Math 170A: Homework 0

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Question 1

```
function result = multiply(A, x)
    [m, n] = size(A);
    if n ~= length(x)
        error("Wrong dimensions");
    end
    result = zeros(m, 1);

    for i = 1:m
        sum = 0;
        for j = 1:n
            sum = sum + A(i, j)*x(j);
        end
        result(i) = sum;
    end
end
```

```
>> A = rand(9);
>> x = rand(9, 1);
>> A*x

ans =

    3.4243
    3.2543
    3.5680
    3.1967
    2.6078
    2.0030
    2.4774
    2.7110
    3.3496

>> multiply(A,x)

ans =

    3.4243
    3.2543
```

```
3.5680
3.1967
2.6078
2.0030
2.4774
2.7110
3.3496
```

The inside for loop does $3n$ operations and the outside for loop loops m times, so there are $3mn$ flops.

Question 2

```
function result = multiplyAB(A, B)
    [m, n] = size(A);
    [n2, p] = size(B);
    if n ~= n2
        error("Wrong dimensions");
    end
    result = zeros(m, p);

    for i = 1:m
        for j = 1:p
            sum = 0;
            for k = 1:n
                sum = sum + A(i, k)*B(k, j);
            end
            result(i, j) = sum;
        end
    end
end
```

```
>> A = rand(9,4);
>> B = rand(4,6);
>> A*B

ans =

    0.5601    0.8339    0.7232    0.5796    0.7100    0.6261
    1.2457    1.9806    1.7908    1.3379    1.7244    1.4657
    0.9912    1.3138    1.5655    0.5909    1.4228    1.5787
    0.6251    1.1983    1.0191    0.8751    0.9974    0.6766
    0.4712    1.3692    1.6492    0.6806    1.6021    1.1497
    0.7390    1.5050    1.6385    0.8429    1.5931    1.2708
    0.7440    1.0066    1.0009    0.5917    1.0366    1.0455
    0.8851    1.2795    1.3087    0.7378    1.3029    1.2701
    0.6987    0.9972    1.0369    0.5697    0.9068    0.9171

>> multiplyAB(A, B)

ans =

    0.5601    0.8339    0.7232    0.5796    0.7100    0.6261
    1.2457    1.9806    1.7908    1.3379    1.7244    1.4657
    0.9912    1.3138    1.5655    0.5909    1.4228    1.5787
    0.6251    1.1983    1.0191    0.8751    0.9974    0.6766
```

```
0.4712    1.3692    1.6492    0.6806    1.6021    1.1497
0.7390    1.5050    1.6385    0.8429    1.5931    1.2708
0.7440    1.0066    1.0009    0.5917    1.0366    1.0455
0.8851    1.2795    1.3087    0.7378    1.3029    1.2701
0.6987    0.9972    1.0369    0.5697    0.9068    0.9171
```

The inner loop has $3n$ FLOPs. The middle loop runs p times and the outer loop runs m times so there are $3mnp$ FLOPs in total.