1.

a)

$$\begin{bmatrix} 1/3 & 1/3 & 0 & 1/3 \\ 1/3 & 1/3 & 1/3 & 0 \\ 0 & 2/5 & 3/5 & 0 \\ 2/3 & 1/3 & 0 & 0 \end{bmatrix} \begin{bmatrix} st \\ ba \\ ma \\ bl \end{bmatrix} = \begin{bmatrix} 19/3 \\ 19/3 \\ 34/5 \\ 17/3 \end{bmatrix}$$

$$\left[\begin{array}{cccc|c} 1 & 1 & 0 & 1 & 19 \\ 1 & 1 & 1 & 0 & 19 \\ 0 & 2 & 3 & 0 & 34 \\ 2 & 1 & 0 & 0 & 17 \end{array}\right] \sim \left[\begin{array}{cccc|c} 1 & 1 & 0 & 1 & 19 \\ 0 & 0 & 1 & -1 & 0 \\ 0 & 2 & 3 & 0 & 34 \\ 0 & -1 & 0 & -2 & -21 \end{array}\right] \sim \left[\begin{array}{cccc|c} 1 & 1 & 0 & 1 & 19 \\ 0 & 1 & 0 & 2 & 21 \\ 0 & 0 & 1 & -1 & 0 \\ 0 & 2 & 3 & 0 & 34 \end{array}\right]$$

$$\sim \left[\begin{array}{cccc|c} 1 & 0 & 0 & -1 & -2 \\ 0 & 1 & 0 & 2 & 21 \\ 0 & 0 & 1 & -1 & 0 \\ 0 & 0 & 3 & -4 & -8 \end{array}\right] \sim \left[\begin{array}{cccc|c} 1 & 0 & 0 & -1 & -2 \\ 0 & 1 & 0 & 2 & 21 \\ 0 & 0 & 1 & -1 & 0 \\ 0 & 0 & 0 & -1 & -8 \end{array}\right] \sim \left[\begin{array}{cccc|c} 1 & 0 & 0 & 0 & 6 \\ 0 & 1 & 0 & 0 & 5 \\ 0 & 0 & 1 & 0 & 8 \\ 0 & 0 & 0 & 1 & 8 \end{array}\right]$$

strawberries = 6
bananas = 5
mangos = 8
blueberries = 8

b) 0 strawberries
0 bananas
1/2 mangos
1/2 blueberries

the score would be 8

2. a)

$$p = 1 - 0.95^{e^{(a \ln age + b \ln total\ chol + c \ln HDL\ chol + d \ln SBP - 25.66)}}$$

$$p = 1 - 0.95^{a \cdot age \times b \cdot total\ chol \times c \cdot HDL\ chol \times d \cdot SBP}$$

$$0.95^{e^{(R-25.66)}} = 1 - p$$

$$\cancel{(R - 25.66) \ln 0.95 = \ln \ln (1-p)}$$

$$\ln 0.95^{e^{(R-25.66)}} = \ln (1-p)$$

$$e^{(R-25.66)} \ln 0.95 = \ln (1-p)$$

$$\cancel{R \ln 0.95 = 25.66 \ln (1-p) \ln \ln (1-p)}$$

$$e^{(R-25.66)} = \ln (1-p) / \ln 0.95$$

$$R - 25.66 = \ln \left(\frac{\ln (1-p)}{\ln 0.95} \right)$$

$$R = \ln \left(\frac{\ln (1-p)}{\ln 0.95} \right) + 25.66$$

$R = 26.5278 = a \cdot \ln(\text{age}) + b \cdot \ln(\text{total chol}) + c \cdot \ln(\text{HDL chol}) + d \cdot \ln(\text{SBP})$

$26.4883 = a \cdot \ln(\text{age}) + b \cdot \ln(\text{total chol}) + c \cdot \ln(\text{HDL chol}) + d \cdot \ln(\text{SBP})$

$26.3147 = a \cdot \ln(\text{age}) + b \cdot \ln(\text{total chol}) + c \cdot \ln(\text{HDL chol}) + d \cdot \ln(\text{SBP})$

$24.0791 = a \cdot \ln(\text{age}) + b \cdot \ln(\text{total chol}) + c \cdot \ln(\text{HDL chol}) + d \cdot \ln(\text{SBP})$

