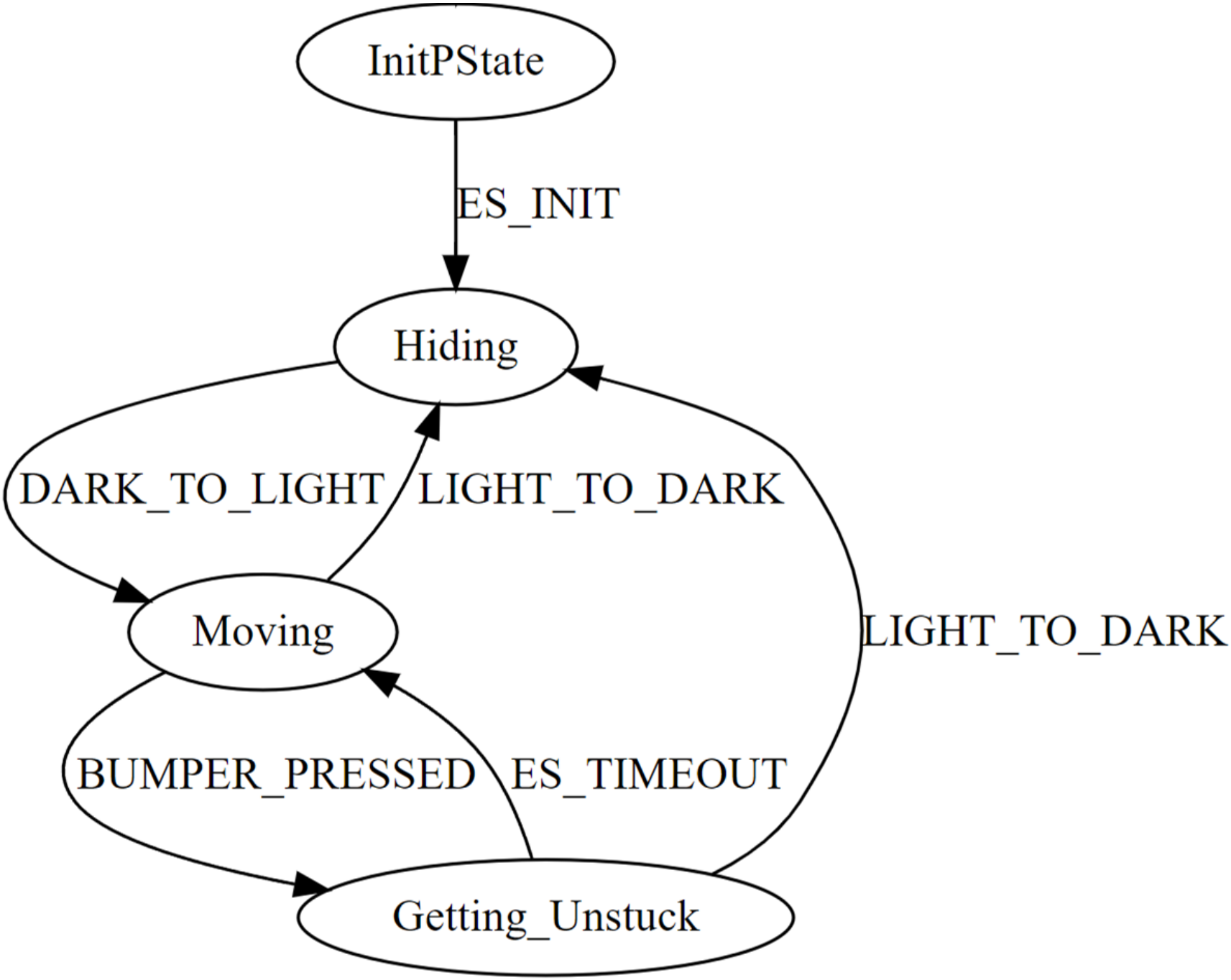
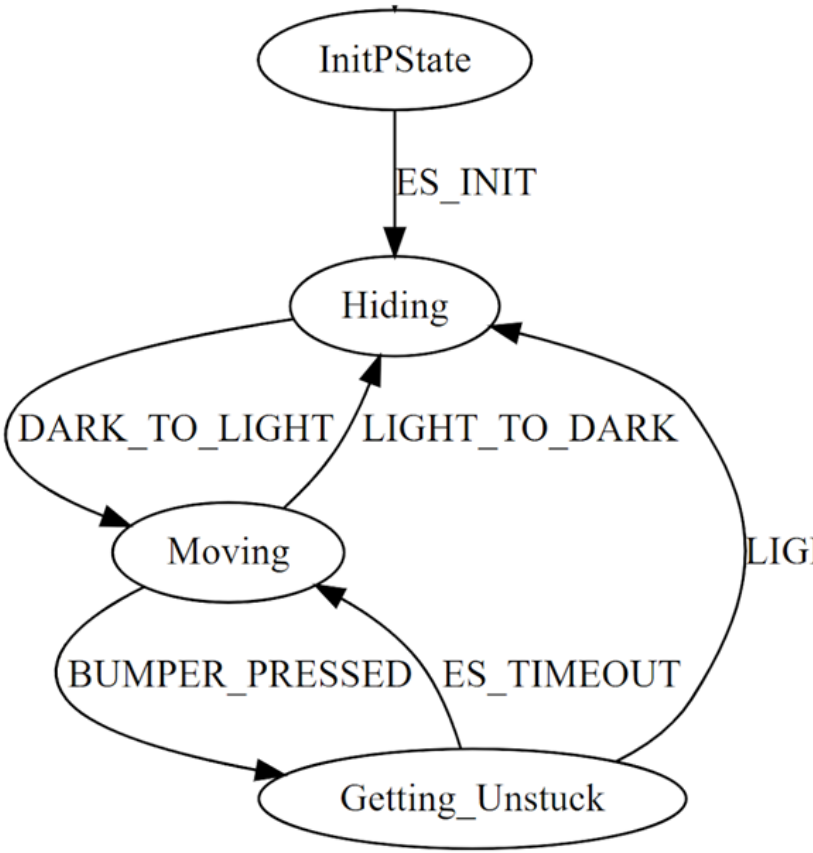
# state machine visualizer


InitPState
ES_INIT
Hiding
DARK_TO_LIGHT
LIGHT_TO_DARK
Moving
LIGHT_TO_DARK
BUMPER_PRESSED
ES_TIMEOUT
Getting_Unstuck

# https://dreampuf.github.io/GraphvizOnline/

```
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    init -> InitPState[label = ES_INIT];
    InitPState -> Hiding [label = ES_INIT];
    Hiding -> Moving [label = DARK_TO_LIGHT];
    Moving -> Hiding [label = LIGHT_TO_DARK];
    Moving -> Getting_Unstuck [label = BUMPER_PRESSED];
    Getting_Unstuck -> Hiding [label = LIGHT_TO_DARK];
    Getting_Unstuck -> Moving [label = ES_TIMEOUT];

}
```

Engine: dot Format: svg



```
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    init -> InitPState[label = ES_INIT];
    InitPState -> Hiding  [label = ES_INIT];
    Hiding -> Moving  [label = DARK_TO_LIGHT];
    Moving -> Hiding  [label = LIGHT_TO_DARK];
    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
    Getting_Unstuck -> Hiding  [label = LIGHT_TO_DARK];
    Getting_Unstuck -> Moving  [label = ES_TIMEOUT];

}
```

```
TemplateFSMState_t nextState;  ES_Tattle();

switch (CurrentState) {

    case InitPState:
        if (ThisEvent.EventType == ES_INIT) {
            nextState = Hiding; makeTransition = TRUE;
            ThisEvent.EventType = ES_NO_EVENT;
        }
        break;

    case Hiding:
        switch (ThisEvent.EventType) {

            case ES_ENTRY: break;

            case ES_EXIT: break;

            case DARK_TO_LIGHT:
                goForward(MOVING_SPEED); nextState = Moving;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                break;

            default:
                break;
        }
        break;

    case Moving:
        if (ThisEvent.EventType == LIGHT_TO_DARK) {
            stopMovement(); nextState = Hiding;
            makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
```

```
TemplateFSMState_t nextState;  ES_Tattle();

switch (CurrentState) {

    case InitPState:
        if (ThisEvent.EventType == ES_INIT) {
            nextState = Hiding; makeTransition = TRUE;
            ThisEvent.EventType = ES_NO_EVENT;
        }
        break;

    case Hiding:
        switch (ThisEvent.EventType) {

            case ES_ENTRY: break;

            case ES_EXIT: break;

            case DARK_TO_LIGHT:
                goForward(MOVING_SPEED); nextState = Moving;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                break;

            default:
                break;
        }
        break;

    case Moving:
        if (ThisEvent.EventType == LIGHT_TO_DARK) {
            stopMovement(); nextState = Hiding;
            makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
```

NOW?

# NEXT?

```
TemplateFSMState_t nextState;  ES_Tattle();

switch (CurrentState) {

    case InitPState:
        if (ThisEvent.EventType == ES_INIT) {
            nextState = Hiding; makeTransition = TRUE;
            ThisEvent.EventType = ES_NO_EVENT;
        }
        break;

    case Hiding:
        switch (ThisEvent.EventType) {

            case ES_ENTRY: break;

            case ES_EXIT: break;

            case DARK_TO_LIGHT:
                goForward(MOVING_SPEED); nextState = Moving;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                break;

            default:
                break;
        }
        break;

    case Moving:
        if (ThisEvent.EventType == LIGHT_TO_DARK) {
            stopMovement(); nextState = Hiding;
            makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
```

```
TemplateFSMState_t nextState;  ES_Tattle();

switch (CurrentState) {

    case InitPState:
        if (ThisEvent.EventType == ES_INIT) {
            nextState = Hiding; makeTransition = TRUE;
            ThisEvent.EventType = ES_NO_EVENT;
        }
        break;

    case Hiding:
        switch (ThisEvent.EventType) {

            case ES_ENTRY: break;

            case ES_EXIT: break;

            case DARK_TO_LIGHT:
                goForward(MOVING_SPEED); nextState = Moving;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                break;

            default:
                break;
        }
        break;

    case Moving:
        if (ThisEvent.EventType == LIGHT_TO_DARK) {
            stopMovement(); nextState = Hiding;
            makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
```

# WHY?

beginning of the string

small letter (s)

acceptable string length

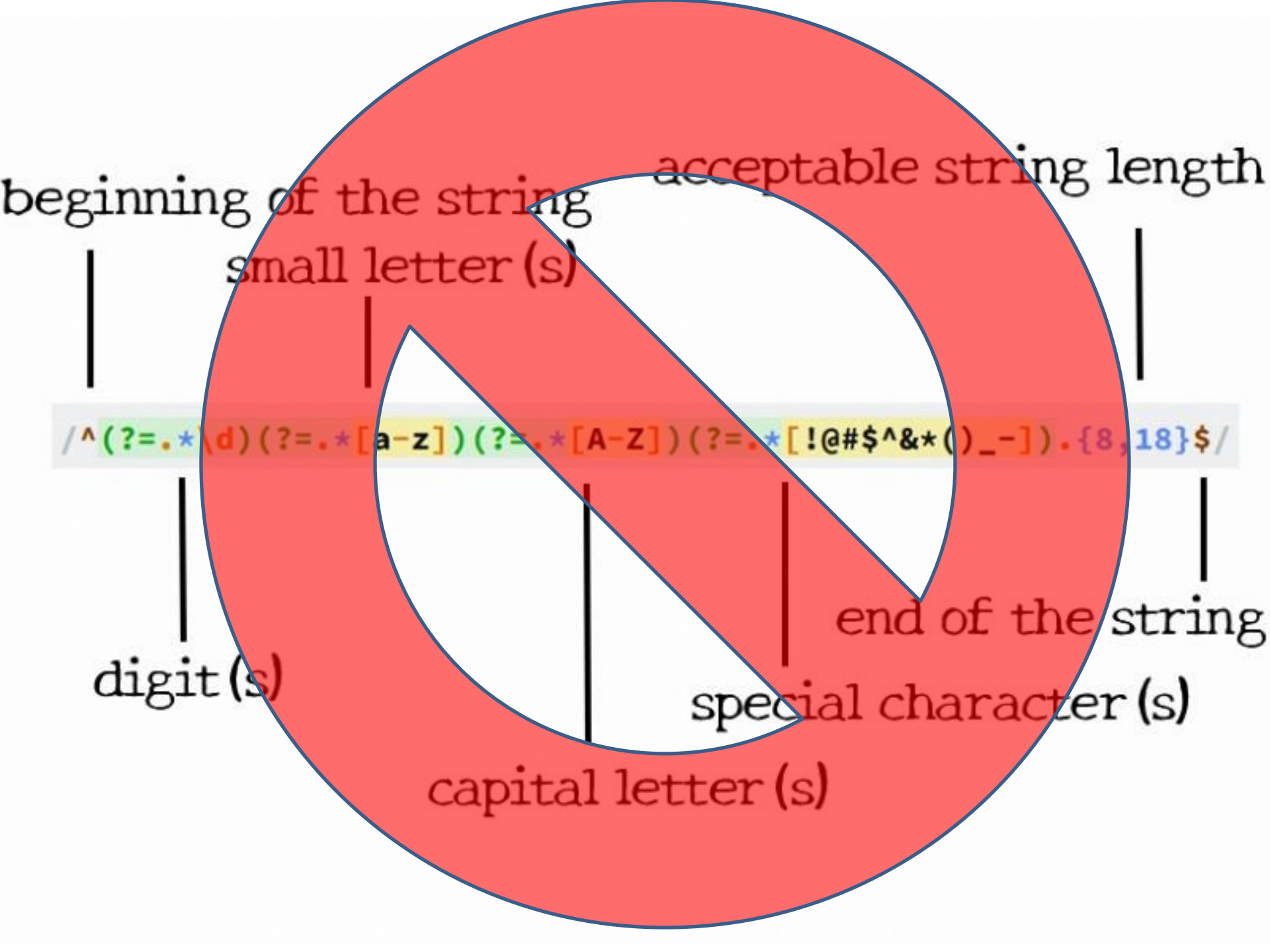
```
/^(?=.*\d)(?=.*[a-z])(?=.*[A-Z])(?=.*[!@#$^&*()_-]).{8,18}$/
```

digit (s)

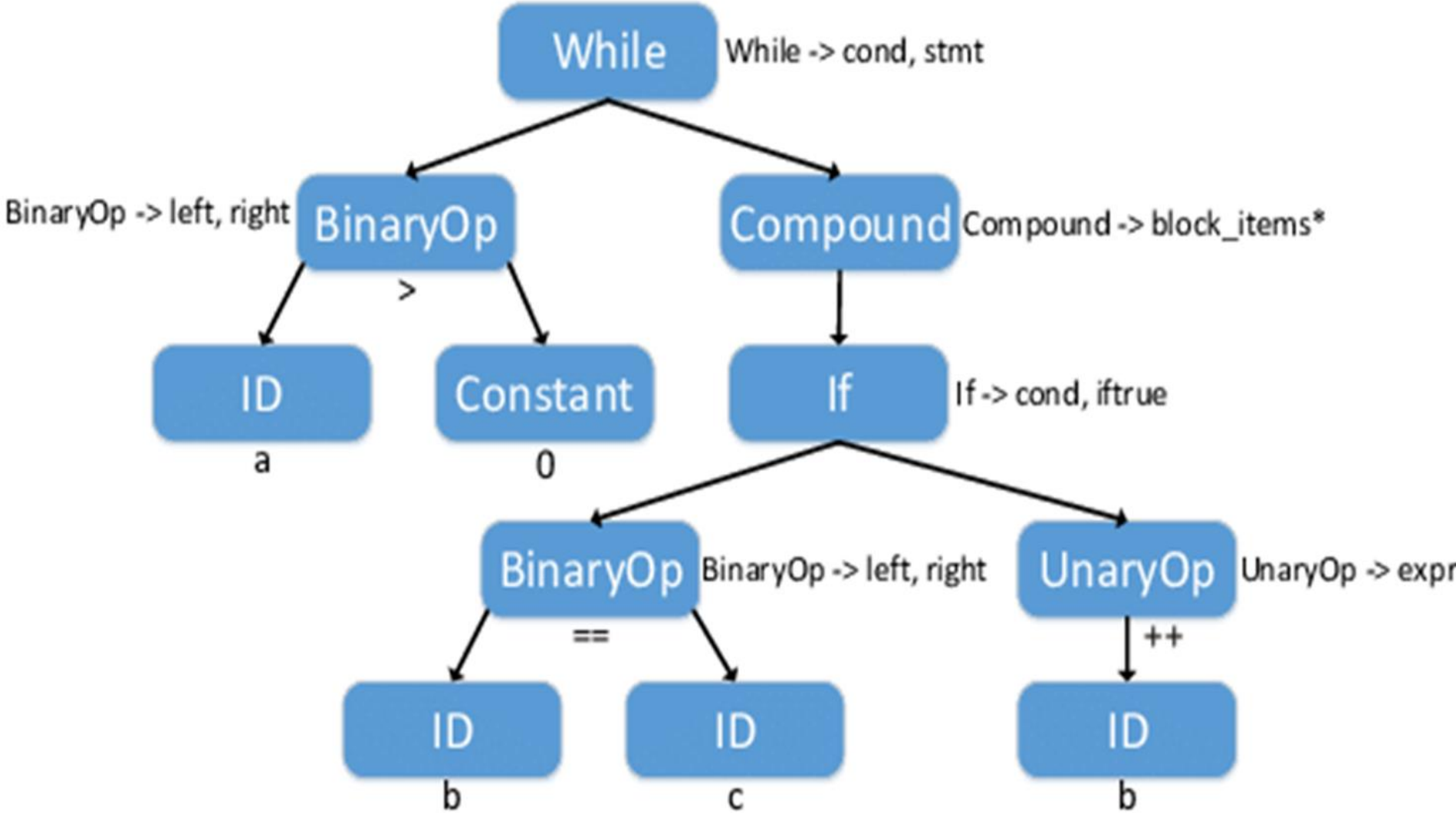
capital letter (s)

special character (s)

end of the string


beginning of the string
small letter (s)
acceptable string length
/^(?=.*\d)(?=.*[a-z])(?=.*[A-Z])(?=.*[!@#$^&*()_-]).{8,18}$/
digit (s)
capital letter (s)
special character (s)
end of the string

```
while(a>0){ if(b==c){b++;} };
```



# https://github.com/eliben/pycparser

eliben / pycparser Public

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**About**

Complete C99 parser in pure Python

## 1.1 What is pycparser?

**pycparser** is a parser for the C language, written in pure Python. It is a module designed to be easily integrated into applications that need to parse C source code.

## 1.2 What is it good for?

Anything that needs C code to be parsed. The following are some uses for **pycparser**, taken from real user reports:

- C code obfuscator
- Front-end for various specialized C compilers
- Static code checker

## 1.3 Which version of C does pycparser support?

**pycparser** aims to support the full C99 language (according to the standard ISO/IEC 9899). Some features from C11 are also supported, and patches to support more are welcome.

**pycparser** supports very few GCC extensions, but it's fairly easy to set things up so that it parses code with a lot of GCC-isms successfully. See the FAQ for more details.

