ROOT-R Interface Minimizer/Optimizer

Kirby Hermansen

Lorenzo Moneta

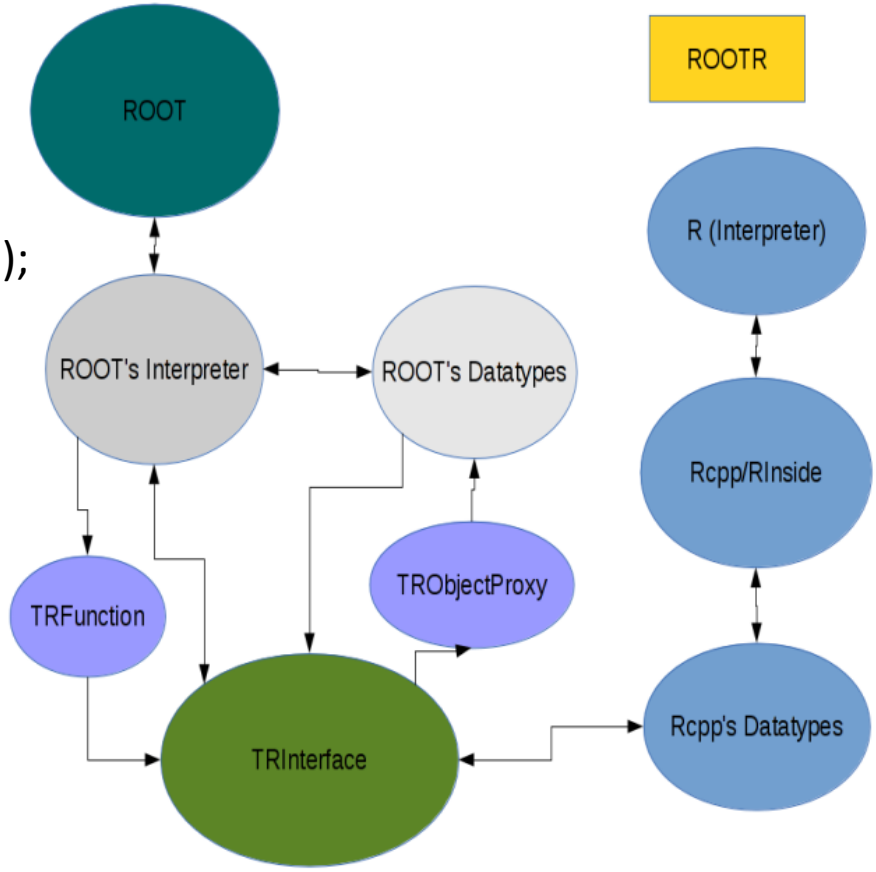
Background

- ROOT-R Interface already exists (TRInterface.h)
- R has great potential for use in optimizations

ROOT-R Interface (Omar Zapata)

```
#include<TRInterface.h>
gR->Parse("print(seq(1,5,0.5))");
Int_t power=gR->ParseEval("2^3").ToScalar();
TVector v=gR->ParseEval("seq(1,5,0.5)").ToVector();
v.Print();

TVectorD BreitWignerVectorized(TVectorD xx){
TVectorD result(xx.GetNoElements());
        for(Int_t i=0;i<xx.GetNoElements();i++) {
result[i]=TMath::BreitWigner(xx[i]); }
 return result; }
```




```
ROOT::R::TRInterface &r=gR->Instance();
r["BreitWigner"]=ROOT::R::TRFunction(BreitWignerVectorized);
```

Math/RMinimizer.h

- Implements from BasicMinimizer class
- The class is a new plugin which can be implemented by:

ROOT::Math::MInimizerOptions::SetDefaultMinimizer("RMinimizer")

- Functions to provide Hessian and covariant matrices, error vector, and number of function calls
- Minimize() function performs optimization
- Constructor RMinimizer(Option_t) passes the method of optimization as an Option_t

RMinimizer.cxx

Function wrapper:

```
const ROOT::Math::IMultiGenFunction *gFunction;
double minfunction(TVectorD x){
    return (*gFunction)(x.GetMatrixArray()); }
```

Method options: "Nelder-Mead", "BFGS", "CG", "L-BFGS-B", "SANN", "Brent”

Utilize either optim or optimx (optimization functions in R)

Optim vs. Optimx

- RMinimizer utilizes either (prefers optimx if available)
- Optimx is a newer package in R which does not come standard but offers more potential
  - Includes extra algorithms like nlm and spg…
- Some of the output is more difficult to work with (list vectors instead of doubles)

