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FLOW CHART & ALGORITHMS

Planning Your Code

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Flowchart Introduction

- The first flowchart was created by **Von Neumann** in 1945
- Flowchart are important for planning and working of a program
- Flowcharts decreases our efforts i.e. they are easy to understand and check logics and algorithms
- Flowcharts are important to do before you start writing code

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WHAT YOU WILL KNOW…

- Prior Knowledge
  - How…
  - How…

- What You Will Know & Be Able To Do
  - Calculate…
  - Build a…
  - Be able to describe… how an R/C circuit works

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How will you be measured

- To what extent will the verb be measured?
- How will success be determined?

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NEW WORDS...

- Algorithm
- Flowchart
- Graphical
- Pseudocode

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ALGORITHMS

- It is a list of instructions specifying a precise description of a step by step process that terminates after a finite number of steps for solving an algorithm problem producing the correct answer in the end
- It is a recipe for solving problems
- A finite set of an instruction that specifies a sequence of operation to be carried out in order to solve a specific problem.
- An unambiguous procedure specifying a finite number of steps to be taken.

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What’s another description for an Algorithms?

Flowcharts

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What is a Flowchart?

- Flowcharts are a graphical representation of a program
  - Representation of a solution to a particular problem, which comes under the category of Programming Practices and Techniques
- Flowcharts are symbolic diagrams which shows type of data(numeric, character etc.), data flow, control flow and programming logics and algorithms.

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Programming an Algorithm

- A typical programming task can be divided into
- two phases:
  - ***Problem solving phase***
    - Produce an ordered sequence of steps that describe solution of problem
    - This sequence of steps is called an ***algorithm***
  - ***Implementation phase***
    - implement the program in some programming language

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ALGORITHM – PROBLEM SOLVING PHASE

- PSEUDOCODE - specifies the steps of algorithm using natural language of superimposed control structure.
- FLOWCHART - a traditional graphical tool with standardized symbols. Show the sequence of steps in an algorithm

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PROPERTIES OF ALGORITHM

- **Finiteness** – Has an exact number of steps to be taken and has an end
- **Absence of Ambiguity** - means that every instruction is precisely described and clearly specified
- **Sequence of Execution** - instructions are performed from top to bottom
- **Input and Output** - defined the unknowns of the problem is specified and with the expected outcome
- **Effectiveness** - the solution prescribed is guaranteed to give a correct answer and that the specified process is faithfully carried out
- **Scope Definition** - applies to a specific problem or class of problem

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Before You Start Writing Code...

- **State the problem clearly**
  - A problem cannot be solved correctly unless it is understood
- **Plan and Write the Logical Order of Instructions**
  - Refine the algorithm successively to get step by step detailed algorithm
  - Get description that is very close to a computer language
  - The computer follows the direction exactly at the given sequence.

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FLOWCHARTING GUIDLINES

- The flowchart should flow from top to bottom
- If the chart becomes complex, utilize connecting blocks
- Avoid intersecting flow lines
- Use meaningful description in the symbol

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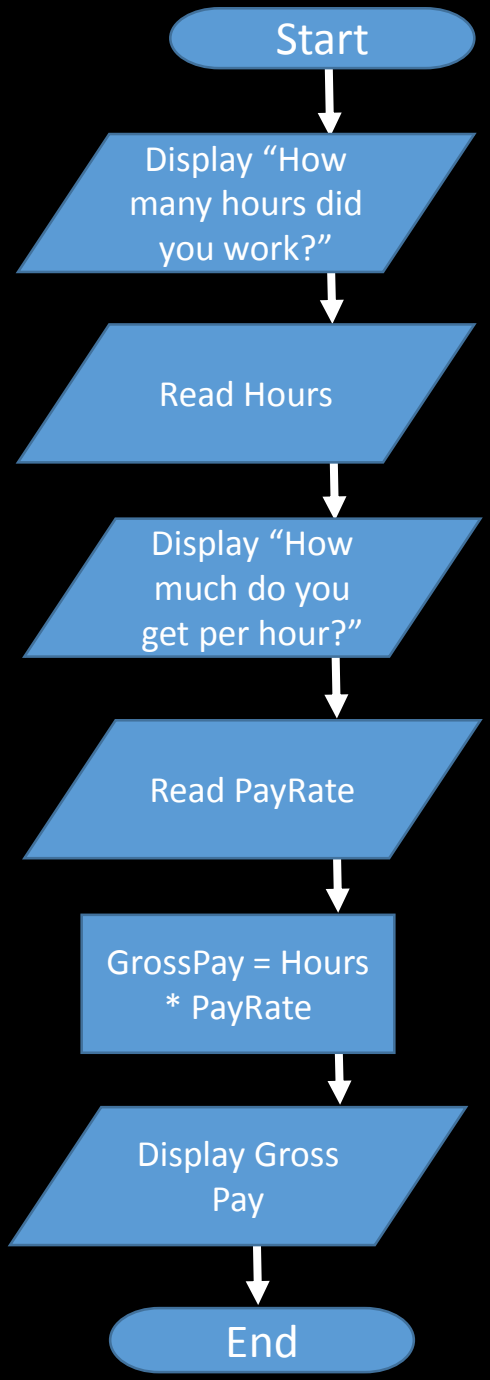
Flowchart Example

- A flowchart is a diagram that depicts the “flow of control” of a program.



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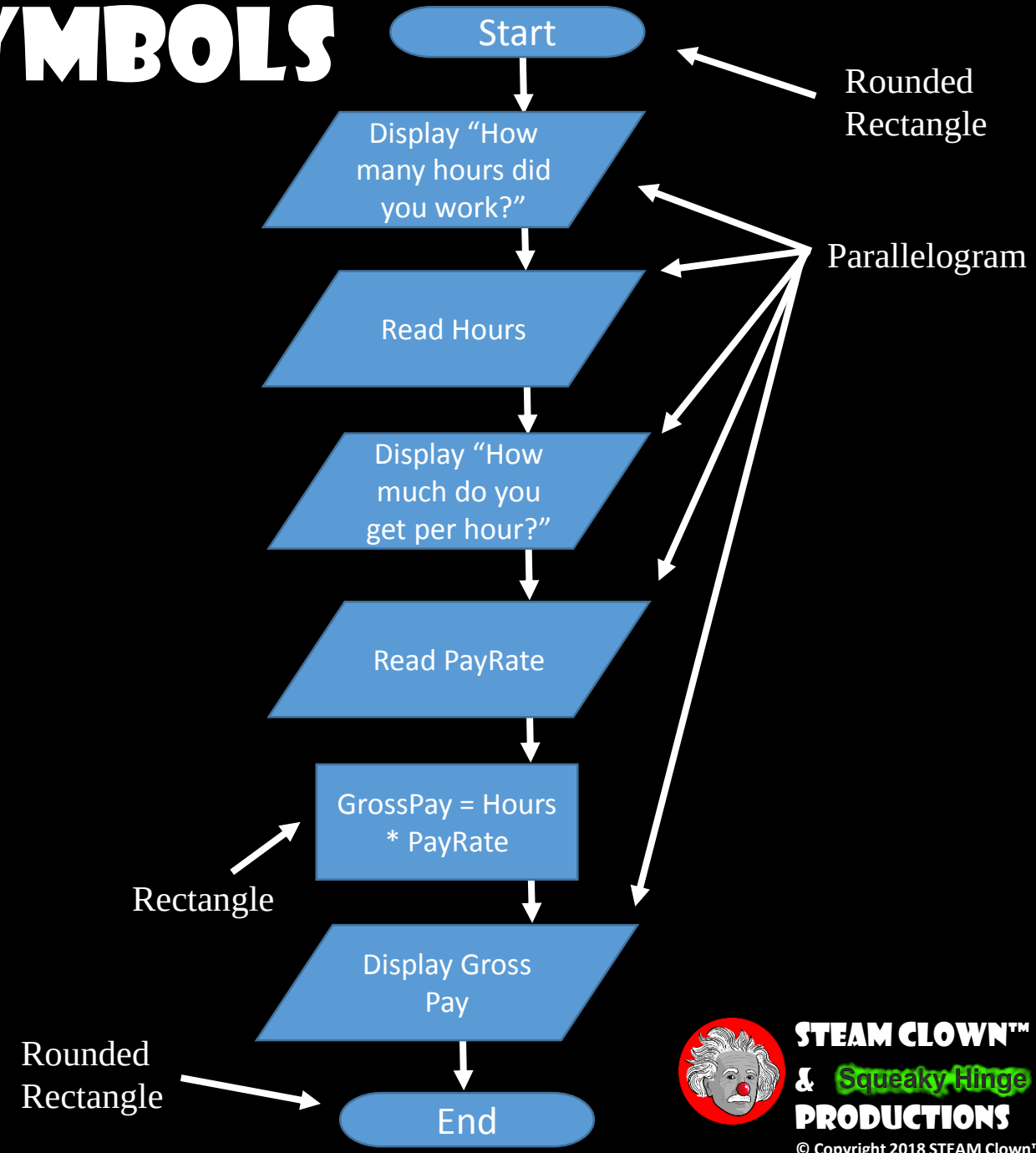
Basic Flowchart Symbols

- Notice there are three types of symbols in this flowchart:
  - rounded rectangles
  - parallelograms
  - a rectangle
- Each symbol represents a different type of operation.



