

Online Activity

In our first year courses, the use of and influence of computers is very much suppressed. Students often use computers to either input answers (eg. WebWork) or to use some sort of software to check answers (eg. Wolfram Alpha). What this assignment will attempt to do is to create applications via the computer to help aid student's visual understanding of key ideas in their first year courses.

Learning Objectives:

1. To design a computer application usable in a first year course.
2. To learn about a new programming language or to learn new things about a familiar programming language.
3. To learn to upload material to your UBC website.

Project:

Using mathematica 8 (or any other suitable language), create and design an application that can be used to help students with a concept in mathematics and upload this project to a public place (your website at UBC for example). A list of ideas will be given at the end of this statement (you can of course choose to go off the board). Mathematica 8 is recommended for its ease of creating a file that is easy to upload to a website so that students can use. Please post on the wiki what example you would like to do so that we can limit overlap as best as we can. See

<http://www.math.ubc.ca/~cbruni/TAAP/ContinuityGraph.html>

for an example (that is far from finished but it provides an example as to what I'm thinking of. The source code can be found at the bottom of the page. This still has a lot of work before its good and ready but at least its a sample. I'll be tweaking it this week.

Possible suggestions of topics:

1. Expanding on the given code example to a piecewise function with 3 intervals of definition
2. Expanding on the given code example to one where we choose two parameters to make the curve differentiable
3. Write a code trying to show students what a piecewise function really is (so drawing two full graphs then one where the pieces are merged into one picture)

4. Giving an example of a related rates problem pictorially (maybe the standard snowball or ladder example)
5. Giving an example of the use of the Mean Value theorem for a car
6. Giving an example using the intermediate value theorem
7. Giving a dynamical example of a product vs cost production function to see that there is an optimal value for the cost of an item that maximizes revenue.
8. An example of a series that is conditionally convergent and when you rearrange the terms in the sum, one gets a different result.
9. A pictorial example of what it means to integrate a function
10. An applet where one can see what it means to compute the moments of a shape or perhaps one that computes the work done to lift a bucket of coal up a shaft.
11. An applet where one can see what it means for a vector to be an eigenvector.

Notes:

1. Please don't spend more than a few hours on this project. I knew nothing of Mathematica when I started and after about two hours, I produced something similar to what you see (I do have some knowledge of programming though so this might be a bit skewed). Try looking online for code snippets that you can integrate into your project. Feel free to ask for help and maybe myself or someone else in the group has an idea.
2. It would be nice if we could have this completely shared amongst our group - so sharing the source code and allowing everyone to upload the material onto their websites (yes this would mean that the content in theory is completed, however what it would be good with is that everyone would have their own versions of the software should they want to use it in the future or modify it further to suit their future classes needs. If everyone does this - we could have up to 6 files that might help students while answering questions.
3. Using Mathematica 7 or lower is fine as well. From what I have read though only Mathematica 8 has this ability to create a .cdf file which

can be used to upload things easily online. If you can only access Mathematica 7 (which the FISHER server gives access to) that's okay - if you want I can compile the file in Mathematica 8 and give you the nice output that you can upload to your website.

4. When I created my file, I was realizing that students really don't understand these piecewise continuity function questions. Perhaps this will help giving motivation as to picking a problem to write your code on.
5. This might sound silly but don't strive on perfection!!! Given the limited time we are to work on this, it's better to have something that works pretty good and then we can modify it at a later date. If this takes too much time, I can always extend it into the next online activity. For example, in my code I think the best way for this to be fully useful to a student is to also give them the option to enter their own functions instead of making them the fixed ones I give to them. For now, I just wanted some 'dirty' code that while isn't perfect, at least it gives student's a valuable learning opportunity that they didn't have before.

Source Code:

```
Manipulate[
  Plot[Piecewise[{{f[x, a], x >= 1}, {g[x], x < 1}}, {x, minX, maxX},
    PlotRange -> {Automatic, {-10, 10}},
    AxesLabel -> {"x", "f(x)"},
    ImagePadding -> 55, ImageSize -> 1000,
    PlotPoints -> 5000,
    Mesh -> ControlActive[10, 10], MaxRecursion -> 15,
    Epilog ->
      Inset[Plot[
        Piecewise[{{f[y, a], y >= 1}, {g[y], y < 1}}, {y, p[[1]] - 0.8,
          p[[1]] + 0.8}, PlotStyle -> Red,
        Axes -> False, Frame -> True, ImageSize -> 1000/5],
        Scaled[zv]]
  ]
,
```

```

{{p, {1, 0}}, Locator, Appearance -> None},
{{zw, {0.3, 0.8}, "Zoom window"}, Slider2D},
{{a, 0, "a ="}, -10, 10, 0.1, AppearanceElements -> All,
  ContinuousAction -> True},
{{minX, -5, "minX ="}, -5, 5, 0.1, AppearanceElements -> All,
  ContinuousAction -> True},
{{maxX, 5, "maxX ="}, -5, 5, 0.1, AppearanceElements -> All,
  ContinuousAction -> True},
Initialization :>
{
  minX = -5; maxX = 5;
  f[x_, a_] := x^2 + a;
  g[x_] := x + 2;
}
]

```