local/include/libblas/reader.hpp
-- Installing: /usr/local/include/libblas/exception.hpp
-- Installing: /usr/local/include/libblas/writer.hpp
-- Installing: /usr/local/include/libblas/transform.hpp
-- Installing: /usr/local/include/libblas/capi
-- Installing: /usr/local/include/libblas/capi/libblas.h
-- Installing: /usr/local/include/libblas/capi/las_config.h
-- Installing: /usr/local/include/libblas/capi/las_version.h
-- Installing: /usr/local/include/libblas/spatialreference.hpp
-- Installing: /usr/local/include/libblas/factory.hpp
-- Installing: /usr/local/bin/lasinfo
-- Installing: /usr/local/bin/las2las
-- Installing: /usr/local/bin/txt2las
-- Installing: /usr/local/bin/las2col
-- Installing: /usr/local/bin/las2pg
-- Up-to-date: /usr/local/bin/las2las
-- Installing: /usr/local/bin/lasblock
-- Installing: /usr/local/bin/ts2las
-- Installing: /usr/local/bin/las2txt
-- Installing: /usr/local/bin/libblas-config
-- Installing: /usr/local/share/cmake/libLAS/libblas-config.cmake
-- Installing: /usr/local/share/cmake/libLAS/libblas-config-version.cmake
-- Installing: /usr/local/share/cmake/libLAS/libblas-depends.cmake
-- Installing: /usr/local/share/cmake/libLAS/libblas-depends-release.cmake
```

```

星期三 18 : 25
joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1/build

In file included from /home/joke/下载/NERCMS_Test/libLAS-1.8.1/test/unit./tut/tut.hpp:17:0,
                 from /home/joke/下载/NERCMS_Test/libLAS-1.8.1/test/unit/writer_test.cpp:10:
/home/joke/下载/NERCMS_Test/libLAS-1.8.1/test/unit./tut/tut_assert.hpp:295:6: warning: 'void tut::{anonymous}::skip(const char*)' defined but
not used [-Wunused-function]
void skip(const char* msg = "")
^~~~
/home/joke/下载/NERCMS_Test/libLAS-1.8.1/test/unit./tut/tut_assert.hpp:281:6: warning: 'void tut::{anonymous}::fail(const char*)' defined but
not used [-Wunused-function]
void fail(const char* msg = "")
^~~~
/home/joke/下载/NERCMS_Test/libLAS-1.8.1/test/unit./tut/tut_assert.hpp:64:6: warning: 'void tut::{anonymous}::ensure_not(bool)' defined but no
t used [-Wunused-function]
void ensure_not(bool cond)
^~~~
[ 96%] Building CXX object test/unit/CMakeFiles/libblas_test.dir/zipreader_test.cpp.o
[ 97%] Building CXX object test/unit/CMakeFiles/libblas_test.dir/zipwriter_test.cpp.o
[ 98%] Building CXX object test/unit/CMakeFiles/libblas_test.dir/libblas_test_suite.cpp.o
In file included from /home/joke/下载/NERCMS_Test/libLAS-1.8.1/test/unit./tut/tut.hpp:8:
/home/joke/下载/NERCMS_Test/libLAS-1.8.1/test/unit./tut/tut_assert.hpp:19:0: warning: ignoring #pragma clang diagnostic [-Wunknown-pragmas]
#pragma clang diagnostic push
/home/joke/下载/NERCMS_Test/libLAS-1.8.1/test/unit./tut/tut_assert.hpp:20:0: warning: ignoring #pragma clang diagnostic [-Wunknown-pragmas]
#pragma clang diagnostic ignored "-Wunused-function"
/home/joke/下载/NERCMS_Test/libLAS-1.8.1/test/unit./tut/tut_assert.hpp:311:0: warning: ignoring #pragma clang diagnostic [-Wunknown-pragmas]
#pragma clang diagnostic pop
[ 98%] Linking CXX executable ../../bin/Release/libblas_test
[100%] Built target libblas_test
joke@Joke:~/下载/NERCMS_Test/libLAS-1.8.1/build$ 

```

3. `make install`之后进行测试，选择的是安装包中自带的test文件进行测试。测试代码`lasinfo`  
`.../test/data/T0_core_last_clip.las`，结果失败了，`lasinfo`无法正常使用。

