Computer Science Bitmap Assignment Instructions

- Your final submission will be a Python .py program

In this assignment you will write a dot-matrix "bitmap" display emulator, and a shape drawing program. The dot-matrix display is 80 wide by 24 tall, so it has 80*24=1920 bits. It only has two colors: off and on. Off will be represented by a space " ", while On will be represented by an asterisk, "*".

When the program starts, it should ask the user for a bitmap number. Then it should display the bitmap followed by the bitmap number. For ever 1 bit in the bitmap number, the program should display an asterisk, for every 0 bit it should display a space. The bit in the 1s place (2^0) represents row 0, column 0. The bit in the 2s place (2^1) represents row 0, column 1. The bit in the 2^{11} place represents row 0, column 11. The bit 2^{80} place represents row 1, column 0. The bit in the 2^{91} place represents row 1, column 11. Hint: 91 is 80*1 + 11.

Then it should ask the user if they want to add a line. If the user enters "yes", then it should ask them for a starting row and column, and an ending row and column. It should then ask them if it should turn the line on or off. If the user selects on, it draw the line in on bits ("*"s), if the user selects off it should draw the line in off bits (" "s) (it is actually erasing the line!). Then it should print the bitmap followed by the bitmap number. Then the program should ask the user if they want to add a line again.

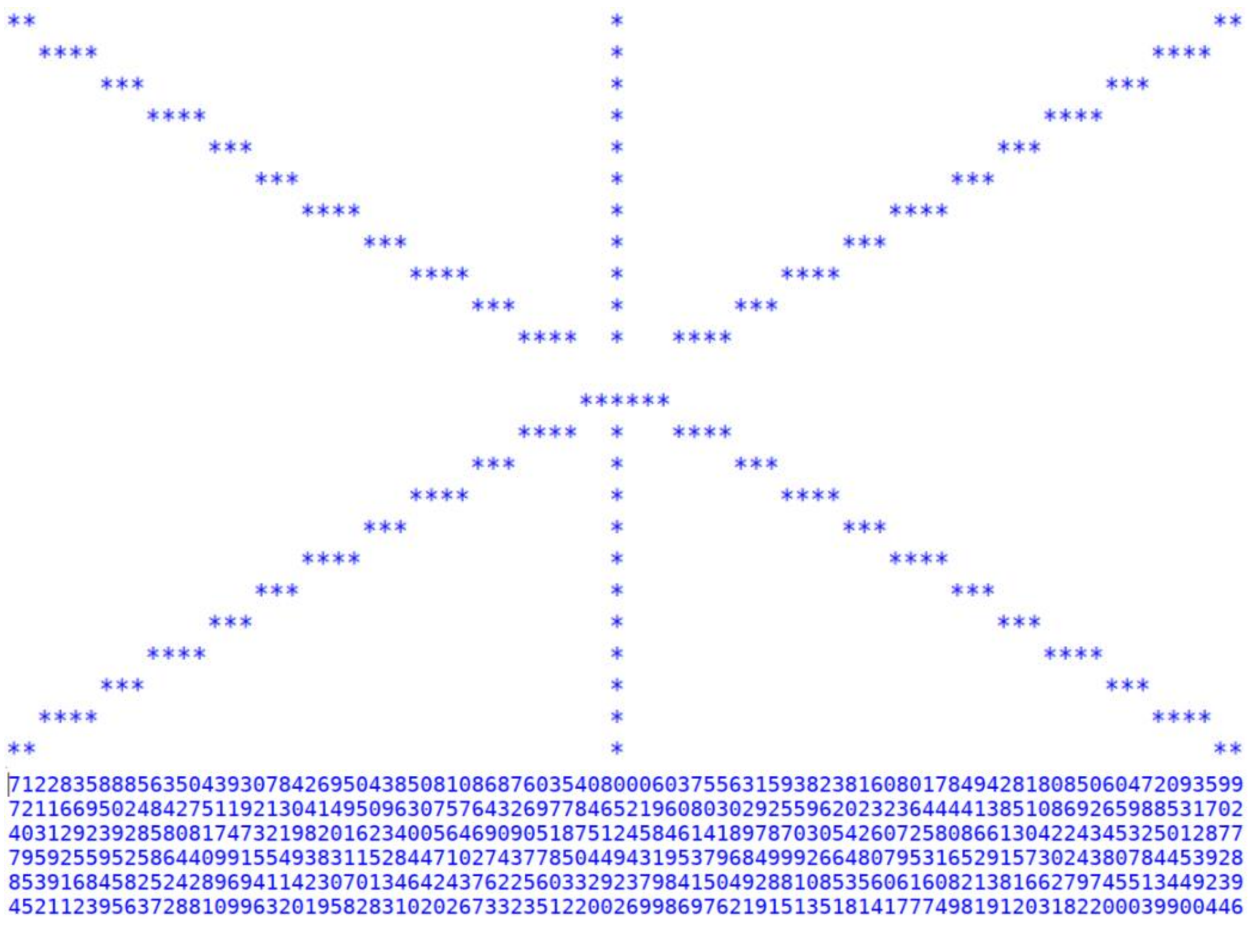
Part 1:

