Register Allocation

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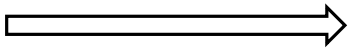
Control Flow Graph

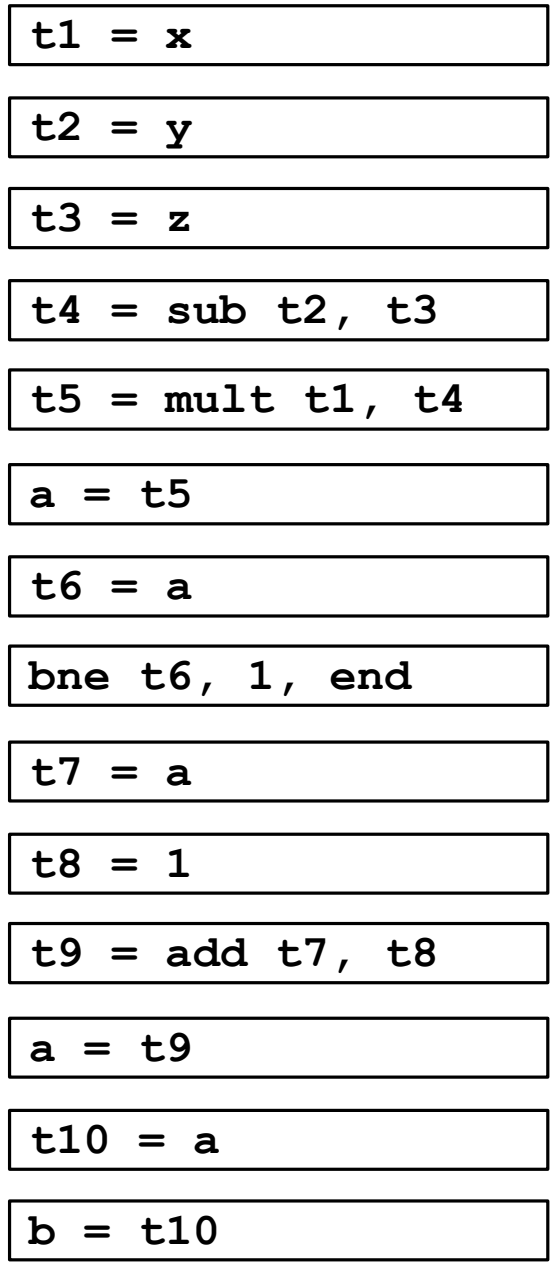
- Create a node for each IR instruction
- Create an edge between an instruction and it’s next instruction
- If the instruction is a **branch**:
  - Connect it to the instruction the comes after the **target label**

