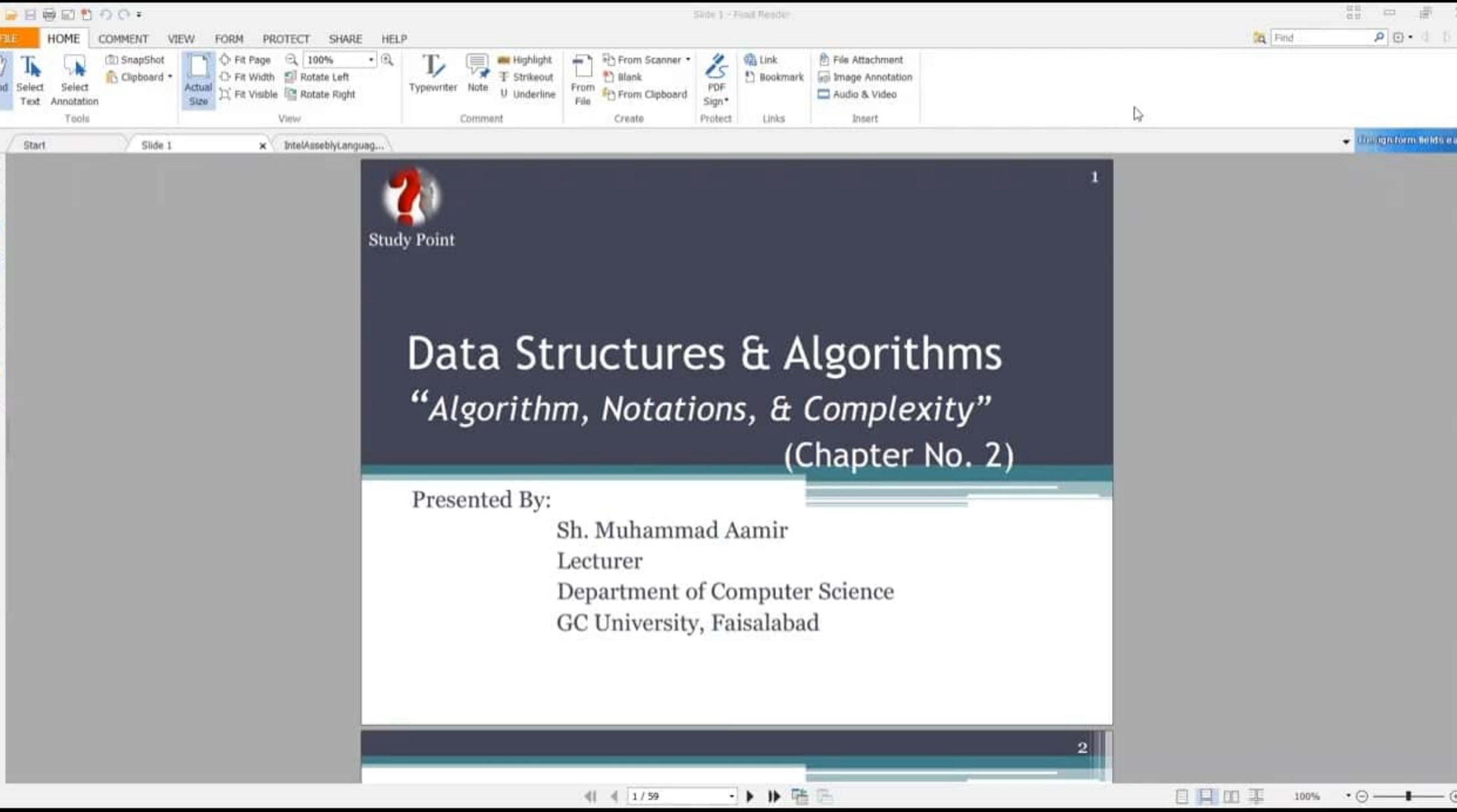

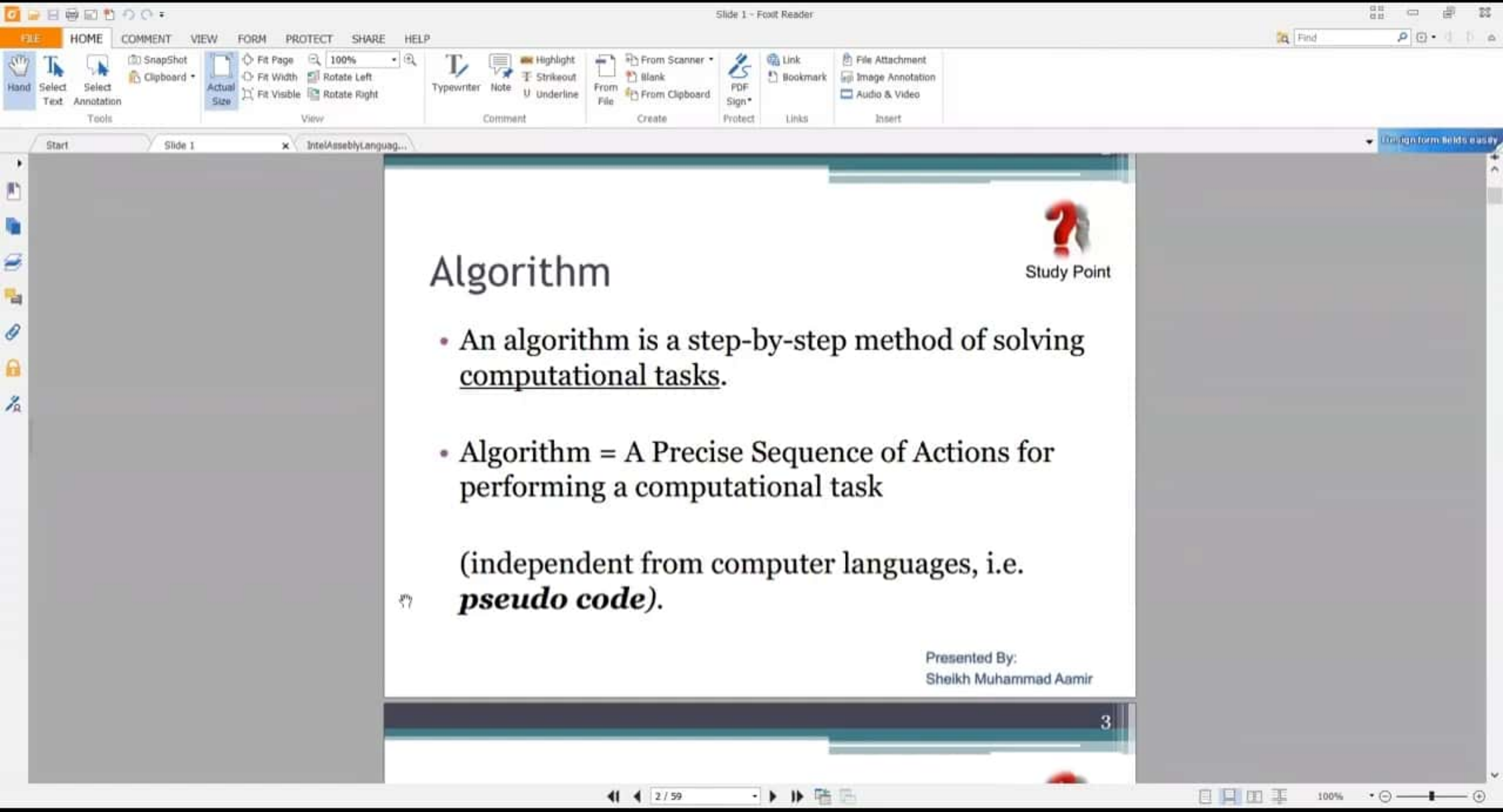

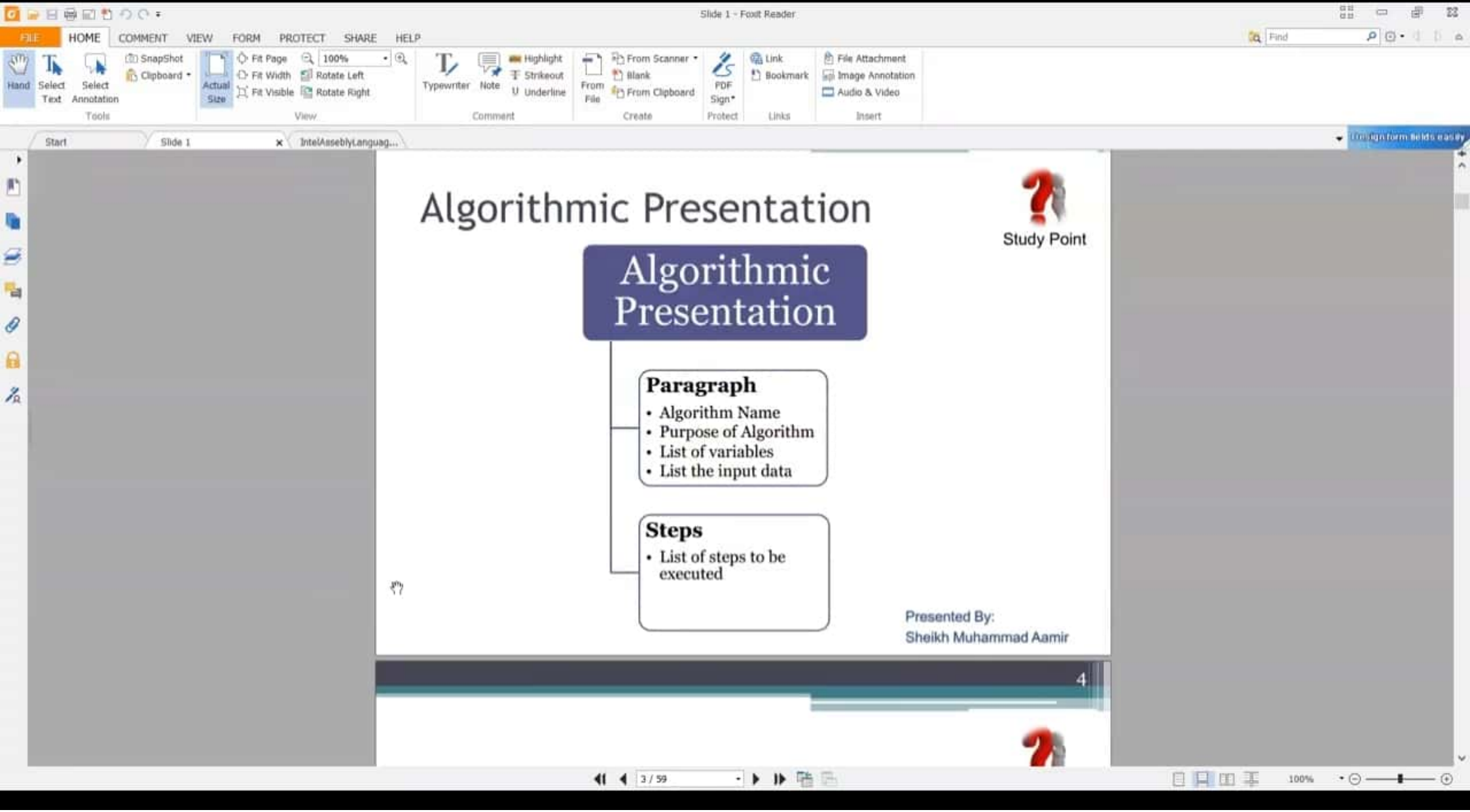

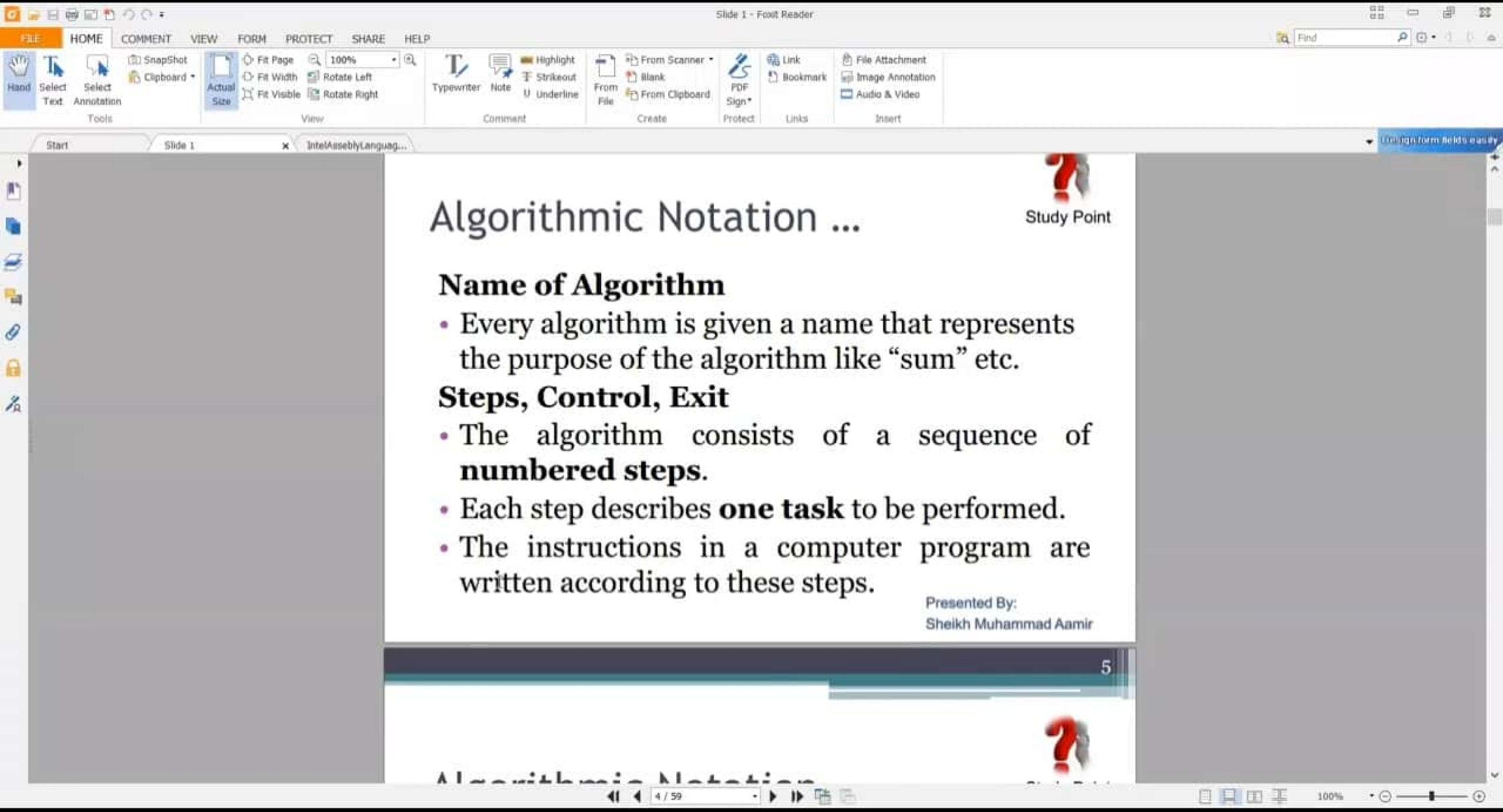

