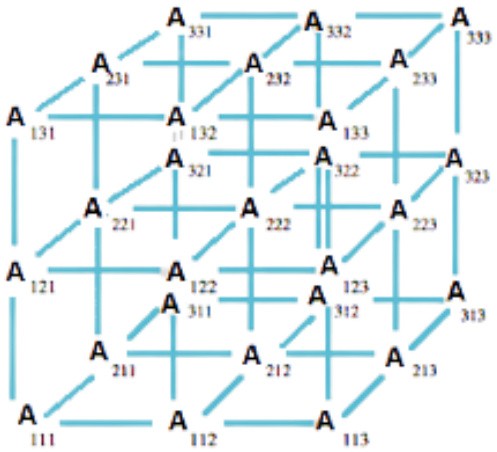
CCS354 – Tensors and Graphs

Lab exercise-02



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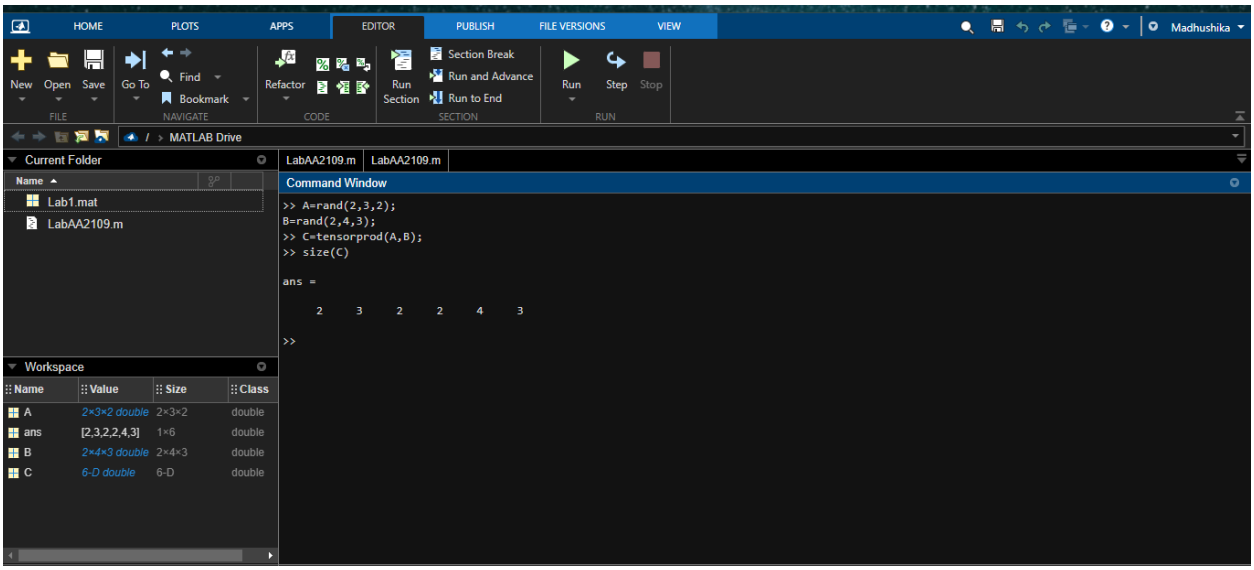
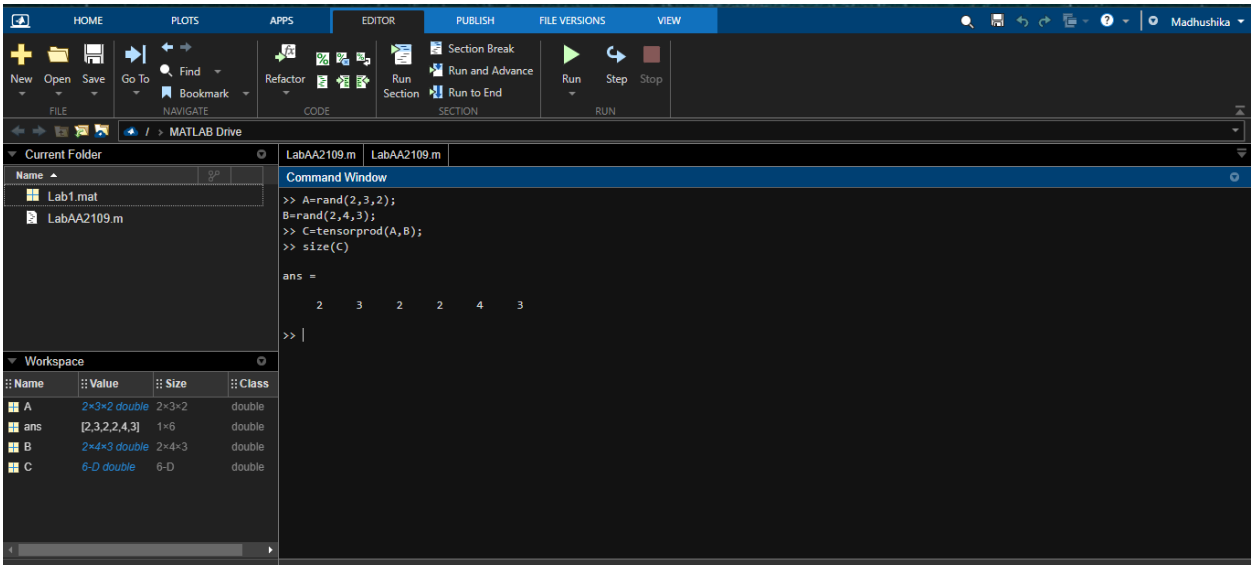