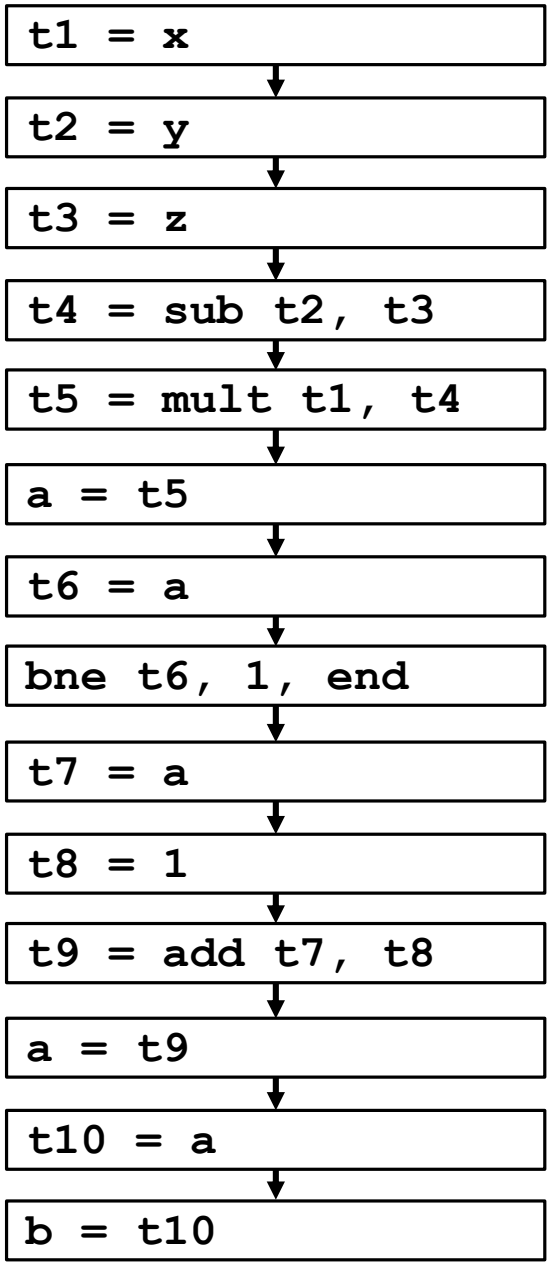
Control Flow Graph

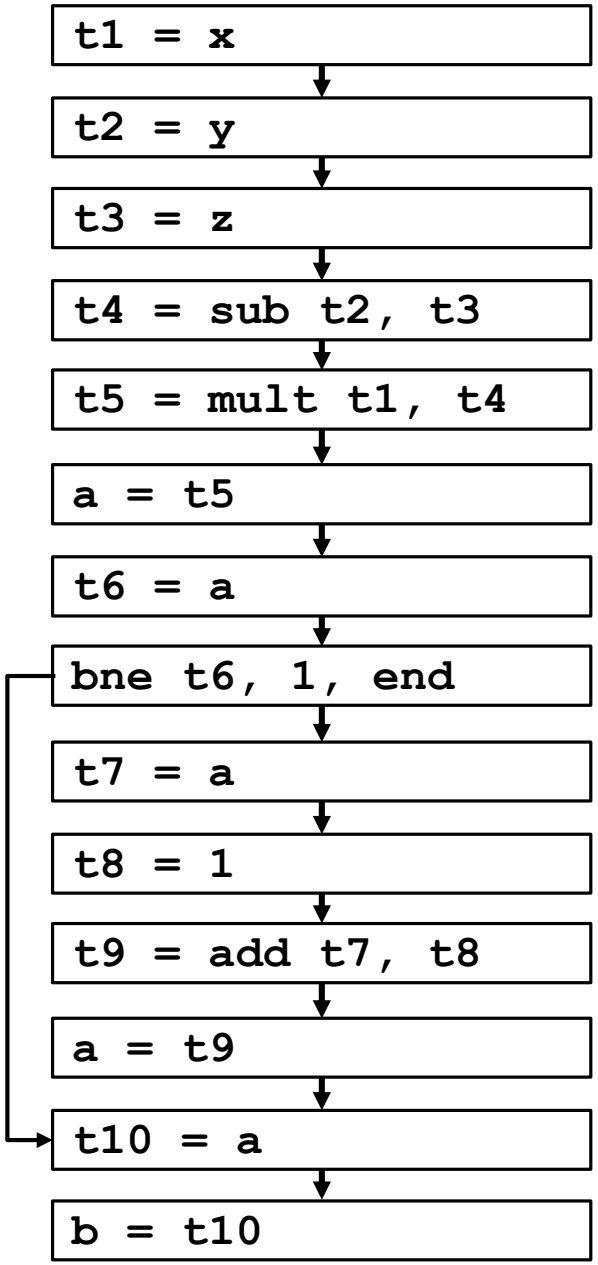
```
a = x * (y - z)
if (a) {
  a = a + 1;
}
b = a
```



```
t1 = x
t2 = y
t3 = z
t4 = sub t2, t3
t5 = mult, t1, t4
a = t5
t6 = a
bne t6, 1, end
t7 = a
t8 = 1
t9 = add t7, t8
a = t9
end:
t10 = a
b = t10
```


t1 = x
t2 = y
t3 = z
t4 = sub t2, t3
t5 = mult t1, t4
a = t5
t6 = a
bne t6, 1, end
t7 = a
t8 = 1
t9 = add t7, t8
a = t9
t10 = a
b = t10


t1 = x
t2 = y
t3 = z
t4 = sub t2, t3
t5 = mult t1, t4
a = t5
t6 = a
bne t6, 1, end
t7 = a
t8 = 1
t9 = add t7, t8
a = t9
t10 = a
b = t10

