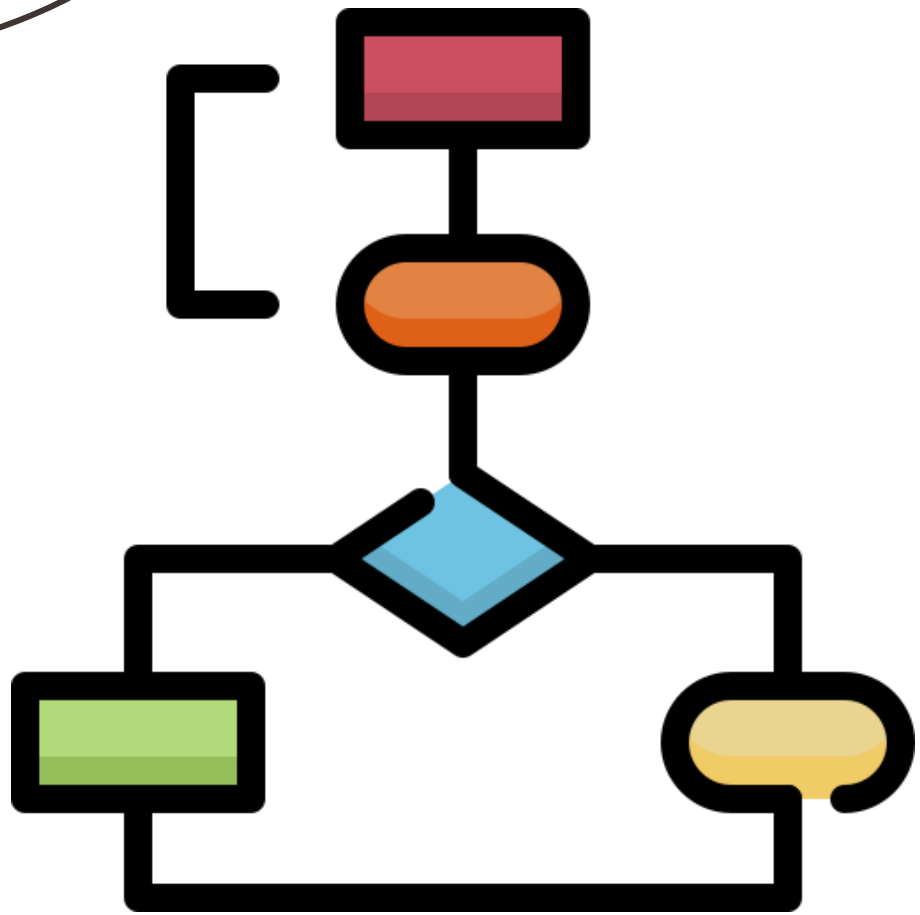


Flowcharts: A Visual Guide to Algorithm Design

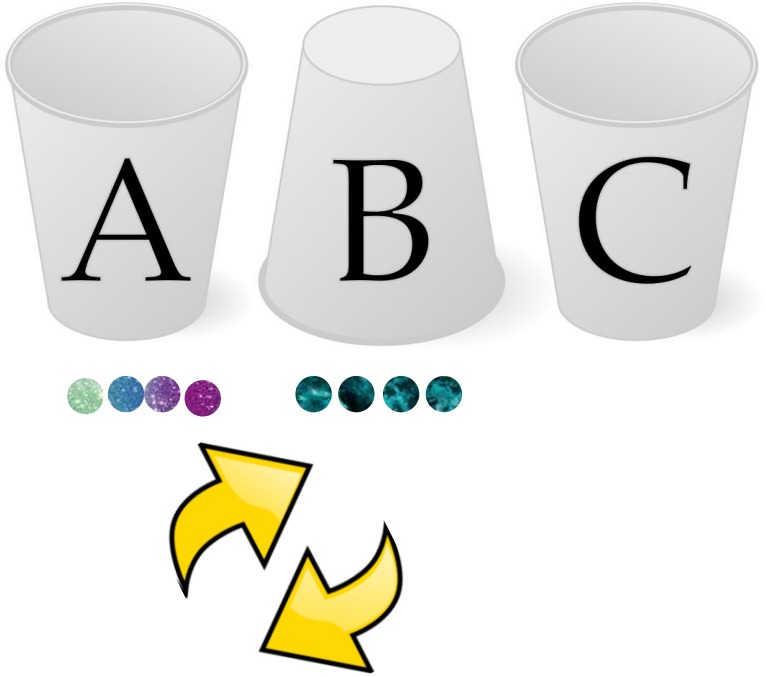
By Ali Sajedifar

What Is an Algorithm?

