Framework-independent *PlotUtils*

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1 Introduction

Abstract : This note covers the normal *PlotUtils* installation on your local computer without using MINERvA custom environment. The goal is to provide set of scripts that will compile and install *PlotUtils* in local PC/Laptop or where one wish to install. This document is not a replacement of any such already existing documents, rather this document is meant to be used by anyone who wants to install *PlotUtils* independent of MINERvA Software Framework.

PlotUtils **:** *PlotUtils* is a primary service package in MINERvA-Software with several utility classes. It is being heavily used in all MINERvA data analysis. It contains a set of classes, macros and scripts which can be used for analysing and plotting of MINERvA data (after AnaTuples). The powerful functions and utilization are discussed by several experts and are available at MINERvA-doc-23740-v1[1], MINERvA-doc-11232-v1[2], MINERvA-doc-12246-v3[3], MINERvA-doc-10281-v2[5] MINERvA-doc-10076-v2[4] and MINERvA-doc-8841-v2[6].

Goal : Goal is to provide a script which can compile and produce standalone library of PlotUtils, so that AnaTuples and *MnvHistograms* can easily be accessed in local machine without installing entire Minerva-software framework. One can use provided installation scripts to automatize *PlotUtils* installation, or otherwise if one does not have good reasons not to use it, can follow few steps by setting paths manually. You may consider to have a look the presentation at MINERvA-doc-21484-v1[7].

2 Prerequisite

Given the choice of operating systems on personal laptops, there is a script-based installation method by altering few files and at the end it allows you to keep using your favourite operating system. However, *PlotUtils* needs following packages to be installed in your system.

- *ROOT* Version: 6 or later, this is to avoid clang conflicts [GPVM, I manage to install with ROOT Version 5.34, but I would not recommend that to use at this stage]
- *cmake*: library needed to compile ROOT6 if you wish to do so
- CVS: you must be able to use cvs to checkout all scripts
- *boost*: library
- *CLHEP*: Optional Library

Installation of required packages are available in respective package website. It is best practice to follow the procedures and steps given in the website to install it, if you choose to use a different way of installing the required dependencies, then you must set appropriate paths before you start next steps for *PlotUtils*.

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3 Steps to install *PlotUtils*

Note that: most of the paths and procedures presented here can be adapted to your system and your taste. You can for instance decide to use different path names, or a different directory structure. In case you do not have particular needs, or you don't know what you are doing, please follow the procedure very carefully and without diverging from it at all. This will make support easier in case something does not work as expected.

*"**Please follow each and every steps very carefully**, failing which would result a broken library".*

Step - 1 Make sure dependencies are installed and paths are set properly in your favorite 'evn' script.

A set of scripts needed to compile and install *PlotUtils* are kept at [*mnvsoft*]/*Personal*/*sjena*/*plotutils*. You must obtain access to the Minerva CVS repository at Fermilab

```
export CVSROOT="minervacvs@cdcvs.fnal.gov:/cvs/mnvsoft"
export CVS_RSH=ssh
Or
export CVSROOT=":pserver:anonymous@cdcvs.fnal.gov:/cvs/mnvsoft"
```

Step - 2 Checkout helper scripts into your favorite path

```
cvs co -d temp Personal/sjena/plotutils
cd temp
ls
#you should see following scripts

export WD=${PWD} #this is your utility path say $WD$
```

Follow next (step - 3) for 'automatic' installation or follow step - 4 for 'manual' installation.

Step - 3 Using automated script: To be added

Step - 4 Manual Steps: These are the steps you must follow if you would like manually install: (you must start after step-2)

- Change the variable $*PLOTUTILSPATH* path to a suitable path where you wish to install *PlotUtils*. Let say you want to install your *PlotUtils* in 'minerva' folder which is at '/home-/user/sjena/', so the change you must do in standalone.sh file is as follows:

```
export PLOTUTILSPATH="/minerva/app/users/sjena/standalone
    /gpvm"
to
export PLOTUTILSPATH="/home/user/sjena/minerva"
```

- once you set above you do following

```
source standalone.sh
cd $PLOTUTILSPATH
```

- obtain the *PlotUtils* by cvs checkout by following

```
cvs co Ana/PlotUtils
cd Ana/PlotUtils
```

- Copy relevant files

```
cp $WD/PlotUtilsDictSD.h $PLOTUTILSPATH/Ana/PlotUtils/
    dict/PlotUtilsDict.h

cp $WD/PlotUtilsDictSD.xml $PLOTUTILSPATH/Ana/PlotUtils/
    dict/PlotUtilsDictSD.xml

cp $WD/standalone.sh $PLOTUTILSPATH/Ana/PlotUtils/setup/.
```

- prepare for installation

```
cd Ana/PlotUtils
source setup/standalone.sh
make -f Makefile.Linux # for linux
or
make -f Makefile.osx   # for macos
or
make -f Makefile.gpvm  # for gpvm
```

- Add rootlogon file by copying it to suitable path.

```
cp ${WD}/standalone_rootlogon.C  ~/.rootlogon.C
```

Step - 5 If you have successfully compiled until this then you are done!
You must always source *PLOTUTILSROOT/setup/standalone.sh* to use it and enjoy using it.

