

1984 ACM  
Twelfth Annual  
**COMPUTER  
SCIENCE  
CONFERENCE**

PROCEEDINGS



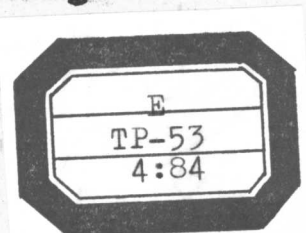
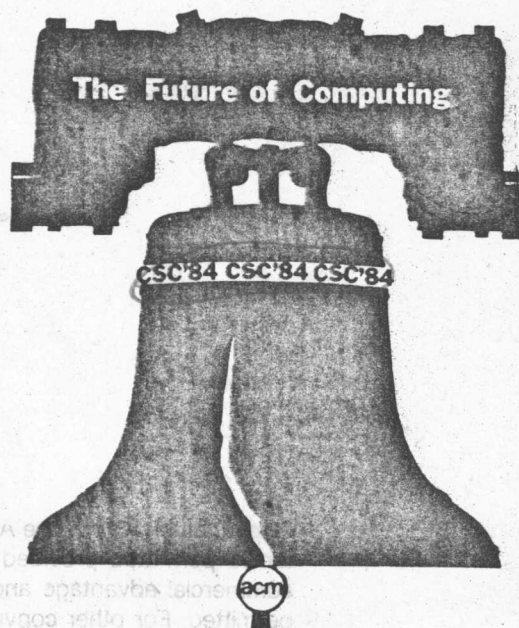


**1984  
ACM  
Twelfth Annual  
COMPUTER  
SCIENCE  
CONFERENCE**

**February 14-16**

**SIGCSE SYMPOSIUM**

**February 16-17**



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**Franklin Plaza Hotel  
Philadelphia, Pennsylvania**

011164

**The Association for Computing Machinery, Inc.**  
11 West 42nd Street  
New York, New York 10036

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## ACM PRESIDENT'S WELCOME

The Computer Science Conference is our forum for the bright young Computer Scientists in our field. ACM is proud to sponsor this conference and we welcome you to our twelfth annual meeting. The opportunity to hear the best research papers and to interact with the latest wave of graduates is particularly valuable and we hope you will participate in the sessions as well as the Employment Register. In this era of WAR GAMES and other inane misrepresentations of our technology, I'm sure you'll find the conference theme on "Social and Ethical Implications of Computers" timely and interesting.

A handwritten signature in cursive script that reads "David H. Brandin". The signature is written in black ink and is positioned above the printed name and title.

**David H. Brandin**  
**President**

## CONFERENCE CHAIRMAN'S MESSAGE

Welcome to Philadelphia and CSC 1984. The CSC '84 Conference Committee has planned a diverse program of technical and social activities that promises to be both educational and entertaining. The program includes a morning plenary session for each of three conference theme days, parallel papers and abstracts sessions each afternoon, numerous excursions in and around Philadelphia, exhibits, an employment register, and the finals of the ACM Student Programming Contest.

The highlights of the technical program are the three theme days on The Factory of the Future, Coping with Small Computers—The Computerization of the Campus, and Social and Ethical Implications of Computing. The organizers and participants in the theme day activities have put together a program that should be of considerable interest to everyone. The keynote and invited papers from the plenary sessions are published in full in the proceedings, together with the text of the refereed papers and the abstracts. Of special interest, too, are two panels (on Sources of Government Funding for Colleges and Universities, and the Effect of Teaching Ada on Software Engineering), and the chairman's program concerning recent developments in the joint **ACM/IEEE** Accreditation studies. The joint **CSC/SIGCSE** awards luncheon features Gwen Bell, Director of the Computer Museum in Boston, who will show the film "See It Then," classic clips of the first computers in action.

I am pleased that you have come to Philadelphia, and I'm excited about CSC '84. I hope that you will find your stay as educational and enjoyable as the planning efforts have been.

