C++ Cheat Sheet

Class: CSCI 1300

General Reminders

`#include "myfile.h"`	Include file.
`rand()`	Random int, `#include<cstdlib>`.
`int(var)`	Convert a data type var to int.
`float(var)`	Convert a data type var to float.
`double(var)`	Convert a data type var to double.
`static_cast<t>(var)`	Convert `var` to the type `t`.
`void myF() const`	read only fonction.
`inline`	the whole code of the inline function is inserted or substituted at the point of its call during the compilation.
`constexpr`	that specify that an expression must be evaluated at compile time.
`sizeof(var)`	return the number of bytes used by the variable. `sizeof` runs at compile-time.
`move(obj)`	During assignation move the already existing object instead of creating a copy of it (memory optimizations).
`ternary Opearator`	condition ? ifTrue : ifFalse

Strings

`str[i]`	Get or set the char at the index `i`.
`.length()`	Return the number of characters.
`.substr(a,b)`	Returns the substring starting at index `a` with length `b`.
`.find(subStr)`	Return the start index of the substring
`.replace(i,l,str)`	Replace l characters starting at index `i` with `str`.
`#include <string>`	all the above must include string.
`stoi(str)`	Convert a string to int.
`stof(str)`	Convert a string to float,
`stod(str)`	Convert a string to double,
`to_string(var)`	Convert `var` to a string,

Vectors

`#include<vector>`	Include vector library.
`vector<type> V;`	Instantiate a vector.
`vector<type> V{6,3,3};`	Instantiate a vector from Array.
`vector<type> V(s, var);`	Instantiate a vector of size `s` with all elements initialized to `var`.
`v[i]`	Get or set the element at index `i`.
`.at(i)`	Returns the element at index `i` and performs a bound check.
`.size()`	Return the number of elements.
`.push_back(Value)`	Add the new element at the end.
`.pop_back()`	Remove the last element.
`.clear()`	Empty the vector.
`.insert(i, Value)`	Insert `Value` at `i`.
`.reserve(size)`	Pre-allocate memory for performance, Use it when the maximum size is known.
`.front()`	Returns the first element.
`.back()`	Returns the last element.
`.empty()`	Returns true if vector is empty.
`.erase(it)`	Erase element at iterator `it`.

Arrays

0	1	...	n
"Max"	"Tom"	...	arr[n]

This table illustrate the structure of an array of strings. Considering that n is equal to the number of element minus one. Arrays are a static data type.

`int arr[4];`	Create a array of int and with 4 element.
`int arr[4]={6,3};`	
`arr[i]`	Get or set the element at the index i.

Structures

```
struct myStruct {
    string param1;    // atribute 1
    double param2;   // atribute 2
}s1, s2;            // myStruct instances
```

`myStruct Obj;`	instantiate structure object.
`Obj.param1`	Access param1 of `Obj`.

Streams

`#include<fstream>`	Include stream library.
`#include<sstream>`	Include string stream library.
`ifstream fin;`	Instantiate a input stream.
`ofstream fout;`	Instantiate a output stream.
`fstream f(fileMode);`	Instantiate a input/output stream.
`stringstream s(str);`	Instantiate a string stream.
`fout<<"hello"`	Output in stream "helloWorld".
`fin>>var`	Input from stream to var.

fstream functions

`getline(fin, line)`	Get the next line from `fin` and assign it to `line`.
`.open("file.txt")`	Open txt file whith the stream.
`.is_open()`	Return true if the file is open.
`.close()`	Close the stream file.

File modes

`ios::in`	Open for reading.
`ios::out`	Open for writing.
`ios::app`	Open for appending (writing at end).
`ios::trunc`	Truncate file to zero length if it exists.
`ios::ate`	Open and start at the end of the file.
`ios::binary`	Open in binary mode (no text processing).

File modes can be combined using the bitwise OR operator `|`.

manipulators

`<<dec<<`	Set number base to decimal.
`<<hex<<`	Set number base to hexadecimal.
`<<oct<<`	Set number base to octal.
`<<scientific<<`	Display floating-point numbers in scientific notation.
`<<setprecision(n)<<`	Set decimal points, `#include<iomanip>`.
`<<setw(n)<<`	Establishes a print field of n spaces.
`<<fixed<<`	Display floating point numbers in fixed point notation.
`<<showpoint<<`	Enables or disables the unconditional inclusion of the
`<<noshowpoint<<`	decimal point character in floating-point output.
`<<left<<`	output the string on the left.
`<<right<<`	output the string on the right.

clear buffer

The buffer must be cleared after after getting an input from a stream if you input and output in the same file at the same time.

```
if(cin.fail() == true) {
    cin.clear();
    cin.ignore(1000, '\n');
}
```

Error Handling

```
try {
    // risky operation
} catch (exceptions) {
    // runs if an exception of type Ex is thrown
}
```

`#include<cassert>`	Include assert library.
`#include<stdexcept>`	Common standard exceptions.
`throw myException`	Throw an error of type myException.
`exception::what()`	Retrieve diagnostic message.
`catch (const auto& e)`	Catch exceptions by const reference.
`catch(...)`	Fallback handler; rethrow if unsure.
`exception`	Parent of all exceptions class.

Object Oriented Programing(OOP)

```
class myClasses :public parentClass{
    private:
        // private methods and variables
    public:
        // public methods and variables

        myClasses(int p1, int p2){...} // Constructor

        ~myClasses(){...} // Destructor

        // Override the inherited method parentMethod()
        void parentMethod() override { ... }

        //Example Operator Overloading
        Number operator+(const Number &n){
            return Number(value + n.value);
        }
};
```

`myClasses myObj(3,5);`	Instantiate an myClasses type obj.
`myClasses myObj;`	Call the default constructor.
`protected:`	similar to private, but it can also be accessed in the inherited class.
`virtual`	Specify that a method can be overridden in a derived class.