- Write a function to display the bitmap and the bitmap number.
- Get your program working so that it starts, asks for the bitmap number, and then displays the bitmap and the bitmap number.
- You are **NOT ALLOWED** to use bin() or bitarray or other similar tools in your answer. You can use them to check your work, but **remove it or comment it out** before you submit.
- You must use bitwise arithmetic.

Hint: Print one line for each row.
Hint: For some row and column, you should use the formula 80*row+column

Hint: You will need to use bitwise arithmetic to determine if each bit is 1 (on, "*") or 0 (off, " ").

For example, the number
71228358885635043930784269504385081086876035408000603755631593823816080178494281808506047209
35997211669502484275119213041495096307576432697784652196080302925596202323644441385108692659885
31702403129239285808174732198201623400564690905187512458461418978703054260725808661304224345
32501287779592559525864409915549383115284471027437785044943195379684999266480795316529157302438
07844539288539168458252428969411423070134642437622560332923798415049288108535606160821381662
797455134492394521123956372881099632019582831020267332351220026998697621915135181417774981912
031822000399004467 5 should draw a giant star like it does below. The star is also in Example 1. It's a very large number because its 1920 bits long... or 1331 decimal digits long. Just make sure to copy and paste the whole thing!



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712283588856350439307842695043850810868760354080006037556315938238160801784942818085060472093599
721166950248427511921304149509630757643269778465219608030292559620232364444138510869265988531702
403129239285808174732198201623400564690905187512458461418978703054260725808661304224345325012877
795925595258644099155493831152844710274377850449431953796849992664807953165291573024380784453928
853916845825242896941142307013464243762256033292379841504928810853560616082138166279745513449239
452112395637288109963201958283102026733235122002699869762191513518141777498191203182200039900446
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Part 2:

Write a function to ask the user if they want to add a line. Use the function with a loop to repeat the line adding until the user says "no." Write a function to turn bits on or off. You should use loops and rounding to determine the row/column locations. If the line has more rows than columns, you should set the same number of bits as there are rows for the line to cross. If the line has more columns than rows, you should set the same number of bits as there are columns for the line to cross. So, if you are drawing a line from 0,0 to 23,79, you should set 80 bits on or off. If you are drawing a line from 0,0, to 23,0, you should set 24 bits on or of (one on each row).

- You are **NOT ALLOWED** to use bin() or bitarray or other similar tools in your answer. You can use them to check your work, but **remove it or comment it out** before you submit.
- You must use bitwise arithmetic.

Hint: the round() function in Python can round numbers.

Hint: you can either draw the line column-wise (by making a loop over the columns) or row-wise (by making a loop over the rows). When there are more rows than columns in the line, it's better to loop row-wise. When there's more columns than rows to cover, it's better to loop column-wise. For example, if you're drawing from 0,0 to 23,79 it's better to loop over the columns from 0 to 79 (including 79).

