**CS 206 Homework 2**

**Your name:**

**Due: Tuesday, September 20.**

```
>
```

# Instructions

Do all of your work in this Maple worksheet. If you are asked to explain something, type your explanation in this worksheet. Do not give the most terse answer that you can think of. Try to give a full explanation of whatever is being asked. Your explanations should be clear, well written, and make use of proper spelling, punctuation, grammar, etc. Make your explanations as presentable as possible. Make use of Maple's basic formatting and word processing abilities. (Do not use a # to put your explanations on a Maple command line after a prompt.)

If you need to do a calculation, you should use Maple to do the calculation here in this worksheet. Do not do a calculation on a handheld calculator and then copy the result into this worksheet.

If you need more Maple prompts for commands, use Ctrl-j to create a new prompt.

Be sure to save your worksheet (as a "classic worksheet") as you work on it.

```
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```

# Problem 1

The general form for a cubic polynomial is $a\,x^3 + b\,x^2 + c\,x + d$. In this problem you are to find values for the four coefficients so that the graph of the cubic passes through the four points (1, -5), (3, 0), (4, 11.1), and (7, 3.2). Then you will draw a graph to verify that the cubic does contain these four points.

You need to set up four equations in four unknowns that Maple can solve. First, let the name **cubic_poly** represent the general cubic polynomial. Replace the **???** with the proper Maple syntax.

```
> cubic_poly := ???;
```

The following four Maple commands are supposed to define and name the four equations that you need to solve. Complete each command by using the **subs** command to substitute an *x* value into **cubic_poly** and setting the result equal to a *y* value. (Hint: What does it mean to say that the point (1,-5) is on the graph of the cubic polynomial?)

```
> eqn1 := ??? ;
> eqn2 := ??? ;
> eqn3 := ??? ;
```

```
> eqn4 := ??? ;
```

Now we use Maple's **solve** command to solve this system of four equations in four unknowns.

```
> solve( {eqn1, eqn2, eqn3, eqn4}, {a, b, c, d} );
```

We could use the **subs** command to verify this solution, but we will verify it with a graph instead. The following four commands assign **a**, **b**, **c**, **d** their solved values, create a graph of the cubic, a graph of the four points, and then a combined graph which is displayed. There are blanks in the commands that you need to fill in, and there are several intentional syntax and typing errors that you need to find and correct.

```
> assign( %% )
> plot1:=plot( cubic-eqn, x= ):
> plot2=plots( [ [1, 5],[3, 0],[4, 11,1] [7 32] ), style:=point,
  symbol=?):
> plots[display]({plot1,plot1]):
>
```

```
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# Problem 2

Sometimes Maple cannot solve equations symbolically. Consider the system of equations

$$x^3 + y^3 = 5\,x\,y - \frac{1}{4}$$

$$x - y^2\cos(y) = 0.$$

Here is Maple's symbolic solution.

```
> solve( {x^3+y^3=5*x*y-1/4, x-y^2*cos(y)=0}, {x, y} );
```

Notice that Maple did not produce a very useful result. In such a case we try to solve the equations numerically.

The above system of equations has five solutions in the *xy*-plane with their *x* and *y* coordinates between -5 and 5. Draw a graph of the two equations, by using the **implicitplot** command, that shows these five solutions. Then use the **fsolve** command (five times) to find approximate values for all five of these solutions.

```
> plots[impliciplot](    );
> fsolve(    );
> fsolve(    );
> fsolve(    );
> fsolve(    );
> fsolve(    );
>
```

```
>
```

# Problem 3

Here is another example where Maple cannot solve an equation symbolically.

```
> solution := solve( -x^2+x+1/4=exp(-x^2-1/2), x );
```

Notice that Maple did not produce a solution. In such a case we try to solve the equation numerically.

```
> fsolve( -x^2+x+1/4=exp(-x^2-1/2), x );
```

Now we have a solution, but is it the only solution?

Part (a): Draw graphs of the functions $-x^2 + x + \frac{1}{4}$ and $\mathbf{e}^{\left(-x^2-\frac{1}{2}\right)}$ using the **plot** command below.

Look for another solution to the equation. You need to replace the **???**'s in the **plot** command so that you can find another solution.

```
> plot( [ -x^2+x+1/4, exp(-x^2-1/2) ], x=???..??? );
```

Part (b): In the space below, use several **plot** commands to zoom in and get an approximate value for your other solution. How many correct decimal places can you get in your answer? Try to get as many decimal places as you can by zooming in with a graph. *Explain* what happens as you try to keep on getting more decimal places graphically.

```
>
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```

Part (c): Now give **fsolve** a hint so that it can evaluate your other solution to 100 decimal places. Replace the **???**'s with appropriate bounds on your other solution.

```
> Digits := 100:
> fsolve( -x^2+x+1/4=exp(-x^2-1/2), x=???..??? );
>
```

```
>
```