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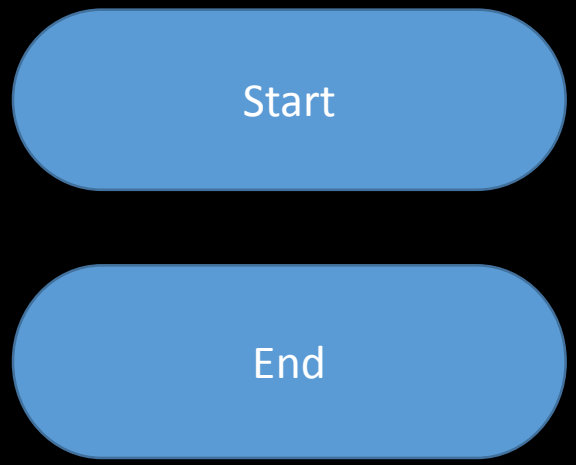
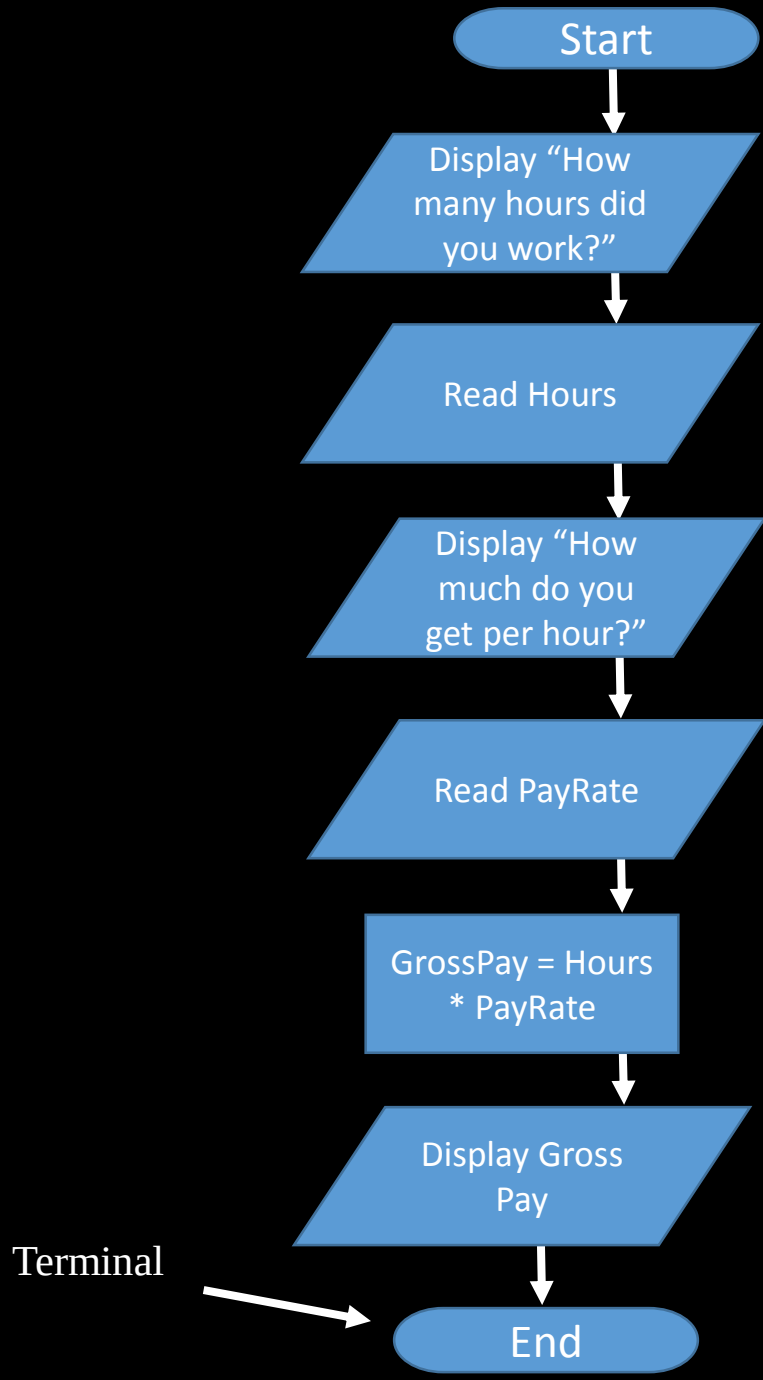
TERMINALS

- Represented by rounded rectangles
- Indicate a starting or ending point





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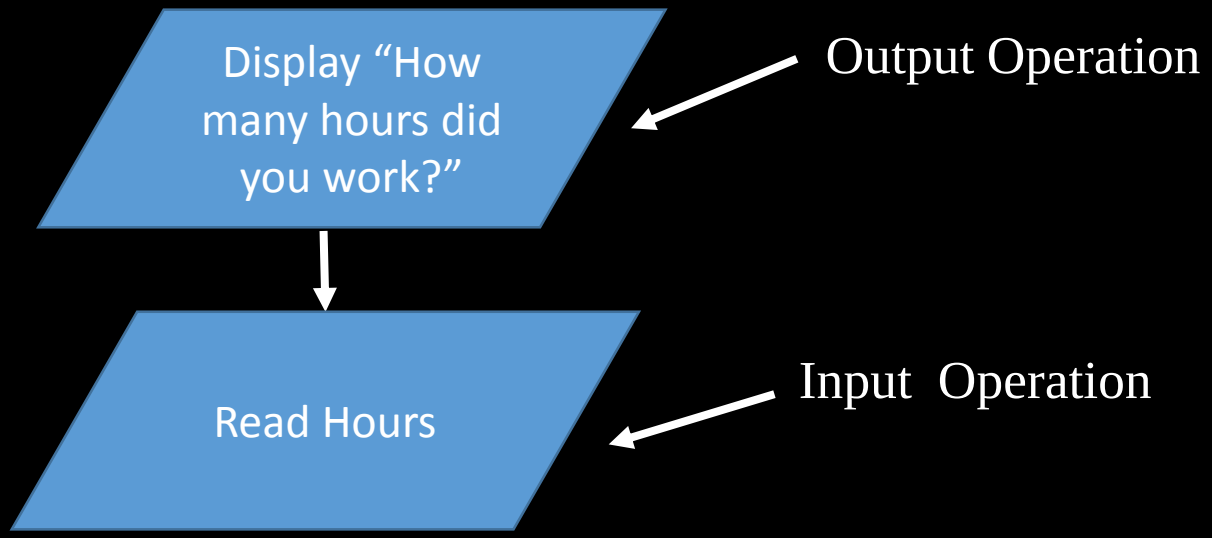
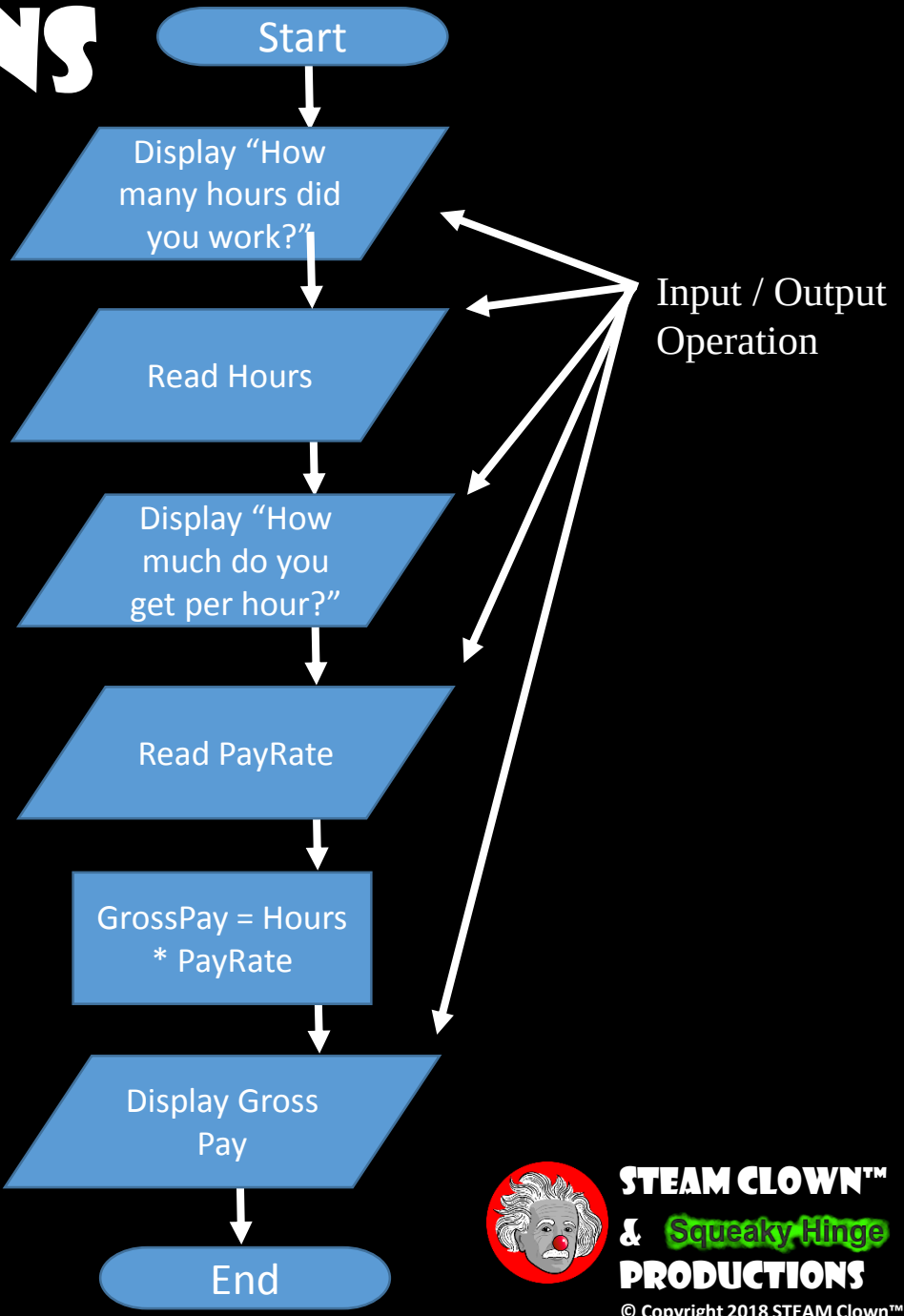
INPUT/OUTPUT OPERATIONS

- represented by parallelograms
- indicate an input or output operation





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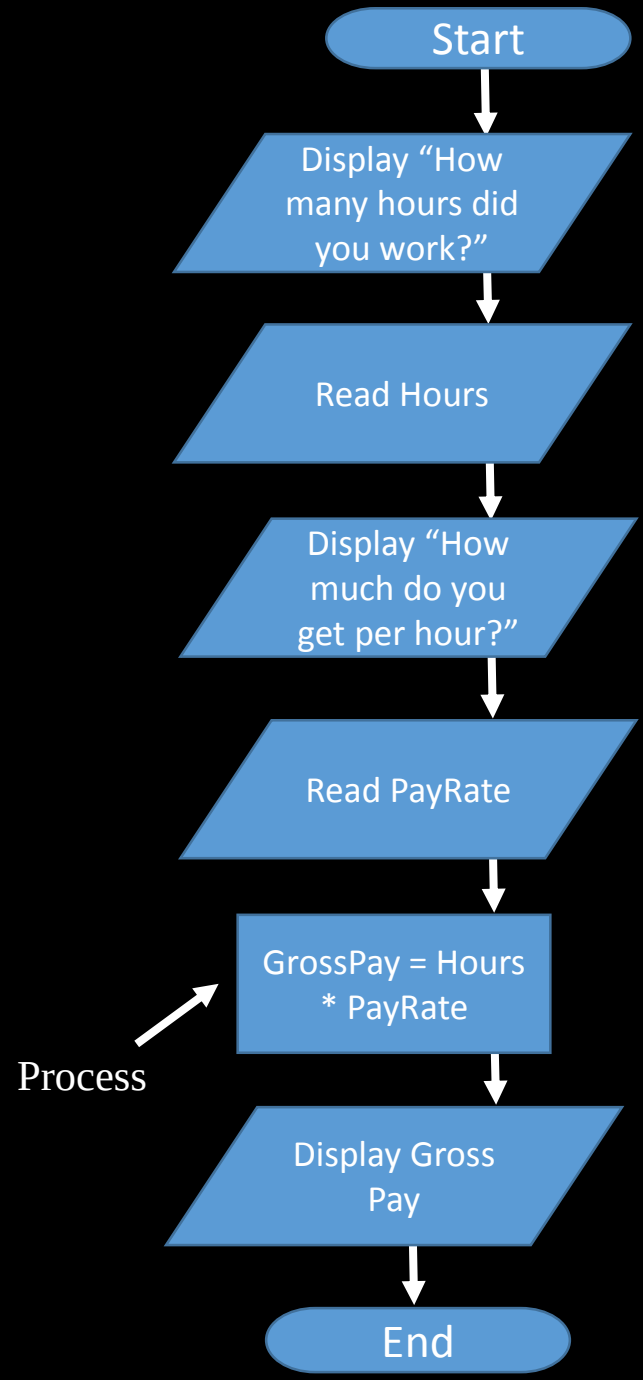
PROCESS

- represented by rectangles
- indicates a process such as a mathematical computation or variable assignment

GrossPay = Hours * PayRate



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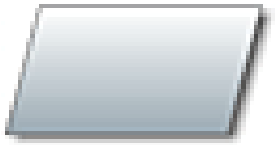
Symbol	Name	Function
	Start/end	An oval represents a start or end point.
	Arrows	A line is a connector that shows relationships between the representative shapes.
	Input/Output	A parallelogram represents input or ouptut.
	Process	A rectangle represents a process.
	Decision	A diamond indicates a decision.

