



第三次Lab:

# Dataflow Analysis



# 什么是def\_use分析

- *Def-Use* 分析 (*Definition-Use Analysis*) 是程序分析中的一种重要数据流分析技术, 用于确定程序中变量定义 (*def*) 和使用 (*use*) 之间的关系
  - 定义 (*Definition/Def*) : 对变量的赋值或写入操作
  - 使用 (*Use*) : 对变量值的读取操作
  - 示例:

```
1: x = 5    // Def of x
2: y = x + 3 // Use of x Def of y
3: x = 8    // Def of x
4: z = x * 2 // Use of x Def of z
```

Def-Use 分析会建立以下关系:

第1行的定义在第2行被使用

第3行的定义在第4行被使用



# 一、任务

- 本学期代码仓库:<https://gitee.com/fdu-ssr/compiler2025spring>
- *GIR*参考文档<https://docs.qq.com/sheet/DTXBCSIZZS25mQnhQ?tab=urh0bh>
- 本次实验需要补充`compiler2025spring/lab3/code/src/lian/semantic/stmt_def_use_analysis.py`
- 本次任务要求:
  - 编写指定*GIR*指令的`def_use`分析, 标记指令中哪些符号被`define`了, 那些符号被`use`了, 包括  
`call_expression if_stmt array_write array_read`指令

# 二、代码运行方式



(1) 运行scripts/lian.sh脚本

\$. /lian.sh <待分析代码文件路径> -l 语言名称

例如：

./lian.sh /python/change.py -l python

(2) 运行结果为：

tests/lian\_workspace/dataframe.html

将这个文件在网页中打开

gir\_ir.bundle0  
module\_symbols

/home/corgi/lianspace/lian-langapi/lian-internal/tests/lian\_workspace/gir/gir\_ir.bundle0

	operation	parent stmt id	stmt id	data type	name	unit id	attrs	parameters	body	target	operand
0	variable_decl	0	10		a	4					
1	method_decl	0	12		f1	4			13.0		
2	block_start	12	13			4					
3	global_stmt	13	14		a	4					
4	variable_decl	13	15		b	4					
5	assign_stmt	13	16			4				b	a
6	assign_stmt	13	17			4				a	4
7	block_end	12	13			4					
8	method_decl	0	19		%unit_init	4			20.0		
9	block_start	19	20			4					
10	assign_stmt	20	11			4				a	3
11	call_stmt	20	18		f1	4				%vv1	
12	block_end	19	20			4					
13	method_decl	0	39		append	7		40.0	42.0		
14	block_start	39	40			7					
15	parameter_decl	40	41		e	7					
16	block_end	39	40			7					
17	block_start	39	42			7					
18	array_write	42	43			7					
19	block_end	39	42			7					

/home/corgi/lianspace/lian-langapi/lian-internal/tests/lian\_workspace/module\_symbols

	module id	symbol name	unit ext	lang	parent module id	symbol type	unit path
0	4	change	.py	python	0	1	/home/corgi/lianspace/lian-langapi/lian-internal/tests/lian_workspace/src/change
1	5	javascript			0	12	/home/corgi/lianspace/lian-langapi/lian-internal/tests/lian_workspace/externs/javascript
2	6	python			0	12	/home/corgi/lianspace/lian-langapi/lian-internal/tests/lian_workspace/externs/python
3	7	pybuiltin	.py	python	6	1	/home/corgi/lianspace/lian-langapi/lian-internal/tests/lian_workspace/externs/pybuiltin

# 三、结果的查看方式



/home/corgi/workspace/compiler2025spring/lab3/code/tests/lian\_workspace/glang/glang\_bundle0

operation	parent_stmt_id	stmt_id	attrs	data_type	name	parameters	body	unit_id	target	operand	positional_args	receiver_object	field	source	array	index
0	method_decl	0			aaa		11.0	1								
1	block_start	10						1								
2	assign_stmt	11						1	a	1						
3	assign_stmt	11						1	b	2						
4	assign_stmt	11						1	b	a						
5	call_stmt	11			func1			1	%v0		['a']					
6	field_write	11						1				obj1	field	3		
7	field_read	11						1	%v1			obj2	field1			
8	assign_stmt	11						1	b	%v1						
9	array_read	11						1	%v2						arr	0
10	assign_stmt	11						1	c	%v2						
11	array_read	11						1	%v1						arr	a
12	assign_stmt	11						1	d	%v1						
13	block_end	10						1								

