

Iterative constructions

Fundamentals of Computer Science

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Ismael Etxeberria Agiriano

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Escuela Universitaria
de Ingeniería
Vitoria-Gasteiz

Ingeniaritzako
Unibertsitate Eskola
Vitoria-Gasteiz



Universidad
del País Vasco

Euskal Herriko
Unibertsitatea

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Iterative constructions

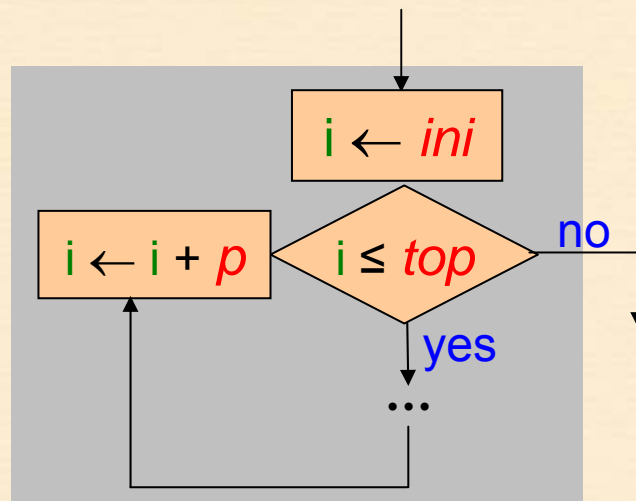
1. Iterative algorithms analysis
2. Ex11: While
3. Ex12: For
4. Ex13: Do - Loop
5. Summary

1.1 Iterative problems

- *Don't stop until you get 145 beats per minute*
- *You are going to take 10 laps to the field*
- *Calculate the average: add up all grades of a subject and divide by the number of students (count)*
- *Find a number that complies certain conditions*
 - *One? All of them?*
 - *In which domain?*
- *Count up all votes in an urn*
 - *While there are votes left*
 - *Until there is no vote left*
- *Operations with strings*
- *You won't leave the house until you find your wallet*

1.2 Analysis: For

- Can I determine in advance **how many times** I need to execute the body (“...”)?
 - Yes: then use a **For** loop
- It uses a counter i . It's divided into three clauses:
 1. **Initialization**: give an initial value ini to the counter i
 2. **Condition**: verify if the counter i has arrived to top
 3. **Actualization**: increment the counter i the step p



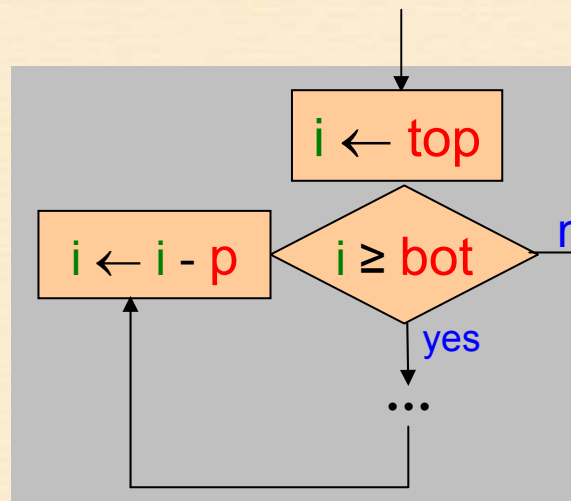
For $i = ini$ **To** top **Step** p

...

Next i

For: decreasing

- *Instead of counting we may set i to discount or decrement:*
 1. **Initialization** : give an initial value **top** to the counter i , the superior value
 2. **Condition** : verify if the counter i has arrived to **bot** (while $i \geq \text{bot}$)
 3. **Actualization** : decrement the counter i the step p , which is negative

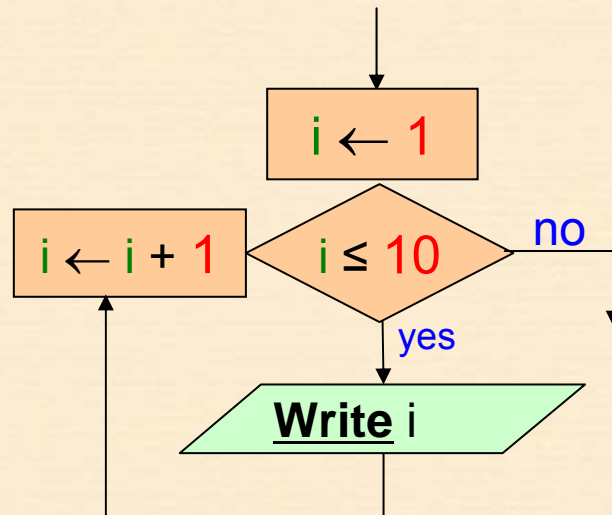


For $i = \text{top}$ To bot Step $-p$

...

