

# Trustworthy Deep Learning

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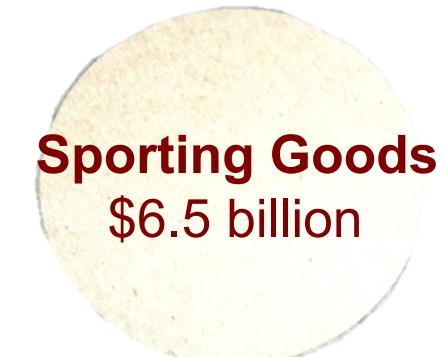
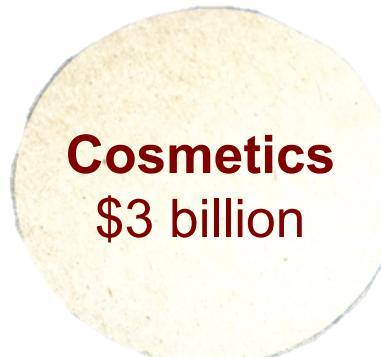


# The Counterfeit Goods Problem



- \$1.7 trillion-a-year problem<sup>1</sup>
- 5-7% of the world's trade is counterfeited<sup>2</sup>
- Grows over 150% each year<sup>3</sup>
- (Paper) \$5 bn Telgi stamp paper scam in India
- (Luxury) eBay asked to pay \$63 mn in damages to LVMH<sup>4</sup>
- (Luxury) 40 mn fake watches vs. 26 mn real ones sold<sup>5</sup>
- (Toys) Counterfeit toys worth \$27 mn seized at US ports in 2011<sup>6</sup>

## Market Losses



# What is Entrupy About?

**Every product line and physical object is unique**

- Verify authenticity of any physical object
- Non-intrusive with strong security guarantees
- Portable, cheap, fast, easy to use



# Fake vs Real: Microscopy and ML to the Rescue

Authentic



Louis Vuitton  
Material

Fake



250X Magnification



- Advanced Machine learning algorithms (Deep Learning)
- Instant Results (2-5 Seconds)
- Authentication Report for each bag

# entrupy

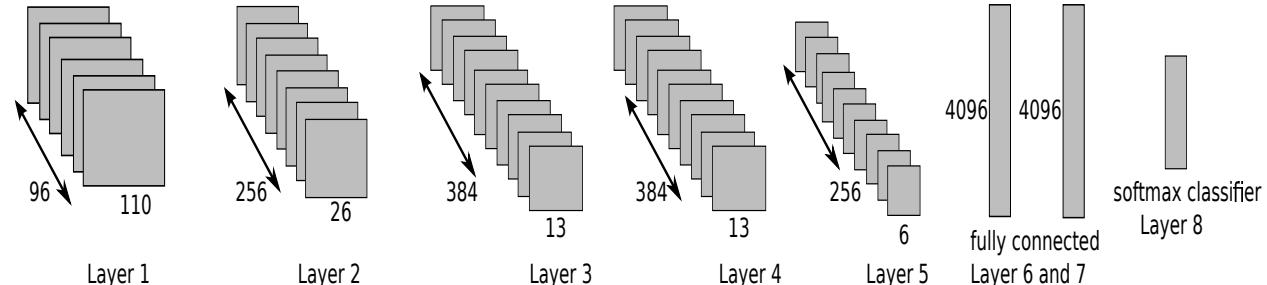
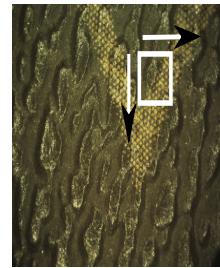
FingerprintDB



