

# MTH8408 : Méthodes d'optimisation et contrôle optimal

## Laboratoire 3: Optimisation sans contraintes et méthodes itératives

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In [ ]:

```
using Pkg
Pkg.activate(".") #Accède au fichier Project.toml
Pkg.add("LDLFactorizations")
Pkg.add("OptimizationProblems")
Pkg.add("Plots")
Pkg.add("SolverCore")
Pkg.add("LinearOperators")
Pkg.add("BenchmarkTools")
Pkg.add("OptimizationProblems")
Pkg.add("NLPModelsJuMP")
Pkg.instantiate()
Pkg.status()

Activating project at `~/Documents/code/MTH8408-Hiv24/lab3_JP`
Updating registry at `~/.julia/registries/General.toml`
Resolving package versions...
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Project.toml`
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Manifest.toml`
Resolving package versions...
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Project.toml`
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Manifest.toml`
Resolving package versions...
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Project.toml`
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Manifest.toml`
Resolving package versions...
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Project.toml`
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Manifest.toml`
Resolving package versions...
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Project.toml`
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Manifest.toml`
Resolving package versions...
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Project.toml`
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Manifest.toml`
Resolving package versions...
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Project.toml`
No Changes to `~/Documents/code/MTH8408-Hiv24/lab3_JP/Manifest.toml`
Status `~/Documents/code/MTH8408-Hiv24/lab3_JP/Project.toml`
[54578032] ADNLPModels v0.7.0
[ecbce9bc] BenchmarkProfiles v0.4.4
[6e4b80f9] BenchmarkTools v1.4.0
[7073ff75] IJulia v1.24.2
[10dff2fc] JSOSolvers v0.11.0
[40e66cde] LDLFactorizations v0.10.1
[5c8ed15e] LinearOperators v2.6.0
[a4795742] NLPModels v0.20.0
[792afdf1] NLPModelsJuMP v0.12.5
[5049e819] OptimizationProblems v0.7.3
[91a5bcdd] Plots v1.40.1
[581a75fa] SolverBenchmark v0.6.0
[ff4d7338] SolverCore v0.3.7
[37e2e46d] LinearAlgebra
[de0858da] Printf
```

In [ ]:

```
using BenchmarkTools, SolverCore, LinearOperators
using JSOSolvers, NLPModels, OptimizationProblems #
using ADNLPModels
using SolverBenchmark
using LinearAlgebra, NLPModels, Printf
using OptimizationProblems.ADNLPProblems
```

### Exercice 1: Méthode quasi-Newton L-BFGS

Compléter votre implémentation de la méthode L-BFGS et illustrer son utilisation sur un des problèmes sans contraintes de la collection OptimizationProblems.jl.

SOLUTION:

In [ ]:

```
"""
Function that implements an armijo line search
Obligatory inputs: xk, dk, fk, gk, slope, nlp.
Outputs: armijo parameter t, new fk.
"""
function armijo(xk, dk, fk, gk, slope, nlp :: AbstractNLPModel; τ1 = 1.0e-4, t_update = 1.5)
    t = 1.0
    fk_new = obj(nlp, xk + dk) # t = 1.0
    while fk_new > fk + τ1 * t * slope
        t /= t_update
        fk_new = obj(nlp, xk + t * dk)
    end
    return t, fk_new
end

"""
Function that solves an unconstrained nlp object with a limited bfgs algorithm
Obligatory inputs: nlp object,
Outputs: Execution Stats
"""
```

```
function limited_bfgs(nlp :: AbstractNLPModel;
    x :: AbstractVector = nlp.meta.x0,
    atol :: Real = √eps(eltype(x)),
    rtol :: Real = √eps(eltype(x)),
    max_eval :: Int = -1,
    max_time :: Float64 = 30.0,
    f_min :: Float64 = -1.0e16,
    verbose :: Bool = true,
    mem :: Int = 5)
start_time = time()
elapsed_time = 0.0

T = eltype(x)
n = Int(nlp.meta.nvar)

xt = zeros(T, n)
∇ft = zeros(T, n)

f = obj(nlp, x)
∇f = grad(nlp, x)
#####
H = InverseLBFGSOperator(n;mem=mem) ### Use InverseLBFGSOperator instead of I ###
#####

∇fNorm = norm(∇f) #nrm2(n, ∇f)
ε = atol + rtol * ∇fNorm
iter = 0

@info log_header([:iter, :f, :dual, :slope, :bk], [Int, T, T, T, T],
hdr_override=:Dict{f=>"f(x)", :dual=>"||∇f||", :slope=>"∇fᵀd"})

optimal = ∇fNorm ≤ ε
unbdd = f ≤ f_min
tired = neval_obj(nlp) > max_eval ≥ 0 || elapsed_time > max_time
stalled = false
status = :unknown

while !(optimal || tired || stalled || unbdd)

#####
d = H*∇f ### Compute d
d *= -1 ### Somehow fixes a bug to proceed like this
#####
slope = dot(d, ∇f)
if slope ≥ 0
    @error "not a descent direction" slope
    status = :not_desc
    stalled = true
    continue
end

# Perform improved Armijo linesearch.
t, ft = armijo(x, d, f, ∇f, slope, nlp)

@info log_row(Any[iter, f, ∇fNorm, slope, t])

# Update L-BFGS approximation.
xt = x + t * d
∇ft = grad(nlp, xt) # grad!(nlp, xt, ∇ft)
#####
st = xt - x
yt = ∇ft - ∇f
push!(H, st, yt) ### Update H with a new st and yt
#####

# Move on.
x = xt
f = ft
∇f = ∇ft

∇fNorm = norm(∇f) #nrm2(n, ∇f)
iter = iter + 1

optimal = ∇fNorm ≤ ε
unbdd = f ≤ f_min
elapsed_time = time() - start_time
tired = neval_obj(nlp) > max_eval ≥ 0 || elapsed_time > max_time
end
@info log_row(Any[iter, f, ∇fNorm])

if optimal
    status = :first_order
elseif tired
    if neval_obj(nlp) > max_eval ≥ 0
        status = :max_eval
    elseif elapsed_time > max_time
        status = :max_time
    end
elseif unbdd
    status = :unbounded
end

return GenericExecutionStats(
nlp,
status=status,
solution=x,
objective=f,
dual_feas=∇fNorm,
iter=iter,
elapsed_time=elapsed_time,
)
end
```

limited\_bfgs

Nous illustrons son utilisation et sa performance sur le problème unconstrained Tridia de la collection OptimizationProblems.jl. Nous travaillerons avec 100 variables.

In [ ]: OptimizationProblems.tridia\_meta

```
Dict{Symbol, Any} with 17 entries:
:has_equalities_only    => false
:origin                 => :unknown
:has_inequalities_only  => false
:defined_everywhere     => missing
:has_fixed_variables    => false
:variable_ncon          => false
:nvar                   => 100
:is_feasible            => true
:minimize               => true
:ncon                   => 0
:name                   => "tridia"
:best_known_lower_bound => -Inf
:objtype                => :other
:best_known_upper_bound => 5049.0
:has_bounds             => false
:variable_nvar          => true
:contype                => :unconstrained
```

```
In [ ]: n = 100
nlp = tridia(n=n)

stats = limited_bfgs(nlp)
```

	Info:	iter	f(x)	∇f	vfrd	bk
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:49				
[	Info:	0	5.0e+03	1.2e+03	-1.4e+06	7.7e-03
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	1	2.0e+03	1.6e+03	-4.8e+03	6.7e-01
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	2	1.1e+03	1.2e+03	-1.3e+03	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	3	4.5e+02	3.1e+02	-1.1e+02	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	4	3.5e+02	2.3e+02	-3.2e+02	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	5	1.7e+02	2.2e+02	-1.7e+02	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	6	1.5e+02	4.3e+02	-1.0e+02	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	7	8.5e+01	1.3e+02	-1.9e+01	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	8	7.1e+01	9.2e+01	-2.1e+01	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	9	5.6e+01	1.0e+02	-2.8e+01	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	10	3.8e+01	1.0e+02	-3.3e+01	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	11	3.7e+01	2.0e+02	-2.7e+01	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	12	2.2e+01	5.4e+01	-3.7e+00	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	13	1.9e+01	3.8e+01	-6.2e+00	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	14	1.5e+01	4.4e+01	-7.6e+00	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	15	1.1e+01	7.3e+01	-4.7e+00	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	16	8.3e+00	3.6e+01	-1.9e+00	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	17	6.9e+00	2.5e+01	-1.8e+00	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	18	5.7e+00	2.7e+01	-2.6e+00	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	19	4.6e+00	4.3e+01	-1.7e+00	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	20	3.6e+00	2.0e+01	-7.8e-01	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	21	3.0e+00	1.8e+01	-1.0e+00	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	22	2.3e+00	2.0e+01	-1.3e+00	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	23	2.2e+00	4.0e+01	-9.3e-01	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	24	1.6e+00	1.3e+01	-2.7e-01	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	25	1.4e+00	1.0e+01	-3.3e-01	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	26	1.2e+00	1.1e+01	-4.7e-01	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	27	9.1e-01	1.8e+01	-4.6e-01	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:	28	7.1e-01	1.1e+01	-1.3e-01	1.0e+00
[	@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
[	Info:					

```
└ Info:      55   7.4e-02   3.2e+00  -1.3e-02   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      56   6.5e-02   1.9e+00  -1.6e-02   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      57   5.4e-02   2.2e+00  -1.3e-02   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      58   4.6e-02   2.9e+00  -1.5e-02   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      59   3.6e-02   2.1e+00  -1.4e-02   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      60   2.6e-02   1.9e+00  -2.2e-02   6.7e-01
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      61   2.2e-02   3.9e+00  -1.0e-02   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      62   1.6e-02   1.4e+00  -3.0e-03   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      63   1.3e-02   1.1e+00  -4.5e-03   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      64   1.0e-02   1.2e+00  -5.0e-03   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      65   7.9e-03   2.0e+00  -4.3e-03   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      66   5.5e-03   9.1e-01  -1.2e-03   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      67   4.5e-03   6.1e-01  -1.6e-03   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      68   3.6e-03   7.3e-01  -1.6e-03   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      69   3.3e-03   1.3e+00  -9.8e-04   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      70   2.6e-03   5.1e-01  -5.0e-04   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      71   2.3e-03   3.9e-01  -4.1e-04   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      72   2.0e-03   4.2e-01  -8.2e-04   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
```

Info:	73	1.5e-03	6.5e-01	-8.7e-04	1.0e+00
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Info:	74	1.4e-03	8.3e-01	-4.7e-04	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	75	1.1e-03	2.8e-01	-1.2e-04	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	76	9.7e-04	2.4e-01	-2.5e-04	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	77	7.9e-04	3.2e-01	-3.3e-04	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	78	5.9e-04	5.2e-01	-4.0e-04	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	79	4.4e-04	3.9e-01	-1.4e-04	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	80	3.3e-04	2.0e-01	-1.2e-04	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	81	2.5e-04	1.8e-01	-9.8e-05	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	82	1.9e-04	2.2e-01	-1.2e-04	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	83	1.3e-04	1.7e-01	-5.8e-05	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	84	8.6e-05	1.2e-01	-7.6e-05	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	85	6.1e-05	2.3e-01	-4.7e-05	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	86	3.7e-05	8.8e-02	-9.0e-06	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	87	3.0e-05	6.5e-02	-2.2e-05	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	88	1.8e-05	7.5e-02	-2.1e-05	6.7e-01
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	89	1.4e-05	1.0e-01	-6.0e-06	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	90	9.9e-06	4.6e-02	-3.5e-06	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	91	7.6e-06	2.9e-02	-1.7e-06	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	92	6.4e-06	2.5e-02	-3.2e-06	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	93	5.7e-06	5.3e-02	-2.4e-06	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	94	4.3e-06	1.5e-02	-5.1e-07	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	95	3.9e-06	1.7e-02	-1.4e-06	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	96	3.3e-06	2.3e-02	-7.5e-07	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	97	3.0e-06	1.7e-02	-2.2e-07	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	98	2.8e-06	9.1e-03	-2.3e-07	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	99	2.7e-06	6.8e-03	-1.5e-07	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	100	2.6e-06	8.3e-03	-2.0e-07	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	101	2.5e-06	7.7e-03	-1.2e-07	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	102	2.4e-06	5.7e-03	-1.8e-07	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	103	2.3e-06	8.1e-03	-1.7e-07	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	104	2.2e-06	1.3e-02	-9.0e-08	1.0e+00
@ Main	/home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75				
Info:	105	2.1e-06			

```
└ Info:      129    9.2e-08    7.0e-03   -6.7e-08    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      130    6.3e-08    4.4e-03   -1.9e-08    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      131    4.9e-08    2.3e-03   -1.7e-08    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      132    3.7e-08    2.1e-03   -1.2e-08    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      133    3.0e-08    2.2e-03   -1.7e-08    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      134    2.4e-08    3.1e-03   -7.6e-09    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      135    2.0e-08    1.2e-03   -2.5e-09    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      136    1.8e-08    9.7e-04   -2.9e-09    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      137    1.6e-08    9.6e-04   -4.3e-09    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      138    1.6e-08    2.5e-03   -3.7e-09    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      139    1.3e-08    7.1e-04   -6.3e-10    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      140    1.3e-08    5.4e-04   -1.3e-09    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      141    1.2e-08    6.1e-04   -1.5e-09    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      142    1.1e-08    1.1e-03   -1.5e-09    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      143    1.0e-08    5.5e-04   -6.0e-10    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      144    9.9e-09    4.3e-04   -9.6e-10    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      145    9.3e-09    6.3e-04   -7.8e-10    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
└ Info:      146    9.1e-09    7.5e-04   -3.5e-10    1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
```



```
Info:      147      8.8e-09      4.2e-04      -5.1e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      148      8.5e-09      3.4e-04      -2.8e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      149      8.2e-09      3.6e-04      -8.1e-10      6.7e-01
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      150      8.1e-09      8.3e-04      -4.8e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      151      7.8e-09      3.1e-04      -1.6e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      152      7.7e-09      2.8e-04      -3.5e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      153      7.4e-09      3.9e-04      -5.2e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      154      7.0e-09      5.3e-04      -1.3e-09      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      155      6.7e-09      1.2e-03      -1.0e-09      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      156      6.0e-09      5.0e-04      -5.3e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      157      5.6e-09      4.6e-04      -6.1e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      158      5.2e-09      5.4e-04      -1.3e-09      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      159      5.0e-09      1.6e-03      -1.1e-09      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      160      4.2e-09      6.7e-04      -6.7e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      161      3.7e-09      4.5e-04      -6.3e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      162      3.2e-09      5.8e-04      -9.8e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      163      2.5e-09      6.3e-04      -1.7e-09      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      164      2.1e-09      1.5e-03      -1.6e-09      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      165      1.3e-09      2.9e-04      -2.1e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      166      1.2e-09      2.5e-04      -4.2e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      167      9.4e-10      4.3e-04      -3.7e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      168      7.9e-10      4.4e-04      -1.5e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      169      6.7e-10      2.6e-04      -2.4e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      170      5.3e-10      1.9e-04      -9.0e-11      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      171      4.6e-10      2.6e-04      -1.6e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      172      3.5e-10      2.3e-04      -2.7e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      173      2.8e-10      5.9e-04      -2.4e-10      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      174      1.4e-10      1.5e-04      -4.2e-11      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      175      1.1e-10      1.0e-04      -4.3e-11      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      176      8.5e-11      1.1e-04      -7.1e-11      6.7e-01
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      177      8.0e-11      2.7e-04      -3.7e-11      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      178      5.6e-11      8.4e-05      -1.1e-11      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      179      4.9e-11      5.7e-05      -1.0e-11      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      180      4.1e-11      6.2e-05      -1.6e-11      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      181      3.2e-11      1.0e-04      -1.7e-11      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      182      2.6e-11      7.5e-05      -5.0e-12      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      183      2.2e-11      4.1e-05      -4.9e-12      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      184      1.9e-11      3.8e-05      -4.2e-12      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      185      1.6e-11      4.5e-05      -4.2e-12      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      186      1.5e-11      3.9e-05      -1.4e-12      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      187      1.4e-11      1.9e-05      -1.1e-12      1.0e+00
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:75
Info:      188      1.3e-11      1.5e-05
@ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:99
"Execution stats: first-order stationary"
```

```
In [ ]: print(stats)
```

