fast outer product in Matlab

I have two matrices in Matlab, A of size n x m and B is of size n x m too. I want to create a new matrix C which is something like:

```
for i=1:n
    C = C + outerProduct(A(i,:), B(i,:))
end
```

i.e. C is a matrix of size m x m, the sum of all outer products of the rows of A and B. Is there a fast way to do it without the for loops? For loops are notorious to be slow in Matlab.

matlab

asked Jan 10 '12 at 15:47

kloop

962 3 16 34

3 Answers

The operation you are performing (the sum of the row outer products) is equivalent to the

multiplication of a transposed version of `A` with `B`:

```
C = A.'*B;
```

You can see this using the following example:

```
>> mat = magic(5);  %# A sample 5-by-5 matrix
>> A = mat(1:4,:);  %# Create a 4-by-5 matrix
>> B = mat(2:5,:);  %# Create another 4-by-5 matrix

>> C = zeros(5);  %# Initialize C to be 5-by-5
>> for i = 1:4, C = C + A(i,:).'*B(i,:); end;  %'# Calculate C as you are now

>> isequal(C, A.'*B)  %'# Test for equality with the shorter solution

ans =

     1  %# Equal!
```

edited Jan 10 '12 at 16:02

answered Jan 10 '12 at 15:54

gnovice
85.7k 9 183 269

No, that wouldn't be it -- this uses the inner product for each cell. – kloop Jan 10 '12 at 15:55

2 $C_{ij} = \sum_k A_{ki} B_{kj} = \sum_k A^T_{ik} B_{kj} = A^T * B$ – Nzbuu Jan 10 '12 at 15:58

actually, I think that's correct. Thanks. – kloop Jan 10 '12 at 15:59

Have you profiled your `for` loop code and found it to be too slow? If not, do it before you spend too much time agonizing over the loop penalty.

Your `for` loop is not particularly bad because you loop only `n` times but do `O(n*m)` work each loop. Since you're doing a lot of work each iteration, the loop penalty doesn't hit as hard. The

really bad situations are nested loops, e.g. if you calculated the outer products with nested `for` loops too.

answered Jan 10 '12 at 15:53

japreiss
6,510 1 17 55

Perhaps I am misunderstanding, but I believe what you are looking for is

c = a*b';

answered Jan 12 '12 at 4:17

lsfinn
426 2 3

That would produce an n-by-n result, not an m-by-m result. – gnovice Jan 12 '12 at 5:19