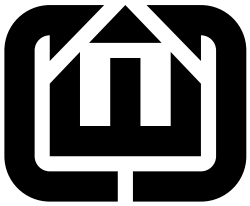
CEC GRC dot format printer



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Contents

1 Overview

2 Node printers

2.1 Control-flow graph nodes

The basic operation for a control-flow graph node is to create a new graph node, use the visitor to label it, draw its data dependencies, and draw arcs and recurse on its successors. Since it may be a DAG, this is done as a depth-first search with the `reached` set indicating which nodes have been visited.

1 ⟨*declarations* 1⟩≡
```
void visit_cfg(GRCNode *);
```

2 ⟨*definitions* 2⟩≡

```
void GRCDP::visit_cfg(GRCNode *n) {
  assert(n);

  if (reached.find(n) == reached.end()) {
    reached.insert(n);

    // Print a definition for the node
    assert(cfgnum.find(n) != cfgnum.end());

    mynum = cfgnum[n]; // used by most visitors
    o << 'n' << mynum << ' ';
    n->welcome(*this);

    // Draw data dependencies

    for (vector<GRCNode *>::const_iterator k = n->dataPredecessors.begin() ;
         k != n->dataPredecessors.end() ; k++) {
      assert(cfgnum.find(*k) != cfgnum.end());
      o << 'n' << cfgnum[*k] << " -> n" << cfgnum[n];
      if (clean) o << " [color=red]\n";
      else o << " [color=red constraint=false]\n";
    }

    /*for (vector<GRCNode *>::const_iterator k = n->dataSuccessors.begin() ;
         k != n->dataSuccessors.end() ; k++) {
      assert(cfgnum.find(*k) != cfgnum.end());
      o << 'n' << cfgnum[n] << " -> n" << cfgnum[*k];
      if (clean) o << " [color=blue]\n";
      else o << " [color=blue constraint=false]\n";
    }*/
    // Draw control dependencies

    for ( vector<GRCNode*>::iterator j = n->successors.begin() ;
          j != n->successors.end() ; j++ ) {
      if (*j) {
        o << 'n' << cfgnum[n] << " -> n" << cfgnum[*j];
        if ( n->successors.size() > 1) {
          if (clean) {
            if (dynamic_cast<Switch*>(n) != NULL ||
                dynamic_cast<Sync*>(n) != NULL)
              o << " [label=\"" << j - n->successors.begin() << "\"]";
            else if (dynamic_cast<Test*>(n) != NULL &&
                     j == n->successors.end() - 1)
              o << " [label=\"P\"]";
          } else {
            o << " [label=\"" << j - n->successors.begin() << "\"]";
          }
        }
        o << '\n';
```

```
      } else if (!clean) {
          o << 'n'<< cfgnum[n] << " -> n" << nextnum << "[label=\""
            << j-n->successors.begin() << "\"]" << '\n';
          o << 'n' << nextnum++
            << " [shape=octagon style=filled color=black]\n";
      }
    }

    // Visit control successors and predecessors

    for ( vector<GRCNode*>::iterator j = n->successors.begin() ;
          j != n->successors.end() ; j++ )
      if (*j) visit_cfg(*j);

    for ( vector<GRCNode*>::iterator j = n->predecessors.begin() ;
      j != n->predecessors.end() ; j++ ) visit_cfg(*j);

    // Visit data successors and predecessors

    for ( vector<GRCNode*>::iterator j = n->dataSuccessors.begin() ;
          j != n->dataSuccessors.end() ; j++ ) visit_cfg(*j);

    for ( vector<GRCNode*>::iterator j = n->dataPredecessors.begin() ;
      j != n->dataPredecessors.end() ; j++ ) visit_cfg(*j);
  }
}
```

3 ⟨*declarations* 1⟩+≡

```
Status visit(Switch &);
Status visit(Test &);
Status visit(Terminate &);
Status visit(Sync &);
Status visit(Fork &);
Status visit(Action &);
Status visit(Enter &);
Status visit(STSuspend &);
Status visit(EnterGRC &);
Status visit(ExitGRC &);
Status visit(Nop &);
Status visit(DefineSignal &);
```

