



COLLEGE OF ENGINEERING, PUNE

Wellesly Road, Shivajinagar, Pune- 411 005

14/01/19

PPL Assignment 1

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1) Tiger, Goat, Grass Puzzle

- Two sets are made for items on bank a and bank b.
Tiger, goat and grass are all assumed to be on bank a initially, and the current bank is set to be a.
- Two more sets represent the illegal combinations Tiger-goat and Goat-Grass.
- The program runs until there are 0 items on bank a.
If the current bank is set to 'a' :
 - If there are 3 items on bank a, an item is chosen at random for crossing.
 - If the crossing leaves behind an illegal set, the crossing is undone. Otherwise, the crossing is completed by removing the item from bank a and adding it to bank b.
- Current bank is set to 'b'.
- If there are less than 3 items on bank a, crossing is done for a random item without requiring a check.

If the current bank is set to 'b' :

- If the latest crossing creates an illegal combination on bank b, an item is chosen to cross back to bank a.
- If the latest crossing is not problematic, the farmer can return alone.
- Current bank is set to 'a'.

Note: The current bank represents the position of the farmer.



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2) Dice Rolling Simulator

- The user has to input letter 'r' to roll the dice or 'q' to quit the programme.
- For every dice roll, a pseudo-random number from 1 to 6 is generated using the random.randrange() function.
- The user is continued to be asked whether to roll or quit until he/she quits the programme.

3) Application to block website from opening

- In linux systems, the host path "/etc/hosts" specifies IP addresses to go to in response to certain browser requests.
- This programme reads the file to check if the input website is already blocked. If not, a line is added to the file, that redirects the given website to localhost IP 127.0.0.1, so it cannot be accessed.
- The programme must be run as root.
- To unblock the website, the file /etc/hosts must be deleted as root.

4) A program that randomly chooses a number to guess and the user has a few chances to guess the number correctly

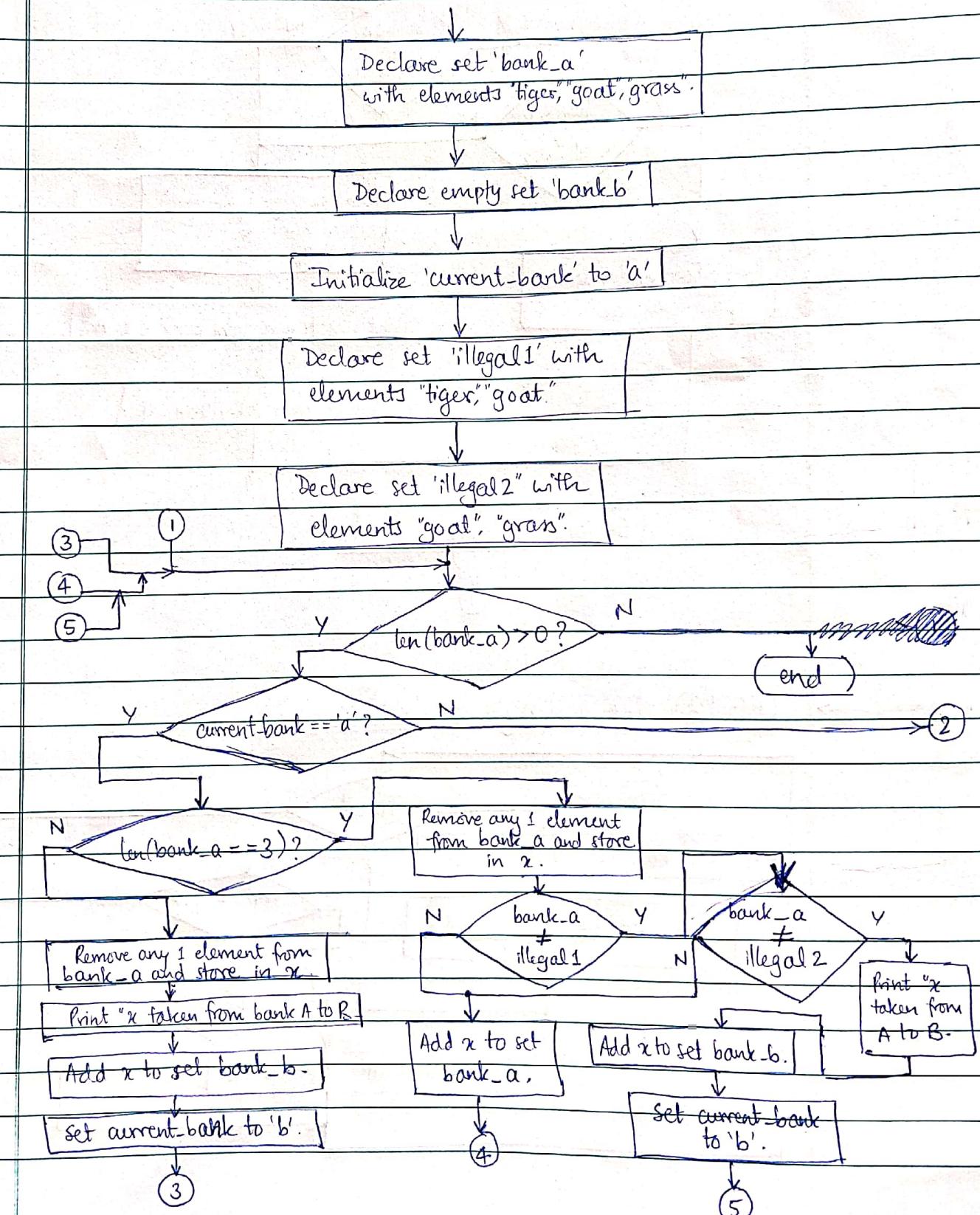
- The number to be guessed is chosen by the program using random.randrange() function.
- The guess input by the user is compared with the chosen number and the appropriate message is displayed.
- The program is quit after 3 guesses or after a correct guess is made, whichever occurs first.



