

# FACTORIES

TEAM ENIGMA

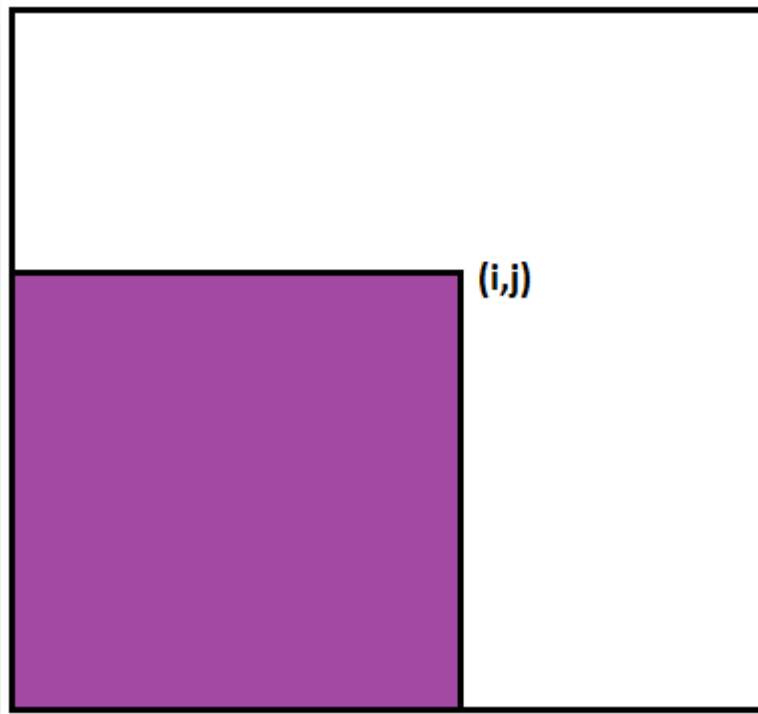
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# ABOUT PROJECT

- ▶ In this project it is expected to find the best location to place factories by minimizing the total discontent of people.
- ▶ Programming language we used is C++.
- ▶ **INPUT:**
- ▶ First Line: Number of factories to be built ( $n$ )
- ▶ Second Line: ( $n$ ) integers denoting ranges of these factories
- ▶ Third Line: Contains 2 integers  $w, h$  where  $(0, 0)$  to  $(h, w)$  is a rectangular region where the factories need to be built.
- ▶ Next  $h$  Lines: Contains  $w$  integers denoting the discontent of people at point  $(i, j)$ .
- ▶ **CONSTRAINTS:** Program should be executed below 10 sec and the available memory is limited to 1GB.

# ALGORITHM IDEA

- ▶ A new array  $\text{disc}[h][w]$  is built in such a way that  $\text{disc}[i][j]$  is the sum of all discontent values in the shaded region.

