Modeling Forum

Results of the 1998 Mathematical Contest in Modeling

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Introduction

A total of 472 teams of undergraduates, from 246 institutions from 8 countries, spent the second weekend in February working on applied mathematics problems. They were part of the twelfth Mathematical Contest in Modeling (MCM). On Friday morning, the MCM faculty advisor opened a packet and presented each team of three students with a choice of one of two problems. After a weekend of hard work, typed solution papers were mailed to COMAP on Monday. Nine of the top papers appear in this issue of *The UMAP Journal*.

Results and winning papers from the first thirteen contests were published in special issues of *Mathematical Modeling* (1985–1987) and *The UMAP Journal* (1985–1997). The 1994 volume of *Tools for Teaching*, commemorating the tenth anniversary of the contest, contains all of the 20 problems used in the first ten years of the contest and a winning paper for each. Limited quantities of that volume and of the special MCM issues of the *Journal* for the last few years are available from COMAP.

Problem A: The Scanner Problem

Introduction

Industrial and medical diagnostic machines known as Magnetic Resonance Imagers (MRI) scan a three-dimensional object, such as a brain, and deliver

The UMAP Journal 19 (3) (1998) 189–210.

their results in the form of a three-dimensional array of pixels. Each pixel consists of one number, indicating a color or a shade of gray that encodes a measure of water concentration in a small region of the scanned object at the location of the pixel. For instance, 0 can picture high water concentration in black (ventricles, blood vessels), 128 can picture a medium water concentration in gray (brain nuclei and gray matter), and 255 can picture a low water density in white (lipid-rich white matter consisting of myelinated axons). Such MRI scanners also include facilities to picture on a screen any horizontal or vertical slice through the three-dimensional array (slices are parallel to any of the three Cartesian coordinate axes).

Algorithms for picturing slices through oblique planes, however, are proprietary. Current algorithms

- are limited in terms of the angles and parameter options available,
- are implemented only on heavily used dedicated workstations,
- lack input capabilities for marking points in the picture before slicing, and
- tend to blur and "feather out" sharp boundaries between the original pixels.

A more faithful, flexible algorithm implemented on a personal computer would be useful

- for planning minimally invasive treatments;
- for calibrating the MRI machines;
- for investigating structures oriented obliquely in space, such as post-mortem tissue sections in animal research;
- for enabling cross sections at any angle through a brain atlas consisting of black-and-white line drawings.

To design such an algorithm, one can access the values and locations of the pixels but not the initial data gathered by the scanner.

Problem

Design and test an algorithm that produces sections of three-dimensional arrays by planes in any orientation in space, preserving the original gray-scale values as closely as possible.

Data Sets

The typical data set consists of a three-dimensional array A of numbers $A(i, j, k)$, where $A(i, j, k)$ is the density of the object at the location $(x, y, z)_{i,j,k}$. Typically, $A(i, j, k)$ can range from 0 through 255. In most applications, the data

set is quite large. Teams should design data sets to test and demonstrate their algorithms. The data sets should reflect conditions likely to be of diagnostic interest. Teams should also characterize data sets that limit the effectiveness of their algorithms.

Summary

The algorithm must produce a picture of the slice of the three-dimensional array by a plane in space. The plane can have any orientation and any location in space. (The plane can miss some or all data points.) The result of the algorithm should be a model of the density of the scanned object over the selected plane.

Problem B: The Grade Inflation Problem

Background

Some college administrators are concerned about the grading at A Better Class (ABC) College. On average, the faculty at ABC have been giving out high grades (the average grade now given out is an A−), and it is impossible to distinguish between the good and the mediocre students. The terms of a very generous scholarship only allow the top 10% of the students to be funded, so a class ranking is required.

The dean had the thought of comparing each student to the other students in each class, and using this information to build up a ranking. For example, if a student obtains an A in a class in which all students obtain an A, then this student is only "average" in this class. On the other hand, if a student obtains the only A in a class, then that student is clearly "above average." Combining information from several classes might allow students to be placed in deciles (top 10%, next 10%, etc.) across the college.

Problem

Assuming that the grades given out are (A+, A, A−, B+, . . .), can the dean's idea be made to work?

Assuming that the grades given out are only (A, B, C, . . .), can the dean's idea be made to work?

Can any other schemes produce a desired ranking?

