Contents

Part I

Sample Course Materials

Course Outline

Title:	Math for Computer Technicians
Course Number:	Math 92
Credits:	4
Date:	June 23, 2003
Institution:	Clackamas Community College
Outline Developed by:	Don Hutchison and Mark Yannotta
Type of Program:	Developmental
Course Description:	This is a math course designed for students in the computer technician program. It is the only required math component of the program and was designed to familiarize students with the mathematics in the computer industry. Topics include scientific notation, unit analysis, decimal, binary, and hexadecimal arithmetic, set theory, Boolean algebra, logical operators, truth tables, and circuitry.
Course Objectives:	Use the rules of exponents to simplify expressions, particularly those with bases of 2, 10, and 16. Use unit analysis to ensure that the appropriate units accompany the answer to application exercises. Convert among decimal, binary, and hexadecimal notations with the assistance of a calculator. Perform basic operations on binary and hexadecimal numbers. Use two's-complement notation to represent negative numbers. Convert among decimal, binary, and hexadecimal notations by algorithm. Display sets and subsets with a Venn diagram. Use a Venn diagram as a tool for problem solving. Write the dnf (disjunctive normal form) of a function from a truth table. Create a truth table from a dnf. Create a Venn diagram from a truth table. Find the Boolean expression associated with a Venn diagram. Simplify an elementary Boolean expression using the laws of Boolean algebra. Find the circuit associated with a Boolean expression. Find the circuit associated with a truth table. Simplify a circuit using a Karnaugh map. Use a table to represent a CYMK color scheme. Complete a Venn diagram for an RGB color scheme. Use six digit hexadecimal notation for a particular RGB color.
Length of Course:	42 hours
Grading Method:	Grades are determined on the basis of homework, quizzes, tests, and a comprehensive final examination.
Prerequisites:	Math 65 (Algebra II), or the proper placement score

Required Text: Text materials created by department members will be distributed in class

Major Topic Outline:

Calculator and Algebra Skills: Operations using positive and negative exponents, interpreting scientific notation, accuracy and precision, basic calculator functions, and unit analysis

Binary Arithmetic: Understanding place value, introduction to the binary system, operations on binary numbers, two's complement notation, and binary fractions

Hexadecimal Arithmetic: Conversions between binary, decimal and hexadecimal, operations on hexadecimal numbers, color theory and RGB display, ASCII, parity and error checking

Sets and Logic: Operations on sets, Venn diagrams, truth tables, logical operators

Elementary Boolean AlgebraI: Introduction to Boolean variables, DeMorgan's Law, Boolean Algebra, factoring Boolean expressions, modular arithmetic

Circuit Reduction: Switching circuits, disjunctives, dnf, gated circuits, Karnaugh maps, reduction of three, four and five variable circuits

Color Codes: CYMK color representation, RGB color representation, hexadecimal codes for web page, printer, or monitor color

A suggested timeline:

CLASS HOURS	TOPIC:
3	Calculator and Algebra Skills
4	Binary and hexadecimal notation
4	Binary and hexadecimal arithmetic
4	Two's complement notation
2	Venn diagrams
4	Boolean expressions
4	Boolean algebra
4	Truth tables
4	Circuit design
4	Circuit reduction
5	Tests and reviews
42	Total

Syllabus
MTH 92
Mathematics for Computer Technicians
Summer 2002

Hours: 5:00 P.M.–7:20 P.M. Monday and Wednesday (June 24th—August 14th) in S135

Text: *Mathematics for New Technologies,* Hutchison and Yannotta

Calculator: TI-34, TI-36X, TI-83 (you will need to get a free program from the Math Lab)

Instructor: Don Hutchison

Telephone: 503-657-6958, Ext. 2366 E-mail: donh@clackamas.edu

Office Hours: In S117: Monday and Wednesday 3:00 – 4:30 or by appointment

Homework: The first assignment is the course syllabus quiz, which is to be submitted electronically sometime before the second class meeting.

Unless otherwise noted in class, all exercises from the text are assigned. Each assignment should be submitted by the due date. See the attached calendar for those dates (subject to revision). Homework will be worth a total of 50 points.