Algorithmic Notation ...

Study Point

- The steps of an algorithm are executed one after another, beginning with **Step 1** and ending at **Exit** statement is encountered
- The control may be transferred to Step n of the algorithm by the statement **"Go to Step n"**
- If several statements appear in the same step, e.g
  Set K := 1, LOC := 1 and MAX := ARR[1]
  Then they are executed from left to right

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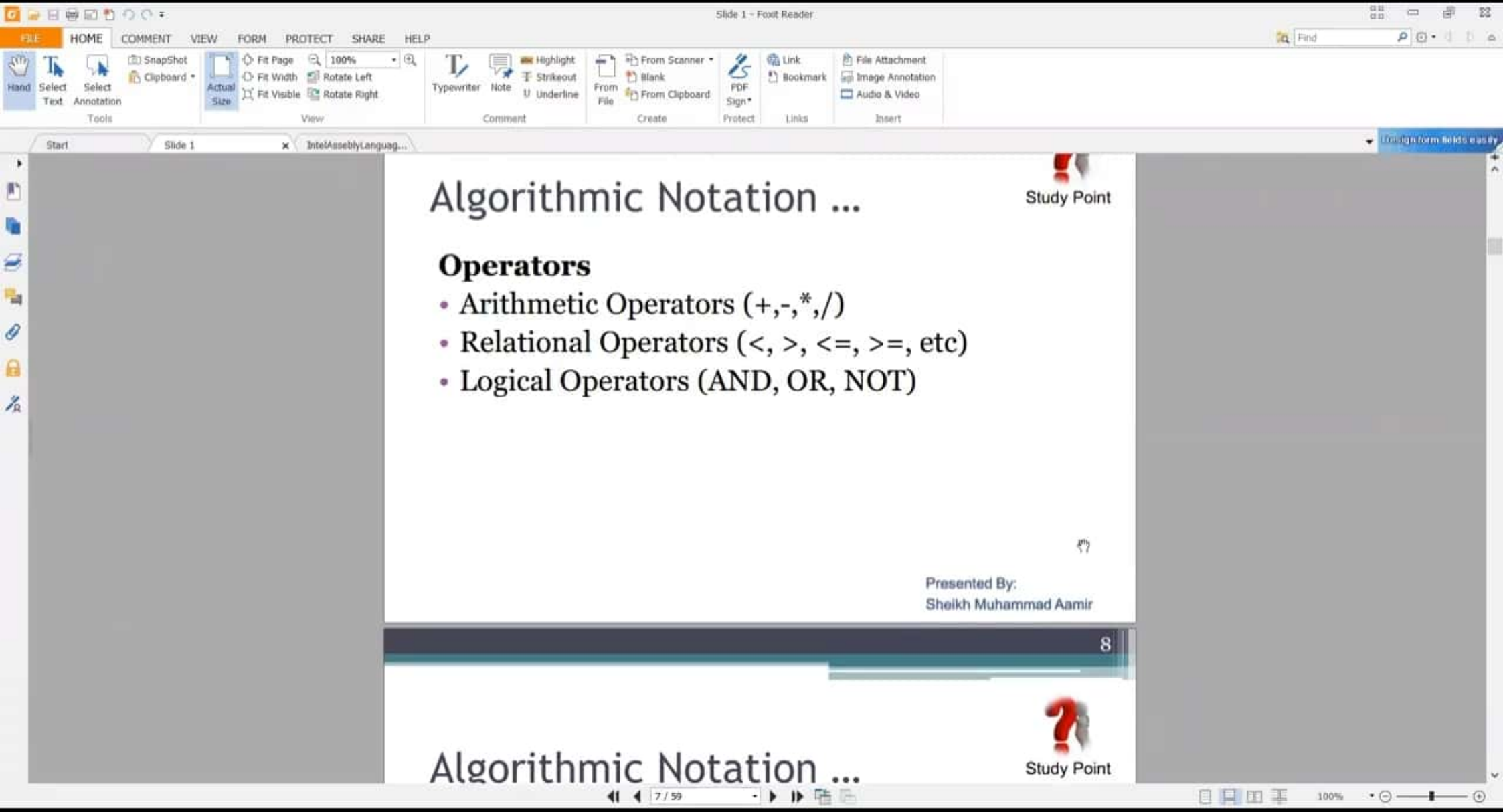
Algorithmic Notation ...
Study Point