An algorithm is a sequence of well-defined steps that maps inputs to outputs.
“Well-defined” means each step is executable by the operator.

Example Task:
Define the contents of three cups as:
A, B, C

Goal:
Swap the contents of cup A and cup B.

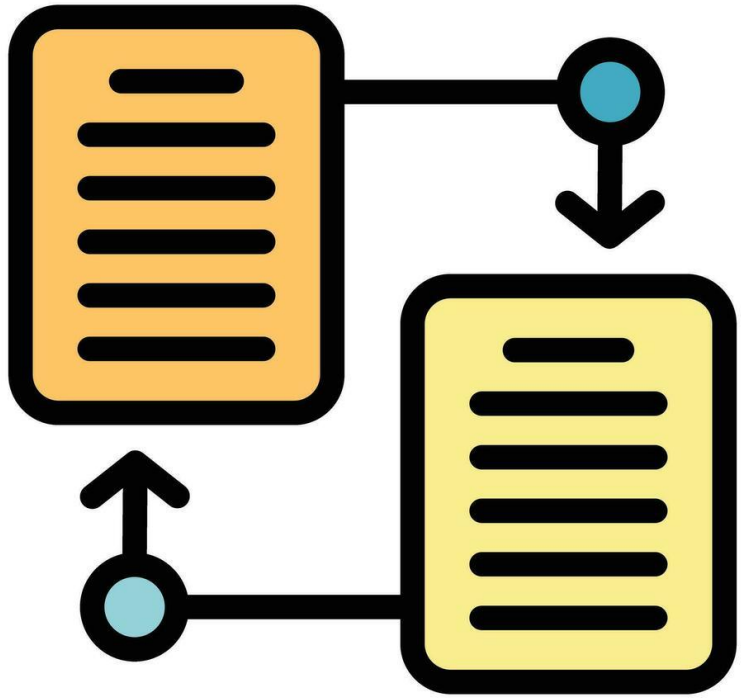


Solution :
C = A
A = B
B = C

(Here, C is used as a temporary helper variable —
swap(A, B, C))

