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Now arriving: the new HP Prime graphing calculator

Chris Olley, Jessica Cespedes and GT Springer

Imagine a handheld math machine with a high-resolution multi-touch color screen. Imagine wireless connectivity, a comprehensive set of apps and high powered programming tools that provide revolutionary functionality for teachers and students alike.

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The Art of Science Learning: Shaping the 21st Century Workforce

Laura Berlin

This exciting initiative was created to provide a thoughtful, creative, and interdisciplinary approach to science education. By using a variety of learning modalities, more students are motivated and inspired to pursue S.T.E.M. learning in the context of 21st century skills.

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A change in learning

Kevin Fitzpatrick

As a retired teacher, Kevin relates his experience of the first time he used an HP graphing calculator in the classroom. Find out his thoughts on the evolution of technology and its impact on teaching and learning.

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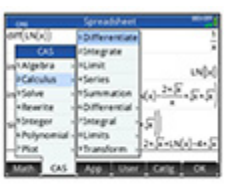
My favorite HP Prime functions



Namir Shammas

Namir takes us through his thoughts on the new HP Prime calculator, reviewing its various features, operations, apps and functions.

Learn more

Learn more about current articles and feedback from the latest *HP Solve* newsletter, including a new Issue Index and information on the next HP Handheld Conference.

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The New HP Prime Graphing Calculator

Chris Olley (King's College London), Jessica Cespedes (Hewlett-Packard) & GT Springer (Hewlett-Packard)

If you are an educator and would like to receive the FREE HP Prime emulator for use on your PC and in the classroom, please visit http://www.hp.com/sbso/product/calculators-emulators/usemulator.html and select the "Prime Graphing" calculator.

Fig. 1 – HP Prime showing Apps view.

Imagine a handheld math machine with a high-resolution multi-touch color screen. Imagine that you could plug a small dongle into that machine for wireless connectivity to the teacher's class computer allowing instant polling and the sharing of students' screens, teacher files and settings. Imagine a machine with a spreadsheet, dynamic geometry, a full computer algebra system (CAS) and high powered programming tools, which is so easily and clearly configurable with its exam mode that it will be allowed for use in exams. No need to imagine further, the HP Prime graphing calculator has arrived.

HP Prime looks very sophisticated, with a brushed aluminum finish and 3.5" sharp color display. The touch screen is smooth and very accurate, allowing the user to drag and move objects and navigate drop down menus. But looks are just the beginning; HP Prime boasts a comprehensive set of Apps, an integrated Exam Mode, data streaming capabilities[1] and a Connectivity Kit that together provide revolutionary functionality for teachers and students alike. According to Gizmodo, a top tech blog, HP Prime "appears to be one of the most advanced color touchscreen calculators the scientific world has ever seen." (http://bit.ly/146moqr)

HP Apps

HP Apps are designed to explore mathematical topics and solve problems. They make it easy to view numeric, graphic and symbolic representations of mathematical concepts. Customize your HP Apps by filling any one of them with data while you work, and then save it with a name you'll remember. Then reset the app and use it for something else. You can come back to your saved app anytime and even send it to your colleagues or students with a PC or the Wireless Connectivity Kit. HP Apps have app functions as well as app variables; use them while in the app, or from the CAS view, Home view, or in programs.

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[1] *Data streamer sold separately, expected availability near the end of 2013.*

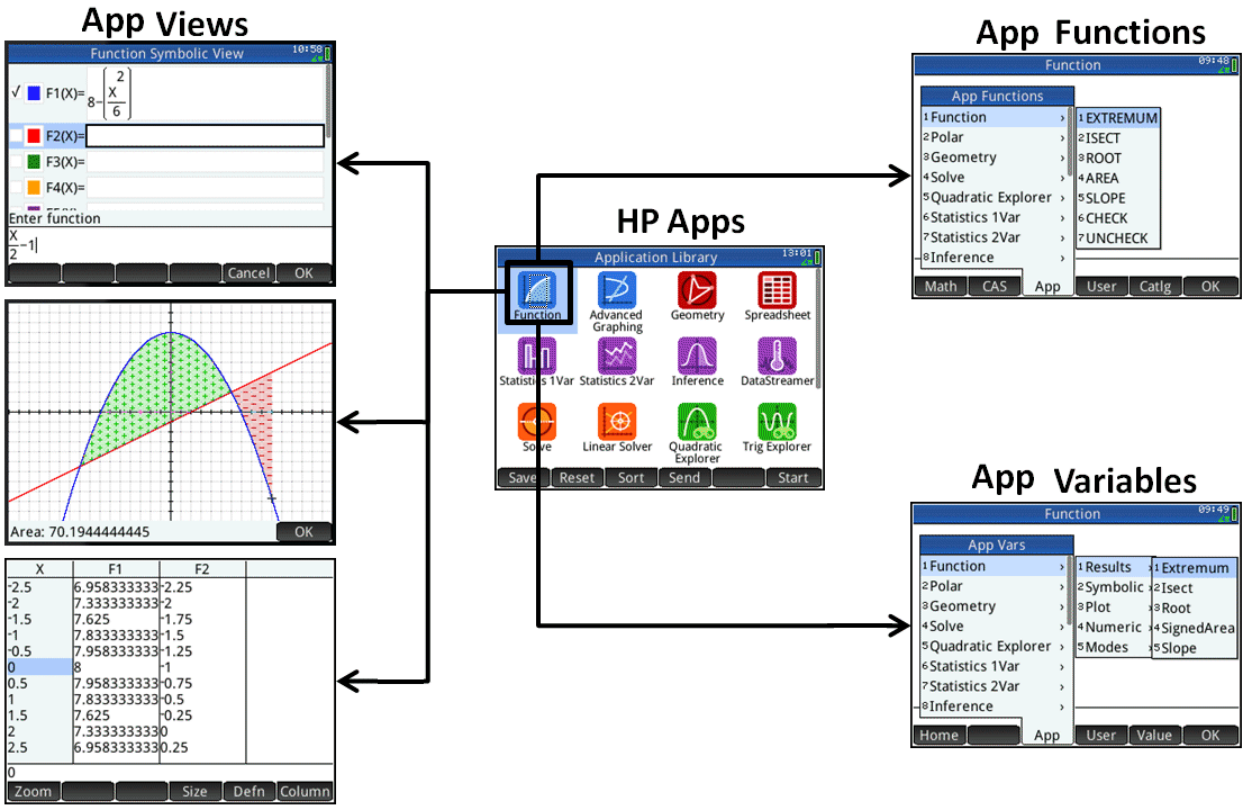

Fig. 2 – Organizational layout showing the integration of Prime's Applications.

HP Apps are color-coded for easy identification:

- **5 graphing apps (blue)** to explore graphs –including the new Advanced Graphing App
- **2 Special apps (red):** the Geometry app and the Spreadsheet app
- **4 Statistics Apps (purple)** for descriptive and inferential statistics and data collection
- **4 Solver Apps (orange)** for solving specific types of problems (triangles finance, etc.)
- **3 Explorer Apps (green)** for investigating a function's equation and its graph.

Advanced Graphing App

The **Advanced Graphing App** is a major advance in Prime. This App will graph almost anything including any equation or inequality in *x* and *y*. Below is just one of the example with its equation included.

Additionally, the Advanced Graphing App can handle all of the following with ease:

- Conic sections (rotated ones, too)
- Polynomials in standard or general form
- Inequalities (not just linear) Functions

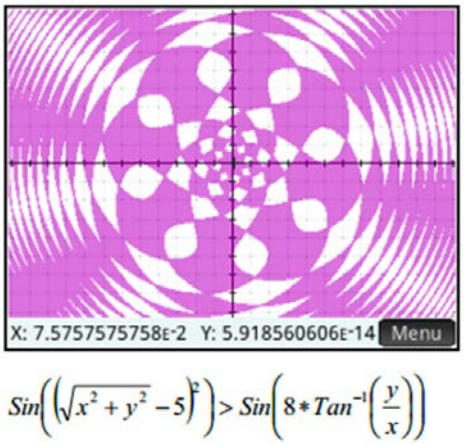

Fig. 3 – Graphing application example.

Dynamic Geometry and Spreadsheet Mode

The **Geometry App** is a dynamic geometry application that allows you to create geometric constructions and explore their properties interactively.

