INF 154 LECTURE 4

DECISIONS, DECISIONS

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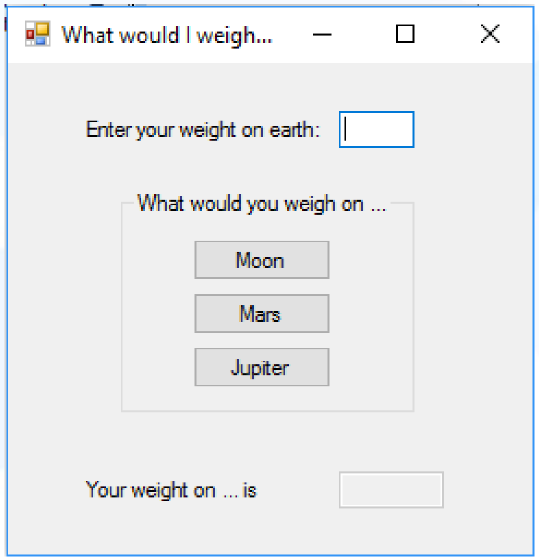
After this lecture you should be able to …

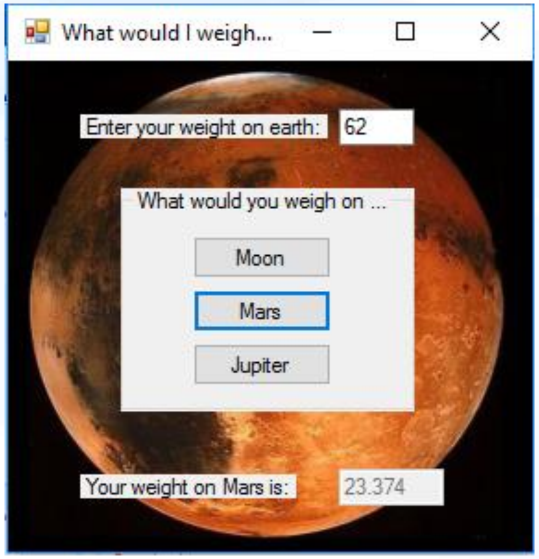
1. Use If statements for conditional execution in your programs
2. Use one-way if statements, two-way if statements, nested if-statements and else-if statements.
3. Write conditional statements using conditional operators such as ==, <, >, >=
4. Write compound conditional statements using the logical operators &&, || and !
5. Handle basic input errors using if statements

Introducing If statements

Consider the program which asks you for your weight on earth and then determine what your weight would be on the Moon, Mars and Jupiter respectively.

Our form looks as follows:





Enter your weight on earth: 62

What would you weigh on ...