Tests: There will be 2 tests and a quiz this Summer. Some tests will consist of both an in-class group component and an individual component for a combined score of 100 points. The quiz will be worth 50 points. Problems will be based on the homework and the lectures. **If you are unable to be present for a test, arrangements must be made PRIOR to the day of the test by calling me at the above extension.** Ten percent will be deducted from any test taken late.

Grades: Letter grades will be assigned on the standard 10% increment scale. The course may also be taken as a **Pass/No Pass** course or for an **Audit (a student must attend class to receive an Audit)**. You must let me know in writing if you prefer something other than a letter grade. **If you stop attending class, you must officially withdraw. A student who does not complete the course and does not officially withdraw will receive a No Pass.**

Final Exam: The final exam will be held on August 14th from 5:00 P.M.–7:00 P.M. The final exam will be worth 200 points.

I post the following quiz on my web site as an .rtf document. Students are to download it, answer all questions, and then e-mail it to me as an attached .rtf file. This assures both that students are familiar with my expectations and that they are able to find my web site and contact me via e-mail.

MTH 92 Syllabus Quiz

Name:

Student ID Number:

Given homework, tests, quizzes, and the final, how many total points are possible?

Where and when are the instructor's office hours?

How many chapters are in the text? Are they all covered this term?

Where would you find the due date for the homework from chapter 3? What is that due date? How many total exercises are due that day?

What is the date of the final exam?

What must you do if you are unable to attend class on the day of a test?

What exercise answers are available in the text? Where will you find them?

If a student scores 87 and 90 on the test, 42 on the quiz, and gets 45 points for the homework, how many points does (s)he need on the final to get an "A" for the class?

For the first class meeting, we frequently use the following activity. I call up the following as a Word document. Each student introduces himself, replies to each of the next three lines, and then gives one of the definitions. That term is then eliminated from the list.

Name
Last Successful Math Class
Best Math Memory
First Computer Memory

Define one of the Following Words in the Context of Mathematics or Computers (assistance permitted)

Mathematics	Algebra	Computer
Calculator	Abacus	Program
Addition	Subtraction	Multiplication
Division	Product	Sum
Equation	Expression	Inequality
Quotient	Ratio	Fraction
Percentage	Decimal	Property
Exponent	Number	Digit
Statistic	Average	Numerator
Denominator	Base	Absolute Value
Computation	Negative	Positive
Zero	Technician	Text
Answer	Solution	Exam

This is used as an in-class activity. It provides both relevance and complexity so that almost every student learns something of significance to the student.

Examples of Unit Analysis

1. A floppy disk is rotating at 300 rpm. The machine can execute 25 instructions per microsecond.
    a. How many instructions per minute can the machine execute?
    b. How long does it take the disk to make a complete revolution?
    c. What is the disk's latency time?
    d. How many instructions can the machine perform during the disk's latency time?

2. A hard drive is rotating at 5000 rpm. The machine can execute 25 instructions per microsecond.
    a. How many instructions per minute can the machine execute?
    b. How long does it take the disk to make a complete revolution?
    c. What is the disk's latency time?
    d. How many instructions can the machine perform during the disk's latency time?

3. A picture is represented on a monitor screen by a rectangular array containing 1024 columns and 768 rows of picture elements (pixels). How many bytes of memory are required to store the picture, if each pixel requires one byte of storage?

4. The average novel contains 385 pages. Each page averages forty lines, and each line averages 63 characters. Assume that each character requires one byte of storage.
    a. Express the size of an average novel as a percentage of the storage on a single 1.44 MB floppy disk.
    b. Express the size of an average novel as a percentage of the storage on a single 1.2 GB hard drive disk.
    c. How many (average size) complete novels can be stored on a single 1.2 GB disk?

Definitions

Byte	eight bits
Kilobyte (K)	2^{10} bytes
Megabyte (MB)	2^{10} kilobytes
Gigabyte (GB)	2^{10} megabytes
Millisecond	one thousandth of a second
Microsecond	one thousandth of a millisecond
Nanosecond	one thousandth of a microsecond
Picosecond	one thousandth of a nanosecond
Latency Time	the average time it takes the r/w head to locate desired data (equal to $\frac{1}{2}$ the time of a single revolution)

MTH 092 In-Class Activity
Group Member Names:

Turn this paper in with your homework for Chapters 5 and 6.
Background: The notation Z, used to represent integers is from the German word, "zahlen", which roughly means "to count". To represent the integers in modular arithmetic, we use a subscript to denote the modulus. For example, Z_{12} would represent the integers(mod 12) and would be the set of integers {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11}.