Generic Execution stats  
status: first-order stationary  
objective value: 1.2824360088337822e-11  
primal feasibility: 0.0  
dual feasibility: 1.533229397405431e-5  
solution: [0.9999965771090676 0.4999983282656731 0.24999917035173627 0.12499953412164919 ... 4.3035947366902296e-10]  
iterations: 188  
elapsed time: 0.01155400276184082

As we see, it took 188 iterations to converge to a local mimimum of approximately 0.

### Exercice 2: Méthode Newton-CG

Compléter votre implémentation de la méthode Newton-CG et illustrer son utilisation sur un des problèmes sans contraintes de la collection OptimizationProblems.jl.

SOLUTION:

```
In [ ]: """
Function that obtains a search direction with the conjugate gradient algorithm
Inputs: Hessian and gradient
Ouput: A new direction
"""
```



```
"""
function cg_optim(H, ∇f)
    #setup the tolerance:
    n∇f = norm(∇f)
    #####
    ek = min(0.5, sqrt(n∇f)).*n∇f # added
    #####
    n = length(∇f)
    z = zeros(n)
    r = ∇f
    d = -r

    j = 0
    while norm(r) ≥ ek && j < 3 * n
    #####
        if dot(d, H * d) ≤ 0
            pk = (j == 0) ? - ∇f : z # added
            end
    #####
            α =dot(r,r)./(dot(d, H * d)) # added
    #####
            z += α * d
            nrr2 = dot(r, r)
            r += α * H * d
    #####
            β = dot(r,r)./nrr2 # added
    #####
            d = -r + β.*d
            j += 1
        end
    return z # or return d?
end

"""
Function that uses an armijo linesearch, with a Newton algorithm while using a conjugate gradient direction each step
Inputs: An NLP object and other mandatory parameters.
Ouptut: Execution stats.

"""
function armijo_Newton_cg(nlp          :: AbstractNLPModel;
                        x              :: AbstractVector = nlp.meta.x0,
                        atol           :: Real = √eps(eltype(x)),
                        rtol           :: Real = √eps(eltype(x)),
                        max_eval       :: Int = -1,
                        max_time       :: Float64 = 30.0,
                        f_min          :: Float64 = -1.0e16)

    start_time = time()
    elapsed_time = 0.0

    T = eltype(x)
    n = nlp.meta.nvar

    f = obj(nlp, x)
    ∇f = grad(nlp, x)
    #####
    H = hess_op(nlp, x)  ### Initialize H as linear operator representing the Hessian matrix
    #####

    ∇fNorm = norm(∇f) #nrm2(n, ∇f)
    ε = atol + rtol * ∇fNorm
    iter = 0

    @info log_header([:iter, :f, :dual, :slope, :bk], [Int, T, T, T, T],
                    hdr_override=Dict{:f=>"f(x)", :dual=>"||∇f||", :slope=>"∇fᵀd"})

    optimal = ∇fNorm ≤ ε
    unbdd = f ≤ f_min
    tired = neval_obj(nlp) > max_eval ≥ 0 || elapsed_time > max_time
    stalled = false
    status = :unknown

    while !(optimal || tired || stalled || unbdd)

        d = cg_optim(H, ∇f)

        slope = dot(d, ∇f)
        if slope ≥ 0
            @error "not a descent direction" slope
            status = :not_desc
            stalled = true
            continue
        end

        # Perform improved Armijo linesearch.
        t, f = armijo(x, d, f, ∇f, slope, nlp)

        @info log_row(Any[iter, f, ∇fNorm, slope, t])

        # Update L-BFGS approximation.
        x += t * d
        ∇f = grad(nlp, x)
    #####
        H = hess_op(nlp, x) ### Update H!
    #####

        ∇fNorm = norm(∇f) #nrm2(n, ∇f)
        iter = iter + 1

        optimal = ∇fNorm ≤ ε
        unbdd = f ≤ f_min
        elapsed_time = time() - start_time
        tired = neval_obj(nlp) > max_eval ≥ 0 || elapsed_time > max_time
    end
    @info log_row(Any[iter, f, ∇fNorm])

    if optimal
        status = :first_order
    elseif tired
        if neval_obj(nlp) > max_eval ≥ 0
            status = :max_eval
```

```
elseif elapsed_time > max_time
    status = :max_time
end
elseif unbdd
    status = :unbounded
end

return GenericExecutionStats(nlp, status = status, solution=x, objective=f, dual_feas=∇fNorm,
                             iter=iter, elapsed_time=elapsed_time)
end
```

armijo\_Newton\_cg

Une deuxième fois, illustrons sa performance sur le problème `tridia` avec 100 variables.

```
In [ ]: n = 100
nlp = tridia(n=n)
stats = armijo_Newton_cg(nlp)
```

```
└ Info:   iter      f(x)      ||∇f||      ∇fᵀd      bk
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:69
└ Info:     0   6.3e+02   1.2e+03  -8.8e+03   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:     1   1.2e+02   5.1e+02  -1.0e+03   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:     2   2.7e+01   2.0e+02  -1.8e+02   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:     3   1.5e+01   9.7e+01  -2.3e+01   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:     4   2.2e+00   4.4e+01  -2.5e+01   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:     5   4.9e-01   1.7e+01  -3.5e+00   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:     6   2.4e-01   7.7e+00  -5.1e-01   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:     7   9.9e-02   3.8e+00  -2.8e-01   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:     8   1.4e-03   1.6e+00  -1.9e-01   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:     9   2.6e-04   7.3e-01  -2.2e-03   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:    10   1.1e-04   2.9e-01  -3.0e-04   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:    11   4.0e-05   1.4e-01  -1.5e-04   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:    12   1.8e-07   4.1e-02  -7.9e-05   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:    13   2.6e-09   6.8e-03  -3.5e-07   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:    14   3.4e-13   5.3e-04  -5.2e-09   1.0e+00
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:93
└ Info:    15   3.4e-13   1.1e-05
└ @ Main /home/julien/Documents/code/MTH8408-Hiv24/lab3_JP/lab3_pallage.ipynb:110
"Execution stats: first-order stationary"
```

```
In [ ]: print(stats)
```

Generic Execution stats  
status: first-order stationary  
objective value: 3.37580889992935e-13  
primal feasibility: 0.0  
dual feasibility: 1.1199496148809964e-5  
solution: [0.9999999912018402 0.5000000300459599 0.2500000476635215 0.12499997802900703 ... 2.570225077445835e-9]  
iterations: 15  
elapsed time: 0.026151180267333984

Ici, on remarque que ça a pris seulement 15 itérations pour converger à un minimum local de valeur similaire l'exercice 1 et ce deux fois plus rapidement!

### Exercice 3: Benchmark LBFGS vs Taille mémoire

Comparer LBFGS avec mémoire  $m = 1$ ,  $m = 5$  et  $m = 20$  sur une collection de problèmes sans contraintes de `OptimizationProblems.jl`. Préciser combien de problèmes sont utilisés, inclure des profils de performance, et mentionner un/des problèmes qui ne sont pas résolus par l’algorithme.

---

SOLUTION:

```
In [ ]: OptimizationProblems.meta
```

Row	nvar	variable_nvar	ncon	variable_ncon	minimize	name	has_equalities_only	has_inequalities_only	has_bounds	has_fixed_variables	objtype	comment
	Int64	Bool	Int64	Bool	Bool	String	Bool	Bool	Bool	Bool	Symbol	String
1	1	false	0	false	true	AMPGO02	false	false	false	false	other	1
2	1	false	0	false	true	AMPGO03	false	false	false	false	other	1
3	1	false	0	false	true	AMPGO04	false	false	false	false	other	1
4	1	false	0	false	true	AMPGO05	false	false	false	false	other	1
5	1	false	0	false	true	AMPGO06	false	false	false	false	other	1
6	1	false	0	false	true	AMPGO07	false	false	false	false	other	1
7	1	false	0	false	true	AMPGO08	false	false	false	false	other	1
8	1	false	0	false	true	AMPGO09	false	false	false	false	other	1
9	1	false	0	false	true	AMPGO10	false	false	false	false	other	1
10	1	false	0	false	true	AMPGO11	false	false	false	false	other	1
11	1	false	0	false	true	AMPGO12	false	false	false	false	other	1
12	1	false	0	false	true	AMPGO13	false	false	false	false	other	1
13	1	false	0	false	true	AMPGO14	false	false	false	false	other	1
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
361	100	true	0	false	true	tointgss	false	false	false	false	other	1
362	100	true	0	false	true	tquartic	false	false	false	false	least_squares	1
363	8	false	3	false	true	triangle	false	true	true	true	other	1
364	2244	false	1896	false	true	triangle_deer	false	true	true	true	other	1
365	1366	false	1182	false	true	triangle_pacman	false	true	true	true	other	1
366	4444	false	4025	false	true	triangle_turtle	false	true	true	true	other	1
367	100	true	0	false	true	tridia	false	false	false	false	other	1
368	100	true	0	false	true	vardim	false	false	false	false	other	1
369	8	false	0	false	true	vibrbeam	false	false	false	false	least_squares	1
370	31	false	0	false	true	watson	false	false	false	false	least_squares	1
371	100	true	0	false	true	woods	false	false	false	false	other	1
372	3	false	3	false	true	zangwil3	true	false	false	false	other	1

Ici, on utilise la documentation de la librairie OptimizationProblems <https://jso.dev/OptimizationProblems.jl/dev/benchmark/> pour obtenir les problèmes à résoudre et déclarer les solveurs dans un dictionnaire.

On initialise la mémoire à 5,10,20 avec limited\_bfgs afin de voir l'impact de la mémoire sur la performance.

```
In [ ]: ad_problems = (eval(Meta.parse(problem))() for problem ∈ OptimizationProblems.meta[!, :name])

solvers = Dict{
    :lbfgs_5 => model -> limited_bfgs(model; mem=5),
    :lbfgs_10 => model -> limited_bfgs(model; mem=10),
    :lbfgs_20 => model -> limited_bfgs(model; mem=20),
}

stats = bmark_solvers(
    solvers, ad_problems,
    skipif=prob -> (!unconstrained(prob) || get_nvar(prob) > 150 || get_nvar(prob) < 5),
)

┌ Info:          Name    nvar    ncon      status      Time      f(x)      Dual      Primal
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:127
┌ Info:          NZF1      91      0    first_order    3.0e-01    2.1e+04    3.7e-05    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      arglina     100      0    first_order    2.8e-01    5.0e+01    7.8e-15    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      arglinb     100      0    first_order    2.1e-01    2.5e+01    3.3e-04    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      arglinc     100      0    first_order    2.1e-01    5.1e+01    4.4e-03    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      argtrig     100      0    first_order    2.2e-01   -9.9e+03    5.5e-08    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      arwhead     100      0    first_order    1.8e-01    0.0e+00    5.0e-07    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      bdqrtic     100      0    first_order    2.3e-01    1.9e+02    2.1e-04    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      biggs6        6      0    unbounded     2.2e-05   -3.2e+22    4.1e+22    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      brownal     100      0    first_order    2.3e-01    1.9e-09    6.8e-04    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      broyden3d     100      0    first_order    2.1e-01    3.6e-01    1.4e-07    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      broydn7d     100      0    first_order    3.0e-01    3.6e+01    7.6e-07    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      brybnd      100      0    first_order    3.0e-01    1.3e+00    1.4e-05    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Warning: catenary: number of variables adjusted to be a multiple of 3
└─ @ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/catenary.jl:4
┌ Warning: catenary: number of variables adjusted to be greater or equal to 6
└─ @ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/catenary.jl:6
┌ Info:      chainwoo     100      0    first_order    2.3e-01    1.0e+00    7.8e-04    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      chnrosnb     100      0    first_order    2.3e-01    2.3e-10    7.4e-05    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      clplatea     100      0    first_order    4.5e-01   -9.1e-03    1.3e-08    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      clplateb     100      0    first_order    4.8e-01   -6.2e-03    1.5e-08    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
┌ Info:      clplatec     100      0    first_order    5.2e-01   -5.1e-03    1.6e-08    0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
```

