2 Variables

2.1 Introduction

In this chapter you will learn what a variable is, how to declare a variable, i.e. tell the computer that there is a variable in the program, and how to assign values to variables. You will also learn how to perform simple mathematic calculations, how to read values from the keyboard, how to display information on the screen and control where on the screen the information will be displayed. We will also present a number of programming examples with JSP graphs.

2.2 Why Variables

A variable is used by the program to store a calculated or entered value. The program might need the value later, and must then be stored in the computer's working memory. Example:

Variable name	**Variable value**
dTaxpercent	0.25

Here we have selected the name 'dTaxpercent' to hold the value 0.25. You can in principle use any variable name, but it is recommended to use a name that corresponds to the use of the variable. When the variable name appears in a calculation the value will automatically be used, for example:

```
1500 * dTaxpercent
```

means that 1500 will be multiplied by 0.25.

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2.3 Declaring Variables

The purpose of declaring a variable is to tell the program to allocate space in the working memory for the variable. The declaration:

```
int iNo;
```

tells that we have a variable with the name iNo and that is of integer type (int). You must always specify the data type to allocate the correct memory space. An integer might for instance require 4 bytes while a decimal value might require 16 bytes. How many bytes to allocate depends on the operating system. Different operating systems use different amounts of bytes for the different data types.

The variable name should tell something about the usage of the variable. Also, a standard used by many people is to allocate 1-3 leading characters to denote the data type (i for integer).

Note that each program statement is ended by a semicolon.

Below we declare a variable of decimal type:

```
double dUnitPrice;
```

`double` means decimal number with double precision. Compare to `float` which has single precision. Since `double` requires twice as many bytes, a `double` variable can of course store many more decimals, which might be wise in technical calculations which require high precision.

The most common data types:

short	integer	Usually 2 bytes
int	integer	Usually 4 bytes
float	decimal	Usually 4 bytes
double	decimal	Usually 8 bytes
bool	true or false	Usually 1 byte

You can declare several variables of the same type in one single statement:

```
double dUnitPrice, dTotal, dToBePaid;
```

The variables are separated by commas.

Note that C++ is case sensitive, i.e. a 'B' and 'b' are considered different characters. Therefore the variables:

```
dTobepaid
dToBePaid
```
are two different variables.

2.4 Assignment

Now we have explained how to declare variables, but how do the variables get their values? Look at the following code:

```
dTaxpercent = 0.25;

iNo = 5;
dUnitprice = 12;
```

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Here the variable dTaxpercent gets the value 0.25, the variable iNo the value 5 and the variable dUnitprice the value 12. The equal character (=) is used as an assignment operator. Suppose that the next statement is:

```
dTotal = iNo * dUnitprice;
```

In this statement the variable iNo represents the value 5 and dUnitprice the value 12. The right part is first calculated as 5 * 12 = 60. This value is then assigned to the variable dTotal. Note that it is not the question of an equality in normal math like in the equation x = 60, where x has the value 60. In programming the equal sign means that something happens, namely that *the right part is first calculated, and then the variable to the left is assigned that value.*

C++ performs the math operations in correct order. In the statement:

```
dToBePaid = dTotal + dTotal * dTaxpercent;
```

the multiplication `dTotal * dTaxpercent` will first be performed, which makes 60 * 0.25 = 15. The value 15 will then be added to `dTotal` which makes 60 + 15 = 75. The value 75 will finally be assigned to the variable `dToBePaid.`

If C++ would perform the operations in the stated order, we would get the erroneous value 60 + 60, which makes 120, multiplied by 0.25, which makes 30.

If you need to perform an addition before a multiplication, you must use parentheses:

```
dToBePaid = dTotal * (1 + dTaxpercent);
```

Here the parenthesis is calculated first, which gives 1.25. This is then multiplied by 60, which gives the correct value 75.

Priority rules:

( )
* /
+ -

2.5 Initiating Variables

It is possible to initiate a variable, i.e. give it a start value, directly in the declaration:

```
double dTaxpercent = 0.25;
```

Here we declare the variable dTaxpercent and simultaneously specify it to get the value 0.25.