Algorithmic Notation ...

Study Point

Comments

- Comments are used to explain the purpose of step or statement. These may be given at the end of each statement or at the beginning of the step.
- Comments are written in [ ] for an algorithm.

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Algorithmic Notation ...

Study Point

Algorithmic Notation ...

Study Point

Assignment Statement

- The assignment statement is used to evaluate an expression and assign the calculated value to the variable
- ":=" operator is used to assign a value to the variable with Set keyword
- E.g. Set A:= 5

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Algorithmic Notation ...

Study Point

Algorithmic Notation …

Study Point

Input and Output

- Data may be **read / input** by using Read statement

  e.g. **Read :** variable names

- Similarly, messages placed in double quotes and data in variables may be output by means of a **Write / Print** statement as

  e.g. **Write :** message / variable names

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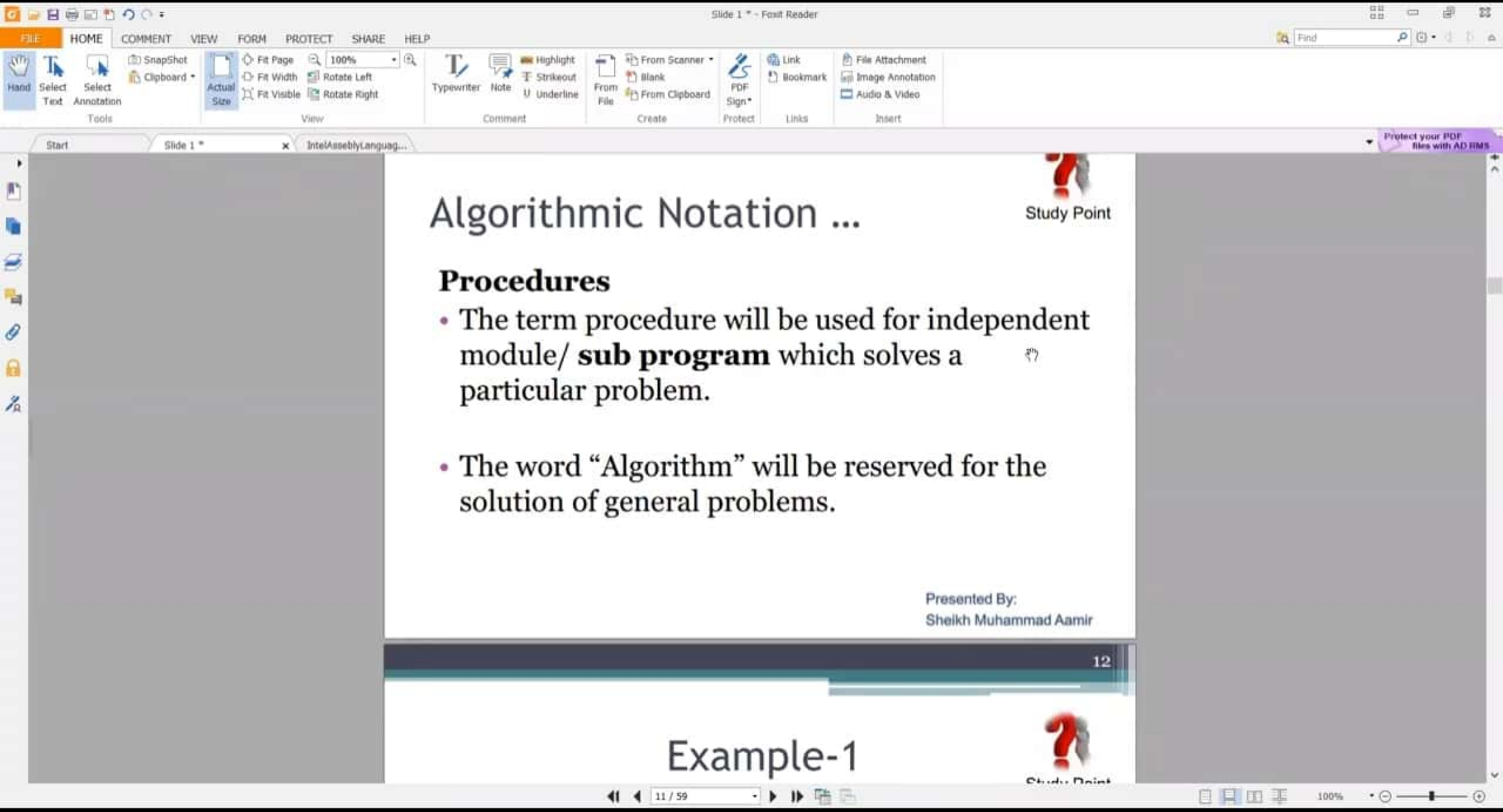
Algorithmic Notation …