1. Complete the following addition table for Z_4 and answer the questions below. Remember that you are doing these calculations modulo 4.

+	0	1	2	3
0				
1				
2				
3				

A. Which number is the additive inverse of 3 in Z_4?
(i.e., What number plus 3 gives you the number 0 in this system?)

B. Which number is the additive inverse of 2 in Z_4?

C. Is addition in this system commutative? (i.e., Does $a + b = b + a$ for all a, b?)

D. On the back of this sheet, make a multiplication table for Z_5. Use only the digits {1, 2, 3, 4}, because multiplication by zero is trivial. What is the multiplicative inverse of 3 in this system?

2. Compute the following in Z_{12}.

A. $3 + 6 + 9 + 5$ B. $4\ 3\ 7$ C. $2\ 3\ 7 + 6$ D. $(3 + 8) - 2\ 3\ 9$

MTH 092 Presentation

Among the requirements for this class is a final project. This project will consist of an 8-minute PowerPoint presentation. The project is worth a total of seventy-five points. Those points will be assigned based on the following breakdown: **Thirty-five for relevance** to the course, fifteen for presentation, and twenty-five for content (math especially). Below is a set of possible topics, followed by some guidelines. This project must be completed to receive a passing grade for the class.

Examples of Possible Topics

Digital Photography	Digital Music
Error-Correcting Codes	Circuit Design
RGB	Historical Math Accounts
Number Bases	Unicode

Requirements

No later than October 29th, each group (consisting of either two or three students) will e-mail a proposal to me at donh@clackamas.cc.or.us. By November 19th, a more detailed description of the presentation will be sent to the same address. This message will include a short synopsis of the talk. The presentations will be given in class on December 10th in a predetermined order. Each presentation will last between eight and ten minutes. After the presentation, each group will e-mail a copy of the PowerPoint slides to the previously mentioned address. An additional hard copy must be given to me in class on the day you give your presentation.

Proposal

Each proposal is due (via e-mail) on Wednesday, October 29th, by 4 PM. The proposal will include the title, at least one WWW source that will be used, a one-paragraph description of the topic, and one paragraph explaining its relevance to this class (or math in general). The proposal will be submitted electronically to the address mentioned above.

Suggestions

Work in pairs. Find a common meeting time and really plan out a topic together, rather than working separately then trying to slap something together at the end.

Do not plagiarize. Cite all the websites/references you use on the last slide. Failure to do so could result in a *failing grade*.

Be creative and have fun. Explain the topic in your own words in your own way.

Do not procrastinate. This project takes time to do well.

Number Bases

Past, Present and Future

Part One
Overview and History

- Why did number systems arise?
  - Trading and Record Keeping
  - Telling Time
  - Measuring and Building

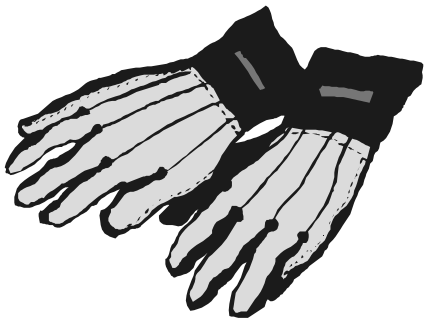
What defines a number base?

Number that determines what place values mean within a number system.

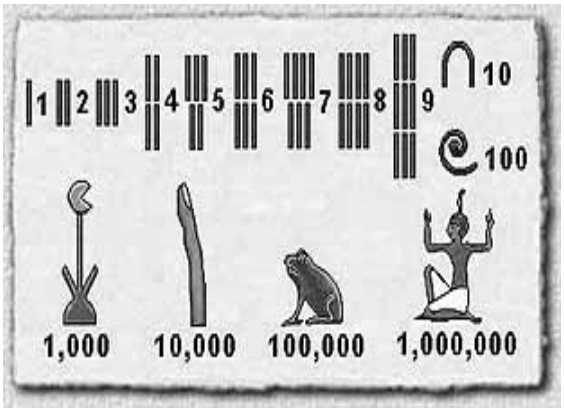
$$256_{10} = 2 \times 10^2 + 5 \times 10^1 + 6 \times 10^0$$

