CS 621: Go-the-Distance 1

Due: Wednesday, September 14, 2005 (In Lecture or 4130 Upson by 4pm)

Submit a hardcopy listing of `PWayProd` with the rest of your first assignment. In addition, email `cv@cs.cornell.edu` a copy of your implementation as an attachment. Scoring is on a 0-to-3 scale (3 = complete success, 2 = overlooked a small detail, 1 = germ of the right idea, 0 = missed the point of the problem.) One point will be deducted for insufficiently commented code. Maximum of one point for code that does not run on our test script.

There will be six Go-The-Distance problems during the term. The top three scores will contribute to your final grade. (See course website for details.)

In this problem you are to generalize `ThreeWayProd` so that it handles the case

$$y = (A_1 \otimes A_2 \otimes \cdots \otimes A_p)\, x$$

where $A_i \in \mathbb{R}^{n_i \times n_i}$ for $i = 1{:}p$ and $x, y \in \mathbb{R}^N$ where $N = n_1 \cdots n_p$.

Complete the following MATLAB function so that it performs as specified:

```
  function y = PWayProd(A,x)
% A is a p-by-1 cell array
% A{i} is n()-by-n(i)
% x is N-by-1 with N = n(1)*...*n(p)
% y = (A{1} x ... x A{p})*x
```

How many flops are required? How many "reshape flops" are required where it is assumed that an operation of the form `reshape(z,p,q)` involves pq reshape flops. The answers to these questions should be found amongst the comments in the code itself.

Here is an example of how to use cell arrays in MATLAB:

```
p = 5;
A = cell(5,1);
for k = 1:p
    A{k} = randn(5,5);
end
x = randn(5,1);
y = CellProd(A,x);

  function y = CellProd(A,x)
% A is a length p cell array
% A{i} is an m-by-m matrix
% x is an n-by-1 vector
% y = A{1}*A{2}*...*A{p}x

p = length(A);
y = x;
for k=p:-1:1
   y = A{k}*y;
end
```