We will look at "Decisions" in a few slides

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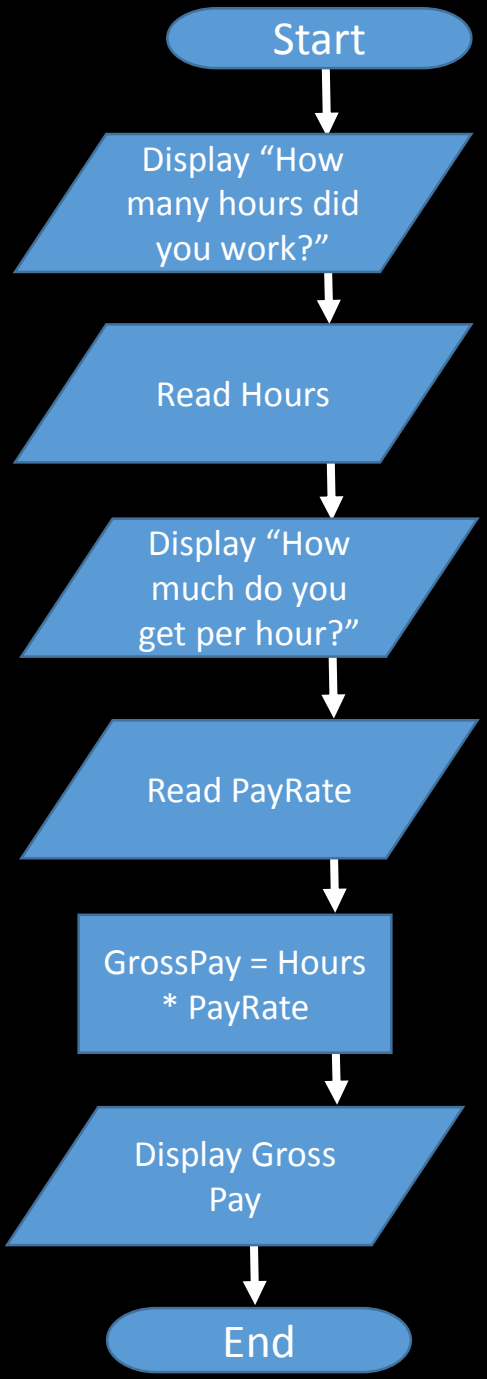
Stepping Through the Flowchart

- Identify the Inputs and Outputs
- List Variables



Variables & Their Values

Hours = ??

PayRate = ??

GrossPay = ??

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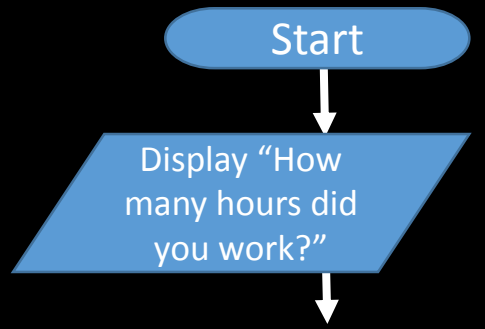
Stepping Through the Flowchart



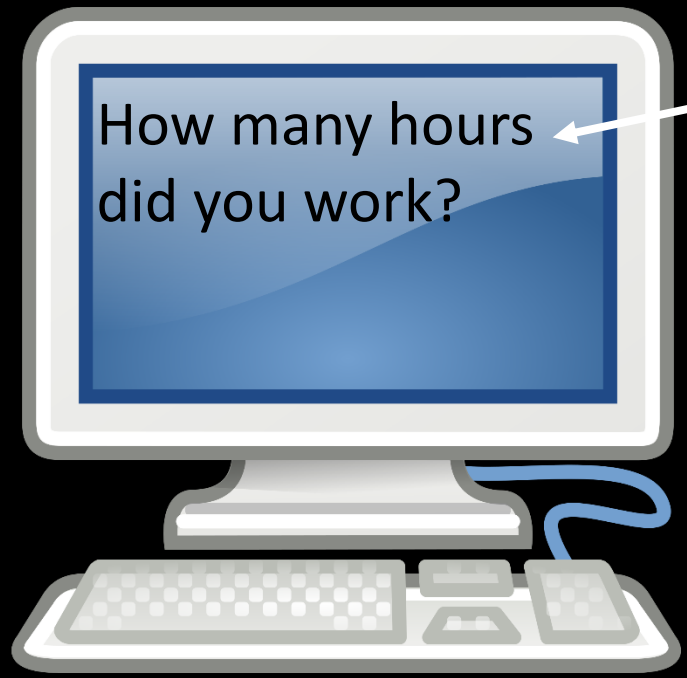
- Output the question "Hours" to the users

Variables & Their Values

Hours = ??

PayRate = ??

GrossPay = ??



Program Outputs "How many hours did you work?"

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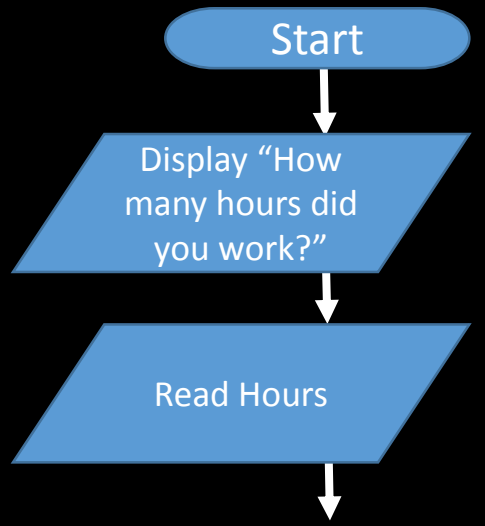
Stepping Through the Flowchart

- Get Answer “Hours” from the users

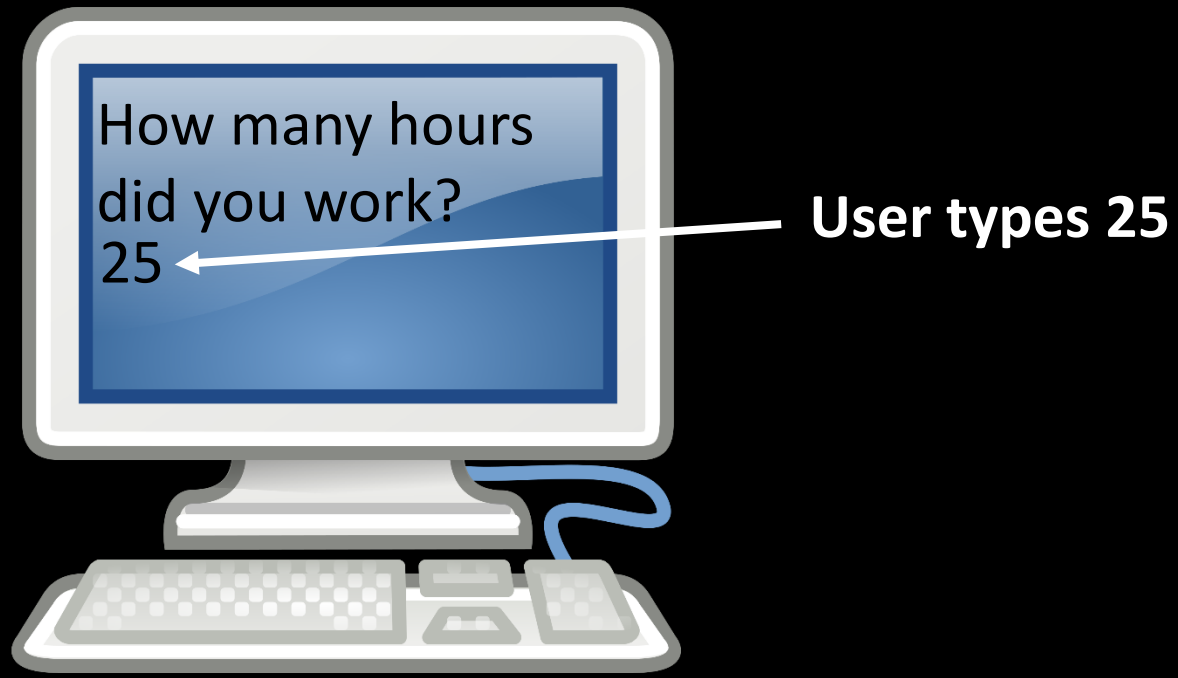


Variables & Their Values

Hours = 25

PayRate = ??

GrossPay = ??



