UNSFW Contest 2024 Problems

UNSW CPMSoc

1 April 2024

Contents

Nice [Maths]

Hello there!

Your first task is to evaluate $3p$, where p is the largest prime factor of 2024.

Enter your answer into the box below to submit and check your answer!

For all the tasks, including this one, you can submit as many times as you like with no penalty! Only your best submission will be counted.

Fuck (Part 1) [Maths]

Today is the dreaded of received my UNSW Result of assessment. I open the email to find that I have failed COMP4920, the compulsory ethics course.

Out of frustration, I want to shout every string of length 69 that contains only the characters F, U, C and K, and contains the substring $FUCK$. For example, "FUCKFUCKFUCKFUCKFUCKFUCKFUCKFUCKFUCKFUCKFUCKFUCKFUCKFUCKFUCKUFUCKFUCKFUCKFUCKFUCK" is a string I want to shout, but "FFFFFFFFFFFFFFFFFUUUUUUUUUUUUUUUUUCCCCCCCCCCCCCCCCCCCKKKKKKKKKKKKKKKKK" is not. The strings that I want to shout are not necessarily actual words from the English language.

How many strings do I want to shout? Submit a single integer.

Fuck (Part 2) [Maths]

Today is the dreaded of received my UNSW Result of assessment. I open the email to find that I have failed COMP4920, the compulsory ethics course.

Out of frustration, I want to shout every string of length 4 that contains only the characters F, U, C and K, and contains the substring $FUCK$. For example, "FUCK" is a string that I want to shout, but "FUCC" is not. The strings that I want to shout are not necessarily actual words from the English language.

How many strings do I want to shout? Submit a single integer.

Fuck (Part 3) [Maths]

Today is the dreaded of received my UNSW Result of assessment. I open the email to find that I have failed COMP4920, the compulsory ethics course.

Out of frustration, I want to shout every string of length 10 that contains only the characters F, U, C and K, and contains the substring $FUCK$. For example, "FFFFFFUCK" and "FUCKFUCKFU" are strings that I want to shout, but "FUUUUUUUCK" is not. The strings that I want to shout are not necessarily actual words from the English language.

How many strings do I want to shout? Submit a single integer.

Reverse [Maths]

"I hope our contest doesn't crash like last time!" says Cyril.

"Let's make sure there aren't too many submissions," says Isaiah.

They turn to you for advice.

Tell them the number of submissions made in this contest so far.

Scoring

Let m be the integer that you submit, and suppose it is the nth submission made in this contest. Your score for the submission will be $10/(1 + |m - n|) \times 100\%$ of the points for this task.

Huh (Part 1) [Maths]

During a recent SPAR contest, Aob and Balice came across a really difficult task.

A: "HUH? Why is our prime factorisation algorithm not working?"
B: "Huh, interesting, it seems that the numbers are too big."
A: "HUH??? How are we gonna solve this problem then???"

Please help Aob and Balice by solving the following task.

Suppose we have a set $S = A, B, C$, where:

- $A = 2^{a_1} \times 3^{a_2} \times 5^{a_3} \times 7^{a_4} \times \cdots$,
- $B = 2^{b_1} \times 3^{b_2} \times 5^{b_3} \times 7^{b_4} \times \cdots$, and
- $C = 2^{c_1} \times 3^{c_2} \times 5^{c_3} \times 7^{c_4} \times \cdots$.

Then, let $\text{huh}(S) = 2^{\text{med}(a_1,b_1,c_1)} \times 3^{\text{med}(a_2,b_2,c_2)} \times 5^{\text{med}(a_3,b_3,c_3)} \times \cdots$, where $\text{med}(a, b, c)$ is the median of a, b and c.

Evaluate $\text{huh}(X)$, where $X = \{$
302399712859282561563579696380054729344728251413614649923202714895276740215926876641212742652195
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863205645011067398477252593080487245433243410577635720197975036436349404401933657341965530194470
4968975521222306105663
}.

Huh (Part 2) [Maths]

During a recent SPAR contest, Aob and Balice came across another really difficult task.

