



Computer Science @ RIT

B. Thomas Golisano College of Computing & Information Sciences

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COMPUTER SCIENCE @ RIT

Breaking the PayPal.com HIP

“[A HIP] is a program that can generate and grade tests that it itself cannot pass (much like some professors).” -Luis von Ahn

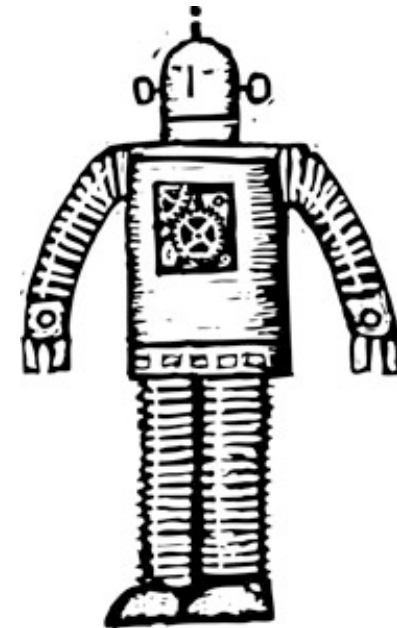
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Bots on the Internet

- Generate accounts to abuse free services
- Deliver massive amounts of SPAM from free email addresses
- Signup for services to take advantage of free offers
- Brute force username/passwords
- Blog comment spam
- Voting in online polls



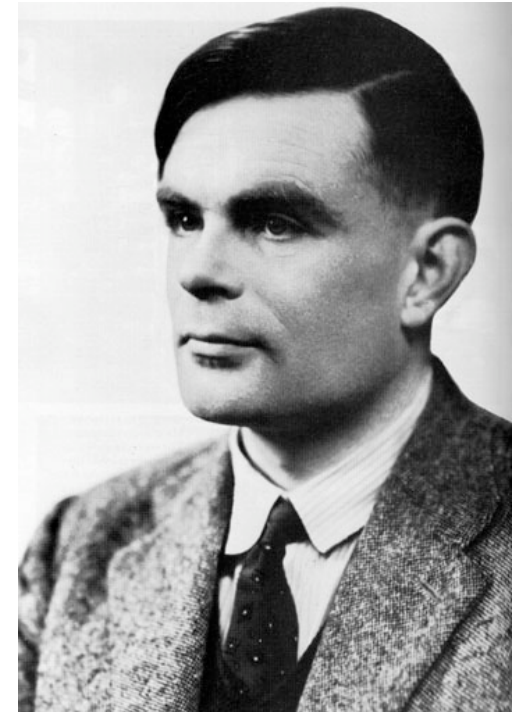
How to proof “humanness”

- Present a challenge to the user that only humans can solve
- Challenges represent hard AI problems
- Challenges should be easy for a human to solve but hard for robots
- A “Human Interactive Proof” or a “CAPTCHA” (Complete Automated Public Turing test to tell Computers and Humans Apart)



Turing Test

- Operational definition of intelligence
- Turing Test
 - Administered by a human
 - 2 players: a computer and a human
 - Which is the human?
- Human Interactive Proof
 - Administered by a computer
 - Is the player a human?



Hard AI Problems

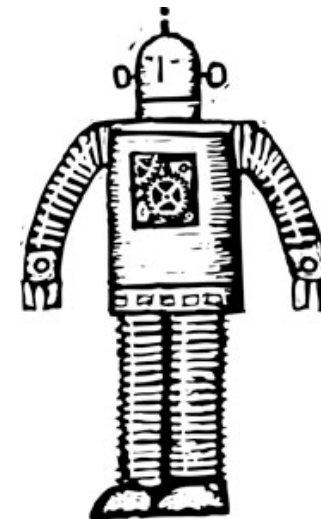
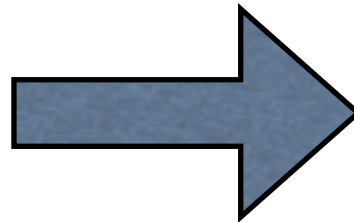
- Moni Naor proposed several human verification methods
 - Gender Recognition: “Is this a male or female?”
 - Expression Understanding: “Person happy or sad?”
 - Finding Body Parts: “Click on the left arm.”
 - Deciding Nudity: “Which person is naked?”
 - Drawing Understanding: “What is this a pic of?”
 - Handwriting Recognition: “Type this text.”
 - Speech Recognition: “Transcribe this spoken text.”
 - Filling in Words: “Select the correct subject.”
 - Disambiguation: “Disambiguate the pronoun ‘it’.”



