Backward reasoning

Precondition: ??

```
z = 0;
if (x != 0) {
    z = x;
} else {
    z = z+1;
  }
```

Postcondition: z > 0;

$$wp(z = 0, (x > 0) \,||\, (x == 0 \,\&\&\, z > -1))$$

$$= \{(x > 0) \,||\, (x == 0 \,\&\&\, 0 > -1)\}$$

$$= \{(x > 0) \,||\, (x == 0 \,\&\&\, true)\}$$

$$= \{(x > 0) \,||\, (x == 0)\}$$

$$= \{(x >= 0)\}$$

$$z = 0;$$

$$wp(if\ (x != 0)\ z = x; else\ z = z + 1;, z > 0)$$

$$= \{(x != 0 \,\&\&\, x > 0) \,||\, (x == 0 \,\&\&\, z > -1)\}$$

$$= \{(x > 0) \,||\, (x == 0 \,\&\&\, z > -1)\}$$

$$if\ (x != 0)\{$$

$$wp(z = x, z > 0) = \{x > 0\}$$

$$z = x;$$

$$\}$$

$$else\{$$

$$wp(z = z + 1, z > 0) = \{z + 1 > 0\} = \{z > -1\}$$

$$z = z + 1;$$

$$\}$$

$$postcondition : \{z > 0\}$$

Forward reasoning

Precondition: x >= 0

```
z = 0;
if (x != 0) {
    z = x;
} else {
    z = z+1;
  }
```

Postcondition: ??;

$x_0 \geq 0$

$z_0 = 0$

$if\ (x_0 \neq 0)$

$\{x_0 \neq 0 \&\& x_0 \geq 0 \&\& z_0 == 0\} = \{x_0 > 0 \&\& z_0 == 0\}$

$z = x;$

$\{x_0 > 0 \&\& z == x_0\}$

$else$

$\{x_0 == 0 \&\& x_0 \geq 0 \&\& z_0 == 0\} = \{x_0 == 0 \&\& z_0 == 0\}$

$z = z_0 + 1;$

$\{x_0 == 0 \&\& z == 1\}$

$\{x_0 > 0 \&\& z == x_0\} \,||\, \{x_0 == 0 \&\& z == 1\}$

$= \{z > 0\} \,||\, \{z == 1\}$

$= \{z > 0\}$