

# James Abello

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## Education

- Computer Science President's Post Doctoral Fellow - University of California, Santa Barbara.
- Ph.D. University of California, San Diego.  
Specialization in Combinatorial Algorithms,  
Supervised by Professor Stanley Gill Williamson.
- M.S. University of California, Santa Barbara.  
Specialization in Operating Systems,  
Supervised by Professor John Bruno.

## Research Areas

- Current areas of research center around External Memory Algorithms and Visualization of Massive Data Sets. Typical examples include **The Web**, **Query co-occurrence**, **Internet**, **Wireless Call Detail** and **Epidemiological data**.
- Previous research focus included Computational Geometry, Combinatorics and Complexity, Algorithm Animation and some applications in Petroleum Engineering and Biology.

## Professional Experience

- **Industrial**
  - Senior Research Scientist, Ask.com, 2004 – 2007.
  - Senior Member of Technical Staff, AT&T Labs, and Bell Labs, 1995 - 2002.
- **Academic**
  - DIMACS, Rutgers University: Research Associate, 2002-present.
  - Computer Science Department, Texas A&M University  
Research Associate Professor, 1994-1995;  
Director of the Laboratory for Algorithms Design, 1990-1994;  
Assistant Professor, 1988-1993;  
Supervised 1 Ph.D. Dissertation and 7 Master Theses.
  - Computer Science and Mathematics Departments - University of California, Santa Barbara and San Diego: Visiting Professor and Lecturer, 1986-1987.
- **Administrative**
  - Organizer of [DyDAn Seminar series](#), 2007.
  - Organizer of DIMACS [Computational and Mathematics Epidemiology Seminar series](#), 2006-2007.

- Program Co-Chair (with G. Cormode) of DIMACS [Tutorial on Data Mining and Epidemiology](#), March 23-24, 2006.
- Program Chair of the First Workshop on [Data Mining and Epidemiology](#), March 18-19, 2004.
- Program Chair of the First AT&T Visualization Days, May 30, 2001.
- Program Co-Chair (with J. Vitter) of the First DIMACS Workshop on [External Memory Algorithms and Visualization](#), May 20-22, 1998.
- Co-Editor of the Massive Computing Series, Kluwer Academic Publishers, 1998-present.
- Associate Managing Editor of the Journal on Computing and Information, Canada, 1994-1998.
- Founder and Director of the Laboratory for Algorithms Design, Texas A&M University, 1990-1994.

## Software

- *An External Memory Algorithms Platform* (on going project). The goal is to provide the basis for a system to "mine" dynamic weighted graphs with several billion edges. Three of its major components are: *Graph-Zoom*, *MGV*, and a *Quasi-Clique Extractor*. Each of these components is described briefly next.
  - *Graph-Zoom*. A Unix/Windows prototype to navigate large graphs. It is based on a hierarchy of spanning trees. It incorporates a rectangular Fish-Eye view technique to provide focus within context. It uses our own circular layout of graph hierarchies(in cooperation with J. Korn and M. Kreuzeler).
  - [MGV](#). Uses semi-external memory algorithms to build hierarchical partitions of weighted multi-digraphs. These partitions are mapped to the screen. They provide a virtual geography for the input stream. This virtual geography is used to guide the exploration of the data set. MGV follows the client-server paradigm and it is implemented in C and Java 3D. (In cooperation with J. Korn. [US patent 6781599](#)).
  - *Quasi-Clique Extractor*. Extracts subgraphs with density above certain pre-specified threshold (quasi-cliques) and uses these subgraphs as seeds to partition the vertex set(in cooperation with S. Sudarsky). The extractor is implemented in C. Some of this work has been cited in popular writings like: American Scientist ([Sept-Oct 2006](#), Jan-Feb 2000) and [Siam News \(1999\)](#).
- *X-AGE*: An Animated Graph Environment. This is an interactive system for algorithms teaching and research; Texas A&M University, 1991-1994;
- *SEDS*: A Simple Experimental Distributed System. It provides a single machine, multiple user environment for an experimental distributed function-base; Computer Science Department and Center for Robotics Systems, University of California, Santa Barbara, CA, 1987;
- A Template to Implement Mathematical Software following the Interpretive Frame Approach; Mathematics Department, University of California, San Diego, 1984.

