Homework 4

Integrity: Your honor is extremely important. This academic security policy is designed to help you succeed in meeting academic requirements while practicing the honorable behavior our country rightfully demands of its military. Do not compromise your integrity by violating academic security or by taking unfair advantage of your classmates.

Authorized Resources: You can **ONLY** seek help from the instructor. Homework is an individual exercise.

[25 pts] Forward Kinematics

Using the template from the website, create a `Jupyter notebook` for this assignment. Remember to setup your notebook like this

```
from __future__ import division
from __future__ import print_function
import sympy
from sympy import symbols, sin, cos, pi, simplify
import numpy as np
```

1. Write a function that takes in the DH parameters (θ, α, d, a) and returns the homogeneous matrix for it.

   ```
   def homogeneousMatrix(theta, alpha, d, a):
       """
       This calculates a homogeneous matrix for the given parameters
       """
       ...
       return matrix
   ```

   Using this function and the values below, print out the translation for this transform using:

   1. α is 20 degrees
   2. θ is 45 degrees
   3. d is 6 inches
   4. a is 5 inches

   Hint: You should get (x, y, z): $[5 - 6 * sin(pi/9) 6 * cos(pi/9)]$

2. Given an array of DH parameters for a robot arm, write a function which takes this and returns a homogeneous matrix for the robot arm. Where the array would look like

   ```
   arm = [
       [theta, alpha, d, a],
       [theta, alpha, d, a],
       [theta, alpha, d, a],
       ...
   ]
   ```

```
def forward(params):
    """
    Given the params, it returns the forward kinematics equations
    """
    ...
    return eqns
```

Using this function, determine the equation for the robot arm with the following DH parameters. Make sure you simplify your answer symbolically.

i	θ_i	α_i	d_i	a_i
1	θ_1	0	3	0
2	θ_2	0	5	0
3	θ_3	0	0	2
4	θ_4	α_4	2	0

Print the equations and separately print the translation. *Hint:* You should get for the z translation: 2.0*cos(a4) + 8.0