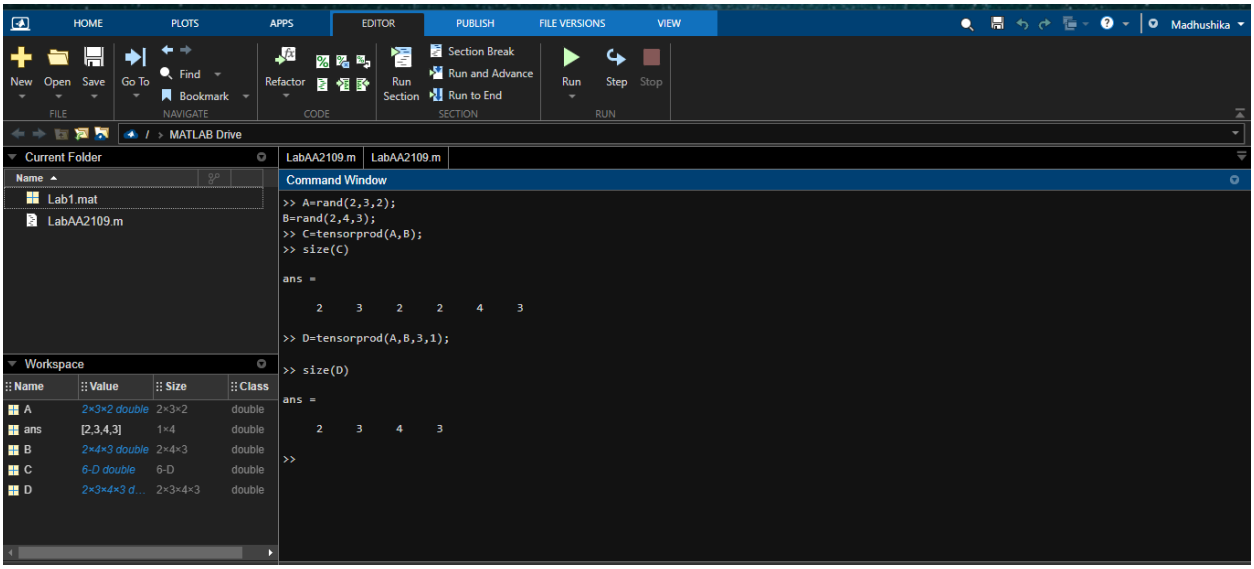
1. Create two 3-D tensors A (2,3,2) [i,j,k] and B (2,4,3) [k,l,m] with random elements.

a. Calculate the outer product of the two tensors. Check the size of the result.