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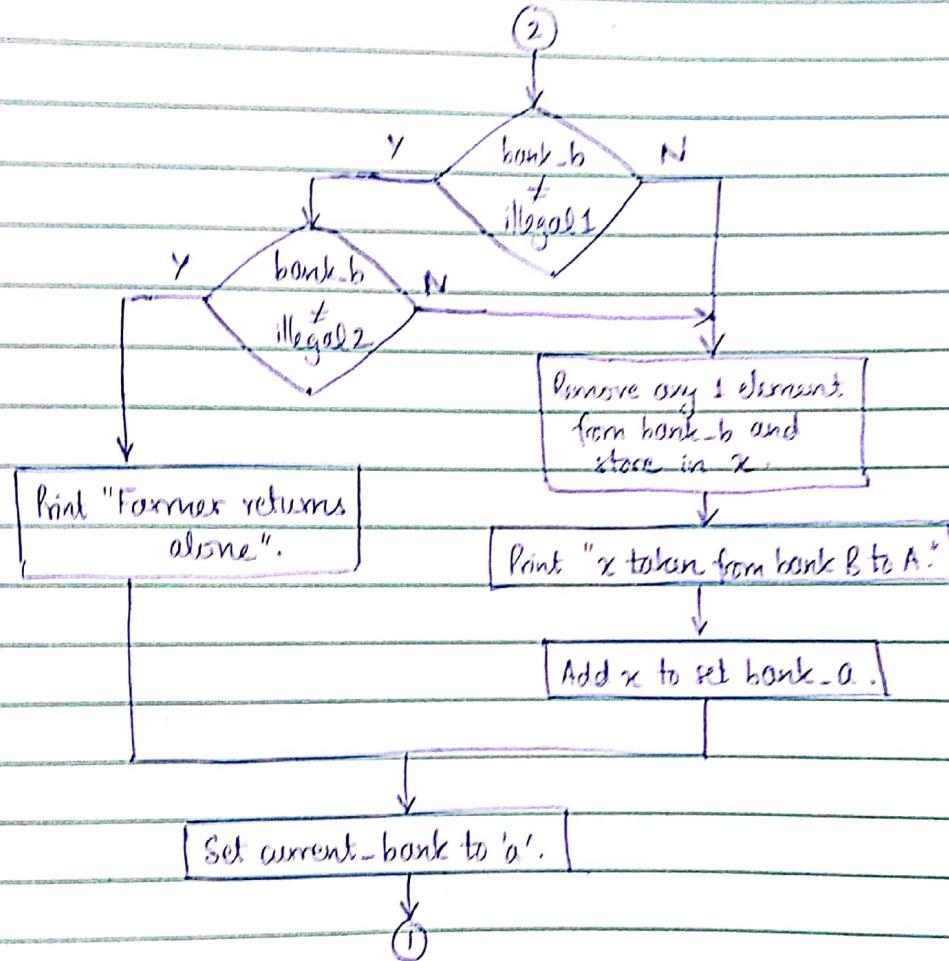
CFG (1) Tiger, Goat, Grass Puzzle



