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Q-1 Gauss-seidel method Algorithm:

→ steps:

(1) start.

(2) declare the variable and read the order of matrix n.

(3) read stopping criteria er

(4) read coeff. aim as.

do for i=1 to n

j=1 to n

read a[i][j], repeat for i and j.

(5) read coeff. b[i] for i=1 to n.

(6) initialize x0[i]=0 for i=1 to n.

(7) set key = 0

(8) for i=1 to n, set sum = b[i]

for j=1 to n, set sum = sum - a[i][j] × x0[j]

repeat j, x[i] = sum / a[i][i]

if abs. value of [x[i] - x0[i] / x[i]] > er then

set key = 1

set x0[i] = x[i]

repeat i

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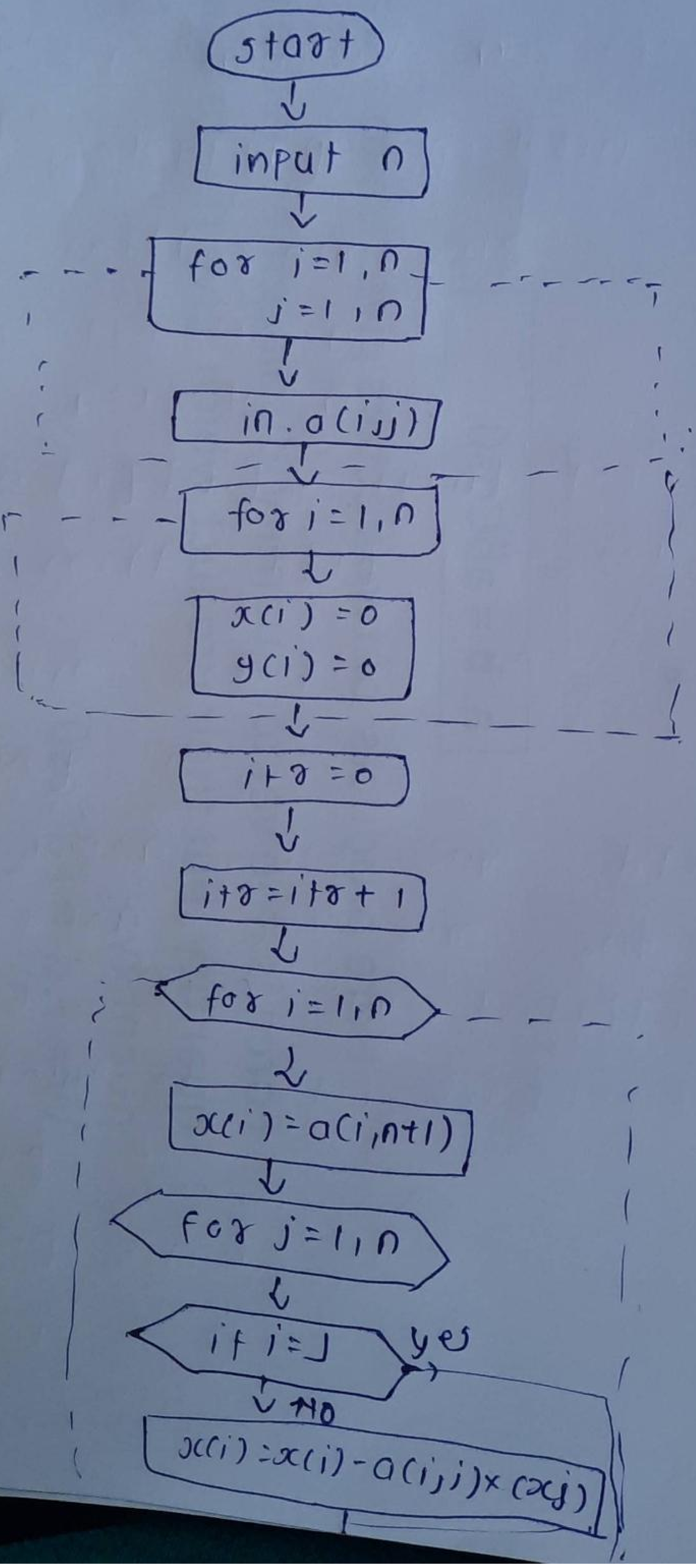
(9) if key=1 then

Go to step 6

otherwise print results.

→ simple flowchart:



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→ Limitations:

(1) requires large no. of iterations to reach converge.

(2) not suitable for large systems.

(3) convergence time increase with size of the system.

(4) it does not guarantee convergence for each and every matrix.

(5) Effect on convergence due to choice of slack bus.

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Q-2 yes, we can say that simpson's rule is better than trapezoidal's rule.

-> Explaination:

-> both of the rules are used to find approximation of values of definite integral but the trapezoidal rule determines the area under the graph by approximating it to that of a trapezoid that is the entire area between the curve and x axis. which is to say that the integral can be approximated by adding together several such trapezia.

