Teaching Math in SGU with Computer Algebra Systems

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We agree with the ideas presented yesterday: modern computer algebra systems (CAS) change the way to do mathematics and **to teach** mathematics.

Mathematics in the Context of Grenada

- Grenada is a small island in the Caribbean (next to Trinidad) with area approximately 133 square miles.
- It is a developing nation.

Rationale

- Mathematics is a challenge for many students in Grenada.
- To address the issue we introduce the use of Computer Algebra Systems at St. George's University.

Computer Algebra Systems

- Maple
- Mathematica
- Maxima
- GeoGebra
- …

Computer Algebra Systems selected for use in SGU

- Maxima
- GeoGebra

Reasons for Maxima and GeoGebra

- Free for users
- Good Graphic User Interface
- Easy to install
- Easy to use
- Maxima is available for Windows, Android, etc.

Method of Implementation

- CAS is introduced evolutionary not revolutionary
- CAS can be introduced from the beginning of the course.
- We created a Power Point presentation which includes instructions for the installation of Maxima and GeoGebra.
- Demonstrations were conducted in the learning environment to capture students' interest.

Topics

- Factor, Expand, …
- Find GCD, LCM
- Basic algebraic transformations (Use Maxima to check)
- Solve linear equations and systems
- Graphical representation of linear systems in case of two variables

Topics

- Solving Quadratic Equations
- Factoring Quadratic Trinomials & Polynomials
- Matrices
- Logs
- Areas and Volumes

Benefits for the Students

- Free
- Easy to install
- Excellent Graphic User Interface
- No time lost to multiple and divide by hand.
- Students can solve problems and/or check results.
- Students can generate additional examples in order to master math concepts.
- Solve math problems that are difficult for students.

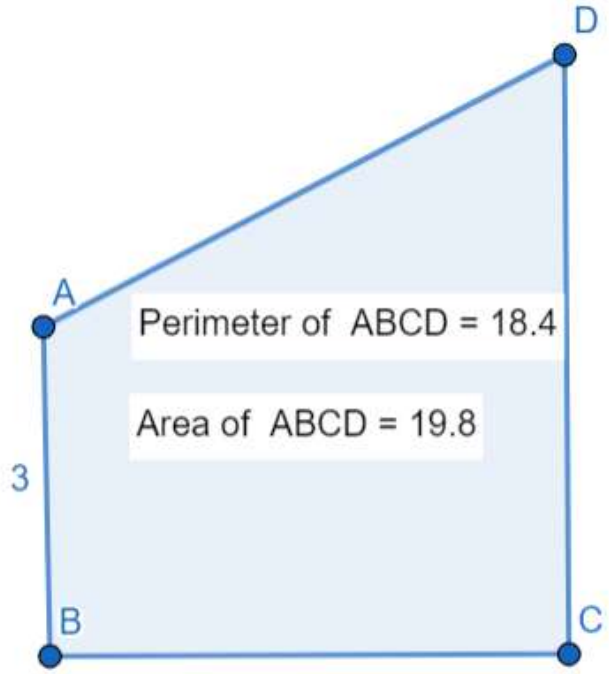
Benefits for Teachers

- Teachers do not have to lose time by working difficult examples
- Generate additional examples for students.
- Faculty can use it to demonstrate, and prepare for classes.
- Check students' submissions
- Solve lengthy math problems
- We can concentrate in the class on ideas.

