



# THE WILLIAM LOWELL PUTNAM MATHEMATICAL COMPETITION

## ANNOUNCEMENT OF WINNERS

of the forty-eighth annual competition held on December 5, 1987

### WINNING TEAMS

<i>Rank</i>	<i>School</i>	<i>Team Members (in alphabetical order)</i>
1	HARVARD UNIVERSITY	David J. Moews, Bjorn M. Poonen, Michael Reid
2	PRINCETON UNIVERSITY	Daniel J. Bernstein, David J. Grabiner, Matthew D. Mullin*
3	CARNEGIE MELLON UNIVERSITY	Petros I. Hadjicostas, Joseph G. Keane, Karl M. Westerberg
4	UNIVERSITY OF CALIFORNIA, BERKELEY	David P. Moulton, Jonathan E. Shapiro, Christopher S. Welty
5	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	David T. Blackston, James P. Ferry, Waldemar P. Horwat

The first place team receives an award of \$5,000 and each member of the team receives \$250. The awards for second place are \$2,500 and \$200; for third place \$1,500 and \$150; for fourth place \$1,000 and \$100; and for fifth place \$500 and \$50.

In each of the following categories, the listing is in alphabetical order.

### THE PUTNAM FELLOWS — THE SIX HIGHEST RANKING INDIVIDUALS

Each receives an award of \$500.

DAVID J. GRABINER	Princeton University
DAVID J. MOEWS	Harvard University
BJORN M. POONEN	Harvard University
MICHAEL REID	Harvard University
CONSTANTIN S. TELEMAN	Harvard University
JOHN S. TILLINGHAST	University of California, Davis

### THE NEXT FIVE HIGHEST RANKING INDIVIDUALS

Each receives an award of \$250.

DANIEL J. BERNSTEIN	Princeton University
CONSTANTINE N. COSTES	Harvard University
JEREMY A. KAHN	Harvard University
RAV KUMAR RAMAKRISHNA	Cornell University
JAPHETH WOOD	Washington University, St. Louis

### HONORABLE MENTION — TEAMS

RICE UNIVERSITY	Charles R. Ferenbaugh, Thomas M. Hyer, John W. McIntosh
STANFORD UNIVERSITY	Thomas H. Chung, John A. Overdeck, Joshua R. Zucker
UNIVERSITY OF TORONTO	Gary F. Baumgartner, Edward I. Doolittle, Jeffrey S. Rosenthal
WASHINGTON UNIVERSITY, ST. LOUIS	Daniel N. Ropp, Japheth Wood, Peter Shawhan
YALE UNIVERSITY	Kamal F. Khuri-Makdisi, Robert S. Manning, William M. Nelson

### HONORABLE MENTION — INDIVIDUALS

THOMAS R. AMOTH, Oregon State University	KAMAL F. KHURI-MAKDISI, Yale University
LELAND F. BROWN, California Institute of Technology	JORDAN LAMPE, University of California, Berkeley
EMORY F. BUNN, Princeton University	DANIEL D. LEE, Harvard University
YEOW MENG CHEE, University of Waterloo	JOHN W. MCINTOSH, Rice University
TIMONTHY Y. CHOW, Princeton University	ROBERT S. MANNING, Yale University
WILLIAM P. CROSS, California Institute of Technology	DAVID P. MOULTON, University of California, Berkeley
GALIA D. DAFNI, Pennsylvania State University	MATTHEW D. MULLIN, Princeton University
DOUGLAS R. DAVIDSON, Princeton University	DU NGUYEN, Ottawa University
FRANK M. D'IPPOLITO, Waterloo University	DAVID L. PETRY, University of Oregon
EDWARD J. DOOLITTLE, University of Toronto	DANIEL N. ROPP, Washington University, St. Louis
SERGE ELNITSKY, Carleton University	DAVID B. SECREST, University of Illinois, Urbana-Champaign
CHENTEH KENNETH FAN, Harvard University	ROBERT G. SOUTHWORTH, California Institute of Technology
PETROS HADJICOSTAS, Carnegie Mellon University	GLENN P. TESLER, California Institute of Technology
THOMAS R. HAGEDORN, Princeton University	MARTIN TRUDEAU, Université de Montréal
THOMAS S. HARKE, University of Alberta	CHRISTOPHER S. WELTY, University of California, Berkeley
WALDEMAR P. HORWAT, Massachusetts Institute of Technology	KARL M. WESTERBERG, Carnegie Mellon University
WILLIAM C. JOCKUSCH, Carleton College	GLEN T. WHITNEY, Harvard University
ALEX T. KACHURA, University of Waterloo	RUSSIL WVONG, University of British Columbia
JOSEPH G. KEANE, Carnegie Mellon University	JOSHUA R. ZUCKER, Stanford University