```

Command 'cls' not found, but there are 17 similar ones.
joke@Joke:~/下载/NERCMS_Test/libLAS-1.8.1/build$ clear
joke@Joke:~/下载/NERCMS_Test/libLAS-1.8.1/build$ lasinfo .../test/data/T0_core_last_clip.las
lasinfo: error while loading shared libraries: libblas.so.3: cannot open shared object file: No such file or directory

```

4. 解决方法是运行`/sbin/ldconfig`文件来设置动态链接，可能是安装完成后一些设置工作还没有做，执行  
`sudo sh /sbin/ldconfig`，之后重新测试，成功。

```
joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1/build
joke@Joke: /sbin

joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1$ sudo sh /sbin/ldconfig
joke@Joke: /sbin$ lasinfo
Input LAS file not specified!
-----
lastInfo (libLAS 1.8.1 with GeoTIFF 1.3.0)

lasinfo options:
-h [ --help ]           produce help message
-i [ --input ] arg      input LAS file
-v [ --verbose ]         Verbose message output
--no-vlrs               Don't show VLRS
--no-schema              Don't show schema
--no-check               Don't scan points
--xml                   Output as XML
-p [ --point ] arg      Display a point with a given id. --point 44
--locale                Use the environment's locale for output

Filtering options:
-e [ --extent ] arg     Extent window that points must fall within to keep.
                        Use a comma-separated or quoted, space-separated
                        list, for example,
                        -e minx, miny, maxx, maxy
                        or
                        -e minx, miny, minz, maxx, maxy, maxz"
                        -e "minx miny minz maxx maxy maxz"
--minx arg               Extent must be greater than or equal to minx to be
                        kept.
                        --minx 1234.0
--miny arg               Extent must be greater than or equal to miny to be
                        kept.
                        --miny 5678.0
--minz arg               Extent must be greater than or equal to minz to be
                        kept. If maxx and maxy are set but not minz *and*
                        maxz, all z values are kept.
                        --minz 0.0
--maxx arg               Extent must be less than or equal to maxx to be kept.
                        --maxx 1234.0
--maxy arg               Extent must be less than or equal to maxy to be kept.
                        --maxy 5678.0
--maxz arg               Extent must be less than or equal to maxz to be kept.
                        If maxx and maxy are set but not maxz *and* minz, all