A concern is that the grade in a single class could change many students' deciles. Is this possible?

Data Sets

Teams should design data sets to test and demonstrate their algorithms. Teams should characterize data sets that limit the effectiveness of their algorithms.

The Results

The solution papers were coded at COMAP headquarters so that names and affiliations of the authors would be unknown to the judges. Each paper was then read preliminarily by two "triage" judges at Southern Connecticut State University (Problem A) or at Carroll College (Montana) (Problem B). At the triage stage, the summary and overall organization are the basis for judging a paper. If the judges' scores diverged for a paper, the judges conferred; if they still did not agree on a score, a third judge evaluated the paper.

Final judging took place at Harvey Mudd College, Claremont, California. The judges classified the papers as follows:

	Outstanding	Meritorious	Honorable Mention	Successful Participation	Total
Scanner	4	31	47	106	189
Grade Inflation	3	48	69	163	283
	7	79	116	269	472

The seven papers that the judges designated as Outstanding appear in this special issue of *The UMAP Journal*, together with commentaries. We list those teams and the Meritorious teams (and advisors) below; the list of all participating schools, advisors, and results is in the **Appendix**.

Outstanding Teams

Institution and Advisor **Team Members**

Scanner Papers

"A Method for Taking Cross Sections of Three-Dimensional Gridded Data"

Eastern Oregon University — Kelly Slater Cline
LaGrande, OR — Kacee Jay Giger
Norris Preyer — Timothy O'Conner

"A Model for Arbitrary Plane Imaging, or the Brain in Pain Falls Mainly on the Plane"
Harvey Mudd College — Jeff Miller, Dylan Helliwell, Michael Moody, Thaddeus Ladd

"A Tricubic Interpolation Algorithm for MRI Image Cross Sections"
Macalester College — Paul Cantrell, Nicholas Wenninger, Karla V. Ballman, Tamás Németh-Csőri

"MRI Slice Picturing"
Tsinghua University — Ni Jiang, Chen Jun, Ye Jun, Li Ling

Grade Inflation Papers

"Alternatives to the Grade Point Average for Ranking Students"
Duke University — Jeffrey A. Mermin, W. Garrett Mitchener, Greg Lawler, John A. Thacker

"A Case for Stricter Grading"
Harvey Mudd College — Aaron F. Archer, Andrew D. Hutchings, Michael Moody, Brian Johnson

"Grade Inflation: A Systematic Approach to Fair Achievement Indexing"
Stetson University — Amanda M. Richardson, Jeff P. Fay, Deland, FL, Erich Friedman, Matthew Galati

Meritorious Teams

Scanner Papers (31 teams)
California Polytechnic State Univ., San Luis Obispo, CA (two teams) (Thomas O'Neil)
East China Univ. of Science and Technology, Shanghai, China (Yuanhong Lu)
Fudan University, Shanghai, China (Xi Zhou)
Harvey Mudd College, Claremont, CA (Ran Libeskind-Hadas)
Lawrence Technological Univ., Southfield, MI (Ruth G. Favro)
Macalester College, St. Paul, MN (Susan Fox)

N.C. School of Science and Mathematics, Durham, NC (two teams) (Dot Doyle)
Nankai University, Tianjin, China (XingWei Zhou)
Nat'l. Univ. of Defence Technology, Changsha, HuNan, China (Cheng LiZhi)
Nat'l. Univ. of Defence Technology, Changsha, HuNan, China (Wu Yu)
Rose-Hulman Institute of Technology, Terre Haute, IN (Aaron D. Klebanoff)
Seattle Pacific University, Seattle, WA (Steven D. Johnson)
South China Univ. of Technology, Guangzhou, Guangdong, China (Xie Lejun)
Southeast University, JiangSu, Nanjing, China (Zhou Jian Hua)
Southeast University, JiangSu, Nanjing, China (Wu Hua Hui)
Tsinghua University, Beijing, China (Hu Zhiming)
University of Alaska Fairbanks, Fairbanks, AK (John P. Lambert)
University of Colorado–Boulder, Boulder, CO (Anne Dougherty)
University of Massachusetts–Lowell, Lowell, MA (Lou Rossi)
University of Missouri–Rolla, Rolla, MO (Michael G. Hilgers)
University of Puget Sound, Tacoma, WA (Robert A. Beezer)
Univ. of Science and Technology of China, Hefei, Anhui, China (Rong Zhang)
University College–Cork, Cork, Ireland (J.B. Twomey)
Western Washington University, Bellingham, WA (Sebastian Schreiber)
Worcester Polytechnic Inst., Worcester, MA (Bogdan Vernescu)
Xi'an Jiaotung University Xi'an, Shaanxi, China (He Xiaoliang)
Xi'an Jiaotong University, Xi'an, Shaanxi, China (Zhou Yicang)
XiDian University Xi'an, Shaanxi, China (Liu Hongwei)
Youngstown State University, Youngstown, OH (Thomas Smotzer)