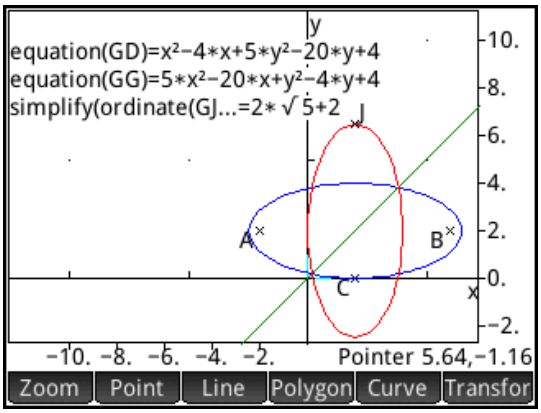

Fig. 4 – Geometry application example.

With an array of menu buttons at your disposal, you have limitless possibilities to create geometric objects:

- **Zoom**: zoom in or out, etc.
- **Point**: midpoints, intersections, points on objects, etc.
- **Line**: segments, lines, tangents, perpendiculars, etc.
- **Polygon**: triangles, quadrilaterals, and special polygons
- **Curve**: circles and other conic sections, locus of points, graphs of functions, etc.
- **Transfor(m)**: translation, reflection, dilation, etc.

The **Spreadsheet App** allows for a textbook style view of spreadsheets. And with HP Prime, you also get the power of a CAS integrated with the spreadsheet. The Spreadsheet app can return numerical approximations for a formula, or it can use the CAS to return exact numeric or symbolic results.

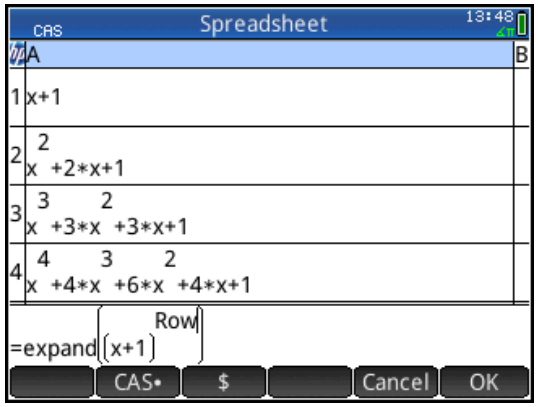

Fig. 5 – Spreadsheet application example.

CAS and Exam Mode

HP Prime features two home screens - a **CAS** screen which deals with exact objects and the traditional home screen which deals with approximate objects. This recognition of the fundamental pure/applied, exact/approximate distinctions is central to an underlying philosophy which has the potential to transform the way we think about exploring mathematics. Using CAS together with HP Apps represents a major advance in providing a space to explore mathematical ideas.

Even though HP Prime is enabled with CAS, the calculator also includes a comprehensive and secure **Exam Mode** that can be adjusted by teachers depending on their needs. The menu system allows for a vast range of features like CAS to be turned on or off. Specific apps can also be turned off for specific exams or subjects. The system is password protected so the user is unable to use blocked features. For school use, teachers can select the settings they want, disable any features, create a password and then beam this setting to all of the connected student Prime units, wirelessly. A series of bright LEDs light up in the same sequence while exam mode is engaged, and every setting has a unique configuration of lights.

Exam Mode allows the following:

- Give your configuration a name
- Set a time period
- Set a password
- Check a box to erase memory when examination mode starts

Check a box to make the LED lights blink while in examination mode.

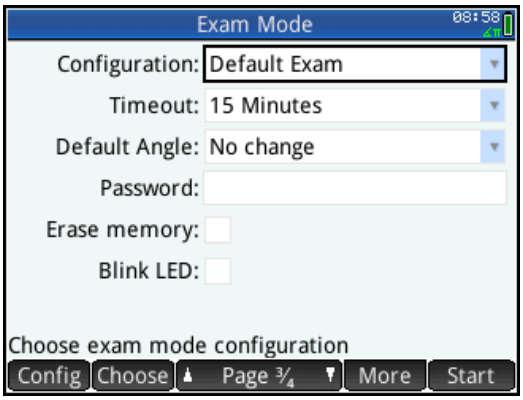

Fig. 6 – Exam mode options.

Wireless Connectivity for Formative Assessment

One of the most unique features of HP Prime is its ability to connect to PCs wirelessly. Transfer files via the included connectivity software or plug in a small USB dongle[2] into the top of the calculator. The teacher's computer will immediately recognize the dongle in class so files and settings can then be transferred wirelessly to the computer.

Additionally, HP Prime's screen can be shown on the teacher's screen. The class polling function allows the teacher to set a question from her computer for students to offer responses from their Prime units with the results shown in table and chart form. Many schools purchase individual polling systems but HP Prime has this as just one of its many features. Additionally, the **Wireless Connectivity Kit** is a plug-and-play system which works similarly to a Bluetooth pairing, which means no set up is required.

The Wireless Connectivity Kit has three panes:

- **Calculator Pane**: see the data on the connected calculator, edit apps, write programs, and synchronize the new data with the connected HP Prime calculator
- **Content Pane**: create and edit Exam Mode configurations, create polls and quizzes, etc.
- **Class Pane**: see all HP Prime displays in your classroom network, monitor students, send apps, data, polls, quizzes, share one student's display for discussion purposes, send and start an Exam Mode configuration to the entire class, etc.

Data Streaming

The **Data Streamer App** works with the HP StreamSmart 410 and up to four Fourier® sensors to collect data in real time. The final data set is sent to one of the two **Statistics Apps** (1-Var & 2 Var Statistics) for analysis. Just plug the microphone sensor into the StreamSmart 410 and start the Data Streamer App. The microphone is automatically identified. Tap to see your own voice in real time, and zoom in/out while data is still streaming.

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[2] *Wireless Connectivity Kit with included dongle sold separately, expected availability near the end of 2013.*

Fig. 7 is an example of the Data Streamer App in use. All this data you see was collected in 0.144 seconds-roughly 1/7 of a second!

HP Prime will be available in September around the new school year. This is only a fraction of what this calculator can do, for more information and to view the demo video please visit www.hp.com/go/calculators . If you want to play with HP Prime yourself, the virtual emulator is also available free to educators at http://www.hp.com/sbso/product/calculators-emulators/usemulator.html.

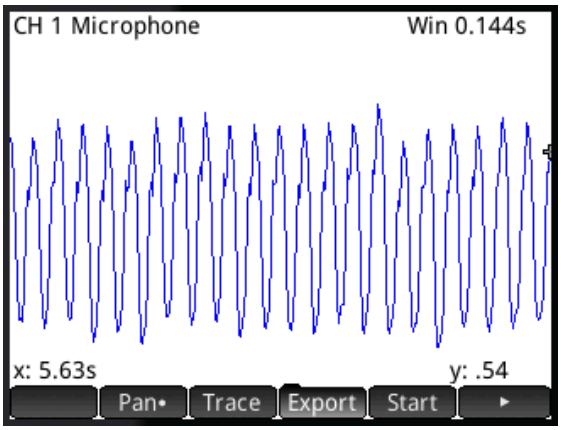

Fig. 7 – Captured sound waveform.

The Art of Science Learning

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The Art of Science Learning – Shaping the 21st Century Workforce
An Initiative in the Right Direction!

Laura Berlin

As a teacher and a mother I am naturally concerned about the world that is out there facing our youth. How do we prepare them to be happy, productive, contributing members of the 21st Century? How do we ensure they have a decent standard of living and quality of life? The world is changing quickly, the challenges are great and the future is uncertain. The jobs that our students will have do not even exist yet. How we prepare them for this unpredictable future will dictate not only their individual and collective successes in life, but also the future wellbeing of our nation and the world.

Predictions by organizations such as the Bureau of Labor (Occupational Outlook Handbook 2013) and the International Labor Organization show occupations in The S.T.E.M. (Science, Technology, Engineering and Mathematics) related fields to be among the highest paying and most important for solving the complicated problems our world will be facing in the coming years. The reports also show gross mismatch between skills of the workforce and those needed for productivity and success in these jobs. The challenge of our world's educators is to prepare our youth with the skills that will enable them to successfully perform these critical jobs, allowing us to improve the health of our economies, populations and planet.