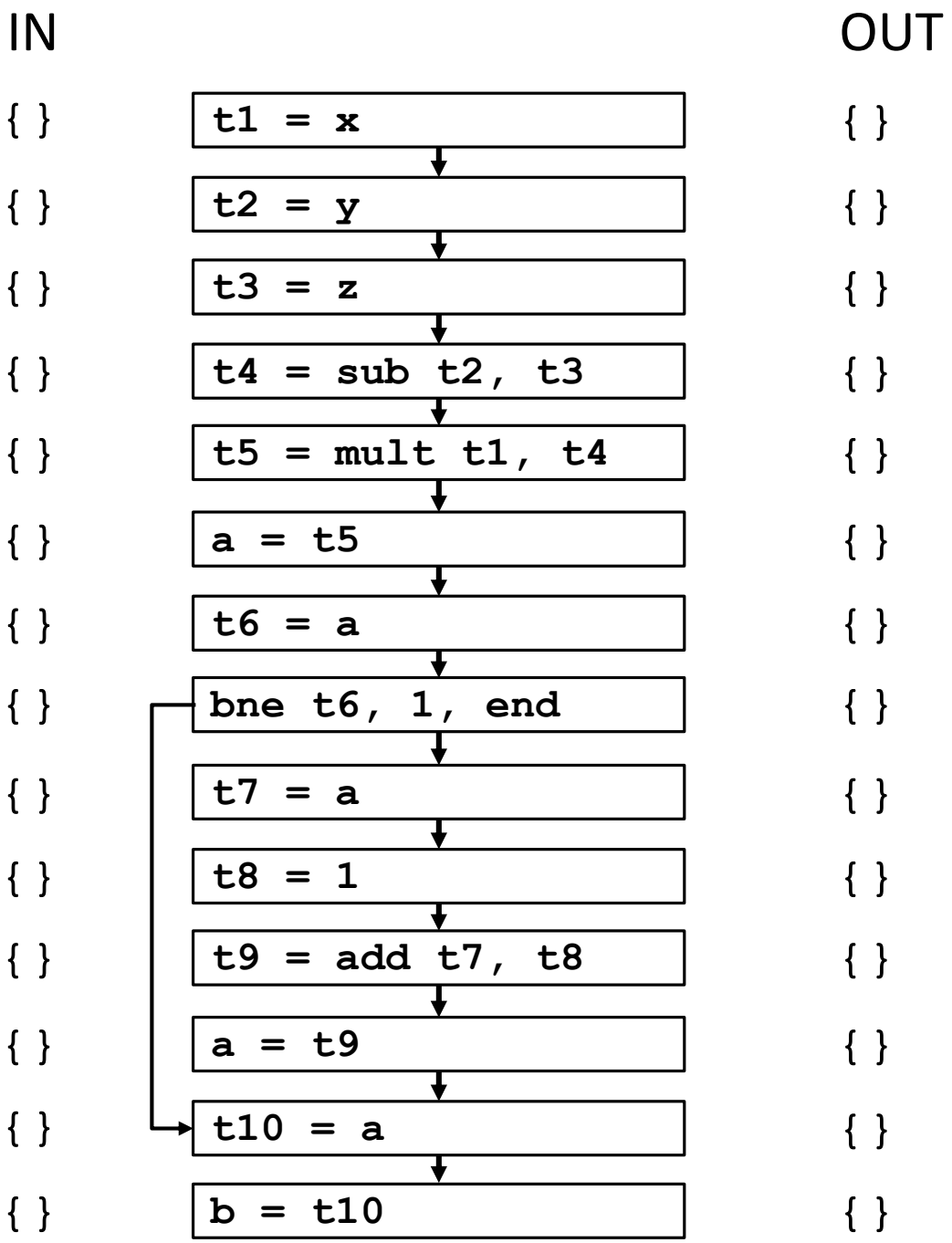

t1 = x
t2 = y
t3 = z
t4 = sub t2, t3
t5 = mult t1, t4
a = t5
t6 = a
bne t6, 1, end
t7 = a
t8 = 1
t9 = add t7, t8
a = t9
t10 = a
b = t10