You can mix initations and pure declarations in the same program statement:

```
double dTaxpercent = 0.25, dTotal, dToBePaid;
```

In addition to assigning the dTaxpercent a value, we have also declared the variables dTotal and dToBePaid, which not yet have any values. In the statement:

```
int iNo = 5, iNox = 1, iNoy = 8, iSum;
```

we have initiated several variables and declared the variable iSum.

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2.6 Constants

Sometimes a programmer wants to ensure that a variable does not change its value in the program. A variable can of course not change its value if you don't write code that changes its value. But when there are several programmers in the same project, or if a program is to be maintained by another programmer, it might be safe to declare a variable as a constant. Example:

const double dTaxpercent = 0.25;

The key word `const` ensures that the constant `dTaxpercent` does not change its value. Therefore, a statement like this is forbidden:

```
dTaxpercent = 0.26;
```

A constant must be initiated directly by the declaration, i.e. be given a value in the declaration statement. Consequently the following declaration is also forbidden:

```
const double dTaxpercent;
```

2.7 More about Assignment of Values

We have seen how a variable can be initiated in the declaration and how the variable can be assigned a value in other parts of the program. A variable can also get new values several times in the program.

A variable can furthermore be changed by originating from the current value of the variable. The following example shows how the variable `iNo` is decreased by 2:

```
iNo = iNo - 2;
```

As we have previously said the right part will first be calculated and then be assigned to the variable on the left side. Suppose that the variable `iNo` from the beginning has the value 5. The right part will then be 5-2 = 3. 3 is then assigned to the variable to the left, i.e. `iNo`. The effect of this statement is thus that `iNo` changes its value from 5 to 3, i.e. is decreased by 2.

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A more compact way of coding giving the same result is:

```
iNo -= 2;
```

The operator -= means that the variable on the left side is decreased by the value on the right side. The operator += works in the same way. Example:

```
dPrice += 10;
```

Here the value of the variable `dPrice` is increased by 10.

The operator *= implies that the variable on the left side is multiplied by the value on the right side. In the following statement the variable `dDiscount` is multiplied by 1.10, i.e. it is increased by 10%:

```
dDiscount *= 1.10;
```

The operator /= works in the same way:

```
dNumber /= 2;
```

Here the variable `dNumber` is divided by 2.

In many situations the value of a variable should be increased by 1. We will give many examples of this in the following. Here are two variants of code how this can be made:

```
iNo = iNo + 1;
iNo += 1;
```

Still another way:

```
iNo++;
```

Here we use the operator ++ which increases the value of the variable by 1. It is from this operator that C++ has got its name.

Increasing a value by 1 is called incrementation. In the same way you can use the operator -- for decrementation, i.e. decrease a value by 1. Example:

iNo--;

2.8 The main function

So far we have described code details needed to be able to construct a program. Now we will step back a little and look at the entire program. Look at the following program skeleton:

```
void main()
{
    …
    … Various program statements
    …
}
```

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To be able to run (execute) a program, a function called `main()` must exist. A function is a section of code that performs a specific task. Usually a program consists of several functions, but one of them must have the name `main()`, and the very execution is started in `main()`. In our first programs we only use one function in each program, and consequently it must be named `main()`. The parenthesis after main indicates that it is a function. Each function has a parenthesis after the function name, sometimes it is empty and sometimes it contains values or parameters.

A function is supposed to return a value, which could be the result of calculations or a signal that the function turned out successfully or failed. The return value can then be used by the program section calling the function. In our environment it is the operating system Windows that starts the function `main()`. Windows does not need any return value from our programs, and as a consequence we use the key word `void` in front of `main()`. `void` means that the function will not return any value.

We will discuss functions in a later chapter and will then go deeper into these details. So for now you don't need to bother about all details, only that you write `void main()` in the beginning of your programs.

All code belonging to a function must be enclosed by curly brackets, one left curly bracket ({) as the first character and one right (}) as the last. It is also good programming conventions to **indent** the code between the curly brackets as shown by the example above. The editor in Visual C++ will assist you with the indentation. When you have typed a left curly bracket and pressed Enter, the next and subsequent lines will be automatically indented.

2.9 Input and Output

A program mostly needs data to be entered from the keyboard and results to be displayed on the screen. We will write a little program which displays a request for a value from the user and then reads this value:

```
#include <iostream>
using namespace std;
void main()
{
    int iNo;
    cout << "Specify quantity: ";
    cin >> iNo;
}
```

We will soon talk about the first #include statement.