4 ⟨*definitions* 2⟩+≡

```
Status GRCDP::visit(Switch &s) {
  if (clean) {
    o << "[label=\"s" << stnum[s.st]
      << "\" shape=diamond peripheries=2]\n";
    o << "{ rank=same n" << mynum << " n" << stnum[s.st] << " }\n";
  } else {
    o << "[label=\"" << mynum << " switch ";
    o << stnum[s.st]
      << "\" shape=diamond color=pink style=filled]\n";
    drawSTlink(&s,s.st);
  }
  return Status();
}

Status GRCDP::visit(Test &s) {
  o << "[label=\"";
  if (!clean) o << mynum << " test ";
  s.predicate->welcome(ep);
  o << "\" shape=diamond]\n";
  return Status();
}

Status GRCDP::visit(STSuspend &s){
  o << "[label=\"";
  if (!clean) o << mynum << " Suspend ";
  o << stnum[s.st]
    << "\" shape=egg]\n";
  return Status();
}

Status GRCDP::visit(Terminate &s) {
  if (clean) {
    o << "[label=\"" << s.code
      << "\" shape=octagon]\n";
  } else {
    o << "[label=\"" << mynum << ' ' << s.index << '@'
      << s.code
      << "\" shape=octagon color=red style=filled "
         "fontcolor=white fontname=\"Times-Bold\"]\n";
  }
  return Status();
}

Status GRCDP::visit(Sync &s) {
  o << "[label=\"";
  if (!clean) o << mynum << " sync" << " " << stnum[s.st];
  o << "\" shape=invtriangle]\n";

  // Set all the predecessors (should be Terminates) at the same level
```

```
  o << "{ rank=same; ";
  for ( vector<GRCNode*>::iterator i = s.predecessors.begin() ;
        i != s.predecessors.end() ; i++ )
    o << 'n' << cfgnum[*i] << "; ";
  o << "}\n";
  return Status();
}

Status GRCDP::visit(Fork &s) {
  o << "[label=\"";
  if (!clean) o << mynum << " fork";
  o << "\" shape=triangle]\n";
  return Status();
}

Status GRCDP::visit(Action &s) {
  o << "[label=\"";
  if (!clean) o << mynum << " action ";
  s.body->welcome(ep);
  o << '\"';
  if (dynamic_cast<Emit*>(s.body))
    o << " shape=house orientation=270]\n";
  else
    o << " shape=box]\n";
  return Status();
}

Status GRCDP::visit(Enter &s) {
  if (clean) {
    // Calculate the child number

    STNode *n = s.st;
    STNode *parent = NULL;
    STexcl *exclusive = NULL;
    for (;;) {
      parent = n->parent;
      exclusive = dynamic_cast<STexcl*>(parent);
      if ( exclusive != NULL ) break;
      n = parent;
    }
    vector<STNode*>::iterator i = exclusive->children.begin();
    while (*i != n && i != exclusive->children.end()) i++;
    int childnum = i - exclusive->children.begin();

    o << "[label=\"s" << stnum[parent] << '=' << childnum << "\" shape=box]\n";

  } else {
    o << "[label=\"" << mynum << " enter " << stnum[s.st]
      << "\" shape=house color=palegreen1 style=filled]\n";
  }
```

```
  return Status();
}

Status GRCDP::visit(EnterGRC &s){
  o << "[label=\"";
  if (!clean) o << mynum << " EnterGRC";
  o << "\"]\n";
  return Status();
}

Status GRCDP::visit(ExitGRC &s){
  o << "[label=\"";
  if (!clean) o << mynum << " ExitGRC";
  o << "\"]\n";
  return Status();
}

Status GRCDP::visit(Nop &s){
  o << "[label=\"";
  if (!clean) o << mynum << " ";
  if (s.isflowin()) o << "*"; else
    if (s.isshortcut()) o << "#";
    else o << "\\n" << s.code;
  o << "\" shape=circle]\n";
  return Status();
}

Status GRCDP::visit(DefineSignal &s){
  o << "[label=\"";
  if (!clean) o << mynum << " DefS\\n";
  o << s.signal->name
    << "\" shape=house orientation=90]\n";
  return Status();
}
```

2.2 Selection Tree Nodes

The basic operation for a selection tree node is to print the node and its label using the visitor, then recurse on its children. This is a simple recursive walk because the selection tree is a tree.

