Math 3890, Machine Problem 12: Due 11/19

1) Write a function `lsc0dh` to compute an approximate solution of the BVP defined by $\Delta u := u_{xx} + u_{yy} = f$ on the unit square Ω with homogeneous Dirichlet boundary condtions. Use the spline space $\mathcal{S}_d^0(\triangle)$ associated with a given triangulation $\triangle$ of Ω. You should use my functions `domT`, `getindex`, `bcoord`, `basisder`, and `c1smooth`. The collocation should be done at the domain points of order m. The function will set up a system of collocation equations of the form $Oc = r$.
   a) You should add the equations $\lambda Ec = 0$, where `E` is the C^1 smoothness matrix produced by `c1smooth`, and λ is a parameter to control smoothness.
   b) You can find values of the xx-derivatives of the Bernstein basis polynomials with the call `bxx = basisder(d,2,rq,sq,tq,rx,sx,tx)`, where `rq,sq,tq` are the barcentric coordinates of the domain points of order m in T, and `rx,sx,tx` are the direction coordinates for the unit directional derivative pointing in the x-direction.

2) Write a script to
   a) define u and f as anonymous functions
   b) read in a triangulation and compute the lists
   c) prompt for a value of `d` and `lams` and call your function `lsc0dh` to find the coefficients
   d) report the value of `c1ck` for our spline
   e) call `valspgrid` to evaluate it on a 51×51 grid and report the max and RMS errors and time to solve
   f) plot the spline surface

3) Test your script with the test function $u(x, y) = \sin(\pi x)\sin(\pi y)$ on the unit square. Define $f(x, y) = -2 * \pi^2 * u(x, y)$, $d = 4$, and lams = 1e6. Run the script for type2 triangulations with 25, 81, and 289 vertices and tabulate the times, max and RMS errors. Turn in a plot of the spline for the first triangulation only.

   Here is a suggestion for the parameters of `lsc0dh`:

```
[c,t1] = lsc0dh(d,x,y,v1,v2,v3,e1,e2,e3,ie1,ie2,tril,trir,bdy,f,lams)
```