Hint: If you're looping column-wise, find a way to calculate what row you should be on. For example, if you're drawing from 0,0 to 23,79, and you're currently on column 55 you should be on row 16. This is because you're 55/79=0.6962 (~70%) of the way through the columns already. You need to draw rows 0 to 23, so 23 * 0.6962 is 16.012... you can round that to 16. So, when you're on column 55 you should be on row 16. Note that the distance from row 0 to row 23 is 23, even though we'll be changing bits in 24 rows. Similarly, the distance between column 0 and column 79 is 79, even though we'll be changing bits in 80 columns. This is because we're rounding.

Hint: It might be easier to get this working on lines that start at 0,0 before trying to get it working for any line.

Part 3:

- Fix your program so that if the user doesn't enter a valid answer for on/off or yes/no, the program simply asks again.
- Fix your program so that if the user enters a number less than 0 or greater than 23 for rows or 80 for columns, the program simply asks again.
- Fix your program so that if the user enters a end column greater than the start column, the program still works correctly.
- Fix your program so that if the user enters an end row greater than the start row, the program still works correctly.
- Fix your program so that if the user enters the same start and end row AND the same start and end column, it does not crash, it should set (or clear) a single bit.
- Fix your program so that it does not crash due to dividing by zero.
- It is okay for the program to crash with "ValueError: invalid literal for int()" errors. To get full marks, these should be the **only** errors/crashes.

Hint: the abs() function in Python gives you the absolute value.

Example 1:

```
>>>
================================== RESTART: /home/bitmap.py
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Enter bitmap number: 0
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0
Add a line? yes
Start row? 0
Start column? 0
End row? 23
End col? 79
On or off? on
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7122835888559185605410241618401295690888284436771279515819460192563254987013788760527854878705
5205827715967432708262649245429194814551034759635181068507496829749099591549846015135857173490
0356366965471180908054844507429892494241146311533720677354120346501291407593701017820835437232
1402297786527126451444267015601496443880278963857245828575595068211919757540473956464452428055
7354564781379052539066426885275745925926791578089329444588167291655151044303234073372316643591
1894283827449865544172601664812069201653010502815715299791420864506471323476398662885725052151
616705039713404190755
Add a line? yes
Start row? 0
Start column? 79
End row? 23
End col? 0
On or off? on
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7122835888559185605410265185888309343193555341853469942895198452988263254655372659721545327237
3428359749393222248741530743019664850177467808983454094322744696306330947099787190144569019 05
4631346092045419379385236309764537129203593773149786374137929783965080540244629031991955846 15
9042556245890138578368182741651904035027555094264524468057670060472168036235010073211691140 27
5074218612145497749690954044661218259905720366138909514313348387139247488104507465044984555 64
5915844168795551794995143592984888419611329706795579809145170092514990552355897436697107076 39
92262499361695465475
Add a line? yes
Start row? 11
Start column? 0
End row? 11
End col? 79
On or off? on
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712283588855918560541026518588830934319355341853469942895198452988263254655372659721545327237
342835974939322224874153074301966485017746780898345409432274469630633094709978719014456901905
463134609204541937938523630976453712920359377314978637413792978396508054024462903199195584615
904255624686466997950120279191211206505246727507360205497545413002715634978497278809588031828
678025649394210848659262276353135425363283288043718124772814465959370523712853620033914994381
837918339624095523354481906631252347948150519646024674844473702380202361891267082401764860754
15736350806676340739
Add a line? yes
Start row? 0
Start column? 39
End row? 23
End col? 39
On or off? on
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712283588856350439307842695043850810868760354080006037556315938238160801784942818085060472093
599721166950248427511921304149509630757643269778465219608030292559620232364444138510869265988
531702403129239285808174732198201623400564690905187512458461418978703054260725808661304224345
325012877893378735372644089959027574420248458668594472000878715388068345742899653799530216379
251011853181305641658158704335800825669331195245189977332708897954234810374706185861042000462
732864787666792689014999614756429551126886005484499010038105025446921974539008002364699734258
26223812886210281475
Add a line? yes
Start row? 11
Start column? 0
End row? 11
End col? 79
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On or off? off
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712283588856350439307842695043850810868760354080006037556315938238160801784942818085060472093
599721166950248427511921304149509630757643269778465219608030292559620232364444138510869265988
531702403129239285808174732198201623400564690905187512458461418978703054260725808661304224345
325012877795925595258644099155493831152844710274377850449431953796849992664807953165291573024
380784453928853916845825242896941142307013464243762256033292379841504928810853560616082138166
279745513449239452112395637288109963201958283102026733235122002699869762191513518141777498191
20318220003990044675
Add a line? no
>>>
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Example 2:

```
=================================== RESTART: /home/bitmap.py
==================================
Enter bitmap number:
557415871638820148295713944850899143245629567421444501925073314862896515077041471996282708901
453372337288424410699067868126307191750988131612878106718790626668996424628995179780872632793
455469914078102729720840910675306161443505120942990773344260198233717093228741405518336786614
8820147609501397023165775872


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557415871638820148295713944850899143245629567421444501925073314862896515077041471996282708901
453372337288424410699067868126307191750988131612878106718790626668996424628995179780872632793
455469914078102729720840910675306161443505120942990773344260198233717093228741405518336786614
8820147609501397023165775872
Add a line? yes
Start row? 11
Start col? 60
End row? 12
End col? 60
On or off? on
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168097408092776759062653061847960740037127942804944745357186140413635177598295940143312276462
941119772202260189009183645121286187104346089280133108233128236959611312780351765175440261965
801883782308108535925827340199929182558126209980320150656737222917971288319424348742930895625
857115050611663161581098762 24
Add a line? narf
Add a line? 0`12
Add a line? al;skdjf
Add a line? no
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>>>
```

Example 3:

```
>>>
================================= RESTART: /home/bitmap.py
=================================
Enter bitmap number: 0
























0
Add a line? yes
Start row? 0
Start col? 0
End row? 23
End col? 0
On or off? on
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785582900455076842299379767437153034800020870748058314161511824877667756509517596454107100745
979919589023174644431757296654702950254086637425321767272430687563281929055600054323018037256
947259938262688996015477605770344944555972769500732433143639784726302354299404729310822608604
717579226090638849581054984721137809718726923580997120015889202665580400453825176536480666292
118975501598777948379161524109902677604159126954434590326495664699820479443104833618292283471
58800985783954926441368155110488819183865309633605075005314201875713804531869995077992449
Add a line? yes
Start row? 0
Start col? 0
End row? 0
End col? 79
On or off? on
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785582900455076842299379767437153034800020870748058314161511824877667756509517596454107100745
979919589023174644431757296654702950254086637425321767272430687563281929055600054323018037256
947259938262688996015477605770344944555972769500732433143639784726302354299404729310822608604
717579226090638849581054984721137809718726923580997120015889202665580400453825176536480666292
118975501598777948379161524109902677604159126954434590326495664699820479443104833618292283471
58800985783954926441368155110488819183865309633605075005314201876922730351484624252698623
Add a line? yes
Start row? 23
Start col? 79
End row? 0
End col? 79
On or off? on
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47485572590394570702735049685377553256872580224307673944355698168423195352095141164326625354
32402893572594254025910184667847774175022602440067101744640220315148934509248118975377662194
01082360124364531191552244331277212434944090831682787585089706388794901268462705160795154374546
81208442604997903086844698613029162302663195252775065685777533537903500022871672917434125115
07841370049924055118766520098287864204698255625444151445110517003455054965501719248098210312
95830500361791574894849507369141486609360866918726619339821682336870464627598694220965982631494
72002252961426178047
Add a line? yes
Start row? 23
Start col? 79
End row? 23
End col? 0
On or off? on
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9497114518078914140546982441673994723685035566582670867411113925469715626350737761164012463182626750645804192534562786386776996771767300751935887182744976559026325588008055555803093800055329782724043364955134822493801990716237681666336268696884453836160329402363494949742907980590966315360029728856102838403023606898900273641226814788326466894983500780137346801138034824749114586242100207860825028559619847628655378204658254227775837376526780594202140232808994261040191160704721925089704221116118038560377463813340749506717533820412190439137693604853646186125222805601515890278
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Add a line? yes
Start row? 0
Start col? 0
End row? 0
End col? 0
On or off? off