The first thing to be done in this program is that the integer variable iNo is declared. We will need it later in the program.

Then, the text

```
Specify quantity:
```

will be displayed on the screen. cout is an abbreviation of console out. With console we mean the keyboard and screen together. The text to be displayed on the screen (Specify quantity) must be surrounded by quote marks (" "). The characters << are called stream operator and indicates that each character is streamed to the console. We will return to streams when we work with files in a later chapter.

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It can be hard to remember in which direction to write the stream operator. You can regard it as an arrow directed towards the console, i.e. the characters are streamed out to the console.

The next program statement (cin statement) implies that the program wants something from the console (cin = console in). The program stops and waits for the user to enter a value and press Enter. The value is stored in the variable iNo. The stream operator >> is here in the opposite direction and indicates that the entered value is streamed the other way, i.e. in to the program.

You may have noticed that the text ”Specify quantity: ” in the cout statement contains an extra space after the colon. This implies that also the space character is streamed to the screen. The visual effect of this is that, when the user enters the number 24, it is not shown close to the text “Specify quantity: “ but appears at a distance of one space character. Write the program and run it, and experiment with space characters and different texts.

2.9.1 #include

cout and cin are functions not automatically available. Therefore we must tell the compiler that these functions are defined in an external file called iostream. When you compile the program, the compiler does not understand the words cout and cin. It will then read iostream and insert the code for how cout and cin should be executed. This is the reason why you the statement

```
#include <iostream>
```

must be present first in your program.

Some external files use the extension .h, which is an abbreviation of **header file**. Another name of such a file is **include file**. We will use other header files later on when we need particular functions.

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2.9.2 namespace

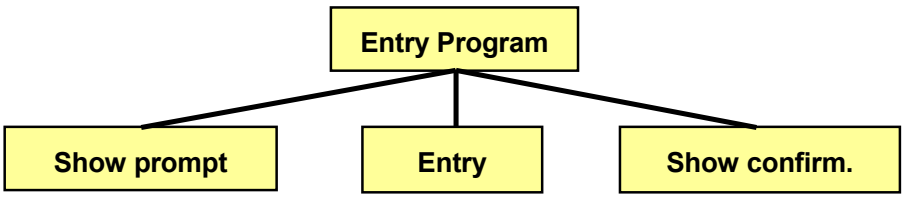
Some development tools, like for instance modern versions of Visual C++, store their include files and classes with code in namespaces. In object oriented programming (which is outside of this course) it is possible to store your own classes in different namespaces. To notify Visual C++ about the include files to be used, reside in the standard namespace, we use the statement

```
using namespace std;
```

2.10 An Entry Program

We will now write a program that prompts the user for a number and then shows a confirmation on the screen about which number the user wrote.

To practice algorithm creation we will first write a JSP graph that shows the program steps before writing the code:



The upper box shows the name of the program (Entry Program). The program contains three steps corresponding to the three boxes which are read from left to right. First we will show the user prompt. The user will then have the opportunity to enter a number. Last, we will show a confirmation about which number the user entered. The program will look like this:

```
#include <iostream>
using namespace std;
void main()
{
   int iNo;
   cout << "Specify quantity: ";
   cin >> iNo;
   cout << "You entered: ";
   cout << iNo;
}
```

First we must include iostream since we are going to read from and write to the console, and indicate the standard namespace to be used. In the main() function we declare the integer variable iNo and then show the text “Specify quantity: “. The cin statement implies that the program halts and waits for keyboard entry. When the user has entered a number and pressed Enter, the number is stored in the variable iNo. Then the program continues with displaying the text “You entered: “ followed by the value of the variable iNo. If the user for instance entered the value 24, the printed text will be “You entered: 24”. Write the program and run it. Experiment with different entries and other texts.

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Note that, even if the program uses two cout statements for the printed confirmation, the result still is one printed line on the screen.

We will now expand the program so that the user can enter a quantity and a price:

```
#include <iostream.h>
void main()
{
   int iNo;
   double dPrice;
   cout << "Specify quantity: ";
   cin >> iNo;
   cout << "Specify unit price: ";
   cin >> dPrice;
   cout << "You entered the quantity " << iNo <<
            " and the price " << dPrice;
}
```

We have used an integer variable for the quantity and a double variable for the unit price, since the price could require decimals.