Step - 6 Although there is no harm in keep this temp folder, but you may consider to cleanup the temp folder that got created during installation i.e. the folder *${WD}*.

4 Various Script

You can find following scripts in my *cvs* personal area. These are the helper scripts to install *PlotUtils* in local pc (MINERvA-doc-21484-v1[7] explains we need such files).

standalone.sh -

```
#Setup Script for Standalone PlotUtils
#
#-------------------------------------------------------------------
#/minerva/app/users/sjena/standalone/gpvm/Ana/PlotUtils
export PLOTUTILSPATH="/minerva/app/users/sjena/standalone/gpvm"
#-------------------------------------------------------------------
export PLOTUTILSROOT=${PLOTUTILSPATH}"/Ana/PlotUtils"
export LD_LIBRARY_PATH=${PLOTUTILSROOT}:${LD_LIBRARY_PATH}
export PYTHONPATH=${PLOTUTILSROOT}/python:${PYTHONPATH}
export PLOTUTILSTYPE="STANDALONE"
export PLOTUTILSVERSION="ROOT5"
```

standalone_rootlogon.C -

```
{
  if( gSystem->Getenv("PLOTUTILSROOT") )
  {
```

```
    gInterpreter->AddIncludePath( gSystem->ExpandPathName("$PLOTUTILSROOT")
        ) );
    string newpath = string(gROOT->GetMacroPath()) + ":" + string(gSystem
        ->ExpandPathName("$PLOTUTILSROOT"));
    gROOT->SetMacroPath( newpath.c_str() );

    //    gSystem->Load( "libCintex.so" );  // needed to process the
        dictionaries for the objects
    //Cintex::Enable();
    gSystem->Load( gSystem->ExpandPathName("$PLOTUTILSROOT/libplotutils.so
        ") );
    std::cout << "tried to load libplotutils.so" << endl;
    //gInterpreter->ExecuteMacro("PlotStyle.C");
  }

}
```

Makefile.OsX - This file is inspired by an original file written by Philip A Rodrigues [8]

```
# this came from Phil Rodrigues
# HMS 1-6-2018 got C++ root version 6 to work on a mac building MnvH1D
    standalone
# HMS - January 2018 - standalone PlotUtils based on version from Phil
    Rodrigues

# to make this work you need to:

# get boost from

# http://www.boost.org/

# I put this in my PlotUtils directory and had no path issues

# you need this setup (in setup/standalone.sh)
# export LD_LIBRARY_PATH=${PLOTUTILSROOT}:${LD_LIBRARY_PATH}
# export PYTHONPATH=${PLOTUTILSROOT}/python:${PYTHONPATH}
# export PLOTUTILSTYPE="STANDALONE"
# export PLOTUTILSVERSION="ROOT6"

# and put setup/OSX.rootlogon.C in your rootlogin to load properly

# How this was built;
# installed root binary 6.14.2 on OSX 10.13.2 using XCode 9.2
# installed boost in local directory

# Changed CInt and Reflex to Cling
# need to patch some bad C++ in MnvH2D and MnvH3D as root 6 is less
    forgiving.
#
# Used flags to remove PlotUtils/MnvRecoshifter as it brings in the whole
    MINERvA code stack.
# set Wformat to 0 to remove format warnings due to calls to Form(
```

```
EXTERNALINCLUDES := -I$(MINERVAKERNELROOT) -I$(LCGEXTERNAL)/clhep/1.9.4.7/
    $(CMTCONFIG)/include
INCLUDES := $(EXTERNALINCLUDES) -I. -I`root-config --incdir` -I./PlotUtils
CXXFLAGS := `root-config --cflags` $(INCLUDES)
LDFLAGS  := -shared `root-config --glibs` -lCling -Wl

# We're going to compile all the cxx files in PlotUtils/ into a library
    libplotutils.so
SOURCES = $(wildcard PlotUtils/*.cxx)
OBJS    = $(SOURCES:.cxx=.o)

# How to make a .o file from a .cxx file
%.o: %.cxx
    g++ -g -Wformat=0 -DMNVROOT6=1 -DMNV_MnvRecoShifter_h=1 -
        DMNV_MnvRecoShifter_cxx -fPIC -c -o $@ $< $(CXXFLAGS)

# The target to be made when you just run 'make'
all: libplotutils.so

libplotutils.so: $(OBJS) plotutilsDict.o
    g++ -o $@ $(LDFLAGS) $^

# Make the reflex dictionary for all the PlotUtils classes. Phil found
# this command by running the cmt make with 'make VERBOSE=1' and
# copying the command from there. We need these dictionaries to be
# able to use PlotUtils from python and to be able to read/write
# PlotUtils classes to/from disk.
#
plotutilsDict.cxx: dict/PlotUtilsDict.h dict/PlotUtilsDictOSX.xml
    genreflex dict/PlotUtilsDict.h -o plotutilsDict.cxx --gccxmlopt='--
        gccxml-compiler g++ ' --select=dict/PlotUtilsDict.xml   --rootmap=
        plotutilsDict.rootmap --rootmap-lib=libplotutilsDict --rootmap-lib
        =libplotutils  -D_GNU_SOURCE -DGAUDI_V20_COMPAT  $(INCLUDES) -
        DMNV_MnvRecoShifter_h=1 -DMNV_MnvRecoShifter_cxx

clean:
    rm -f *.o *.so plotutilsDict.cxx PlotUtils/*.o

.PHONY: clean
```

