PS1 U91023753 GIACOMO CAPPELLETTO

a) $\vec{V}_{BH} = \begin{bmatrix} -4 \\ 3 \end{bmatrix}$, $\vec{V}_{BC} = \begin{bmatrix} 12 \\ -5 \end{bmatrix}$, $\vec{V}_{BL} = \begin{bmatrix} 15 \\ 3 \end{bmatrix}$ (GIVEN)

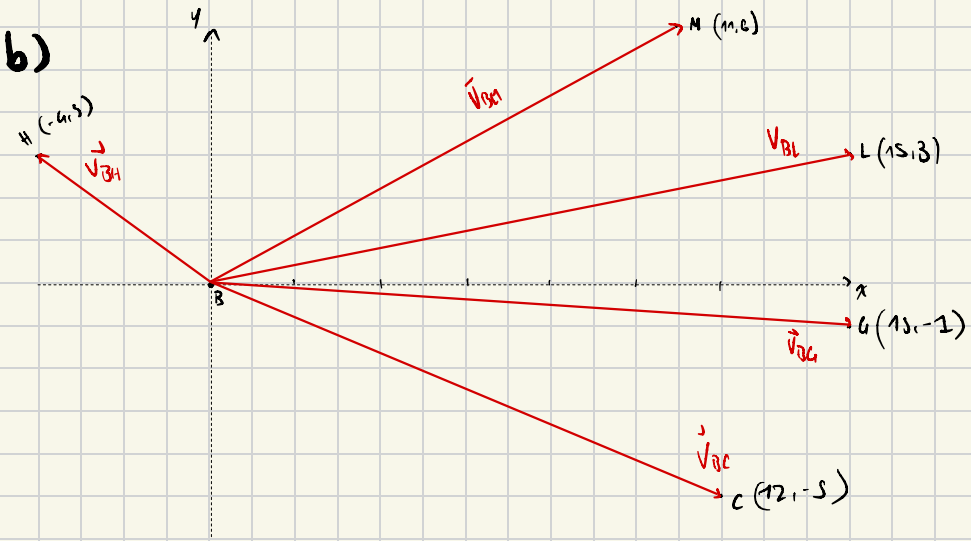
$\vec{V}_{BM} = \vec{V}_{BH} + \vec{V}_{HM}$

$= \begin{bmatrix} -4 \\ 3 \end{bmatrix} + \begin{bmatrix} 15 \\ 3 \end{bmatrix} = \begin{bmatrix} 11 \\ 6 \end{bmatrix}$

$\vec{V}_{BG} = \vec{V}_{BC} + \vec{V}_{CL} + \vec{V}_{LG}$

$= \begin{bmatrix} 12 \\ -5 \end{bmatrix} + \begin{bmatrix} 3 \\ 8 \end{bmatrix} + \begin{bmatrix} 0 \\ -4 \end{bmatrix} = \begin{bmatrix} 15 \\ -1 \end{bmatrix}$

b)

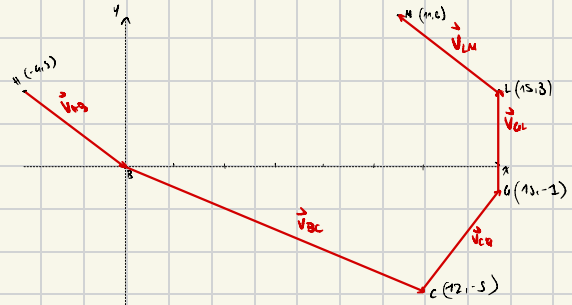


c) HARVARD → BU → COMPUT → GUN. → LECH → MED.

$\vec{V}_{HB} = -\vec{V}_{BH} = \begin{bmatrix} 4 \\ -3 \end{bmatrix}$, $\vec{V}_{BC} = \begin{bmatrix} 12 \\ -5 \end{bmatrix}$, $\vec{V}_{CU} = \begin{bmatrix} 15-12 \\ -1+5 \end{bmatrix} = \begin{bmatrix} 3 \\ 4 \end{bmatrix}$, $\vec{V}_{UL} = \begin{bmatrix} 0 \\ 4 \end{bmatrix}$

$\vec{V}_{LM} = \begin{bmatrix} 11-15 \\ 6-3 \end{bmatrix} = \begin{bmatrix} -4 \\ 3 \end{bmatrix}$

d)



(USING B AS ORIGIN)

PS1 U91023753 GIACOMO CAPPELLETTO

c) $l_{tot} = \sum_{i=1}^{5} \sqrt{\vec{v}_i^T \cdot \vec{v}_i} = 32$ (miles)

```
tot = [[4,-3]; [12,-5]; [3,4]; [0,4]; [-4,3]];
norms = sqrt(sum(tot.^2, 2));
sum_of_norms = sum(norms);
disp(sum_of_norms);
```

```
32
```