A: "HUH? Why is our prime factorisation algorithm not working again?"
B: "Huh, interesting, it seems that the numbers are too big yet again... and now there are more numbers too."
A: "HUH??? How are we gonna solve this problem then??? We didn't even solve the previous problem..."

Please help Aob and Balice again by solving the following task.

Suppose we have a set $S = \{A, B, C, D, E, F, G, H, I\}$, where:

- $A = 2^{a_1} \times 3^{a_2} \times 5^{a_3} \times 7^{a_4} \times \cdots$,
- $B = 2^{b_1} \times 3^{b_2} \times 5^{b_3} \times 7^{b_4} \times \cdots$,
- $C = 2^{c_1} \times 3^{c_2} \times 5^{c_3} \times 7^{c_4} \times \cdots$,
- $D = 2^{d_1} \times 3^{d_2} \times 5^{d_3} \times 7^{d_4} \times \cdots$,
- $E = 2^{e_1} \times 3^{e_2} \times 5^{e_3} \times 7^{e_4} \times \cdots$,
- $F = 2^{f_1} \times 3^{f_2} \times 5^{f_3} \times 7^{f_4} \times \cdots$,
- $G = 2^{g_1} \times 3^{g_2} \times 5^{g_3} \times 7^{g_4} \times \cdots$,
- $H = 2^{h_1} \times 3^{h_2} \times 5^{h_3} \times 7^{h_4} \times \cdots$, and
- $I = 2^{i_1} \times 3^{i_2} \times 5^{i_3} \times 7^{i_4} \times \cdots$.

Then, let $\text{huh}(S) = 2^{\text{med}(a_1,b_1,c_1,d_1,e_1,f_1,g_1,h_1,i_1)} \times 3^{\text{med}(a_2,b_2,c_2,d_2,e_2,f_2,g_2,h_2,i_2)} \times 5^{\text{med}(a_3,b_3,c_3,d_3,e_3,f_3,g_3,h_3,i_3)} \times \cdots$, where $\text{med}(a, b, c, d, e, f, g, h, i)$ is the median of a, b, c, d, e, f, g, h and i.