Note that, when entering a decimal value, you must use a decimal *point*, not decimal comma.

The last cout statement contains some news; you can combine several texts and variable values into one single statement, provided that you use the stream operator between every text and variable. We have split the statement on two lines, but you can write the whole statement on one single line. Blanks or line breaks in the code has no effect on the displayed result.

You could also combine the entry of quantity and price in the following way:

```
cout << "Specify quantity and unit price: ";
cin >> iNo >> dPrice;
```

First the text prompt is displayed to the user. When the program halts and waits for entry, you can enter a quantity and unit price with a space character in between, or press Enter. The first entered value is stored in the variable iNo and the second in dPrice.

If you press Enter after the first entered number, the program will still be waiting for yet another value. You must also enter the unit price before the program can continue the execution.

If you want a line break in the displayed result, you can use the keyword `endl`:

```
cout << "You entered the quantity " << iNo <<
         endl << "and the price " << dPrice;
```

The statement implies that the printed result will look like this:

```
You entered the quantity 5
and the price 12.45
```

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2.11 Formatted Output

When programming for a DOS window, which we have done so far and will do during the rest of the course, there are very limited possibilities for a nice layout of printed information, especially if you compare to common Windows environment. C++ however offers a few functions for improved control of printed information. We will discuss the following:

- Fixed / floating decimal point. When printing large numbers, it might happen that C++ uses floating decimal point. For instance the number 9 560 000 000 (fixed) might be printed as 9.56E+9, which is interpreted as 9.56 x 10^9 (floating decimal point). C++ itself controls when to use either of these representations. Many times we want to control this ourselves.
- Number of decimals for numeric data.
- Number of screen positions allocated for data.

To be able to use these possibilities we will have to include the file iomanip.h.

2.11.1 Fixed Decimal Point

To instruct the program to output values with fixed decimal points the function setiosflags() is used. It must reside in a cout statement:

```
cout << setiosflags(ios::fixed);
```

The characters io in setiosflags represent input/output. A flag is a setting that can be switched on or off (0 or 1). The double colon :: is a class operator and is used to refer to a value defined in a certain class. “fixed” is such a value. We will not go further into classes in this course, but it does not hurt to have basic knowledge about classes.

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To return to letting C++ decide when to use fixed or float format, use the following statement:

```
cout << resetiosflags(ios::fixed);
```

2.11.2 Number of Decimals

To instruct the program to use a specific number of decimals, use the following statement:

```
cout << setprecision(2);
```

which specifies two decimals to be used in subsequent outputs.

Many times the statements are combined:

```
cout << resetiosflags(ios::fixed) <<
    setprecision(2);
```

2.11.3 Number of Positions

An efficient way of having numeric data printed in columns with the 1 unit digit straight below each other, is to use the setw() function. 'w' represents width. Example:

```
cout << setw(8) << dAverage;
```

This statement allocates eight positions for the value of the variable dAverage, and the value is printed right-aligned within this space.

Remember that setw() only applies to the next value, which implies that it must be repeated for each value to be printed. Example:

```
cout << setw(8) << dValue1 << endl;
cout << setw(8) << dValue2 << endl;
cout << setw(8) << dAverage << endl;
```

Here the three variable values will be printed below each other right aligned within eight screen positions, which implies a nice column with the 1 unit digits right below each other.

Here is an example of how you can combine printed data with heading texts:

```
cout << "Number of units: " << setw(5) <<
  iNo << endl;
cout << setiosflags(ios::fixed) <<
   setprecision(2);
cout << "Price per unit:  " << setw(8) <<
  dPrice << endl;
cout << "Total price:      " << setw(8) <<
  dTotal;
```