## 1.4 What grammar does pycparser follow?

**pycparser** very closely follows the C grammar provided in Annex A of the C99 standard (ISO/IEC 9899).

```python
def show(self, buf=sys.stdout
        , offset=0, attrnames=False
        , nodenames=False, showcoord=False, _my_node_name=None):
    lead = ' ' * offset
    if nodenames and _my_node_name is not None:
        buf.write(lead + self.__class__.__name__+ ' <' + _my_node_name + '>: ')
    else:
        buf.write(lead + self.__class__.__name__+ ': ')

    if self.attr_names:
        if attrnames:
            nvlist = [(n, getattr(self,n)) for n in self.attr_names]
            attrstr = ', '.join('%s=%s' % nv for nv in nvlist)
        else:
            vlist = [getattr(self, n) for n in self.attr_names]
            attrstr = ', '.join('%s' % v for v in vlist)
        buf.write(attrstr)

    if showcoord:
        buf.write(' (at %s)' % self.coord)
    buf.write('\n')

    for (child_name, child) in self.children():
        child.show(
            buf,
            offset=offset + 2,
            attrnames=attrnames,
            nodenames=nodenames,
            showcoord=showcoord,
            _my_node_name=child_name)
```

pycparser/pycparser/c_ast.py

```python
def myshow(node, xnode=ET.Element("root"), buf=sys.stderr, offset=0
        , attrnames=False, nodenames=False, showcoord=False, _my_node_name=None):
    lead = ' ' * offset
    xnode.set("class", node.__class__.__name__)

    if node.attr_names:
        if attrnames:
            nvlist = [(n, getattr(node, n)) for n in node.attr_names]
            attrstr = ', '.join('%s=%s' % nv for nv in nvlist)
            for nv in nvlist:
                if(nv[1] == None):
                    xnode.set(nv[0], "")
                else:
                    xnode.set(nv[0], str(nv[1]))
        else:
            vlist = [getattr(node, n) for n in node.attr_names]
            attrstr = ', '.join('%s' % v for v in vlist)

    for (child_name, child) in node.children():
        cxname = re.sub(r'\[.*\]', '', child_name)
        cxnode = ET.SubElement(xnode, cxname)

        myshow(child,
               cxnode,
               buf,
               offset=offset + 2,
               attrnames=attrnames,
               nodenames=nodenames,
               showcoord=showcoord,
               _my_node_name=child_name)

    return xnode
```

c_ast_xml_xslt.py

## pycparser/pycparser/c_ast.py

```python
def show(self, buf=sys.stdout
        , offset=0, attrnames=False
        , nodenames=False, showcoord=False, _my_node_name=None):
    lead = ' ' * offset
    if nodenames and _my_node_name is not None:
        buf.write(lead + self.__class__.__name__+ ' <' + _my_node_name
    else:
        buf.write(lead + self.__class__.__name__+ ': ')

    if self.attr_names:
        if attrnames:
            nvlist = [(n, getattr(self,n)) for n in self.attr_names]
            attrstr = ', '.join('%s=%s' % nv for nv in nvlist)
        else:
            vlist = [getattr(self, n) for n in self.attr_names]
            attrstr = ', '.join('%s' % v for v in vlist)
        buf.write(attrstr)

    if showcoord:
        buf.write(' (at %s)' % self.coord)
    buf.write('\n')

    for (child_name, child) in self.children():
        child.show(
            buf,
            offset=offset + 2,
            attrnames=attrnames,
            nodenames=nodenames,
            showcoord=showcoord,
            _my_node_name=child_name)
```

## c_ast_xml_xslt.py

```python
def myshow(node, xnode=ET.Element("root"), buf=sys.stderr
        , offset=0, attrnames=False
        , nodenames=False, showcoord=False, _my_node_name=None):
    lead = ' ' * offset
    xnode.set("class", node.__class__.__name__)

    if node.attr_names:
        if attrnames:
            nvlist = [(n, getattr(node, n)) for n in node.attr_names]
            attrstr = ', '.join('%s=%s' % nv for nv in nvlist)
            for nv in nvlist:
                if(nv[1] == None):
                    xnode.set(nv[0], "")
                else:
                    xnode.set(nv[0], str(nv[1]))
        else:
            vlist = [getattr(node, n) for n in node.attr_names]
            attrstr = ', '.join('%s' % v for v in vlist)

    for (child_name, child) in node.children():
        cxname = re.sub(r'\[.*\]', '', child_name)
        cxnode = ET.SubElement(xnode, cxname)

        myshow(child,
               cxnode,
               buf,
               offset=offset + 2,
               attrnames=attrnames,
               nodenames=nodenames,
               showcoord=showcoord,
               _my_node_name=child_name)

    return xnode
```

```python
import re
import sys
from pycparser import c_parser, c_ast, parse_file
from xml.dom import minidom
from lxml import etree as ET

def myshow(node, xnode=ET.Element("root"), buf=sys.stderr
    , offset=0, attrnames=False, nodenames=False
    , showcoord=False, _my_node_name=None):
    # ...

ast2 = parse_file("/dev/stdin", use_cpp=False)
xml2 = myshow(ast2, attrnames=True, nodenames=False)

if(len(sys.argv) < 2):
    print(prettify(ET.tostring(xml2, encoding='unicode')))
else:
    result = xml2
    for i in range(1,len(sys.argv)):
        xslt_doc = ET.parse(sys.argv[i])
        transformer = ET.XSLT(xslt_doc)
        result = transformer(result)
    print(result)
```

c_ast_xml_xslt.py

```python
import re
import sys
from pycparser import c_parser, c_ast, parse_file
from xml.dom import minidom
from lxml import etree as ET

def myshow(node, xnode=ET.Element("root"), buf=sys.stderr
    , offset=0, attrnames=False, nodenames=False
    , showcoord=False, _my_node_name=None):
    # ...

ast2 = parse_file("/dev/stdin", use_cpp=False)
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if(len(sys.argv) < 2):
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c_ast_xml_xslt.py

```python
import re
import sys
from pycparser import c_parser, c_ast, parse_file
from xml.dom import minidom
from lxml import etree as ET

def myshow(node, xnode=ET.Element("root"), buf=sys.stderr
    , offset=0, attrnames=False, nodenames=False
    , showcoord=False, _my_node_name=None):
    # ...

ast2 = parse_file("/dev/stdin", use_cpp=False)
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if(len(sys.argv) < 2):
    print(prettify(ET.tostring(xml2, encoding='unicode')))
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    for i in range(1,len(sys.argv)):
        xslt_doc = ET.parse(sys.argv[i])
        transformer = ET.XSLT(xslt_doc)
        result = transformer(result)
    print(result)
```

c_ast_xml_xslt.py

```
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType =
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
```

```
<ext class="FuncDef">
  <decl class="Decl" name="RunTemplateFSM">
    <type class="FuncDecl">
      <args class="ParamList">
        <params class="Decl" name="ThisEvent">
          <type class="TypeDecl" declname="ThisEvent">
            <type class="IdentifierType" names="['ES_Event']"/>
          </type>
        </params>
      </args>
      <type class="TypeDecl" declname="RunTemplateFSM">
        <type class="IdentifierType" names="['ES_Event']"/>
      </type>
    </type>
  </decl>
  <body class="Compound">
    <block_items class="Decl" name="makeTransition">
      <type class="TypeDecl" declname="makeTransition">
        <type class="IdentifierType" names="['uint8_t']"/>
      </type>
      <init class="ID" name="FALSE"/>
    </block_items>
    <block_items class="Decl" name="nextState">
      <type class="TypeDecl" declname="nextState">
        <type class="IdentifierType" names="['TemplateFSMState_t']"/>
      </type>
    </block_items>
    <block_items class="FuncCall">
      <name class="ID" name="ES_AddTattlePoint"/>
      <args class="ExprList">
        <exprs class="ID" name="__FUNCTION__"/>
        <exprs class="ArrayRef">
          <name class="ID" name="StateNames"/>
          <subscript class="ID" name="CurrentState"/>
        </exprs>
        <exprs class="ID" name="ThisEvent"/>
      </args>
    </block_items>
    <block_items class="Switch">
      <cond class="ID" name="CurrentState"/>
      <stmt class="Compound">
```

```
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_N
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EV
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME
                    nextState = Getting_Unstuck; makeTransition = TRU
                    ThisEvent.EventType = ES_NO_EVENT;
```

```
<block_items class="Switch">
  <cond class="ID" name="CurrentState"/>
  <stmt class="Compound">
    <block_items class="Case">
      <expr class="ID" name="InitPState"/>
      <stmts class="If">
        <cond class="BinaryOp" op="==">
          <left class="StructRef" type=".">
            <name class="ID" name="ThisEvent"/>
            <field class="ID" name="EventType"/>
          </left>
          <right class="ID" name="ES_INIT"/>
        </cond>
        <iftrue class="Compound">
          <block_items class="Assignment" op="=">
            <lvalue class="ID" name="nextState"/>
            <rvalue class="ID" name="Hiding"/>
          </block_items>
          <block_items class="Assignment" op="=">
            <lvalue class="ID" name="makeTransition"/>
            <rvalue class="ID" name="TRUE"/>
          </block_items>
          <block_items class="Assignment" op="=">
            <lvalue class="StructRef" type=".">
              <name class="ID" name="ThisEvent"/>
              <field class="ID" name="EventType"/>
            </lvalue>
            <rvalue class="ID" name="ES_NO_EVENT"/>
          </block_items>
        </iftrue>
      </stmts>
      <stmts class="Break"/>
    </block_items>
```

# gv_digraph.xslt

```
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    init -> InitPState[label = ES_INIT];
    InitPState -> Hiding  [label = ES_INIT];
    Hiding -> Moving  [label = DARK_TO_LIGHT];
    Moving -> Hiding  [label = LIGHT_TO_DARK];
    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
    Getting_Unstuck -> Hiding  [label = LIGHT_TO_DARK];
    Getting_Unstuck -> Moving  [label = ES_TIMEOUT];

}
```

```
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    init -> InitPState[label = ES_INIT];
    InitPState -> Hiding  [label = ES_INIT];
    Hiding -> Moving  [label = DARK_TO_LIGHT];
    Moving -> Hiding  [label = LIGHT_TO_DARK];
    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
    Getting_Unstuck -> Hiding  [label = LIGHT_TO_DARK];
    Getting_Unstuck -> Moving  [label = ES_TIMEOUT];

}
```

# gv_digraph.xslt

```
<xsl:template match="/">
  <xsl:text>
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states</xsl:text>
      <!-- for every condition in the CurrentState switch statement -->
      <xsl:for-each select="
      //block_items[@class='Switch' and ./cond[@class='ID' and @name='CurrentState']]
      /stmt/block_items[@class='Case']
      /expr[@class='ID']
      ">
        <xsl:text>
    </xsl:text>
        <!-- output name of the condition label -->
        <xsl:value-of select="@name"/><xsl:text>;</xsl:text>
      </xsl:for-each>

    <xsl:text>

    // transitions
    init -> </xsl:text>
            <!-- locate right hand side value of CurrentState assignment statement inside the InitTemplateFSM() function -->
            <xsl:value-of select="
            //ext[@class='FuncDef' and ./decl[@class='Decl' and @name='InitTemplateFSM']]
            //block_items[@class='Assignment' and @op='=' and ./lvalue[@class='ID' and @name='CurrentState']]
            /rvalue/@name"
            />
    <xsl:text>[label = ES_INIT];
</xsl:text>

  <!-- for all = operations to nextState apply templates (BELOW) that are suitable -->
  <xsl:apply-templates select="//*[@op='=' and ./lvalue[@name='nextState'] ]"/>

  <xsl:text>
}</xsl:text>
</xsl:template>
```

# gv_digraph.xslt

```
<xsl:template match="/">
  <xsl:text>
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states</xsl:text>
      <!-- for every condition in the CurrentState switch statement -->
      <xsl:for-each select="
      //block_items[@class='Switch' and ./cond[@class='ID' and @name='CurrentState']]
      /stmt/block_items[@class='Case']
      /expr[@class='ID']
      ">
        <xsl:text>
    </xsl:text>
        <!-- output name of the condition label -->
        <xsl:value-of select="@name"/><xsl:text>;</xsl:text>
      </xsl:for-each>

    <xsl:text>

    // transitions
    init -> </xsl:text>
            <!-- locate right hand side value of CurrentState assignment statement inside the InitTemplateFSM() function -->
            <xsl:value-of select="
            //ext[@class='FuncDef' and ./decl[@class='Decl' and @name='InitTemplateFSM']]
            //block_items[@class='Assignment' and @op='=' and ./lvalue[@class='ID' and @name='CurrentState']]
            /rvalue/@name"
            />
    <xsl:text>[label = ES_INIT];
</xsl:text>

  <!-- for all = operations to nextState apply templates (BELOW) that are suitable -->
  <xsl:apply-templates select="//*[@op='=' and ./lvalue[@name='nextState'] ]"/>

  <xsl:text>
}</xsl:text>
</xsl:template>
```

```
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    init -> InitPState[label = ES_INIT];
    InitPState -> Hiding  [label = ES_INIT];
    Hiding -> Moving  [label = DARK_TO_LIGHT];
    Moving -> Hiding  [label = LIGHT_TO_DARK];
    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
    Getting_Unstuck -> Hiding  [label = LIGHT_TO_DARK];
    Getting_Unstuck -> Moving  [label = ES_TIMEOUT];

}
```

```
// states
InitPState;
Hiding;
Moving;
Getting_Unstuck;
```

```
// states</xsl:text>
  <!-- for every condition in the CurrentSta
  <xsl:for-each select="
  //block_items[
    @class='Switch'
    and ./cond[@class='ID'
    and @name='CurrentState']
  ]
  /stmt/block_items[@class='Case']
  /expr[@class='ID']
  ">
    <xsl:text>
</xsl:text>
    <!-- output name of the condition label
    <xsl:value-of select="@name"/><xsl:text>
  </xsl:for-each>
```

```
<block_items class="Switch">
  <cond class="ID" name="CurrentState"/>
  <stmt class="Compound">
    <block_items class="Case">
      <expr class="ID" name="InitPState"/>
      <stmts class="If">
        <cond class="BinaryOp" op="==">
          <left class="StructRef" type=".">
            <name class="ID" name="ThisEvent"/>
            <field class="ID" name="EventType"/>
          </left>
          <right class="ID" name="ES_INIT"/>
        </cond>
        <iftrue class="Compound">
          <block_items class="Assignment" op="=">
            <lvalue class="ID" name="nextState"/>
            <rvalue class="ID" name="Hiding"/>
          </block_items>
          <block_items class="Assignment" op="=">
            <lvalue class="ID" name="makeTransition"/>
            <rvalue class="ID" name="TRUE"/>
          </block_items>
          <block_items class="Assignment" op="=">
            <lvalue class="StructRef" type=".">
              <name class="ID" name="ThisEvent"/>
              <field class="ID" name="EventType"/>
            </lvalue>
            <rvalue class="ID" name="ES_NO_EVENT"/>
          </block_items>
        </iftrue>
      </stmts>
      <stmts class="Break"/>
    </block_items>
    <block_items class="Case">
      <expr class="ID" name="Hiding"/>
      <stmts class="Switch">
        <cond class="StructRef" type=".">
          <name class="ID" name="ThisEvent"/>
          <field class="ID" name="EventType"/>
        </cond>
        <stmt class="Compound">
          <block_items class="Case">
            <expr class="ID" name="ES_ENTRY"/>
            <stmts class="Break"/>
          </block_items>
          <block_items class="Case">
            <expr class="ID" name="ES_EXIT"/>
            <stmts class="Break"/>
          </block_items>
          <block_items class="Case">
            <expr class="ID" name="DARK_TO_LIGHT"/>
```

```
// states
InitPState;
Hiding;
Moving;
Getting_Unstuck;
```

```
// states</xsl:text>
  <!-- for every condition in the CurrentSta
  <xsl:for-each select="
  //block_items[
    @class='Switch'
    and ./cond[@class='ID'
    and @name='CurrentState']
  ]
  /stmt/block_items[@class='Case']
  /expr[@class='ID']
  ">
    <xsl:text>
</xsl:text>
    <!-- output name of the condition label
    <xsl:value-of select="@name"/><xsl:text>
  </xsl:for-each>
```

```
<block_items class="Switch">
  <cond class="ID" name="CurrentState"/>
  <stmt class="Compound">
    <block_items class="Case">
      <expr class="ID" name="InitPState"/>
      <stmts class="If">
        <cond class="BinaryOp" op="==">
          <left class="StructRef" type=".">
            <name class="ID" name="ThisEvent"/>
            <field class="ID" name="EventType"/>
          </left>
          <right class="ID" name="ES_INIT"/>
        </cond>
        <iftrue class="Compound">
          <block_items class="Assignment" op="=">
            <lvalue class="ID" name="nextState"/>
            <rvalue class="ID" name="Hiding"/>
          </block_items>
          <block_items class="Assignment" op="=">
            <lvalue class="ID" name="makeTransition"/>
            <rvalue class="ID" name="TRUE"/>
          </block_items>
          <block_items class="Assignment" op="=">
            <lvalue class="StructRef" type=".">
              <name class="ID" name="ThisEvent"/>
              <field class="ID" name="EventType"/>
            </lvalue>
            <rvalue class="ID" name="ES_NO_EVENT"/>
          </block_items>
        </iftrue>
      </stmts>
      <stmts class="Break"/>
    </block_items>
    <block_items class="Case">
      <expr class="ID" name="Hiding"/>
      <stmts class="Switch">
        <cond class="StructRef" type=".">
          <name class="ID" name="ThisEvent"/>
          <field class="ID" name="EventType"/>
        </cond>
        <stmt class="Compound">
          <block_items class="Case">
            <expr class="ID" name="ES_ENTRY"/>
            <stmts class="Break"/>
          </block_items>
          <block_items class="Case">
            <expr class="ID" name="ES_EXIT"/>
            <stmts class="Break"/>
          </block_items>
          <block_items class="Case">
            <expr class="ID" name="DARK_TO_LIGHT"/>
```

```
// states
InitPState;
Hiding;
Moving;
Getting_Unstuck;
```

```
// states</xsl:text>
  <!-- for every condition in the CurrentSta
  <xsl:for-each select="
  //block_items[
    @class='Switch'
    and ./cond[@class='ID'
    and @name='CurrentState']
  ]
  /stmt/block_items[@class='Case']
  /expr[@class='ID']
  ">
    <xsl:text>
</xsl:text>
    <!-- output name of the condition label
    <xsl:value-of select="@name"/><xsl:text>
  </xsl:for-each>
```

```
<block_items class="Switch">
  <cond class="ID" name="CurrentState"/>
  <stmt class="Compound">
    <block_items class="Case">
      <expr class="ID" name="InitPState"/>
      <stmts class="If">
        <cond class="BinaryOp" op="==">
          <left class="StructRef" type=".">
            <name class="ID" name="ThisEvent"/>
            <field class="ID" name="EventType"/>
          </left>
          <right class="ID" name="ES_INIT"/>
        </cond>
        <iftrue class="Compound">
          <block_items class="Assignment" op="=">
            <lvalue class="ID" name="nextState"/>
            <rvalue class="ID" name="Hiding"/>
          </block_items>
          <block_items class="Assignment" op="=">
            <lvalue class="ID" name="makeTransition"/>
            <rvalue class="ID" name="TRUE"/>
          </block_items>
          <block_items class="Assignment" op="=">
            <lvalue class="StructRef" type=".">
              <name class="ID" name="ThisEvent"/>
              <field class="ID" name="EventType"/>
            </lvalue>
            <rvalue class="ID" name="ES_NO_EVENT"/>
          </block_items>
        </iftrue>
      </stmts>
      <stmts class="Break"/>
    </block_items>
    <block_items class="Case">
      <expr class="ID" name="Hiding"/>
      <stmts class="Switch">
        <cond class="StructRef" type=".">
          <name class="ID" name="ThisEvent"/>
          <field class="ID" name="EventType"/>
        </cond>
        <stmt class="Compound">
          <block_items class="Case">
            <expr class="ID" name="ES_ENTRY"/>
            <stmts class="Break"/>
          </block_items>
          <block_items class="Case">
            <expr class="ID" name="ES_EXIT"/>
            <stmts class="Break"/>
          </block_items>
          <block_items class="Case">
            <expr class="ID" name="DARK_TO_LIGHT"/>
```

```
// states
InitPState;
Hiding;
Moving;
Getting_Unstuck;
```

```
// states</xsl:text>
  <!-- for every condition in the CurrentSta
  <xsl:for-each select="
  //block_items[
    @class='Switch'
    and ./cond[@class='ID'
    and @name='CurrentState']
  ]
  /stmt/block_items[@class='Case']
  /expr[@class='ID']
  ">
    <xsl:text>
</xsl:text>
    <!-- output name of the condition label
    <xsl:value-of select="@name"/><xsl:text>
  </xsl:for-each>
```

```
<block_items class="Switch">
  <cond class="ID" name="CurrentState"/>
  <stmt class="Compound">
    <block_items class="Case">
      <expr class="ID" name="InitPState"/>
      <stmts class="If">
        <cond class="BinaryOp" op="==">
          <left class="StructRef" type=".">
            <name class="ID" name="ThisEvent"/>
            <field class="ID" name="EventType"/>
          </left>
          <right class="ID" name="ES_INIT"/>
        </cond>
        <iftrue class="Compound">
          <block_items class="Assignment" op="=">
            <lvalue class="ID" name="nextState"/>
            <rvalue class="ID" name="Hiding"/>
          </block_items>
          <block_items class="Assignment" op="=">
            <lvalue class="ID" name="makeTransition"/>
            <rvalue class="ID" name="TRUE"/>
          </block_items>
          <block_items class="Assignment" op="=">
            <lvalue class="StructRef" type=".">
              <name class="ID" name="ThisEvent"/>
              <field class="ID" name="EventType"/>
            </lvalue>
            <rvalue class="ID" name="ES_NO_EVENT"/>
          </block_items>
        </iftrue>
      </stmts>
      <stmts class="Break"/>
    </block_items>
    <block_items class="Case">
      <expr class="ID" name="Hiding"/>
      <stmts class="Switch">
        <cond class="StructRef" type=".">
          <name class="ID" name="ThisEvent"/>
          <field class="ID" name="EventType"/>
        </cond>
        <stmt class="Compound">
          <block_items class="Case">
            <expr class="ID" name="ES_ENTRY"/>
            <stmts class="Break"/>
          </block_items>
          <block_items class="Case">
            <expr class="ID" name="ES_EXIT"/>
            <stmts class="Break"/>
          </block_items>
          <block_items class="Case">
            <expr class="ID" name="DARK_TO_LIGHT"/>
```