[illegible]

```
Info:      indef      100      0      max_time  3.0e+01 -9.8e+03  8.4e-07  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      integreq    100      0      first_order  4.4e-01  5.9e-17  1.1e-08  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      kirby2      5        0      first_order  2.6e-03  1.5e+01  5.4e+02  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      lanczos1     6        0      first_order  2.8e-04  2.1e-06  4.4e-07  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      lanczos2     6        0      first_order  3.0e-04  2.1e-06  5.8e-07  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      lanczos3     6        0      first_order  3.1e-04  2.2e-06  4.8e-07  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      liarwhd     100      0      first_order  1.9e-01  8.8e-12  1.0e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      mgh17        5        0      first_order  5.6e-05  5.5e-02  8.7e-07  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      morebv       100      0      first_order  1.3e+00  2.4e-12  3.7e-08  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      ncb20         100      0      max_time  3.0e+01  1.6e+02  1.4e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      ncb20b        100      0      max_time  3.0e+01  2.0e+02  3.1e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      noncvxu2      100      0      first_order  2.4e-01  2.3e+02  1.3e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      noncvxun      100      0      first_order  2.1e-01  2.3e+02  1.2e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      nondia       100      0      first_order  1.9e-01  1.4e-12  5.8e-05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      nondquar      100      0      first_order  2.8e-01  1.3e-06  5.9e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      osborne1      5        0      max_time  3.0e+01  2.3e-02  3.1e-01  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      osborne2     11        0      first_order  2.9e-03  2.0e-02  5.5e-08  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer1c       8        0      first_order  3.6e-01  8.4e+01  3.5e+00  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer1d       7        0      first_order  3.1e-01  1.4e+01  3.0e-01  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer2c       8        0      first_order  9.5e-02  2.2e+00  2.2e-01  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer3c       8        0      first_order  7.1e-02  1.7e+00  8.4e-02  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer4c       8        0      first_order  6.3e-02  2.4e+00  8.4e-02  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer5c       6        0      first_order  4.5e-04  1.1e+00  3.1e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer6c       8        0      first_order  2.8e-01  4.8e-02  7.1e-03  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer7c       8        0      first_order  2.8e-01  2.2e+00  2.8e-02  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer8c       8        0      first_order  1.7e-01  3.0e-01  8.4e-03  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      penalty1      100      0      first_order  2.5e-01  1.2e+00  4.0e+00  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      penalty2      100      0      first_order  2.7e-01  9.7e+04  1.6e-02  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      penalty3      100      0      first_order  3.8e-01  1.0e+00  3.6e-03  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      powellsg       100      0      first_order  2.1e-01  6.1e-10  2.0e-05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      power          100      0      first_order  2.3e-01  2.7e-03  7.2e-02  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      quartc         100      0      first_order  1.9e-01  6.1e-02  1.6e-01  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sbrybnd        100      0      first_order  1.7e+00  1.4e+01  4.0e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      schmvett       100      0      first_order  2.0e-01 -2.9e+02  1.0e-07  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      scosine        100      0      max_time  3.0e+01 -7.4e+01  1.6e+04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      squad          100      0      first_order  2.1e-01  1.8e-15  4.3e-08  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sparsine       100      0      first_order  2.6e-01  3.5e-10  1.2e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sparsqr        100      0      first_order  2.1e-01  2.9e-08  9.5e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      spmsrtls       100      0      first_order  4.8e-01  4.2e-15  6.1e-08  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      srosenbr       100      0      first_order  2.0e-01  8.2e-15  2.1e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      thurber        7        0      first_order  9.9e-02  2.8e+03  1.4e+00  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      tointgss       100      0      first_order  2.0e-01  9.7e+00  2.5e-07  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      tqartic         100      0      first_order  1.9e-01  1.7e-20  8.2e-10  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      tridia          100      0      first_order  2.0e-03  1.3e-11  1.5e-05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      vardim          100      0      first_order  2.7e-01  2.5e+03  8.2e+05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      vibrbeam        8        0      first_order  4.4e-03  4.6e+00  5.3e+00  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      watson          31        0      unbounded  3.2e-03 -3.8e+90  8.1e+90  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      woods           100      0      first_order  2.1e-01  2.6e-09  3.9e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
```

```
└ Info:      Name      nvar      ncon      status      Time      f(x)      Dual      Primal
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:127
└ Info:      NZF1      91      0      first_order  1.1e-03  2.1e+04  2.6e-05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      arglina   100      0      first_order  1.3e-04  5.0e+01  7.8e-15  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      arglinb   100      0      first_order  1.4e-04  2.5e+01  3.3e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      arglinc   100      0      first_order  1.0e-04  5.1e+01  4.4e-03  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      argtrig   100      0      first_order  3.1e-03  -9.9e+03  5.6e-08  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      arwhead   100      0      first_order  1.6e-04  0.0e+00  2.9e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      bdqrtic   100      0      first_order  5.9e-04  1.9e+02  1.3e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      biggs6    6      0      unbounded   1.8e-05  -3.2e+22  4.1e+22  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      brownal   100      0      first_order  9.4e-05  1.9e-09  6.8e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      broyden3d  100      0      first_order  1.3e-03  3.6e-01  3.1e-07  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      broydn7d  100      0      first_order  1.6e-02  3.6e+01  6.6e-07  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      brybnd    100      0      first_order  1.2e-02  1.3e+00  1.4e-05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: catenary: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/catenary.jl:4
└ Warning: catenary: number of variables adjusted to be greater or equal to 6
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/catenary.jl:6
└ Info:      chainwoo   100      0      first_order  4.2e-03  1.0e+00  9.9e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      chnrosnb   100      0      first_order  1.7e-02  5.8e-11  7.8e-05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      clplatea   100      0      first_order  2.8e-03  -9.1e-03  1.6e-08  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      clplateb   100      0      first_order  3.0e-03  -6.2e-03  1.4e-08  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      clplatec   100      0      max_time    3.0e+01  -5.1e-03  2.4e-08  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      cosine    100      0      first_order  3.6e-04  -9.9e+01  2.8e-08  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      cragglvy   100      0      first_order  1.7e-03  3.2e+01  3.8e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      cragglvy2  100      0      first_order  1.7e-03  2.5e+01  5.6e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      curly     100      0      max_time    3.0e+01  -1.0e+04  3.5e-05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      curly10    100      0      max_time    3.0e+01  -1.0e+04  3.5e-05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      curly20    100      0      max_time    3.0e+01  -1.0e+04  5.0e-05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      curly30    100      0      max_time    3.0e+01  -1.0e+04  3.7e-05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_efgh.jl:12
└ Info:      dixmaane   99      0      first_order  3.9e-03  1.0e+00  1.7e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_efgh.jl:12
└ Info:      dixmaanf   99      0      first_order  4.2e-03  1.0e+00  3.4e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_efgh.jl:12
└ Info:      dixmaang   99      0      first_order  3.9e-03  1.0e+00  9.1e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_efgh.jl:12
└ Info:      dixmaanhh  99      0      first_order  4.1e-03  1.0e+00  6.7e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_ijkl.jl:12
└ Info:      dixmaani   99      0      first_order  3.0e-02  1.0e+00  2.6e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_ijkl.jl:12
└ Info:      dixmaanjj  99      0      first_order  2.5e-02  1.0e+00  3.9e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_ijkl.jl:12
└ Info:      dixmaank   99      0      first_order  1.7e-02  1.0e+00  9.2e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_ijkl.jl:12
└ Info:      dixmaanll  99      0      first_order  1.4e-02  1.0e+00  1.5e-05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_mnop.jl:12
└ Info:      dixmaanmm  99      0      first_order  5.0e-02  1.0e+00  1.1e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_mnop.jl:12
└ Info:      dixmaann   99      0      first_order  3.2e-02  1.0e+00  2.7e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_mnop.jl:12
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└ Info:      dixmaano      99      0      first_order      3.2e-02      1.0e+00      4.4e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPPProblems/dixmaan_mnop.jl:12
└ Info:      dixmaanp      99      0      first_order      3.4e-02      1.0e+00      8.0e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      dixon3dq      100     0      first_order      4.0e-03      3.4e-14      4.8e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      dqdrtic      100     0      first_order      2.0e-04      4.0e-12      4.3e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      dqrtic      100     0      first_order      6.7e-04      2.9e-02      1.1e-01      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      edensch      100     0      first_order      7.4e-04      6.0e+02      2.2e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      eg2          100     0      first_order      1.9e-04      -9.7e+01      8.5e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      engvall      100     0      first_order      3.3e-04      1.1e+02      6.7e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      enso         9       0      first_order      9.9e-04      3.9e+02      9.7e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      errinros     100     0      first_order      6.2e-03      3.9e+01      5.6e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      extrosnb     100     0      first_order      4.4e-04      3.2e-11      1.5e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      fletcbv2     100     0      first_order      4.4e-03      -5.1e-01      1.4e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      fletcbv3     100     0      first_order      3.6e-03      -2.0e+00      5.6e-09      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      fletchr      100     0      first_order      5.6e-03      3.5e-13      3.9e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      fminsrf2     100     0      first_order      3.7e-03      1.0e+02      8.4e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      freuroth     100     0      first_order      1.2e-03      6.0e+03      2.3e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      gauss1       8       0      first_order      3.2e-03      6.6e+02      9.7e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      gauss2       8       0      first_order      4.2e-03      6.2e+02      4.3e-03      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      gauss3       8       0      first_order      4.1e-03      6.2e+02      5.3e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      genhumps     100     0      first_order      6.5e-02      3.5e-11      3.7e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      genrose      100     0      first_order      4.0e-03      1.0e+00      1.8e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      genrose_nash  100     0      first_order      1.9e-02      1.0e+00      1.2e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      hahn1        7       0      max_time      3.0e+01      2.7e+04      5.2e+06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      indef       100     0      max_time      3.0e+01      -9.8e+03      6.6e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      integreq     100     0      first_order      2.0e-02      5.8e-17      1.1e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      kirby2       5       0      first_order      2.5e-03      1.5e+01      5.5e+02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      lanczos1      6       0      first_order      2.0e-04      2.1e-06      5.8e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      lanczos2      6       0      first_order      2.2e-04      2.1e-06      3.1e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      lanczos3      6       0      first_order      2.1e-04      2.2e-06      7.1e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      liarwhd      100     0      first_order      3.0e-04      1.1e-10      1.3e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      mgh17        5       0      first_order      5.9e-05      5.5e-02      1.2e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      morebv       100     0      first_order      4.7e-01      2.7e-11      3.7e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      ncb20        100     0      max_time      3.0e+01      1.7e+02      6.6e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      ncb20b       100     0      max_time      3.0e+01      2.0e+02      2.4e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      noncvxu2     100     0      first_order      1.3e-02      2.3e+02      1.3e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      noncvxun     100     0      first_order      4.7e-03      2.3e+02      1.5e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      nondia       100     0      first_order      3.8e-04      3.4e-15      7.8e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      nondquar     100     0      first_order      2.5e-02      7.4e-07      5.6e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      osborne1     5       0      max_time      3.0e+01      2.3e-02      4.1e+04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
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Info:      osborne2      11      0      first_order      7.3e-04      2.0e-02      2.6e-08      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer1c      8      0      first_order      6.1e-03      8.4e+01      1.8e+00      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer1d      7      0      first_order      6.0e-03      1.4e+01      2.5e-01      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer2c      8      0      first_order      3.8e-03      2.2e+00      9.1e-02      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer3c      8      0      first_order      2.1e-03      1.7e+00      7.8e-02      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer4c      8      0      first_order      3.3e-03      1.8e-01      6.4e-02      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer5c      6      0      first_order      3.2e-04      1.1e+00      1.4e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer6c      8      0      first_order      3.7e-03      4.8e-02      1.8e-03      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer7c      8      0      first_order      2.8e-03      2.7e+00      2.5e-02      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer8c      8      0      first_order      2.9e-03      3.0e-01      4.2e-03      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      penalty1     100      0      first_order      4.6e-04      1.2e+00      4.0e+00      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      penalty2     100      0      first_order      2.9e-03      9.7e+04      2.0e-02      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      penalty3     100      0      first_order      2.7e-03      1.0e+00      5.2e-03      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      powellsq      100      0      first_order      4.8e-04      1.4e-09      1.9e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      power        100      0      first_order      3.5e-04      1.6e-03      7.1e-02      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      quartc       100      0      first_order      5.9e-04      2.9e-02      1.1e-01      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sbrybnd       100      0      first_order      3.2e+00      7.6e+00      3.7e-04      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      schmvett       100      0      first_order      6.5e-04      -2.9e+02      1.1e-07      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      scosine        100      0      max_time      3.0e+01      -7.8e+01      2.8e+04      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sinquad        100      0      first_order      2.8e-03      9.8e-16      3.9e-08      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sparsine        100      0      first_order      1.9e-02      4.3e-10      9.1e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sparsqr         100      0      first_order      6.4e-04      4.7e-08      1.6e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      spmsrtls        100      0      first_order      8.0e-03      7.7e-15      7.3e-08      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      srosenbr        100      0      first_order      2.6e-04      4.0e-13      2.0e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      thurber         7      0      first_order      1.8e-03      2.8e+03      3.7e-02      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      tointgss        100      0      first_order      6.6e-04      9.7e+00      1.9e-07      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      tqartic         100      0      first_order      2.9e-04      4.2e-20      3.4e-09      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      tridia          100      0      first_order      1.7e-03      1.8e-12      1.4e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      vardim          100      0      first_order      2.3e-04      2.5e+03      8.2e+05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      vibrbeam         8      0      first_order      6.4e-04      5.3e+00      1.9e+00      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      watson           31      0      unbounded      3.0e-03      -3.8e+90      8.1e+90      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      woods           100      0      first_order      2.8e-04      1.7e-09      1.1e-03      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      Name      nvar      ncon      status      Time      f(x)      Dual      Primal