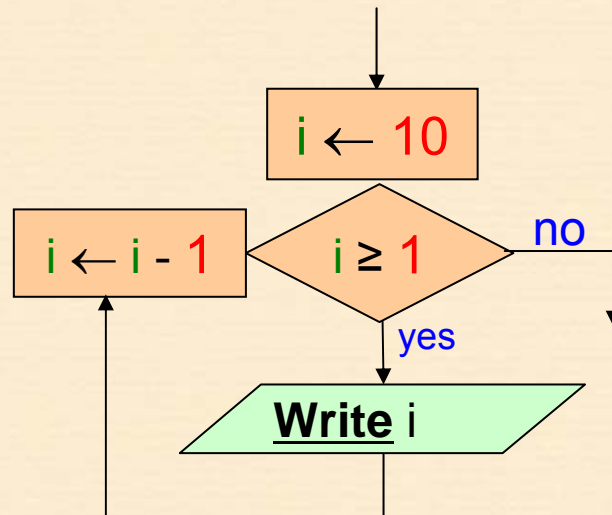
Next i

For: Write numbers from 1 to 10 (increment)



```
Sub Write_Click()  
    Dim i As Integer  
    For i = 1 To 10 Step 1  
        pct1.Print CStr (i)  
    Next i  
End Sub
```

For: Write numbers from 10 to 1 (decrement)



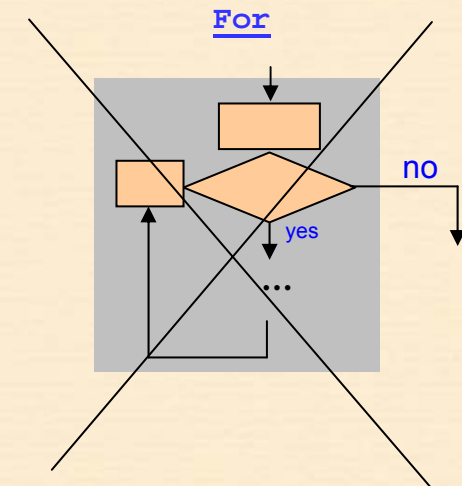
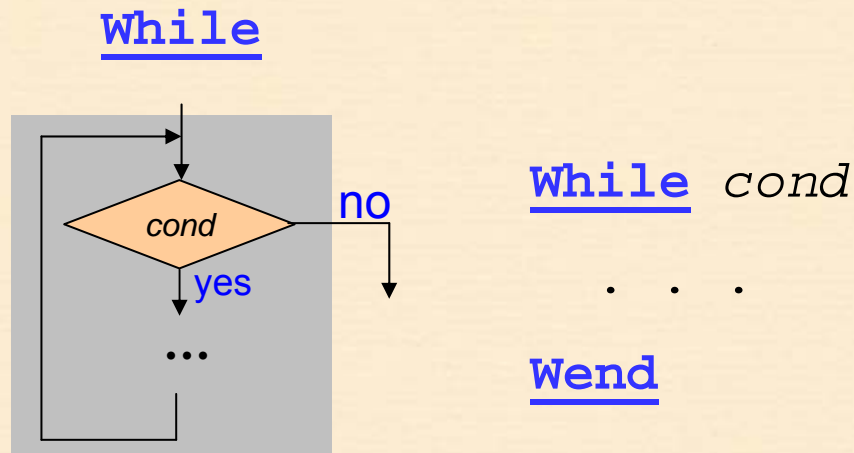
```
For i = 10 To 1 Step -1
```

```
    pct1.Print CStr (i)
```

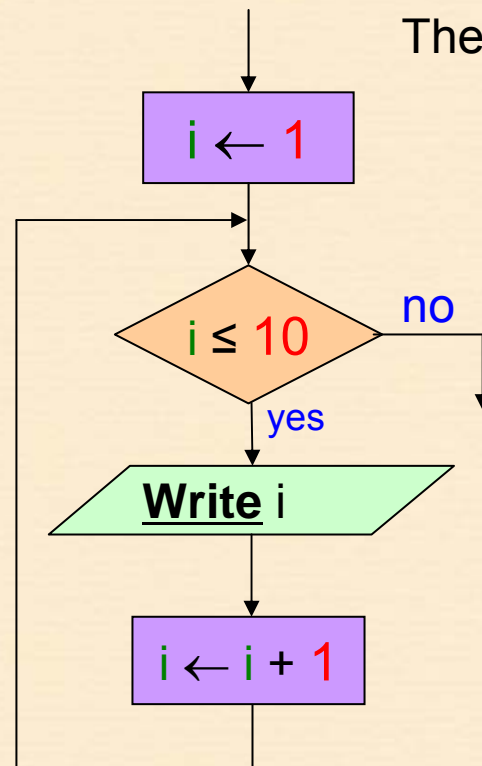
```
Next i
```

1.3 Analysis: While

- Can I determine in advance **how many times** I need to execute the body (“...”) ? no
- Can I just finish?
- Do I want the body to be executed zero or more times?
 - Yes: While construction