Optical Character Recognition

“Much of the world’s information is held captive in hard-copy documents. OCR systems liberate this information by converting the text on paper into electronic form.”
-George L. Nagy

- Definition: the process of translating images of handwritten, typewritten, or printed text into a format understood by machines
- Why? allows for reduced storage size, editing, indexing, searching, etc.



I. Pre-Processing

- Necessary due to poor printing, old paper, or bad scanners
- Noise removal: average filtering
- Skew correction: estimate angle of text
- Thresholding: all values above/below value = 1
- Bounding boxes: extract ROI

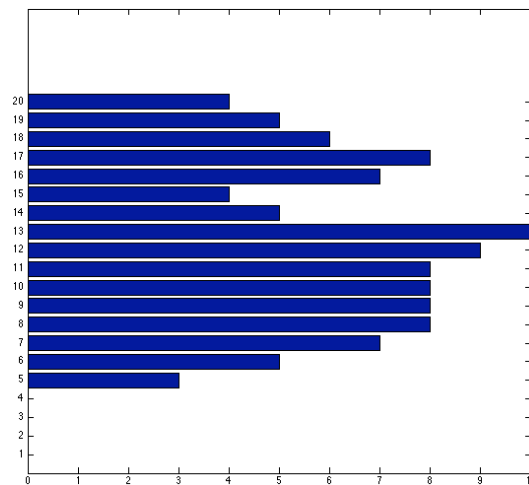
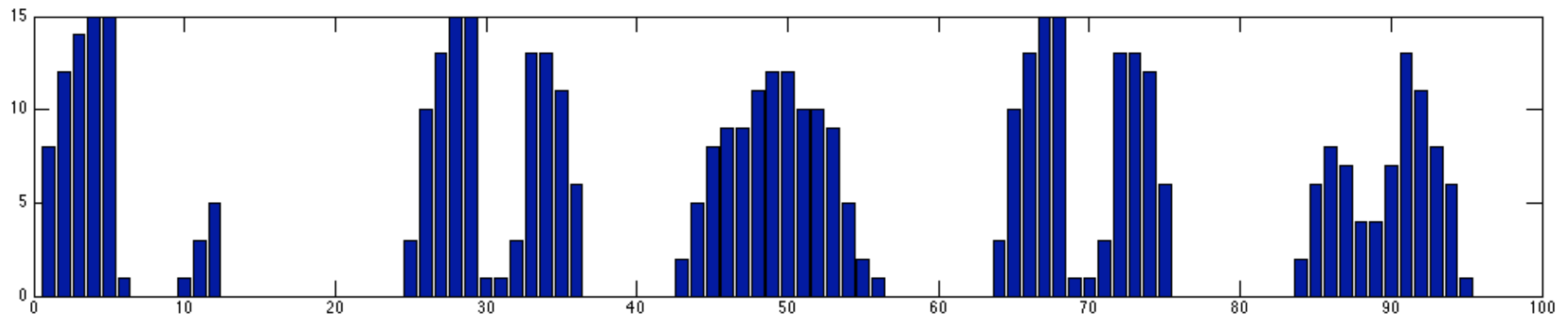
2. Segmentation

- Splitting a word into single symbols
- Dissection Approach
 - Split image based on character-like properties
 - Image Projections, Connected Components
- Recognition-Based Approach
 - Search image for characters using classifier
- Hybrid Approach
 - Search for known words as entire components (no segmentation at all!)