To improve a process…

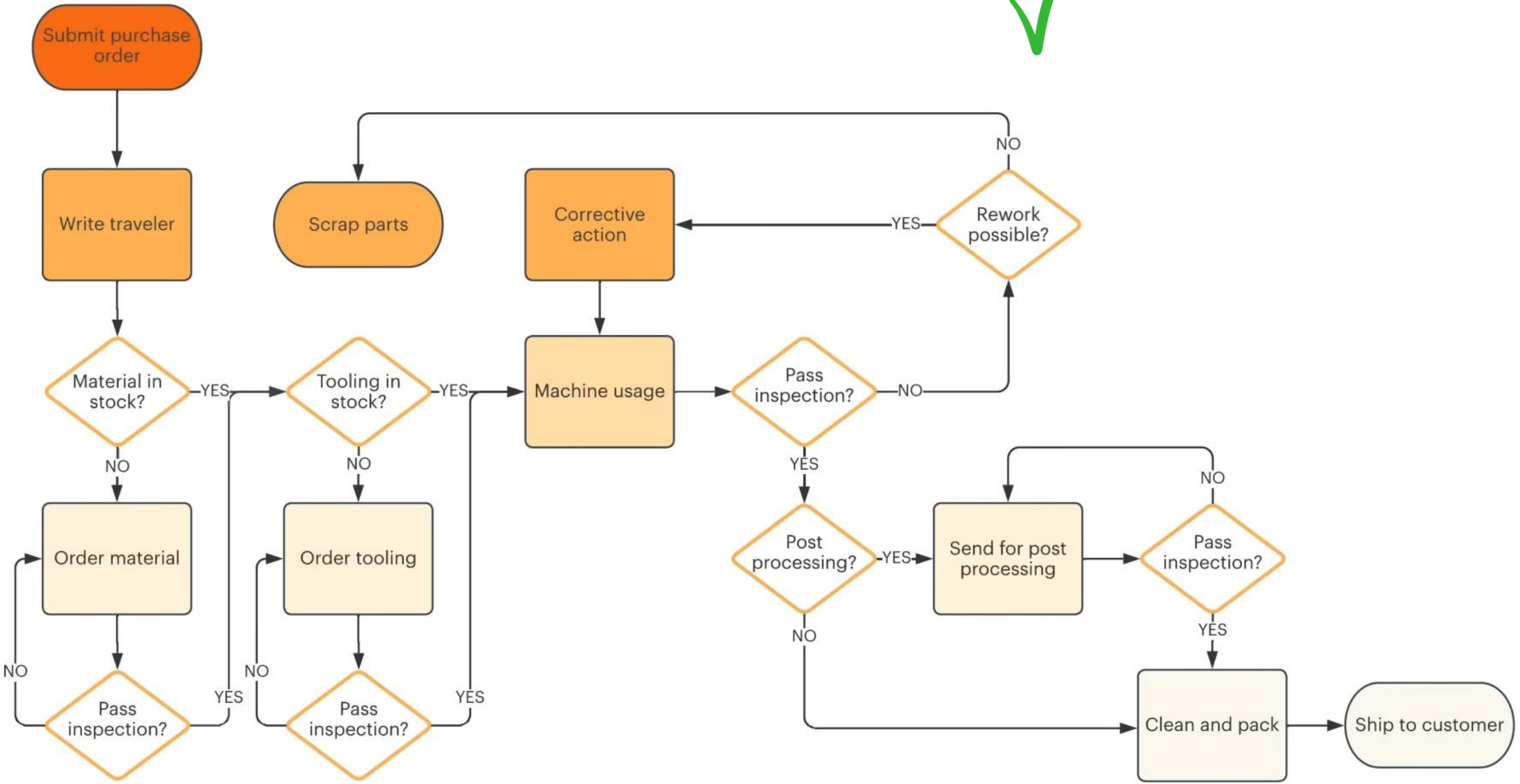
We must first understand it



Production Workflow

1. The first step in our production workflow is to submit a purchase order.
2. Once the purchse order has been submitted, it is important that a traveler is written.
3. If the material is in stock, continue to check if the tooling is in stock.
4. If the material is not in stock, the material will need to be ordered.
5. At this point, an inspection will be conducted.
6. If it passes the inspection, continue to check if the tooling is in stock.
7. If it does not pass the inspection, the material will need to be ordered again.
8. If the tooling is in stock, continue to machine usage.
9. If the tooling is not in stock, the tooling will need to be ordered.
10. At this point, another inspection will be conducted.
11. If it passes the inspection, continue to machine usage.
12. If it does not pass the inspection, the tooling will need to be ordered again.
13. After the machine is used, another inspection will be conducted.
14. If it passes the inspection, continue to post processing.
15. If it does not pass inspection, check to see if rework is possible.
16. If rework is possible, take corrective action and then continue to machine usage.
17. If rework is not possible, scrap parts and begin from step 1.
18. If after using the machine, the order passes inspection, verify if post processing is necessary.
19. If post processing is necessary, send order for post processing.
20. If post processing is not required, clean and pack order.
21. After sending to post processing, perform inspection.
22. If order passes inspection, clean dn pack the order.
23. If order does not pass inspection, send for post processing once more.
24. After cleaning and packing order, ship to customer.

Production Workflow



1. Identify the exact steps in your process.

2. Remove unnecessary complexity.

3. Present the information clearly and quickly.

We will achieve all of this using Flowcharts.

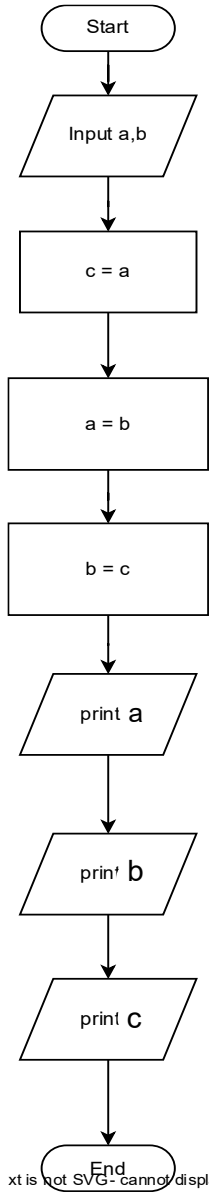
Flowchart Symbols

Symbol	Name	Function
	Start/end	An oval represents a start or end point
	Arrows	A line is a connector that shows relationships between the representative shapes
	Input/Output	A parallelogram represents input or output
	Process	A rectangle represents a process
	Decision	A diamond indicates a decision