Future Work

- Use of the gradient needs to be integrated with common ROOT gradient calculations provided by ROOT
- Functions returning matrix and vector values need to be tested more extensively
- Optimization needs to be verified to work effectively
- Class is designed to be added to ROOT with the introduction of the R interface

root [7] .x fit2a.C

Calling R with command result <- optimx(initialparams, minfunction,method='BFGS',control = list(ndeps=stepsizes,maxit=1000,trace=0,abstol=1.000000e-02),hessian=TRUE)

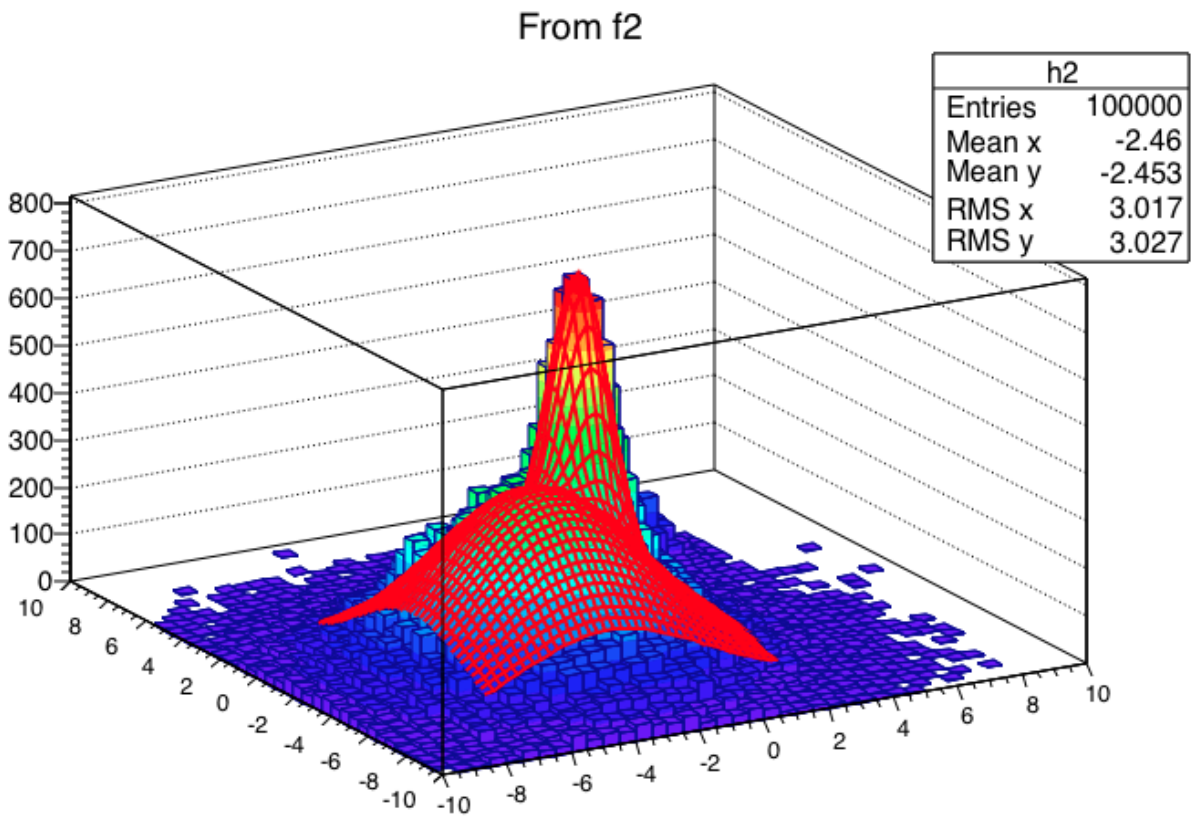
Value at minimum =1195

****

Minimizer is RMinimizer / Migrad

Chi2	=	1195
NDf	=	1128
NCalls	=	1386
p0	=	400
p1	=	-3.005
p2	=	2.951
p3	=	-3.004
p4	=	2.956
p5	=	640
p6	=	0.002807
p7	=	0.802
p8	=	0.001035
p9	=	0.9042
p10	=	160
p11	=	3.981
p12	=	0.6985
p13	=	3.983
p14	=	0.6965

(class TCanvas*)0x7fe6a5ba84a0



References and Thanks

http://root.cern.ch/drupal/content/how-use-r-root-root-r-interface

Many thanks to Lorenzo Moneta and Omar Zapata both for past work and work with me!

https://github.com/kirbyherm/root-r-tools