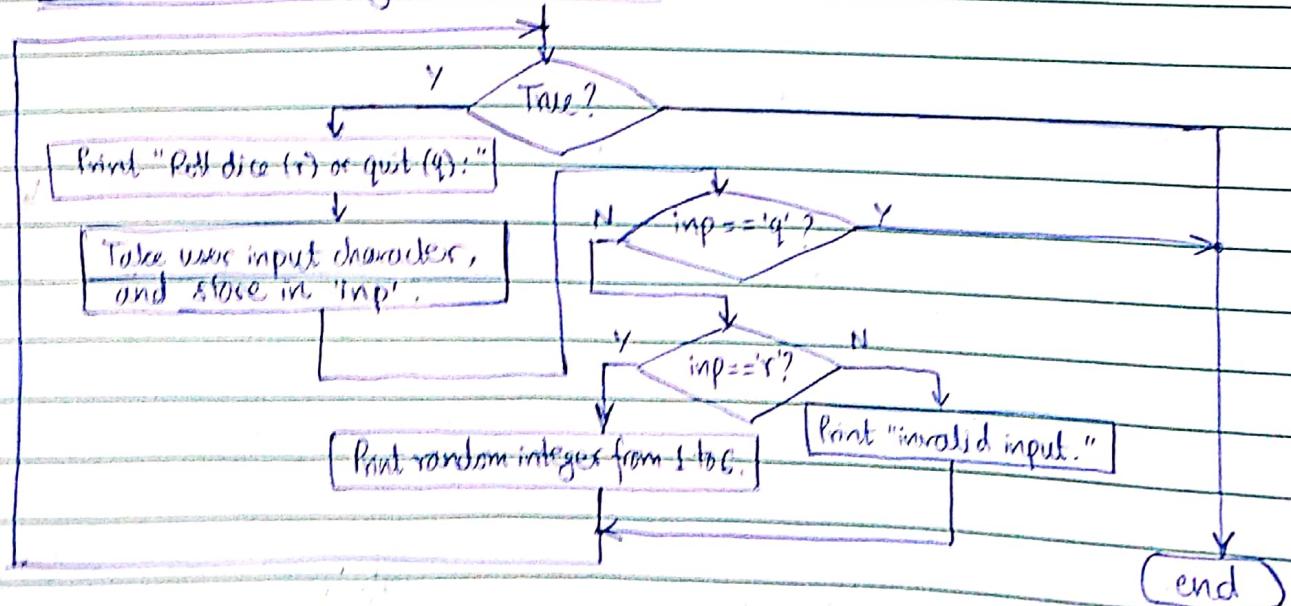


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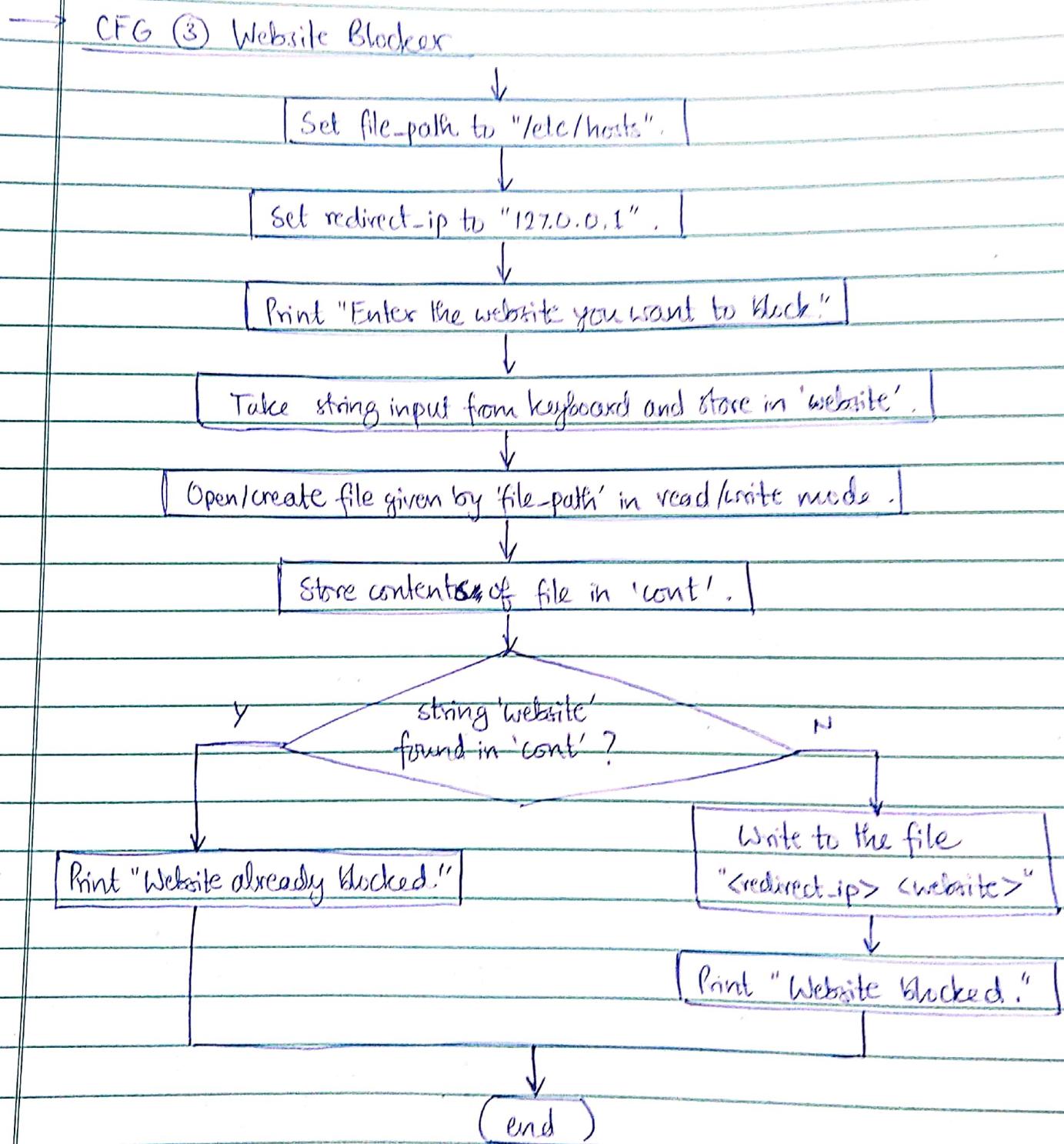
→ CFG (2) dice rolling simulation





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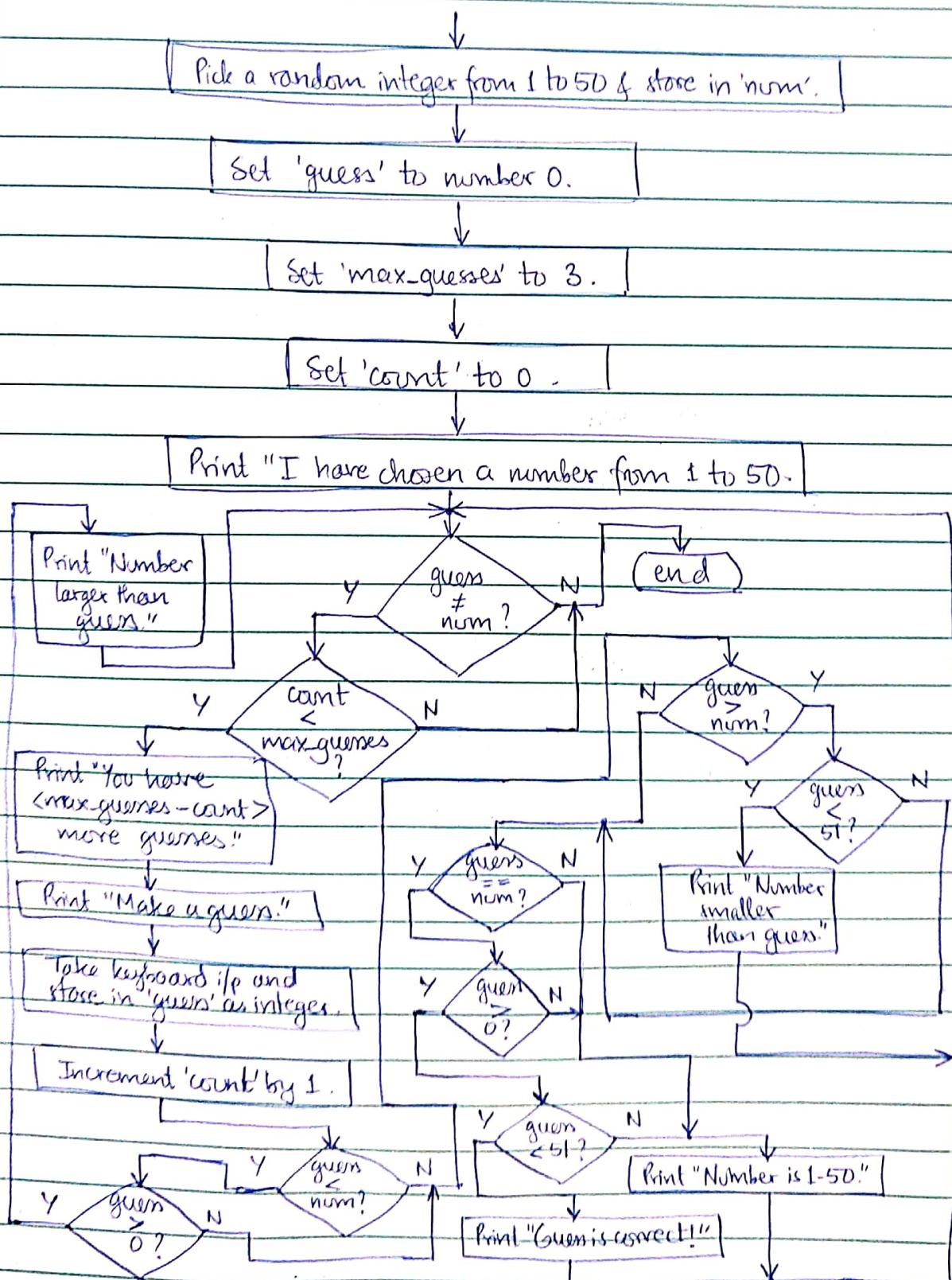




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CFG ④ Number guessing game





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5) Missing page number

- The problem is solved using set theory.
- The given list of pages is converted to a set type. \rightarrow Set A
- Another set (universal) is generated from the range of numbers 1-25. \rightarrow Set B.
- The set $(B - A)$ is the set of missing pages.

