1. For each of the five optimizations listed below, please write the corresponding codes before and after the optimization applied. Example format of your answers is shown below.

    a. loop unrolling
    b. function cloning
    c. loop-invariant code motion
    d. common sub-expression elimination
    e. strength reduction

Example Format: (copy propagation)

before optimization

```
x = y;
if (x > 1)
  s = x * f(x - 1);
```

⇨

after optimization of copy propagation

```
x = y;
if (y > 1)
  s = y * f(y - 1);
```