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:127
Info:      NZF1         91      0      first_order      1.6e-03      2.1e+04      3.0e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      arglina         100      0      first_order      1.3e-04      5.0e+01      7.8e-15      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      arglinb         100      0      first_order      1.2e-04      2.5e+01      3.3e-04      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      arglinc         100      0      first_order      9.0e-05      5.1e+01      4.4e-03      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      argtrig         100      0      first_order      8.8e-03      -9.9e+03      1.0e-07      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      arwhead         100      0      first_order      1.5e-04      0.0e+00      2.9e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      bdqrtic         100      0      first_order      5.9e-04      1.9e+02      1.5e-04      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      biggs6           6      0      unbounded      1.7e-05      -3.2e+22      4.1e+22      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      brownal         100      0      first_order      9.2e-05      1.9e-09      6.8e-04      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      broyden3d        100      0      first_order      1.3e-03      3.6e-01      5.7e-07      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      broydn7d        100      0      first_order      1.9e-02      3.6e+01      6.4e-07      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      brybnd           100      0      first_order      1.4e-02      1.3e+00      1.8e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: catenary: number of variables adjusted to be a multiple of 3
@ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPPProblems/catenary.jl:4
Warning: catenary: number of variables adjusted to be greater or equal to 6
@ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPPProblems/catenary.jl:6
Info:      chainwoo         100      0      first_order      3.8e-03      1.0e+00      1.0e-03      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      chnrosnb         100      0      first_order      1.6e-02      1.1e-10      5.1e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      clplatea         100      0      first_order      4.1e-03      -9.1e-03      1.6e-08      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      clplateb         100      0      first_order      5.0e-03      -6.2e-03      1.5e-08      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      clplatec         100      0      max_time      3.0e+01      -5.1e-03      2.0e-08      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
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Info:      cosine      100      0      first_order      4.1e-04      -9.9e+01      2.9e-08      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      cragglvy      100      0      first_order      1.7e-03      3.2e+01      5.3e-04      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      cragglvy2      100      0      first_order      2.2e-03      2.5e+01      3.6e-04      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      curly      100      0      first_order      1.9e-01      -1.0e+04      2.1e-07      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      curly10      100      0      first_order      2.0e-01      -1.0e+04      2.1e-07      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      curly20      100      0      max_time      3.0e+01      -1.0e+04      5.7e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      curly30      100      0      max_time      3.0e+01      -1.0e+04      1.2e-04      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: dixmaan: number of variables adjusted to be a multiple of 3
@ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_efgh.jl:12
Info:      dixmaane      99      0      first_order      4.6e-03      1.0e+00      2.7e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: dixmaan: number of variables adjusted to be a multiple of 3
@ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_efgh.jl:12
Info:      dixmaanf      99      0      first_order      4.2e-03      1.0e+00      3.6e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: dixmaan: number of variables adjusted to be a multiple of 3
@ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_efgh.jl:12
Info:      dixmaang      99      0      first_order      4.1e-03      1.0e+00      9.4e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: dixmaan: number of variables adjusted to be a multiple of 3
@ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_efgh.jl:12
Info:      dixmaanhh      99      0      first_order      4.1e-03      1.0e+00      9.0e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: dixmaan: number of variables adjusted to be a multiple of 3
@ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_ijkl.jl:12
Info:      dixmaani      99      0      first_order      3.2e-02      1.0e+00      2.7e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: dixmaan: number of variables adjusted to be a multiple of 3
@ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_ijkl.jl:12
Info:      dixmaanjj      99      0      first_order      2.3e-02      1.0e+00      4.9e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: dixmaan: number of variables adjusted to be a multiple of 3
@ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_ijkl.jl:12
Info:      dixmaank      99      0      first_order      1.6e-02      1.0e+00      9.7e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: dixmaan: number of variables adjusted to be a multiple of 3
@ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_ijkl.jl:12
Info:      dixmaanll      99      0      first_order      1.4e-02      1.0e+00      2.0e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: dixmaan: number of variables adjusted to be a multiple of 3
@ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_mnop.jl:12
Info:      dixmaanmm      99      0      first_order      5.4e-02      1.0e+00      1.2e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: dixmaan: number of variables adjusted to be a multiple of 3
@ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_mnop.jl:12
Info:      dixmaann      99      0      first_order      4.2e-02      1.0e+00      2.7e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: dixmaan: number of variables adjusted to be a multiple of 3
@ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_mnop.jl:12
Info:      dixmaano      99      0      first_order      4.1e-02      1.0e+00      4.4e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: dixmaan: number of variables adjusted to be a multiple of 3
@ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_mnop.jl:12
Info:      dixmaanpp      99      0      first_order      2.9e-02      1.0e+00      1.1e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      dixon3dq      100      0      first_order      4.7e-03      2.2e-14      5.5e-08      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      dqdrtic      100      0      first_order      1.9e-04      4.0e-12      4.3e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      dqdrtic      100      0      first_order      4.9e-04      3.4e-02      1.3e-01      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      edensch      100      0      first_order      7.0e-04      6.0e+02      2.5e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      eg2      100      0      first_order      1.8e-04      -9.7e+01      8.5e-08      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      engvall      100      0      first_order      3.3e-04      1.1e+02      6.3e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      enso      9      0      first_order      1.0e-03      3.9e+02      2.2e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      errinros      100      0      first_order      5.8e-03      3.9e+01      1.3e-03      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      extrosnb      100      0      first_order      4.4e-04      2.6e-11      1.2e-04      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      fletcbv2      100      0      first_order      2.1e-02      -5.1e-01      1.4e-08      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      fletcbv3      100      0      first_order      3.3e-03      -2.0e+00      3.5e-09      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      fletchr      100      0      first_order      5.4e-03      2.2e-13      3.8e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      fminsrf2      100      0      first_order      4.3e-03      1.0e+02      1.3e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      freuroth      100      0      first_order      1.2e-03      6.0e+03      2.5e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      gauss1      8      0      max_time      3.0e+01      6.6e+02      2.6e-03      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      gauss2      8      0      max_time      3.0e+01      6.2e+02      2.1e-02      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      gauss3      8      0      max_time      3.0e+01      6.2e+02      7.8e-03      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      genhumps      100      0      first_order      5.6e-02      4.0e-10      1.1e-05      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      genrose      100      0      first_order      3.2e-03      1.0e+00      1.9e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      genrose_nash      100      0      first_order      3.7e-03      1.0e+00      1.5e-06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      hahn1      7      0      max_time      3.0e+01      2.7e+04      5.2e+06      0.0e+00
@ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
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```

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└ Info:      indef      100      0      first_order      3.4e-03      -9.8e+03      5.3e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      integreq      100      0      first_order      2.0e-02      5.8e-17      1.1e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      kirby2      5      0      first_order      2.5e-03      1.5e+01      6.1e+02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      lanczos1      6      0      first_order      2.0e-04      2.1e-06      8.8e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      lanczos2      6      0      first_order      2.2e-04      2.1e-06      3.9e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      lanczos3      6      0      first_order      2.4e-04      2.2e-06      8.0e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      liarwhd      100      0      first_order      2.5e-04      3.7e-10      1.2e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      mgh17      5      0      first_order      5.6e-05      5.5e-02      2.6e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      morebv      100      0      first_order      5.6e-01      1.8e-12      3.4e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      ncb20      100      0      max_time      3.0e+01      1.6e+02      8.3e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      ncb20b      100      0      max_time      3.0e+01      2.0e+02      4.2e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      noncvxu2      100      0      first_order      1.0e-02      2.3e+02      1.3e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      noncvxun      100      0      first_order      6.6e-03      2.3e+02      8.9e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      nondia      100      0      first_order      3.5e-04      1.0e-13      1.1e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      nondquar      100      0      first_order      3.2e-02      7.9e-07      5.6e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      osborne1      5      0      max_time      3.0e+01      2.3e-02      1.4e+02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      osborne2      11      0      first_order      1.2e-03      2.0e-02      5.5e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      palmer1c      8      0      first_order      1.2e-02      8.4e+01      1.4e+00      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      palmer1d      7      0      first_order      1.9e-02      1.4e+01      2.1e-01      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      palmer2c      8      0      first_order      1.1e-02      2.2e+00      8.6e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      palmer3c      8      0      first_order      2.2e-02      1.7e+00      8.4e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      palmer4c      8      0      first_order      2.4e-02      1.8e-01      1.4e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      palmer5c      6      0      first_order      3.7e-04      1.1e+00      1.0e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      palmer6c      8      0      first_order      7.6e-03      4.8e-02      6.8e-03      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      palmer7c      8      0      first_order      4.2e-03      2.7e+00      2.1e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      palmer8c      8      0      first_order      4.7e-03      3.0e-01      1.3e-03      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      penalty1      100      0      first_order      4.7e-04      1.2e+00      4.0e+00      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      penalty2      100      0      first_order      2.9e-03      9.7e+04      2.2e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      penalty3      100      0      first_order      3.1e-03      1.0e+00      5.2e-03      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      powellsg      100      0      first_order      5.1e-04      7.9e-11      2.2e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      power      100      0      first_order      3.5e-04      2.8e-03      6.6e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      quartc      100      0      first_order      4.5e-04      3.4e-02      1.3e-01      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      sbrybnd      100      0      first_order      1.1e+00      1.4e+01      3.8e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      schmvett      100      0      first_order      6.4e-04      -2.9e+02      2.2e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      scosine      100      0      max_time      3.0e+01      -7.5e+01      2.2e+04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      sinquad      100      0      first_order      3.5e-03      6.1e-16      5.7e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      sparsine      100      0      first_order      2.4e-02      4.5e-10      1.1e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      sparsqur      100      0      first_order      5.2e-04      5.1e-08      1.5e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      spmsrtls      100      0      first_order      8.1e-03      8.1e-15      8.3e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      srosenbr      100      0      first_order      2.6e-04      4.0e-13      2.0e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      thurber      7      0      first_order      2.7e-03      2.8e+03      1.2e+00      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      tointgss      100      0      first_order      7.2e-04      9.7e+00      1.8e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      tquartic      100      0      first_order      3.5e-04      2.2e-20      2.4e-09      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      tridia      100      0      first_order      2.0e-03      1.9e-11      1.7e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      vardim      100      0      first_order      3.2e-04      2.5e+03      8.2e+05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      vibrbeam      8      0      first_order      9.3e-04      5.3e+00      1.4e+00      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      watson      31      0      unbounded      4.0e-03      -3.8e+90      8.1e+90      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      woods      100      0      first_order      3.7e-04      2.7e-11      2.2e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Dict{Symbol, DataFrames.DataFrame} with 3 entries:
 :lbfgs_5 => 105×39 DataFrame...
 :lbfgs_20 => 105×39 DataFrame...
 :lbfgs_10 => 105×39 DataFrame...
```

