Algorithmization and Programming of Solutions

Part I

TOPIC #2

REPRESENTATION OF ALGORITHMS

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1. Representation of algorithms

METHODS OF REPRESENTING ALGORITHMS, GRAPHICAL ELEMENTS OF A FLOWCHART, STRUCTURAL PARTS OF A FLOWCHART, AN EXAMPLE OF AN ALGORITHM REPRESENTED USING A FLOWCHART

Methods for representing algorithms

Algorithms are designed for those, who will execute them, i.e., for humans or computers

Consequently, it is necessary to represent an algorithm in a form that is understandable for a performer

Methods for representing algorithms are the following:

- **the verbal method** – an algorithm is written in a natural language, e.g., guidelines, user manual
- **the graphical method** – an algorithm is represented using graphical elements, e.g., a flowchart, UML (unified modelling language) diagrams
- **the formal method** – an algorithm is written in a formal language, i.e., a pseudocode or a source code

Examples of an algorithm representation in different forms (1/3)

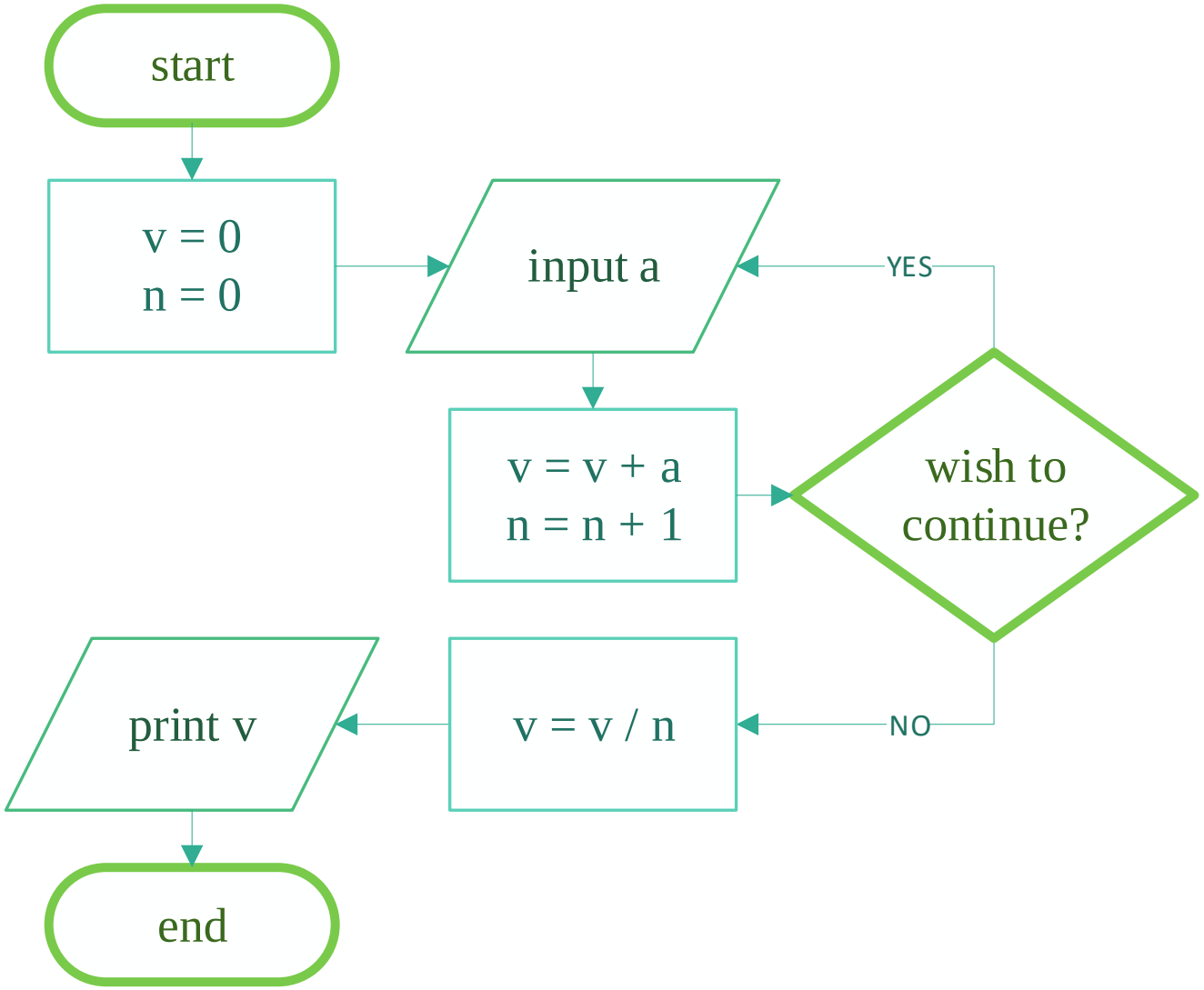
The task: compute an average grade for a test in a group of students