This is truly a daunting challenge. As among infinite uncertainties, one thing is clear: the current education model is not working to adequately prepare our children for this rapidly changing world. Our present model, developed for the Industrial Revolution to meet the needs of industrialism is out dated and is squandering our children's talents. It is only allowing some of our students to be successful. It is dislocating people from their natural talents and not educating the whole child. It is causing many highly intelligent children to think that they are not. It is causing many students to avoid S.T.E.M. related education and careers. Intelligence is diverse. According to Sir Ken Robinson, creativity expert and featured speaker on *TED* (Technology, Education, Design) *Talks*, "humans learn and think about the world in all the ways we experience it: visually, with sound, kinesthetically, abstractly, and with movement". We need to value and utilize all these modalities in education. Not to do this is to fail to use all the tools in the human toolbox. We need all of our children to be successful!

We need to utilize all of our children's tools or "ways of learning" to best foster the skills they will need. But, what exactly are the skills they will need? S.T.E.M. related skills are important for our future world. S.T.E.M. occupations are projected to grow 17% through 2018. S.T.E.M. workers earn 26% higher wages than non-S.T.E.M. workers. S.T.E.M. workers are less likely to experience joblessness and if they do, they are quicker to find a new job than non-S.T.E.M. workers (www.girlstart.org.) But there are other, non-traditionally taught, skills that are just as important. Substantial research has been done to define and prioritize these skills. It has resulted in a list commonly referred to as the "21st Century Skills". At the top of the list are critical thinking and problem solving, creativity and innovation, communication and

Fig. 1 – Eagerly learning students are successful.

collaboration, visual literacy, scientific and numerical literacy, and cross-disciplinary thinking (Partnership for 21st Century Skills Framework, www.21stcenturyskills.org). According to *The New American Workplace,* a book by James O'Toole and Edward Lawler, nearly two-thirds of U.S. wealth in 2006 was generated by information services [as opposed to material goods]. This figure continues to increase. Job structure is changing away from the traditional top-down hierarchy. Now there is less supervision, more autonomy, more collaboration, and less predictability. Globally competitive companies realize that human capital is their most important resource. Firms are looking for employees that are independent problem solvers and, as described by CEO of UPS in 2005, "who can learn how to learn". Harvey Seifter reports in his project, *The Art of Science Learning*, 400 major corporations were surveyed and identified communication, teamwork and creativity as the top three most important employee skills needed for their company's competitiveness. However, these same companies reported that only twenty to twenty three percent of their employees possess these skills at the level needed.

Is there anything happening in education to address these issues?

Is there anything happening that is using a variety of learning modalities to motivate and inspire more students to pursue S.T.E.M. learning in the context of practicing 21st century skills such as communication, collaboration, innovation and problem-solving?

Happily, the answer is yes!

One of the most exciting recent developments is the above-mentioned project, ***The Art of Science Learning: Shaping the 21st Century Workforce.*** Founded, investigated and directed by Harvey Seifter, this initiative, funded by the National Science Foundation, began its "Phase 1" in 2011 and involves three U.S. cities: San Diego, Chicago and Worchester, Massachusetts.

This project responds to the increasing demand for a workforce that is skilled in creative, interdisciplinary and collaborative approaches to innovation, as well as one that is scientifically and mathematically literate. It aims to build on the successful bodies of experience of forward thinking leaders and fortune 500 companies who have turned to arts-based strategies, to enhance collaboration and communication for management and employees as well as for organizational resources to strengthen creative and innovation processes. These leaders recognize the profound implications for the future of failing to be competitive in the global economy.

Fig. 2 – The 21st Century requires advanced skills.

Major objectives of the **Art of Science Learning** project are to implement and investigate the effectiveness of arts-based learning methods as a way to:

- Generate innovation in the field of informal science learning
- Strengthen the innovation skills of S.T.E.M. learners and professionals
- Enhance the innovativeness of cross-disciplinary teams
- Foster S.T.E.M. engagement in the general public

Phase 1 of the project, "Building Communities of Practice" convened more than 400 scientists, artists,educators, researchers, business leaders and policy makers at the Smithsonian Institute, Illinois Institute of Technology, and Calit2 at UCSD in San Diego. These groups collaborated to explore connections among arts-based learning and scientific innovation. Lessons learned from Phase 1 will be applied to Phase 2, "Incubators for Innovation".

Presently in the first year of Phase 2, the next four years of the project will focus on processes to bring about the development of:

- **A Curriculum** that uses arts-based learning to teach innovation to cross-disciplinary and multi-generational learners;

- **Three Arts-based Incubators for S.T.E.M. Innovation** at San Diego's Balboa Park Cultural Partnership, Chicago's Museum of Science and Industry and Worcester's EcoTarium;

- **Experimental Research** to measure the impact of arts-based learning on the creativity, collaborative behavior and innovation outputs of S.T.E.M. learners;

- **An Experiential Exhibition** in San Diego about art, science, and innovation, co- created with the Fleet Science Center, to open with the 2015 Balboa Park Centennial celebration. The exhibit will travel to the other incubator cities and then tour the country to reach national audiences with compelling stories about creativity at the intersection of art, science and learning.

Currently, San Diego's Balboa Park Cultural Partnership is in the process of selecting participants for **San Diego's Incubator for S.T.E.M. Innovation.** Applications for participation were due by June 20, 2013. 100 people with diverse interests and expertise will be selected from the applicants for a year-long program where they will be divided into teams, trained by national and local expert faculty in visual and performing arts-based strategies, work on developing programs and products that address San Diego's Civic Challenge, "the mismatch of our water supply and demand", and develop S.T.E.M. curriculum inspired by the arts.

Quantitative and ethnographic data gathering and research will be conducted. It is anticipated that innovative, effective programs and products addressing San Diego's water problems will be developed and brought to market. Community events, festivals and workshops will draw people together for fun, learning, and realizing new possibilities (www.bpcp.org , www.theartofsciencelearning.org).

The participants of the Incubators for Innovation teams will be selected by September of 2013 and will begin their training in October of 2013. After months of training, they will begin to apply the arts-based innovation to the

S.T.E.M. related challenges of San Diego's water supply. In addition to the Innovative Incubator team participants, there are other opportunities to participate in the project. There will be opportunities to partner or participate in community events, host Incubator meetings, classes, or workshops, create a temporary innovation prototype gallery, performance or exhibit lab, or develop collaborations with "Art of Science Learning" national partners. National partners include the American Association for the Advancement of Science, Americans for the Arts, and the Association of Science-Technology.

For more information about The Art of Science Learning project or how to get involved, please see the NSF's grant announcement or contact: info@artofsciencelearning.org

Nan Renner is the Director of San Diego Incubator for Innovation, Balboa Park Cultural Partnership. (619) 232-7502 ext. 1210.
Amanda Sincavage is the San Diego Incubator Administrator. Aly Evans is the National Project Manager.

Recent research is showing that creativity is not the special talent of a few, but a quality that can be nourished and encouraged in us all. Increasingly, it is understood that one learns through the hand and body as well as through the mind and that hands-on experience is an essential element in developing the creative imagination (www.artofsciencelearning.org/the-arts-can-help-bridge-the-innovation-gap.html). This is welcomed news as we are discovering that creativity is an essential and critical skill of today and tomorrow's workers.

The Art of Science Learning: Shaping the 21st Century Initiative is providing a thoughtful, creative, interdisciplinary approach into science education. The knowledge gained from this project has the potential to make the study of science more attractive and inspiring to students, enhance the scientific literacy of the American people, and ensure a higher level of creativity and innovation across the 21st-century American workforce.

As a mother and a teacher, I feel good about this direction!

About the Author

Laura. Berlin is a visual arts teacher and department head at Clairemont High School in San Diego. She holds Single Subject Teaching Credentials in Visual Art and English and a Masters Degree in Technology and Learning.

Global STEMx Education Conference

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There is a growing demand for improving STEMx* learning around the world, requiring new ways of thinking about STEMx education. The world's first massively open online conference for STEMx educators, The Global STEMx Education Conference takes place September 19-21, 2013. It is a **new, free opportunity** for primary, secondary, and tertiary (K16) educators around the world to share and learn about innovative approaches to STEMx learning and teaching.

You don't want to miss it, and you don't need to miss it.

Accessible 24/7 – wherever you can connect

The STEMxCon will be a highly inclusive and engaging event featuring live presentations 24 hours a day to accommodate teachers, education visionaries, and education policy leaders from around the world. Presentations are conducted online with a live audience, and are recorded for future viewing. The conference is organized in English, but presentations may be conducted in other languages. It is free to 'attend' at anytime over the 3-days.