6) First 10 pairs of amicable numbers

- Amicable numbers are those pairs of numbers, each of which is equal to the sum of the proper divisors of the other.
- Proper divisors are the positive factors of a number other than itself.
- The program iterates serially through the natural numbers, finding the sum of the proper divisors of each.
- If this sum is less than or equal to the number, no further check is made and the next iteration begins. This is to eliminate pair repetition and non-distinct numbers like (6,6).
- If the sum of the proper divisors is greater than the number, then the sum of the proper divisors of this first sum is calculated, and compared with the starting number.
- If they are found to be equal, the pair is displayed.
- A count is maintained for every pair found.
- The program exits once the first 10 pairs have been displayed.

7) Armstrong numbers in the given range

- The lower and upper bound of the desired range is input by the user.
- Armstrong numbers are those that are equal to the sum of the cubes of their digits.



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- The program iterates through the range. Each number is first converted into a string of digits and each digit is converted back to an integer. We now get a list of digits.
- Iterating through the list, the sum of the cubes of the digits is calculated.
- If the sum is equal to the original number, then it is displayed.
- The program exits when all the numbers in the range have been checked.

8) Program to compute LU decomposition (Doolittle Algorithm)

- The size of the matrix (square) and its elements are taken as user input.
- The 2D matrix is represented as a list of lists.
- The upper and lower triangular matrices to be computed are initialized to 0, and of the input size.
- LU decomposition factors the matrix as the product of a lower triangular matrix and an upper triangular matrix.

$$A = LU \quad (\text{size } n)$$

For $i \in [0, n-1]$,

$$\text{k}^{\text{th}} \text{ column of } L : L_{ik} = \left[A_{ik} - \sum_{j=0}^{i-1} (L_{ij} U_{jk}) \right] / U_{kk}$$

$$\text{k}^{\text{th}} \text{ row of } U : U_{ik} = \left[A_{ik} - \sum_{j=0}^{i-1} (L_{ij} U_{jk}) \right]$$

$$\text{where } A = \begin{bmatrix} a_{00} & \dots & a_{0n} \\ \vdots & \ddots & \vdots \\ a_{n0} & \dots & a_{nn} \end{bmatrix}, L = \begin{bmatrix} 1 & 0 & \dots & 0 \\ l_{10} & 1 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ l_{n0} & l_{n1} & \dots & 1 \end{bmatrix}, U = \begin{bmatrix} u_{00} & u_{01} & \dots & u_{0n} \\ 0 & u_{11} & \dots & \vdots \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & u_{(n-1)n} \end{bmatrix}$$

- After computation by the above formulae, the 3 matrices are displayed.



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→ CFG (5) Missing pages

Make set from given page no. list and store in 'given'.

Store in 'pages' set of numbers from 1 to 25 .

Print "Missing pages : "

Display difference of sets 'pages' and 'given'.

(end)

→ CFG (6) Amicable numbers

Assign 0 to 'count'.

Assign 200 to 'a'.

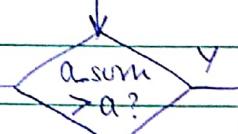
Count < 10 ?

Increment 'a' by 1.

Call findDivSum with 'a'.

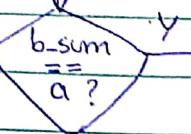
Store return value in a-sum.

(end)



Call findDivSum with 'a.sum'.

Store return value in 'b.sum'.



Print a, a-sum .

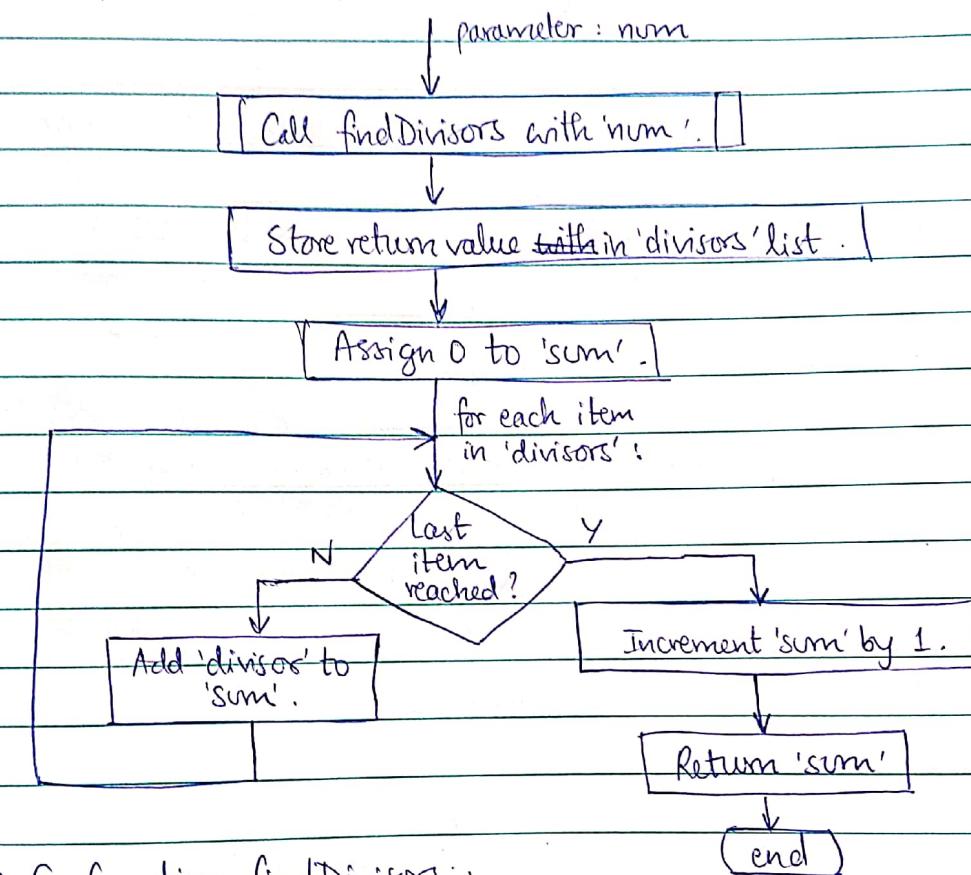
Increment count by 1.