An algorithm represented using **the verbal method**:

1. Input a grade.
2. Add this grade to a sum of grades.
3. Repeat the 1st and the 2nd step until all grades are inputted.
4. Divide the sum of grades by the number of students.
5. Output the result.

Examples of an algorithm representation in different forms (2/3)

The graphical method (a flowchart)



Examples of an algorithm representation in different forms (3/3)

An algorithm represented using **the formal method** (a pseudocode):

```
v = 0, n = 0
do {
        input a
        v = v + a, n = n + 1
} while (wish to continue)
v = v / n
print v
```

A flowchart

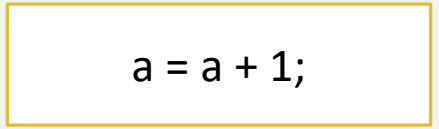
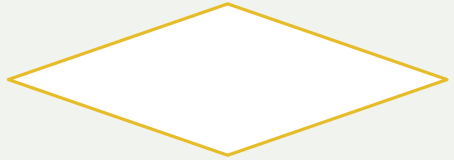
A flowchart is a diagram that depicts a process or computer algorithm

A flowchart consists of **graphical elements** that represent actions and conditions, and **arrows** with or without labels that show a sequence of execution of these actions

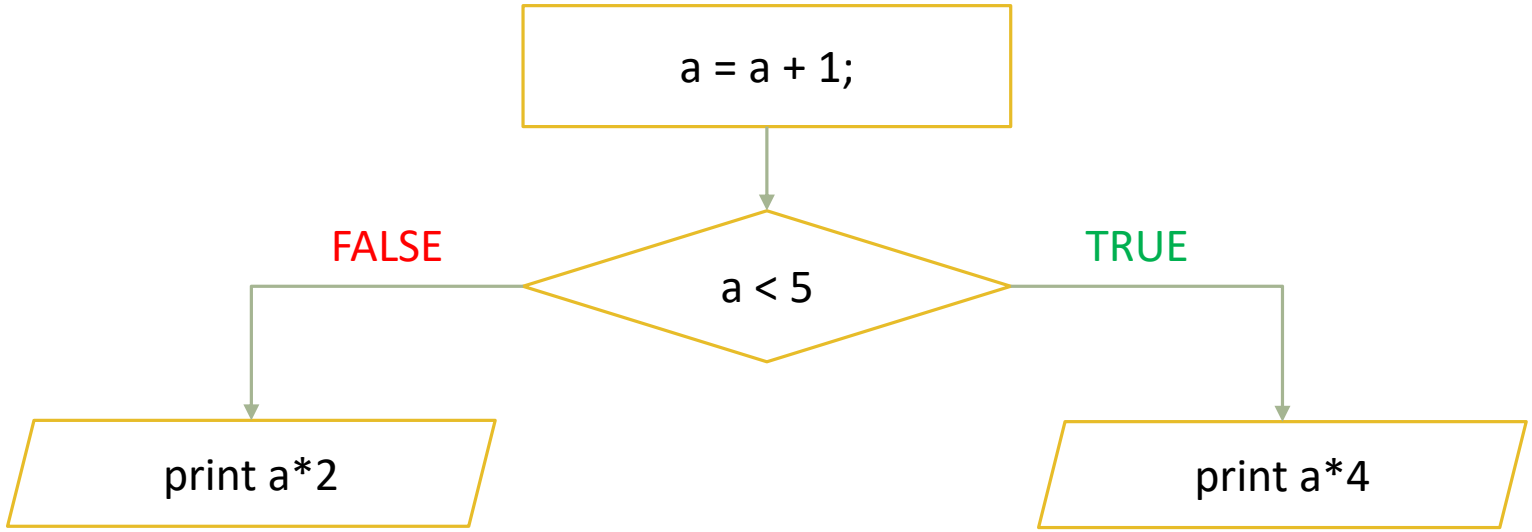
Usually, actions are split into to categories:

- input/output actions
- other actions (e.g., assignment, arithmetical operations, function calls)

Graphical elements of a flowchart

Symbol	Description	Example
	An oval is used at the beginning or at the end of a flowchart	
	A rectangle denotes a process or an action	
	A parallelogram denotes input or output operation	
	A diamond denotes branching or decision making	

Sequence of actions of a flowchart



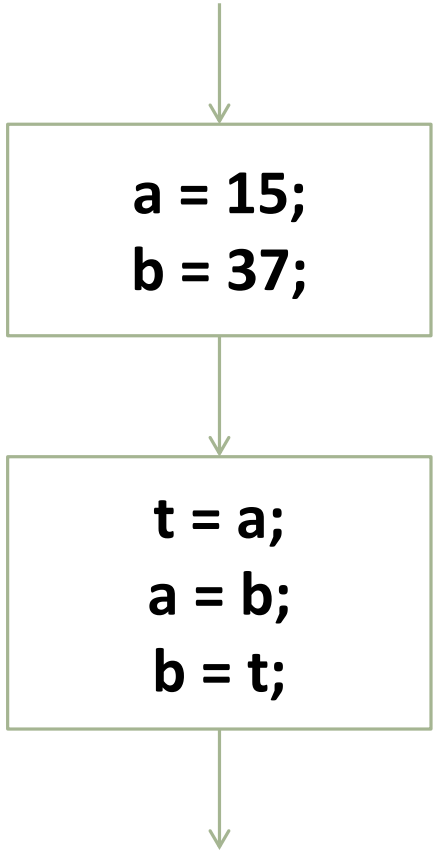
Structural parts of a flowchart

Linear actions – actions are performed sequentially

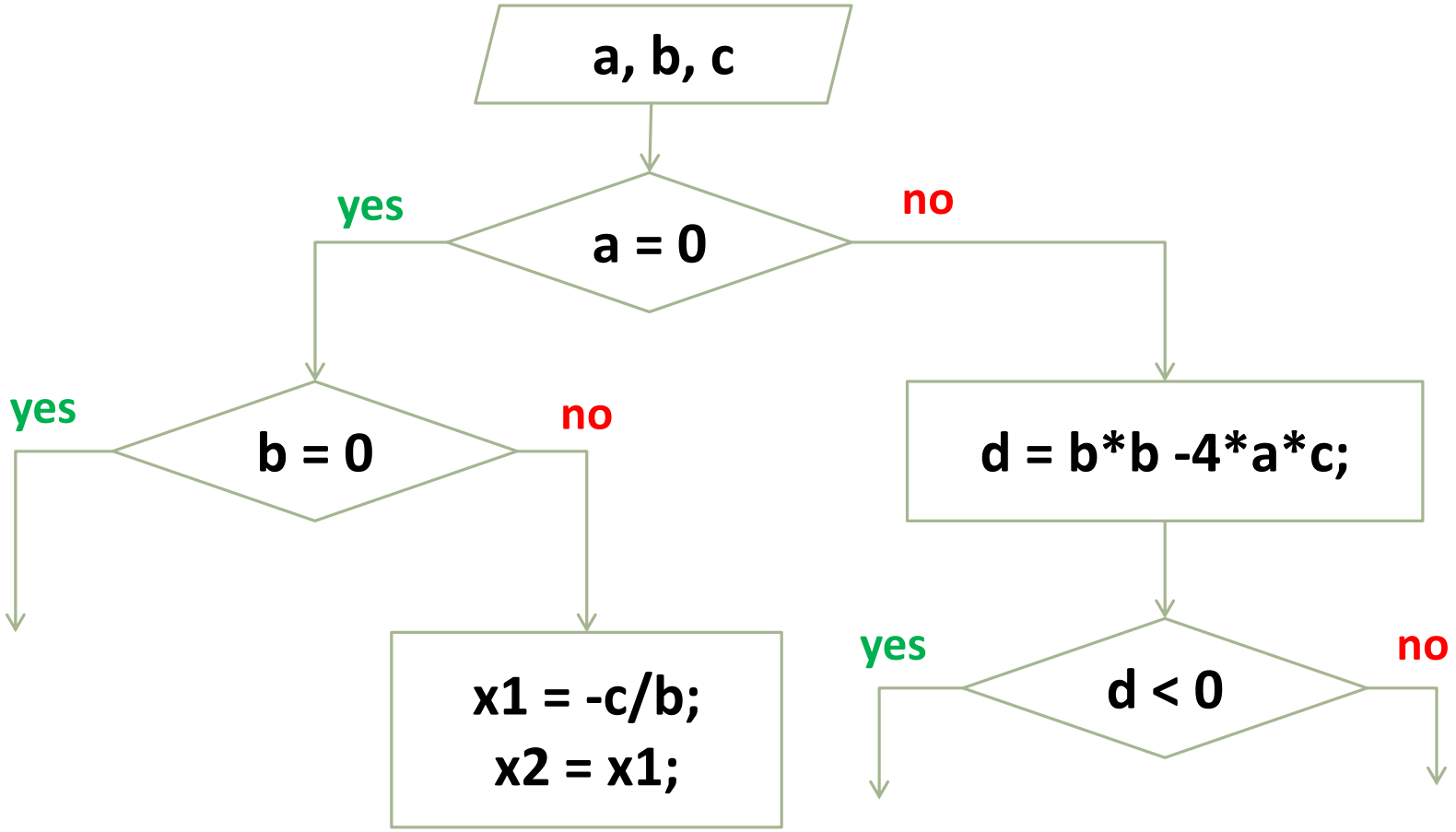
Branching – an action has to be chosen depending on a condition

Cyclic actions – actions are repeated several times, the number of iterations (i.e., repetitions) depends on a condition of a loop