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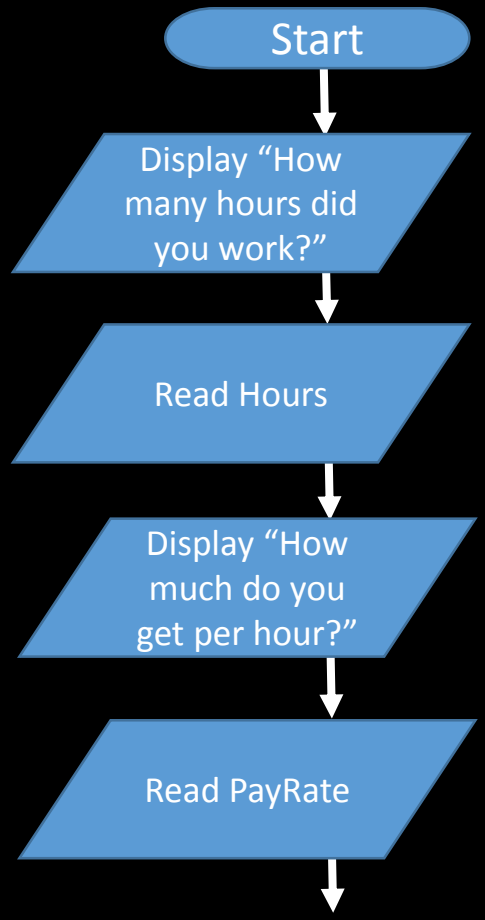
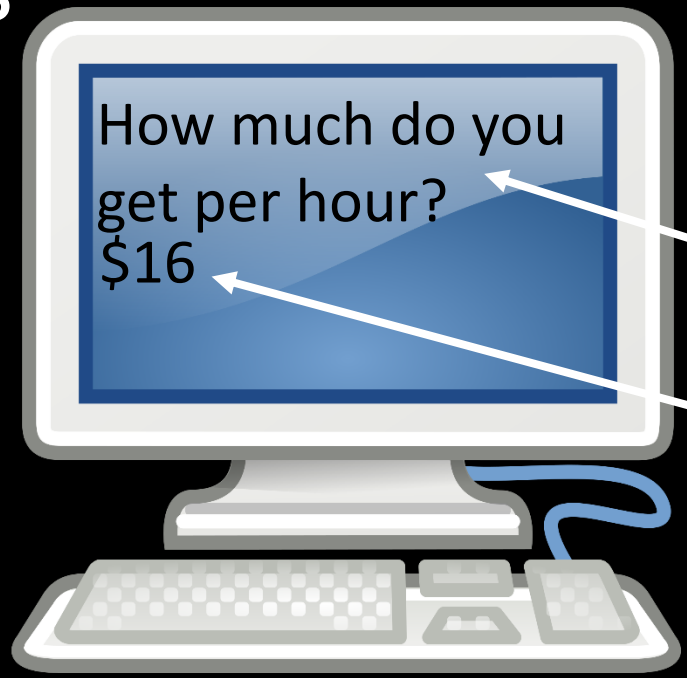
Stepping Through the Flowchart

- Output the question "PayRate" to the users
- Get Answer "PayRate" from the users



Variables & Their Values

Hours = 25
PayRate = $16
GrossPay = ??



Program Outputs "How do you get?"

Get PayRate from User

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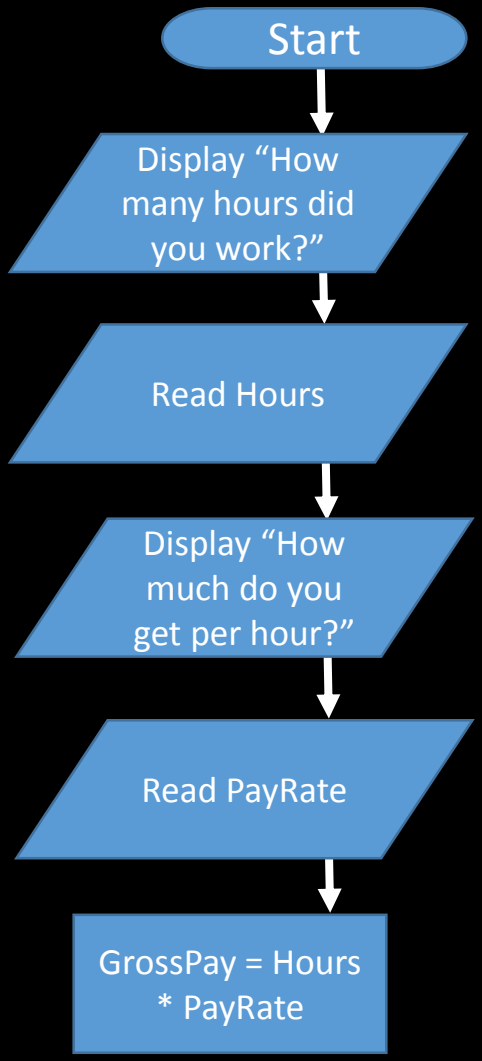
Stepping Through the Flowchart

- Process the calculation

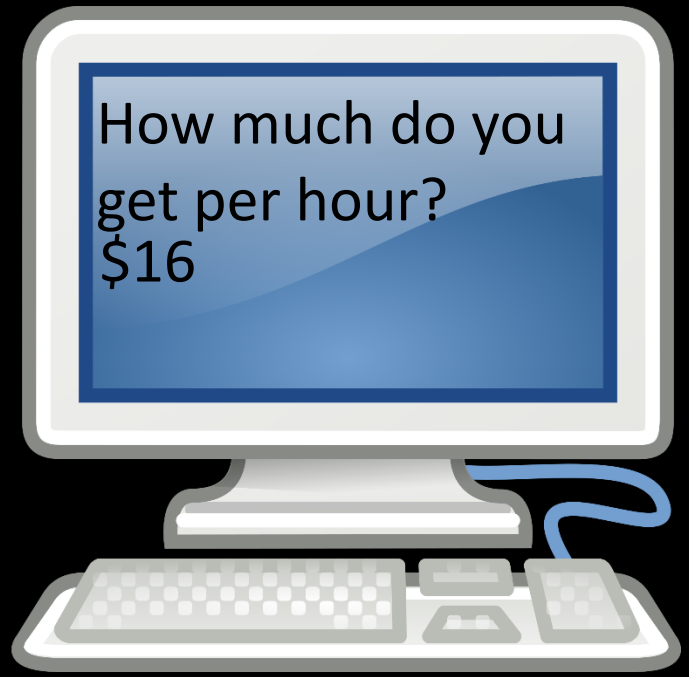
GrossPay = Hours * PayRate

GrossPay = 25 * $16



Variables & Their Values

Hours = 25
PayRate = $16
GrossPay = $400



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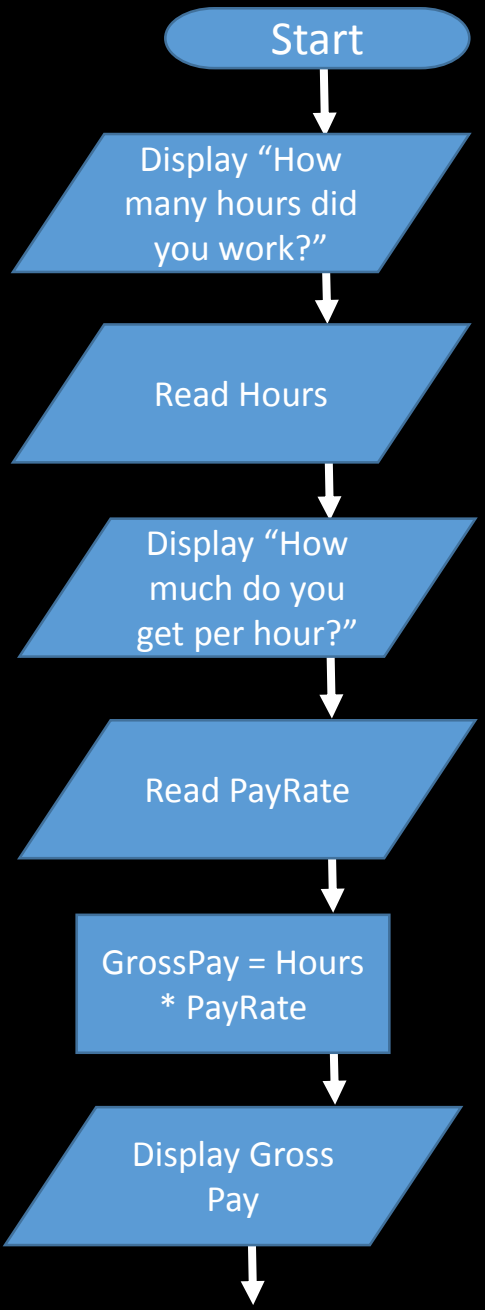
Stepping Through the Flowchart

- Output the "GrossPay" to the users



Variables & Their Values

Hours = 25
PayRate = $16
GrossPay = $400

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Stepping Through the Flowchart

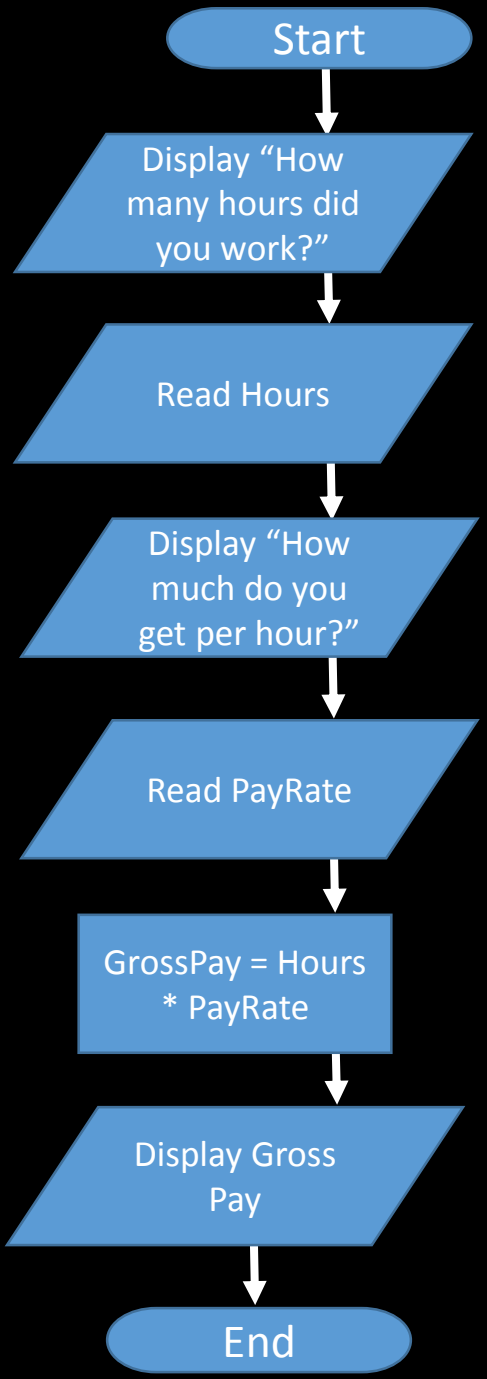
- End

Variables & Their Values

Hours = 25

PayRate = $16

GrossPay = $400



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Three Flowchart Structures

- Sequence
- Selection
- Iteration

What do you think these mean?