Write numbers from 1 to 10 (increment) using While



The normal solution is using a For construction as the purpose is clearer, but here we want to compare both structures

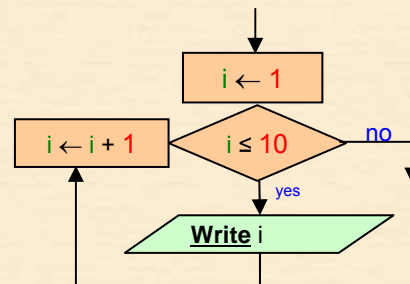
```
i = 1
```

```
While i <= 10
```

```
  pct1.Print CStr (i)
```

```
  i = i + 1
```

```
Wend
```



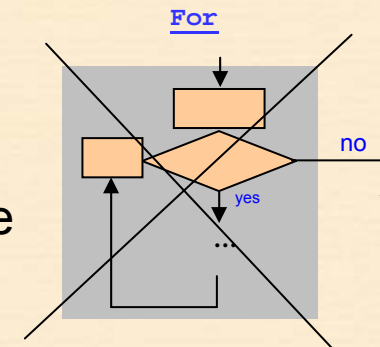
```
For i = 1 To 10 Step 1
```

```
  pct1.Print CStr (i)
```

```
Next i
```

1.4 Analysis: Do-Loop

- If I cannot determine beforehand how many times I need to execute the body
- And I cannot just finish
- Do I want to execute it **at least once**?
 - Yes: Do – Loop While / Until structure

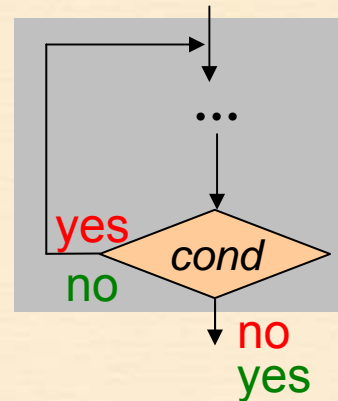


Do - Loop
While / Until

Do

...

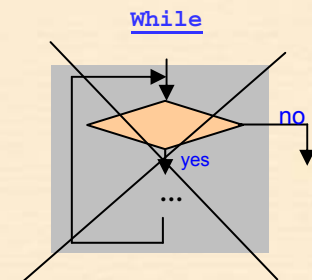
Loop While cond



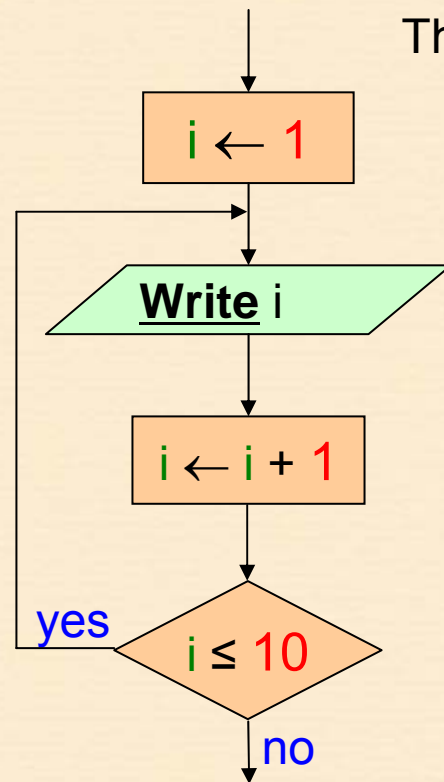
Do

...

