INTEGRATED MATHEMATICS MACHINES

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Abstract

We consider two different integrated mathematics environments. One new product is software, TI InterActive!™, the other is hardware, Casio Cassiopeia™. These two environments represent the major directions mathematics machines are moving. We'll very briefly look at the capabilities of each. To conclude, we speculate on directions software and hardware are going.

Introduction

It's difficult to define an *integrated mathematics machine*. We can find various products ranging from scientific calculators to full computer algebra systems that are designed to be complete assistants. In fact, Derive was originally called, *Derive, A Mathematical Assistant.* There are two new products that fall under this heading coming from Texas Instruments and Casio. These products represent the direction the development mathematical software and hardware for teaching is going.

TI InterActive!

TI InterActive! is a software solution that uses a word processor as the substrate and includes a graphing, statistical calculator with a modest computer algebra capabilities. For external connections, TI InterActive! can communicate with a browser and with a calculator, CBL, or Ranger. The mathematics interface is designed to be comfortable for TI calculators users.

TI InterActive! presents a screen with a set of buttons on three toolbars. See Figure 1, TI InterActive! Document Window. The first two toolbars include a standard set of word processor and file management buttons. The third toolbar is where we focus. The buttons on the third bar are (left to right): *Insert Math Box* for numeric & algebraic calculations and defining variables & functions; *Preferences* for Math Box; *Insert Graph* in Cartesian, polar, or parametric form, or a data plot; *Generate Table* for defined functions; *Insert List* and manipulate data; *Insert Matrix*; *Insert Spreadsheet*; *Insert Calculator Screen* from a linked calculator; *Statistical Regression*; *Connect to Web Browser*; *Send Email*. These capabilities give us a graphing calculator inside a word processor
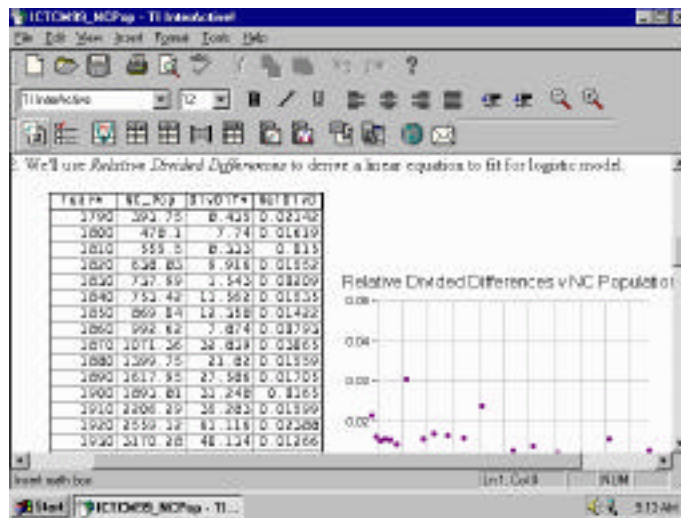
Figure 1: TI InterActive! Document Window

with a very flexible layout. In Figure 1 we see a heading describing a calculation with a spreadsheet showing our data next to a graph. The section document shown is where divided differences were used to fit a logistic curve to the North Carolina population (cf: "Curve Fitting and Modeling: What's the Difference," www.mathsci.appstate.edu/~wmcb/NCCTM_99). In Figure 2 the toolbars have been hidden to increase the screen size. We see a "Math Box" with a logistic model presented just above the combined data/function plot showing the fit. Note the formatting of the mathematics in the Math Box matches the pretty print of TI-89 and TI-92'. Also note that the function f is defined in the Math Box using a syntax available on the TI-89 and TI-92 Plus. The message "Done" can be hidden as can all output or input lines.

The computer algebra capabilities of this TI InterActive! version are quite modest. Equations can be solved exactly or approximately using 'solve' or 'zeros', expressions can be factored or expanded, and rational expressions can be normalized. The computer algebra routines know the trigonometric functions.

TI's web site states, "Pricing will be announced shortly before release, but the single-user license (School and Home Edition) is expected to cost less than a TI-83." Also it is noted that TI InterActive! will be part of the *Volume Purchase Program.* (For Macintosh users: TI InterActive! will run under Virtual PC or Soft Windows.)

Casio Cassiopeia

The Casio Cassiopeia A-20 is a risc-based (80 MHz Hitachi SH-3), palmtop computer running Windows CE. The A-20 includes Microsoft's Pocket Word and Pocket Excel.
What makes the Cassiopeia a mathematics environment is including new versions of standard mathematics software: Maple CE, Geometer's Sketchpad, and MRI Graphing Calculator. Maple
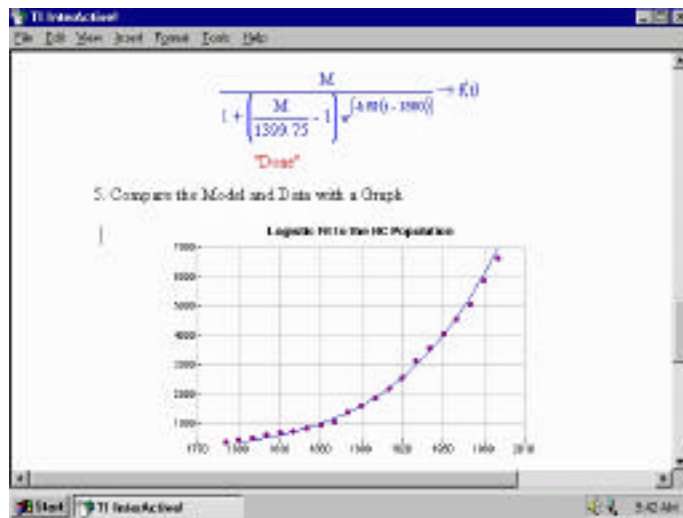
Figure 2: Mathematics in TI InterActive!

