Program Optimisation
Solutions of Homework 7

1. The function `f1` was originally defined as:

```
f1 (n,x,y) {
    if (n <= 1) return y;
    n = n-1;
    z = x+y;
    z = f1 (n,y,z);
    return z;
}
```

We eliminate tail recursion from it to produce the following function:

```
       f1 (n,x,y) {
_f1:   if (n <= 1) return y;
       n = n-1;
       z = x+y;
       n = n;
       x = y;
       y = z;
       goto _f1;
}
```

The function `f` was originally defined as:

```
f (n) {
    z = f1 (n,1,1);
    return z;
}
```

As the call to `f1` is at the end of the function body, we can eliminate it, similar to the previous case, by copying the body of the function `f1`. The new definition of `f` is as follows:

```
f (n) {
    n = n;
```

```
          x = 1;
          y = 1;
_f1:  if (n <= 1) return y;
          n = n-1;
          z = x+y;
          n = n;
          x = y;
          y = z;
          goto _f1;
      }
```

Finally here is the original definition of the function `main`.

```
main () {
    n = read ();
    y = f (n);
    write (y);
}
```

We eliminate the call to `f` to produce the following definition.

```
main () {
    n = read ();
    n = n;
    n = n;
    x = 1;
    y = 1;
_f1:  if (n <= 1) {y = y; goto _f;}
    n = n-1;
    z = x+y;
    n = n;
    x = y;
    y = z;
    goto _f1;
_f:  write (y)
    }
```