Linear actions

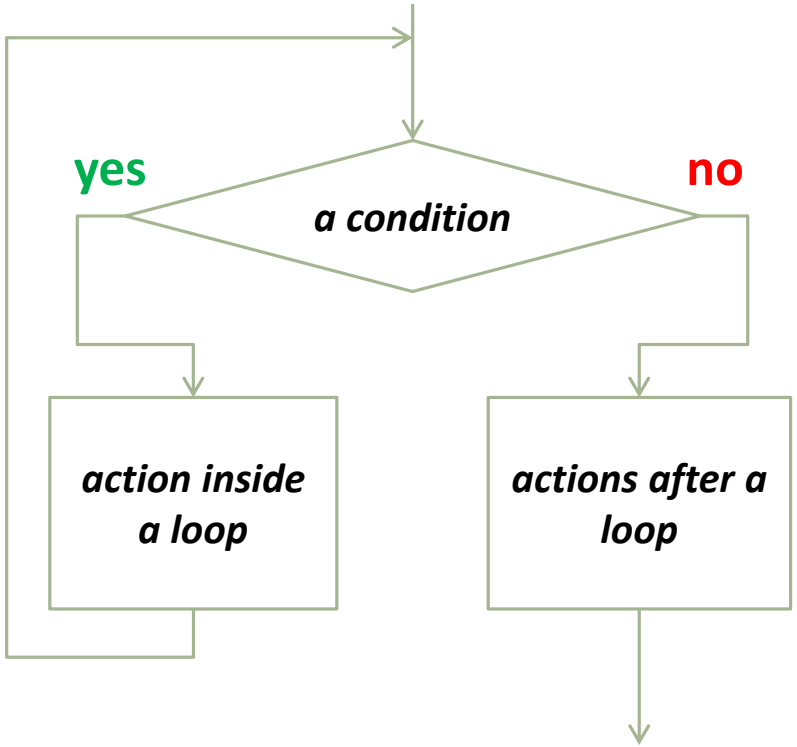


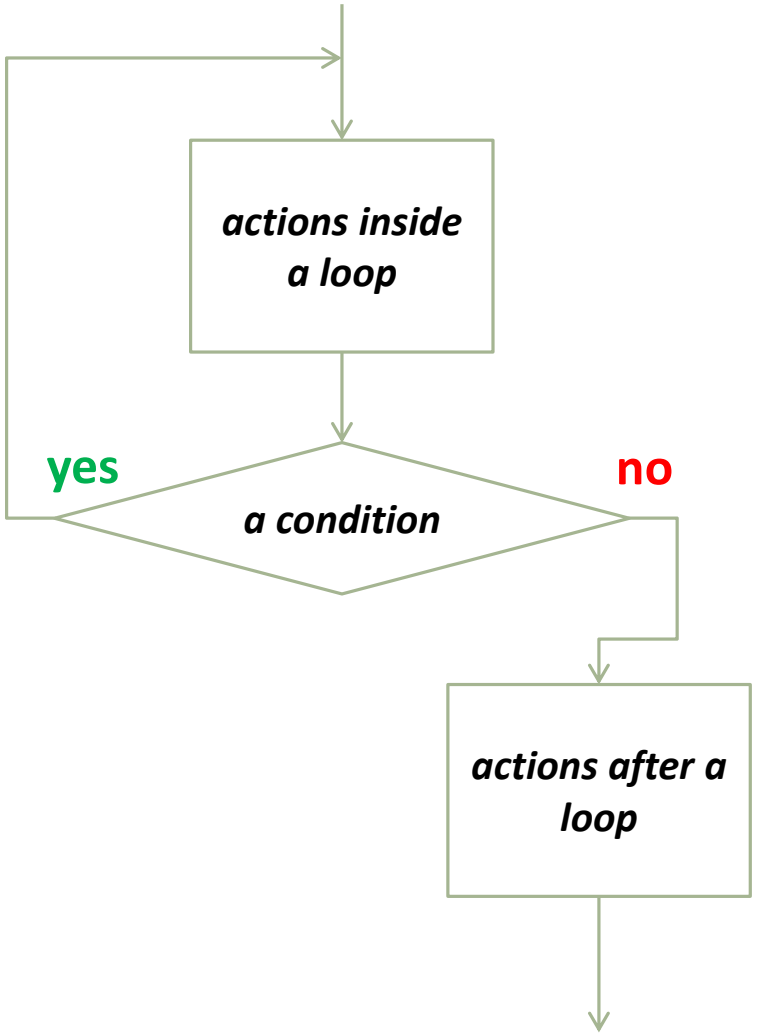
Branching



Cyclic actions (1/2)