Grade Inflation Papers (48 teams)
Benedictine College, Atchison, KS (Jo Ann Fellin, OSB)
Bucknell University, Lewisburg, PA (Sally Koutsoliotas)
Colby College, Waterville, ME (Jan Holly)
College of William and Mary, Williamsburg, VA (Larry Leemis)
Colorado College, Colorado Springs, CO (Barry A. Balof)
David Lipscomb Institute, Nashville, TN (Mark A. Miller)
E. China Univ. of Sci. and Tech., Shanghai, China (Xiwen Lu)
Eastern Mennonite University, Harrisonburg, VA (John Horst)
Grinnell College, Grinnell, IA (Marc Chamberland)
Gustavus Adolphus College, St. Peter, MN (Gary Hatfield)
Harvey Mudd College, Claremont, CA (Ran Libeskind-Hadas)
Humboldt State Univ., Arcata, CA (Roland Lamberson)
Johns Hopkins University, Batlimore, MD (Daniel Q. Naiman)
Lafayette College, Easton, PA (Thomas Hill)
Lawrence Technological Univ., Southfield, MI (Howard Whitston)
Loyola College–Maryland, Baltimore, MD (Timothy J. McNeese)
Messiah College, Grantham, PA (Douglas C. Phillippy)
Mt. St. Mary's College, Emmitsburg, MD (John August)
N.C. School of Science and Mathematics, Durham, NC (John Kolena)
Natl. Univ. of Defence Technology, Changsha, HuNan, China (Wu MengDa)
Nazareth College, Rochester, NY (Kelly M. Fuller)
Nebraska Wesleyan University, Lincoln, NE (P. Gavin LaRose)
Pomona College, Claremont, CA (Richard Elderkin)
Rose-Hulman Institute of Technology, Terre Haute, IN (Aaron D. Klebanoff)

Saint Mary's College, Notre Dame, IN (Joanne Snow)
Salisbury State University, Salisbury, MD (Steven M. Hetzler)
Shanghai Normal University, Shanghai, China (Shenghuan Guo)
Southeast University, JiangSu, Nanjing, China (Shen Yu Jiang)
Southern Connecticut State University, New Haven, CT (Ross B. Gingrich)
Trinity University, San Antonio, TX (Diane G. Saphire)
Tsinghua University, Beijing, China (Ye Jun)
Tsinghua University, Beijing, China (Hu Zhiming)
U.S. Military Academy, West Point, NY (Kellie Simon)
United States Air Force Academy, USAF Academy, CO (Harry N. Newton)
United States Air Force Academy, USAF Academy, CO (Mark Parker)
Univ. of Science and Technology of China, Hefei, Anhui, China (Yi Shi)
Univ. of Wisconsin–Stevens Point, Stevens Point, WI (Nathan Wetzel)
University of Alaska Fairbanks, Fairbanks, AK (John P. Lambert)
University of Dayton, Dayton, OH (J.M. O'Hare)
University of Puget Sound, Tacoma, WA (Perry Fizzano)
University of Toronto, Toronto, Ontario, Canada (James G.C. Templeton)
Valparaiso University, Valparaiso, IN (Rick Gillman)
Wake Forest University, Winston-Salem, NC (Edward Allen)
Western Carolina University, Cullowhee, NC (Jeff A. Graham)
Western Carolina University, Cullowhee, NC (Scott Sportsman)
Western Connecticut State Univ., Danbury, CT (Judith A. Grandahl)
Worcester Polytechnic Inst., Worcester, MA (Arthur C. Heinricher)
Xidian University, Xi'an, Shaanxi, China (Mao Yongcai)
Youngstown State University, Youngstown, OH (Paul Mullins)

Awards and Contributions

Each participating MCM advisor and team member received a certificate signed by the Contest Director and the appropriate Head Judge.

