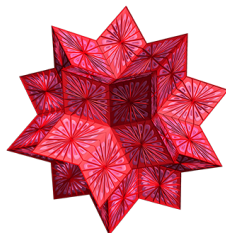Mathematics Computer Laboratory - Math 1200 - Version 14
Lab 3 - Mathematica Basics©

Due

In this lab you will save your file, so you need a flash drive. You may also email the file to yourself or save it on a cloud storage.

1. The objective of this lab is to learn to produce a Mathematica document while reviewing the Mathematica commands from the last two labs. Mathematica has many of the word processing capabilities of programs such as Word. Open a new Mathematica notebook.

A. Use Mathematica to find the value (exact or numerical approximation) of each of the following. You can look up the correct Mathematica syntax in your earlier labs.

   (i) $\{25 - 3[11 + 4(7 - 9)]\} \div \{2[8 - 3(4 - 6)] + 3(7 - 2)\}$

   (ii) $\frac{9^2 - 3(4^2 - 3^2)}{[26 - 7(8 - 5)]^3}$

   (iii) $\ln 5.71$

   (iv) $e^{1.7}$ to 14 significant figures

   (v) $\log_6 85$ to 20 significant figures

2. You can make it easier to read a Mathematica window. To enlarge the screen, drag out any side of it by moving the mouse to a side so that its pointer looks like $\leftrightarrow$, then, holding down the left mouse button, move it out. (In some machines, there might be only certain special areas for this process.)

B. Use Mathematica to multiply out or combine the following expressions. You may need to use commands `Simplify`, `Expand`, `Together`, or `Factor`.

   (i) $\frac{x+5}{(x+1)(x-1)} + \frac{2}{(x+2)(x+1)}$

   (ii) $(3x + y)(2x - 3y)(4x + 5y)$

   (iii) $\frac{x^2 - 9}{x^2 + 2x - 3} - \frac{2x^2 - x - 1}{4x^2 + 4x + 1}$

   (iv) $81x^4 - 216x^3 y + 216x^2 y^2 - 96xy^3 + 16y^4$

3. A Mathematica document is called a notebook. To save your current notebook, insert your memory device (memory stick, etc.) in the computer. Click on the **Save As** button and find the appropriate drive for your memory device. Then give your document a name The name of your document should appear on the top bar and the file document-name.**nb** should appear on your memory device. It is a good idea to re-save documents periodically. If you do not wish to change a name just click on the **Save** button.

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C. Define functions $f(x) = x^2 - 3x + 2$, $g(x) = x^2 - 1$ and $h(x) = x^2 - x - 2$ and perform the following operations.

    (i) Evaluate $f(g(2))$.

    (ii) Factor $f(x)$.

    (iii) Multiply out $f(x)h(x)$.

    (iv) Simplify $\frac{f(x)}{g(x)}$.

    (v) Combine $\frac{1}{g(x)} - \frac{1}{h(x)}$ into a single fraction and simplify.

D. Solve the following equations.

    (i) $h(x) = 0$

    (ii) $f(x) \div h(x) = g(x)$

    (iii) The system of equation $x^2 - x - y = 6$ and $2x - y = 2$.

E. Define the new functions $f(x) = x^2 - 2x - 2$ and $g(x) = 2x^2 + x - 2$. Preform the following steps.

    (i) Graph $y = f(x)$ on the interval $[-2, 4]$.

    (ii) Graph $y = f(x)$ and $y = g(x)$ for the interval $[-5, 2]$ on the same coordinate system.

    (iii) Read off points of intersections of these graphs and state your answers in the next cell. Make this cell a text cell as follows. Highlight this cell by clicking on its bracket] on the far right side. It should be overlaid by a small blue rectangle. Then click consecutively on **Format**, **Style** and **Text**.

4. Let's create a title for this document. Click right before the top cell (the mouse pointer will look like ✕) and push the return key ⏎. Now, you should have a new cell.

Click consecutively on **Format**, **Style** and **Title** and then type in the title "Mathematica Basics". This title should be in larger red colored font. (You may also type in the title first, highlight its cell by clicking on its bracket] on the far right side. It should be overlaid by a small blue rectangle, and then click consecutively on Format, Style and Title.)

To center the title, highlight it (hold down the left mouse button and drag it over the title) and then click on buttons **Format**, **TextAlignment** and **Align Center** in that order. You may also find it necessary to adjust your window size. In the future, you way want to make this operation simpler by using the center button on the tool bar which you can display by clicking on **Window** and then **Show ToolBar**.

