1 Introductory Algebra

Dates: July 15 to August 16, 2019 (5 weeks)
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Website: https://sites.google.com/morris.umn.edu/ummintroalgebra/home
WeBWorK site: http://webwork.morris.umn.edu/webwork2/2019IntroductoryAlgebra/

1.1 Prerequisites/Relation to Math 0901 Basic Algebra

- Students in Introductory Algebra will have a diverse background of mathematical experience. There is no formal prerequisite, other than a willingness to ask questions and meet deadlines.

- Introductory Algebra will help you review and strengthen your math background up to the level of precalculus. The topics studied do not cover all the material in a high school algebra course.

- Students who complete the Introductory Algebra satisfactorily may enroll in Math 1012 Precalculus I Functions and/or Math 1013 Precalculus II: Trigonometry.

- Although Introductory Algebra is not a formal course at UMM, the topics covered in Introductory Algebra are roughly the same as in Math 0901 Basic Algebra. If you find the structure of online Introductory Algebra does not work well for you, you can take Math 0901 Basic Algebra in the fall where you will have face-to-face interactions with your instructor and more time to work on the concepts.

1.2 Topics

Unit 1: Prealgebra Review: Fractions.
Unit 2: The real number line and variables.
Unit 3: Linear Equations and inequalities.
Unit 4: Graphing linear equations and inequalities.
Unit 5: Systems of linear equations and inequalities.
Unit 6: Exponents and Polynomials.
Unit 7: Factoring.

Unit 8: Rational expressions and equations.
Unit 9: Relations and Functions.
Unit 10: Rational exponents and radicals.
Unit 11: Radical equations.
Unit 12: Quadratic Functions.
Unit 13: Cumulative Final Exam.

1.3 Time Commitment

- The course is divided into 13 self-contained units organized around different topics in algebra. The Units build on themselves somewhat, so it is important to master a Unit in a timely fashion.

- The Units are spaced out over five weeks, with roughly three Units per week. You have five weeks to complete all the Units.

- You may work ahead, but make sure not to fall behind as each Unit has a due date for completion. Generally, each week you need to complete three units to stay on pace. A suggested **timeline for completion** is available on the website.

- What is important is that you engage with the material sufficiently to retain the knowledge of the concepts when they are used in your subsequent math and science classes. **This is best achieved by working on the course four to six days a week, rather than in one or two marathon sessions.**

1.4   Components

1. **WeBWorK.** The components of the course are in WeBWorK, an advanced math online homework system (details on how to login and use WeBWorK are in Section 2 of the syllabus). In WeBWorK you will be able to answer questions and know immediately if your answer is correct, making it an excellent tool to review algebra since you can quickly identity areas you need to focus on. Write your solutions clearly to the problems you are solving in WeBWorK, and make sure you can look back at them and follow the process of your solution. **If you return to your notes and cannot understand what you did, then you need to work on improving the detail included in your handwritten solutions.**

2. **Communication with Barry.** You can ask me question using the ⌑Email Instructor⌑ button in WeBWorK, or just emailing me at mcquarrb@morris.umn.edu. You can expect a response within 24 hours, except on weekends when it may take longer.

3. **Calculators.** You will be allowed to use calculators on the homework and tests, but you should realize that a calculator alone cannot give you the algebraic mastery that you need to pass this course and to succeed in future courses. Focus on doing problems by hand and use the calculator sparingly, mainly for the arithmetic of multiplication or division of larger numbers (for smaller numbers be able to do the arithmetic by hand).

4. **Unit Lecture Notes.** I will provide lecture notes to introduce each of the topics in each Unit.

   There are sometimes different ways to solve mathematical problems. If you are proficient in a technique that is different than the one described in my lecture notes for a particular type of problem, talk with me about it. As long as you can answer the questions correctly and using correct mathematics, that will be sufficient.

5. **Unit Examples.** I will provide examples for typical types of problems for each of the topics in each Unit.

6. **Videos.** I will occasionally provide example problems with a video of me solving the problem.

7. **purplemath.** I have provided links to the topics on the website purplemath as a further resource.

8. **(Graded) Homework in WeBWorK.** Each Unit has Homework, consisting of about 20 questions. You can attempt Homework questions multiple times until you get them right.

9. **(Graded) Unit Tests in WeBWorK.** Each Unit has 30 minute Unit Test, consisting of about 10 questions. You will be able to retake Unit tests to improve your grade, but there will be a limit to the number of times you can retake a Unit test each day. **You should review the problems you had difficulty with before retaking a Unit Test, since the goal is to retain mastery of these techniques for your fall courses, not just to get 100% on the Unit Tests.**

10. **(Graded) Final Exam.** A cumulative 60 minute Final Exam, consisting of about 25 questions, will count as the final Unit. Unlike the Unit Tests, you will only have one attempt at the Final Exam.

11. There is no textbook you need to purchase, although if you have a textbook you can certainly use it as another resource.

1.5   Satisfactory Completion

For satisfactory completion, you will need an overall average of greater than 75%.

