

Assignment 2

Yulei Sui

University of Technology Sydney, Australia

Assignment 2: Quizzes + A Coding Task

- Two sets of quizzes (10 ponts)
 - LLVM compiler and its intermediate representation
 - Code graphs (including ICFG and PAG)
- One coding task (10 ponts)
 - **Goal:** implement a context-sensitive graph traversal on ICFG and print **feasible** paths from a source node to a sink node on the graph

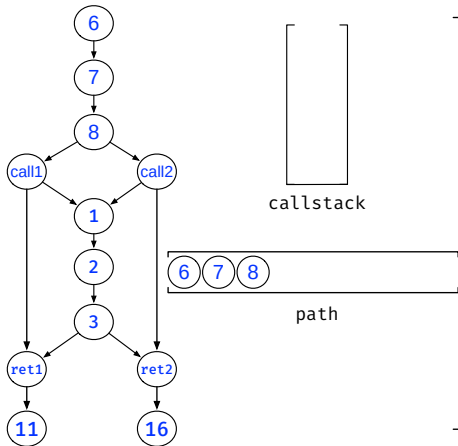
Assignment 2: Quizzes + A Coding Task

- Two sets of quizzes (10 ponts)
 - LLVM compiler and its intermediate representation
 - Code graphs (including ICFG and PAG)
- One coding task (10 ponts)
 - **Goal:** implement a context-sensitive graph traversal on ICFG and print **feasible** paths from a source node to a sink node on the graph
 - **Specification and code template:**
<https://github.com/SVF-tools/SVF-Teaching/wiki/Assignment-2>
 - **SVF CPP API**
<https://github.com/SVF-tools/SVF-Teaching/wiki/SVF-CPP-API>

All the above quizzes and coding task is due by **13th September**. You are encouraged to finish the quizzes before starting your coding task.

Context-Sensitive Control-Dependence

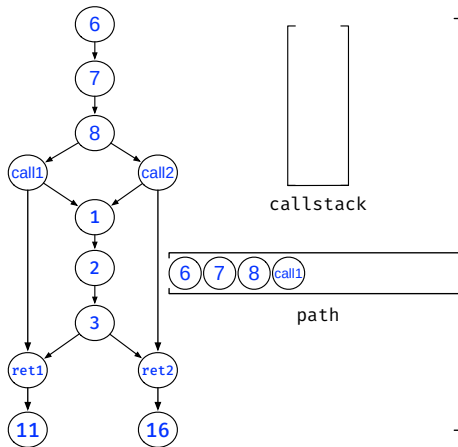
Obtaining a path from node 6 to node 11 on ICFG



```
visited: set<NodeID>
path: vector<NodeID>
callstack: stack<callsite> //A stack of LLVM call instructions
DFS(visited, path, callstack, src, dst)
1 visited.insert(src)
2 path.push_back(src)
3 if src == dst then
4   Print path
5 foreach edge e ∈ outEdges(src) do
6   if e.dst ∉ visited then
7     if e.isIntraCFGEde() then
8       DFS(visited, path, callstack, e.dst, dst)
9   else if e.isCallCFGEde() then
10    callstack.push(e.getCallsite())
11    DFS(visited, path, callstack, e.dst, dst)
12  else if e.isRetCFGEde() then
13    if !callstack.empty() && callstack.top()==e.getCallsite() then
14      callstack.pop()
15      DFS(visited, path, callstack, e.dst, dst)
16 visited.erase(src);
17 path.pop_back();
```

Context-Sensitive Control-Dependence (Coding task)