3. Classification

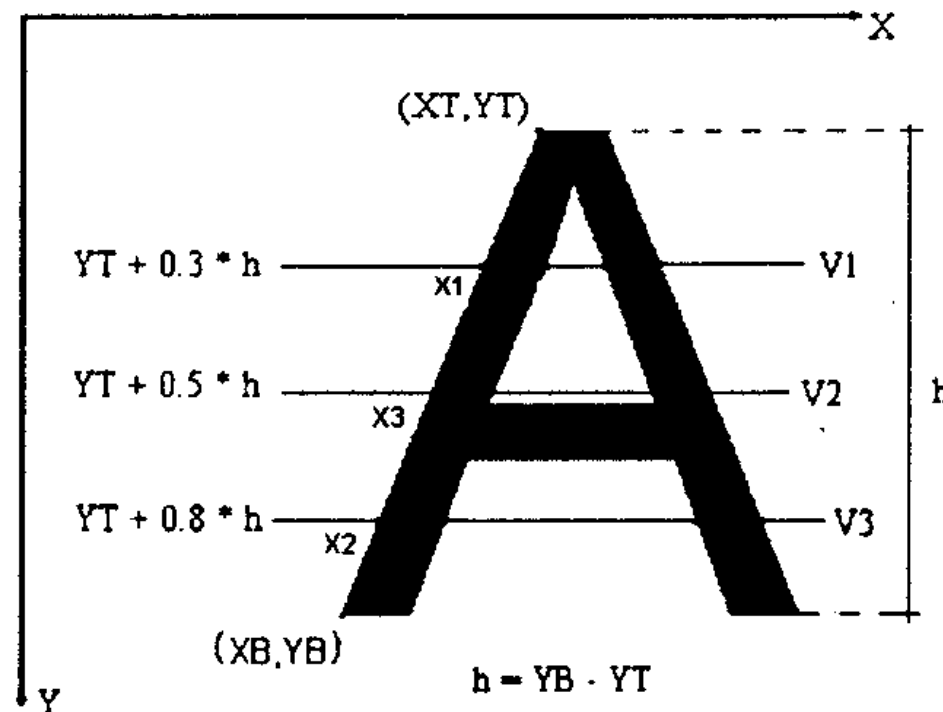
- Classification method (nearest neighbor, neural networks, SVM, etc.) is largely irrelevant
- Feature set is the most important decision
 - Extraction: process of transforming the input data into a reduced representation
 - Can be done by domain experts or PCA
- Feature Examples:
 - Entire image matrix (no feature extraction at all!)
 - Image projections (horizontal or vertical)

Features: Image Projections



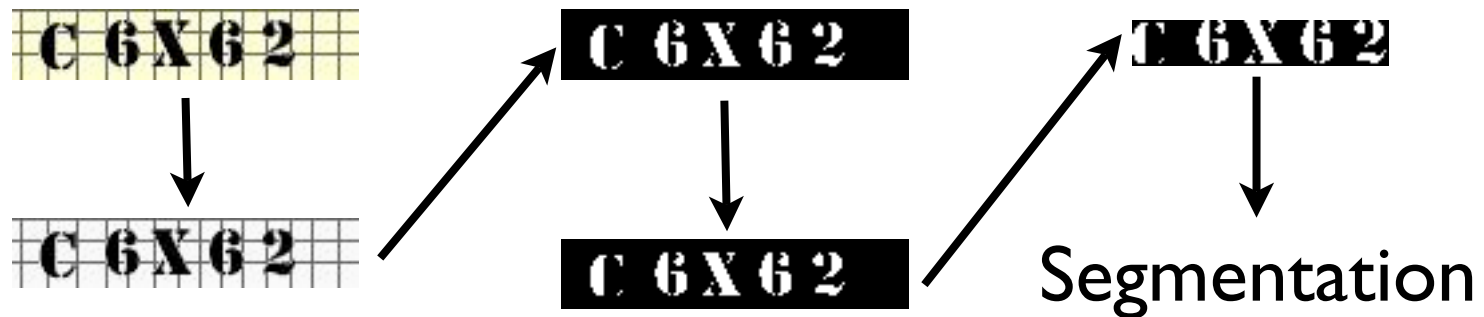
Features: Expert Chosen

- Use curvature, line slope, space, line interconnection, relative distance between two lines, and other topological and geometrical features (17 features in total)



