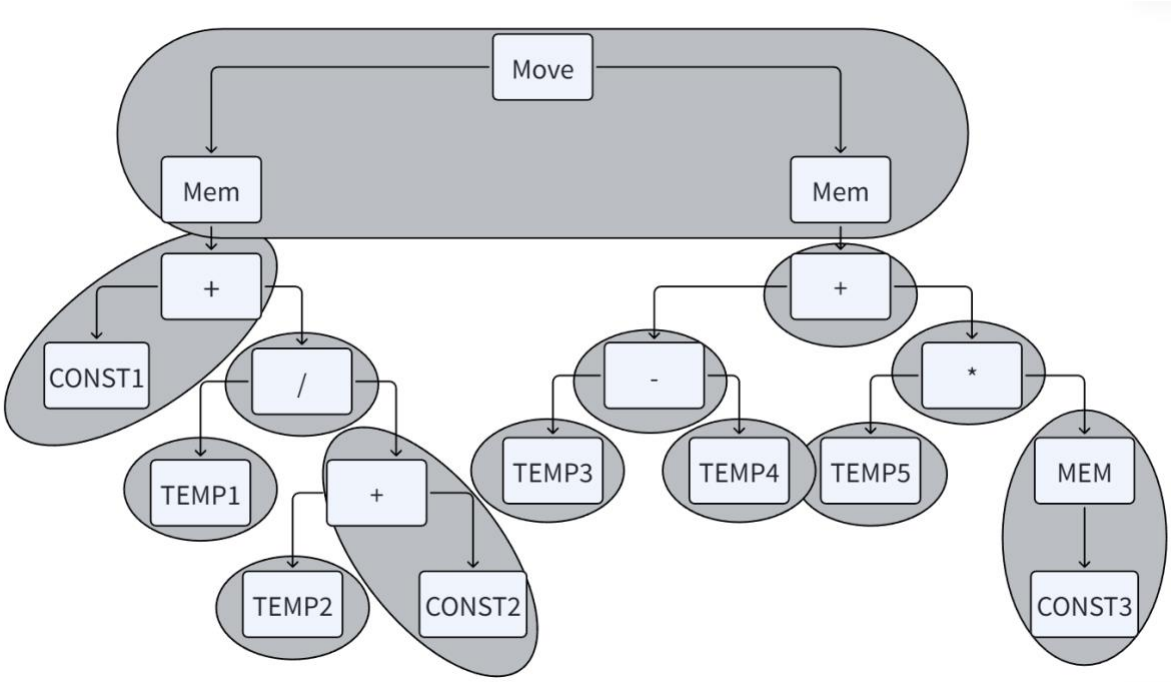
Instruction Selection

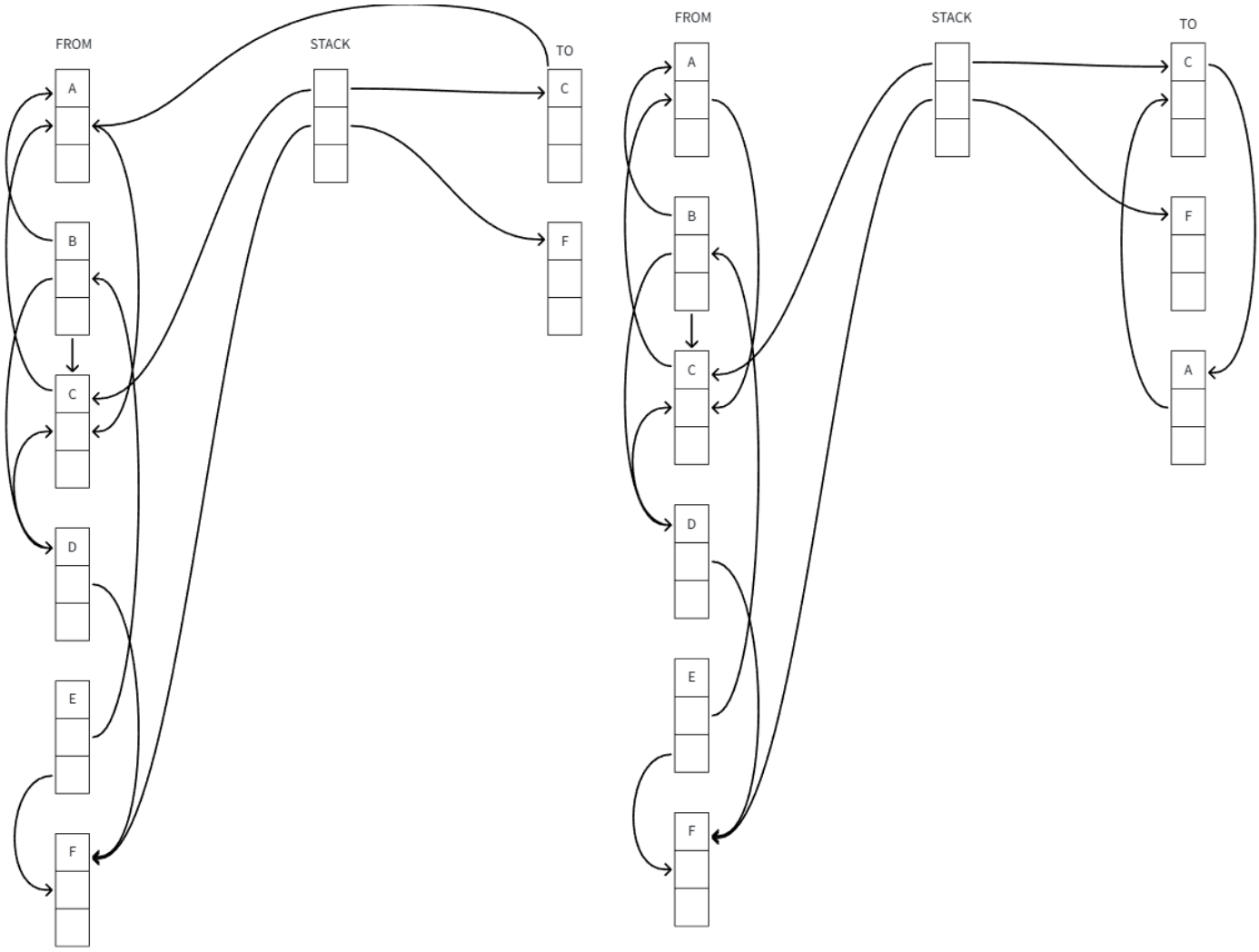


1.
2. r1 ← t2 + c2
   r2 ← t1 / r1
   r3 ← r2 + c1
   r4 ← t3 – t4
   r5 ← M[r0 + c3]
   r6 ← t5 * r5
   r7 ← r4 + r6
   M[r3] ← M[r7]

   Min_cost = 27

Garbage Collection

1.