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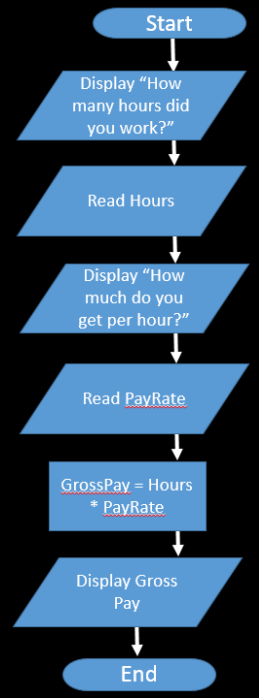
Sequence Structures

- A series of actions are performed in a sequence
- The pay calculation example was a sequence flowchart
  - There are not “decisions” or selections in a top level sequence



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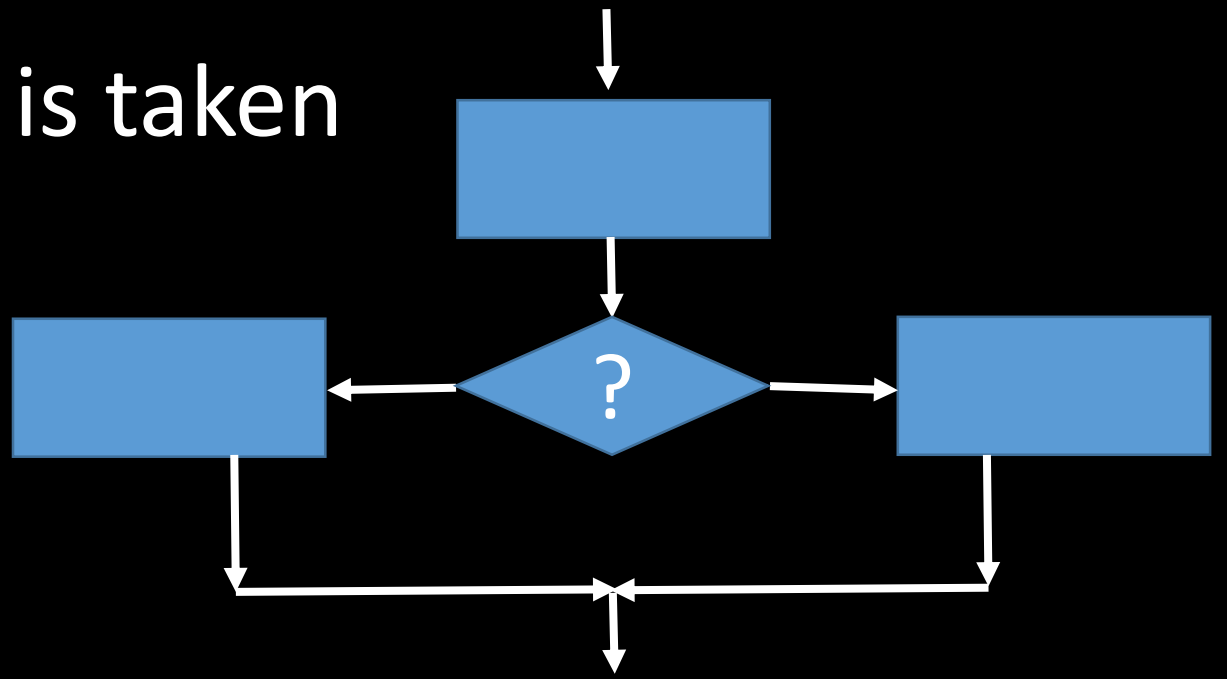
Selection Structure

- This where a question is being asked
- This is a decision point
- One of two possible actions is taken
  - This depends on the result of the test condition
  - Typically is a “TRUE” or “FALSE” answer



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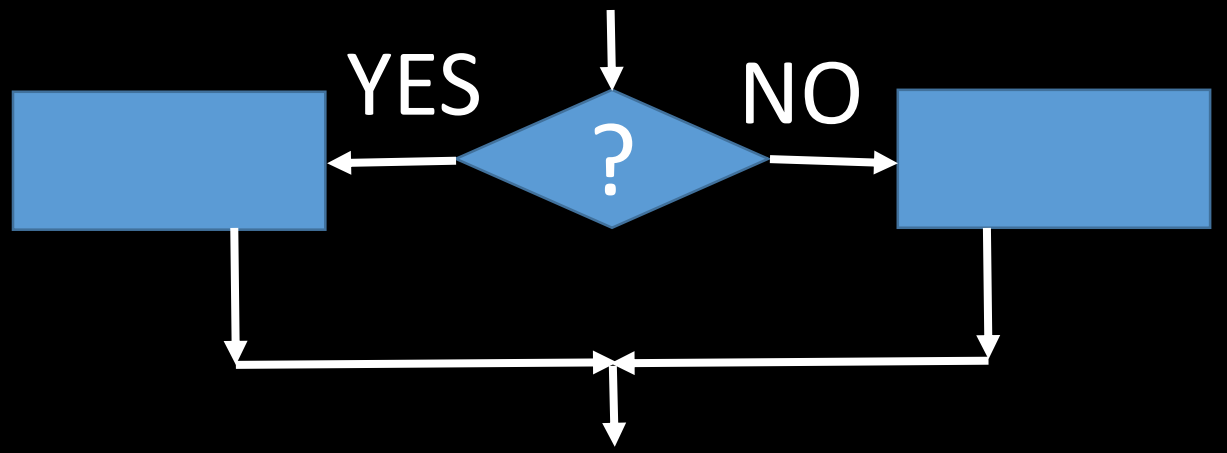
Selection Structure

- A new symbol, the diamond, indicates a yes/no question. If the answer to the question is yes, the flow follows one path. If the answer is no, the flow follows another path



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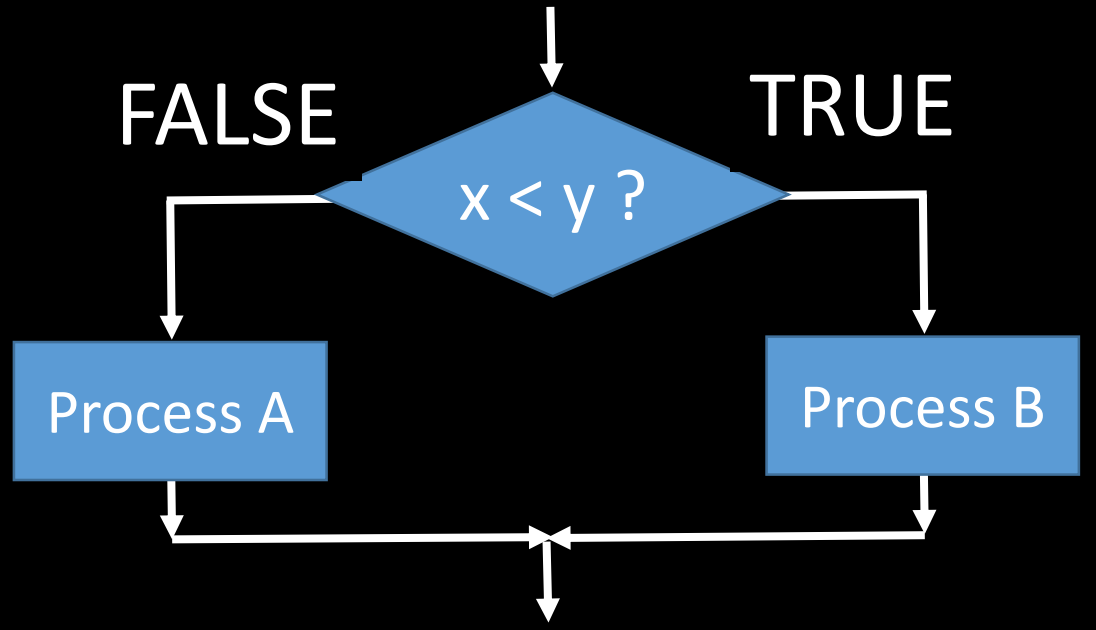
SELECTION STRUCTURE

- In the flowchart segment below, the question “is x < y?” is asked
- If the answer is NO, then process A is performed
- If the answer is YES, then process B is performed



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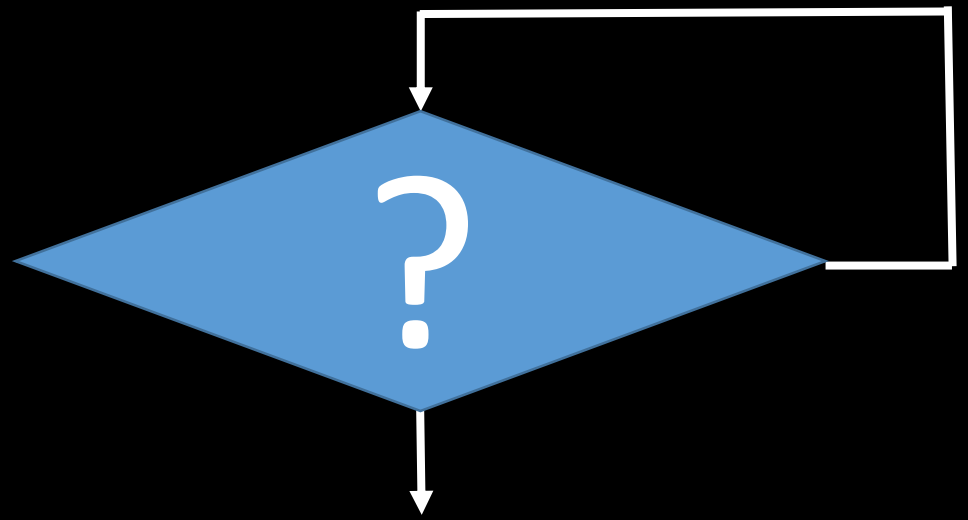
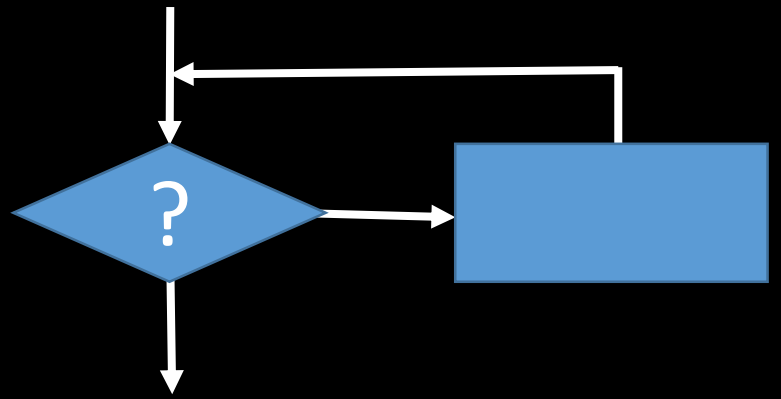
Iteration Structure

- An iteration structure represents part of the program that repeats
- This type of structure is commonly known as a loop





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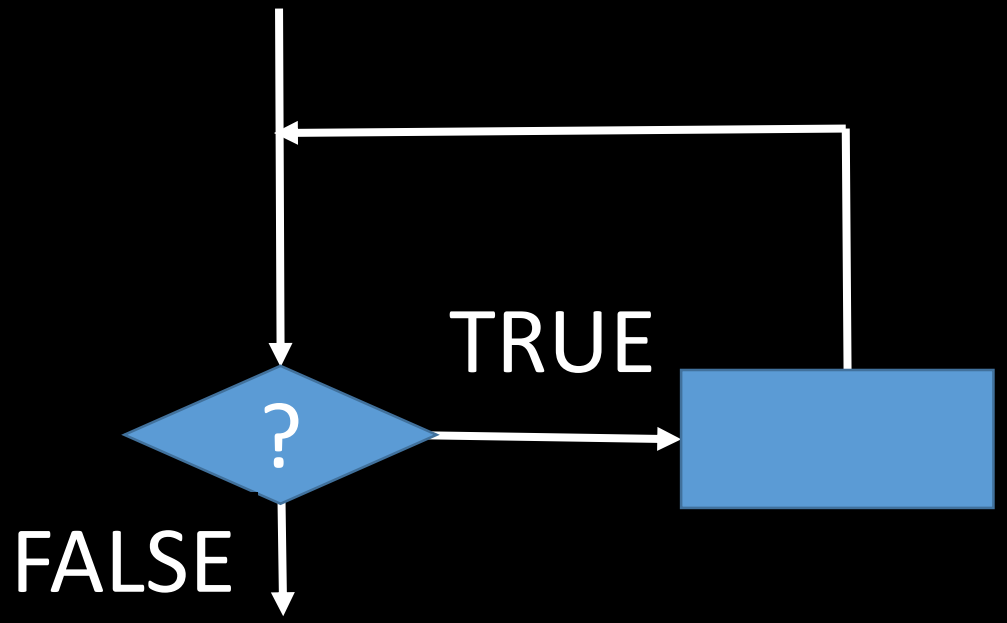
ITERATION STRUCTURE

- A loop tests a condition, and if the condition exists, it performs an action
- Then it tests the condition again
- If the condition still exists, the action is repeated
- This continues until the condition no longer exists.