```
// states
InitPState;
Hiding;
Moving;
Getting_Unstuck;
```

```
// states</xsl:text>
  <!-- for every condition in the CurrentSta
  <xsl:for-each select="
  //block_items[
    @class='Switch'
    and ./cond[@class='ID'
    and @name='CurrentState']
  ]
  /stmt/block_items[@class='Case']
  /expr[@class='ID']
  ">
    <xsl:text>
</xsl:text>
    <!-- output name of the condition label
    <xsl:value-of select="@name"/><xsl:text>
  </xsl:for-each>
```

```
<block_items class="Switch">
  <cond class="ID" name="CurrentState"/>
  <stmt class="Compound">
    <block_items class="Case">
      <expr class="ID" name="InitPState"/>
      <stmts class="If">
        <cond class="BinaryOp" op="==">
          <left class="StructRef" type=".">
            <name class="ID" name="ThisEvent"/>
            <field class="ID" name="EventType"/>
          </left>
          <right class="ID" name="ES_INIT"/>
        </cond>
        <iftrue class="Compound">
          <block_items class="Assignment" op="=">
            <lvalue class="ID" name="nextState"/>
            <rvalue class="ID" name="Hiding"/>
          </block_items>
          <block_items class="Assignment" op="=">
            <lvalue class="ID" name="makeTransition"/>
            <rvalue class="ID" name="TRUE"/>
          </block_items>
          <block_items class="Assignment" op="=">
            <lvalue class="StructRef" type=".">
              <name class="ID" name="ThisEvent"/>
              <field class="ID" name="EventType"/>
            </lvalue>
            <rvalue class="ID" name="ES_NO_EVENT"/>
          </block_items>
        </iftrue>
      </stmts>
      <stmts class="Break"/>
    </block_items>
    <block_items class="Case">
      <expr class="ID" name="Hiding"/>
      <stmts class="Switch">
        <cond class="StructRef" type=".">
          <name class="ID" name="ThisEvent"/>
          <field class="ID" name="EventType"/>
        </cond>
        <stmt class="Compound">
          <block_items class="Case">
            <expr class="ID" name="ES_ENTRY"/>
            <stmts class="Break"/>
          </block_items>
          <block_items class="Case">
            <expr class="ID" name="ES_EXIT"/>
            <stmts class="Break"/>
          </block_items>
          <block_items class="Case">
            <expr class="ID" name="DARK_TO_LIGHT"/>
```

```
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    init -> InitPState[label = ES_INIT];
    InitPState -> Hiding  [label = ES_INIT];
    Hiding -> Moving  [label = DARK_TO_LIGHT];
    Moving -> Hiding  [label = LIGHT_TO_DARK];
    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
    Getting_Unstuck -> Hiding  [label = LIGHT_TO_DARK];
    Getting_Unstuck -> Moving  [label = ES_TIMEOUT];

}
```

```
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    init -> InitPState[label = ES_INIT];
    InitPState -> Hiding  [label = ES_INIT];
    Hiding -> Moving  [label = DARK_TO_LIGHT];
    Moving -> Hiding  [label = LIGHT_TO_DARK];
    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
    Getting_Unstuck -> Hiding  [label = LIGHT_TO_DARK];
    Getting_Unstuck -> Moving  [label = ES_TIMEOUT];

}
```

```
// transitions
init -> InitPState[label = ES_INIT];
```

```
// transitions
init -> InitPState[label = ES_INIT];
```

```
uint8_t InitTemplateFSM(uint8_t Priority)
{
    MyPriority = Priority;
    // put us into the Initial PseudoState
    CurrentState = InitPState;
    // post the initial transition event
    if(ES_PostToService(MyPriority, INIT_EVENT) == TRUE)
    {
        return TRUE;
    } else {
        return FALSE;
    }
}
```

```xml
<ext class="FuncDef">
  <decl class="Decl" name="InitTemplateFSM">
    <type class="FuncDecl">
      <args class="ParamList">
        <params class="Decl" name="Priority">
          <type class="TypeDecl" declname="Priority">
            <type class="IdentifierType" names="['uint8_t']"/>
          </type>
        </params>
      </args>
      <type class="TypeDecl" declname="InitTemplateFSM">
        <type class="IdentifierType" names="['uint8_t']"/>
      </type>
    </type>
  </decl>
  <body class="Compound">
    <block_items class="Assignment" op="=">
      <lvalue class="ID" name="MyPriority"/>
      <rvalue class="ID" name="Priority"/>
    </block_items>
    <block_items class="Assignment" op="=">
      <lvalue class="ID" name="CurrentState"/>
      <rvalue class="ID" name="InitPState"/>
    </block_items>
    <block_items class="If">
      <cond class="BinaryOp" op="==">
        <left class="FuncCall">
          <name class="ID" name="ES_PostToService"/>
          <args class="ExprList">
            <exprs class="ID" name="MyPriority"/>
            <exprs class="CompoundLiteral">
              <type class="Typename" name="">
                <type class="TypeDecl" declname="">
                  <type class="IdentifierType" names="['ES_Event']"/>
                </type>
              </type>
              <init class="InitList">
                <exprs class="ID" name="ES_INIT"/>
                <exprs class="Constant" type="int" value="0x0000"/>
              </init>
            </exprs>
          </args>
        </left>
        <right class="ID" name="TRUE"/>
      </cond>
      <iftrue class="Compound">
        <block_items class="Return">
          <expr class="ID" name="TRUE"/>
        </block_items>
      </iftrue>
      <iffalse class="Compound">
        <block_items class="Return">
          <expr class="ID" name="FALSE"/>
        </block_items>
      </iffalse>
    </block_items>
  </body>
</ext>
```


```
// transitions
init -> InitPState[label = ES_INIT];
```

```
uint8_t InitTemplateFSM(uint8_t Priority)
{
    MyPriority = Priority;
    // put us into the Initial PseudoState
    CurrentState = InitPState;
    // post the initial transition event
    if(ES_PostToService(MyPriority, INIT_EVENT) == TRUE)
    {
        return TRUE;
    } else {
        return FALSE;
    }
}
```

```
<ext class="FuncDef">
  <decl class="Decl" name="InitTemplateFSM">
    <type class="FuncDecl">
      <args class="ParamList">
        <params class="Decl" name="Priority">
          <type class="TypeDecl" declname="Priority">
            <type class="IdentifierType" names="['uint8_t']"/>
          </type>
        </params>
      </args>
      <type class="TypeDecl" declname="InitTemplateFSM">
        <type class="IdentifierType" names="['uint8_t']"/>
      </type>
    </type>
  </decl>
  <body class="Compound">
    <block_items class="Assignment" op="=">
      <lvalue class="ID" name="MyPriority"/>
      <rvalue class="ID" name="Priority"/>
    </block_items>
    <block_items class="Assignment" op="=">
      <lvalue class="ID" name="CurrentState"/>
      <rvalue class="ID" name="InitPState"/>
    </block_items>
    <block_items class="If">
      <cond class="BinaryOp" op="==">
        <left class="FuncCall">
          <name class="ID" name="ES_PostToService"/>
          <args class="ExprList">
            <exprs class="ID" name="MyPriority"/>
            <exprs class="CompoundLiteral">
              <type class="Typename" name="">
                <type class="TypeDecl" declname="">
                  <type class="IdentifierType" names="['ES_Event']"/>
                </type>
              </type>
              <init class="InitList">
                <exprs class="ID" name="ES_INIT"/>
                <exprs class="Constant" type="int" value="0x0000"/>
              </init>
            </exprs>
          </args>
        </left>
        <right class="ID" name="TRUE"/>
      </cond>
      <iftrue class="Compound">
        <block_items class="Return">
          <expr class="ID" name="TRUE"/>
        </block_items>
      </iftrue>
      <iffalse class="Compound">
        <block_items class="Return">
          <expr class="ID" name="FALSE"/>
        </block_items>
      </iffalse>
    </block_items>
  </body>
</ext>
```

```
// transitions
init -> InitPState[label = ES_INIT];
```

```
// transitions
init -> </xsl:text>
        <!-- locate right hand side value of CurrentState assignment statement inside the InitTemplateFSM() fun
        <xsl:value-of select="
        //ext[@class='FuncDef' and ./decl[@class='Decl' and @name='InitTemplateFSM']]
        //block_items[@class='Assignment' and @op='=' and ./lvalue[@class='ID' and @name='CurrentState']]
        /rvalue/@name"
        />
<xsl:text>[label = ES_INIT];
```

```
uint8_t InitTemplateFSM(uint8_t Priority)
{
    MyPriority = Priority;
    // put us into the Initial PseudoState
    CurrentState = InitPState;
    // post the initial transition event
    if(ES_PostToService(MyPriority, INIT_EVENT) == TRUE)
    {
        return TRUE;
    } else {
        return FALSE;
    }
}
```

# gv_digraph.xslt

```
<xsl:template match="/">
  <xsl:text>
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states</xsl:text>
      <!-- for every condition in the CurrentState switch statement -->
      <xsl:for-each select="
      //block_items[@class='Switch' and ./cond[@class='ID' and @name='CurrentState']]
      /stmt/block_items[@class='Case']
      /expr[@class='ID']
      ">
        <xsl:text>
    </xsl:text>
        <!-- output name of the condition label -->
        <xsl:value-of select="@name"/><xsl:text>;</xsl:text>
      </xsl:for-each>

    <xsl:text>

    // transitions
    init -> </xsl:text>
            <!-- locate right hand side value of CurrentState assignment statement inside the InitTemplateFSM() function -->
            <xsl:value-of select="
            //ext[@class='FuncDef' and ./decl[@class='Decl' and @name='InitTemplateFSM']]
            //block_items[@class='Assignment' and @op='=' and ./lvalue[@class='ID' and @name='CurrentState']]
            /rvalue/@name"
            />
    <xsl:text>[label = ES_INIT];
</xsl:text>

  <!-- for all = operations to nextState apply templates (BELOW) that are suitable -->
  <xsl:apply-templates select="//*[@op='=' and ./lvalue[@name='nextState'] ]"/>

  <xsl:text>
}</xsl:text>
</xsl:template>
```

# gv_digraph.xslt

```
<xsl:template match="/">
  <xsl:text>
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states</xsl:text>
      <!-- for every condition in the CurrentState switch statement -->
      <xsl:for-each select="
      //block_items[@class='Switch' and ./cond[@class='ID' and @name='CurrentState']]
      /stmt/block_items[@class='Case']
      /expr[@class='ID']
      ">
        <xsl:text>
    </xsl:text>
        <!-- output name of the condition label -->
        <xsl:value-of select="@name"/><xsl:text>;</xsl:text>
      </xsl:for-each>

    <xsl:text>

    // transitions
    init -> </xsl:text>
            <!-- locate right hand side value of CurrentState assignment statement inside the InitTemplateFSM() function -->
            <xsl:value-of select="
            //ext[@class='FuncDef' and ./decl[@class='Decl' and @name='InitTemplateFSM']]
            //block_items[@class='Assignment' and @op='=' and ./lvalue[@class='ID' and @name='CurrentState']]
            /rvalue/@name"
            />
    <xsl:text>[label = ES_INIT];
</xsl:text>

  <!-- for all = operations to nextState apply templates (BELOW) that are suitable -->
  <xsl:apply-templates select="//*[@op='=' and ./lvalue[@name='nextState'] ]"/>

  <xsl:text>
}</xsl:text>
</xsl:template>
```

```
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    init -> InitPState[label = ES_INIT];
    InitPState -> Hiding  [label = ES_INIT];
    Hiding -> Moving  [label = DARK_TO_LIGHT];
    Moving -> Hiding  [label = LIGHT_TO_DARK];
    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
    Getting_Unstuck -> Hiding  [label = LIGHT_TO_DARK];
    Getting_Unstuck -> Moving  [label = ES_TIMEOUT];

}
```

```
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            else if(ThisEvent.EventParam == 2) {
                    previousBumpers = 2; backUpLeft(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            // ...
            }
            break;

        case Getting_Unstuck:
            if (ThisEvent.EventType == LIGHT_TO_DARK)  {
                stopMovement(); nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == ES_TIMEOUT
                && ThisEvent.EventParam == SIMPLE_SERVICE_TIMER) {
                if(Roach_ReadBumpers() == 0) {
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                } else {
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                }
            }
            break;

        default:
            break;
    }

    if (makeTransition == TRUE) {
        RunTemplateFSM(EXIT_EVENT); CurrentState = nextState;
        RunTemplateFSM(ENTRY_EVENT);
    }
    ES_Tail();
    return ThisEvent;
}
```

```
<!--
  Inside top switch statement this template handles assignments to nextState guarded by switch statements
-->
<xsl:template match="*[@op='=' and ./lvalue[@name='nextState'] and 2=count(ancestor::block_items[@class='Case'])]">
            <xsl:text>    </xsl:text>
            <!-- top switch statement labels the current state -->
            <xsl:value-of select="
                ancestor::block_items[@class='Case'][2]/expr[@class='ID']/@name
            "/>
            <xsl:text> -> </xsl:text>
            <!-- right hand side of assignment supplies the next state -->
            <xsl:value-of select="rvalue/@name"/>
            <xsl:text>  [label = </xsl:text>
            <!-- take value of EventType from inner case statement id name  -->
            <xsl:value-of select="
              ../expr[@class='ID']/@name
             "/>
             <xsl:text>]; // switch switch
</xsl:text>
  </xsl:template>
```

```
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            else if(ThisEvent.EventParam == 2) {
                    previousBumpers = 2; backUpLeft(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            // ...
            }
            break;

        case Getting_Unstuck:
            if (ThisEvent.EventType == LIGHT_TO_DARK)  {
                stopMovement(); nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == ES_TIMEOUT
                && ThisEvent.EventParam == SIMPLE_SERVICE_TIMER) {
                if(Roach_ReadBumpers() == 0) {
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                } else {
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                }
            }
            break;

        default:
            break;
    }

    if (makeTransition == TRUE) {
        RunTemplateFSM(EXIT_EVENT); CurrentState = nextState;
        RunTemplateFSM(ENTRY_EVENT);
    }
    ES_Tail();
    return ThisEvent;
}
```

```
<!--
  Inside top switch statement this template handles assignments to nextState guarded by switch statements
-->
<xsl:template match="*[@op='=' and ./lvalue[@name='nextState'] and 2=count(ancestor::block_items[@class='Case'])]">
            <xsl:text>    </xsl:text>
            <!-- top switch statement labels the current state -->
            <xsl:value-of select="
                ancestor::block_items[@class='Case'][2]/expr[@class='ID']/@name
            "/>
            <xsl:text> -> </xsl:text>
            <!-- right hand side of assignment supplies the next state -->
            <xsl:value-of select="rvalue/@name"/>
            <xsl:text>  [label = </xsl:text>
            <!-- take value of EventType from inner case statement id name  -->
            <xsl:value-of select="
              ../expr[@class='ID']/@name
             "/>
             <xsl:text>]; // switch switch
</xsl:text>
  </xsl:template>
```

```
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            else if(ThisEvent.EventParam == 2) {
                    previousBumpers = 2; backUpLeft(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            // ...
            }
            break;

        case Getting_Unstuck:
            if (ThisEvent.EventType == LIGHT_TO_DARK)  {
                stopMovement(); nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == ES_TIMEOUT
                && ThisEvent.EventParam == SIMPLE_SERVICE_TIMER) {
                if(Roach_ReadBumpers() == 0) {
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                } else {
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                }
            }
            break;

        default:
            break;
    }

    if (makeTransition == TRUE) {
        RunTemplateFSM(EXIT_EVENT); CurrentState = nextState;
        RunTemplateFSM(ENTRY_EVENT);
    }
    ES_Tail();
    return ThisEvent;
}
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<!--
  Inside top switch statement this template handles assignments to nextState guarded by switch statements
-->
<xsl:template match="*[@op='=' and ./lvalue[@name='nextState'] and 2=count(ancestor::block_items[@class='Case'])]">
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            <!-- top switch statement labels the current state -->
            <xsl:value-of select="
                ancestor::block_items[@class='Case'][2]/expr[@class='ID']/@name
            "/>
            <xsl:text> -> </xsl:text>
            <!-- right hand side of assignment supplies the next state -->
            <xsl:value-of select="rvalue/@name"/>
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            <xsl:value-of select="
              ../expr[@class='ID']/@name
             "/>
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ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            else if(ThisEvent.EventParam == 2) {
                    previousBumpers = 2; backUpLeft(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            // ...
            }
            break;

        case Getting_Unstuck:
            if (ThisEvent.EventType == LIGHT_TO_DARK)  {
                stopMovement(); nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == ES_TIMEOUT
                && ThisEvent.EventParam == SIMPLE_SERVICE_TIMER) {
                if(Roach_ReadBumpers() == 0) {
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                } else {
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                }
            }
            break;

        default:
            break;
    }

    if (makeTransition == TRUE) {
        RunTemplateFSM(EXIT_EVENT); CurrentState = nextState;
        RunTemplateFSM(ENTRY_EVENT);
    }
    ES_Tail();
    return ThisEvent;
}
```

```
<!--
  Inside top switch statement this template handles assignments to nextState guarded by switch statements
-->
<xsl:template match="*[@op='=' and ./lvalue[@name='nextState'] and 2=count(ancestor::block_items[@class='Case'])]">
            <xsl:text>    </xsl:text>
            <!-- top switch statement labels the current state -->
            <xsl:value-of select="
                ancestor::block_items[@class='Case'][2]/expr[@class='ID']/@name
            "/>
            <xsl:text> -> </xsl:text>
            <!-- right hand side of assignment supplies the next state -->
            <xsl:value-of select="rvalue/@name"/>
            <xsl:text>  [label = </xsl:text>
            <!-- take value of EventType from inner case statement id name  -->
            <xsl:value-of select="
              ../expr[@class='ID']/@name
             "/>
             <xsl:text>]; // switch switch
</xsl:text>
  </xsl:template>
```

```
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            else if(ThisEvent.EventParam == 2) {
                    previousBumpers = 2; backUpLeft(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            // ...
            }
            break;

        case Getting_Unstuck:
            if (ThisEvent.EventType == LIGHT_TO_DARK)  {
                stopMovement(); nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == ES_TIMEOUT
                && ThisEvent.EventParam == SIMPLE_SERVICE_TIMER) {
                if(Roach_ReadBumpers() == 0) {
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                } else {
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                }
            }
            break;

        default:
            break;
    }

    if (makeTransition == TRUE) {
        RunTemplateFSM(EXIT_EVENT); CurrentState = nextState;
        RunTemplateFSM(ENTRY_EVENT);
    }
    ES_Tail();
    return ThisEvent;
}
```

```
<!--
  Inside top switch statement this template handles assignments to nextState guarded by switch statements
-->
<xsl:template match="*[@op='=' and ./lvalue[@name='nextState'] and 2=count(ancestor::block_items[@class='Case'])]">
            <xsl:text>    </xsl:text>
            <!-- top switch statement labels the current state -->
            <xsl:value-of select="
                ancestor::block_items[@class='Case'][2]/expr[@class='ID']/@name
            "/>
            <xsl:text> -> </xsl:text>
            <!-- right hand side of assignment supplies the next state -->
            <xsl:value-of select="rvalue/@name"/>
            <xsl:text>  [label = </xsl:text>
            <!-- take value of EventType from inner case statement id name  -->
            <xsl:value-of select="
              ../expr[@class='ID']/@name
             "/>
             <xsl:text>]; // switch switch
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  </xsl:template>
```

```
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            else if(ThisEvent.EventParam == 2) {
                    previousBumpers = 2; backUpLeft(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            // ...
            }
            break;

        case Getting_Unstuck:
            if (ThisEvent.EventType == LIGHT_TO_DARK)  {
                stopMovement(); nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == ES_TIMEOUT
                && ThisEvent.EventParam == SIMPLE_SERVICE_TIMER) {
                if(Roach_ReadBumpers() == 0) {
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                } else {
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                }
            }
            break;

        default:
            break;
    }

    if (makeTransition == TRUE) {
        RunTemplateFSM(EXIT_EVENT); CurrentState = nextState;
        RunTemplateFSM(ENTRY_EVENT);
    }
    ES_Tail();
    return ThisEvent;
}
```

