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METHODS OF THE SOLUTION OF EQUATIONS IN MAPLE

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Maple - system of computer mathematics, which designed a wide range of users. Until these days it is called as a system of computer algebra. It is indicated a special role of symbolic computations and transformations, which is capable of this system. But the name narrows the score of the system. In fact it is already able to perform quickly and efficiently is not only symbolic but also numerical calculations and combines this with a graphical visualization and preparation of electronic documents. It would seem ridiculously to call such a powerful system as Maple 7 is a mathematical system for all people. But it is becoming useful for a number of users of personal computers, who forced to mathematical calculations and all functions connecting with it. All this stretches from the solution of educational problems to modeling of complex physical objects, systems and devices even it does graphic arts. (For example, fractals)

Maple is a typical integrated system. It includes:

- powerful programming language (language for interactive connection with a system)
- an editor for the preparation and editing documents and programs
- a powerful help system with thousands of examples
- a core of algorithms and rules for the conversion
- numerical and symbolic processor
- diagnostic system
- a library of built-in and optional features

packs for functions of other manufacturers and support of several other languages of programming

For all these tools there is an access from program. Maple is one of the powerful and reasonable, integrated system of symbolic maths, which is created by firm «Waterlo Maple» (Canada)

Solution of the ordinary equations.

There is an universal command solve (eq,x) for solving of the ordinary equations, when eq – equation, x – variable. As a result result of this command in the output string appears an expression, which is a decision of this equation. For example:

```
>solve(a*x+b=c,x);
```

$$-\frac{b-c}{a}$$

If the equation has multiple solutions, which we need for further calculations to the command solve we must assign a name. Appeal to k-numeral decision of this equation produced by designation of its name with number k in square brackets: name[k] [1].For example:

>x:=solve(x^2-a=0,x);

$$x := -\sqrt{a}, \sqrt{a}$$

>x[1];

$$-\sqrt{a}$$

>x[2];

$$\sqrt{a}$$

>x[1]+x[2];

$$0$$

Solving of the systems of equations.

Systems of equations is solved by a help of such commandsolve ({eq1,eq2,…}, but in the options of command we must specify equations in the first bracket by commas, and variables in the second bracket by commas too. If you need use obtained solving equations for further calculations we assign a name to the command solve. After that we can produce mathematical operations on solutions. For example,

>s:=solve({a*x-y=1,5*x+a*y=1},{x,y});

s:={ $x = \frac{a+1}{5+a^2}, y = \frac{a-5}{5+a^2}$ }

>assign(s); simplify(x-y);

$$\frac{6}{5+a^2}$$

Numerical solution of the equations.

If transcendental equations have not analytical decisions, it is used a special command fsolve(eq,x), which has options as a command solve [2]. For example:

>x:=fsolve(cos(x)=x,x);

x:=.7390851332

Solving of reccurent and functional equations.

The commandrsolve(eq,f) can solve reccurent equations for an entive function f. The user may ask several initial conditions for a function f(n) and get a particular solution for a this reccurent equation. For example:

>eq:=2*f(n)=3*f(n-1)-f(n-2);

$$eq := 2f(n) = 3f(n-1) - f(n-2)$$

>rsolve({eq,f(1)=0,f(2)=1},f);

$$2 - 4\left(\frac{1}{2}\right)^n$$

Universal command solve can do functional equations, for emample:

>F:=solve(f(x)^2-3*f(x)+2*x,f);

F:=proc(*x*) RootOf(_*Z*^2 - 3*_*Z*+ 2**x*) end

In result we get decision in an implicit form. But Maple can work with such decisions. We can convert an implicit form of functional equations into elementar function with a help of command “convert”. Continuing above example, we may get a decision in an explicit form:

>f:=convert(F(x),radical);

$f := \frac{3}{2} + \frac{1}{2}\sqrt{9-8x}$

Solving of the trigonometric equations.

The command solve for such tasks issues only main decisions, that is decisions' range [0,2p]. For giving all decisions we previously enter an additional command _EnvAllSolutions:=true. For example:

>EnvAllSolutions:=true:

> solve(sin(x)=cos(x),x);

$\frac{1}{4}\pi + \pi\_Z$ ~

In Maple the symbol *_Z*~ represents a constant integer, that is why this equation has a familiar form $x := \pi/4 + \pi n$, when *n* – whole numbers [3].

Solving of the transcendental equations.

We must enter an optional command_EnvExplicit:=true before the command solve for an aim of getting a decision in clear form.

An example of the solution of a transcendental equations and simplifications of the solutions.

> eq:={ 7*3^x-3*2^(z+y-x+2)=15, 2*3^(x+1)+
3*2^(z+y-x)=66, ln(x+y+z)-3*ln(x)-ln(y*z)=-ln(4) }:

> _EnvExplicit:=true:

> s:=solve(eq,{x,y,z}):

> simplify(s[1]);simplify(s[2]);

{*x*=2,*y*=3,*z*=1}, {*x*=2,*y*=1,*z*=3}

Task 3.

1. Find all the solutions of the system $\begin{cases} x^2 - y^2 = 1, \\ x^2 + xy = 2. \end{cases}$

Dial:

> eq:={x^2-y^2=1,x^2+x*y=2};

> _EnvExplicit:=true:

> s:=solve(eq,{x,y});

$s := \{x = \frac{2}{3}\sqrt{3}, y = \frac{1}{3}\sqrt{3}\}, \{x = -\frac{2}{3}\sqrt{3}, y = -\frac{1}{3}\sqrt{3}\}$

Now find the sum of the two sets of the solutions. Dial:

> x1:=subs(s[1],x): y1:=subs(s[1],y):
x2:=subs(s[2],x): y2:=subs(s[2],y):

> x1+x2; y1+y2;

What are these amounts of the solutions?

2. Numerically solve the equation $x^2 = \cos(x)$. Dial:

> x=fsolve(x^2=cos(x),x);

x=.8241323123

3. Find the function *f*(*x*), satisfying this equation $f^2(x) - 2f(x) = x$. Dial:

>F:=solve(f(x)^2-2*f(x)=x,f);

F:=proc(*x*) RootOf(_*Z*^2-2*_*Z*-*x*)end

>f:=convert(F(x), radical);

$f := 1 + \sqrt{1+x}$

4. Find all the decisions of this task $5\sin x + 12\cos x = 13$.

Dial:

>_EnvAllSolutions:=true:

> solve(5*sin(x)+12*cos(x)=13,x);

$\arctan\left(\frac{5}{12}\right) + 2\pi\_Z$ ~

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