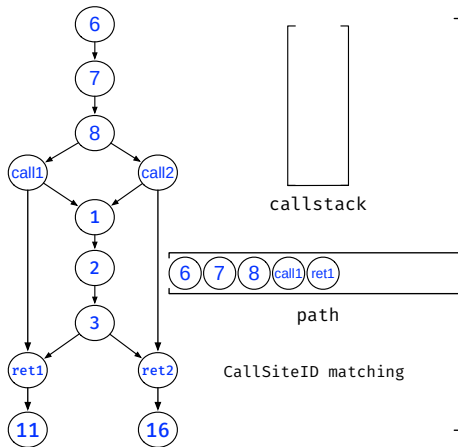
Obtaining a path from node 6 to node 11 on ICFG



```
visited: set<NodeID>
path: vector<NodeID>
callstack: stack<callsite> //A stack of LLVM call instructions
DFS(visited, path, callstack, src, dst)
1 visited.insert(src)
2 path.push_back(src)
3 if src == dst then
4   Print path
5 foreach edge e ∈ outEdges(src) do
6   if e.dst ∉ visited then
7     if e.isIntraCFGEde() then
8       DFS(visited, path, callstack, e.dst, dst)
9     else if e.isCallCFGEde() then
10      callstack.push(e.getCallSite())
11      DFS(visited, path, callstack, e.dst, dst)
12     else if e.isRetCFGEde() then
13       if !callstack.empty() && callstack.top()=e.getCallSite() then
14         callstack.pop()
15         DFS(visited, path, callstack, e.dst, dst)
16 visited.erase(src);
17 path.pop_back();
```

Context-Sensitive Control-Dependence (Coding task)

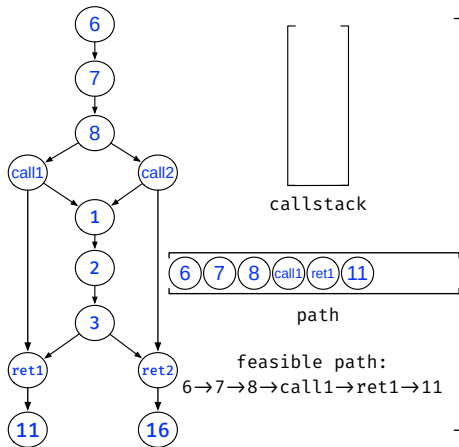
Obtaining a path from node 6 to node 11 on ICFG



```
visited: set<NodeID>
path: vector<NodeID>
callstack: stack<callsite> //A stack of LLVM call instructions
DFS(visited, path, callstack, src, dst)
1 visited.insert(src)
2 path.push_back(src)
3 if src == dst then
4   Print path
5 foreach edge e ∈ outEdges(src) do
6   if e.dst ∉ visited then
7     if e.isIntraCFGEde() then
8       DFS(visited, path, callstack, e.dst, dst)
9     else if e.isCallCFGEde() then
10      callstack.push(e.getCallSite())
11      DFS(visited, path, callstack, e.dst, dst)
12     else if e.isRetCFGEde() then
13       if !callstack.empty() && callstack.top()=e.getCallSite() then
14         callstack.pop()
15         DFS(visited, path, callstack, e.dst, dst)
16 visited.erase(src);
17 path.pop_back();
```

Context-Sensitive Control-Dependence (Coding task)

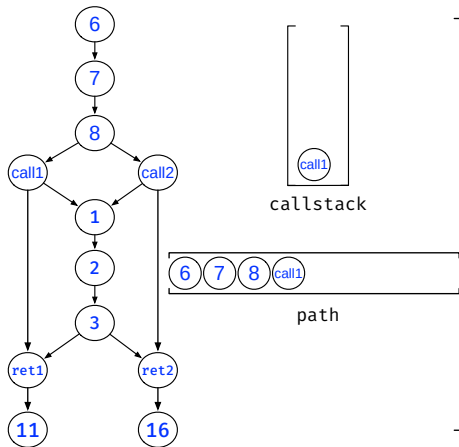
Obtaining a path from node 6 to node 11 on ICFG



```
visited: set<NodeID>
path: vector<NodeID>
callstack: stack<callsite> //A stack of LLVM call instructions
DFS(visited, path, callstack, src, dst)
1 visited.insert(src)
2 path.push_back(src)
3 if src == dst then
4   Print path
5 foreach edge e ∈ outEdges(src) do
6   if e.dst ∉ visited then
7     if e.isIntraCFGEde() then
8       DFS(visited, path, callstack, e.dst, dst)
9     else if e.isCallCFGEde() then
10      callstack.push(e.getCallsite())
11      DFS(visited, path, callstack, e.dst, dst)
12    else if e.isRetCFGEde() then
13      if !callstack.empty() && callstack.top()=e.getCallsite() then
14        callstack.pop()
15        DFS(visited, path, callstack, e.dst, dst)
16 visited.erase(src);
17 path.pop_back();
```