-> whereas on the other hand simpson's rule is more accurate is to approximate the curve with a sequence of quadratic parabolic segments instead of straight lines.

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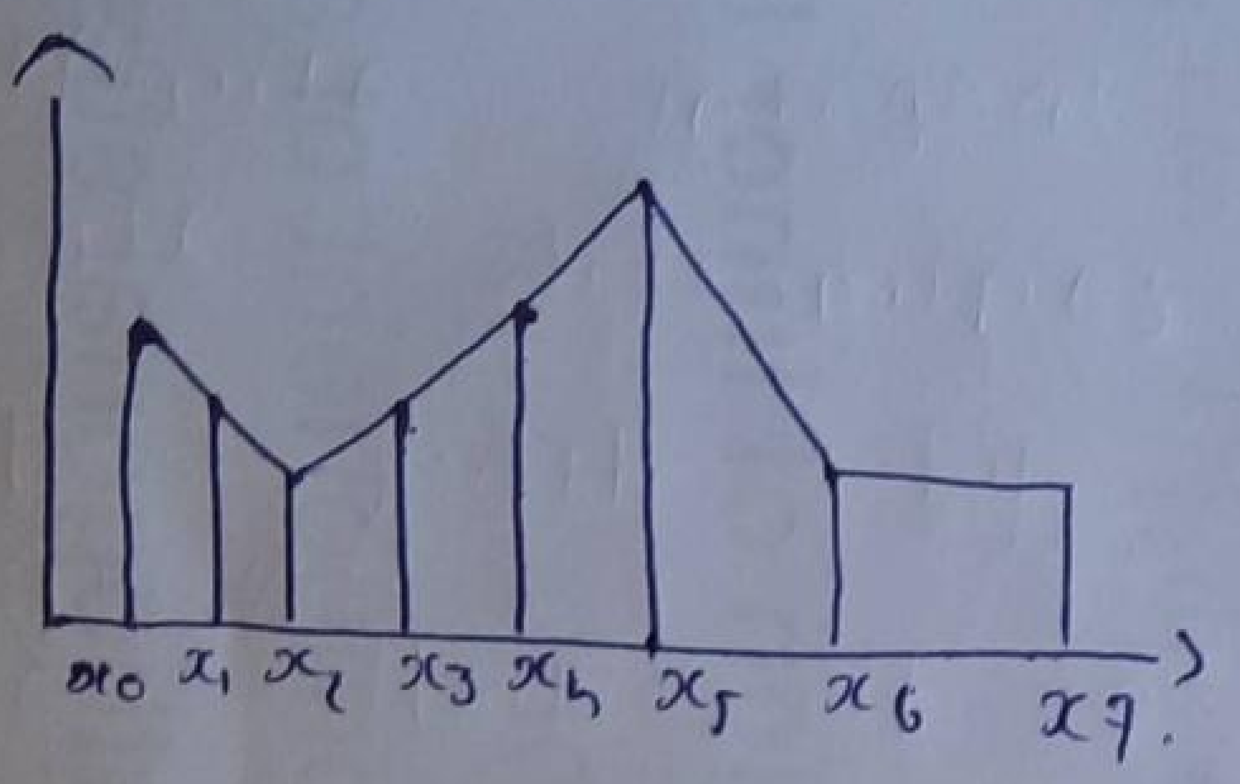
→ This makes it a more complex method and one that yeilds a value closer to the definite integral that is acually being determined.

→ Example:



→ in the graph we can see that we have 8 values of x and hence there are 7 intervals.

→ In trapezoidal we take every interval as it is.

→ whereas in simpson we further divide it into 2 parts and then apply the formula. hence simpson's rule is more precise.

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Q-3

-> Interpolation:

-> Interpolation is the process of using points with known values to estimate values of other unknown points.

-> It is the assignment of values to points intermediate to two data points.

=> Applications in petroleum Engineering:-

(1) it can be used to predict unknown values for any geogruphic points data, such as elevation, rainfall', noise levels etc.

(2) It is used in imputation of missing values of well ~~dlog~~ log datasets

(3) It may also be used to assign values to grid elements in maps.

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(4) It is also used in heat transfer estimation in petroleum industry.

(5) used in approximating of function values at points where there is no data reading.

(6) used in when finding derivatives from experimental data values.

(7) Data handling in Reservoir simulation:

→ P, T, V are those properties which are available in tabular form.

→ so data handling can be achived by interpolation and curve fitting the former method is used more commonly in reservoir simulation.

