L3. Introduction to Conditionals

Boolean expressions
The If-Else Construct
And, or, not

What We Cannot Do

We cannot make a computation contingent upon other things.

If the value of the arithmetic expression Dice1 + Dice2 is seven, then increase the value of the variable GamesWon by one.

The If-Else Construct Solves this Problem

We will introduce this language feature by solving problems about the behavior of a given quadratic

\[ q(x) = x^2 + bx + c \]

on a given interval \( L \leq x \leq R \).

Assume Variables \( b, c, L, R \) are Initialized

E.g.,

\[
\begin{align*}
b &= \text{input('Enter b':)} \\
c &= \text{input('Enter c':)} \\
L &= \text{input('Enter L':)} \\
R &= \text{input('Enter R':)}
\end{align*}
\]

The Situation

\[ q(x) = x^2 + bx + c \quad \bullet \quad x_r = -b/2 \]

Write a fragment that prints "yes" if \( q(x) \) increases across the interval and "no" if it does not.

Problem 1
Solution Fragment

\[ x_c = \frac{-b}{2}; \]
if \( x_c \leq L \)
\[
\text{disp('Yes')}
\]
else
\[
\text{disp('No')}
\]
end

Problem 2

Write a fragment that prints the maximum value that \( q(x) \) attains on the interval.

Maximum at \( L \)

\[ q(x) = x^2 + bx + c \quad \bullet \quad x_c = \frac{-b}{2} \]

Maximum at \( R \)

\[ q(x) = x^2 + bx + c \quad \bullet \quad x_c = \frac{-b}{2} \]

Depends on whether \( x_c \) is to the right or left of the interval midpoint.
Solution Fragment

\[ xc = -\frac{b}{2}; \]
\[ \text{Mid} = \frac{(L+R)}{2}; \]
\[ \text{if } xc \leq \text{Mid} \]
\[ \quad \text{maxVal} = R^2 + b*R + c \]
\[ \text{else} \]
\[ \quad \text{maxVal} = L^2 + b*L + c \]
\[ \text{end} \]

Problem 3

Write a fragment that prints "yes" if \( xc \) is in the interval and "no" if \( xc \) is not in the interval.

Solution Fragment

\[ xc = -\frac{b}{2}; \]
\[ \text{if } (L \leq xc) \&\& (xc \leq R) \]
\[ \quad \text{disp}(\text{‘Yes’}) \]
\[ \text{else} \]
\[ \quad \text{disp}(\text{‘No’}) \]
\[ \text{end} \]

Illegal: \( L \leq xc \leq R \)
Saying the Opposite

xc is in the interval \([L,R]\) if

\[ L \leq xc \text{ and } xc \leq R \]

xc is not in the interval \([L,R]\) if

\[ xc < L \text{ or } R < xc \]

Another Solution Fragment

\[ xc = -b/2; \]
\[ \text{if } (xc < L) \text{ || } (R < xc) \]
\[ \quad \text{disp}('No') \]
\[ \quad \text{else} \]
\[ \quad \text{disp}('Yes') \]
\[ \quad \text{end} \]

Solution Fragment

\[ xc = -b/2; \]
\[ \text{if } (L \leq xc) \&\& (xc \leq R) \]
\[ \quad \text{disp}('Yes') \]
\[ \quad \text{else} \]
\[ \quad \text{disp}('No') \]
\[ \quad \text{end} \]

The if-else Construct

\[ \text{if } \text{boolean expression} \]
\[ \quad \text{Commands to execute if the expression if TRUE} \]
\[ \text{else} \]
\[ \quad \text{Commands to execute if the expression if FALSE} \]
\[ \text{end} \]

Boolean Expressions

\[ (xc < L) \text{ || } (R < xc) \]

Their value is either true or false.

Made up of comparisons that are either true or false.

Connected by logical operators:

and, or, not

Boolean Expressions

\[ (xc < L) \text{ || } (R < xc) \]

Their value is either true or false.

Made up of other (simpler) boolean expressions that are connected by boolean operators:

and, or, not
Arithmetic Expressions

\[(x+3) \times (y-z)\]

Their value is a number.

Made up of other (simpler) arithmetic expressions that are connected by arithmetic operators:
+ , - , * , /

Relational Operators

<  Less than
>  Greater than
<= Less than or equal to
>= Greater than or equal to
== Equal to
~= Not equal to

The And Operator &&

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The Or Operator ||

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The not Operator ~

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Question Time

What is the value of \(X\) and \(Y\) after the following script is executed:

\[X = 6; Y = 8;\]
\[If \ X < Y\]
\[\quad Y = Y/2;\]
\[else\]
\[\quad X = X/2;\]
\[end\]

A. \(X\) is 3 and \(Y\) is 4
B. \(X\) is 6 and \(Y\) is 8
C. \(X\) is 6 and \(Y\) is 4
D. \(X\) is 3 and \(Y\) is 8