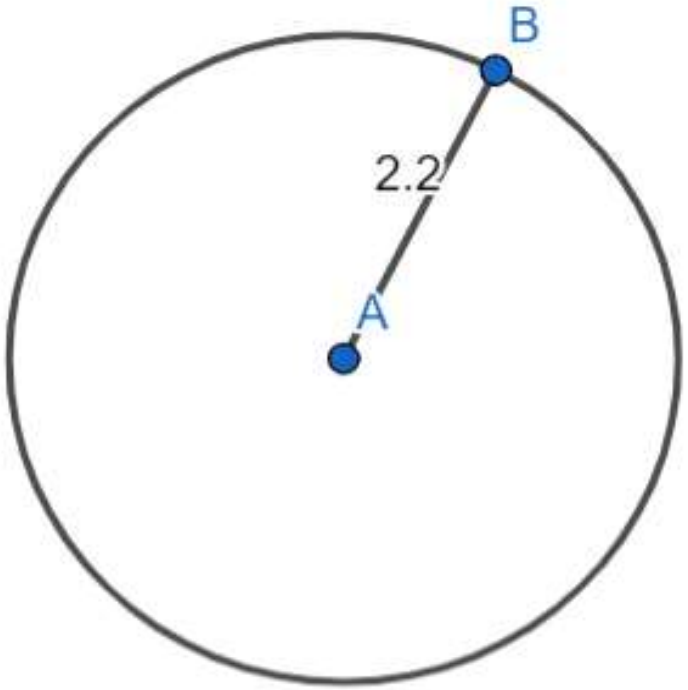
Challenges

- Teachers are stuck in their traditional way of teaching math.
- Limited accessibility to devices.
- Limited Internet services

Examples



Examples



Circumference of c = 13.8

Examples

```
factor(546);
2 3 7 13
```

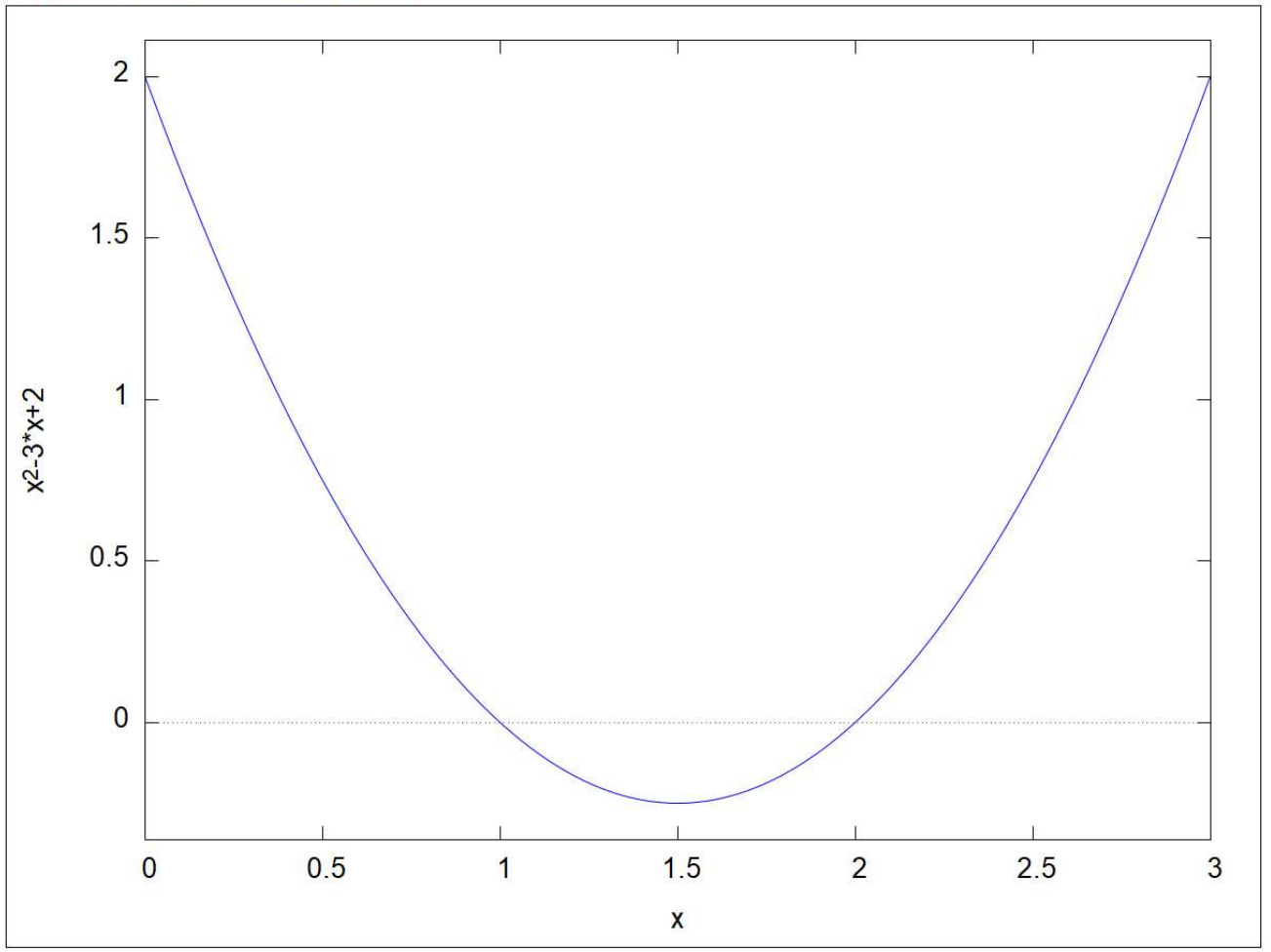
```
gcd(348, 234);
6

lcm(348, 234);
13572
```