Have an interesting approach to STEMx teaching? Then look at Call for Presentation Proposals where ideas for presentation within the conference strands are accepted until 1st September.

STEMxCon builds on HP's commitment supporting innovative teaching and learning through the HP Catalyst Initiative. HP is serving as the founding sponsor, and core conference support also comes from our partner International Society for Technology in Education (ISTE).

Registration is free

Sign up on the conference community website to be kept informed. Tell other teaching colleagues and educators about this global, around-the-clock learning opportunity.

For further updates, join the STEMxCon network and follow us on Twitter @STEMxCon and #**stemxcon**

What is the x in STEMxCon? The Science, Technology, Engineering, and Mathematics acronym is no longer adequate, as it is missing well over 20 letters that represent key skills & disciplines. As such, x = Computer Science (CS), Computational Thinking (CT), Inquiry (I), Creativity & Innovation (CI), Global Fluency (GF), Collaboration (C), and other emerging disciplines and 21st century skills.

A Change in Learning

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A Change in Learning

Kevin Fitzpatrick

I began my career teaching 6th grade in a small Catholic school, in the Bronx, NY in 1975. The only technology I had access to then was the infamous "ditto" machine that produced wet, blue copies that I could either write or type on and then run through the machine. At that time teaching was "I lecture, you take notes, you replicate the process", the "sage on the stage" dictating to the (hopefully) enrapt throng of youngsters hungry for the daily pearls of wisdom that I would see fit to share each day. Classroom technology began and ended with chalk and chalkboards and the very high tech filmstrip projector. After a brief detour for a year and a half as an Operations Analyst in the NYC financial district, I resumed my teaching career at the high school level where I remained until deciding to retire in October of 2012. Along the road, while the fundamental tenets of mathematics remained unchanged for hundreds, if not thousands of years, the approaches to teaching and learning and the evolution of technology have undergone a significant transformation.

In the summer of 1989 I attended a weeklong program at Ohio State where I was introduced, for the first time, to a graphing calculator and how it might change the way high school mathematics was taught and learned. It was truly an eye-opening week, and with the support of some very open-minded people at Greenwich High School, I was given the opportunity to run a pilot class using this new approach. It caught on very quickly, so much so that the parents of the kids in the other sections were asking why their children were not learning this way. That helped things move along very quickly and within three years graphing calculators had made their way into the entire mathematics curriculum at Greenwich High, being required in all courses from Algebra I on up. With the HP48 series the calculator preferred by the majority of my BC Calculus students. For the past twenty years, teaching and learning mathematics has benefited from the acceptance and use of handheld calculators that open the door to mathematics for those who may not be symbolically inclined. Everyone was now able to visualize, test thoughts, and look to see what might be happening. All students could follow a string of computations because of a machine that does not judge what you are doing, but simply and quickly, gives you a result. Even if that result is an error message, it adds to the fun of learning. Another great benefit has been that graphing calculators came along at the same time as portable music and computers were talking real roots in the culture. Ownership and mobility were keynotes of devices that the average high school student was looking for and these fit the bill nicely.

Fig. 1 – Teaching in any environment.

Students moving up from middle to high school now had to learn about the basics of the graphing calculator, as they were still not widely accepted in all but an occasional honors track, even though the device itself enabled topics to be broached earlier in the curriculum. The occasional ninth grade student who arrived with a working knowledge of a machine would always pleasantly surprise me, but I always had to assume that it was a group starting from scratch and would teach that way. I can't put my finger on exactly when that changed, but it has changed dramatically. Most incoming high school students now have at least one portable device, either a phone or a tablet, that makes the former graphing calculator about as "current" as a ditto machine would be in a copier world. They arrive fully versed in the uses of the devices, far more so than most of the faculty of an average school,

especially those "seasoned" teachers who have 10 or more years in the classroom. The challenge became making the learning of mathematics alive and viable (and somehow in their minds necessary) while making sure to incorporate things that they use everyday, learning their language and using it and not asking them to put things aside to wallow in antiquity. Having done that for a long time, and having looked at the middle school as "behind the times" in that regard, I am now in an interesting position. I retired in 2012 from high school mathematics teaching, but after doing a little substituting, I was asked to teach three sections at a middle school just down the road from my home. One each of 6^{th}, 7^{th}, 8^{th} grade each an honors track. I agreed to do it, thinking that it was now time to work with the younger students, to see if what I've thought all these years was really appropriate, I will get to see first hand if using graphing calculators as early as 6^{th} grade, especially with all the advances they had made over the years, would add to the interest and fun of learning mathematics during a time where seemingly there is a drop off in interest in the subject. The important part will be no different than it was back in the early 90's at the high school level; we must make the devices tools to be used to advance creativity and comprehension, not something that is simply used as a quick answer giver.

The topics in the middle school also would seem to be a great place to "play" with the technology. A solid emphasis on Statistics and Geometry adds to the need to think creatively and offer different ways to learn and approach material. The additions of statistical and geometrical applications on graphing calculators would seem to make it the perfect supplementary tool for students already well versed in the portable, technological universe. The feeling has been that the middle school mathematics student is still building skills and the use of graphing calculators specifically, will keep that skill building from being effective. My experience, having been in the mix for the past twenty five years, is that most often, it is quite the opposite. The opening up of the material to the visual and numerical learners adds levels of successes that keep more students interested in the subject, allow for more connections across disciplines should only strengthen the skills long term. Just like using a pen instead of a pencil, the tool is not the culprit, it is the recognition and effective use of the tool that either helps or hurts the process. I have an opportunity to test these ideas I have been given carte blanche by the administration to do what I think will work, to be able to choose one or more devices for student use. It's an exciting time for this old dog who, hopefully will be taught a number of new tricks by kids who are curious and hungry to learn. This is the beginning of a brand new journey for me and one thing I've discovered over the years is to keep an open mind and be ready to learn from the kids as they have much to teach…to be continued.

About the Author

Kevin Fitzpatrick has over 35 years of teaching experience in high school mathematics, teaching in subjects from Pre-Algebra to Geometry and AP Calculus. He has participated in various technology projects and programs throughout the years for companies including Hewlett-Packard, Casio and Texas Instruments. He actively participates in mathematical publications and holds NYS and CT certifications for 7-12 mathematics. Additionally, Kevin has an M.A. in Mathematics Education from Colgate University and five post-graduates degrees from acclaimed universities across the United States.

An Education Innovation: HP Catalyst Academy

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An Education Innovation: HP Catalyst Academy

Helping meet the demand for highly qualified "STEM" teachers

In this 21st century, we know there are science and technology challenges and the ability to respond, solve and think through these issues is pressing. These issues require creativity; collaboration; and literacy in **s**cience, **t**echnology, **e**ngineering, **m**ath, and other critical skills (called "STEMx" skills).

We know the need for STEMx educators is critical; most of the 30 fastest-growing occupations in the next decade will require a solid background in STEM education, yet around the world, the demand for high-quality STEMx teachers is outpacing existing teacher training systems.

At the annual conference of the International Society for Technology in Education (ISTE), HP and its partners, introduced - HP CATALYST ACADEMY - a ground-breaking initiative designed to meet the demand for qualified STEMx educators.

Teacher professional development in a manageable way

HP Catalyst Academy is an exciting approach to online professional development: practical, forward-thinking, and free. Partners include New Media Consortium and ISTE.

The Catalyst Academy's mini-courses are for teachers, who don't have enough time to take full courses and don't learn enough from typical webinars. Participants receive recognition of their professional development through an open-badging platform: each mini-course offers progress badges, to acknowledge the educators' improved skills.

Courses are designed by Catalyst Academy Fellows—established STEMx trailblazers. They cover a range of topics; examples include social media for STEMx (taught via Facebook), game design, environmental science in action, app design, global citizenship and environmental stewardship, geospatial technologies, and digital fabrication.

"I'm really excited about where this is going," said Jim Vanides, global education project manager, HP. "We have wonderful Catalyst Academy Fellows, and their courses sound fantastic. I can't wait to see how this grows."

Learn more and register for free courses at HP Catalyst Academy. Tell other teachers about this free, online learning opportunity.

Like HP Catalyst on Facebook.

Watch these videos:

- Expert advisors discuss their work and why it is important.
- Get to know the HP Catalyst Academy (Academy fellows talk about their new mini-courses.)

Making a Difference: The Power of HP Volunteers

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Making a Difference: The Power of HP Volunteers

HP employees are always encouraged to give some of their time back to the community through various kinds of volunteer efforts. Empowering students with the tools they need to succeed in the future is one key area of focus.