```
<!--
  Inside top switch statement this template handles assignments to nextState guarded by switch statements
-->
<xsl:template match="*[@op='=' and ./lvalue[@name='nextState'] and 2=count(ancestor::block_items[@class='Case'])]">
            <xsl:text>    </xsl:text>
            <!-- top switch statement labels the current state -->
            <xsl:value-of select="
                ancestor::block_items[@class='Case'][2]/expr[@class='ID']/@name
            "/>
            <xsl:text> -> </xsl:text>
            <!-- right hand side of assignment supplies the next state -->
            <xsl:value-of select="rvalue/@name"/>
            <xsl:text>  [label = </xsl:text>
            <!-- take value of EventType from inner case statement id name  -->
            <xsl:value-of select="
                ../expr[@class='ID']/@name
            "/>
            <xsl:text>]; // switch switch
</xsl:text>
  </xsl:template>
```

```
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            else if(ThisEvent.EventParam == 2) {
                    previousBumpers = 2; backUpLeft(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            // ...
            }
            break;

        case Getting_Unstuck:
            if (ThisEvent.EventType == LIGHT_TO_DARK)  {
                stopMovement(); nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == ES_TIMEOUT
                && ThisEvent.EventParam == SIMPLE_SERVICE_TIMER) {
                if(Roach_ReadBumpers() == 0) {
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                } else {
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                }
            }
            break;

        default:
            break;
    }

    if (makeTransition == TRUE) {
        RunTemplateFSM(EXIT_EVENT); CurrentState = nextState;
        RunTemplateFSM(ENTRY_EVENT);
    }
    ES_Tail();
    return ThisEvent;
}
```

```
<!--
  Inside the top switch statement this template handles assignments to nextState guarded by if statements
-->
<xsl:template match="*[@op='=' and ./lvalue[@name='nextState'] and 1=count(ancestor::block_items[@class='Case'])]">
        <xsl:text>    </xsl:text>
        <!-- top level switch statement labels the current state -->
        <xsl:value-of select="
            ancestor::block_items[@class='Case'][1]/expr[@class='ID']/@name
        "/>
        <xsl:text> -> </xsl:text>
        <!-- right hand side of assignment supplies the next state -->
        <xsl:value-of select="rvalue/@name"/>
        <xsl:text>  [label = </xsl:text>

    <!-- locate first enclosing context that tests EventType (such as some if statement) -->
    <xsl:for-each select="
            ancestor::*[
              .//*[@op='==' and .//field[@name='EventType']]
            ][1]
    ">
        <!-- inside the first enclosing context that tests EventType take the value it is tested against -->
        <xsl:value-of select="
            .//*[@op='==' and .//field[@name='EventType']]
            /right/@name
          "/>
    </xsl:for-each>
    <xsl:text>]; // switch if
</xsl:text>
</xsl:template>
```

```
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            else if(ThisEvent.EventParam == 2) {
                    previousBumpers = 2; backUpLeft(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            // ...
            }
            break;

        case Getting_Unstuck:
            if (ThisEvent.EventType == LIGHT_TO_DARK)  {
                stopMovement(); nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == ES_TIMEOUT
                && ThisEvent.EventParam == SIMPLE_SERVICE_TIMER) {
                if(Roach_ReadBumpers() == 0) {
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                } else {
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                }
            }
            break;

        default:
            break;
    }

    if (makeTransition == TRUE) {
        RunTemplateFSM(EXIT_EVENT); CurrentState = nextState;
        RunTemplateFSM(ENTRY_EVENT);
    }
    ES_Tail();
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<xsl:template match="*[@op='=' and ./lvalue[@name='nextState'] and 1=count(ancestor::block_items[@class='Case'])]">
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        <!-- top level switch statement labels the current state -->
        <xsl:value-of select="
            ancestor::block_items[@class='Case'][1]/expr[@class='ID']/@name
        "/>
        <xsl:text> -> </xsl:text>
        <!-- right hand side of assignment supplies the next state -->
        <xsl:value-of select="rvalue/@name"/>
        <xsl:text>  [label = </xsl:text>

      <!-- locate first enclosing context that tests EventType (such as some if statement) -->
      <xsl:for-each select="
            ancestor::*[
              .//*[@op='==' and .//field[@name='EventType']]
            ][1]
      ">
        <!-- inside the first enclosing context that tests EventType take the value it is tested against -->
        <xsl:value-of select="
            .//*[@op='==' and .//field[@name='EventType']]
            /right/@name
          "/>
      </xsl:for-each>
      <xsl:text>]; // switch if
</xsl:text>
</xsl:template>
```

```
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            else if(ThisEvent.EventParam == 2) {
                    previousBumpers = 2; backUpLeft(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            // ...
            }
            break;

        case Getting_Unstuck:
            if (ThisEvent.EventType == LIGHT_TO_DARK)  {
                stopMovement(); nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == ES_TIMEOUT
                && ThisEvent.EventParam == SIMPLE_SERVICE_TIMER) {
                if(Roach_ReadBumpers() == 0) {
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                } else {
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                }
            }
            break;

        default:
            break;
    }

    if (makeTransition == TRUE) {
        RunTemplateFSM(EXIT_EVENT); CurrentState = nextState;
        RunTemplateFSM(ENTRY_EVENT);
    }
    ES_Tail();
    return ThisEvent;
}
```

```
<!--
  Inside the top switch statement this template handles assignments to nextState guarded by if statements
-->
<xsl:template match="*[@op='=' and ./lvalue[@name='nextState'] and 1=count(ancestor::block_items[@class='Case'])]">
        <xsl:text>    </xsl:text>
        <!-- top level switch statement labels the current state -->
        <xsl:value-of select="
            ancestor::block_items[@class='Case'][1]/expr[@class='ID']/@name
        "/>
        <xsl:text> -> </xsl:text>
        <!-- right hand side of assignment supplies the next state -->
        <xsl:value-of select="rvalue/@name"/>
        <xsl:text>  [label = </xsl:text>

      <!-- locate first enclosing context that tests EventType (such as some if statement) -->
      <xsl:for-each select="
            ancestor::*[
              .//*[@op='==' and .//field[@name='EventType']]
            ][1]
      ">
        <!-- inside the first enclosing context that tests EventType take the value it is tested against -->
        <xsl:value-of select="
            .//*[@op='==' and .//field[@name='EventType']]
            /right/@name
          "/>
      </xsl:for-each>
      <xsl:text>]; // switch if
</xsl:text>
</xsl:template>
```

# c_ast_xml_xslt.py

```python
import re
import sys
from pycparser import c_parser, c_ast, parse_file
from xml.dom import minidom
from lxml import etree as ET

def myshow(node, xnode=ET.Element("root"), buf=sys.stderr
    , offset=0, attrnames=False, nodenames=False
    , showcoord=False, _my_node_name=None):
    # ...

ast2 = parse_file("/dev/stdin", use_cpp=False)
xml2 = myshow(ast2, attrnames=True, nodenames=False)

if(len(sys.argv) < 2):
    print(prettify(ET.tostring(xml2, encoding='unicode')))
else:
    result = xml2
    for i in range(1,len(sys.argv)):
        xslt_doc = ET.parse(sys.argv[i])
        transformer = ET.XSLT(xslt_doc)
        result = transformer(result)
    print(result)
```

c_ast_xml_xslt.py

```python
import re
import sys
from pycparser import c_parser, c_ast, parse_file
from xml.dom import minidom
from lxml import etree as ET

def myshow(node, xnode=ET.Element("root"), buf=sys.stderr
    , offset=0, attrnames=False, nodenames=False
    , showcoord=False, _my_node_name=None):
    # ...

ast2 = parse_file("/dev/stdin", use_cpp=False)
xml2 = myshow(ast2, attrnames=True, nodenames=False)

if(len(sys.argv) < 2):
    print(prettify(ET.tostring(xml2, encoding='unicode')))
else:
    result = xml2
    for i in range(1,len(sys.argv)):
        xslt_doc = ET.parse(sys.argv[i])
        transformer = ET.XSLT(xslt_doc)
        result = transformer(result)
    print(result)
```

c_ast_xml_xslt.py

# usage

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/xc32-cpp.exe' \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py gv_digraph.xslt \
    | uniq \
    > gv_digraph.gv
```

usage

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/xc32-cpp.exe' \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py gv_digraph.xslt \
    | uniq \
    > gv_digraph.gv
```

# usage

```
(smv) # wc -l sample/*
    310 sample/step000_c_code_containing_state_machine.c
   1294 sample/step001_c_code_after_cpp.c
   1137 sample/step002_c_code_supported_by_pycparser.c
   5873 sample/step003_abstract_syntax_tree.xml
     26 sample/step004_gv_digraph.gv
     23 sample/step005_gv_digraph_unique.gv
(smv) #
```

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/xc32-cpp.exe' \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py gv_digraph.xslt \
    | uniq \
    > gv_digraph.gv
```

# usage

```
(smv) # wc -l sample/*
   310 sample/step000_c_code_containing_state_machine.c
  1294 sample/step001_c_code_after_cpp.c
  1137 sample/step002_c_code_supported_by_pycparser.c
  5873 sample/step003_abstract_syntax_tree.xml
    26 sample/step004_gv_digraph.gv
    23 sample/step005_gv_digraph_unique.gv
(smv) #
```

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/xc32-cpp.exe' \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py gv_digraph.xslt \
    | uniq \
    > gv_digraph.gv
```

# usage

```
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   310 sample/step000_c_code_containing_state_machine.c
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    26 sample/step004_gv_digraph.gv
    23 sample/step005_gv_digraph_unique.gv
(smv) #
```

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/xc32-cpp.exe' \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py gv_digraph.xslt \
    | uniq \
    > gv_digraph.gv
```

usage

```
(smv) # wc -l sample/*
   310 sample/step000_c_code_containing_state_machine.c
  1294 sample/step001_c_code_after_cpp.c
  1137 sample/step002_c_code_supported_by_pycparser.c
  5873 sample/step003_abstract_syntax_tree.xml
    26 sample/step004_gv_digraph.gv
    23 sample/step005_gv_digraph_unique.gv
(smv) #
```

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/xc32-cpp.exe' \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py gv_digraph.xslt \
    | uniq \
    > gv_digraph.gv
```

usage

```
(smv) # wc -l sample/*
   310 sample/step000_c_code_containing_state_machine.c
  1294 sample/step001_c_code_after_cpp.c
  1137 sample/step002_c_code_supported_by_pycparser.c
  5873 sample/step003_abstract_syntax_tree.xml
    26 sample/step004_gv_digraph.gv
    23 sample/step005_gv_digraph_unique.gv
(smv) #
```

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/xc32-cpp.exe' \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py gv_digraph.xslt \
    | uniq \
    > gv_digraph.gv
```

usage

```
(smv) # wc -l sample/*
   310 sample/step000_c_code_containing_state_machine.c
  1294 sample/step001_c_code_after_cpp.c
  1137 sample/step002_c_code_supported_by_pycparser.c
  5873 sample/step003_abstract_syntax_tree.xml
    26 sample/step004_gv_digraph.gv
    23 sample/step005_gv_digraph_unique.gv
(smv) #
```

# details

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/xc32-cpp.exe' \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py gv_digraph.xslt \
    | uniq \
    > gv_digraph.gv
```

usage

```python
from pycparser import c_parser, c_ast, parse_file

# ...

ast2 = parse_file("/dev/stdin", use_cpp=False)

# ...
```

c_ast_xml_xslt.py

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/xc32-cpp.exe' \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py gv_digraph.xslt \
    | uniq \
    > gv_digraph.gv
```

usage

```
964- typedef __builtin_va_list __isoc_va_list;
965- # 145 "c:\\program files\\microchip\\xc32\\v4.10\\pic32mx\\include\\musl\\bits
966  typedef int ssize_t;
967- # 336 "c:\\program files\\microchip\\xc32\\v4.10\\pic32mx\\include\\musl\\bits
968  typedef long long off_t;
969- # 506 "c:\\program files\\microchip\\xc32\\v4.10\\pic32mx\\include\\musl\\bits
970  typedef struct _IO_FILE FILE;
971- # 23 "c:\\program files\\microchip\\xc32\\v4.10\\pic32mx\\include\\musl\\stdio
972- # 50 "c:\\program files\\microchip\\xc32\\v4.10\\pic32mx\\include\\musl\\stdio
973  typedef union _G_fpos64_t {
974   char __opaque[16];
975   double __align;
976  } fpos_t;
977
978- extern __attribute__((section(".data._stdout"))) FILE *const *_stdout;
979- extern __attribute__((section(".data._stderr"))) FILE *const *_stderr;
980- extern __attribute__((section(".data._stdin"))) FILE *const *_stdin;
981
```

```
832  typedef int ssize_t;
833  typedef long long off_t;
834  typedef struct _IO_FILE FILE;
835  typedef union _G_fpos64_t {
836   char __opaque[16];
837   double __align;
838  } fpos_t;
839
840
```

```
| egrep -avi '^#|va_list|__attribute__' \
| perl -pe's{__extension__}{ }g;' \
```

```diff
422
423- __extension__ typedef unsigned long long UINT64;
424
425
426  typedef union
427  {
428      UINT8 Val;
429      struct
430      {
431-         __extension__ UINT8 b0:1;
432-         __extension__ UINT8 b1:1;
433-         __extension__ UINT8 b2:1;
434-         __extension__ UINT8 b3:1;
435-         __extension__ UINT8 b4:1;
436-         __extension__ UINT8 b5:1;
437-         __extension__ UINT8 b6:1;
438-         __extension__ UINT8 b7:1;
439      } bits;
440  } UINT8_VAL, UINT8_BITS;
```

```diff
314
315+  typedef unsigned long long UINT64;
316
317
318  typedef union
319  {
320      UINT8 Val;
321      struct
322      {
323+         UINT8 b0:1;
324+         UINT8 b1:1;
325+         UINT8 b2:1;
326+         UINT8 b3:1;
327+         UINT8 b4:1;
328+         UINT8 b5:1;
329+         UINT8 b6:1;
330+         UINT8 b7:1;
331      } bits;
332  } UINT8_VAL, UINT8_BITS;
```

```diff
1028 int snprintf(char *restrict, size_t, const char *restrict, ...);
1029
1030- int vprintf(const char *restrict, __isoc_va_list);
1031- int vfprintf(FILE *restrict, const char *restrict, __isoc_va_list);
1032- int vsprintf(char *restrict, const char *restrict, __isoc_va_list);
1033- int vsnprintf(char *restrict, size_t, const char *restrict, __isoc_va_list);
1034
1035 int scanf(const char *restrict, ...);
1036 int fscanf(FILE *restrict, const char *restrict, ...);
1037 int sscanf(const char *restrict, const char *restrict, ...);
1038- int vscanf(const char *restrict, __isoc_va_list);
1039- int vfscanf(FILE *restrict, const char *restrict, __isoc_va_list);
1040- int vsscanf(const char *restrict, const char *restrict, __isoc_va_list);
1041
1042 void perror(const char *);
```

```diff
887  int snprintf(char *restrict, size_t, const char
888
889
890  int scanf(const char *restrict, ...);
891  int fscanf(FILE *restrict, const char *restrict,
892  int sscanf(const char *restrict, const char *res
893
894  void perror(const char *);
```

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/xc32-cpp.exe' \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py gv_digraph.xslt \
    | uniq \
    > gv_digraph.gv
```

usage

```
12    // transitions
13    init -> InitPState[label = ES_INIT];
14    InitPState -> Hiding  [label = ES_INIT];
15    Hiding -> Moving  [label = DARK_TO_LIGHT];
16    Moving -> Hiding  [label = LIGHT_TO_DARK];
17    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
18    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
19    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
20    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
21    Getting_Unstuck -> Hiding  [label = LIGHT_TO_DARK];
22    Getting_Unstuck -> Moving  [label = ES_TIMEOUT];
```

→

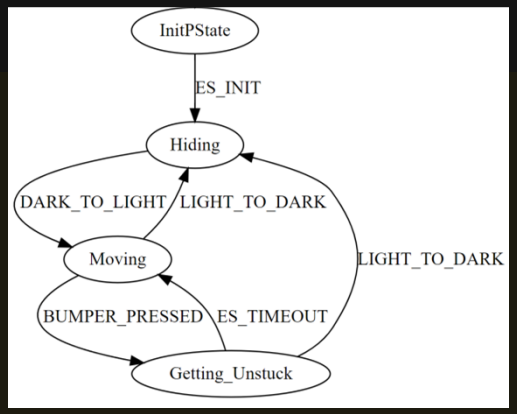
```
12    // transitions
13    init -> InitPState[label = ES_INIT];
14    InitPState -> Hiding  [label = ES_INIT];
15    Hiding -> Moving  [label = DARK_TO_LIGHT];
16    Moving -> Hiding  [label = LIGHT_TO_DARK];
17    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
18    Getting_Unstuck -> Hiding  [label = LIGHT_TO_DARK];
19    Getting_Unstuck -> Moving  [label = ES_TIMEOUT];
```

```
switch (CurrentState) {
    // ...
    case Moving:
        if (ThisEvent.EventType == LIGHT_TO_DARK) {
            stopMovement();
            nextState = Hiding;
            makeTransition = TRUE;
            ThisEvent.EventType = ES_NO_EVENT;
        }
        if (ThisEvent.EventType == BUMPER_PRESSED) {
        if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(90);
                ES_Timer_InitTimer(0,3000);
                nextState = Getting_Unstuck;
                makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
        }
        else if(ThisEvent.EventParam == 2) {
                previousBumpers = 2; backUpLeft(90);
                ES_Timer_InitTimer(0,3000);
                nextState = Getting_Unstuck;
                makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
        }
        else if(ThisEvent.EventParam == 4) {
                turnLeft(90);
                ES_Timer_InitTimer(0,3000);
                nextState = Getting_Unstuck;
                makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
        }
        else if(ThisEvent.EventParam == 8) {
                turnRight(90);
                ES_Timer_InitTimer(0,3000);
                nextState = Getting_Unstuck;
                makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
        }
        }
        break;
```

```
// transitions
init -> InitPState[label = ES_INIT];
InitPState -> Hiding  [label = ES_INIT];
Hiding -> Moving  [label = DARK_TO_LIGHT];
Moving -> Hiding  [label = LIGHT_TO_DARK];
Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
Getting_Unstuck -> Hiding  [label = LIGHT_TO_DARK];
Getting_Unstuck -> Moving  [label = ES_TIMEOUT];
```

```c
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            else if(ThisEvent.EventParam == 2) {
                    previousBumpers = 2; backUpLeft(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            // ...
            }
            break;

        case Getting_Unstuck:
            if (ThisEvent.EventType == LIGHT_TO_DARK)  {
                stopMovement(); nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == ES_TIMEOUT
                && ThisEvent.EventParam == SIMPLE_SERVICE_TIMER) {
                if(Roach_ReadBumpers() == 0) {
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                } else {
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                }
            }
            break;

        default:
            break;
    }

    if (makeTransition == TRUE) {
        RunTemplateFSM(EXIT_EVENT); CurrentState = nextState;
        RunTemplateFSM(ENTRY_EVENT);
    }
    ES_Tail();
    return ThisEvent;
}
```

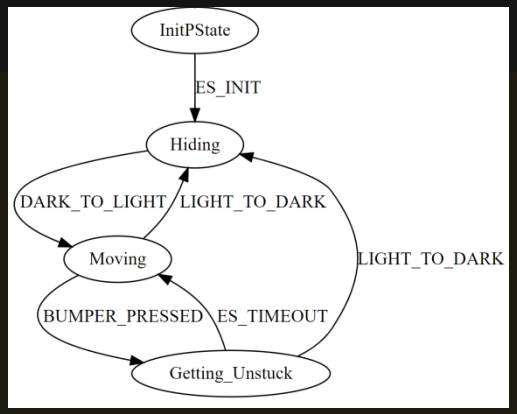
```graphviz
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    init -> InitPState[label = ES_INIT];
    InitPState -> Hiding  [label = ES_INIT];
    Hiding -> Moving  [label = DARK_TO_LIGHT];
    Moving -> Hiding  [label = LIGHT_TO_DARK];
    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
    Getting_Unstuck -> Hiding  [label = LIGHT_TO_DARK];
    Getting_Unstuck -> Moving  [label = ES_TIMEOUT];

}
```



# review

```c
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            else if(ThisEvent.EventParam == 2) {
                    previousBumpers = 2; backUpLeft(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            // ...
            }
            break;

        case Getting_Unstuck:
            if (ThisEvent.EventType == LIGHT_TO_DARK)  {
                stopMovement(); nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == ES_TIMEOUT
                && ThisEvent.EventParam == SIMPLE_SERVICE_TIMER) {
                if(Roach_ReadBumpers() == 0) {
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                } else {
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                }
            }
            break;

        default:
            break;
    }

    if (makeTransition == TRUE) {
        RunTemplateFSM(EXIT_EVENT); CurrentState = nextState;
        RunTemplateFSM(ENTRY_EVENT);
    }
    ES_Tail();
    return ThisEvent;
}
```