## Books

- J. Abello, G. Cormode (eds.), [Discrete Methods in Epidemiology](#), Vol. 70 of DIMACS, AMS, May 2006.
- J. Abello, P. Pardalos, M. Resende (eds.), [Handbook of Massive Data Sets](#), Vol. 3 of the Kluwer Series on Massive Computing, 2002.
- J. Abello, J. Vitter (eds.), [External Memory Algorithms](#), Vol. 50 of the AMS-DIMACS Series in Discrete Mathematics and Theoretical Computer Science, 1999

## Patents

- J. Abello and J. Korn, “System and Method for Visualizing massive Multi-diagraphs”, [US patent 6781599](#)

## Honors and Awards

- *DIMACS Permanent Member*, Rutgers University, 1995;
- *First Prize Paper/Poster Award(with M. Veach)*, ACM National Conference, Phoenix, AZ, March 1994;
- Fellow of the Institute of Combinatorics and its Applications, 1993;
- *SIAM Young Investigator Award*, ICIAM, Paris, 1988;
- Post Doctoral Visitor: IMA(University of Minnesota) and MSRI(University of California, Berkeley), 1987;
- *University of California President's Post-Doctoral Fellow*, 1986-1987;
- General Dynamics Scholarship, University of California, San Diego, 1984;
- *Outstanding Teaching Award*, University of California, Santa Barbara, 1983.

## Invited Lectures

- Massive Graph Mining. Computer Science department, University of Montpellier, France and the University of Rostock, Germany, 2006. IPAM, Graduate Summer School: Intelligent Extraction of Information from Graphs and High Dimensional Data, UCLA, July 2005.
- The Majority Rule and Combinatorial Geometry (via the Symmetric Group), Annales du Lamsade, Paris, 2004.
- Workshop on Algorithms and Models for the Web-Graph, **FOCS** (Vancouver, Canada, November 2002) and Virtual Worlds and Simulation Conference, (San Antonio, TX, January 2002).
- [Massive Multi-Digraphs](#). Plenary Speaker at the Australian Conference in Optimization and Industry (Great Keppel Island, July 2001) and at the Ukranian Academy of Sciences (Kiev, June 2000). Variations on the same subject constituted computer science colloquium talks at the University of Sidney(Australia, July 2001), University of California(Santa Barbara, October 2001), University of Arizona(Tucson, October 2001), University of Rostock(Germany, May 2002), Center for Communications Research(Princeton, June 2002), DIMACS Connect Institute(Piscataway, July 2002) and the CUNY Graduate Center(New York, Sept 2002).

## Research Funding

- **DHS**
  - Leader of the Universal Information Graphs Project, Dynamic Data Analysis Center of Excellence, Rutgers University, 2007.
- **NSF**
  - Data Structures for Giga-Visualization(with A. Efrat and S. Kobourov), \$240,000, 2002-2004;
  - Hashing for Massively Parallel Computation(with A. Chin), \$31,804, 1994;
  - Combinatorial Aspects of Point Visibility, \$32,358, 1993;
  - Complexity of Restricted Independence Systems(with O. Egecioglu), \$80,222, 1989;
- **USDA**
  - A Decision Making System for Prioritization in Salmonella Control, \$30,000, 1994;
- **EDUCATIONAL GRANTS**
  - An Honors Upper Division Sequence in Computer Science, Texas A&M University;
  - Instructional Development Grants, UCSB and UCSD, 1984 and 1985;

## Professional Memberships

ACM, AMS, EACTS, ICA, IEEE, MAA, SIAM.