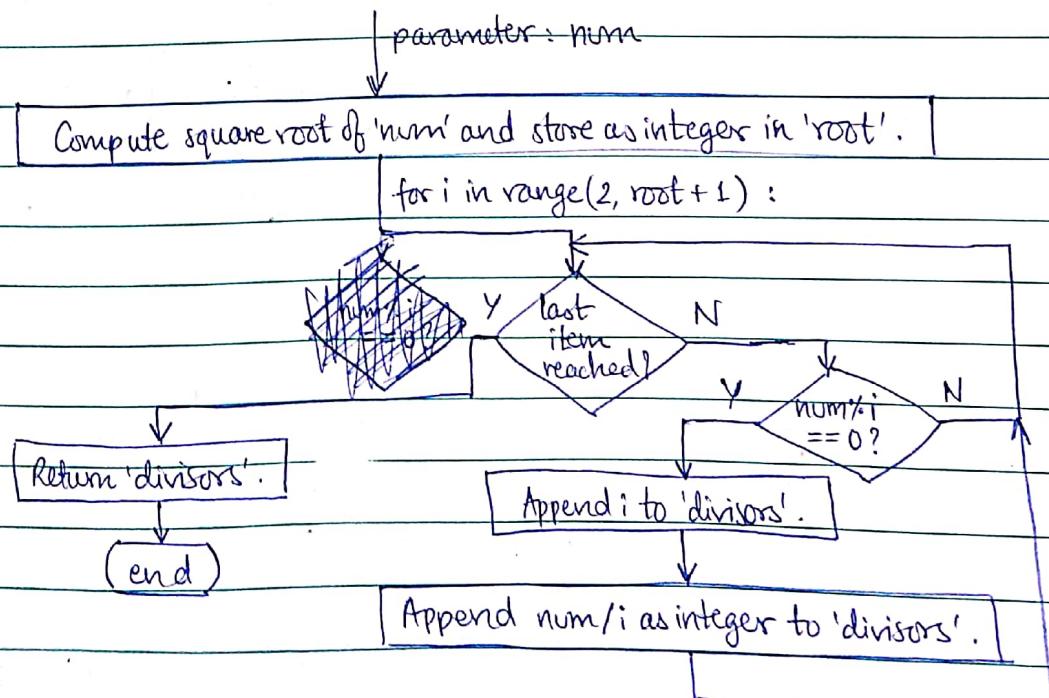
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CFG for function findDivSum :



CFG for function findDivisors :