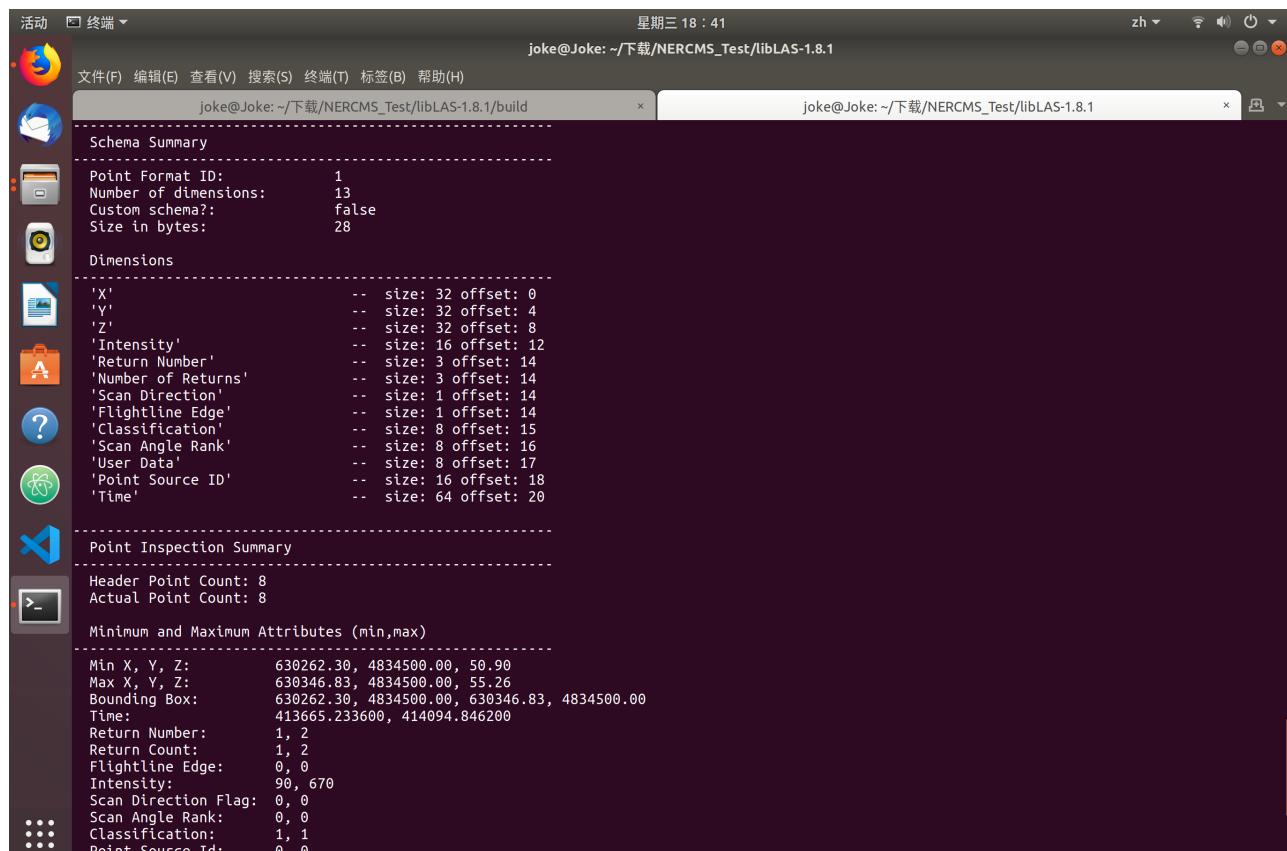
joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1$ lasinfo test/data/T0_core_last_clip.las
-----
Header Summary

Version: 1.0
Source ID: 0
Reserved: 0
Project ID/GUID: '00000000-0000-0000-0000-000000000000'
System ID: ''
Generating Software: 'TerraScan'
File Creation Day/Year: 0/0
Header Byte Size: 227
Data Offset: 229
Header Padding: 2
Number Var. Length Records: None
Point Data Format: 1
Number of Point Records: 8
Compressed: False
Number of Points by Return: 4 4 0 0
Scale Factor X Y Z: 0.01000000000000 0.01000000000000 0.01000000000000
Offset X Y Z: -0.00 -0.00 -0.00
Min X Y Z: 630262.30 4834500.00 50.90
Max X Y Z: 630346.83 4834500.00 55.26
Spatial Reference:
Reference defined, but GDAL is not available for WKT support

Geotiff_Information:
Version: 1
Key_Revision: 1.0
Tagged_Information:
  End_Of_Tags.
Keyed_Information:
  End_Of_Keys.
End_Of_Geotiff.

-----
Schema Summary

Point Format ID: 1
Number of dimensions: 13
Custom schema?: false
Size in bytes: 28
```



```

活动 窗口 终端
星期三 18 : 41
joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1

文件(F) 编辑(E) 查看(V) 搜索(S) 终端(T) 标签(B) 帮助(H)
joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1/build x joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1 x

