**CS5*0***

**Introduction to CS50**

**Large language models** – complex de limbaje de programare.

Don t use the chat bot for direct answer. Use it as a copilot to help you to go to the answer.

**Binary** – use 0 and 1;

In a program this are the steps input -> algorithm-> output (repreat). Next the output can become the input.

In programming one of the bad practice it s to repeat yourself like copy and past a block for n times, instead you can use a loop and write a single block.

Best practice is to simplify the implementation.

Trying to reduce your ideas to build a big projects. Brake your project in smaller steps.

**Lecture 1 – learn about C and how to solve problems**

We will learn how to slove problems and how to not solve problems.

How to say Hello World in C : printf(“Hello World!”);

We will write the code in higher level programming language and we will need something to convert the source code in machine code.

Compiler convert source code to machine code (lower level language).

**3 main commands**

code name.c – create the file with the language and name that you want.

make name – compile the code

./name – run the code

Libraris wite like #include <stdio.h> - teach the program to use printf.

Clear in terminal clears the terminal.

Void – dosen t have a return value

Return value (int, char, Boolean, string, float, double)

Linux – operating system

Terminal in the vscode is a server.

In vscode you have 2 files one c file and the other one is a binary file(only 0 and 1 in the file)

**Textual commands:**

mv - rename the file that you want

ls – list the file in the folder in green are executable and the with files are created today.

rm– remove the file

cp – copy a file

cd – change directory

code name.language – makes a new file with the name and programming language that you want.

Const key word is used for constant variable. A variable that can t be changed.

Do while – It s executing the code one time and enter in while if the condition is fullfiled.

RAM – random acces memory – it s finit – you can count depending how much memory you have. Here all the results are stored. If you don t have memory you will get the return 0 and error integer overflow.

If you want to count negative and positive number you have to split memory in a half. Half for negative and the other half for positive.

%li – print long integer.

Float use 32 bits and double use 64 bits

Truncation – eliminate everything after the dot.

Type casting – you treat the value as you write in ().

Floating point imprecision – you can t represent all the number because you have a limited memory.

In 19 january year 2038 clock ends his cycle because he reach the limit of the int number.

**Shorts**

**Data types**

In C you have to specify all the data types every time you declare a variable.

Double can have 64 bits is more precies than float that has 32 bits.

Void is not a data type it s just a type. That means is not gone return any value in the function. Void is used as a place holder for nothing.

Librarys – bool is storing a Boolean values true and false.

String collection of characters, words etc. Use c50.h library to work with bool and string.

After you declare a variable you don t have to use again the data type declaration. Just use the name of the variable equal and the value.

**Operators**

Substract, add, multiply, divide.

Modulus operator gives you the remainder of the number.

X++ increments x by 1.

X—decrements x by 1.

Boolean expression true or false to make a decision in if.

**Logical operator AND , OR, NOT**

X && Y - > true && true = true

- > true && false = flase

If one of them is false the logic is false.

X || Y - > one of them has to be true in order the logic to execute.

! - > NOT

Relational operators

< less, > greater, <= less and equal, <= greater and equal, == equal.

Attention = is for assignment a value.

**Conditionals expression**

If(Boolean - expression)

{

What is here execute!

}

If(Boolean - expression)

{

What is here execute!

}else

{

What is here execute!

{

It has 2 paths.

Switch(x)

{

Case 1:

….

Case x

…

Default:

…if no case it s use it s gone use the default case.

}

Use breake to exit the switch.

Ternary operator (? :)

Int x = (expr) ? 5 : 6;

**Loops**

While (codntion)

{

…..

}

It s gone pe executed until the condition is gone be false or a waye to brake out of the loop

To breake the loop use ctrl + c.

Do

{

}

While()

It s gone execute one time the code what is in the curly braces

for(strat; expr; increment) loop it s begin with a number 1 and it goes until you 10 for example. And increments everytime with one or two or depends what do you want. We use a counter variable to loop.

**Command Line**

ls – list, shows you all the files in the directory and also directorys.

cd – change directory you can type cd and name of the directory.

pwd – tells you where you are in the directory.

mkdir – create a directory

cp – takes 2 arguments source and where you want to put he file

rm - remove file

rm -rf – remove everything without ask you anything

rm -r – remove directory

rm -f – force remove

mv – move files

clear – clear terminal

**Magic number**

Preprocessor placement

#define name replacement – find and replace.

Everytime when the program see name it s gone replace with replacement.

**Section**

Variable is a container, storage, allows use to give a name tot the container.

Variable is a value that can change.

Equal is and assignment operator.

