

Learn RISC-V CPU Implementation and BSV

(BSV: a High-Level Hardware Design Language)

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L3: Structure of BSV Programs



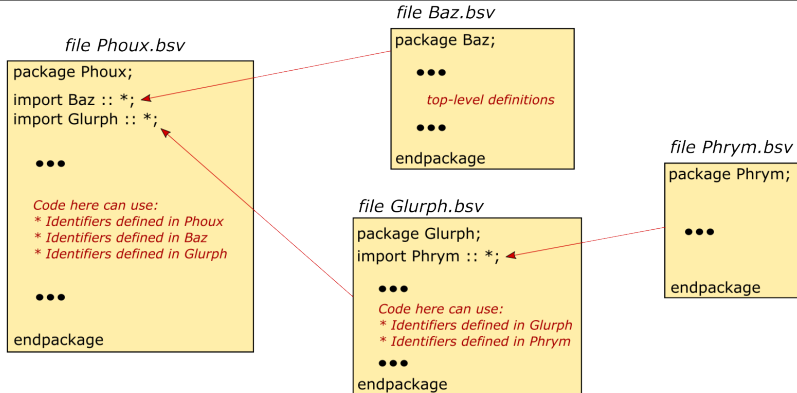
First: a Minimal (trivial!) BSV program

Examples

Demo: please see directory Ex_03_A, code and Makefile

(More related exercises in the book.)

File-level view of a BSV program



What's in a BSV package/file?

file Phoux.bsv

```
package Phoux;  
import Baz :: *;  
export a, M_IFC (..), mkM;  
typedef enum { ... } E;  
typedef struct { ... } S;  
Bit #(32) a = 23;  
function Bit #(32) foo (...);  
...  
endfunction  
interface M_IFC;  
...  
endinterface  
module mkM (M_IFC);  
...  
endmodule  
endpackage
```

Filename and packagename must match (bsc will complain if not)

Package statement (with end-package) is optional; if omitted, **bsc** will use filename

import/export statements (at top-level of packages only)

Type declarations (at top-level of packages only)

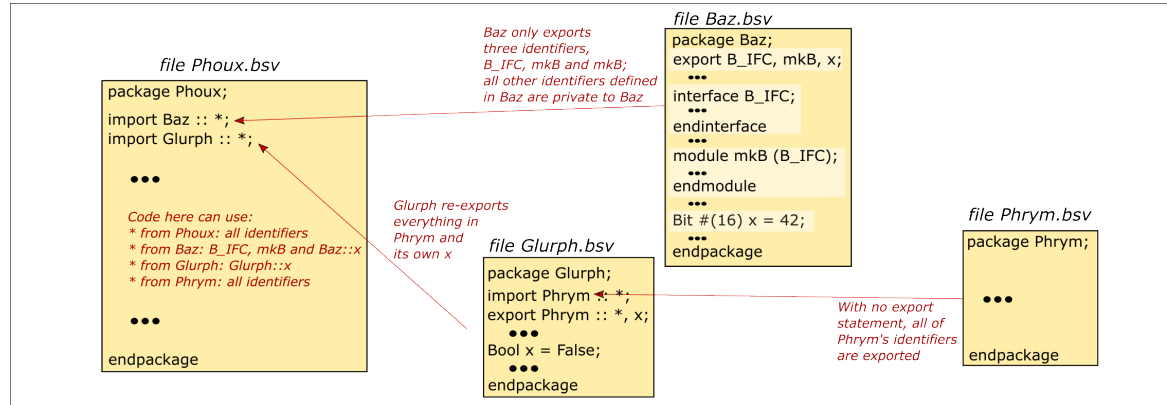
Value definitions (at top-level and inner scopes)

Function definitions (at top-level and inner scopes)

Interface declarations (at top-level of packages only)

Module definitions (top-level and inner scopes)

Namespace control with package imports and exports



Extending our Minimal BSV program to two packages/files

Examples

Demo: please see directory Ex_03_B, code and Makefile

(More related exercises in the book.)