2. DEF 都成为白色

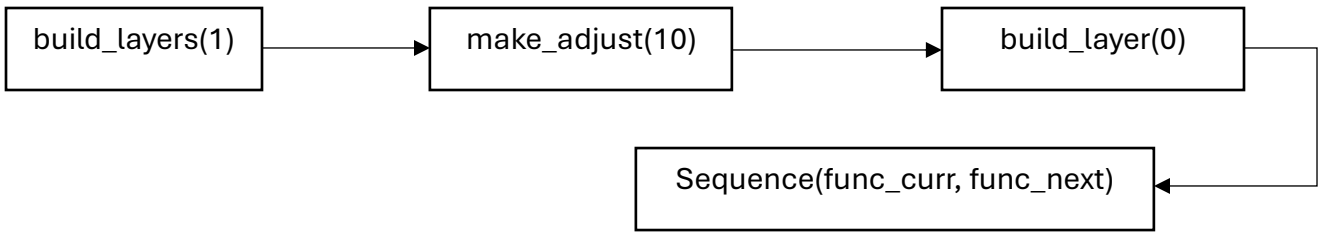
B 与 D 的引用断开，导致 D 无法被扫描到

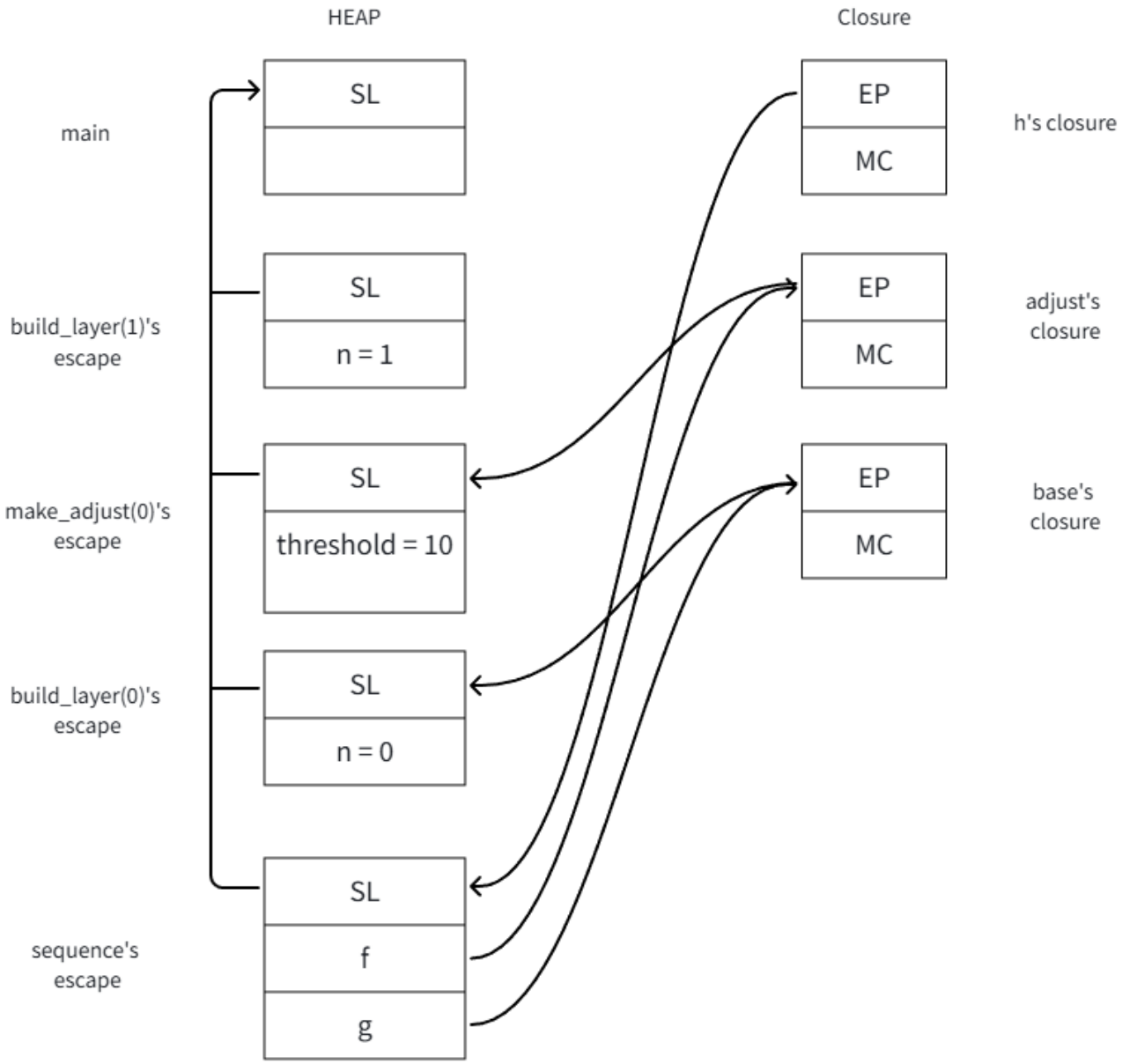
虽然 A 添加了对 E 的引用，但是因为 A 已经是黑色，不会再次扫描

期望的做法（合理即可）：将被添加引用的对象标记为灰色；将被删除引用的对象标记为灰色

Functional Programming

1.





