## Homework \# 3

The first two problems are due next Wednesday (2/04) and the computer assignment is due in two weeks on $2 / 11$.

1. Show that

$$
A^{T}\left(A A^{T}+\lambda I_{n}\right)^{-1}=\left(A^{T} A+\lambda I_{m}\right)^{-1} A^{T}
$$

2. let $x \in R^{m}$. Show that the norms $\|x\|_{p}, p \geq 1$ are convex functions of $x$. Show that the 1-norm is convex but not strictly convex.
3. Consider the problem $b=A x+n$, where $x$ and $n$ are independent Gaussian random vectors. $x$ is $N\left(0, R_{x}\right)$ and $n$ is $N\left(0, R_{n}\right)$. Assume $R_{x}$ and $R_{n}$ are positive definite matrices. Find the MAP estimate of $x$.
4. Matlab Computer Study
(a) Conduct computer experiments to compare the performance of $\ell_{1}$ norm based sparse signal recovery with Matching Pursuit type algorithms from the last homework.
(b) Please include a complexity (flop count) study.
