

## MATH 175

### Analytical and Numerical Integration with Maple

October 2, 2009

#### Starting Maple in MG 104

1. Login to the computer using the name and password given to you. If your account exists and you do not know the password, come see me to get a new password.
2. Once logged in, right-click the screen (anywhere) and choose terminal.
3. In the new terminal screen that pops up type *xmapple* and press return.
4. Once Maple has loaded, click [ $\>$ ] at the top of the screen and type the commands at this prompt.

Caution: Use  $\wedge$  to create superscripts in Maple, however, when you are finished typing the exponent, use the right arrow key ( $\rightarrow$ ) to get out of the exponent.

#### Background and examples in Maple

Please do the following examples in Maple before attempting the Exercises.

```
> int(x^2,x)
       $\frac{1}{3}x^3$ 
> int(x^2,x=0..4)
       $\frac{8}{3}$ 
> int(sin(4*x),x)
       $-\frac{1}{4}\cos(4x)$ 
> int(x*(3*x^2+2)^{5/3},x)
       $\frac{1}{16}(3x^2+2)^{8/3}$ 
```

When Maple can't do an integral, it may return it unevaluated or have a solution you do not understand. Use the *evalf* command to get Maple to evaluate it numerically as in the following example.

```
> int(cos(x^3),x=0..1)
> evalf(int(cos(x^3),x=0..1))
      .9317044406
```

Maple uses a sophisticated numerical integration routine to evaluate definite integrals that it can't do analytically. We learned about Trapezoidal rule in class which is simple to understand and use, but is not very accurate or efficient. The Maple *student* package has a command *trapezoid* that implements the method, see the example below.

```
> with(student):  
> trapezoid(x^2,x=0..4)  
8 +  $\sum_{i=1}^3 i^2$   
> evalf(trapezoid(x^2,x=0..4))  
22.  
> evalf(trapezoid(x^2,x=0..4,10))  
21.44000000
```

### Exercises

Each group should hand in one Maple worksheet with solutions to the following exercises by Tuesday October 6. Start a new Maple worksheet, putting your names at the top and labeling each question. In the Maple worksheet you can toggle between typing text and executing Maple commands by clicking T and [ $\>$ ] at the top of the Maple screen.

1. Use *int* to compute the following definite and indefinite integrals. Make sure the answer Maple gives you is understandable.
  - (a)  $\int_0^4 (2x - 3x^2 + x) dx$ .
  - (b)  $\int_0^\pi \cos^2(x) dx$ .
  - (c)  $\int \sin(nx) dx$ , where  $n$  is a positive constant.
  - (d)  $\int_0^4 \cos(x^2) dx$ .
  - (e)  $\int \frac{x}{(x^2+1)^2} dx$ .
  - (f)  $\int x^{-3}(1+x^{-2})^{2/3} dx$ .
2. Use the trapezoidal rule in Maple to approximate the integrals in 1(a)(b)(d). What is the % error in your approximation?
3. You should have difficulty evaluating the following integrals in Maple. Explain why.
  - (a)  $\int \cos(x^2) dx$ .
  - (b) 1(c)(e)(f) with trapezoidal rule.