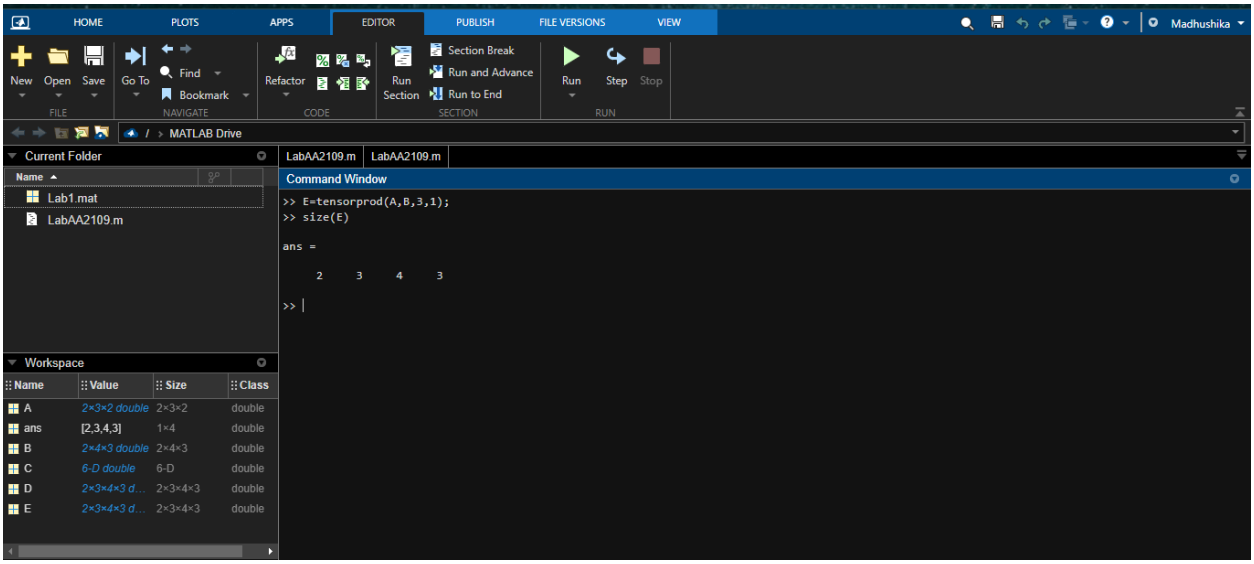




b. Calculate the tensor product Aki, and Bl,mk



c. Calculate the tensor product $Ai,,k$ and Bk,l,m.



d. Discuss the answers in (b) and (c) with screenshots as a proof.

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A (2, 3, 2) [i, j, k]

B (2, 4, 3) [k, l, m]

(a) To calculate the outer product we use tensorprod function

tensorprod (A, B) returns outerproduct of A and B

Size of outerproduct → [size (A) size (B)]
obtained results → [2 3 2 2 4 3]
Size A → 2 × 3 × 2
Size B 2 × 4 × 3

(b) Tensor product of $A^{i,j}_{k}$ and $B^{k}_{l,m}$

Here Both A and B contract in same dimension which is k

∴ the end result may gives $A^{ij}\ B_{l,m}$ $A\ B^{ij}_{l\ m}$ (4d)

