$^1/_2$DIVINE + DIVINE = 1 and $^1/_4$DIVINE

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Masaryk University

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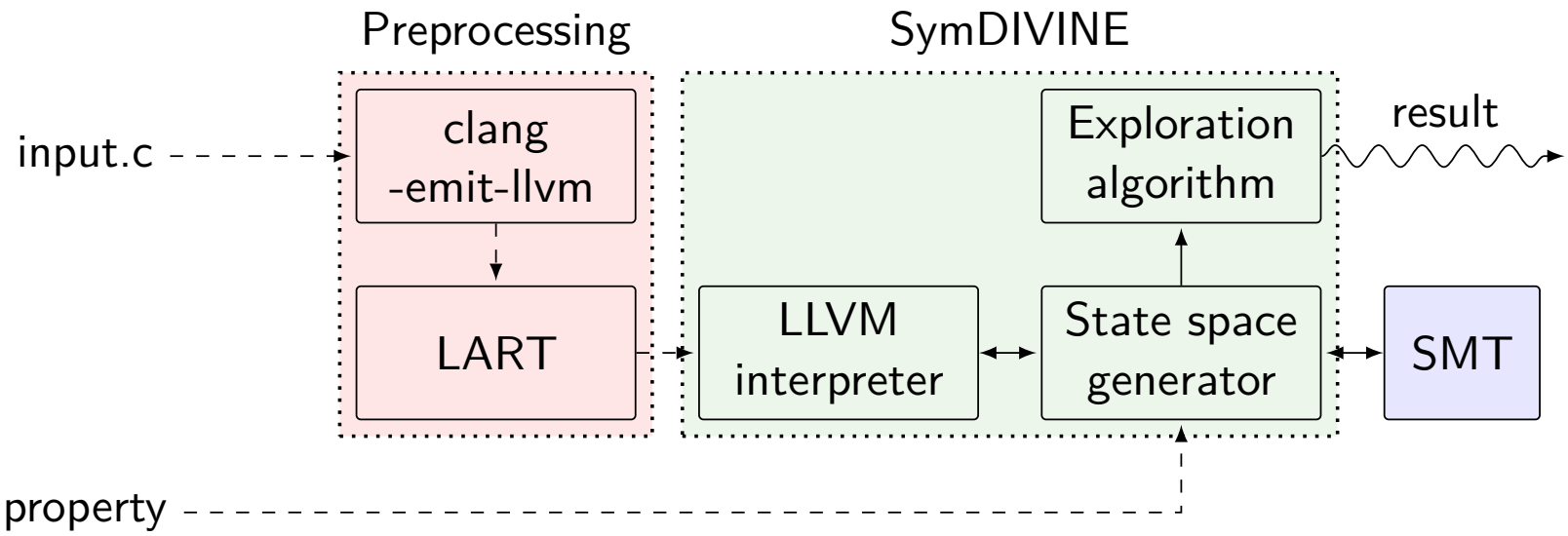
Recapitulation SymDIVINE



State space generation example SymDIVINE

Recapitulation DIVINE

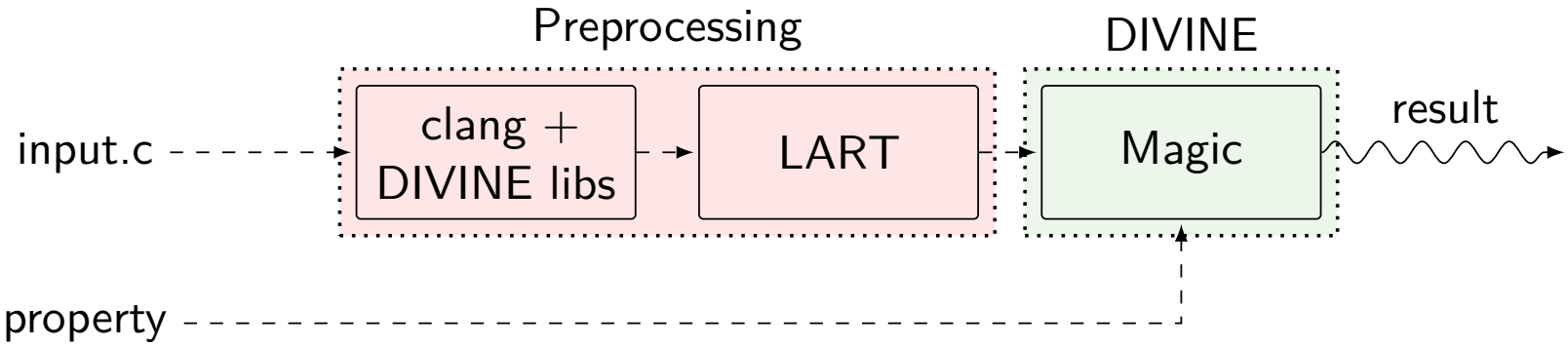
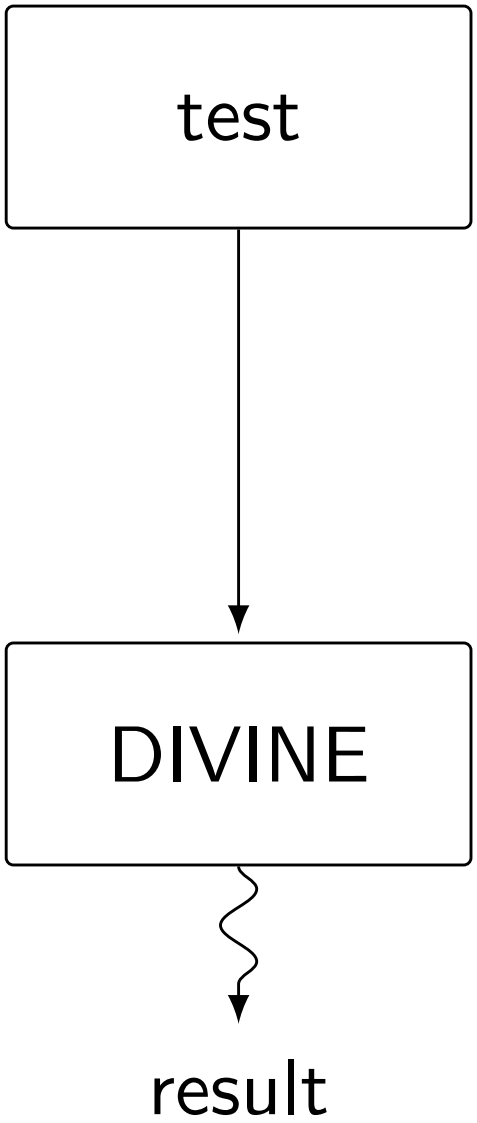
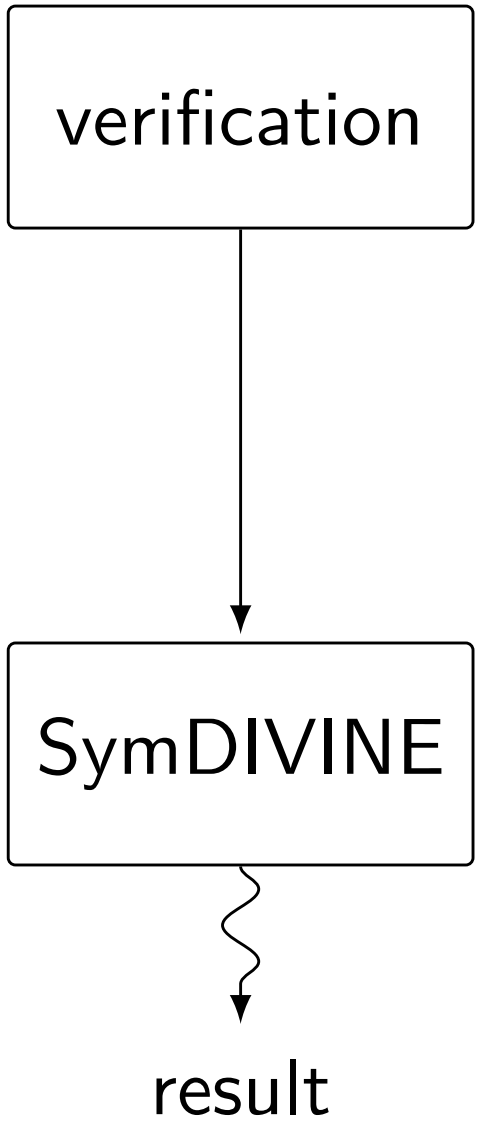