## Selected Publications

- **In Progress**

[AD07] J. Abello and R. Dementiev, "*Semi-External Induced Subgraphs*", to be submitted to Symposium on Discrete Algorithms, SODA, 2007.

[AG07] J. Abello, B. Gaudin, H. Schulz and C. Tominski, "*Name That Cluster*", Submitted to IEEE Information Visualization Symposium, Sacramento, CA, October 2007.

[AC07] J. Abello and M. Capalbo, "*Finding Max Cliques in Power Law Graphs with high Clustering Coefficients*", Submitted to Internet Mathematics.

- **Massive Data Sets**

[ACF06] J. Abello, G. Cormode, D. Fradkin, D. Madigan, O. Melnik and I. Muchnik, "*Selected Data Mining Concepts, In Discrete Methods in Epidemiology*", vol. 70 of the AMS-DIMACS Series, Co-edited by J. Abello and G. Cormode, pp 1- 40, 2006.

[AP06] J. Abello and A. Pogel, "*Graph Partitions and Concept Lattices*", In Discrete Methods in Epidemiology, vol. 70 of the AMS-DIMACS Series, Co-edited by J. Abello and G. Cormode, pp 115 - 138, 2006.

[AC06] J. Abello and M. Capalbo, "*Random Graphs (and the Spread of Infections in a Social Network)*", In Discrete Methods in Epidemiology, Vol. 70 of the AMS-DIMACS Series, Co-edited by J. Abello and G. Cormode, pp 115 - 138, 2006.

[AH04] J. Abello and Frank van Ham, "[Matrix Zoom: A Visual Interface to Semi-External Graphs](#)", IEEE InfoVis Proceedings, pp 183 – 190, 2004.

[A04A] J. Abello, "[Hierarchical Graph Maps](#)", *Computers & Graphics* 28(3): 345-359 (2004).

[AP04] J. Abello, Alex J. Pogel, Lance Miller, "[Breadth First Search Graph Partitions and Concept Lattices](#)", *J. UCS* 10(8): 934 -954 (2004).

[AK03] J. Abello, Yannis Kotidis, "[Hierarchical Graph Indexing](#)", *CIKM* 2003: 453-460.

[AB02] J. Abello, Adam L. Buchsbaum, Jeffery Westbrook, "[A Functional Approach to External Graph Algorithms](#)", *Algorithmica* 32(3): 437-458 (2002).

[AK02] J. Abello, J. Korn, "[MGV: A System for Visualizing Massive Multidigraphs](#)", *IEEE Transactions on Visualization and Computer Graphics*, Vol. 8, No 1, January-March 2002.

[SA02] J. F. Sibeyn, J. Abello, U. Meyer, "[Heuristics for Semi-External Depth First Search on Directed Graphs](#)", *ACM Symposium on Parallel Algorithms and Architectures*, *SPAA 2002*: 282-292.

[AR02] J. Abello, M. Resende, and S. Sudarsky, "[Massive Quasi-Clique Detection](#)" In *Proceedings of Latinoamerican Informatics*, May 2002, Springer Verlag LNCS.

[AP99] J. Abello, P. Pardalos, M. Resende, "[On Very Large Maximum Clique Problems](#)", in *External Memory Algorithms*, (J. Abello and J. Vitter, Editors), *AMS-DIMACS Series in Discrete Mathematics and Theoretical Computer Science*, Vol. 50, pp 119-130, 1999.

- **Visualization**

[AH06] J. Abello, F. van Ham, and N. Krishnan, "[Ask-GraphView-: A Large Scale Graph Visualization System](#)", *IEEE Transactions in Visualization and Computer Graphics*, 12(5): 669-676 (2006)

[TA06] C. Tominski, J. Abello, F. van Ham, and H. Schumann, "[Fisheye Tree Views and Lenses for Graph Visualization](#)", In *Proceedings of the Conference on Information Visualization, IV 2006*, London, July 05 – 07, pp 17-25, 2006.