This code will render an output like this:

```
Number of units:      10
```

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```
Price per unit:       12.25
Total price:         122.50
```

We presume that the variable iNo is declared as int, while dPrice and dTotal are double variables. That requires that the number of positions for iNo is 3 less than for the others, which correspond to the decimal point and the two decimals.

Note that we in the cout statements have inserted blanks to make the heading texts be equal in length. That makes it easier to calculate the number of positions required in the setw() function.

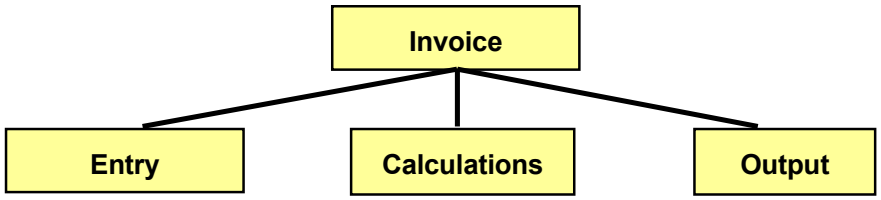
2.12 Invoice Program

We will now write a program where the user is prompted for quantity and unit price of a product, and the program should respond with an invoice receipt like this:

```
INVOICE
=======
Quantity:             30
Price per unit:       42.50
Total price:        1593.75
Tax:                 318.75
```

The program should thus calculate the total price and tax amount.

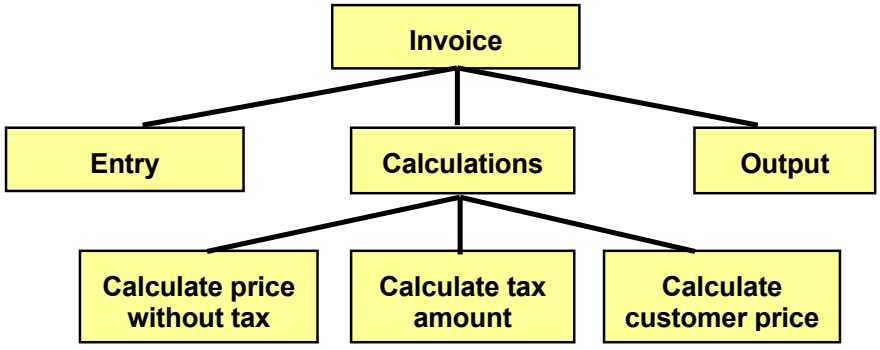
We start with a JSP graph:



First, the user will enter quantity and unit price of the product (the Entry box). Then we will calculate the total price and tax amount (the Calculations box). Last, the information will be printed (the Output box).

The first and last boxes are pretty uncomplicated, but the Calculations box requires that we go deeper before starting to code. Input data is quantity and unit price. We multiply these, which gives the price without tax. We then multiply this amount by the tax percent, which gives the tax amount. Finally we add these amounts to get the customer price.

The detailed JSP graph will then look:



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Here is the code:

```
/*Invoice program
The file iomanip.h is needed to be able to
format the output on the screen*/

#include <iostream>
#include <iomanip>
void main()
{
   //Declarations
   int iNo;
   double dUnitPr, dPriceExTax, dCustPrice, dTax;
   const double dTaxPerc = 25.0;

   //Entry of quantity and unit price
   cout<< "Specify quantity and unit price: ";
   cin >> iNo >> dUnitPr;

   //Calculations. First the price without tax
   dPriceExTax = dUnitPr * iNo;
   //then the tax amount
```

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```
    dTax = dPriceExTax * dTaxPerc / 100;
    //and finally the customer price
    dCustPrice = dPriceExTax + dTax;

    //Output
    cout << endl << "INVOICE";
    cout << endl << "=======" << endl;
    cout << "Quantity:       " <<  setw(5) << iNo << endl;
    cout << setprecision(2) << setiosflags(ios::fixed);
    cout << "Price per unit:" << setw(8) << dUnitPr << endl;
    cout << "Total price:    " << setw(8) << dCustPrice <<endl;
    cout << "Tax:             "  <<setw(8) << dTax << endl;
}
```

As you can see we have inserted comments in the code. Comments don't affect the final size of the program or performance. Therefore, use comments frequently, partly to explain the operations to others, and partly as a check list at maintenance of the program some years later.

Comments are surrounded by the characters /* and */. All text between these delimiters is treated as comments. You can have as many lines as you want between these delimiters. Another way is to begin a comment line with //, Then only that line will be treated as comment.

After the include statements the required variables are declared. The variable iNo is an integer, while all variables capable of storing an amount have been declared as double. The tax percent is declared as constant, since it should not be amended in the program.