```graphviz
digraph fsm {

    init [shape = "point", color = "black"
      ,style="filled",width=.1,forcelabels=false];

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    init -> InitPState[label = ES_INIT];
    InitPState -> Hiding  [label = ES_INIT];
    Hiding -> Moving  [label = DARK_TO_LIGHT];
    Moving -> Hiding  [label = LIGHT_TO_DARK];
    Moving -> Getting_Unstuck  [label = BUMPER_PRESSED];
    Getting_Unstuck -> Hiding  [label = LIGHT_TO_DARK];
    Getting_Unstuck -> Moving  [label = ES_TIMEOUT];

}
```



# EventParam

```
digraph fsm {

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    InitPState -> Hiding [label = ES_INIT ]; // switch if
    Hiding -> Moving [label = DARK_TO_LIGHT ]; // switch switch
    Moving -> Hiding [label = LIGHT_TO_DARK ]; // switch if
    Moving -> Getting_Unstuck [label = BUMPER_PRESSED ]; // switch if
    Moving -> Getting_Unstuck [label = BUMPER_PRESSED ]; // switch if
    Moving -> Getting_Unstuck [label = BUMPER_PRESSED ]; // switch if
    Moving -> Getting_Unstuck [label = BUMPER_PRESSED ]; // switch if
    Getting_Unstuck -> Hiding [label = LIGHT_TO_DARK ]; // switch if
    Getting_Unstuck -> Moving [label = ES_TIMEOUT ]; // switch if

}
```

```
digraph fsm {

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    InitPState -> Hiding [label = ES_INIT ]; // switch if
    Hiding -> Moving [label = DARK_TO_LIGHT ]; // switch
    Moving -> Hiding [label = LIGHT_TO_DARK ]; // switch
    Moving -> Getting_Unstuck [label = BUMPER_PRESSED ];
    Moving -> Getting_Unstuck [label = BUMPER_PRESSED ];
    Moving -> Getting_Unstuck [label = BUMPER_PRESSED ];
    Moving -> Getting_Unstuck [label = BUMPER_PRESSED ];
    Getting_Unstuck -> Hiding [label = LIGHT_TO_DARK ];
    Getting_Unstuck -> Moving [label = ES_TIMEOUT ]; //

}
```

```
digraph fsm {

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    InitPState -> Hiding [label = ES_INIT ]; // switch if
    Hiding -> Moving [label = DARK_TO_LIGHT ]; // switch sw
    Moving -> Hiding [label = LIGHT_TO_DARK ]; // switch if
    Moving -> Getting_Unstuck [label = "BUMPER_PRESSED(1)"
    Moving -> Getting_Unstuck [label = "BUMPER_PRESSED(2)"
    Moving -> Getting_Unstuck [label = "BUMPER_PRESSED(4)"
    Moving -> Getting_Unstuck [label = "BUMPER_PRESSED(8)"
    Getting_Unstuck -> Hiding [label = LIGHT_TO_DARK ]; //
    Getting_Unstuck -> Moving [label = "ES_TIMEOUT(0)" ]; /

}
```

BUMPER_PRESSED(1)

```
if (ThisEvent.EventType == BUMPER_PRESSED)
{
    if(ThisEvent.EventParam == 1)
    {
        previousBumpers = 1;
        backUpRight(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 2)
    {
         previousBumpers = 2;
         backUpLeft(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 4)
    {
         turnLeft(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 8)
    {
         turnRight(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
}
break;
```

BUMPER_PRESSED(1)

```
if (ThisEvent.EventType == BUMPER_PRESSED)
{
    if(ThisEvent.EventParam == 1)
    {
        previousBumpers = 1;
        backUpRight(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 2)
    {
         previousBumpers = 2;
         backUpLeft(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 4)
    {
         turnLeft(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 8)
    {
         turnRight(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
}
break;
```

```
  <block_items class="FuncCall">
    <name class="ID" name="ES_Timer_InitTimer"/>
    <args class="ExprList">
      <exprs class="Constant" type="int" value="0"/>
      <exprs class="Constant" type="int" value="3000"/
    </args>
  </block_items>
  <block_items
      class="Assignment" op="=">
    <lvalue class="ID" name="nextState"/>
    <rvalue class="ID" name="Getting_Unstuck"/>
  </block_items>
  <block_items class="Assignment" op="=">
    <lvalue class="ID" name="makeTransition"/>
    <rvalue class="ID" name="TRUE"/>
  </block_items>
  <block_items class="Assignment" op="=">
    <lvalue class="StructRef" type=".">
      <name class="ID" name="ThisEvent"/>
      <field class="ID" name="EventType"/>
    </lvalue>
    <rvalue class="ID" name="ES_NO_EVENT"/>
  </block_items>
</iftrue>
<iffalse class="If">
  <cond class="BinaryOp" op="==">
    <left class="StructRef" type=".">
      <name class="ID" name="ThisEvent"/>
      <field class="ID" name="EventParam"/>
    </left>
    <right class="Constant" type="int" value="4"/>
  </cond>
  <iftrue class="Compound">
```

```
  <block_items class="FuncCall">
    <name class="ID" name="ES_Timer_InitTimer"/>
    <args class="ExprList">
      <exprs class="Constant" type="int" value="0"/>
      <exprs class="Constant" type="int" value="3000"/>
    </args>
  </block_items>
  <block_items EventLabel="BUMPER_PRESSED(2)"
      class="Assignment" op="=">
    <lvalue class="ID" name="nextState"/>
    <rvalue class="ID" name="Getting_Unstuck"/>
  </block_items>
  <block_items class="Assignment" op="=">
    <lvalue class="ID" name="makeTransition"/>
    <rvalue class="ID" name="TRUE"/>
  </block_items>
  <block_items class="Assignment" op="=">
    <lvalue class="StructRef" type=".">
      <name class="ID" name="ThisEvent"/>
      <field class="ID" name="EventType"/>
    </lvalue>
    <rvalue class="ID" name="ES_NO_EVENT"/>
  </block_items>
</iftrue>
<iffalse class="If">
  <cond class="BinaryOp" op="==">
    <left class="StructRef" type=".">
      <name class="ID" name="ThisEvent"/>
      <field class="ID" name="EventParam"/>
    </left>
    <right class="Constant" type="int" value="4"/>
  </cond>
  <iftrue class="Compound">
```

```
$ wc -l xslt/*xslt
  107 xslt/s0020_add_EventLabel_switch_if.xslt
   88 xslt/s0025_add_EventLabel_switch_switch.xslt
  168 xslt/s0080_gv_digraph.xslt
  363 total
$
```

# updated usage

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/'xc32-cpp.exe \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py gv_digraph.xslt \
    | uniq \
    > gv_digraph.gv
```

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/'xc32-cpp.exe \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py xslt/*.xslt \

    > gv_digraph.gv
```

```
$ wc -l xslt/*xslt
  107 xslt/s0020_add_EventLabel_switch_if.xslt
   88 xslt/s0025_add_EventLabel_switch_switch.xslt
  168 xslt/s0080_gv_digraph.xslt
  363 total
$
```

```python
import re
import sys
from pycparser import c_parser, c_ast, parse_file
from xml.dom import minidom
from lxml import etree as ET

def myshow(node, xnode=ET.Element("root"), buf=sys.stderr
    , offset=0, attrnames=False, nodenames=False
    , showcoord=False, _my_node_name=None):
    # ...

ast2 = parse_file("/dev/stdin", use_cpp=False)
xml2 = myshow(ast2, attrnames=True, nodenames=False)

if(len(sys.argv) < 2):
    print(prettify(ET.tostring(xml2, encoding='unicode')))
else:
    result = xml2
    for i in range(1,len(sys.argv)):
        xslt_doc = ET.parse(sys.argv[i])
        transformer = ET.XSLT(xslt_doc)
        result = transformer(result)
    print(result)
```

c_ast_xml_xslt.py

```
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            else if(ThisEvent.EventParam == 2) {
                    previousBumpers = 2; backUpLeft(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            // ...
            }
            break;

        case Getting_Unstuck:
            if (ThisEvent.EventType == LIGHT_TO_DARK)  {
                stopMovement(); nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == ES_TIMEOUT
                && ThisEvent.EventParam == SIMPLE_SERVICE_TIMER) {
                if(Roach_ReadBumpers() == 0) {
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                } else {
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                }
            }
            break;

        default:
            break;
    }

    if (makeTransition == TRUE) {
        RunTemplateFSM(EXIT_EVENT); CurrentState = nextState;
        RunTemplateFSM(ENTRY_EVENT);
    }
    ES_Tail();
    return ThisEvent;
}
```

```
<!--
  Inside top switch statement this template handles assignments to nextState guarded by switch statements
-->
<xsl:template match="*[@op='=' and ./lvalue[@name='nextState'] and 2=count(ancestor::block_items[@class='Case'])]">
            <xsl:text>    </xsl:text>
            <!-- top switch statement labels the current state -->
            <xsl:value-of select="
                ancestor::block_items[@class='Case'][2]/expr[@class='ID']/@name
            "/>
            <xsl:text> -> </xsl:text>
            <!-- right hand side of assignment supplies the next state -->
            <xsl:value-of select="rvalue/@name"/>
            <xsl:text>  [label = </xsl:text>
            <!-- take value of EventType from inner case statement id name  -->
            <xsl:value-of select="
              ../expr[@class='ID']/@name
             "/>
             <xsl:text>]; // switch switch
</xsl:text>
  </xsl:template>
```

# previous “switch switch”

# previous “switch if”

```
ES_Event RunTemplateFSM(ES_Event ThisEvent)
{
    uint8_t makeTransition = FALSE;
    TemplateFSMState_t nextState;  ES_Tattle();

    switch (CurrentState) {

        case InitPState:
            if (ThisEvent.EventType == ES_INIT)
            {
                nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }
            break;

        case Hiding:
            switch (ThisEvent.EventType) {

                case ES_ENTRY: break;

                case ES_EXIT: break;

                case DARK_TO_LIGHT:
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                    break;

                default:
                    break;
            }
            break;

        case Moving:
            if (ThisEvent.EventType == LIGHT_TO_DARK) {
                stopMovement(); nextState = Hiding;
                makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == BUMPER_PRESSED) {
            if(ThisEvent.EventParam == 1) {
                previousBumpers = 1; backUpRight(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            else if(ThisEvent.EventParam == 2) {
                    previousBumpers = 2; backUpLeft(TURNING_SPEED);
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                    nextState = Getting_Unstuck; makeTransition = TRUE;
                    ThisEvent.EventType = ES_NO_EVENT;
            }
            // ...
            }
            break;

        case Getting_Unstuck:
            if (ThisEvent.EventType == LIGHT_TO_DARK)  {
                stopMovement(); nextState = Hiding; makeTransition = TRUE;
                ThisEvent.EventType = ES_NO_EVENT;
            }

            if (ThisEvent.EventType == ES_TIMEOUT
                && ThisEvent.EventParam == SIMPLE_SERVICE_TIMER) {
                if(Roach_ReadBumpers() == 0) {
                    goForward(MOVING_SPEED); nextState = Moving;
                    makeTransition = TRUE; ThisEvent.EventType = ES_NO_EVENT;
                } else {
                    ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
                }
            }
            break;

        default:
            break;
    }

    if (makeTransition == TRUE) {
        RunTemplateFSM(EXIT_EVENT); CurrentState = nextState;
        RunTemplateFSM(ENTRY_EVENT);
    }
    ES_Tail();
    return ThisEvent;
}
```

```
<!--
  Inside the top switch statement this template handles assignments to nextState guarded by if statements
-->
<xsl:template match="*[@op='=' and ./lvalue[@name='nextState'] and 1=count(ancestor::block_items[@class='Case'])]">
        <xsl:text>    </xsl:text>
        <!-- top level switch statement labels the current state -->
        <xsl:value-of select="
            ancestor::block_items[@class='Case'][1]/expr[@class='ID']/@name
        "/>
        <xsl:text> -> </xsl:text>
        <!-- right hand side of assignment supplies the next state -->
        <xsl:value-of select="rvalue/@name"/>
        <xsl:text>  [label = </xsl:text>

    <!-- locate first enclosing context that tests EventType (such as some if statement) -->
    <xsl:for-each select="
            ancestor::*[
              .//*[@op='==' and .//field[@name='EventType']]
            ][1]
    ">
        <!-- inside the first enclosing context that tests EventType take the value it is tested against -->
        <xsl:value-of select="
            .//*[@op='==' and .//field[@name='EventType']]
            /right/@name
          "/>
    </xsl:for-each>
    <xsl:text>]; // switch if
</xsl:text>
</xsl:template>
```

# updated “switch if”

```
<!--
 Inside the top switch statement this template handles
 assignments to nextState guarded by if statements
-->
<xsl:template match="
 *[
     @op='='
     and ./lvalue[@name='nextState']
     and 1=count(ancestor::block_items[@class='Case'])
 ]">
         <xsl:text>    "</xsl:text>
         <!-- top level switch statement labels the current state -->
         <xsl:value-of select="
             ancestor::block_items[@class='Case'][1]/expr[@class='ID']/@name
         "/>
         <xsl:text>" -> "</xsl:text>
         <!-- right hand side of assignment supplies the next state -->
         <xsl:value-of select="rvalue/@name"/>
         <xsl:text>" [label = "</xsl:text>
     <!-- locate first enclosing context that == tests
         EventType (such as some if statement) -->
     <xsl:for-each select="
             ancestor::*[
               .//*[@op='==' and .//field[@name='EventType']]
             ][1]
     ">
         <!-- inside the first enclosing context that tests EventType
             take the value it is tested against -->
         <xsl:value-of select="
             .//*[@op='==' and .//field[@name='EventType']]
             /right/@name
           "/>
     </xsl:for-each>
     <xsl:text>" ]; // switch if
</xsl:text>
</xsl:template>
```

```
<!--
 Inside the top switch statement this template handles
 assignments to nextState guarded by if statements
-->
<xsl:template match="
 *[
     @op='='
     and ./lvalue[@name='nextState']
     and 1=count(ancestor::block_items[@class='Case'])
 ]">
         <xsl:text>    "</xsl:text>
         <!-- top level switch statement labels the current state -->
         <xsl:value-of select="
             ancestor::block_items[@class='Case'][1]/expr[@class='ID']/@name
         "/>
         <xsl:text>" -> "</xsl:text>
         <!-- right hand side of assignment supplies the next state -->
         <xsl:value-of select="rvalue/@name"/>
         <xsl:text>" [label = "</xsl:text>
         <xsl:value-of select="@EventLabel"/>
     <xsl:text>" ]; // switch if
</xsl:text>
</xsl:template>
```

```
<!--
  Inside top switch statement this template handles
  assignments to nextState guarded by switch statements
-->
<xsl:template match="
  *[
      @op='='
      and ./lvalue[@name='nextState']
      and 2=count(ancestor::block_items[@class='Case'])
    ]">
        <xsl:text>    "</xsl:text>
        <!-- top switch statement labels the current state -->
        <xsl:value-of select="
            ancestor::block_items[@class='Case'][2]/expr[@class='ID']/@name
        "/>
        <xsl:text>" -> "</xsl:text>
        <!-- right hand side of assignment supplies the next state -->
        <xsl:value-of select="rvalue/@name"/>
        <xsl:text>" [label = "</xsl:text>
        <!-- take value of EventType from inner case statement id name  -->
        <xsl:value-of select="
            ../expr[@class='ID']/@name
          "/>
        <xsl:text>" ]; // switch switch
</xsl:text>
  </xsl:template>
```

```
<!--
  Inside top switch statement this template handles
  assignments to nextState guarded by switch statements
-->
<xsl:template match="
  *[
      @op='='
      and ./lvalue[@name='nextState']
      and 2=count(ancestor::block_items[@class='Case'])
    ]">
        <xsl:text>    "</xsl:text>
        <!-- top switch statement labels the current state -->
        <xsl:value-of select="
            ancestor::block_items[@class='Case'][2]/expr[@class='ID']/@name
        "/>
        <xsl:text>" -> "</xsl:text>
        <!-- right hand side of assignment supplies the next state -->
        <xsl:value-of select="rvalue/@name"/>
        <xsl:text>" [label = "</xsl:text>
        <!-- take value of EventType from inner case statement id name  -->
        <xsl:value-of select="@EventLabel"/>

        <xsl:text>" ]; // switch switch
</xsl:text>
  </xsl:template>
```

# updated “switch switch”

# EventLabel

```
if (ThisEvent.EventType == BUMPER_PRESSED)
{
    if(ThisEvent.EventParam == 1)
    {
        previousBumpers = 1;
        backUpRight(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 2)
    {
         previousBumpers = 2;
         backUpLeft(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 4)
    {
         turnLeft(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 8)
    {
         turnRight(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
}
break;
```

BUMPER_PRESSED(1)

```
<xsl:template
  match="
  *[
    @op='='
    and ./lvalue[@name='nextState']
    and 1=count(ancestor::block_items[@class='Case'])
  ]
">

  <xsl:variable name="EventType">
    ...
  </xsl:variable>

  <xsl:variable name="EventParam">
  ..
  </xsl:variable>

  <xsl:variable name="EventLabel">
    <xsl:choose>
      <xsl:when test=" normalize-space($EventParam)='' ">
        <xsl:copy-of select="normalize-space($EventType)" />
      </xsl:when>
      <xsl:otherwise>
        <xsl:copy-of select="normalize-space($EventType)" />
        <xsl:text>(</xsl:text>
        <xsl:copy-of select="normalize-space($EventParam)" />
        <xsl:text>)</xsl:text>
      </xsl:otherwise>
    </xsl:choose>
  </xsl:variable>

  <xsl:copy>
    <xsl:choose>
      <xsl:when test=" normalize-space($EventType)='' ">
        <!-- if EventType not identified do not add EventLabel attribute -->
      </xsl:when>
      <xsl:otherwise>
        <xsl:attribute name="EventLabel">
          <xsl:copy-of select="$EventLabel" />
        </xsl:attribute>
      </xsl:otherwise>
    </xsl:choose>
    <xsl:apply-templates select="@*|node()" />
  </xsl:copy>

</xsl:template>
```

```
if (ThisEvent.EventType == BUMPER_PRESSED)
{
    if(ThisEvent.EventParam == 1)
    {
        previousBumpers = 1;
        backUpRight(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 2)
    {
         previousBumpers = 2;
         backUpLeft(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 4)
    {
         turnLeft(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 8)
    {
         turnRight(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
}
break;
```

BUMPER_PRESSED(1)

```
<xsl:template
  match="
  *[
    @op='='
    and ./lvalue[@name='nextState']
    and 1=count(ancestor::block_items[@class='Case'])
  ]
">

  <xsl:variable name="EventType">
    ...
  </xsl:variable>

  <xsl:variable name="EventParam">
   ..
  </xsl:variable>

  <xsl:variable name="EventLabel">
    <xsl:choose>
      <xsl:when test=" normalize-space($EventParam)='' ">
        <xsl:copy-of select="normalize-space($EventType)" />
      </xsl:when>
      <xsl:otherwise>
        <xsl:copy-of select="normalize-space($EventType)" />
        <xsl:text>(</xsl:text>
        <xsl:copy-of select="normalize-space($EventParam)" />
        <xsl:text>)</xsl:text>
      </xsl:otherwise>
    </xsl:choose>
  </xsl:variable>

  <xsl:copy>
    <xsl:choose>
      <xsl:when test=" normalize-space($EventType)='' ">
        <!-- if EventType not identified do not add EventLabel attribute -->
      </xsl:when>
      <xsl:otherwise>
        <xsl:attribute name="EventLabel">
          <xsl:copy-of select="$EventLabel" />
        </xsl:attribute>
      </xsl:otherwise>
    </xsl:choose>
    <xsl:apply-templates select="@*|node()" />
  </xsl:copy>

