Compiler Construction

Static Links

What are Static link

Goal

How to handle escaping variables and recursion?

Static Links

A mechanism:

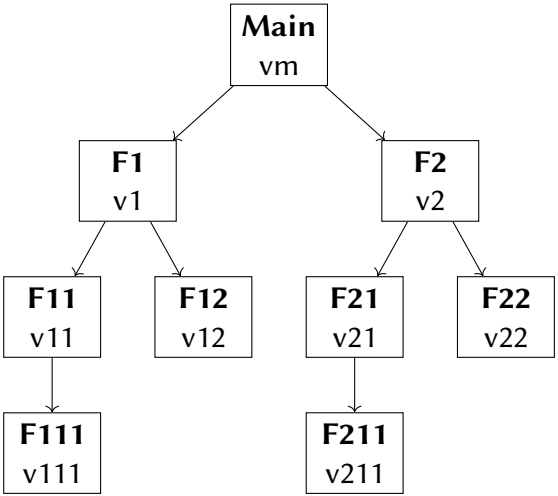
- computed a compile time
- that produces code
- that will be used at runtime

escapes-n-recursion

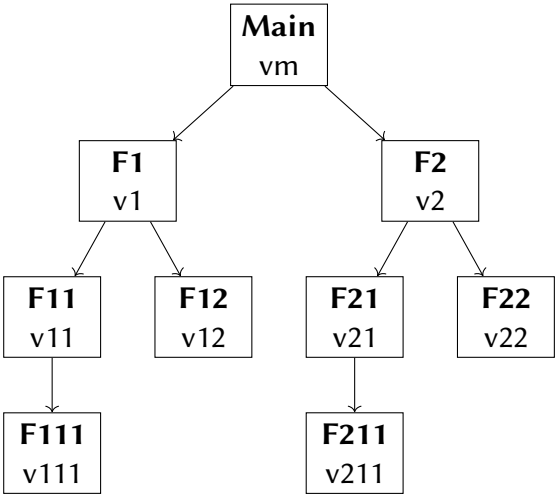
```
let function trace(fn: string, val: int) =
      (print(fn); print("("); print_int(val); print(") "))

    function one(input : int) =
    let function two() =
        (trace("two", input); one(input - 1))
    in
      if input > 0 then
        (two(); trace("one", input))
    end
in
  one(3); print("\n")
end
```

```
two(3) two(2) two(1) one(1) one(2) one(3)
```

Deep Static Function Hierarchies

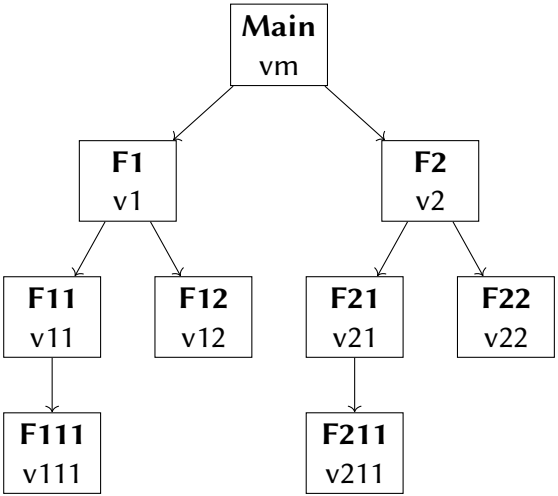


Deep Static Function Hierarchies



What if:

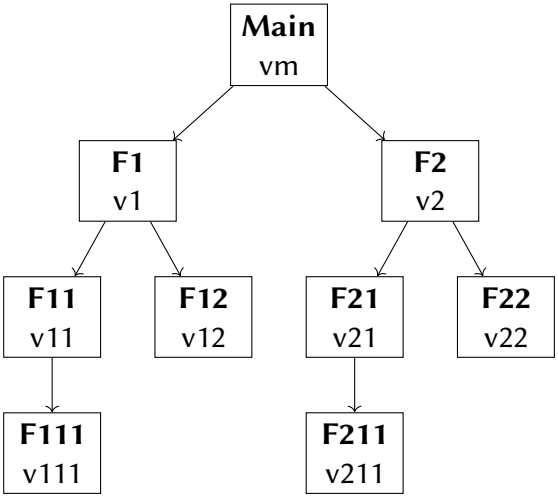
Deep Static Function Hierarchies



What if:

1. **Main** uses **vm**

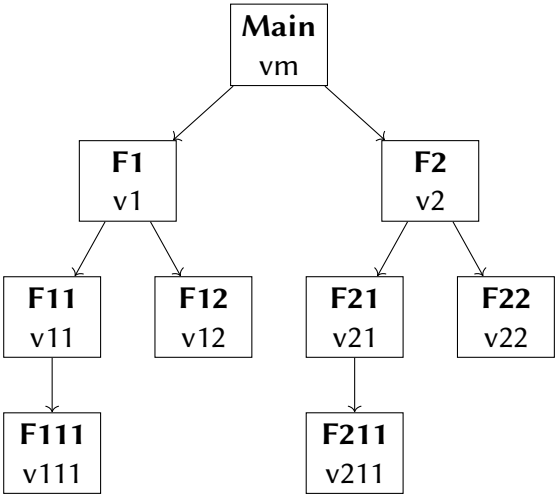
Deep Static Function Hierarchies



What if:

1. **Main** uses **vm**
2. **Main** calls **F1**

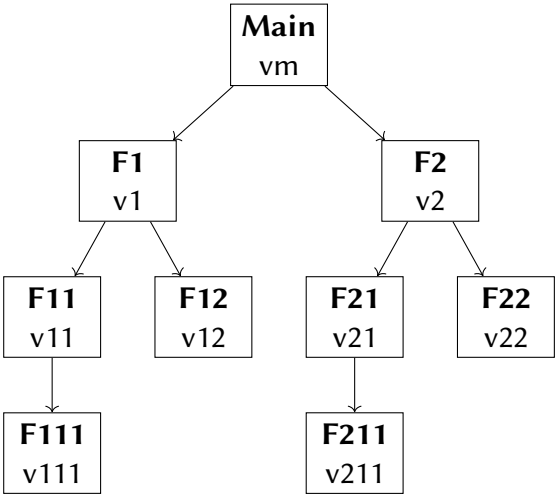
Deep Static Function Hierarchies



What if:

1. **Main** uses **vm**
2. **Main** calls **F1**
3. **F1** uses **v1**

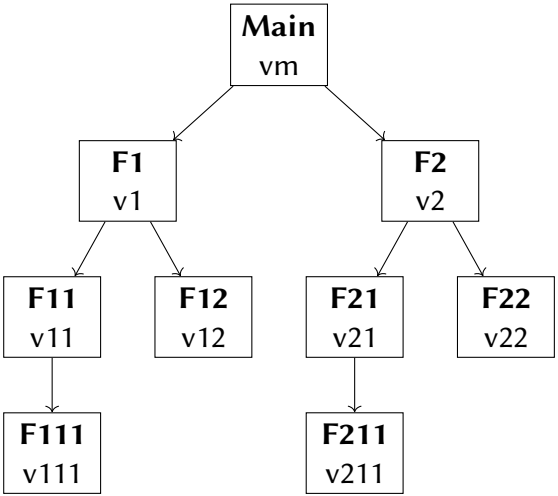
Deep Static Function Hierarchies



What if:

1. **Main** uses **vm**
2. **Main** calls **F1**
3. **F1** uses **v1**
4. **F1** uses **vm**, non local

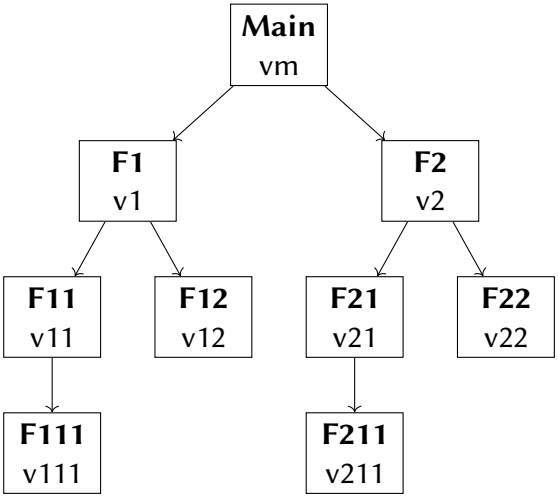
Deep Static Function Hierarchies



What if:

1. **Main** uses **vm**
2. **Main** calls **F1**
3. **F1** uses **v1**
4. **F1** uses **vm**, non local
5. **F1** calls **F11**

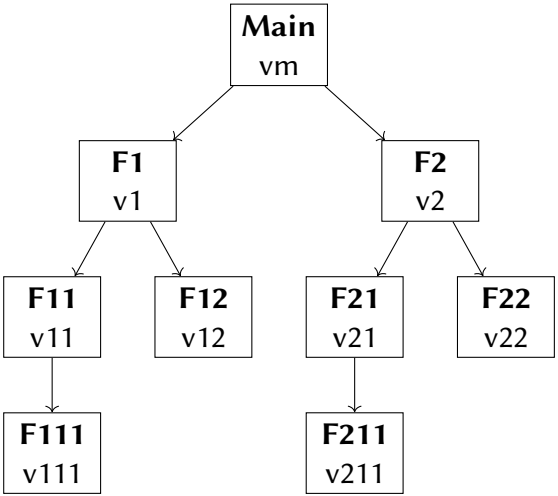
Deep Static Function Hierarchies



What if:

1. **Main** uses **vm**
2. **Main** calls **F1**
3. **F1** uses **v1**
4. **F1** uses **vm**, non local
5. **F1** calls **F11**
6. **F11** uses **v11**