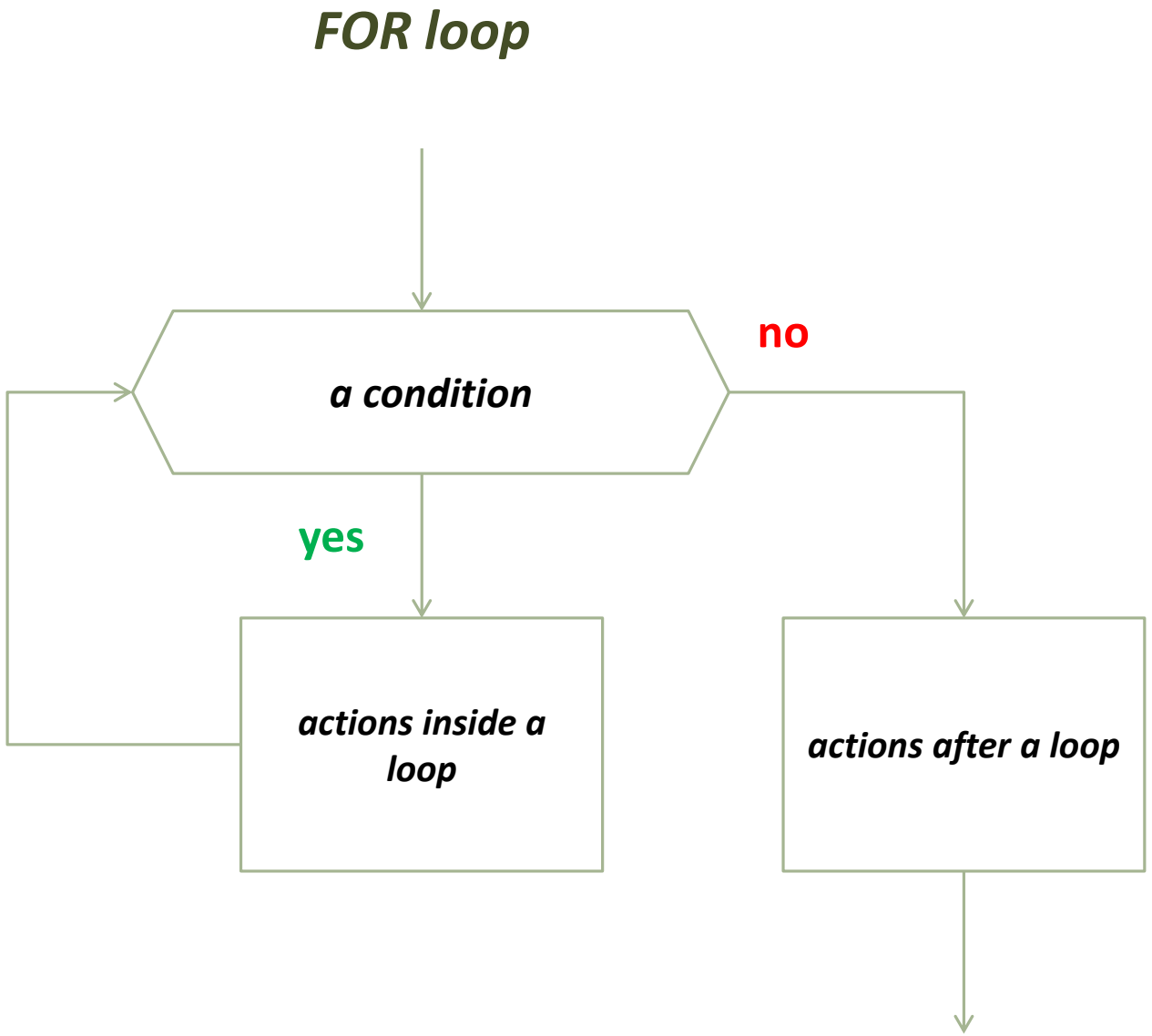
WHILE loop





DO .. WHILE loop

Cyclic actions (2/2)



