Expressions, Variables, and Sequential Programs

01204111 Computer and Programming

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Outline

- Simple sequential programs
- Arithmetic expressions
- Basic output
- Variables and important data types

Task: *Dining Bill*

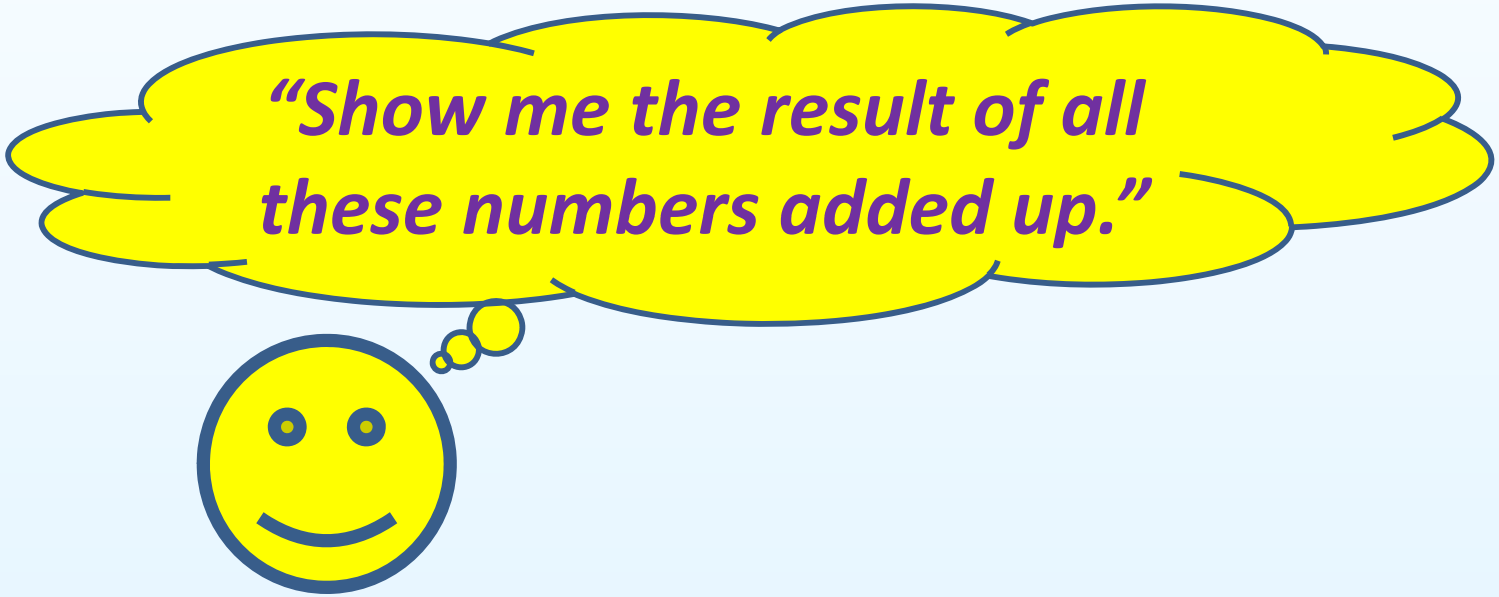
- At a dining place with your friends, there are five items you ordered:

Item	Price
Salad	82
Soup	64
Steak	90
Wine	75
Orange Juice	33

- Write a program to compute the total cost of the bill.

Dining Bill – Ideas and Steps

- We simply want to know the summation of all the five numbers
- Somehow, we need to tell the computer to



Dining Bill – First Program in C#

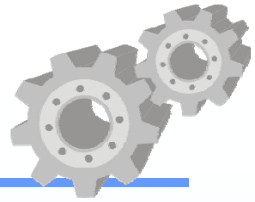
- Notes: the outermost "namespace" declaration is omitted

```
using System;

class Program
{
    static void Main()
    {
        Console.WriteLine( 82+64+90+75+33 );
    }
}
```

Did the Math Operation first.

Explanation



collection of tools.

Tell the computer we want to use the **System** library

```
using System;

class Program
{
    static void Main()
    {
        Console.WriteLine( 82+64+90+75+33 );
    }
}
```

In C#, a program must be inside a **class**.
(The class name can be anything.)

