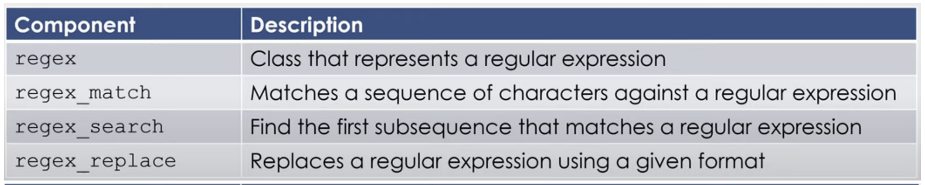
Regular Expressions

What is

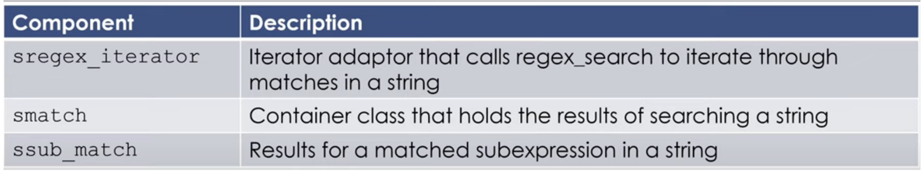
- a sequence of characters that define a search pattern
- can use in terminal. <- not really relevant but useful for me
- The most important thing is just to test your regex

How to use

- import `regex`



Component	Description
`regex`	Class that represents a regular expression
`regex_match`	Matches a sequence of characters against a regular expression
`regex_search`	Find the first subsequence that matches a regular expression
`regex_replace`	Replaces a regular expression using a given format

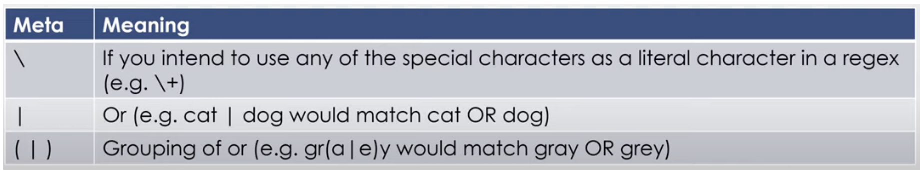


Component	Description
`sregex_iterator`	Iterator adaptor that calls regex_search to iterate through matches in a string
`smatch`	Container class that holds the results of searching a string
`ssub_match`	Results for a matched subexpression in a string

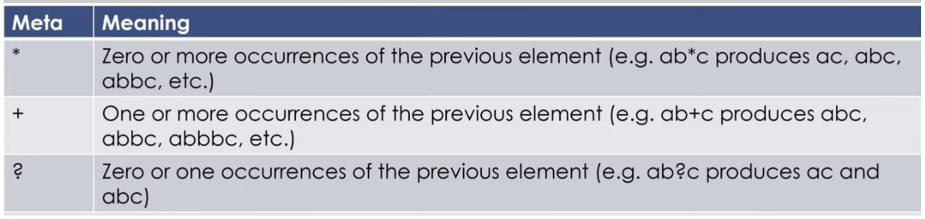
- **NOTE**: the syntaxtical correctness of a regular expression is tested at RUNTIME

Metachacter

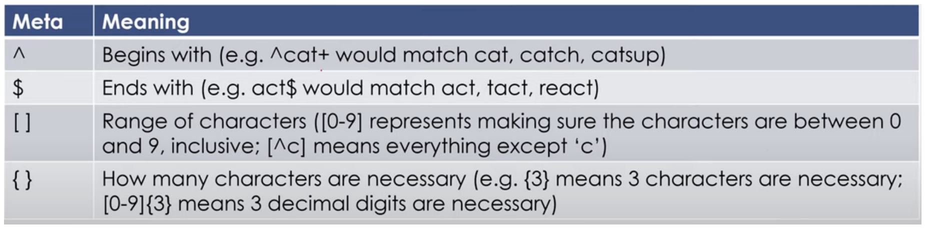
- any character that has special meaning



Meta	Meaning
\\	If you intend to use any of the special characters as a literal character in a regex (e.g. \\+)
|	Or (e.g. cat | dog would match cat OR dog)
(|)	Grouping of or (e.g. gr(a|e)y would match gray OR grey)