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Q-4

x	y	Δy	$\Delta^2 y$	$\Delta^3 y$	$\Delta^4 y$
2.35	0.8544				
		0.00424			
			-0.00001		
2.36	0.8586				
				-0.00001	
		0.00423			
2.37	0.8628		-0.00002		0.00001
		0.00421		0	
2.38	0.8671		-0.00002		
		0.00419			
2.39	0.8712				

→ for intermediate term, we will use stirling's formula:

$\therefore x = x_0 + ph$

$\therefore 2.372 - 2.37 = ph$

$\therefore p = \dfrac{0.002}{0.01} = 0.2$

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$$f(x) = 0.86289 + 0.2(0.00422) - (0.00002)$$
$$(0.02) + (-0.032)(-0.000005) +$$
$$(-0.0016)(0.00001)$$

$$\therefore f(x) = 0.86289 + 0.000844 - 0.0000004$$
$$+ 0.00000016 - 1.6 \times 10^{-8}$$

$$\boxed{\therefore f(2.372) = 0.86372}$$

→ comparing to original.

$$\ln(2.372) = 0.86373.$$

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Q-5

$$I = \int_{y=1}^{1.5} \int_{x=1}^{2} \frac{dx\,dy}{x+y}$$

Here $h = 0.5$, $K = 0.25$

simpson's rule is

$$\int_{y_{i-1}}^{y_{i+1}} \int_{x_{i-1}}^{x_{i+1}} f(x,y)\,dx\,dy = \frac{hk}{9}\Big[(f_{i-1,j-1}, 4f_{i-1,j} + f_{i-1,j+1}) + 4(f_{i,j-1} + 4f_{ij} + f_{i,j+1}) + 4(f_{i+1,j-1}, 4f_{i+1,j} + f_{i+1,j+1})\Big]$$

→ substituting the values in above equation.

$j-1 = 1$, $i-1 = 1$
$j = 1.25$, $i = 1.5$
$j+1 = 1.5$, $i+1 = 2$

$$= \frac{0.5 \times 0.25}{9}\Big[(f_{1,1} + 4f_{1,1.25} + f_{1,1.5}) + 4(f_{1.5,1} + f_{1.5,1.25} + f_{1.5,1.5}) + (f_{2,1} + f_{2,1.25}, f_{2,1.5})$$

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x \ y →	1	1.25	1.5
1	0.5	0.4444	0.4
1.5	0.4	0.36364	0.3333
2	0.3333	0.3079	0.2857

$\simeq \left[(0.5 + 4(0.4444 + 0.4) + 4(0.4 + 4(0.36364) + 0.3333) + (0.3333 + 4(0.3079) + 0.2857)\right]$

$\simeq 0.01388(0.5 + 1.77776 + 0.4 + 1.6 + 5.81824 + 1.33332 + 0.33333 + 1.2308 + 0.2857)$

$= 0.01388 \times (13.27915)$

$\simeq 0.18443252$

$I = \int_{y=1}^{1.5} \int_{x=1}^{2} \frac{1}{x+y}\, dx\, dy = \underline{\underline{0.18443252}}$

→ Actual answer $= \underline{\underline{0.184401}}$

ERROR $= |0.184401 - 0.184321| = \underline{\underline{0.000031}}$

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Q-6 Given data.

$$I = \int_0^1 \frac{dx}{x+1}$$

Solution :

Taking $h = 0.5, 0.25, 0.125$ succesively.

(1) when $h = 0.5 \rightarrow y = (1+x)^{-1}$

x :	0	0.5	1
y :	1	0.6666	0.5

so, $I = \frac{0.5}{2}(1 + 0.5 + 2 \times 0.6666)$

$\boxed{I = 0.7083}$

(2) when $h = 0.25 \rightarrow y = (1+x)^{-1}$

x :	0	0.25	0.5	0.75	1
y :	1	0.8	0.6666	0.5714	0.5

so $I = \frac{0.25}{2}\left[(1+0.5) + 2(0.8 + 0.6666 + 0.5714)\right]$

$\boxed{I = 0.697.}$

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(3) when $h = 0.125 \rightarrow y = (1+x)^{-1}$

x	0	0.125	0.25	0.375	0.5	0.625	0.75
y	1	0.8889	0.8	7272	0.6667	0.6153	0.57

x	0.875	1
y	0.5333	0.5

so, $I = \frac{0.125}{2}\left[(1+0.5) + 2(0.8889 + 0.8 + 0.7272 + 0.6667) + 0.6513 + 0.5714 + 0.5333)\right]$

$$\boxed{I = 0.6941}$$

using Romberg's method.

$\rightarrow I(h, h/2) = \frac{1}{3}(4I(h/2) - I(h))$

$= \frac{1}{3}(4 \times 0.697 - 0.7083)$

$= 0.6932$

$\rightarrow I(h/2, h/4) = \frac{1}{3}[4I(h/4) - I(h/2)]$

$= \frac{1}{3}(4 \times 0.6941 - 0.697)$

$= 0.6931$

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$$I\,(h, h/2, h/4) = \frac{1}{3}\left[4\,I\,(h/2, h/4) - I\,(h, h/2)\right]$$

$$= \frac{1}{3}\left[4 \times 0.69 \ldots - I\,(\ldots\right.$$

$$= 0.6931$$

Hence, The value of Integral is.

$$\boxed{\therefore \int_0^1 \frac{1}{1+x}\,dx = 0.6931}$$