[AK04] J. Abello, S. Kobourov, R. Yusufov, "Visualizing Large Graphs with Compound Fish Eye Views and Treemaps", *Graph Drawing*, 2004:431-441.

[TA04] C. Tominski, James Abello and Heidrun Schumann: "[Axes-based visualizations with radial layouts](#)", *Proceedings of the 19<sup>th</sup> ACM Symposium on applied computing*, Nicosia, Cyprus, March 14-17, *SAC 2004*: 1242-1247.

[AS03] J. Abello, H. Schumann, C. Tominski, "[Axes Based Visualizations for Time Series Data](#)", in *IEEE InfoVis Poster Proceedings*, Seattle, October 19-24, 2003

[AKK02] J. Abello, J. Korn, and M. Kreuzler, "[Navigating Giga-Graphs](#)", In *ACM Proceedings of Advanced Visualization Interfaces (AVI)*, pp 290-299, Trento, Italy, 2002.

[AF01] J. Abello, I. Finocchi, and J. Korn, "[Graph Sketches](#)", In *IEEE InfoVis Proceedings*, pp 67-71, San Diego, Ca, October 2001.

[AK00] J. Abello, J. Korn, "[Visualizing Massive Multi-Digraphs](#)", In *IEEE InfoVis Proceedings*, pp 39-48, Salk Lake City, Utah, October 2000.

[AK99] J. Abello, S. Krishnan, "[Navigating Graph Surfaces](#)", 4th Intl. Congress on Industrial and Applied Mathematics (ICIAM), Edinburg, July 1999; *Approximation and Complexity in Numerical Optimization: Continuous and Discrete Problems*, (P. M. Pardalos, editor), Kluwer Academic Publishers, pp. 1-12, 1999.

[AKG99] J. Abello, E. Koutsofios, E. Gansner and S. North, "[Large-Scale Network Visualization](#)", Computer Graphics, SIGGRAPH Newsletter, Vol. 33, Number 3, August 1999, pp. 13-15.

[AS94] J. Abello, C. Smith, "[An Interpreted Algorithm Animation System](#)", Journal on Computing and Information, pp 1569-1588, 1994.

[ASV94] J. Abello, S. Sudarsky, T. Veatch, J. Waller, "AGE: An Animated Graph Environment" , in AMS-DIMACS series in Discrete Mathematics and Theoretical Computer Science, N. Dean and G. Shannon (Eds.), vol. 15, pp 57-69, 1994.

- **Discrete and Computational geometry**

[AK02] J. Abello, K. Kumar, "[Visibility Graphs and Oriented Matroids](#)", Discrete and Computational Geometry, vol. 28, pp. 449-465, 2002.

[AC98] J. Abello, V. E. Castro, T. Shermer, J. Urrutia, "*Illumination of Orthogonal Polygons with Orthogonal Floodlights*", International Journal on Computational Geometry and Applications, vol. 8, No 1, pp 25-38, 1998.

[AG98] J. Abello, E. Gansner, "*Short and Smooth Polygonal Paths*", LNCS vol. 1380, pp 151-162, 1998.

[AE95] J. Abello, O. Egecioglu, K. Kumar, "*Visibility Graphs of Staircase Polygons and the Weak Bruhat Order I: From Visibility Graphs to Maximal Chains*" , Discrete and Computational Geometry, Vol. 14, No 3, 1995, pp 331-358.

[AK95] J. Abello, K. Kumar, "*Visibility Graphs of 2-Spiral Polygons*", LNCS vol. 911, pp.1-15, 1995.

[AE93] J. Abello, O. Egecioglu, "*Visibility Graphs of Staircase Polygons with Uniform Step Length*", Intl. Journal of Computational Geometry and Applications, Vol. 3, No.1, 1993, pp. 27-37.