Examples

```
) solve([x^2−3·x+2], [x]);
```

$$[x=1, x=2]$$

```
) wxplot2d([x^2−3·x+2], [x,0,3])$
```



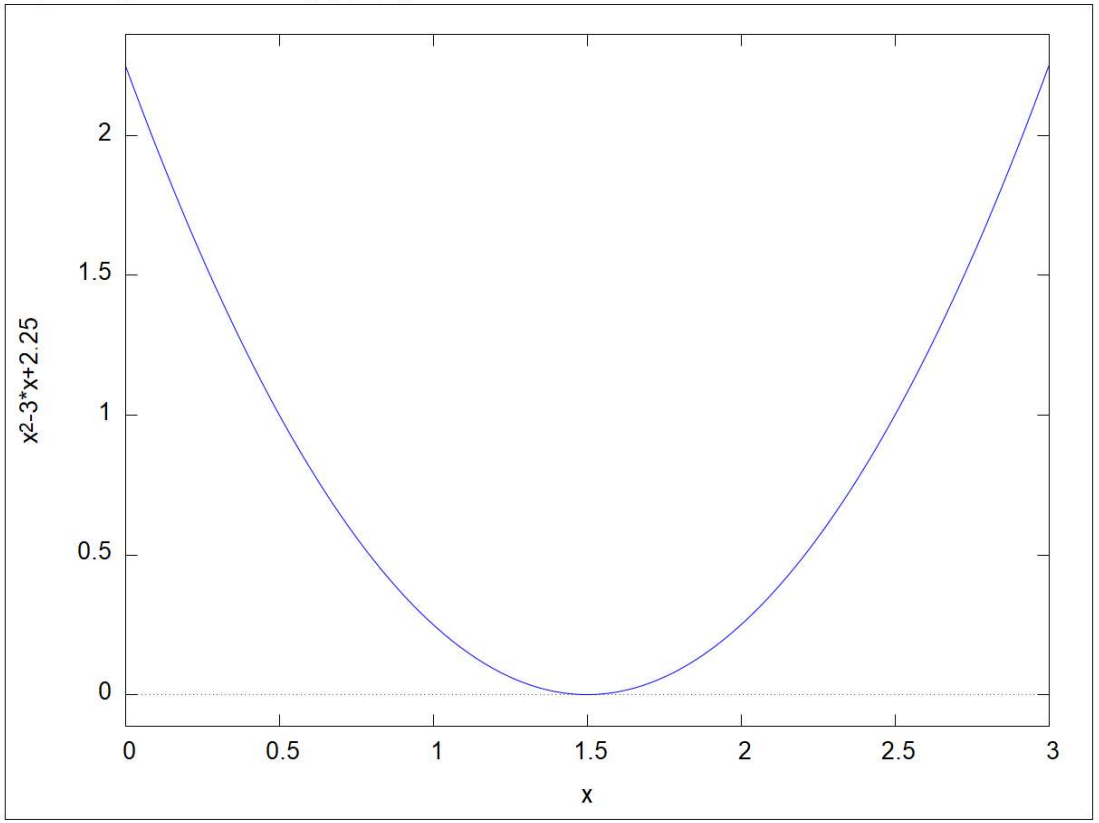
Examples

```
solve([x^2−3·x+2.25], [x]);
```

