GPU Programming in Computer Vision

Preliminary Meeting

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What you will learn in the practical course

- Introduction to NVIDIA CUDA Framework
- Introduction to Parallel Computing on GPUs
- How to parallelise basic Computer Vision algorithms in CUDA/C++
- Practical project experience
- Team work, presentation skills

Important Dates

- Preliminary Meeting: 6. July 2015 (today)
- Registration for the matching system on TUMOnline: 10 - 15. July 2015
  - List your preferred practical courses
- Submitting Preferred Students: 16. - 20. July 2015 (by course organisers)
- Please specify if you have attended any computer vision or CUDA course before !
- Matching Results: 23. July 2015
- Only assigned students are allowed to attend !!!

Course Organisation

- 4-5 weeks Block Course (March 2016)
- 1 week lecture and exercise session
- 3 weeks project phase
- Our computer lab will be open for students
- Computers are equipped with very recent GPUs - GTX 750, one for each student.
- Students will work in groups: ideally 8 groups, each has 3 students.
- Every group will be assigned to one advisor.

Course Structure

- First Week
  - Theoretical lecture in the morning
  - Hands-on programming exercises in the afternoon
- Following 3-4 weeks
  - Project phase, one project to each group
    - Your own ideas,
    - Project Proposals, any related topic to Computer Vision, Image Processing, Machine Learning
- Final presentation of the projects

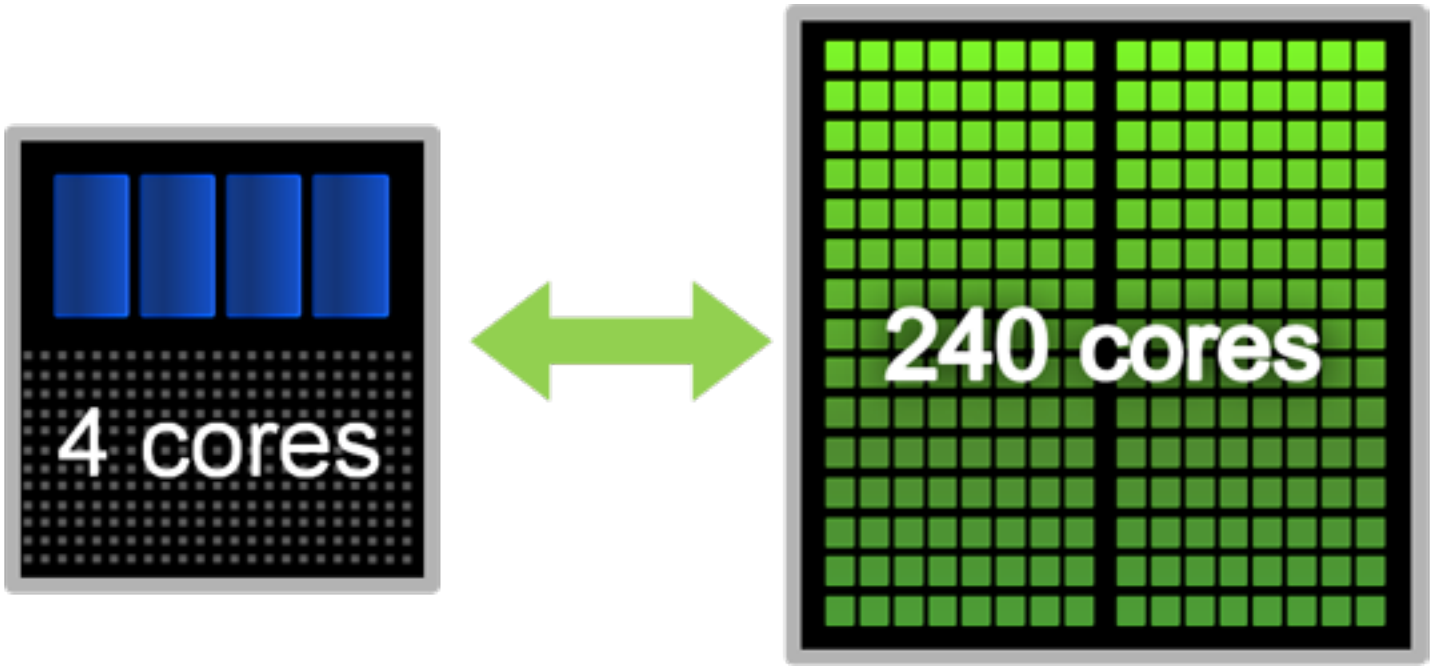
Evaluation Criteria

- Successful completion of the exercises
- Gained expertise in CUDA/parallel programming
- Quality of your final project
  - Successful completion of the project
    - Projects will be evaluated by the project advisors
  - Your talk

