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# Type Casting

This lab serves multiple goals:

* To help you develop good lab habits,
* To declare, assign, and display variables of different datatypes,
* To understand how to use arithmetic operators,
* To experience the differences in numerical datatypes,
* To learn how to “cast” between numerical datatypes,
* To understand what types of operations are “legal”.

## Numerical Datatypes

For this part, it is recommended to have the [datatypes cheatsheet](https:///princomp.github.io/docs/programming_and_computer_usage/datatypes_in_csharp) readily available. Note that there are numerous references at the bottom of the cheatsheat. You are encouraged to open those links and have a look at the official documentation, if you have not already done so. Being able to reference the official documentation will help you in your studies.

### Literals and Variables

*This part should first be attempted using pen and paper before using an IDE.*

Assume we have the following statements:

int a = 21, b = 4;
float f = 2.5000000f;
double d = -1.3;
decimal m = 2.5m;

Answer the following:

* How many variables are declared?
* For each of those variables, give their name, datatype, and value.

Solution:

There are 5 variables.

| Name | Datatype | Value |
| --- | --- | --- |
| a | int | 21 |
| b | int | 4 |
| f | float | 2.5000000 |
| d | double | -1.3 |
| m | decimal | 2.5 |

### Operations

Consider the following expressions, all of which use the variables we declared above. For each of them, decide if they are legal, and if so, determine the result and its corresponding datatype. The first two are given as examples:

| Operation | Legal? | Result | Datatype |
| --- | --- | --- | --- |
| a + d | Yes | $19.7$ | double |
| m + f | No | N/A | N/A |
| a / b |   |   |   |
| b \* f |   |   |   |
| d + f |   |   |   |
| d + b |   |   |   |
| a + m |   |   |   |
| f / m |   |   |   |
| d \* m |   |   |   |

## Casting

### Cast Operator

Create a new project, and then do the following.

1. Add in your program the following:
* float floatVar = 4.3f;
int intVar = floatVar; // This statement will give you an error
* You will get an error that reads
* Cannot implicitly convert type 'float' to 'int'. An explicit conversion exists (are you missing a cast?)
* Can you explain it?
1. Your IDE is suggesting that we use a “cast” to “force” C# to store the value of the variable floatVar into the variable intVar. To do so, replace the statement
* int intVar = floatVar; // This statement will give you an error
* with the following:
* int intVar = (int)floatVar; // This statement will compile
1. Using a Console.WriteLine statement, observe the value stored in intVar. Can you tell if the value stored in floatVar was rounded or truncated before being stored in the variable intVar? Conduct further experiments if needed to answer this question.

### Implicit and Explicit Casting

1. Look back at the warning given by the IDE. It uses the term “implicitly convert” before introducing the cast operator.
2. While you needed a cast to convert a float to an int, do you need one to convert an int to a float? Try the following:
* int intVar = 21;
float floatVar = intVar; // Does this need a cast?
* Generally, you need an explicit cast if an implicit conversion would lead to data loss. Since all possible int values are also valid float values, no explicit cast is needed!
1. Do these cases need an explicit cast, or will an implicit conversion work? Try them in your IDE to check your answers!
* double to int
* int to double
* float to double
* double to float
* int to decimal
* decimal to float
* float to decimal

That last result may have been surprising. While decimal has higher precision than float and double, it requires an explicit cast from either of those types, as you would be attempting to “force” imprecise data into a datatype that is supposedly extremely precise. Think about measuring wood with an inaccurate tape measure and then cutting it with laser precision; that is what storing a float as a decimal is!