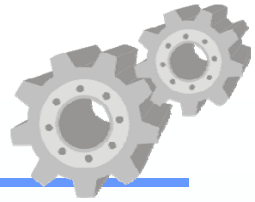
Code in Main() is to be run on the programme.

Program's entry point is indicated by start of the **Main()** method.

This line is our only statement (i.e., command) in the program

Namespace.Class.Method()
<omnitted>.Console.WriteLine()

What Is a Statement?



- A (programming) **statement** is a complete command to order the computer to do something
- In our example, it is the line

```
Console.WriteLine( 82+64+90+75+33 );
```

- This is equivalent to giving a command

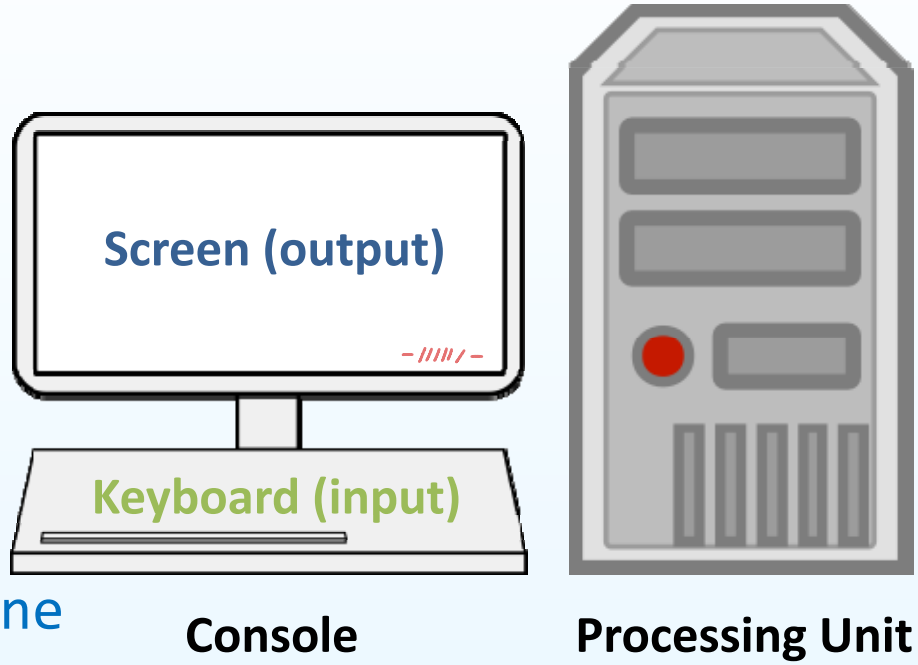
"Hey **Console**! Please **write** a **line** with the value of the expression **82+64+90+75+33**."

- In C#, a single statement ends with **;** (semicolon)
- A program usually consists of many statements

except if cause block (loop and condition is considered by me as block, NOT statement.)

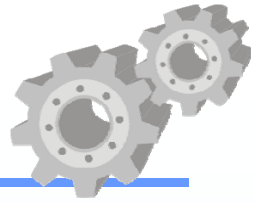
What Is the Console?

- The ***console*** is a simple text entry and display device for the computer
  - Keyboard for text input
  - Screen for text output
- In C#
  - The method `Console.Write` or `Console.WriteLine` outputs text to screen
  - The method `Console.ReadLine` inputs text from keyboard



Function, Procedure

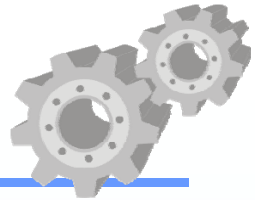
What Is a Method?



- A **method** is a set of steps prepared to perform a certain task
  - Also known as a **procedure** or a **function** in some programming languages
- Examples are
  - `Console.WriteLine` – writes something on the screen
  - `Console.ReadLine` – reads input from the keyboard
- Methods that give back values can be used as **expressions** (i.e.: int a = Console.Read();) → Value-returning method.

  assignment statements
  - E.g., `Console.ReadLine` gives a string value that user entered on the keyboard
- We will learn how to write your own method in the next class
  - For now, we will use only methods already provided by C#

What Is an Expression?



