

**SC11 Education Program**  
**Mathematics Track – SAGE Sessions**

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**Sessions:**

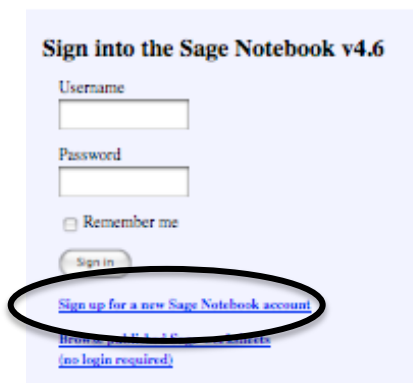
- Saturday, 10:30-noon, Introduction to Sage as a Tool for Computing  
This session is a hands-on introduction to a recent development in computer tools for mathematics, the Sage Mathematics Computing Environment. Sage is a comprehensive package that addresses mathematical topics ranging from rational arithmetic and elementary algebra to some of the most advanced research topics in Number Theory and Discrete Mathematics. Along with its wide ranging collection of tools, Sage is important because it is open source, free, and accessible with nothing more than a web browser. This introductory session will focus on using Sage as a tool for exploring elementary topics in mathematics and will be accessible to mathematics teachers at all levels. The topics that will be explored will be restricted to precalculus material, and potential pedagogical applications will be highlighted. Be prepared to learn new facts about pi, Fibonacci numbers, and Mandelbrot's set. Assumed background: basic computer literacy; calculus; basic familiarity with vectors and matrices.
  
- Saturday, 2-3, Exploration in Sage Part I  
This workshop will continue the hands-on introduction to the Sage Mathematics Computing Environment. This session will focus on using Sage as a tool for exploring intermediate mathematical topics, particularly topics that could be encountered in Calculus and other undergraduate courses. The presentation will include material on some of the advanced graphics features, such as phase plane portraits and surface plots, as well as standard problems in symbolic differentiation and integration. In addition, the workshop will provide exploratory problems that may well lead the participants to new insights. Assumed background: "Introduction to Sage as a Tool for Computing" session or equivalent.
  
- Saturday, 3:30-5, Exploration in Sage Part II  
This workshop will continue the hands-on introduction to the Sage Mathematics Computing Environment. This session will focus on using Sage as a tool for exploring advanced topics related to recent mathematical research. This will include an overview of the advanced programs such as GMP and PARI that are included in the Sage package. The session will also include a presentation on integer relation algorithms and some recent results. Prerequisite: "Exploration in Sage Part I" session or equivalent.
  
- Sunday, 3:30-5, Exploration in Sage Part III  
This session will provide participants with an accelerated introduction to the Sage Mathematics Computing Environment, incorporating components from Parts I and II. Prerequisite: "Exploration in Sage Part II" session or equivalent.
  
- Monday, 10:30-noon, Using Sage as a Tool in Undergraduate Mathematics Modeling Classes Part I  
This session will examine using Sage software tools to attack algebraic and empirical modeling problems from the physical, biological, and management sciences. Participants will work through problems from a typical junior-level modeling course, including applications using calculus, differential equations, linear algebra, and statistics. This first session of the two part sequence will be run as "guided hands-on" so that participants less familiar with the application problem or with Sage can become comfortable with the software and with the use of the software in a modeling situation. Assumed background: "Introduction to Sage as a Tool for Computing" session or equivalent.

- Monday, 2-3, Using Sage as a Tool in Undergraduate Mathematics Modeling Classes Part II  
This second session of this two part sequence will continue with modeling problem exploration using Sage. Time and audience interest permitting, this session will be more self-paced, allowing participants to choose from a set of problems to explore. Prerequisite: "Using Sage as a Tool in Undergraduate Mathematics Modeling Classes Part I" session or equivalent.