</xsl:template>
```

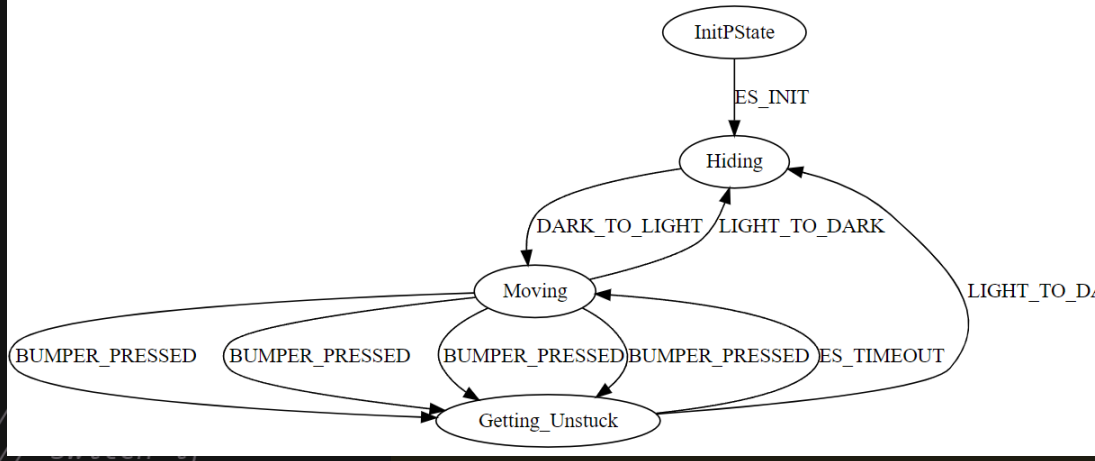
```
if (ThisEvent.EventType == BUMPER_PRESSED)
{
    if(ThisEvent.EventParam == 1)
    {
        previousBumpers = 1;
        backUpRight(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 2)
    {
         previousBumpers = 2;
         backUpLeft(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 4)
    {
         turnLeft(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 8)
    {
         turnRight(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
}
break;
```

```
<xsl:variable name="EventType">
  <!-- locate first (any) enclosing context
  (still inside a switch statement case block)
  that tests EventType (such as some if statement) -->
  <xsl:for-each
    select="
            ancestor::*[
              ancestor::block_items[@class='Case']
              and .//*[@op='==' and .//field[@name='EventType']]
            ][1]
  ">
    <!-- inside the first enclosing context that tests EventType take
    the value it is tested against -->
    <xsl:value-of
      select="
            .//*[@op='==' and .//field[@name='EventType']]
            /right/@name
    " />
  </xsl:for-each>
</xsl:variable>

<xsl:variable name="EventParam">
  <!-- locate first (any) enclosing context
  (still inside a switch statement case block)
  that tests EventParam (such as some if statement) -->
  <xsl:for-each
    select="
            ancestor::*[
              ancestor::block_items[@class='Case']
              and .//*[@op='==' and .//field[@name='EventParam']]
            ][1]
  ">
    <!-- inside the enclosing context that tests EventParam take the
    name of what it is tested against -->
    <xsl:value-of
      select="
            .//*[@op='==' and .//field[@name='EventParam']]
            /right/@name
    " />
    <!-- since the thing EventParam is tested against may be a constant such as
    <right class="Constant" type="int" value="0"/>
    and constants have no name attribute also try to take the value of the thing
    -->
    <xsl:value-of
      select="
            .//*[@op='==' and .//field[@name='EventParam']]
            /right/@value
    " />
  </xsl:for-each>
</xsl:variable>
```

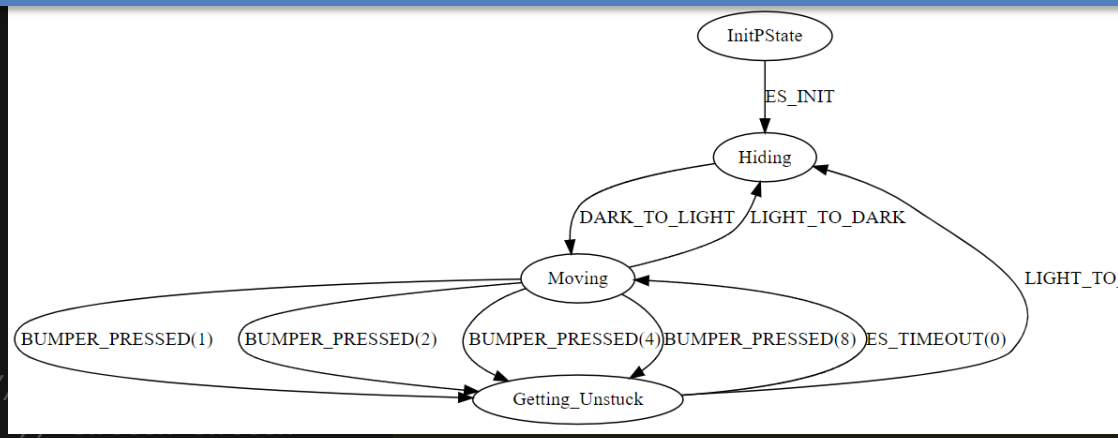
```
if (ThisEvent.EventType == BUMPER_PRESSED)
{
    if(ThisEvent.EventParam == 1)
    {
        previousBumpers = 1;
        backUpRight(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 2)
    {
         previousBumpers = 2;
         backUpLeft(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 4)
    {
         turnLeft(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
    else if(ThisEvent.EventParam == 8)
    {
         turnRight(TURNING_SPEED);
         ES_Timer_InitTimer(SIMPLE_SERVICE_TIMER,TURN_TIME);
         nextState = Getting_Unstuck;
         makeTransition = TRUE;
         ThisEvent.EventType = ES_NO_EVENT;
    }
}
break;
```

```
<xsl:variable name="EventType">
  <!-- locate first (any) enclosing context
  (still inside a switch statement case block)
  that tests EventType (such as some if statement) -->
  <xsl:for-each
    select="
            ancestor::*[
              ancestor::block_items[@class='Case']
              and .//*[@op='==' and .//field[@name='EventType']]
            ][1]
  ">
    <!-- inside the first enclosing context that tests EventType take
    the value it is tested against -->
    <xsl:value-of
      select="
            .//*[@op='==' and .//field[@name='EventType']]
            /right/@name
    " />
  </xsl:for-each>
</xsl:variable>

<xsl:variable name="EventParam">
  <!-- locate first (any) enclosing context
  (still inside a switch statement case block)
  that tests EventParam (such as some if statement) -->
  <xsl:for-each
    select="
            ancestor::*[
              ancestor::block_items[@class='Case']
              and .//*[@op='==' and .//field[@name='EventParam']]
            ][1]
  ">
    <!-- inside the enclosing context that tests EventParam take the
    name of what it is tested against -->
    <xsl:value-of
      select="
            .//*[@op='==' and .//field[@name='EventParam']]
            /right/@name
    " />
    <!-- since the thing EventParam is tested against may be a constant such as
    <right class="Constant" type="int" value="0"/>
    and constants have no name attribute also try to take the value of the thing
    -->
    <xsl:value-of
      select="
            .//*[@op='==' and .//field[@name='EventParam']]
            /right/@value
    " />
  </xsl:for-each>
</xsl:variable>
```

```
digraph fsm {

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    InitPState -> Hiding [label = ES_INIT ]; //
    Hiding -> Moving [label = DARK_TO_LIGHT ];
    Moving -> Hiding [label = LIGHT_TO_DARK ];
    Moving -> Getting_Unstuck [label = BUMPER_PRESSED ]; // switch if
    Moving -> Getting_Unstuck [label = BUMPER_PRESSED ]; // switch if
    Moving -> Getting_Unstuck [label = BUMPER_PRESSED ]; // switch if
    Moving -> Getting_Unstuck [label = BUMPER_PRESSED ]; // switch if
    Getting_Unstuck -> Hiding [label = LIGHT_TO_DARK ]; // switch if
    Getting_Unstuck -> Moving [label = ES_TIMEOUT ]; // switch if
```




```
digraph fsm {

    // states
    InitPState;
    Hiding;
    Moving;
    Getting_Unstuck;

    // transitions
    InitPState -> Hiding [label = ES_INIT ]; //
    Hiding -> Moving [label = DARK_TO_LIGHT ];
    Moving -> Hiding [label = LIGHT_TO_DARK ]; // switch if
    Moving -> Getting_Unstuck [label = "BUMPER_PRESSED(1)" ]; // swit
    Moving -> Getting_Unstuck [label = "BUMPER_PRESSED(2)" ]; // swit
    Moving -> Getting_Unstuck [label = "BUMPER_PRESSED(4)" ]; // swit
    Moving -> Getting_Unstuck [label = "BUMPER_PRESSED(8)" ]; // swit
    Getting_Unstuck -> Hiding [label = LIGHT_TO_DARK ]; // switch if
    Getting_Unstuck -> Moving [label = "ES_TIMEOUT(0)" ]; // switch i
```



# DONE

- C => AST
- Handling
  - CurrentState
  - NextState
  - EventType
  - EventParam
- Flat FSM

# TODO

- Handling
  - functions (?)
  - cascades (?)
  - ???
- HSM (?)
- IDE (?)

? functions ?

ECE118_RoachLab_Bailen/ece118_lab0/ECE118_Lab0_Part7_Alexis.X/TemplateFSM.c

```
case In_Light:
    if (ThisEvent.EventType == DARK_TO_LIGHT)
    {
        nextState = In_Light;
        makeTransition = TRUE;
        ThisEvent.EventType = ES_NO_EVENT;
    }
    if (IsBumperPressEvent(ThisEvent))
    {
        nextState = Reversing;
        makeTransition = TRUE;
        ThisEvent.EventType = ES_NO_EVENT;
    }
    break;
```

ECE118_RoachLab_Bailen/ece118_lab0/ECE118_Lab0_Part7_Alexis.X/TemplateFSM.c

```c
case In_Light:
    if (ThisEvent.EventType == DARK_TO_LIGHT)
    {
        nextState = In_Light;
        makeTransition = TRUE;
        ThisEvent.EventType = ES_NO_EVENT;
    }
    if (IsBumperPressEvent(ThisEvent))
    {
        nextState = Reversing;
        makeTransition = TRUE;
        ThisEvent.EventType = ES_NO_EVENT;
    }
    break;
```

```c
uint8_t IsBumperPressEvent(ES_Event event)
{
    uint8_t upper_bound
        = REAR_RIGHT_BUMPER_PRESSED;
    uint8_t lower_bound
        = FRONT_LEFT_BUMPER_RELEASED;
    uint8_t event_enum = event.EventType;
    uint8_t inBumperEnumRange
        = (event_enum >= lower_bound)
        && (event_enum <= upper_bound);
    if (inBumperEnumRange) {
        return event.EventParam;
    } else { return FALSE; }
}
```

# ECE118_RoachLab_Bailen/ece118_lab0/ECE118_Lab0_Part7_Alexis.X/TemplateFSM.c

```c
case In_Light:
    if (ThisEvent.EventType == DARK_TO_LIGHT)
    {
        nextState = In_Light;
        makeTransition = TRUE;
        ThisEvent.EventType = ES_NO_EVENT;
    }
    if (IsBumperPressEvent(ThisEvent))
    {
        nextState = Reversing;
        makeTransition = TRUE;
        ThisEvent.EventType = ES_NO_EVENT;
    }
    break;
```

```c
uint8_t IsBumperPressEvent(ES_Event event)
{
    uint8_t upper_bound
        = REAR_RIGHT_BUMPER_PRESSED;
    uint8_t lower_bound
        = FRONT_LEFT_BUMPER_RELEASED;
    uint8_t event_enum = event.EventType;
    uint8_t inBumperEnumRange
        = (event_enum >= lower_bound)
        && (event_enum <= upper_bound);
    if (inBumperEnumRange) {
        return event.EventParam;
    } else { return FALSE; }
}
```

```xml
<stmts class="If">
  <cond class="FuncCall">
    <name class="ID" name="IsBumperPressEvent"/>
    <args class="ExprList">
      <exprs class="ID" name="ThisEvent"/>
    </args>
  </cond>
  <iftrue class="Compound">
    <block_items class="Assignment" op="=">
      <lvalue class="ID" name="nextState"/>
      <rvalue class="ID" name="Reversing"/>
    </block_items>
    <block_items class="Assignment" op="=">
      <lvalue class="ID" name="makeTransition"/>
      <rvalue class="ID" name="TRUE"/>
    </block_items>
    <block_items class="Assignment" op="=">
      <lvalue class="StructRef" type=".">
        <name class="ID" name="ThisEvent"/>
        <field class="ID" name="EventType"/>
      </lvalue>
      <rvalue class="ID" name="ES_NO_EVENT"/>
    </block_items>
  </iftrue>
</stmts>
<stmts class="Break"/>
```

? cascades ?

ECE118_RoachLab_Bailen\ece118_lab0\ECE118_Lab0_Part8.X\SubHSM_Dark.c

```c
case Reversing:
    switch (ThisEvent.EventType) {
    case ES_ENTRY:
        GoBackward();
        break;

    //Handle rear bumpers
    case REAR_LEFT_BUMPER_PRESSED:
    case REAR_RIGHT_BUMPER_PRESSED:
        nextState = Driving;
        makeTransition = TRUE;
        ThisEvent.EventType = ES_NO_EVENT;
        break;

    //Handle front bumpers
    case FRONT_LEFT_BUMPER_RELEASED:
    case FRONT_RIGHT_BUMPER_RELEASED:
        nextState = ContinueMoving;
        makeTransition = TRUE;
        ThisEvent.EventType = ES_NO_EVENT;
        break;

    default:
        break;
    }
    break;
```

ECE118_RoachLab_Bailen\ece118_lab0\ECE118_Lab0_Part8.X\SubHSM_Dark.c

```c
case Reversing:
    switch (ThisEvent.EventType) {
    case ES_ENTRY:
        GoBackward();
        break;

    //Handle rear bumpers
    case REAR_LEFT_BUMPER_PRESSED:
    case REAR_RIGHT_BUMPER_PRESSED:
        nextState = Driving;
        makeTransition = TRUE;
        ThisEvent.EventType = ES_NO_EVENT;
        break;

    //Handle front bumpers
    case FRONT_LEFT_BUMPER_RELEASED:
    case FRONT_RIGHT_BUMPER_RELEASED:
        nextState = ContinueMoving;
        makeTransition = TRUE;
        ThisEvent.EventType = ES_NO_EVENT;
        break;

    default:
        break;
    }
    break;
```

```xml
<block_items class="Case">
  <expr class="ID"
    name="REAR_LEFT_BUMPER_PRESSED"/>
</block_items>
<block_items class="Case">
  <expr class="ID"
    name="REAR_RIGHT_BUMPER_PRESSED"/>
  <stmts class="Assignment" op="=">
    <lvalue class="ID" name="nextState"/>
    <rvalue class="ID" name="Driving"/>
  </stmts>
  <stmts class="Assignment" op="=">
    <lvalue class="ID" name="makeTransition"/>
    <rvalue class="ID" name="TRUE"/>
  </stmts>
  <stmts class="Assignment" op="=">
    <lvalue class="StructRef" type=".">
      <name class="ID" name="ThisEvent"/>
      <field class="ID" name="EventType"/>
    </lvalue>
    <rvalue class="ID" name="ES_NO_EVENT"/>
  </stmts>
  <stmts class="Break"/>
</block_items>
```

? hsm ?

# ECE118_RoachLab_Bailen\ece118_lab0\ECE118_Lab0_Part8.X*HSM*.c

```c
Event RunTemplateHSM(ES_Event ThisEvent) {
 uint8_t makeTransition = FALSE; TemplateHSMState_t nextState

 switch (CurrentState) {
     case InitPState:
         if (ThisEvent.EventType == ES_INIT)
         {
             InitLightSubHSM();
             InitDarkSubHSM();
             InitJigSubHSM();
             ES_Timer_SetTimer(JIG_TIMER, JIG_TIME);
             nextState = InDark;
             makeTransition = TRUE;
             ThisEvent.EventType = ES_NO_EVENT;
         }
         break;
     case InLight:
         ThisEvent = RunLightSubHSM(ThisEvent);
         switch (ThisEvent.EventType) {
         case ES_ENTRY:
             ES_Timer_InitTimer(JIG_TIMER, JIG_TIME);
             break;
         case ES_EXIT:
             ES_Timer_StopTimer(JIG_TIMER);
             break;
         case LIGHT_TO_DARK:
             nextState = InDark;
             makeTransition = TRUE;
             ThisEvent.EventType = ES_NO_EVENT;
             break;
         case ES_TIMEOUT:
             nextState = Jig;
             makeTransition = TRUE;
             ThisEvent.EventType = ES_NO_EVENT;
             ES_Timer_SetTimer(JIG_SPIN_TIMER
                 , JIG_SPIN_TIME);
             break;
         default:
             break;
         }
         break;
     case InDark:
         ThisEvent = RunDarkSubHSM(ThisEvent);
         switch (ThisEvent.EventType) {
         case ES_ENTRY:
             StopMotors();
             break;
         case DARK_TO_LIGHT:
             nextState = InLight;
             makeTransition = TRUE;
             ThisEvent.EventType = ES_NO_EVENT;
             break;
         default:
             break;
         }
         break;
     case Jig:
         ThisEvent = RunJigSubHSM(ThisEvent);
         switch (ThisEvent.EventType) {
         case JIG_FINISHED:
             nextState = InLight;
             makeTransition = TRUE;
             ThisEvent.EventType = ES_NO_EVENT;
```

TOP

```c
Event RunLightSubHSM(ES_Event ThisEvent) {
 uint8_t makeTransition = FALSE; TemplateSubHSMState_t nex

 switch (CurrentState) {
     case InitPSubState:
         if (ThisEvent.EventType == ES_INIT){
             nextState = Running;
             makeTransition = TRUE;
             ThisEvent.EventType = ES_NO_EVENT;
         }
         break;
     case Running:
         switch (ThisEvent.EventType) {
             case ES_ENTRY:
                 CurveForward(turnDirection);
                 break;
             case ES_EXIT:
                 StopMotors();
                 break;
             case ES_TIMEOUT:
                 if (ThisEvent.EventParam
                     == LIGHT_SUB_HSM_TIMER) {
                     previousBump = ES_NO_EVENT;
                 }
                 break;
             case FRONT_LEFT_BUMPER_PRESSED:
                 turnDirection = RIGHT;
                 nextState = Reversing;
                 makeTransition = TRUE;
                 ThisEvent.EventType = ES_NO_EVENT;
                 break;
             case FRONT_RIGHT_BUMPER_PRESSED:
                 turnDirection = LEFT;
                 nextState = Reversing;
                 makeTransition = TRUE;
                 ThisEvent.EventType = ES_NO_EVENT;
                 break;
             default:
                 break;
         }
         break;
     case Reversing:
         switch (ThisEvent.EventType) {
             case ES_ENTRY:
                 ES_Timer_InitTimer(
                     LIGHT_SUB_HSM_TIMER
                     , REVERSE_TIME_250MS);
                 GoBackward();
                 turnTime = SIXTEENTH_TURN_TIME;
                 break;
             case ES_EXIT:
                 ES_Timer_StopTimer(LIGHT_SUB_HSM_TIMER);
                 StopMotors();
                 break;
             case FRONT_LEFT_BUMPER_PRESSED:
             case FRONT_RIGHT_BUMPER_PRESSED:

                 turnTime = EIGHTH_TURN_TIME;
                 break;
             case ES_TIMEOUT:
                 if (ThisEvent.EventParam
                     == LIGHT_SUB_HSM_TIMER) {
                     nextState = Turning;
```

IN_LIGHT

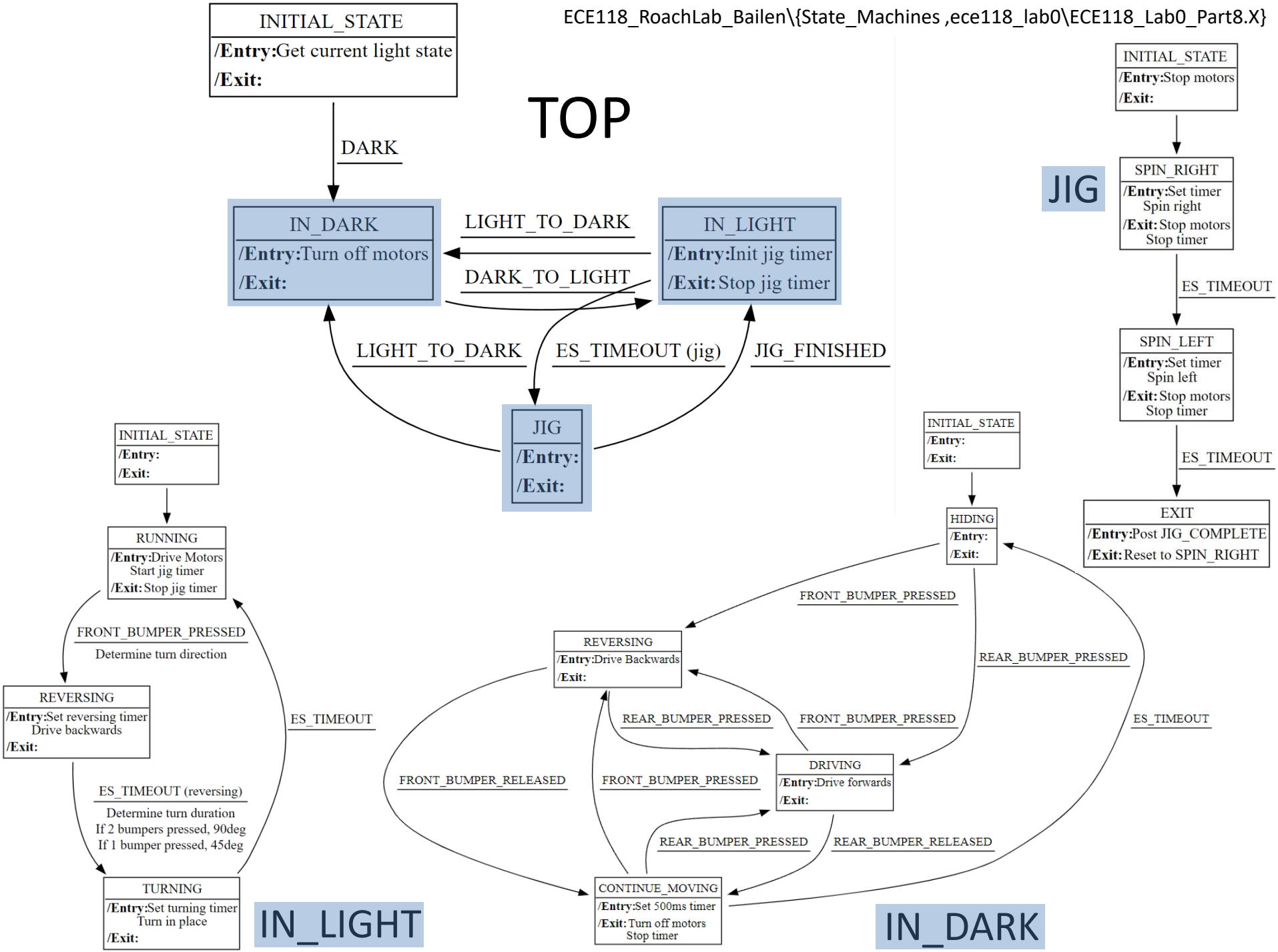
```c
Event RunDarkSubHSM(ES_Event ThisEvent) {
 uint8_t makeTransition = FALSE; TemplateSubHSMState_t

 switch (CurrentState) {
     case InitPSubState:
         if (ThisEvent.EventType == ES_INIT) {
             nextState = Hiding;
             makeTransition = TRUE;
             ThisEvent.EventType = ES_NO_EVENT;
         }
         break;
     case Hiding:
         switch (ThisEvent.EventType) {
             case FRONT_LEFT_BUMPER_PRESSED:
             case FRONT_RIGHT_BUMPER_PRESSED:
                 nextState = Reversing;
                 makeTransition = TRUE;
                 ThisEvent.EventType = ES_NO_EVENT;
                 break;
             case REAR_LEFT_BUMPER_PRESSED:
             case REAR_RIGHT_BUMPER_PRESSED:
                 nextState = Driving;
                 makeTransition = TRUE;
                 ThisEvent.EventType = ES_NO_EVENT;
                 break;
             default:
                 break;
         }
         break;
     case Reversing:
         switch (ThisEvent.EventType) {
             case ES_ENTRY:
                 GoBackward();
                 break;
             case REAR_LEFT_BUMPER_PRESSED:
             case REAR_RIGHT_BUMPER_PRESSED:
                 nextState = Driving;
                 makeTransition = TRUE;
                 ThisEvent.EventType = ES_NO_EVENT;
                 break;
             case FRONT_LEFT_BUMPER_RELEASED:
             case FRONT_RIGHT_BUMPER_RELEASED:
                 nextState = ContinueMoving;
                 makeTransition = TRUE;
                 ThisEvent.EventType = ES_NO_EVENT;
                 break;
             default:
                 break;
         }
         break;
     case Driving:
         switch (ThisEvent.EventType) {
             case ES_ENTRY:
                 GoForward();
                 break;
             case FRONT_LEFT_BUMPER_PRESSED:
             case FRONT_RIGHT_BUMPER_PRESSED:
                 nextState = Reversing;
                 makeTransition = TRUE;
                 ThisEvent.EventType = ES_NO_EVENT;
                 break;
             case REAR_LEFT_BUMPER_RELEASED:
             case REAR_RIGHT_BUMPER_RELEASED:
```

IN_DARK

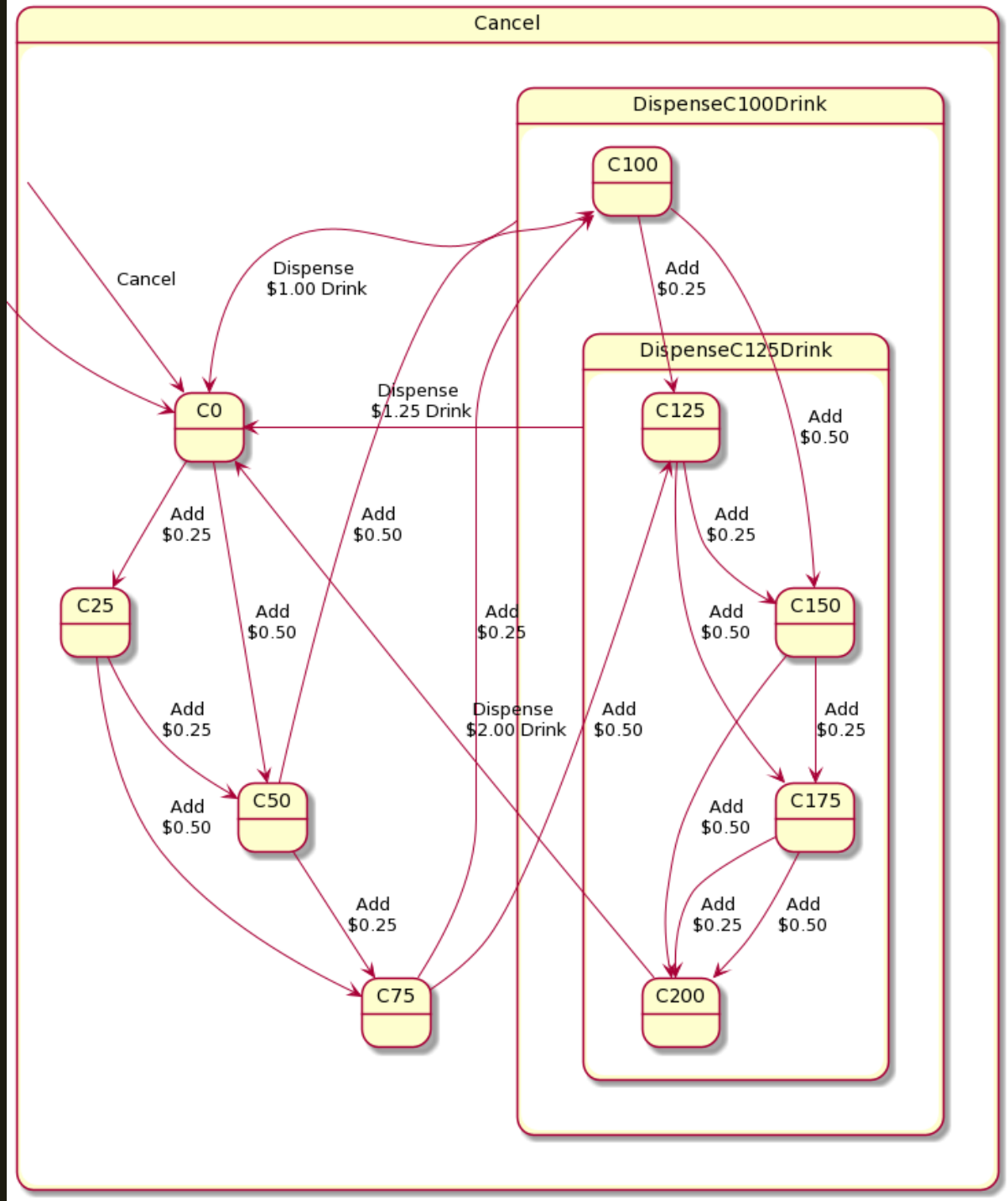
```c
Event RunJigSubHSM(ES_Event ThisEvent) {
 uint8_t makeTransition = FALSE; TemplateSubHSMState_t

 switch (CurrentState) {
     case InitPSubState:
         if (ThisEvent.EventType == ES_INIT)
         {
             nextState = SpinRight;
             makeTransition = TRUE;
             ThisEvent.EventType = ES_NO_EVENT;
         }
         break;
     case SpinRight:
         switch (ThisEvent.EventType) {
             case ES_ENTRY:
                 ES_Timer_StartTimer(JIG_SPIN_TIMER);
                 Turn(RIGHT);
                 break;
             case ES_EXIT:
                 ES_Timer_StopTimer(JIG_SPIN_TIMER);
                 StopMotors();
                 break;
             case ES_TIMEOUT:
                 if (ThisEvent.EventParam
                     == JIG_SPIN_TIMER) {
                     ES_Timer_SetTimer(JIG_SPIN_TIMER
                     , JIG_SPIN_TIME);
                     nextState = SpinLeft;
                     makeTransition = TRUE;
                     ThisEvent.EventType = ES_NO_EVENT;
                 }
                 break;
             default:
                 break;
         }
         break;
     case SpinLeft:
         switch (ThisEvent.EventType) {
             case ES_ENTRY:
                 ES_Timer_StartTimer(JIG_SPIN_TIMER);
                 Turn(LEFT);
                 break;
             case ES_EXIT:
                 ES_Timer_StopTimer(JIG_SPIN_TIMER);
                 StopMotors();
                 break;
             case ES_TIMEOUT:
                 ES_Timer_SetTimer(JIG_SPIN_TIMER
                     , JIG_SPIN_TIME);
                 ReturnEvent.EventType = JIG_FINISHED;
                 ReturnEvent.EventParam = JIG_FINISHED;
                 PostTemplateHSM(ReturnEvent);
                 nextState = SpinRight;
                 makeTransition = TRUE;
                 ThisEvent.EventType = ES_NO_EVENT;
                 break;
             default:
                 break;
         }
         break;
     default:
         break;
 }
```

JIG

ECE118_RoachLab_Bailen\{State_Machines ,ece118_lab0\ECE118_Lab0_Part8.X}



```
subgraph cluster_cancel {
    label = "Cancel"
    style = rounded

E2 [shape=rect label="" width=2 style=invis]
E2:sw->C0  [label=cancel]

    C0 [label = <
        <table cellborder="0" style="rounded">
            <tr><td>C0</td></tr>
            <hr/>
            <tr><td></td></tr>
        </table>
    > margin=0 shape=none]

    C25 [label = <
        <table cellborder="0" style="rounded">
            <tr><td>C25</td></tr>
            <hr/>
            <tr><td></td></tr>
        </table>
    > margin=0 shape=none]

    C50 [label = <
        <table cellborder="0" style="rounded">
            <tr><td>C50</td></tr>
            <hr/>
            <tr><td></td></tr>
        </table>
    > margin=0 shape=none]

    C75 [label = <
        <table cellborder="0" style="rounded">
            <tr><td>C75</td></tr>
            <hr/>
            <tr><td></td></tr>
        </table>
    > margin=0 shape=none]

    subgraph cluster_DispenseC100Drink {
        label = "DispenseC100Drink"
        style = rounded

        C100 [label = <
            <table cellborder="0" style="rounded">
                <tr><td>C100</td></tr>
                <hr/>
                <tr><td></td></tr>
            </table>
        > margin=0 shape=none]
```



# DONE

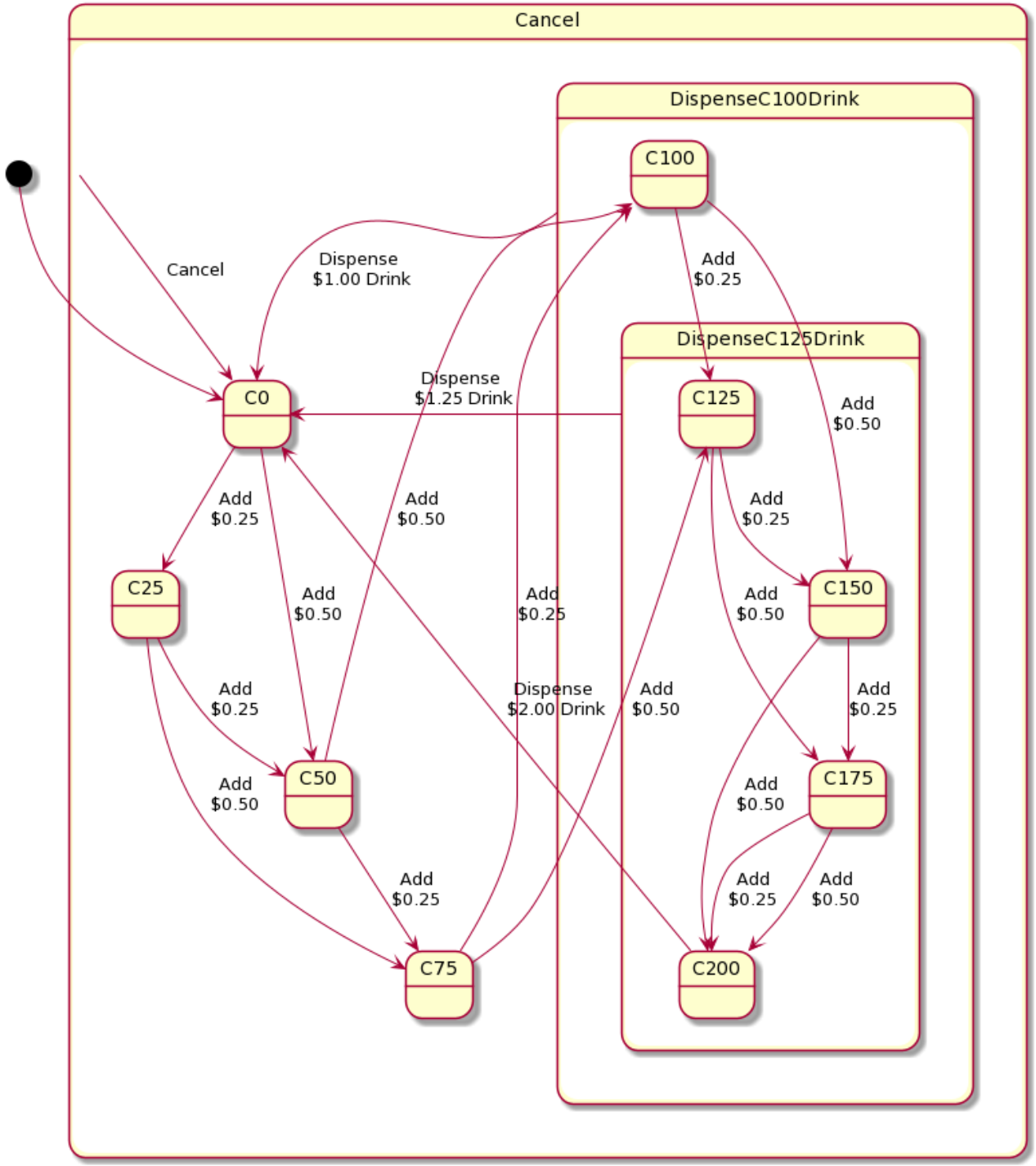
- C => AST
- Handling
  - CurrentState
  - NextState
  - EventType
  - EventParam
- Flat FSM

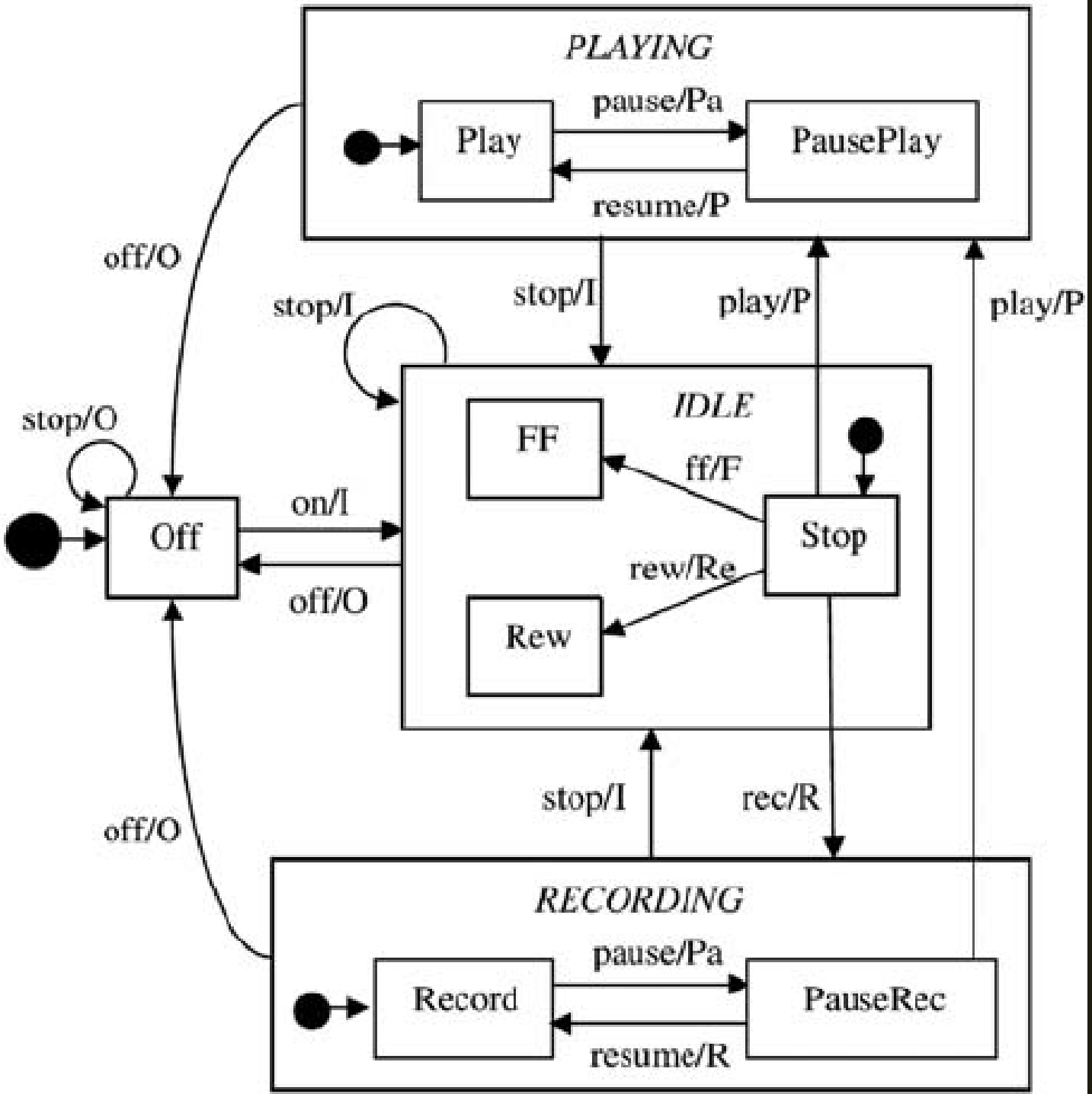
# TODO

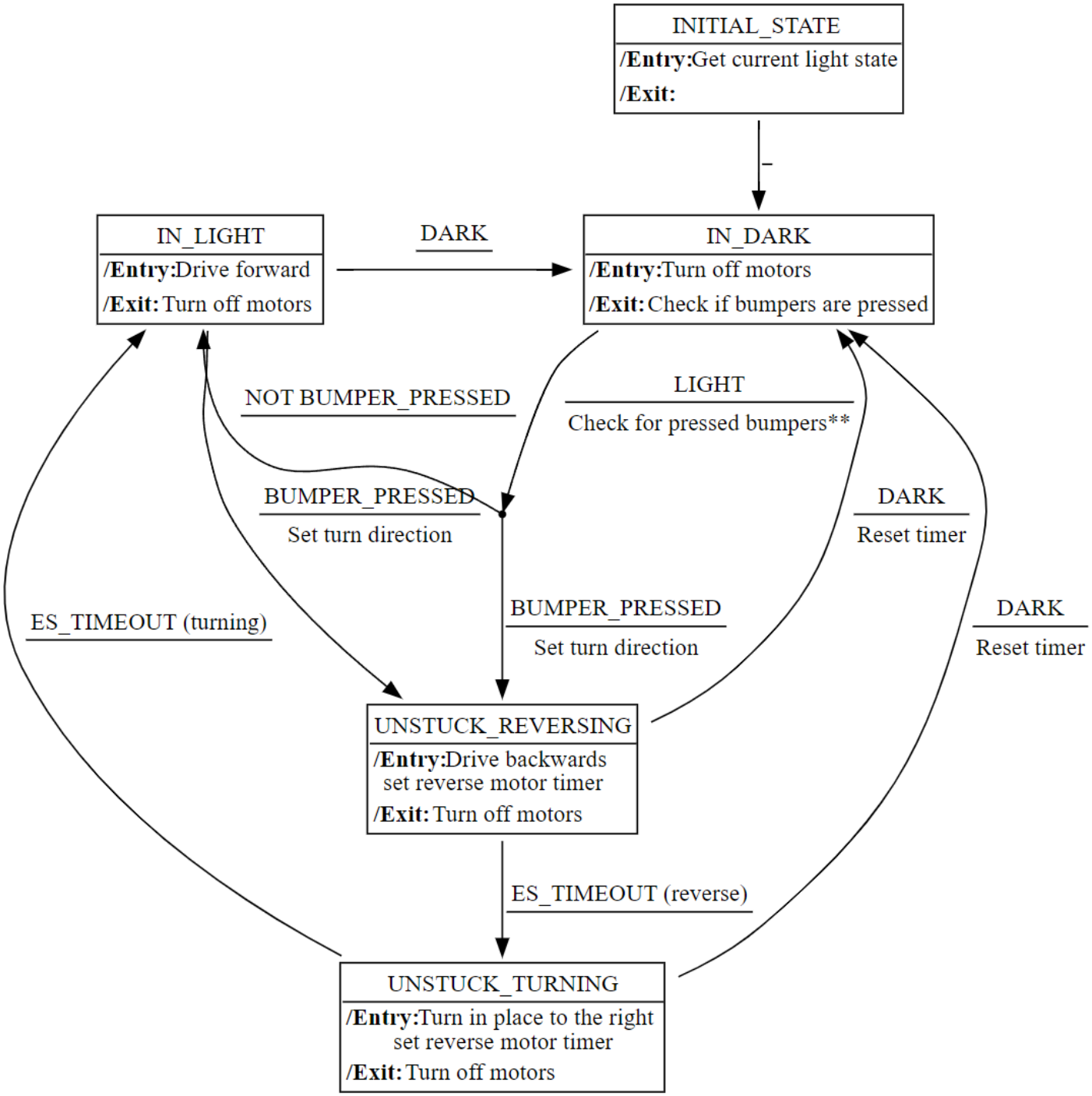
- Handling
  - functions (?)
  - cascades (?)
  - ???
- HSM (?)
- IDE (?)

# extras