The grade will be calculated by the following formula (there is no extra credit):

Homework (12 Units)	40%
Unit Tests (12 Units)	40%
Cumulative Final Exam (Unit 13)	20%

2 WeBWorK

1. Your goal in WeBWorK is more than just to get the right answer. You should be making sure that you are learning from the problems, not just doing them.

2. When you successfully complete a problem, you should pause and reflect, making sure that you can quickly do similar problems.

3. If you don't understand how you got the right answer after some reflection, talk with Barry.

4. Start problems early so you have time to seek out assistance if needed!

2.1 How to Login

- Introductory Algebra is located here: http://webwork.morris.umn.edu/webwork2/2019IntroductoryAlgebra

- **username:** the part before @ in your UMM email (abcd123@morris.umn.edu has username abcd123)

- **initial password:** your UMM student ID number (change it to something else once you login)

- if you cannot login after a couple of tries email me (mcquarrb@morris.umn.edu) and I will reset your password

2.2 Unit Homework Sets (about 20 questions per Unit)

- When you login, you will be presented with different homework sets you can work on, one Homework Set for each Unit. All students get similar problems, but each student will get their own individualized problems in a homework set.

- **Each homework set has a due date, after which you will not be able to get any credit for completing those problem sets.** When a problem set closes, the answers will be available to you.

- Once you select the Homework for a Unit, you can

  - Access Barry's Resources, purplemath resources, and WeBWorK resources (on the right).
  - Download PDF (at the bottom) of the problem sets if you like, and work on them away from the computer. Or you can work on some scratch paper and complete problems while you are still right in front of the computer.
  - Follow the link to *functions and symbols* syntax if there is a mathematical symbol you don't know how to input.
  - Click on Problem 1 to get started.
  - Complete some of the problems and return later to complete the rest, and WeBWorK will remember the ones you have already completed.

2.2.1 Individual Problems

- Preview My Answers button shows you the formatting of the answers you typed in. This can be helpful to make sure your syntax is correct, for example to see the difference between $1+2/3+4$ and $(1+2)/(3+4)$.

- Check Answers button checks your answers and can give you some feedback in some cases, but does not submit your answers for grading.

- Submit Answers button is used to submit your answers for grading. The grade will show up below the buttons after you submit your answers. To get credit for a correct answer you must enter your answer online using the Submit Answers button! The computer system will keep track of your progress, so I will not be grading these problems. **Generally there is no penalty for the number of attempts on a particular problem,** but if you get up to 10 or more attempts and haven't gotten the correct answer, set that problem aside and review your materials to see if you can find your error.

- Email Instructor button is used to send an email to me. The email will show me your particular problem, so I prefer you use this method to ask questions arising in WeBWorK. You can email me for each problem you have a question on in a homework set. **Try to include plenty of detail on how you have tried to solve the problem (not just the final answer you have).**

- Some problems allow you to earn partial credit. You will always retain the highest partial credit you have earned from all attempts, so if you try again and do worse you aren't penalized.

- If you have difficulty getting WeBWorK to accept an answer you are <u>sure</u> is correct, send me an email from within WeBWorK from the problem using Email Instructor and move on to other homework.

- If WeBWorK seems to be impossibly slow or you have other trouble with the system, send me an email and go work on some of your other homework.

2.3 30 Minute Unit Tests (about 10 questions per Test)

- The Unit Tests problems will be similar to the homework, but the tests will be timed so you have 30 minutes to complete the test.

- Unit Tests are designed so you have one attempt at fixing any errors in your solutions (i.e., once you have started a test, you can click Grade Test at the bottom, and then you will have one chance to fix any errors on the test (try to fix all the problems that are incorrect, then click Grade Test to finish the test). Once you have clicked Grade Test twice, the test is finished and you cannot change your answers.

- You can take a Unit Test a maximum of four times in an 18 hour period. Each time you start a new Unit Test you will be slightly different questions to solve. If you choose to retake a Unit Test, you should review the material beforehand.

2.4 60 Minute Cumulative Final Exam (about 25 questions)

- Unlike Unit Tests, you will only have one attempt at the Final Exam. There will not be able to try again to improve your score and understanding, so make sure you prepare well for the final exam.

- You will have 60 minutes to complete the Final Exam, be sure to click Grade Test when you are done.

2.5 WeBWorK Syntax

There is a link to a more complete list of functions and symbols at the start of each problem set in WeBWorK.