Loop Until cond



Write numbers from 1 to 10 using Do – Loop While



The normal solution is using a For construction as the purpose is clearer, but here we want to compare both structures

```
i = 1
```

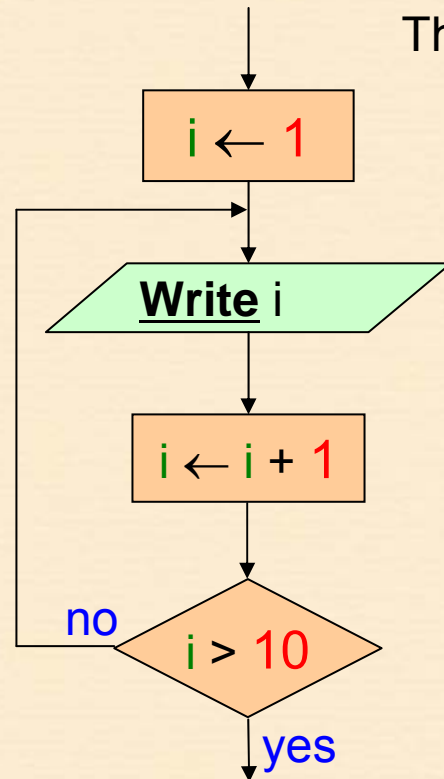
Do

```
pctl1.Print CStr (i)
```

```
i = i + 1
```

Loop While i <= 10

Write numbers from 1 to 10 using Do – Loop Until



The normal solution is using a For construction as the purpose is clearer, but here we want to compare both structures

```
i = 1
```

