CMPSCI 145 Spring 2014
Lab #1
Professor William T. Verts

Setting Up

This project <u>must</u> be performed on a Microsoft Windows-based PC, and not on an Apple Macintosh, unless you have installed Windows through Boot Camp, Parallels 9 (`http://www.parallels.com/`), VM-WARE Fusion 6 (`http://www.vmware.com`), or have some other way of running Windows-based software on a Mac such as Cross Over Mac (`http://www.codeweavers.com/products/crossover-mac/`).

Create a special folder on your disk called `Z99` to hold everything associated with this project. If you wish to use a flash drive, put the `Z99` folder at its root instead. For example, if your flash drive comes up as disk `E:` then you should create the `Z99` folder at the root of the `E:` disk.

Go to the class Web page and click the link to download the Z99 spreadsheet, or type the address in manually (all on one line):

http://www-unix.oit.umass.edu/~verts/software/
Z99_Windows_Distribution_V1_5_4.zip

Download the 1751K `.ZIP` file. Unpack everything from the downloaded archive into your `Z99` folder, then close the archive (do <u>not</u> attempt to run the programs from within the archive itself). The contents are as follows:

1.   `Z99 Fixed-Point.exe`
2.   `Z99 Floating-Point.exe`
3.   `Z99_Help.pdf`
4.   `ReadMeZ99.txt`
5.   A couple of `.Z99` data files.

Please read both the `ReadMeZ99.txt` file and the `Z99_Help.pdf` file. You may examine the `.Z99` files in Windows Notepad as well, but be careful to not make any changes. Make certain that the `Z99_Help.pdf` file is in the <u>same</u> folder as the two `.EXE` files, as you may launch the help file directly from within the Z99 program itself. If desired, create a shortcut to either or both of the `.EXE` files on your desktop. (Note: if you go in through the "Free Software" link on my home page you'll notice that there is an <u>older</u> program available which is <u>also</u> called Z99, but that one is for MS-DOS instead of Windows. Do <u>not</u> use that program.)

Running the Program

Launch either version of the program by double-clicking on its icon. For anyone familiar with Microsoft Excel, there are many similarities (and quite a few differences). Try typing text and numbers into the various cells to get used to the data entry dialogs, and create simple formulae that reference those cells. For example, put 10 into cell `A1`, 20 into cell `A2`, and the formula

=A1+A2 into cell A3. The number shown in A3 should be 30. Edit either A1 or A2 to take on new values, and watch the result in A3 change appropriately.

Scroll around the grid. Explore the menus. Widen columns. Change the fonts and colors. Draw lines around cells. Lock and unlock cells, copy and paste formulae, select some cells and print them, etc. Launch the help document. Load in the sample files and look at their formulae. Have fun! Once you are comfortable with the basic structure and format of Z99 exit the program.

Steps of the Assignment Part 1: Building the Model

1.   Start up the *floating-point* version of Z99.

2.   In cell A1 type your full name. Don't worry if you do not see all of it; we'll widen the columns later.

3.   In cell A2 type the formula **=NOW** and hit ⌧Enter⏎. A number such as 41723.5747659028 will appear in that cell. Format that cell as a date. It should appear as the current day.

4.   In cell A3 type the formula **=NOW** again. Format that cell as a time. It should appear as the current time of day.

5.   Select the three cells A1:A3 with the mouse, and set the font to Times New Roman, boldface. Set the background color to a light cyan (light blue-green). Draw a thick-lined box around the three cells with thin interior lines (use the appropriate toolbar button).

6.   In cell A4 enter the formula **=REPRESENTATION** (this function will return either Floating-Point or Fixed-Point depending on which version of Z99 is running). Draw a thick-lined box around the cell.

7.   In cell A5 enter the string **Scale Factor**, and then set the font of that cell to Times New Roman, boldface. Set the background color of A5 to a light cyan. Enter the number 10 into cell A6. Draw a thick-lined box around the two cells with thin interior lines.

8.   In cells B1 and C1 enter the strings **Multiply** and **Divide**, respectively. Set the font to Times New Roman, boldface. Set the background color of those four cells to light cyan. Draw a thick-lined box around the three cells with thin interior lines.

9.   In cells B2 and C2 enter the number **1**. In cell B3 enter the formula **=B2*A6**, and in cell C3 enter the formula **=C2/A6**. Select cells B3:C3, click Edit-Copy, select cells B4:C999, and click Edit-Paste. You should see a series of numbers appear in columns B and C, all the way to the bottom of the spreadsheet. Draw a thick-lined box around cells B2:C999 with thin interior lines.

10.   Click Options-AutoSize All Columns to set the "best fit" width.

11.   Using File-Save store the spreadsheet on your disk as LAB1.Z99 in the same Z99 directory where the two .EXE programs are located.

