Homework #0

• Programming:

1. Using basic programming (for loops, while loops, and if statements), write a function in Matlab that takes as input:
   - dimension \( n \);
   - component \( i \);
and outputs the \( i \)th vector of the standard orthonormal basis (0’s for all components except the \( i \)th component, which has a value of 1).
   (a) Print out or write out your function.

2. Using basic programming (for loops, while loops, and if statements), write a function in Matlab that takes as input:
   - dimension \( n \);
   - column vector \( v \) with \( n \) components;
   - column vector \( w \) with \( n \) components;
and outputs the dot product \( v \cdot w \).
   (a) Print out or write out your function.
   (b) Apply your function to the case with vectors \([1; 4; \allowbreak -2; 6]\) and \([8; -2; 1; 5]\) and print out or write out the results.

3. Using basic programming (for loops, while loops, and if statements), write a function in Matlab that takes as input:
   - dimension \( n \);
   - \( n \times n \) matrix \( A \);
   - column vector \( x \) with \( n \) components;
computes \( Ax \) and outputs the number of flops used.
   (a) Print out or write out your function.
   (b) Apply your function to the case with a \( 100 \times 100 \) random matrix and vector and print out or write out the results. Do the same for \( 200 \times 200 \), \( 400 \times 400 \), and \( 800 \times 800 \).

4. Using basic programming (for loops, while loops, and if statements), write a function in Matlab that takes as input:
   - dimension \( n \);
   - \( n \times n \) matrix \( A \);
   - column vector \( x \) with \( n \) components;
computes \( Ax \) using column-oriented matrix-vector multiplication, and outputs the number of flops used.
(a) Print out or write out your function.
(b) Apply your function to the case with a $100 \times 100$ random matrix and vector and print out or write out the results. Do the same for $200 \times 200$, $400 \times 400$, and $800 \times 800$.

5. Using basic programming (for loops, while loops, and if statements), write a function in Matlab that takes as input:
   
   - dimension $n$;
   - $n \times n$ matrix $A$;
   - $n \times n$ matrix $B$;

   computes $AB$ and outputs:
   
   - the number of additions/subtractions used;
   - the number of multiplications/divisions used;

(a) Print out or write out your function.
(b) Apply your function to the case with a $100 \times 100$ random matrix and vector and print out or write out the results. Do the same for $200 \times 200$, $400 \times 400$, and $800 \times 800$. 