6 ⟨*declarations* 1⟩+≡

```
void visit_st(STNode *);
```

7a ⟨*definitions* 2⟩+≡

```
void GRCDP::visit_st(STNode *n) {
  assert(n);

  mynum = stnum[n];
  o << 'n' << mynum << ' ';
  n->welcome(*this);

  // Visit children

  for ( vector<STNode*>::const_iterator i = n->children.begin() ;
        i != n->children.end() ; i++ )
    if (*i) {
      visit_st(*i);
      o << 'n' << stnum[n] << " -> n" << stnum[*i];
      if (!clean || dynamic_cast<STexcl*>(n) != NULL)
        o << " [label=\"" << (i - n->children.begin()) << "\"]";
      o << '\n';
    } else {
      o << 'n'<< stnum[n] << " -> n" << nextnum << "[label=\""
        << i - n->children.begin() << "\"]"<<'\n';
      o << 'n' << nextnum++;
      if (clean) o <<  " [shape=point]\n";
      else o << " [shape=octagon style=filled color=black]\n";
    }
}
```

7b ⟨*declarations* 1⟩+≡

```
Status visit(STexcl &);
Status visit(STref &);
Status visit(STpar &);
Status visit(STleaf &);
```

8 ⟨*definitions* 2⟩+≡

```
Status GRCDP::visit(STexcl &s) {
  if (clean) {
    o << "[label=\"s" << mynum << "\" shape=diamond peripheries=2]\n";
  } else {
    o << "[label=\"" << mynum << "\" shape=diamond color=pink style=filled]\n";
  }
  return Status();
}

Status GRCDP::visit(STref &s) {
  if (clean) {
    o << "[shape=box label=\"\"]\n";
  } else {
    o << "[label=\"" << mynum << " ";
    if(s.isabort()) o << "A";
    if(s.issuspend()) o << "S";
    o << "\" ]\n";
  }
  return Status();
}

Status GRCDP::visit(STpar &s) {
  if (clean) {
    o << "[label=\"\" shape=triangle]\n";
  } else {
    o << "[label=\"" << mynum << "\" shape=triangle]\n";
  }
  return Status();
}

Status GRCDP::visit(STleaf &s) {
  if (clean) {
    o << "[label=\"";
    if(s.isfinal()) o << "*";
    o << "\" shape=box]\n";
  } else {
    o << "[label=\"" << mynum << " ";
    if(s.isfinal()) o << "*";
    o << "\" shape=box]\n";
  }
  return Status();
}
```

3 Topmost files

9 ⟨*GRCPrinter.hpp* 9⟩≡

```
#ifndef _GRC_PRINTER_HPP
#  define _GRC_PRINTER_HPP
#  include "AST.hpp"
#  include "EsterelPrinter.hpp"
#  include <iostream>
#  include <map>
#  include <set>

namespace GRCDot {
  using namespace AST;
  using std::map;
  using std::set;

  typedef map<GRCNode *, int> CFGmap;
  typedef map<STNode *, int> STmap;
  void GRCDot(std::ostream &, GRCgraph *, Module *, bool, bool);
  int GRCDot(std::ostream &o, GRCgraph *g, Module *m, bool drawstlink,
             bool clean,  CFGmap &cfgmap, STmap &stmap, int mxnode);

  class GRCDP : public Visitor {
    std::ostream &o;
    CFGmap &cfgnum; // Node numbers for control-flow graph
    STmap &stnum; // Node numbers for selection tree
    set<GRCNode *> reached; // Used during DFS of CFG

    int nextnum;
    int mynum;

    EsterelPrinter ep;
  public:
    GRCDP(std::ostream &oo, CFGmap &cm, STmap &sm, int nextnum) :
      o(oo), cfgnum(cm), stnum(sm), nextnum(nextnum), ep(oo, false),
      drawstlink(false), clean(false) {}

    virtual ~GRCDP() {}

    // Output style flags

    bool drawstlink;
    bool clean;

    ⟨declarations 1⟩

    void drawSTlink(GRCNode *, STNode *);
  };
};
#endif
```