Figure 3: Casio Cassiopeia A-20

CE is a student oriented version of Maple with a new interface that fits in the A-20's small form factor. Maple CE necessarily doesn't have the full capabilities of Maple V; the limited ram and hard drive prohibit large computations and software packages. The interface sports several pallettes for ease of input. Popup context sensitive menus from Maple V are implemented in the Action menu; see Figure 4. The Expression pallettes share the right half of the screen with the Plot frame as seen in Figure 5. A welcome new interface feature, which has been often requested, is making the terminating semicolons optional. Another feature unique to this version is that Maple attempts to correct syntax error as best it can and ask for more information by inserting question mark in the input cell.

Geometer's Sketchpad will look the same on a Cassiopeia as on a desktop; the menus match those of the standard version. The toolpad is to the right, of the main window, instead of the left.

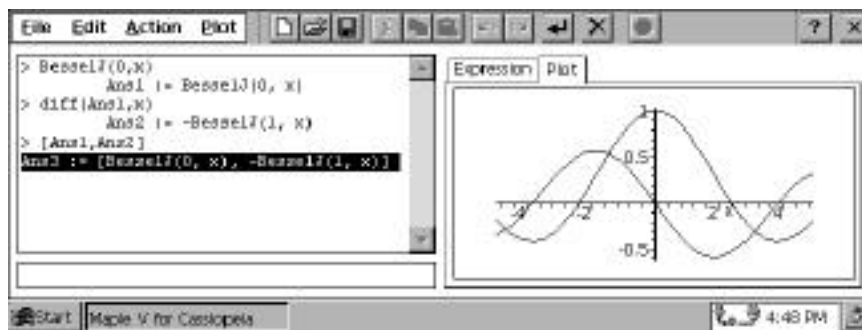Figure 4: Maple for Windows CE Opening Screen

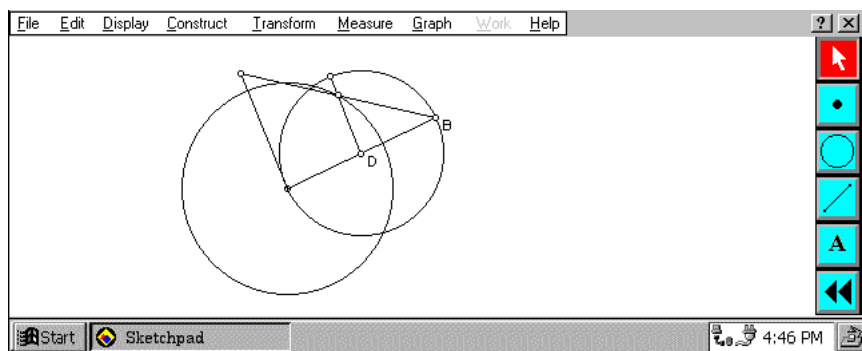Figure 5: Maple for Windows CE Session with Plots

Figure 6: Geometer's Sketchpad

The MRI Graphing Calculator included with the A-20 is essentially the same as the Windows version. The impressive list of functions available includes numeric differentiation and integration, financial calculations, and statistical distributions and testing. Graphs and equations can be pasted into Pocket Word. See Figure 7.

Figure 7: MRI Graphing Calculator

Future Directions

We could look at each of these tools separately for the entire hour and not exhaust interest. However, the real question is, "Where do we go from here?" Above we saw a calculator migrating into a computer and merging with standard software tools. We also noted a software package that originally ran on mainframes become scaled to a palmtop computer. Over the next five years, the increase in computing power will enable much richer computer algebra facilities in low power, small devices. Advances in interface design and input methods will enable us to have a mathematics computer that will fit in our pockets, but will have a full-size, "unrollable" color display, a complete folding keyboard, and use wireless connections to transfer data and access the web. Let's get together again at ICTCM 17 to see who makes our perfect integrated mathematics machine.

Acknowledgements

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Web Links

TI InterActive!:	www.ti.com/calc/docs/interactive
Casio Cassiopeia:	education.casio.com/computer.htm
Maple for Windows CE:	www.maplesoft.com/
Geometer's Sketchpad:	www.keypress.com/sketchpad/
MRI-Graphing Calculator:	www.mathresources.com/gcalc_preview.htm

Table 1: WWW Information Links