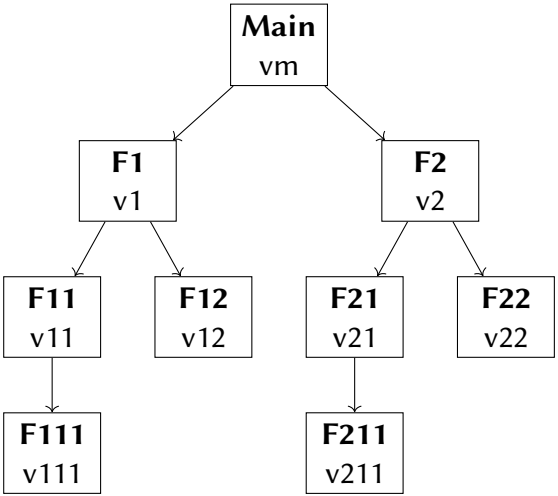
Deep Static Function Hierarchies



What if:

1. **Main** uses **vm**
2. **Main** calls **F1**
3. **F1** uses **v1**
4. **F1** uses **vm**, non local
5. **F1** calls **F11**
6. **F11** uses **v11**
7. **F11** uses **v1**

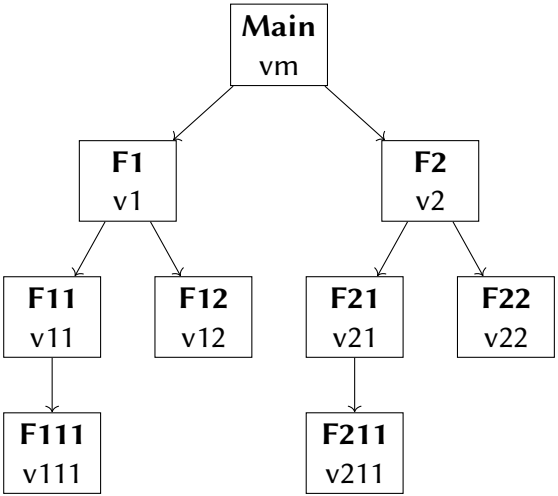
Deep Static Function Hierarchies



What if:

1. **Main** uses **vm**
2. **Main** calls **F1**
3. **F1** uses **v1**
4. **F1** uses **vm**, non local
5. **F1** calls **F11**
6. **F11** uses **v11**
7. **F11** uses **v1**
8. **F11** uses **vm**

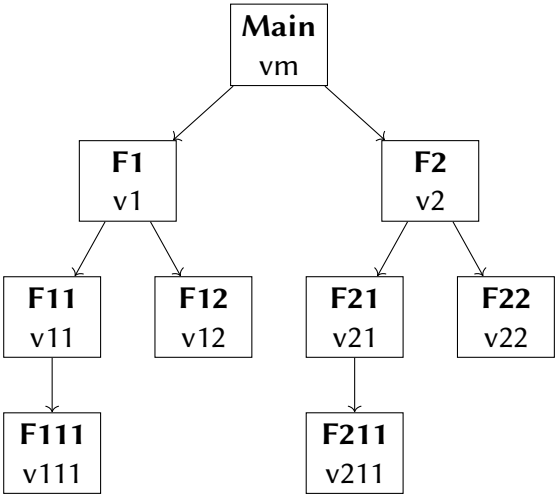
Deep Static Function Hierarchies



What if:

1. **Main** uses **vm**
2. **Main** calls **F1**
3. **F1** uses **v1**
4. **F1** uses **vm**, non local
5. **F1** calls **F11**
6. **F11** uses **v11**
7. **F11** uses **v1**
8. **F11** uses **vm**
9. **F11** calls **F12**

Deep Static Function Hierarchies



What if:

1. **Main** uses **vm**
2. **Main** calls **F1**
3. **F1** uses **v1**
4. **F1** uses **vm**, non local
5. **F1** calls **F11**
6. **F11** uses **v11**
7. **F11** uses **v1**
8. **F11** uses **vm**
9. **F11** calls **F12**
10. **F12** calls **F1**

Deep Static Function Hierarchies

The caller must provide the callee with its static link.

Caller	Callee	Static Link
Main	F1	$\texttt{fp}_{\texttt{Main}} = \texttt{fp}$
F1	F11	$\texttt{fp}_{\texttt{F1}} = \texttt{fp}$
F11	F12	$\texttt{fp}_{\texttt{F1}} = \texttt{sl}_{\texttt{F11}} = \texttt{*fp}_{\texttt{F11}} = \texttt{*fp}$
F12	F2	$\texttt{fp}_{\texttt{Main}} = \texttt{sl}_{\texttt{F1}} = \texttt{*sl}_{\texttt{F12}} = \texttt{**fp}_{\texttt{F12}} = \texttt{**fp}$
F2	F22	$\texttt{fp}_{\texttt{F2}} = \texttt{fp}$
F22	F11	$\texttt{fp}_{\texttt{F1}} = \texttt{???}$

Assuming that the static link is stored at `fp`.

Summary