Start Coding

Some basic information here!

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Table of Contents

Code Design Basics

To be able to code solution for some problem, you have to be able to solve that problem first yourself, without any coding at all!

Real values can help to solve the problem

Example 1: fractions

For example you have to create an app that calculates the product of two fractions, you have first be able to calculate that product ”manually”, may be using pen and paper! Or at least you have to know how that calculations is normally, with arithmetic methods, to be done.

So sometimes it is good to use a concrete case to start with. We can have a real example first.

In this case we can have to fractions, e.g. 5/6 and 11/18.

Then we calculate the product (as we know a bit math):

Product is 5*11/6*18 and it is 55/108

So to our code we have to create 4 integer variables, eg.
x1, x2, y1, y2
And for the result may be r1 and r2.

And then we assign values:
x1 = 5
y1 = 6
x2 = 11
y2 = 18

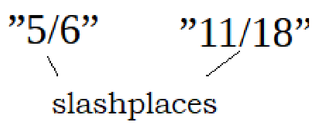
And results:
r1 = x1*x2
r2 = y1 * y2

And we get the result.

Of course it may happen that fractions are given as strings: so we have to be able to split the strings and then convert parts to integers and assign to variables.

SO, may be we use strings and user gives e.g.
”5/6” and ”11/18”.

Now we have first find the character ’/’, called slash: may be the name of that position is slashplace.



Then we remove numerators that are between position 0 and slashplace.
And then we remove denumerators that are between slashplace and the ends of the strings: end position is normally the lenght of the string…

Example 2: check email

We take another example.
Problem:
Find the country code of url, normally we use the name ”top-level domain”.

How to do it? Start again with ”paper and pen”!

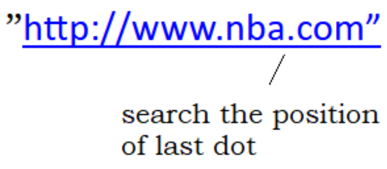
Write anyt real url and study it a bit

E.g.
”http://www.nba.com”

Url has standard format
Country code is after the last dot.

SO:

Find the place of the last dot.



Catch the part between the end of url and the place of the last dot: you get ”com”

Example 3: Roman numerals

Your code converts Western (Arabic) numerals to Roman

First, we have to understand what western and roman numerals are…

Symbol	I	V	X	L	C	D	M
Value	1	5	10	50	100	500	1000

Then it is easy to notice that there are several choices, thus desicion making is needed.
If e.g. user gives 5, we can print V.

```
From 1 to 10 we can easily get
by just using if statements
In Pseudocode:
If val is 1 then roman is I
If val is 2 then roman is II
If val is 3 then roman is III
If val is 4 then roman is IV
And so on
```

But what about bigger western values?

How can do if values are bigger?
We can not code thousands of if sentences!

Instead we can try to take divide the value in smaller pieces,

convert pieces to roman type and combine them to get final value

Let’s take (again) a real value and use ”paper&pen” to solve problem first manually:

Arabic value is now 2222

Get thousands

2222/1000 we get 2
2) Calculate remaining part
2222 % 1000 is 222
3) Get hundreds
222/100 is 2
4) Remains 222 % 100 => 22
5) Get 50’s -> no
6) Get 20’s => 22/20 is 1, remains 2

7) No tens and 2 is II

Now, the code is easier to write!!

Program design

About program flow
In programs execution can go
straight forward
or it contains desicion making (branching)
or there are loops

Tree different ways to go.

We can create the plan of the program or algorithm by using
pseudocode or flowchart

In pseudocode we use clear text show to program flow, often structures that are used in programs: if, if – else, while, do – while, print and so on… We also add there indentations...
From pseudocode it can be easier to create the code.

Example 4: Pseudocode

We have to solve a quadratic equation: it is a second order equation.

$$ax^2 + bx + c = 0$$

Of course, we have to know what a quadratic equation is and what do characters a, b and c mean here. And is there a formula to solve equation and how many roots there may be.

