

A COMPLEXITY-THEORETIC FOUNDATION FOR DIGITAL IMAGE WATERMARKING SYSTEMS



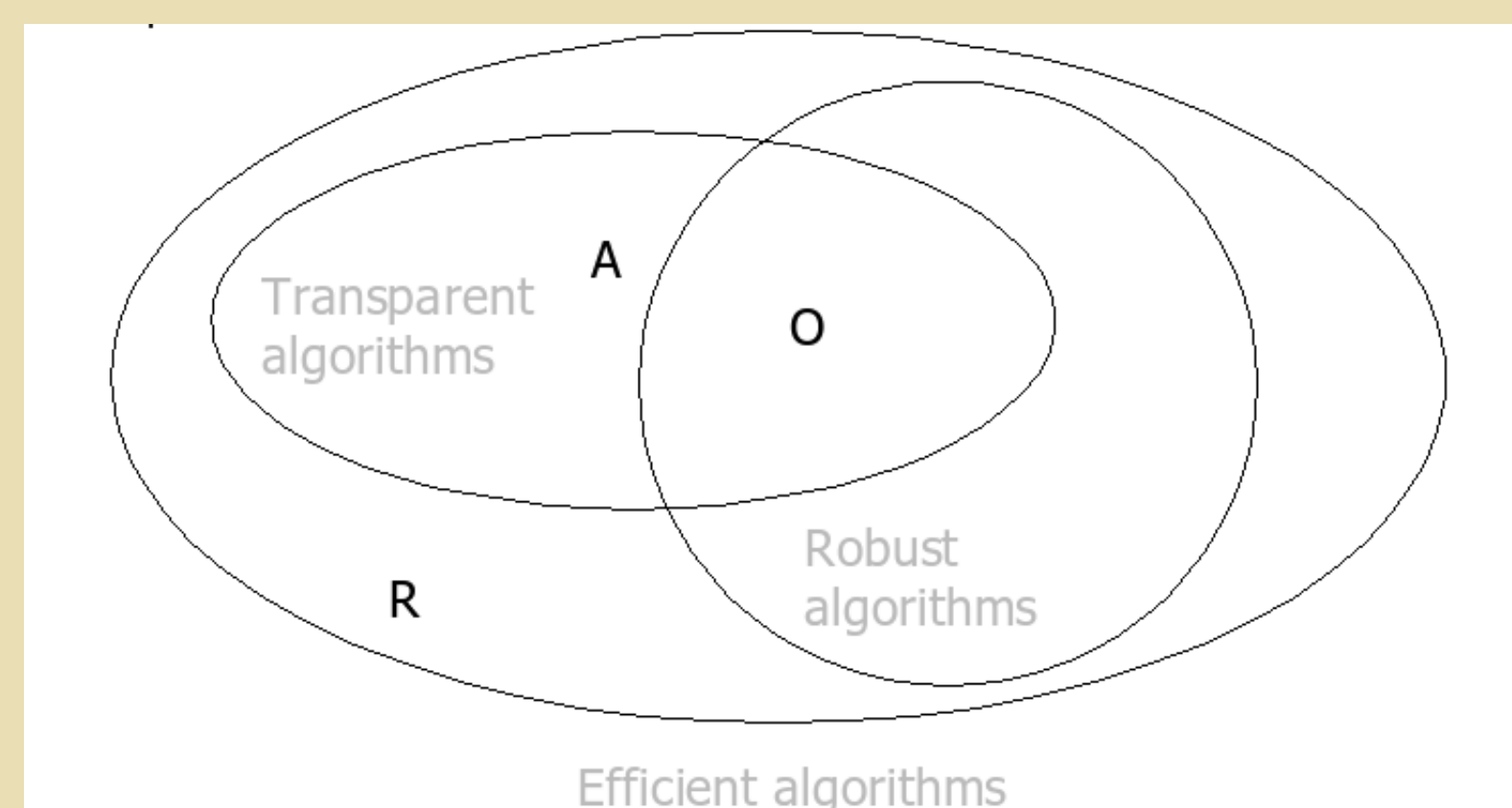
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MODELING IMAGE DISTINGUISHABILITY

Which computable functions modify images *imperceptibly* to the human visual system? A computational model for these so-called *hiding functions* is key to a formal framework for studying security and effectiveness of image watermarking systems.

Several subclasses of polynomial-time computable functions (based on automata, distortion metrics, and information distances) have been studied. A definition of provably secure image watermarks based on hiding functions has been proposed.

Applications also include image indexing, searching, and adding care labels directly into textile designs.



Fundamental Constraints on Operations by Owner, Attacker, and Receiver in an Image Watermarking Setting

Approach and Impact

New approach

- complexity-theoretic model
- based on findings and experimental results of vision-scientific studies

Research Impact

- understanding of a key feature of human visual system
- may help establish existence of provably secure watermarks

PLANNED ACTIVITIES

- proving or disproving existence of computationally secure image watermarking systems under various formal models and characterizations of the insertion, extraction, and tampering algorithms used in watermarking systems;
- characterizing the class of algorithms that preserve perceptual fidelity of input images under various distortion metrics that are supported by current theories of vision (these algorithms are called hiding functions);
- characterizing the maximum capacity of watermarking systems and the trade-off relationships between it and transparency and robustness;
- applying hiding functions to approximate data matching problems and indexing/querying multimedia databases and libraries;
- developing an application for embedding into and extracting care instructions from existing designs on textile clothing.