Undergraduate Research
ARG Initial meeting

JANUARY 26, 2011

STEFANI 229

10:30AM

NAYDA SANTIAGO

Purpose

ESTABLISH THE GUIDELINES FOR RESEARCH FOR THE FALL SEMESTER 2011.

DESCRIBE THE RESEARCH TOPICS AND DEADLINES FOR THE SEMESTER.

SET UP MEETING TIMES FOR SPRING 2011.

Agenda

- Introduction
  - People
  - Research topics
- Laboratory
- News
- Deadlines
- Workshops
- Groups

Introduction

- Please present yourself
  - Name
  - Where are you from
  - What are you studying
  - Year
  - Area of interest (if any).

Introduction

- Nayda Santiago
  - Aguada, Eladio Tirado Lopez (SU Guanabano), 1st class ever.
  - PhdEE MSU, MSEngEE Cornell, BSEE UPRM
  - Associate Professor
- Area of interest:
  - Parallel computing
  - High Performance Computing
  - GPUs
  - Low power software
  - FPGAs

Additional Qualifications

- Working in undergraduate research since 1990.
  - +150 undergraduate students supervised
  - Awards
    - 2008 Distinguished Professor of Electrical and Computer Engineering
    - 2008 Distinguished Computer Engineer CIAPR
    - 2008 HENAAC (Hispanic Engineer National Achievement Awards Conference) Education Award
    - 2009 Distinguished Alumni of the University of Puerto Rico, Mayaguez Campus
  - Member of the CIAPR, IEEE and the ACM
  - Founding member of the Computing Alliance for Hispanic Serving Institutions (CAHSI).
  - Committee member of the GPGPU-3 and GPGPU-4 conference.

Introduction

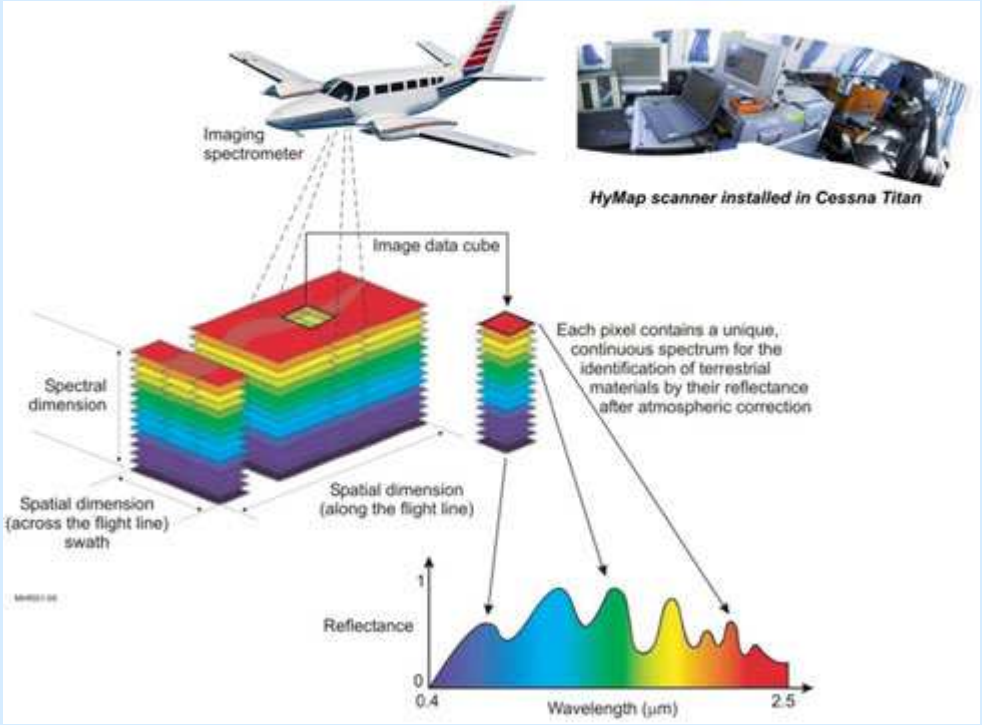
- Teaching/Research Philosophy
  - Everybody is equal
  - Fairness above all things
  - All students are able to learn and contribute
    - They just need to find their passion
  - Those who
    - Think they are better than others
    - Cannot work in groups
    - Lie /cheat
    - Are not responsible (be there when expected)
      - Are not welcome to work with me
  - “Continuous effort - not strength or intelligence - is the key to unlocking our potential.” - Liane Cordes
  - “Always make new mistakes” - Esther Dyson