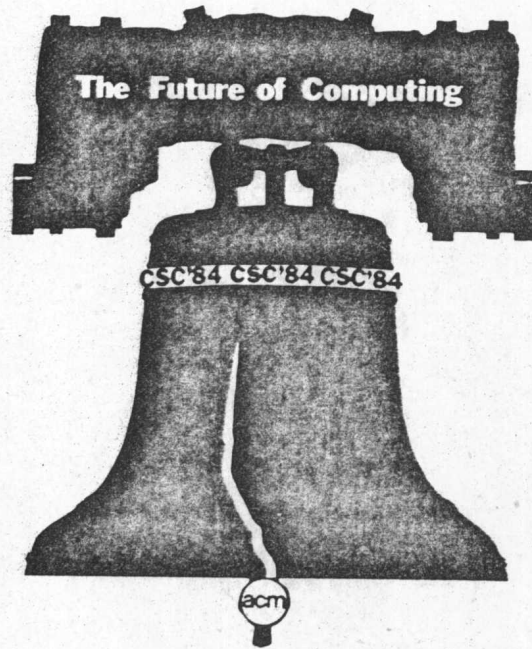
I would like to take this opportunity to thank everyone involved in the planning and organization of CSC '84. The support and assistance from the faculty, staff, and students of Temple University, the institutional conference patrons, ACM volunteers, the staff of the Franklin Plaza and Four Seasons Hotels, and numerous friends and colleagues have all been instrumental in the planning and organization of this conference.

I would also like to thank my wife, Martha, and my children, Dara and Shelley, and the families of other major contributors to CSC '84 for their patience and forbearance.



Frank L. Friedman

General Chairman, CSC '84



## ACKNOWLEDGEMENTS

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### **Program Chair**

James Korsh  
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### **Abstracts Chair**

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### **Publicity**

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TRW

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Elliot Koffman  
Temple University  
Don Asplen  
Apollo, Inc.  
Debbie Hitman  
Hewlett-Packard

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Irene Tasca  
Jerry Goldberg  
Dana Deglin  
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Temple University

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Arthur Andersen & Co.

### **Employment Register**

Orrin Taulbee  
University of Pittsburgh

### **Employment Register—Local Chair**

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Temple University

### **Proceedings**

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MOCO, Inc.

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### **Secretary/Treasurer**

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AT&T Information Systems

### **Chapter Activities**

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Goldey Beacom College

### **Chair, SIGCSE '84**

Richard Austing  
University of Maryland

### **Student Activities**

Jim Whiteman  
Sharon Doherty  
Temple University

### **ACM Headquarters Conference Support**

Bobbie Zucker  
Robertta Bukar  
Sidney Hayman  
Helene Tannor  
Adelaide Beatty

## ACKNOWLEDGEMENTS

The 1984 CSC Committee wishes to thank all of the following people for their help during the Conference, and in the many months preceding. The efforts and contributions of all of these individuals are very much appreciated.

### TECHNICAL COMMITTEE

Philip Bagley  
Lillian Cassel  
Elliot Koffman  
Roger Nagel  
Alexander Pelin  
Arthur Poe  
Nathan Relles

### GENERAL ASSISTANCE

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Joan Rapp  
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Nathan Relles  
C.S. Sankar  
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Linda Johnson  
Ivy Sue Lyons  
Katherine Ross  
Eve Salzman  
Kevin Schuyler  
Abby Sherman

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Anany Levitin  
Roger Lynn  
Leon Robbins  
James Solderitsch

### PROGRAM

Bruce Barnes  
Norman Cohen  
Arthur Fink  
Donald Hillman  
Charles Kapps  
Arthur Poe

We also appreciate the contributions of people inadvertently omitted from this list, and numerous other assistants whose names were not available in time for publication.

## CSC '84—PATRONS

Institutional support has played a vital role in the 1984 Computer Science Conference. The 1984 CSC Committee gratefully acknowledges the support of the following organizations:

Temple University—Peter J. Liacouras, President

School of Business Administration—Edward M. Mazze, Dean

Department of Computer and Information Sciences—Leonard J. Garrett, Chair

Office of Computing and Information Systems—Susan J. Foster, Deputy Director

### Programming Contest

Hewlett-Packard Corporation, Valley Forge, PA

### Theme Day Sponsors

Factory of the Future—Digital Equipment Corporation, Hudson, MA

Coping with Small Computers—Intelligent Electronics, Inc., Lionville, PA

Social and Ethical Implications of Computers—Systems and Computers  
Technology, Malvern, PA

