

COMPSCI 105: Lecture #17 Spreadsheet Improvements (A Spittle-Flecked Rant)

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Spreadsheets are Great!

- 2D Grids containing *Billions* of Cells
- Totally Free-Format:
 - Numbers
 - Text
 - Formulae
 - Left Blank
- Automatic Recalculation
- Instant “What If?” Models

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Could They Be Better?

- Yes, they are ubiquitous today, and...
- ...yes, we have better tools than back then:
 - More functions available
 - Multipage Notebooks
 - Advanced Graphics
 - Macros (Built-in Programming Language)
- ...but we’ve been using the *same basic layout* since VisiCalc (1978)! (With one exception.)

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Some Blind Spots

- Only Two Data Types:
 - Strings
 - Numbers (Double-Precision 64-bit Binary Floats)
- Cell Addresses are Clumsy
 - What does A1 or \$B\$6 *really* mean?
 - Named ranges can help, but only so far.
- How Good are the Answers?
 - You get a numeric answer; can you trust it?

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A Few Modest Suggestions

- BCD Arithmetic
- Interval Arithmetic or UNUMs
- Extended Data Types
- Built-In Dimensional Analysis
- Expanded (and Corrected) Dates
- Base-Conversion Formats

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Rant #1: BCD Arithmetic

- Problem:
 - 64-bit Double-Precision Binary Floats suffer from round-off error in unexpected places ($\frac{1}{10}$ is an infinite fraction).
 - Currency conversions *can't* legally have round-off error.
- Solution:
 - Keep each decimal digit as 4 independent bits (Binary Coded Decimal, or BCD).
 - Enough space available in a Double to keep 13 BCD sig figs (but not the 15-16 of a Binary Float).
- Issue:
 - Not as information dense as pure binary.
 - No hardware support (yet), must be done in software.

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Rant #2: Interval Arithmetic

- Problem:
 - No information about how “good” any answer is.
 - Is there a confidence interval? Error bars? NO.
- Solution(s):
 - Interval Arithmetic: Carry every calculation as two numbers, a low bound and a high bound, gives confidence interval at end. Answer guaranteed to be in between.
 - Universal Numbers (UNUMs) are an idea that extends Interval Arithmetic to variable-precision binary.
- Issue:
 - No hardware support (yet), must be done in software.

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Rant #3: Expanded Data Types

- Problem:
 - Spreadsheets only deal with strings and numbers.
 - Microsoft badly trowed in complex arithmetic as strings. =**IMSUM**("5+6i","3-2i") gives "8+4i"
- Solution:
 - Allow data types such as complexes, polynomials, lists, audio clips, images, video, etc.
- Issue:
 - Basic spreadsheet engines have to be completely rewritten from scratch.

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Rant #4: Dimensional Analysis

- Problem:
 - Any spreadsheet model involving units have to be carefully analyzed to avoid conversion issues (multiplying gallons times miles can't be detected).
- Solution:
 - Attach units to quantities, have spreadsheet maintain, as in: **2.54{cm/in} * 10{in} = 25.4{cm}**
- Issue:
 - Basic spreadsheet engines have to be completely rewritten from scratch.

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Rant #5: Expanded Dates

- Problem:
 - Dates don't go earlier than January 1, 1900.
 - Persistent error claiming 1900 is a leap year.
- Solution:
 - Extend model back at least to October 15, 1582 (start of Gregorian Calendar).
 - Maybe even go with Julian Day numbers.
- Issue:
 - Compatibility with current spreadsheets.

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Rant #6: Base-Conversion Formats

- Problem:
 - Numbers can't be shown in different bases (there are a few functions that return equivalent strings in different bases, but not as cell formats).
- Solution:
 - Extend formats (General, Currency, Percent, etc.) to include at least Binary, Octal, Hex, etc.
- Issue:
 - ??? Shouldn't be that hard!

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Your Responsibilities

- You are a consumer of high-tech products.
- It's your money!
- It's your time!
- It's your life!
- You should ***demand*** better tools.

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But Hasn't Anybody ever tried to do this Before?

- There *were* spreadsheets other than Microsoft Excel, Lotus 1-2-3, or Borland Quattro.
- I've even written a few spreadsheets myself with weird capabilities.
- 3D Spreadsheets (early 1990s).
- Lotus Improv for NeXT (1988).

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The NeXT Computer (an aside)

- 1984: Apple releases Macintosh, Steve Jobs thrown out of Apple, Jobs goes away.
- 1988: Jobs announces NeXT (\$5000):
 - Fastest Processor chip then used on Macs,
 - 16 megabytes of memory (PCs had <1 megabyte),
 - 1024×1024 display (PCs were 320×200),
 - CD-quality audio (PCs could go “beep”),
 - Built-in networking (neither PCs nor Macs),
 - Laser printer standard (PCs used dot-matrix),
 - Lotus Improv spreadsheet.

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Lotus Improv Spreadsheet

- Hypercube instead of 2D grid.
- Up to 12 dimensional data.
- View data from along any axis.
- Names rather than cell addresses.
- Genesis of Multipage Notebooks used today.
- Never very popular, tech folded in as pivot tables in modern spreadsheets.

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Cut to the Video...

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