Real Time Human Pose Estimation: Parallel Performance
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Problem

Pose Estimation
- Determining position of limbs and joints of people from still images
- Useful for human robot interaction, gesture recognition, and prediction

Challenges
- Kinect provides real-time pose estimation but requires IR sensor
- Current image-only pose estimators too slow for real-time application

Approach

Pose Machines

Image Features

- Use multiple stages of part prediction with boosted random forests [1]
- Predict on multiple hierarchies of parts
- Stages and hierarchies pass information using context features

 GPUs

GPU Parallelization - Training

- Use GPU to accelerate training, train on more images
  - Current speed: projected 10 days for 100,000 images
  - Most time used in sort and deciding splits
  - Main operation in deciding splits is calculating running sums to calculate gain
  - Sort is $\theta(N \log N)$
  - Gain calculation is $\theta(N)$
- Developed new algorithm for faster running sums
  - Runtime $\theta(\frac{N}{k} \log N)$ – $k$ is number of parallel processes
  - In practice $k << N$, so approximately $\theta(\frac{N}{k} \log N)$ runtime
  - More precise than naïve sum

Random Forests

- Collection of trees trained on random subset of samples & features [2]
- Branching algorithm – each input navigates to leaf node of each tree to determine output distribution
- Used modification of method by Sharp (2008)
- Added parallelization over trees

GPU Parallelization - Testing

Context Features

- Embarrassingly Parallel
- Minimized copies between GPU, CPU

Results

4x Speed Improvement from CPU testing

Runtime Performance

- Achieved real-time speeds
- Accuracy could still be improved
  - Larger training sets
  - More stages/hierarchies
  - Multiple scales
- Accuracy vs. time performance tradeoff
- Most non-data accuracy improvements are linear time additions

Works Cited


Acknowledgements

- Thanks to Professor Yaser Sheikh and Varun Ramakirkisna for their help and guidance this summer.