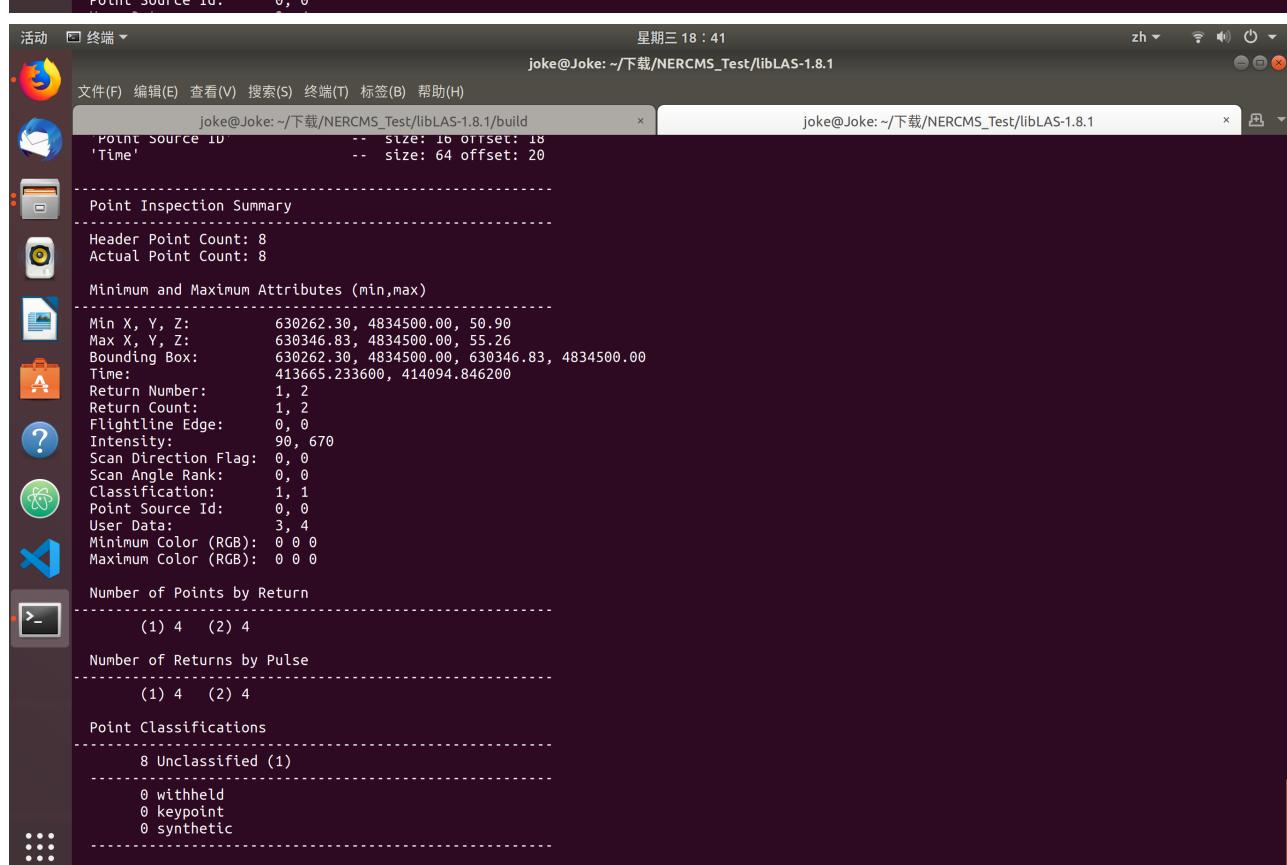
Schema Summary
Point Format ID: 1
Number of dimensions: 13
Custom schema?: false
Size in bytes: 28

Dimensions
'X'          -- size: 32 offset: 0
'Y'          -- size: 32 offset: 4
'Z'          -- size: 32 offset: 8
'Intensity'   -- size: 16 offset: 12
'Return Number' -- size: 3 offset: 14
'Number of Returns' -- size: 3 offset: 14
'Scan Direction' -- size: 1 offset: 14
'Flightline Edge' -- size: 1 offset: 14
'Classification' -- size: 8 offset: 15
'Scan Angle Rank' -- size: 8 offset: 16
'User Data'    -- size: 8 offset: 17
'Point Source ID' -- size: 16 offset: 18
'Time'        -- size: 64 offset: 20

Point Inspection Summary
Header Point Count: 8
Actual Point Count: 8

Minimum and Maximum Attributes (min,max)
Min X, Y, Z: 630262.30, 4834500.00, 50.90
Max X, Y, Z: 630346.83, 4834500.00, 55.26
Bounding Box: 630262.30, 4834500.00, 630346.83, 4834500.00
Time: 413665.233600, 414094.846200
Return Number: 1, 2
Return Count: 1, 2
Flightline Edge: 0, 0
Intensity: 90, 670
Scan Direction Flag: 0, 0
Scan Angle Rank: 0, 0
Classification: 1, 1
Point Source Id: 0, 0

```

```

活动 窗口 终端
星期三 18 : 41
joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1

文件(F) 编辑(E) 查看(V) 搜索(S) 终端(T) 标签(B) 帮助(H)
joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1/build x joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1 x

