

Decide and Repeat

Algorithms with selection and repetition



Same list, different day

PAUSE AND TRY

What happens differently on a sunny day? On a day brushing takes longer?

YOUR MORNING, AS AN ALGORITHM

1. Get dressed.
2. If it is raining, take an umbrella.
3. Brush your teeth until they are clean.
4. Walk to school.

Talk with a partner. Which steps happen every day exactly once? Which steps can change?

By the end of class you can...

- 1 Name the three building blocks of algorithms and find each one in an everyday routine.
- 2 Explain how selection uses a true-or-false decision to choose what happens next.
- 3 Explain how repetition repeats steps until a goal is reached, and spot a loop that never ends.
- 4 Show decisions and loops in written steps and in flowcharts.
- 5 Predict how changing the order of steps changes the result.

A large, white, rounded square containing the number '1' in a bold, dark teal font.

1

PART 1

Three building blocks

Sequencing, selection, and repetition

Sequencing

THE BACKBONE

Steps are done one after another, in order. Each one happens once, in its place.

"Get dressed."

Selection

DECISION MAKING

A true-or-false decision chooses which step happens next.

"If it is raining, take an umbrella."

Repetition

LOOPING

A step, or a group of steps, repeats until a goal is reached.

"Brush until your teeth are clean."

Finding the blocks in a routine

Step	Building block	How you can tell
1. Get dressed.	Sequencing	Always done, once, in its place
2. If it is raining, take an umbrella.	Selection	A decision controls whether it happens
3. Brush your teeth until they are clean.	Repetition	Repeats until a goal ("clean") is reached
4. Walk to school.	Sequencing	Always done, once, after step 3



The whole list is still a sequence. Selection and repetition live **inside** that order, so sequencing is the backbone that holds the other two in place.

Writing a step three times is not repetition



Real repetition is **one instruction** to repeat until a goal is reached. The goal, not a guess, decides when to stop.

STILL JUST SEQUENCING

1. Stir the batter.
2. Stir the batter.
3. Stir the batter.

Three separate steps, each done once. Is three stirs right? It's a guess.

REPETITION

1. Stir the batter until there are no lumps.

One step. It works whether the batter needs two stirs or twenty.

A large, white, rounded square containing the number '2' in a bold, teal, sans-serif font.