Motivating students and teachers in Chile

HP Chile recently focused its volunteer efforts on the city of Paine, where the HP Chile data center is located. Paine includes a substantial rural population where children grow up at considerable social risk. Typically in rural Chile, youngsters find school boring and dull; they don't see tertiary education as a real option, and they have low expectations for their future.

HP Chile volunteers decided to help schools in the city of Paine, and selected six on the basis of educational opportunities and needs: El Transito, Barbara Kast, Maria Carvajal, Gregorio Morales, Javier Eyzaguirre, and Culitrin.

Throughout the month of May, volunteers got involved in four different ways:

- HP Chile volunteers increased the environmental awareness of more than 100 pre-school and elementary schoolchildren by finding new ways to create games and toys with recycled materials; and nature discovery activities (a bean plant experiment taught youngsters about the world around them and the cycle of life).
- More than 200 secondary school students gained hope for their future by attending motivational, leadership, and entrepreneurship workshops run by HP Chile volunteers. Employees helped these teenagers to identify and develop leadership skills, discussed case studies on successful Chilean entrepreneurs, and explored concepts such as added value.
- Employees also delivered interactive workshops on MS PowerPoint and Excel to 40 teachers from the schools. These teachers enjoyed learning computing skills relevant to their daily work – how to achieve a high-impact presentation and how to use formulae, create charts, and more.
- In addition, HP volunteers upgraded school equipment and infrastructure, and technical support staff provided software, hardware, and networking services.

The HP volunteer effort was deeply appreciated: "It was a significant contribution for my teachers and students; we could feel the warmth and empathy in every moment," said José A. Tasso, of the Paine Education department.

The Paine education community can count on HP Chile in the future as well – volunteers hope to develop and deepen this fantastic relationship.

Morocco's new student entrepreneurs

There's a stark reality in Morocco -- 50% of middle school students will quit school and never return. But thanks to HP Morocco employees, more than 350 students in the city of Casablanca learned the basics of starting a business. These skills could give a very real-life boost to the ability of these students to earn a living.

The employees delivered Jr. Achievement Morocco's Entrepreneurship Master Class program to students between the ages of 14 and 16 attending senior school in Casablanca.

"Our goal was to introduce students to entrepreneurship and provide them with an alternative to violence and delinquency," says Amal Abahmaoui, Enterprise Group, EMEA. "Although we stressed the importance of continuing studies until at least until the end of high school, we also recognized the reality that only 50% of students in their senior year will continue their studies. The rest will leave. Some of these young people will go on to work with their parents, while others will simply wander

"We were there to tell them that they can start a small activity by selling clothes, food, electronics, etc. and make a profit - and therefore a decent living – by starting a small business."

The course taught students the basics of how to create their own companies. HP employees started the exercise by explaining how companies choose a name and logo, using HP as an example. The students were then divided into small groups. Each group chose a name and a logo and had to explain why they made their choice.

The employees then introduced and explained the functions of key departments and roles in a company—finance, marketing, operations, human resources, etc. The students were then asked to list their main strengths, and then match them to the most relevant job qualification – students good in math might choose to be a CFO; natural leaders might choose to be a CEO.

Afterwards, the students learned some basic business skills. They computed fixed and variable costs to determine how much money they would need to buy raw materials to produce 1,000 "wish cards". Then they virtually "bought" the raw materials to produce a sample of their wish card. Depending on the cost computed, on the effort invested in the card and on how much competition there was from other groups, they then chose a price to charge for each card. At the end of the exercise, one group was chosen as a winner in each class.

"We are extremely proud of this event," says Amal. "We received very positive feedback from both the students and the volunteers. Although this is a one-day program, several students have asked us if we could come back and do another entrepreneurship day."

This event might well have sown seeds that will enable disadvantaged youth to bloom and go on to lead productive lives.

To learn more about HP Volunteer efforts please visit http://www8.hp.com/us/en/hp-information/social-innovation/volunteerism.html

My Favorite HP Prime Functions

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My Favorite HP Prime Functions

Namir Shammas

Introduction

HP has chosen to launch the new HP Prime using much publicity and fanfare. This type of promotion seems to indicate that HP is committed to producing calculators that once again will lead the pack of calculator manufacturers. In fact, beta versions of the emulator for the HP Prime were released to the interested public. HP has benefited from this strategy by collecting valuable suggestions and bug reports. All of this feedback aims at raising the users' anticipation for the new product and reducing bugs in the new graphing calculator.

The HP Prime graphing calculator is essentially a handheld mathematical beast! The product packs a lot of punch. The documentation for the HP Prime runs over 600 pages, discussing a whole myriad of features, apps, and built-in functions.

The HP Prime operates in two major modes, namely the Home mode and CAS mode. When you press the **Menu** button (located under the **Num** button) you get the **Math** menu (that supports Home-mode functions), the **CAS** menu, and other menus. I will discuss groups of functions that are in both the Home and CAS modes, which I found to be interesting. I will give very brief examples for these functions. My aim is to give you a taste and whet your appetite if you have not been already exposed to the HP Prime. The list of functions that I cover is purely subjective and somewhat arbitrary, influenced by functions that I have used in the past.

The Probability Functions

Figure 1 shows the probability functions that are part of the **Math** menu. Note the last three submenus in the **Probability** menu—the **Density**, **Cumulative**, and **Inverse**. All three submenus yield similar options to work with the Normal, Student-t, Chi-Square, Snedecor's F, Binomial, and Poisson distributions.

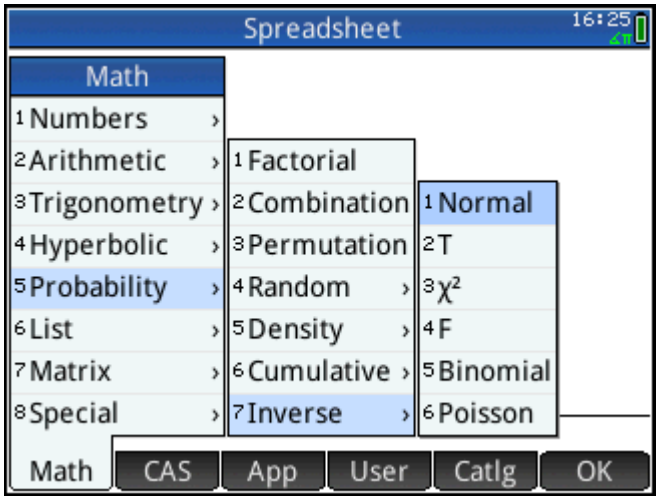

Figure 1 – The Probability Functions.

Of particular interest to all who perform statistical hypothesis calculations are the Normal, Student-t, Chi-Square, and Snedecor's F inverse cumulative distribution functions (which I will abbreviate using ICDF). These functions replace legacy tables of ICDF values found in just about every statistical book. Using the ICDFs allows you to wave goodbye to the legacy ICDF tables. Figure 2 shows examples for the Normal

and Student-t ICDFs. The figure shows the Normal ICDF for a distribution with a mean of 0, standard deviation of 1, and probability of 0.75. In addition, the figure shows the Student-t ICDF for a distribution with 10 degrees of freedom and 0.75 probability.

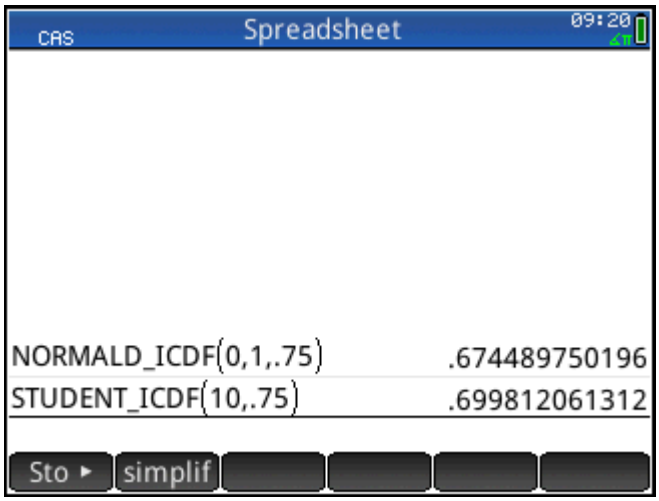

Figure 2 – Using the Normal and Student ICDFs.