Do

```
pctl1.Print CStr (i)
```

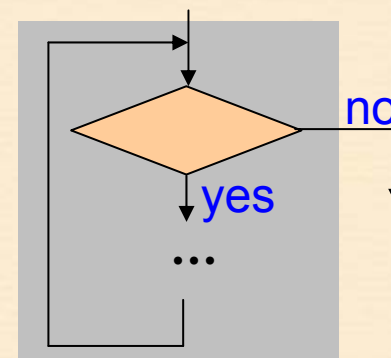
```
i = i + 1
```

Loop Until i > 10

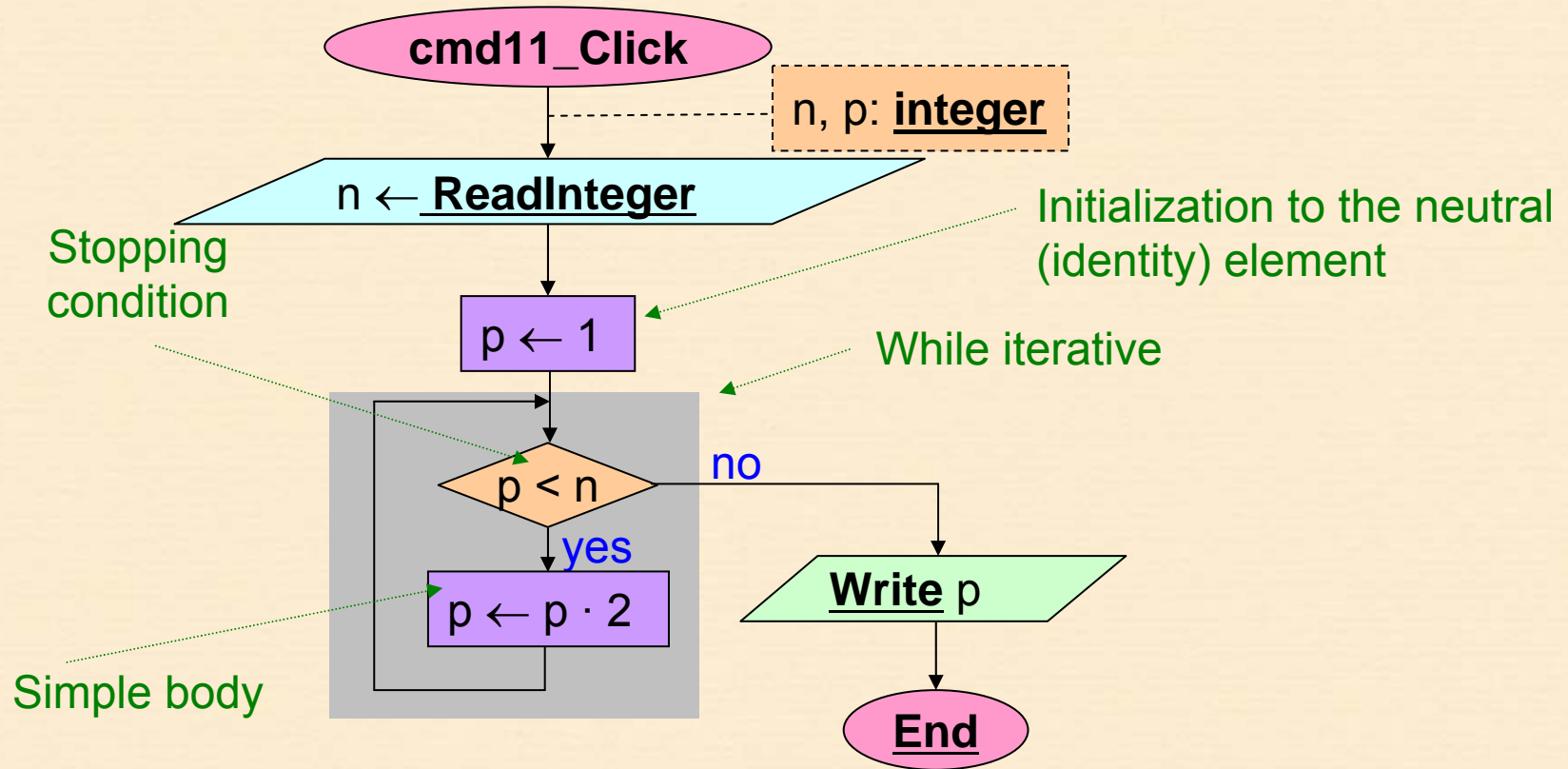
2. Example 11

- **Title**
 - While iterative
- **Name**
 - cmd11_Click
- **Description**
 - Calculate the first natural power of 2 greater than or equal to a given number
- **Observations**
 - Zero or more times: While
 - **Productory** (Capital Pi, Π)

While



Ex11: Flowchart



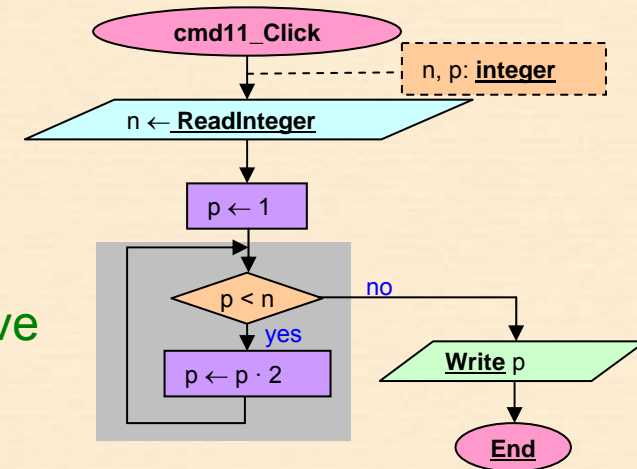
Ej11: Codificación VB

```

Sub cmd11_Click()
    Dim s As String
    Dim n As Integer, p As Integer
    s = InputBox ("Number: ")
    n = CInt (s)
    p = 1
    While p < n
        p = p * 2
    Wend
    MsgBox "Power: " & p
End Sub

```

While iterative



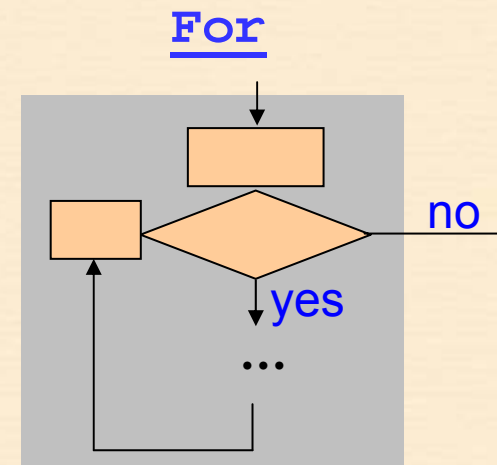
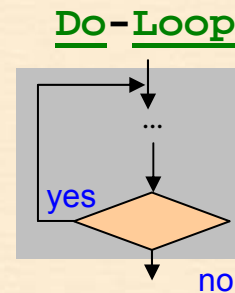
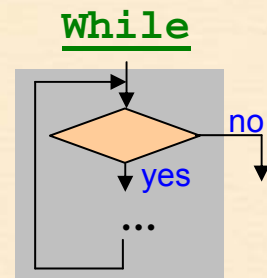
4. Example 12

- **Title**
 - For iterative
- **Name**
 - cmd12_Click
- **Description**
 - Write the partial sums of the n first terms of the arithmetic progression with $a_1 = 1$ and $a_i = a_{i-1} + i$ for every $i > 1$
- **Observations**
 - n times: For
 - **Summatory** (Capital Sigma, Σ)