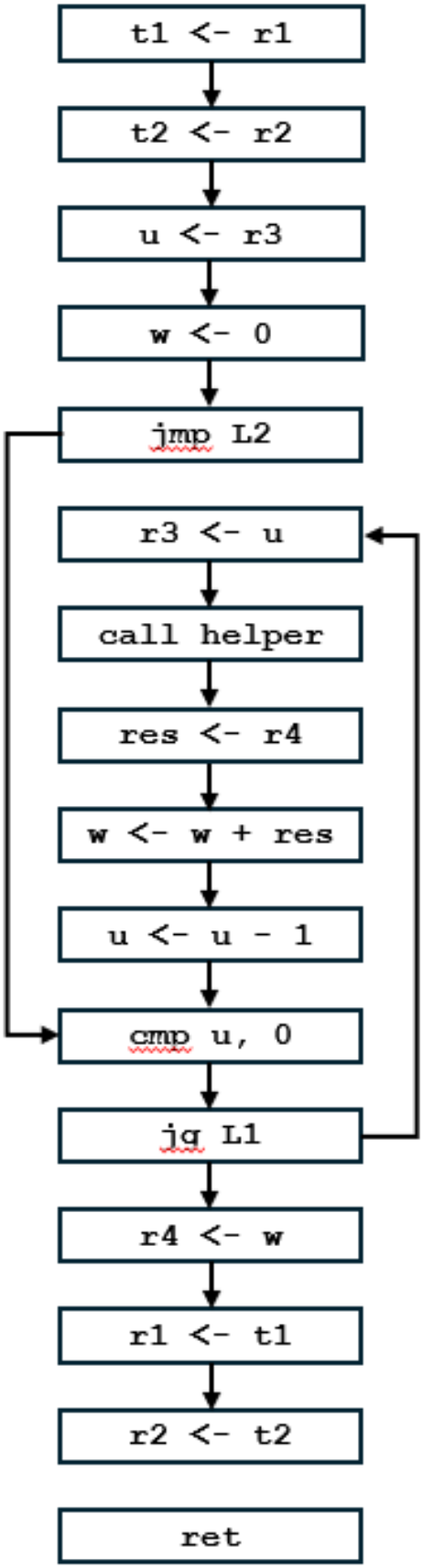
2. 2

3. 45

4. 是 pure-function；合理说明后续的函数闭包调用可能用到之前函数内部的局部变量，但之前函数执行完毕后局部变量的生命周期已经结束，无法访问。

Register Allocation

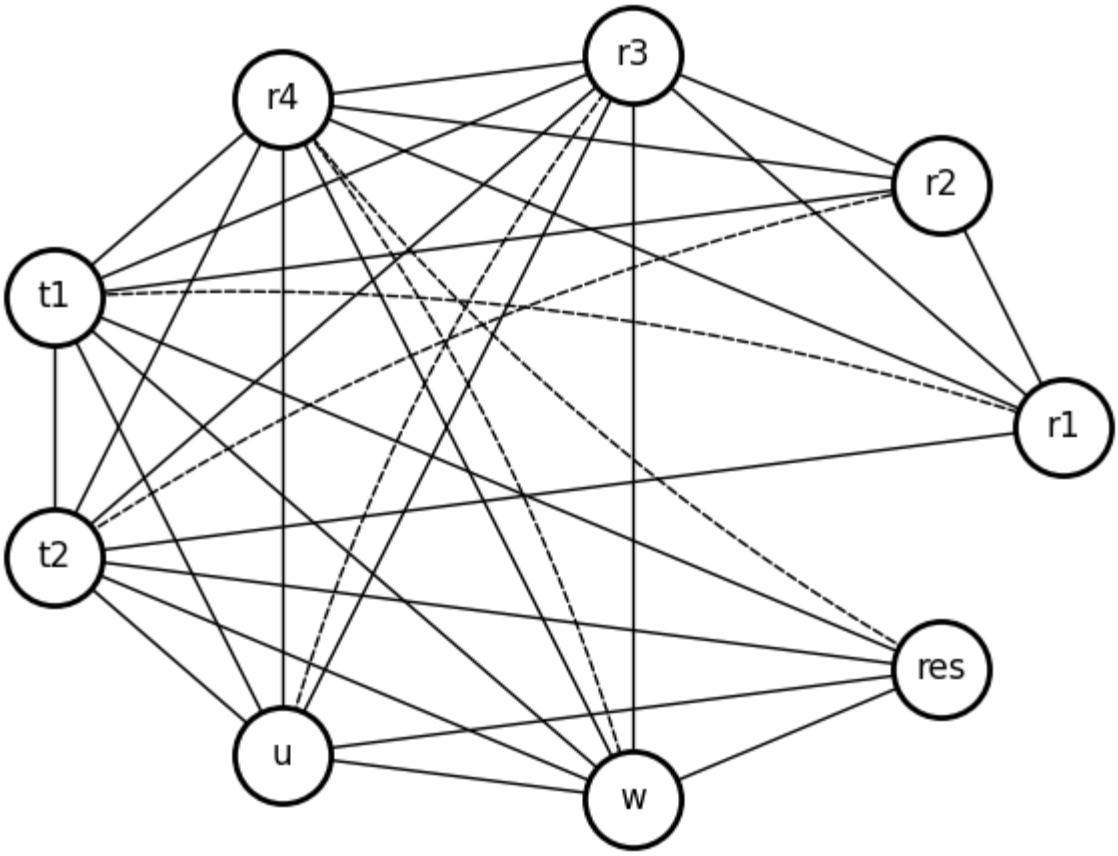
1.