Context-Sensitive Control-Dependence (Coding task)

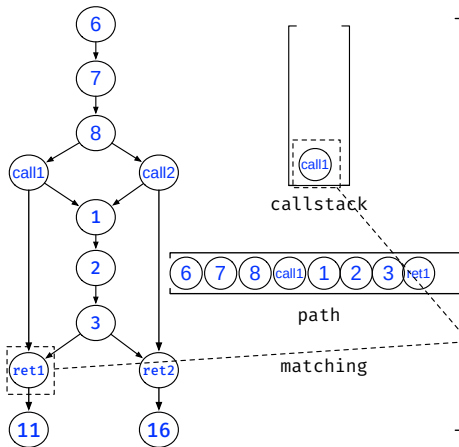
Obtaining a path from node 6 to node 11 on ICFG



```
visited: set<NodeID>
path: vector<NodeID>
callstack: stack<callsite> //A stack of LLVM call instructions
DFS(visited, path, callstack, src, dst)
1 visited.insert(src)
2 path.push_back(src)
3 if src == dst then
4   Print path
5 foreach edge e ∈ outEdges(src) do
6   if e.dst ∉ visited then
7     if e.isIntraCFGEde() then
8       DFS(visited, path, callstack, e.dst, dst)
9     else if e.isCallCFGEde() then
10      callstack.push(e.getCallsite())
11      DFS(visited, path, callstack, e.dst, dst)
12    else if e.isRetCFGEde() then
13      if !callstack.empty() && callstack.top()=e.getCallsite() then
14        callstack.pop()
15        DFS(visited, path, callstack, e.dst, dst)
16 visited.erase(src);
17 path.pop_back();
```


Context-Sensitive Control-Dependence

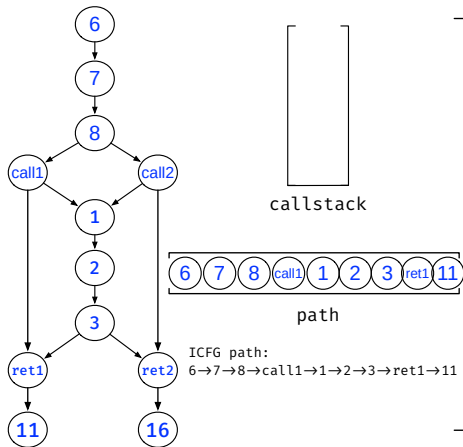
Obtaining a path from node 6 to node 11 on ICFG



```
visited: set<NodeID>
path: vector<NodeID>
callstack: stack<callsite> //A stack of LLVM call instructions
DFS(visited, path, callstack, src, dst)
1 visited.insert(src)
2 path.push_back(src)
3 if src == dst then
4   Print path
5 foreach edge e ∈ outEdges(src) do
6   if e.dst ∉ visited then
7     if e.isIntraCFGEde() then
8       DFS(visited, path, callstack, e.dst, dst)
9     else if e.isCallCFGEde() then
10      callstack.push(e.getCallsite())
11      DFS(visited, path, callstack, e.dst, dst)
12    else if e.isRetCFGEde() then
13      if !callstack.empty() && callstack.top()==e.getCallsite() then
14        callstack.pop()
15        DFS(visited, path, callstack, e.dst, dst)
16 visited.erase(src);
17 path.pop_back();
```

Context-Sensitive Control-Dependence (Coding task)

