Common Mistakes with Sage

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1 Common Error Messages and Their Solutions

Many (but not all) mistakes that you make in Sage will result in an error message. This is usually several lines of output all in red. You can ignore most of the message; just look down at the last line, which tells you the type of error.

1.1 SyntaxError: invalid syntax

This is one of the broader errors, and many mistakes can lead to this error. Here are some examples:

- Missing Explicit Multiplication

  Every multiplication in Sage must be explicitly typed.

  For example, to define the function $f(x) = 5x^2+3x-2$, you must type a multiplication after the 5 and 3: `f(x)=5*x^2+3*x-2`. If you try `f(x)=5x^2+3x-2`, you will get this error.

- Extra End Parenthesis

  Every set of parentheses must have a beginning and an end: $(\cdots)$. If you have an extra end parenthesis, you will get this error. For example, try `f(x)=sin(x))`.

- Unmarked Comment

  Sometimes you may want to write a note in Sage. You can do this by putting a pound sign (#) at the beginning of the line. This tells Sage that the rest of the line is a comment and should be ignored when processing. If you leave of the comment marker, Sage will try to intepret your comment as a command, often resulting in a syntax error (may depend on exactly what's in your comment).

1.2 SyntaxError: unexpected EOF while parsing

This syntax error results from missing an end parenthesis (or, equivalently, having an extra beginning parenthesis).

For example, `f(x)=sin(x` will result in this error.

This mistake is more common than having an extra end parenthesis. If you see "unexpected EOF," then add some ending parentheses.

1.3 TypeError: 'sage.rings.integer.Integer' object is not callable

This type of error may result from a missing multiplication. For example, if you try `3(5+2)` you will get this error. The reason is that Sage confuses this with function notation, such as `f(5+2)`. When you type `3(5+2)`, Sage wants to call a function named "3," but of course 3 is not a function, so it is "not callable." What you want to type is `3*(5+2)`, with an explicit multiplication.

You will get variation in the wording of this error if you have a noninteger in place of 3. For example, `(3/2)(5+2)` will result in "TypeError: 'sage.rings.rational.Rational' object is not callable."

1.4 NameError: name '__' is not defined

There are a few different situations in which a "NameError" may arise.

- Failing to Declare a Variable

  The variable x is automatically declared, but any other variable must be explicitly declared using `%var`.

  For example, you may want to find $\frac{d}{dx}ax^2 + bx + c$, so you type

  `derivative(a*x^2+b*x+c,x)`.

  When you run this, you will get "NameError: name 'a' is not defined."

  Instead, you need to do this:

  ```
  %var a,b,c
  derivative(a*x^2+b*x+c,x)
  ```

  Note: There are certain contexts that do not require a variable declaration. For example, if you type `y=10`, you do not have to declare y. In this case, y is not really a variable, it's just another name for 10.

- Misspelling a Command Name

  This error can also result from a simple typo. For example, if you try `f(x)=son(x)` instead of `f(x)=sin(x)` you will get "NameError: name 'son' is not defined."

- Forgetting Quote Marks

  Some options, such as the plot options `color` and `linestyle`, will require quote marks.

  For example, if you want to change the plot color to black, you can add `color='black'` inside the plot command. If you leave off the quote marks, you will get "NameError: name 'black' is not defined."

1.5 RuntimeError: Error in line(): option '__' not valid.

Many commands have optional arguments. For example, you can set the plot range using the xmin and xmax options: `plot(f(x),xmin=-10,xmax=10)`. If you misspell one of these options, you may get this error.

For example, if you misspell "xmax" and type `plot(x^2,xmin=0,xman=5)`, you will get "RuntimeError: Error in line(): option 'xman' not valid."

1.6 ValueError: Integral is divergent.

Mathematically, this is really no error at all. This error may result when you try to calculate a divergent improper integral.

For example, try to find $\int_0^1 \frac{1}{x}\,dx$ by typing: `integral(1/x,x,0,1)`.

1.7 ValueError: Sum is divergent.

This is similar to the last error, but this message results when you try to calculate the sum of a divergent infinite series.

For example, try to find $\sum_{n=1}^{\infty} \frac{1}{n}$ by typing: `sum(1/n,n,1,+Infinity)`

(note: you must have `%var n` before this line).

Some divergent series will not give you this error. Here are some examples:

`sum(n*(-2)^n,n,1,+Infinity)` will output `Infinity`.

`sum(n*(-1)^n,n,1,+Infinity)` will output `und`.

`sum(n*2^n,n,1,+Infinity)` will output `+Infinity`.

2 Other Common Mistakes

Some mistakes commonly made when using Sage *do not* result in an error message, but you don't get the right answer. You must be very careful about these!

2.1 Missing Explicit Multiplication

Sometimes missing multiplications will result in an error message (see above). However, here is an example that does not: To define the function $f(x) = (x-3)(x+2)$, you must type `f(x)=(x-3)*(x+2)`, with an explicit multiplication between the two factors. If you leave off this multiplication, you will *not* get an error message, but you *will* get the wrong function!

2.2 Missing Parentheses

There are many situations when parentheses are not optional.

For example, to write the fraction $\frac{x+y}{5}$ in Sage, you must type `(x+y)/5`. If you leave the parentheses off, you will not get an error message, you'll just get the wrong fraction: $x + y/5 = x + \frac{y}{5} \neq \frac{x+y}{5}$.

Here's an example involving powers: `e^2*x` $= e^2 \cdot x \neq e^{2x} =$ `e^(2*x)`.

2.3 Scientific Notation

If the output from Sage is `2.801232340e9`, you may think this is a number close to 2.8. However, this is actually a very large number (about 2.8 *billion*). You have to watch out for scientific notation in Sage, which is indicated by the little "e" in the output above. This output is actually $2.801232340 \times 10^9 = 2,801,232,340$.

Here is another example: `3.456400000e-12` is not close to 3.5, it is actually close to 0:

$3.456400000 \times 10^{-12} = 0.0000000000034564 \approx 0$.

2.4 Derivatives

There are two kinds of derivative questions: (1) the derivative function, such as $f'(x)$, and (2) the derivative at a particular value, such as $f'(3)$.

The derivative command in Sage answers the first question. If you want $f'(x)$, then type `derivative(f,x)`.

To answer the second question, you should use a two step process. First, assign the derivative function a name. I like to use "df" for "derivative of f", but you can use any name you want. Type `df(x)=derivative(f,x)`.

Now that you have the derivative function, the second step is to plug the particluar value into this. For example, `df(3)` is $f'(3)$, and `df(-1)` is $f'(-1)$.

If you want the second derivative, then you add a 2 to the derivative command:

`derivative(f,x,2)` is $f''(x)$.

Similarly, `derivative(f,x,10)` is the 10th derivative, $f^{(10)}(x)$.

A common mistake is to use `derivative(f,x,2)` when you want $f'(2)$. Of course, $f''(x)$ is very different from $f'(2)$.

Help me build this list! Tell me any other common mistakes you come across. Thanks.