The Matrix Functions

The **Math** menu offers you a plethora of matrix functions that seasoned users of programmable calculators would have only dreamt of having some 30 or 40 years ago. Figure 3 shows the **Matrix** menu with it submenus, showing the options for the **Create** submenu. I found the **Random** and **Vandermonde** functions to be interesting. The latter function creates a matrix **X** that can be used with a vector **y** to calculate the coefficients of a polynomial. The number of columns in the Vandermode matrix equals the order of the resulting polynomial plus one.

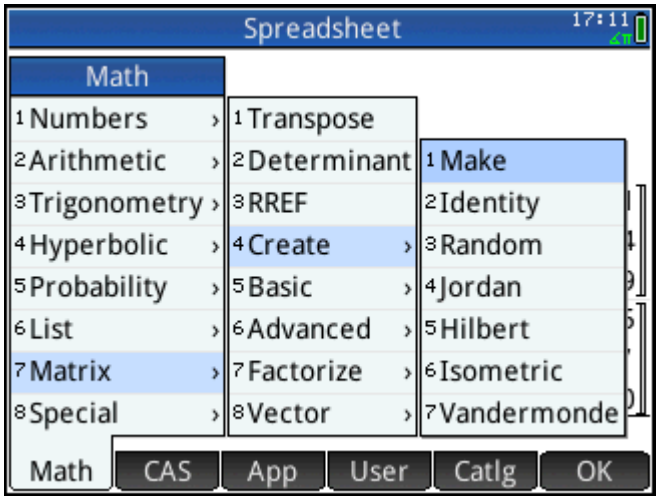

Figure 3 – The Create submenu Functions.

Figure 4 shows sample calls to functions **vandermonde** and **RANDMAT**. The call to function **vandermonde** supplies an argument that is an array of three values of x. The function returns a Vandermonde matrix where the first column has 1s, the second column has values that match the input

array, and the third column has values that are the squares of the input array. The call to function **RANDMAT** specifies that the output matrix is **M1** having a 3 by 3 matrix of random integers with values between -99 and 99.

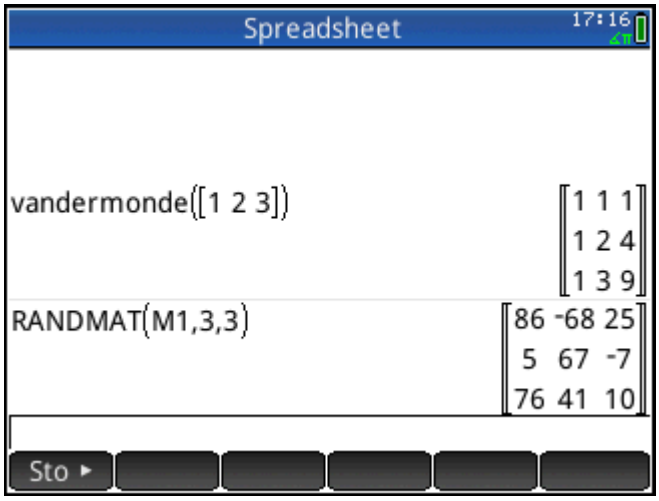

Figure 4 – Sample calls to function vandermonde and RANDMAT.

The **Matrix** menu has the **Basic** submenu that calculates various types of norms and matrix properties. I find the **Norm** and **Condition** functions to be very interesting. The **Norm** function is usually used to calculate a summary of errors in iterative calculations (like optimization problems and the iterative solutions of very large systems of linear equations). The **Condition** function (which is a bit complex to implement from scratch) returns the condition of a matrix. This value indicates how easy it is for the matrix to yield solutions of linear equations. The lower the condition number is, the easier it is to solve a system of linear equations with the matrix. Figure 5 shows a call to the **COND** function using the matrix **M1**. The figure also shows the calculation of the norm of matrix **M1**.

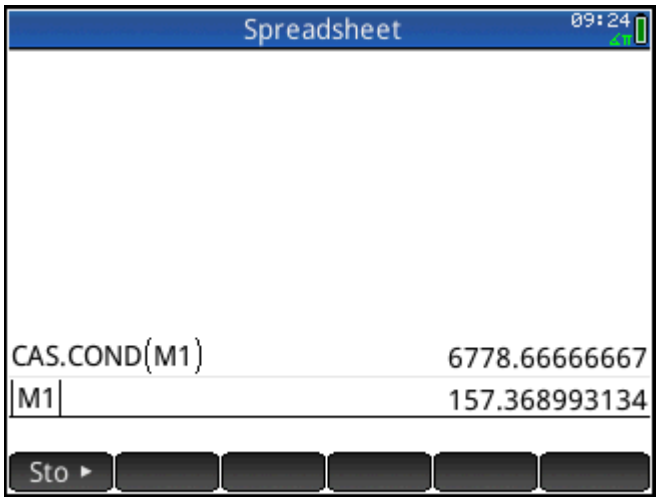

Figure 5 – Using the COND and norm functions.

The **Matrix** menu has the **Factorize** submenu that calculates various types of factorized matrices. I find the **LSQ**, **LU**, **QR**, and **SVD** to be versatile and powerful functions. Regarding the **LSQ** function, this function returns the least-squares regression coefficients of an independent-variable matrix **X** and a

dependent-variable vector **y**. The January 2013 issue of *HP Solve* presented a series of four articles, aimed at the HP39gII, that show you how powerful and versatile function **LSQ** is. The functions **LU**, **QR**, and **SVD** perform various kinds of matrix factorizations used in solving systems of linear equations. The functions **QR** and **SVD** handle difficult factorization cases. Here is an example for using function **LU** with matrix **M1** that I created earlier. The **LU** function factorizes the matrix argument into a lower matrix L, upper matrix U, and index matrix P. Typing **LU(M1)** at the command line yields Figures 6 and 7 which show the three output matrices.

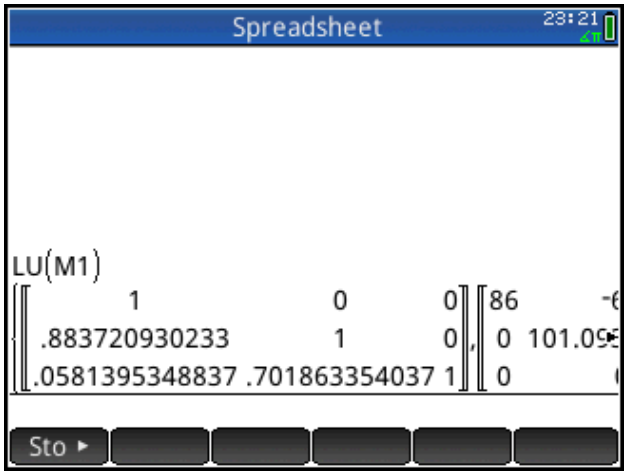

Figure 6 – Sample call to function LU showing output matrix L.

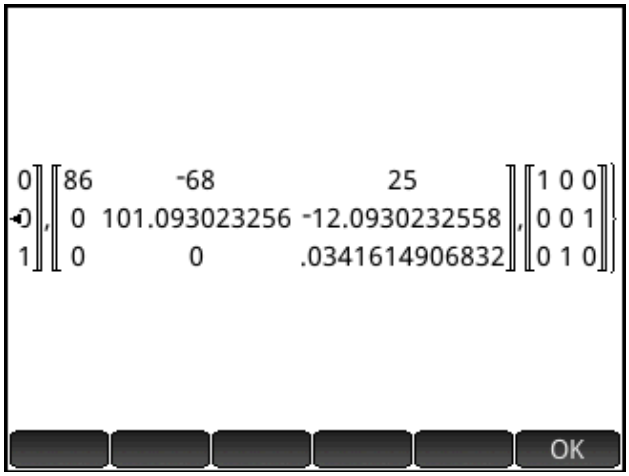

Figure 7 – Sample call to function LU showing output matrices U and P.

