20181018a curve sketching

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October 18, 2018

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### Points to note in curve sketching

1. x-intercept (y==0)
2. y-intercept (x==0)
3. critical points, and their nature
4. limiting behaviors (when x getting extreme)

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Let f(x) = 2*x^3 - 9*x^2 + 1

library(Ryacas)  
library(mosaic)

x = Sym('x')  
f = 2\*x^3 - 9\*x^2 + 1  
df = deriv(f,x)  
ddf = deriv(df,x)

# 1. x-intercept  
Solve(f==0,x)

## expression(list(x == 3 \* cos(acos(25/27)/3) + 3/2, x == 3 \* cos((acos(25/27) +   
## 2 \* pi)/3) + 3/2, x == 3 \* cos((acos(25/27) + 4 \* pi)/3) +   
## 3/2))

This seems difficult for exams  
So we may seek other ways to draw the graph

# 3. critical points  
Solve(df==0,x) # critical points at x==0 and x==3

## expression(list(x == 0, x == 3))

Eval(ddf,list(x=c(0,3))) # at x==0 it being a peak, at x==3, it being a trough

## [1] -18 18

Eval(f,list(x=c(0,3))) # y==1 when x==0, y==-26 when x==3

## [1] 1 -26

# At the same time we also get #2 (y-intercept)

# 4. limiting behaviors  
Limit(f,x,Infinity)

## expression(Inf)

Limit(f,x,-Infinity)

## expression(-Inf)

In this way we can sketch the curve without considering the x-intercepts

# double checking with mosaic  
plotFun(2\*x^3 - 9\*x^2 + 1 ~ x)