Example: Pre-process, Segment

- Pre-Processing

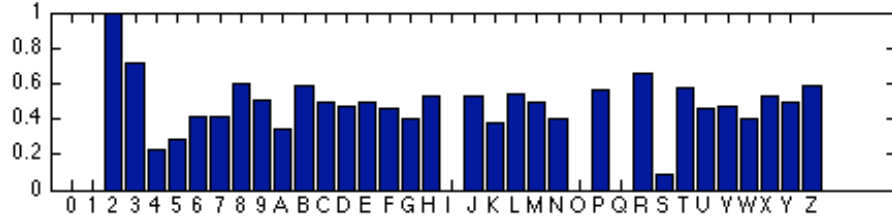
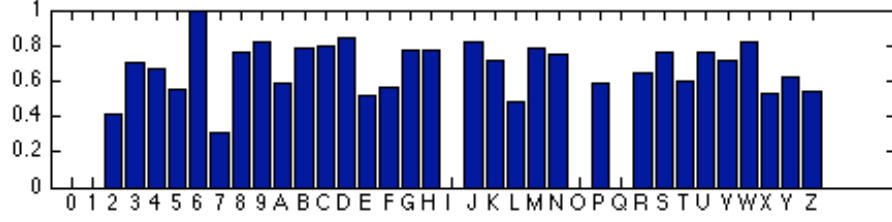
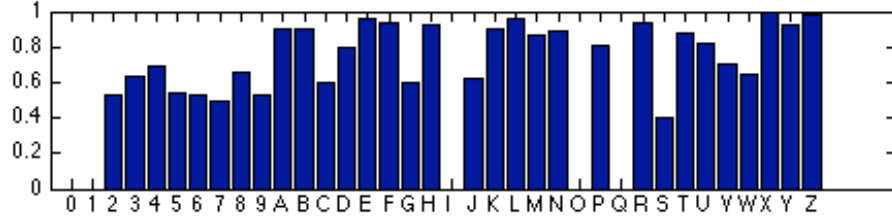
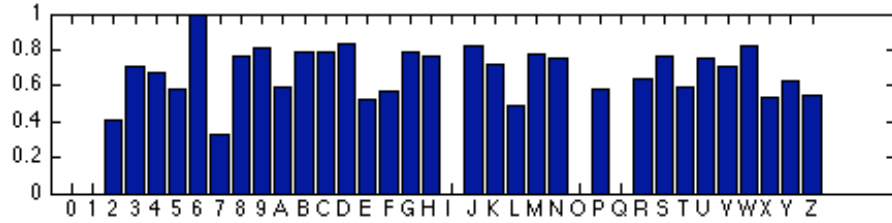
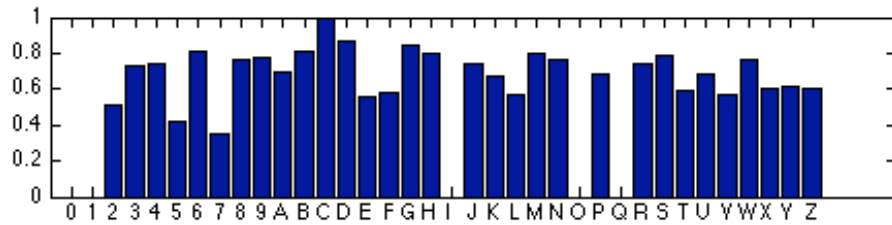