rat: replaced 2.25 by 9/4 = 2.25

$$\left[x=\frac{3}{2}\right]$$

```
wxplot2d([x^2−3·x+2.25], [x,0,3])$
```

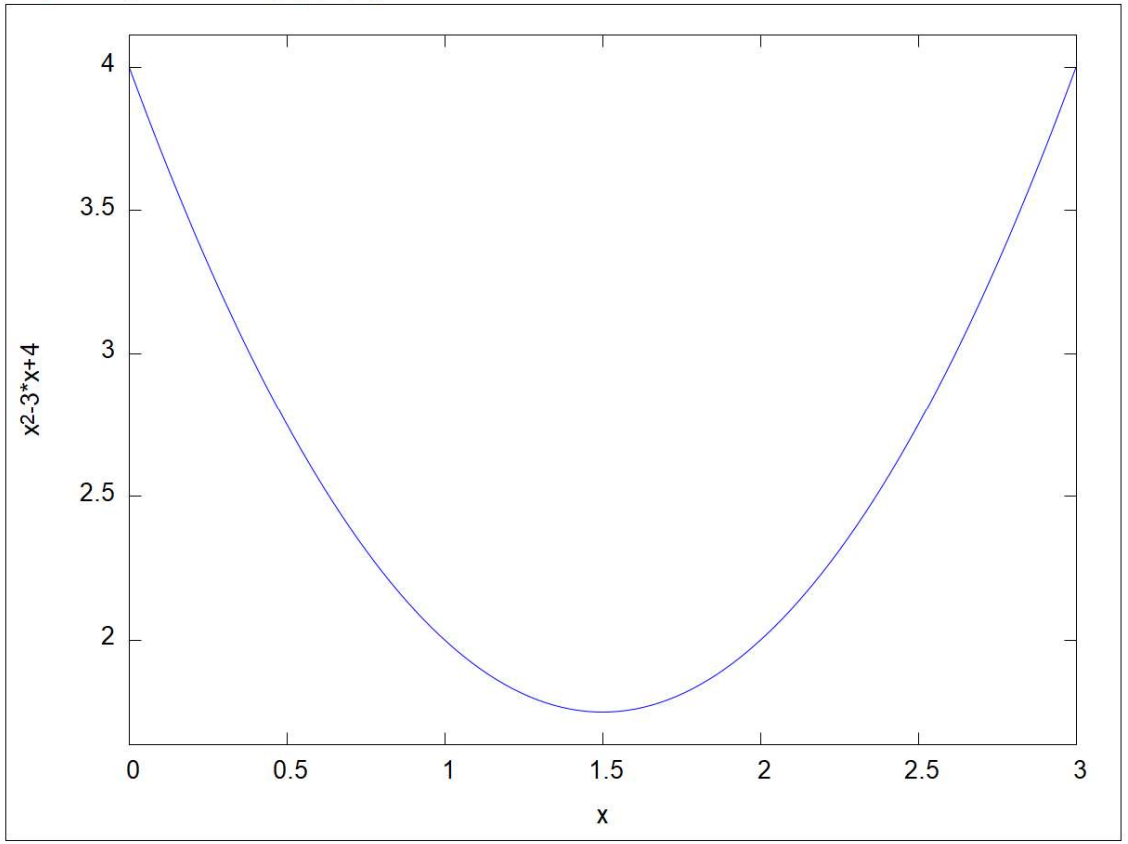


Examples

```
solve([x^2−3·x+4], [x]);
```

$$\left[x=-\frac{\sqrt{7}\,\%i-3}{2},x=\frac{\sqrt{7}\,\%i+3}{2}\right]$$

```
wxplot2d([x^2−3·x+4], [x,0,3])$
```