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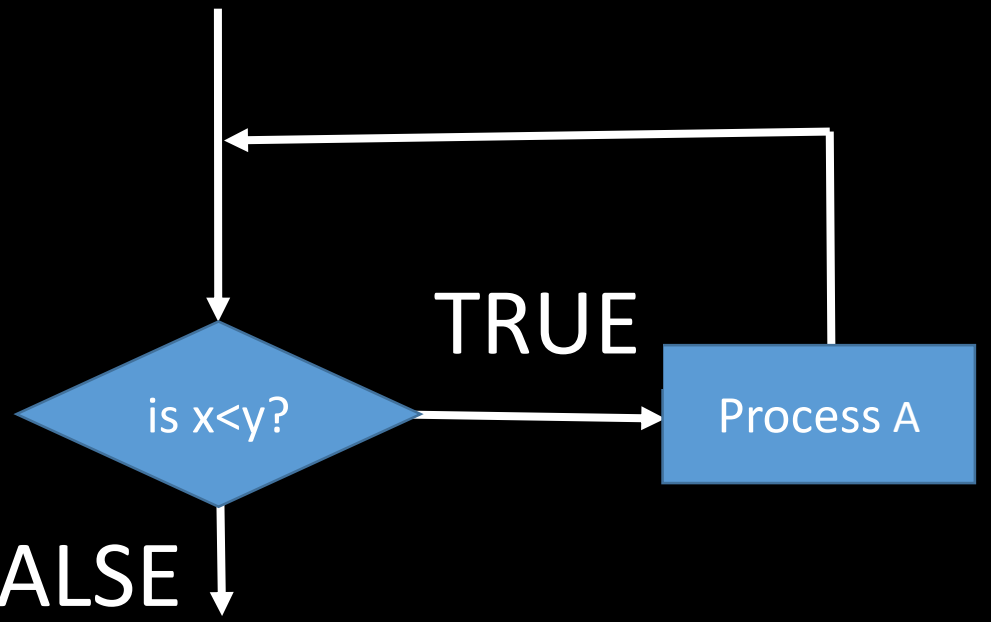
ITERATION STRUCTURE

- In the flowchart segment, the question “is x < y?” is asked
- If the answer is yes, then Process A is performed
- Then the question “is x < y?” is asked again
- Process A is repeated as long as x is less than y
- When x is no longer less than y, the iteration stops and the structure is exited

What needs to happen in Process A?



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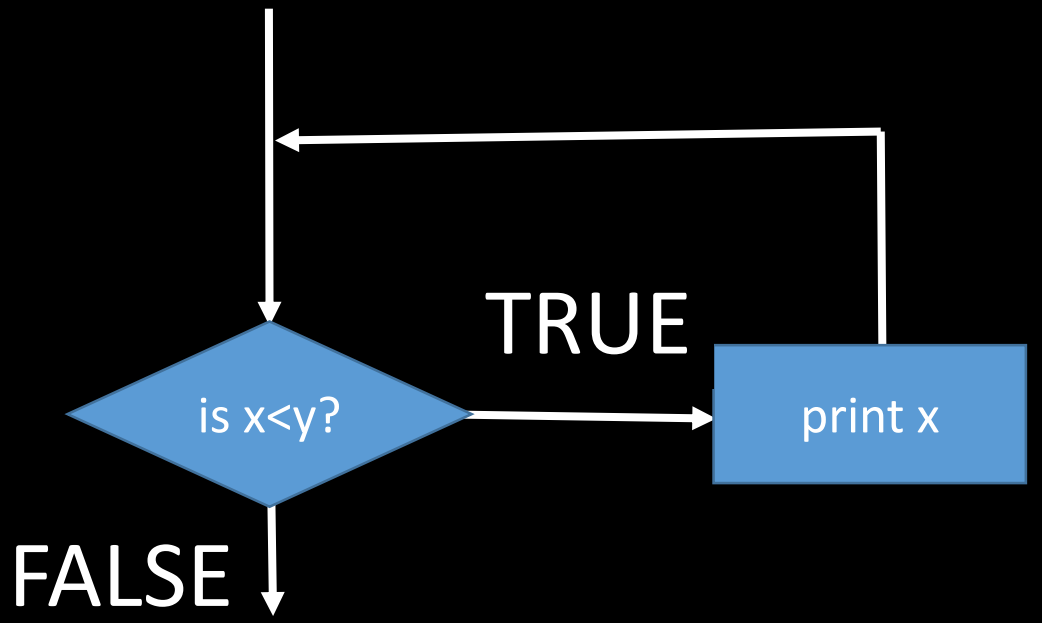
CONTROLLING AN ITERATION STRUCTURE

- The action performed by an iteration structure must eventually cause the loop to terminate. Otherwise, an infinite loop is created
- In this flowchart segment, x is never changed. Once the loop starts, it will never end.

QUESTION: How can this flowchart be modified so it is no longer an infinite loop?



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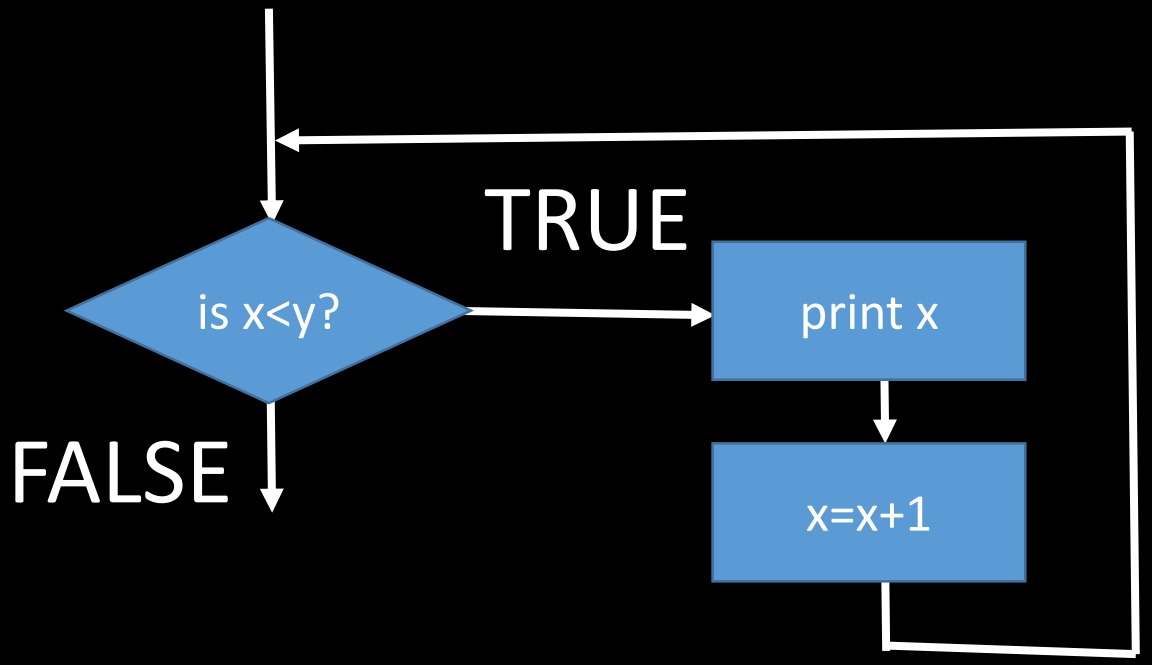
CONTROLLING AN ITERATION STRUCTURE

QUESTION: How can this flowchart be modified so it is no longer an infinite loop?

ANSWER: By adding an action within the iteration that changes the value of x



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IF X STARTS AT 5 AND Y IS = 10?

How many times does the loop loop?

Print 9

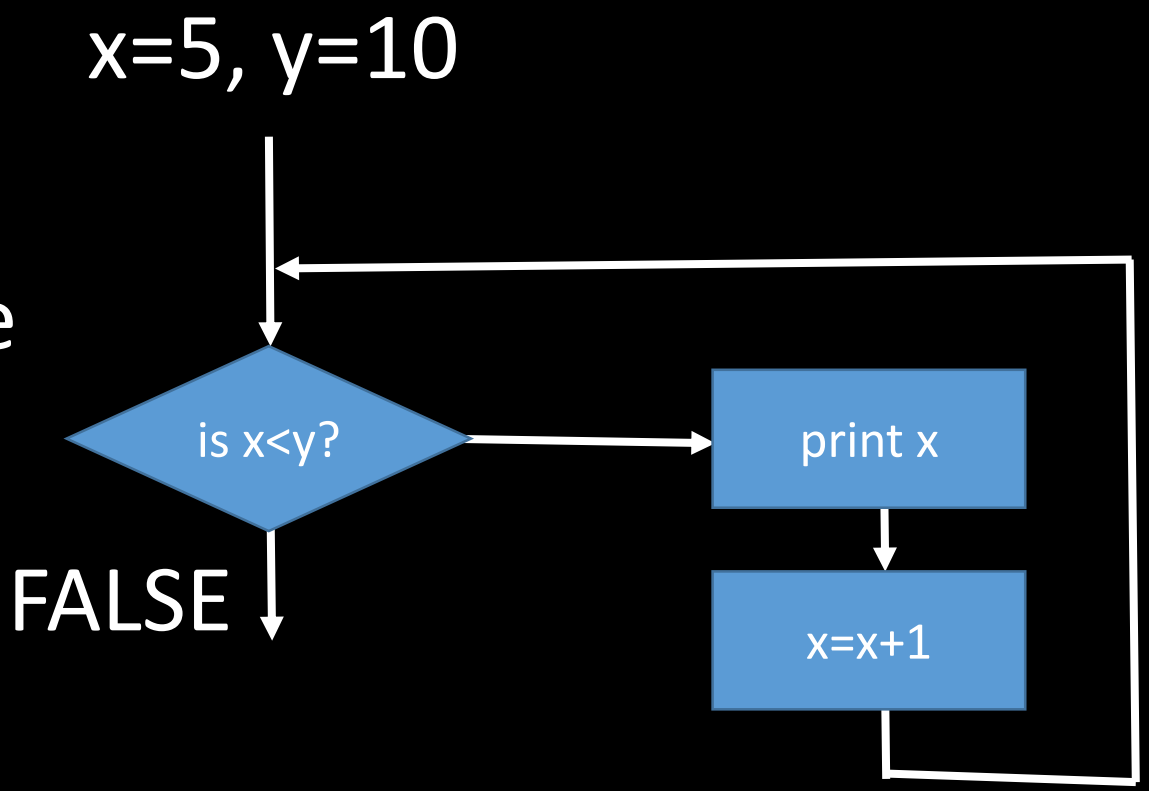
What is the value of y?

y = 10, and does not change

What is the value of x?

