

## CS 206 Homework 5

Your name:

Due: Thursday, November 3.

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### 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 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.

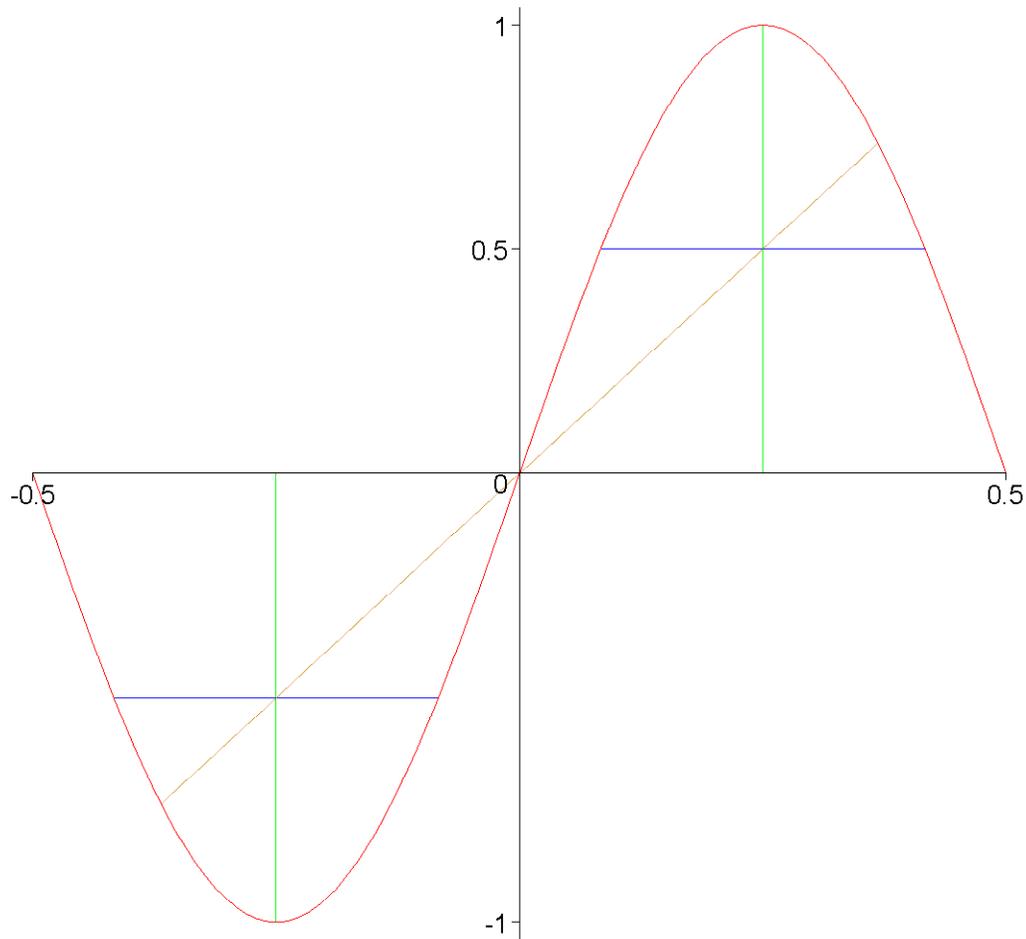
If you need more Maple prompts for commands, use Ctrl-j to create a new prompt.

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

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### Problem 1

Use Maple commands to reproduce the following graph as accurately as possible. The red curve is a sine function with period 1. Any calculations that you need to do in order to draw this graph should be done in this worksheet. (You will need to use Maple's online help to look up `xtickmarks` and `ytickmarks`.)