Grouping Value 5

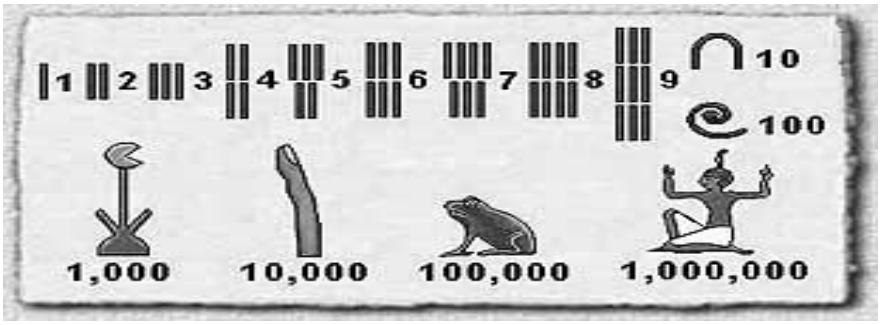
- One of the oldest systems
- Used as a grouping value
- Used by many cultures

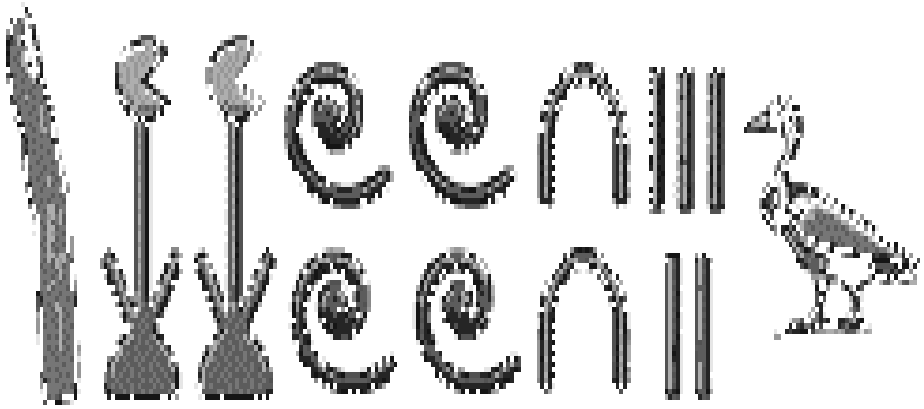


The Egyptians

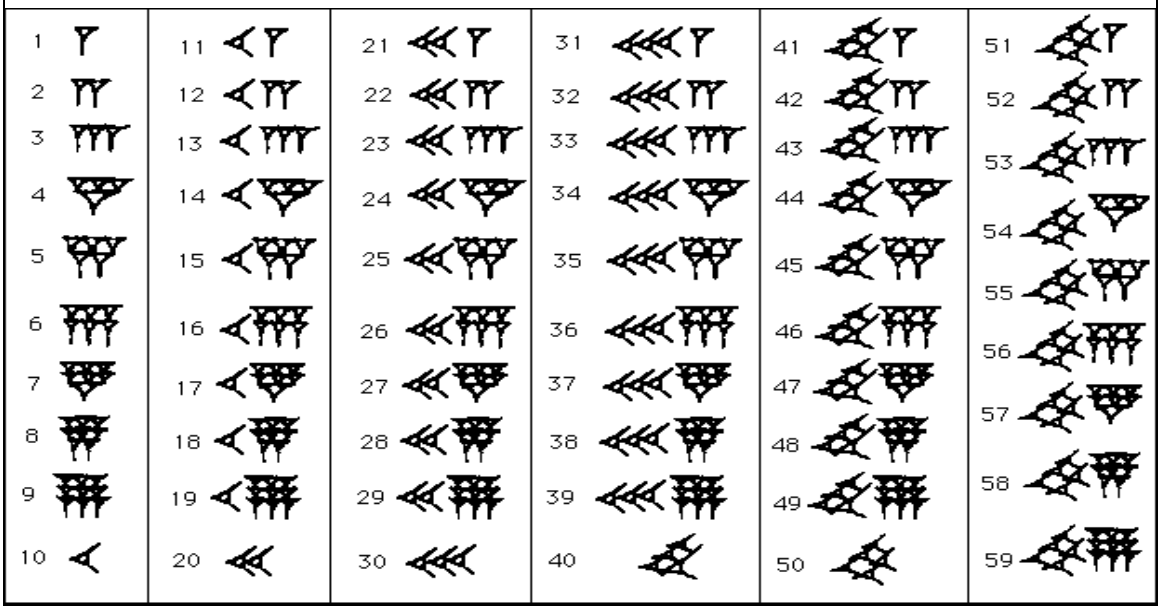


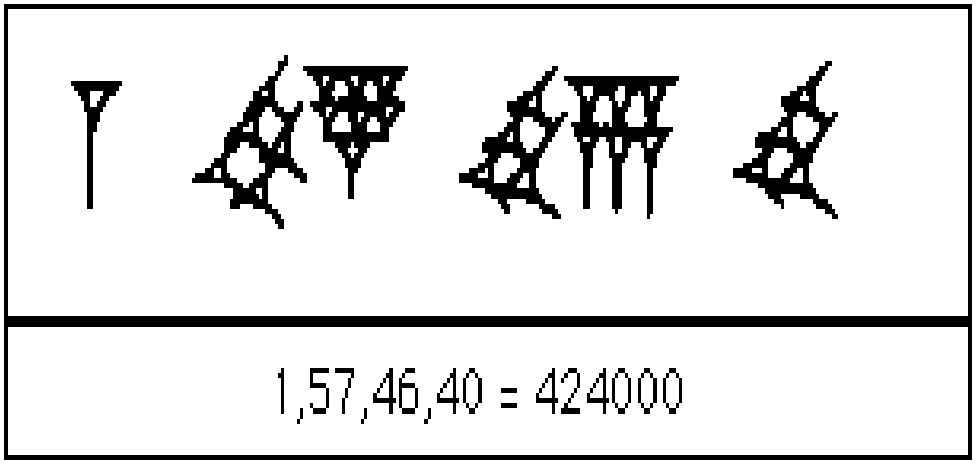
- Used a Base 10 system of hieroglyphs