2.

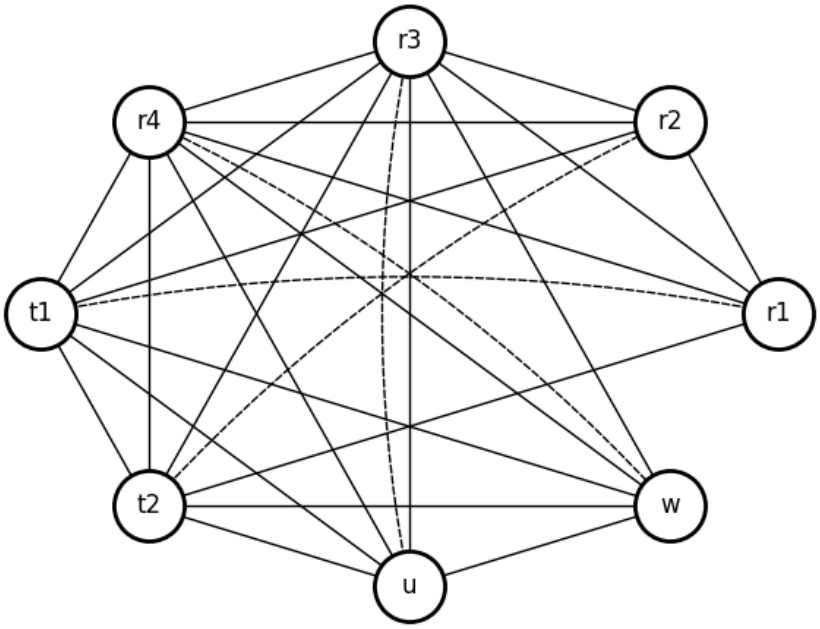
	def	use	in	out
t1 <- r1	t1	r1	r1 r2 r3	t1 r2 r3
t2 <- r2	t2	r2	t1 r2 r3	t1 t2 r3
U <- r3	u	r3	t1 t2 r3	t1 t2 u
W <- 0	w		t1 t2 u	t1 t2 u w
Jmp l2			t1 t2 u w	t1 t2 u w
L1:				
r3 <- u	r3	u	t1 t2 u w	t1 t2 u w r3
call helper	r3 r4	r3	t1 t2 u w r3	t1 t2 u w r4
res <- r4	res	r4	t1 t2 u w r4	t1 t2 u w res
w <- w + res	w	w res	t1 t2 u w res	t1 t2 u w
u <- u - 1	u	u	t1 t2 u w	t1 t2 u w
L2:				
cmp u, 0		u	t1 t2 u w	t1 t2 u w
jg L1			t1 t2 u w	t1 t2 u w
r4 <- w	r4	w	t1 t2 w	t1 t2 r4
r1 <- t1	r1	t1	t1 t2 r4	r1 t2 r4
r2 <- t2	r2	t2	r1 t2 r4	r1 r2 r4
ret			r1 r2 r4	

3.



4.