Exercise:

Draw a flowchart for an algorithm that:

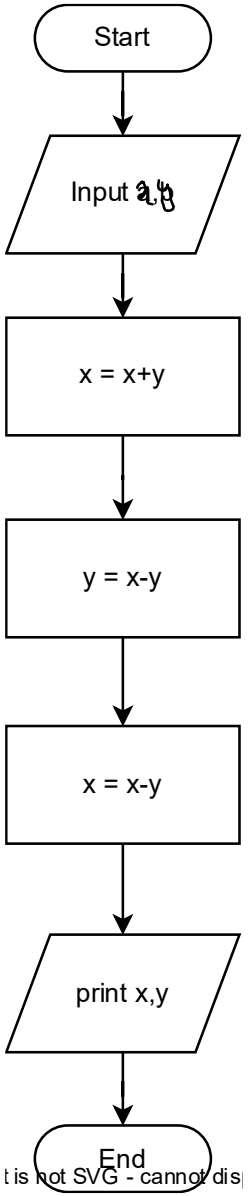
- Takes two numbers as input, and
- Swaps their values.



Exercise:

Draw a flowchart for an algorithm that:

- Takes two numbers as input, and Swaps their values
- **Without using a temporary variable**



Example to Show How the Swap Works (Without a Temporary Variable)