- An **expression** is something that can be evaluated to a value
  - An **arithmetic expression** can be evaluated to a numerical value
- In our example, it is the part

ตรงนี้

```
Console.WriteLine( 82+64+90+75+33 );
```

- This part gets evaluated by the computer. The result, 344, is then given to the `Console.WriteLine` method.

Other Statement Examples

```
Console.WriteLine(20);
```

- displays a single value, 20, and move the cursor to the new line

```
Console.WriteLine();
```

- simply move the cursor to the new line

```
Console.WriteLine("Hello");
```

- displays the text HELLO and move the cursor to the new line
- "HELLO" is a **string** expression

```
Console.Write("Hi");
```

- displays the text Hi without moving the cursor to the new line

สรุปค่ำ
- Statement = คำสั่ง
- Expression = การคำนวณการ → i.e.
  - → Arithmatic คิดเลข
  - → Assignment เซ็ตค่าตัวแปร
  - → Boolean เช็ค True/false

Dining Bill – Revised Program

- Let us modify our previous example to make it output more informative

```
using System;

class Program
{
    static void Main()
    {
        Console.Write("Total cost is ");
        Console.WriteLine(82+64+90+75+33);
    }
}
```

- Our program now has two statements, executed from top to bottom

Better Than a Calculator?

- Of course, using a simple calculator for this task might seem much easier. However,
  - Repeating the whole task is tedious, especially with many numbers You know, Programmers are such a lazy specie.
  - When making a small mistake, the whole process must be restarted from the beginning
- With a program, all steps can be easily repeated and modified

Task: *Discounted Dining Bill*

- Based on the previous scenario, one of your friends just happens to carry a member card with 20% discount
- Modify the program to compute the final cost

Discounted Dining Bill – Ideas

- Start with the same summation expression
- With 20% discount, the final cost will be 80% of the original
- Therefore, we just multiply the original expression by 0.8
- In most programming languages, * means multiply

Discounted Dining Bill – 1st Attempt

- Will this work?

```
using System;

class Program
{
    static void Main()
    {
        Console.Write("Total cost is ");
        Console.WriteLine( 82+64+90+75+33 * 0.8);
    }
}
```

Caveats – Operator Precedence

- In C# (and most programming languages), different operators have different precedence in order of operations
- For example, * has precedence over + in this expression, no matter how many spaces are used

```
82+64+90+75+33 * 0.8
```

- Therefore, the above expression is equivalent to:

```
82+64+90+75+(33*0.8)
```

which is <u>wrong</u>

! P/E/M D/A S

Parenthesis, Exponential, Multiplication

Division, Addition, Subtraction

Operator Precedence

- C# (and most programming languages) evaluates expressions in this order

Operators	Precedence
( ) P	Highest
* / % MD(M)	:
+ - AS	Lowest

- Operations of the same precedence are evaluated from left to right
- When not sure, always use parentheses

Operator Precedence: Examples

Expression	Equivalent to
2*3+4*5	(2*3)+(4*5)
1+2+3+4	((1+2)+3)+4
(2+3)/5*4	((2+3)/5)*4
3-2-5-(7+6)	((3-2)-5)-(7+6)
10+9%2+30	(10+(9%2))+30
10/2*5%3	((10/2)*5)%3

Discounted Dining Bill – Revised Program

```
using System;

class Program
{
    static void Main()
    {
        Console.Write("Total cost is ");
        Console.WriteLine( (82+64+90+75+33) * 0.8);
    }
}
```

3 statements

Task: *Shopping Bill*

- At a grocery store, you are putting these items in your shopping cart

$$\sum_{i=1}^{N} (price_i \times quantity_i)$$

Item	Price per item		How many
Apple	12	×	6
Orange	15	×	3
Banana	8	×	4
Tomato	10	×	5
Melon	30	×	2

- Write a program to compute the total cost of items in your shopping chart

Shopping Bill – Program #1

- Knowing that * has precedence over +, this program will work
  - But the expression looks confusing

```
using System;

class Program
{
    static void Main()
    {
        Console.Write("Total cost is ");
        Console.WriteLine(12*6+15*3+8*4+10*5+30*2);
    }
}
```

Shopping Bill – Program #2

- This is the same program, but parentheses and spaces can make the program much easier to read and spot errors

```
using System;

class Program
{
    static void Main()
    {
        Console.Write("Total cost is ");
        Console.WriteLine(
            (12*6) +
            (15*3) +
            ( 8*4) +
            (10*5) +
            (30*2) );
    }
}
```