In [ ]: *# this code was found as is @ <https://jso.dev/OptimizationProblems.jl/dev/benchmark/>*

```
cols = [:id, :name, :nvar, :objective, :dual_feas, :neval_obj, :neval_grad, :neval_hess, :iter, :elapsed_time, :status]
header = Dict(
  :nvar => "n",
  :objective => "f(x)",
  :dual_feas => "||∇f(x)||",
  :neval_obj => "# f",
  :neval_grad => "# ∇f",
```

```
:neval_hess => "# ∇²f",
:elapsed_time => "t",
)
for solver ∈ keys(solvers)
  pretty_stats(stats[solver][!, cols], hdr_override=header)
end
```



25	NZF1	91	2.09e+04	2.62e-05	119	93	0	92	1.07e-03	first_order
38	arglina	100	5.00e+01	7.84e-15	2	2	0	1	1.29e-04	first_order
39	arglinb	100	2.48e+01	3.28e-04	70	3	0	2	1.41e-04	first_order
40	arglinc	100	5.11e+01	4.44e-03	71	3	0	2	1.01e-04	first_order
41	argtrig	100	-9.90e+03	5.59e-08	113	91	0	90	3.08e-03	first_order
42	arwhead	100	0.00e+00	2.91e-06	27	12	0	11	1.56e-04	first_order
45	bdqrtic	100	1.89e+02	1.29e-04	66	39	0	38	5.87e-04	first_order
50	biggs6	6	-3.17e+22	4.12e+22	3	3	0	2	1.81e-05	unbounded
55	brownal	100	1.92e-09	6.77e-04	27	4	0	3	9.39e-05	first_order
58	broyden3d	100	3.56e-01	3.09e-07	54	44	0	43	1.30e-03	first_order
59	broydn7d	100	3.55e+01	6.63e-07	347	320	0	319	1.63e-02	first_order
60	brybnd	100	1.34e+00	1.44e-05	128	108	0	107	1.23e-02	first_order
65	chainwoo	100	1.00e+00	9.86e-04	356	295	0	294	4.23e-03	first_order
67	chnrosnb	100	5.84e-11	7.76e-05	621	564	0	563	1.70e-02	first_order
72	clplatea	100	-9.15e-03	1.60e-08	70	66	0	65	2.83e-03	first_order
73	clplateb	100	-6.20e-03	1.41e-08	73	69	0	68	3.05e-03	first_order
74	clplatec	100	-5.11e-03	2.37e-08	12334434	321785	0	321784	3.00e+01	max_time
76	cosine	100	-9.90e+01	2.84e-08	27	18	0	17	3.62e-04	first_order
77	cragglvy	100	3.23e+01	3.81e-04	83	60	0	59	1.72e-04	first_order
78	cragglvy2	100	2.52e+01	5.62e-04	86	63	0	62	1.72e-03	first_order
79	curly	100	-1.00e+04	3.51e-05	12887766	150839	0	150838	3.00e+01	max_time
80	curly10	100	-1.00e+04	3.51e-05	12130794	142037	0	142036	3.00e+01	max_time
81	curly20	100	-1.00e+04	5.01e-05	9622945	111478	0	111477	3.00e+01	max_time
82	curly30	100	-1.00e+04	3.67e-05	7256110	74206	0	74205	3.00e+01	max_time
84	dixmaane	99	1.00e+00	1.66e-06	67	55	0	54	3.95e-03	first_order
85	dixmaanf	99	1.00e+00	3.35e-06	62	51	0	50	4.19e-03	first_order
86	dixmaang	99	1.00e+00	9.12e-06	56	48	0	47	3.94e-03	first_order
87	dixmaanh	99	1.00e+00	6.71e-06	63	50	0	49	4.14e-03	first_order
88	dixmaani	99	1.00e+00	2.59e-06	310	299	0	298	2.95e-02	first_order
89	dixmaanj	99	1.00e+00	3.91e-06	241	223	0	222	2.49e-02	first_order
90	dixmaank	99	1.00e+00	9.22e-06	175	158	0	157	1.74e-02	first_order
91	dixmaanl	99	1.00e+00	1.47e-05	136	123	0	122	1.38e-02	first_order
92	dixmaanm	99	1.00e+00	1.15e-06	391	364	0	363	4.96e-02	first_order
93	dixmaann	99	1.00e+00	2.66e-06	240	224	0	223	3.19e-02	first_order
94	dixmaano	99	1.00e+00	4.36e-06	244	226	0	225	3.22e-02	first_order
95	dixmaanp	99	1.00e+00	8.01e-06	256	231	0	230	3.37e-02	first_order
96	dixon3dq	100	3.41e-14	4.84e-08	441	424	0	423	3.96e-03	first_order
97	dqdrtic	100	3.99e-12	4.27e-05	31	12	0	11	2.01e-04	first_order
98	dqrtic	100	2.92e-02	1.14e-01	53	29	0	28	6.69e-04	first_order
100	edensch	100	6.03e+02	2.23e-06	30	22	0	21	7.38e-04	first_order
101	eg2	100	-9.74e+01	8.54e-08	19	8	0	7	1.93e-04	first_order
103	engvall	100	1.09e+02	6.71e-06	34	22	0	21	3.34e-04	first_order
104	enso	9	3.94e+02	9.65e-07	39	26	0	25	9.92e-04	first_order
105	errinros	100	3.88e+01	5.58e-04	270	199	0	198	6.18e-03	first_order
106	extrosnb	100	3.22e-11	1.48e-04	50	30	0	29	4.44e-04	first_order
107	fletcbv2	100	-5.14e-01	1.37e-08	250	235	0	234	4.42e-03	first_order
108	fletcbv3	100	-2.03e+00	5.57e-09	68	48	0	47	3.55e-03	first_order
109	fletchcr	100	3.45e-13	3.88e-06	436	395	0	394	5.64e-03	first_order
110	fminsrf2	100	1.00e+02	8.37e-07	136	117	0	116	3.72e-03	first_order
111	freuroth	100	5.98e+03	2.34e-05	38	23	0	22	1.22e-03	first_order
112	gauss1	8	6.58e+02	9.69e-05	316	180	0	179	3.17e-03	first_order
113	gauss2	8	6.24e+02	4.34e-03	392	247	0	246	4.22e-03	first_order
114	gauss3	8	6.22e+02	5.31e-05	389	230	0	229	4.06e-03	first_order
116	genhumps	100	3.51e-11	3.68e-06	1985	1209	0	1208	6.47e-02	first_order
117	genrose	100	1.00e+00	1.78e-06	298	253	0	252	4.03e-03	first_order
118	genrose_nash	100	1.00e+00	1.22e-06	379	281	0	280	1.91e-02	first_order
120	hahn1	7	2.66e+04	5.18e+06	410931	410838	0	410837	3.00e+01	max_time
285	indef	100	-9.83e+03	6.61e-07	14482744	314940	0	314939	3.00e+01	max_time
286	integreq	100	5.84e-17	1.10e-08	8	8	0	7	2.03e-02	first_order
288	kirby2	5	1.52e+01	5.45e+02	206	123	0	122	2.52e-03	first_order
290	lanczos1	6	2.15e-06	5.75e-07	104	83	0	82	2.01e-04	first_order
291	lanczos2	6	2.15e-06	3.12e-07	111	90	0	89	2.20e-04	first_order
292	lanczos3	6	2.17e-06	7.13e-07	109	86	0	85	2.06e-04	first_order
293	liarwhd	100	1.08e-10	1.31e-04	38	20	0	19	3.02e-04	first_order
301	mgh17	5	5.52e-02	1.21e-06	38	26	0	25	5.89e-05	first_order
306	morebv	100	2.74e-11	3.75e-08	9018	8593	0	8592	4.70e-01	first_order
308	ncb20	100	1.67e+02	6.56e-07	5714527	102539	0	102538	3.00e+01	max_time
309	ncb20b	100	1.97e+02	2.36e-06	5452305	88160	0	88159	3.00e+01	max_time
311	noncvxu2	100	2.32e+02	1.34e-04	510	489	0	488	1.26e-02	first_order
312	noncvxun	100	2.33e+02	1.47e-04	191	174	0	173	4.67e-03	first_order
313	nondia	100	3.45e-15	7.84e-06	48	25	0	24	3.82e-04	first_order
314	nondquar	100	7.41e-07	5.60e-06	1528	1148	0	1147	2.48e-02	first_order
315	osborne1	5	2.33e-02	4.07e+04	71456443	995802	0	995801	3.00e+01	max_time
316	osborne2	11	2.01e-02	2.56e-08	85	74	0	73	7.29e-04	first_order
317	palmer1c	8	8.44e+01	1.81e+00	100	52	0	51	6.14e-03	first_order
318	palmer1d	7	1.40e+01	2.48e-01	100	57	0	56	5.97e-03	first_order
319	palmer2c	8	2.22e+00	9.13e-02	77	38	0	37	3.84e-03	first_order
320	palmer3c	8	1.65e+00	7.85e-02	58	22	0	21	2.12e-03	first_order
321	palmer4c	8	1.77e-01	6.38e-02	91	40	0	39	3.33e-03	first_order
322	palmer5c	6	1.06e+00	1.35e-06	18	13	0	12	3.22e-04	first_order
324	palmer6c	8	4.78e-02	1.80e-03	163	83	0	82	3.70e-03	first_order
325	palmer7c	8	2.69e+00	2.46e-02	113	68	0	67	2.80e-03	first_order
326	palmer8c	8	2.95e-01	4.21e-03	129	79	0	78	2.90e-03	first_order
327	penalty1	100	1.16e+00	4.05e+00	53	21	0	20	4.59e-04	first_order
328	penalty2	100	9.71e+04	1.98e-02	59	28	0	27	2.93e-03	first_order
329	penalty3	100	1.00e+00	5.17e-03	128	69	0	68	2.69e-03	first_order
335	powellsg	100	1.40e-09	1.91e-05	60	41	0	40	4.81e-04	first_order
336	power	100	1.56e-03	7.07e-02	60	28	0	27	3.53e-04	first_order
337	quartc	100	2.92e-02	1.14e-01	53	29	0	28	5.88e-04	first_order
343	sbrybnd	100	7.64e+00	3.72e-04	22559	20915	0	20914	3.16e+00	first_order
344	schmvett	100	-2.94e+02	1.07e-07	26	22	0	21	6.47e-04	first_order
345	scosine	100	-7.81e+01	2.76e+04	797113	718704	0	718703	3.00e+01	max_time
346	sinquad	100	9.76e-16	3.86e-08	138	105	0	104	2.81e-03	first_order
347	sparsine	100	4.30e-10	9.06e-05	362	286	0	285	1.94e-02	first_order
348	sparsqur	100	4.72e-08	1.57e-05	41	27	0	26	6.40e-04	first_order
349	spmsrtls	100	7.70e-15	7.25e-08	87	77	0	76	7.95e-03	first_order
350	srosenbr	100	4.00e-13	1.97e-05	42	22	0	21	2.60e-04	first_order
360	thurber	7	2.82e+03	3.73e-02	198	132	0	131	1.82e-03	first_order
361	tointgss	100	9.71e+00	1.86e-07	20	18	0	17	6.65e-04	first_order
362	tquartic	100	4.21e-20	3.37e-09	24	19	0	18	2.95e-04	first_order
367	tridia	100	1.78e-12	1.44e-05	154	135	0	134	1.68e-03	first_order
368	vardim	100	2.52e+03	8.22e+05	95	21	0	20	2.27e-04	first_order
369	vibrbeam	8	5.29e+00	1.94e+00	225	127	0	126	6.40e-04	first_order
370	watson	31	-3.83e+90	8.06e+90	2	2	0	1	3.05e-03	unbounded
371	woods	100	1.72e-09	1.10e-03	48	28	0	27	2.84e-04	first_order



	id	name	n	f(x)	∇f(x)	# f	# ∇f	# ∇²f	iter	t	status
	25	NZF1	91	2.09e+04	2.96e-05	295	156	0	155	1.62e-03	first_order
	38	arglina	100	5.00e+01	7.84e-15	2	2	0	1	1.26e-04	first_order
	39	arglinb	100	2.48e+01	3.28e-04	70	3	0	2	1.23e-04	first_order
	40	arglinc	100	5.11e+01	4.44e-03	71	3	0	2	8.99e-05	first_order
	41	argtrig	100	-9.90e+03	1.01e-07	1354	228	0	227	8.77e-03	first_order
	42	arwhead	100	0.00e+00	2.91e-06	27	12	0	11	1.54e-04	first_order
	45	bdqrtic	100	1.89e+02	1.49e-04	66	41	0	40	5.89e-04	first_order
	50	biggs6	6	-3.17e+22	4.12e+22	3	3	0	2	1.69e-05	unbounded
	55	brownal	100	1.92e-09	6.77e-04	27	4	0	3	9.20e-05	first_order
	58	broyden3d	100	3.56e-01	5.72e-07	55	44	0	43	1.27e-03	first_order
	59	broydn7d	100	3.55e+01	6.44e-07	423	391	0	390	1.95e-02	first_order
	60	brybnd	100	1.34e+00	1.76e-05	151	130	0	129	1.44e-02	first_order
	65	chainwoo	100	1.00e+00	1.01e-03	369	299	0	298	3.81e-03	first_order
	67	chnrosnb	100	1.11e-10	5.09e-05	587	544	0	543	1.55e-02	first_order
	72	clplatea	100	-9.15e-03	1.63e-08	100	98	0	97	4.10e-03	first_order
	73	clplateb	100	-6.20e-03	1.53e-08	118	116	0	115	4.97e-03	first_order
	74	clplatec	100	-5.11e-03	2.02e-08	12244119	325169	0	325168	3.00e+01	max_time
	76	cosine	100	-9.90e+01	2.90e-08	27	18	0	17	4.08e-04	first_order
	77	cragglvy	100	3.23e+01	5.25e-04	82	60	0	59	1.75e-03	first_order
	78	cragglvy2	100	2.52e+01	3.58e-04	100	77	0	76	2.17e-03	first_order
	79	curly	100	-1.00e+04	2.10e-07	3381	2886	0	2885	1.86e-01	first_order
	80	curly10	100	-1.00e+04	2.10e-07	3381	2886	0	2885	1.98e-01	first_order
	81	curly20	100	-1.00e+04	5.74e-05	9654650	110767	0	110766	3.00e+01	max_time
	82	curly30	100	-1.00e+04	1.21e-04	6994007	82353	0	82352	3.00e+01	max_time
	84	dixmaane	99	1.00e+00	2.68e-06	70	64	0	63	4.59e-03	first_order
	85	dixmaanf	99	1.00e+00	3.64e-06	61	51	0	50	4.23e-03	first_order
	86	dixmaang	99	1.00e+00	9.44e-06	60	49	0	48	4.06e-03	first_order
	87	dixmaanh	99	1.00e+00	9.03e-06	62	50	0	49	4.14e-03	first_order
	88	dixmaani	99	1.00e+00	2.70e-06	344	322	0	321	3.18e-02	first_order
	89	dixmaanj	99	1.00e+00	4.88e-06	229	209	0	208	2.31e-02	first_order
	90	dixmaank	99	1.00e+00	9.70e-06	165	145	0	144	1.60e-02	first_order
	91	dixmaanl	99	1.00e+00	1.98e-05	136	123	0	122	1.37e-02	first_order
	92	dixmaanm	99	1.00e+00	1.18e-06	411	394	0	393	5.40e-02	first_order
	93	dixmaann	99	1.00e+00	2.70e-06	318	294	0	293	4.18e-02	first_order
	94	dixmaano	99	1.00e+00	4.42e-06	315	292	0	291	4.13e-02	first_order
	95	dixmaap	99	1.00e+00	1.06e-05	219	201	0	200	2.92e-02	first_order
	96	dixon3dq	100	2.25e-14	5.51e-08	574	548	0	547	4.68e-03	first_order
	97	dqdrtic	100	3.99e-12	4.27e-05	31	12	0	11	1.89e-04	first_order
	98	dqrtic	100	3.41e-02	1.32e-01	46	22	0	21	4.91e-04	first_order
	100	edensch	100	6.03e+02	2.48e-06	30	22	0	21	7.02e-04	first_order
	101	eg2	100	-9.74e+01	8.54e-08	19	8	0	7	1.84e-04	first_order
	103	engval1	100	1.09e+02	6.34e-06	34	22	0	21	3.27e-04	first_order
	104	enso	9	3.94e+02	2.18e-06	39	26	0	25	1.01e-03	first_order
	105	errinros	100	3.88e+01	1.35e-03	305	189	0	188	5.82e-03	first_order
	106	extrosnb	100	2.62e-11	1.24e-04	51	31	0	30	4.38e-04	first_order
	107	fletcbv2	100	-5.14e-01	1.36e-08	342	324	0	323	2.05e-02	first_order
	108	fletcbv3	100	-2.04e+00	3.48e-09	61	45	0	44	3.34e-03	first_order
	109	fletchcr	100	2.21e-13	3.78e-06	508	465	0	464	5.39e-03	first_order
	110	fminsrf2	100	1.00e+02	1.30e-06	166	145	0	144	4.28e-03	first_order
	111	freuroth	100	5.98e+03	2.46e-05	38	23	0	22	1.18e-03	first_order
	112	gauss1	8	6.58e+02	2.64e-03	7285000	197519	0	197518	3.00e+01	max_time
	113	gauss2	8	6.24e+02	2.07e-02	7544758	185083	0	185082	3.00e+01	max_time
	114	gauss3	8	6.22e+02	7.79e-03	7595067	163414	0	163413	3.00e+01	max_time
	116	genhumps	100	3.98e-10	1.15e-05	1702	1111	0	1110	5.64e-02	first_order
	117	genrose	100	1.00e+00	1.93e-06	305	259	0	258	3.22e-03	first_order
	118	genrose_nash	100	1.00e+00	1.50e-06	350	285	0	284	3.70e-03	first_order
	120	hahn1	7	2.66e+04	5.18e+06	410304	410211	0	410210	3.00e+01	max_time
	285	indef	100	-9.82e+03	5.26e-08	205	109	0	108	3.43e-03	first_order
	286	integreq	100	5.84e-17	1.10e-08	8	8	0	7	2.00e-02	first_order
	288	kirby2	5	1.52e+01	6.13e+02	206	123	0	122	2.52e-03	first_order
	290	lanczos1	6	2.15e-06	8.76e-07	99	75	0	74	1.97e-04	first_order
	291	lanczos2	6	2.15e-06	3.93e-07	113	82	0	81	2.18e-04	first_order
	292	lanczos3	6	2.17e-06	7.98e-08	123	94	0	93	2.39e-04	first_order
	293	liarwhd	100	3.71e-10	1.19e-04	40	19	0	18	2.51e-04	first_order
	301	mgh17	5	5.52e-02	2.56e-06	39	27	0	26	5.60e-05	first_order
	306	morebv	100	1.79e-12	3.36e-08	11235	10723	0	10722	5.58e-01	first_order
	308	ncb20	100	1.64e+02	8.33e-07	5976236	98564	0	98563	3.00e+01	max_time
	309	ncb20b	100	1.97e+02	4.16e-06	5421406	91078	0	91077	3.00e+01	max_time
	311	noncvxu2	100	2.32e+02	1.26e-04	426	406	0	405	1.01e-02	first_order
	312	noncvxun	100	2.33e+02	8.91e-05	268	259	0	258	6.61e-03	first_order
	313	nondia	100	1.04e-13	1.08e-05	48	25	0	24	3.49e-04	first_order
	314	nondquar	100	7.92e-07	5.63e-06	2050	1576	0	1575	3.16e-02	first_order
	315	osborne1	5	2.34e-02	1.36e+02	69891650	972573	0	972572	3.00e+01	max_time
	316	osborne2	11	2.01e-02	5.49e-08	138	117	0	116	1.17e-03	first_order
	317	palmer1c	8	8.44e+01	1.42e+00	161	75	0	74	1.19e-02	first_order
	318	palmer1d	7	1.40e+01	2.12e-01	264	129	0	128	1.86e-02	first_order
	319	palmer2c	8	2.22e+00	8.64e-02	183	106	0	105	1.10e-02	first_order
	320	palmer3c	8	1.65e+00	8.37e-02	155	79	0	78	2.25e-02	first_order
	321	palmer4c	8	1.77e-01	1.35e-02	537	284	0	283	2.44e-02	first_order
	322	palmer5c	6	1.06e+00	9.97e-07	18	13	0	12	3.74e-04	first_order
	324	palmer6c	8	4.78e-02	6.80e-03	320	166	0	165	7.60e-03	first_order
	325	palmer7c	8	2.69e+00	2.14e-02	170	97	0	96	4.23e-03	first_order
	326	palmer8c	8	2.95e-01	1.26e-03	226	96	0	95	4.71e-03	first_order
	327	penalty1	100	1.16e+00	4.05e+00	53	21	0	20	4.72e-04	first_order
	328	penalty2	100	9.71e+04	2.16e-02	57	27	0	26	2.94e-03	first_order
	329	penalty3	100	1.00e+00	5.18e-03	145	77	0	76	3.07e-03	first_order
	335	powellsg	100	7.91e-11	2.15e-05	62	47	0	46	5.14e-04	first_order
	336	power	100	2.77e-03	6.60e-02	59	27	0	26	3.52e-04	first_order
	337	quartc	100	3.41e-02	1.32e-01	46	22	0	21	4.54e-04	first_order
	343	sbrybnd	100	1.37e+01	3.77e-04	8008	7478	0	7477	1.14e+00	first_order
	344	schmvett	100	-2.94e+02	2.20e-07	28	24	0	23	6.45e-04	first_order
	345	scosine	100	-7.48e+01	2.21e+04	811554	734719	0	734718	3.00e+01	max_time
	346	sinquad	100	6.10e-16	5.73e-08	172	132	0	131	3.49e-03	first_order
	347	sparsine	100	4.47e-10	1.13e-04	454	359	0	358	2.45e-02	first_order
	348	sparsqur	100	5.09e-08	1.46e-05	37	23	0	22	5.19e-04	first_order
	349	spmsrtls	100	8.14e-15	8.30e-08	83	79	0	78	8.14e-03	first_order
	350	srosenbr	100	3.97e-13	1.96e-05	42	22	0	21	2.58e-04	first_order
	360	thurber	7	2.82e+03	1.24e+00	291	201	0	200	2.66e-03	first_order
	361	tointgss	100	9.71e+00	1.84e-07	20	18	0	17	7.20e-04	first_order
	362	tquartic	100	2.15e-20	2.37e-09	24	19	0	18	3.46e-04	first_order
	367	tridia	100	1.86e-11	1.67e-05	172	147	0	146	2.02e-03	first_order
	368	vardim	100	2.52e+03	8.22e+05	95	21	0	20	3.21e-04	first_order
	369	vibrbeam	8	5.28e+00	1.43e+00	374	192	0	191	9.32e-04	first_order
	370	watson	31	-3.83e+90	8.06e+90	2	2	0	1	4.00e-03	unbounded
	371	woods	100	2.73e-11	2.18e-04	51	30	0	29	3.73e-04	first_order