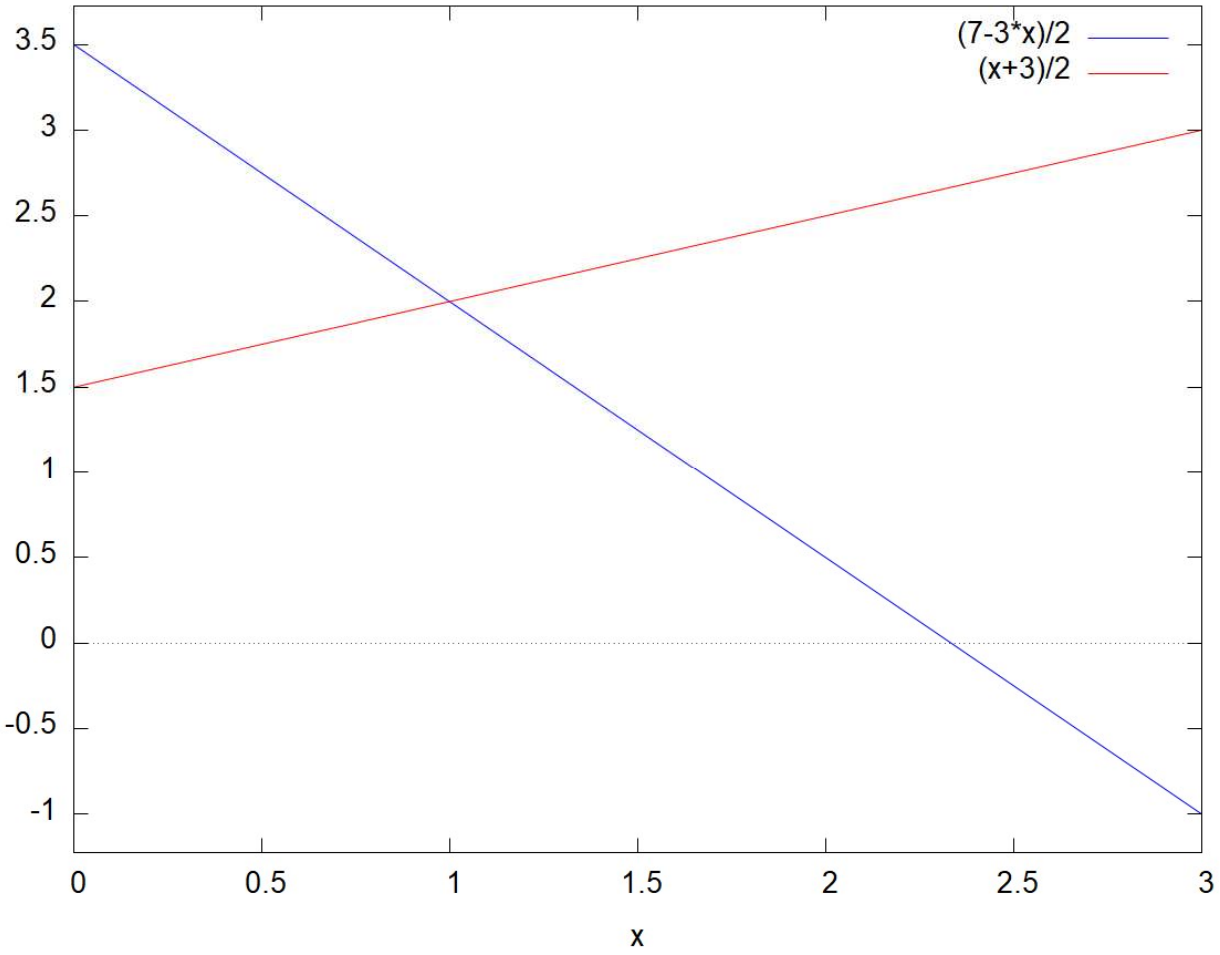


Examples

```
solve([3·x+2·y=7,2·y−x=3], [x,y]);
```

$$[[x=1,y=2]]$$

```
wxplot2d([−(3·x−7)/2,(x+3)/2], [x,0,3])$
```




```
solve([3·x+2·y=7], [y]);
```