Indent for clarity

Task: *Bill Sharing*

- At the same restaurant, <u>five</u> people are splitting the bill and share the total cost
- Write a program to compute the amount each person has to pay

Item	Price
Salad	82
Soup	64
Steak	90
Wine	75
Orange Juice	33

Bill Sharing – Ideas

- Just compute the total and divide it by 5
- The result should be the amount each person has to pay

Bill Sharing – First Attempt

```
using System;

class Program
{
    static void Main()
    {
        Console.Write("Total amount: ");
        Console.WriteLine( 82+64+90+75+33 );
        Console.Write("Each has to pay: ");
        Console.WriteLine( (82+64+90+75+33) / 5 );
    }
}
```

- This is the output. Is it correct?

```
Total amount: 344
Each has to pay: 68
```

Integer vs. Floating Point Division

- In C#, when dividing two integers (whole numbers), the result is also a whole number
  - Similar to a long division taught in primary school
  - The fraction part is discarded
- To obtain the result with fraction, at least one of the numbers must be floating point

Expression	Evaluated to
10/4	2 (not 2.5)
10.0/4	2.5
10/4.0	2.5
10.0/4.0	2.5

Returning same datatype of the most precise datatypes in expression

Bill Sharing – Revised Program

```
using System;

class Program
{
    static void Main()
    {
        Console.Write("Total amount: ");
        Console.WriteLine( 82+64+90+75+33 );
        Console.Write("Each has to pay: ");
        Console.WriteLine( (82+64+90+75+33) / 5.0 );
    }
}
```

- The result should be correct
- However, the summation expression gets repeated twice

Bill Sharing – Revised Program#2

- We now store the result of the total amount in a variable

```
using System;

class Program
{
    static void Main()
    {
        int total;
        total = 82+64+90+75+33;
        Console.Write("Total amount: ");
        Console.WriteLine(total);
        Console.Write("Each has to pay: ");
        Console.WriteLine(total/5.0);
    }
}
```

What Is a Variable?

- A ***variable*** is a storage location for storing a value
- In C#, a variable needs to be declared with a data type before used