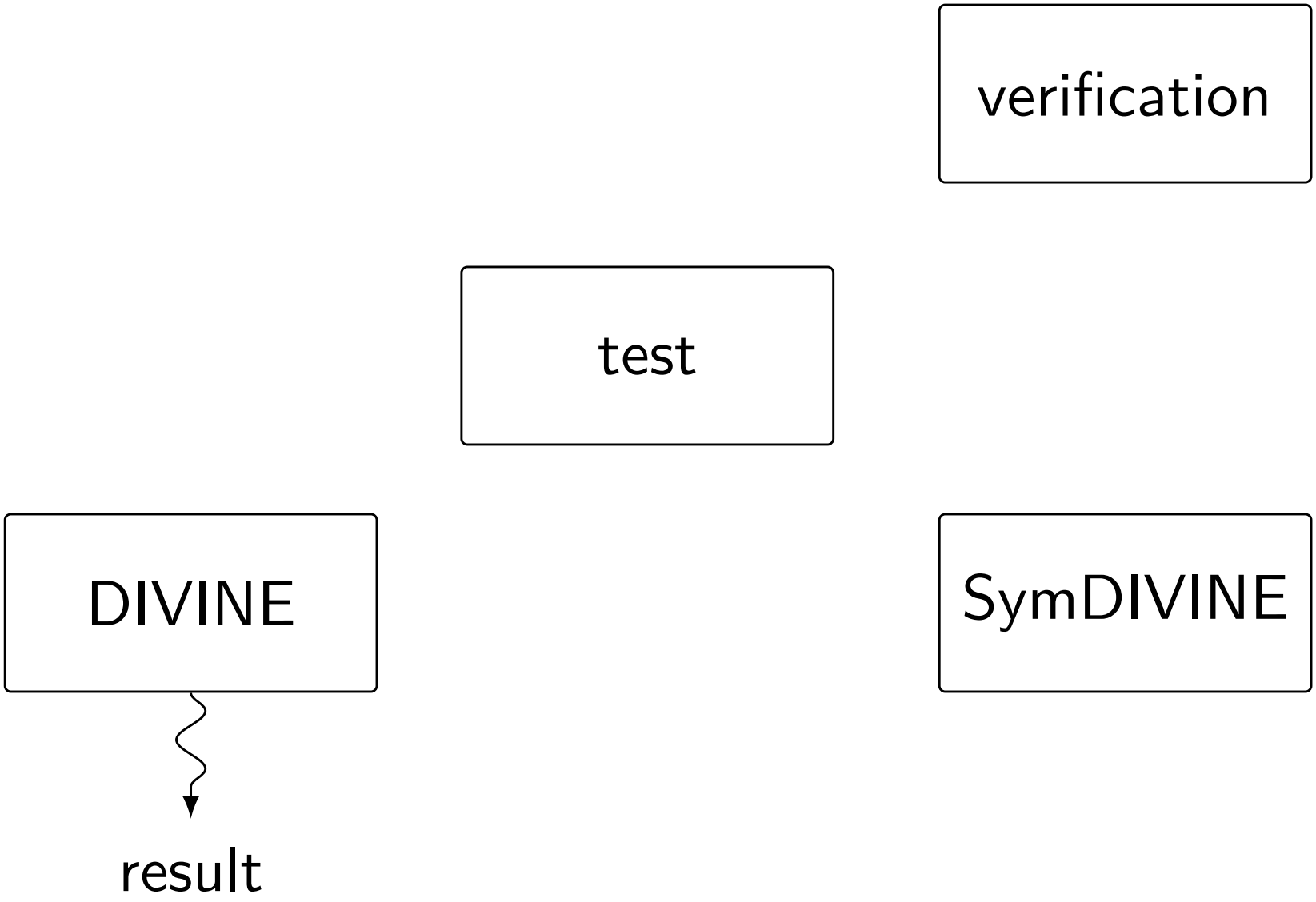
Figure 1: Mornfall

Big idea

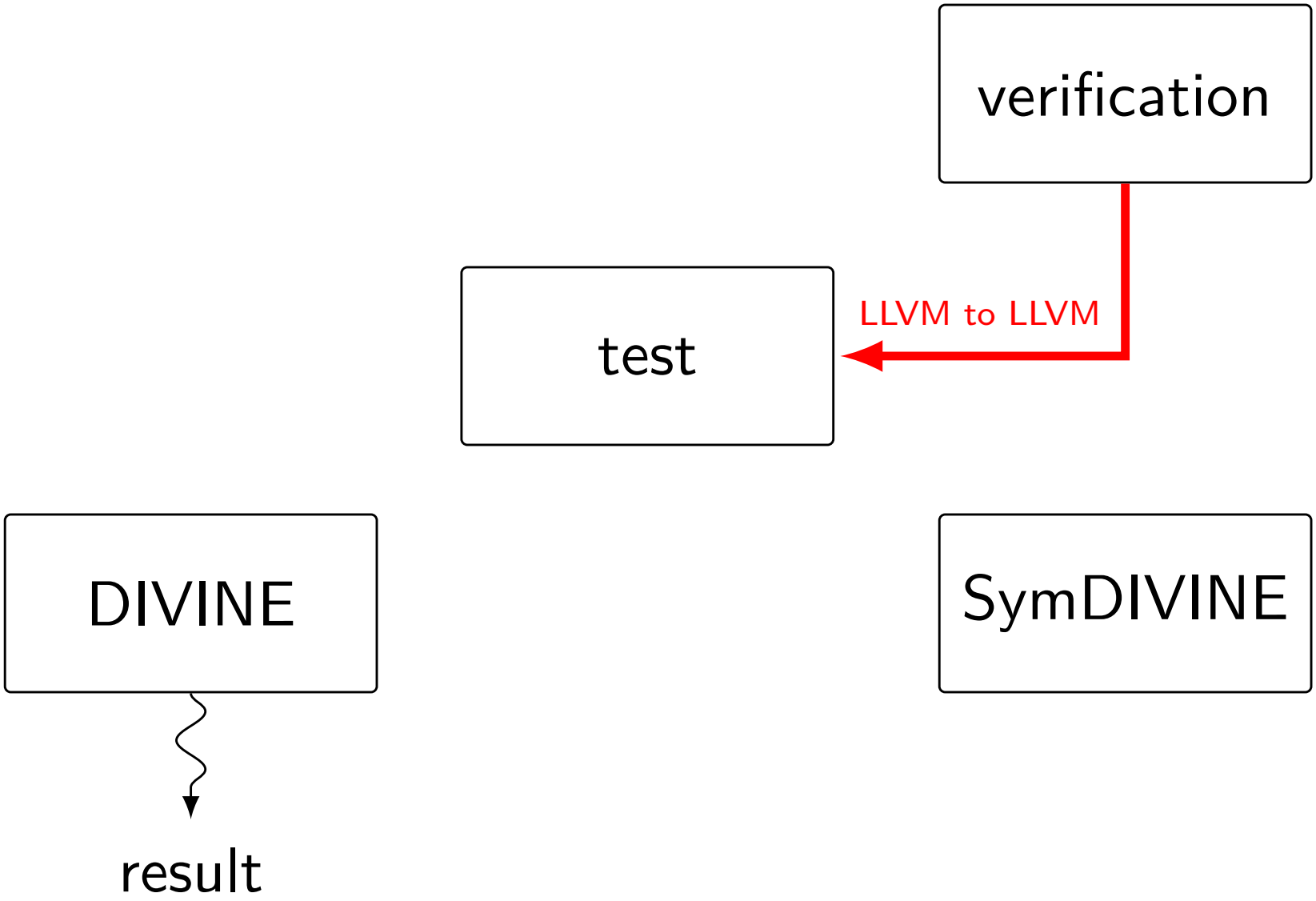