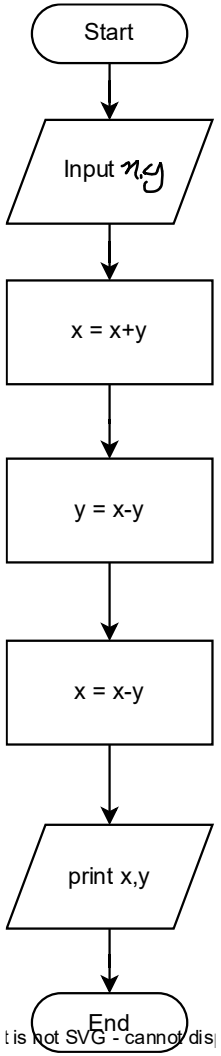
Let x = 5 and y = 3

Step 1: x = x + y
x = 5 + 3 = 8

Step 2: y = x – y
y = 8 – 3 = 5

Step 3: x = x – y
x = 8 – 5 = 3

Final result:
x = 3
y = 5

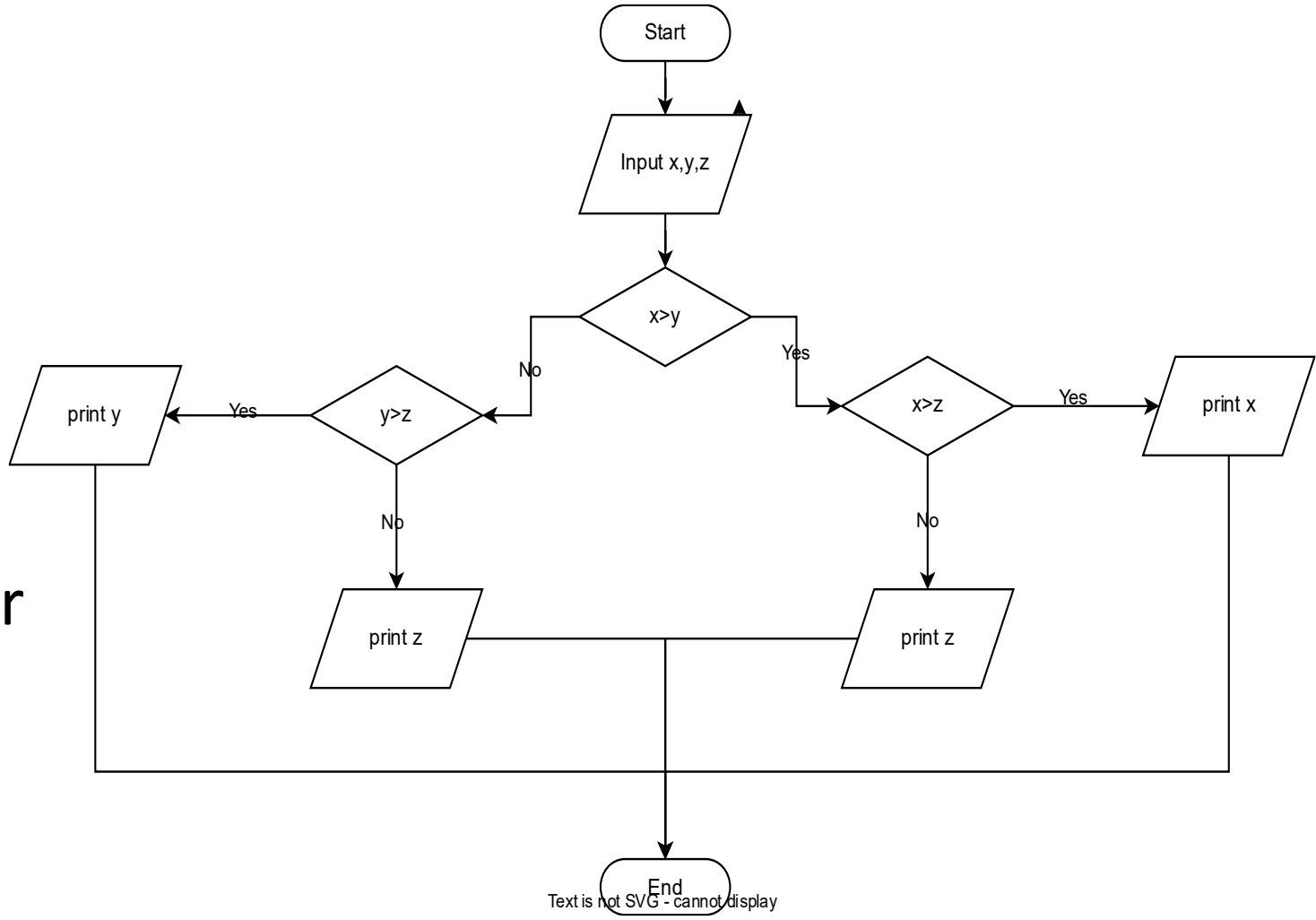


The values have been successfully swapped without using a temporary variable.

Exercise:

Draw a flowchart for an algorithm that:

- Takes three numbers as input (x, y, z)
- Determines the largest number
- Prints the largest value

