C++ STL

vector, list, string

@arbuztw

Standard Template Library

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  - linked list
  - map
  - ...

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  - linked list
  - map
  - ...
- 常用到的演算法也要自己寫嗎?
  - 二分搜尋
  - 排序
  - 全排列

Standard Template Library

- 1990年代成為C++ Standard的一部分
- 包含演算法(algorithm)、容器(container)、迭代器(iterator)...
- 用C++ Template(樣版)來實作

泛型程式設計 (Generic Programming)

- 問題: 給一個`int`陣列，請找出最小值。
  - 實做`int findMax(int arr[], int size)`

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- 給一個`char`陣列，請找出最小值。
- 給一個...陣列，請找出最小值。

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- 給一個`double`陣列，請找出最小值。
- 給一個`char`陣列，請找出最小值。
- 給一個...陣列，請找出最小值。
- 要寫N次一樣的函數?

Template

- 如果能這樣該有多好

```
T findMax(T arr[], int size) {
   T mx = arr[0];
   for (int i = 1; i < size; i++)
      if (arr[i] > mx)
         mx = arr[i];
   return mx;
}
```

- 令T = int, double, char ...

Template

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T findMax(T arr[], int size) {
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- 令T = int, double, char ...
- C++ Template!
- 「可重用性(reusibility)」的表現

vector

- 動態伸縮的陣列，可以快速存取任意元素。
- 常用函數

```
#include <vector>

std::vector<T> vec;        // T為一個type (e.g. int/char...)
std::vector<T> vec(n);     // 長度為n的vector
std::vector<T> vec(n, x); // 長度為n且初始化為x的vector
vec[i];                    // i-th element
vec.push_back(element);    // 新增element到vector尾端
vec.pop_back();            // 移除
vec.size();                // 回傳vector長度
vec.clear();               // 清空vector
```

- Reference:
  http://www.cplusplus.com/reference/vector/vector/

vector範例

```cpp
#include <iostream>
#include <vector>

int main() {
   std::vector<int> vec;

   vec.push_back(3);
   vec.push_back(2);
   vec.pop_back();
   vec.push_back(1);

   std::cout << "size = " << vec.size();
   std::cout << ", element: " << vec[0] << ", " << vec[1] << std::endl;

   return 0;
}
```

```
size = 2, element: 3, 1
```

list

- double linked-list，可以快速插入/删除元素。
- 常用函數

```
#include <list>

std::list<T> xs;
xs.push_front(element);
xs.push_back(element);
xs.pop_front();
xs.pop_back();
xs.insert(iterator, element);   //在iterator前插入element
xs.erase(iterator);             //删除iterator指向的元素
```

- Reference:
  http://www.cplusplus.com/reference/list/list/

iterator (迭代器)

- 類似指標，指向容器(container)中的元素
- 無需關心容器底層的實作
- Example

```
std::list<int> xs;
std::list<int>::iterator it;

for (it = xs.begin(); it != xs.end(); it++)
   std::cout << *it << std::endl;
```

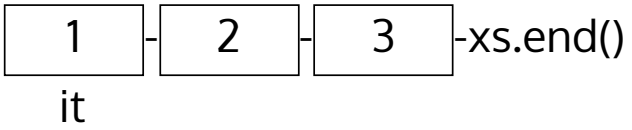
- (Invalidation)在erase或vector push_back後，記憶體位置可能會改變，因此不保證原先的iterator仍會指到對的位置
- 更多invalidation: Iterator invalidation rules

list範例

```
std::list<int> xs;
std::list<int>::iterator it;

for (int i = 1; i <= 3; i++)
   xs.push_back(i);

it = xs.begin();
/*it++;
xs.insert(it, 6);
xs.insert(it, 7);
it--;
xs.erase(it);*/
```



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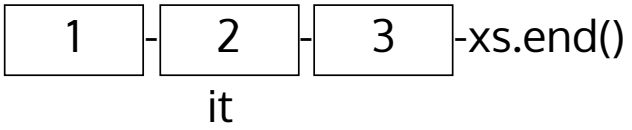

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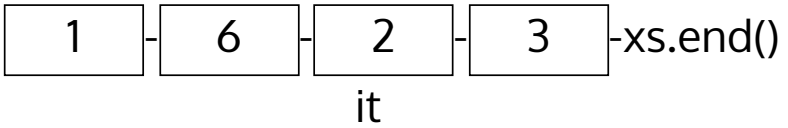

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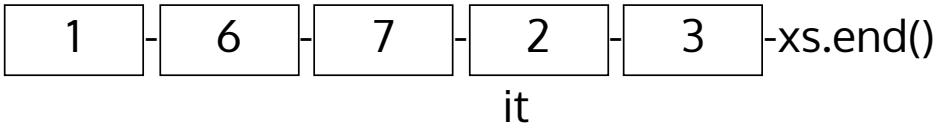

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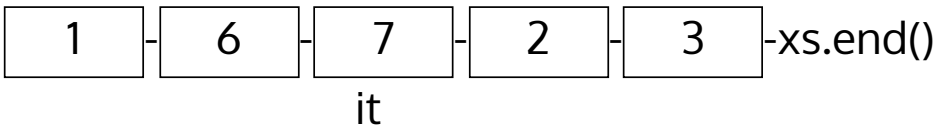

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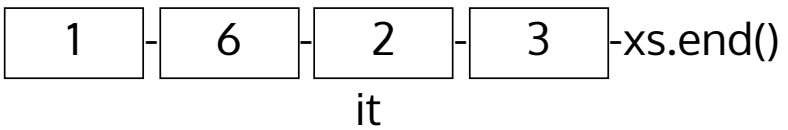

string

- 字串物件
- 常用函數

```
#include <string>

std::string str1, str2;
str1[i];
str1 + str2;
str1 == str2;
str1.length(); str1.size();
str1.substr(0, 3);
str1.replace(0, 3, str2);
str1.reverse();
str1.find(str2);
str1.c_str();
```

- Reference:
  http://www.cplusplus.com/reference/string/string/

string範例

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

using std::string;

int main() {
   string str1, str2;
   size_t k;

   str1 = string("hello");
   str1 += string(" world");
   str2 = string("ello");

   k = str1.find(str2);

   std::cout << str2 << " is at index " << k << " of " << str1;

   return 0;
}
```

```
ello is at index 1 of hello world
```