[AH92] J. Abello, L. Hua, and S. Pisupati, "*On Visibility Graphs of Simple Polygons*", Congressus Numerantium, Vol. 90, pp. 119-128, 1992.

- **Combinatorics, Algorithms and Complexity**

[A04B] J. Abello, "[The Majority Rule and Combinatorial Geometry \(via the Symmetric Group\)](#)", Annales Du Lamsade, No. 3, pp 1- 13, October 2004.

[AB01] J. Abello, S. Butenko, P. Pardalos, and M. Resende, "[Finding Independent Sets in a Graph Using Continuous Multivariable Polynomial Formulations](#)" , Journal of Global Optimization, Vol. 21, pp. 111-137, 2001.

[AD97] J. Abello, S. Dolev, "[On the Computational Power of Self-Stabilizing Systems](#)", Theoretical Computer Science, Vol. 182, No 1-2, pp. 159-170, August 1997.

[AK95] J. Abello and K. Kumar, "*On the Complexity of some Synthetic Problems in Computational Geometry*", J. Computing and Information, pp. 92-110, 1995.

[SA95] J. Shawe-Taylor, C. Domingo, H. Bodlaender, J. Abello, "[Learning Minor Closed Graph with Membership and Equivalence Queries](#)", NeuroCOLT TRS, NC-TR-94-014, Jan 1995.

[JK94] J. Abello, V. Kreinovich, H.T. Nguyen, S. Sudarsky, J. Yen, " *Computing an Appropriate Control Strategy Based Only on a Given Plant's Rule-Based Model can be Hard. (NP-Hard)*", Proceedings of NAFIPS/IFIS/NASA 1994, pp. 331-332, San Antonio, December 18-21, 1994.

[AH93] J. Abello, A. Hoang, and J. Russell, "[A Hierarchy of Pattern Recognition Algorithms for the Diagnosis of Sucker Rod Pumped Wells](#)", J. Computing and Information, pp. 359-364, IEEE, Ontario, May 1993.

[AK93] J. Abello, K. Kumar, and O. Egecioglu, "[A Combinatorial View of Visibility Graphs of Polygons](#)", IEEE Proceedings of International Conference on Computing and Information, 1993, pp. 87-92.

[AH92] J. Abello, L. Hua, and M. Lu, "*An Efficient Parallel Algorithm for the Longest Common Subsequence Problem*", LNCS, Springer Verlag, Vol. 4, 1992, pp. 123-130.

[JA91] J. Abello, "[The Weak Bruhat Order, Consistent Sets and Catalan Numbers](#)", SIAM Journal on Discrete Mathematics, 4(1), pp 1-16, February 1991.

[AF91] J. Abello, M. Fellows, J. Stillwell, "*On the Complexity and Combinatorics of Covering Finite Complexes*", Australasian Journal of Combinatorics, Vol. 4, 1991.

[JA86] J. Abello, "*Algorithms for Consistent Sets*", Congressus Numerantium, Vol. 53, pp. 23-38, 1986.

[JA85] J. Abello, "*Intrinsic Limitations of the Majority Rule, an Algorithmic Approach*", SIAM J. Alg. Disc. Meth., 6(1), pp 133-144, January 1985.

[AJ84] J. Abello, C. Johnson, "*How Large are Transitive Simple Majority Domains*", SIAM J. Alg. Disc. Meth., 5(4), pp 603-618, 1984.

- **Under Review**

[AF] J. Abello and P. Fishburn, "*Real vs. Rational Visibility*".

[AC] J. Abello and J. Chen, "*Some Results on Graph Emulation*".

## **Grant Reports**

J. Abello, "*Decision Tools for Salmonella Control*", Report to the USDA, TR 94-007, CS Dept, Texas A&M University, 1994.

J. Abello and O. Egecioglu, "*Complexity of Algorithms for Some Restricted Independence Systems*", Capital City Conference on Combinatorics and Complexity, Washington DC, July 1989, and Eleventh British Combinatorial Conference, London, July 1987.