2

PART 2

Selection: a true-or-false question

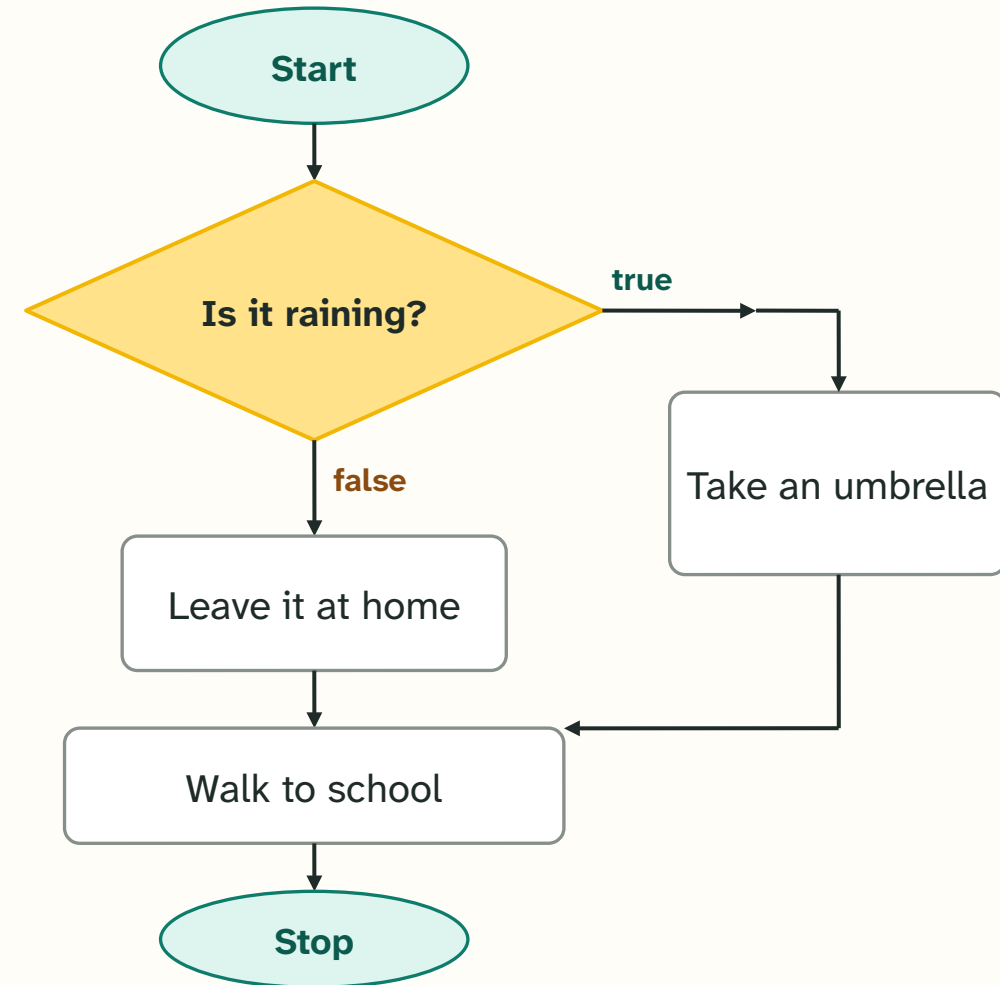
A decision chooses the next step



Selection happens when a choice of what the algorithm does next depends on a **true or false** decision. The question is called the **condition**.

IN WORDS

```
If it is raining,  
    take an umbrella;  
otherwise,  
    leave it at home.  
Walk to school.
```



Pass, or try again?

PAUSE AND TRY

Trace the algorithm for each score. What does it say?

```
If the score is at least 70,  
    say "pass";  
otherwise,  
    say "try again".
```

Score	It says...
85	
70	
64	

A large, white, rounded square containing the number '3' in a bold, teal, sans-serif font.

3

PART 3

Repetition: until the goal

A loop repeats until its goal is reached

IN WORDS

Start with an empty jug.
Repeat until the jug holds
at least 10 cups:
pour in 3 cups.



Repetition is when a process repeats until a desired outcome is reached. The repeated steps are a **loop**; each time through is a **pass**.

Check: at least 10?	Pour?	Cups after
0 -> no	pour 3	3
3 -> no	pour 3	6
6 -> no	pour 3	9
9 -> no	pour 3	12
12 -> yes	stop	12

4 passes. The jug ends at 12 cups, not 10.

A goal that is never reached



If the goal can never be reached, the loop runs forever. That is an **infinite loop**.

IN WORDS

```
Set x to 0.  
Repeat until x is 7:  
    add 2 to x.  
Say x.
```

X AFTER EACH PASS



It jumps from 6 to 8. It is never exactly 7.

Your turn: change one thing so the loop stops. How many ways can you find?

A large, white, rounded square containing a bold, teal number '4'.

4

PART 4

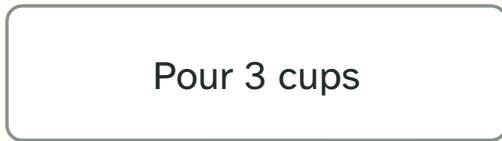
Words and diagrams

Flowchart pieces and their words



Start or Stop

Where the algorithm begins and ends



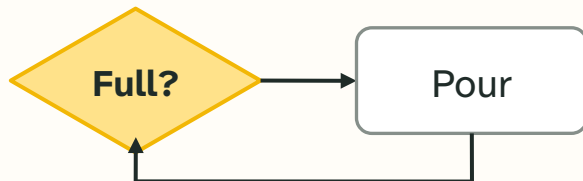
A step (sequencing)

"Pour in 3 cups."



Decision diamond (selection)

"If ..., then ...; otherwise, ..." Two arrows out: true and false



Arrow back (repetition)

"Repeat ... until ..." or "Go back to step 2."