Your weight on Mars is: 23.374

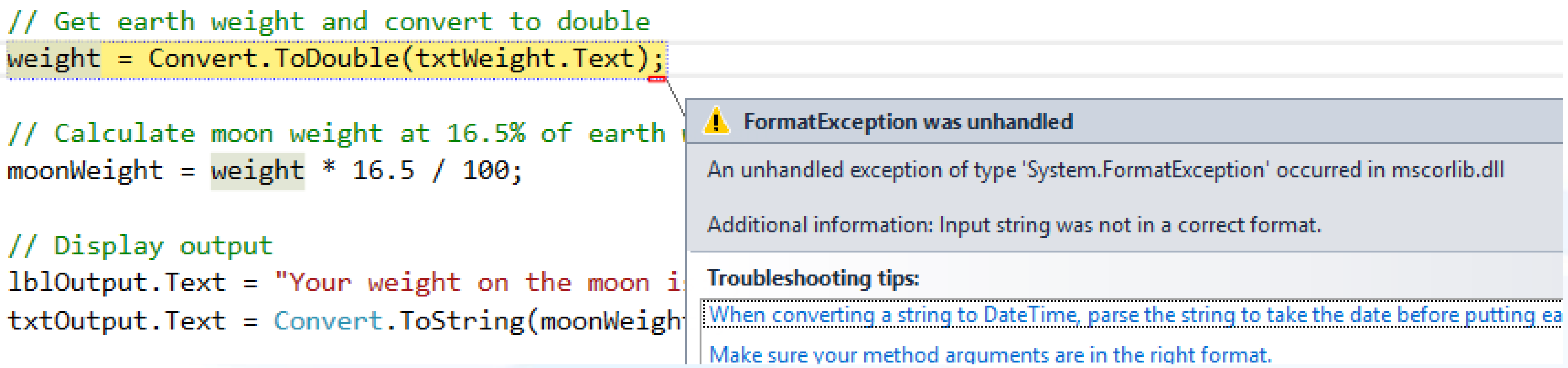
Introducing If statements

Below is the code for the Moon event handler. The other two look similar.

```
private void btnMoon_Click(object sender, EventArgs e)
{
    // Declare variables
    double weight, moonWeight;

    // Get earth weight and convert to double
    weight = Convert.ToDouble(txtWeight.Text);

    // Calculate moon weight at 16.5% of earth weight
    moonWeight = weight * 16.5 / 100;

    // Display output
    lblOutput.Text = "Your weight on the moon is:";
    txtOutput.Text = Convert.ToString(moonWeight);

    // Change the background to the moon
    this.BackgroundImage = Image.FromFile("C:\\Users\\.....\\moon.jpg"); // Not full path

    this.BackgroundImageLayout = ImageLayout.Stretch; // Make image layout Stretch
}
```

Introducing If statements

If we run the program with this code and leave the text box blank when clicking one of the buttons, the following error occurs:



```
// Get earth weight and convert to double
weight = Convert.ToDouble(txtWeight.Text);

// Calculate moon weight at 16.5% of earth
moonWeight = weight * 16.5 / 100;

// Display output
lblOutput.Text = "Your weight on the moon i
txtOutput.Text = Convert.ToString(moonWeigh
```

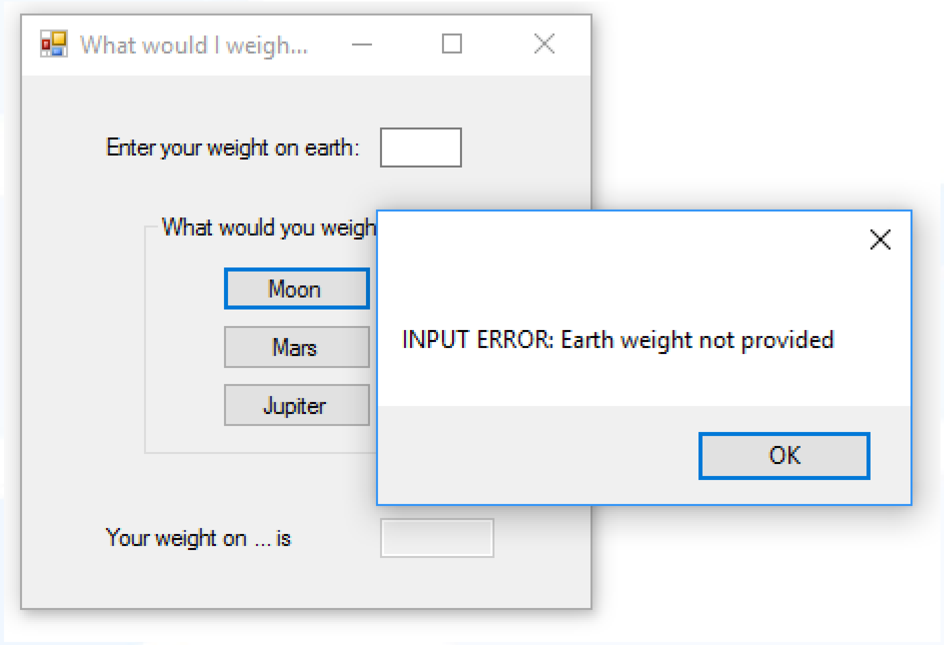
```
FormatException was unhandled
An unhandled exception of type 'System.FormatException' occurred in mscorlib.dll

Additional information: Input string was not in a correct format.

Troubleshooting tips:
When converting a string to DateTime, parse the string to take the date before putting ea
Make sure your method arguments are in the right format.
```

The input string is empty and therefore is not in a format that allows the conversion to happen.

