

Package: ConConPiWiFun (via r-universe)

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Type Package

Title Optimisation with Continuous Convex Piecewise (Linear and Quadratic) Functions

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Description Continuous convex piecewise linear (ccpl) resp. quadratic (ccpq) functions can be implemented with sorted breakpoints and slopes. This includes functions that are ccpl (resp. ccpq) on a convex set (i.e. an interval or a point) and infinite out of the domain. These functions can be very useful for a large class of optimisation problems. Efficient manipulation (such as $\log(N)$ insertion) of such data structure is obtained with map standard template library of C++ (that hides balanced trees). This package is a wrapper on such a class based on Rcpp modules.

License GPL (≥ 2)

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ConConPiWiFun-package *This package contains an implementation of continuous convex piecewise (linear) functions (quadratic coming soon)*

Description

Continuous convex piecewise linear (ccpl) resp. quadratic (ccpq) functions can be implemented with sorted breakpoints and slopes. This includes functions that are ccpl (resp. ccpq) on a convex set (i.e. an interval or a point) and infinite out of the domain. These functions can be very useful for a large class of optimisation problems. Efficient manipulation (such as $\log(N)$ insertion) of such data structure is obtained with map standard template library of C++ (that hides balanced trees). This package is a wrapper on such a class based on Rcpp modules.

Details

Package: ConConPiWiFun
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 Date: 2013-02-08
 License: GPL

Author(s)

Robin Girard

Maintainer: <robin.girard@mines-paristech.fr>

References

Related Papers are

Examples

```
library(ConConPiWiFun)
#### See
#? cplfunction for continuous convex piecewise functions
#? cplfunctionvec for (optimized) list of continuous convex piecewise functions
```

cplfunction	<i>This class implements continuous convex piecewise linear functions</i>
-------------	---

Description

This includes functions that are ccpl (resp. ccpq) on a convex set (i.e. an interval or a point) and infinite out of the domain. These functions can be very useful for a large class of optimisation problems. Efficient manipulation (such as log(N) insertion) of such data structure is obtained with map standard template library of C++ (that hides balanced trees). This package is a wrapper on such a class based on Rcpp modules.

Author(s)

Robin Girard

See Also

to See Also as [cplfunction](#),

Examples

```
##
##Construction of a piecewise linear function
##

Slopes=c(-1,2,Inf) # increasing ! convexity is required
Breakpoints=c(-Inf,2,4) # increasing. length is number of slopes +1
FirstNonInfBreakpointVal=3
CCPWLfunc1=new(cplfunction,Slopes,Breakpoints,FirstNonInfBreakpointVal)
plot(CCPWLfunc1) #visualisation method

###Etoile transformation (legendre transform of f)
# Changes f no return value
CCPWLfunc1$Etoile()
plot(CCPWLfunc1) #if f = CCPWLfunc1 CCPWLfunc1 becomes is f^(y) =inf_x {xy-f(x)}
CCPWLfunc1$Etoile()
plot(CCPWLfunc1) ## (f^*)^* is f !
```

```

###Squeeze function
# Changes f, no return value
left=-Inf; right=3
CCPWfunc1$Squeeze(left,right) # CCPWfunc1 is now infinite (or not definite) out of [left,right]
# i.e. all breakpoints out of [left,right] removed

###Swap function
# Changes f no return value !
y=2;
CCPWfunc1$Swap(y)
plot(CCPWfunc1); #now f = CCPWfunc1 is replaced by x -> f(y-x)

### Sum function (uses fast insertion) do not affect operands
CCPWfunc1=new(cplfunction,c(-1,2,Inf) ,c(-Inf,2,4),0)
CCPWfunc2=new(cplfunction,c(-1,2,Inf),c(-Inf,1,3),0)
CCPWfunc1plus2=Sum1(CCPWfunc1,CCPWfunc2)
CCPWfunc1plus2

par(mfrow=c(1,3))
plot(CCPWfunc2,col='red');
plot(CCPWfunc1,col='blue');
plot(CCPWfunc1plus2);

rm(list=ls())
gc()

```

cplfunctionvec	<i>This class implements "optimized list" of continuous convex piecewise linear functions</i>
----------------	---

Description

This is a wrapper to stl vector of convex piecewise linear functions. Allows to loop efficiently on such list.