In [ ]: *# this code was found partially @ <https://jso.dev/OptimizationProblems.jl/dev/benchmark/>*

```
first_order(df) = df.status .== :first_order
```

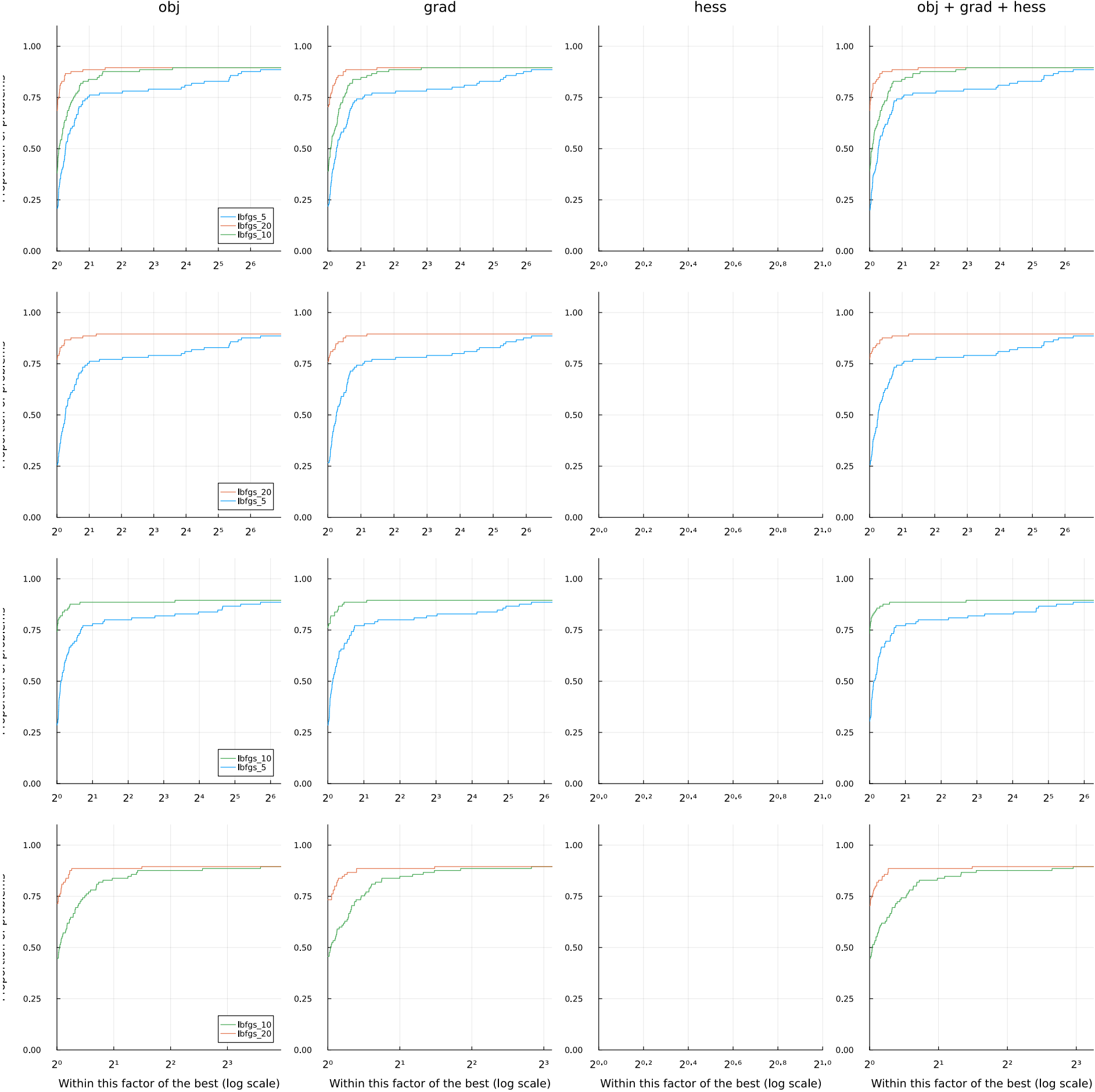


```
unbounded(df) = df.status == :unbounded
solved(df) = first_order(df) | unbounded(df)
costnames = ["obj", "grad", "hess", "obj + grad + hess"]
costs = [
    df -> !solved(df) .* Inf .+ df.neval_obj,
    df -> !solved(df) .* Inf .+ df.neval_grad,
    df -> !solved(df) .* Inf .+ df.neval_hess,
    df -> !solved(df) .* Inf .+ df.neval_obj .+ df.neval_grad .+ df.neval_hess,
]

using Plots
gr()

profile_solvers(stats, costs, costnames)
```

Warning: some measures are zero; shifting all by one  
@ BenchmarkProfiles /home/julien/.julia/packages/BenchmarkProfiles/KnjdY/src/performance\_profiles.jl:16  
Warning: some measures are zero; shifting all by one  
@ BenchmarkProfiles /home/julien/.julia/packages/BenchmarkProfiles/KnjdY/src/performance\_profiles.jl:16  
Warning: some measures are zero; shifting all by one  
@ BenchmarkProfiles /home/julien/.julia/packages/BenchmarkProfiles/KnjdY/src/performance\_profiles.jl:16  
Warning: some measures are zero; shifting all by one  
@ BenchmarkProfiles /home/julien/.julia/packages/BenchmarkProfiles/KnjdY/src/performance\_profiles.jl:16



Analyse des résultats:

On utilise ici 105 problèmes, les profils de performance sont présentés ci-haut. À noter que je n'impose pas la dimension des problèmes, car cela fait crash les solveurs pour une raison mystérieuse. Ces 105 problèmes prennent environ 20 min à rouler. Je ne vais donc pas augmenter davantage la taille.

On remarque sans surprise que la méthode lbfgs 20 qui a une plus grande mémoire résout un peu plus de problèmes que les deux autres méthodes, mais plus on accepte un facteur loin du meilleur plus les deux autres méthodes deviennent compétitives. En effet, pour 2^3 et plus, les trois solveurs se confondent.

En se référant au tableau généré plus haut, on remarque que le problème osborne1 n'est pas résolu par les trois solveurs testés. On peut obtenir cette information avec la colonne status qui indique qu'on a atteint le temps maximal de calcul pour ce problème.

Exercice 4: Benchmark LBFGS vs Newton-CG

Comparer la meilleure variante obtenue (justifier) à l'Exercice 3 et comparer cette méthode à Newton-CG sur la même collection de problèmes sans contraintes de OptimizationProblems.jl. Préciser combien de problèmes sont utilisés, inclure des profils de performance, et mentionner un/des problèmes qui ne sont pas résolus par l'algorithme.

SOLUTION:

Étant donné que la méthode lbfgs\_20 résoud davantage de problèmes que les deux autres méthodes, nous allons utiliser cet algorithme.

```
In [ ] : ad_problems = (eval(Meta.parse(problem))() for problem in OptimizationProblems.meta[!, :name])

solvers = Dict{
  :newton_cg => model -> armijo_Newton_cg(model),
  :lbfgs_20 => model -> limited_bfgs(model; mem=20),
}

stats = bmark_solvers(
  solvers, ad_problems,
  skipif=prob -> (!unconstrained(prob) || get_nvar(prob) > 150 || get_nvar(prob) < 5),
)
```

	Info:	Name	nvar	ncon	status	Time	f(x)	Dual	Primal
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:127							
	Info:	NZF1	91	0	first_order	5.0e-01	2.1e+04	3.6e-05	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	arglina	100	0	first_order	3.3e-01	5.0e+01	7.8e-15	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	arglinb	100	0	first_order	3.4e-01	2.5e+01	2.1e-04	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	arglinc	100	0	first_order	2.9e-01	5.1e+01	1.8e-03	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	argtrig	100	0	not_desc	0.0e+00	7.5e-01	5.8e+00	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	arwhead	100	0	first_order	3.2e-01	0.0e+00	3.6e-08	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	bdqrtic	100	0	first_order	3.4e-01	1.9e+02	7.6e-06	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	biggs6	6	0	first_order	3.5e-04	-1.0e+01	8.0e-08	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	brownal	100	0	first_order	3.6e-01	1.9e-09	6.2e-04	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	broyden3d	100	0	first_order	3.4e-01	5.1e-15	4.8e-07	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	broydn7d	100	0	not_desc	4.4e-01	9.8e+01	3.7e+00	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	brybnd	100	0	first_order	3.6e-01	2.1e-16	1.4e-07	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Warning: catenary: number of variables adjusted to be a multiple of 3								
	@ OptimizationProblems.ADNLPPProblems	/home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/catenary.jl:4							
	Warning: catenary: number of variables adjusted to be greater or equal to 6								
	@ OptimizationProblems.ADNLPPProblems	/home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/catenary.jl:6							
	Info:	chainwoo	100	0	not_desc	3.8e-01	1.7e+03	3.5e+01	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	chnrosnb	100	0	not_desc	3.3e-01	9.1e+01	1.5e+00	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	clplatea	100	0	first_order	5.3e-01	-9.1e-03	2.4e-10	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	clplateb	100	0	first_order	5.1e-01	-6.2e-03	9.0e-09	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	clplatec	100	0	first_order	5.6e-01	-5.1e-03	7.0e-11	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	cosine	100	0	not_desc	0.0e+00	8.7e+01	7.2e+00	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	cragglvy	100	0	first_order	3.9e-01	3.2e+01	5.8e-05	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	cragglvy2	100	0	first_order	3.5e-01	2.5e+01	1.9e-04	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	curly	100	0	not_desc	0.0e+00	-6.2e-03	1.3e+01	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	curly10	100	0	not_desc	0.0e+00	-6.2e-03	1.3e+01	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	curly20	100	0	not_desc	0.0e+00	-1.3e-02	2.8e+01	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Info:	curly30	100	0	not_desc	0.0e+00	-2.0e-02	4.6e+01	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Warning: dixmaan: number of variables adjusted to be a multiple of 3								
	@ OptimizationProblems.ADNLPPProblems	/home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_efgh.jl:12							
	Info:	dixmaane	99	0	first_order	4.0e-01	1.0e+00	1.2e-08	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Warning: dixmaan: number of variables adjusted to be a multiple of 3								
	@ OptimizationProblems.ADNLPPProblems	/home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_efgh.jl:12							
	Info:	dixmaanf	99	0	first_order	4.0e-01	1.0e+00	1.1e-07	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Warning: dixmaan: number of variables adjusted to be a multiple of 3								
	@ OptimizationProblems.ADNLPPProblems	/home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_efgh.jl:12							
	Info:	dixmaang	99	0	first_order	1.9e-02	1.0e+00	7.8e-06	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Warning: dixmaan: number of variables adjusted to be a multiple of 3								
	@ OptimizationProblems.ADNLPPProblems	/home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_efgh.jl:12							
	Info:	dixmaanhh	99	0	first_order	1.7e-02	1.0e+00	7.7e-06	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Warning: dixmaan: number of variables adjusted to be a multiple of 3								
	@ OptimizationProblems.ADNLPPProblems	/home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_ijkl.jl:12							
	Info:	dixmaani	99	0	first_order	5.4e-01	1.0e+00	8.9e-07	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Warning: dixmaan: number of variables adjusted to be a multiple of 3								
	@ OptimizationProblems.ADNLPPProblems	/home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_ijkl.jl:12							
	Info:	dixmaanjj	99	0	first_order	5.0e-01	1.0e+00	1.0e-07	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Warning: dixmaan: number of variables adjusted to be a multiple of 3								
	@ OptimizationProblems.ADNLPPProblems	/home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_ijkl.jl:12							
	Info:	dixmaank	99	0	first_order	1.1e-01	1.0e+00	6.1e-06	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Warning: dixmaan: number of variables adjusted to be a multiple of 3								
	@ OptimizationProblems.ADNLPPProblems	/home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_ijkl.jl:12							
	Info:	dixmaanll	99	0	first_order	1.0e-01	1.0e+00	5.9e-07	0.0e+00
	@ SolverBenchmark	/home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175							
	Warning: dixmaan: number of variables adjusted to be a multiple of 3								
	@ OptimizationProblems.ADNLPPProblems	/home/julien/.julia/packages/OptimizationProblems/fijkh/src/ADNLPPProblems/dixmaan_mnop.jl:12							