INFORMS, the Institute for Operations Research and the Management Sciences, gave a cash award and a three-year membership to each member of the teams from Macalester College (Scanner Problem) and Stetson University (Grade Inflation Problem). Moreover, INFORMS gave free one-year memberships to all members of Meritorious and Honorable Mention teams.

The Society for Industrial and Applied Mathematics (SIAM) designated one Outstanding team from each problem as a SIAM Winner. The teams were from Macalester College (Scanner Problem) and Harvey Mudd College (Grade Inflation Problem). The Harvey Mudd team presented its results at a at a special Minisymposium of the SIAM Annual Meeting in Toronto in July. Each of the three Harvey Mudd team members was awarded a $300 cash prize. Their school was given a framed, hand-lettered certificate in gold leaf.

The Mathematical Association of America (MAA) designated one Outstanding team from each problem as an MAA Winner. The teams were from Eastern Oregon University (Scanner Problem) and Duke University (Grade Inflation

Problem). Both teams presented their solutions at a special session of the MAA Mathfest in Toronto in July. Each team member was presented a certificate by MAA President-Elect Tom Banchoff.

Judging

Director
Frank R. Giordano, COMAP, Lexington, MA

Associate Directors
David C. Arney, Dept. of Mathematical Sciences, U.S. Military Academy, West Point, NY
Robert L. Borrelli, Mathematics Dept., Harvey Mudd College, Claremont, CA

Scanner Problem

Head Judge
Marvin S. Keener, Executive Vice-President, Oklahoma State University, Stillwater, OK

Associate Judges
Kelly Black, Mathematics Dept., University of New Hampshire, Durham, NH
Paul Boisen, Defense Dept., Ft. Meade, MD
Courtney Coleman, Mathematics Dept., Harvey Mudd College, Claremont, CA
Patrick Driscoll, Dept. of Mathematical Sciences, U.S. Military Academy, West Point, NY (INFORMS)
William Fox, Dept. of Mathematical Sciences, U.S. Military Academy, West Point, NY
Debbie Levinson, Dept. of Mathematics, Colorado College, Colorado Springs, CO (SIAM)
Mark Levinson, Edmonds, WA (SIAM)
Jack Robertson, Head, Mathematics and Computer Science, Georgia College and State University, Milledgeville, GA (MAA)
Theresa M. Sandifer, Southern Connecticut State University, New Haven, CT
John L. Scharf, Carroll College, Helena, MT
Lee Seitelman, Glastonbury, CT

Grade Inflation Problem

Head Judge
Maynard Thompson, Mathematics Dept., University of Indiana, Bloomington, IN

Associate Judges
Karen Bolinger, Dept. of Mathematics, Clarion University of Pennsylvania, Clarion, PA
James Case, Baltimore, Maryland
Doug Faires, Dept. of Mathematics and Statistics, Youngstown State University, Youngstown, OH
Jerry Griggs, University of South Carolina, Columbia, SC (SIAM)
Mario Juncosa, RAND Corporation, Santa Monica, CA
John Kobza, Industrial and Systems Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA (INFORMS)
Mario Martelli, Dept. of Mathematics, California State University, Fullerton, CA
Vijay Mehrotra, Onward Inc., Mountain View, CA (INFORMS)
Veena Mendiratta, Lucent Technologies, Naperville, IL
Don Miller, Dept. of Mathematics, St. Mary's College, Notre Dame, IN
Catherine Roberts, Northern Arizona University, Flagstaff, AZ (SIAM)
Kathleen M. Shannon, Salisbury State University, Salisbury, MD (MAA)
Robert M. Tardiff, Dept. of Mathematical Sciences, Salisbury State University, Salisbury, MD
Michael Tortorella, Lucent Technologies, Holmdel, NJ
Marie Vanisko, Carroll College, Helena, MT
Daniel Zwillinger, Zwillinger & Associates, Arlington, MA

Triage Session

Scanner Problem

Head Triage Judge
Theresa M. Sandifer, Southern Connecticut State University, New Haven, CT

