2. Consider the pill picking robot desired by Timetooth Technologies. Their requirement is to have a preferably one-DOF gripper in a compact form factor (since it has to fit within a small cup) and be able to pick up a single pill lying in the cup in any orientation. A vacuum-based gripper is not desired.

a. Comment on whether you think a hard gripper or a compliant/soft gripper will be more suitable for this task. Please include 4-6 sentence rationale for your preference. Even if you do not have a very precise reason, you could still include hypotheses in your arguments. Submit your answer in a PDF file format .

HARD GRIPPER	COMPLIANT SOFT GRIPPER
1.The hard gripper cannot access the strength of the pill so it can break the pill. 3.It also can damage the pill by its fixed force and thus even the small size difference can damage the pills.	2.It is more applicable in the case as the pills are manufactured with a very minute details in composition and should be handled in a subtle way according to their size so that the pill does not lose its medicinal value. 4.By compliance we might use the gripper for various sizes of pills which however may not be the case for hard gripper.

b. Briefly review ‘flexible mechanisms’, ‘soft robotic grippers’, ‘universal grippers’, ‘paper grippers’ and ‘origami robots’ from information available on the web and comment on whether any of the ideas you explored seem suitable for this application. Include weblinks (either videos or papers) of any specific grippers that you felt might be worth considering and may serve as a good reference. Submit your answer in Word/ text (less preferred) format or in PDF file format (with preferably clickable links).

I think origami based soft GRIPPER can do the work as they can shape shift to enter the small area and also behave as a better compliant mechanism for the gripper.
Some of the Gripper mechanisms that can be coupled with origami are the following.

1. Soft Robotics' octopus-inspired robots industrial grippers
2. Origami gripper
3.https://www.liebertpub.com/doi/10.1089/soro.2015.0019

3. Consider the exoskeleton scruffing problem from TimeTooth Technologies. Consider only one side of the exoskeleton and consider it to be a planar 2R elbow manipulator.
A.
Reasonable link lengths by searching for (or measuring your own)
hip-to-knee distance 47cm as link 1
Knee-to-ankle 52cm as link 2

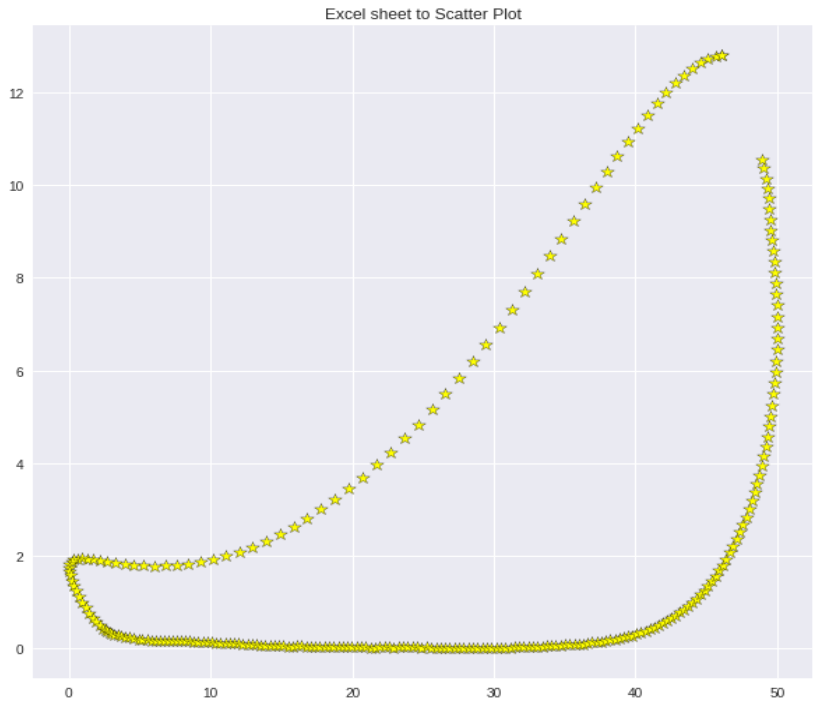
Gait trajectory
It is the trajectory made by the human leg while completing a gait cycle with The gait cycle has been broadly divided into two phases: stance phase and swing phase. The stance phase is about 60 percent of the gait cycle The swing phase is described when the limb is not weight bearing and represents about 40 percent of the gait cycle.

Step height is the distance measured between line of progression of the left foot and the line of progression of the right foot.

Step length is the distance between the point of initial contact of one foot and the point of initial contact of the opposite foot.

b. Given the attached CSV file containing (x,y) values of the ankle coordinates for a typical gait cycle, figure out using online resources how to import/read this file (Hint: pip install xlrd). Then import the file and plot all the points on the x-y plane showing the ankle coordinates over the entire gait cycle. Submit code and the results from the code including the plot.

Sol
The ipynb file is uploaded as gait.ipynb



5. In the DH convention are all joint axes always aligned with respective z axis?
Yes as per DH convention all the joint axes are aligned to the Respective Z axis irrespective of the type of the joint be it prismatic be it revolute.

6. In the DH convention, are the origins of all the coordinate frames always at the centres of the joints?
No the origins depend on the intersection of the common normal of the Zi and Zi-1 axis intersection and also if the Zi-1 and Zi intersect then the origin is at the intersection of them

7. Is it true that a homogeneous transformation consists of both a rotation and a translation?
Yes Homogeneous Transformation consists of both rotation and translation$[R] and [D]$.

8. For a sequence of rotations performed one after the other, can the rotation matrices for each individual rotation be multiplied together to form the overall rotation matrix (capturing the sequence of rotations)?
Yes the sequence of Rotations performed one after another along a fixed axis can be multiplied together to give a complete rotation matrix.

9. Is a composite rotation matrix consisting of a sequence of several rotations still an orthogonal matrix with determinant equal to 1?
Suppose a sequence of Rotation along X,Y,Z the rotation matrix is $[Rxyz]=[Rx][Ry][Rz]$
And property of orthogonality can be shown if R $R^T=I$
Thus after substituting in the above eqn and using property of transpose
$[[Rx][Ry][Rz]]\ [[Rx][Ry][Rz]]^T=[[Rx][Ry][Rz]]\ [Rz]T[Ry]T[Rx]T$
$[[Rx][Ry][Rz]]\ [Rz]T[Ry]T[Rx]T=I$

And as we know Rx Ry Rz are orthogonal matrices so the transpose is their inverse so the whole equation comes out to be Identity matrix.