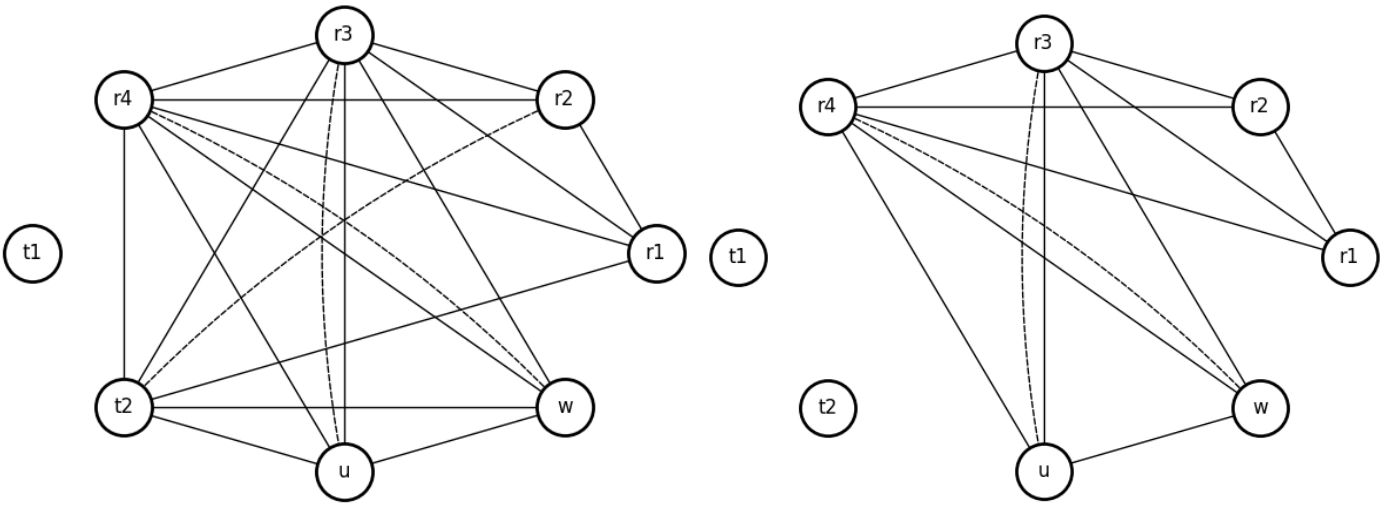
(1). Coalesce res, r4



(2). Calc priority：

t1: 1/3; t2: 1/3; u: 41/5; w: 22/5

spill t1, t2



(3) Simplify u, w

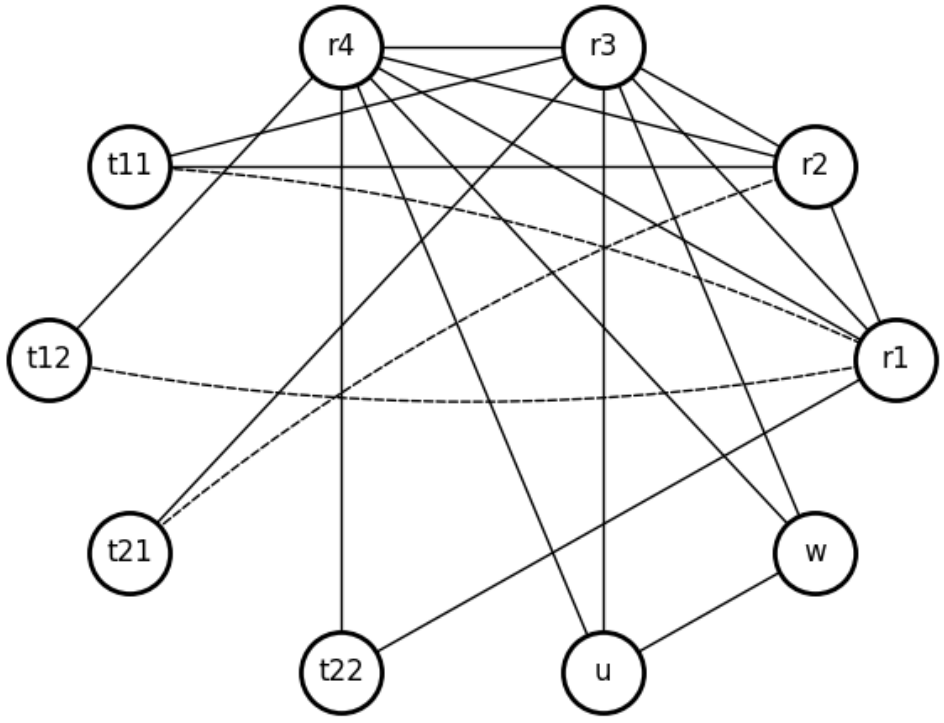
w ← r1, u ← r2

(4) Actually spill t1, t2

(5) Rewrite

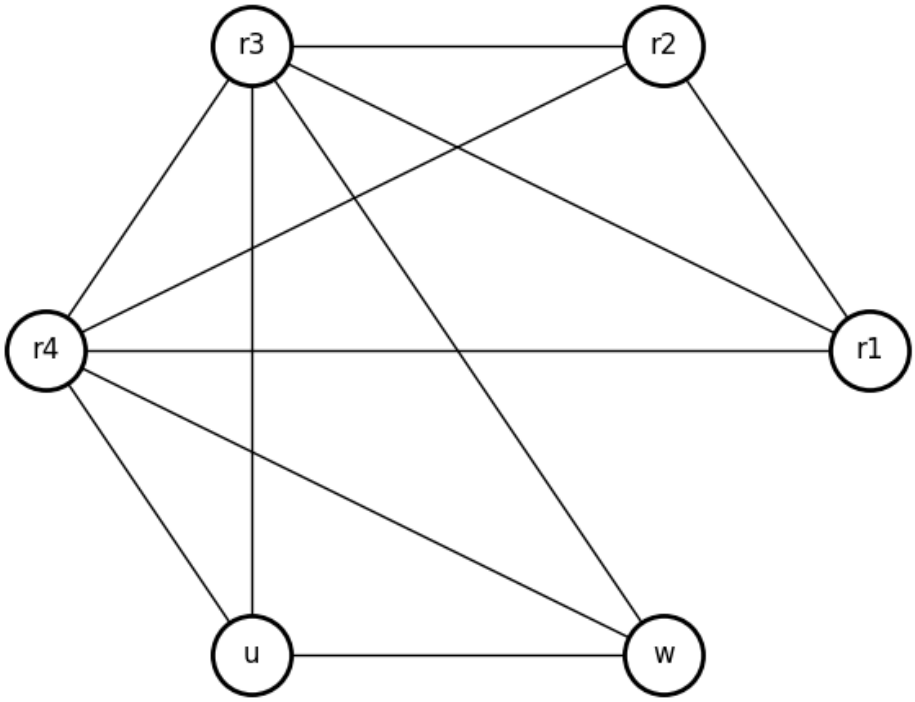
	def	use	in	out
t11 <- r1	t11	r1	r1 r2 r3	t11 r2 r3
M[t1_loc] <- t11		t11	t11 r2 r3	r2 r3
t21 <- r2	t21	r2	r2 r3	t21 r3
M[t2_loc] <- t21		t21	t21 t2 r3	r3
u <- r3	u	r3	r3	u
w <- 0	w		u	u w
jmp l2			u w	u w
L1:				
r3 <- u	r3	u	u w	u w r3

call helper	r3 r4	r3	u w r3	u w r4
w <- w + r4	w	w r4	u w r4	u w
u <- u - 1	u	u	u w	u w
L2:				
cmp u, 0		u	u w	u w
jg L1			u w	u w
r4 <- w	r4	w	w	r4
t12 <- M[t1_loc]	t12		r4	r4 t12
r1 <- t12	r1	t12	r4 t12	r1 r4
t22 <- M[t2_loc]	t22		r1 r4	r1 r4 t22
r2 <- t22	r2	t22	r1 r4 t22	r1 r2 r4
ret			r1 r2 r4	



(6) Coalesce r1 ← t11; r1 ← t12; r2 ← t21; r2 ← t22

(7) Simplify r1 ← w; r2 ← u



(8) Code

M[t1_loc] ← r1

M[t2_loc] ← r2

r2 ← r3

r1 ← 0

jmp L2.

L1.

r3 ← r2

call helper

r1 ← r1 + r4

r2 ← r2 – 1

L2.

cmp r2, 0

jg L1.

r4 ← r1

r1 ← M[t1_loc]

r2 ← M[t2_loc]

ret