Xihao Zhu's lab01 documentation
Problem1.
I have used matlab before.

Problem2.
I used GNU Octave to do this homework.(GNU Octave is pretty much like Matlab, but just a free version, if you have any problem running my code please contact me. My email is zhuxh529@gmail.com, phone is 6184340261).

Problem3.
Just navigate to my directory, and type "rotate" in command line of Octave.
Result is:

```
p2 =

     0
     0
    -1

p2 =

     0.00000
     0.70711
    -0.70711
```

so two rounds get different results, which is what we want(order of matrix calculation is reverse, so results are different).

Problem 4.
(a)
(i)
alpha =[10 20 30}
position =[1 2 3]

T=

0.92542	0.01803	0.37852	3.00000
0.16318	0.88256	-0.44097	2.00000
-0.34202	0.46985	0.81380	1.00000
0.00000	0.00000	0.00000	1.00000

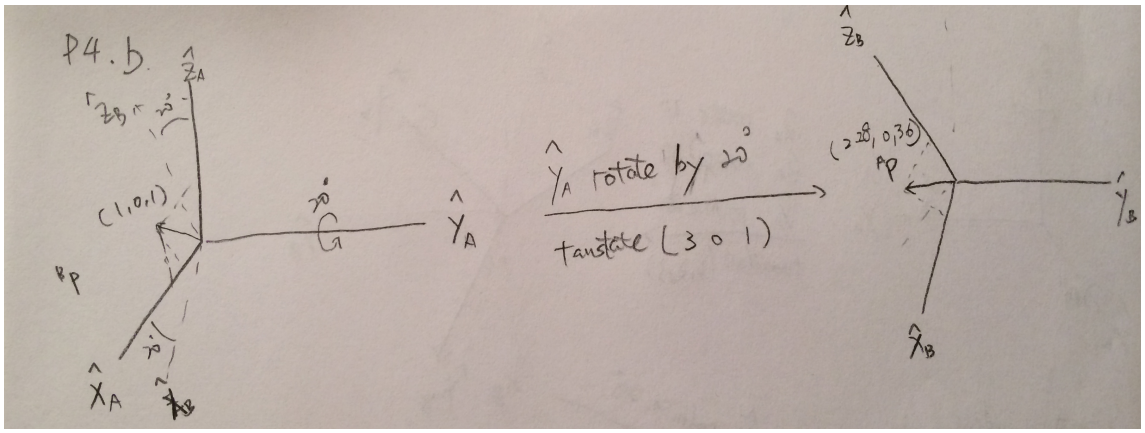
(ii)
alpha =[0 20 0]
position=[3 0 1]