Study Point



Example-1

Study Point

(ADDITION) This algorithm will find the sum to two variables A, B in C.

Steps:

1. Write: "Enter first value"
2. Read: A
3. Write: "Enter second value"
4. Read: B
5. SET C:= A + B
6. Write: "The sum is ", C
7. Exit

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Example-2

Example-2

Study Point

(Temperature) This algorithm will convert the temperature from C (Celsius) to F (Fahrenheit) after reading from user.

Steps:

1. Write: "Enter temperature in Celsius"
2. Read: C
3. SET F:= C * 9 / 5 + 32
4. Write: "The temperature in Fahrenheit is ", F
5. Exit

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Control Structures

Study Point

Control Structures

Study Point

1) Sequence Logic, or sequential flow

2) Selection Logic, or conditional flow

3) Iteration Logic, or repetition flow

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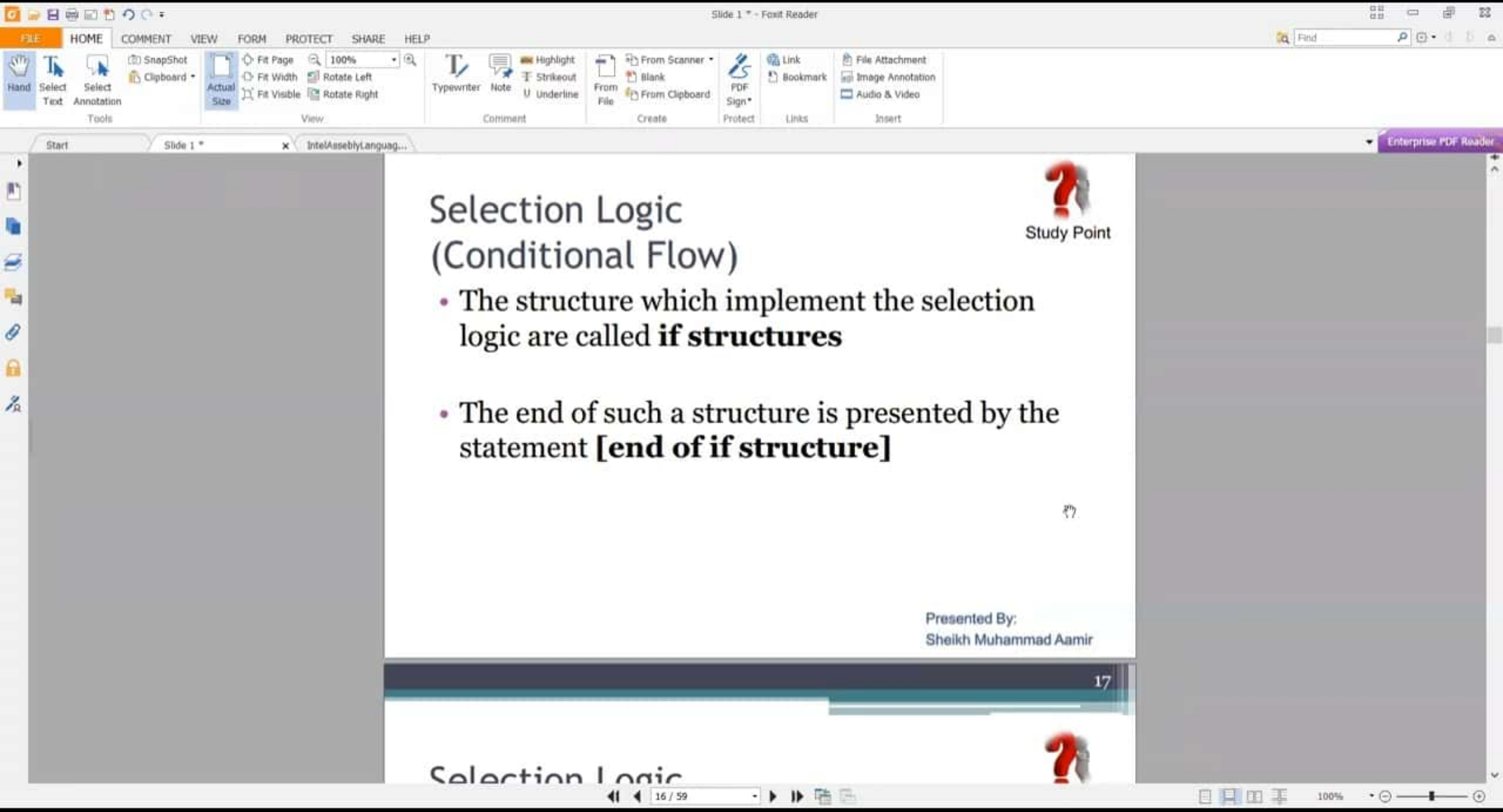
Sequential Logic