- Different symbols for each power of ten
- No formal place value yet





The Sumerians and Babylonians





1,57,46,40 = 424000

Babylonian Tables

Squares:

$8^2 = 1{,}4 = 64$

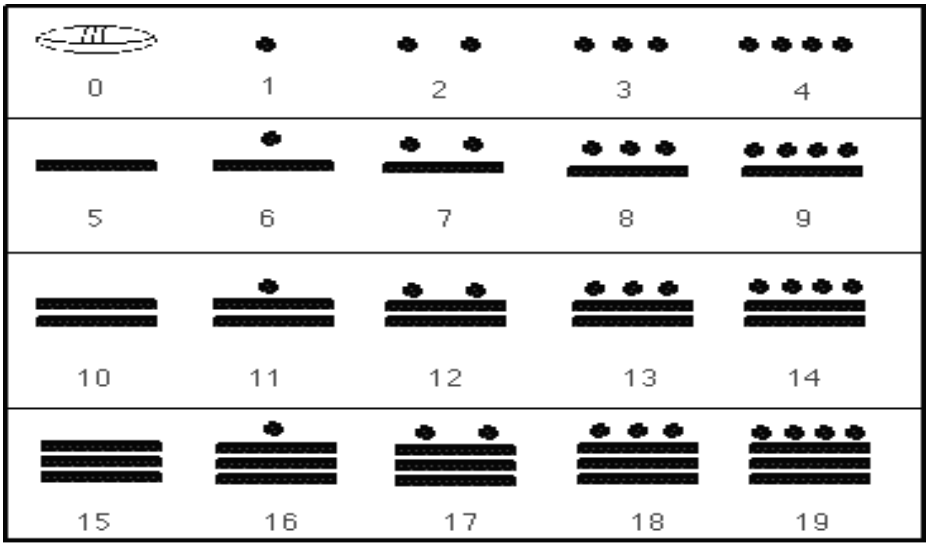
Reciprocals:

2 = 0; 30

3 = 0; 20

The Mayans and Base 20

The Mayan Numbers



Oh no! A math problem!!