CS392F P1 Design Description and Instructions

Writing Model-to-Text Transformations with VM2T

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0 Running the examples

Please execute the bash-script in Cygwin.

1. Make the the script executable
chmod u+x ./run.script.sh
2. Run the script
./run.script.sh [the parts you want to run(optional)]
e.g
./run.script.sh ---- run all parts (Part 1,2&3)
./run.script.sh 3 1 ---- run part 3 and part 1

1 Part 1

1.1 Design

The *vm* code could generate *fsm.java* with methods "*goto[node name]()*". The only private variable of *fsm* class is *currentState*, which is of type *State*. The reason for this variable to be *private* is to obey the rule of encapsulation in object-oriented programming. The "*goto*" methods simply calls *currentState*. "*gotoXXX*" and returns a state. If the state is null, that means the transition between the two nodes is not possible. Otherwise a new state is returned and *currentState* is assigned to the new state. The transition status would be printed according to the project requirements. The *getName()* method would call the *currentState.getName()* and return the node name.

Our *vm* code for part 1 is shown as the follows,

```
#set($MARKER="//----")

${MARKER}fsm.java
package myfsm;

public class fsm{

  private State currentState;
  public fsm()
  {
#foreach($node in $nodeS)
  #if(${node.type}=="start")
```

```
    currentState=new ${node.nodeid}();
  #end
#end
  }

#foreach($node in $nodeS)
  public void goto${node.name}()
  {
      State tmpState=currentState.goto${node.name}();
      if(tmpState!=null)
      {
              System.out.println("go to ${node.name}");
          currentState=tmpState;
      }else
      {
              System.out.println("ignoring transition to ${node.name}");
      }
  }
#end

  public String getName()
  {
    return currentState.getName();
  }
}


${MARKER}State.java

package myfsm;

public interface State
{
#foreach($node in $nodeS)
   State goto${node.name}();
#end
   String getName();
}

#foreach($node in $nodeS)
${MARKER}${node.nodeid}.java

package myfsm;

public class ${node.nodeid} implements State
{
   private String name;
   private String type;

   public ${node.nodeid}()
   {
```

```
        name="${node.name}";
        type="${node.type}";
    }
#foreach($tmpnode in $nodeS)
    public State goto${tmpnode.name}()
    {
#set($hastrans=0)
  #foreach($transition in $transitionS)
    #if(${node.nodeid}==${transition.startsAt})
      #if(${tmpnode.nodeid}==${transition.endsAt})
        #set($hastrans=1)
      #end
    #end
  #end
  #if(${hastrans}==1)
        return new ${tmpnode.nodeid}();
  #else
        return null;
  #end
    }
#end
    public String getName()
    {
        return name;
    }
}
#end
```

1.2 Generated code

State.java is simply a java interface and all the methods there are public abstract methods.

The *nXXX.java* are nodes with *nodeid* as class names. In the "*goto*" methods in each class, the tuples in transition tables are inspected. If a transition is possible, then the state in *endsAt* would be returned. Otherwise *null* would be returned.

2 Part 2

2.1 Design

Part 2 has the same prolog database as that of part 1, but the *fsm* is more abstract. Here, *fsm.java* uses *enum* to include all the possible states. Also, in each "*gotoXXX*" method, the *vm* evaluated the tuples in transition table. In this case a switch statement is used to test whether the transition from *currentState* to state XXX is possible. Therefore it would print out exactly the same results as that of part 1.

Our *vm* code for part 2 is shown as the follows,

```
#set($MARKER="//----")
${MARKER}fsm.java
```

```
package myfsm;

public class fsm {
  public enum states {#set($comma="")#foreach($node in $nodeS)$comma
${node.name}#set($comma=",")#end }
#foreach($node in $nodeS)
  #if(${node.type}=="start")
  states currentState = states.${node.name};
  #end
#end
  public String getName() { return currentState.toString(); }
#foreach($node in $nodeS)
  public void goto${node.name}() {
    switch(currentState) {
  #set ($transFlag=0)
  #foreach($transition in $transitionS)
    #if (${transition.endsAt} == ${node.nodeid})
              #set ($transFlag=1)
              #foreach($node in $nodeS)
                #if (${node.nodeid} == ${transition.startsAt})
    case ${node.name} :
                        #end
              #end
            #end
  #end
  #if (${transFlag} == 1)
      System.out.println("going to ${node.name}");
      currentState = states.${node.name};
      break;
  #end
    default :
      System.out.println("ignoring transition to ${node.name}");
          }
  }
#end
}
```

