```
=== 演習1 解答例 ============================
--- compile-and-run.txt ---
$ g++ -std=c++17 ex10-1.cpp
$ ./a.out
usage: ./a.out N
$ ./a.out 5
1 2 4 8 16
$ ./a.out 6
1 2 4 8 16 31
$ ./a.out 10
1 2 4 8 16 31 57 99 163 256


--- print.hpp ---
#include <iostream>
template<typename T>
void print(const T& c)
{
   for (auto& e: c)
      std::cout << e <<" ";
   std::cout <<"\n";
}

template<typename Itr>
void print(Itr b, Itr e)
{
   for ( ; b != e; ++b)
      std::cout << *b <<" ";
   std::cout <<"\n";
}


--- ex10-1.cpp ---
// モーザー数列
#include <algorithm>
#include <iostream>
#include <vector>
#include "print.hpp"

int n = 1;
int moser() {
   int an = (n*n*n*n - 6*n*n*n + 23*n*n - 18*n + 24)/24;
   ++n;
   return an;
}

int main(int argc, char *argv[])
{
   if (argc < 2) {
      std::cout <<"usage: "<< argv[0] <<" N\n";
      return 1;
   }
   int N {std::stoi(argv[1])};
   std::vector<int> x(N);
   std::generate(x.begin(), x.end(), moser);
   print(x);
}
```

```
=== 演習2 解答例 ============================
--- compile-and-run.txt ---
$ g++ -std=c++17 ex10-2.cpp
$ ./a.out
usage: ./a.out n
$ ./a.out 7
3 2 6 1 9 4 8 6 2
3 2 6 1 7 4 7 6 2
$ ./a.out 5
3 2 6 1 9 4 8 6 2
3 2 5 1 5 4 5 5 2
$ ./a.out 2
3 2 6 1 9 4 8 6 2
2 2 2 1 2 2 2 2 2


--- print.hpp ---
#include <iostream>
template<typename T>
void print(const T& c)
{
   for (auto& e: c)
      std::cout << e <<" ";
   std::cout <<"\n";
}

template<typename Itr>
void print(Itr b, Itr e)
{
   for ( ; b != e; ++b)
      std::cout << *b <<" ";
   std::cout <<"\n";
}


--- ex10-2.cpp ---
// std::replace_if
#include <algorithm>
#include <iostream>
#include <vector>
#include "print.hpp"

int n {0};
bool pred(int x) { return x > n; }

int main(int argc, char *argv[])
{
   if (argc < 2) {
      std::cout <<"usage: "<< argv[0] <<" n\n";
      return 1;
   }
   n = std::stoi(argv[1]);
   std::vector x {3,2,6,1,9,4,8,6,2};
   print(x);
   std::replace_if(x.begin(), x.end(), pred, n);
   print(x);
}
```

```
=== 演習3 解答例 ============================
--- compile-and-run.txt ---
$ g++ -std=c++17 ex10-3.cpp
$ ./a.out
usage: ./a.out n
$ ./a.out 3
3 2 6 1 9 4 8 6 2
3 2 1 2
$ ./a.out 4
3 2 6 1 9 4 8 6 2
3 2 1 4 2
$ ./a.out 7
3 2 6 1 9 4 8 6 2
3 2 6 1 4 6 2


--- print.hpp ---
#include <iostream>
template<typename T>
void print(const T& c)
{
   for (auto& e: c)
      std::cout << e <<" ";
   std::cout <<"\n";
}

template<typename Itr>
void print(Itr b, Itr e)
{
   for ( ; b != e; ++b)
      std::cout << *b <<" ";
   std::cout <<"\n";
}


--- ex10-3.cpp ---
// std::copy_if, std::back_inserter()
#include <algorithm>
#include <iterator>
#include <iostream>
#include "print.hpp"

int n{0};
bool pred(int x) { return x <= n; }

int main(int argc, char *argv[])
