Computational Geometry
Scientific Data/Information Visualization
Computer Graphics
Statistics/Machine learning
Image Processing/Computer Vision
Spatial Databases: data modeling, indexing, query processing
Geographical Information System
GIS
Remote Sensing
Environmental Modeling
Social-Economic Modeling
Social Studies
Census/Taxation
Urban planning
Transportation
Air quality
Hydrology
Ecology
Air quality
Remote Sensing
GIS
Spatial Databases: data modeling, indexing, query processing
Big Geospatial Data Challenges

- **Event** Locations, trajectories and O-D data
  - E.g., Taxi trip records (GPS traces or O-D locations)
  - 0.5 million in NYC (medallion taxi cab only) and 1.2 million in Beijing per day
  - From O-D locations to trajectories to frequent patterns

- **Satellite**: e.g., from GOES to GOES-R (2015/2016) [$11B]
  - Spectral (3X)*spatial (4X)* temporal (5X)=60X
  - 2km*2km*5min*16bands \(\rightarrow\) (360*60)*(180*60)*(12*24)*16~ 1+ trillion pixels per day
  - Derived thematic data products (vector)
    - [http://www.goes-r.gov/products/baseline.html](http://www.goes-r.gov/products/baseline.html)
    - [http://www.goes-r.gov/products/option2.html](http://www.goes-r.gov/products/option2.html)

- **Species** distributions
  - E.g. 400+ million occurrence records (GBIF)
  - E.g. 717,057 polygons and 78,929,697 vertices for 4148 birds distribution data (NatureServe)
ASCI Red: 1997 First 1 Teraflops (sustained) system with 9298 Intel Pentium II Xeon processors (in 72 Cabinets)

<table>
<thead>
<tr>
<th>Location</th>
<th>Sandia National Laboratories, United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>850 kW</td>
</tr>
<tr>
<td>Operating system</td>
<td>Cougaar / Linux</td>
</tr>
<tr>
<td>Space</td>
<td>1,600 sq ft (150 m²)</td>
</tr>
<tr>
<td>Memory</td>
<td>1212 gigabytes</td>
</tr>
<tr>
<td>Speed</td>
<td>1.3 teraflops (peak)</td>
</tr>
<tr>
<td>Ranking</td>
<td>TOP500: 1, June 2000</td>
</tr>
</tbody>
</table>

- Feb. 2013
- 7.1 billion transistors (551mm²)
- 2,688 processors
- 4.5 TFLOPS SP and 1.3 TFLOPS DP
- Max bandwidth 288.4 GB/s
- PCI-E peripheral device
- 250 W (17.98 GFLOPS/W -SP)
- Suggested retail price: $999

What can we do today using a device that is more powerful than ASCI Red 16 years ago?
GeoTECI@CCNY

**HIGHEST-DB**
- High-performance GraphHics units based Engine for Spatial-Temporal data
- Spatial and Spatiotemporal indexing, query processing and optimization

**Trajectory** data management on GPUs
- Segmentation/simplification/compression/Aggregation/Warehousing
- Map matching with road networks
- Data mining (moving cluster, convoy, swarm...)

... when yellow cabs, green cabs and MTA buses meet with multi-core CPUs, GPUs and MICs in NYC...
... when GOES-R satellites, extratropical cyclones and hummingbirds meet with TITAN ...
...building a highly-configurable experimental computing environment for innovative BigData technologies...