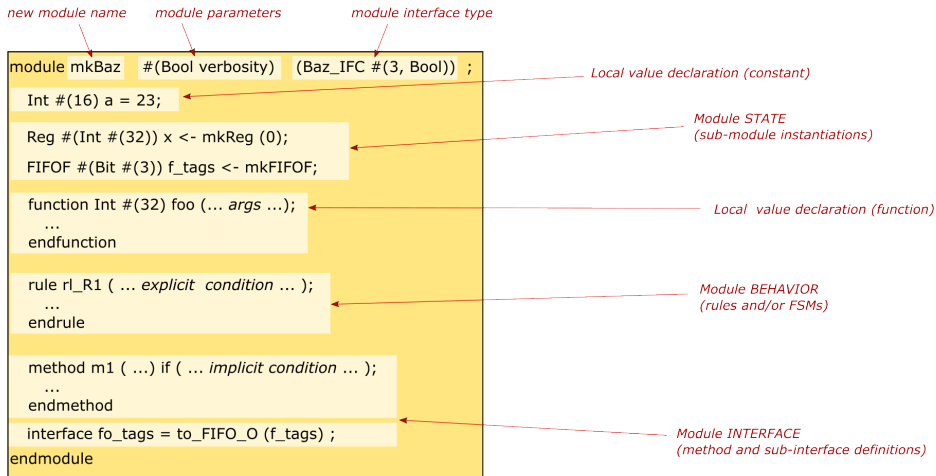
What's in an Interface Declaration?

The diagram shows an interface declaration for `Baz_IFC` with several annotations pointing to its components:

- `interface`: new interface type
- `Baz_IFC`: new interface type
- `numeric type n`: numeric type parameter declaration
- `type t`: value type parameter declaration
- `method Action m1 (Int #(32) x, Bool y, t z);`: Action method declaration (methods can have arguments)
- `method ActionValue #(Bit #(16)) m2 (... args ...);`: ActionValue method declaration
- `method Bit #(16) m3 (... args ...);`: Value method declaration (return type is not Action or ActionValue)
- `interface FIFO_O #(Bit #(n)) fo_tags;`: Nested sub-interface declaration
- `endinterface`: Existing interface type

```
interface Baz_IFC #( numeric type n, type t );  
  method Action m1 (Int #(32) x, Bool y, t z);  
  method ActionValue #(Bit #(16)) m2 (... args ...);  
  method Bit #(16) m3 (... args ...);  
  
  interface FIFO_O #(Bit #(n)) fo_tags;  
endinterface
```

What's in a Module Declaration?



Extending our Minimal BSV program to define a module with an interface

Examples

Demo: please see directory Ex_03_C, code and Makefile

(More related exercises in the book.)

What's in a Rule?

new rule name

rule condition ("explicit condition")

```
rule rl_Fetch_req ( rg_running  
                    && (! f_Fetch_from_Retire.notEmpty) );
```

```
let pred_pc = rg_pc + 4;  
let y       = fn_Fetch (rg_pc, pred_pc, rg_epoch, rg_inum);
```

```
f_Fetch_to_Decode.enq (y.to_D);  
f_Fetch_to_IMem.enq (y.mem_req);
```

```
rg_pc  <= pred_pc;  
rg_inum <= rg_inum + 1;
```

```
endrule
```

Two local variable definitions

*Two Actions
(invocations of FIFO ".enq" methods)*

*Two Actions
(invocations of register "._write" methods)*

What's in an Interface Definition?

```
method Action init ( Initial_Params initial_params ) if ( ! rg_running );  
  rg_pc      <= initial_params.pc_reset_value;  
  rg_running <= True;  
endmethod  
  
method Bit #(XLEN) read_epc;  
  return csr_mepc;  
endmethod
```

method name

method arguments

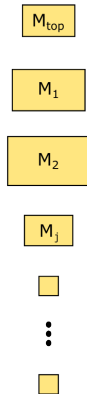
method condition ("implicit condition")

method body
(Action and ActionValue methods can contain Actions;
Value methods cannot contain Actions)

return statement
(in Value-methods and ActionValue methods
but not in Action methods)

Static elaboration

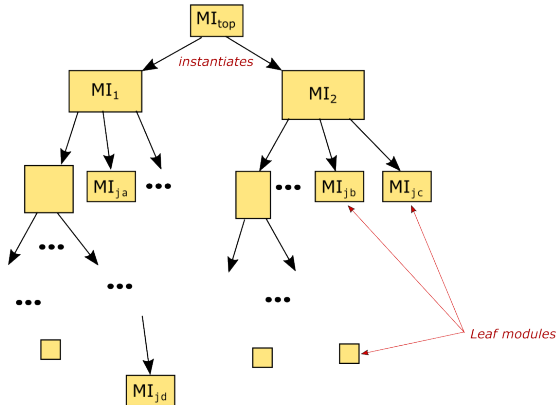
module definitions



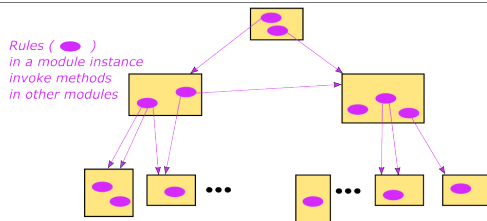
Static Elaboration



module instance hierarchy



Module interaction



End