**The main resources you will need:**

- An account on the SAGE server: <http://sagemath.shodor.org:8000/> (you will have access to all of our worksheets through your account).
- The help files, quick references, and other information about SAGE at the Sage website: <http://sagemath.org/>
- Our email addresses in case you have further questions:  
[calkin@clemsun.edu](mailto:calkin@clemsun.edu)  
[hirsthp@appstate.edu](mailto:hirsthp@appstate.edu)  
[warner@clemsun.edu](mailto:warner@clemsun.edu)

**How to create an account on the Shodor Sage Notebook Site:**



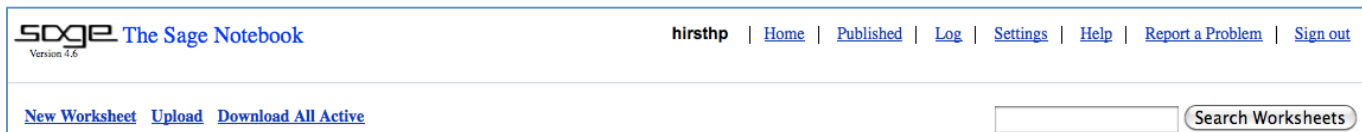
**Sign up for a Sage Notebook account**

- Create a username**  
Your username must start with a letter and be between 3 and 64 characters long. You may only use letters, numbers, underscores, @, and dots.
- Create a good password**  
Your password must be between 4 and 32 characters long. Your password can not contain your username nor spaces.
- Re-type your password**

**Basic Navigation in your Sage Notebook Space:**

Once in the Sage Notebook, you will see your “home” space, which will (eventually) include a list of worksheets you have created that you can open by clicking on the name.

In the header for the Notebook space at the left of the browser window, there are links to create a new worksheet, upload a worksheet from your computer, or download worksheets to your computer:

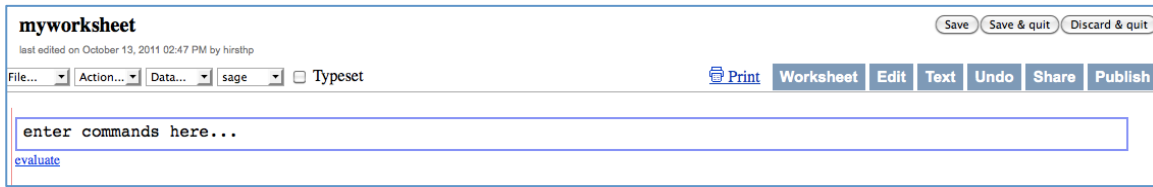


Other navigation accessible in the Notebook space at the top right:

- Published: allows you to access all worksheets that all users have made available. You can make a worksheet available by clicking on the “share now” link next to the worksheet name. If you open someone else’s published worksheet, you can edit a copy and save it for your own use.
- Home: returns you to your list of worksheets.
- Settings: allows you to change your password and email address.

- Help: takes you to a wealth of features including detailed tutorials.
- Log: keeps a running listing of recent commands you have executed (independent of worksheet).

Once you open or create a new worksheet, you will see the worksheet functions as shown below. To execute commands, type them into the cell (the box outlined in blue) and press “evaluate.”



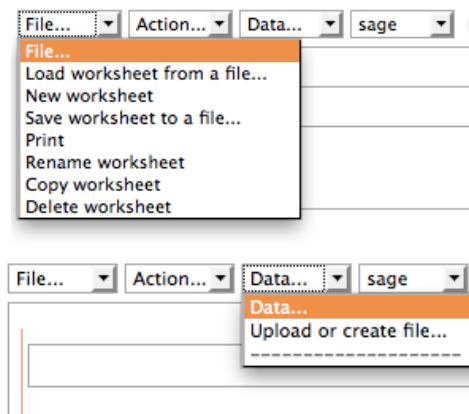
A few tips worth knowing:

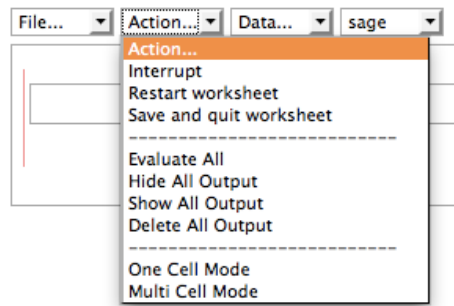
- You can simultaneously press the shift and enter keys instead of clicking on evaluate.
- You can learn about a command by entering the name appended with a question mark, then evaluate. Two question marks provides more information.
- You can see a list of commands that start with a particular string by typing the string and then the tab key.
- You can find out about a command by typing a left parenthesis after the it and pressing the tab key.
- To refer to an object (variable, expression, function, matrix, etc.) later assign it a name using the equal symbol.
- If you have an object (variable, expression, function, matrix, etc.) that you have assigned a name to, you can type the name of the object followed by a period and press tab to see all the things you can do with that object.
- To insert a new evaluation cell anywhere in the notebook, move your cursor until you see the thick blue line and click once. To insert a text cell anywhere in the notebook, move your cursor until you see the thick blue line and “shift-click” once.
- To refer to the output from the previous evaluation you can use “\_” – underscore.
- When you get an error, you may be able to get insight into the problem by looking at the “traceback,” which is involved by clicking to the left of the output cell.

Other functionality (blue buttons at the upper right):

- Worksheet: returns you to the worksheet.
- Edit: allows you to enter text into the worksheet.
- Text: allows you to view your commands as plain text, e.g., to copy into a command line version of Sage.
- Undo: allows you to revert to the last saved version of the worksheet.
- Share: allows you to share your worksheet with a specific set of users.
- Publish: allows you to make your worksheet available to all users.

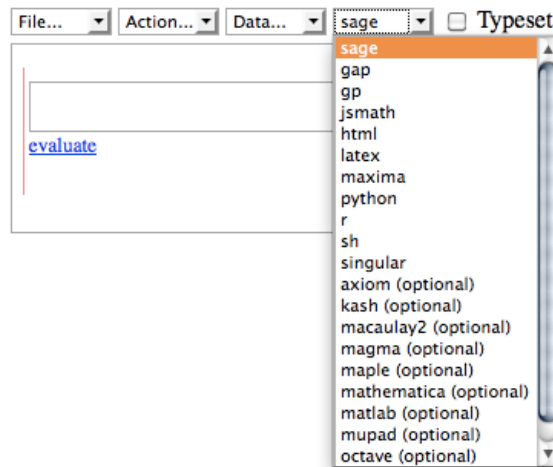
Menu items (picklists at the upper left) are largely self-explanatory.





The rightmost picklist allows you to evaluate the cells in your worksheet using a specific software package (sage is the default). So you could use the notebook interface to work in maxima, python, or r, for example.

Notice the “optional” tag on some of these modes – those software packages are not included with sage and thus require you to have the particular software package installed, and some additional set up within sage.



For example, if you request to run in “maple” mode, and you have not set up Maple, you will see the following instructions in the traceback:

```
RuntimeError: Unable to start maple because the command 'maple -t' failed.
```

```
In order to use the Maple interface you need to have Maple installed
and have a script in your PATH called "maple" that runs the
command-line version of Maple. Alternatively, you could use a remote
connection to a server running Maple; for hints, type
print maple._install_hints_ssh()
```

```
(1) You might have to buy Maple (http://webstore.maplesoft.com/).
```

```
(2) * LINUX: The maple script comes standard with your Maple install.
```

```
* APPLE OS X:
```

```
(a) create a file called maple (in your PATH), with the following contents:
```

```
#!/bin/sh
/Library/Frameworks/Maple.framework/Versions/Current/bin/maple $@
```

```
(b) Save the file.
```

```
(c) Make the file executable.
```

```
chmod +x maple
```

```
* WINDOWS:
```

```
You must install Maple-for-Linux into the VMware machine (sorry, that's
the only way at present).
```