Hacettepe University
Department of Computer Science & Engineering

BiL137 Programming/Software Laboratory
Experiment 1

Subject	: An Introduction to Programming with C
Submission Date	: 02.10.2010
Date Due	: 24.11.2010
Programming Language	: C
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INTRODUCTION / AIM:
The aim of this experiment is to introduce you to programming.

PROBLEM:
The problems and assigned students are as follows :

1) There are several methods to calculate π. Two of these are

a) Leibniz Series $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \ldots\ldots \quad \frac{(-1)^k}{2k+1}$

b) Charles Huttons' Method $\frac{\pi}{4} = \arctan\frac{1}{2} + \arctan\frac{1}{3}$

$$\arctan(x) = \sum_{k=0}^{\infty} \frac{(-1)^k x^{2k+1}}{2k+1}$$

Write a program that calculates π by using these two methods. For the latter, arc tangent value may be calculated using the first fifty terms. Also output the difference between the exact π value and the calculated ones.

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2) Write a program that calculates cosinus ve sinus for an input value between 0 and 2π.

a) $\cos(x) = \sum_{k=0}^{\infty} \frac{(-1)^k x^{2k}}{(2k)!}$

b) sin (x) = $\sum_{k=0}^{\infty} \frac{(-1)^k x^{2k+1}}{(2k+1)!}$

Calculate partial summation up to 34^{th} terms. Your program should also output the absolute error which is the difference between real and calculated values.

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3)According to Ramanujan, there are at most two (m,n) values that satisfy 1729 = $m^3 + n^3$ where m and n $\in$ N. Accept (m,n) as a solution unless (n,m) is also a solution. Write a program that finds Ramanujan numbers up to an input value.

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4)Babylon square root calculation method :

X = $\sqrt{a}$ $\quad 0 < X_1 < a \quad X_2 = \frac{(X_1 + \frac{a}{X_1})}{2} \qquad Xn = \frac{(X_{n-1} + \frac{a}{X_{n-1}})}{2}$

Write a program that accepts a positive integer from keyboard and calculates its square root using the method above. Continue iteration until $|X_{k+1} - X_k| < \varepsilon$ where $\varepsilon = 0.000001$.

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5)Write a program that calculates the binomial coefficients by the formula C(n,i) = $\frac{n!}{i!(n-i)!}$ where i = 0,1,2..n for a specific value n entered from the keyboard.

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6)A palindromic number is an integer, which yields itself when its digits are reversed. Write a program to find all palindromic numbers up to an input value. Ex: 16461

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7)An automorphic number is the one that appears at the end of its square, e.g. 5 x 5 = 2**5**, 25 x 25 = 6**25**. Write a program to find all automorphic numbers up to an input value n.

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8)Amicable numbers are two numbers, each of which is equal to the sum of all the exact divisors of the other except that number itself. For example, 220 and 284 are amicable numbers since 220 has the exact divisor 1,2,4,5,10,11,20,22,44,55,110, whose sum is 284, and 284 has the exact divisors 1,2,71,142 whose sum is 220. Write a program to find all amicable numbers up to an input value.

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9)Write a program that finds the perfect numbers up to n, input from the keyboard.A number is perfect, if the sum of its positive divisors except itself is equal to that number.

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10) Write a program that reads two integer numbers, determine if they are relatively prime. Two numbers are relatively prime if they have no common divisors.

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11) Any positive integer can be represented in exactly one way as a product of primes**.** Write a program that gets integer value from user and finds its prime factors.

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12) If f is continuous on [a, b] and a regular partition is determined by a = X_0, X_1, X_2 …X_n = b;

then

$\int_a^b f(x)dx \approx \frac{b-a}{2n}$ [f (X_0) + 2f(X_1) + 2f(X_2).. + 2f(X_{n-1}) + f(X_n)]. This rule is called the Trapezodial for numerical integration. Write a program that accepts coefficients of a second-

degree polynomial, boundaries a and b, and the number of intervals n to calculate $\int_a^b f(x)dx$ using this rule.

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13) The Midpoint Rule for numerical integration says if f is continuous on [a,b], and a regular partition of [a,b] is determined by a = X_0 , X_1 , X_2 …X_n = b; then

$$\int_a^b f(x)dx \approx \frac{b-a}{n} [\, f(\overline{X_1}) + f(\overline{X_2}) + \ldots\ldots + f(\overline{X_{n-1}}) + f(\overline{X_n}) \,]$$

where $\overline{X}_i = (X_{i-1} + X_i) / 2$.

Write a program that gets coefficients of a second-degree polynomial, boundaries a and b, and number of intervals n to calculate $\int_a^b f(x)dx$ using this rule.

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14) Write a program that finds the highest power of p dividing n! by using Legendre's formula where p and n are inputs from the keyboard. highest power = $\sum_{k=1}^{\infty} \frac{n}{p^k}$ n>1 , p is a prime number and p<=n.

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REPORTS:

Your reports must be PDF documents and adhere to the Hacettepe University Computer Science Department Report Writing Guidelines. Submissions with poorly written software can't be expected to receive a high score for the report. Here are some additional guidelines that will help you write your report for this experiment:

- **Briefly explain what you understand from the problem.**
- **Provide a detailed description of your solution.**
- **Do not copy-paste from the experiment sheet.**

SUBMISSION:

Your final works will be accepted on-line from November 22 to November 24, 17:00, sharp. Any late arrival will not be accepted.

You should create and submit a ZIP archive in the following structure for evaluation. An invalid structured archive will cause you partial or full score loss.

Directory	Files	Description
source	*.c, *.cbp	Program source file(s) and CodeBlocks project file
report	*.pdf	Your report (Only pdf format is accepted)

NOTES AND RESTRICTIONS:

- SAVE all your work until the experiment is graded.
- The assignment must be original, INDIVIDUAL work. Shared source codes will be considered as cheating. Also the students who share their works will be punished in the same way.
- It is your responsibility to protect your work from unauthorized access.
- You can ask your questions via course's news group (dersler.137 on news.cs.hacettepe.edu.tr). Discussion of the solution on the newsgroups will be considered "group work", which means "cheating".
- You are expected to follow the course's news group and you will be held responsible for the announcements made there.
- Cheaters will not be tolerated, and anyone caught will be reported to university authorities.
- Respect the office hours of your advisors.