Human versus Machine Perception of Patterns

OR

A visual Turing Test: "Are you a human or a robot?"

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Regularities with varying form and scale pervade our natural and man-made world. From insects to mammals, the ability to sense regular patterns has a neurobiological basis and has been observed in many levels of intelligence and behavior. From Felix Klein's Erlanger program, D'Arcy Thompson's Growth-and-Form, to the Gestalt principles of perception, much of our understanding of the world is based on the perception and recognition of repetitions, generalized by the mathematical concept of symmetry and symmetry groups. Given the ubiquity of symmetry in both the physical and the digital worlds, a computational model for symmetry-based regularity perception is especially pertinent to computer vision, computer graphics, robotics and machine intelligence in general, where an intelligent being (e.g. a robot) seeks to perceive, reason and interact with the chaotic world in the most effective and efficient manner. Surprisingly, we have limited knowledge on how humans perceive regular patterns and little progress has been made in computational models for noisy, albeit near-regular patterns in real data. In this talk, I present parallels as well as differences between machine perception and human perception of visual regularity. I shall report our recent exploration on human perception of patterns using 2D crystallographic groups as a guiding principle via neuroimaging, an un-supervised learning approach for recurring patterns discovery in the wild, a deep learning framework to mimic human perception of symmetry from photos as well as a successful attempt at building a symmetry-based Turing test to tell humans and robots apart: a ***symmetry*** **reCAPTCHA**.