

Maple Lab 3

This lab will help you learn how to use Maple to solve various problems related to derivatives. You will also be introduced to some basic programming using Maple such as writing procedures and loops.

1 Practice

To compute the derivative of a function, we use the command `diff`. Try the following:

```
diff(x^4+x^3+2x^2+x+1,x);
```

Sometimes, it is more convenient to give a function a name before manipulating on it (especially when you need to refer to the function many times). Try the following:

```
f:=x->x^4+x^3+2x^2+x+1;
diff(f(x),x);
f'(x);
f'(2);
```

Try `diff(f,x)`. What do you get? How do you explain it? If you want to rename the function f' to something else, say g , it is a little bit tricky but can be done as follows:

```
g:=t->eval(diff(f(x),x),x = t);
g(1);
plot(g(x),x=-1..1);
```

The second order derivative of a function f is written on paper as f'' , or $\frac{d^2f}{dx^2}$, or $f^{(2)}$. It is impractical to write too many “primes” when we want to write higher order derivatives. For this reason, the n 'th order derivative of f is written on paper as $\frac{d^n f}{dx^n}$ or $f^{(n)}$. Try the following:

```
diff(f(x),x$2);
diff(f(x),x$3);
f''(x);
f'''(2);
```

To write a procedure to compute the factorial of n , we use a “for” loop. Try the following: (after each line, press Shift+Enter, except for the last line where you press Enter)

```
fac:=proc(n)
  local i,s;
  s:=1;
  for i from 1 to n do
    s:=s*i;
  end do;
end proc
```

Now try `fac(5)`.

2 To turn in

1. Let

$$R(x) = \frac{x - 3x^3 + 5x^5}{1 + 3x^3 + 6x^6 + 9x^9}.$$

Use Maple to compute $R'(x)$ and $R''(x)$. Find $R'''(3)$.

2. Find the first 12 derivatives of $\sin(x)$. What is your guess for the n 'th derivative of $\sin(x)$, where n is a generic natural number?
3. Plot the function $f(x) = x^5 + x^4 - 4x^3 - 3x^2 + 3x + 1$ on the interval $[-2, 2]$. Can you identify the “peaks” and “valleys” of this function on the given interval? Hint: use the command `fsolve(expression=0,x)` to solve for x from an equation.