Regular Attendance Is Required

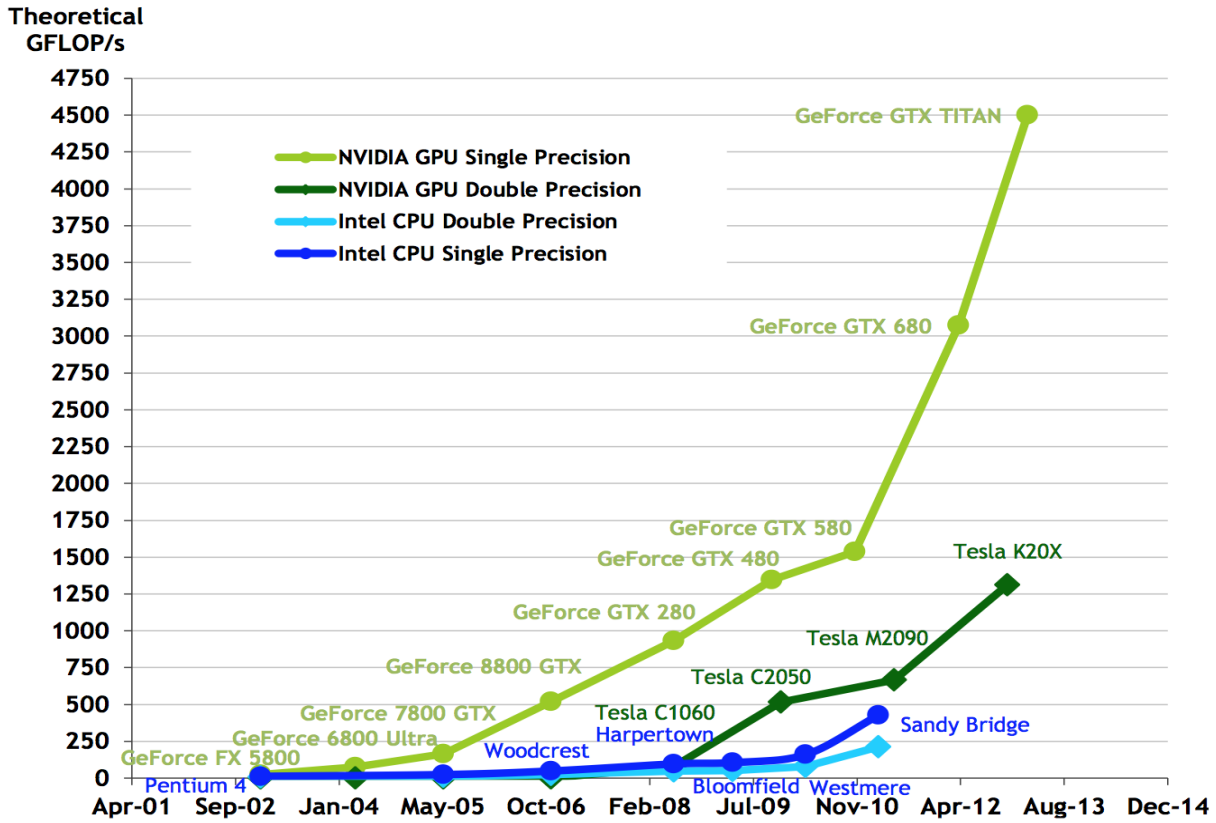
- Attendance at classes/exercises is mandatory
- In case of absence: Medical attest

Motivation on GPU programming



*http://static1.evermotion.org/files/tutorials_content/lechu/octane/001.png

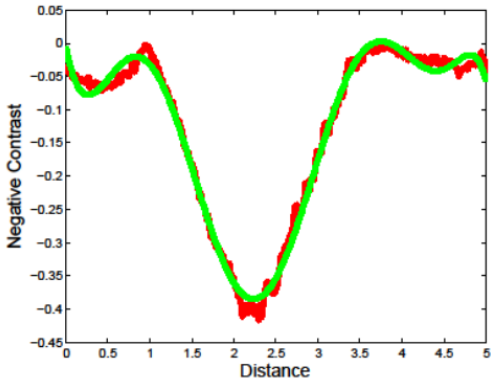
CPU vs GPU

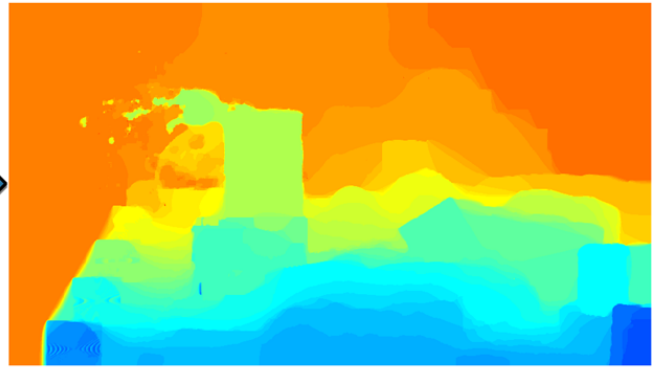

Theoretical GFLOP/s
4750
4500
4250
4000
3750
3500
3250
3000
2750
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
NVIDIA GPU Single Precision
NVIDIA GPU Double Precision
Intel CPU Double Precision
Intel CPU Single Precision
GeForce GTX TITAN
GeForce GTX 680
GeForce GTX 580
GeForce GTX 480
GeForce GTX 280
GeForce 8800 GTX
GeForce 7800 GTX
GeForce 6800 Ultra
GeForce FX 5800
Tesla K20X
Tesla M2090
Tesla C2050
Tesla C1060
Harpertown
Woodcrest
Pentium 4
Sandy Bridge
Bloomfield
Westmere
Apr-01
Sep-02
Jan-04
May-05
Oct-06
Feb-08
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14