/home/corgi/workspace/compiler2025spring/lab3/code/tests/lian\_workspace/semantic/glang\_bundle0.stmt\_status

unit_id	method_id	stmt_id	defined_symbol	used_symbols	field	operation	in_bits	out_bits
0	1	10	12	1		2	0	0
1	1	10	13	3		2	0	0
2	1	10	14	5		2	0	0
3	1	10	15	8		2	0	0
4	1	10	16	12		2	0	0
5	1	10	17	15		2	0	0
6	1	10	18	17		2	0	0
7	1	10	19	20		2	0	0
8	1	10	20	22		2	0	0
9	1	10	21	25		2	0	0
10	1	10	22	27		2	0	0

/home/corgi/workspace/compiler2025spring/lab3/code/tests/lian\_workspace/semantic/glang\_bundle0.symbols\_states

unit_id	method_id	stmt_id	index	symbol_or_state	symbol_id	name	states	default_data_type	state_id	state_type	data_type	array	array_tangping_flag	fields	value
0	1	10	0	1					1	1	int	[]	False	{}	1
1	1	10	1	0	2	a	set()		-1	0					
2	1	10	2	1					3	1	int	[]	False	{}	2
3	1	10	3	0	4	b	set()		-1	0					
4	1	10	4	0	5	a	set()		-1	0					
5	1	10	4	0	6	b	set()		-1	0					
6	1	10	5	0					-1	0					
7	1	10	6	0	7	func1	set()		-1	0					
8	1	10	7	0	8	a	set()		-1	0					
9	1	10	8	0	9	%v0	set()		-1	0					
10	1	10	9	0	10	obj1	set()		-1	0					
11	1	10	10	1					11	1	int	[]	False	{}	3
12	1	10	11	0	12	field	set()		-1	0					
13	1	10	12	0	13	obj1	set()		-1	0					
14	1	10	13	0	14	obj2	set()		-1	0					
15	1	10	14	0	15	field1	set()		-1	0					
16	1	10	15	0	16	%v1	set()		-1	0					
17	1	10	16	0	17	%v1	set()		-1	0					
18	1	10	17	0	18	b	set()		-1	0					
19	1	10	18	0	19	arr	set()		-1	0					
20	1	10	19	1					20	1	int	[]	False	{}	0
21	1	10	20	0	21	%v2	set()		-1	0					
22	1	10	20	0	22	%v2	set()		-1	0					
23	1	10	21	0	23	c	set()		-1	0					
24	1	10	21	0	24	arr	set()		-1	0					
25	1	10	21	0	25	a	set()		-1	0					
26	1	10	21	0	26	%v1	set()		-1	0					
27	1	10	22	0	27	%v1	set()		-1	0					
28	1	10	22	0	28	d	set()		-1	0					

首先查看GIR，例如stmt\_id=14的指令，在symbol\_states表中，绿色列对应着当前行的index，index=4和index=5的行是stmt\_id=14的GIR对应的symbol

stmt\_status记录了每条指令def\_use的关系，define\_symbol列中记录了这条指令define了在symbol\_states表中index=5的symbol，也就是“b”



## 六、编写def\_use

- 本次实验用到的api有：
  - add\_def\_use\_symbols (stmt\_id, def\_symbol, used\_symbols, op)
  - def\_symbol是该条指令被定义的符号
  - used\_symbols是该条指令被使用的符号列表
  - 在使用该api时只用补充正确的stmt\_id, def\_symbol, used\_symbol即可
- 注意事项
  - call\_stmt会use函数名与参数，参数只需考虑positional\_args，positional\_args是一个列表，记录所有实参名
  - array\_write不仅会define array(a[b]的a部分), 也会use array