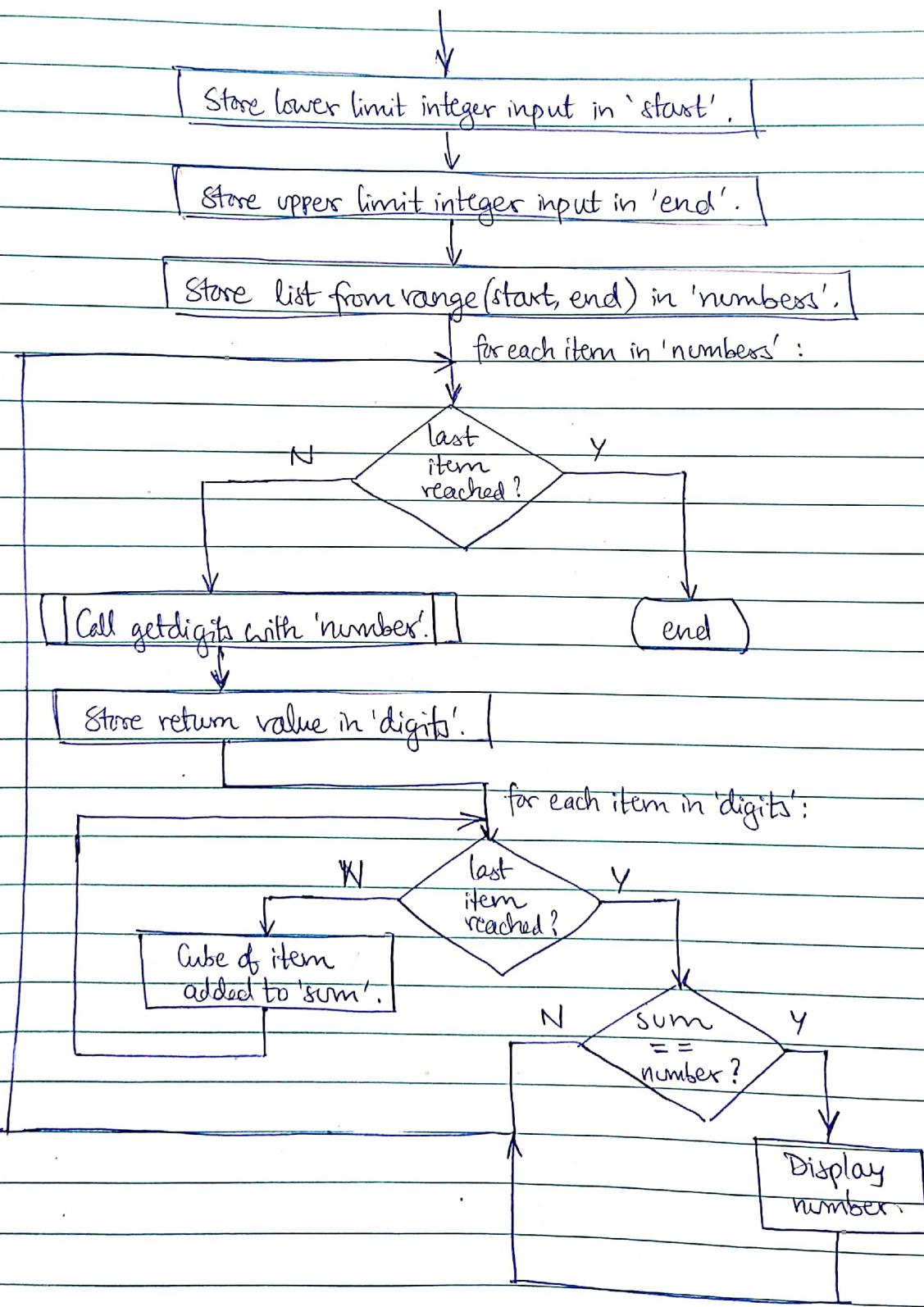




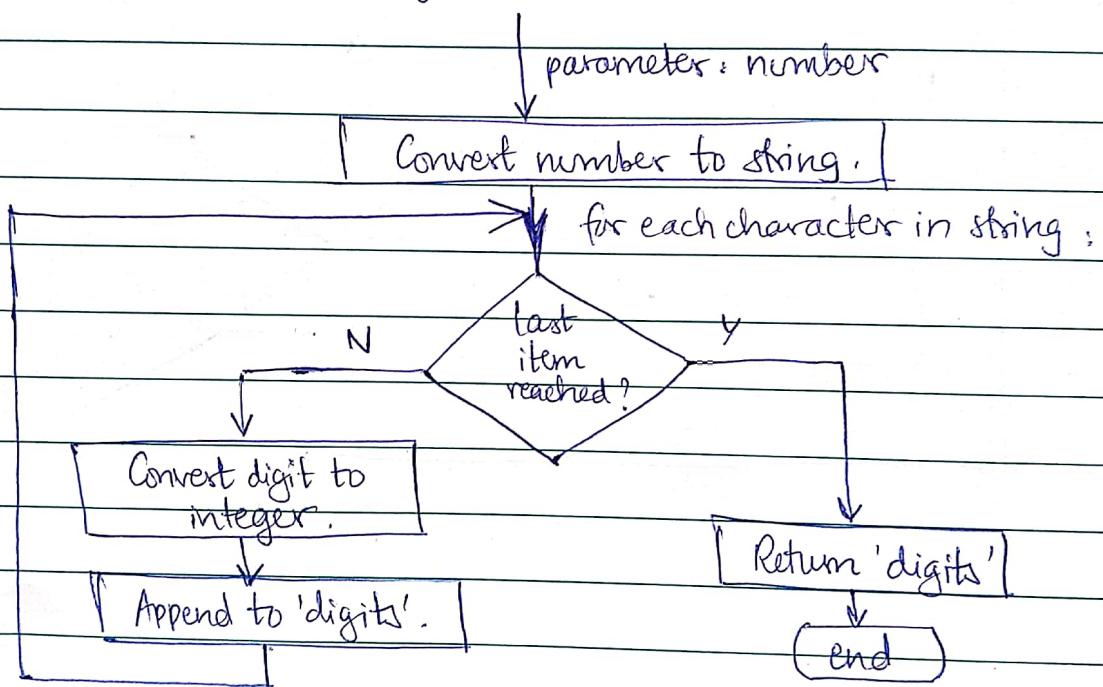
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CFG ⑦ Armstrong numbers



CFG for function getdigit :