%i – replace with the variable int

Int calls = 4;

printf(“calls is %i\n”, calls);

You can use librarys with #include – a library is a pice of code that some one writes and you can use functionalitys in the library by calling the functions.

Function get\_int is like a black box for now.

**Week 2 – Arrays**

Compileing – involve 4 steps (preprocessing, compiling, asambl, linking)

Preprocessing – comverst all the #includes like find and replace.

Compiling – converts the source code in asambley language.

Assambling – takes the asambley code and converts in binary(0 and 1).

Linking – combining files the main file and the files that you use in #include.

Combine all the binary code in one.

Decompile – revers engineering

Debugging – you can use printf to visualize the mistakes.

You can use use debug50. To use the debug you need to compile the program first.

You can use speaking for hearing illogic things.

You can use ai or a paper writing things.

The red dot on the left line side is ar break where you can pause execution.

In a library are functions instead writing the prototype of the function

clang -o hello hello.c

now you can write ./hello instead ./a

If you use a 3 party library yu have to tell c even when you compile.

Clang -o hello hello.c cs*50*

Array is a sequence of values.

Int score[3];

score[0] = 73;

In C string is an array of size x, in the memory. At the end of every string is a value that tells the computer, string is ending here (\0), sentinel value. String is n+1 byte.

Command line arguments

Functions – it s a black box

This can be named function, method, procedure.

It s important when you write a function his name has to be understandable.

A function allow us to simplify the code. It s easyear to debug 10 lines a code instead 100 lines a code.

Function declaration:

Has to have return type, a name, and argument-list if you don t have input void.

Scope variables – 2 types global and local.

Local can be acces just in the function.

Global can be acces from all functions.

Global variables are dangerous if you use the variable in multiple functions and you change the value you affect all the functions that use that variable.

Stcmp – to compare 2 strings.

**Compilation**

Taking the source code and comverting in binary code. The computer dosen t understend the C language.

One of the steps in conversion take the C language and converted in Assembley code, the second one is take the Assembley code and converted in binary.

**Arrays**

Arrays takes all the individual data and store them in a group, in memory.

In CS convention is to count from 0.

To crate an array you need 3 condition: What is the data type, What is the name, and how many you store in array.

You can t change the size of an array.

**Week 3 – Algorithms**

Linear search – every time you search from left to right or right to left.

Worst case is O(n) best case Omega(1).

Binary search – divide and conquer – divide half – half – until you find the number.

You can use this search only if the array is sorted, so if is not sorted you have to use one of the sort algorithms to sort the array and after you can use the binary search.

Worst case is O(log n) and best case Omega(1).

Binary search is better then the linear search but you have to sort the array first and after you can use the binary search.

Big O notation – n^2 , n log n, n, log n , 1 – higher bound (worst case scenario)

O(n) – linear time

O(n^2) – quadratic time

O(1) – constant number of steps

Binary search takes log n steps.

Omega – represents lower bound (best case scenario)

Theta notation – if the algorithm it has same number of steps in best case and worst case scenario.

Return 0 – means the program was a success,

Return 1 or any other number – means the program did not succed.

When we compare two strings we use strcmp(first, second) if this is equal 0 that means the strings are equal if is not that means the strings are not equal.

Using struct you can create your own data type.

Selection sort – loop trough the array and build the sort list one element at the time. O(n^2) it s slow. Also Omega(n^2) still slow for the best case scenario, so it s in Theta(n^2).

Bubble sort – you can use a while(…), compare the variables and swap them. O(n^2) it s slow. Omega(n) this is the best case scenario.

Recursion – a function that it calls hisself. n! = fact(n) in C.

Fact(n) = n \* fact(n – 1);

To implement a recursive solution you have to implement a best case that stops the recursive function, then you have to implement the actual solution that use the function to solve the problem.

Merge sort – sort right half sort left half and merge the sides.

If the program takes more time result in less space.

If the program takes less time result in more space depends what do you want in your program. More space or more time?

Merge sort is using more space.

Merge sort O(n log n) also in Omega(n log n). That meens theta(n log n).

**Week 4 – Memory**

Are only finit nmber of bits that a picture have.

Resolution is how many dots ori pixels are on the screen.

Hexadecimal use 0 – 9 numbers and latters from A – F. Implies 16.

We can use & to see the address of the variable.

Take an address and go to it.

Pointer stores an address of a variable.

Pointers take more space then the variable – 8 bites.

When you compare 2 string for example s == t you are not comparing the string you are comparing the address of the first char of the string.

Strcmp – retrurns 3 numbers 0 if the strings are equal 1 if the first one is grater and – 1 if the second is grater.

2 New functions malloc, free

Malloc(number of bites In the memory) – returns the address of the first bite.