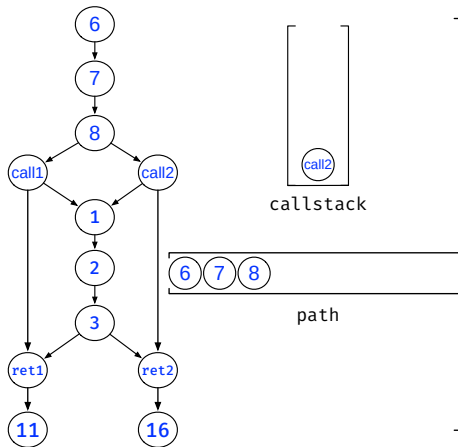
Obtaining a path from node 6 to node 11 on ICFG



```
visited: set<NodeID>
path: vector<NodeID>
callstack: stack<callsite> //A stack of LLVM call instructions
DFS(visited, path, callstack, src, dst)
1 visited.insert(src)
2 path.push_back(src)
3 if src == dst then
4   Print path
5 foreach edge e ∈ outEdges(src) do
6   if e.dst ∉ visited then
7     if e.isIntraCFGEde() then
8       DFS(visited, path, callstack, e.dst, dst)
9     else if e.isCallCFGEde() then
10      callstack.push(e.getCallsite())
11      DFS(visited, path, callstack, e.dst, dst)
12    else if e.isRetCFGEde() then
13      if !callstack.empty() && callstack.top()=e.getCallsite() then
14        callstack.pop()
15        DFS(visited, path, callstack, e.dst, dst)
16 visited.erase(src);
17 path.pop_back();
```

Context-Sensitive Control-Dependence (Coding task)

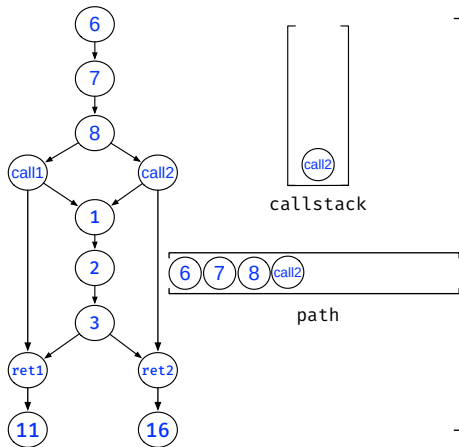
Obtaining a path from node 6 to node 11 on ICFG



```
visited: set<NodeID>
path: vector<NodeID>
callstack: stack<callsite> //A stack of LLVM call instructions
DFS(visited, path, callstack, src, dst)
1 visited.insert(src)
2 path.push_back(src)
3 if src == dst then
4   Print path
5 foreach edge e ∈ outEdges(src) do
6   if e.dst ∉ visited then
7     if e.isIntraCFGEde() then
8       DFS(visited, path, callstack, e.dst, dst)
9     else if e.isCallCFGEde() then
10      callstack.push(e.getCallsite())
11      DFS(visited, path, callstack, e.dst, dst)
12    else if e.isRetCFGEde() then
13      if !callstack.empty() && callstack.top()==e.getCallsite() then
14        callstack.pop()
15        DFS(visited, path, callstack, e.dst, dst)
16 visited.erase(src);
17 path.pop_back();
```

Context-Sensitive Control-Dependence (Coding task)