Associate Judges
Therese L. Bennett, Southern Connecticut State University, New Haven, CT
Ross B. Gingrich, Southern Connecticut State University, New Haven, CT
Cynthia B. Gubitose, Western Connecticut State University, Danbury, CT
C. Edward Sandifer, Western Connecticut State University, Danbury, CT

Grade Inflation Problem
(all were from Mathematics Dept., Carroll College, Helena, MT)

Head Triage Judge
Marie Vanisko

Associate Judges
Peter Biskis, Terence J. Mullen, Jack Oberweiser, Paul D. Olson, and Phillip Rose

Sources of the Problems

The Scanner Problem was contributed by Yves Nievergelt, Mathematics Dept., Eastern Washington University. The Grade Inflation Problem was contributed by Dan Zwillinger, Zwillinger & Associates, Arlington, MA.

Acknowledgments

The MCM was funded this year by the National Security Agency, whose support we deeply appreciate. We thank Dr. Gene Berg of NSA for his coordinating efforts. The MCM is also indebted to INFORMS, SIAM, and the MAA, which provided judges and prizes.

I thank the MCM judges and MCM Board members for their valuable and unflagging efforts. Harvey Mudd College, its Mathematics Dept. staff, and Prof. Borrelli were gracious hosts to the judges.

Cautions

To the reader of research journals:

Usually a published paper has been presented to an audience, shown to colleagues, rewritten, checked by referees, revised, and edited by a journal editor. Each of the student papers here is the result of undergraduates working on a problem over a weekend; allowing substantial revision by the authors could give a false impression of accomplishment. So these papers are essentially au naturel. Light editing has taken place: minor errors have been corrected, wording has been altered for clarity or economy, and style has been adjusted to that of *The UMAP Journal*. Please peruse these student efforts in that context.

To the potential MCM Advisor:

It might be overpowering to encounter such output from a weekend of work by a small team of undergraduates, but these solution papers are highly atypical. A team that prepares and participates will have an enriching learning experience, independent of what any other team does.

Appendix: Successful Participants

KEY:

P = Successful Participation
H = Honorable Mention
M = Meritorious
O = Outstanding (published in this special issue)
A = Scanner Problem
B = Grade Inflation Problem

INSTITUTION	CITY	ADVISOR	A	B
ALABAMA				
Huntingdon College	Montgomery	Sid Stubbs		P
University of Alabama	Huntsville	Claudio H. Morales		P
ALASKA				
Univ. of Alaska	Fairbanks	John P. Lambert	M	M
ARIZONA				
Northern Ariz. Univ.	Flagstaff	Terence R. Blows		H
University of Arizona	Tucson	Bruce J. Bayly		H
CALIFORNIA				
Calif. Inst. of Tech.	Pasadena	Richard M. Wilson	P	
Calif. Poly. State Univ.	San Luis Obispo	Thomas O'Neil	M,M	
Calif. State Univ.	Bakersfield	John Dirkse		P,P
Harvey Mudd College	Claremont	Michael Moody	O	
		Ran Libeskind-Hadas	M	O,M
Humboldt State Univ.	Arcata	Jeffrey B. Haag		H
		Roland Lamberson		M
L.A. Pierce College	Woodland Hills	Bob Martinez		P
Loyola Marymount U.	Los Angeles	Thomas M. Zachariah		P,P
Occidental College	Los Angeles	Ron Buckmire	H	
Pepperdine Univ.	Malibu	Bradley W. Brock		H,H
Pomona College	Claremont	Richard Elderkin		M
Sonoma State Univ.	Rohnert Park	Sunil K. Tiwari		P
Univ. of Redlands	Redlands	Steve Morics	P	
COLORADO				
Colorado College	Colorado Springs	Barry A. Balof		M,P
Fort Lewis College	Durango	Dick Walker		P
Mesa State College	Grand Junction	Edward Bonan-Hamada		P