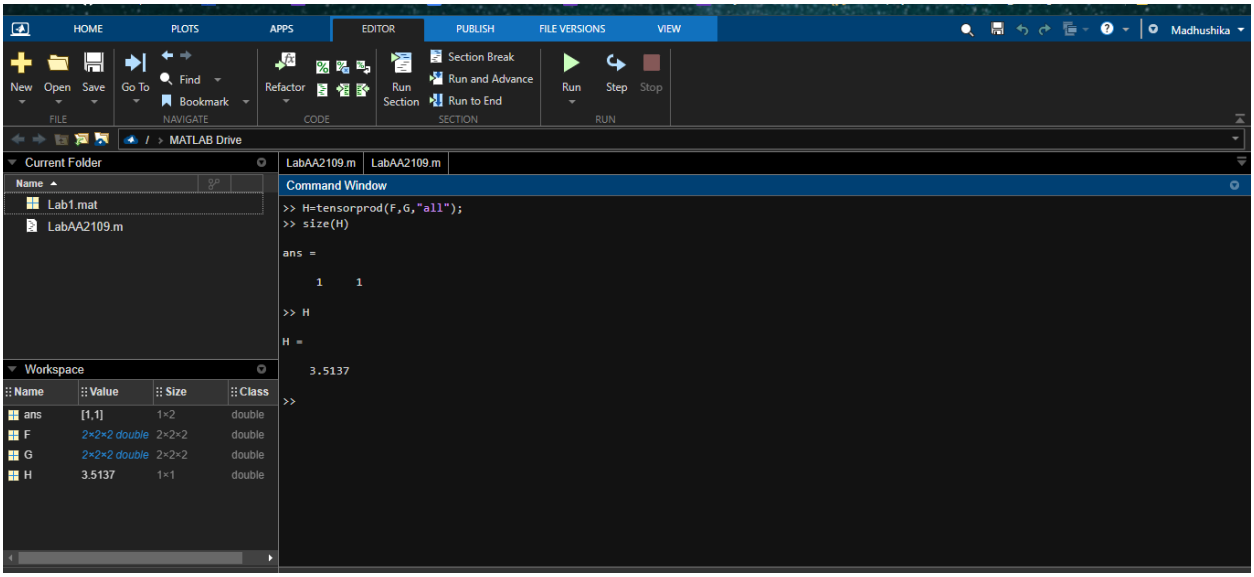
(c) Tensor product of $A^{i,j,k}$ $B_{k,l,m}$

Here if we index

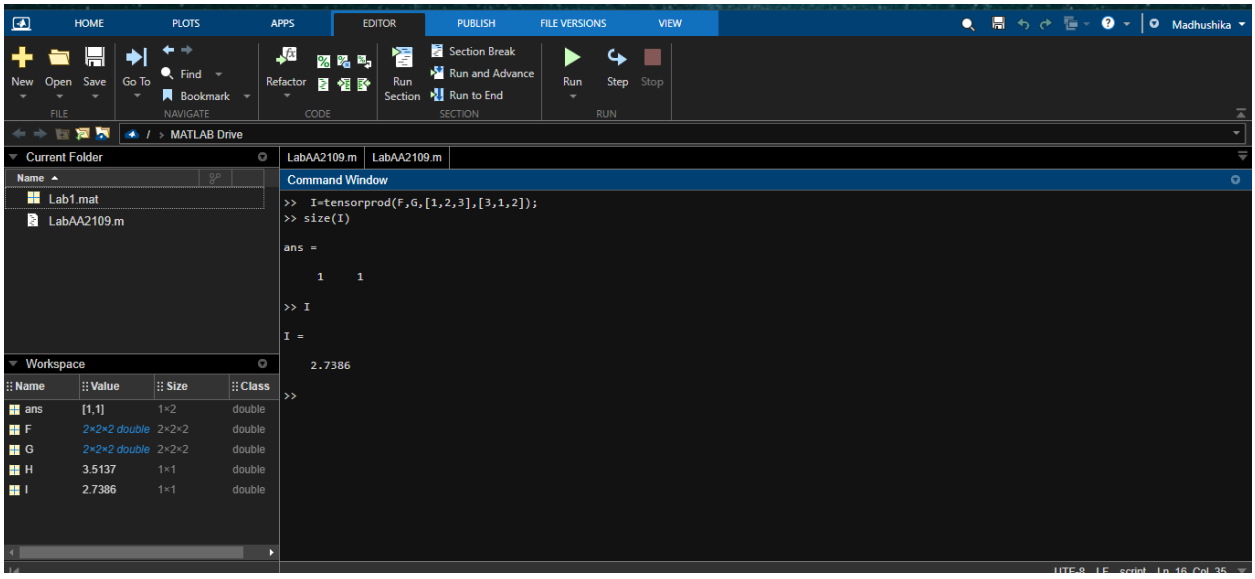
* 3rd dimension of A with 1st dimension of B will contract Hence the result will give us the size of A (uncontracted) and size of B uncontracted.