{
   if (argc < 2) {
      std::cout <<"usage: "<< argv[0] <<" n\n";
      return 1;
   }
   n = std::stoi(argv[1]);
   std::vector x {3,2,6,1,9,4,8,6,2};
   std::vector<int> y;
   print(x);
   std::copy_if(x.begin(), x.end(), std::back_inserter(y), pred);
   print(y);
}
```

```
=== 演習4 解答例 ============================
--- compile-and-run.txt ---
$ g++ -std=c++17 ex10-4.cpp
[okam@localhost ex4]$ ./a.out
usage: ./a.out n
$ ./a.out 3
3 2 6 1 9 4 8 6 2
3 2 1 2
$ ./a.out 4
3 2 6 1 9 4 8 6 2
3 2 1 4 2
$ ./a.out 7
3 2 6 1 9 4 8 6 2
3 2 6 1 4 6 2


--- print.hpp ---
#include <iostream>
template<typename T>
void print(const T& c)
{
   for (auto& e: c)
      std::cout << e <<" ";
   std::cout <<"\n";
}

template<typename Itr>
void print(Itr b, Itr e)
{
   for ( ; b != e; ++b)
      std::cout << *b <<" ";
   std::cout <<"\n";
}


--- ex10-4.cpp ---
// std::remove_if
#include <algorithm>
#include <iterator>
#include <iostream>
#include "print.hpp"

int n{0};
bool pred(int x) { return x > n; }

int main(int argc, char *argv[])
{
   if (argc < 2) {
      std::cout <<"usage: "<< argv[0] <<" n\n";
      return 1;
   }
   n = std::stoi(argv[1]);
   std::vector x {3,2,6,1,9,4,8,6,2};
   print(x);
   x.erase( std::remove_if(x.begin(), x.end(), pred), x.end() );
   print(x);
}
```

```
=== 演習5 解答例 ============================
--- compile-and-run.txt ---
$ g++ -std=c++17 ex10-5.cpp
$ ./a.out
usage: ./a.out n
$ ./a.out 3
3 2 6 1 9 4 8 6 2
3 2 2 1
9 4 8 6 6
$ ./a.out 4
3 2 6 1 9 4 8 6 2
3 2 2 1 4
9 8 6 6
$ ./a.out 6
3 2 6 1 9 4 8 6 2
3 2 6 1 2 4 6
8 9


--- print.hpp ---
#include <iostream>
template<typename T>
void print(const T& c)
{
   for (auto& e: c)
      std::cout << e <<" ";
   std::cout <<"\n";
}

template<typename Itr>
void print(Itr b, Itr e)
{
   for ( ; b != e; ++b)
      std::cout << *b <<" ";
   std::cout <<"\n";
}


--- ex10-5.cpp ---
// std::partition
#include <algorithm>
#include <iterator>
#include <iostream>
#include "print.hpp"

int n{0};
bool pred(int x) { return x <= n; }

int main(int argc, char *argv[])
{
   if (argc < 2) {
      std::cout <<"usage: "<< argv[0] <<" n\n";
      return 1;
   }
   n = std::stoi(argv[1]);
   std::vector x {3,2,6,1,9,4,8,6,2};
   print(x);
   auto it { std::partition(x.begin(), x.end(), pred) };
   print(x.begin(), it);
   print(it, x.end());
}
```

```
=== 演習6 解答例 ============================
--- compile-and-run.txt ---
$ g++ -std=c++17 ex10-6.cpp
[okam@localhost ex6]$ ./a.out 3
3 2 6 1 9 4 8 6 2
3 2 1 2
6 9 4 8 6
[okam@localhost ex6]$ ./a.out 4
3 2 6 1 9 4 8 6 2
3 2 1 4 2
6 9 8 6
[okam@localhost ex6]$ ./a.out 6
3 2 6 1 9 4 8 6 2
3 2 6 1 4 6 2
9 8


--- print.hpp ---
#include <iostream>
template<typename T>
void print(const T& c)