$$\left[y=-\frac{3x-7}{2}\right]$$

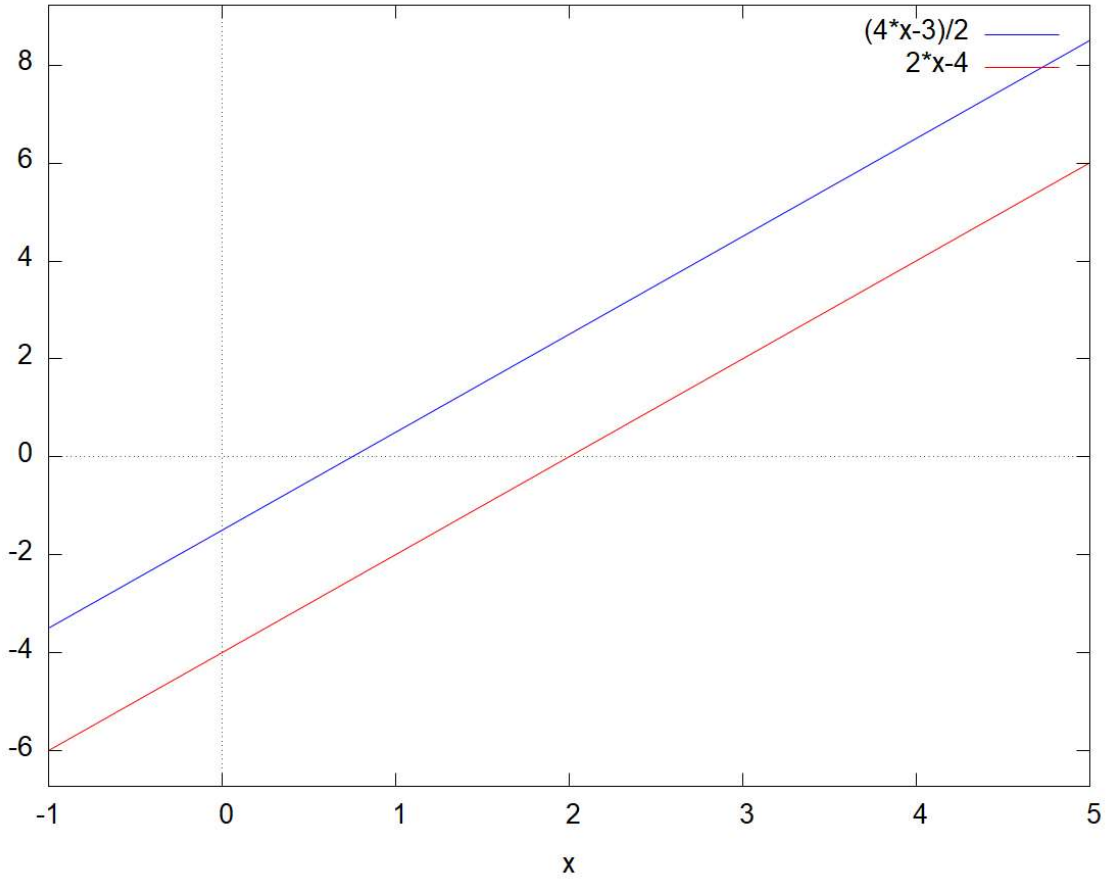
```
solve([2·y−x=3], [y]);
```

$$\left[y=\frac{x+3}{2}\right]$$

Examples

```
solve([2·x−y=4,4·x−2·y=3], [x,y]);
[]
```

```
wxplot2d([(4·x−3)/2,2·x−4], [x,−1,5])$
```




```
solve([2·x−y=4], [y]);
```