# 参考结果-def\_use关系正确即可



/home/corgi/workspace/compiler2025spring/lab3/code/tests/lian\_workspace/glang/glang\_bundle0

operation	parent_stmt_id	stmt_id	attrs	data_type	name	body	unit_id	target	operand	positional_args	condition	then_body	array	index	source
0	method_decl	0			aaa	11.0	1								
1	block_start	10					1								
2	assign_stmt	11					1	a	1						
3	assign_stmt	11					1	b	2						
4	assign_stmt	11					1	b	a						
5	call_stmt	11			func1		1	%v0		['a']					
6	if_stmt	11					1				c	17.0			
7	block_start	16					1								
8	assign_stmt	17					1	e	3						
9	block_end	16					1								
10	array_read	11					1	%v1					arr	0	
11	assign_stmt	11					1	c	%v1						
12	array_read	11					1	%v2					arr	a	
13	assign_stmt	11					1	d	%v2						
14	array_write	11					1						arr	b	c
15	block_end	10					1								

/home/corgi/workspace/compiler2025spring/lab3/code/tests/lian\_workspace/semantic/glang\_bundle0.scope\_space

unit_id	stmt_id	parent_stmt_id	scope_kind	package_stmt	import_stmt	variable_decl	method_decl	class_decl
0	1	0	3				(10, 'aaa')	
1	1	0	1					

/home/corgi/workspace/compiler2025spring/lab3/code/tests/lian\_workspace/semantic/glang\_bundle0.stmt\_status

unit_id	method_id	stmt_id	defined_symbol	used_symbols	field	operation	in_bits	out_bits
0	1	10	12	1	[0]	2	0	0
1	1	10	13	3	[2]	2	0	0
2	1	10	14	5	[4]	2	0	0
3	1	10	15	8	[6, 7]	2	0	0
4	1	10	16	-1	[9]	2	0	0
5	1	10	18	11	[10]	2	0	0
6	1	10	19	14	[12, 13]	2	0	0
7	1	10	20	16	[15]	2	0	0
8	1	10	21	19	[17, 18]	2	0	0
9	1	10	22	21	[20]	2	0	0
10	1	10	23	25	[22, 23, 24]	2	0	0

/home/corgi/workspace/compiler2025spring/lab3/code/tests/lian\_workspace/semantic/glang\_bundle0.symbols\_states

unit_id	method_id	stmt_id	index	symbol_or_state	symbol_id	name	states	default_data_type	state_id	state_type	data_type	array	array_tangping_flag	fields	value
0	1	10	12	0	1				1	1	int	[]	False	{}	1
1	1	10	12	1	0				-1	0					
2	1	10	13	2	1	a	set()		3	1	int	[]	False	{}	2
3	1	10	13	3	0				-1	0					
4	1	10	14	4	0				-1	0					
5	1	10	14	5	0	b	set()		-1	0					
6	1	10	15	6	0				-1	0					
7	1	10	15	7	0	func1	set()		-1	0					
8	1	10	15	8	0	a	set()		-1	0					
9	1	10	16	9	0	%v0	set()		-1	0					
10	1	10	16	10	0	c	set()		-1	0					
11	1	10	18	10	1				11	1	int	[]	False	{}	3
12	1	10	18	11	0	e	set()		-1	0					
13	1	10	19	12	0	arr	set()		-1	0					
14	1	10	19	13	1				14	1	int	[]	False	{}	0
15	1	10	19	14	0	%v1	set()		-1	0					
16	1	10	20	15	0	%v1	set()		-1	0					
17	1	10	20	16	0	c	set()		-1	0					
18	1	10	21	17	0	arr	set()		-1	0					
19	1	10	21	18	0	a	set()		-1	0					
20	1	10	21	19	0	%v2	set()		-1	0					
21	1	10	22	20	0	%v2	set()		-1	0					
22	1	10	22	21	0	d	set()		-1	0					
23	1	10	23	22	0	arr	set()		-1	0					
24	1	10	23	23	0	b	set()		-1	0					
25	1	10	23	24	0	c	set()		-1	0					
26	1	10	23	25	0	arr	set()		-1	0					