Evaluate $\text{huh}(Y)$, where $Y = \{$
109561518492027755785142204139899976315399913663455403339086278800829295532546785536993267746092
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37,
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84684929870150592150371067363133092696404389470959482683828075507362337059098921814572288800439111532563457828219787785891375196210329752593873582001616487945195041725634379718782867229216067587354629404872856524112779590722563603814117087940261310433456610602997298974800710124924665619634046414888247313367846758077759373763678946080070110530496636008206248021798145549513908797481072803912116710144469676625560539484436486916974487743125772203310032778415707028645435113309005643792294710559633703481545336363008777702175305750739515537420353771045335473199865366631611861089681438283460968099638975415772542082082740105551426755268779591028714256075290381764760635556020607611631829933285635297005278328154445904128153305413452475223056323812931723086370280097662461476864748144116051622749274369743063112636855482924116881839666196419862911247755705317078911745530606165704132164198208203209677918210686433932973612862691739832595619516634093588161490488207012784403151965788475641494994521010795495603820664979069144578111364653506261254519571920522359049807836525428138502584555914389473529165882168316276654912951414253400931377655235857125632972746584727596762667539703132949346703362423405270885767340034857339386913718615612501887632356793627388486093676799523961700439682128293600329929352982030353100059360731364106483303202000872907872580172916643376878057080305814795921080880745681103167782849805663897749033173077139124008750666641950120840407838489901900252337801516810755087356912243872426615560659077326803818902063489411592982093321054774935913337540566049461832828614628967315486275223317045428371640640952235102326578633744837778075503659357802905 7,
41139139182545591679718806440446875093505489513901113945160079585922742909715051039826297941483889444558392390365598560738250165265949415255633214739087593720047698437641906870257226985219947360179202447716903415218620094344051861384362870110008034313406226340589479993040740552397275867054441693905608537749145205107921113924204635194330748198570048334717814050533481262239201248164062266876611599816841847208913957380044630291656768654150390993188307311943650710008854568013309207307577960029931471953904473924398680959304363734112079720084367761085504278349276473263759222788959686722884081677952657233448792048958847838266089711718307411627814800285642119794240015904784517021456609823945712272136834120296891786359503189346567650937854448399182675501587711618056182595372521751118824417203360064045570425517083259568272537789042824162752789647656722548685229631407362737000279687836510285989346597424983330577761717020650802121453644154240338062385207369384625394856245228779193797770701241606536583260894769329265850573960123901388441129186080587079402402519486531048904745353539401779516486414747720469655161367417706620685472401676268008526914351123709819681257172943170078880096616353392178621068885827382869481297644328241566243342556659959007663263562906933519578625510567614655233442470056019723834292900047652044697917723617226417595883231871252559639422457090913796038626831027314407654839580150325171482495568864968563539628536324426887199635535478473447967971837210267075541290627453269896805248842964734257913266188220692344138457954587254222928999839877059813788213733955799438820630969902498682106424026408423205481105354639500168981557675348274962157643876037782454249208755883572720103499819793457544818434702692174688671137872936633670787850821709133975968784513147006620928686201966361299118152742764296122390126761861398028162297126712060367245348972877193990225353592421569106635909285153095224923452266505793752989247277503131840222845445318531901453133116087822431966385045749943981227204183994201609685345055201599523621310119471218499756440287409143599666980945788260469580459060373936996458105976349541774086682801568905609353015608650053398141492687249327306992764643012044926132165119003404142832936475023447609810090750603912846348518388923968720308332900009634003277663367,
19997586890846364316454166740425040216949051335028888284602805470712443918491897906460387308123342202751933300300520851955651355859856036000090982688805004261341652036065497641570072008159626051877266698009404767765064043719874541041550006676928251896472655554380301305286972080319270299737897321664376666684346814298162116226103547528002551773828336527712447556143512169687781076584437298085255300995972959970004897635305752391584773524304307135693064811416273803404433251089317386258612772886241470873248552658966523783653183849755859048362467005019857586417645392001698572192984436602761699277551899359116251624298961883087978585125629679270454498237577327417034720774008565045642023554046794921197634120914475237793555906052010006971357310461174937977866771748324524223223438000195633037474659531140732610271425782158937086429845791879618282315912362777305490245415911275060564566370135997642417132097041059010622600695678036773250210332916090814698257858458395894286330753563527318795761405399162736181985496306757373530842442093626291471113198037859