$$[y=2x-4]$$

```
solve([4·x−2·y=3], [y]);
```

$$\left[y=\frac{4x-3}{2}\right]$$

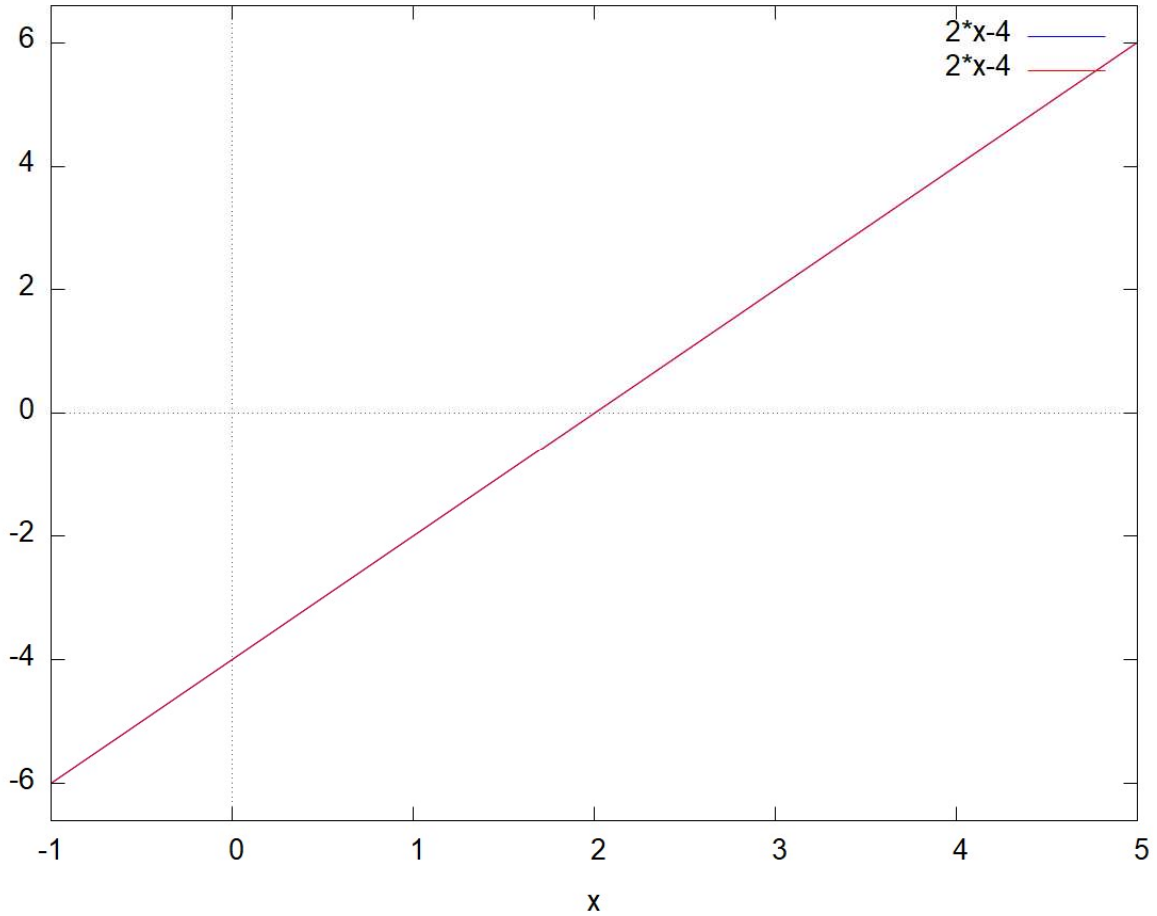
Examples

```
solve([2·x−y=4,4·x−2·y=8], [x,y]);
```

solve: dependent equations eliminated: (2)

$$\left[\left[x=\frac{\%r1+4}{2},y=\%r1\right]\right]$$

```
wxplot2d([2·x−4,2·x−4], [x,−1,5])$
```




```
solve([2·x−y=4], [y]);
```

$$[y=2x-4]$$

```
solve([4·x−2·y=8], [y]);
```

$$[y=2x-4]$$

Examples

```
(%i2) A: matrix(
        [7,0,3],
        [5,-2,1],
        [6,4,-1]
      );
```

$$(\%o2)\begin{pmatrix}7 & 0 & 3\\ 5 & -2 & 1\\ 6 & 4 & -1\end{pmatrix}$$

```
(%i4) determinant(A);
(%o4) 82
```

```
(%i6) invert(A);
```

$$(\%o6)\begin{pmatrix}-\frac{1}{41} & \frac{6}{41} & \frac{3}{41}\\ \frac{11}{82} & -\frac{25}{82} & \frac{4}{41}\\ \frac{16}{41} & -\frac{14}{41} & -\frac{7}{41}\end{pmatrix}$$

Examples

```
solve([3·log(x)−2=3], [x]);
```

$$\left[x = \%e^{5/3} \right]$$

Using CAS helps students to deal with complicated problems, lets students to check results obtained by hand. Teacher can use CAS for demonstrations during the lecture and for preparing students' assignments. We believe that using CAS in the classroom will improve the quality of teaching mathematics.

Thank you for attention!