Research Topics

- **High Performance Computing and Emerging Architectures**
  - Applications
    - Hyperspectral Imaging
    - Cancer detection
  - Emerging
    - GPUs
    - FPGAs
    - Cloud
- **High Performance Computing for Exascale processing**
  - Simmulated Annealing/ GA for circuit placement and routing.
  - Teragrid
- **Software Techniques for Low power consumption**

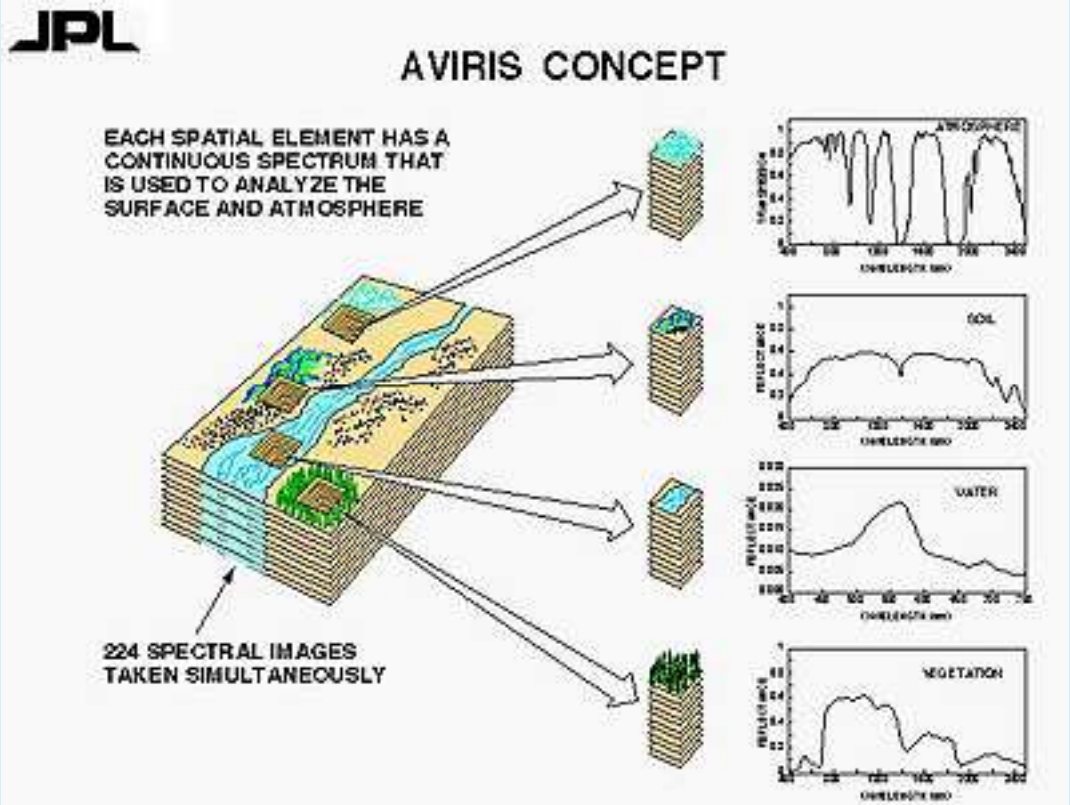
Hyperspectral Imaging

- Hyperspectral Images



http://www.csiro.au/news/newsletters/0611_metals/story2.htm
And http://en.wikipedia.org/wiki/Hyperspectral_imaging

Hyperspectral Imaging



We can identify what is present in the image due to the spectral signature.
NOTICE
ONE PIXEL IS BIG!

http://rst.gsfc.nasa.gov/Intro/Part2_24.html

For Cancer?

- Hyperspectral sensors can scan a patient's body in search of pre-cancerous lesions or to provide spectral information through endoscopy procedures.
- Hyperspectral medical instruments
  - non-invasive diagnosis of cancer
  - assessment of wound conditions
- For the patient
  - diagnose the condition in a non-invasive manner

http://www.headwallphotonics.com/downloads/Hyperspectral_Biomedical_Imaging.pdf

Goal

- Develop a set of libraries on GPUs to speed up computing of common hyperspectral imaging algorithms.

