Functional Coverage For SystemC (FC4SC)

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Agenda

1. What is FC4SC
2. FC4SC features overview
3. Coverage constructs
4. Coverage options, control & DB interrogation
5. Coverage database management
6. Roadmap
7. Q&A Session

What is FC4SC (1)

- C++11 header only library providing functional coverage capabilities
- No dependency on any 3rd party library
- Based on *IEEE 1800 - 2012 SystemVerilog Standard*

What is FC4SC (2)

1. Download library:

   https://github.com/amiq-consulting/fc4sc

2. Include it in your project:

   ```
   #include "fc4sc.hpp"
   ```

   Done!

FC4SC features overview

1. Coverage constructs: bin, coverpoint, cross, covergroup
2. Coverage options: weight, goal, at_least
3. Coverage control: start(), stop()
4. Runtime database interrogation
5. Database saving
6. Database management tools

UCIS DB format

Constructs: bin

Bin: collection of values and intervals

FC4SC

```
bin<int>(
   "less_than_8", // bin name
   1,             // 1
   interval(2,3), // [2:3]
   interval(7,4)  // [4:7]
);
bin_array<int>("split",
   3,              // 3 bins
   interval(0,255) // [0:255]
);

illegal_bin<int>("illegal", 10);
ignore_bin<int>("ignore", 100);
```

SystemVerilog

```
bins less_than_8 = {
    1,
    [2:3],
    [4:7]
};
bins split[3] = {
    [0:255]
};

illegal_bins illegal = {10};
ignore_bins ignore = {100};
```

Constructs: coverpoint (1)

- Contains bins with data of interest
- Handles sampling
- ignore bin -> illegal bin -> regular bin

FC4SC

```
COVERPOINT(int, datacp, data)
{
bin<int>("pos", interval( 0, 10)),
bin<int>("neg", interval(-10, 0)),
illegal_bin<int>("zero", 0)
};
```

SystemVerilog

```
datacp : coverpoint data
{
  bins pos = {[0:10]};
  bins neg = {[-10:0]};
  illegal_bins zero = {0};
}
```

Constructs: coverpoint (2)

FC4SC

```
COVERPOINT(int,cp,data*2,flag!=0)
{
  // ...
};
```

SystemVerilog

```
coverpoint (data*2) iff (flag!=0)
{
  // ...
}
```

Sample expression

Sample condition

Both are evaluated at sample point!

Constructs: cross

- Cartesian product of coverpoints' bins
- Behaves the same as a coverpoint in all regards

FC4SC

```
COVERPOINT(int, cp1, d1) {
  bin<int>("zero", 0),
  bin<int>("positive", 1, 2, 3)
};
COVERPOINT(int, cp2, d2) {
  bin<int>("zero", 0),
  bin<int>("negative",-1,-2,-3)
};
auto cp1_x_cp2 = cross<int,int>(
  "cp1_x_cp2", &cp1, &cp2);
```

SystemVerilog

```
cp1 : coverpoint d1 {
  bins zero = {0};
  bins positive = {1,2,3};
}
cp2 : coverpoint d2 {
  bins zero = {0};
  bins negative = {-1,-2,-3};
}
cp1_x_cp2 : cross cp1, cp2;
```

Constructs: covergroup

- Ties together all coverage constructs
- Dispatches sampling data to coverpoints and crosses

FC4SC

```
class cvg: public covergroup {
public:
  int d1;
  COVERPOINT(int, cp1, d1) {
    bin<int>("zero", 0),
    bin<int>("positive", 1, 2, 3)
  };
  CG_CONS(cvg) {/*constructor*/}
};
```

SystemVerilog

```
covergroup cvg {
  cp1 : coverpoint d1 {
    bins zero = {0};
    bins positive = {1,2,3};
  }
}
```

Options, Control & DB interrogation (1)

- Options are used for:
  - adjusting coverage distributions
  - setting coverage goals
  - adding comments
- Control: *starting* and *stopping* sampling
- DB interrogation (at runtime):
  - getting coverage percentage (type/instance)
  - getting number of hits
- Usable on: covergroup, coverpoint, cross

Options, Control & DB interrogation (2)

```
cvg_ex cvg;     // create
cvg.d1 = 0;     // update d1
cvg.sample();   // sample
EXPECT_EQ(cvg.get_inst_coverage(),
50); // 50% covered



cvg.stop();     // stop sampling
cvg.d1 = 2;
cvg.sample();
EXPECT_EQ(cvg.get_inst_coverage(),
50); // still 50%
```

```
class cvg_ex: public covergroup
{
public:
  int d1;
  CG_CONS(cvg_ex, int w = 100) {
    this->option.weight = w;
  }
  COVERPOINT(int, cp1, d1) {
    bin<int>("zero", 0),
    bin<int>("positive", 1, 2, 3)
  };
};
```