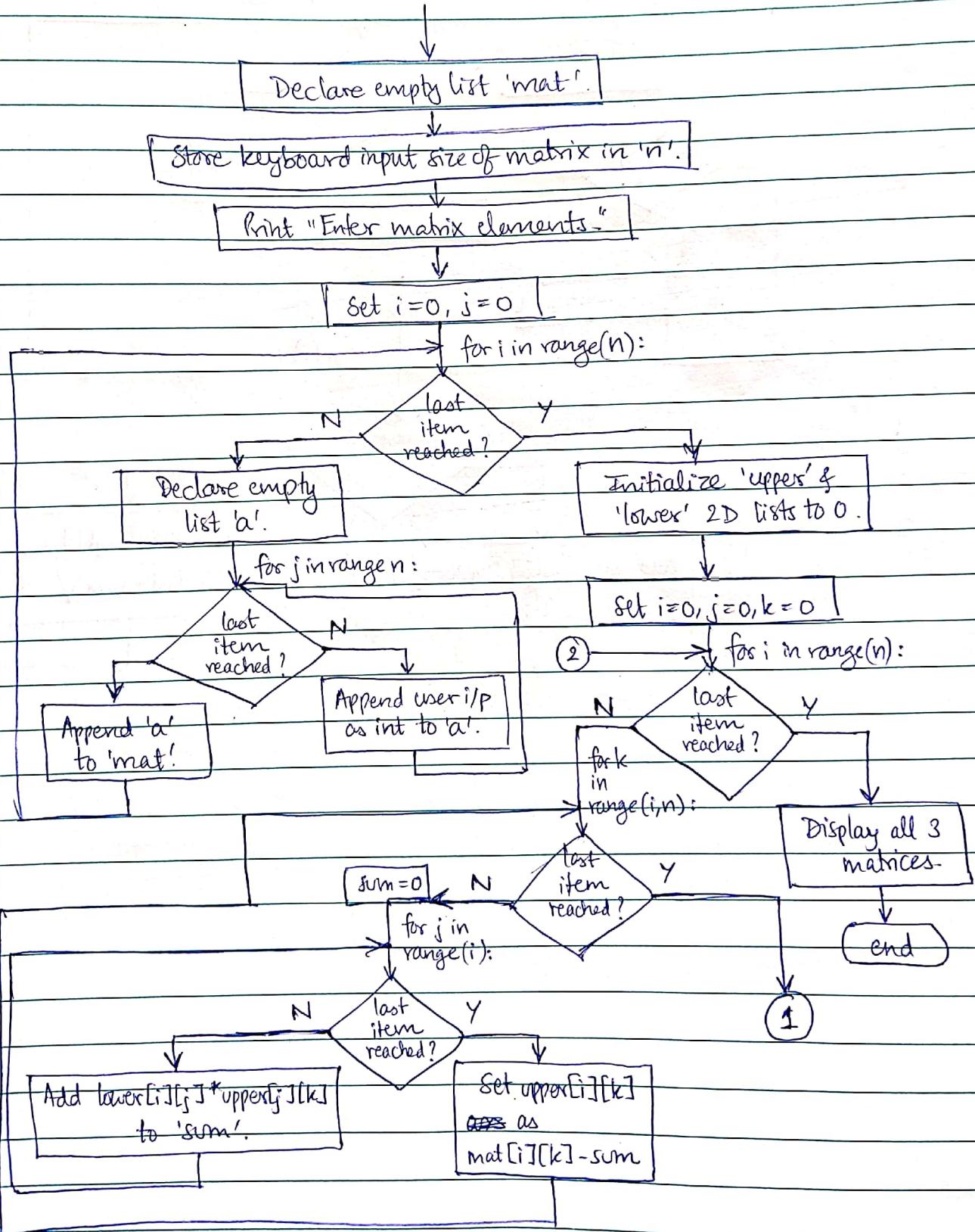




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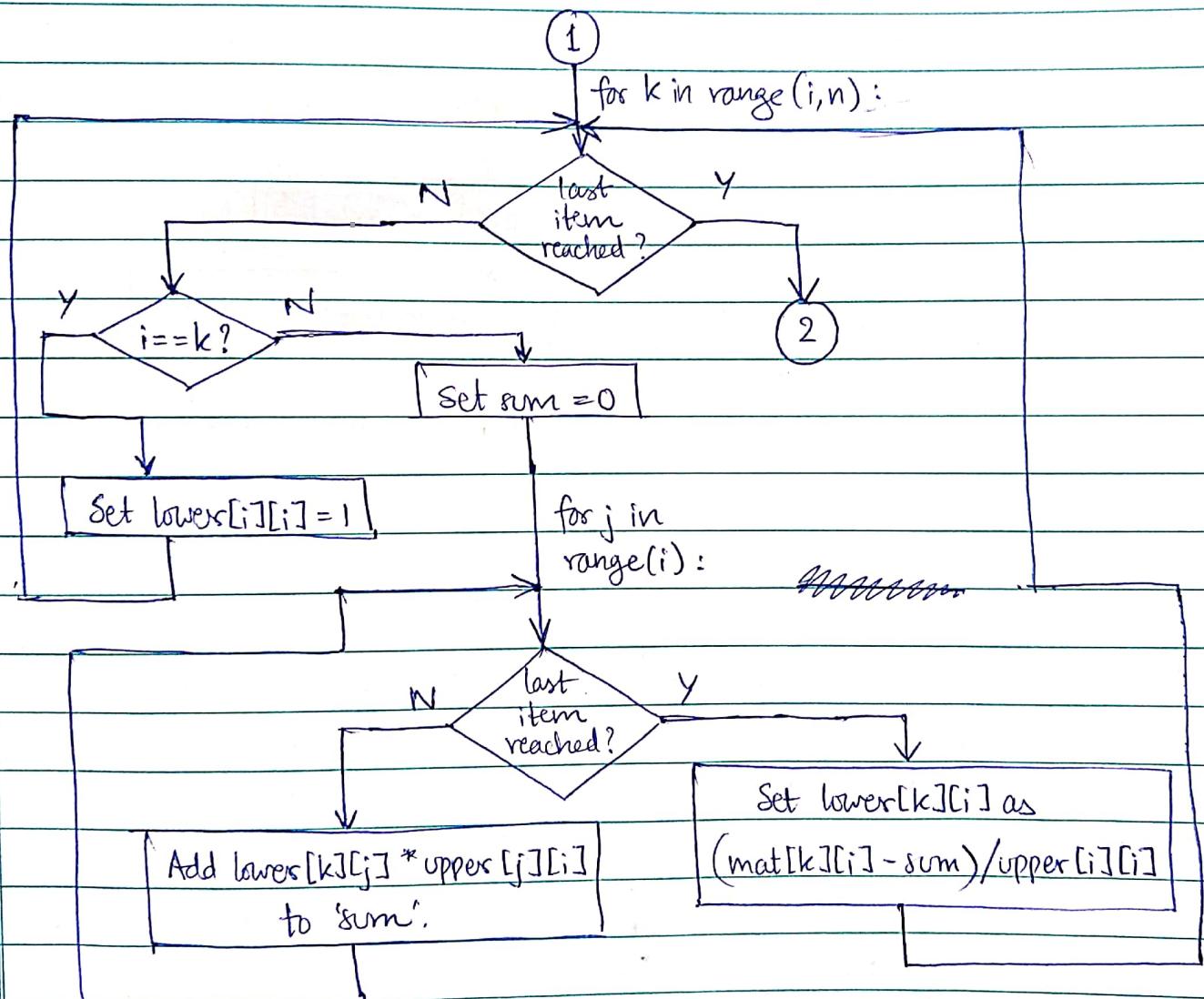
CFG (8) LU Decomposition





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9) Find first 10 harmonic divisor numbers.

- Harmonic divisor numbers are those for which the harmonic mean of the divisors is an integer.
- The ~~divisors of~~ program iterates through the natural numbers, finding the divisor of each, storing them in a list.
- Another list stores their reciprocals.
- The arithmetic mean of the reciprocals is found by using the mean() method in the statistics library.
- The reciprocal of the arithmetic mean gives the harmonic mean.
- If the harmonic mean is equal to its floor, it is an integer. If so, the number is displayed and count is incremented.
- The program runs ~~as~~ until the count becomes 10.

10) First 10 numbers from geometric series

- The first term a and common ratio r of the series are taken as input from the user.
- The first 10 terms are displayed after calculating them using the formula