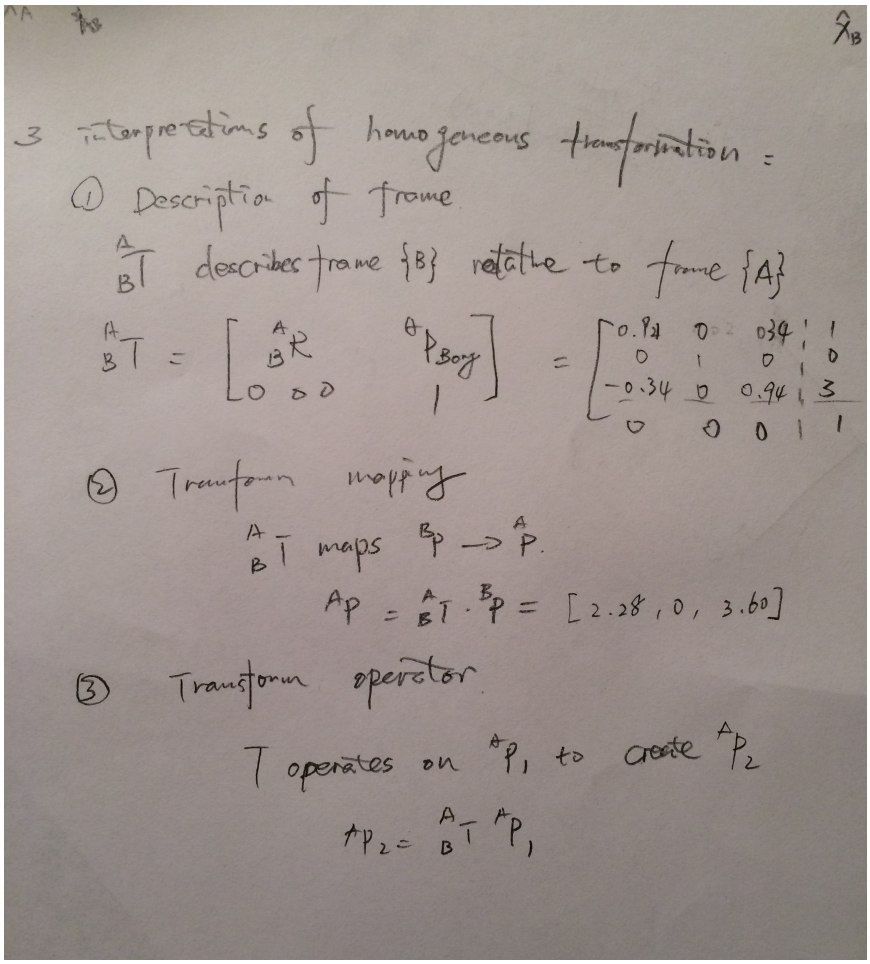
T=

0.93969	0.00000	0.34202	1.00000
0.00000	1.00000	0.00000	0.00000
-0.34202	0.00000	0.93969	3.00000
0.00000	0.00000	0.00000	1.00000

(b)
Translated position is
T*[1;0;1;1]=
2.28171
0.00000
3.59767
1.00000

so translated position is
2.28171
0.00000
3.59767
graph sketch:


P4.b.
$\hat{Z}_A$
$\hat{Y}_A$
$\hat{X}_A$
(1, 0, 1)
20°
20°
20°
BP
$\hat{Y}_A$ rotate by 20°
translate (3 0 1)
$\hat{Z}_B$
(2.28, 0, 3.6)
AP
$\hat{Y}_B$
$\hat{X}_B$


$\hat{X}_B$
3 interpretations of homogeneous transformation =
① Description of frame
${}^A_B T$ describes frame {B} relative to frame {A}
${}^A_B T = \begin{bmatrix} {}^A_B R & {}^A P_{Borg} \\ 0\ 0\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 0.94 & 0 & 0.34 & 1 \\ 0 & 1 & 0 & 0 \\ -0.34 & 0 & 0.94 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$
② Transform mapping
${}^A_B T$ maps ${}^B P \rightarrow {}^A P$.
${}^A P = {}^A_B T \cdot {}^B P = [2.28, 0, 3.60]$
③ Transform operator
T operates on ${}^A P_1$ to create ${}^A P_2$
${}^A P_2 = {}^A_B T\ {}^A P_1$

(i)
[T, T_inv]=euler2ht(a,p) gets
T =

0.92542	0.01803	0.37852	3.00000
0.16318	0.88256	-0.44097	2.00000
-0.34202	0.46985	0.81380	1.00000
0.00000	0.00000	0.00000	1.00000

T_inv =

0.92542	0.16318	-0.34202	-2.76058
0.01803	0.88256	0.46985	-2.28906
0.37852	-0.44097	0.81380	-1.06743
0.00000	0.00000	0.00000	1.00000

Then multiply both of T and T_inv
T*T_inv
ans =

1.00000	-0.00000	0.00000	0.00000
-0.00000	1.00000	0.00000	0.00000
0.00000	0.00000	1.00000	-0.00000
0.00000	0.00000	0.00000	1.00000

correct!

(ii)

[T, T_inv]=euler2ht(a,p) gets
T =

0.93969	0.00000	0.34202	1.00000
0.00000	1.00000	0.00000	0.00000
-0.34202	0.00000	0.93969	3.00000
0.00000	0.00000	0.00000	1.00000

T_inv =

0.93969	0.00000	-0.34202	0.08637
0.00000	1.00000	0.00000	0.00000
0.34202	0.00000	0.93969	-3.16110
0.00000	0.00000	0.00000	1.00000

Then multiply both of T and T_inv
T*T_inv
ans =

1.00000	0.00000	0.00000	0.00000
0.00000	1.00000	0.00000	0.00000
0.00000	0.00000	1.00000	-0.00000
0.00000	0.00000	0.00000	1.00000

correct!

(d)
(i)
T(B->A)=

0.93969	0.00000	0.34202	1.00000
0.00000	1.00000	0.00000	0.00000
-0.34202	0.00000	0.93969	3.00000
0.00000	0.00000	0.00000	1.00000

T(C->B)=

0.92542	0.01803	0.37852	3.00000
0.16318	0.88256	-0.44097	2.00000
-0.34202	0.46985	0.81380	1.00000
0.00000	0.00000	0.00000	1.00000

