Theme 4. ELEMENTS OF PROGRAMMING IN MAPLE. THE TYPES OF DATA. EXPRESSIONS OPERANDS AND OPERATIONS

Plan

4.1. Maple language elements

Output file - a text file that includes all or part of the code.

The functions, variables and constants are the main objects that make up the original program (source files).

Elements of the language *Maple* - basic design used in writing programs.

These include: alphabet, identifiers, keywords, comments, etc.

Alphabet - set of characters that you can type on the keyboard to create structures of language Maple.

These are keywords (reserved words) characters operations, variable names, functions and commands, strings, numbers, separators. Maple interpreter reads each line and splits it into tokens, which immediately performs.

Syntax - a set of rules Maple recording facilities.

Ukrainian alphabet can be used only in character strings, constants or comments (in the explanation of the program).

Characters period is a key period of transition to a new line, horizontal and vertical tab new page. These characters share one token from the other.

The interpreter ignores several consecutive characters span, allowing their use to improve the visibility of the program.

Separators interpreter used for different tasks - from organizing program text instructions to the compiler to perform specific actions:

,   coma (comma) - in the transfer;
;   semicolon (semicolon) - end operator;
[]   brackets (square brackets) - definition sequence (array);
{}   braces (curly brackets) - definition set;
()   Round brackets (parenthesis) - definition and other functions.

Constants - the number, symbol or string of characters that does not change during program execution.

There are constants: objectives; real (floating point); character; term.

Maple contains a number of named constants - such values to which to refer by name. Some of these constants can not be changed. These include:

- *true,* false - logical values "true" and "false";
- *infinity* - infinity;
- *I* - imaginary unit;
- *Pi* - constant 3.14159265.

Some constants can be overridden, for example, Digits, which specifies the number of significant digits for floating point (default 10).

To see all the constants in Maple, run the following command: ?Ininame.

4.2. Numbers

Maple works with the following types of numbers:

- (Integer) decimal integer (0, 1, 123, -456, etc.)
- (Fraction) in a rational ratio of integers (7/9, -123/127 etc.)
- (Float) valid from mantissa and order (1.23E5, 123.456E-10)
- Complex (2 + 3I).

Natural number - any sequence of digits.

Integer - integers with sign either.

Integer defined as a sequence of numbers from 0 to 9. Example integer constants: 10, 32767, -32767.+ −

Maple can work with integers of arbitrary size, limited number of digits 228.

Large numbers that do not fit on one line, Maple moves to the next line using the backslash character (\).

Calculations with integers implement four arithmetic operations (addition +, subtraction -, multiplication *, division /) and factorial (!).

Get a list of all the commands for working with integers can be typing the command: ?Integer.

Some of these commands:

- *irem* - calculation of the balance of the division of two integers: irem (53,7) = 4
- *igcd* - finding the greatest common divisor of integers: igcd (192,90) = 6
- *isprime* - check whether the integer easy.

Common fractions Asked by the operation division of two integers. Maple automatically performs reducing fractions, eg 32/12;

$$\frac{8}{3}$$

Above all fractions can perform basic arithmetic operations.

To convert common fractions to decimal value is the team evalf (). The second parameter of this command specifies the number of digits, for example: evalf (3/8, 4) = 0.3750.

Fraction and its decimal representation are not identical objects Maple.

Floating point- the actual number that has whole and fractional part. All fractional part of the separating point, not a comma.

To record real constants in exponential form using a 'e' or 'E', for example: 15.78, 0.5, 1.0, 1.2e7, .00075, -2.5 2.

Calculation of real numbers is made by default with 10 significant numbers.

If all the numbers are in terms integers, fractions or radicals, the result appears as using these data types.

If the present terms floating point performance is the result of a "mixed" expression is a floating-point.

Example.   *3e2 + 3/4 + sqrt (5) + 3/4 * 0.1 + surd (6,3) * 43/10*;

$$300.8250000 + \sqrt{5} + \frac{43}{10} 6^{(1/3)}$$

Radicals asked as a result of the introduction of the fractional degree of whole or fractional numbers or calculations on them as the square root sqrt (), or calculating the root of the n-th degree surd (number, n).

In Maple exponentiation given character or sequence two asterisks (**).

Complex numbers. For the imaginary unit used in Maple constant.

If at least one part of a complex number (real or imaginary) calculated as floating point numbers, then the result will be the same.*I*

Basic commands for working with complex numbers:

- *Re ()* highlight the real part of a complex number
- *Im ()* allocation of the imaginary part of a complex number.

4.3. Identifiers

Special characters (Or sequence) used to perform specific actions, such as switching to a new line, tab audio.*ESC*

Line(String) - any character set, taken in quotation marks, for example. The length of the line may be in Maple 268435439 symbols.

"This is one string"

Connecting lines can be performed using concatenation ||, or appeal to the function cat (line 1, line 2).

Comment - descriptive text in the program that can record any part of it. Comment as a sequence of characters ignored by the compiler and interpreted as spaces.

It is recommended to use a comment as often, allowing easier to understand the code in its modifications.

Identifiers - the names of variables and functions that are created in the program.

Identifier using only two sets of characters that you can type on the keyboard:

- letters of the alphabet - A ... Z, a ... z, an underscore "_";
- Arabic numerals 0, 1, 2..9.

Requirements:

- must begin with a letter or underscore sign;
- should carry clear meaning of the name of a variable or function;
- should not match the keyword.

Examples: temp1, Skip_1, Alfa, Fi, Sum, Ad, aD.

It Maple is case sensitive - small and large letters of the alphabet are different.

Key (service reserved) word - predefined identifiers that have special meaning.

and break by catch description do done elif else end error export fi finally for from global if in intersect local minus mod module next not od option options or proc quit read return save stop then to try union use while

Function words can not be used as their IDs.