Ideally we would want the following to happen ….

Introducing If statements

A simple error message appears and if the user clicks OK there is a second chance to provide input.



INPUT ERROR: Earth weight not provided

To implement this error handling in our program we use an IF STATEMENT

Introducing If statements

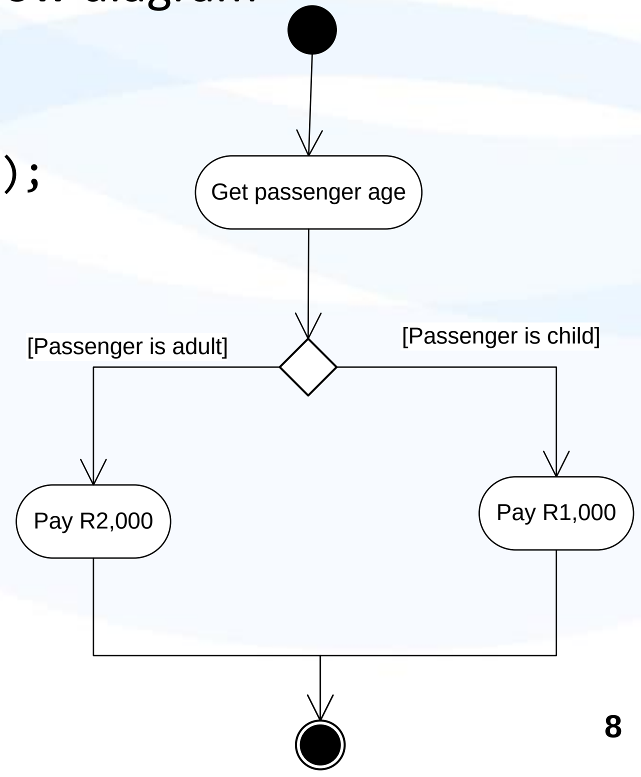
The Moon button’s event handler with the If statement added looks as follows:

```
private void btnMoon_Click(object sender, EventArgs e)
{
    // Declare variables
    double weight, moonWeight;

    // Check if user provided input
    if (txtWeight.Text == "")  // Is the text box empty?
    {
        MessageBox.Show("INPUT ERROR: Earth weight not provided");
    }
    else
    {
        // Get earth weight and convert to double
        weight = Convert.ToDouble(txtWeight.Text);

        THE REST OF THE EVENT HANDLER’S CODE AS IT WAS GOES HERE
    }
}
```

Introducing If statements

- If statements provide programmers with a way to choose between alternative routes in a program.
- Suppose a program has to calculate the price of a flight ticket, and there is a different rate for adults and children.
- The flow of execution is shown alongside in a flow diagram and the code to implement it below.

```
passengerAge = Convert.ToInt32(txtAge.Text);

if (passengerAge > 12)
{
    ticketPrice = 2000;
}
else
{
    ticketPrice = 1000;
}
```



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Introducing If statements

- The **if** keyword is followed by a **condition** in brackets.
- The condition can have one of two values – true or false.
- The **else** keyword is optional (if it is not there, it is as if no code is allocated to the else part).
- There is no semicolon after the condition.
- Use curly brackets to group instructions in the true and false sections respectively.

```
if (txtWeight.Text == "") // In brackets is the conditional
                          // statement that can be TRUE or FALSE
{
     // Code here executes if the condition is TRUE
}
else
{
    // Code here executes if the condition is FALSE
}
```

Introducing If statements

- When the **if** (true) part or the **else** (false) part only has one statement, you don't need curly brackets, but we prefer to always use them.
- Each statement in these parts ends with a semicolon.
- The condition usually compares two values using a logical operator like >, < or ==.

```
if(number < 5)
    value = "Low";
else
    value = "High";
```

