

Standard library (STL)

Programming Concepts in Scientific Computing
EPFL, Master class

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STL: input/output streams library: cout/cin

```
#include <iostream>

int main() {
    std::cout << "Hello" << std::endl;
    double a;
    std::cin >> a;
    std::cout << "Hello: " << a << std::endl;
}
```

STL: input/output streams library: cout/cin

```
#include <iomanip>
#include <iostream>

int main() {
    double a;
    std::cin >> a;

    std::cout << std::scientific;
    std::cout << std::setprecision(15);
    std::cout << "Hello: " << a << std::endl;
}
```

STL: string of character: string

```
#include <iostream>
#include <string>

int main(int argc, char *argv[]) {
    std::string name;
    name = argv[1];

    std::cout << "Hello: " << name << std::endl;
}
```

STL: file input/output: fstream

```
#include <fstream>
```

```
int main(int argc, char *argv[]) {  
    std::string name;  
    name = argv[1];  
    std::ifstream fin(name.c_str());  
    while (fin.good()) {  
        double a;  
        fin >> a;  
    }  
}
```

STL: string input/output: stringstream

```
#include <iostream>
#include <sstream>

int main(int argc, char *argv[]) {
    std::stringstream sstr;
    for (int i = 1; i < argc; ++i) {
        sstr << argv[i] << ",";
    }
    std::cout << "Comma separated list of arguments: ";
    std::cout << sstr.str() << std::endl;

    int N = 0;
    sstr >> N;
}
```

STL: containers

- ▶ STL Containers: generic description (design pattern)
- ▶ They are based on a container-iterator relation
- ▶ This simplifies the transition from one type to another
- ▶ Classical types are:
 - ▶ vector
 - ▶ list
 - ▶ set
 - ▶ map
 - ▶ multimap

STL containers: vector

The include:

```
#include <vector>
```


STL containers: vector

Loops:

```
int N = 100;           Templated class  
std::vector<double> v(N);
```

What does this 'unsigned' keyword mean?

```
for (unsigned int i = 0; i < v.size(); ++i) {  
    v[i] = 100.;  
}
```

STL containers: vector

Loops:

```
int N = 100;
std::vector<double> v(N);

for (unsigned int i = 0; i < v.size(); ++i) {
    v[i] = 100.;
}
```

Or equivalently

```
std::vector<double>::iterator it = v.begin();
std::vector<double>::iterator end = v.end();

while (it != end) {
    *it = 100;
    ++it;
}
```

STL containers: map

Associating keys with values Python: dictionary

```
#include <map>
```

STL containers: map

Example with planets

```
enum ParticleType {  
    planet,  
    star,  
    atom,  
};  
  
std::map<std::string, ParticleType> particle_types;  
  
particle_types["mars"] = planet;  
particle_types["sun"] = star;  
particle_types["copper"] = atom;
```

STL containers: map

Looping over keys and values

```
std::map<std::string, ParticleType>::iterator it = partic
std::map<std::string, ParticleType>::iterator end = parti

for (; it != end; ++it) {
    std::string key = it->first;
    ParticleType p_type = it->second;

    std::cout << "key:" << key << " -> ";
    std::cout << p_type << std::endl;
}
```

STL: algorithms

There are many STL algorithms available.

Examples:

- ▶ `std::find` searches for a match in a container in $O(N)$ advances.
- ▶ `std::sort` sorts a container in $O(N \cdot \log_2(N))$ swaps (which then is not the same for list, vectors)
- ▶ `std::binary_search` searches into a sorted container in $O(\log_2(N))$ advances (which is then long for non random access iterators like lists)

Take away message

<http://en.cppreference.com/>
<http://www.cplusplus.com/reference/>