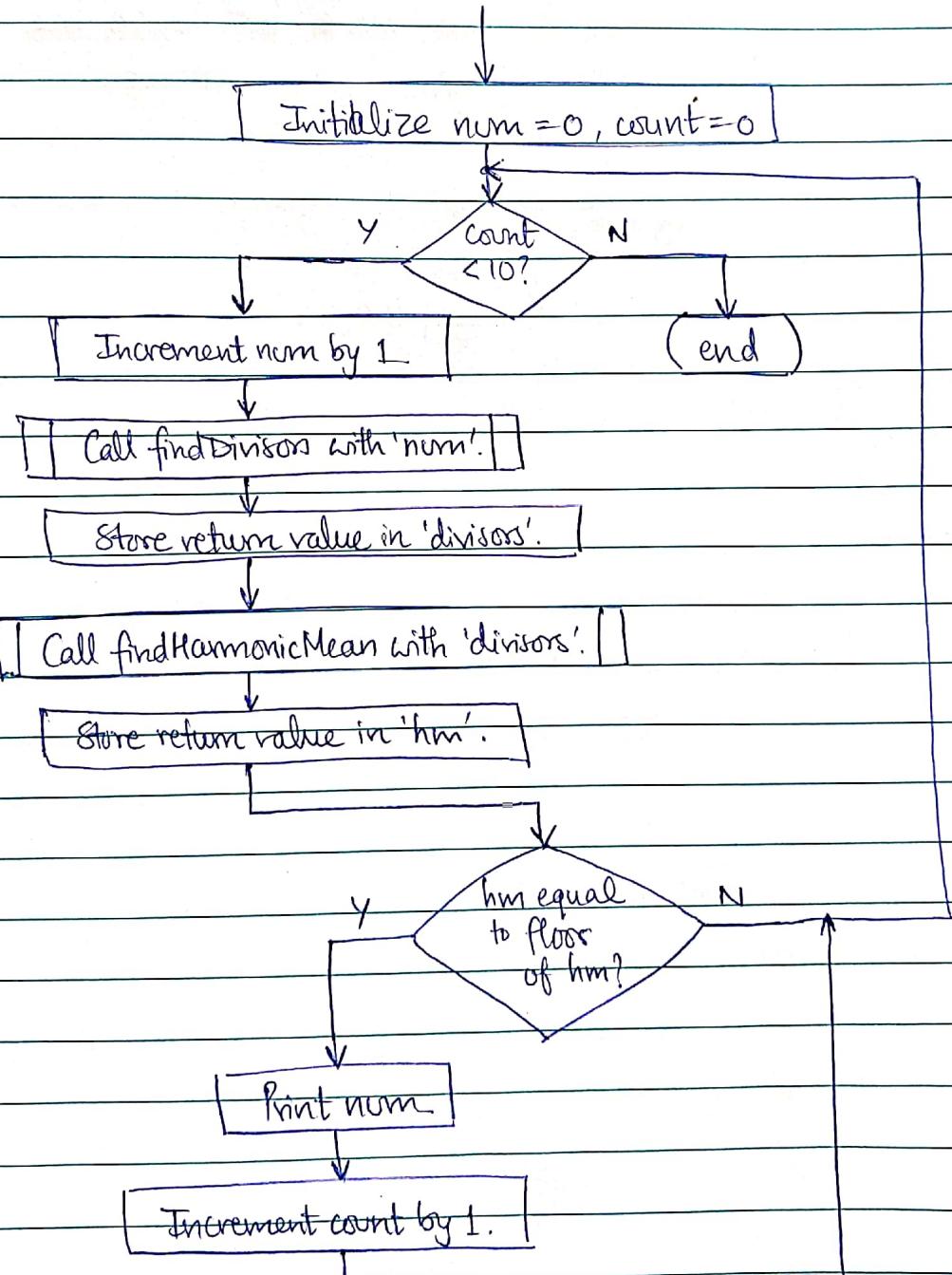
$$a_n = a_{n-1} \cdot r$$



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→ CFG (9) Harmonic Divisor Numbers

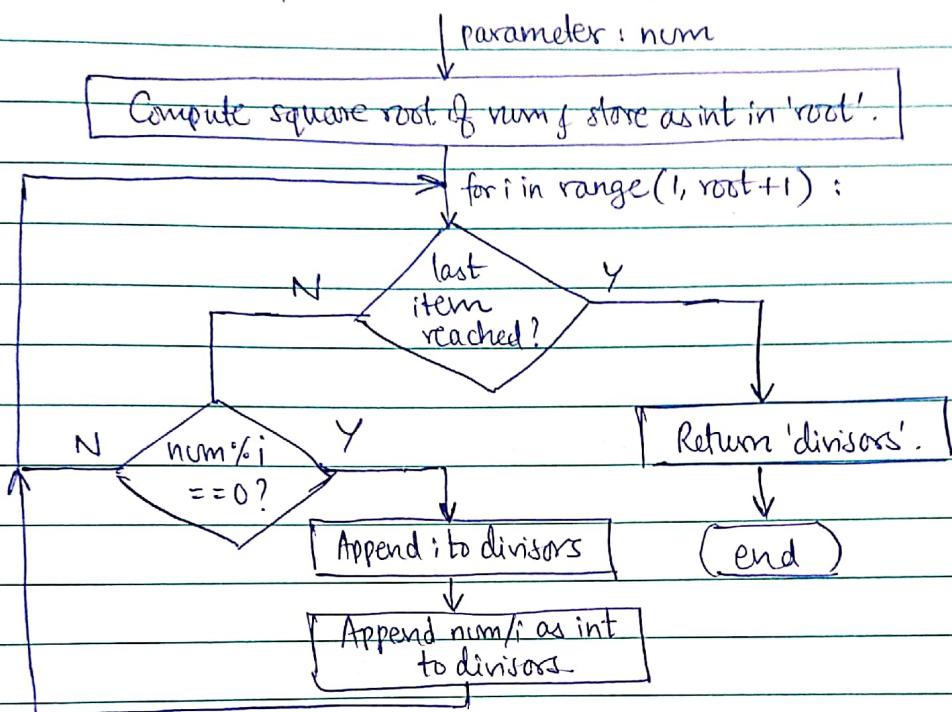




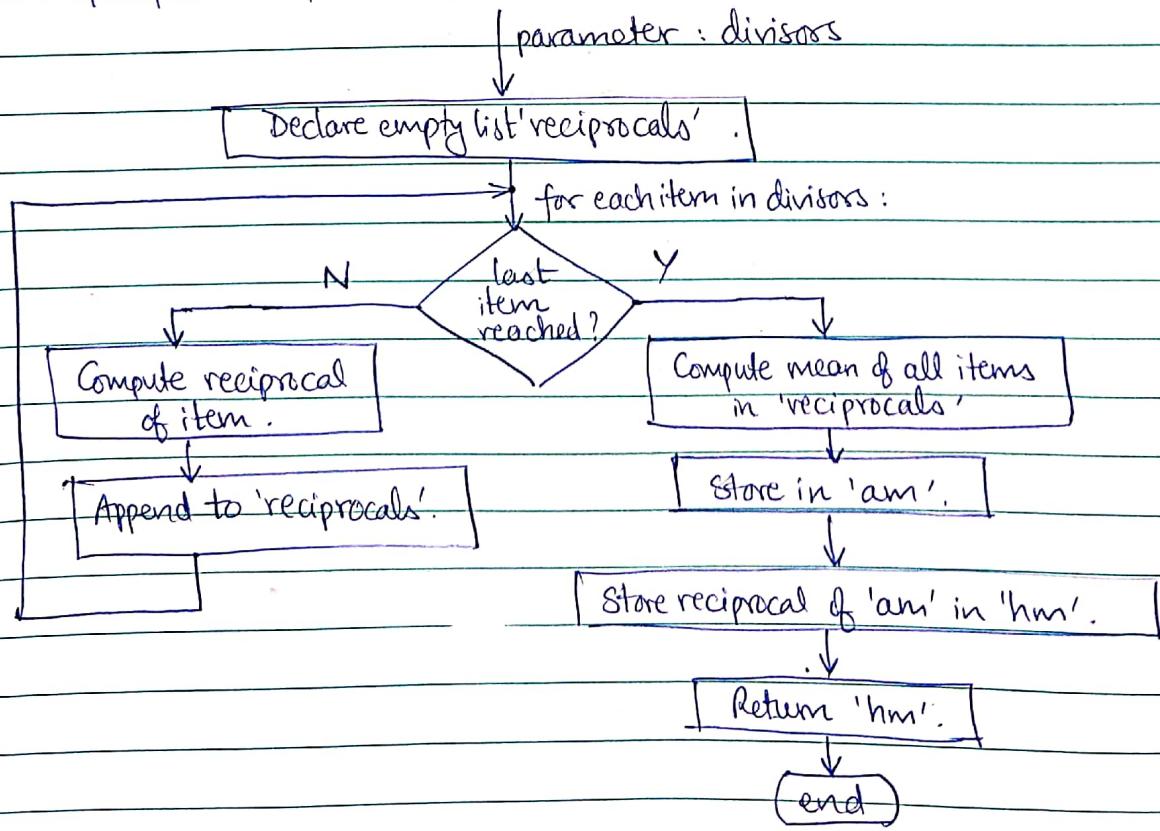
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CFG for function findDivisors :



CFG for function findHarmonic Mean :





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CFG (10) Geometric series