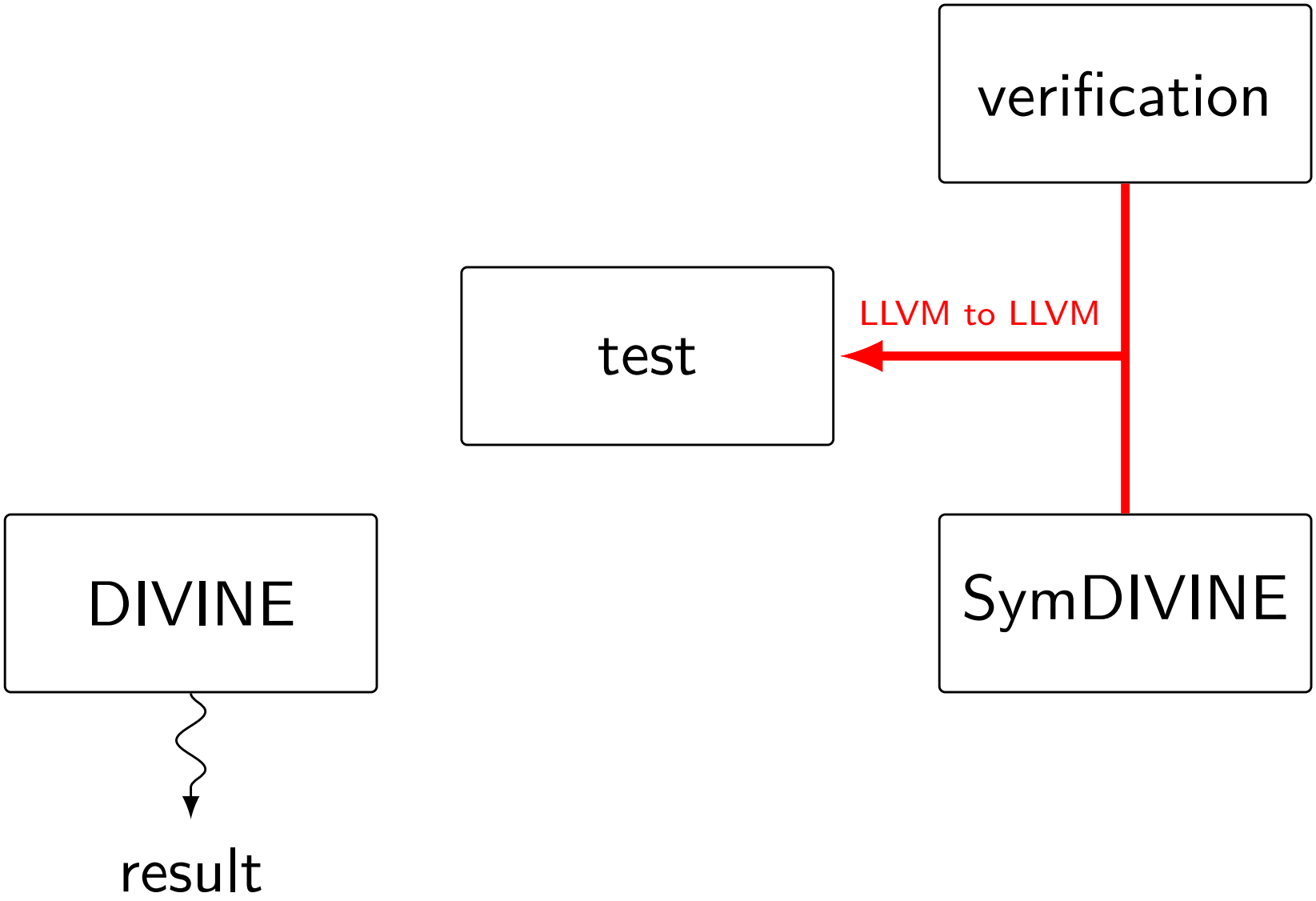
Big idea



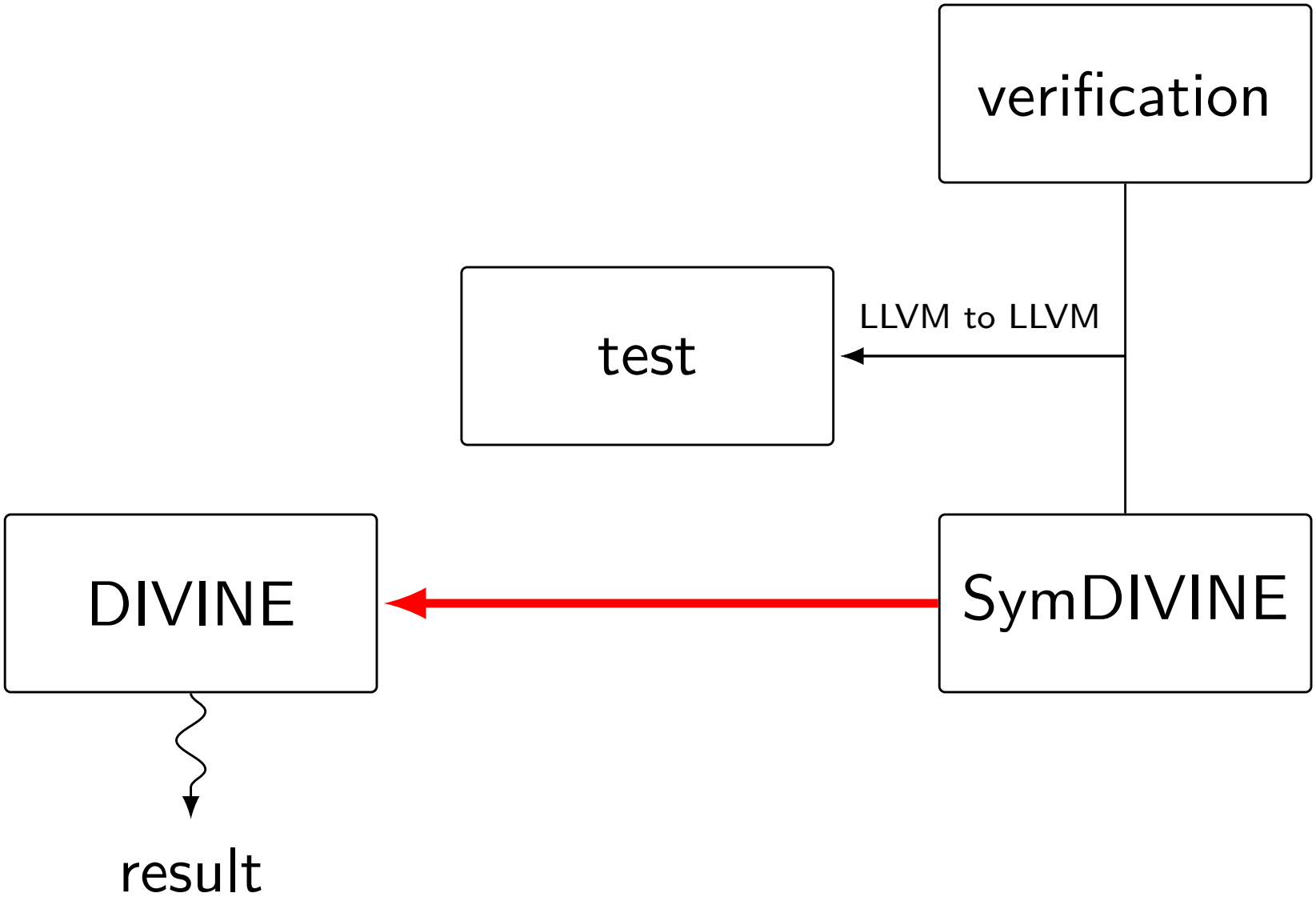
Big idea