OOP With header file

If you use a header the file wich contain the main function must include the header file.

Header file(myHeader.h)

```
#ifndef MYCLASS_H //if no def for MyClass
#define MYCLASS_H //else

using namespace std;

class MyClass{
    public:
        ⋮
    private:
        ⋮
};
#endif
```

Class file(.cpp)

```
#include "myHeader.h"

MyClass::MyClass(int p1, ...){
    publicAtribute = p1;
    ⋮
}
```

Genericity

```
    template <typename T_1, ..., typename T_n>
    class myClasse{
        ⋮
```

```
myClasse<T_1, ..., T_n>(...);
```

Switch case

```
switch (x){
    case 0:
        /*Code in case x = 0*/
    break;
        ⋮
    case n:
        /*Code in case x = n*/
    break;
    default:
        /*Code if no case match*/
}
```

Pointer & References

`int* myInt;`	* means myInt work form a pointer.
`new`	dynamically allocate a block of memory.
`delete`	release dynamically allocated memory.
`NULL`	Macro that referens to null pointer.
`*var`	Get var value, where var is a pointer.
`&var`	Get memory addresse of **var**.
`void* var`	Pointer with no associated data type.

Bitwise Operators

`&`	Bitwise AND.	`~`	Bitwise NOT.	`^`	Bitwise XOR.
`|`	Bitwise OR.	`<<`	Left shift.	`>>`	Right shift.

Namespaces

`namespace NS {...}`	Define a namespace.
`NS::func()`	Access member of namespace.
`using namespace NS;`	Import all names from namespace.
`using NS::func;`	Import specific name from `NS`.
`namespace {...}`	Anonymous namespace: limits scope to current translation unit (file).
`inline namespace NS {...}`	Members are accessible without qualification by default.
`namespace alias = NS;`	Create an alias for a namespace.
`::globalVar`	Access global namespace explicitly.

Lambda Expression

```
    ... = [captureClause] (parameters) -> returnType {
    // definition}
```

[&]	capture all external variables by reference.
[=]	capture all external variables by value.
$[a, \&b]$	capture 'a' by value and 'b' by reference.

cmath

`#include<cmath>`	Include cmath library.
`sqrt(x)`	Square root of `x`.
`pow(x, y)`	`x` raised to the power `y`.
`abs(x)`	Absolute value overloads.
`floor(x)`	Greatest integer $\leq$ `x`.
`ceil(x)`	Smallest integer $\geq$ `x`.
`fmod(x, y)`	Floating-point remainder of `x`/`y`.

Special Ints

signed fixed width integer types

int8_t	int16_t	int32_t	int64_t
int_fast8_t	int_fast16_t	int_fast32_t	int_fast64_t
int_least8_t	int_least16_t	int_least32_t	int_least64_t

unsigned fixed width integer types

uint8_t	uint16_t	uint32_t	uint64_t
uint_fast8_t	uint_fast16_t	uint_fast32_t	uint_fast64_t
uint_least8_t	uint_least16_t	uint_least32_t	uint_least64_t

other integer types

intmax_t & uintmax_t	Maximum-width integer type.
intptr_t & uintptr_t	Integer types capable of storing a pointer value.
size_t	An unsigned integer data type to represent the size of objects in bytes; commonly used for array indexing and loop counters.

Preprocessing

`#define NAME value`	Define a macro.
`#define F(x) x*x`	Define a function-like macro.
`#ifdef NAME`	If the macro `NAME` is defined.
`#ifndef NAME`	If the macro `NAME` is not defined.
`#else`	Alternative case for ifdef/ifndef.
`#endif`	End conditional directive.
`#include`	Include a file.
`__FILE__`	Current file name.
`__LINE__`	Current line number.
`__DATE__`	Compilation date.
`__TIME__`	Compilation time.
`#pragma`	Implementation-specific instruction.

• `once` — simple include guard for header files. • `pack(push, n)` / `#pragma pack(pop)` — set and restore struct packing/alignment to n bytes. • `pack(n)` — set struct member alignment to n. • `GCC optimize("...")` — enable compiler-specific optimizations (GCC/Clang). • `#pragma warning(push)` / `#pragma warning(pop)` / `#pragma warning(disable:NNNN)` — control MSVC warnings. • `#pragma message("text")` — emit a compile-time message. • `#pragma comment(lib, "name.lib")` — instruct MSVC linker to link a library.

Compiler Commends

`clang++ filesName`	commend to compile c++ code with **clang**, clang is a LLVM compiler.
`-o name`	define the name of the compiled object.
`-v`	Makes the compiler print detailed information. "v" stands for "Verbose".
`-E`	Prints the preprocessor output.
`-Wall`	activates all warnings
`-Wextra`	Enable extra warnings beyond `-Wall`.
`-c filesName`	generate an object file. To add `.o` filse to the compilation simply add those like a regular file.
`-O0, -O1, -O2, -O3, -Ofast`	Optimizations levels, where `-O0` is not optimization

Basic syntax

```
if (myBoolean){
        ⋮
}
```

```
while(myBoolean){
    ⋮
}
```

```
for (size_t i = 0; i < n; i++){
    ⋮
}
```

```
for (auto Obj: Lst){
    ⋮
}
```

```
void function (TYPE1 var, TYPE2 defaultVar = value){
    ⋮
    return something;
}
```