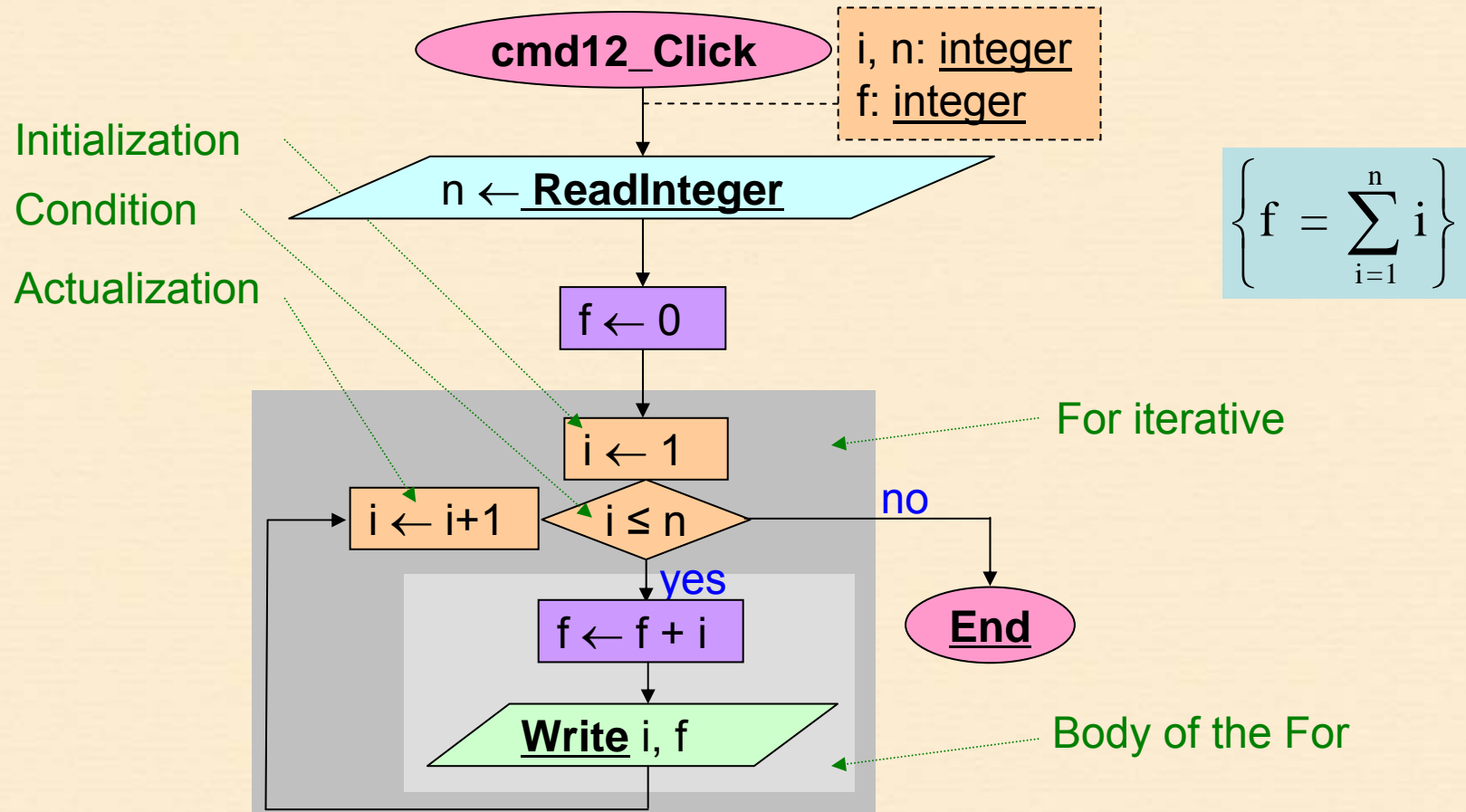
$$\left\{ f = \sum_{i=1}^n i \right\}$$

Output for n = 8

i	f
–	–
1:	1
2:	3
3:	6
4:	10
5:	15
6:	21
7:	28
8:	36



Ej12: Flowchart



Ex12: VB implementation

```

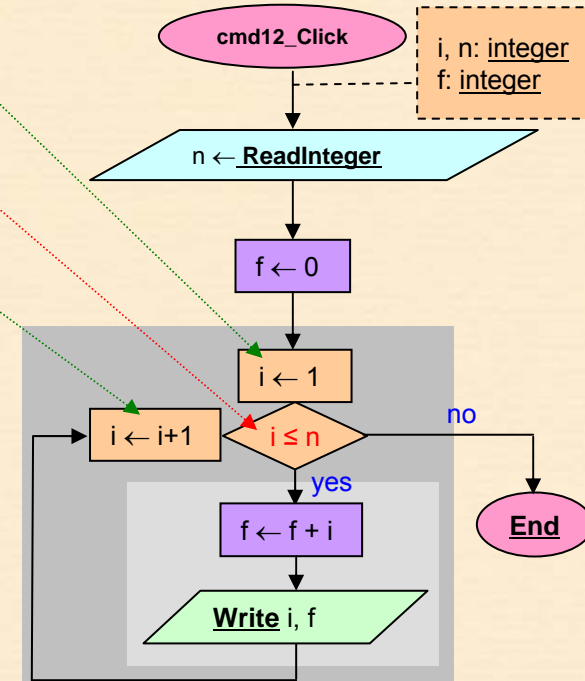
Sub cmd12_Click()
    Dim s As String
    Dim i As Integer, n As Integer
    Dim f As Integer
    s = InputBox ("Number: ")
    n = CInt (s)
    f = 0
    For i = 1 To n Step 1
        f = f + i
        pct1.Print CStr (i) & ": " & _
                  CStr (f)
    Next i
End Sub