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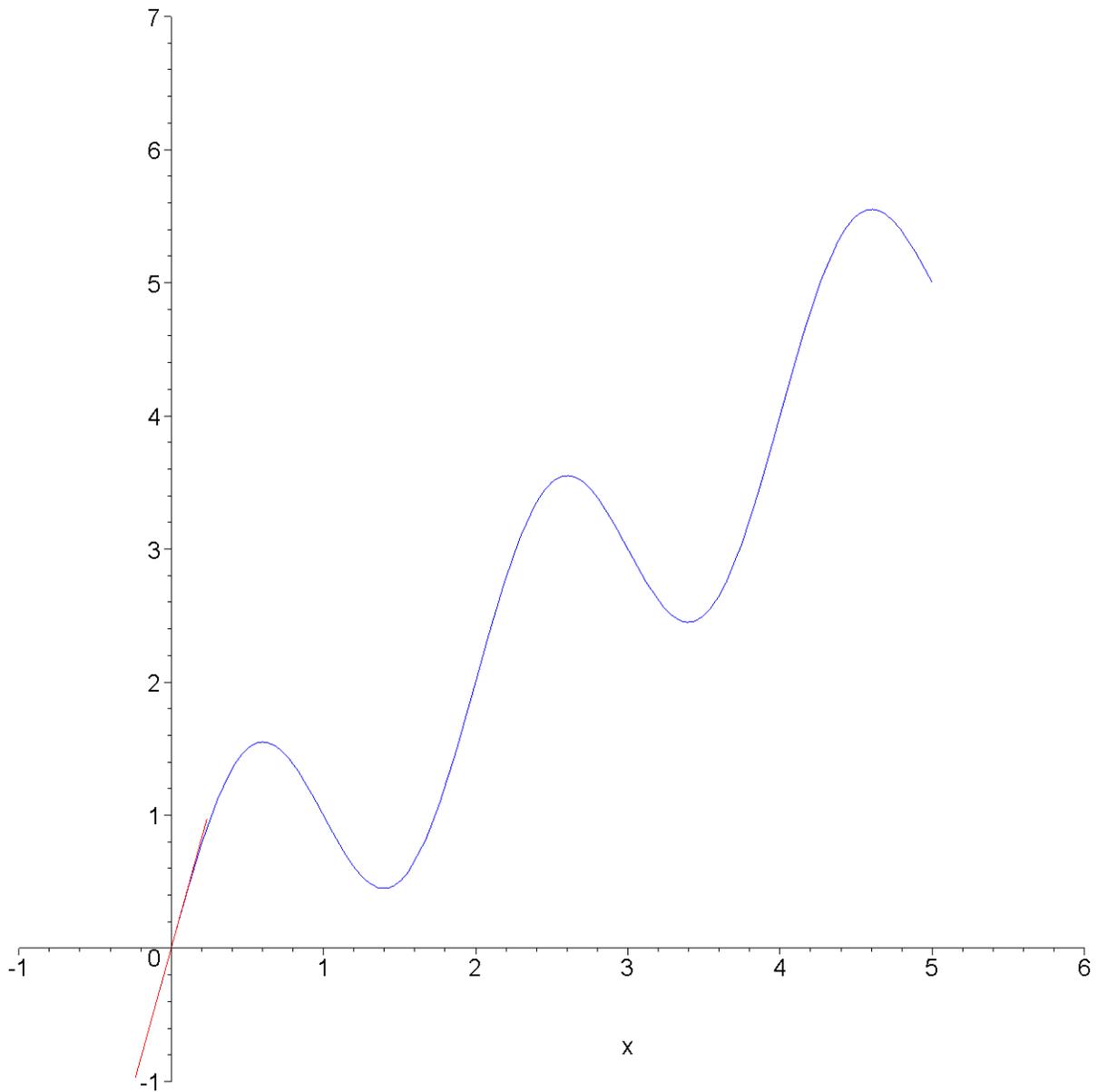
## **Problem 2**

Use a plot-valued-function to create the following animation. The function used in the animation is  $f(x) = x + \sin(\pi x)$ .

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[ > f := x -> x + sin(Pi*x);
                                f := x → x + sin(π x)
```

The red line segment is always tangent to the graph of  $f(x)$ . The length of the red line segment is always 2 and the center of the segment is always at the point of tangency. Since the length of the red line segment is always 2, but the slope of the segment is always changing, the horizontal range for the graph of the segment is always changing. Your plot-valued-function needs to compute the length of the range for the red segment.

The blue graph is a "background" graph for this animation. There are 150 frames in this animation.



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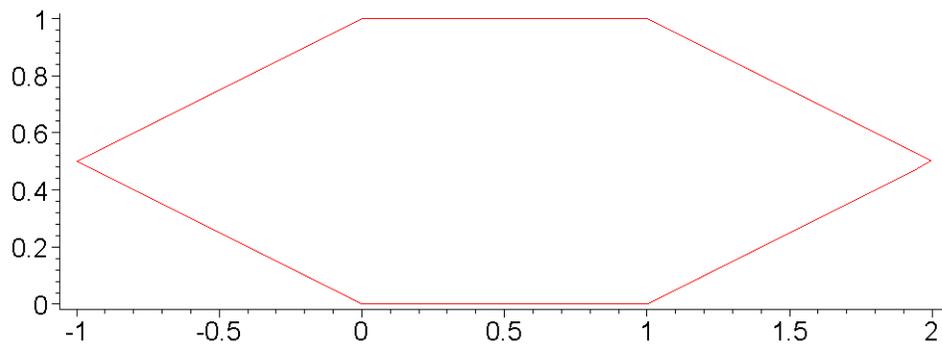
Hints: First, create a plot valued function that takes one input,  $x_0$ , and plots the tangent line to the function  $f(x)$  at  $x_0$  (use the point-slope form for the equation of the tangent line). Don't worry yet about the range of the tangent line, just make the range  $(x_0-1, x_0+1)$ . If you combine that plot with the "background" graph, you should get  $f(x)$  with one of its tangent lines. Use this version of your plot valued function to create an animation that moves the tangent line of  $f(x)$  across the graph of  $f(x)$ , but with the length of the tangent line varying a lot. After you have that animation, change the range of the tangent line from  $(x_0-1, x_0+1)$  to a range that depends on the slope of the tangent line (for example, notice that, the greater the slope is, the smaller this range should be if we want the length of the tangent line to be 1). The formula for the length of the range when  $x = x_0$  uses the slope  $Df(x_0)$ , and it can be derived by using the Pythagorean Theorem.

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### **Problem 3**

Define Maple functions  $\mathbf{f}$  and  $\mathbf{g}$  so that the vector valued function  $(\mathbf{f}(t), \mathbf{g}(t))$ , with  $t$  between 0 and 1, parameterizes the following shape. Define your parameterization so that  $f(0) = 0$ ,  $g(0) = 0$ , and as  $t$  increases the parameterization goes around the shape in the counter clockwise direction.



Hint: Your  $\mathbf{f}$  and  $\mathbf{g}$  can be piecewise defined functions with six (linear) pieces in each function (though there is a way to do this with only four (linear) pieces in each of  $\mathbf{f}$  and  $\mathbf{g}$ ).

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