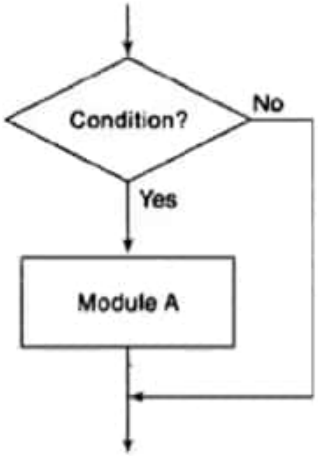


Selection Logic (Conditional Flow)...

Study Point

- **Single Alternative**
  - **If condition, then;**
    - **[Module A]**

    [End of If structure]



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Selection Logic

Example

Study Point

(EVENODD) This algorithm will find a given number NUM either even or odd.

Steps:

1. Write: "Enter any number"
2. Read: NUM
3. SET R:= NUM mod 2
4. If R = 0, then
   Write: "The given number is even "
   Else:
   Write: "The given number is odd"
   [End of If structure]
5. Exit

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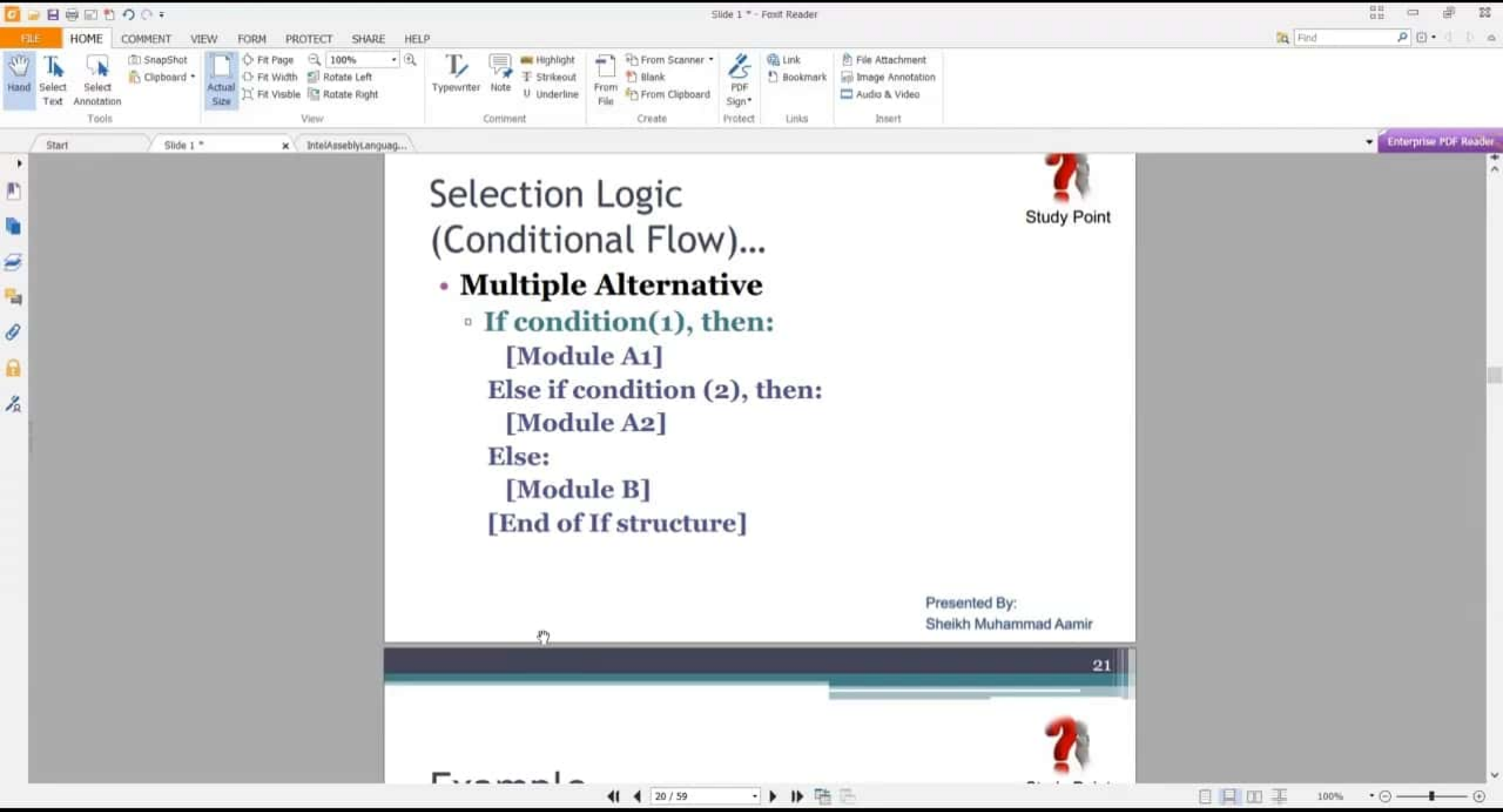