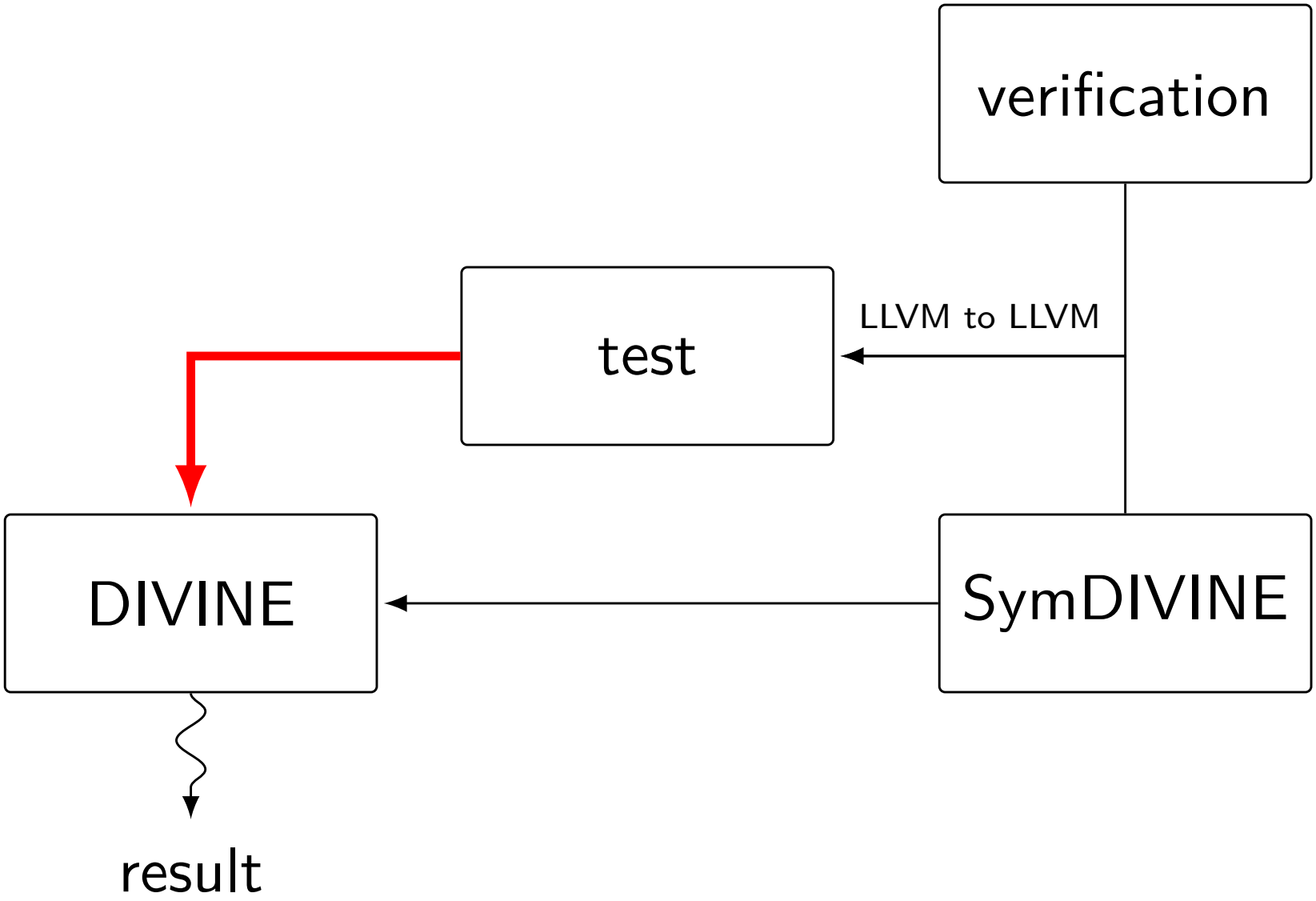
Big idea



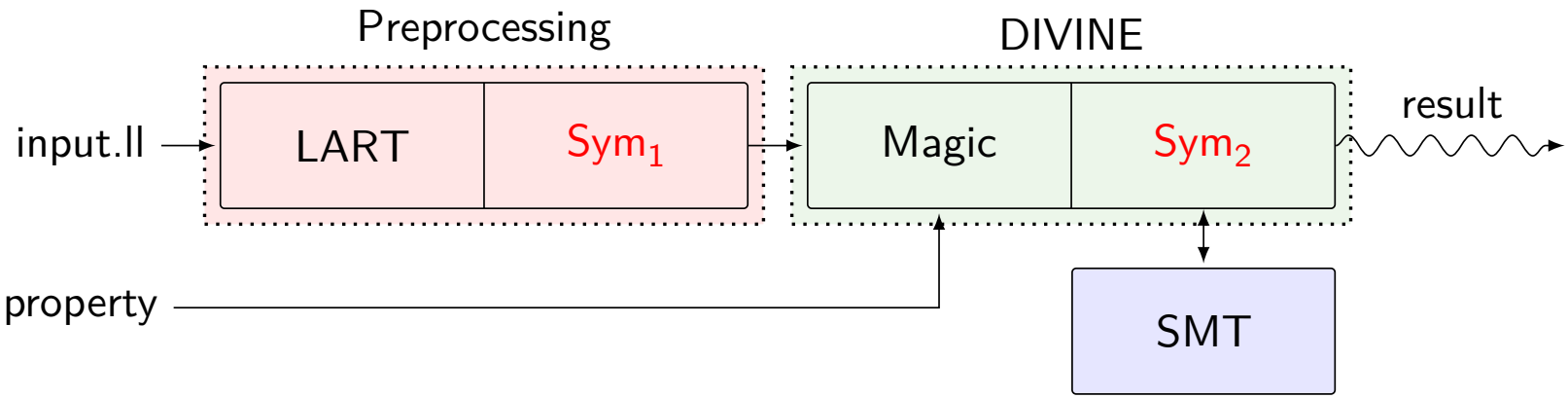
Big idea



Big idea

