Recursion Exercise 1

Recursion Exercise 1

Rewrite the following recursive function in iterative form.

```
unsigned int f (const unsigned int n)
{
  if (n <= 2) return 1;
  return f(n-1) + 2 * f(n-3);
}
```

(From: Script Exercise 128)

Recursion Exercise 1

Solution below uses just 4 variables.

Other solutions are of course also possible.

```
unsigned int f_it (const unsigned int n)
{
   if (n <= 2) return 1;
   unsigned int a = 1;  // f(0)
   unsigned int b = 1;  // f(1)
   unsigned int c = 1;  // f(2)
   for (unsigned int i = 3; i < n; ++i) {
     const unsigned int a_prev = a;  // f(i-3)
     a = b;                          // f(i-2)
     b = c;                          // f(i-1)
     c = b + 2 * a_prev;             // f(i)
   }
   return c + 2 * a;                 // f(n-1) + 2 * f(n-3)
}
```

(From: Script Exercise 128)

Recursion Exercise 2

Recursion Exercise 2

Rewrite the following recursive function in iterative form.

```
unsigned int f (const unsigned int n)
{
  if (n == 0) return 1;
  return f(n-1) + 2 * f(n/2);
}
```

(From: Script Exercise 129)

Recursion Exercise 2

Solution below stores intermediate results in a vector.
Other solutions are of course also possible.

```
unsigned int f_it (const unsigned int n)
{
  if (n == 0) return 1; // special case

  std::vector<unsigned int> f_values(n+1, 0);
  f_values[0] = 1;
  for (unsigned int i=1; i<=n; ++i)
    f_values[i] = f_values[i-1] + 2*f_values[i/2];

  return f_values[n];
}
```

Recursion Exercise 3

Recursion Exercise 3

Write a function `rev_out` (see template below) which outputs the contents of an `istream` in reverse order using recursion.

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

// POST: output the content of is in reverse order to
//       std::cout, and removed it from is.
void rev_out (std::istream& is)
{
  // your code
}

int main () {
  std::stringstream input ("abcdefghijklmno");
  rev_out (input);
  return 0;
}
```

Recursion Exercise 3

Other solutions are of course also possible.

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

// POST: output the content of is in reverse order to
//       std::cout, and removed it from is.
void rev_out (std::istream& is)
{
  char val;
  if (is >> val) {
    rev_out(is);
    std::cout << val;
  }
}

int main () {
  std::stringstream input ("abcdefghijklmno");
  rev_out (input);
  return 0;
}
```