Example: Shape Analysis

Example: Depth from Focus

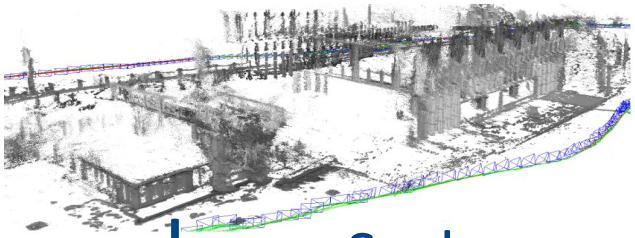
Reconstruct a depth map from differently focused images





Example: LSD-SLAM on GPU

Porting Large-Scale Direct Monocular SLAM to GPU



Large-Scale

Monocular

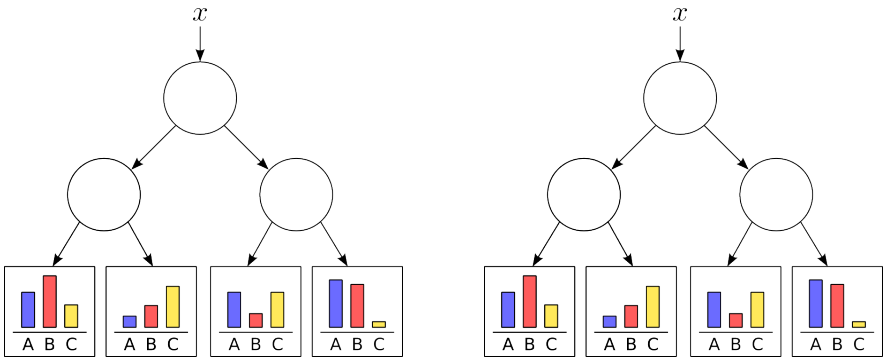
Direct

Project Proposal:
Port part of
LSD-SLAM to the GPU.

https://github.com/tum-vision/lsd_slam

Example: Random Forest on GPU

Implementation of Random Forest Classifier on GPU



ScaRF

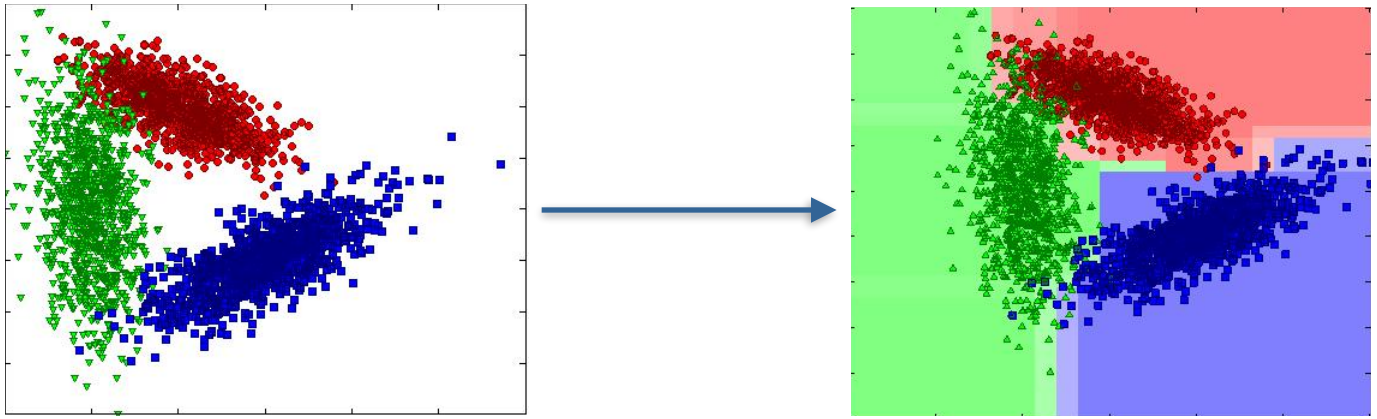
Main Page | Namespaces | Classes | Files

Class List | Class Index | Class Hierarchy | Class Members

Class List

Here are the classes, structs, unions and interfaces with bri

scarf	TreeTrainingUtils.cuh
CalculateFeature	Functor to transform the data
DataSet	Contains the information refer
TrainingSet	This class is designed to actua
ExtractLabel	
p	Functor to obtain the probabilit
RF	
RFConfig	Random Forest Configuration
Tree	Decision Tree



*https://github.com/alfonsoros88/ScaRF

Recent Works

- Dense Tracking and Mapping in Real-Time
  - https://www.youtube.com/watch?v=Df9WhgibCQA
- Kinect Fusion
  - http://msrvideo.vo.msecnd.net/rmcvideos/152815/152815.mp4

Not Assigned to the course ?

Don’t Worry ! Be Happy !

- Exciting IDP Projects
- Guided Research
- Master Thesis

Enjoy the practical course!