Mathematical Constants Available In WeBWorK

- pi gives 3.14159265358979, e.g. cos(pi) is -1
- e gives 2.71828182845905, e.g. ln(e*2) is $1 + \ln(2)$

Mathematical Symbols Available In WeBWorK

- $+$ Addition
- $-$ Subtraction
- * Multiplication can also be indicated by a space or juxtaposition, e.g. 2x, 2 x or 2*x, also 2(3+4).
- / Division
- ^ or ** You can use either ^ or ** for exponentiation, e.g. 3^2 or 3**2
- () You can also use square brackets, [ ], and braces, { }, for grouping, e.g. [1+2]/[3(4+5)]
- $\sqrt{x}$ is given by sqrt(x)
- $|x|$ is given by abs(x)

Syntax for entering expressions

- Be careful entering expressions just as you would be careful entering expressions in a calculator.
- Sometimes using the * symbol to indicate mutiplication makes things easier to read. For example (1+2)*(3+4) and (1+2)(3+4) are both valid. So are 3*4 and 3 4 (3 space 4, not 34) but using a * makes things clearer.
- Use ('s and)'s to make your meaning clear. You can also use ['s and]'s and {'s and }'s.
- Don't enter 2/4+5 (which is 5.5) when you really want 2/(4+5) (which is 2/9).
- Don't enter 2/3*4 (which is 8/3) when you really want 2/(3*4) (which is 2/12).
- Entering big quotients with square brackets, e.g. [1+2+3+4]/[5+6+7+8], is a good practice.
- Be careful when entering functions. It's always good practice to use parentheses when entering functions. Write sin(t) instead of sint or sin t. But WeBWorK is smart enought to accept sin t or even sint. However, sin 2t is interpreted as sin(2)t, i.e. (sin(2))*t. Be careful.
- Do not enter sin^2t even though you might see something like this written in a text book. Mathematically speaking sin^2t is shorthand for (sin(t))^2(the square of sin of t) and must be entered this way. (You can enter it as sin(t)^2 or even sint^2, but don't try such things unless you really understand the precedence of operations. The "sin" operation has highest precedence, so it is performed first, using the next token (i.e. t) as an argument. Then the result is squared.)
- Is -5^2 positive or negative? It's negative. This is because the square operation is done before the negative sign is applied. Use (-5)^2 if you want to square negative 5.
- When in doubt use parentheses!!!
- The complete rules for the precedence of operations, in addition to the above, are

    - Multiplications and divisions are performed left to right: 2/3*4 = (2/3)*4 = 8/3.
    - Additions and subtractions are performed left to right: 1-2+3 = (1-2)+3 = 2.
    - Exponents are taken right to left: 2^3^4 = 2^(3^4) = 2^81 = a big number.

3 Topic Details/Learning Objectives

A student will be able to use the following concepts/techniques in a variety of situations.

- **Unit 1: Prealgebra Review: Fractions.**

  Classifying numbers, fractions, prime factorization, equivalent fractions, reduced form, operations with fractions (add, subtract, multiply, divide), least common denominator, improper fractions, mixed numbers, percents.

- **Unit 2: The real number line and variables.**

  Real number line, operations with real numbers (add, subtract, multiply, divide), integer exponents, absolute value, distance, order of operations, equivalent algebraic expressions, factors, terms, distributive property, like terms, simplifying parentheses, substitution into variable expressions, inequality and interval notation, English to algebraic expressions.

- **Unit 3: Linear Equations and inequalities.**

  Equivalent equations, addition, multiplication and division principles, canceling common factors, solving equations, transposing literal equations, solving linear inequalities, intersection, union, empty set, word problems with equations.

- **Unit 4: Graphing linear equations and inequalities.**

  Rectangular coordinate system, distance formula, midpoint formula, slope, vertical lines, horizontal lines, parallel and perpendicular lines, sketching linear equations and inequalities, equation of linear line (slope-intercept, slope-point, point-point forms).

- **Unit 5: Systems of linear equations and inequalities.**

  Independent and dependent equations, inconsistent and consistent equations, method of substitution, method of elimination, solving systems of inequalities by sketching.

- **Unit 6: Exponents and Polynomials.**

  Rules of exponents, negative exponents, operations with polynomials (add, subtract, multiply, divide), special cases of multiplication.

- **Unit 7: Factoring.**

  Common factors, factoring by grouping, factoring x^2+bx+c and ax^2+bx+c, prime polynomial, difference of squares, perfect squares, sum and difference of cubes, zero factor property, solving quadratic equations.

- **Unit 8: Rational expressions and equations.**

  Rational expressions, simplifying, operations with rational expressions (add, subtract, multiply, divide), complex rational expressions, solving rational equations, extraneous solutions, proportion and similar triangles.

- **Unit 9: Relations and Functions.**

  Relations, functions, domain and range, functional notation, vertical line test, examples of functions.

- **Unit 10: Rational exponents and radicals.**

  Rational exponents, radical expressions, operations with radicals (add, subtract, multiply, divide), rationalizing, square root function.

- **Unit 11: Radical equations.**

  Solving radical equations, complex numbers, operations with complex numbers (add, subtract, multiply, divide), variation, absolute value equations and inequalities.

- **Unit 12: Quadratic Functions.**

  Quadratic functions (standard and vertex form), completing the square, square root property, quadratic formula, discriminant, solving quadratic equations, transforming equations into quadratic equations, sketching quadratics.

- **Unit 13: Cumulative Final Exam.**

  Check your mastery of all the Units.