NULL is address 0.

Valgrind check usage of memory.

Valgrind is for memory related bugs.

Garbage values – if you don t assign values to a variable you will get a garbage number.

When you use malloc you use heap and when you use variables you use stack.

Pass by reference instead a you will use \*a.

2 errors can appear heap overflow and stack overflow.

Segmentation fault – you touch segments of memory that do not belong in your program.

File I/O

Pointers

Int gets 4 bytes in memory

Char gets 1 byte

Float get 4 bytes

Double get 8 bytes

Long get 8 bytes

String or char\* get 4 or 8.

A pointer is nothing more then an address.

Fopen – find file and open the file.

R – read the file

W – write in the file

Fclose – close the file the memory is free.

Buffer is a temp place that you can store data in your program.

Week 5 – Data structures

Queue – fifo – first in first out.

You can use push when you have to put things inside queues.

You can use pop to take things out of queues.

Stacks – lifo – last in first out.

LinkedList use one node per value and another pointer to point for the next value.

Trees - binary search trees.

Leafs – the nodes at the bottom

Roots – are on the top.

Each node have 2 pointers. Left and Right.

Trees are keept in a sorted order that’s why you can use binary search on a tree.

Tree is a composition of an subtree plus one more node. It s a recursive data structure.

Anything in the right side is bigger and anything in the left side is smaller.

Dictionaries stores keys and values.

Like words and definitions.

Hashing takes any numbers of imputs and match with a finit number of values.

Hash function – takes imput and output some values. We can use hash and create hash table. Combination of arrays and linked lists. We take the speed benefits of arrays and horizontal structures from linkedlist.

First addres point to the next node so if we have the first node occupied in the hash table we will link the nodes and form a linkedlist in a hash table.

Basicly is an array of linkedlist.

Hash tables are big O(n) in the worst case scenario.

If I increase the size of the array we will not forme linkedlist we will have only one array so we will have constant time. The downside is memory.

**Week 6 – Python**

To run and compile a file you write python file.py.

Libraries use import example import cs50

You can import specific functionalities from the library like

From cs50 import get\_string command.

In python you can t use var++ or var--.

String = str in python.

For I in range(n) loop in python.

Python increments the value I and u don t have to do it.

Named parameter – default end=”\n” so you can overridet and clear end=”” so now you gone have the printing onn the same line.

Integer overflow is not a problem, python will allocate more space

Pip

With python you don t have to think at lower level think about details like pointers. Now you can think at a higher level of abstraction.

text.strip() – take out beginning and the end white spaces.

text.lower – convert all the carcaters to lower cases.

text.capitalize – makes first later uppercase.

Everytime you use one of this functions you have to assign the result to the old string or to he old variable.

text.split() – split the prase and transform the phrase in to a list of words.

Basicly return a list.

To read a csv fule you can use csv library.

Python is not compiled and this use an interpretor.

Week 8

Routers – purpose to rout information

TCP/ IP - IP stands for internet protocol

TCP – guarantees delivery

Port numbers – 80 HTTP and 443 HTTPS

DNS – domain name system server – Ask the server what is the ip

Inside the DNS is a dictionary.

When you buy a domain you tell the world what will be the name of your ip addres.

DHCP – Dynamic host configuration protocol

HTTP -gouverns how web browser and how web servers speak.

HTTP – hyper text transfer protocol.

HTTPS – hyper text transfer protocol secure – is encrypted.

<https://www.example.com/> - represent the principal

<https://www.example.com/path> - represent a specific folder

www.example.com – this is the full domain name

www – the host name(web addres)

.com top level domain and stand for commercial

And there are more

.edu – stands for education

https is the protocol

GET – request information from the server – clicking in links etc.

POST – sending information – posting a picture.

Curl – connect to an url

HTML – make up language

Tags and attributes

DHCP – assigns you an ip addres, so you don t chose same ip addres with some one else. Is just a program that intereact between and internet.

IP- DHCP – internet

DNS – translates ip addres to human language

Acces point – connect to the internet.

Interent – it s a connection of local networks.

The internet it s a chain of local networks.

Interent is a set of rules that defines how local networks connects and talk to each other.

Numbers in the ip tells the direction.

TCP – transmition control protocol

IP – dose not guarantee the transfer of the data that’s why we need TCP.

TCP – guarantee delivery

TCP/IP

TCP helps to breake in to chunks

IP gets the package wrap with TCP and tells where to go.

Let create a variable

HTTP – Is a set of rules how the data should be transfer the information.

(application layer portocol)

In javascript functions can be anonymous

Event is a respons when a user is doing something