2. Create two 3-D tensors A (2,2,2) and B (2,2,2) with random elements

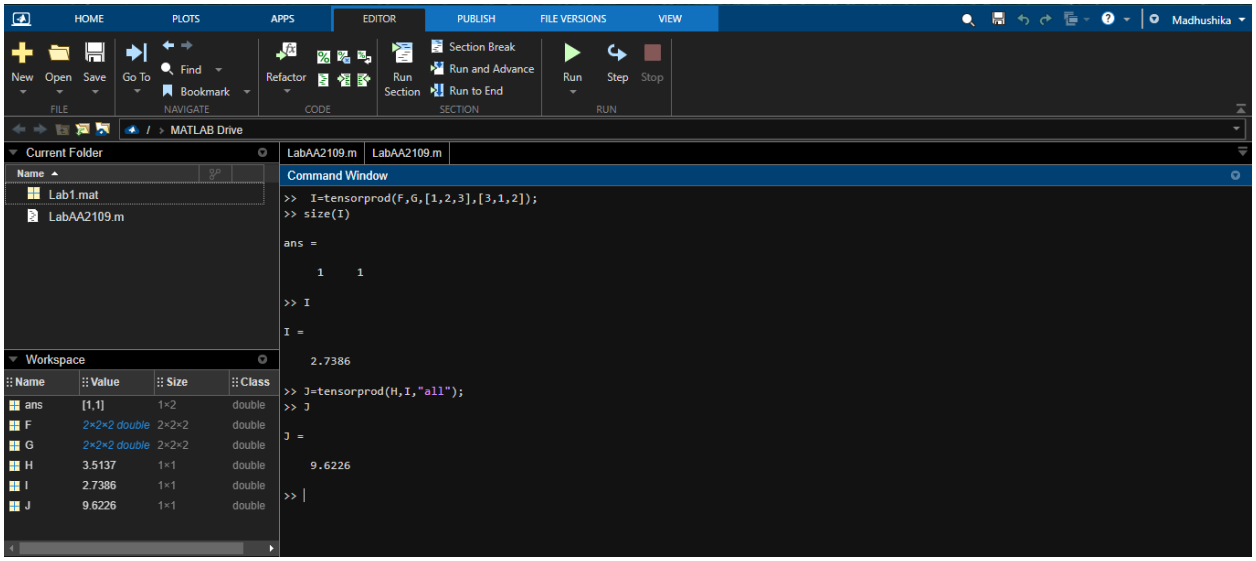
a. Calculate the tensor product $A\ ijk$and $Bijk$ ($Here$, i = 2,j = 2 and k = 2)



b. Calculate the tensor product $A\ ijk$ and $Bjki$. ($Here$, i = 2, = 3, and k = 2).



c. Calculate the inner product of the tensors in above (a) and (b).



d. Discuss the answers with screenshots as a proof

F(2,2,2)
G(2,2,2)

a. when calculate tensor product of F and G each i,j,k are contracted with each other

∴ we can use "all"

$A^{ijk} \quad B_{ijk} \Rightarrow$ Scaler

b.