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└ Info:      dixmaanm      99      0      first_order  5.5e-01  1.0e+00  9.5e-10  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_mnop.jl:12
└ Info:      dixmaann      99      0      first_order  6.4e-01  1.0e+00  2.8e-07  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_mnop.jl:12
└ Info:      dixmaano      99      0      first_order  1.9e-01  1.0e+00  2.1e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Warning: dixmaan: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPProblems/dixmaan_mnop.jl:12
└ Info:      dixmaanp      99      0      first_order  1.6e-01  1.0e+00  2.7e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      dixon3dq      100      0      first_order  3.0e-01  0.0e+00  0.0e+00  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      dqdrtic      100      0      first_order  2.9e-01  1.8e-11  8.6e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      dqrtic      100      0      first_order  3.1e-01  1.9e-02  6.4e-02  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      edensch      100      0      first_order  3.1e-01  6.0e+02  4.0e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      eg2      100      0      first_order  3.3e-01  -9.9e+01  1.4e-09  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      engval1      100      0      first_order  2.9e-01  1.1e+02  3.3e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      enso      9      0      not_desc  8.4e-04  5.0e+02  3.0e+01  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      errinros      100      0      first_order  4.3e-01  3.9e+01  1.1e-03  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      extrosnb      100      0      first_order  5.0e-01  3.6e-06  8.2e-05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      fletcbv2      100      0      first_order  4.1e-01  -5.1e-01  1.2e-10  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      fletcbv3      100      0      not_desc  3.5e-01  -4.1e-02  1.4e-03  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      fletchr      100      0      max_time  3.0e+01  NaN      NaN      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      fminsrf2      100      0      first_order  6.3e-01  1.0e+02  1.1e-07  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      freuroth      100      0      not_desc  0.0e+00  5.0e+04  3.9e+03  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      gauss1      8      0      first_order  4.6e-03  6.6e+02  5.9e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      gauss2      8      0      first_order  5.6e-03  6.2e+02  4.5e-03  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      gauss3      8      0      first_order  8.8e-03  6.2e+02  5.8e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      genhumps      100      0      not_desc  0.0e+00  2.5e+06  8.5e+02  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      genrose      100      0      not_desc  3.5e-01  3.9e+02  5.4e+01  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      genrose_nash      100      0      not_desc  3.1e-01  3.9e+02  5.2e+01  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      hahn1      7      0      not_desc  5.7e-03  5.4e+03  2.2e+06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      indef      100      0      not_desc  0.0e+00  9.2e+01  1.1e+01  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      integreq      100      0      first_order  5.6e-01  3.4e-20  2.6e-10  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      kirby2      5      0      first_order  1.5e-03  1.5e+01  5.6e+02  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      lanczos1      6      0      not_desc  3.0e-04  1.5e-03  1.1e-03  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      lanczos2      6      0      not_desc  3.0e-04  1.5e-03  1.1e-03  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      lanczos3      6      0      not_desc  2.9e-04  1.5e-03  1.1e-03  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      liarwhd      100      0      first_order  2.9e-01  6.7e-15  2.9e-06  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      mgh17      5      0      not_desc  7.3e-05  5.9e-02  4.7e-04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      morebv      100      0      first_order  6.1e-01  1.0e-12  2.2e-09  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      ncb20      100      0      not_desc  4.7e-01  1.8e+02  4.7e-02  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      ncb20b      100      0      not_desc  1.1e+00  2.0e+02  1.6e-03  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      noncvxu2      100      0      not_desc  0.0e+00  2.6e+06  9.5e+03  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      noncvxun      100      0      not_desc  0.0e+00  2.7e+06  1.0e+04  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
└ Info:      nondia      100      0      first_order  2.8e-01  1.4e-08  4.7e-05  0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
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Info:      nondquar      100      0      first_order      5.2e-01      5.8e-09      2.5e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      osborne1       5      0      first_order      2.2e-03      2.4e-02      4.1e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      osborne2      11      0      not_desc      5.6e-04      1.7e-01      6.9e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer1c       8      0      first_order      4.1e-03      8.4e+01      1.3e+00      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer1d       7      0      first_order      3.5e-03      1.4e+01      1.7e-01      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer2c       8      0      first_order      4.6e-03      2.2e+00      8.6e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer3c       8      0      first_order      5.3e-03      1.7e+00      7.3e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer4c       8      0      first_order      5.1e-03      2.4e+00      7.9e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer5c       6      0      first_order      2.5e-03      1.1e+00      1.4e-09      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer6c       8      0      first_order      4.9e-03      4.8e-02      3.2e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer7c       8      0      first_order      2.8e-03      2.7e+00      2.1e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer8c       8      0      first_order      5.0e-03      3.0e-01      1.1e-03      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      penalty1      100      0      first_order      3.2e-01      1.4e+00      4.6e+00      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      penalty2      100      0      first_order      4.0e-01      9.7e+04      7.6e-03      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      penalty3      100      0      not_desc      4.8e-01      1.0e+08      5.8e+04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      powellsg      100      0      first_order      3.3e-01      7.0e-08      1.6e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      power      100      0      first_order      2.8e-01      1.8e-03      4.7e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      quartc      100      0      first_order      3.1e-01      1.9e-02      6.4e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sbrybnd      100      0      not_desc      0.0e+00      7.8e+02      2.7e+04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      schmvett      100      0      not_desc      0.0e+00      -1.9e+02      2.0e+01      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      scosine      100      0      not_desc      0.0e+00      8.7e+01      8.1e+02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sinquad      100      0      not_desc      3.3e-01      1.1e-01      2.8e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sparsine      100      0      first_order      5.1e-01      2.1e+03      2.0e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sparsqur      100      0      first_order      3.2e-01      1.7e-08      6.2e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      spmsrtls      100      0      not_desc      0.0e+00      3.6e+01      4.8e+00      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      srosenbr      100      0      not_desc      2.8e-01      2.1e+02      1.4e+01      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      thurber       7      0      not_desc      2.3e-03      1.5e+04      1.4e+02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      tointgss      100      0      first_order      3.2e-01      9.7e+00      3.8e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      tquartic      100      0      not_desc      2.9e-01      3.6e-01      4.7e-02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      tridia      100      0      first_order      2.2e-02      3.4e-13      1.1e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      vardim      100      0      first_order      3.2e-01      3.6e+03      1.1e+06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      vibrbeam       8      0      first_order      1.0e-03      1.6e-01      2.2e+00      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      watson      31      0      not_desc      1.3e-01      1.6e+00      2.9e+01      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      woods      100      0      not_desc      3.4e-01      8.1e+02      1.2e+02      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      Name      nvar      ncon      status      Time      f(x)      Dual      Primal
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:127
Info:      NZF1       91      0      first_order      1.1e-03      2.1e+04      2.6e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      arglina      100      0      first_order      1.4e-04      5.0e+01      7.8e-15      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      arglinb      100      0      first_order      1.4e-04      2.5e+01      3.3e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      arglinc      100      0      first_order      9.9e-05      5.1e+01      4.4e-03      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      argtrig      100      0      first_order      3.2e-03      -9.9e+03      5.6e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      arwhead      100      0      first_order      1.7e-04      0.0e+00      2.9e-06      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      bdqrtic      100      0      first_order      6.5e-04      1.9e+02      1.3e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      biggs6       6      0      unbounded      2.4e-05      -3.2e+22      4.1e+22      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      brownal      100      0      first_order      9.8e-05      1.9e-09      6.8e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      broyden3d      100      0      first_order      1.3e-03      3.6e-01      3.1e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      broydn7d      100      0      first_order      1.7e-02      3.6e+01      6.6e-07      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      brybnd      100      0      first_order      1.3e-02      1.3e+00      1.4e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Warning: catenary: number of variables adjusted to be a multiple of 3
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPPProblems/catenary.jl:4
Warning: catenary: number of variables adjusted to be greater or equal to 6
└ @ OptimizationProblems.ADNLPPProblems /home/julien/.julia/packages/OptimizationProblems/fiJkh/src/ADNLPPProblems/catenary.jl:6
Info:      chainwoo      100      0      first_order      4.3e-03      1.0e+00      9.9e-04      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      chnrosnb      100      0      first_order      1.8e-02      5.8e-11      7.8e-05      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      clplatea      100      0      first_order      2.9e-03      -9.1e-03      1.6e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      clplateb      100      0      first_order      3.1e-03      -6.2e-03      1.4e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      clplatec      100      0      max_time      3.0e+01      -5.1e-03      2.4e-08      0.0e+00
└ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
```

[illegible]



```
Info:      indef      100      0      max_time      3.0e+01      -9.8e+03      6.6e-07      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      integreq      100      0      first_order      2.0e-02      5.8e-17      1.1e-08      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      kirby2      5      0      first_order      2.5e-03      1.5e+01      5.5e+02      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      lanczos1      6      0      first_order      2.0e-04      2.1e-06      5.8e-07      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      lanczos2      6      0      first_order      2.1e-04      2.1e-06      3.1e-07      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      lanczos3      6      0      first_order      2.1e-04      2.2e-06      7.1e-07      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      liarwhd      100      0      first_order      3.0e-04      1.1e-10      1.3e-04      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      mgh17      5      0      first_order      5.6e-05      5.5e-02      1.2e-06      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      morebv      100      0      first_order      4.5e-01      2.7e-11      3.7e-08      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      ncb20      100      0      max_time      3.0e+01      1.7e+02      6.6e-07      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      ncb20b      100      0      max_time      3.0e+01      2.0e+02      2.4e-06      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      noncvxu2      100      0      first_order      1.2e-02      2.3e+02      1.3e-04      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      noncvxun      100      0      first_order      4.3e-03      2.3e+02      1.5e-04      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      nondia      100      0      first_order      2.9e-04      3.4e-15      7.8e-06      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      nondquar      100      0      first_order      2.3e-02      7.4e-07      5.6e-06      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      osborne1      5      0      max_time      3.0e+01      2.3e-02      4.1e+04      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      osborne2      11      0      first_order      7.5e-04      2.0e-02      2.6e-08      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer1c      8      0      first_order      6.9e-03      8.4e+01      1.8e+00      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer1d      7      0      first_order      6.2e-03      1.4e+01      2.5e-01      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer2c      8      0      first_order      3.3e-03      2.2e+00      9.1e-02      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer3c      8      0      first_order      2.3e-03      1.7e+00      7.8e-02      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer4c      8      0      first_order      3.8e-03      1.8e-01      6.4e-02      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer5c      6      0      first_order      3.7e-04      1.1e+00      1.4e-06      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer6c      8      0      first_order      4.4e-03      4.8e-02      1.8e-03      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer7c      8      0      first_order      3.5e-03      2.7e+00      2.5e-02      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      palmer8c      8      0      first_order      4.7e-03      3.0e-01      4.2e-03      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      penalty1      100      0      first_order      4.6e-04      1.2e+00      4.0e+00      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      penalty2      100      0      first_order      3.0e-03      9.7e+04      2.0e-02      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      penalty3      100      0      first_order      2.7e-03      1.0e+00      5.2e-03      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      powellsg      100      0      first_order      4.6e-04      1.4e-09      1.9e-05      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      power      100      0      first_order      3.8e-04      1.6e-03      7.1e-02      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      quartc      100      0      first_order      6.0e-04      2.9e-02      1.1e-01      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sbrybnd      100      0      first_order      3.2e+00      7.6e+00      3.7e-04      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      schmvett      100      0      first_order      6.0e-04      -2.9e+02      1.1e-07      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      scosine      100      0      max_time      3.0e+01      -7.8e+01      4.6e+05      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sinquad      100      0      first_order      2.9e-03      9.8e-16      3.9e-08      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sparsine      100      0      first_order      2.0e-02      4.3e-10      9.1e-05      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      sparsqur      100      0      first_order      6.0e-04      4.7e-08      1.6e-05      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      spmsrtls      100      0      first_order      8.1e-03      7.7e-15      7.3e-08      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      srosenbr      100      0      first_order      2.6e-04      4.0e-13      2.0e-05      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      thurber      7      0      first_order      1.8e-03      2.8e+03      3.7e-02      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      tointgss      100      0      first_order      7.4e-04      9.7e+00      1.9e-07      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      tquartic      100      0      first_order      3.6e-04      4.2e-20      3.4e-09      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      tridia      100      0      first_order      2.0e-03      1.8e-12      1.4e-05      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      vardim      100      0      first_order      3.3e-04      2.5e+03      8.2e+05      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      vibrbeam      8      0      first_order      6.5e-04      5.3e+00      1.9e+00      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      watson      31      0      unbounded      4.6e-03      -3.8e+90      8.1e+90      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Info:      woods      100      0      first_order      3.6e-04      1.7e-09      1.1e-03      0.0e+00
└─ @ SolverBenchmark /home/julien/.julia/packages/SolverBenchmark/YM13z/src/run_solver.jl:175
Dict{Symbol, DataFrames.DataFrame} with 2 entries:
 :newton_cg => 105×39 DataFrame...
 :lbfgs_20 => 105×39 DataFrame...
```

In [ ]: *# this code was found as is @ <https://jso.dev/OptimizationProblems.jl/dev/benchmark/>*

```
cols = [:id, :name, :nvar, :objective, :dual_feas, :neval_obj, :neval_grad, :neval_hess, :iter, :elapsed_time, :status]
header = Dict(
  :nvar => "n",
  :objective => "f(x)",
  :dual_feas => "||∇f(x)||",
  :neval_obj => "# f",
  :neval_grad => "# ∇f",
  :neval_hess => "# ∇²f",
  :elapsed_time => "t",
```

