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GNU Octave: some mistakes and difficulties

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Abstract

In this paper, we shall focus our attention on some of the mathematical difficulties which are facing learners in science and engineering when they use GNU Octave. Using this software, one may unfortunately, face some difficulties such as receiving no answer, wrong answer or some and not all the expected answers. For the user to be aware of, we shall describe these difficulties through some mathematical examples.

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1 Introduction

GNU Octave is considered as a high-level language which is primarily intended for numerical computing [1]. It is considered as one of the easiest languages to solve linear and non-linear equations, numerical linear algebra and statistical

analysis. It is intended to be a companion to students in science, engineering and any other subject that requires the use of computers to solve mathematical problems.

In general three types of errors can face users of any programming software; these are: syntax errors, runtime errors or logical errors and rounding errors. But in the end the problem is left completely to the programmer's skill to judge whether the results are expected or not. This task becomes very easy when you know the solution of the problem exactly. In fact Octave and MATLAB have many similarities as, but Octave is a command line interface where users have to type each command in the command prompt. While MATLAB comes with best GUI [2].

In this paper, we shall investigate different types of difficulties , one may encounter when solving some mathematical problems using Octave. Similar to what we did in [3], where we have presented some mathematical problems with MATLAB.

These are including; receiving no answer at all, wrong answer or some and not all the expected answers.

2 Results and examples

We shall describe some of the difficulties which are facing the undergraduate students in science and engineering, who are using Octave for solving some mathematical problems, and these are described briefly in this section by dividing such difficulties into specific cases. We have used the on line version "https://octave-online.net", which is supposed to be updated frequently.

Case 1: Octave gives wrong answers for solving some simple mathematical problems: we shall display some of these problems and solve it mathematically and computationally using Octave.

Example 1:

$$0^0 = \infty.$$

But using Octave we receive the following answer:

```
octave:1> 0^0
 ans =  1
```

Example 2:

$$\infty^0 = \text{NaN}$$

Octave gives:

```
octave:2> inf^0
   ans = 1
```

Example 3:

$$\frac{x}{x} = 1 \quad x \neq 0.$$

Using Octave:

```
octave:3> x/x
 ans = (sym) 1
```

Example 4:

$$1^{\infty} = \text{NaN}$$

Octave gives:

```
octave:4> 1^inf
   ans = 1
```

Example 5:

$$(1+i) < (2+i),$$

this type of comparisons can not be done in complex analysis, though Octave gives:

```
octave:5> (1+i)<(2+i)
   ans = 1
```

which is absolutely wrong.

Example 6:

$$\Gamma(-2) = -\infty,$$

Octave gives:

```
octave:6> gamma(-2)
   ans = inf
```

Example 7:

$$\beta(5,-4) = -\infty,$$

Octave gives:

```
octave:7> beta(5,-4)
   ans = inf
```

On the limits, we found many cases at which Octave is unable to deal with and gives seriously wrong answers.

Example 8:

$$\lim_{x \to -0} (\sqrt{x}) = \text{ undefined value}$$

Octaves gives:

```
octave:8> syms x
octave:8> limit(sqrt(x),x,0,'left')
   ans = (sym) 0
```

Example 9:

$$\lim_{x \to {}^{-}0} (\ln x) = \text{undefined value}$$

Octave gives:

```
octave:9> syms x
octave:9> limit(log(x),x,0,'left')
   ans = (sym) -inf
```

Example 10: If z is a complex number, then

$$\lim_{z \to 0} (\frac{z}{\overline{z}})^2 = \text{undefined value}$$

Octave gives:

```
octave:10> z=x+iy
octave:10> limit((z/conj(z))^2,z,0)
   ans = 0
```

Example 11:

$$\lim_{x \to 1} (\frac{1}{x-1}) = \text{undefined value}$$

Octave gives:

```
octave:11> syms x
octave:11> limit(1/(x-1),x,1)
 ans = (sym) inf
```

Below are some examples on integration.
Example 12: The integral

$$\int_{-5}^{-2} \sqrt{(x)}\, dx \text{ is undefined on the interval [-5,-2].}$$

Octave gives:

```
octave:12> syms x
octave:12> int(sqrt(x),x,-5,-2)
   ans (sym) =
       -4sqrt(2)i/3+10sqrt(5)i/3
```

Case 2: Octave can not solve some simple mathematical problems as we shall see in the following examples.

Example 12:

$$\int_0^1 \frac{x^{20}}{x^{20}+(x-1)^{20}}\,dx = \frac{1}{2},$$

Octave gives:

```
octave:12> syms x
octave:12> int(x^(20)/(x^20+(x-1)^20),x,0,1)
   Waiting.....!!! OUT OF TIME !!!
```

no answer.

Example 13:

$$\int_0^{\pi} \frac{xsin(x)}{1+cos^2(x)}\,dx = \frac{\pi^2}{4}$$

Octave gives:

```
octave:13> syms x
octave:13> int((x*sin(x))/(1+cos(x)^2),x,0,pi)
   ans = int(x*sin(x)/(1+cos(x)^2),x = 0 .. pi)
   Waiting.....!!! OUT OF TIME !!!
```

Example 14:

$$\int_{-\pi}^{\pi} \frac{xsin(x)}{1+cos^2(x)}\,dx = 0$$

Octave gives:

```
octave:14> syms x
octave:14> int((x*sin(x))/(1+cos(x)^2)),x,-pi,pi)
   ans = int(x*sin(x)/(1+cos(x)^2),x = -pi .. pi)
   Waiting.....!!! OUT OF TIME !!!
```

Example 15:

$$\sum_{n=1}^{\infty} \frac{1}{x^{1/5}} = \infty,$$

```
octave:15> syms x
octave:15> symsum(1/(x)^(1/5),x,1,inf)
   ans = symsum(1/(x)^(1/5),x = 0 .. inf)
   Waiting.....!!! OUT OF TIME !!!
```

Case 3: Octave does not display the full answers, actually it does not give all the solutions and here are some examples.

Example 16:

$$(-16)^{\frac{1}{4}} = \pm\sqrt{2}(1+i), \pm\sqrt{2}(1-i)$$

but Octave gives only one root as we shall see in these examples.

```
octave:16> (-16)^(1/4)
   ans = 1.4124+1.4124i
```

Example 16:

$$\sqrt{2}i = \pm(1+i)$$

Octave gives:

```
octave:16> sqrt(2*i)
   ans = 1+i
```

Example 17:

$$\sqrt{-}4 = \pm 2i$$

Octave gives:

```
octave:16> sqrt(-4)
   ans = 2i
```

3 conclusion

MATLAB and Octave are two very similar numerical computing environments widely used by scientists and engineers [4]. While MATLAB is a trade mark of Mathworks subject to licensing, Octave shares many of the capabilities of MATLAB free of charge.

There is no doubt that both softwares have spread widely in scientific, academic and industrial fields. Octave contains tools for solving mathematical, scientific and engineering problems successfully such as MATLAB. Though it fails to solve some basic problems in mathematics. We do recommend that the people in charge pay more effort to develop this software to make it more accurate when solving mathematical problems; as the answers are either false or true when comparing between the exact and the computed answers.

References

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