

Professor Michael Cutlip, of the University of Connecticut, and Professor Mordecai Schacham, of the Ben-Gurion University of the Negev, are nominated as a team for the 2010 AIChE David Himmelblau Award for Innovations in Computer-Based Chemical Engineering. The award citation reads: For creating a novel data-analysis program that provides students worldwide with the ability to solve systems of linear equations, nonlinear algebraic and transcendental equations, linear and polynomial regression, and first-order ODEs. Excerpts written by supporting colleagues say:

- *“For students, the program is comprehensive in its ability to solve systems of linear equations, nonlinear algebraic and transcendental equations, first-order ordinary differential equations (ODEs), and linear and polynomial regression. By using well-know transformations, it can also be applied to higher-order ODEs, DAEs, and some PDEs. Thus, with one small package, students are able to solve most of the types of problems they will experience. This was recognized early by Professor Scott Fogler, who chose POLYMATH to solve kinetics problems in his widely used textbook, ‘Elements of Chemical Reaction Engineering’.”*
- *“Over the past 20 years they have advanced the Chemical engineering Curriculum more than anyone else through the incorporation of numerical methods in the core chemical engineering courses. The second edition of their book, Problem Solving in Chemical and Biochemical Engineering with POLYMATH, Excel and MATLAB uses numerical methods to show how to solve the next generation of problems in virtually each course in the curriculum.”*
- *“We have made extensive use of this software package in our Principles of Chemical Processes, Fluid Mechanics I, Process Fluid Transport, Separation Processes I, and Chemical Reaction Engineering courses. Students purchase this book in their sophomore year and use the POLYMATH software throughout the curriculum.”*
- *“Mike and Mordechai have worked tirelessly over the years to develop and improve both the Polymath numerical routines and the user interface. The interface alone is very valuable, as it allows for simple problem entry, automatic equation rearrangement, determination of degrees of freedom, and the highlighting of many user-entry errors.”*
- *“It was by far the easiest to use, most reliable, and most practical equation-solving math package available when I was an undergraduate, and it retains these characteristics now that I am a professor. In fact, it has evolved into an even more useful package by interfacing with Excel and Matlab in novel ways. The ODE solver that functions within Excel is probably the most useful feature in Polymath, although the new interface with DIPPR and accessibility to physical-property data will give that capability a run for top billing.”*

According to Mike Cutlip, “The origins of Polymath go back to 1979 when we obtained support from the Control Data Corporation of Minneapolis, MN to develop a course in Chemical Reaction Engineering for the Plato Educational Computer System. The Plato system was originally developed at the University of Illinois. Our project was the result of Prof. Leroy F. Stutzman, who was a professor in the Chemical Engineering Department at the University of Connecticut (he was one of the founders of CDC).

The project attracted Prof. Mordechai Shacham for a sabbatical-leave year from Ben Gurion University of the Negev in Israel. Mordecai came to Connecticut and worked on this project for two years. During this course development, we both recognized that a general, problem-solving capability was needed that could solve nonlinear equations, ordinary differential equations, and also provide some regression

capabilities. Therefore, a calculator for the Plato course in Chemical Reaction Engineering was developed and this tool was used within the course. One of the first offerings of this self-paced and mastery-oriented course was at the University of Michigan in the fall of 1981.

Reference: Shacham, M. and M.B. Cutlip (1982). A simulation package for the PLATO educational computer system. Computers & Chemical Engineering, 6, 209-218.

As the IBM PC was being developed in about 1983, Mordecai and I obtained additional support from CDC to further develop our calculation tool into a stand-alone software package to be offered for the emerging marketplace for the IBM personal computer. This software was called Polymath and version 1.0 was introduced as a commercial product at the San Francisco AIChE Meeting in November of 1984.

Commercial sales continued and there was use by universities that were a part of the Control Data Engineering Centers Program until CDC dismantled the Centers program and stopped marketing Polymath in the late 1980s.

The CACHE Corporation began marketing academic site licenses of Polymath in 1990 with version 2.1. These site licenses were unique in that the Polymath software could be installed by students, faculty, and staff on their own personal computers. Also, computer labs could provide access to Polymath.

Polymath development continued by Professors Cutlip and Shacham with version 2.1 followed by 3.0 in 1992, 4.0 in 1996, 5.0 in 2001 and 6.0 in 2005. In 2001, Polymath Software began to market Educational and Professional versions through the internet with a small company located in Connecticut. Programming assistance over the years was provided originally by Orit Shacham and since 2000 by Michael Elly.

The authors of Polymath have continued with the development of the software through the years and have extended Polymath to provide solutions of formulated problems within Excel and MATLAB, which allows easy access to the DIPPR Physical-Chemical Database to users. Users can easily utilize this extensive database during problem solving. Additionally, a new version 7.0 is being programmed in the Microsoft .NET system.

The use of Polymath software and the site licenses through the CACHE Corporation has gradually increased over the years. As of September 30, 2009, the departmental or university site licenses number approximately

TOTAL UNITED STATES = 73
TOTAL CANADA and MEXICO = 11
TOTAL OTHERS = 41
GRAND TOTAL = 125

Six engineering textbooks either provide Polymath Software or make extensive use of this software package. The best-selling book, *"Fundamentals of Chemical Reaction Engineering"*, by H. Scott Fogler has extensively applied Polymath in recent editions of this very popular text. The authors of Polymath have also extensively used their software in a recent second edition of *"Problem Solving in Chemical and Biochemical Engineering with POLYMATH, Excel and MATLAB."* The CACHE Corporation has also encouraged free distribution of Polymath on three specially-developed CD-ROMs that were initiated on the CACHE 25th-Anniversary CD-ROM. This CD-ROM was freely and widely distributed at the AIChE Annual Meeting in 1994 and followed by two more CD-ROMs with similar distribution. All of the ASEE Summer Schools since 1990 have had sessions related to Polymath and the software has been freely provided to all interested new faculty attendees.

Many papers have been written about the use of Polymath in (mainly) Chemical Engineering education. The extensive application of this software has introduced many students to the use of numerical methods via Polymath for the solution of chemical engineering problems. All of this has been enabled on the personal computers of students, faculty and professionals.