20181019h application of optimization

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library(Ryacas)  
library(mosaic)  
library(manipulate)

The cost of a company recruting x junior programmer and y senior programmer:  
C(x,y) == 2000 + 2*x^3 - 12*x\*y + y^2  
Find the minimum costs and the respective x and y

x = Sym('x')  
y = Sym('y')  
C = 2000 + 2\*x^3 - 12\*x\*y + y^2  
dCx = deriv(C,x); dCx

## expression(6 \* x^2 - 12 \* y)

dCy = deriv(C,y); dCy

## expression(2 \* y - 12 \* x)

Solve(dCx==0,y)

## expression(list(y == x^2/2))

Solve(dCy==0,y)

## expression(list(y == 6 \* x))

Solve(dCy-dCx==0,y)

## expression(list(y == (12 \* x + 6 \* x^2)/14))

Solve((x^2/2) == (6 \* x), x)

## expression(list(x == 0, x == 12))

Solve((x^2/2) == (12 \* x + 6 \* x^2)/14, x)

## expression(list(x == 0, x == 12))

Solve((6 \* x) == (12 \* x + 6 \* x^2)/14,x)

## expression(list(x == 0, x == 12))

Eval(x^2/2,list(x=c(0,12)))

## [1] 0 72

Therefore the two critical points are:  
(0,0) and (12,72)

# To confirm that (12,72 is a minimal)  
ddCxx = deriv(dCx,x); ddCxx

## expression(12 \* x)

ddCyy = deriv(dCy,y); ddCyy

## expression(2)

ddCxy = deriv(dCx,y); ddCxy

## expression(-12)

Eval(ddCxx\*ddCyy - ddCxy^2, list(x=c(0,12)))

## [1] -144 144

Eval(ddCxx, list(x=c(0,12)))

## [1] 0 144

So that (0,0) is a saddle, and (12,72) is a minimum

plotFun(2000 + 2\*x^3 - 12\*x\*y + y^2 ~ x & y,  
 surface = T,  
 xlim = c(-20,20), ylim = c(-100,100))