### Host Reception Sponsors

Kulicke and Soffa Industries, Inc., Horsham, PA

### Apple IIe Raffle

Lendman Associates, Virginia Beach, VA

### Registration

IBM Corporation, Philadelphia, PA

### General Contributors

Comtech Systems, Inc., Columbus, OH

AT&T Information Systems, Bala Cynwyd, PA



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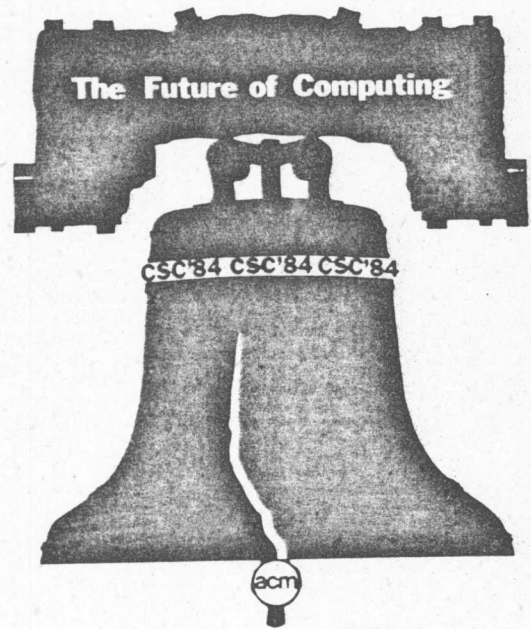
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**GENERAL  
INFORMATION  
AND  
SPECIAL EVENTS**





## GENERAL INFORMATION

### Conference Location

Franklin Plaza Hotel  
Two Franklin Plaza  
Philadelphia, PA 19103  
(215) 448-2000

Four Seasons Hotel  
18th Street & Benjamin Franklin Parkway  
Philadelphia, PA 19103  
(215) 963-1500

Most events are planned for the Franklin Plaza Hotel, which is the headquarters for the 1984 Computer Science Conference. The Chairman's activities and luncheon (Wednesday, February 15) will be held in the Four Seasons Hotel. The Conference Luncheon (Thursday, February 16) will also be held in the Four Seasons, and several ACM business meetings will take place there throughout the week.

### Conference Registration

The registration area is located on the Mezzanine Level of the Franklin Plaza Hotel. Registration hours are:

Monday, February 13	5:00 PM-9:00 PM
Tuesday, February 14	8:00 AM-6:00 PM
Wednesday, February 15	8:00 AM-4:00 PM
Thursday, February 16	8:00 AM-4:00 PM
Friday, February 17	8:00 AM-10:00 AM

Full Conference Registration and Student Fees include attendance at all technical sessions, admission to the exhibit, and a copy of the Conference Proceedings: Members \$75; Non-Members \$110; Students \$10. Additional copies of the Proceedings may be obtained by purchasing a ticket at the Ticket Counter and exchanging it for a Proceedings at the Proceedings Counter (\$15). Non-Members who have paid the Full \$110 registration fee and wish to join ACM will find a "chit" in their registration packet entitling them to join ACM for a first year cost of \$15.

Department Chairs Registration includes attendance at technical sessions, admission to the exhibit, a Proceedings, and a ticket to the Chairs Luncheon on Wednesday afternoon (\$100).

Single-day Registration includes admission to technical sessions and the exhibit for that particular day: Members \$45; Non-Members \$60.

Tickets for pre-paid special events (Conference Luncheon and tours) are included in Pre-Registration packets. Additional tickets may be purchased at the Ticket Counter.

### Exhibits

The exhibits will be open to all conference attendees and will take place in the Pacific Ballroom of the Franklin Plaza Hotel during the following hours.

Tuesday, February 14	Noon-6:30 PM*
Wednesday, February 15	10:00 AM-5:00 PM
Thursday, February 16	10:00 AM-5:00 PM
Friday, February 17	9:00 AM-11:00 AM**

\*5:00 PM-6:30 PM—Reception in Exhibit Hall

\*\*SIGCSE Technical Symposium on Computer Science Education

**Speakers Lounge**—Salon 1, Franklin Plaza Hotel, Mezzanine Level

Technical Program and Abstracts participants are urged to use this room for preparing their presentations, and for meeting with other members of their sessions.

**Press Room**—Salon 7, Franklin Plaza Hotel

Members of the Press are encouraged to register in order to obtain press kits and information on various conference activities. The Press Room will operate during the following hours:

Monday, February 13	3:00 PM-6:00 PM
Tuesday, February 14	8:30 AM-5:00 PM
Wednesday, February 15	8:30 AM-5:00 PM
Thursday, February 16	8:30 AM-5:00 PM
Friday, February 17	8:30 AM-Noon

**Information Center**—Lobby outside Exhibit Hall Area, Franklin Plaza Hotel, Mezzanine Level

Staff from the Philadelphia Convention Bureau will be available to answer questions about Philadelphia and the CSC '84 tours, and to assist with your own plans for activities in and around the Delaware Valley. The Information Center will operate during the following hours:

