Pattern Recognition

Speech, Image, Handwriting, etc.

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VOICE RECOGNITION

• Automatic conversion of speech into textual representation

• Preprocessing
  Partitioning and compression of speech into a stream of feature vectors

• Recognition
  Identification of words through an optimal path of a graph (most time consuming)
VOICE RECOGNITION

• Preprocessing
  • loop oriented with fixed bounds and no loop carried dependencies
  • High DLP with provision for TLP
  • Computationally intensive requiring floating point and integer operations
  • Small working set and memory footprint with regular data access patterns
  • High degree of spatial and temporal locality?
VOICE RECOGNITION

• Recognition

  • Large working set with highly irregular control and data access patterns
  
  • Big memory foot print during initialization requiring high bandwidth
  
  • Large caches and bigger block size reduce cache misses
  
  • Little ILP but TLP offers substantial gains
  
  • Algorithmic changes can exploit data locality
VOICE RECOGNITION

• Other Algorithms
  - Dynamic Time Warping, hidden Markov modeling, Neural Networks etc.

• Benchmarks
  - Common benchmarks are RASTA (pre-processing) and Sphinx (recognition)

• Scaling Trends
  - Complex search mechanisms requiring more computational resources
  - Large sets of databases requiring tremendous memory
IMAGE RECOGNITION

• Also a 3-step process:
  • Edge detection:
    Filtering
  • Image processing / Characterization
  • Matching
IMAGE RECOGNITION

- Processing / Characterization
  - We need to find image descriptors:
    Shape contexts, Fourier descriptors, etc.
  - Similar characteristics to voice recognition preprocessing except:
    - Not necessary to use floating point or excessive computation,
    - Yet more points to look at, which grow with the size of the image,
    - And although the memory access pattern is very regular, is important to remember that now we are looking at a 2D window.
IMAGE RECOGNITION

• Matching
  • Once again, similar to voice recognition, but problems really exacerbated!
  • Several algorithms: SVMs, Shortest Augmenting Path, etc
  • Remember that dictionary must be MUCH larger
  • Little ILP, some DLP, but mostly TLP
  • Topics to explore: CAMs, prefetching (but be careful!)
HANDWRITING RECOGNITION

• Special case of image recognition

• Similar algorithms for selecting descriptors and matching
  - Neural Nets, Hidden Markov Models, etc

• Matching library is small and fixed size

• Rarely done in hardware
  - Low data rate

• Scaling
  - Constant number of descriptor points irrespective of sample size
  - Limited opportunities for extensions