10 ⟨*GRCPrinter.cpp* 10⟩≡

```
#include "GRCPrinter.hpp"
#include <cassert>

namespace GRCDot {

  ⟨definitions 2⟩

  void drawDot(std::ostream &o, GRCgraph *g, Module *m, bool drawstlink,
               bool clean, CFGmap &cfgmap, STmap &stmap, int mxnode)
  {
    GRCDP visitor(o, cfgmap, stmap, mxnode+1);
    visitor.drawstlink = drawstlink;
    visitor.clean = clean;

    o << "digraph " << m->symbol->name << " {" << std::endl;
    o << "size=\"7.5,10\"\n";

    visitor.visit_st(g->selection_tree);
    visitor.visit_cfg(g->control_flow_graph);

    o << "}" << std::endl;
  }

  int GRCDot(std::ostream &o, GRCgraph *g, Module *m, bool drawstlink,
               bool clean,  CFGmap &cfgmap, STmap &stmap, int mxnode)
  {
     assert(g);
     assert(m);
     assert(m->symbol);
     mxnode = g->enumerate(cfgmap, stmap, mxnode);
     drawDot(o, g, m, drawstlink, clean, cfgmap, stmap, mxnode);
     return mxnode;
  }

  void GRCDot(std::ostream &o, GRCgraph *g, Module *m, bool drawstlink,
               bool clean)
  {
    assert(g);
    assert(m);
    assert(m->symbol);

    CFGmap cfgmap;
    STmap stmap;

    int mxnode = g->enumerate(cfgmap, stmap);
    drawDot(o, g, m, drawstlink, clean, cfgmap, stmap, mxnode);

  }
```

```
  void GRCDP::drawSTlink(GRCNode *g, STNode *s)
  {
    o << "{ rank=same; n" << cfgnum[g] << "; n" << stnum[s] << " }\n";
    if (!drawstlink) return;

    assert( stnum.find(s) != stnum.end() );

    o << 'n' << cfgnum[g] << " -> n" << stnum[s];
    o << "[color=blue constraint=false]";
    o << '\n';
  }
}
```

12 ⟨*cec-grcdot.cpp* 12⟩≡

```
#include "IR.hpp"
#include "AST.hpp"
#include "GRCPrinter.hpp"
#include <iostream>
#include <stdlib.h>

struct UsageError {};

int main(int argc, char *argv[])
{
  try {

    bool clean = false;
    bool stlink = false;

    --argc; ++argv;

    while (argc > 0 && argv[0][0] == '-') {
      switch (argv[0][1]) {
      case 'c': clean = true; break;
      case 'l': stlink = true; break;
      default:
        std::cerr << "unrecognized option \"" << argv[0] << "\"\n";
        /* FALLTHROUGH */
      case 'h':
        throw UsageError();
      }
      --argc; ++argv;
    }

    if (argc > 0) throw UsageError();

    IR::XMListream r(std::cin);
    IR::Node *n;
    r >> n;

    AST::Modules *mods = dynamic_cast<AST::Modules*>(n);
    if (!mods) throw IR::Error("Root node is not a Modules object");

    for ( std::vector<AST::Module*>::iterator i = mods->modules.begin() ;
          i != mods->modules.end() ; i++ ) {
      assert(*i);

      AST::GRCgraph *g = dynamic_cast<AST::GRCgraph*>((*i)->body);
      if (!g) throw IR::Error("Module is not in GRC format");

      GRCDot::GRCDot(std::cout, g, *i, stlink, clean);
    }
  } catch (IR::Error &e) {
```

```
      std::cerr << e.s << std::endl;
      exit(-1);
    } catch (UsageError &) {
      std::cerr <<
        "Usage: cec-grcdot [-c] [-s] [-h]\n"
        "-c   Print a cleaner version of the graph\n"
        "-l   Draw links to the ST graph\n"
        "-h   Print this usage message\n"
        ;
      return 1;

    }
    return 0;
  }
```