

CSEN 102– Introduction to Computer Science

Lecture 3: Algorithmic Problem Solving Conditional Operations

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Synopsis

- What is computer science?
- What is an algorithm?

Definition (Algorithm)

An **algorithm** is a **well-ordered** collection of **unambiguous** and **effectively computable operations** that, when executed, **produces a result** and **halts in a finite amount of time**.

- Why **python**?
- What are the necessary elements for **sequential** algorithms?
 - **Input** (e. g., “**A = eval(input())**”)
 - **Output** (e. g., “**print(A)**”, or “**print("text")**”)
 - **Calculation, manipulation** (e. g., “**A = B + C**”)

Sequential operations

Example (See last lecture)

For a given number of eggs, find out how many dozen eggs we have and how many extra eggs are left over.

```
1 eggs = eval(input())
2 dozens = int(eggs / 12)
3 extras = eggs - (dozens * 12)
4 print("Your_number_of_eggs_is_")
5 print(dozens)
6 print("_dozen(s)_and_")
7 print(extras)
8 print("_extra(s) ")
```

- Let the **input** be 27
- What is the **output**?

Where the function **int** rounds down the result to an integer. For example **int(10/3) = 3**.

How to construct an algorithm

- Identify the **input** of the algorithm
- Introduce **variables** for
 - **Input**
 - (intermediate) **results**
- Analyze the task into **sequential steps**
- Provide for detailed **output**

Objectives

By the end of this lecture, you should be able to:

- Design algorithms using conditional operations

Algorithms: operations

Algorithms can be constructed by the following operations:

- Sequential Operation
- Conditional Operation
- Iterative Operation

Conditional operation – idea



Decision

```
1 nameOfSinger = input()
2 if nameOfSinger == 'Mohamed Mounir':
3     print('I will go home')
4 else:
5     print('I will stay at the GUC')
```

Conditional operation – principle

● Rationale

- Determines whether or not a condition is true; and based on whether or not it is true; **selects the next step** to do

● Notation

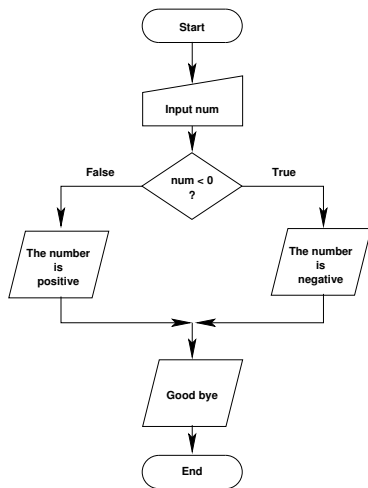
- Use the same primitives as before plus the following:

```
1 if condition:  
2     # <operations for the then-part>  
3 else  
4     # <operations for the else-part>
```

● Execution

- Evaluate *<condition>* expression to see whether it is true or false.
- If true, then execute operations in **if**-part
- Otherwise, execute operations in **else**-part

Conditional operation – diagram



```
1 num = eval(input())
2 if num < 0:
3     print("The number is negative")
4 else:
5     print("The number is positive")
6
7 print("Good-bye for now")
```

Conditional operation – examples

Example 1:

Write an algorithm to compute the absolute value of a given number.

```
1 Number = int(input())
2
3 if (Number >= 0):
4     Value = Number
5 else:
6     Value = (-1) * Number
7
8 print(Value)
```

Conditional operation – examples

Example 2:

Give the user a choice of seeing the area or the circumference of a circle given its radius.

```
1 radius = eval(input())
2 response = input("Type A_for_area_or_C_for_circumference")
3 if (response == "A"):
4     area = (radius * radius * 3.14)
5     print(area)
6 else:
7     circumference = (2 * radius * 3.14)
8     print(circumference)
```

Conditional Operation – examples

Example 3:

Write an algorithm to convert Euro (EUR, €) to Egyptian Pound (EGP, £E) and Egyptian Pound to Euro. The inputs to your algorithm are the following:

- Amount of money to be converted
- Conversion Type (*i. e.*, 1 for EUR to EGP and 2 for EGP to EUR)
- Exchange Rate (*i. e.*, the EGP equivalent for 1 EUR)

```
1 amount, type, rate = eval(input()), eval(input()), eval(inp
2 if type == 1:
3     amount = amount * rate
4 else:
5     amount = amount / rate
6 print(amount)
```

Compounded conditions

Conditions may be **compounded** using **AND**, **OR** and **NOT**.

- **E1 or E2**: true if at least one of them is true; false otherwise.
- **E1 and E2**: true if both are true; false otherwise.
- **not E**: true if E is false and false if E is true.

Find the sum of three positive numbers

```
1 A, B, C = int(input()), int(input()), int(input())
2 if (A > 0) and (B > 0) and (C > 0):
3     Sum = (A+B+C)
4     print(Sum)
```

Conditional algorithms with more than two choices

Nested if-statement

```
1  if first_condition:
2      # <do first thing>
3  else:
4      if second_condition:
5          # <do second thing>
6          else:
7              # <do something else>
```

Nested if-statement – examples

Example 1

Algorithm to find the largest of three numbers.

```
1 A, B, C = eval(input()), eval(input()), eval(input())
2 if A >= B:
3     if A >= C:
4         print(A)
5     else:
6         print(C)
7 else:
8     if B >= C:
9         print(B)
10    else:
11        print(C)
```

Nested if-statement – examples

Example 2

Write an algorithm that reads each student's marks, print either a grade or an error message. Students marks in a class are graded on the following policy:

- A: 85-100
- B: 74-85
- C: 60-74
- D: 50-60
- F: <50

Nested if-statement – examples

Solution with if and else

```
1 Mark = eval(input())
2 if(Mark >=0):
3     if (Mark >100):
4         print("invalid_mark")
5     else:
6         if (Mark <50):
7             print("grade is F")
8         else:
9             if (Mark <60):
10                print("grade is D")
11            else:
12                if (Mark <74):
13                    print("grade is C")
14                else:
15                    if (Mark <85):
16                        print("grade is B")
17                    else:
18                        print("grade is A")
```

Nested if-statement – examples

Solution with if and elif

```
1 Mark = eval(input())
2
3 if (Mark >=0):
4     if (Mark >100):
5         grade = "invalid_mark"
6     elif (Mark <50):
7         grade = "grade is F"
8     elif (Mark <60):
9         grade = "grade is D"
10    elif (Mark <74):
11        grade = "grade is C"
12    elif (Mark <85):
13        grade = "grade is B"
14    else:
15        grade = "grade is A"
16
17 print(grade)
```

Nested if-statement – examples

Example 3

Given an employee's eligible medical expenses for a calendar year, write an algorithm which computes the amount of reimbursement from group medical insurance.

- The insurance does not cover the first 100 LE of medical expenses.
- It pays 90% of the remaining amount in the first 2000 LE of expenses and 100% of any additional expenses.

Nested if-statement – examples

```
1 LL = 100
2 UL = 2000
3 Expense = int(input())
4
5 if (Expense < LL):
6     Refund = 0
7 else:
8     if (Expense < UL):
9         Refund = 0.9 * (Expense-LL)
10        else:
11            Refund = 0.90 * (UL-LL) + (Expense - UL)
12
13 print(Refund)
```