So we can remember that in terms of a, b and c, the formula is.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

And that the square root expression is called discriminant:

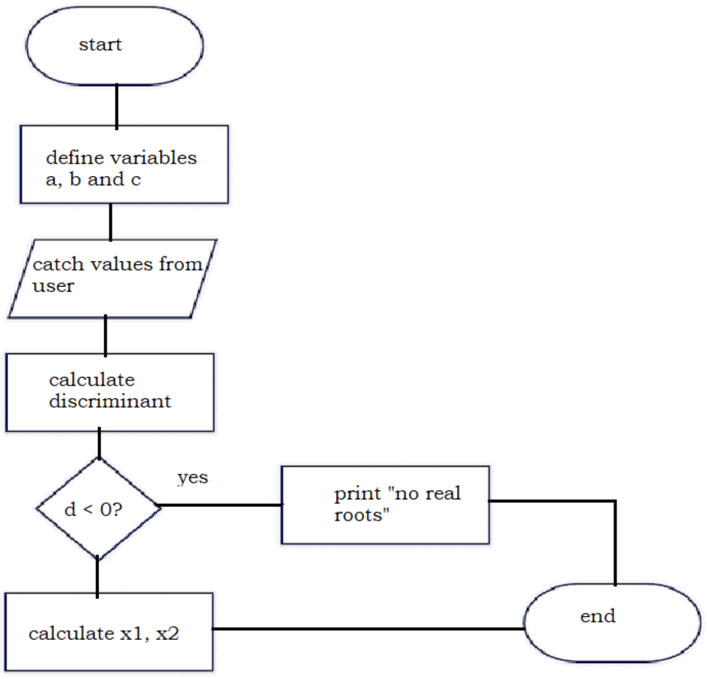
$$\sqrt{b^2 - 4ac}$$

So, we can first create the pseudocode.

```
Add values to a, b and c
calculate the discriminant (d)
if d < 0
    print no real roots
else
    calculate x1 and x2 using the formula
    print x1 and x2
```

and with flowchart next...

Example 5: flowchart



So,may be the coding is easier now!

Example 6: what does that code do?

What about understanding some code or program flow?
Let’s try to find out helping methods.

Example 5
What does the code do?

e.g. we have now a simple swapping code here:
In C# the code could be
int a = 5;
int b = 99;

6

int temp = a;
a = b;
b = temp;

Let’s study the code:
a = 5
b = 99

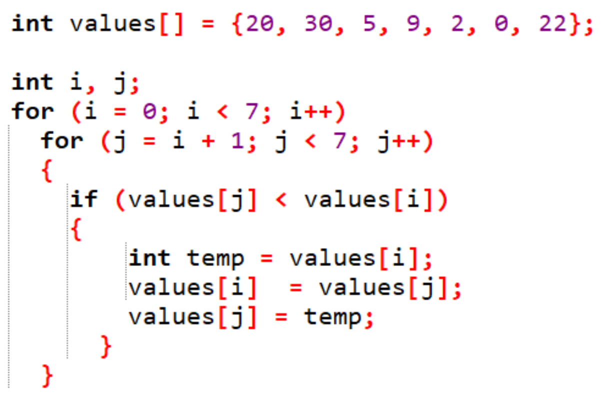
swap values: we can not write a = b,
because then we lose the original value of a (5)
we need an extra variable, name could be temp, and then:

temp = a   now temp is 5, a is 5, b is 99
a = b   now a is 99, b is 99, temp is 5
b = temp   now b is 99, temp is 99, a is 5

Example 7: simulating the code

We take a look at the selection sort method

Here is the C code:



```c
int values[] = {20, 30, 5, 9, 2, 0, 22};

int i, j;
for (i = 0; i < 7; i++)
  for (j = i + 1; j < 7; j++)
  {
    if (values[j] < values[i])
    {
        int temp = values[i];
        values[i]  = values[j];
        values[j] = temp;
    }
  }
```

Let’s try to understand the method by simulating that code.

Here we have values:

20	30	5	9	2	0

Round 1:
We want to find the smallest value and add it to the beginning of this array
SO, the first value is now 20, place is values[0]

Now we compare 20 to the next value of the array (place is values[1]
if the next value, 30, is smaller, we swap values

Round 1:
SO, let's go on:
30 < 20?