6^{th} test of x < y

x= 10



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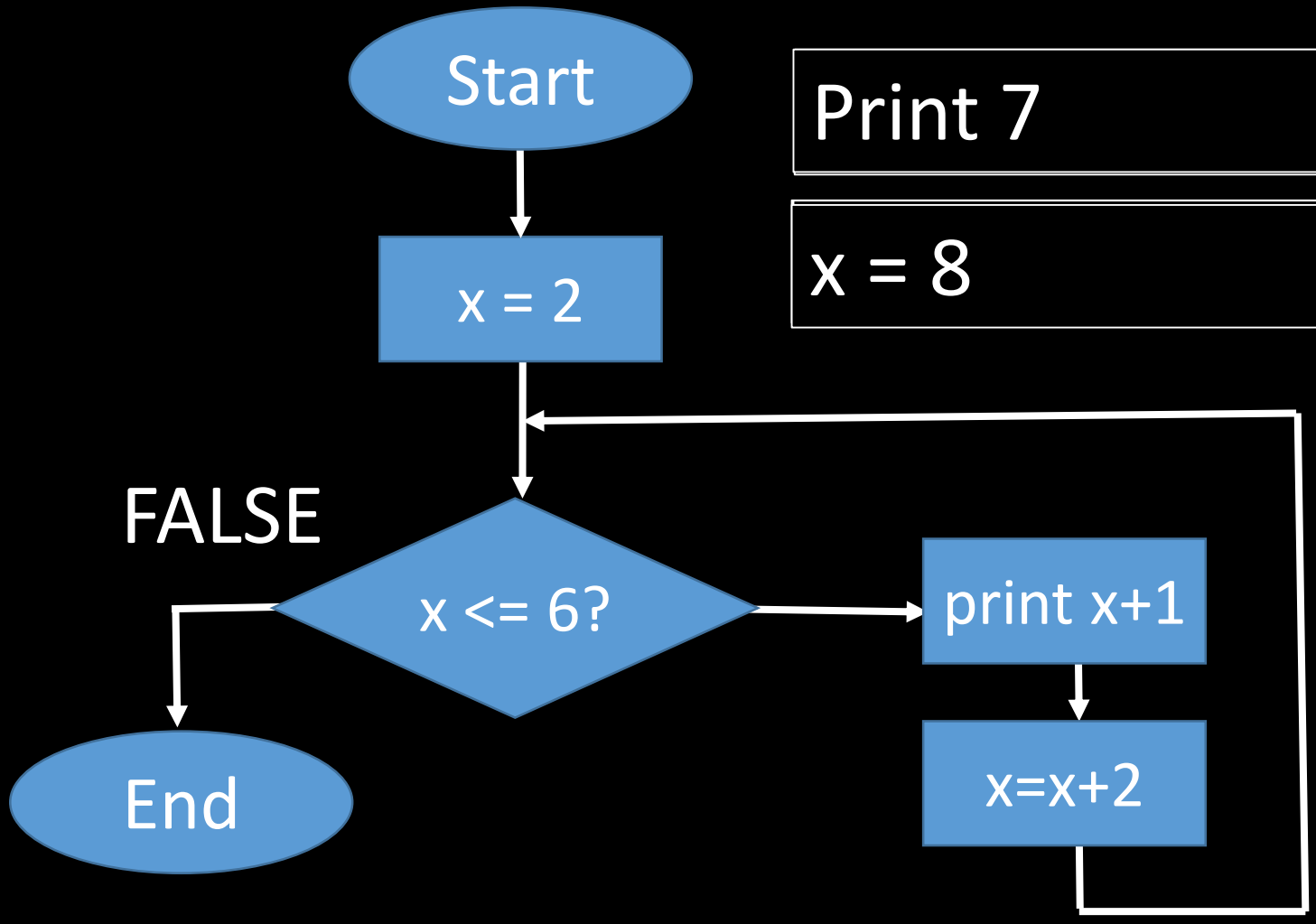
The relational operators in C++ are:

operator	description
==	Equal to
!=	Not equal to
<	Less than
>	Greater than
<=	Less than or equal to
>=	Greater than or equal to



Print 7

x = 8

What is the Test?

x <=6? and 6 doesn't change

What is the value of x?

4th test of x <=6

x= 8

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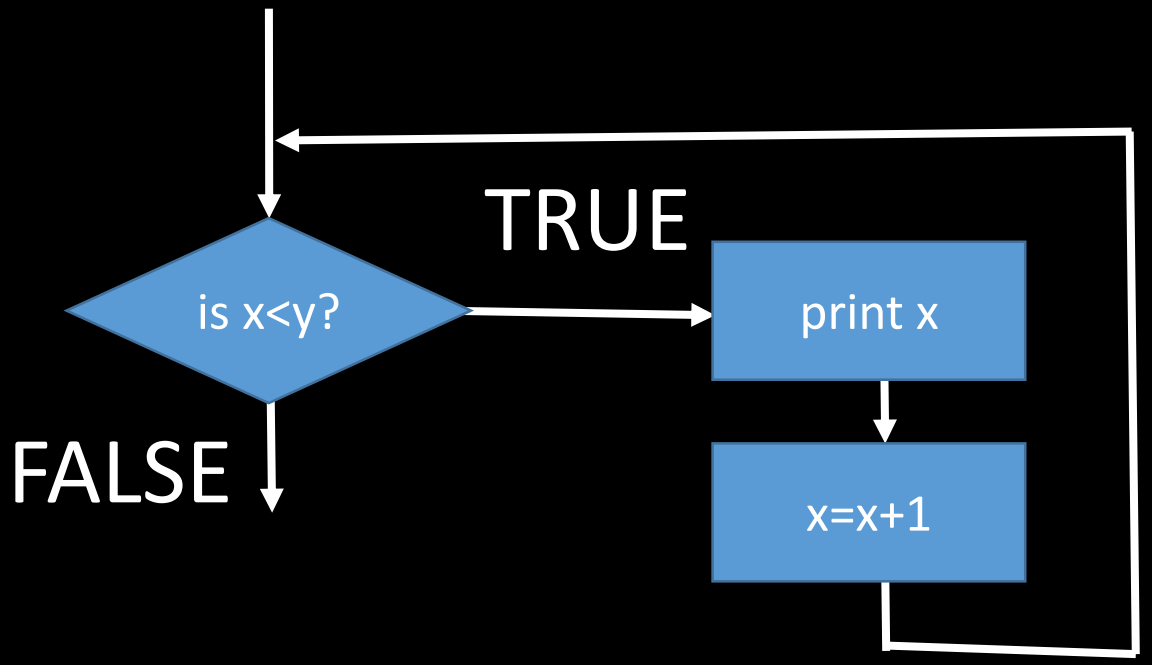
A PRE-TEST ITERATION STRUCTURE

- This type of structure is known as a pre-test iteration structure
- The condition is tested *BEFORE* any actions are performed
- In a pre-test iteration structure, if the condition is not TRUE, the loop will never begin



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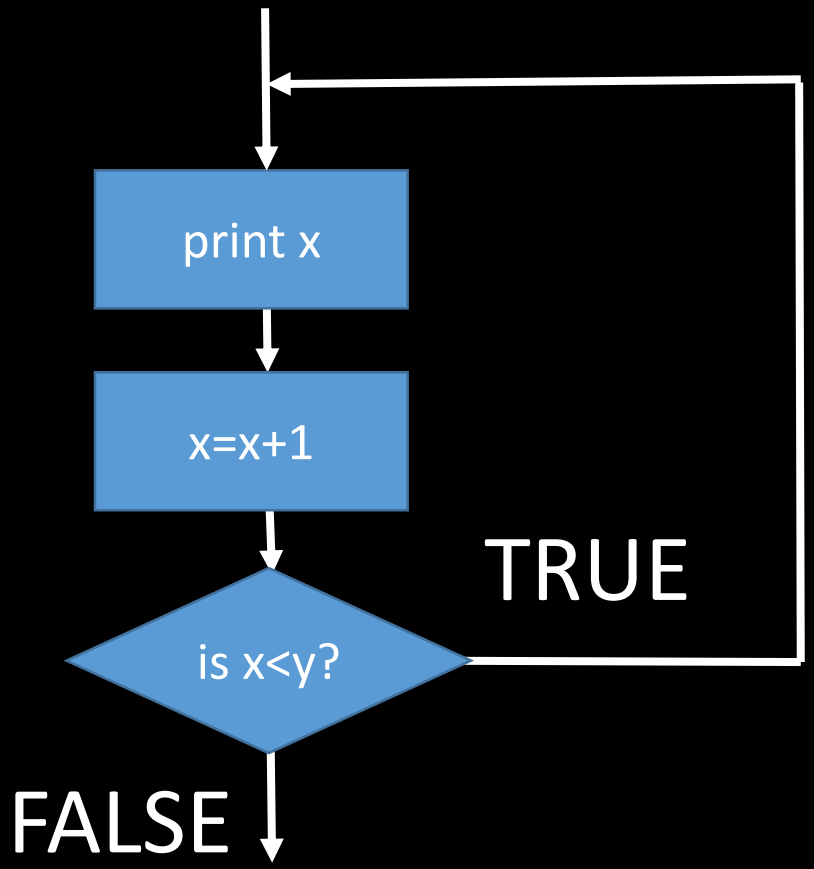
A POST-TEST ITERATION STRUCTURE

- This flowchart segment shows a post-test iteration structure
- The condition is tested AFTER the actions are performed
- A post-test iteration structure always performs its actions at least once