Point Source ID          -- size: 16 offset: 18
'Time'                   -- size: 64 offset: 20

Point Inspection Summary
Header Point Count: 8
Actual Point Count: 8

Minimum and Maximum Attributes (min,max)
Min X, Y, Z: 630262.30, 4834500.00, 50.90
Max X, Y, Z: 630346.83, 4834500.00, 55.26
Bounding Box: 630262.30, 4834500.00, 630346.83, 4834500.00
Time: 413665.233600, 414094.846200
Return Number: 1, 2
Return Count: 1, 2
Flightline Edge: 0, 0
Intensity: 90, 670
Scan Direction Flag: 0, 0
Scan Angle Rank: 0, 0
Classification: 1, 1
Point Source Id: 0, 0
User Data: 3, 4
Minimum Color (RGB): 0 0 0
Maximum Color (RGB): 0 0 0

Number of Points by Return
(1) 4 (2) 4

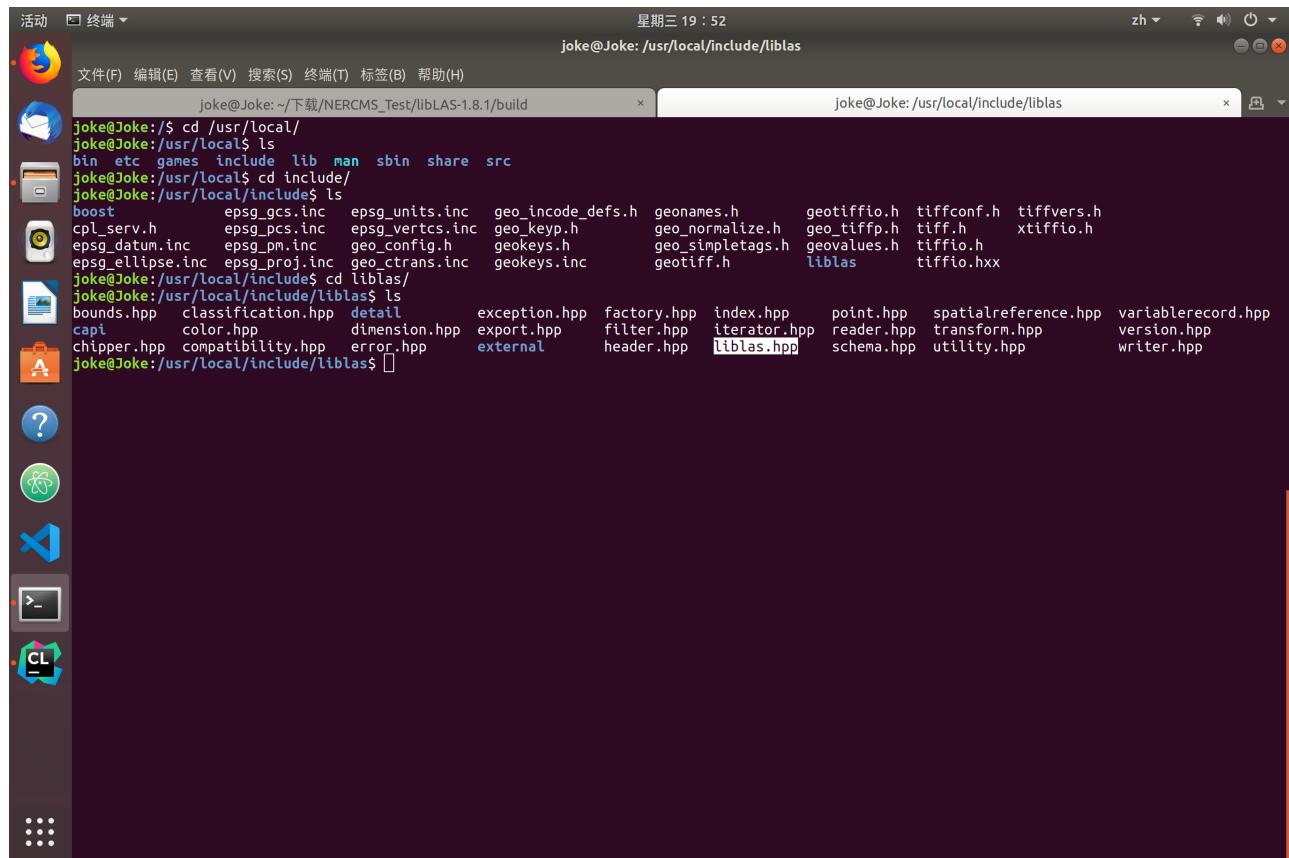
Number of Returns by Pulse
(1) 4 (2) 4

Point Classifications
8 Unclassified (1)