```

Initialisation

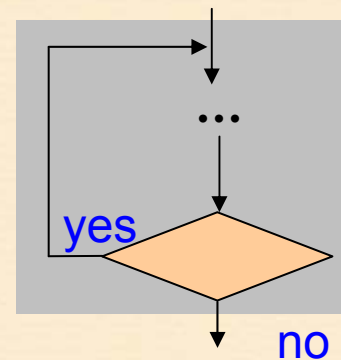
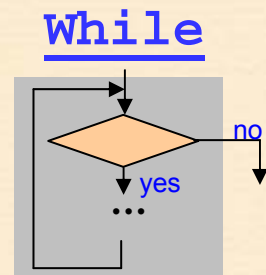
Condition

Actualization

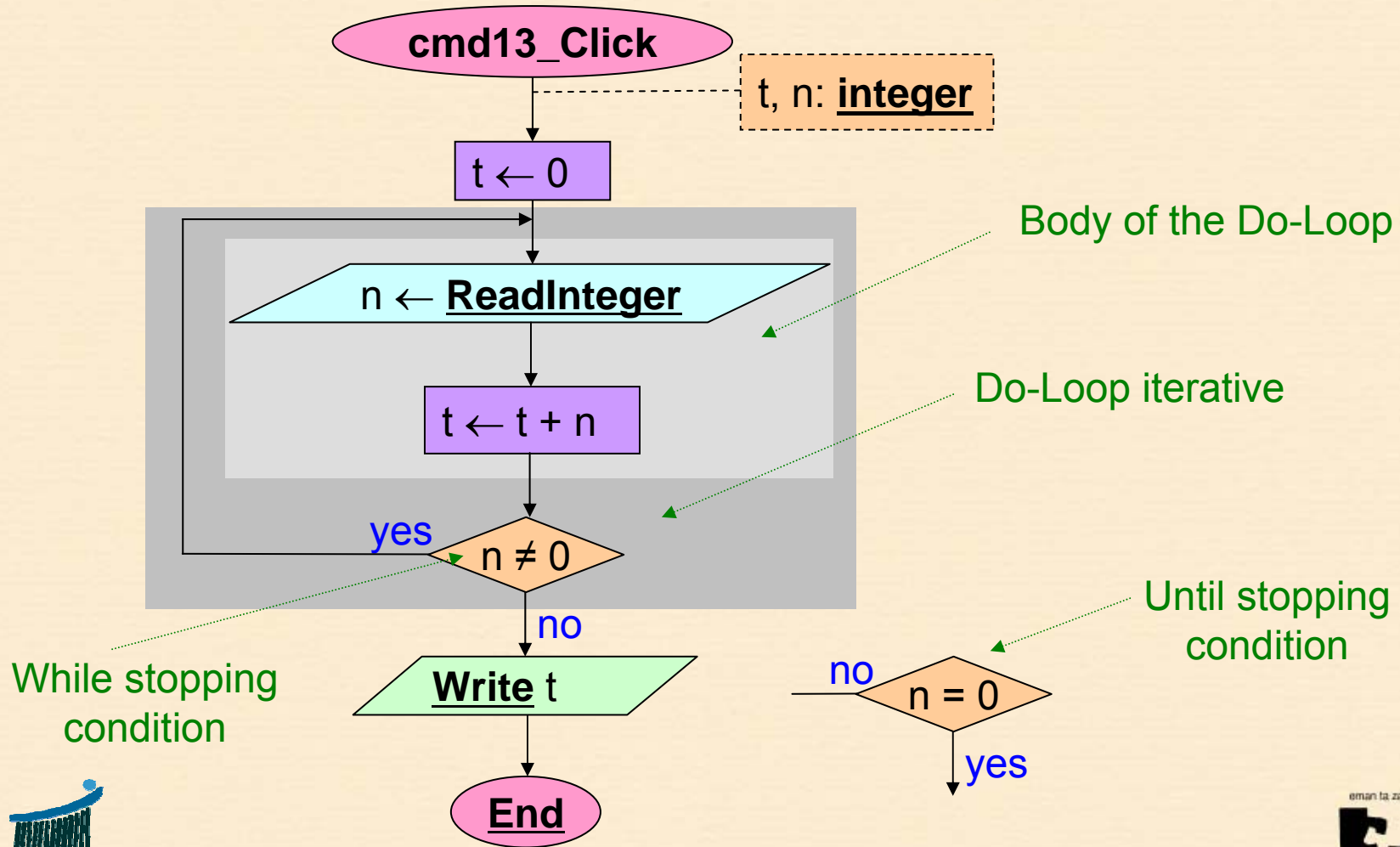


3. Example 13

- **Title**
 - Do - While iterative
- **Name**
 - cmd_Click13
- **Description**
 - Add up a series of numbers introduced from the keyboard until a zero is read.
- **Observations**
 - Once or more than once: Do - Loop Do - Loop
 - **Sum**



Ej13: Flowchart



While stopping condition

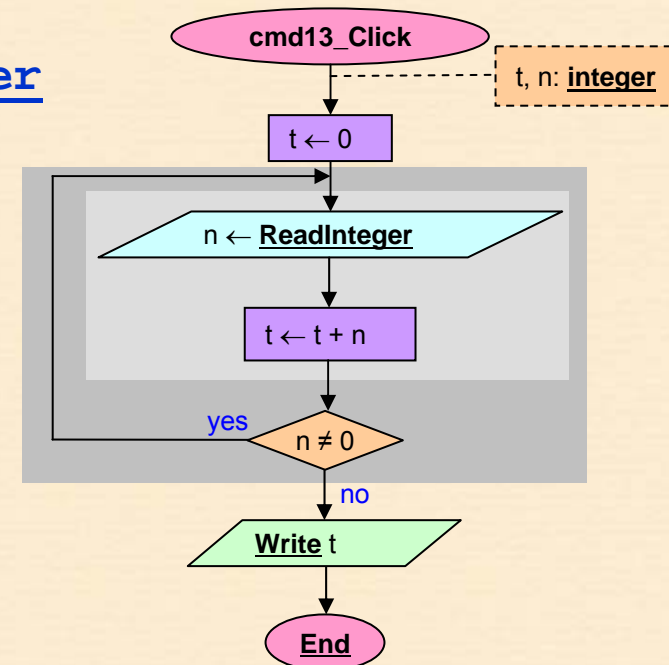
Body of the Do-Loop

Do-Loop iterative

Until stopping condition

Ej13: VB implementation

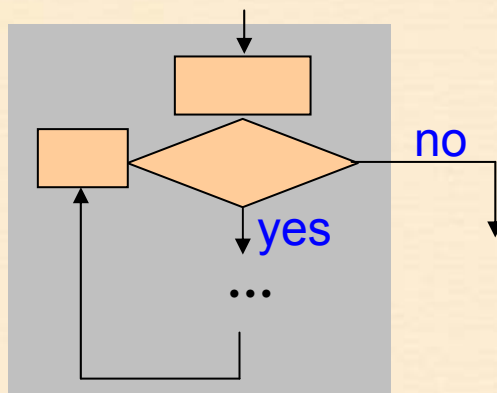
```
Sub cmd13_Click()  
  Dim s As String  