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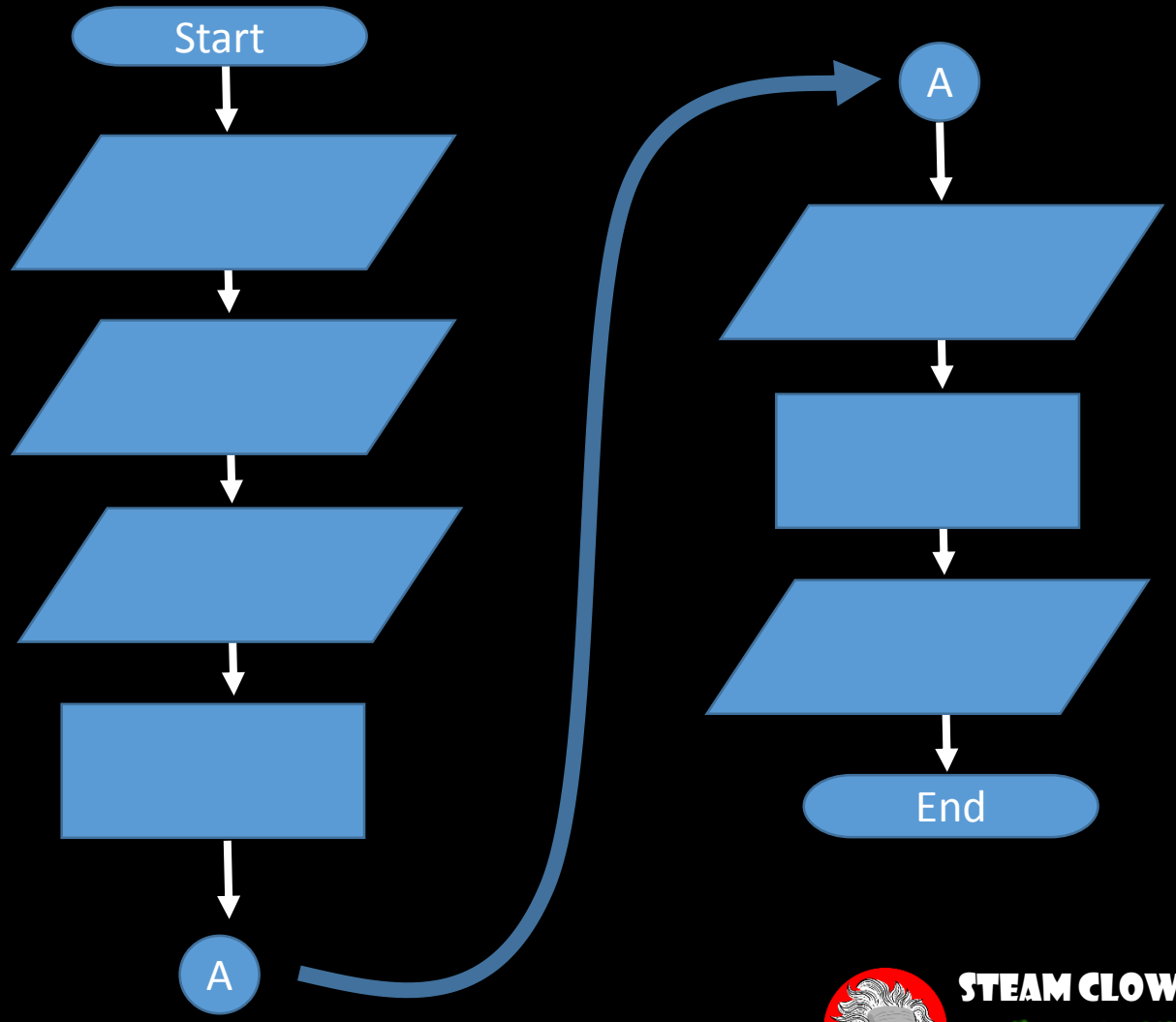
What if the flowchart can't fit on one page?

- A connector structure, lets you connect different flowchart segments
- The "A" connector indicates that the second flowchart segment begins where the first segment ends



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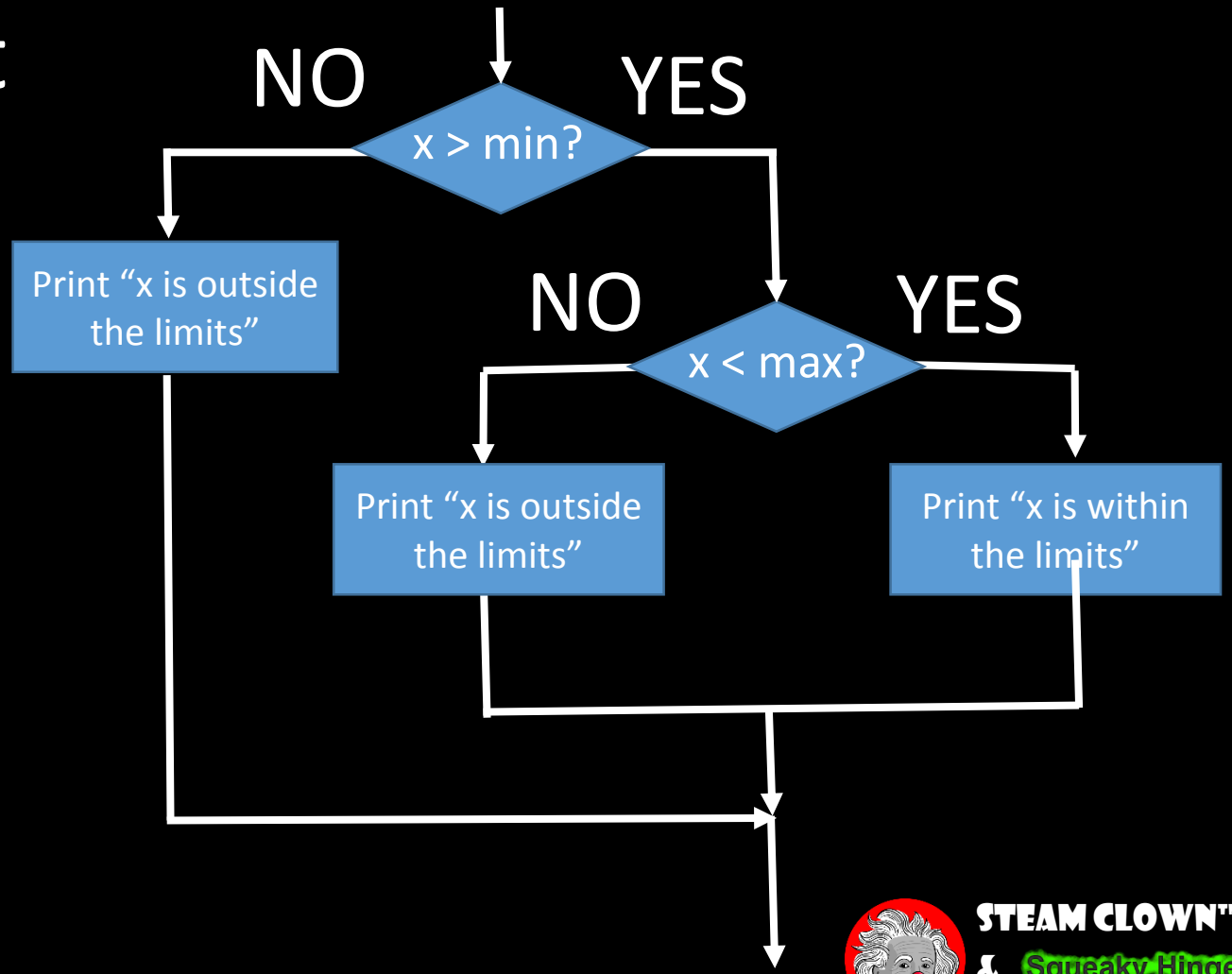
COMBINING STRUCTURE

- This flowchart segment shows two selection structures combined



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REFERENCE SLIDES

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IF X STARTS AT 5 AND Y IS = 10?

How many times does the loop loop?

Print 9

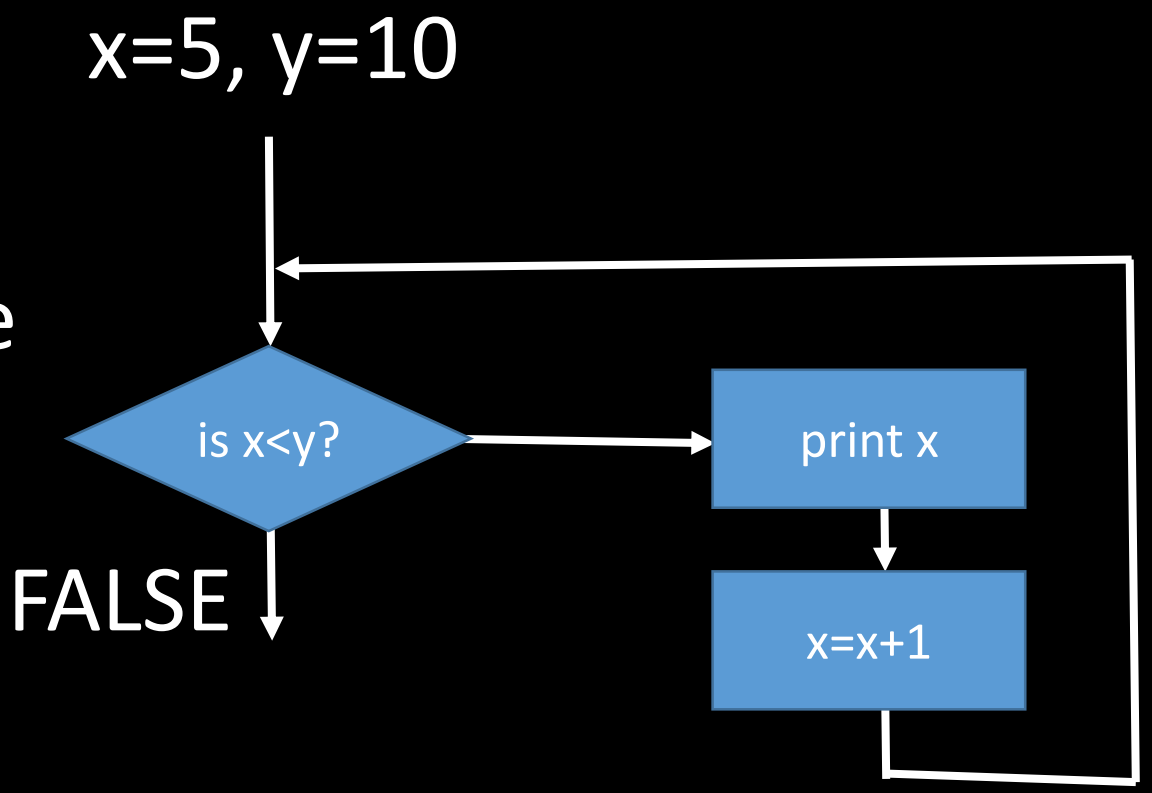
What is the value of y?

y = 10, and does not change

What is the value of x?

6^{th} test of x < y

x= 10



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APPENDIX

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Appendix B: Attribution for Sources Used

- This tutorial is based upon Appendix C from "*Starting Out with C++: From Control Structures to Objects* (5th Edition)" - Copyright Tony Gaddis 2007, Published by Addison-Wesley

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