## **Theses**

J. Abello, "*A Study of an Independence System Arising in Group Choice via the Weak Bruhat Order*", Ph.D. Thesis, University of California, San Diego, 1985.

J. Abello, "*Computability, Logic and Limitations of the Formal Systems*", MS Thesis, University of Puerto Rico, Mayaguez, PR, 1979.

## Research Statement

A possible way to describe the current stage of my career is that of an experimental computer scientist with a solid theoretical foundation. This is the result of being fascinated by the fundamental questions that have been arising from the exploration of *very large data sets*, (for us a data set is very large if it does not fit on the available *RAM*).

A variety of massive data sets exhibit an underlying structure that can be modeled as dynamic weighted multi-digraphs with a collection of edge dependent attributes that are application dependent, (Web, Internet data and Telecommunications traffic are prime examples).

When a multi-digraph does not fit in *RAM* many of the classical algorithms break down. Operations that we usually take for granted, like graph traversing, get wretched when they are faced with the I/O bottleneck. Even though cluster of PC's or enough Parallel I/O are currently used to alleviate this problem, the truth of the matter is that these are just temporal solutions. Behind the scenes, there are fundamental computational questions that are reminiscent of the challenges faced by early computing pioneers. From my view point, sequential media is outgrowing random access storage at a speed and cost that makes imperative to approach the problem of massive data sets as a massive distributed network computing problem instead of using variations of Von\_Newmann architectures that are handicapped by their inherent bottlenecks. This is succinctly an area of research where I would like to concentrate my efforts in the near future.

The motivation for my current research direction, is the result of 5 years of experience in developing and implementing techniques to process, navigate, analyze and visualize multi-digraphs, arising in the telecommunications industry, with sizes ranging from million to several billion edges (please see our contributions to this area in the publication summary). One of the clear messages we have learned is that *RAM* and processor investments alone are not able to keep up with the data generation ability of the computing and communication devices that are becoming so common in our daily endeavors.

- **Data Streams**

In light of the previous discussion, one of my research interests revolves around algorithms and architectures that operate on sets of data streams each of which is accessible only through a small random access window. These architectures shall be flexible enough to be able to incorporate in their processor network special agents that interact with the external world on a semi-continuous fashion. Some of the technological tools necessary for this undertaking include mobile Internet-able devices, a fast local interconnection network, a PC cluster, a basic visualization platform, I/O libraries, languages and system performance tools and web server technology. The theoretical tools with potential applicability are rooted in circuit and communication complexity, random graph theory, combinatorics, game theory, optimization, distributed and succinct data structures, probability, statistics, algebraic topology and dynamical systems. This type of research calls for a highly interdisciplinary team and a large portion of the necessary hardware and software readily available.

- **Visual Metaphors**

A second major topic of my research emphasis consists on the creation of computational efficient visual metaphors for the representation, navigation and analysis of very large data sets. The rationale is that these metaphors shall be useful not only for the experimentation stages of the first major research topic described above but they shall also become useful for traffic analysis of data associated with the organization where this research will be undertaken. In this regard, I delivered an invited talk at the Virtual Worlds and Simulation conference, held in San Antonio, TX, on January 28-30, 2002. The purpose was to explore the potential use of some of our *graph mining algorithms* for the detection of suspicious international networks. This is part of a new research effort titled: "*New Mathematical Weaponry for Combating "Netwar"*".

- **Applied Computational Geometry**

I will continue my investigations on Geometry especially on problems relevant to visualization and computer graphics. These include visibility representations of graphs and posets and interactive rendering of polygonal terrains and volumetric data sets arising in medicine.

## Teaching Statement

I have been the recipient of several teaching awards at different levels in the educational system. During my undergraduate studies in Mathematics and Physics, I pursued a specialization in Pedagogy.