$$
\begin{aligned}
&1073709015256517405793700359817723928681691587056781927889939758934130214817784442559549825883318572053063855942678197602039400539931983728771576418893592590812871347547914881568127104224953769628422671461605045561912951316306277829075854102146861724240094451052090492862673394772230063241814010910753342339873375148259955692082084707464252607970384481837771517564388270016566876211828485742469508547964472464928413743419426692501485823763184884697173367919262631067017260799894471590739364051688353729111060341296541041320940550625925724752450106438750677395711086692367376991989348315964363991417903171294359375420742108143492923710511,
$$
$$
\begin{aligned}
&1161839475337764360209535742806070535970021996078767344425657837960662727858938431849756136719305086013902755960872392660936129838202677863052098333253423877207381886734196373405868950294374368738308172802854650208777026404230897528370432412801523058126747675344510491514774979895795893097884011463593560072164179504000717974289058100299272550895030522362214065975613677838360936306112082047416605179272512549451766874408168224976624042938890045693859720612225743224328322236094885213492616505348698805516052863554228407825523252005187673945087144992815129272306892014054459514585531086148467937452216239951464753486242948892861112169203065322525788459226837302758640173560240362458815698189762960402146270453886108832627232084205850686379154787432850447120906369544492588472084469817800881846522045009531712153882711657591322958024702436140034304329791074565922895590870015189683871178730335389811490039687195789709968902871367348153528674982229061166022836399983352149989883823403327069710214911785331381796130430554408729250987970195972155105406810328746752628728678992003593864277303417772501964735720951821835060752155422063111098644334276040520565238777092248864688332865910554414442061332379249755164818667050226102588468245541667898123859366915907879657235486775706153490641389776953474439759523511226055012541596420580858101253357281690627592138567028843602535860885478399400237089313314527292282918685941769924373636351555745972375778160810702235755176893896732007643413956879676030131213843744563353342244886939956028528807209791257929014113844918651514427216548666504131285819578968588289246039738176696414201826712865050628106338732517919,
$$
$$
\begin{aligned}
&7122616531585737234379993370807468043795466912698060055283661020015967867540673146242059249759903362665042153320508787877997599619077397380218285328073071655166257506179066362090222677656435253011360879329314903726764177313217822143773837934937177208478509450412354113530475563926567863466826544777795347322418336293910151789309292704609537570068822491377860925541503493993704370333754463420287714818291275668275307250351481263816653336208736998459063011019411683166454905585175514797825117913671440498344850256452998359016506633921287744388480110807032990989076514154556839733117908760071555310315519168406204124944680296813623830534748661103205747262230867568953636431531834896072812075062263032776591433459162587300670419466200578648872264486782881939507663029414278493252659021271498205633475439934456399772895572609106923792089314258209284884596354234974873842334434194099633504708169240005020916895915693436575125128582264103307495778476028131740055358788864802819940114957368364157314352178245558197355758208341459897330660174864744014515254371442905883047740971226987931561374083516317231693003752981522372279173607639044014370541887218082572244046494612264182456455892038186086680040003816441400909068437267770110723779056698715223423525897098363215749839129404446529836632401425005735424666989016549264406092032577490382482943115985055763039370873943680363792962719779650145948176387431076326697394424429114580929040067449006738846313457694627418050268875171787268870167859412937749870375867268913466993088815741108003676036413458403535561788666651561748202789786487249504637345114185239911307187772588643774948005319647080342830250901207132610169601077642729771287341916114395061640084338932632797475208274322753399716694864867958405513349884684464724602239753128181620463171324752959115475284592040266013427156792810930142024099361459763404220014843996237705074022414652759054577723719521410814468258967190496368077633396628464091574790953594159868806480404107208727696943248737700569430028931063816266089501376280454509213554470608999361889607042852362529907611805339854809765618305537558168918482360625766024623565513884927819180975249162249323731451925240432349164946312310856782773297048146964442886362088724566555575691514719006762222757940501582181523510975502435833945180368162101128989
}.
$$

Someone [Maths]

The Collatz conjecture is one of the most famous unsolved problems in mathematics. Prove it.

Your submission will be judged by *someone*. *Someone* can judge submissions quite quickly, but CPMSoc can't afford to pay them to work much, so for this task you may only submit 5 times per day. It is therefore recommended that you talk to *someone* yourself to decide what to submit.

Shitbits [Programming]

Program time limit: 1 second
Program memory limit: 512 MB

As a gift from your friend, you were given an N-bit number (in base 2). Unfortunately, you accidentally dropped it in shit, resulting in some bits becoming shitbits. You vaguely remember that the number was divisible by K, but you are not sure, so you want to check whether or not there exists an assignment of 0s and 1s to the shitbits such that the N-bit number is divisible by K.

Input

The first line contains the two integers N and K.
The second line of input contains a string of length N containing "0", "1" and "?", where "?" denotes a shitbit. The N-bit number will be represented with the most significant bit first, and least significant bit last. For example, 10001 (base 2) = 17 (base 10). Note that there might not be any shitbits at all in the input, and that the most significant bit can be 0.

Constraints

For all test cases:

- $1 \leq N, K \leq 1000$.
- Each character in the string is either "0", "1" or "?".

Output

Output "NO SHIT" if there exists an assignment of 0s and 1s to the shitbits such that the N-bit number is divisible by K, and "SHIT" otherwise.

Sample Input 1

```
6 3
0100??
```

Sample Output 1

```
NO SHIT
```

Sample Input 2

```
6 3
010011
```

Sample Output 2

```
SHIT
```

Scoring

There are 20 test cases, each worth 5% of the points for this problem. Your score for a submission will be the sum of the points of the test cases you answered correctly. Recall that your final score on the task is the score of your highest scoring submission.