4.4. Data Types

A message with the appropriate information in the call value.

The set of values for which some defined set of operations, called the set of values of a certain type.

Object type defines a set of values that this object can receive and operations can be performed on them.

Integers, fractional numbers, floating point numbers are the main types of data.

For more complex data types include arrays, sets, lists.

Single- and multi-dimensional arrays of arrays created by the announcement of the elements of simple data types. Items stored in multidimensional array rows.

To create an array, the command array (i1..j1, i2..j2, ..., M), which returns an array with elements from the list M.

Plural - a list of items restricted brackets:

A:={a, b, c};

Lists - a list of items restricted brackets:

B:=[a, b, c];

Vectors - a list of items restricted triangular brackets:

C:=<a, b, c>;

Appeal to the elements of the set, list, array element index indicating made in square brackets.

Index names are the character names of the subscript.

For their task should be named after a character in brackets specify the sequence of expressions, and it is also the name of an index can be subscript.

Computer variable - is a named location of storage where data types. By default, the variable is a scalar quantity.

If the expression uses a variable which is not assigned any numerical value, such a shift is seen as a system Maple unknown quantity, but the expression containing the unknown called symbolic expression. Just to work with such expressions created first and Maple.

4.5. Expressions operations, operands, symbols

In Maple distinguish the concept of function commands and operators.

Expression is a combination of variable names, numbers and other facilities connected characters allowable operations (addition +, subtraction, multiplication, division, appropriation, equality, etc.).

Introduction to expressions given string rules editor. Star fixing the end of the expression is a semicolon, indicating the results output to the monitor. Star two points cancels output and can be used to record several expressions in one line.$- */: ==;:$

Operations- combinations of symbols that define actions to transform values. Operations define the actions on operands - constants, variables or character strings. Each operand has type.

The operands using operations can be combined in a primary expression, which in turn are operands. Their combination results in a more complex expression, etc.

There are three types of expressions:

- **mathematical** - the result is the expression;
- **text** - the result is a string of characters;
- **logical** - the result is the adoption of "yes" or "no."

Depending on the type of operations are divided into primary expressions, unary, binary, ternary, assignment and type cast on the number of operators in this expression.

Symbols

+ add (addition)	"Kavychky double (double quotes)
− Subtraction (subtraction)	. Decimal point (decimal point)
/ division (division)	.. range (range)
∗ multiplication (multiplication)	< less than (less than)
^ Exponentiation (exponentiation)	<= less than or equal to (less than or equal)
:= assignment (assignment)	> more than (more than)
= equality (exclamation mark)	>= greater than or equal (greater or equal)
! exclamation mark (equality)	<> uneven (unequal)

: Two dots (colon)	^ cover (cap)
% percentage (percent)	Room # (number)
|| concatenation (concatenation)	@ Formulation (composition)
union union of sets	:: type declaration
minus difference sets	-> creation tool
intersect intersection of sets	

Action characters:

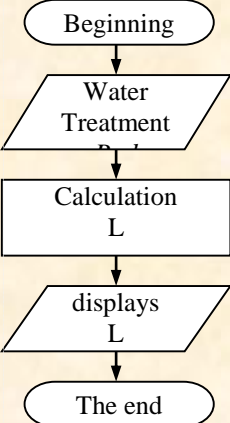|	
:	the catch phrase that prevents output calculation results in line;
;	the catch phrase that forms displays the results of calculations in a single line;
#	comments pointer;
=	assignment operator;
'	limiting variable, using which ignored previous data;
%	returns the last calculation result.

Types of binary (two operands) operations

Marks	name operations	Examples
* /	Multiplicative - multiplication, division	*z: = x * y; z: = x / y;*
+ -	Additive - addition and subtraction	*z: = x + y; z: = xy;*
> = <<= == <>	The ratio - greater than, equal to, less than, less than, equal to, is not equal	*x <y*
mod	The balance of the division of integers	7 mod 5
$	The operator sequence	$1 ..5
!	Factorial	10!

Priority determines the order of operations in terms of calculation

Operations	Titles
() [] ->	primary
* /	multiplicative
+ -	additive
<<=> =	relation

Example. Develop a block diagram verbal algorithm and write the language of the Maple program to compute the circumference by the formula.$l = 2\pi r$

Flowchart	Verbal description	Output text on Maple

Beginning → Water Treatment Rad → Calculation L → displays L → The end	Getting started
	
	Please enter a numeric value Rad
	
	Calculate the circumference $L = 2\pi r$
	
	Print the value of the circumference
	
	Finish the job.
		restart;
		Радіус кола:
		$Rad := 30$;
		    30
		
		Довжина кола:
		$L := 2 \cdot Rad \cdot Pi$;
		    $60\,\pi$
		
		Результат:
		L;
		    $60\,\pi$
		$evalf(\%) = 188.4955592$

4.6. Analysis of mathematical expressions

Maple has opportunities for analytic transformation mathematical formulas. These include operations such as bringing such, factorization, opening brackets and more.

Each expression parsing exposed, resulting in the construction of the expression tree. In the first, the root node is marked type of expression, and each branch corresponds to one of the components of the expression of members or operands.

The user can make parsing expressions using the command: whattype (), type (), nops () and op ().

As a result of the calculation expression will be equal to one of the main objects of Maple:

Object	Type	subtype
Line	*string*	
Name	*name*	*symbol, indexed*
Integer	*integer*	*negint, posint, nonnegint, even, odd, prime*
Fraction or rational number	*rational*	*integer, fraction*
Decimal	*numeric*	*integer, fraction*
List	*list*	
Plural	*set*	
Calling	*function*	

The most commonly used in the transformation commands and functions Maple located in its core system, which is constantly in the memory of the PC.