Compare the code to the JSP graph and you will discover that we have followed the sequence of the boxes when coding.

2.13 Time Conversion Program

We will now examine a common technique, namely to use the modulus operator (%) to get the decimals of a division, to check whether a number is evenly dividable by another number, to get an interval for random numbers and much more.

The modulus operator % gives the remainder at integer division

For instance, if you divide 6 by 3, the division is even and there will be no remainder. The remainder is zero, i.e. 6%3 equals 0. If you divide 7 by 3 the result is 2 with the remainder 1. 7%3 equals 1.

A peculiarity at division with the / operator is that, if both the numerator and denominator are of the int type, then also the quotient is an integer, i.e. the decimals will be discarded. For instance 7/3 equals 2.

We will use this in a program where the user enters a number of seconds, which the program converts to hours, minutes and seconds.

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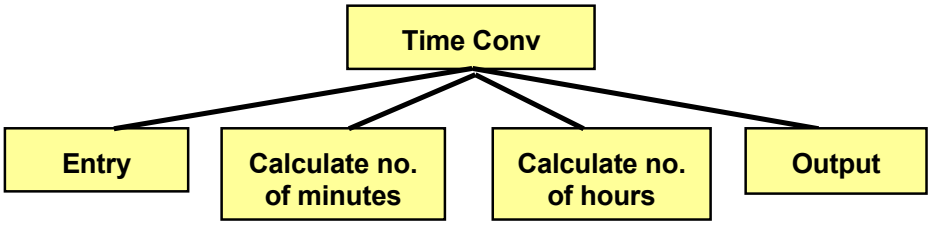
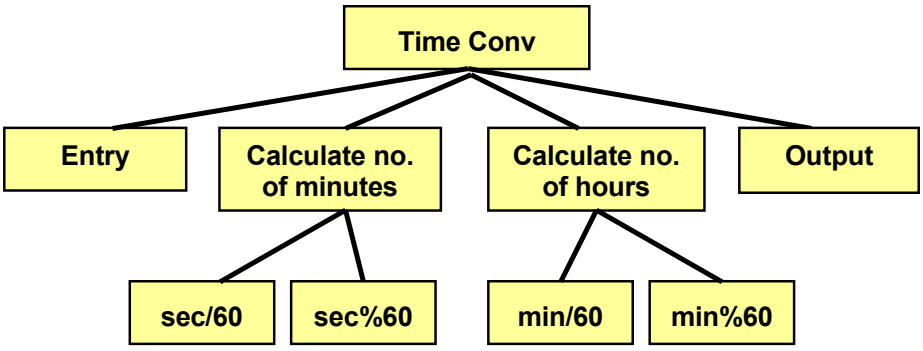
We start with a JSP graph:



Entry and output are pretty uncomplicated, while the calculation of no. of minutes and hours requires more details. Suppose the user enters 63 seconds. First we divide the entered number by 60, i.e. 63/60. Since both are integers, the quotient is an integer = 1. Then we use the modulus operator. 63%60 gives the remainder 3. We have calculated that 63 seconds makes 1 minute and 3 seconds. If the user enters a large number, we might have got so many minutes that hour calculation could be done. We would then originate from the number of minutes and in the same way divided by 60. The calculation is shown in the JSP graph:



Here is the code:

```
#include <iostream>
using namespace std;
void main()
{
     //Declarations
       int iNoOfSec, iSecLeft, iNoOfMin, iMinLeft, iNoOfHours;

     //Entry of no. of seconds to be converted
       cout << "Specify no. of seconds: ";
       cin >> iNoOfSec;

     //Number of entire minutes:
       iNoOfMin = iNoOfSec / 60;
     //Number of seconds left:
       iSecLeft = iNoOfSec % 60;

     // iNoOfMin is now the origin of the hours calculation:
```

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```
    iNoOfHours = iNoOfMin / 60;
  //and no. of minutes left:
    iMinLeft = iNoOfMin % 60;

  //Output
    cout << "Number of hours    = " << iNoOfHours << endl;
    cout << "Number of minutes = " << iMinLeft << endl;
    cout << "Number of seconds = " << iSecLeft << endl;
}
```

Compile and run the program with different input.

2.14 Type Conversion

A problem with the division operator / is that it discards the decimals from the quotient if both the numerator and the denominator are of integer type. For instance if you have summed some integers and want to calculate the average by dividing by the number of integers. The precision will then be bad since the decimals will get lost:

```
int iNumerator = 7, iDenominator = 3;
cout << iNumerator / iDenominator;
```

This code section will give the output 2 and not 2.333 as expected.

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Compare with the following code:

```
double dNumerator = 7;
int iDenominator = 3;
cout << dNumerator / iDenominator;
```

Here the numerator is of double type, and then the compiler understands that it should perform a normal division and include the decimals. The output will in this case be 2.333.

Many times you might have declared variables as int, but still want a division with the decimals kept. The solution is to do a type conversion (type cast) to double for the numerator before the division is executed:

```
int iNumerator = 7, iDenominator = 3;
cout << (double) iNumerator / iDenominator;
```

Type cast is performed by specifying the new data type within parentheses immediately before the variable. Here we have put double within parentheses before the variable numerator, which makes a decimal division to be performed with the result 2.333.

2.15 The Random Number Generator

In situations where an unpredictable result is required, the random number generator is used. Examples of such situations are game programs, pools, dice rolling etc.

The random number generator provides random numbers in the interval 0-32768. Why just 32768? It has to do with the binary storage of numbers. Two bytes can contain 65536 different numbers (2^{16}). Half of these are dedicated for negative numbers and half to positive = 32768.

The function `rand()` gives a number in the interval 0-32768. rand is an abbreviation of random. We use this number with the modulus operator: `rand()%6` which gives the remainder at integer division with 6, i.e. a number in the interval 0-5. The reason why it can't be greater is that, if for instance the remainder had been 7, then 6 could be divided once more and the remainder had been 1.

We now add 1:

```
rand()%6 + 1
```

which gives an integer in the interval 1-6, i.e. a random dice roll.

Each time you run a program using random numbers, it will start from the same "location", i.e. you will always get the same series of numbers. That is of course not acceptable. Therefore you must tell the generator to start at a random position, which is done with the function:

```
srand(time(0))
```

srand means "start random". The function uses the system clock (time) as origin for the calculation. The system clock contains the number of milliseconds since Jan 1st 1970 (different for different processors). We can't predict the millisecond to be used when the generator gets its starting point.

To make this work, you must include the header files stdlib.h och time.h. Note that these include files require '.h'.

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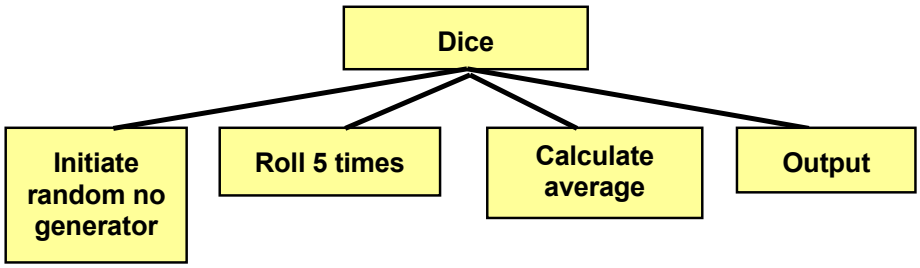
2.16 Game Program

We will now write a program that uses the random number generator and rolls a dice 5 times. We will also calculate the average score. First we will create a JSP graph:



The code will be:

```
#include <iostream>
#include <iomanip>    //for formatting of output
#include <stdlib.h>     //for random generator
#include <time.h>       //for system clock
using namespace std;
void main()
{
   //Declarations
   int iRoll1, iRoll2, iRoll3, iRoll4, iRoll5;
   double dAverage;
   const int iNo = 5;
   //Initiate random number generator
   srand(time(0));
   //Roll 5 times
   iRoll1 = rand()%6+1;
   iRoll2 = rand()%6+1;
   iRoll3 = rand()%6+1;
   iRoll4 = rand()%6+1;
   iRoll5 = rand()%6+1;
   //Calculate average
   dAverage = (double)( iRoll1 + iRoll2 + iRoll3 + iRoll4
               + iRoll5) / iNo;
   //Output
   cout << "Number of rolls: " << iNo << endl;
   cout << setprecision(1) <<  setiosflags(ios::fixed);
   cout << "Average score: " << dAverage;
}
```

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In the statement where we calculate the average we have first added the five rolls and then made a type cast to double before we divide with iNo to not loose decimals.

In the second last cout statement we have requested 1 decimal and fixed decimal point.

Run the programs several times. You will get different results each time. Also try to extend the program to also print the 5 rolls.

2.17 Summary

In this chapter we have taken our first stumbling steps in C++ programming. We have learnt what a variable is, how it is declared and assigned a value. We have also learnt to read and write data, and in connection to that, also present data in a more user-friendly way by means of formatted output. We have learnt how to include header files and we have written some example programs utilizing specialties like the modulus operator, type casting and random number generation.

But above all we have practiced how to build a solution to a problem by means of algorithms and JSP graphs. And this will be still more important when we enter into the subject of the next chapter, selections and loops.

2.18 Exercises

1. Originate from the Entry program and extend it so that the user can enter two numbers. Both numbers should then be printed on the screen by the program.
2. Write a program that prompts the user for two numbers and prints their sum.

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3. Extend the previous excercise so that the program prints the sum, difference, product and quotent of the two numbers.
4. Write a program that prompts the user for 3 decimal numbers and then prints them on the screen with the decimal points right below each other.
5. Originate from the Invoice program and amend it so that:
   a) the user can enter a tax percent.
   b) a 10% discount is deducted before the tax calculation
   c) the last cout statement is organized in a more structured way
   d) The price with tax excluded is printed
   e) the discount amount is printed.

6. Write a program that prompts the user for the gas quantity and the gas price per litre. The program should then print a gas receipt like this:

```
          RECEIPT
          =======
Volume:         45.24 l
Litre price:     9.56 kr/l
-----------
To be paid:   432.49 kr
```

7. Write a program that prompts the user for current and previous electricity meter value in kWh and the price per kWh. The program should then calculate the total price of the current consumption.
8. Write a program that prompts the user for five integers. The program should then print:
   a) the sum of the integers
   b) average
   c) the sum of the squared numbers
   d) the sum of the cube of the numbers

9. Write a program that prompts the user for a number, divides it by 3 and prints the result in the form: “4 and remainder 2”.
10. You want a program that converts a temperature in Celsius to Fahrenheit according to the formula:
    `tempF = 1.8 * tempC + 32`
    Create the conversation with the user in your own way.
11. Originate from the TimeConv program which converts a given number of seconds to hours, minutes and seconds. Change it so that the user can enter a number of minutes and the program responds with a number of hours and minutes.
12. Write a program that prompts the user for a number of days and responds with number of years, months and days. For simplicity, you can treat all months as having 30 days.
13. Write a program that prompts the user for the distance between two cities and in what speed you intend to drive. The program should print the time for the trip.
14. Change the previous program so that, instead of speed, it prompts for the time allocated for the trip. The program should respond with the speed required for the trip.
15. Change the previous program so that you can enter the speed and the time for the trip. The program should then respond with the driving distance.

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16. Write a program that converts a given number of Swedish ”öre” to the number of 50-öre coins, crowns, 5-crowns, 10-crowns, 20-crown notes, 50-crown notes and 100-crown notes.
17. A farmer wants to build a wooden fence around a rectangular field. He measures the length and the width of the field and decides how high the fence should be. He also decides how wide the space between each board of the fence should be. Each board is 10 cm wide. Help him with a program that calculates the total length of all boards required to be bought.
18. Improve the previous program so that it also takes into account the amount of board waste (10%) at cutting the boards to suitable length.
19. Extend the previous program so that you also can enter a price per meter of the boards and have the total price printed.
20. Originate from the Game program which creates random rolls of a dice. Extend it so it also printes the individual rolls.
21. Modify the previous program so that it rolls two dice at a time and prints the score sum of the two rolls. Five such double-rolls should be made.
22. The ”lotto” game creates random numbers in the interval 1-35. A simple lotto game contains seven such numbers. Create a program that provides a simple lotto game set of numbers. Don't pay attention to repetition of a single number.
23. So far we have used the random number generator to produce integers. Figure out how we could get random numbers with one decimal. Then write a program that produces five temperatures in the interval 18.0 - 23.5.

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