# CS900 Lab - Day 02

## July 1st, 2003

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**New Topics Covered**

C Programming Basics – Lecture: Day 1 & 2, King: Chapter 1,2 and 3
Basic Input/Output – Lecture: Day 2, King: Chapter 3

**Installing**

Copy the following files from the directory /course/cs900/day02: io.c, triangle.c and aircraft.c. You can do the following:

- Login using your login name and password
- Create a subdirectory day02 in your home directory by typing in shell:

```
cd ~/cs900
mkdir day02
cd day02
```

- Copy over the files

```
cp /course/cs900/day02/*.c .
```

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## Exercise 1 – I/O

The file io.c currently contains only an include directive and an empty main() function. Modify the file to create a program that will prompt a user to enter his/her age and height, store the data in variables of type int, and then print out the user's age and height in a sentence.

A sample run of the program might look like this (user input is in *italics*):

```
How old are you?
> 19
How tall are you (Round to the nearest foot.)?
> 6
You are 19 years old and 6 feet tall.
```

Since you are using variables of type `int`, you will only be able to take height in whole numbers. Remember to properly comment your program.

To compile your program, type `gcc -Wall -o io io.c` in a shell. To run it, type `io` and press enter.

*Hint: Take a look at the sections in the book dealing with variable declaration and* `printf()` and `scanf()`. *Since your data should be of type* `int`*, you will only need to use* `%d` *for the I/O calls.*

Instead of using only integers, make your program capable of taking a decimal height that is not a whole number, like 5.8 feet. Print out the age and height in a sentence without any unnecessary 0s (look at the info on `printf()` in your book).

## Exercise 2 – Law of Cosines

Write a program that computes the length of the third side in a triangle given the length of the two other sides as well as the angle between them. The law of cosines says that $c^2 = a^2 + b^2 - 2\,a\,b\,\cos(C)$ where a,b, and c are the three sides of a triangle and C is the measure of the angle across from side c. Write a program to input a, b, and C in degrees and compute the length of c. The cosine function is found in math.h and requires a float in radians and returns cosine of that angle.

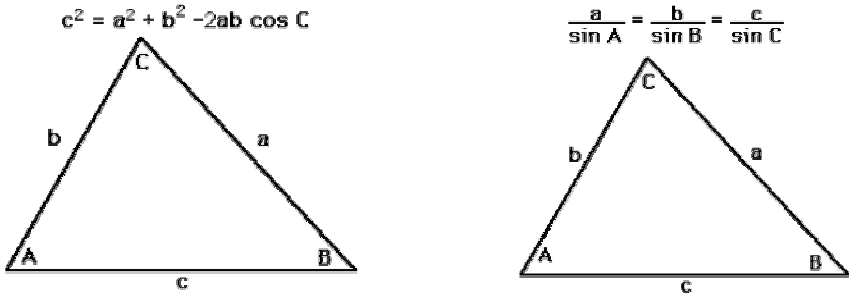


**Figure 1: Laws of cosines (left) and sines (right, needed for problem 3)**

*Example:*

```
Enter length a          =  10
Enter length b          =  5
Enter angle C (in deg)  =  45
The value of c is       =  7.368126
```

Implement your program in the triangle.c file. To compile, use

```
gcc -Wall -o triangle triangle .c,
```

and to run, type

```
triangle
```

Be sure to fill in the header and to properly comment your program.

## Exercise 3 – Aircraft Navigation

Calculating the necessary to counter a wind velocity and proceed along a desired bearing to a destination is a classic problem in aircraft navigation. It makes good use of the law of sines and the law of cosines. The problem can be sketched as follows:

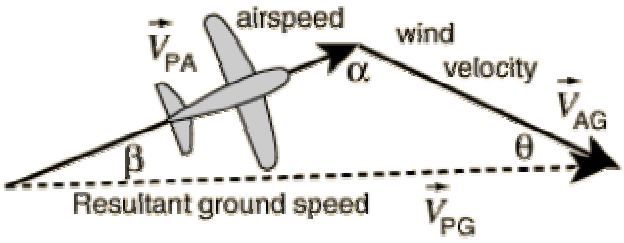


**Figure 2: Computing ground speed**

The angle θ is just the difference between the wind direction and the desired bearing. With that angle and the law of sines, the offset angle β for the aircraft is obtained. Then the law of cosines is applied to get the resultant ground speed.

Write a C program (aircraft.c) that takes as inputs the airspeed, the wind velocity and the angle θ representing the difference between the wind direction and the desired bearing. Compute and output the offset angle β which defines the heading the plane has to take in order to move in the desired direction, as well as the ground speed.

Example:

```
Enter the airspeed :  600
Enter the windspeed:  100
Enter angle        :  120

Heading     =  8.298921
Groundspeed =  543.717104
```

If possible, use user-defined functions to implement the program. Hint: You may define and call the following two functions:

```
double heading(double air_speed, double wind_speed, double angle);
```

and

```
double speed(double air_speed, double wind_speed, double angle);
```