INSTITUTION	CITY	ADVISOR	A	B
U.S. Air Force Academy	USAF Academy	Steven F. Baker	P	
		Harry N. Newton		M
		Mark Parker	P	M
Univ. of Colorado	Boulder	Anne Dougherty	M	
		Bengt Fornberg	P	
Univ. of South. Colorado	Pueblo	Bruce N. Lundberg		P
CONNECTICUT				
Connecticut College	New London	Kathy McKeon		H
Southern Conn. State Univ.	New Haven	Ross B. Gingrich		M
		Theresa Bennett	P	
U.S. Coast Guard Academy	New London	Janet A. McLeavey		P
Western Conn. State Univ.	Danbury	Judith A. Grandahl		M
		Paul Hines		H
		C. Edward Sandifer		P
DISTRICT OF COLUMBIA				
Georgetown University	Washington	Andrew Vogt	H	P
FLORIDA				
Florida Inst. of Technology	Melbourne	Gary W. Howell		P,P
Florida Southern College	Lakeland	William G. Albrecht		P
		Charles B. Pate		P
		Allen Wuertz	P	
Jacksonville University	Jacksonville	Paul R. Simony	P	
		Robert A. Hollister	P	P
Stetson University	Deland	Erich Friedman		O
GEORGIA				
Agnes Scott College	Decatur	Robert A. Leslie		H
Georgia College & State Univ.	Milledgeville	Craig Turner	P	
State Univ. of West Georgia	Carrollton	Scott Gordon		P
		Everett D. McCoy	P	
IDAHO				
Boise State University	Boise	Alan R. Hausrath	P	
ILLINOIS				
Greenville College	Greenville	Galen R. Peters	P	
Illinois Wesleyan University	Bloomington	Zahia Drici	P	
Northern Illinois University	Dekalb	Hamid Bellout		P
Wheaton College	Wheaton	Paul Isihara		H,P

INSTITUTION	CITY	ADVISOR	A	B
INDIANA				
Ball State University	Muncie	Fred Gylys-Colwell		P
Earlham College	Richmond	Mic Jackson		P
		Charlie Peck	H	
		Tekla Lewin		H
Indiana University	Bloomington	Larry Moss	P	H
	South Bend	Morteza Shafii-Mousavi	H	
Rose-Hulman Inst. of Tech.	Terre Haute	Frank Young	H	
		Aaron D. Klebanoff	M	M
Saint Mary's College	Notre Dame	Joanne Snow		M,H
Valparaiso University	Valparaiso	Rick Gillman		M,P
IOWA				
Drake University	Des Moines	Luz M. De Alba		P
		Alexander F. Kleiner		H
Graceland College	Lamoni	Steve K. Murdock		P
Grinnell College	Grinnell	Marc Chamberland	P	M
Iowa State University	Ames	Stephen J. Willson		P
Luther College	Decorah	Reginald D. Laursen		P
Simpson College	Indianola	Rick Spellerberg		H
		M.E. "Murphy" Waggoner	P	
Univ. of Northern Iowa	Cedar Falls	Gregory M. Dotseth		H
		Timothy L. Hardy		P
KANSAS				
Baker University	Baldwin City	Bob Fraga	P	P
Benedictine College	Atchison	Jo Ann Fellin, OSB		M
Bethel College	North Newton	Monica Meissen	P	
KENTUCKY				
Asbury College	Wilmore	Kenneth P. Rietz		H
Bellarmine College	Louisville	John A. Oppelt	P	
Brescia College	Owensboro	Chris A. Tiahrt		P
LOUISIANA				
McNeese State University	Lake Charles	Karen Aucoin		H
Northwestern State Univ.	Natchitoches	Lisa R. Galminas		P
MAINE				
Bowdoin College	Brunswick	Helen Moore		P
Colby College	Waterville	Jan Holly		M,P