Tentacle [Programming]

Program time limit: 1 second
Program memory limit: 512 MB

Chef Yamamotosuzukiakihabaraonigawara is preparing a tentacle dish at his 5 star michelin rated restaurant, *Yamamotosuzukiakihabaraonigawara's*. Unfortunately his guests are foreigners (bad) so they will not be able to handle high levels of umami, however cutting tentacles haphazardly will reduce their umami content by too much.

Umaminess is defined as the number of inversions in the tentacle. That is, given a tentacle array T of size n, the umaminess of T is the number of pairs of indices (i, j) such that $i < j$ and $T_i > T_j$.

He can chop off one element either from the front or from the back of the tentacle at a time. What is the minimum number of chops required so that the umaminess of the tentacle becomes at most k?

Input

The first line of input contains the integers n and k, the size of the array and the target umaminess respectively. The seconds line contains n integers $T_1, T_2, \ldots, T_n$ where T_i is the ith element of T.

Constraints

For all test cases:

- $1 \leq n \leq 200\,000$.
- $0 \leq k \leq \frac{1}{2}N(N-1)$.
- $1 \leq T_i \leq 10^9$, for all i.

Additionally:

- For Subtask 1 (20% of points), $n \leq 50$.
- For Subtask 2 (20% of points), $n \leq 750$.
- For Subtask 3 (20% of points), $n \leq 5\,000$.
- For Subtask 4 (40% of points), there are no additional constraints.

Sample Input 1

```
5 1
3 2 1 5 4
```

Sample Output 1

```
2
```

Explanation 1

Since $k = 1$, we need to modify the array to include at most 1 inversion. We can do this by removing the first and last element, which leaves the array $[2, 1, 5]$, which has exactly 1 inversion since $2 > 1$ (but $2 < 5$ and $1 < 5$). This uses 2 chops, which is the minimum possible.

Scoring

For each subtask (worth 20%, 20%, 20% and 40% of points, as per the Constraints section), your program will be run on multiple secret test cases one after another, and if it produces the correct output for **all** test cases, it solves that subtask. Your program will receive the points for each subtask it solves. Recall that your final score on the task is the score of your highest scoring submission.

Sinx [Programming]

Program time limit: 1 second
Program memory limit: 512 MB

You have trained for years and years, tackled thousands of maths problems and solved some of the hardest problems in the world. Alas, it is time for you to perhaps solve the most challenging question yet: evaluate sin(1).

Your task is to find the nth decimal digit (after the decimal point) of sin(1), where 1 is given in radians.

Input

The first and only line of input contains the integer n.

You should read from standard input.
In Python, you could use the line `N = int(input())`.
In C or C++, you could use the line `int N; scanf("%d", &N);`.

Constraints

Each input case will satisfy the following constraints:

- $1 \leq n \leq 300\,000$.

Additionally:

- For Subtask 1 (10% of points), $n \leq 10$
- For Subtask 2 (20% of points), $n \leq 1000$.
- For Subtask 2 (50% of points), $n \leq 100\,000$.
- For Subtask 2 (20% of points), there are no additional constraints.

Output

Output a single integer, the nth digit of sin(1).

You should write to standard output.
In Python, you could use the line `print(answer)`.
In C or C++, you could use the line `printf("%d\n", answer);`.

Sample Input 1

```
1
```

Sample Output 1

```
8
```

Sample Input 2

```
2
```

Sample Output 2

```
4
```

Scoring

For each subtask (worth 10%, 20%, 50% and 20% of points, as per the Constraints section), your program will be run on multiple secret test cases one after another, and if it produces the correct output for **all** test cases, it solves that subtask. Your program will receive the points for each subtask it solves. Recall that your final score on the task is the score of your highest scoring submission.