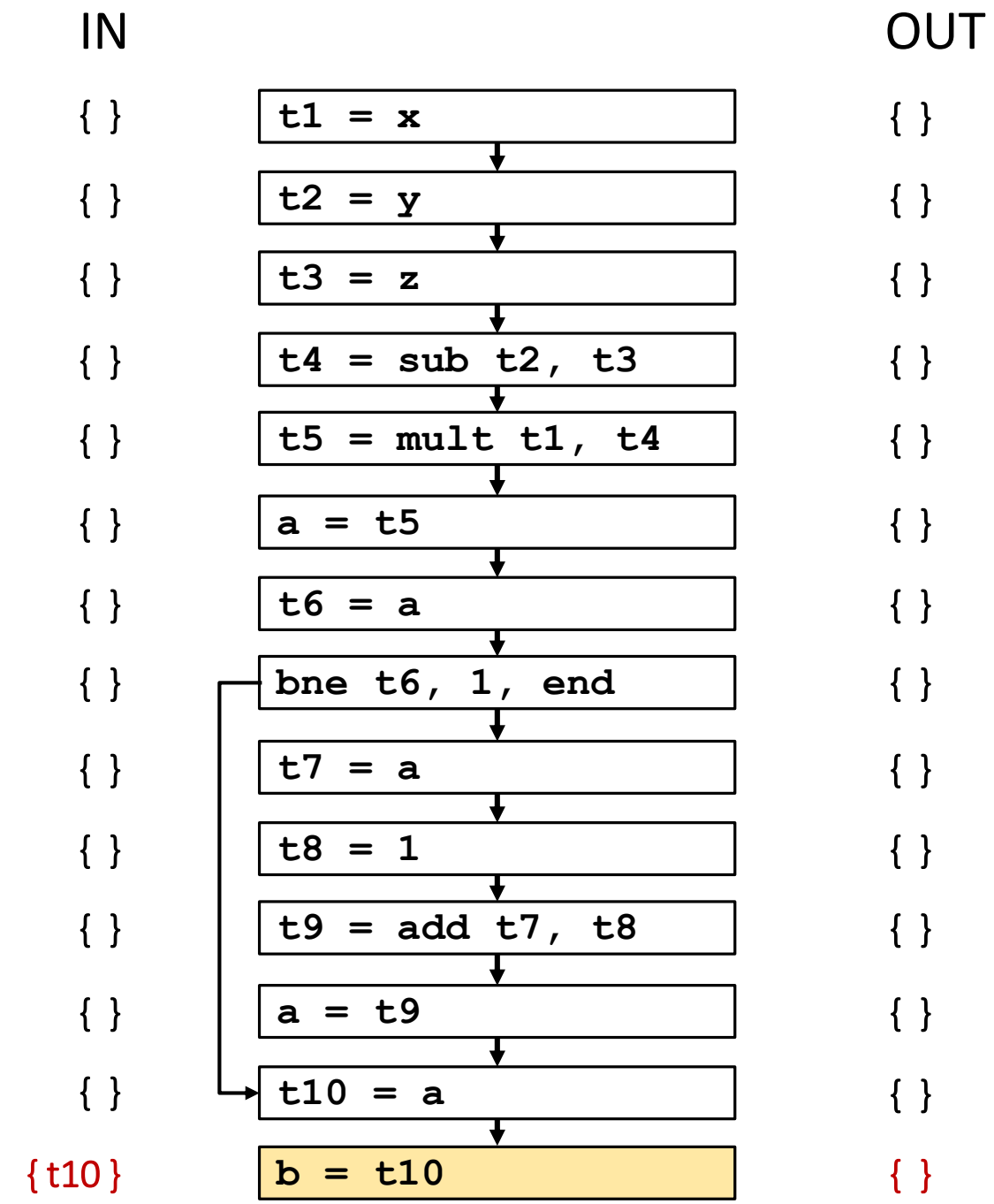
Liveness Analysis