You can combine the **vandermonde** and **LSQ** functions in the following short program to calculate the coefficient of an interpolating polynomial. The order of that polynomial is equal to the number of data points minus one. The program **VandPoly** is:

```
EXPORT VandPoly(x,y)
BEGIN
  LOCAL xm;
  xm:=CAS.vandermonde(x);
  RETURN LSQ(xm,y);
END;
```

As an example, I can use the program **VandPoly** to calculate the coefficients of the quadratic polynomial that passes through the three points (1, 6), (2, 11), and (3, 18). By executing the following command:

```
VandPoly([1 2 3][6 11 18])
```

I get the array [3 2 1] which means that the interpolating quadratic polynomial is:

$y = 3 + 2x + x^2$

The Special Functions

The **Math** menu has the **Special** submenu which offers special functions. These functions are the Beta, Gamma, Psi, Zeta, error function, complimentary error function, exponential integral, sine integral, and cosine integral. The Gamma and error function are perhaps the most popular functions in the list. Figure 8 shows sample calls to most of the functions in the **Special** submenu.

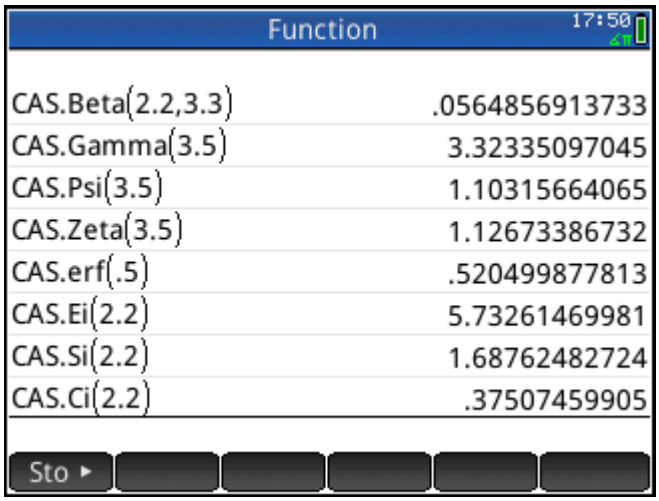

Figure 8 – Sample calls to functions in the Special submenu.

Working with the Solve Functions

The **CAS** menu has several submenus, including the **Solve** submenu. Figure 9 shows the **Solve** submenu. This submenu offers functions that solve for the roots of polynomials, general equations, differential equations, and systems of linear equations.

Figure 10 shows sample calls to various root-seeking functions that calculate the roots of polynomials and non-polynomials. The first few function calls solve for the real and complex roots of polynomials. The last two calls invoke function **nSolve** to numerically calculate the two different roots for the equation exp(x)-3*x^2=0 at near the initial guesses of 5 and -1.

Working with the Polynomial Functions

Figure 11 shows the options for the **Special** submenu. These options support various kinds of particular polynomials. Among them are the Hermite, Lagrange, Laguerre, Legendre, and Chebyshev orthogonal polynomials. These polynomials represent the solutions for various classes of ordinary differential equations. They also play a key role in the various types of Gaussian quadrature. By solving for the roots of these orthogonal polynomials you can calculate the nodes (also known as abscissa points) and their

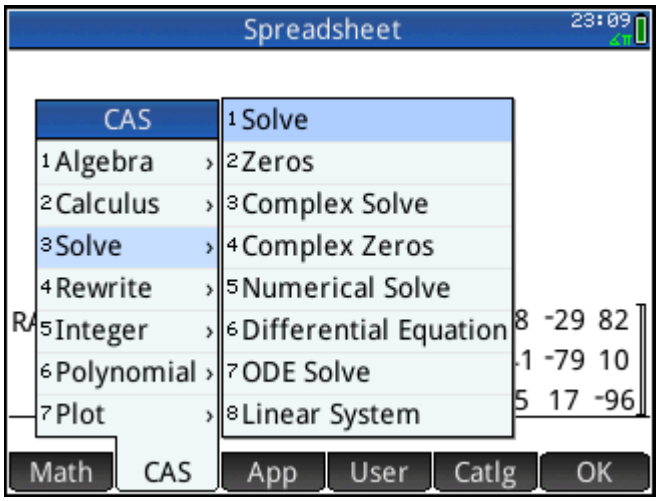

Figure 9 – The Solve submenu.

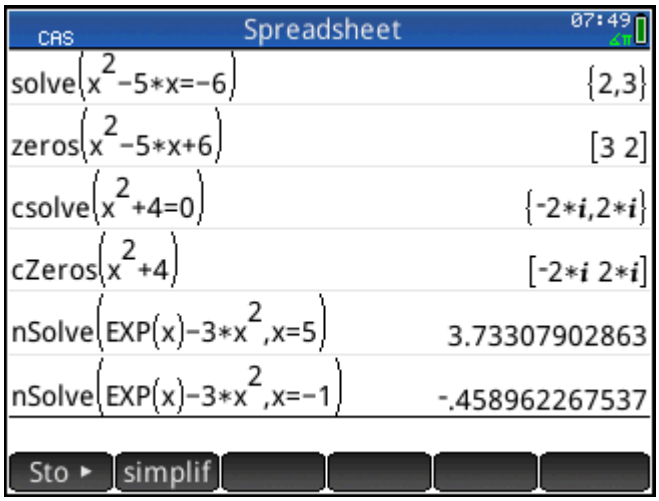

Figure 10 – Calculating the roots for various equations.

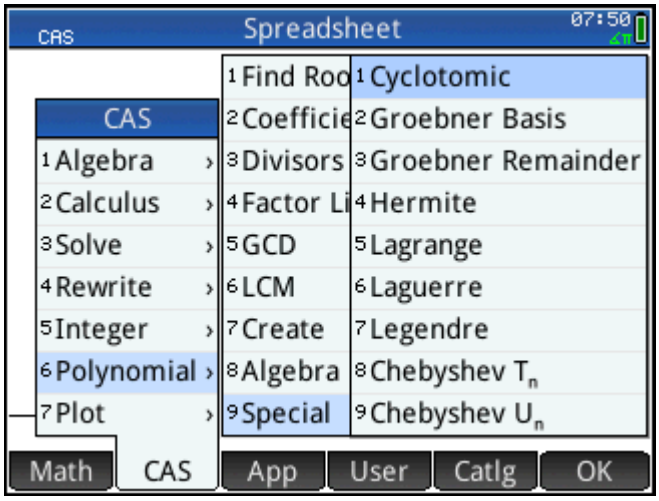

Figure 11 – The special polynomials.

associated weights used in evaluating the Gaussian quadrature. The HP Prime allows you to use these functions to obtain the polynomial equation for the order you specify. Alternatively, you can include a value for the polynomial and have the function return a value. The HP Prime is the first calculator that supports the above orthogonal polynomials.

Figure 12 shows sample calls to the Hermite polynomial. The first call requests that the calculator returns the polynomial expression for the 5th order Hermite polynomial. The second call includes the value for x and tells the calculator to return 5th order Hermite polynomial evaluated at x=1. The last command tells the calculator to simplify the previous result and give us a single number.

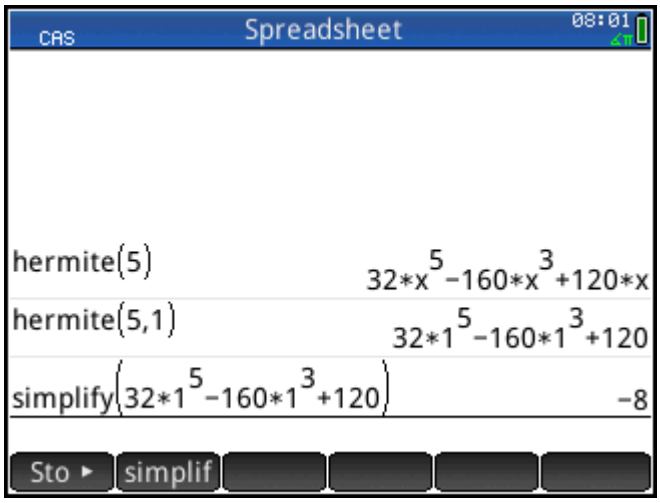

Figure 12 – Sample calls to the Hermite function.

Symbolic Differentiation and Integration Functions

The **CAS** menu has the **Calculus** menu, shown in Figure 13, which shows several submenus for various calculation operations. The first two options are among the ones that I find very interesting, allowing the CAS system to do best what we expect it to.