Author(s)

Robin Girard

See Also

to See Also as [cplfunction](#), [cpqfunctionvec](#)

Examples

```
#####
# construction of a vector of
# continuous convex piecewise linear functions

CCPWLfuncList=new(cplfunctionvec)
CCPWLfuncList$push_back(new(cplfunction,c(-1,1) ,c(-Inf,0),0))
CCPWLfuncList$push_back(new(cplfunction,c(-1,1) ,c(-Inf,0),0))

CCPWLfuncList=new(cplfunctionvec)
n=1000; Y=rnorm(n); S1=array(-1,n);S2=array(1,n); B0=array(-Inf,n); B1=rnorm(n);
for (i in 1:n){
  CCPWLfuncList$push_back(new(cplfunction,c(S1[i],S2[i]) ,c(B0[i],B1[i]),0))
}
CCPWLfuncList$size() ## gives the size
## The same but faster
CCPWLfuncList=new(cplfunctionvec)
CCPWLfuncList$SerialPush_2Breaks_Functions(S1,S2,B0,B1);

##### method OptimMargInt solves
#      min_x sum_{i=1}^n C_i(x_i)
#      Pmoins_i <= x_i <= Pplus_i   i=1,...,n
#      Cmoins_i <= sum_{j=1}^i x_j <= Cplus_i   i=1,...,n

Pmoins=array(-1,n);Pplus=array(1,n);Cmoins=array(0,n);Cplus=array(5,n);
res=CCPWLfuncList$OptimMargInt(Pmoins,Pplus,Cmoins,Cplus)

par(mfrow=c(1,2))
plot(Y,type='l',ylim=range(res$xEtoile))
lines(y=Pmoins,x=1:n,col='blue'); lines(y=Pplus,x=1:n,col='blue');
lines(y=res$xEtoile,x=1:n,col='red')
text(x=800,y=3,paste("Optimum=",signif(sum(abs(res$xEtoile-Y)),digits=6)))
plot(Y,type='l',ylim=c(min(Y),max(diffinv(res$xEtoile)[1:n+1])))
lines(y=Cmoins,x=1:n,col='blue'); lines(y=Cplus,x=1:n,col='blue');
lines(y=diffinv(res$xEtoile)[1:n+1],x=1:n,col='red')

rm(list=ls())
gc()
```

Description

This includes functions that are ccpq on a convex set (i.e. an interval or a point) and infinite out of the domain. These functions can be very usefull for a large class of optimisation problems. Efficient manipulation (such as $\log(N)$ insertion) of such data structure is obtained with map standard template library of C++ (that hides balanced trees). This package is a wrapper on such a class based on Rcpp modules.

Author(s)

Robin Girard

See Also

to See Also as [cplfunction](#),

Examples

```
##
#Construction of a piecewise quadratic function
##
Slopes1=c(-1,2)
Slopes0=c(-2,0)# increasing ! convexity is required
Breakpoints=c(-Inf,2,4) # increasing. length is number of slopes +1
FirstNonInfBreakpointVal=3
CCPWLfunc1=new(cpqfunction,Slopes0,Slopes1,Breakpoints,FirstNonInfBreakpointVal)
CCPWLfunc1$get_BreakPoints_() ## return Breaks AND Slopes
plot(CCPWLfunc1)

###Etoile transformation (legendre transform of f)
# Changes f no return value
CCPWLfunc1$Etoile()
CCPWLfunc1$get_BreakPoints_()
CCPWLfunc1$Etoile()
CCPWLfunc1$get_BreakPoints_() ## (f^*)^* is f !

###Squeeze function
# Changes f, no return value
left=-1; right=4
CCPWLfunc1$Squeeze(left,right) # CCPWLfunc1 is now infinite (or not definite) out of [left,right]
# i.e. all breakpoints out of [left,right] removed
CCPWLfunc1$get_BreakPoints_()

###Swap function
# Changes f no return value !
y=2;
CCPWLfunc1$Swap(y)
CCPWLfunc1$get_BreakPoints_() #now f = CCPWLfunc1 is replaced by x -> f(y-x)

### Sum function (uses fast insertion) do not affect operands
```

```

CCPWLfunc1=new(cpqfunction,Slopes0,Slopes1,Breakpoints,FirstNonInfBreakpointVal)
CCPWLfunc2=new(cpqfunction,Slopes0,Slopes1+1,Breakpoints,FirstNonInfBreakpointVal)
CCPWLfunc1plus2=Sumq(CCPWLfunc1,CCPWLfunc2)
CCPWLfunc1plus2$get_BreakPoints_()

```

```

rm(list=ls())
gc()

```

cpqfunctionvec	<i>This class implements "optimized list" of continuous convex piecewise quadratic functions</i>
----------------	--

Description

This is a wrapper to stl vector of convex piecewise quadratic functions. Allows to loop efficiently on such list.