INSTITUTION	CITY	ADVISOR	A	B
MARYLAND				
Goucher College	Baltimore	David Horn	H	
		Robert E. Lewand		P
Hood College	Frederick	John Boon, Jr.		P
Johns Hopkins University	Batlimore	Daniel Q. Naiman		M
Loyola College–Maryland	Baltimore	Dipa Choudhury	H,H	
		Timothy J. McNeese		M
Mt. St. Mary's College	Emmitsburg	John August		M
		Theresa A. Francis		P
Salisbury State University	Salisbury	Steven M. Hetzler		M
St. Mary's Coll. of Md.	St. Mary's City	James Tanton	P	P
MASSACHUSETTS				
Bentley College	Waltham	Lucia Kimball		P
Boston College	Chestnut Hill	Paul R. Thie	P	
Boston University	Boston	Glen Hall		P
Harvard University	Cambridge	Curtis McMullen		P
Salem State College	Salem	Joyce Anderson		P
Simon's Rock College	Great Barrington	Allen B. Altman	P	H
		Michael Bergman	P	
Smith College	Northampton	Ruth Haas	P	
Univ. of Massachusetts	Amherst	Edward A. Connors	H	
	Lowell	J. "Kiwi" Graham-Eagle	P	
		Lou Rossi	M	
Western New England Coll.	Springfield	Lorna Hanes		P
Williams College	Williamstown	Stewart Johnson	P	P
Worcester Polytechnic Inst.	Worcester	Arthur C. Heinricher		M
		Bogdan Vernescu	M	
MICHIGAN				
Albion College	Albion	Scott Dillery	P	P
		David Seely		P
Calvin College	Grand Rapids	Thomas L. Jager	H	
Eastern Michigan Univ.	Ypsilanti	Christopher E. Hee	H	P
Hillsdale College	Hillsdale	John P. Boardman	P	P
Lawrence Tech. Univ.	Southfield	Ruth G. Favro	M	
		Scott Schneider		P
		Howard Whitston		M
Michigan State University	E. Lansing	C.R. MacCluer		P
MINNESOTA				
Gustavus Adolphus Coll.	St. Peter	Gary Hatfield		M

INSTITUTION	CITY	ADVISOR	A	B
Macalester College	St. Paul	Karla V. Ballman	O	
		Susan Fox	M	
		Daniel Kaplan		P
Univ. of Minnesota	Duluth	Zhuangyi Liu		P
	Morris	Peh Ng		P,P
Winona State University	Winona	Steven Leonhardi		P
MISSOURI				
Central Missouri State Univ.	Warrensburg	L. Vincent Edmondson		P
Northwest Missouri State U.	Maryville	Russell Euler	P	P
Truman State University	Kirksville	Steve Smith	P	P
Univ. of Missouri	Rolla	Michael G. Hilgers	M,H	
MONTANTA				
Carroll College	Helena	Terence J. Mullen		P
		Jack Oberweiser	P	
		Phil Rose	H	
		Anthony M. Szpilka		P
NEBRASKA				
Hastings College	Hastings	David B. Cooke		H
Nebraska Wesleyan Univ.	Lincoln	P. Gavin LaRose		M,P
NEVADA				
Sierra Nevada College	Incline Village	Elizabeth Carter		P
NEW JERSEY				
Camden County College	Blackwood	Allison Sutton	P	
New Jersey Inst. of Tech.	Newark	John Bechtold	H	
NEW MEXICO				
New Mexico State Univ.	Las Cruces	Joseph Lakey	P	
NEW YORK				
Buffalo State College	Buffalo	Robin Sanders		H
Great Neck South HS	Great Neck	Robert Silverstone	P	
Ithaca College	Ithaca	James E. Conklin	P	
		John C. Maceli		P
Nassau Community Coll.	Garden City	Abraham S. Mantell	P	
Nazareth College	Rochester	Kelly M. Fuller		M,H
Niagara University	Niagara	Steven L. Siegel	P	
Pace University	Pleasantville	Robert Cicenia		P

INSTITUTION	CITY	ADVISOR	A	B
St. Bonaventure Univerity	St. Bonaventure	Francis C. Leary		H
		Albert G. White	P	
SUNY Geneseo	Geneseo	Chris Leary		P
U.S. Military Academy	West Point	Chuck Mitchell	P	
		James S. Rolf	H	
		Kellie Simon		M
		Charles C. Tappert	H	
Wells College	Aurora	Carol C. Shilepsky		P
Westchester Comm. College	Valhalla	Rowan Lindley		P
		Sheela Whelan		P
NORTH CAROLINA				
Appalachian State University	Boone	Holly P. Hirst	P	P
Duke University	Durham	Greg Lawler		O
N.C. School of Sci. & Math.	Durham	Dot Doyle	M,M	
		John Kolena		M
Salem College	Winston-Salem	Debbie L. Harrell		H
		Paula G. Young		P
Univ. of North Carolina	Chapel Hill	Douglas G. Kelly		H
		Jon W. Tolle	P	
	Pembroke	Raymond E. Lee		P
Wake Forest University	Winston-Salem	Edward Allen		M
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		Tony Roberts		H
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		Zeng Qingli		P
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Central-south Institute of Tech.	Hengyang, Hunan	Li Xianyi		H

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