These statements do exactly the same.

```
if(number < 5)
{
    value = "Low";
}
else
{
    value = "High";
}
```

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Comparison Indicators

Assume: A = 5, B = 3 (both integers)

Operation	Standard notation	C# notation	Example	Result
Is equal to	=	==	A == B	False
Is not equal to	≠	!=	A != B	True
Is greater than	>	>	A > B	True
Is less than	<	<	A < B	False
Is greater than or equal to	≥	>=	A >= B	True
Is less than or equal to	≤	<=	A <= B	False

Comparison Indicators

Do the following in groups of two:

Assume: A = 4, B = 6 (both integers)

	Operation	**Example**	**Result**
i	Is equal to	A == B	
ii	Is not equal to	A != B	
iii	Is greater than	A > B	
iv	Is less than	A < B	
v	Is greater than or equal to	A >= B	
vi	Is less than or equal to	A <= B	

Conditional statements

- The conditional statement in an if statement can have only one of two values – true or false.
- It is thus a boolean expression.
- A variable of type bool also counts as a boolean expression.
- A property that has type bool is also a boolean expression

Examples:

```
    if (btnInput.Enabled)
    if (radMusic.Checked)
    if (hasPassed)  // where hasPassed is a variable of type bool
    if (age >= 50)
    if (txtInput.Text == "") // where "" is an empty string
```

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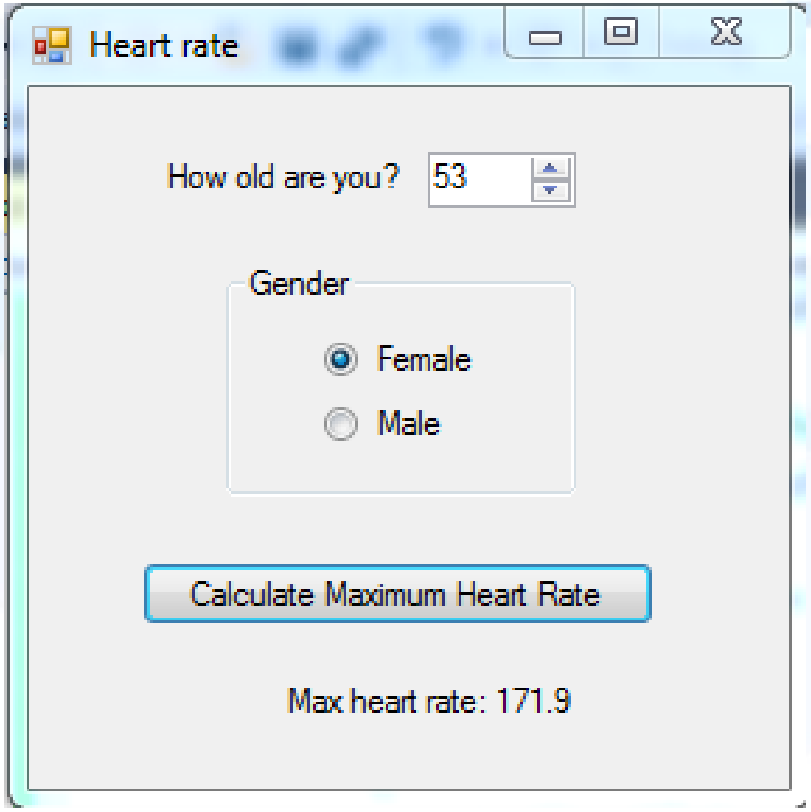
Theory exercise 2

We are going to rewrite the maximum heart rate program that we wrote in Lecture 3 so that the interface looks as below. Instead of buttons for Male and Female calculations we only have one Calculate button. We use RadioButtons to choose a gender.

How will the code for this Calculate Button look?

Note: Because we are using a Numeric Updown for the input there will always be some default input value. The problem we solved in the previous program will not occur here.


Heart rate

How old are you? 53

Gender

(● Female) ○ Male

Calculate Maximum Heart Rate

Max heart rate: 171.9

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Theory exercise 2

We will NOT create Event handlers for the RadioButtons. Instead we are going to have a Button with a Click event handler that will use the radio buttons' Checked property to determine which gender was chosen.

