

Teaching Math in SGU with Computer Algebra Systems

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Abstract. We discuss usage of computer algebra systems in teaching College Mathematics in St. George's University. Some examples are given.

Introduction

St. George's University School of Arts and Sciences comprise mainly of local and Caribbean students. From our lens in Grenada, students display a negative perception of Mathematics at all levels in their academic journey, from primary, secondary and tertiary level education. Many variables are responsible for the learning of mathematics. These factors include but are not limited to: teachers, students, environment and classroom setting; teachers must lead this process.

We agree with the ideas presented in [1, 2]: modern computer algebra systems (CAS) change the way to do mathematics and to teach mathematics. Some of our experience of using CAS in education was described earlier [5, 6]. We believe that with the introduction of technology in mathematics classroom students' performance will improve. We selected the use of two Computer Algebra Systems: Maxima and GeoGebra for teaching Mathematics at St. George's University; both programs are free with an excellent user graphic interface for its users.

Grenada as a third world country has limited resources with low income as compared to the other developing countries. The cost to students will be zero, Students, will not incur any cost to use CAS in the learning environment in SGU.

To assist students, we have created a Power Point presentation with instructions for the use of both Maxima and GeoGebra. Students will also have the advantage of checking for accuracy as well as to generate additional examples in order to achieve mastery in various Math topics. Polya's Problem Solving Technique can be incorporated by SGU students in the learning environment for mathematics:

1. Identify the problem (Identify and understand the problem)
2. Devise a plan (Use Maxima/ GeoGebra)

3. Carryout the Plan (Correctly input the information in Maxima / GeoGebra; use the power point for assistance) CAS
4. Check-Back (Check physical workings with CAS answers).

Teachers are stagnated with the method in which math is taught in the Caribbean. We believe that with the use of technology students will be motivated to learn Math concepts in the learning environment. Teachers can also use CAS to generated additional examples for students as well as it can positively assist with the explanations of complicated Math problems; teachers do not have to waste time on problems that are difficult from the computational point of view. Topics which can be incorporated with the use of CAS: basic simplification, factorization, solving polynomial equations, solving linear systems with 2, 3 and more variables, matrices (determinant of 3x3 and inverse of a matrix), Geometry (area, perimeter and volume of shapes), and others. Below, we give just a few examples of how we are using CAS in the classroom.

1. Examples with Maxima

Certainly, Mathematica or Maple would be even better to use in the classroom, but Maxima can do most of things needed and as it was mentioned earlier, Maxima is free. Some examples and discussion of using Maxima in education can be found in [3, 4].