2.2 Generated code

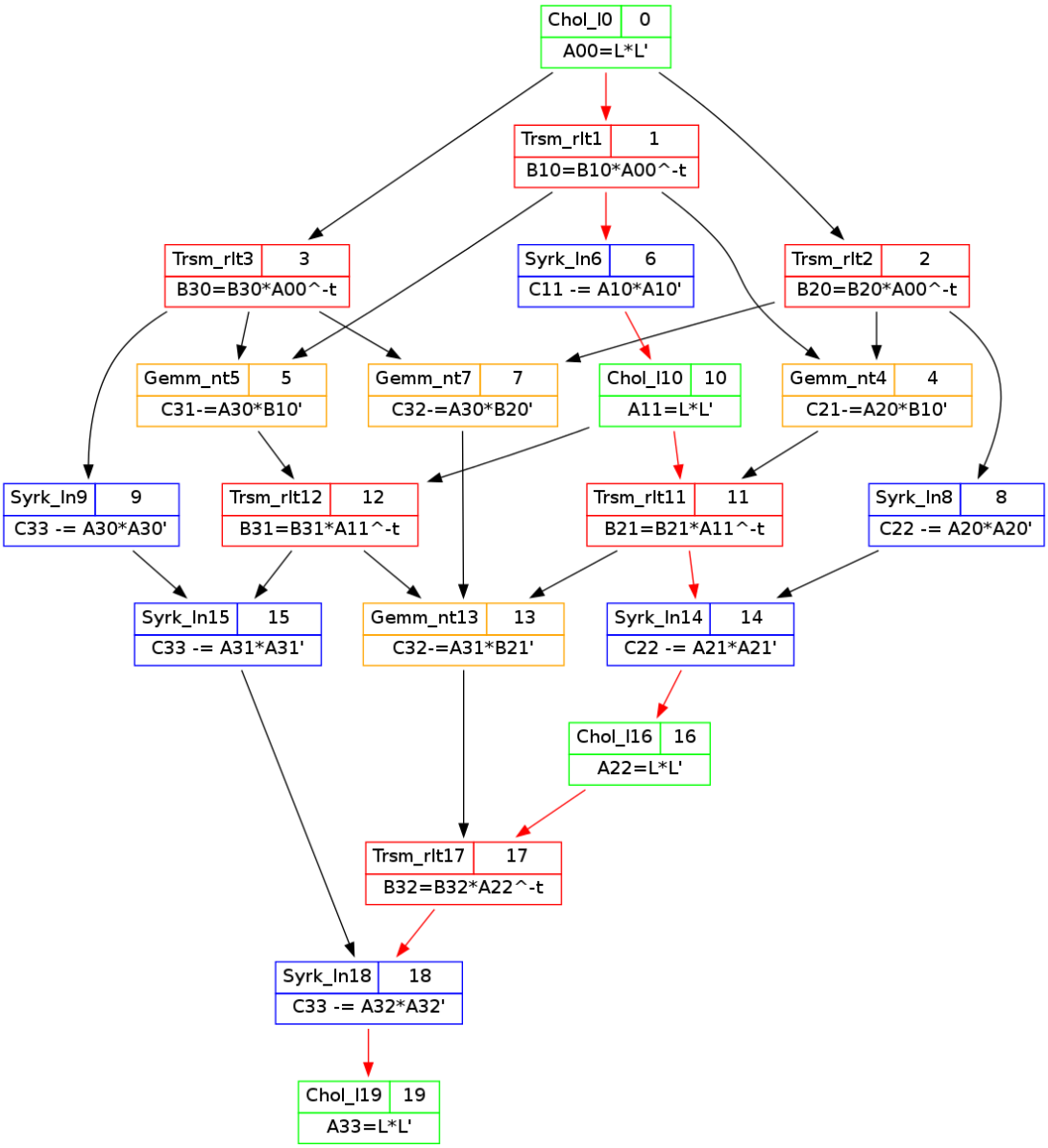
fsm.java is an all-in-one class wrapping up all "gotoXXX" methods with the *enum* states.