$26.5278 = a\ln 60 + b\ln 188 + c\ln 55 + d\ln 132$

$26.4883 = a\ln 61 + b\ln 180 + c\ln 47 + d\ln 124$

$26.3147 = a\ln 60 + b\ln 180 + c\ln 50 + d\ln 120$

$24.0791 = a\ln 23 + b\ln 132 + c\ln 45 + d\ln 132$

b) $a = -3.3666$

$b = 18.1398$

$c = -6.7643$

$d = -5.7730$

3. a) $\vec{m}_1 = \cos(45°)\vec{a} + \cos(-30°)\vec{b} = \frac{\sqrt{2}}{2}\vec{a} + \frac{\sqrt{3}}{2}\vec{b}$

$\vec{m}_2 = \sin(45°)\vec{a} + \sin(-30°)\vec{b} = \frac{\sqrt{2}}{2}\vec{a} - \frac{1}{2}\vec{b}$

b) $\vec{m}_1 + \sqrt{3}\,\vec{m}_2 = \frac{\sqrt{2}}{2}\vec{a} + \frac{\sqrt{6}}{2}\vec{a} \cancel{+ \frac{\sqrt{3}}{2}\vec{b}} \cancel{- \frac{\sqrt{3}}{2}\vec{b}}$

$\frac{(\sqrt{2} + \sqrt{6})}{2}\vec{a} = \vec{m}_1 + \sqrt{3}\,\vec{m}_2$

$$\vec{a} = \frac{2}{\sqrt{2}+\sqrt{6}}\vec{m}_1 + \frac{2\sqrt{3}}{\sqrt{2}+\sqrt{6}}\vec{m}_2$$

$u = \frac{2}{\sqrt{2}+\sqrt{6}}$ $\quad v = \frac{2\sqrt{3}}{\sqrt{2}+\sqrt{6}}$

c) All human beings are born equal in dignity and rights

4. No one :(

EE16A: Homework 1

Problem 2: The Framingham Risk Score

In [1]:

```
# Tip: np.log works element-wise on an np.array
import numpy as np

# part a) Calculate R
def solve_R(p):
    return np.log(np.log(1-p)/np.log(0.95))+25.66

print(solve_R(0.1150))
print(solve_R(0.1108))
print(solve_R(0.0940))
print(solve_R(0.0105))

# part b) Solve the set of linear equations
A = np.array([[np.log(66), np.log(198), np.log(55), np.log(132)],
              [np.log(61), np.log(180), np.log(47), np.log(124)],
              [np.log(60), np.log(180), np.log(50), np.log(120)],
              [np.log(23), np.log(132), np.log(45), np.log(132)]])
b = np.array([26.5278, 26.4883, 26.3147, 24.0791])
x = np.linalg.solve(A, b)
print(x)
```

```
26.5278341206
26.4883087533
26.3146867366
24.0790883417
[ -3.36661767  18.13979205  -6.76430254  -5.77301414]
```

Problem 3: Filtering out the troll

In [2]:

```
import numpy as np
import matplotlib.pyplot as plt
import wave as wv
import scipy
from scipy import io
import scipy.io.wavfile
from scipy.io.wavfile import read
from IPython.display import Audio
import warnings
warnings.filterwarnings('ignore')
sound_file_1 = 'm1.wav'
sound_file_2 = 'm2.wav'
```

Let's listen to the recording by the first microphone (it can take some time to load the sound file).

In [3]:
```
Audio(url='m1.wav', autoplay=False)
```
Out[3]:

0:00

And this is the recording by the second microphone (it can take some time to load the sound file).

In [4]:
```
Audio(url='m2.wav', autoplay=False)
```
Out[4]:

0:00

We read the first recording to `corrupt1` and second recording to `corrupt2` variables.

In [5]:
```
rate1,corrupt1 = scipy.io.wavfile.read('m1.wav')
rate2,corrupt2 = scipy.io.wavfile.read('m2.wav')
```

Enter the gains to combine the two recordings to get the clean speech.

Note: The square root of a number a can be obtained as `np.sqrt(a)` in IPython.

In [6]:
```
# enter the gains u to weight recording 1 and v to weight recording 2
u = 2/(np.sqrt(2) + np.sqrt(6))
v = 2*(np.sqrt(3))/(np.sqrt(2) + np.sqrt(6))
```

Weighted combination of the two recordings

In [7]:
```
s1 = u*corrupt1 + v*corrupt2
```

Let's listen to the resulting sound file (make sure your speaker's volume is not very high, the sound may be loud if things go wrong).

In [8]:
```
Audio(data=s1, rate=rate1)
```
Out[8]:

0:00 / 0:10

(Practice) Problem 5: Finding Charges from Potential Measurements

In [ ]:
```

```