COMS 4771 Spring 2017 Homework 3

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Problem 2
(a)
Constraint: $\sum_{i=d}^{D} x_d = C$
If we take derivatives for each dimension d,
$\frac{d}{x_d} = \lambda$
We can plug this to the Constraint equation, and get
$\frac{1}{\lambda} = \frac{2C}{D(D+1)}$
Therefore
$x_d = \frac{2Cd}{D(D+1)}$
and Maximum value of f(x) is

$$\boxed{\sum_{d=1}^{D} dlog \frac{2Cd}{D(D+1)}}$$

(b)
Constraint: $\sum_{d=1}^{D} x_i^2 \leq 1$
So, these are all equations and inequalities we have.
$\frac{1}{x_d} = \lambda 2 x_d$ for each dimension d.
$\sum_{d=1}^{D} x_d^2 \leq 1$
$\lambda(\sum_{i=d}^{D} x_d^2 - 1) = 0$

From the first equation, if λ is zero, then all x_i goes to infinity which does not satisfy the second inequality. So $\sum_{d=1}^{D} x_d^2 = 1$.

Then, by solving above equations,
$x_d = \sqrt{\frac{2d}{D(D+1)}}$
and Maximum value of f(x) is

$$\boxed{\sum_{d=1}^{D} dlog \sqrt{\frac{2d}{D(D+1)}}}$$