Importing necessary modules

In [1]:
```
import numpy as np
import pandas as pd
import scipy.stats as sts
import matplotlib.pyplot as plt
from scipy.stats import t,f,f_oneway
```

Task1: Aerospace problems

In [2]:
```
aero=[15,16,16,0,7,20,6,8,17,25,8,21,29,11,9,21,3,12]

x=np.mean(aero)
n=len(aero)
S=np.std(aero)
alpha=0.1
dof=n-1


lhs=x-1.65*(S/(n)**0.5)
rhs=x+1.65*(S/(n)**0.5)

print("The confidence interval of population means are = ",lhs," - ",rhs)
```

```
The confidence interval of population means are =  10.607300683580702  -  16.503810427530407
```

In [3]:
```
t_critical=t.ppf(alpha/2,dof)
print("The t_critical value is "+str(t_critical))

print('The sample mean is:',x)
print('The sample standard deviation is :',S)
```

```
The t_critical value is -1.7396067260750676
The sample mean is: 13.555555555555555
The sample standard deviation is : 7.580840045962527
```

conclusion:-

- The mean of sample is 13.5 which means that the average comp time of sample employees is 13.5
- The standard deviation of the sample is 7.8006, with the significance level alpha is = 0.1.
- The Degree of freedom is 17.
- The population means are lies between 10.521<= u >=16.5892.

Task2: Dairy company problem

In [4]:
```
m1=[4.05,4.01,4.04,4.02]
m2=[4.02,3.99,4.01,3.99,4.00,4.00]

alpha=0.01
x1=np.mean(m1)
x2=np.mean(m2)

v1=(np.std(m1))**2
v2=(np.std(m2))**2

n1=len(m1)
n2=len(m2)
df=(n1+n2)-2

numerator = abs(x1-x2)
denominator = (v1*(n1-1)**0.5 + v2*(n2-1))*(1/n1 + 1/n2)**0.5

numerator = abs(x1-x2)

denominator = (v1*(n1-1)**0.5 + v2*(n2-1))*(1/n1 + 1/n2)**0.5

t_statistics=numerator/denominator

print('The t_statistics:',t_statistics)

p_value=t.sf(abs(t_statistics),df)*2

print('The p_value is :',p_value)

```

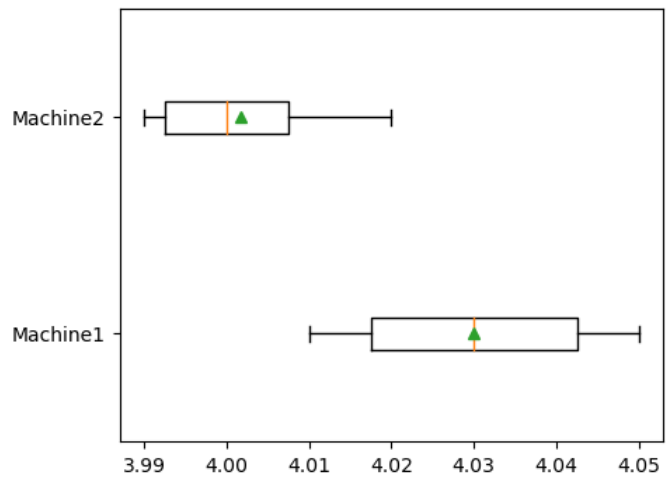
```
The t_statistics: 43.78622210178448
The p_value is : 8.165969367082735e-11
```

Ho=whether the average fill for these machines is the not same

Ha=whether the average fill for these machines is the same.

Two tail test should be conducted.

In [5]:
```
fig=plt.figure(figsize=(5,4))
data=[m1,m2]
plt.boxplot(data,vert=0,showmeans=True)
plt.yticks([1,2],['Machine1','Machine2'])
plt.show()
```



Make a statistical conclusion:

decision rule:

i. If p-value < α : Rejection of Null Hypothesis(H0)

ii. If -t-critical > t-statistic > +t-critical : Rejection of Null Hypothesis(H0)

in our study:

p_value=0.3159055 > alpha=0.01 :Accept of null hypothesis.

t_statistics=1.0698385 < t_critical=-3.3553873 :Accept of null hypothesis.

Make a business decision:-

The statistical calculation from the above which is accepting the null hypothesis.

Evan the quality manager wants to conclude by saying that the average fill for these machines is the not same Which are differing to each other.

Task2 cont: Consider the same problem stated in task-2. Now, Evan wishes to determine whether the average fill for four machines is the same. Random samples of fill measures (in quarts) for 19 jugs of milk are collected from the four machines. The sample data is shown in the table provided in the next slide:

Ho=The average filling of milk of four machines are not same.

Ha=The average filling of milk of four machines are same.

In [6]:
```
m3=[4.00,3.97,3.95,3,98,3.97]
m4=[4.01,4.00,3.99,4.02]

n1=len(m1)
n2=len(m2)
n3=len(m3)
n4=len(m4)
n=n1+n2+n3+n4

dfc=4-1
dfe=20-4
```

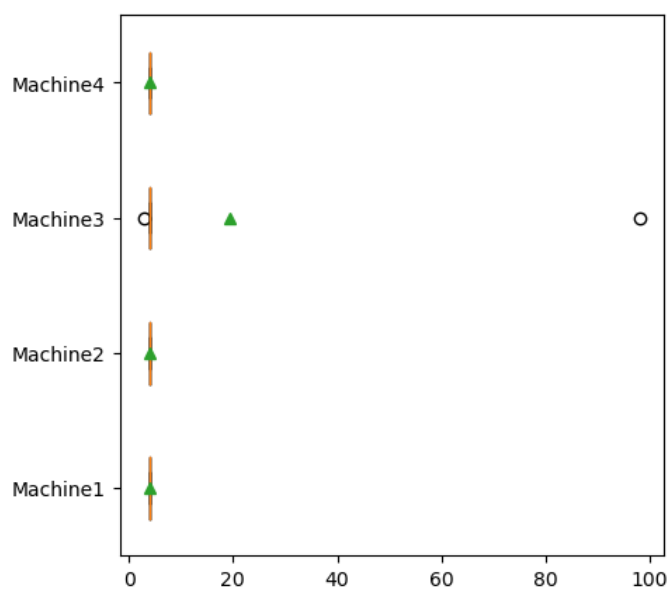
In [7]:
```
f_critical =f.ppf(1-0.01,dfc,dfe)
print('F_critical=',f_critical)

f_statistics,p_value=f_oneway(m1,m2,m3,m4)

print('F_statistics:',f_statistics)
print('P_value:',p_value)
```

```
F_critical= 5.2922140455209465
F_statistics: 0.7246278502878643
P_value: 0.5519601735201322
```

In [8]:
```
fig=plt.figure(figsize=(5,5))
data=[m1,m2,m3,m4]
plt.boxplot(data,vert=0,showmeans=True)
plt.yticks([1,2,3,4],['Machine1','Machine2','Machine3','Machine4'])
plt.show()
```



Make a statistical conclusion:

decision rule:

i. If p-value < α : Rejection of Null Hypothesis(H0)

ii. If -f-critical > f-statistic > +f-critical : Rejection of Null Hypothesis(H0)

in our study:

p_value=0.55196017 > alpha=0.01 :Accept of null hypothesis.

f_statistics=0.7246278 < f_critical=5.292214 :Accept of null hypothesis.

Make a business decision:-

The statistical calculation from the above which is accepting the null hypothesis.

Evan the quality manager wants to conclude by saying that the average fill for these four machines is the not same Which are differing to each other.