This variable's name is `total`

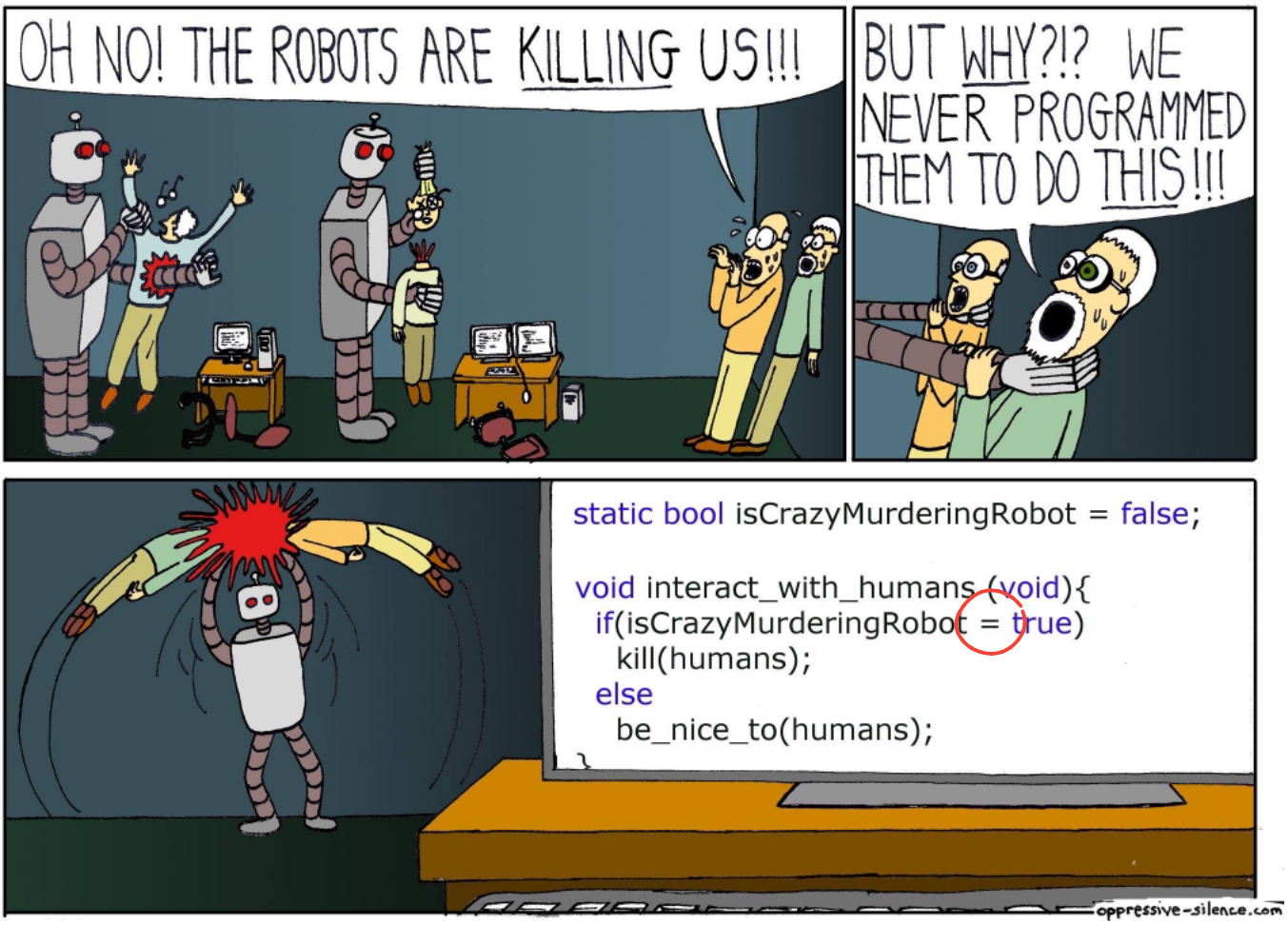
```
int total;
```

It is used to store an integer

- Once declared, it can store a value with an assignment statement (=)

```
total = 82+64+90+75+33;
```

! = is assignment, == is boolean!


OH NO! THE ROBOTS ARE KILLING US!!!
BUT WHY?!? WE NEVER PROGRAMMED THEM TO DO THIS!!!
static bool isCrazyMurderingRobot = false;
void interact_with_humans (void){
if(isCrazyMurderingRobot = true)
kill(humans);
else
be_nice_to(humans);
}
oppressive-silence.com

More on Variable Declaration

- Declaration and assignment can be done in one statement

```
int total = 82+64+90+75+33;
```

- Multiple variables can be declared (and assigned) in one statement

```
int width=30, height=50, area;
```

Naming Variables

- Different programming languages may have slightly different rules for naming a variable
- Some common rules are
  - A name consists of only alphanumeric characters (A-Z, a-z, 0-9) and underscores (_)
  - The first character cannot be a number
  - A name must not be a reserved word
  - Lowercase and uppercase letters mean different things

A variable name __ is acceptable, but not even a good idea (also considered BAD practice.)

Naming Variables: Examples

Name	Correct?	Reason
radius	✓	OK
pay_rate	✓	OK
G_force	✓	OK
while	✗	is a reserved word
jack&jill	✗	contains a symbol &
8bus	✗	starts with a number
buggy-code	✗	contains a symbol -
class	✗	is a reserved word
Class	✓	OK
_class	✓	OK

Readability Counts!

- Your program is written not only for computer, but also human, to read
- Variable names should be meaningful

Those who says computer code is what programmers can coincidentially read, ~~and use~~ this as an excuse to write bad, unreadable code SUCKS.

Not-a-really-good

~~Bad~~ Example

```
int a = 30;
int b = 50;
int c = a * b;
```

Context?

Good Example

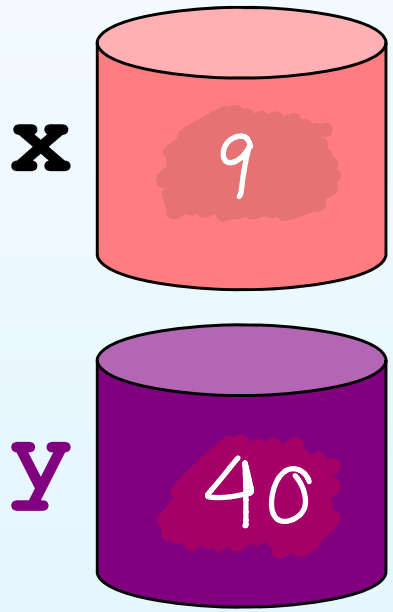
```
int height = 30;
int width = 50;
int area = height * width;
```

How a Variable Stores Value?