then
T(C->A)=T(B->A)*T(C->B)=

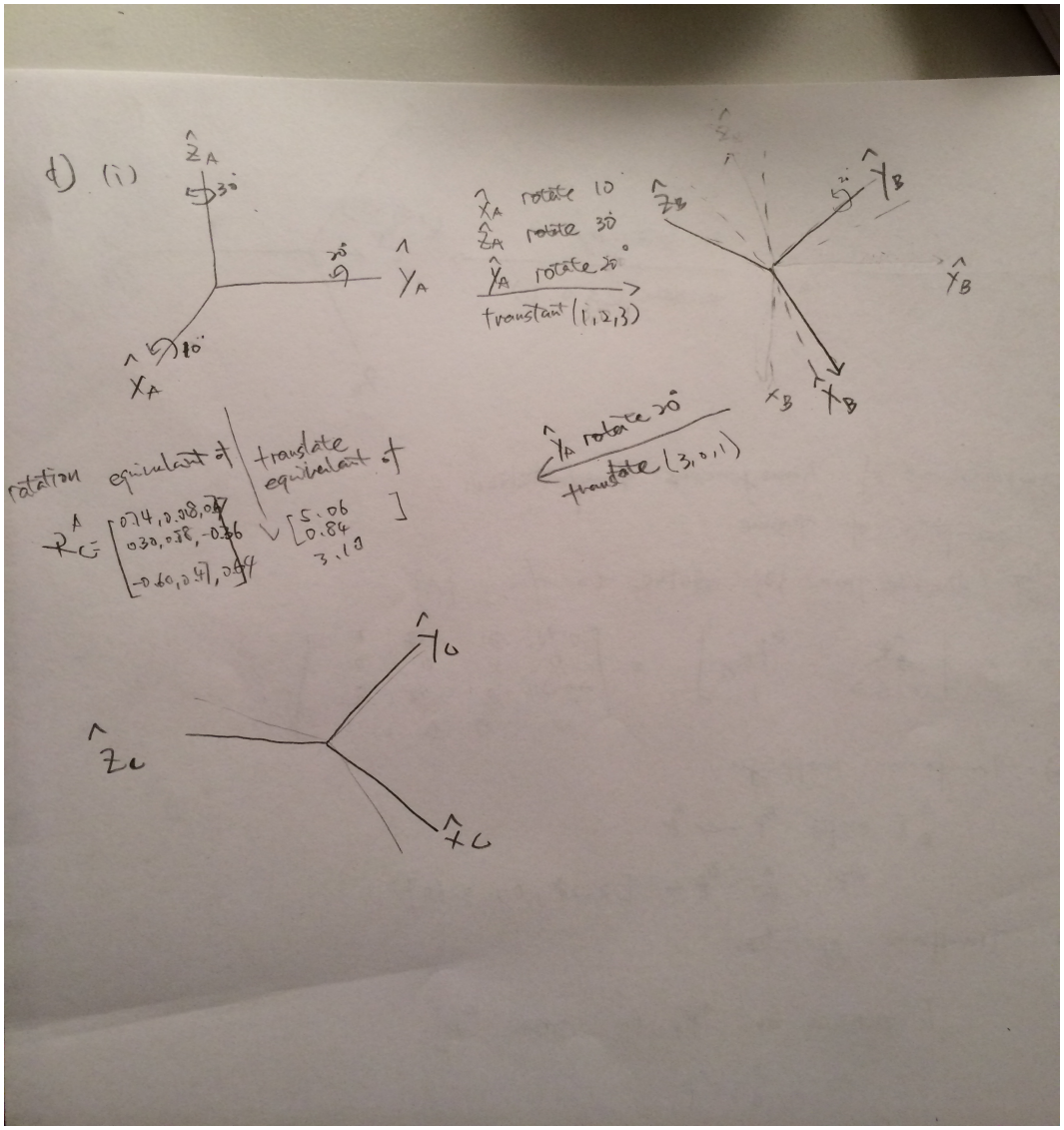
0.75263	0.17764	0.63403	4.16110
0.16318	0.88256	-0.44097	2.00000
-0.63790	0.43535	0.63526	2.91363

0.00000 0.00000 0.00000 1.00000

By using the same method, we can get
T(A->C)=T(B->C)*T(A->B) where the later 2 Ts are T_inv of a.i and a.ii
=

0.75263 0.16318 -0.63790 -1.59950
0.17764 0.88256 0.43535 -3.77273
0.63403 -0.44097 0.63526 -3.60723
0.00000 0.00000 0.00000 1.00000

check T(C->A)*T(A->C)=I, correct



(ii)
given T(C->A), T(C->B)
we can use inverse transform to get T(B->C), then
T(B->A)=T(C->A)*T(B->C)
=

0.92542	0.01803	0.37852	3.00000
0.16318	0.88256	-0.44097	2.00000
-0.34202	0.46985	0.81380	1.00000
0.00000	0.00000	0.00000	1.00000

It's the same as I calculated before.

(iii)
given T(C->A), T(B->A)
we can use inverse transform to get T(A->B), then
T(C->B)=T(A->B)*T(C->A)=

0.93969	0.00000	0.34202	1.00000
0.00000	1.00000	0.00000	0.00000
-0.34202	0.00000	0.93969	3.00000
0.00000	0.00000	0.00000	1.00000

It's the same as i calculated before.