Introduction

- Fast on-road object detection is an important ADAS feature (advanced driver assistance systems).
- We propose CUDA implementation of soft cascade detector [1] that allows real-time object detection on Tegra K1 platform.
- Applicable for pedestrian and vehicle detection.

Soft Cascade

\[ H_t(x) = \sum_{i=1,\ldots,t} c_i(x) \]

Based on AdaBoost approach and features, but is able to reject negative patches after each new feature evaluated.

Optimization notes

- Thread / window
  - Access to gmem is coalesced in the beginning, but sparse at the latest stages; unbalanced workload, warp processes relatively long sequence of 32 windows, they likely diverge.
  - Time of block residence on SM(X) is \( T(b) = \max\{ T(w_0), \ldots, T(w_{\text{blok\_size}}) \} \);

- Warp / N windows
  - Each warp loads 8 features for 4 windows. Each feature consists of 4 pixels. Total warp transactions: 8x4 of 16 bytes (instead of 32x4 of 4 bytes). Warp is active while at least one of window positions is active.
  - Balanced workload; spatial locality.

Results: Caltech [2], Pedestrians

<table>
<thead>
<tr>
<th>Sequence</th>
<th>thread / window (ms)</th>
<th>warp / window (ms)</th>
<th>warp / 4 windows (ms)</th>
<th>speedup w/w (X-factor)</th>
<th>speedup w/4w (X-factor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>seq06</td>
<td>169.13</td>
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