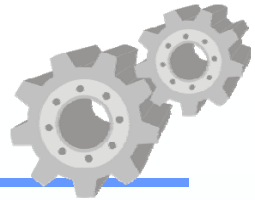
- A variable can be declared only once
- Assignment can be done over and over
  - However, a variable can store one value at a time
- A variable serves as an expression evaluated to its stored value

Declare	`int x;`
Assign	`x = 5;`
Assign	`x = 20;`
Declare	`int y;`
Assign	`y = x*2;` → y=40
Assign	`x = 8;`
Assign	`x = x+1` → x=9

No longer affect the value of y



Important Data Types



- Sometimes you need to store something other than an integer in a variable
- C# provides several data types for different purposes
- Some important types are listed here

Type	Purpose	Usage Example
`int`	storing a whole number (positive, negative, zero)	`int total = 25;`
`double`	storing a number with fraction	`double g_force = 9.81;`
`char`	storing a single character	`char first = 'A';`
`string`	storing a sequence of character	`string name = "John";`

not char[]

Short Name	.NET Class	Type	Width	Range (bits)
byte	Byte	Unsigned integer	8	0 to 255
sbyte	SByte	Signed integer	8	-128 to 127
int	Int32	Signed integer	32	-2,147,483,648 to 2,147,483,647
uint	UInt32	Unsigned integer	32	0 to 4294967295
short	Int16	Signed integer	16	-32,768 to 32,767
ushort	UInt16	Unsigned integer	16	0 to 65535
long	Int64	Signed integer	64	-9223372036854775808 to 9223372036854775807
ulong	UInt64	Unsigned integer	64	0 to 18446744073709551615
float	Single	Single-precision floating point type	32	-3.402823e38 to 3.402823e38
double	Double	Double-precision floating point type	64	-1.79769313486232e308 to 1.79769313486232e308
char	Char	A single Unicode character	16	Unicode symbols used in text
bool	Boolean	Logical Boolean type	8	True or false
object	Object	Base type of all other types		
string	String	A sequence of characters		
decimal	Decimal	Precise fractional or integral type that can represent decimal numbers with 29 significant digits	128	±1.0 × 10e−28 to ±7.9 × 10e28

ใช้ single quotes ด้วย

Conclusion

- A **program** consists of one or more statements
- Each **statement** can be an assignment that assigns the value of an expression to a variable, or a **method** call that takes zero or more expressions for performing certain tasks ?!
- An **expression** is a portion of code that can be evaluated to a value
- A **variable** is a storage in the memory for storing a single value
  - The **type** of the stored value must match the type of the variable itself
- The method `Console.WriteLine` can be used to displayed the value of an expression on screen

References

- Basic C# syntax, variables, and expressions https://msdn.microsoft.com/en-us/library/hh147285(v=vs.88).aspx
- Operator precedence and order of evaluation https://msdn.microsoft.com/en-us/library/2bxt6kc4.aspx
- C# reserved words https://msdn.microsoft.com/en-us/library/x53a06bb.aspx
- Data types https://msdn.microsoft.com/en-us/library/cs7y5x0x(v=vs.90).aspx

Syntax Summary I

- C# program structure

Namespace
Class
Method

Without namespace

```
using System;

class ProgramName
{
    static void Main()
    {
        statement1;
        statement2;
            :
    }
}
```

With namespace

```
using System;

namespace NamespaceName
{
    class ProgramName
    {
        static void Main()
        {
            statement1;
            statement2;
                :
        }
    }
}
```

Console.Write()
lol.a:test();

namespace lol{
class a{
public void test(){
system.console.write("");
}}}

Syntax Summary II

- Variable declaration
  - Without initial value

```
DataType variableName;
```

  - With initial value

```
DataType variableName = value;
```

  - Multiple declarations

```
DataType variableName1 = value1, variableName2 = value2, …;
```

=3