p1

March 17, 2023

[1]:
```
using Plots
using AdvConvex.HW3
using AdvConvex.HW4
using Optim
```

```
[ Info: Precompiling Plots
[91a5bcdd-55d7-5caf-9e0b-520d859cae80]
[ Info: Precompiling AdvConvex
[a70558b1-94d0-46ca-a15d-76cbf33c1d08]
[ Info: Precompiling Optim
[429524aa-4258-5aef-a3af-852621145aeb]
```

[2]:
```
mat = get_spam_data()
X_train, Y_train, X_test, Y_test = train_test_split(mat, 0.05)
```

[2]:
```
([-2.3025850929940455 -1.7147984280919266 … -2.3025850929940455
-2.3025850929940455; -2.3025850929940455 -2.3025850929940455 …
-2.3025850929940455 -2.3025850929940455; … ; 2.4932054526026954 3.7864597824528
… 2.7788192719904172 2.4932054526026954; 4.883559211528279 6.499937405290376 …
4.11251186617755 4.160444363926624], [1.0, -1.0, -1.0, -1.0, -1.0, 1.0, 1.0,
1.0, 1.0, -1.0  …  -1.0, -1.0, -1.0, -1.0, 1.0, 1.0, -1.0, 1.0, 1.0, 1.0],
[-2.3025850929940455 -2.3025850929940455 … -0.030459207484708574
-1.3862943611198906; -2.3025850929940455 -2.3025850929940455 …
-1.3093333199837622 -1.6094379124341003; … ; 2.4069451083182885
1.9600947840472698 … 4.763028270603671 3.893859034800475; 3.7864597824528
2.7788192719904172 … 8.159975242934362 6.933520486868163], [1.0, -1.0, -1.0,
-1.0, -1.0, -1.0, -1.0, 1.0, -1.0, 1.0  …  -1.0, -1.0, 1.0, -1.0, 1.0, 1.0,
-1.0, -1.0, 1.0, -1.0])
```

[4]:
```
f = LogRegProblem(X_test,Y_test)
 f(w) = HW3. (f, w)

prob = DifferentiableProblem(f,  f)
nest_solver = NesterovDescentSolver(
      = 1e-2,
      = 0.0,
    max_iter = 10^4,
    linesearch = BackTrackingLineSearch(),
```

```
)

w_opt_nest, hist_nest = HW4.solve(nest_solver, prob, zeros(size(X_test, 1)));
```

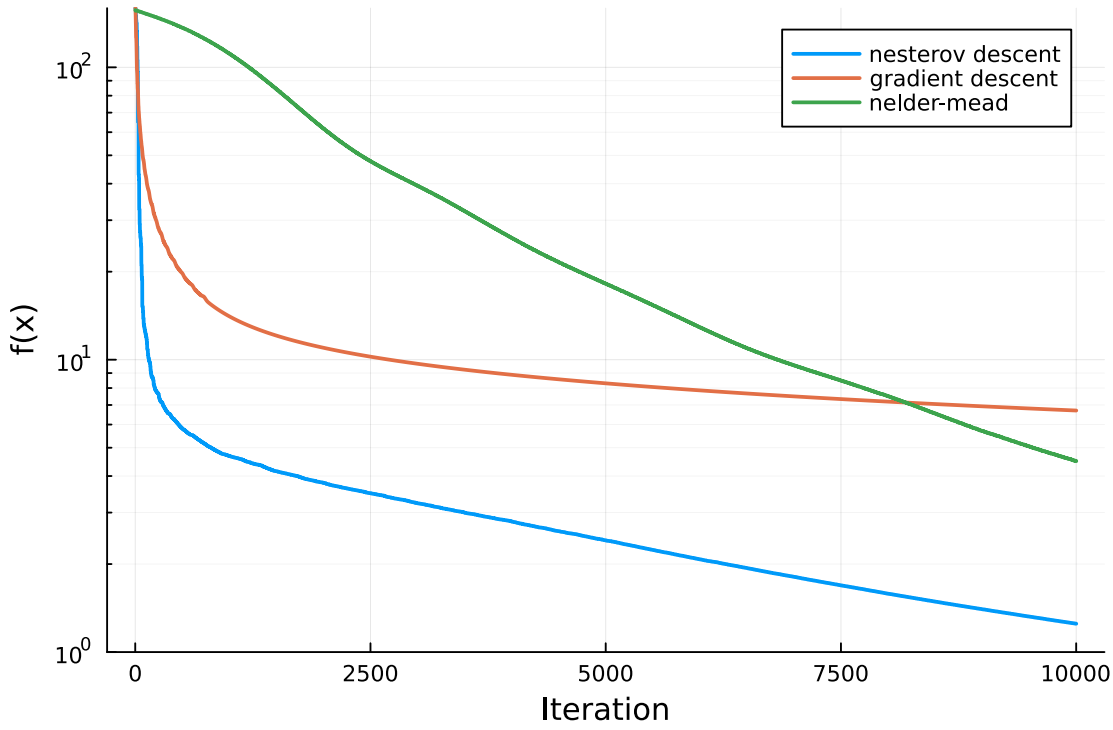
[5]:
```
gd_solver = GradientDescentSolver(
      = 1e-3,
      = 1e-10,
    max_iter = 10^4,
    linesearch = BackTrackingLineSearch(),
)
w_opt_gd, hist_gd = HW3.solve(gd_solver, prob, zeros(size(X_test, 1)));
```

[6]:
```
res = optimize(f, zeros(size(X_test, 1)), NelderMead(),
    Optim.Options(iterations=10_000, show_trace=false, store_trace=true)
)
```

[6]:
```
 * Status: failure (reached maximum number of iterations)

 * Candidate solution
    Final objective value:     4.497449e+00

 * Found with
    Algorithm:     Nelder-Mead

 * Convergence measures
    √(Σ(y -ȳ)²)/n   1.0e-08

 * Work counters
    Seconds run:   0  (vs limit Inf)
    Iterations:    10000
    f(x) calls:    13724
```

[7]:
```
plot(
    hist_nest.f, yscale=:log10,
    label="nesterov descent", lw=2,
    xlabel="Iteration", ylabel="f(x)",
    ylims=(10^(floor(log10(last(hist_nest.f)))),Inf), yminorgrid=true)
plot!(hist_gd.f, label="gradient descent", lw=2)
plot!(getfield.(res.trace, :value), label="nelder-mead", lw=2)
```

[7]:


nesterov descent
gradient descent
nelder-mead
f(x)
10^2
10^1
10^0
0
2500
5000
7500
10000
Iteration