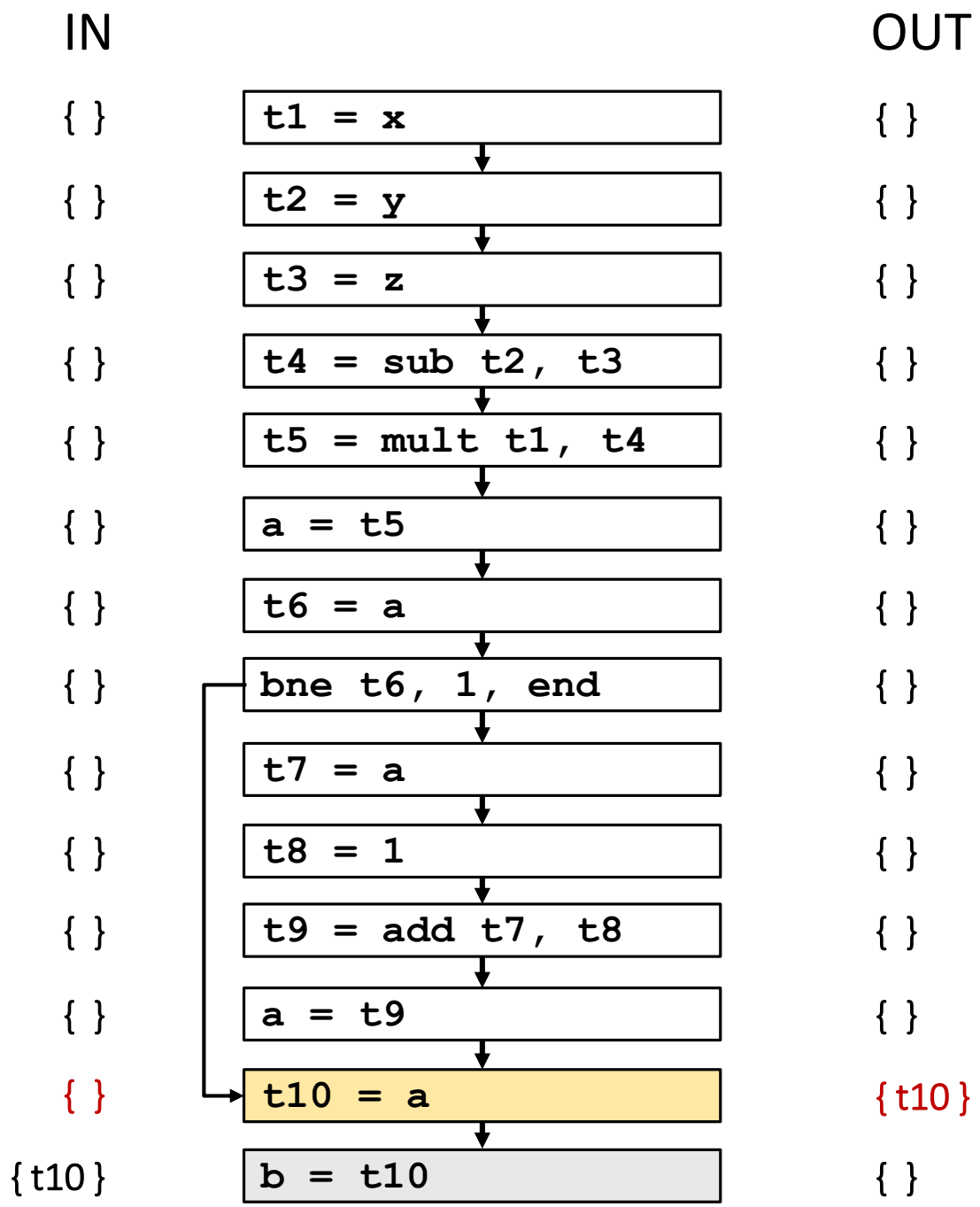
- TODO