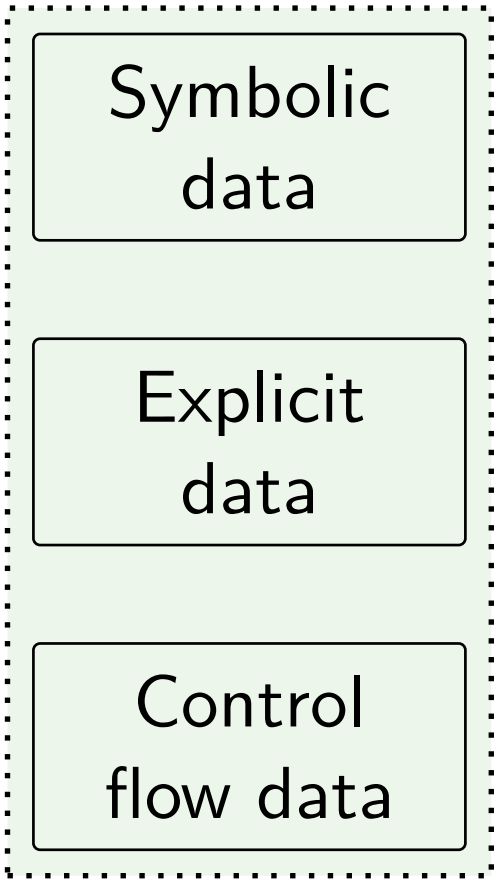


Integration

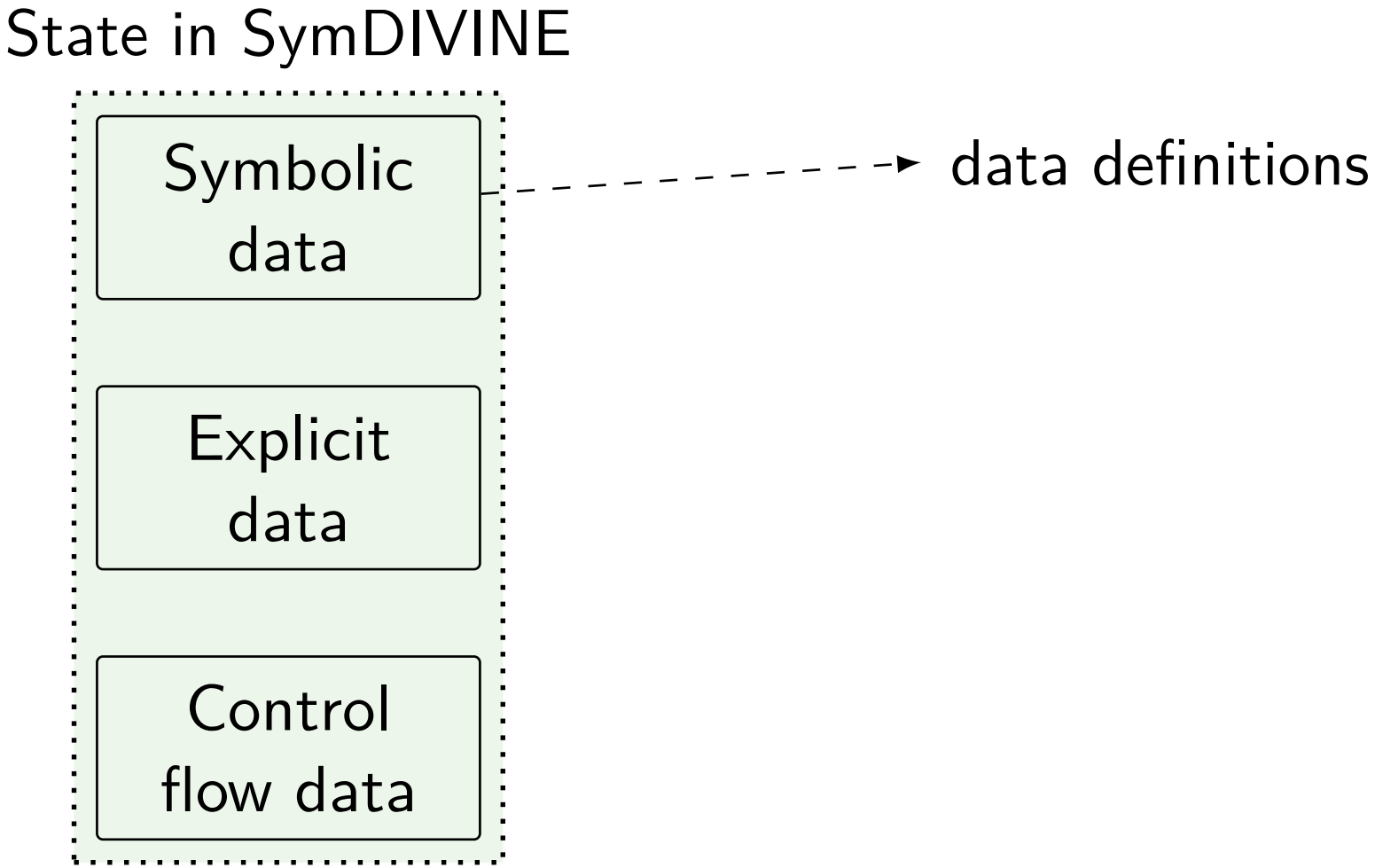


Data representation (Sym_1)