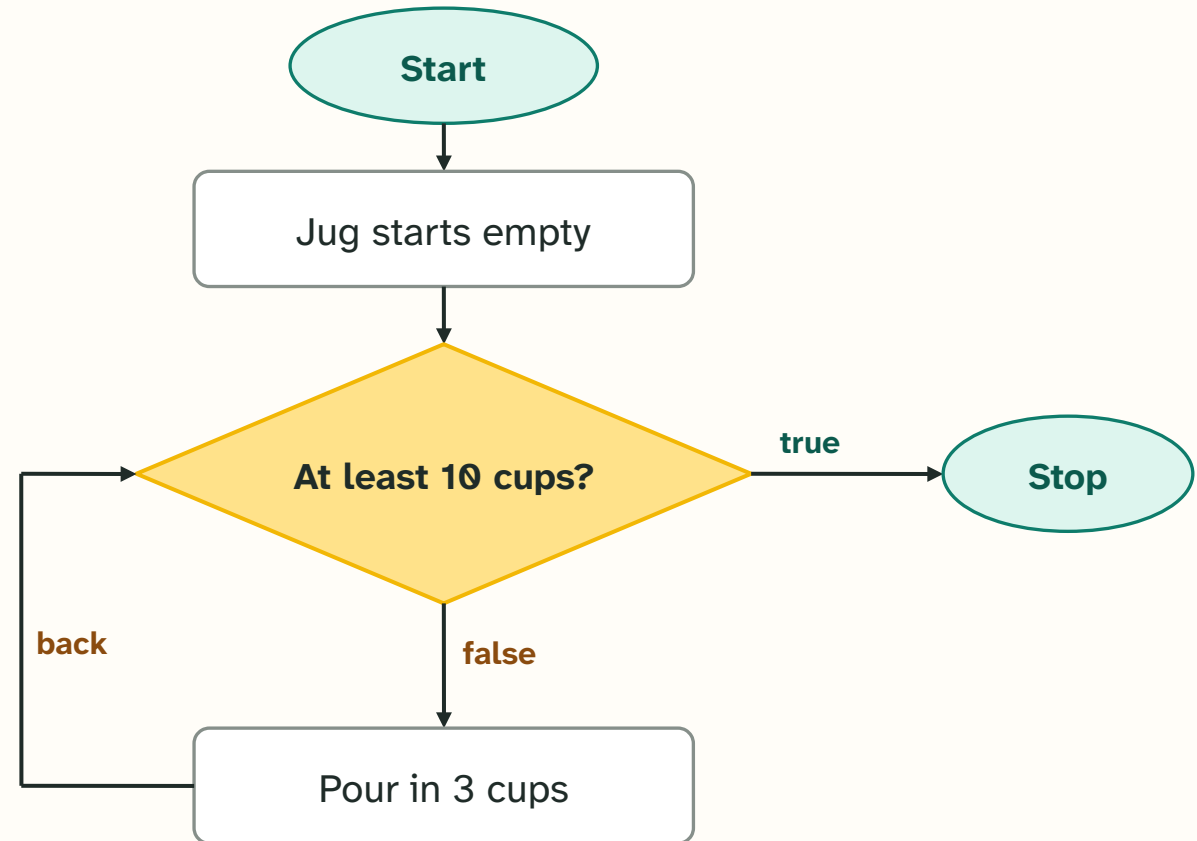
The jug loop as a flowchart

IN WORDS

Start with an empty jug.
Repeat until the jug holds
at least 10 cups:
pour in 3 cups.



A loop is a decision plus an arrow **back**. The diamond asks about the goal before each pass; the true arrow leaves the loop.



5

PART 5

Order matters

Same steps, different order, different result

ADD, THEN HALVE

```
int points = 20;  
points += 10;  
points /= 2;  
System.out.println(points);
```

OUTPUT

15

HALVE, THEN ADD

```
int points = 20;  
points /= 2;  
points += 10;  
System.out.println(points);
```

OUTPUT

20



The order in which sequencing, selection, and repetition are used **contributes to the outcome** of the algorithm.

Where does the decision go?

PAUSE AND TRY

Which version can drain the sink more than once? Why?

VERSION A

```
Repeat until the dishes are done:  
    wash one dish.  
If the water is dirty,  
    drain the sink.
```

VERSION B

```
Repeat until the dishes are done:  
    wash one dish;  
    if the water is dirty,  
        drain and refill.
```

Words to know

Sequencing

Steps done one after another, in order.

Selection

A true-or-false decision chooses what happens next.

Repetition

Steps repeat until a goal is reached (a loop).

Condition

The true-or-false question a decision or loop asks.

Decision diamond

A flowchart shape with a true arrow and a false arrow.

Infinite loop

A loop whose goal is never reached, so it never stops.

Decide or repeat?



Explain to your partner how selection and repetition are different. Use an example from your own day.

SENTENCE STARTER

Selection _____ once and picks a path, but repetition _____ until _____.

Next: the Decide and Repeat puzzle worksheet.