- If the Female RadioButton is Checked we use the formula Maximum heart rate = 209 – (0.7 x age)
- Otherwise, if Male is Checked, we use Maximum heart rate = 214 – (0.8 x age)

```
if (radFemale.Checked)
{
        maxHeartRate = 209 - (F_FACTOR * age);
}
else
{
        maxHeartRate = 214 - (M_FACTOR * age);
}
```

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The complete event handler appears on the next slide.

```
private void btnCalculate_Click(object sender, EventArgs e)
{
    // Declare variables
    int age;
    double maxHeartRate;
    const double F_FACTOR = 0.7; // value for females
    const double M_FACTOR = 0.8; // value for males

    // Get user's age
    age = Convert.ToInt32(nudAge.Value);

    // Calculate max heart rate delending on which gender was chosen
    if (radFemale.Checked)
    {
        maxHeartRate = 209 - (F_FACTOR * age);
    }
    else
    {
        maxHeartRate = 214 - (M_FACTOR * age);
    }

    // Display the result
    lblResult.Text = "Max heart rate: " + Convert.ToString(maxHeartRate);
}
```

Theory exercise 2

One problem with the solution on the previous slide is that the program will not work if none of the RadioButtons are selected.

To solve that we use else-if statements. So the if statement will change to the following:

```
if (radFemale.Checked)
{
      maxHeartRate = 209 - (F_FACTOR * age);
}
else if (radMale.Checked)
{
      maxHeartRate = 214 - (M_FACTOR * age);
}
else
{
      MessageBox.Show("Please select a gender");
}
```

Logical operators

Sometimes we want to check for two things in the same conditional statement.

For example:

We might want to check whether someone is between the ages of 12 and 50, then we have to test for “greater than 12” as well as “less than 50” in one condition.

Or we might want to give a discount but only if the client is a pensioner or the purchase is above R1000.

To handle such compound conditional statements we use the logical operators “AND” and “OR” .

Logical operators

To check whether someone is between the ages of 12 and 50, we will write

```
if (age > 12 && age < 50) // where && means AND
```

To give a discount but only if the client is a pensioner OR the purchase is above R1000, we'll use something like

```
if (chkPensioner.Checked || purchaseAmount > 1000)
                          // where || means OR
```

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Logical operators

Operator	C#	Description	Truth table
Logical And	&&	Both conditions must be true	A B A & B True True True True False False False True False False False False
Logical Or	||	Either or both conditions are true	A B A | B True True True True False True False True True False False False
NOT	!	Makes any false statement true and true statement false	A !A True False False True

Theory exercise 3

Suppose the two Labels start empty and the variables are declared as follows:

```
int value1 = 3;
int value2 = 4;
```

What will the Labels look like after the following code:

```
if (value1 == value2 && value1 > 0)
   lblOut1.Text = "Jack";
   lblOut2.Text = "Jill";
```

```
if (value1 == value2 || value1 > 0)
   lblOut1.Text = "Jack";
   lblOut2.Text = "Jill";
```

```
if (!(value1 > value2))
   lblOut1.Text = "Jack";
   lblOut2.Text = "Jill";
```

Theory exercise 4

What are the problems with the following statements?

How will you fix it?