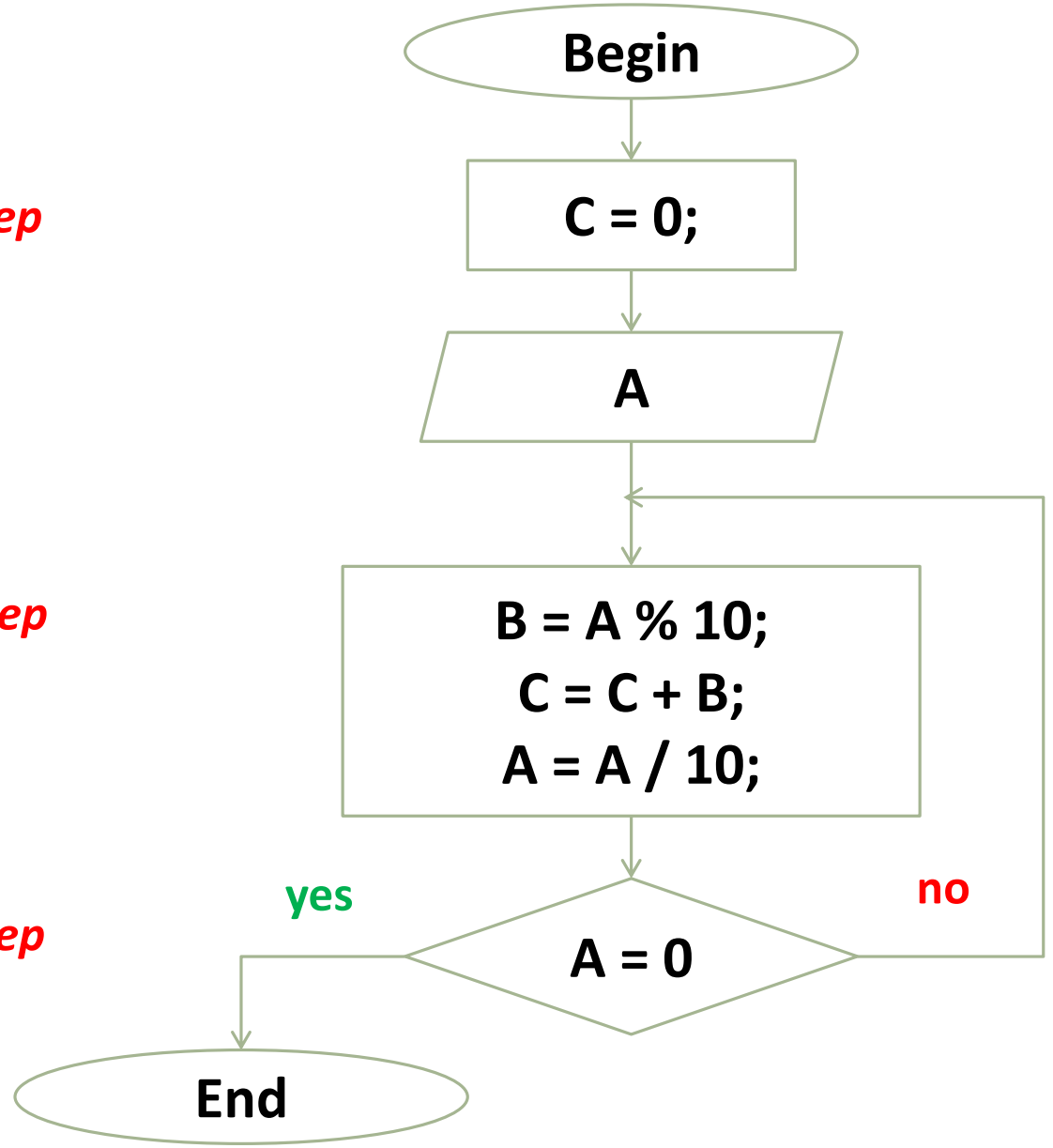
A task and a solution

A task: compute a sum of digits in a number inputted by a user, e.g., a user inputs the number 15893, so the sum of digits in this number equals to 1+5+8+9+3=26

An algorithm:

1. declare variables: **A** – an inputted number, **B** – a remainder of division (modulus), **C** – a sum of digits (initial value – 0)
2. divide **A** by 10: add the remainder **B** to the sum of digits **C** and save the integer part of division in the variable **A**
3. repeat the 2nd step till **A** becomes 0

Flowchart of the algorithm



2. Practical work #1

READING AND CREATING OF ALGORITHM FLOWCHARTS

Reading and creating of algorithm flowcharts

The practical work consists of two parts:

1. reading of algorithm flowcharts (5 tasks, 2-3 questions in each task)
2. creating of algorithm flowcharts (2 tasks)