No, we do nothing

5 < 20?
Yes, we swap values and get:

5	30	20	9	2	0	22

Round 1:
We go on with value 5 now:
9 < 5?
No, we do nothing
2 < 5?
Yes, values are swapped and we get

2	30	20	9	5	0	22

Round 1:
We go on with value 2 now:
0 < 2?
Yes, we swap values and get

0	30	20	9	5	2	22

Round 1:
Finally we compare 0 to 22 and do nothing.

So the result of first round is here!

0	30	20	9	5	2	22

0	30	20	9	5	2	22

Round 2:
we compare the second value (values[1], 30 now) to other values:
20 < 30?
Yes, swapping and we get

0	20	30	9	5	2	22

9 < 20?
Yes, swapping

0	9	30	20	5	2	22

0	9	30	20	5	2	22

5 < 9?
Yes, swapping and we get:

0	5	30	20	9	2	22

2 < 5?
Yes, swapping and we get:

0	2	30	20	9	5	22

0	2	30	20	9	5	22

Next round:
20 < 30?
Yes, swapping and we get:

0	2	20	30	9	5	22

9 < 20?
Yes, swapping and we get:

0	2	9	30	20	5	22

0	2	9	30	20	5	22

5 < 9
Yes, swapping and we get:

0	2	5	30	20	9	22

No more changes ...

0	2	5	30	20	9	22

Next round:
20 < 30?
Yes, swapping and we get:

0	2	5	20	30	9	22

9 < 20?
Yes, swapping and we get:

0	2	5	9	30	20	22

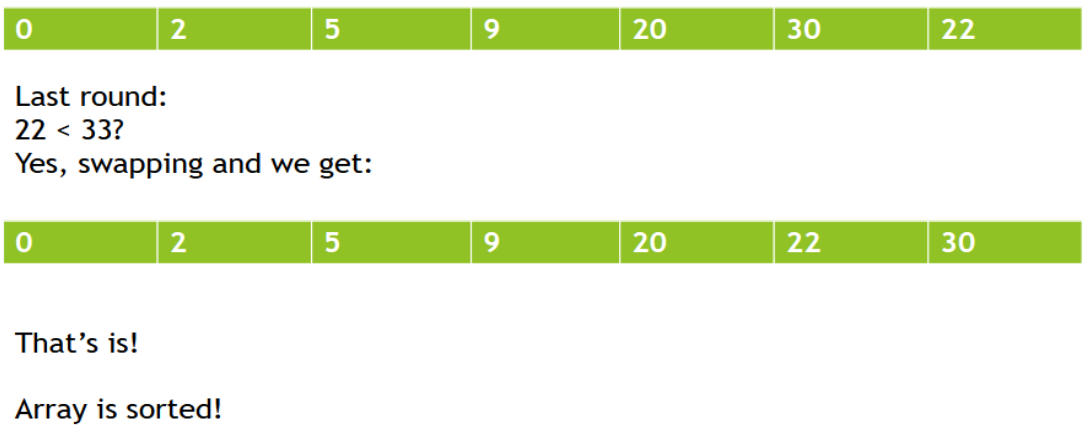
No more changes...

0	2	5	9	30	20	22

Next round:20 < 30?
Yes, swapping and we get:

0	2	5	9	20	30	22

No more changes...



0	2	5	9	20	30	22

Last round:
22 < 33?
Yes, swapping and we get:

0	2	5	9	20	22	30

That’s is!

Array is sorted!

May be it is now easier to remember the method code or create it from scratch …

Example 8: Updating a table

Other ways to try to understand code: you can use a table that has variable names as table headers. Then you can simulate the code and enter values to variables when they change… This is quite good e..g when we have repeating parts, loops, in the code...

Example loop:

```
int sum = 0;
int n = 0;
for (int a = 2, a < 6; a++)
{
  sum = sum + 2;
  n++;
}

float average = sum/n;
print(sum);
print(average);
```

11

Round	a	a < 6??	sum	n
0	?	?	0	0
1	2	true	2	1
2	3	true	5	2
3	4	true	9	3
4	5	true	14	4
5	6	False, break the loop	14	4

Then we calculate
average = 14/4
sum was 14

Instead of table you can also have some boxes for variables and during simulation you can update the vakues of boxes…

That’s all, folks!

Hope to get feedback!