Author(s)

Robin Girard

See Also

to See Also as [cpqfunction](#), [cplfunctionvec](#)

Examples

```

CCPWLfuncList=new(cpqfunctionvec)
CCPWLfuncList$push_back(new(cpqfunction,c(0),c(1),c(-2, 2),0))
CCPWLfuncList$push_back(new(cpqfunction,c(0),c(1),c(-2, 2),0))

CCPWLfuncList=new(cpqfunctionvec)
n=1000; Y=rnorm(n); S0=array(0,n)+Y;S1=array(1,n)+Y; B0=array(-Inf,n); B1=array(Inf,n);
for (i in 1:n){
  CCPWLfuncList$push_back(new(cpqfunction,S0[i],S1[i] ,c(B0[i],B1[i]),0))
}
CCPWLfuncList$size() ## gives the size
## The same but faster
CCPWLfuncList=new(cpqfunctionvec)
CCPWLfuncList$SerialPush_0Breaks_Functions(S0,S1);

#### method OptimMargInt solves
#      min_x sum_i=1^n C_i(x_i)
#      Pmoins_i<= x_i   <=Pplus_i   i=1,...,n
#      Cmoins_i<= sum_j=1^i x_j <=Cplus_i   i=1,...,n

Pmoins=array(-1,n);Pplus=array(1,n);Cmoins=array(0,n);Cplus=array(5,n);
res=CCPWLfuncList$OptimMargInt(Pmoins,Pplus,Cmoins,Cplus)

```

```

par(mfrow=c(1,2))
plot(Y,type='l')
lines(y=Pmoins,x=1:n,col='blue'); lines(y=Pplus,x=1:n,col='blue');
lines(y=res$xEtoile,x=1:n,col='red')
text(x=800,y=3,paste("Optimum=",signif(sum(abs(res$xEtoile-Y)),digits=6)))
plot(Y,type='l',ylim=c(min(Y),max(diffinv(res$xEtoile)[1:n+1])))
lines(y=Cmoins,x=1:n,col='blue'); lines(y=Cplus,x=1:n,col='blue');
lines(y=diffinv(res$xEtoile)[1:n+1],x=1:n,col='red')

rm(list=ls())
gc()

```

OptimPriceStorage	<i>Optimisation of storage operation with market prices taking into account storage efficiency and network taxes.</i>
-------------------	---

Description

Optimisation of storage operation with market prices taking into account storage efficiency and network taxes.

Usage

```

OptimPriceStorage(Prices,Pplus,Pmoins,Cplus,Cmoins=0,
                  efficiencyS=0,efficiencyP=efficiencyS,networkTax=0)

```

Arguments

Prices	A vector of prices
Pplus	A value for the upper power constraint or a vector of values with the same size as Prices
Pmoins	A value for the lower power constraint or a vector of values with the same size as Prices
Cplus	A value for the upper capacity constraint or a vector of values with the same size as Prices
Cmoins	A value for the lower capacity constraint or a vector of values with the same size as Prices
efficiencyS	storage efficiency when storing electricity
efficiencyP	storage efficiency when producing electricity
networkTax	networkTax

Details

function OptimPriceStorage solves # $\min_x \sum_{i=1}^n Y_i \text{efficiency} P_{x_i} (x_i < 0) + (Y_i \text{efficiency} S + \text{networkTax}) x_i (x_i > 0)$ # $P_{\text{moins}_i} \leq x_i \leq P_{\text{plus}_i}$ $i=1, \dots, n$ # $C_{\text{moins}_i} \leq \sum_{j=1}^i x_j \leq C_{\text{plus}_i}$ $i=1, \dots, n$

when $\text{efficiency}=1$ and $\text{networkTax}=0$ this gives # $\min_x \sum_{i=1}^n Y_i x_i$ # $P_{\text{moins}_i} \leq x_i \leq P_{\text{plus}_i}$ $i=1, \dots, n$ # $C_{\text{moins}_i} \leq \sum_{j=1}^i x_j \leq C_{\text{plus}_i}$ $i=1, \dots, n$

Value

A list with

Operation the optimal operation for each time step

Revenue the revenue for each time step

Note

TODO

Author(s)

Robin Girard

References

TODO

See Also

to See Also [cplfunction](#) (method OptimMargInt that is more general)

Examples

```
n=8760
Prices=runif(n,1,100) ##uniform random prices in [1;100] in Euro/MWh
Pmax=1; Pmin=-1; Cmax=5; ## 1MW maximum during 5 hours.
res=OptimPriceStorage(Prices,Pmax,Pmin,Cmax) # solving the optimization problem
sum(res$Revenue)## Revenue
res=OptimPriceStorage(Prices,Pmax,Pmin,Cmax,efficiencyS=0.8) # solving the optimization problem
sum(res$Revenue)## Revenue
```

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