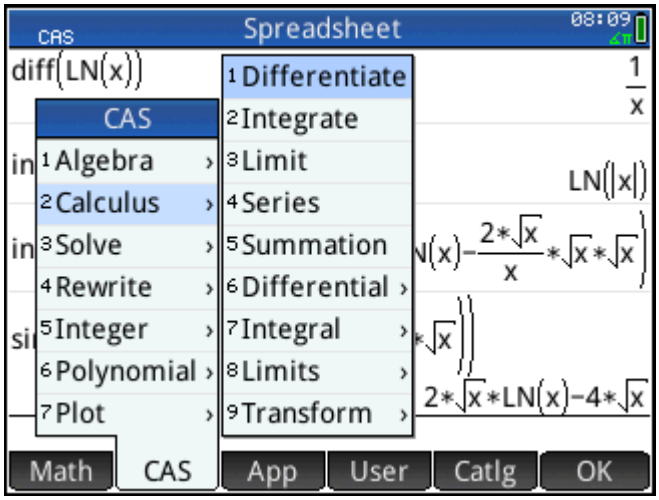

Figure 13 – The Calculus menu and its submenus.

Figure 14 shows examples for symbolic differentiation and integration. The call to the **diff** function returns 1/x as the derivative of the natural logarithm. The call to the integral function **int** integrates 1/x to yield the natural logarithm. The second call to function **int** integrates the function LN(x)/√x to yield 2(√x*LN(X)-2*√x/x*√x*√x). The figure shows that I used the **simplify** menu to simplify the last result into 2*(√x*LN(X)-4*√x).

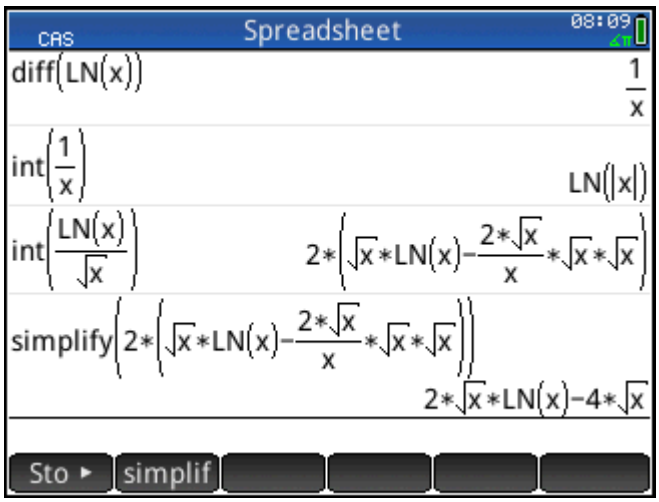

Figure 14 – Performing symbolic differentiation and integration.

Using the HP Prime Emulator as an SDK

The HP Prime emulator is a valuable tool in developing programs for the HP Prime calculator. You can use your favorite text editor on your PC to create the source code programs as text files. These text files also serve as backup. When you create a new program in the emulator, you can delete the skeleton code that the emulator inserts and copy the source code from your text editor into the emulator using the **Edit** | **Paste** menu option. Once you make sure that the program in the emulator is bug free and works the way you want it, you are ready to transfer your program to the physical calculator. You connect the physical HP Prime calculator to your PC via the supplied USB cable. Clicking the **Send** menu on the emulator sends the currently selected program effortlessly to the physical HP Prime. You are now ready to run your new program on the physical calculator!

Observations and Conclusions

The HP Prime packs some serious punch by supporting various features, operations, apps, and functions. This article gave you a small taste of the functions built-in the HP Prime. This new graphing machine brings with it new graphing features and new functions not available on any other hand-held calculator.

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About the Author

Namir Shammas is a native of Baghdad, Iraq. He resides in Richmond, Virginia, USA. Namir graduated with a degree in Chemical Engineering from the University of Baghdad. He also received a master degree in Chemical Engineering from the University of Michigan, Ann Arbor. He worked for a few years in the field of water treatment before focusing for 17 years on writing programming books and articles. Later he worked in corporate technical documentation. He is a big fan of HP calculators and collects many vintage models. His hobbies also include traveling, music, movies (especially French movies), chemistry, cosmology, Jungian psychology, mythology, statistics, and math. As a former PPC and CHHU member, Namir enjoys attending the HHC conferences. Email me at: nshammas@aol.com

From The Editor

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From The Editor – Issue 32

It is really big news when a student's educational tool makes a giant leap forward in capability. And that is the news being reported on (and held up by) in this issue. I am speaking of the new HP Prime advanced graphing calculator with a very powerful CAS and beautiful packaging with a 3.5 inch bright multi-touch color screen.

Here is the content of this issue

S01 – The New HP Prime Graphing Calculator by Chris Olley, Jessica Cespedes & GT Springer. HP advances its calculator line up with what I call a Gen5 calculator that certainly puts it way out in front of every other machine on the market. Here is a tabulation of what I call the generations.

HP Calculator Generations with Programming Techniques

Date	Model	GEN	Prog. Techinque	Remarks
JAN 1972	HP-35A	History	None	Made advanced calculations possible for everyone.
JAN 1974	HP-65A	**Gen1**	RPN with keycodes	Added programmability, sharing, technical equalizing.
JUL 1979	HP-41C	**Gen2**	RPN with named cmds	Added alphanumeric, expandability, interfacing.
AUG 1982	HP-75/71	**Gen3**	BASIC & Forth	added numerical accuracy, computer language.
JUN 1986	HP28⇒50	**Gen4**	RPL	Added symbolic math, more memory, more speed, I/O, less $.
APR 2013	HP Prime	**Gen5**	New, similar to Pascal	Adds Multi-touch color screen, super graphing, CAS, RPN, icons.

S02 – The Art of Science learning – Shaping the 21st Century Workforce, An Initiative in the Right Direction by Laura Berlin describes a variety of learning modalities to inspire students to pursue S.T.E.M. learning, especially developing the skills of communication, collaboration, innovation and problem-solving.

S03 – A Change in Learning by Kevin Fitzpatrick. As a retired teacher Kevin relates his experience of returning to the classroom to follow up on his 1989 first use of an HP graphing calculator in the classroom. He found that the technology is changing rapidly but the student's fun and their teaching the teacher is still alive and well.

S04 – The Global 2013 STEMx Eeucation Conference by HP is described. The easy Accessibility, Free Registration, and What-is details are provided with links.

S05 – An Education Innovation: HP Catalyst Academy by HP provides information on an HP Professional Learning Network for Teachers.

S06 – Making a Difference: The Power of HP Volunteers by HP. HP people do volunteer work to motivate students and teachers in Chile.

S07 –My Favorite HP Prime Functions by Namir Shammas is our technical article for this issue. His favorite Probability functions, Matrix functions, Special functions, Symbolic Differentiation and Integration functions, are described. Namir also includes working with the Solve functions and Polynomial functions and finishes with a brief description of using the HP Prime Emulator as an SDK.

S08 – Regular/assorted Columns

- **From the editor.**
- ***HP Solve* Index by Jake Schwartz.**
- **HHC Conference at Ft. Collins.**

That is it for this issue. We hope you enjoy it. Write us with your ideas for future topics including being an author yourself at: hpsolve@hp.com or rjnelsoncf@cox.net

Richard J. Nelson – Technical Editor.

HP Solve Issue Index

Jake Schwartz is an active and longtime HP User Community historian and tabulator of HP Calculator trivia. He has prepared an Index of all previous ***HP Solve*** issues recording the Author, article Type, Issue number, HP calculator Model mentioned, and Title. Each of these five column heading are sorted so you my easily find any article that you may remember seeing in ***HP Solve***. There are several ***HP Solve*** articles that have information that you simply cannot find in any other source. The Index link may be found on the HP Calculator ***HP Solve*** website.

http://h20331.www2.hp.com/Hpsub/cache/580500-0-0-225-121.html

If you are reading this issue from that website and you want to be notified with the issue emailed to you at no cost be sure to sign up at:

http://h20468.www2.hp.com/external/DFBF29CC-2E13-416E-81D8-CC1868461A18/hp_calculator_newsletter/index.html

HHC 2013 at Ft. Collins

The annual HP Handheld Conference, HHC, will be held the fourth weekend in September (21st & 22nd) in Ft. Collins Colorado - the home of HP's calculators. You may see who is registered and what presentations will be covered during the two Conference days (18 Hrs.) at: http://hhuc.us/2013/reglist.htm

The list of presentations will grow as we get closer to the Conference. There are many HP Prime Presentations being prepared and because of the limited availability of machines these presentations will be by necessity "last minute." HP will do something different this year in terms of their presentation of a new product with the active participation of the attendees. The HHC website for all HHC websites since 1999 may be found at: http://hhuc.us/ The website for HHC 2013 is at: http://hhuc.us/2013/index.htm