



Automated Bug Repair

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Can you find the bug?

```
int factor (int grade, int hw) {
  assume (grade >= 0 && grade <= 100);
  assume (hw >= 0 && hw <= 100);
  int res = grade;
  res = res + 5;
  res += magen(res, hw);
  if (res > 100){
    res = 100;
  }
  assert (res >= 0 && res <= 100);
  return res;
}
```



assert (res >= 0 && res <= 100);

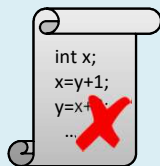
return res;

```
int magen (int x, int hw){
  int p=x;
  if (hw > x){
    p=0.3*hw+0.7*x;
  }
  p=p-x;
  return -p;
}
```



Input

- Sequential imperative program
- Program contains an assertion failure



- Unwinding bound

Translation



```
x=y+1;
x=x*2;
```

$$\hookrightarrow \{x_0=y_0+1, x_1=x_0*2\}$$

```
y=1;
if (x>0){
  y=x;
```

$$\hookrightarrow \{y_0=1, y_1=x_0, b_0=x_0>0, y_2=b_0?y_1:y_0\}$$

```
assert(x>0);
```

$$\hookrightarrow \{x_0 \leq 0\}$$

Mutation



$$\{x_0=y_0+1, x_1=x_0*2\}$$

+

Replace + with -
Replace * with /

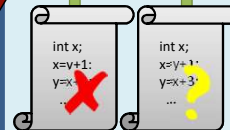
$$\{x_0=y_0+1, x_0=y_0-1\}$$

$$\{x_1=x_0*2, x_1=x_0/2\}$$

Repair



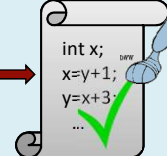
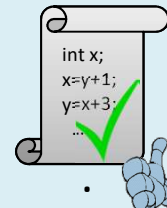
SAT solver



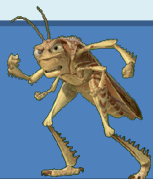
SMT solver

Output

- All minimal repairs
- Increasing size (number of mutations needed)



Manual debugging can be really annoying!



Why not let the computer find and fix the problem for you?