$A^{i\,j\,k}$ (1 2 3) $\quad B_{j\,k\,i}$ (1 2 3)

∴ I used contraction as follows

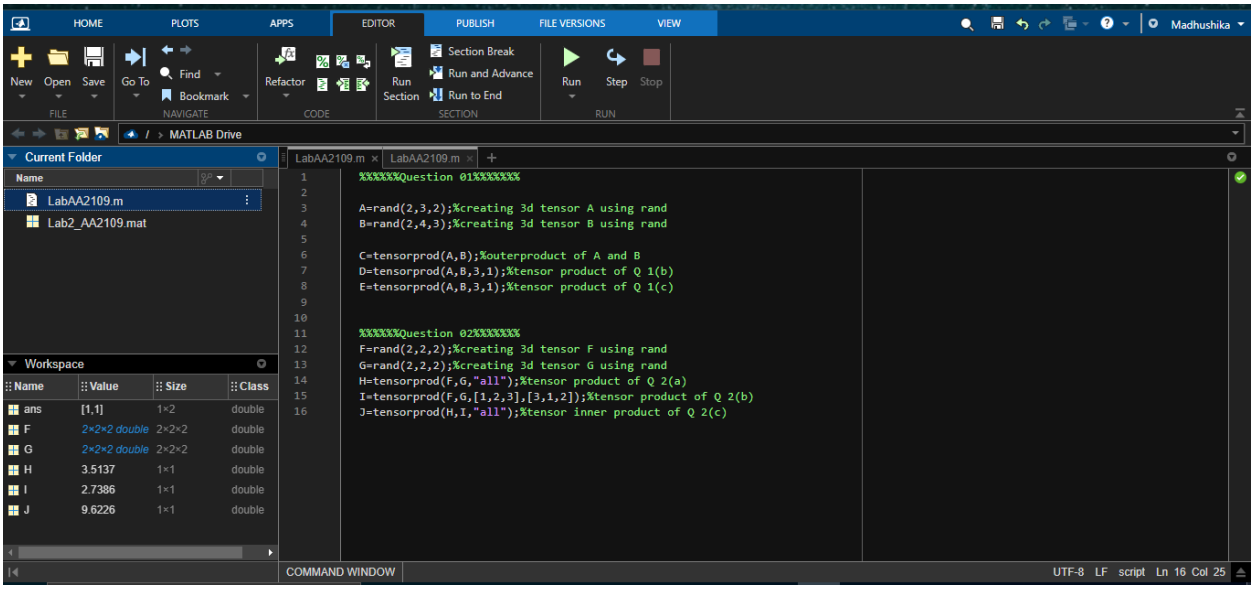
A (i, j, k) (1 2 3)

B (j, k, i) (1 2 3)

∴ result is a scaler = 2.7386

c. For inner product we can use "all" with tensorprod.

Script



Code

```
%%%%%%Question 01%%%%%%%

A=rand(2,3,2);%creating 3d tensor A using rand
B=rand(2,4,3);%creating 3d tensor B using rand

C=tensorprod(A,B);%outerproduct of A and B
D=tensorprod(A,B,3,1);%tensor product of Q 1(b)
E=tensorprod(A,B,3,1);%tensor product of Q 1(c)


%%%%%%Question 02%%%%%%%
F=rand(2,2,2);%creating 3d tensor F using rand
G=rand(2,2,2);%creating 3d tensor G using rand
H=tensorprod(F,G,"all");%tensor product of Q 2(a)
I=tensorprod(F,G,[1,2,3],[3,1,2]);%tensor product of Q 2(b)
J=tensorprod(H,I,"all");%tensor inner product of Q 2(c)

%I did all codes using matlab online but unable to download the script
%therefore i submit as a 2020 matlab script file, when run the code please use 2022 matlab or
online matlab.
```