Example

Study Point

- The solution for quadratic equation $\mathbf{ax^2+bx+c=0}$ where a ≠ 0, are given by quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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Algorithm: (Quadratic Equation) This algorithm input the coefficients A, B, C of quadratic equation

Algorithm: (Quadratic Equation) This algorithm input the coefficients A, B, C of quadratic equation and output the real solutions, if any.

Study Point

Step 1 Read: A, B, C.
Step 2 Set D := $B^2 - 4AC$.
Step 3 If D > 0, Then
(a) Set X1 := (-B + √D) / 2A
Set X2 := (-B - √D) / 2A
(b) Write : X1, X2
Else If D = 0, Then
(a) Set X1 := (-B) / 2A
(b) Write : X1
Else:
Write : 'No real value solution'
[End of If structure]
Step 4 Exit.

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Iteration Logic

Iteration Logic (Repetitive Flow)

Study Point

- Repetitive flow begins with **Repeat** statement and is followed by a module (called the *body of the loop*)
- End of this structure is presented by
  [End of loop]
- The *repeat-for loop* uses the index variable, such as K, to control the loop
- The format of a loop is as
  Repeat for K = R to S by T:
  [Module]
  [End of loop]

Here R is an initial value, S is last value and T is increment. Loop will terminate when K > S

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Iteration Logic

Study Point

Iteration Logic (Repetitive Flow)...

Study Point

- The **repeat-while loop** uses the condition to control the loop.

- The format of this loop is as

Repeat while condition:
[Module]
[End of loop]

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Example:

Algorithm: (Largest Element in Array) Given a non-empty array DATA with N values, this algorithm

Study Point

Example:

Algorithm: (Largest Element in Array) Given a non-empty array DATA with N values, this algorithm finds the location LOC and value MAX of the largest element of DATA

1. [Initialize] Set K :=1, LOC := 1, and MAX :=DATA[1]
2. Repeat Step 3 and step 4 while K ≤ N:
3. If MAX < DATA [K], Then:
   Set MAX := DATA[K] and LOC := K
   [End of If structure]
4. Set K := K + 1
   [End of Step 2 loop]
5. Write LOC, MAX
6. Exit

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Study Point

Why we need algorithm analysis?

- As computers get faster and problem sizes get bigger, analysis will become *more* important.
- Why? The difference between good and bad algorithms will get bigger.

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Complexity of Algorithm

Study Point

- Must have some criteria for measuring the efficiency of Algorithm
- **Time and Space** used by an Algorithm are two main measuring factors for efficiency
- The time is measured by counting the **number of key operations** (e.g. number of comparisons)
- The space is measured by counting the **maximum of memory needed** by the algorithm.

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Complexity of Algorithm...

- The *complexity* of an algorithm *M* is the *function* ***f(n)*** which gives **the running time and/or storage space** requirement of the algorithm in terms of the **size *n*** of the input data.

Example

- Suppose we are given an English short story TEXT, and suppose we want to search through TEXT for the first occurrence of a given 3-letter word W. If W is the 3-letter word "the" then it is likely that W occurs near the beginning of TEXT, so ***f(n)*** will be small.

- On the other hand, if W is the 3-letter word "zoo," then W may not appear in TEXT at all, so ***f(n)*** will be large.

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Study Point

Worst Case

- the maximum value of ***f(n)*** for any possible input

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Average Case

Study Point

"the expected value of *f(n)*"

- The analysis of the average case assumes a certain **probabilistic distribution for the input data**; one such **assumption** might be that all possible permutations of an input data set are **equally likely**.
- The average case also uses the following concept in probability theory.
- Suppose the numbers occur with respective probabilities $p_1, p_2, \ldots p_k$.
- Then the *expectation* or ***average value E*** is given by

$$\mathbf{E = n_1 p_1 + n_2 p_2 + \ldots + n_k P_k}$$

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Linear Search