0 withheld
0 keypoint
0 synthetic

```

5. 安装好libLAS之后查看liblas.hpp的路径，我个人最终的路径应该是  
是/usr/local/include/liblas/liblas.hpp

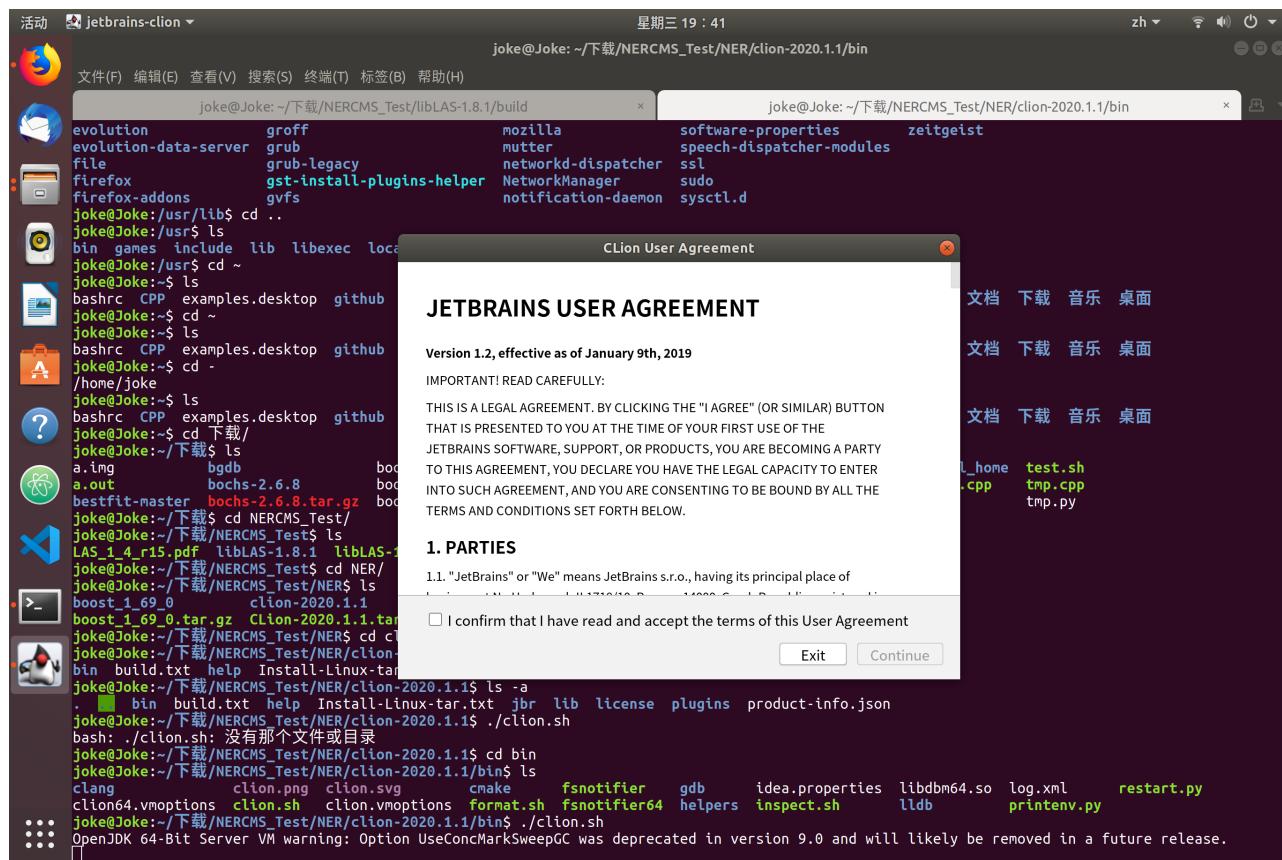


The screenshot shows a terminal window with two tabs. The left tab is at `joke@Joke: ~/下载/NERCMS_Test/libLAS-1.8.1/build` and the right tab is at `joke@Joke: /usr/local/include/liblas`. The terminal displays the command `ls` being run in both locations, showing the directory structure of the libLAS library. The right tab shows files like boost, epsg, geo, geotiff, tiff, and various header files such as `liblas.hpp`.

3. 查阅资料，安装 Jet Brains CLion，使用 libLAS 编程确定 lidar.las 中 Variable Length Records 所占的字节大小，以及点云数据中包含点的总数目。

分析

- 拿到这个问题，发现之前阅读的 [LAS Specification 1.4 - R15](#) 说明书前半部分还是有作用的。根据题目先安装 [Jet Brains CLion](#)



## 2. LAS文件构成:

- Public Header Block
- Variable Length Records(VLRs)
- Point Data Records
- Extended Variable Length Records(EVLRs)