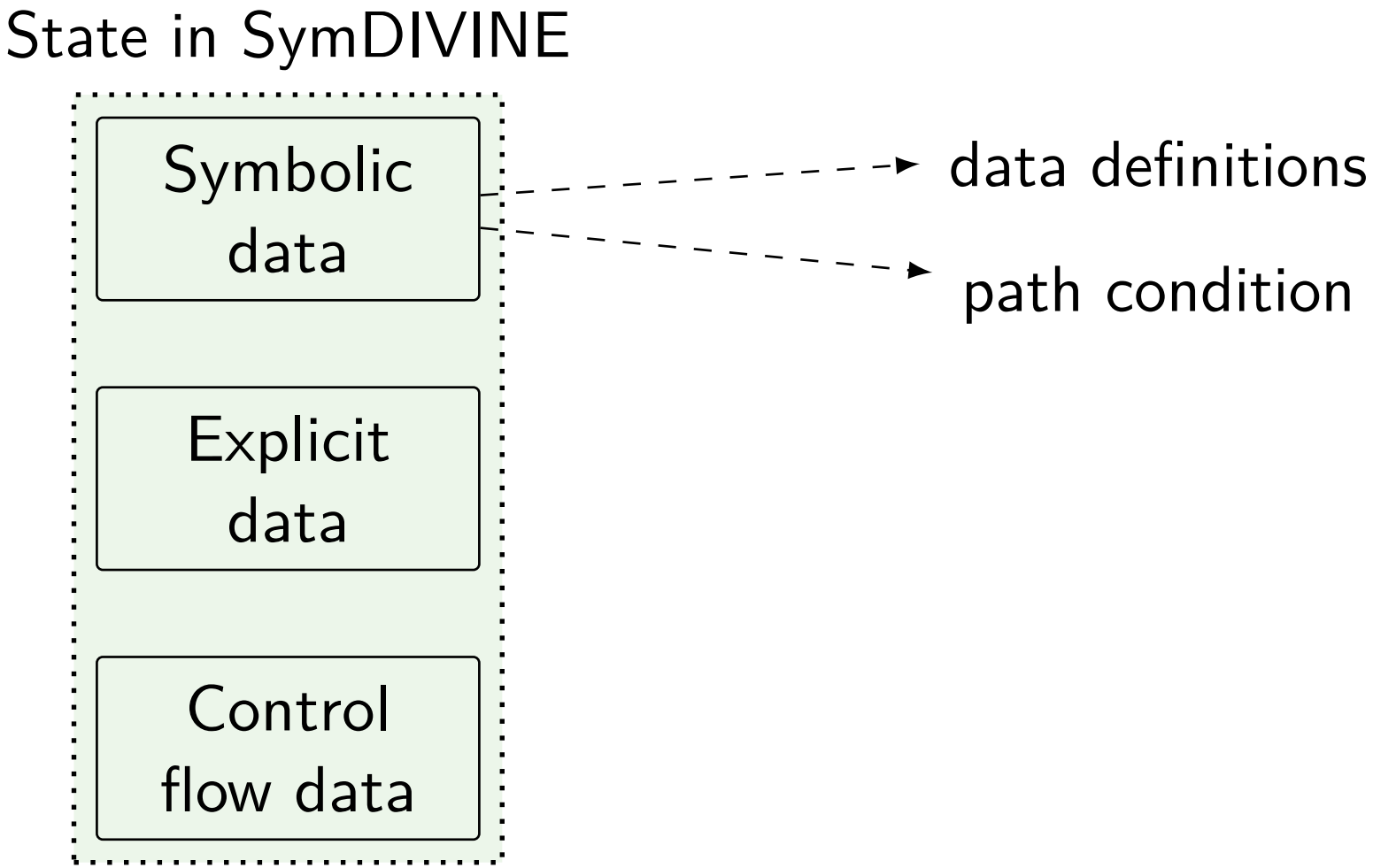
State in SymDIVINE



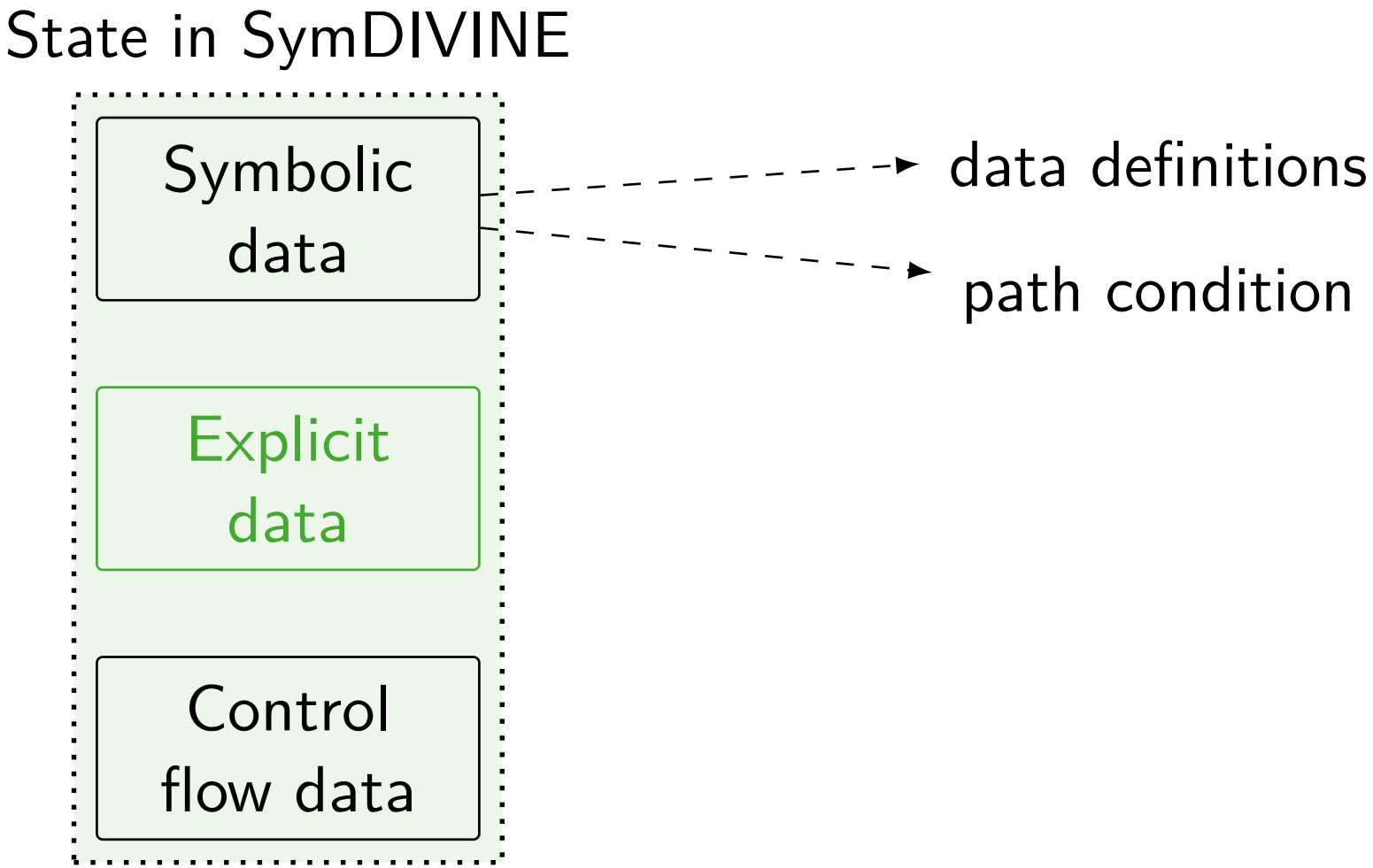
Data representation (Sym_1)



