CSE 720: Sparse Approximation

Jan 18, 2012

Course blog

cs and gt. wordpress. com

Course notes

Email me comments

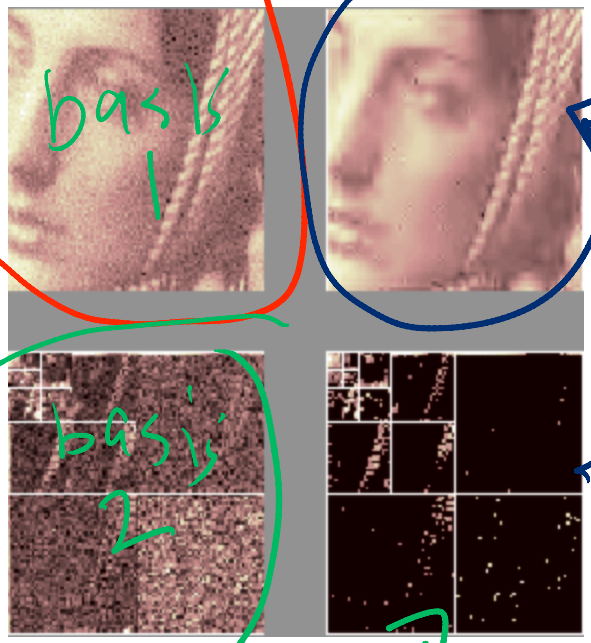
(pass onto Anna)

Case 1

original

"compressed" image

transform (T)



decompress (T^{-1})

(compression)

zero out small components

vars > # eqns

can't talk about sparse soln's

≤ 5 non-zero values

$x_1 +$

$x_2 +$

x_3

x_4

$x_6 = 3$

$x_6 = 2$

$+ x_6 = 5$

$+ x_6 = 7$

$x_5 + x_6 = 20$

under determined sys of eqns.

$$Ax = b \qquad x = \begin{pmatrix} x_1 \\ \vdots \\ x_n \end{pmatrix}$$

$$b = \begin{pmatrix} b_1 \\ \vdots \\ b_d \end{pmatrix}$$

$$d \begin{pmatrix} 1 & & & 1 \\ & 1 & & 1 \\ & & 1 & 1 \\ & & & 1 \end{pmatrix} \quad n$$

$$b = \begin{pmatrix} 3 \\ 2 \\ 5 \\ 7 \\ 20 \end{pmatrix}$$

Sparse Approximation

given $Ax = b$ $(d \leq n)$

want sparse x.

A → given

Ex 1: Image Compression:

b → image A → transform

(compressed) x → sparse (as possible)

Ex 2 Data stream algo.

$Ax = b$

$d << n$

$b \rightarrow$ get the HH

x has a few large components

Ex: $n = \#$ IP pairs

→ design A

want: "heavy hitters" $x_{ij} = 10$ → >10 pkts from $i \rightarrow j$

$n = 2^{64}$.

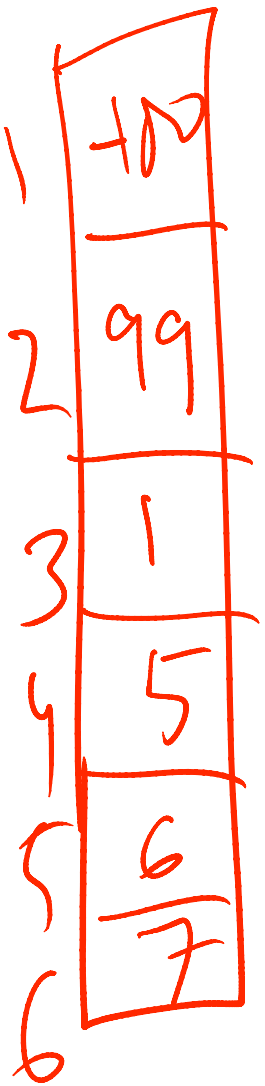
Ex 3 Compressed Sensing $x \in \mathbb{R}^n$

→ Design A

→ given $b\ (= Ax)$ compute a sparse approx to x.

In Ex → LOCATION of large values

↳ Location + (estimates) large values



HH

↓

{1, 2}

Compressed sensing