## 3. LAS阅读时部分注释:

- VLRs和EVLRs都是可选的，并没有一定会出现在文件中，这个可以根据PHB的内容进行判断
- 所有的内容都是使用的小端编址
- PDR (Point Data Record) 的大小在一个文件内部必须是一样的（即必须采用0-10的某一种格式，这种格式也会在PHB中有所说明）
- VLR的长度计算时有两部分组成，一部分是54bytes的VLRH (头部) 以及后面的记录部分
- 在使用XYZ的时候，先乘以比例尺并加上原点偏移距离之后才可以使用
- 其他不是很重要还没记录

4. 要计算VLRs所占字节大小，这个由于PHB后面跟的就是VLR，可以通过查询Header Size获取VLR的起始位置，直接再在PHB中查看Offset to Point Data就可以知道VLRs部分后面的数据点开始处，也就是VLRs的结束位置，相当于拿到了起始以及结束的BYTES位置，相减即可算出VLRs的占空间大小

5. 至于点云数据中点的总数目，其实直接查看PHB中的Number of Point Records即可

## 解答

1. 在编写程序的时候由于不会使用libLAS库，稍微学了一下最为基础的内容读取，编写了较为简单的程序用于题目解答

- 编写完毕简单的读取las头部内容的C++程序

- 由于Clion使用的是cmake进行编译的，需要用到CmakeLists.txt进行规则描述，一开始不知道，直接就执行程序了，结果报了错全部是libblas库中未定义的引用

The screenshot shows the Clion IDE interface with the following details:

- Title Bar:** 星期四 20 : 31 untitled - main.cpp
- File Explorer:** Project tree showing 'main.cpp', 'CMakeCache.txt', and 'CMakeLists.txt' under 'untitled'.
- Code Editor:** Content of main.cpp:

```
#include <iostream>
#include <libblas/libblas.hpp>
#include <libblas/factory.hpp>
#include <libblas/reader.hpp>
using namespace std;

int main() {
    ifstream las;
    las.open("../lidar.las", ios::in | ios::binary);
    if(las){
        libblas::ReaderFactory f;
    }
}
```
- Messages Tab:** Build errors:

```
[100%] Linking CXX executable untitled
CMakeFiles/untitled.dir/main.cpp.o: 在函数“main”中:
/home/joke/CLionProjects/untitled/main.cpp:12: 对‘libblas::ReaderFactory::CreateWithStream(std::istream&)’未定义的引用
/home/joke/CLionProjects/untitled/main.cpp:13: 对‘libblas::Reader::GetHeader() const’未定义的引用
/home/joke/CLionProjects/untitled/main.cpp:13: 对‘libblas::Header::Header(liblas::Header const&)’未定义的引用
/home/joke/CLionProjects/untitled/main.cpp:14: 对‘libblas::Header::GetHeaderSize() const’未定义的引用
/home/joke/CLionProjects/untitled/main.cpp:15: 对‘libblas::Header::GetDataOffset() const’未定义的引用
/home/joke/CLionProjects/untitled/main.cpp:12: 对‘libblas::Reader::~Reader()’未定义的引用
/home/joke/CLionProjects/untitled/main.cpp:12: 对‘libblas::Reader::~Reader()’未定义的引用
CMakeFiles/untitled.dir/main.cpp.o: 在函数“libblas::Header::~Header()”中:
/usr/local/include/libblas/header.hpp:78: 对‘libblas::SpatialReference::~SpatialReference()’未定义的引用
CMakeFiles/untitled.dir/main.cpp.o: 在函数“void std::_Destroy<libblas::VariableRecords<libblas::VariableRecord*>>()”中:
/usr/include/c++/7/bits/stl_construct.h:98: 对‘libblas::VariableRecord::~VariableRecord()’未定义的引用
collect2: error: ld returned 1 exit status
make[3]: *** [untitled] Error 1
CMakeFiles/Makefile2:75: recipe for target 'CMakeFiles/untitled.dir/all' failed
make[2]: *** [CMakeFiles/untitled.dir/all] Error 2
CMakeFiles/Makefile2:62: recipe for target 'CMakeFiles/untitled.dir/rule' failed
make[1]: *** [CMakeFiles/untitled.dir/rule] Error 2
CMakefile:118: recipe for target 'untitled' failed
```
- Bottom Status Bar:** Event Log, 16:31 LF UTF-8 4 spaces C++:untitled | Debug

- 找了半天问题后来才发现，直接虽然也可以调用libblas库中内容，但是在编译时莫名其妙会找不到库文件，必须要在cmakelist里面声明一下我们用的库，这里直接用的是  
`link_libraries("/usr/local/lib/libblas.so.2.4.0")`，里面的路径是我自己libblas库的位置

The screenshot shows the Clion IDE interface with the following details:

- Title Bar:** 星期四 20 : 32 untitled - CMakeLists.txt
- File Explorer:** Project tree showing 'CMakeLists.txt' under 'untitled'.
- Code Editor:** Content of CMakeLists.txt:

```
cmake_minimum_required(VERSION 3.16)
project(untitled)

link_libraries("/usr/local/lib/libblas.so.2.4.0")
set(CMAKE_CXX_STANDARD 14)
add_executable(untitled main.cpp)
```
- Messages Tab:** Build errors (same as the previous screenshot).
- Bottom Status Bar:** Event Log, 57:1 LF UTF-8 4 spaces

2. 之后就程序正常运行了，运行的结果如下，如图所示我们这个las里面应该是没有VLR格式的数据的，存在的点数一共是10100个

The screenshot shows the CLion IDE interface. The top bar displays the date and time as "星期四 20 : 39". The main window has tabs for "main.cpp", "CMakeCache.txt", and "CMakeLists.txt". The "main.cpp" tab is active, showing the following code:

```
#include <iostream>
#include <liblas/libblas.hpp>
#include <liblas/factory.hpp>
#include <liblas/header.hpp>
using namespace std;

int main() {
    ifstream las;
    //文件名写为../Lidar.las由于当前文件被编译之后是存在cmake-build-debug内部的，而数据文件我们放在了外面
    las.open( s: "../lidar.las", ios::in|ios::binary );
    if(las){
        liblas::ReaderFactory f;
        liblas::Reader reader=f.CreateWithStream( & las );
        liblas::Header const header=reader.GetHeader();
        int VLRsFront=header.GetHeaderSize();
        int VLRsEnd=header.GetDataOffset();
        int PointNum=header.GetPointRecordsCount();
        cout<<"PHB所占字节大小为: "<<VLRsFront<<endl;
        cout<<"Point Data起始位置: "<<VLRsEnd<<endl;
        cout<<"VLRs 所占的字节大小为: "<<VLRsEnd-VLRsFront<<endl;
        cout<<"数据点的总个数: "<<PointNum<<endl;
    }
}
```

The "Run" tab shows the output of the program:

```
/home/joke/CLionProjects/untitled/cmake-build-debug/untitled
PHB所占字节大小为: 227
Point Data起始位置: 227
VLRs 所占的字节大小为: 0
数据点的总个数: 10100

Process finished with exit code 0
```

The bottom status bar shows the date and time as "9:71 LF UTF-8 4 spaces C++: untitled | Debug".