Maxima easily allows calculation of the determinant of Matrix A or finding the inverse of the matrix (Figure 1). It is very easy to solve quadratic equation

```
(%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)  $\begin{pmatrix} -\frac{1}{41} & \frac{6}{41} & \frac{3}{41} \\ \frac{11}{82} & -\frac{25}{82} & \frac{4}{41} \\ \frac{16}{41} & -\frac{14}{41} & -\frac{7}{41} \end{pmatrix}$ 
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FIGURE 1. Calculation of the determinant and inverse of matrix A

and illustrate solutions with a plot (Figure 2). It is also easy to solve systems of linear equations and in the case of two equations with two variables to illustrate it (Figure 3).

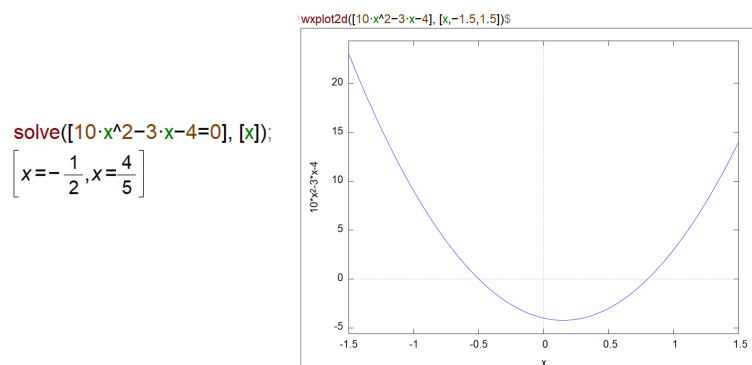


FIGURE 2. Solution of Quadratic Equation

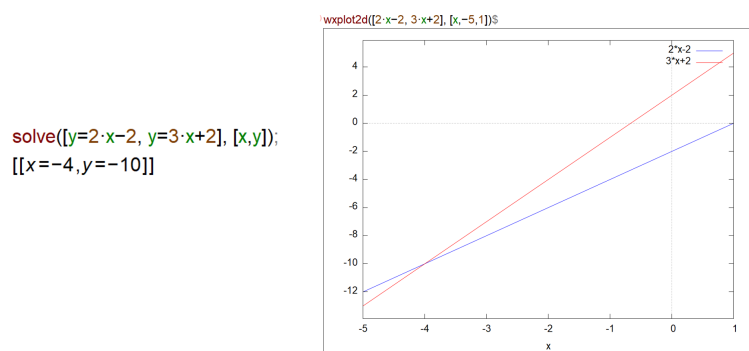


FIGURE 3. Solution of Linear System

2. Some examples with GeoGebra

GeoGebra is useful not only for solving problems, but also for preparing illustrations, demonstrations and experimenting. Some basic examples are shown on figures 5, 4, and 6.

Conclusion

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.

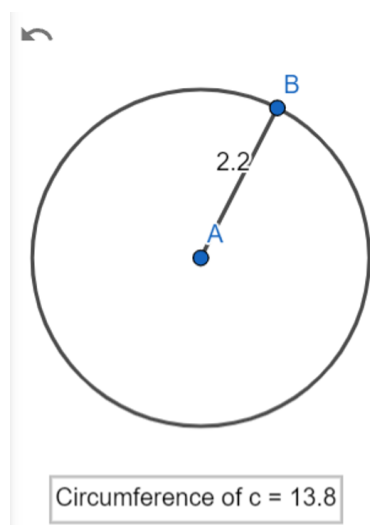


FIGURE 4. Circumference of a circle

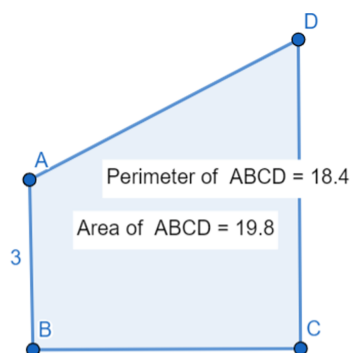


FIGURE 5. Finding of area and perimeter of a trapezium

References

- [1] Vavilov N. A. *Computers as fresh mathematical reality. I. Personal account. Computer Tools in Education (2)*, pp. 5-26, 2020.
- [2] Vavilov N. A., Halin V.G., Yurkov A. V. *Mathematica for non-mathematician: University textbook*, Moscow, 2021 (in Russian)
- [3] Karjanto, N., Husain, H. S. *Adopting Maxima as an Open-Source Computer Algebra System into Mathematics Teaching and Learning*, Proceedings of the 13th International Congress on Mathematical Education, pp. 733-734, Springer International Publishing, 2017.

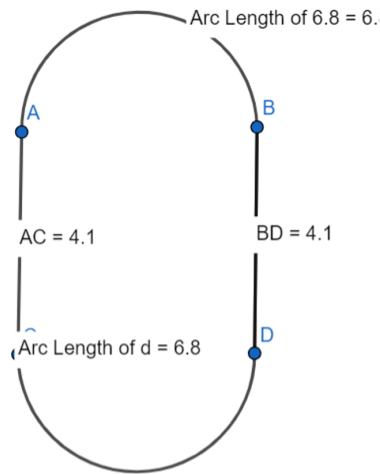


FIGURE 6. Calculation of perimeter

- [4] Fedriani, E. M., Moyano, R. *Using Maxima in the Mathematics Classroom*. International Journal for Technology in Mathematics Education, Vol. 18 Issue 4, pp. 171-176, 2011.
- [5] Mylläri A., Mylläri T., Cummings T. *Using CAS in teaching basic Calculus*. In Abstracts for the International Conference Mathematical Partnership, Parallel Computing and Computer Algebra, MathParCA - 2014, Mochlos, Crete, Greece, pp. 36 - 39, 2014.
- [6] Hypolite S., Mylläri A. *Use Of Computer Algebra Systems In Teaching Math At SGU*. Computer tools in education, pp. 96 - 100, No 3, 2021.

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