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Algebra Tutorial for Prospective Calculus Students

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ALGEBRA TUTORIAL FOR PROSPECTIVE CALCULUS STUDENTS

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PROJECT

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Abstract:

Many undergraduate degrees require students to take one or more courses in calculus. Majors in mathematics, science, and engineering are expected to enroll in several rigorous calculus courses, but those majoring in social and behavioral sciences and business must also have some basic understanding of calculus. The goal of this project is to create a web-based tutorial that can be used by the GSU Mathematics faculty to reinforce the algebra skills needed for introductory or Applied Calculus. The tutorial covers the concepts of the slopes of lines, polynomial arithmetic, factoring polynomials, rational expressions, solving quadratic equations, linear and polynomial inequalities, and finding the roots of polynomial equations. The tutorial will also provide sections that review basic algebra concepts such as interval notation, order of operations, laws of exponents, and arithmetic with radicals. Each topic covered will provide a concise description followed by step-by-step instructions, where appropriate, along with numerous examples and illustrations to assist the reader in understanding the concept. The tutorial is run through a web browser and uses HTML along with a LaTeX library called MathJax for displaying mathematical expressions and equations appropriately. Each section will also include links to tools such as Desmos' online graphing calculator and Khan Academy videos to allow the reader to interact and experiment with algebraic concepts. These included activities are intended to help the student develop a deeper understanding of each topic. Each section will also provide a multitude of practice exercises of varying difficulty along with an answer key. Complete solutions to various problems will also be provided.

Key words: algebra review, algebra tutorial, exponents and logarithms, order of operations, lines, polynomials, factoring polynomials, rational expressions

Background and Purpose

Many undergraduate degrees require students to take one or more courses in calculus. Majors in mathematics, science, and engineering are expected to enroll in several rigorous calculus courses, but those majoring in social and behavioral sciences and business must also have some basic understanding of calculus. Performing well in calculus, however, requires sufficient mastery of many algebra concepts that students are expected to acquire in high school and/or a college algebra course. However, in a 2011 report by the Mathematical Association of America (MAA), nearly 50% of college algebra students in the United States fail to pass the course with a grade of C or better. [1] The goal of this project is to create a web-based tutorial that can help students enrolled in calculus courses reinforce their algebra skills. There are a number of algebra web sites that exist, but many of them contain brief or overly-simplified explanations with minimal examples and exercises with no solutions. Many also are not easy to read as they are formatted using fonts or characters not conducive to reading mathematical symbols or expressions. Finally, many of the existing online tutorials provide textual information, but do not provide supplemental video or multimedia resources. The tutorial proposed for this project presents topics in algebra with explanations and graphical illustrations using mathematical typesetting that is easy to read. This tutorial also provides exercises and step-by-step solutions to each problem. Finally, this tutorial provides links to other mathematical web-based resources, making it a centralized resource for learning or reviewing key algebra concepts, making it easy for students to navigate.

[1] From "A Tale of a Change Initiative Revitalizing College Algebra Program of the Mathematical Association of America" in *Partner Discipline Recommendations for Introductory College Mathematics and the Implications for College Algebra*, by Susan L. Ganter and William E. Haver, 2011: The Mathematical Association of America.

Topics Covered

The tutorial covers the concepts of exponents and logarithms, order of operations, lines, polynomial arithmetic, factoring polynomials, rational expressions, along with some common mistakes made on various topics. These topics were chosen because they are both fundamental to the study of calculus and are most often misunderstood by students entering college mathematics, based on discussions with Governors State University mathematics faculty. If a student is not able to master these topics, success in more advanced mathematics courses such as calculus will most likely be impaired.

Tutorial Features

Each topic in the tutorial will provide a concise description followed by step-by-step instructions, where appropriate, along with definitions, numerous examples and illustrations to assist the reader in understanding the concept. Concepts are illustrated using tables and diagrams to present the material in a way to help the student better understand. The tutorial is a web application that is run through a web browser, such as Chrome, Firefox, or Internet Explorer. It makes use of a JavaScript LaTeX library called MathJax for displaying mathematical expressions and equations appropriately. The section on lines contains links to Desmos' online graphing calculator to give students an interactive opportunity to manipulate lines via an equation or graph to demonstrate how changing one affects the other. The lines section also contains various graphs that illustrate key concepts of lines and special cases of lines, such as vertical versus horizontal, and parallel versus perpendicular. These graphs were created using GeoGebra, an open-source application used for graphing algebraic equations. Almost all the sections contain links to Khan Academy videos to help students get a deeper understanding of the topics and to see the instructor work through more examples. Many of the videos contain

supplemental exercises and solutions for the student to practice to reinforce skills. Each section in the tutorial will also provide a multitude of practice exercises of varying difficulty along with an answer key. Complete solutions to various problems will also be provided. A section entitled "Common Mistakes" is also included in the tutorial to address topics that present the most trouble to students. These topics include the notion of distributing exponents and cancelling terms from equations and rational expressions. According to GSU faculty, these are some of the most frequently made mistakes that students make in algebra. Upon completion of the algebra tutorial, it is hoped that the tutorial can be used by GSU faculty in addressing topics that students need to review or reinforce their skills.