

Sixth Lab For M242, Summer 2000

The lab is due on Tuesday, June 27, 2000. You may have oral discussions with any one in this section but the Maple work must be your own. Absolutely no work is to be shared. Please be warned, all parties to any violation of this rule will be held equally responsible and will get an **F** in this course.

Topic : In this lab we will learn how to extract parts of an expression. This will involve the use of the Maple commands `simplify`, `collect`, `expand`, `op` and `nops`.

Consider the expression $(x + py)^3 + (2x - y)(3x^2 + y^2 - px)$. If we want the expansion of this in powers of x and y then we would use

```
f := (x+p*y)^3 + (2*x-y)*(3*x^2 + y^2 - p*x);
g := simplify(f);  if simplify had not worked try expand
h1 := collect(g, x);
h2 := collect(g, {x,y});
h3 := collect(g, {x,y}, distributed);
```

Note the three different ways of collecting the terms in g (or f). $h1$ organizes the terms of g by powers of x alone ignoring the powers of the other variables. $h2$ organizes the terms of g first by powers of x and then the coefficients of each power of x are organized by powers of y . In $h3$, g is organized in powers of x and y as a polynomial (or more correctly a multinomial). Each of these representations is useful depending on what we have in mind. Expressions may be organized not just in powers of x but in powers of any expression. Try

```
k := (x+sin(x)) * (3*x + sin(x)) + (2*sin(x) + x)^2 ;
collect( expand(k), sin(x) );
```

Now we reexamine the expression $h3$ obtained earlier. We will extract various pieces of $h3$. Suppose we want to extract an expressions which consists of the first three terms in $h3$ and another expression which consists of the rest of the terms in $h3$. Then

```
h3;      just to see the expression
nops(h3); counts the number of terms in h3 (not needed)
op(1,h3); first term in h3 (not needed)
op(2,h3); second term in h3 (not needed)
a := op(1,h3) + op(2,h3) + op(3,h3);  the first three terms of h3
b := h3 - a;      the rest of the terms of h3
```

To extract all the coefficients of the various powers of x, y in $h3$ use

```
coeffs(h3, {x,y});
```

It is a little trickier to get just the coefficient of a single term such as x^2y . We use Maple's `coeff` command which works only on expressions expanded in terms of one variable.

```
h3; just to see the expression, not necessary
t1 := collect(h3, {x,y}); expand h3 in powers of x (then coeff in powers of y)
t2 := coeff(t1, x^2); extract terms which have an x^2
t3 := coeff(t2, y); extract term with y - hence the x^2 y term is extracted
```

Problems

1. [3] Using only hand computations, find the value of A and B so that $f = A \cos x + B \sin x$ satisfies

$$\frac{df}{dx} + f = 3 \cos x + 2 \sin x .$$

2. [12] Let $f = A \cos x + B \sin x + Px^2 + Qx + R$. Find the value of A, B, P, Q, R so that

$$\frac{d^2 f}{dx^2} + 3 \frac{df}{dx} + 2f = 5 \sin x + 2x^2 + 1$$

Hint: The difference between the left and the right hand sides must be zero. Do not reenter the results of any Maple computations - you must use Maple commands to extract these terms.

What To Hand In

Submit your solution stapled together. The Maple report must be organized as explained in section 2.1 of the tutorial.