  Dim n As Integer, t As Integer  
  t = 0  
  Do  
    s = InputBox ("Number: ")  
    n = CInt (s)  
    t = t + n  
  Loop While n <> 0  
  MsgBox CStr (t)  
End Sub
```



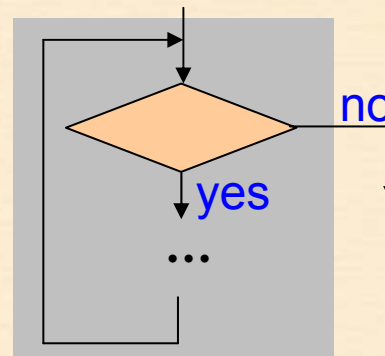
5. Summary

- **Basic examples**
 - *Initialize to the neutral (identity) element*
- **Operations patterns**
 - **Sum.** Neutral element: 0
 - **Count.** Neutral element: 0
 - **Product.** Neutral element: 1
 - **Concatenation.** Neutral element: empty string
 - **Search.** Neutral element: False.

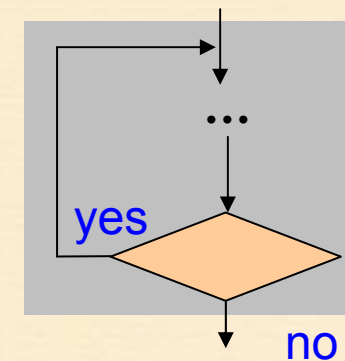
For



While



Do-Loop





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eman ta zabal zazu



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