Emerging architectures

- GPUs
  - Graphical Processing Units
    - NVIDIA
      - GeForce, Quadro, Tesla
      - Cuda
    - AMD
      - Radeon, Fire
      - OpenCl
- Field Programmable Gate Arrays (FPGAs)
- Cloud – Cloud computing

Has this been done?

- Yes, in many different areas.
- No, not for hyperspectral for cancer research.

What does it entail?

- Mathematics
  - Understand the mathematical structure of the algorithms.
  - Given a mathematical description, develop the pseudocode.
- Physics
  - The fundamental concepts of image formation.
  - Physics behind spectral analysis.

- Software
  - Program in Cuda, OpenCL, Python, C, scripting languages.
  - OS
  - Libraries
  - Software Engineering - Testing
- Hardware
  - Architecture
  - Cache coherence
  - Bottlenecks
- PERFORMANCE

HPC for Exascale processing

- Simmulated Annealing/ GA
  - Optimization algorithms
  - Circuit placement and routing.
- Teragrid
  - Free account on the Teragrid
  - For one semester.
- Goal
  - Find the optimal placement of macroblocks on a die for minimum power consumption.

Skillset

- Mathematical Background
- Circuit theory
- Electronics
- Programming
  - Parallel Programming
  - Sequential Programming
- Performance
  - Metrics

Software for Low power

- Dual-core PowerPC MPC8641D, 15-25Watts
- Core 2 Duo E4300, 65Watts
- Core 2 Extreme QX9775, 150Watts
- Core i3-560, 73Watts
- Core i5-680, 73Watts
- Core i7-970, 130Watts
- Celeron Dual-Core E3300, 65W
- Pentium M ULV 723, 5Watts
- AMD Athlon 1400C, 72.1 Watts

Software for Low power

- Techniques for low power consumption
  - Hardware
    - Frequency reduction
    - Turn off functional units
    - Voltage scaling
  - Sofware
    - Modify algorithms
    - Compiler

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OK

Laboratory

- Computing Research Laboratory (CRL)
  - Stefani 105A
  - Closed lab, only access to those authorized.
    - Fernando Vega
    - Lizdabel Morales
    - Amir Chinae
    - Miguel Figueroa
    - Nayda Santiago
  - Rules
    - Sign a document
  - Key?

News

- Trips
  - Sunday, Jan 30, 2011 to Feb 1
    - New Orleans
    - Computing Education 21
  - Thur, Feb 24 to Sun Feb 27
    - Los Angeles
    - Establishing Research Program
- Office
  - Move from Stefani to Sanchez Hidalgo
- Office Hours
  - Tue and Thu 2pm.

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OK

Deadlines

- XXVI Seminario Interuniversitario de Investigación en Ciencias Matemáticas (SIDIM)
  - When: Feb 25-26
  - Where: UPR Humacao
  - Deadline: Jan 28, 2011, abstract
- JTM/PRISM 2011
  - When: March 12
  - Where: Interamericana Bayamon
  - Deadline: Jan 31, abstract

Deadlines

- CAHSI Annual Meeting 2011
  - When: March 27-29
  - Where: San Juan, Caribe Hilton
  - Deadline: Feb 7, 2011, paper
- Others
  - REUs
    - All of you!
  - IAP?
    - April 6
  - Visit by Brent Seales, UKY, Visualization
    - Feb 24, 2011

CAHSI

- Focus Groups
- ARG
- Elsa Villa/ Heather Thiry
  - Interview
  - Survey
  - Evaluation

Workshops

- ARG
  - Affinity Research Group Model
  - Based on Research
    - How to build cooperative teams for research
  - Components
    - Workshops
      - Teach SKILLS!!!
      - Need to learn professional skills
- WHEN?

GROUPS

- Seniors
  - Well seasoned
- Juniors
  - Halfway through studies
- Sophomores
  - Second time around
- Freshman
  - New to research

Additional Comments

- Compare itineraries
- Information requested
  - Resume
  - Official transcript
  - Information (form)
  - Sign form to use CRL

Questions?

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