5. Create a new cell below the title, as in step 4. Click consecutively on **Format**, **Style** and **Subtitle** and then type in your name. The subtitle font should be smaller than the title font, but larger than the rest. (You may also type in your name first, highlight its cell by clicking on its bracket] on the far right side. It should be overlaid by a small blue rectangle, and then click consecutively on Format, Style and Subtitle.) Then, follow the same steps in part 4 to **center your name**. Re-save your Mathematica notebook.

6. For better viewing and proper printing we will adjust word wrapping and paper width. Turn on the ruler bar by clicking consecutively on **Window**, **Toolbar**, and **Ruler**. You will see a ruler which is visible on the left side starting at 0.75 inch; the right side has a solid triangle pointing toward the left at about 7.75 inch. These set the default right and left printing margins for standard $8\frac{1}{2}$ inch by 11 inch paper. For now, we will not change them.

    Now highlight the title cell by clicking on its bracket] on the far right side. (It should be overlaid by a small blue rectangle.) Set the word wrapping to the width of the paper by clicking consecutively on **Format**, **Word Wrapping** and **Wrap at Paper Width** while the cell is highlighted. Now you can adjust the line width in the cell by moving the indicators ⌊ and ⌋ below the ruler. Do not move them outside the printing area. Set ⌊ at **1 inch** and ⌋ at **7.5 inch**. Notice this will result in the title being re-centered.

    These settings are only valid in the cell you are working. To use them in several cells, you must highlight all those cells and repeat this procedure. **You should set both word wrapping and the margins for all cells at the end of your work.** This will also ensures that output cells also have the same settings.

7. Notice that the entire lab is contained within one **single cell**; all work contained in one bracket] on the far right. So be careful when you delete a cell as to not to delete your entire work. The advantage of this is that you can create large documents consisting of many sections and collapse each section and just show each section title. You may explore that on your own. Our labs will not be too long to benefit from it.

    Edit your notebook by cutting out cells which you do not want to include in your report. (Highlight the cell and click on **Edit** and then **Cut**.) Change the ordering of the cells as needed by cutting and pasting them. Edit each individual cell. Save your Mathematica notebook.

8. **Highlight all cells** (go to the far right bracket] in top (or bottom) cell, push down the left mouse button and the drag the mouse to the bottom (or top) cell). **Set word wrapping to Wrap at Paper Width**. **Set the margins** (using ⌊ and ⌋) on the left at **1 inch** and on the right at **7.5 inch**. Save your document. These should have been set for all cells. Verify it by clicking on a couple of diffferent cells and checking them.

9. When reopening an old notebook (saved Mathematica file) to continue the work that you started in the previous session, you should re-evaluate, one by one, all the cells to which you will refer later in the session. However, you can perform this in one step by re-evaluating the entire notebook after opening it by clicking consecutively on Evaluation and Evaluate Notebook.

   Since this is the first thing I do when I grade your work, please save and close your notebook and exit Mathematica. Then reopen Mathematica and your file and evaluate the whole notebook by clicking consecutively on **Evaluation** and **Evaluate Notebook**. If there are error messages, figure out what is wrong and correct it. If you have an **output for a text cell**, for example for Exercise E(iii), you probably have **not specified** it as **text cell** correctly. Follow instructions in E(iii) to correct it.

   Incorrect margins and **word wrapping** settings are the two most common **problems**. Double check your margins and word wrapping and correct them as needed.

10. Although you will submit your work electronically, you may want to print your notebook. So as not to waste paper, please be sure it is the way you want it. To print the whole document, click on **Print** and then $\boxed{\text{OK}}$. To print a single cell or a portion of your document, highlight that portion and choose the $\boxed{\text{Selection}}$ option for printing. In some machines, you can **Preview** your document on the screen before printing it on paper. Use this feature to inspect your document and adjust it before printing it on paper.

11. Mathematica has many other word processing features including Font, tags, Headers and Footers, and Style Sheet. You can even save a notebook in HTML format with Hyperlinks for delivery over the internet. **You may also find the Help menu very useful.** Experiment and learn more about Mathematica's capabilities.

12. It is essential, both as a courtesy to future users, and to continued problem-free usage, to leave the computers as you find them. When you are done, close the software being used and/or log off properly. Remember to take your **flash drive** with you!