When complete, the top of your spreadsheet should look as follows (with your name instead of mine in cell `A1`, and with the current date and time):

	A	B	C
1	William T. Verts	Multiply	Divide
2	4/1/2013	1	1
3	8:54:28 AM	10	0.1
4	Floating-Point	100	0.01
5	Scale Factor	1000	0.001
6	10	10000	0.0001
7		100000	1E-5
8		1000000	1E-6
9		10000000	1E-7
10		100000000	1E-8
11		1000000000	1E-9
12		10000000000	1E-10
13		100000000000	1E-11
14		1000000000000	1E-12
15		10000000000000	1E-13
16		100000000000000	1E-14
17		1E15	1E-15
18		1E16	1E-16
19		1E17	1E-17
20		1E18	1E-18
21		1E19	1E-19

Dr. Bill's Z999 Windows Spreadsheet (Z99 v1.5.2) Floating-Point

File   Edit   Fonts and Color   Alignment   Numeric Format   Options   Accessories   Help

12.   Select all cells in the range `A1:C20`, and **print this selection in Landscape mode**. The printout should appear on a single sheet of paper. Save this page for your report.

The spreadsheet model is now complete. We will next explore the model, first in floating-point and then in fixed-point.

Steps of the Assignment Part 2: Exploring Floating-Point

1.   Scroll down until you find the point where the calculations in column B generate an error. Select all cells from the last valid number in column B up through and including the first occurrence of 0 in column C, inclusive. **Print this selection in landscape mode.** Save this page for your report.

2.   Click the column header for column C to select all cells in that column. Click Numeric Format-Binary to set all cells to binary. Click Numeric Format-Digits, select 30, then click OK. Click Options-Autosize All Columns again. You should see the division column in binary scientific notation.

3.   Again, scroll until you find the point where the calculations in column B generate an error, and select all cells from the last valid number in column B up through and including the first occurrence of 0 (%0.0×2°) in column C, inclusive. **Print this selection in landscape mode.** Save this page for your report.

4.   Save your sheet, and then exit the program.

Steps of the Assignment Part 3: Exploring Fixed-Point

1.   Start up the *fixed-point* version of Z99.

2.   Load in the LAB1.Z99 file (it should be in the "recent files" list just below Exit in the File menu). You should see the same thing as before, except that the binary result in cell B4 may look a little different. Click Options-Autosize All Columns again. Make sure the cursor is in A1.

3.   This time the threshold of where errors occur should be immediately visible. Select all cells from A1 through column C, down to and including the first row where column B has a «Downstream of Error» message. **Print this selection in landscape mode.** Save this page for your report.

4.   Put numbers such as 2 or 1.5 or 3 in cell A6. In each case determine where the overflow error occurs in column B and where column C goes to zero. Put the number 10 back into A6. Pay close attention to what is happening in the division column.

5.   Save the file and exit the program.

Steps of the Assignment Part 4: Exploring The .Z99 File Format

1. Start up Windows Notepad (or your favorite text editor), then click File-Open. Select All-Files from the drop-down list, then find and open the `LAB1.Z99` file. The first few lines will look something like the following:

```
[MAIN]
CREATOR=Dr. Bill's Z99.exe
COPYRIGHT=© Dr. William T. Verts - All Rights Reserved
DATE=3/25/2014 2:49:53 PM
FILENAME=E:\Z99\Lab1.z99
[PRINTER]
MARGINLEFT=1.0
MARGINRIGHT=1.0
MARGINTOP=1.0
MARGINBOTTOM=1.0
...
```

2. Examine the contents of this file, but do not change anything. Think about what the file contains, and how it relates to what you see on screen.

3. Close Notepad. If it asks about saving changes, click "No".

Final Work

Using your favorite word processor (Word, Wordpad, etc.), write a short essay that discusses what is going on in the two versions of the spreadsheet, with emphasis on the following points:

1. What happens at the point where the first multiplication error occurs in column `B`? Why does the division column go to zero at a different point from when the multiply column generates an error? What is happening in the floating-point representation at that point?

2. How and why do the two versions of the spreadsheet differ?

3. Which of the two spreadsheet versions, and which of the two sequences, is likely to generate the "most correct" values? Why?

4. What general lesson(s) can be learned from this exercise about how to perform computations?

5. How does the `.Z99` file format you viewed in Notepad relate to what you see on screen? What is the difference in *representation* exhibited here?

Your essay must be at least ½ page, but not more than one page, in length. It must be *single-spaced*, in 12-point Times New Roman, and fully justified, with 1-inch margins. Your essay *must contain your name* as part of the document, not just written in by hand.

What to Turn In

Your report must contain the following items, **stapled**, in the following order:

1. Your essay on top, with your name printed as part of the document.

2. The top part of the spreadsheet from the floating-point program, containing your name.

3. Error threshold area, floating-point program, in decimal format.

4. Error threshold area, floating-point program, in binary format.

5. Top part down to threshold, fixed-point program, in binary format.

Grading

You will be graded as follows:

1. 50% on whether or not, or how well, you completed the tasks in Z99. For example, you will lose major points if your name is not in cell A1 of the spreadsheet (and printed on the essay, for that matter). Similarly, you will lose points for omitting lines around the cells, background colors, font changes, etc., as well as for incorrectly formatting the columns of numbers.

2. 40% on the quality of the essay (i.e., the completeness and clarity of your arguments).

3. 10% on the format of the document you turned in: the order of the printouts, line spacing, paragraph justification, font, etc. (basically on how well you followed the directions).