3 Part 3

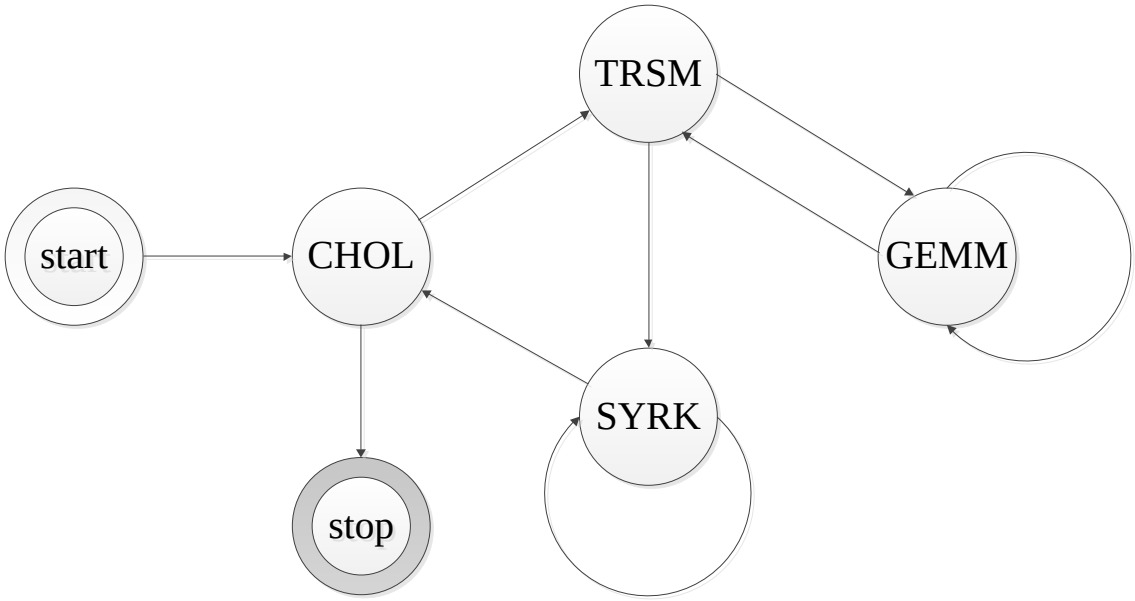
3.1 FSM example

We want to show a FSM (finite state machine) example in the correctness verification for *Supermatrix* run-time system in the *DLA (dense linear algebra)* domain. *Supermatrix* is a run-time system for task scheduling. In the first stage of *Supermatrix* run-time system, we need to generate the *DAG (directed*

acyclic graph) for the dependency relations for the tasks of *linear algebra subroutine*. The following DAG is for a 4x4 *Cholesky* decomposition.



FSM for a correct dependency path in the above *Cholesky* decomposition should be



3.2 Prolog database definition

We use Prolog to represent the above FSM:

```
%dbase(fsm,[node,transition]).

%table(node,[nodeid,name,type]).
node(nStart, start, start).
node(nChol, CHOL, state).
node(nTrsm, TRSM, state).
node(nSyrk, SYRK, state).
node(nGemm, GEMM, state).
node(nStop, stop, stop).

%table(transition,[transid,startsAt,endsAt]).
transition(t1, nStart, nChol).
transition(t2, nChol, nTrsm).
transition(t3, nTrsm, nGemm).
transition(t4, nGemm, nGemm).
transition(t5, nGemm, nTrsm).
transition(t6, nTrsm, nSyrk).
transition(t7, nSyrk, nSyrk).
transition(t8, nSyrk, nChol).
transition(t9, nChol, nStop).
```

3.3 Verification

We use this FSM to verify the correctness of one specific dependency path (the red path in the DAG). The *app.java* is as the follows,

```
import myfsm.*;
```

```
public class app {

   public static void main(String[] args) {
      System.out.println("----");
      paces( new fsm() );
      System.out.println("----");
   }

   public static void paces( fsm f ) {
      f.gotoCHOL();
      f.gotoTRSM();
      f.gotoSYRK();
      f.gotoSYRK();
      f.gotoCHOL();
      f.gotoTRSM();
      f.gotoSYRK();
      f.gotoCHOL();
      f.gotostop();
      System.out.println(f.getName());
   }
}
```

With the help of VM2T tools and our general *vm* files (model-to-text mappings), we can easily generate the code for our FSM with the *vm* files in either part 1 or part 2, thus we can verify the correctness of the red path in DAG.

```
----
go to CHOL
go to TRSM
go to SYRK
go to SYRK
go to CHOL
go to TRSM
go to SYRK
go to CHOL
go to stop
stop
----
```

There is no “ignoring transition to …” message in the output. So we can verify that that specific task dependency path is correct.