```
digraph vendorMachine {
    compound=true ; graph [color=red] ; edge [color=red] ;
    node [color=red style=filled fillcolor=yellow] ;
    Entry[shape="point" label=""]

    subgraph cluster_cancel {
        label = "Cancel"
        style = rounded

    E2 [shape=rect label="" width=2 style=invis]
    E2:sw->C0  [label=cancel]

        C0 [label = <
            <table cellborder="0" style="rounded">
                <tr><td>C0</td></tr>
                <hr/>
                <tr><td></td></tr>
            </table>
        > margin=0 shape=none]

        C25 [label = <
            <table cellborder="0" style="rounded">
                <tr><td>C25</td></tr>
                <hr/>
                <tr><td></td></tr>
            </table>
        > margin=0 shape=none]

        C50 [label = <
            <table cellborder="0" style="rounded">
                <tr><td>C50</td></tr>
                <hr/>
                <tr><td></td></tr>
            </table>
        > margin=0 shape=none]

        C75 [label = <
            <table cellborder="0" style="rounded">
                <tr><td>C75</td></tr>
                <hr/>
                <tr><td></td></tr>
            </table>
        > margin=0 shape=none]

        subgraph cluster_DispenseC100Drink {
            label = "DispenseC100Drink"
            style = rounded

            C100 [label = <
                <table cellborder="0" style="rounded">
                    <tr><td>C100</td></tr>
                    <hr/>
                    <tr><td></td></tr>
                </table>
            > margin=0 shape=none]

            subgraph cluster_DispenseC125Drink {
                label = "DispenseC125Drink"
                style = rounded

                C125 [label = <
                    <table cellborder="0" style="rounded">
                        <tr><td>C125</td></tr>
                        <hr/>
                        <tr><td></td></tr>
                    </table>
                > margin=0 shape=none]

                C150 [label = <
                    <table cellborder="0" style="rounded">
                        <tr><td>C150</td></tr>
                        <hr/>
                        <tr><td></td></tr>
                    </table>
                > margin=0 shape=none]

                C175 [label = <
                    <table cellborder="0" style="rounded">
                        <tr><td>C175</td></tr>
                        <hr/>
                        <tr><td></td></tr>
                    </table>
                > margin=0 shape=none]

                C200 [label = <
                    <table cellborder="0" style="rounded">
                        <tr><td>C200</td></tr>
                        <hr/>
                        <tr><td></td></tr>
                    </table>
                > margin=0 shape=none]
                }
            }
    }

    Entry -> C0 ;
    C0 -> C25[label=" Add\n$0.25 "] ; C0 -> C50[label=" Add\n$0.50 "] ;
    C25 -> C50[label=" Add\n$0.25 "] ; C25 -> C75[label=" Add\n$0.50 "] ;
    C50 -> C75[label=" Add\n$0.25 "] ; C50 -> C100[label=" Add\n$0.50 "] ;
    C100 -> C0[label=" Dispense\n $1.00 Drink " ltail="cluster_DispenseC100Drink"] ;
    C75 -> C100[label=" Add\n$0.25 "] ; C75 -> C125[label=" Add\n$0.50 "] ;
    C100 -> C125[label=" Add\n$0.25 "] ; C100 -> C150[label=" Add\n$0.50 "] ;
    C125 -> C150[label=" Add\n$0.25 "] ; C125 -> C175[label=" Add\n$0.50 "] ;
    C125 -> C0[label=" Dispense\n $1.25 Drink "  ltail="cluster_DispenseC125Drink"] ;
    C150 -> C175[label=" Add\n$0.25 "] ; C150 -> C200[label=" Add\n$0.50 "] ;
    C175 -> C200[label=" Add\n$0.25 "] ; C200 -> C0[label=" Dispense\n $2.00 Drink "] ;
}
```




PLAYING
Play
pause/Pa
PausePlay
resume/P
off/O
stop/I
stop/I
play/P
play/P
IDLE
FF
ff/F
stop/O
Off
on/I
Stop
rew/Re
off/O
Rew
stop/I
rec/R
off/O
RECORDING
pause/Pa
Record
PauseRec
resume/R


INITIAL_STATE
/Entry:Get current light state
/Exit:
–
IN_LIGHT
/Entry:Drive forward
/Exit: Turn off motors
DARK
IN_DARK
/Entry:Turn off motors
/Exit: Check if bumpers are pressed
NOT BUMPER_PRESSED
LIGHT
Check for pressed bumpers**
BUMPER_PRESSED
Set turn direction
DARK
Reset timer
ES_TIMEOUT (turning)
BUMPER_PRESSED
Set turn direction
DARK
Reset timer
UNSTUCK_REVERSING
/Entry:Drive backwards
set reverse motor timer
/Exit: Turn off motors
ES_TIMEOUT (reverse)
UNSTUCK_TURNING
/Entry:Turn in place to the right
set reverse motor timer
/Exit: Turn off motors

# updated usage

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/'xc32-cpp.exe \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py gv_digraph.xslt \
    | uniq \
    > gv_digraph.gv
```

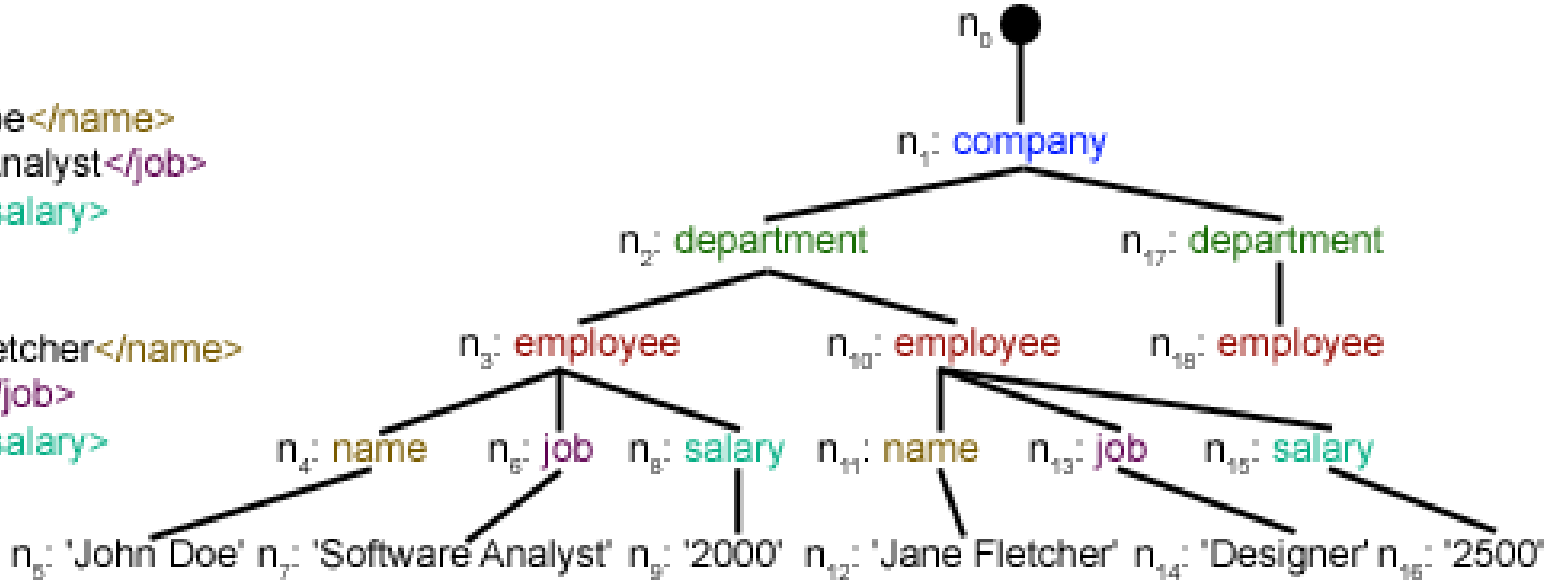
```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/'xc32-cpp.exe \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py xslt/*.xslt \

    > gv_digraph.gv
```

```
(
    cd "/mnt/c/Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X/" \
    && '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/xc32-cpp.exe' \
        -I'C:\Program Files/Microchip/xc32/v4.10/pic32mx/include/' \
        -I'C:\Users/chris/OneDrive/Desktop/ECE118/include' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/FSM_Roach.X' \
        -I'C:\Users/chris/OneDrive/Desktop/MPLAB_Projects/EventChecking.X/' \
        TemplateFSM.c \
) \
    | egrep -avi '^#|va_list|__attribute__' \
    | perl -pe's{__extension__}{ }g;' \
    | python3 c_ast_xml_xslt.py gv_digraph.xslt \
    | uniq \
    > gv_digraph.gv
```

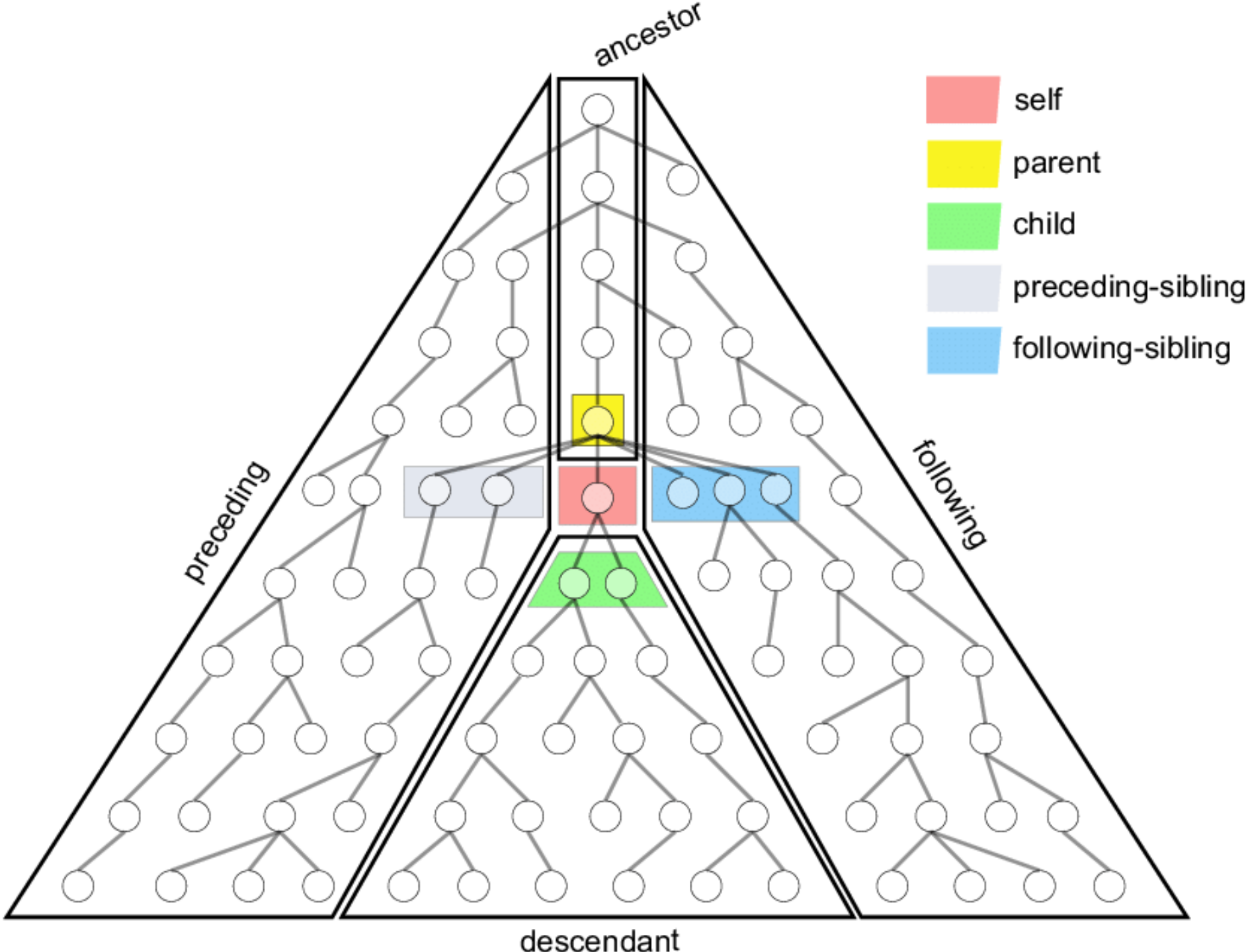
usage

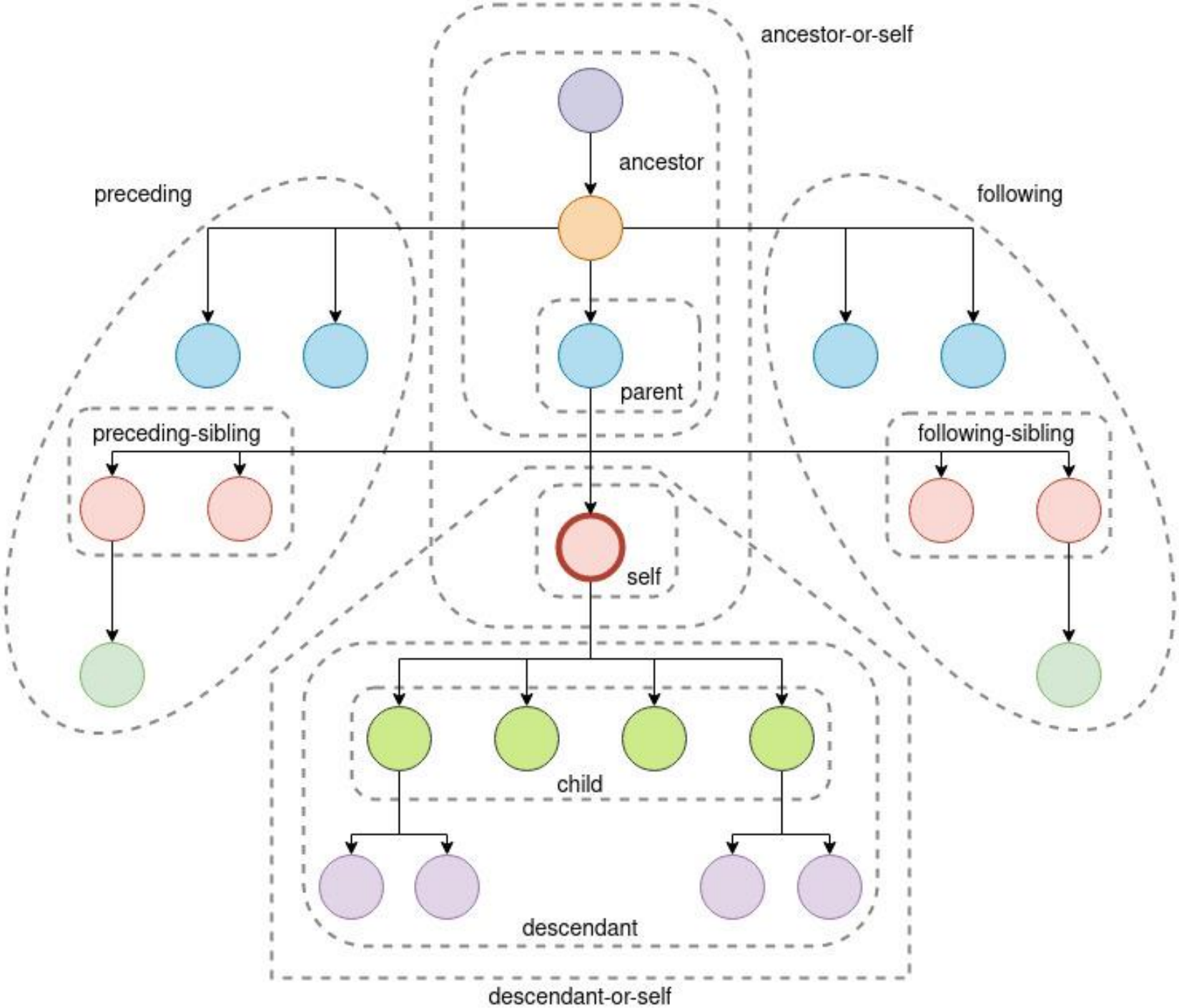
```
$strings '/mnt/c/Program Files/Microchip/xc32/v4.10/bin/xc32-cpp.exe' | head -1
!This program cannot be run in DOS mode.

$strings `which python3` | head -1
/lib64/ld-linux-x86-64.so.2

$wsl.exe -l -v
  NAME      STATE           VERSION
* Ubuntu    Running         2
$
```

```
<company>
  <department>
    <employee>
      <name>John Doe</name>
      <job>Software Analyst</job>
      <salary>2000</salary>
    </employee>
    <employee>
      <name>Jane Fletcher</name>
      <job>Designer</job>
      <salary>2500</salary>
    </employee>
  </department>
  <department>
    <employee>
    </employee>
  </department>
</company>
```




| | |
|---|---|
| Pick elements from anywhere in the DOM with a specific HTML tag | //tagName |
| Pick an element by ID | //tagName[@id="idValue"] |
| Pick an element by class | //tagName[@class="classValue"] |
| Pick the child of an element | //parentName/childName |
| Pick the first child of an element | //parentName/childName[1] |
| Pick the parent of an element | //childName/.. |


ancestor
self
parent
child
preceding-sibling
following-sibling
preceding
following
descendant


ancestor-or-self
ancestor
preceding
following
parent
preceding-sibling
following-sibling
self
child
descendant
descendant-or-self

1. `paper/publisher/parent::*/author`
2. `/bib//address[ancestor::book]`
3. `/bib//author/ancestor::*//zip`

1. The first XPath expression is using the `parent::` axis with an element wildcard node test. From the `publisher` element, it "jumps up" to it's parent, the `paper` element, and then selects the `author` child element. It only selects that `author` element if the `publisher` sibling is present. It could be written more compactly and avoid looking up the node tree with this XPath using a predicate filter on the `paper` element: `paper[publisher]/author`.
2. That XPath selects all of the `address` elements that are descendants of the `bib` element and are also descendants of a `book` element(which could be the ancestor or descendant of the `bib` ancestor). The square braces are a predicate, which filters the nodes that pass the test for the expression. In this case, it must be a descendant of a `book` element in order to "pass" the test and be selected.
3. This XPath looks for any `zip` element that is the descendant of an element that is the ancestor of an `author` element that is the descendant of a `bib` element.

https://stackoverflow.com/questions/43462759/xpath-concept-confusion