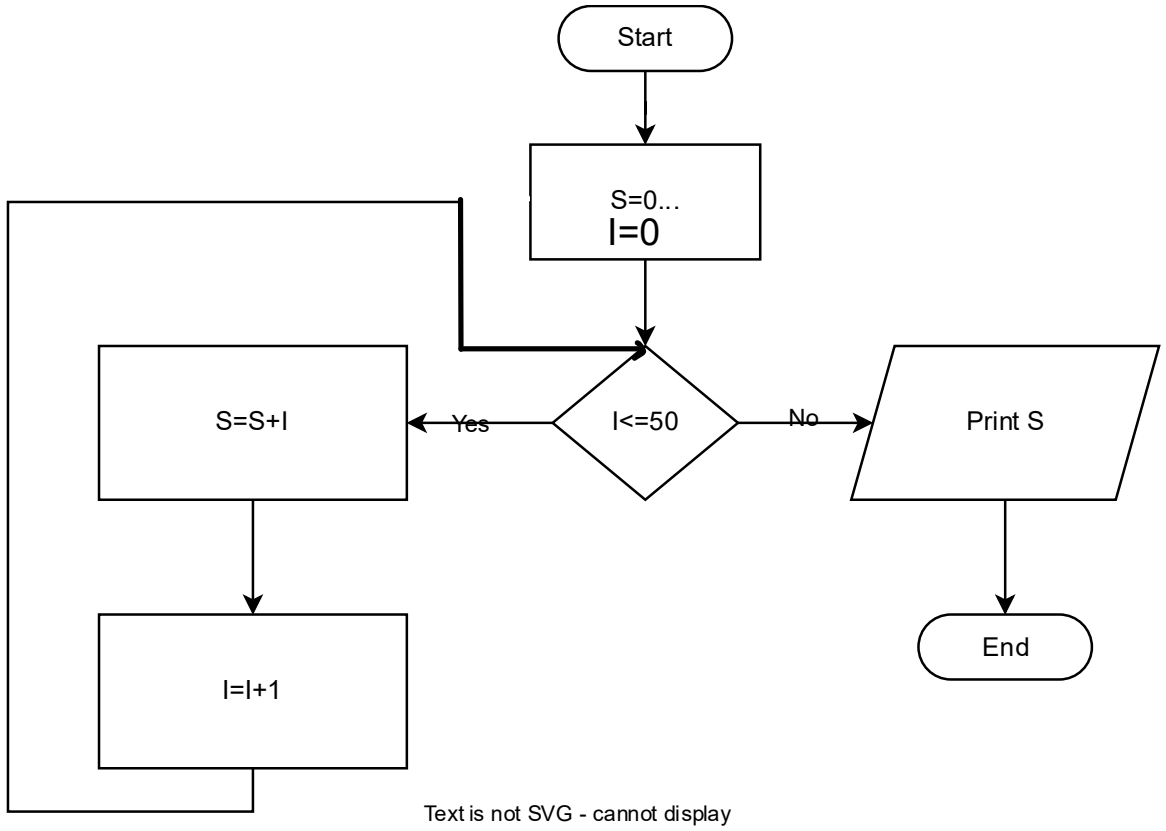


Exercise:

Draw a flowchart for an algorithm that:

- Computes the sum of the series:

  1 + 2 + 3 + ... + 50

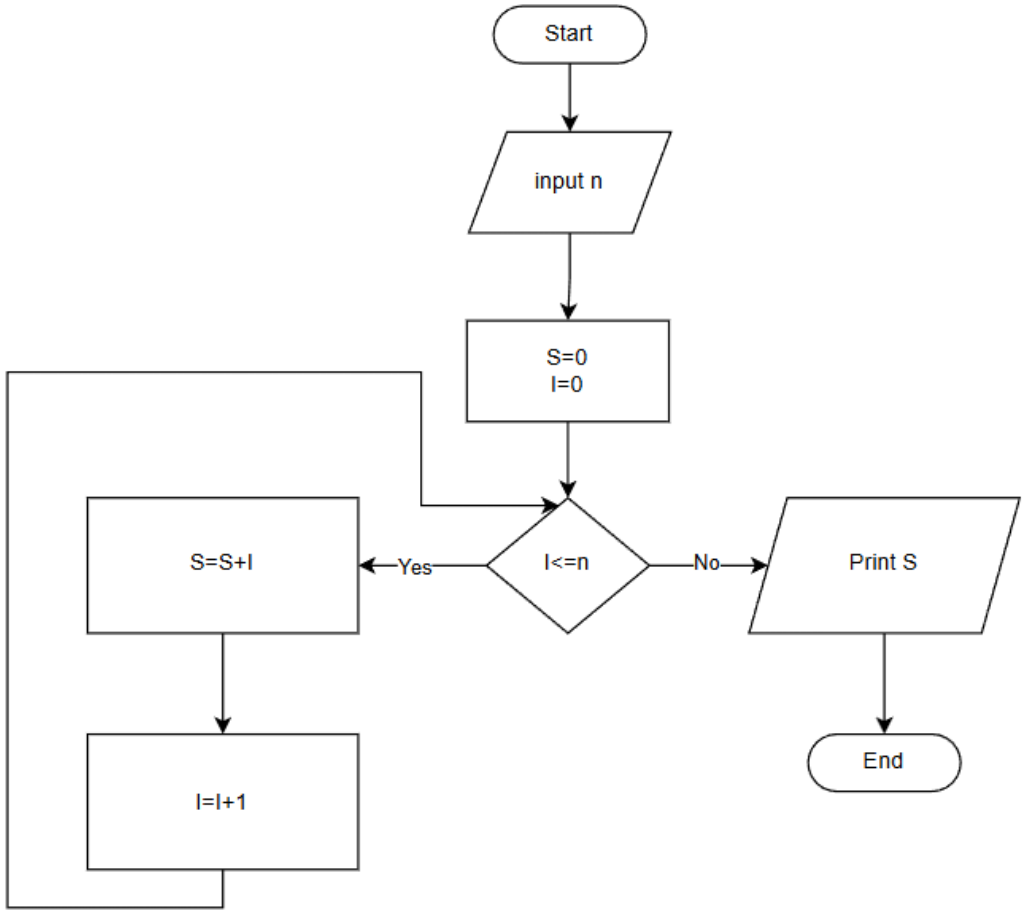


Exercise:

Draw a flowchart for an algorithm that:

- Computes the sum of the series:

  1 + 2 + 3 + ... + n



Example: How the algorithm works for n = 4

Initial values:
S = 0
I = 0

Step 1: Check I ≤ n → 0 ≤ 4 → Yes
S = S + I → S = 0 + 0 = 0
I = I + 1 → I = 1

Step 2: Check I ≤ n → 1 ≤ 4 → Yes
S = S + I → S = 0 + 1 = 1
I = I + 1 → I = 2

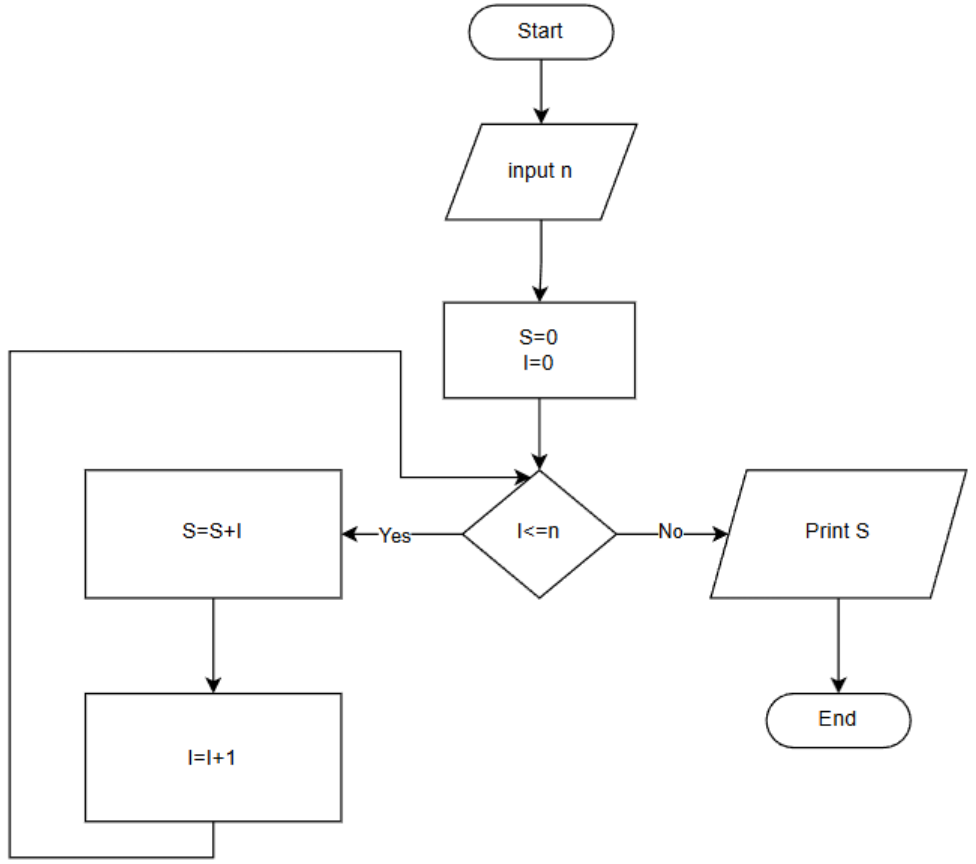
Step 3: Check I ≤ n → 2 ≤ 4 → Yes
S = S + I → S = 1 + 2 = 3
I = I + 1 → I = 3

Step 4: Check I ≤ n → 3 ≤ 4 → Yes
S = S + I → S = 3 + 3 = 6
I = I + 1 → I = 4

Step 5: Check I ≤ n → 4 ≤ 4 → Yes
S = S + I → S = 6 + 4 = 10
I = I + 1 → I = 5

Step 6: Check I ≤ n → 5 ≤ 4 → No
Stop and Print S

Final result:
S = 10



Exercise (Classwork):

Draw a flowchart for an algorithm that:

- Takes a number from the user
- Counts how many digits the number has
- Prints the digit count