The Power of Asymmetry in Binary Hashing

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Parametric Mappings

- Use \( f(x) = \phi(x) \) in some (typically parametric) family \( \phi \in \mathcal{F} \)
  - Ex. \( \phi(x) = \sin(x) \), \( x \in \mathbb{R} \)
  - Could be more complex e.g. multilayer network, kernel-based, etc.

- Why metric \( f \) is \( \phi \in \mathcal{F} \)?
  - Generalisation: learn \( f \) using objects \( x_1, \ldots, x_n \), then use new objects \( x_{n+1}, \ldots, x_{2n} \) to query
  - Comparison of representation

- Asymmetric extension
  - \( \| x_1 - x_2 \|_A \neq \| x_1 - x_2 \|_B \)
    - learns \( A \), \( B \) from training data (sets of database objects)
    - Hash course using \( \phi \)
    - Hash database objects using \( \phi \)

Optimisation
- Goal: tends to highly asymmetry problem with easy asymptotics
- Make observability objective a sub-set of outputting a stage which can be conditionals

Empirical Results

- For query \( y \), use \( g(y) = \phi(y) \) to approximate \( \sin(x, y) \) e.g. find \( y \) in database with small \( g(y) \)

- Learn parametric \( \phi \) and arbitrary vectors \( x_1, \ldots, x_n \) such that on \( x_{n+1}, \ldots, x_{2n} \)
  - \( \sin(x, y) = g(y) \cdot \phi(x) \)

Asymmetric hashes can enable better approximation with shorter bit-length!