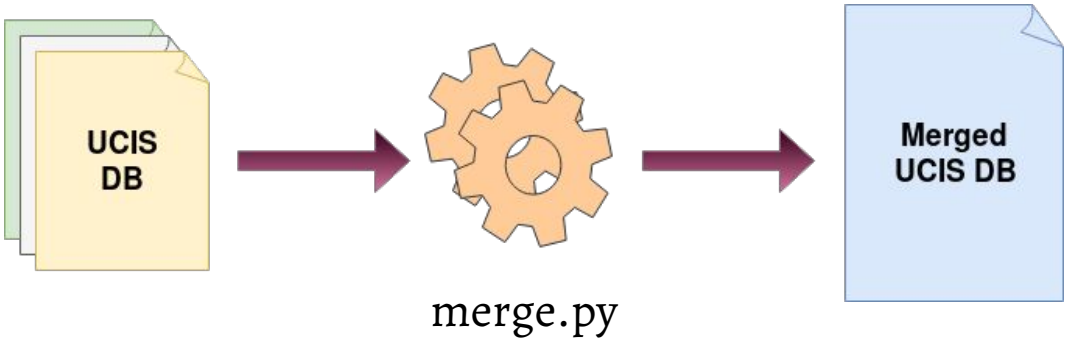
Database management: creation

- Generate XML, respecting UCIS DB Schema:
  fc4sc::global::*coverage_save*("cov_db.xml");

- Databases can be generated at any point during runtime!

Database management: merge

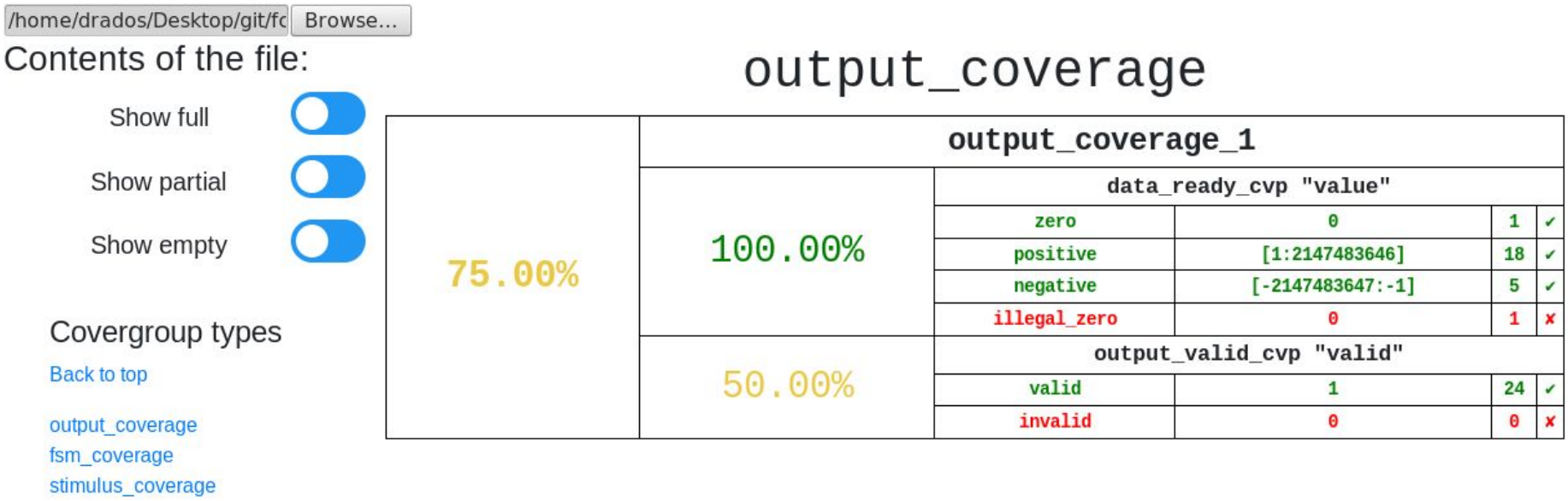
Merge = aggregate the coverage data collected from different executions



$> python merge.py top/directory merged_db.xml

Database management: reporting

JavaScript app: *fc4sc/gui/index.html*



Roadmap

1. Better UCIS DB support
2. Default bins
3. Transition coverage
4. Cross filtering (with)
5. Cross bins definition (binsof , intersect)
6. Different output formats (Json, XML etc.)

Q & A