Meta	Meaning
*	Zero or more occurrences of the previous element (e.g. ab*c produces ac, abc, abbc, etc.)
+	One or more occurrences of the previous element (e.g. ab+c produces abc, abbc, abbbc, etc.)
?	Zero or one occurrences of the previous element (e.g. ab?c produces ac and abc)



Meta	Meaning
^	Begins with (e.g. ^cat+ would match cat, catch, catsup)
$	Ends with (e.g. act$ would match act, tact, react)
[ ]	Range of characters ([0-9] represents making sure the characters are between 0 and 9, inclusive; [^c] means everything except 'c')
{ }	How many characters are necessary (e.g. {3} means 3 characters are necessary; [0-9]{3} means 3 decimal digits are necessary)

Ex: Backslash (ae. escape character)

```
#include <regex>

// use of \ (ae. escape cahracter)
string str1 = "A string that has the pipe symbol: |";
regex pattern("\|");

bool match = regex_search(str, e);
cout << (match ? "Matched" : "Not matched") << endl
>>>
Matched
```

Ex: Pipe (ae. or)

```
string str1 = "Allan";
regex pattern("Laiba|Allan");

// Would match
// Allan
// Laiba

bool match = regex_search(str, e);
cout << (match ? "Matched" : "Not matched") << endl
>>>
Matched
```

Ex: Parenthesis (ae. grouping)

```
string str1 = "Jeffrey";

// Would match any of these:
// Geoffrey
// Jeffrey
// Geoffery
// Jeffery

regex pattern("(Geo|Je)ff(re|er)y");

bool match = regex_search(str, e);
```

```
cout << (match ? "Matched" : "Not matched") << endl
>>>
Matched
```

Ex: Star (ae. 0 or more)

```
// doesn't need to contain b but can
string str1 = "ac";

// Would match:
// ac
// abc
// abbbc
// abbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbc

regex pattern("ab*c");

bool match = regex_search(str, e);
cout << (match ? "Matched" : "Not matched") << endl
>>>
Matched
```

Ex: + (ae. one or more)

Ex: ? (ae. optional)

Ex: ^ (ae. begins with)

Ex: $ (ae. ends with)

Ex: [] (ae. range)

Ex: {} (ae. length of match)

Dynamic Memory Allocators

Problems

- coupling allocation and construction can be wasteful

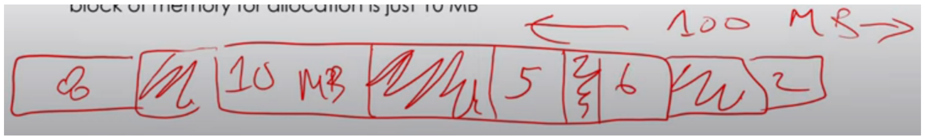
Ex:

```
string *const p = new string[n];
string s;
string *q = p;
while (cin >> s && q != p +n){
    *q++ = s;
}
const size_t size = q - p;
delete[] p;
```

-
    - `string *const p = new string[n]` <- this line makes n strings. What if, in the end we don't need n string instead we need less? We've wasted memory
    - Since initializing a string set it to empty string but right after we write to it (`*q++ = s`)
    - more importantly classes without default constructors can't be dynamically allocated as an array

Fragmentation

- when memory is unusable even though it's theoretically available
- let's say you need 100 mb of memory and your system checks, there is infact 100mb total. If it's not all in a single block of memory then you can use it.



Internal

- if the payload is smaller than the block size
- **Causes**:
    - overhead of maintaning heap data structure
    - padding for alignment purposes
    - explicit policy decisions

External

- the above image. There is enough total memory, but no single free block is large enough

Solution

Allocators

- provide a source of memory for a given type
- once it's no longer needed it gives a place to return that memory

- allows generic containers to decouple memory management from the data itself

Allocator Requirements

- a class X allocating memory for an object T must be able to provide the following
  - X::pointer
  - X::const_pointer
  - X::reference
  - X::const_reference
  - X::value_type
  - X::size_type (unsigned, represents largest size you can allocate for an object)
  - X::difference_type (represents the defference between any two pointers)

Where Used?

- STL Containers
- The string class

Basic Methods

- `allocate`: requires an int as param. acquire space for n objects of type T
- `deallocate`