A total of 2,170 students from 359 colleges and universities in Canada and the United States participated in the Competition. There were teams from 277 institutions. More complete details will appear in the American Mathematical Monthly.

March 1, 1988

Leonard F. Klosinski, Director; Gerald L. Alexanderson and Loren C. Larson, Associate Directors

Leonard F. Klosinski, Director

THE WILLIAM LOWELL PUTNAM MATHEMATICAL COMPETITION

University of Santa Clara

Santa Clara, California 95053

March 1, 1988

Telephone: (408) 984-4526



Dear Professor:

Enclosed is a report on your contestants in the 48th Competition and your team rank (if it was in the range 1-150), a list of the top 555 contestants (which you may wish to share with your committee on graduate students), an announcement of winners, and a list of participating schools. Some tables are given below. Your contributions to the Competition are greatly appreciated.

Sincerely yours,

Leonard F. Klosinski, Director  
 Gerald L. Alexanderson, Associate Director  
 Loren C. Larson, Associate Director

Score	Rank	Score	Rank	Score	Rank	Score	Rank
120	1	53	33	30	149.5	18	318
108	2	51	35	29	163.5	17	331.5
107	3	50	38.5	28	179	16	337
90	4	49	45	27	191	15	340.5
88	5.5	48	52	26.8	196	14	346.5
79	7	47	55.5	26.7	198	13	356.5
78	8	46	57.5	26.6	199	12	371
77	9	45	59.5	26.5	200	11	403
71	10.5	43	63.5	26.4	201	10	491
68	12	42	69.5	26.3	202	9	592
67	13	41	76.5	26.2	203	8	661
63	14.5	40	86	26.1	204	7	700
62	16.5	39	96.5	26	206.5	6	711
61	18.5	38	105.5	25	209.5	5	729.5
60	21	37	111.5	24	213	4	757.5
59	25	36	115	23	219.5	3	800.5
58	28	35	117.5	22	226	2	912
57	29	33	122	21	236	1	1138
56	30	32	128	20	261	0	1726
54	31.5	31	136.5	19	293.5		

FREQUENCY DISTRIBUTION OF PROBLEM SCORES OF THE TOP 204 CONTESTANTS

	A-1	A-2	A-3	A-4	A-5	A-6	B-1	B-2	B-3	B-4	B-5	B-6	Total
10	72	117	119	14	8	5	148	47	27	13	10	8	588
9	24	28	32	8	0	10	5	3	31	14	6	1	162
8	22	22	1	6	2	2	4	4	5	15	3	1	87
7	0	2	0	4	0	0	1	0	0	1	2	1	11
6	0	0	1	0	0	1	0	0	0	0	2	0	4
5	0	0	4	0	0	0	0	0	0	0	0	0	4
4	0	0	2	0	0	0	0	0	0	0	0	1	3
3	0	3	0	1	0	3	0	0	0	0	0	2	9
2	5	10	0	28	1	1	1	1	3	11	8	1	70
1	0	5	5	9	1	4	0	3	11	23	3	3	67
0	45	10	11	25	57	80	15	62	57	79	16	62	519
—	36	7	29	109	135	98	30	84	70	48	154	124	924