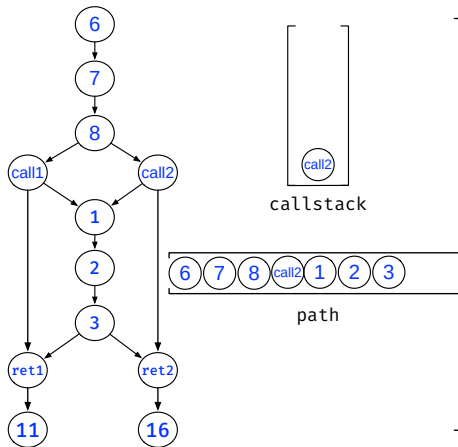
Obtaining a path from node 6 to node 11 on ICFG



```
visited: set<NodeID>
path: vector<NodeID>
callstack: stack<callsite> //A stack of LLVM call instructions
DFS(visited, path, callstack, src, dst)
1 visited.insert(src)
2 path.push_back(src)
3 if src == dst then
4   Print path
5 foreach edge e ∈ outEdges(src) do
6   if e.dst ∉ visited then
7     if e.isIntraCFGEde() then
8       DFS(visited, path, callstack, e.dst, dst)
9     else if e.isCallCFGEde() then
10      callstack.push(e.getCallsite())
11      DFS(visited, path, callstack, e.dst, dst)
12    else if e.isRetCFGEde() then
13      if !callstack.empty() && callstack.top()=e.getCallsite() then
14        callstack.pop()
15        DFS(visited, path, callstack, e.dst, dst)
16 visited.erase(src);
17 path.pop_back();
```

Context-Sensitive Control-Dependence (Coding task)

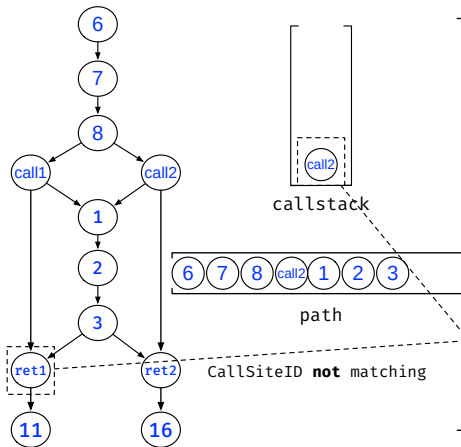
Obtaining a path from node 6 to node 11 on ICFG



```
visited: set<NodeID>
path: vector<NodeID>
callstack: stack<callsite> //A stack of LLVM call instructions
DFS(visited, path, callstack, src, dst)
1 visited.insert(src)
2 path.push_back(src)
3 if src == dst then
4   Print path
5 foreach edge e ∈ outEdges(src) do
6   if e.dst ∉ visited then
7     if e.isIntraCFGEde() then
8       DFS(visited, path, callstack, e.dst, dst)
9     else if e.isCallCFGEde() then
10      callstack.push(e.getCallsite())
11      DFS(visited, path, callstack, e.dst, dst)
12    else if e.isRetCFGEde() then
13      if !callstack.empty() && callstack.top()==e.getCallsite() then
14        callstack.pop()
15        DFS(visited, path, callstack, e.dst, dst)
16 visited.erase(src);
17 path.pop_back();
```

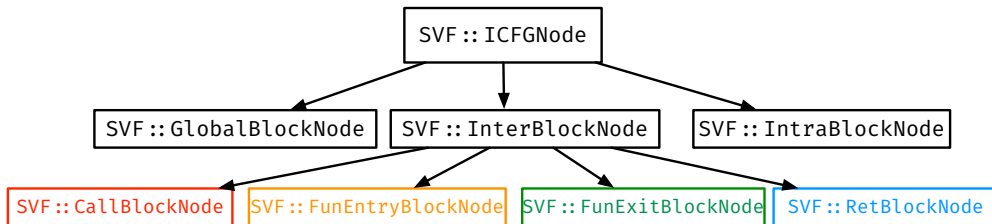
Context-Sensitive Control-Dependence (Coding task)

