

# Sparsity

Representing some phenomenon with as few variables as possible.

## Statistics

- prefer simple models over complex ones
  - ↳ - prevents overfitting
  - improve interpretability

The number of parameters is often used as criterion for model selection:

- Bayes information criterion:  $k \ln(n) - 2 \ln(\hat{L})$  ← features
- Akaike information criterion:  $\ln(J(\theta)) + 2 \frac{n}{N}$  ← # data
- more...
- Lasso regularization

## Signal processing

vectors → signals

data modeling help us do:

- restoration
- compression
- inverse problems

signals are approximated by sparse linear combinations of some prototypes (basis elements / atoms of a dictionary).

dictionary

$$\begin{bmatrix} x_1 & x_2 & x_3 \\ x_4 & x_5 & x_6 \\ x_7 & x_8 & x_9 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} \approx \begin{bmatrix} z_1 \\ z_2 \\ z_3 \end{bmatrix}$$

↓ basis elements      ↓ coefficients (weight)      ↓ signal

↳ this needs to be sparse

