

**Math 2280 Maple Project 1**  
**January 2006**

**Due date:** See the internet due dates. Maple lab 1 has two problems L1.1, L1.2.

**Submitted work.** Please submit one stapled package, the top sheet handwritten. The final pages are appendices made by printing one or more maple work sheets. Hand work should do the steps shown in examples below. Maple code is expected to parallel the code given in the examples below.

**Tutorials.** Students without maple exposure should attend one of the Tutoring Center's maple tutorials in the second week of the semester. See the web page for scheduled times, posted after week two. The brave may start their own tutorial by attempting this lab unaided or by starting with the maple online tutorial; see Example 3 below.

**References:** Code in maple appears in 2280mapleL1-S2006.txt at URL <http://www.math.utah.edu/~gustafso/>. This document: 2280mapleL1-S2006.pdf.

**Problem L1.1. (Quadratic equation)**

Solve the quadratic equation  $ax^2 + bx + c = 0$  and display its factorization:

(A)  $a = 8, b = 22, c = 15$ ;

(B)  $a = 2, b = 4, c = 12$ ;

(C)  $a = 1, b = 8, c = 16$ .

In your solution, show the **solution steps by hand** and also the **maple** code which checks the answer.

**Problem L1.2. (Functions and plotting)**

Define the following functions and plot domains, then plot them.

(A)  $\sin(3\pi x), 0 \leq x \leq 1$ .

(B)  $|5 \ln(2 + x) - 2|, -1 \leq x \leq 2$ .

(C) Let  $a = 4, b = 12, c = \pi/12, t_0 = 15$ . Plot  $a + b \cos(c(t - t_0)), 0 \leq t \leq 72$ .

(D)  $\sinh(\sin(\theta) + \cos(\theta)), -\pi \leq \theta \leq \pi$ . In your solution, show only the maple code and the graphics. Please shrink the graphics to  $2 \times 2$  inches, before printing.

**Start the hand solution on this page.** Staple this page on top of the maple work sheets.

Examples on the next page ...

**Example 1.** Solve  $x^2 + 4x + 6 = 0$  by hand and check using maple.

**Solution:** The square-completion  $(x+2)^2 + 2 = 0$  gives conjugate roots  $x = -2 + \sqrt{2}i$ ,  $x = -2 - \sqrt{2}i$ . The factorization is  $(x+2-\sqrt{2}i)(x+2+\sqrt{2}i) = 0$ . The roots may also be found from the quadratic formula, in which case the root and factor theorems of algebra apply to translate each root  $x = r$  into a factor  $x - r$  of the quadratic equation. The maple code which checks it is

```
eq:=x^2+4*x+6:
ans:=[solve(eq=0,x)];
eq1:=(x-ans[1])*(x-ans[2])=0;
expand(eq1);
```

Notation: Square brackets delimit an array, e.g., `F:=[-1,3,5];` defines array F with three elements  $-1, 3, 5$ . Symbol `F[1]` extracts the first element from array F, while `F[2]` extracts the second element. Get maple help from `?solve`, `?expand` and `?factor` entered into a maple worksheet.

**Example 2.** Define a function  $y = x^2 + 5x + 6$  on  $-4 \leq x \leq -1$  using maple and plot it.

**Solution:** The maple code which applies is

```
f:=unapply(x^2+5*x+6,x): a:=-4: b:=-1:
plot(f(x),x=a..b);
```

The construct `f:=unapply(x^2+5*x+6,x)` is an inline function definition. Subsequent use of the symbol f requires two parentheses and a function argument, e.g., `f(x)`, `f(-1.1)` are valid. Get help by entering `?unapply` and `?plot` into a maple worksheet.

The inline function definition `f:=x->x^2+5*x+6` uses a minus sign (-) and a greater than sign (>) to separate the variable name ( $x$ ) from the function definition ( $x^2+5*x+6$ ). This alternative construction may appear in later maple code. In this elementary example, there is no difference between the two constructs. The maple function `unapply` is more robust and produces fewer surprises for novices.

**Example 3.** Run the maple tutorial in maple versions 6,7,8,9.

**Solution:** In a maple worksheet, enter `?newuser` and choose the *New User's Tour*. In the tour, you will learn some basics of maple.

**Hint on L1.2:** Investigate the help panels for `cos`, `abs`, `exp`, `int` and `Int` (the inert version of `int`). Direct use of `int` in plot commands can produce unexpected results without any error message. The constant  $\pi$  is coded in maple as `Pi`, the upper and lowercase letters being significant. A common error is to code `c=Pi;` instead of the correct `c:=Pi;`. The error message *empty plot* can mean that a variable name is undefined. For example, `plot(x+PI,x=0..1);` will not plot. To see why, use `p:=plot(x+PI,x=0..1);` to display the plot data. The offending variable name is PI (different than Pi or pi).

**End of Maple Lab 1.**