The use of the brute-force method for finding the roots of an equation

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Abstract. . In this paper we propose the brute-force method as a suitable numerical method for finding the roots of equations. We show that the brute-force method easily solves the equations from textbooks. The brute-force method could be used as a supplementary numerical method for solving equations in colleges and high schools.

Keywords: brute-force method, root, education

The methods for solving equations studied in the high schools and colleges have two weaknesses. First, in many cases the solution needs complicated symbolic manipulations. Secondly, in many cases the symbolic manipulations are not able to solve the problems. In such cases we need a numerical method.

In this paper we show that the brute-force method is a suitable numerical method for finding the roots of an equation. The brute-force method uses only the definition of a function and the comparison of two numbers. But if we want to receive the answer immediately, we have to use a computer program. The professors and students could use the brute-force method as a supplementary numerical method for solving equations. Also, the method could be used for fast and easy check of the answers. The experts in the area of discrete optimization do not like and do not recommend the brute-force method. But for the case of the high school and university education the method is suitable. It takes less than one second we to receive the answer, if we use a desktop personal computer.

The brute-force method is as follows. Suppose that we have to solve the equation f(x) = 0. Define F(x) = |f(x)|. Suppose that a root of the function f(x) is within the segment [a,b]. We divide the segment [a,b] by N equal parts by using the points x0 = a, x1, x2, ... ,xN = b. Then we evaluate F(x0), F(x1), F(x2),...,F(xN), and select the minimal of these values. The selected minimal value is the answer.

I have created a simple computer program by using PHP. The program is used in the examples given below. Note that the program easily solves numerically all high school and college problems for finding the roots of equations.

Example 1. Solve the equation $\log_2 x + x - 2 = 0$.

Solution. We use the Ivan Johansen's computer program Graph to draw the graph of the function $f(x) = \log_2 x + x - 2$. See Fig.1.
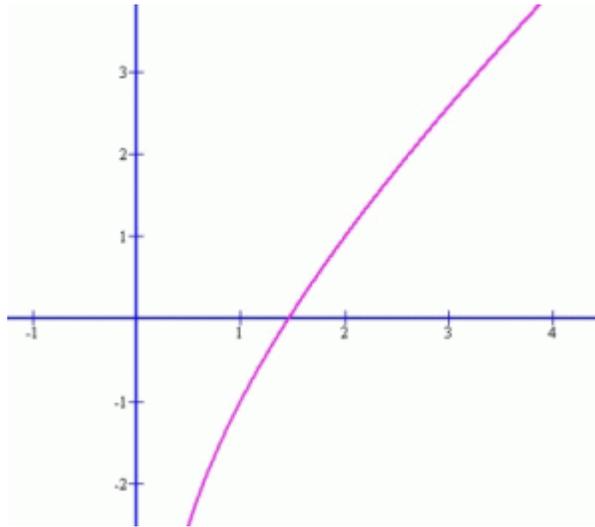

Fig.1

From the graph we see that the function f(x) has one root, which is within the segment [1,2]. By using the computer program, we find the root. We divide the segment by 1000 equal parts. The answer is as follows: $x \approx 1.457$.

Example 2. Solve the equation $2^x - 4x = 0$.

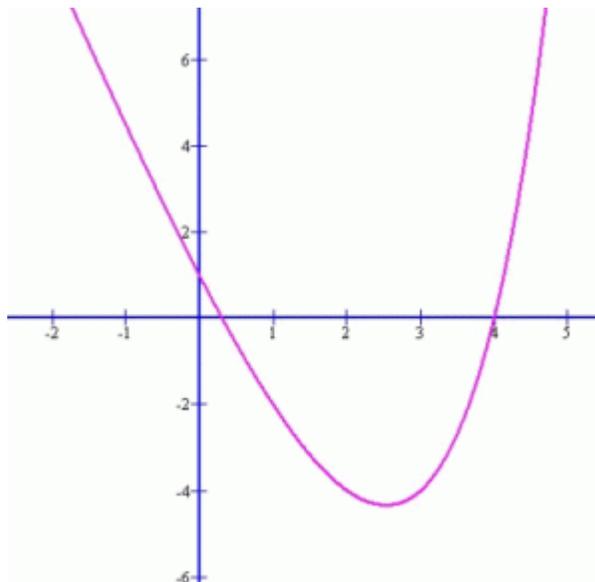**Solution.** We draw the graph of the function $f(x) = 2^x - 4x$. See Fig.2.

Fig.2

From the graph we see that the function f(x) has two roots. The first root is within the segment [0,1]. By using the computer program, we find the root. We divide the segment [0,1] by 10,000 equal parts. The answer is as follows: $x \approx 0.3099$. From the graph we see that the second root is about 4. The check shows that the second root is 4.

Example 3. Solve the equation $x^5 - 10x - 2 = 0$.

Solution. We draw the graph of the function $f(x) = x^5 - 10x - 2$. See Fig.3.
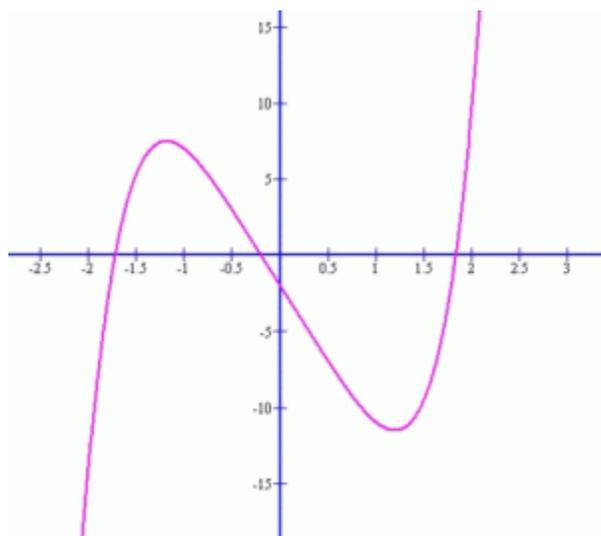

Fig.3

From the graph we see that the function $f(x)$ has three roots, which are within the segments $[-2,-1]$ (Root 1), $[-1,0]$ (Root 2) and $[1,2]$ (Root 3). By using the computer program, we find the roots. We divide each segment by 10,000 equal parts. The answer is as follows: $x1 \approx -1.7243$, $x2 \approx -0.2000$ and $x3 \approx 1.8251$.

We could record the calculations, made by the computer. For the above examples, the file containing records of calculations is available for download as supplementary material.

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