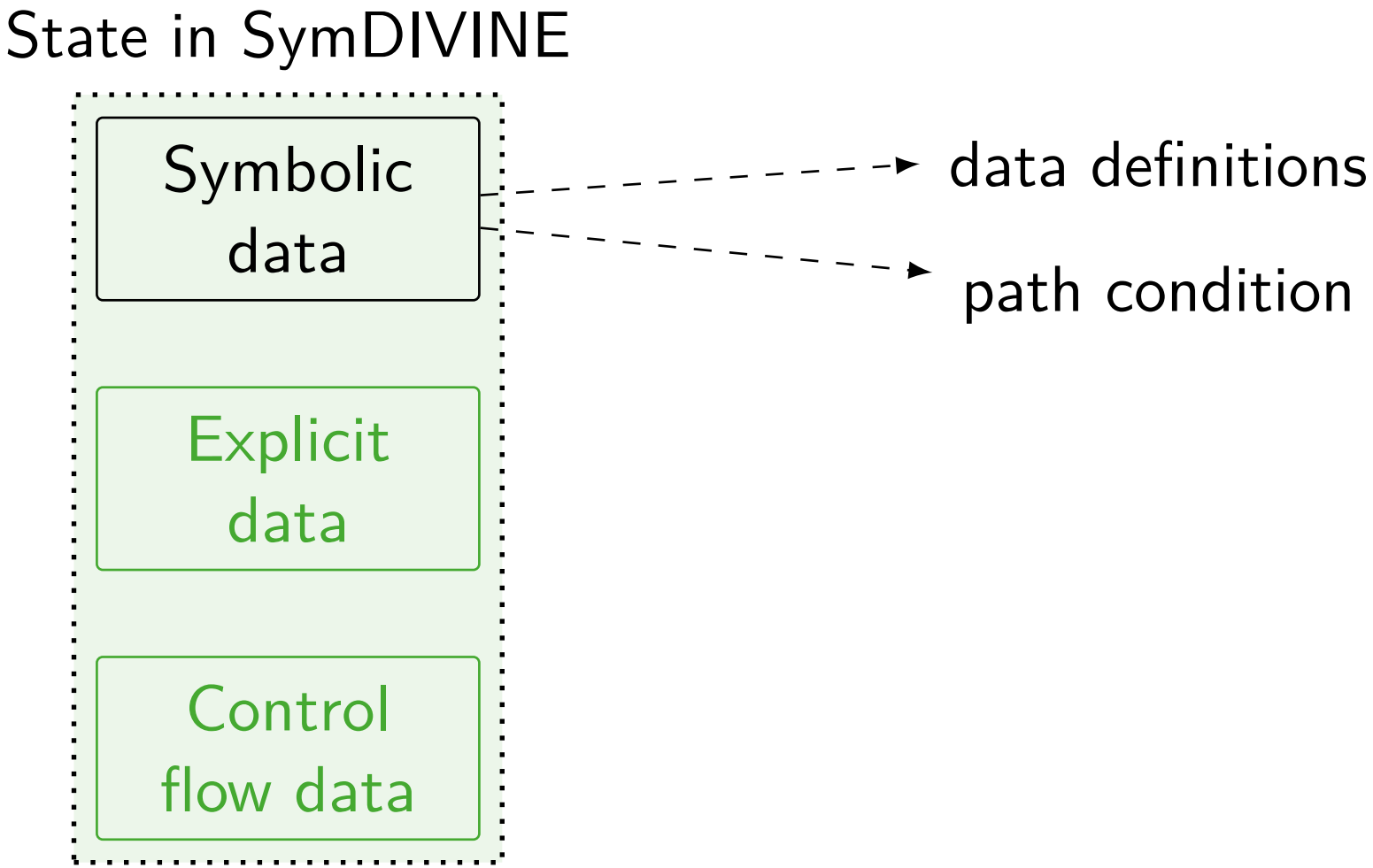
Data representation (Sym_1)



Data representation (Sym_1)



Data representation (Sym_1)



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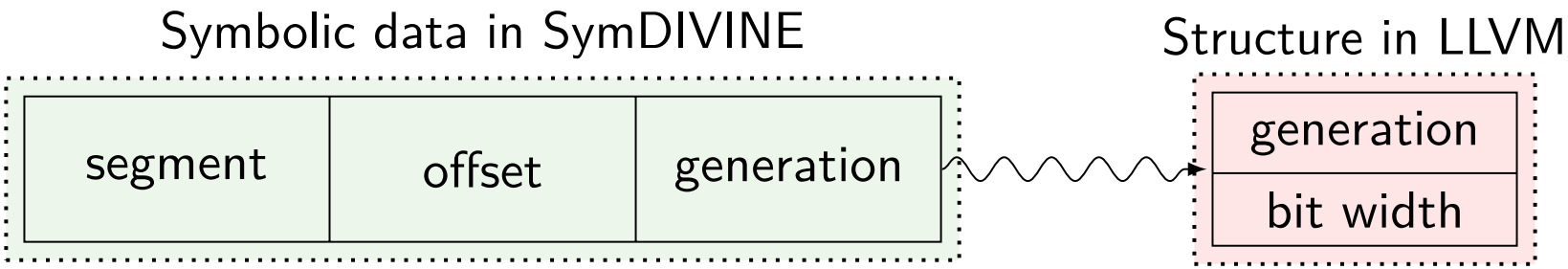


- segment and offset represented as address of structure
- using bit width in SMT solver
- propagation in AST

Data representation example (Sym_1)

```
1 int useless_function(int x, int y) {
2     int z = x + 1;
3     if (x < y) {
4         return y - z;
5     } else {
6         return y;
7     }
8 }
```

...

```
1 int x = __VERIFIER_nondet_int();
2 int y = 1;
3 int res = useless_function(x, y);
```

Data representation example (Sym_1)

```
1 declarations = {z = x + 1, nd_y = 1};
2 path_condition = {true};
```

```
1 nondet_int useless_function(nondet_int x, int y) {
2     nondet_int z = x + 1;
3     nondet_int nd_y = y; //exlicit value
4     if ( x < nd_y) {
5         return nd_y - z ;
6     } else {
7         return nd_y;
8     }
9 }
```

```
1 nondet_int x;
2 int y = 1;
3 nondet_int res = useless_function(x, y);
```