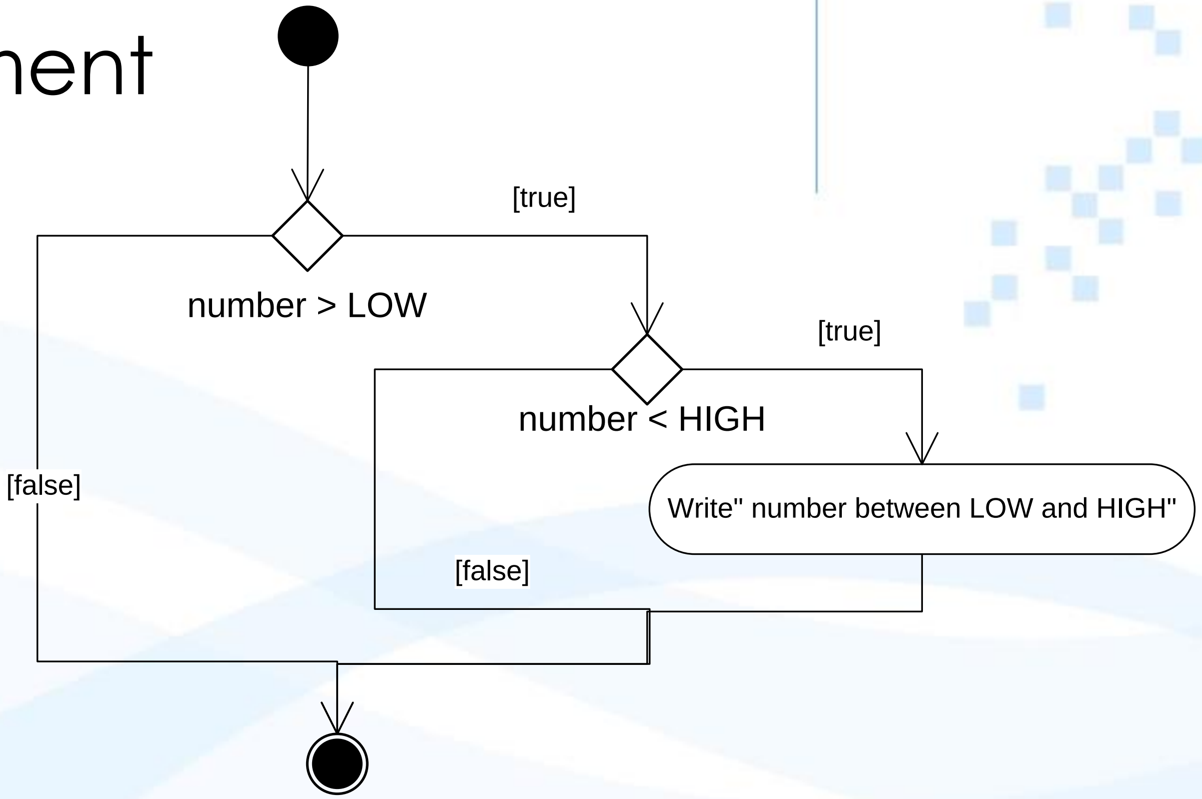
```
if (payRate < 5.65 && payRate > 60)
```

```
if (department == 1 && department == 2)
```

```
if (salesCode != "A" || salesCode != "B")
```

Nested if statement

The true or false parts of an if statement can again contain an if statement.



```
if (number > 5)
{
  if (number < 10)
  {
     lblOutput.Text = Convert.ToString (number) +
                              " is between 5 and 10";
  }
}
```

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Nested if statement

An Else-If statement (as we used in exercise 2) is also a form of nested if statement. We can restructure that code as follows and it will mean exactly the same thing:

```
if (radFemale.Checked)
{
      maxHeartRate = 209 - (F_FACTOR * age);
}
else
    if (radMale.Checked)
    {
        maxHeartRate = 214 - (M_FACTOR * age);
    }
    else
    {
        MessageBox.Show("Please select a gender");
    }
```

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Nested if statement

What is the result of the following conditional statement

```
int first = 7, second = -23, third = 13;
 if (first > second)
 {
     if (first > third)
     {
         MessageBox.Show(Convert.ToString(first)+ "is the largest");
     }
     else
     {
         MessageBox.Show(Convert.ToString(third) + " " +"is the largest");
     }
 }
 else
 {
     if (second > third)
     {
         MessageBox.Show(Convert.ToString(second) + " " + "is the largest");
     }
     else
     {
         MessageBox.Show(Convert.ToString(third) + " " + "is the largest");
     }
 }
```

Nested if statement

PLEASE ALSO STUDY THE EXPLANATION OF IF STATEMENTS AT

https://msdn.microsoft.com/en-us/library/5011f09h.aspx