LAB 9

Problem 1

```
library(nloptr)

# Objective function
obj_func <- function(x) {
  return(-x[1] * x[2])  # f(x, y) = -xy
}

# Constraint function
constraint_func <- function(x) {
  return(c(x[1] + x[2]^2 - 2))
}

# Lower and upper bounds
lb <- c(0, 0)      # x, y   0
ub <- c(2, 2)

# Initial guess
x0 <- c(1, 1)


result <- nloptr(
  x0 = x0,
  eval_f = obj_func,
  eval_g_ineq = constraint_func,
  lb = lb,
  ub = ub,
  opts = list("algorithm" = "NLOPT_GN_ISRES", "maxeval" = 5000, "xtol_rel" = 1e-6)
)
```

```r
print(result)
```

```
Call:

nloptr(x0 = x0, eval_f = obj_func, lb = lb, ub = ub, eval_g_ineq = constraint_func,
    opts = list(algorithm = "NLOPT_GN_ISRES", maxeval = 5000,
        xtol_rel = 1e-06))


Minimization using NLopt version 2.7.1

NLopt solver status: 5 ( NLOPT_MAXEVAL_REACHED: Optimization stopped because
maxeval (above) was reached. )

Number of Iterations....: 5000
Termination conditions:  maxeval: 5000  xtol_rel: 1e-06
Number of inequality constraints:  1
Number of equality constraints:    0
Current value of objective function:  -1.08777466653554
Current value of controls: 1.3077 0.8318231
```

Problem 2

```r
library(nloptr)

obj_func <- function(x) {
  return(2*x[1] + x[2])
}

constraint_func <- function(x) {
  return(c(((x[1]^2 + x[2]^2)^0.5) - 2, (-x[2] + 0.5*x[1] - 1)))
}

lb <- c(0, -1)
ub <- c(2,2)
x0 <- c(1, 0.9)
```

```r
result <- nloptr(
  x0 = x0,
  eval_f = obj_func,
  eval_g_ineq = constraint_func,
  lb = lb,
  ub = ub,
  opts = list("algorithm" = "NLOPT_GN_ISRES", "maxeval" = 5000)
)

print(result)
```

```
Call:

nloptr(x0 = x0, eval_f = obj_func, lb = lb, ub = ub, eval_g_ineq = constraint_func,
    opts = list(algorithm = "NLOPT_GN_ISRES", maxeval = 5000))


Minimization using NLopt version 2.7.1

NLopt solver status: 5 ( NLOPT_MAXEVAL_REACHED: Optimization stopped because
maxeval (above) was reached. )

Number of Iterations....: 5000
Termination conditions:  maxeval: 5000
Number of inequality constraints:  2
Number of equality constraints:    0
Current value of objective function:  -0.999846844940758
Current value of controls: 5.277497e-05 -0.9999524
```

Problem 3

```r
library(nloptr)

solve_case <- function(A) {
  obj_func <- function(x) {
    return(sum(x^2))
  }
  eq_constraint <- function(x) {
```

```r
    return(sum(x) - 1)
  }
  ineq_constraint <- function(x) {
    return(A - x[4])
  }
  lb <- rep(-3, 4)
  ub <- rep(9, 4)
  x0 <- c(rep(A/3, 3), 1 - A)

  result <- nloptr(
    x0 = x0,
    eval_f = obj_func,
    eval_g_eq = eq_constraint,
    eval_g_ineq = ineq_constraint,
    lb = lb,
    ub = ub,
    opts = list("algorithm" = "NLOPT_GN_ISRES", "maxeval" = 1e5, "xtol_rel" = 1e-8)
  )

  print(paste("A =", A))
  print(result)
}

solve_case(0.2)   # Case (i): A < 1/4
```

```
[1] "A = 0.2"

Call:

nloptr(x0 = x0, eval_f = obj_func, lb = lb, ub = ub, eval_g_ineq = ineq_constraint,
    eval_g_eq = eq_constraint, opts = list(algorithm = "NLOPT_GN_ISRES",
        maxeval = 1e+05, xtol_rel = 1e-08))


Minimization using NLopt version 2.7.1

NLopt solver status: 5 ( NLOPT_MAXEVAL_REACHED: Optimization stopped because
maxeval (above) was reached. )

Number of Iterations....: 100000
Termination conditions:  maxeval: 1e+05 xtol_rel: 1e-08
Number of inequality constraints:  1
```

```
Number of equality constraints:    1
Current value of objective function:  0.250000554265554
Current value of controls: 0.2502945 0.2499444 0.2494111 0.25035
```

```
solve_case(0.25)  # Case (ii): A = 1/4
```

```
[1] "A = 0.25"

Call:

nloptr(x0 = x0, eval_f = obj_func, lb = lb, ub = ub, eval_g_ineq = ineq_constraint,
    eval_g_eq = eq_constraint, opts = list(algorithm = "NLOPT_GN_ISRES",
        maxeval = 1e+05, xtol_rel = 1e-08))


Minimization using NLopt version 2.7.1

NLopt solver status: 4 ( NLOPT_XTOL_REACHED: Optimization stopped because
xtol_rel or xtol_abs (above) was reached. )

Number of Iterations....: 95973
Termination conditions:  maxeval: 1e+05 xtol_rel: 1e-08
Number of inequality constraints:  1
Number of equality constraints:    1
Optimal value of objective function:  0.250001098537192
Optimal value of controls: 0.249138 0.2502643 0.2500625 0.2505352
```

```
solve_case(0.3)   # Case (iii): A > 1/4
```

```
[1] "A = 0.3"

Call:

nloptr(x0 = x0, eval_f = obj_func, lb = lb, ub = ub, eval_g_ineq = ineq_constraint,
    eval_g_eq = eq_constraint, opts = list(algorithm = "NLOPT_GN_ISRES",
        maxeval = 1e+05, xtol_rel = 1e-08))


Minimization using NLopt version 2.7.1

NLopt solver status: 5 ( NLOPT_MAXEVAL_REACHED: Optimization stopped because
```

```
maxeval (above) was reached. )

Number of Iterations....: 100000
Termination conditions:  maxeval: 1e+05 xtol_rel: 1e-08
Number of inequality constraints:  1
Number of equality constraints:    1
Current value of objective function:  0.253335680914263
Current value of controls: 0.2344985 0.2323576 0.2331439 0.3
```