- data replacement and propagation in AST

Data representation example (Sym_1)

```
1 declarations = {z = x + 1, nd_y = 1};
2 path_condition = {true};
```

```
1 nondet_int useless_function(nondet_int x, int y) {
2     nondet_int z = plus(x, 1);
3     nondet_int nd_y = y; //exlicit value
4     if (less(x,nd_y)) {
5         return minus(nd_y,z);
6     } else {
7         return nd_y;
8     }
9 }
```

```
1 nondet_int x;
2 int y = 1;
3 nondet_int res = useless_function(x, y);
```

- operations on nondeterministic data and function duplication

Control representation example (Sym_1)

```
1 declarations = {z = x + 1, nd_y = 1};
2 path_condition = {x < nd_y};
```

```
1  nondet_int useless_function(nondet_int x, int y) {
2      nondet_int z = plus(x, 1);
3      nondet_int nd_y = y; //exlicit value
4      bool choice = __divine_choice(2);
5      if (choice) {
6          change_pc(less(x, nd_y));
7          nondet_int ret = minus(nd_y,z);
8          cleanup(ret);
9          return ret;
10     } else {
11         change_pc(not less(x, nd_y));
12         nondet_int ret = nd_y;
13         cleanup(ret);
14         return ret;
```

Function duplication example (Sym_1)

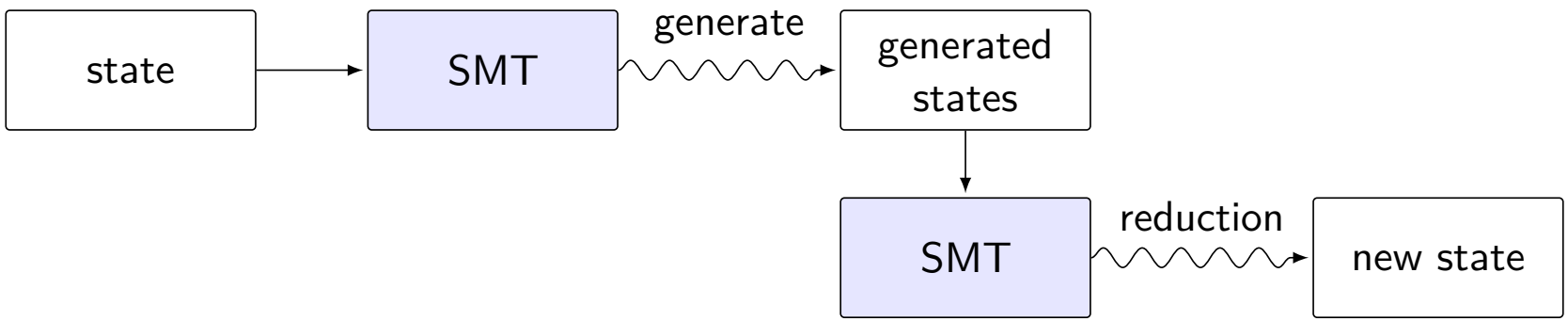
```
1 int function(int x, int y) { ... }
```

```
1 nondet_int function(nondet_int x, int y) { ... }
```

```
1 int function(nondet_int x, nondet_int y) { ... }
```

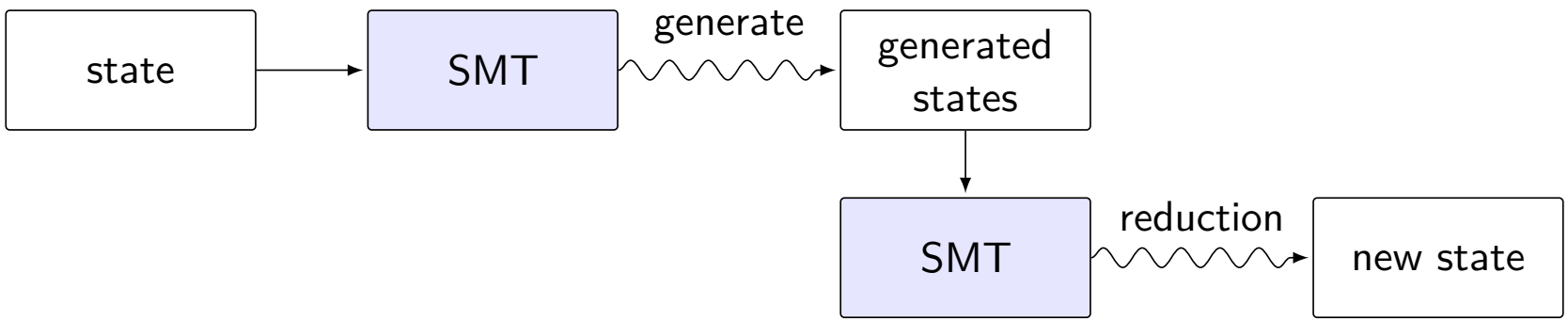
```
1 int x = __VERIFIER_nondet_int();
2 int y = 1, z = 0;
3
4 int res1 = function(x, y);
5 int res2 = function(y, z);
```

DIVINE state space generation Sym_2



- Before generating – checking path condition.

DIVINE state space generation Sym_2

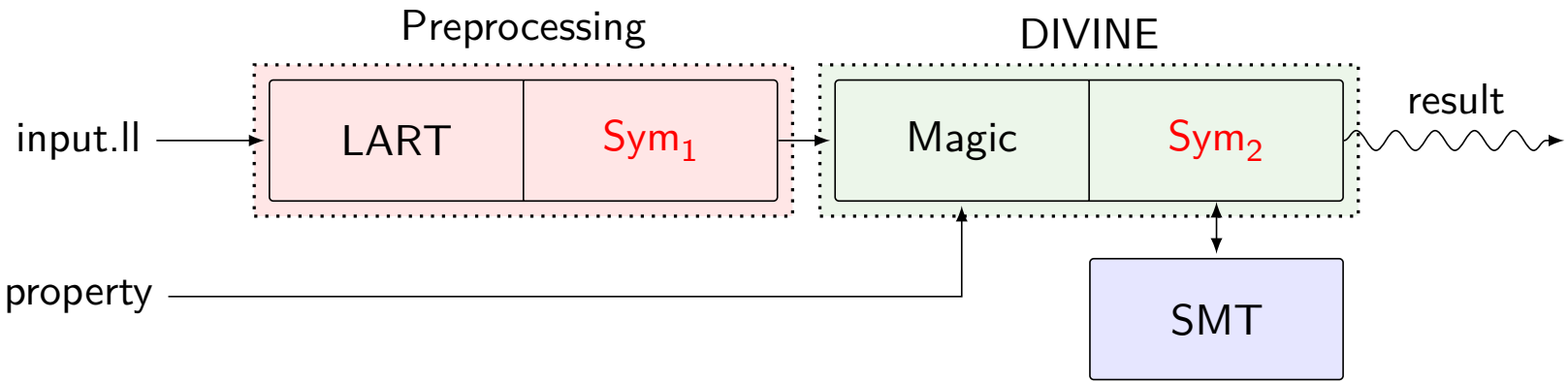


- Checking equality of symbolic part.

DIVINE keeping states Sym_2

- hashing explicit part
- linearly chaining symbolic parts to hash table position

Summary


Preprocessing
DIVINE
input.ll
LART
Sym1
Magic
Sym2
result
property
SMT

Questions and Lunch!