Makefile.linux - This file is derived from the original Makefile written by Philip A Rodrigues [8]

```
# SJ: Using UPS distribution GPVM Instllation
# One can use this in their Local Linux distributions
# You need to install ROOT6, CLHEP, Boost and you use
# this make file you are done.
# Use the script provided to source the enviroment
#
# I tested with Ubintu, SL and MacOS
#
EXTERNALINCLUDES := -I$(MINERVAKERNELROOT) -I$(CLHEP_INC)
INCLUDES := $(EXTERNALINCLUDES) -I. -I`root-config --incdir` -I./PlotUtils
CXXFLAGS := `root-config --cflags` $(INCLUDES)
```

```
LDFLAGS  := -shared `root-config --glibs` -lCling

# We're going to compile all the cxx files in PlotUtils/ into a library
    libplotutils.so
SOURCES = $(wildcard PlotUtils/*.cxx)
OBJS    = $(SOURCES:.cxx=.o)

# How to make a .o file from a .cxx file
%.o: %.cxx
    g++ -g -Wformat=0 -DMNVROOT6=1 -DMNV_MnvRecoShifter_h=1 -
        DMNV_MnvRecoShifter_cxx -fPIC -c -o $@ $< $(CXXFLAGS)

# The target to be made when you just run 'make'
all: libplotutils.so

libplotutils.so: $(OBJS) plotutilsDict.o
    g++ -o $@ $(LDFLAGS) $^

# Make the reflex dictionary for all the PlotUtils classes. Phil found
# this command by running the cmt make with 'make VERBOSE=1' and
# copying the command from there. We need these dictionaries to be
# able to use PlotUtils from python and to be able to read/write
# PlotUtils classes to/from disk.
#
plotutilsDict.cxx: dict/PlotUtilsDict.h dict/PlotUtilsDictOSX.xml
    genreflex dict/PlotUtilsDict.h -o plotutilsDict.cxx --gccxmlopt='--
        gccxml-compiler g++ ' --select=dict/PlotUtilsDict.xml  --rootmap=
        plotutilsDict.rootmap --rootmap-lib=libplotutilsDict --rootmap-lib
        =libplotutils  -D_GNU_SOURCE -DGAUDI_V20_COMPAT  $(INCLUDES) -
        DMNV_MnvRecoShifter_h=1 -DMNV_MnvRecoShifter_cxx

clean:
    rm -f *.o *.so plotutilsDict.cxx PlotUtils/*.o

.PHONY: clean
```

References

[1] MINERvA-doc-23740-v1
https://minerva-docdb.fnal.gov/cgi-bin/private/ShowDocument?docid=23740

[2] MINERvA-doc-11232-v1
https://minerva-docdb.fnal.gov/cgi-bin/private/ShowDocument?docid=11232

[3] MINERvA-doc-12246-v3
https://minerva-docdb.fnal.gov/cgi-bin/private/ShowDocument?docid=12246

[4] MINERvA-doc-10076-v2
https://minerva-docdb.fnal.gov/cgi-bin/private/ShowDocument?docid=10076

[5] MINERvA-doc-10281-v2
https://minerva-docdb.fnal.gov/cgi-bin/private/ShowDocument?docid=10281

[6] MINERvA-doc-8841-v2
https://minerva-docdb.fnal.gov/cgi-bin/private/ShowDocument?docid=8841

[7] Presentation at MINERvA-doc-21484-v1
https://minerva-docdb.fnal.gov/cgi-bin/private/ShowDocument?docid=21484

[8] Makefile MINERvA-doc-15821-v1
https://minerva-docdb.fnal.gov/cgi-bin/private/ShowDocument?docid=15821