- Segmentation

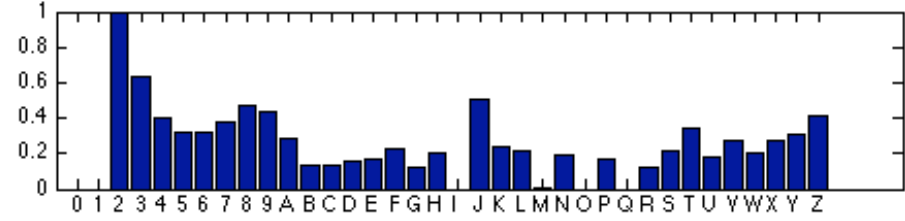
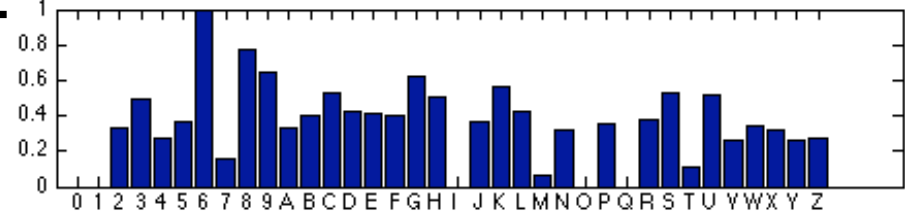
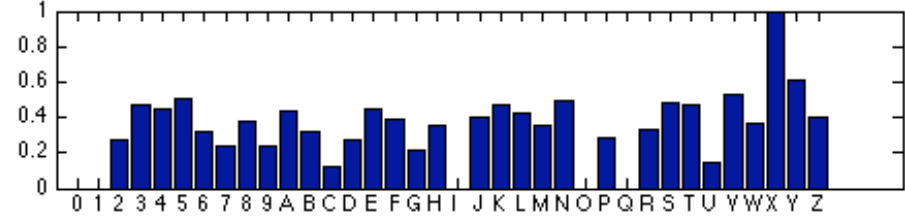
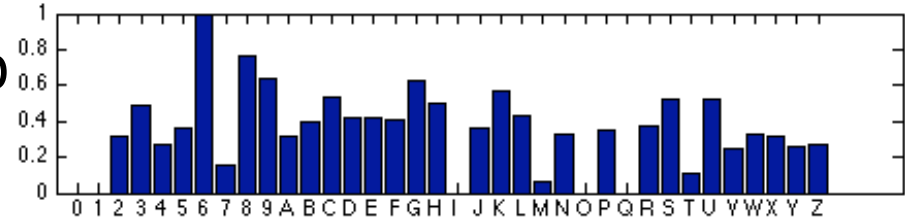
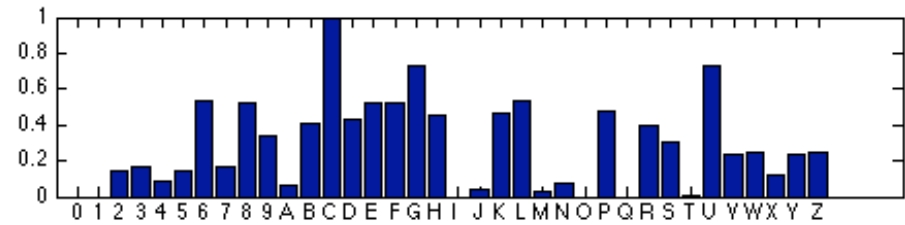


Example: Classification

Horizontal Projections



Template Matching



Comparison of Classifiers

- Sample of 100 test images (hand classified...ugh)
- Pixel Counting Classifier
 - 8% correct
- Vertical Projection Classifier
 - 97% correct classification
- Horizontal Projection Classifier
 - 100% correct classification
- Template Matching Classifier
 - 100% correct classification

Demo Time!

TO COMPLETE YOUR WEB REGISTRATION, PLEASE PROVE THAT YOU'RE HUMAN:

WHEN LITTLEFOOT'S MOTHER DIED IN THE ORIGINAL 'LAND BEFORE TIME,' DID YOU FEEL SAD?

- YES
- NO

(BOTS: NO LYING)