Obtaining a path from node 6 to node 11 on ICFG



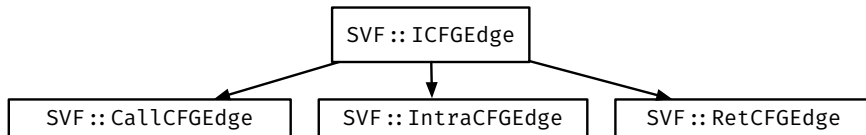
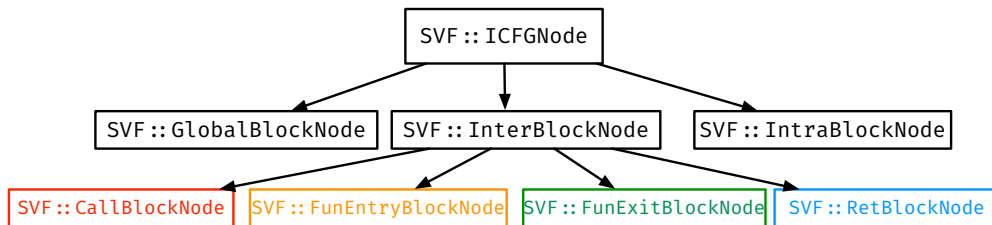
```
visited: set<NodeID>
path: vector<NodeID>
callstack: stack<callsite> //A stack of LLVM call instructions
DFS(visited, path, callstack, src, dst)
1 visited.insert(src)
2 path.push_back(src)
3 if src == dst then
4   Print path
5 foreach edge e ∈ outEdges(src) do
6   if e.dst ∉ visited then
7     if e.isIntraCFGEde() then
8       DFS(visited, path, callstack, e.dst, dst)
9     else if e.isCallCFGEde() then
10      callstack.push(e.getCallSite())
11      DFS(visited, path, callstack, e.dst, dst)
12    else if e.isRetCFGEde() then
13      if !callstack.empty() && callstack.top()=e.getCallSite() then
14        callstack.pop()
15        DFS(visited, path, callstack, e.dst, dst)
16 visited.erase(src);
17 path.pop_back();
```

ICFG Node and Edge Classes



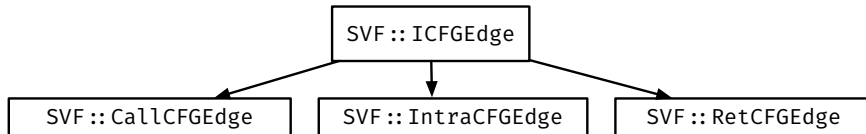
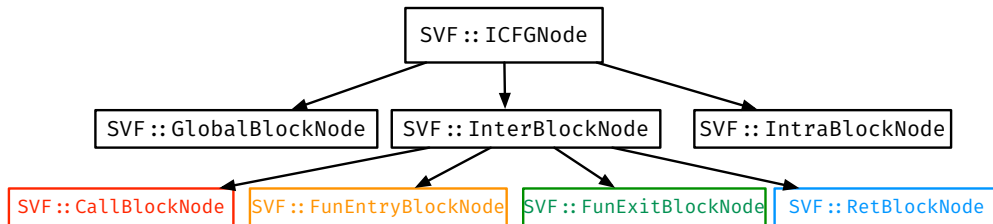
<https://github.com/SVF-tools/SVF/blob/master/include/Graphs/ICFGNode.h>

ICFG Node and Edge Classes



<https://github.com/SVF-tools/SVF/blob/master/include/Graphs/ICFGE.h>

ICFG Node and Edge Classes



<https://github.com/svf-tools/SVF/wiki/Analyze-a-Simple-C-Program#4-interprocedural-control-flow-graph>

cast and dyn_cast

- C++ Inheritance: see slides in Week 2:.
- Casting a **parent** class pointer to pointer of a **Child** type:
 - `SVFUtil::cast`
 - Casts a pointer or reference to an instance of a specified class. This cast fails and aborts the program if the object or reference is not the specified class at runtime.
 - `SVFUtil::dyn_cast`
 - "Checked cast" operation. Checks to see if the operand is of the specified type, and if so, returns a pointer to it (this operator does not work with references). If the operand is not of the correct type, a null pointer is returned.
 - Works very much like the `dynamic_cast<>` operator in C++, and should be used in the same circumstances.
- Example: accessing the attributes of the child class via casting.
 - `RetBlockNode* retNode = SVFUtil::cast<RetBlockNode>(ICFGNode);`
 - `CallCFGEde* callEdge = SVFUtil::dyn_cast<CallCFGEde>(ICFGEde);`