PROJECT SOLUTIONS À LA SAGEMATH (WEEK 10)

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One goal today is to be able to plot *with and without* Sage[1]. You will need *some sort* of computer to access

`sagecell.sagemath.org`.

(If you have trouble, these links are all posted at `quamash.net/math1300`.) You can also scan this QR code.

FIGURE 1. `https://sagecell.sagemath.org/?q=ilvouj`

1. Sage commands to get started

To define a *symbolic* function.

`f(x) = x^3 + 4*x^2 - 2*x + 1`

To differentiate $f(x)$ *with respect to* x, i.e., to find $\frac{\mathrm{d}f}{\mathrm{d}x}$.

`diff(f(x), x)`

To differentiate twice, i.e., to find $\frac{\mathrm{d}^2 f}{\mathrm{d}x^2}$.

`diff(f(x), x, 2)`

To differentiate $xy + \sin(x^2) + e^{-x}$ with respect to x (notice the **asterisk** for multiplication).

`diff(x*y + sin(x^2) + e^(-x), x)`

To plot a parabola on the domain $-1 < x < 1$.

`plot(x^2)`

To plot $g(x) = x^2 \sin(1/x)$ on the domain $[-5, 5]$.

`g(x) = x^2 * sin(1/x)`
`plot(g(x), -5, 5)`

Date: 2019-03-20.

[1]Sage is a family of free open-source mathematics software packages, first released in 2005 by William Stein (among others) at the University of Washington.

To plot the function $h(x) = |x|\sin(1/x)$ and its first derivative $\frac{\mathrm{d}h}{\mathrm{d}x}$ on the domain $[-2, 2]$.

```
h(x) = abs(x)*sin(1/x)
hprime(x)= diff(h(x), x)
plot( h(x),-2,2 ) + plot( hprime(x),-2,2, color='red' )
```

Notice that I defined `hprime(x)` as the *symbolic* derivative of `h(x)`. In the last line, I *concatenated* the `plot` command so that Sage will *superimpose* the plots. That is, `plot(h) + plot(diff(h,x))` tells Sage to plot h, then to plot $\frac{\mathrm{d}h}{\mathrm{d}x}$ in the same pane.

2. Project solutions

Please *make a complete attempt* at problem 1 before looking at this solution.

FIGURE 2. `https://sagecell.sagemath.org/?q=kcogeo`

Again, *make a complete attempt* at problem 2 before looking at this solution.

FIGURE 3. `https://sagecell.sagemath.org/?q=xezxqf`

3. (Optional) Reading material

If you like Sage, I have posted a Gregory Bard's *Sage for Undergraduates* along with two other guides at `quamash.net/math1300`. Bard's introduction (pages 1–20) and access to `sagecell.sagemath.org` is legit the best place to start.

4. Enjoy your Spring Break!