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949711451807891414054698244167399472368503556658267086741111392546971562635073776116401246318
262675064580419253456278638677699677176730075193588718274497655902632558800805555580309380005
532978272404336495513482249380199071623768166633626869688445383616032940236349494974290798059
096631536002972885610283840302360689890027364122681478832646689498350078013734680113803482474
911458624210020786082502855961984762865537820465825422777583737652678059420214023280899426104
019116070472192508970422111611803856037746381334074950671753382041219043913769360485364618612
52228056015158902782
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Add a line? yes
Start row? 0
Start col? 79
End row? 0
End col? 79
On or off? off

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9497114518078914140546982441673994723685035566582670867411113925469715626350737761164012463182
6267506458041925345627863867769967717673007519358871827449765590263255880080555558030938000553
2978272404336495513482249380199071623768166633626869688445383616032940236349494974290798059096
6315360029728856102838403023606898900273641226814788326466894983500780137346801138034824749114
5862421002078608250285596198476286553782046582542277758373765267805942021402328089942610401911
6070472192508970422111611803856037746381334074950671753382041219043913769360485364612567
89318248700571549694
Add a line? yes
Start row? 23
Start col? 0
End row? 23
End col? 0
On or off? off
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9497114518078914140546974585844990172916612572791494685328862071518784514753948736652042741849
7110537780854405791895897617146386564381819260164539397493714290403345626772189015571352306866
3898984282715815245921753238039869508308429875857047201670103608725267441143939396120367268598
5874315014634145034323125076689797875462794475101022445519879136828025397253029132659717468833
9130020502802774682136334581692291194245252546607208233210925285680840609185498327663272555775
6072541927587818729489283612554357700963535656414852091615181186190310022359618578361255
28283829900326993918
Add a line? yes
Start row? 23
Start col? 79
End row? 23
End col? 79
On or off? off
 ********************************************************************************
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4748557259039457070273481401050741673381989041057238848188814254989526200419147042896753371433
6558029694379981597905947926606998290352459623088020156534049251909614332556090126397864859047
5122259999669150749562842850734828597711621409478117629380548772978250077088494060643082175317
9521125454506175478924027462164927191886985022365270934912306250331738066885975727287189666999
3503297742723686960753198028290060903945872333709242529681514604174350780541991695265116044642
0368000780131394429502156912704320730665331363732362697036290366066787453218365623871512
25989189246105157630
Add a line? no
>>>
```

Your file should include the answers to all questions, and the code *from the last step only*.

Marking:

- 1 pt: Program syntax is correct, program is can be run without errors. Only errors caused by entering wrong or weird or the problems listed in Part 3 are allowed.
- 2 pt: Program works for Part 1: The code uses bitwise arithmetic and loops to display asterisks and spaces, and it works correctly. Partial marks will be given for partially-working code.
- 3 pt: Program works for Part 2: The code prompts the user and uses bitwise arithmetic and loops to set the correct bits in the bitmap for the lines the user enters. Partial marks will be given for partially-working code.
    - 1/3 for code that draws the correct rows but not columns or colums but not rows.
    - 2/3 for code that works if the line starts at row 0, column 0.
- 2 pt: Program works for Part 3: The code works even in the circumstances listed in Part 3. Partial marks will be given for partially-working code.
- -1pts: Program doesn't use functions for asking whether to add a line, setting bits on/off.
- -3pts: Not using bitwise arithmetic, using bin() or bitarray, or otherwise avoiding bitwise arithmetic. bin()/bitarray/etc. are allowed to be used to double-check your work, but you should remove them or comment them out before submitting.