Arguably, the fast pace of technological and economical developments are causing an erosion on the foundation of several scientific disciplines. Computer Science is not immune to this trend. In this regard, besides providing the necessary tools to devise machines and software artifacts that "compute" efficiently, it needs to develop educational programs with built in mechanisms that promote interdisciplinary cross fertilization. Such a task, I believe, can be better performed with the backing of a solid theoretical foundation. Our era offers a golden opportunity for Computer Science, Mathematics, Physics, Engineering, Biology and the Social Sciences to nurture each other in a positive way. In concrete terms, *Computer Science teaching can be driven by a hierarchy of interdisciplinary computational challenges that students complete during their education.* In the next paragraph, I describe an example of such an approach.

With funds provided by two educational grants, I founded and directed a Laboratory for Algorithms Design. One of its central objectives was to develop educational software to support some classes in the undergraduate curriculum. Unix tools were developed to enhance some fundamental notions that included Turing Machines, Graph Algorithms, the Symmetric Group, Concurrency control and a host of Local Heuristics. A central project in this regard was a client-server system named "AGE: An Animated Graph Environment". It provided the basis of an interactive system for algorithms teaching and student research. In total 43 applications were based on this system, (more details can be found on publication [8] of the Visualization and Distributed Computing section). It is worth to point out that all these applications were developed by students that were using

AGE as a supporting tool for their classes. This illustrates a possible direction to provide technological training with a solid theoretical backing.

In closing, the knowledge that a teacher shares with his/her students must be structured conceptually; its delivery shall be fun, amusing and entertaining, and its computational experimentation needs to be sound and rigorous.

## Courses Taught

James Abello has taught Computer Programming, Software Fabrication, Operating Systems, Scientific Computing, Discrete Mathematics, Data Structures, Analysis of Algorithms (Sequential and Parallel), Formal Languages, Computability, Complexity Theory, Combinatorial Optimization, Operations Research, Calculus, Linear Algebra, and Numerical Analysis, both at the undergraduate and graduate levels. New courses on Java, Web Based Computing and Information Visualization are his current teaching interests.

## Student Research Advising

- **Ph.D. External Reviewer**

Christian Tominski, “*Event-Based Visualization for User-Centered Visual Analysis*”, PhD thesis, University of Rostock, Germany, 2006.

Frank van Ham, “*Interactive Visualization of Large State Spaces*”, PhD thesis, ISBN 90-386-0704-0, Technische Universiteit Eindhoven, 2005.

- **Ph.D. Students Supervised**

Krishna Kumar, “*Combinatorial Aspects of Point Visibility*”, Computer Science Department, Texas A&M University, August 1993.

- **M.S. Students Supervised**

Timothy Veach, “*An Animated Graph Environment*”, Computer Science Department, Texas A&M University, September 1990.

Sanjay Joshi, “*Some Algorithmic Results in Graph Imbeddings*”, Computer Science Department, Texas A&M University, December 1990 (Co-Chairman).

Ronald Chambers, “*Heuristics for the Traveling Salesman Problem*”, Computer Science Department, Texas A&M University, December 1991.

Sekhar Pisupati, “*Polynomial Algorithms for Visibility Graphs of Staircase Polygons*”, Computer Science Department, Texas A&M University, December 1991.

Chris Roda, “*An Animated Interface to the AGE System*”, Computer Science Department, Texas A&M University, August 1992.

Anne Hwang, “*Pattern Matching for the Evaluation of Sucker-Rod Pumped Wells*”, Petroleum Engineering Department, Texas A&M University, September 1992 (Co-Chairman).

Don Sonom, “*Visualization of Heuristics for Some NP-Complete Problems*”, Computer Science Department, Texas A&M University, December 1993.

Craig Smith, “*A Graphics-based Language for Algorithm Animation*”, Computer Science Department, Texas A&M University, May 1994.

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*Note: James Abello is a US Citizen and his full vitae is available upon request*