Introduction to Maple Activities and Questions

Maple is a computer algebra system, which was first developed in 1980 out of the University of Waterloo in Canada.

Maple can handle numerical, symbolic, and graphical representations. Exploring these representations is one of the course goals of Calculus and Analytic Geometry II.

In the following, **execute the command code by hitting return at the end of the each red line,** as you read and answer questions.
Int displays the integral while int computes it. Here is an integration by parts, because it is the product of two functions:

```
> Int(x^3*ln(x),x); int(x^3*ln(x),x);
```

$$\int x^3 \ln(x)\, dx$$

$$\frac{1}{4}x^4 \ln(x) - \frac{1}{16}x^4 \tag{1}$$

Please note that it should be + c at the end, but Maple leaves that off!

Question 1: Aside from the +c at the end, does Maple's response match our by-hand work?

Maple can also compute the definite integral:

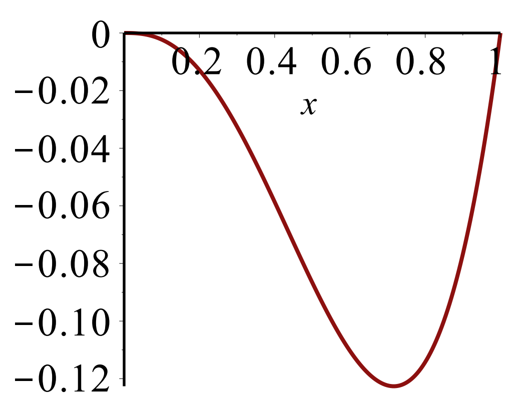
```
> Int(x^3*ln(x),x=0..1); int(x^3*ln(x),x=0..1);
```

$$\int_0^1 x^3 \ln(x)\, dx$$

$$-\frac{1}{16} \tag{2}$$

We can also plot the function, and see the geometric representation of the area under the curve that Maple just solved for.

```
> plot(x^3*ln(x),x=0..1);
```



Question 2: Why is the integral from 0 to 1 negative?

Question 3: The following integral is quite important in statistics and other real-life applications. Does Maple give a nice elementary algebraic antiderivative?

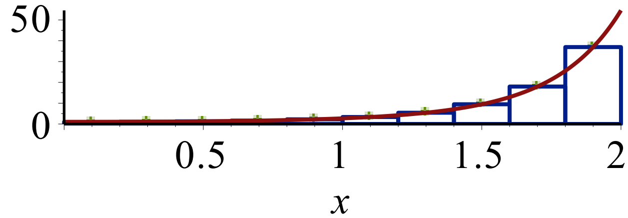
```
> int(exp(x^2),x);
```

(3)

$$\frac{1}{2}\sqrt{\pi}\,\mathrm{erfi}(x) \tag{3}$$

Maple can approximate integrals by Riemann sums. Execute the following and notice the rectangles that have width Δx and height as the function value, which is where $\int f(x)\,\mathrm{d}x$ arises from as Δx goes to 0:

```
> with(Student[Calculus1]): ApproximateInt(exp(x^2),x = 0 .. 2,
  output = plot);
```



A midpoint Riemann sum approximation of $\int_0^2 f(x)\,\mathrm{d}x$, where

Maple knows all the basic techniques of integration that we are supposed to learn, including substitution, integration by parts and much more.
Maple applies these techniques without telling us which one it is using and comes up with a final answer, when it can:

```
> Int(x^2*sin(x^3)*cos(x^3),x); int(x^2*sin(x^3)*cos(x^3),x);
```

$$\int x^2 \sin(x^3)\cos(x^3)\,\mathrm{d}x$$

$$-\frac{1}{6}\cos(x^3)^2 \tag{4}$$

Add an arbitrary constant to that answer.

Question 4: What happens if you consider the subsitution $w = \sin(x^3)$ for the same integral $\int x^2 \sin(x^3)\cos(x^3)\,\mathrm{d}x$? Work this out with a neighbor.

Question 5: Is your answer the same as Maple's? If not, what trig identity from the past will show they are equivalent?

Question 6: Open a web browser and go to the WolframAlpha computational knowledge engine. Type in:
integrate x^2*sin(x^3)*cos(x^3)
and read through the various representations that WolframAlpha provides. Does it provide your by-hand response?

Question 7: Suppose we are interested in evaluating the indefinite integral $\int x\sin(x)\,\mathrm{d}x$ which is the integral of the product of two functions.
Part a) Is this a known integral from Calculus 1?

Part b) Is this integral one that is well-suited for *w*-substitution?

Part c) Type in a command below and execute it to have Maple compute the integral, following the examples above.

Question 8: Compute the same integral $\int x \sin(x)\, dx$ by-hand using integration by parts, and compare with Maple's response.

Show me your responses to the questions before you leave, as I make my way around the room. Homework is on the main calendar webpage. Once you have completed this worksheet, you can work on homework, review, or anything else you want if there is time, or you may leave. Ask me any questions you have-I'm always happy to help.