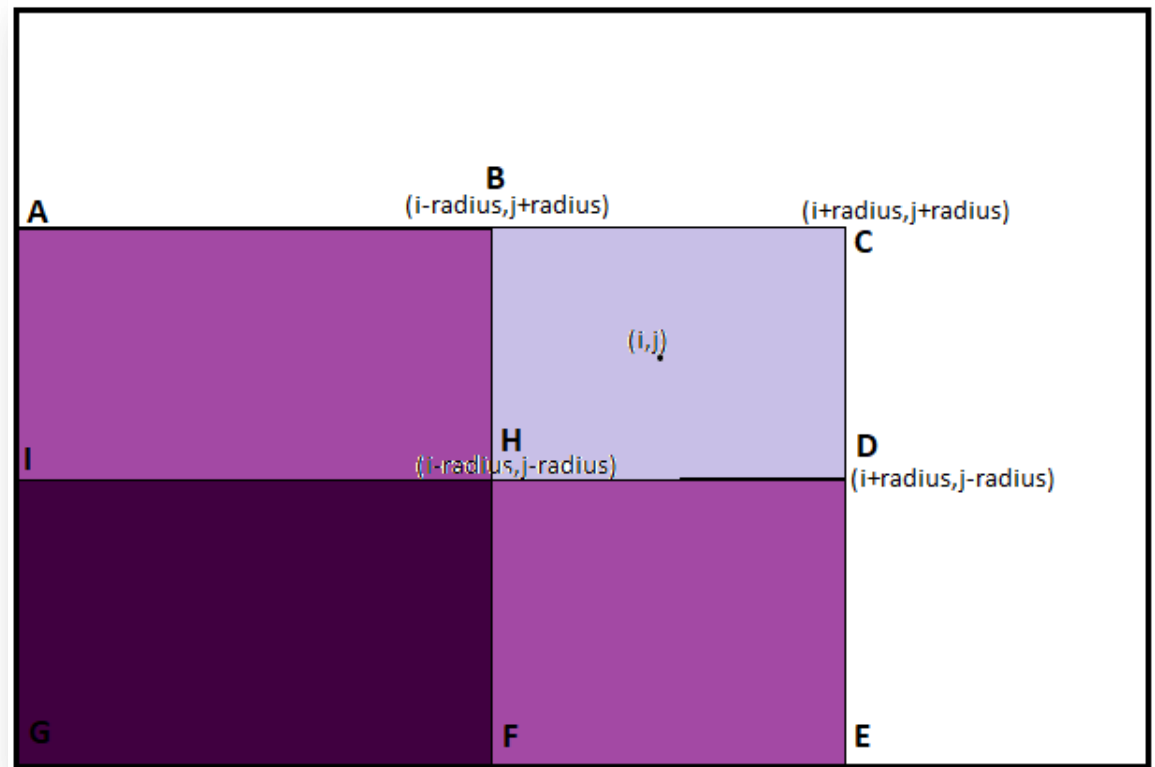


► Below is the code to find array `disc[h][w]`

```
► for(int i=0;i<h;i++){  
    sum=0;  
    for(int j=0;j<w;j++) {  
        sum=sum+d[i][j];  
        disc[i][j]=sum;  
    }  
}  
► for(int i=1;i<h;i++){  
    for(int j=0;j<w;j++) {  
        disc[i][j]=disc[i][j]+disc[i-1][j];  
    }  
}
```

Disc[i][j] gives the sum of all discontents from (0,0) to (i,j).  
To calculate discontent at (i,j) with radius as 'radius' we need to add all discontents in the region BHDC.

Discontent of the region BHDC = Discontent of the region CAGE -  
Discontent of the region ABFG - Discontent of the region IDEG +  
Discontent of the region IHFG



The equation we used to find discontent of region BHDC can be calculated using the below code.

```
for(int i=0;i<h;i++){
    for(int j=0;j<w;j++){
        sum=0;
        if(i+radius<h&& j+radius<w) sum=disc[i+radius][j+radius];
        if(i+radius>=h&& j+radius>=w) sum=disc[h-1][w-1];
        if(i+radius>=h&& j+radius<w) sum=disc[h-1][j+radius];
        if(i+radius<h&& j+radius>=w) sum=disc[i+radius][w-1];
        if(i>radius&& j>radius) sum=sum+disc[i-radius-1][j-radius-1];
        if(i>radius){
            if(j+radius<w) sum=sum-disc[i-radius-1][j+radius];
            else if(j+radius>=w) sum=sum-disc[i-radius-1][w-1];
        }
        if(j>radius){
            if(i+radius<h) sum=sum-disc[i+radius][j-radius-1];
            else if(i+radius>=h) sum=sum-disc[h-1][j-radius-1];
        }
    }
}
```

- ▶ Now to place a factory of a particular radius, we need to minimize our discontent value i.e., by finding a point where this factory with that particular radius will have minimum discontent of people.
- ▶ But it is given that if the second factory is placed in same field then it causes additional discontent, two times higher than the original value and third factory causes additional discontent, three times higher than the original value and so on.
- ▶ Now to include this condition, we will add a new array  $k[h][w]$ , initially its value is one at all points, this value increases by one whenever a factory is placed in the same region.

- ▶ Now to add the additional discontent caused by  $k$  we need to consider the discontent value as  $(1+2+3+..+k)*d[i][j]$  but we considered it to be  $k*d[i][j]$  because our total discontent value (calculated from optil) in first case is greater than the second case. Hence we considered second case.
- ▶ The obtained discontent value is 144,897,349.





Thank you

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