Ruslana and Roads [Programming]

Program time limit: 1 second
Program memory limit: 512 MB

Ruslana lives in a cold, distant village with n houses and m bidirectional weighted roads. Each house has a colour and contains a tenant that wears a coloured hat. Each tenant has a bag containing some number of tiles, each with a label between 1 and n inclusive. No two tiles in a bag have the same label. Everyday each tenant draws two tiles h and d from their bag and adds to their schedule a trip to house h after waiting d days. After d days they take the shortest path to house h. (If there are multiple trips with the same scheduled date, the tenant travels to each house in the same day in the order they were added to the schedule. Also, if a tenant draws their own house then they do not add the trip to their schedule.) If two trips on the same day taken by different tenants share an edge, then the tenants bump into each other, shake hands, and play a game. Each player draws one tile and the person with the higher tile wins both tiles. If the game is a draw, the game is played until someone wins. Before embarking on any trips, tenants also draw three tiles l, r and v, and make sure to clean the roads from the lth to rth road in their path by removing v pieces of debris on each road, reducing the weight of roads in the range by v. After they make a trip to a house, tenants wish to renovate their new abode, painting it their favourite colour, the colour of their hat. Tenants quickly experience nostalgia from bygone days and paint their hat the old colour of the house they just made a trip to, thus swapping colours of their hat and their new house. If multiple tenants make a trip to the same house on the same day, then they all play the tile drawing game together until someone wins. That player decides the colour of the house. If all tiles in bags have an equal chance of being drawn at each stage and are replaced immediately, what is the probability that after t days that no two houses of the same colour in Ruslana's village are connected by a road?

Input

The first line contains three integers t, n and m, which are the total number of days, the number of houses and the number of roads respectively.
The next m lines describe the roads. The ith line contains three integers u_i, v_i and w_i, representing a road between houses u_i and v_i of weight w_i.
The next line contains n integers $c_1, c_2, \ldots, c_n$ where c_i is the colour of house i.
The next line contains n integers $h_1, h_2, \ldots, h_n$ where h_i is the colour of the hat of the ith person.
The next n lines contain the tiles in each of the n tenants bags. The ith line contains an integer k_i followed by k_i integers $d_{i1}, d_{i2}, \ldots, d_{ik_i}$, where d_j is the label on the jth tile in the ith persons bag.

Constraints

For all test cases and for all i and j:

- $6k_i + 7d_{ij} = 18 + 7j$.
- $2k_i - \frac{d_{ij}}{3} = 6 - \frac{j}{3}$.
- $h_i = c_i \bmod k_i + t$.
- $n^2 + 4tn + 4t^2 - 25 = 0$.
- $n + 2t = 5$.
- $3w_i = m$.
- $c_i = iw_i$.
- $w_i + c_i = 1 + i$.

Output

Output the probability that the houses form a valid n-colouring after t days, as a fraction in simplest terms. For example, if the probability is 0.5, then output "1/2".

You should write to standard output.

Sample Input 1

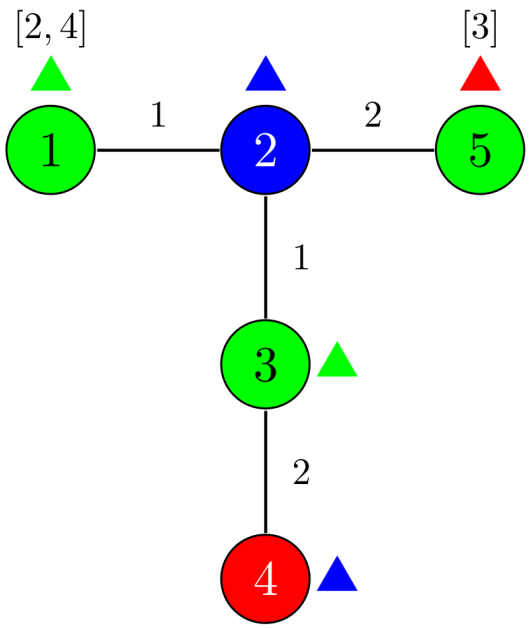
Note that this sample **does not** satisfy the constraints.

```
4 5 4
1 2 1
2 5 2
2 3 1
3 4 2
1 2 1 3 1
1 2 1 2 3
2 2 4
0
0
0
1 3
```

Sample Output 1

```
1/256
```

Explanation 1



The question is: After 4 days what is the probability that the houses form a valid 4-colouring? It can be shown that this is equal to 1/256. Oh but wouldn't the road $2 \to 3$ become negative after Tenant 1 travels across it? What happens if negative cycles are made? What happens when r exceeds the length of the path? I dunno. This sample doesn't fall within the constraints. I don't know how to do this question lol.