```
)  
for solver in keys(solvers)  
    pretty_stats(stats[solver][!, cols], hdr_override=header)  
end
```





	25	NZF1	91	2.09e+04	2.62e-05	119	93	0	92	1.13e-03	first_order
	38	arglina	100	5.00e+01	7.84e-15	2	2	0	1	1.37e-04	first_order
	39	arglinb	100	2.48e+01	3.28e-04	70	3	0	2	1.36e-04	first_order
	40	arglinc	100	5.11e+01	4.44e-03	71	3	0	2	9.89e-05	first_order
	41	argtrig	100	-9.90e+03	5.59e-08	113	91	0	90	3.23e-03	first_order
	42	arwhead	100	0.00e+00	2.91e-06	27	12	0	11	1.66e-04	first_order
	45	bdqrtic	100	1.89e+02	1.29e-04	66	39	0	38	6.46e-04	first_order
	50	biggs6	6	-3.17e+22	4.12e+22	3	3	0	2	2.41e-05	unbounded
	55	brownal	100	1.92e-09	6.77e-04	27	4	0	3	9.80e-05	first_order
	58	broyden3d	100	3.56e-01	3.09e-07	54	44	0	43	1.35e-03	first_order
	59	broydn7d	100	3.55e+01	6.63e-07	347	320	0	319	1.69e-02	first_order
	60	brybnd	100	1.34e+00	1.44e-05	128	108	0	107	1.26e-02	first_order
	65	chainwoo	100	1.00e+00	9.86e-04	356	295	0	294	4.29e-03	first_order
	67	chnrosnb	100	5.84e-11	7.76e-05	621	564	0	563	1.75e-02	first_order
	72	clplatea	100	-9.15e-03	1.60e-08	70	66	0	65	2.95e-03	first_order
	73	clplateb	100	-6.20e-03	1.41e-08	73	69	0	68	3.10e-03	first_order
	74	clplatec	100	-5.11e-03	2.37e-08	12055857	314642	0	314641	3.00e+01	max_time
	76	cosine	100	-9.90e+01	2.84e-08	27	18	0	17	4.21e-04	first_order
	77	cragglvy	100	3.23e+01	3.81e-04	83	60	0	59	1.77e-03	first_order
	78	cragglvy2	100	2.52e+01	5.62e-04	86	63	0	62	1.79e-03	first_order
	79	curly	100	-1.00e+04	3.51e-05	12922080	151238	0	151237	3.00e+01	max_time
	80	curly10	100	-1.00e+04	3.51e-05	12195122	142785	0	142784	3.00e+01	max_time
	81	curly20	100	-1.00e+04	5.01e-05	9462517	109634	0	109633	3.00e+01	max_time
	82	curly30	100	-1.00e+04	3.67e-05	7261456	74260	0	74259	3.00e+01	max_time
	84	dixmaane	99	1.00e+00	1.66e-06	67	55	0	54	3.99e-03	first_order
	85	dixmaanf	99	1.00e+00	3.35e-06	62	51	0	50	4.27e-03	first_order
	86	dixmaang	99	1.00e+00	9.12e-06	56	48	0	47	4.00e-03	first_order
	87	dixmaanb	99	1.00e+00	6.71e-06	63	50	0	49	4.21e-03	first_order
	88	dixmaani	99	1.00e+00	2.59e-06	310	299	0	298	2.96e-02	first_order
	89	dixmaanb	99	1.00e+00	3.91e-06	241	223	0	222	2.48e-02	first_order
	90	dixmaank	99	1.00e+00	9.22e-06	175	158	0	157	1.77e-02	first_order
	91	dixmaanl	99	1.00e+00	1.47e-05	136	123	0	122	1.39e-02	first_order
	92	dixmaanm	99	1.00e+00	1.15e-06	391	364	0	363	5.00e-02	first_order
	93	dixmaann	99	1.00e+00	2.66e-06	240	224	0	223	3.16e-02	first_order
	94	dixmaano	99	1.00e+00	4.36e-06	244	226	0	225	3.19e-02	first_order
	95	dixmaano	99	1.00e+00	8.01e-06	256	231	0	230	3.37e-02	first_order
	96	dixon3dq	100	3.41e-14	4.84e-08	441	424	0	423	4.02e-03	first_order
	97	dqdrtic	100	3.99e-12	4.27e-05	31	12	0	11	1.88e-04	first_order
	98	dqrtic	100	2.92e-02	1.14e-01	53	29	0	28	6.51e-04	first_order
	100	edensch	100	6.03e+02	2.23e-06	30	22	0	21	7.03e-04	first_order
	101	eg2	100	-9.74e+01	8.54e-08	19	8	0	7	1.79e-04	first_order
	103	engvall	100	1.09e+02	6.71e-06	34	22	0	21	3.21e-04	first_order
	104	enso	9	3.94e+02	9.65e-07	39	26	0	25	9.94e-04	first_order
	105	errinros	100	3.88e+01	5.58e-04	270	199	0	198	6.16e-03	first_order
	106	extrosnb	100	3.22e-11	1.48e-04	50	30	0	29	4.39e-04	first_order
	107	fletcbv2	100	-5.14e-01	1.37e-08	250	235	0	234	4.51e-03	first_order
	108	fletcbv3	100	-2.03e+00	5.57e-09	68	48	0	47	3.67e-03	first_order
	109	fletchcr	100	3.45e-13	3.88e-06	436	395	0	394	5.67e-03	first_order
	110	fminsrf2	100	1.00e+02	8.37e-07	136	117	0	116	4.04e-03	first_order
	111	freuroth	100	5.98e+03	2.34e-05	38	23	0	22	1.23e-03	first_order
	112	gauss1	8	6.58e+02	9.69e-05	316	180	0	179	3.23e-03	first_order
	113	gauss2	8	6.24e+02	4.34e-03	392	247	0	246	4.32e-03	first_order
	114	gauss3	8	6.22e+02	5.31e-05	389	230	0	229	4.09e-03	first_order
	116	genhumps	100	3.51e-11	3.68e-06	1985	1209	0	1208	6.59e-02	first_order
	117	genrose	100	1.00e+00	1.78e-06	298	253	0	252	3.96e-03	first_order
	118	genrose_nash	100	1.00e+00	1.22e-06	379	281	0	280	4.45e-03	first_order
	120	hahn1	7	2.66e+04	5.18e+06	408002	407909	0	407908	3.00e+01	max_time
	285	indef	100	-9.83e+03	6.61e-07	14573272	316908	0	316907	3.00e+01	max_time
	286	integreq	100	5.84e-17	1.10e-08	8	8	0	7	2.00e-02	first_order
	288	kirby2	5	1.52e+01	5.45e+02	206	123	0	122	2.49e-03	first_order
	290	lanczos1	6	2.15e-06	5.75e-07	104	83	0	82	1.99e-04	first_order
	291	lanczos2	6	2.15e-06	3.12e-07	111	90	0	89	2.13e-04	first_order
	292	lanczos3	6	2.17e-06	7.13e-07	109	86	0	85	2.06e-04	first_order
	293	liarwhd	100	1.08e-10	1.31e-04	38	20	0	19	3.01e-04	first_order
	301	mgh17	5	5.52e-02	1.21e-06	38	26	0	25	5.60e-05	first_order
	306	morebv	100	2.74e-11	3.75e-08	9018	8593	0	8592	4.54e-01	first_order
	308	ncb20	100	1.67e+02	6.56e-07	5610143	100675	0	100674	3.00e+01	max_time
	309	ncb20b	100	1.97e+02	2.36e-06	5360514	86703	0	86702	3.00e+01	max_time
	311	noncvxu2	100	2.32e+02	1.34e-04	510	489	0	488	1.19e-02	first_order
	312	noncvxun	100	2.33e+02	1.47e-04	191	174	0	173	4.27e-03	first_order
	313	nondia	100	3.45e-15	7.84e-06	48	25	0	24	2.93e-04	first_order
	314	nondquar	100	7.41e-07	5.60e-06	1528	1148	0	1147	2.28e-02	first_order
	315	osborne1	5	2.33e-02	4.07e+04	70424827	981474	0	981473	3.00e+01	max_time
	316	osborne2	11	2.01e-02	2.56e-08	85	74	0	73	7.50e-04	first_order
	317	palmer1c	8	8.44e+01	1.81e+00	100	52	0	51	6.93e-03	first_order
	318	palmer1d	7	1.40e+01	2.48e-01	100	57	0	56	6.22e-03	first_order
	319	palmer2c	8	2.22e+00	9.13e-02	77	38	0	37	3.30e-03	first_order
	320	palmer3c	8	1.65e+00	7.85e-02	58	22	0	21	2.35e-03	first_order
	321	palmer4c	8	1.77e-01	6.38e-02	91	40	0	39	3.82e-03	first_order
	322	palmer5c	6	1.06e+00	1.35e-06	18	13	0	12	3.70e-04	first_order
	324	palmer6c	8	4.78e-02	1.80e-03	163	83	0	82	4.44e-03	first_order
	325	palmer7c	8	2.69e+00	2.46e-02	113	68	0	67	3.51e-03	first_order
	326	palmer8c	8	2.95e-01	4.21e-03	129	79	0	78	4.74e-03	first_order
	327	penalty1	100	1.16e+00	4.05e+00	53	21	0	20	4.58e-04	first_order
	328	penalty2	100	9.71e+04	1.98e-02	59	28	0	27	3.01e-03	first_order
	329	penalty3	100	1.00e+00	5.17e-03	128	69	0	68	2.70e-03	first_order
	335	powellsg	100	1.40e-09	1.91e-05	60	41	0	40	4.62e-04	first_order
	336	power	100	1.56e-03	7.07e-02	60	28	0	27	3.78e-04	first_order
	337	quartc	100	2.92e-02	1.14e-01	53	29	0	28	6.03e-04	first_order
	343	sbrybnd	100	7.64e+00	3.72e-04	22559	20915	0	20914	3.22e+00	first_order
	344	schmvett	100	-2.94e+02	1.07e-07	26	22	0	21	6.03e-04	first_order
	345	scosine	100	-7.78e+01	4.57e+05	788053	710529	0	710528	3.00e+01	max_time
	346	sinqvad	100	9.76e-16	3.86e-08	138	105	0	104	2.93e-03	first_order
	347	sparsine	100	4.30e-10	9.06e-05	362	286	0	285	2.01e-02	first_order
	348	sparsqur	100	4.72e-08	1.57e-05	41	27	0	26	6.04e-04	first_order
	349	spmsrtls	100	7.70e-15	7.25e-08	87	77	0	76	8.08e-03	first_order
	350	srosenbr	100	4.00e-13	1.97e-05	42	22	0	21	2.64e-04	first_order
	360	thurber	7	2.82e+03	3.73e-02	198	132	0	131	1.84e-03	first_order
	361	tointgss	100	9.71e+00	1.86e-07	20	18	0	17	7.38e-04	first_order
	362	tquartic	100	4.21e-20	3.37e-09	24	19	0	18	3.58e-04	first_order
	367	tridia	100	1.78e-12	1.44e-05	154	135	0	134	1.97e-03	first_order
	368	vardim	100	2.52e+03	8.22e+05	95	21	0	20	3.26e-04	first_order
	369	vibrbeam	8	5.29e+00	1.94e+00	225	127	0	126	6.55e-04	first_order
	370	watson	31	-3.83e+90	8.06e+90	2	2	0	1	4.57e-03	unbounded
	371	woods	100	1.72e-09	1.10e-03	48	28	0	27	3.60e-04	first_order

In [ ]: *# this code was found partially @ <https://jso.dev/OptimizationProblems.jl/dev/benchmark/>*

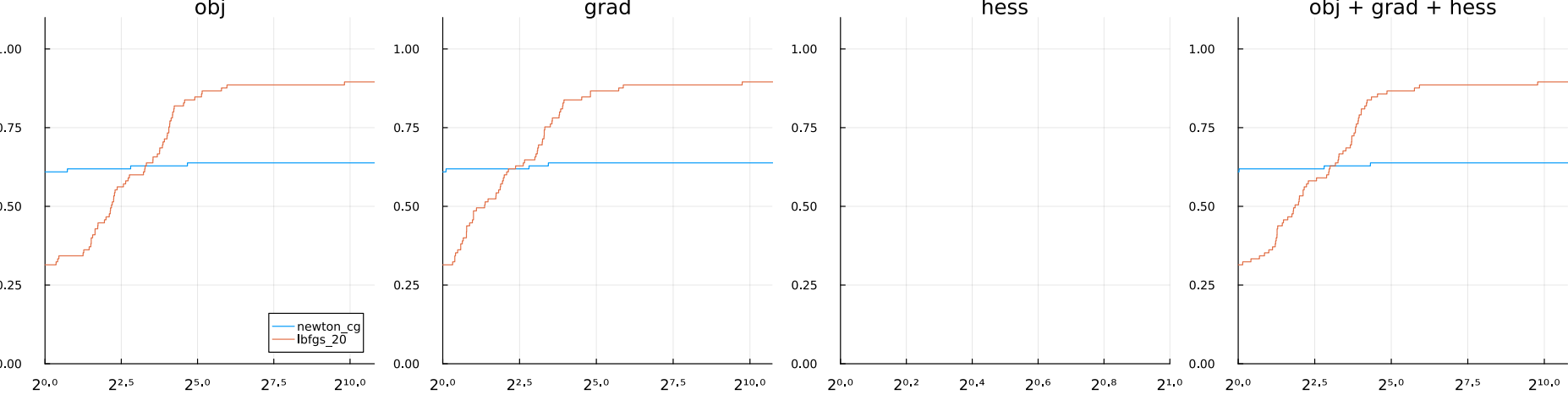
```

first_order(df) = df.status .== :first_order
unbounded(df) = df.status .== :unbounded
solved(df) = first_order(df) .| unbounded(df)
costnames = ["obj", "grad", "hess", "obj + grad + hess"]

```

```
costs = [  
    df -> .!solved(df) .* Inf .+ df.neval_obj,  
    df -> .!solved(df) .* Inf .+ df.neval_grad,  
    df -> .!solved(df) .* Inf .+ df.neval_hess,  
    df -> .!solved(df) .* Inf .+ df.neval_obj .+ df.neval_grad .+ df.neval_hess,  
]  
  
using Plots  
gr()  
  
profile_solvers(stats, costs, costnames)
```

Warning: some measures are zero; shifting all by one  
@ BenchmarkProfiles /home/julien/.julia/packages/BenchmarkProfiles/KnjdY/src/performance\_profiles.jl:16



J'ai un peu de la misère à comprendre les graphiques et j'utilise cet article comme référence: <https://link.springer.com/article/10.1007/s101070100263>.

De ce que je comprends, Newton-CG a environ 60% de probabilité d'être le meilleur initialement, mais plus on est tolérant plus lbfgs20 devient compétitif.

On a produit les profils de performance à partir des 105 problèmes utilisés à l'exercice 3.

On remarque cette fois-ci que `osborne1` est résolu par `newton-cg`, mais que `fletcher` n'est pas résolu (`status = max_time`). On retrouve aussi plusieurs problèmes avec le `status not_desc`, mais je n'ai pas réussi à trouver de la documentation qui explique ce que ça signifie quant à la résolution des problèmes.