Tuesday, February 14	10:00 AM-4:00 PM
Wednesday, February 15	10:00 AM-4:00 PM
Thursday, February 16	10:00 AM-4:00 PM

## GENERAL INFORMATION (CONTINUED)

### Student Activities

In addition to the technical sessions, exhibits, the employment register and the programming contest, special activities are being planned for students. Included are an ACM Student Chapters Workshop, two sessions on career planning, and a Graduate School Forum. CSC '84 offers computer science students a unique opportunity to interact professionally and socially with other students, faculty, and professionals in the computing field. A special student lounge has been set aside in Salon 9 of the Franklin Plaza Hotel.

### Apple IIe Computer Raffle

Lendman Associates, nationwide producers of open houses for data processing professionals has donated an Apple IIe computer, with stand and starter kit (IIe 64k CPU, single disk drive with two-disk controller, high resolution "green" monitor, 80 column card) for a raffle for charity—The Philadelphia Eagles Football Club "Eagles Fly for Leukemia." Raffle tickets will be sold at the "Fly for Leukemia" Booth, Number 59, outside the Exhibit Hall Area (Mezzanine Level). The winner will be selected at the Conference Luncheon, Thursday, February 16.

## EMPLOYMENT REGISTER ACM COMPUTER SCIENCE CONFERENCE 1984

The purpose of the Register is to bring applicants and employers together in a professional manner to aid in the employment process. Listing of employer openings and applicants are available to all interested individuals in the Dominion Ballroom of the Franklin Plaza Hotel during the following hours:

Monday	February 13	6:00 PM–9:00 PM
Tuesday	February 14	10:30 AM–8:00 PM
Wednesday	February 15	10:30 AM–6:00 PM
Thursday	February 16	11:00 AM–3:00 PM

Making contacts and arranging interviews will be the responsibility of the employer and the applicant. However, the Employment Register Staff will facilitate making contacts by:

1. Reserving an interview table for an employer.
2. Operating a message desk—Memo paper and envelopes are provided. A message should be placed in an envelope, addressed to the appropriate individual, and then placed in the appropriate pigeonhole in the set of mail boxes. Note that the Employment Register Staff are not involved in the exchange of messages. Messages not picked up by the end of the conference will be destroyed.
3. Posting sign-up sheets for interviews as provided by the employer. The applicant may choose a suitable time, sign up and appear for an interview at the location designated by the employer.

Some employing organizations may have decided not to send representatives to the conference. This can be determined by checking item 4 on the employer's form. In this case, applicants should direct their inquiries to the individual listed in item 3 on the form.

The applicant need not be present at the Conference. This can be determined by checking item 4 on his/her form. In this case, the employer's representative should use the information in items 1, 2, and 3 to direct inquiries to the applicant.

A copying machine is available in the Employment Register area so that individual pages from either the employer or applicant listing books may be copied.

Information on the availability of complete copies of employer or applicant listings may be obtained by directing a message during the conference to Professor Taulbee or by writing to him immediately after the conference at this address.

Professor Orrin E. Taulbee  
Department of Computer Science  
University of Pittsburgh  
Pittsburgh, Pennsylvania 15260

# THE EIGHTH ANNUAL ACM SCHOLASTIC PROGRAMMING CONTEST

The Eighth Annual International Scholastic Programming Contest will be held on Wednesday, February 15, 1984. As many as 24 teams will be representing each of the 12 ACM regions. It is anticipated that for the first time, the European region will be represented at the contest.

The contest is organized by the ACM Student Chapters Committee. ACM supports regional contests and the International contest and provides travel subsidies to student participants. Upsilon Pi Epsilon, the Computer Science Honor Society, sponsors a student mixer in connection with the contest and awards scholarships to schools of the winning teams.

The teams competing in the contest have been selected by their respective regions through a system of local and regional programming contests. Each team consists of 4 student programmers who work together on a set of programming problems given to them at the beginning of the contest. The winners of the contest are determined on the basis of the number of correctly solved problems they complete. Ties are broken using a scoring system which rewards rapid work and penalizes submission of incorrect programs for judging. Programs are judged on the basis of execution on hidden data by a panel of contest judges who have posed and solved the problems themselves.

The contest this year will be held at the Franklin Plaza Hotel. Computing facilities are being provided by the Hewlett-Packard Company. Each team will be provided with its own work space and terminal. Spectators will be given the opportunity to view the contest in progress. Current standings will be posted throughout the contest. Spectators are encouraged to discuss the contest problems and match their programming skills against some of our finest student programmers.