Training Data



Deep Learning Engine



Microscopic Fingerprint  
Authentication System

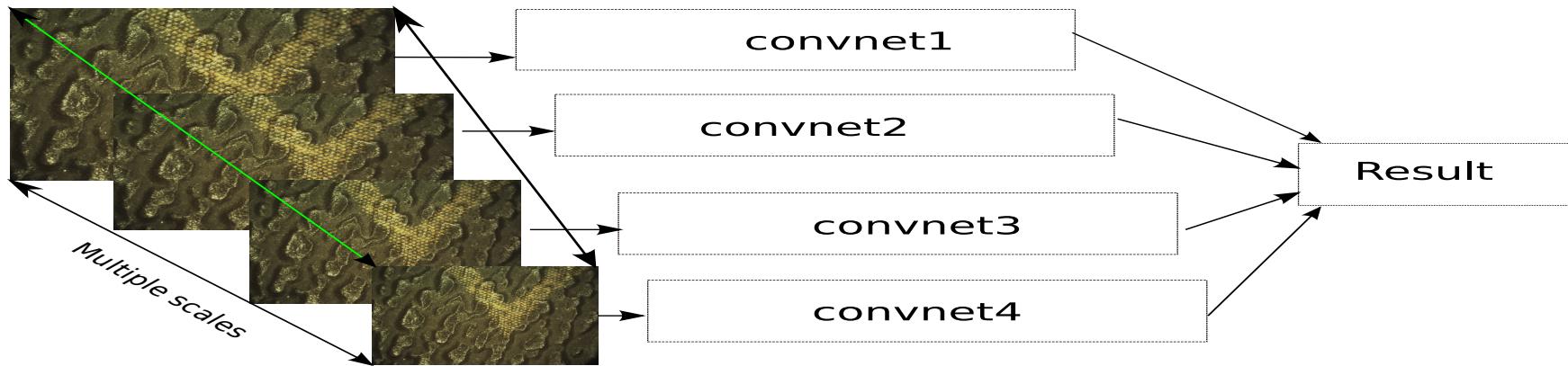
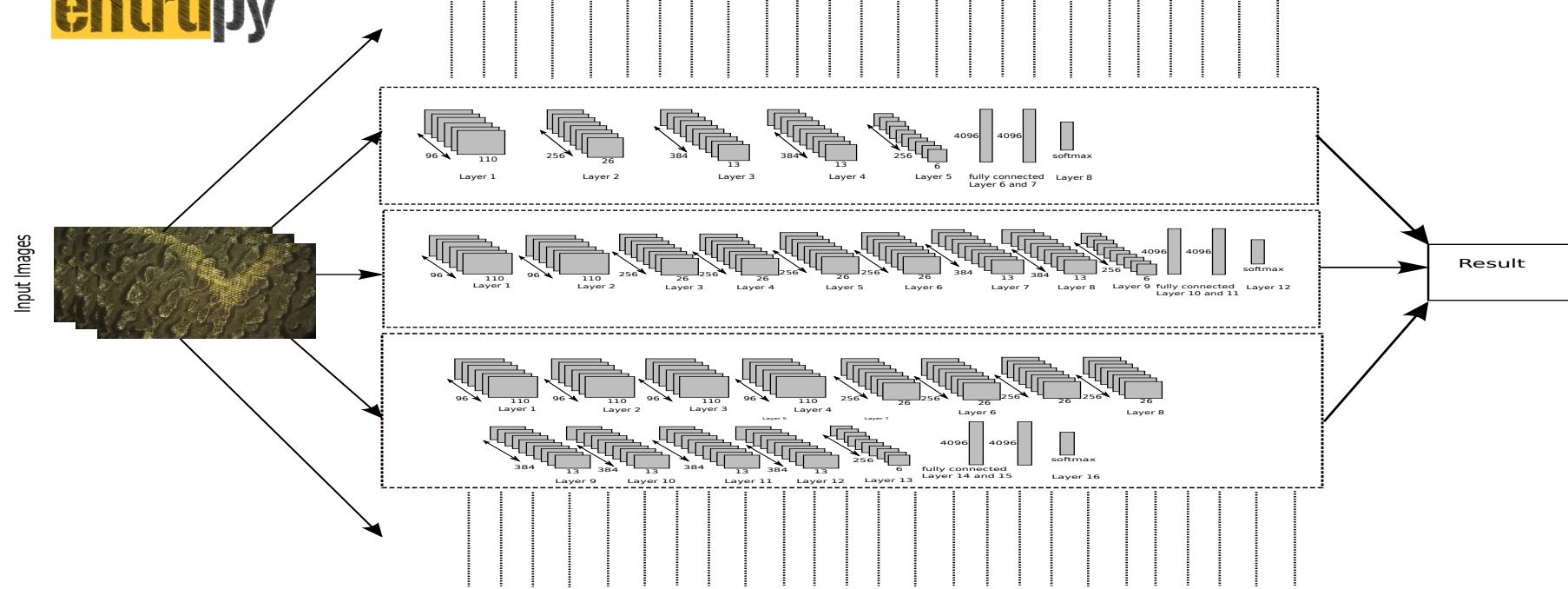
Authentic  
or Fake

Learning the microscopic genomes of every product line

# Trustworthy Machine Learning

- Can we design ML algorithms that provide:
  1.  $P(\text{authentic} \mid \text{fake}) \approx 0$
  2. Maximize  $P(\text{authentic} \mid \text{authentic})$
- Cost of error > 100x price per authentication
- Maintaining customer trust – priceless!

# entrupy



A very early take (3 years ago)



# Initial Outcomes

METHOD	LEATHER	FABRIC	PLASTIC	PAPER	JERSEY	PILLS
DSIFT + K-MEANS + SVM	97.8	95.3	93.6	96.2	98.5	98.6
DSIFT + K-MEANS + k-NN	91.2	90.2	94.2	93.1	95.3	98.6
DAISY + K-MEANS + SVM	95.6	94.3	94.2	96.5	96.2	96.5
DAISY + K-MEANS + k-NN	90.7	88.2	95.2	90.3	97.5	96.4
CNN1	97.6	98.7	98.1	97.4	98.3	98.7
CNN2	98.6	98.0	92.5	92.8	99.3	98.4

# Stats

- 15 brands
- 20 million images
- 20K authentications
- FP < 0.1%
- TP = 98.5+%
- 200+ businesses

The logo consists of the word "Entrupy" in a bold, black, sans-serif font. The letter "E" is stylized with a circular arrow or gear-like pattern inside its left side. The entire word is set against a solid yellow rectangular background.

@Entrupy