{
   for (auto& e: c)
      std::cout << e <<" ";
   std::cout <<"\n";
}

template<typename Itr>
void print(Itr b, Itr e)
{
   for ( ; b != e; ++b)
      std::cout << *b <<" ";
   std::cout <<"\n";
}


--- ex10-6.cpp ---
// std::stable_partition
#include <algorithm>
#include <iterator>
#include <iostream>
#include "print.hpp"

int n{0};
bool pred(int x) { return x <= n; }

int main(int argc, char *argv[])
{
   if (argc < 2) {
      std::cout <<"usage: "<< argv[0] <<" n\n";
      return 1;
   }
   n = std::stoi(argv[1]);
   std::vector x {3,2,6,1,9,4,8,6,2};
   print(x);
   auto it { std::stable_partition(x.begin(), x.end(), pred) };
   print(x.begin(), it);
   print(it, x.end());
}
```

```
=== 演習7 解答例 ============================
--- compile-and-run.txt ---
$ g++ -std=c++17 ex10-6.cpp
$ ./a.out
1 3 2 4 6 8 5 7 9
1 2 3 4 6 8 5 7 9
$ ./a.out
2 3 4 5 6 9 1 7 8
1 2 3 4 6 9 5 7 8
$ ./a.out
2 9 6 8 1 5 7 3 4
1 2 3 4 9 8 7 6 5
$ ./a.out
1 4 5 3 8 6 9 7 2
1 2 3 4 8 6 9 7 5
$ ./a.out
5 7 8 6 3 2 4 9 1
1 2 3 4 8 7 6 9 5


--- print.hpp ---
#include <iostream>
template<typename T>
void print(const T& c)
{
   for (auto& e: c)
      std::cout << e <<" ";
   std::cout <<"\n";
}

template<typename Itr>
void print(Itr b, Itr e)
{
   for ( ; b != e; ++b)
      std::cout << *b <<" ";
   std::cout <<"\n";
}


--- ex10-7.cpp ---
// std::shuffle and partial_sort
#include <algorithm>
#include <random>
#include <vector>
#include "print.hpp"
int main()
{
   std::vector a {1,2,3,4,5,6,7,8,9};
   std::mt19937 engine{std::random_device{}()};
   std::shuffle(a.begin(), a.end(), engine);
   print(a); // 毎回異なる結果

   std::partial_sort(a.begin(), a.begin()+4, a.end());
   print(a); // 1 2 3 4 まで整列
}
```

```
=== 演習8 解答例 ============================
--- compile-and-run.txt ---
$ g++ -std=c++17 ex10-8.cpp
$ ./a.out
4 7 1 8 6 3 2 9 5
3 2 1 4 5 6 8 9 7
$ ./a.out
6 7 2 8 1 3 9 4 5
5 4 2 3 1 6 7 8 9
$ ./a.out
1 7 6 4 2 8 9 3 5
5 1 3 4 2 6 7 9 8
$ ./a.out
6 3 8 4 2 9 7 5 1
2 1 4 3 5 6 7 8 9
$ ./a.out
1 2 9 6 8 3 5 4 7
5 2 1 3 4 6 7 8 9


--- print.hpp ---
#include <iostream>
template<typename T>
void print(const T& c)
{
   for (auto& e: c)
      std::cout << e <<" ";
   std::cout <<"\n";
}

template<typename Itr>
void print(Itr b, Itr e)
{
   for ( ; b != e; ++b)
      std::cout << *b <<" ";
   std::cout <<"\n";
}


--- ex10-8.cpp ---
// std::shuffle and nth_element
#include <algorithm>
#include <random>
#include <vector>
#include "print.hpp"
int main()
{
   std::vector a {1,2,3,4,5,6,7,8,9};
   std::mt19937 engine{std::random_device{}()};
   std::shuffle(a.begin(), a.end(), engine);
   print(a); // 毎回異なる結果

   std::nth_element(a.begin(), a.begin()+5, a.end());
   print(a); // 6は必ず同じ位置にくる
}
```