The ACM International Scholastic Programming Contest is held each year in conjunction with the Computer Science Conference, after the respective regional contests have been held. For information about next year's regional contests or International contest, contact your ACM Regional Representative or the Contest Head.

An open forum on ACM scholastic programming contests will be held from 9:00 a.m. to 10 a.m. Tuesday, February 14. Interested parties are invited to participate.

## Contest Staff

Contest Head:	Lionel Deimel	North Carolina State University
Chief Judge:	Gary Ford	University of Colorado
ACM Representative:	Robert Cupper	Allegheny College
Contest Judges:	James Comer John Metzner Charles Pfleeger Richard Rinewalt Patrick Ryan Judith Schlesinger David Straight	Texas Christian University University of Missouri-Rolla University of Tennessee University of Texas-Arlington U.S. Coast Guard Academy Software Design University of Tennessee
Facilities:	Debbie Hitman	Hewlett-Packard
Contest Software:	Steve Fiedler Frank Carrick	Hewlett-Packard Hewlett-Packard

## SPECIAL EVENTS

### MONDAY, FEBRUARY 13

#### Student Chapter Volunteer Training Workshop

7:30 AM—5:00 PM

Provincial North

Franklin Plaza Hotel

Primarily for officers of student chapters, but others are invited too.

Morning: Discussion of ACM organizational structure, ACM benefits and services, whom to call for help, Chapters responsibilities and reports.

Afternoon: Discussion about chapters activities—fund raising, membership drives, getting speakers, etc.

#### Conference/Host Reception

7:00 PM—9:00 PM

Provincial Ballroom

Franklin Plaza Hotel

Sponsored by: Kulicke and Soffa Industries, Horsham, PA

Renew old acquaintances and meet new friends. Learn about Philadelphia and what's to do, from the Philadelphia Convention Bureau staff, and from a movie about the city.

### TUESDAY, FEBRUARY 14

#### Exhibitors' Reception

5:00 PM—6:30 PM

Pacific Ballroom

Franklin Plaza Hotel

Come for wine and cheese, and an extra look at the exhibits. Visit the ACM booth; sign up for the Apple IIe Raffle for the Philadelphia Eagles Fly for Leukemia Charity.

#### Employment Forum I

3:00 PM—5:00 PM

Adams

Four Seasons Hotel

For students—a look at the job market. Interviewing, resume preparation, career planning, future directions in computing and more.

### WEDNESDAY, FEBRUARY 15

#### Independence Hall/Historic Philadelphia Tour

10:30 AM—12:30 PM

A tour in Fairmont Park Trolleys of the Independence Mall area; including Independence Hall, Congress Hall, Carpenter's Hall, the Betsy Ross House and Society Hill.

#### Department Chair's Luncheon

12:15 PM—2:15 PM

Ballroom

Four Seasons Hotel

This special luncheon for department chairs concludes the Department Chairs Sessions.

#### Graduate School Forum

3:00 PM—5:00 PM

Adams

Four Seasons Hotel

For students: A panel discussion involving representatives from a number of graduate schools; discussion will focus on what to look for in a graduate program and what graduate study prepares you to do.

#### Atlantic City/Casinos Tour

4:00 PM—1:00 AM

Spend an evening at the Atlantic City casinos. Buses will be available to transport you to and from Atlantic City. Once you arrive, you are on your own to enjoy the entertainment, food and recreation.

#### Programming Contest

5:00 PM—1:00 AM

Canadian Ballroom

Franklin Plaza Hotel

### THURSDAY, FEBRUARY 16

#### Conference Luncheon

12:15 PM—2:15 PM

Ballroom

Four Seasons Hotel

Jointly sponsored with the Symposium on Computer Science Education. The luncheon speaker is Gwen Bell of The Computer Museum of Boston.

#### Employment Forum II

3:00 PM—5:00 PM

Adams

Four Seasons Hotel

For students: A panel discussion involving a number of computer professionals. This will be a discussion of the working environment in banking, high technology industries, small companies, large companies, etc.

#### Candlelight/Restaurant Tour

5:30 PM—7:30 PM (or later, as you wish)

A trip around town on a Fairmont Park Trolley—see the lights on Boathouse Row, view Philadelphia from the top of the Art Museum Steps, visit Rittenhouse Square and Society Hill, and have the trolley return you to the hotel or leave you off at one of Philadelphia's many fine restaurants.