2

a) $b = \begin{bmatrix} 5 \\ 13 \\ 5 \\ 4 \\ 5 \end{bmatrix}$

```
tot = [[4,-3]; [12,-5]; [3,4]; [0,4]; [-4,3]];
norms = sqrt(sum(tot.^2, 2));
disp(norms)
sum_of_norms = sum(norms);
disp(sum_of_norms);
```

```
    5
   13
    5
    4
    5

   32
```

b) given sum and slope we can compute ($a = \frac{dy}{dx}$) $dy = a\,dx$ by performing a dot product of the runs and the slopes

$$l = a \cdot b = a^T b = \begin{bmatrix} 0.2 & -0.1 & 0 & 0 & 0.1 \end{bmatrix} \begin{bmatrix} 5 \\ 13 \\ 5 \\ 4 \\ 5 \end{bmatrix} = 1.7146$$

```
tot = [[4,-3]; [12,-5]; [3,4]; [0,4]; [-4,3]];
norms = sqrt(sum(tot.^2, 2));
sum_of_norms = sum(norms);
a = [0.2,-0.1,0,0,0.1];
disp(norm(a.*norms.'))
```

```
1.7146
```

3

a) $\begin{bmatrix} 2 & 3 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} 4 \\ 5 \end{bmatrix} = \begin{bmatrix} 24+35 \\ -4+5 \end{bmatrix} = \begin{bmatrix} 23 \\ 1 \end{bmatrix}$

$V_3 = V_1 A \rightarrow (2\times1)(2\times2) \rightarrow$ Number of columns in V_1 does not match rows of A $(2 \neq 3)$

b) $b_{HG} = \begin{bmatrix} 5 \\ 13 \\ 5 \end{bmatrix} = x \quad A = \begin{bmatrix} 0.1 & -0.1 & 0.1 \\ 0 & -0.01 & 0 \\ 0.5 & -0.1 & 0.1 \\ -0.01 & 0 & -0.01 \end{bmatrix} \begin{matrix} \leftarrow a_1 \\ \leftarrow a_2 \\ \leftarrow a_3 \\ \leftarrow a_4 \end{matrix} \rightarrow Ax = \begin{bmatrix} -0.3 \\ -0.13 \\ 1.7 \\ -0.1 \end{bmatrix}$

```
x = [5; 13; 5];
A = [0.1, -0.1, 0.1;
     0, -0.01, 0;
     0.5, -0.1, 0.1;
    -0.01, 0, -0.01];
result = A * x;
disp(result);
```

```
 -0.3000
 -0.1300
  1.7000
 -0.1000
```

c) $Ax + \begin{bmatrix} 0.15 \\ 0.15 \\ 0.15 \\ 0.15 \end{bmatrix} = \begin{bmatrix} -0.15 \\ 0.02 \\ 1.55 \\ 0.05 \end{bmatrix} \rightarrow$ FILTER $\rightarrow \begin{bmatrix} 0 \\ 0.02 \\ 0 \\ 0.05 \end{bmatrix} \rightarrow a_2, a_4$ ARE VALID OPTIONS

```
x = [5; 13; 5];
A = [0.1, -0.1, 0.1;
     0, -0.01, 0;
     0.5, -0.1, 0.1;
    -0.01, 0, -0.01];
result = A * x;
b=[0.15;0.15;0.15;0.15];
altitude = result+b;
altitude(altitude <= 0) = 0;
altitude(altitude > 0.15) = 0;
disp(altitude)
```

```
         0
    0.0200
         0
    0.0500
```

4

a) $C_1 = \begin{bmatrix} 2 & 3 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} 4 & -3 \\ 5 & 6 \end{bmatrix} = \begin{bmatrix} 23 & 12 \\ 1 & 10 \end{bmatrix}$

$C_2 = BA = (2\times2)(2\times2)$ possible ✓

columns B = rows A

b) $A = \begin{bmatrix} 0.1 & -0.1 & 0.1 \\ 0 & -0.01 & 0 \\ 0.5 & -0.1 & 0.1 \\ -0.01 & 0 & -0.01 \end{bmatrix} \quad B = \begin{bmatrix} 5 & 6 & 8 \\ 10 & 11 & 6 \\ 8 & 6 & 13 \end{bmatrix}$

a_1, b_2

```
A = [0.1, -0.1, 0.1;
     0, -0.01, 0;
     0.5, -0.1, 0.1;
    -0.01, 0, -0.01];
B=[5,6,8;
   10,11,6;
   8,6,13];
C=A*B
C(C <= 0)=0;
C(C > 0.15) = 0;
disp(C)
```

```
C = 4×3
    0.3000    0.1000    1.5000
   -0.1000   -0.1100   -0.0600
    2.3000    2.5000    4.7000
   -0.1300   -0.1200   -0.2100

         0    0.1000         0
         0         0         0
         0         0         0
         0         0         0
```