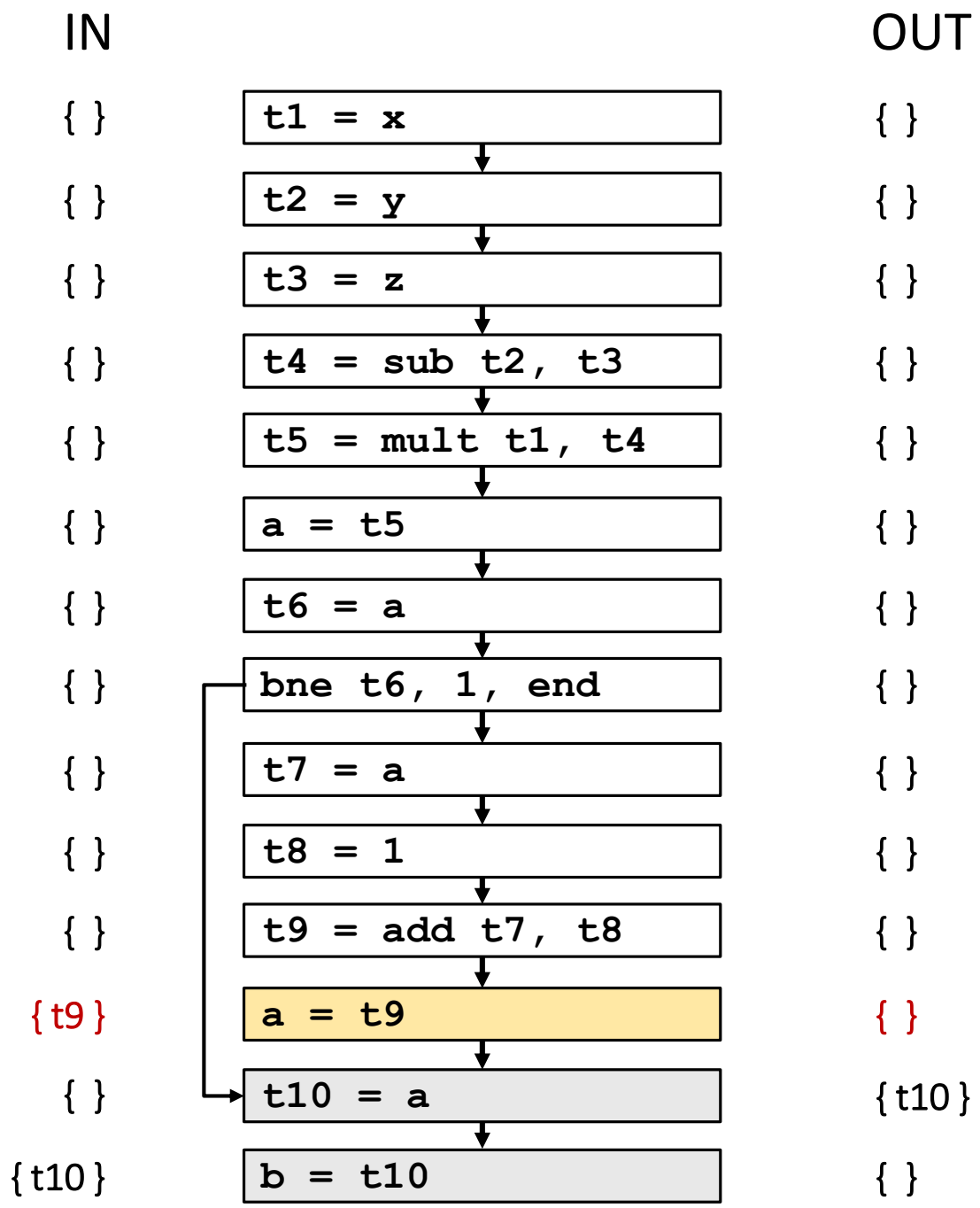
Liveness Analysis

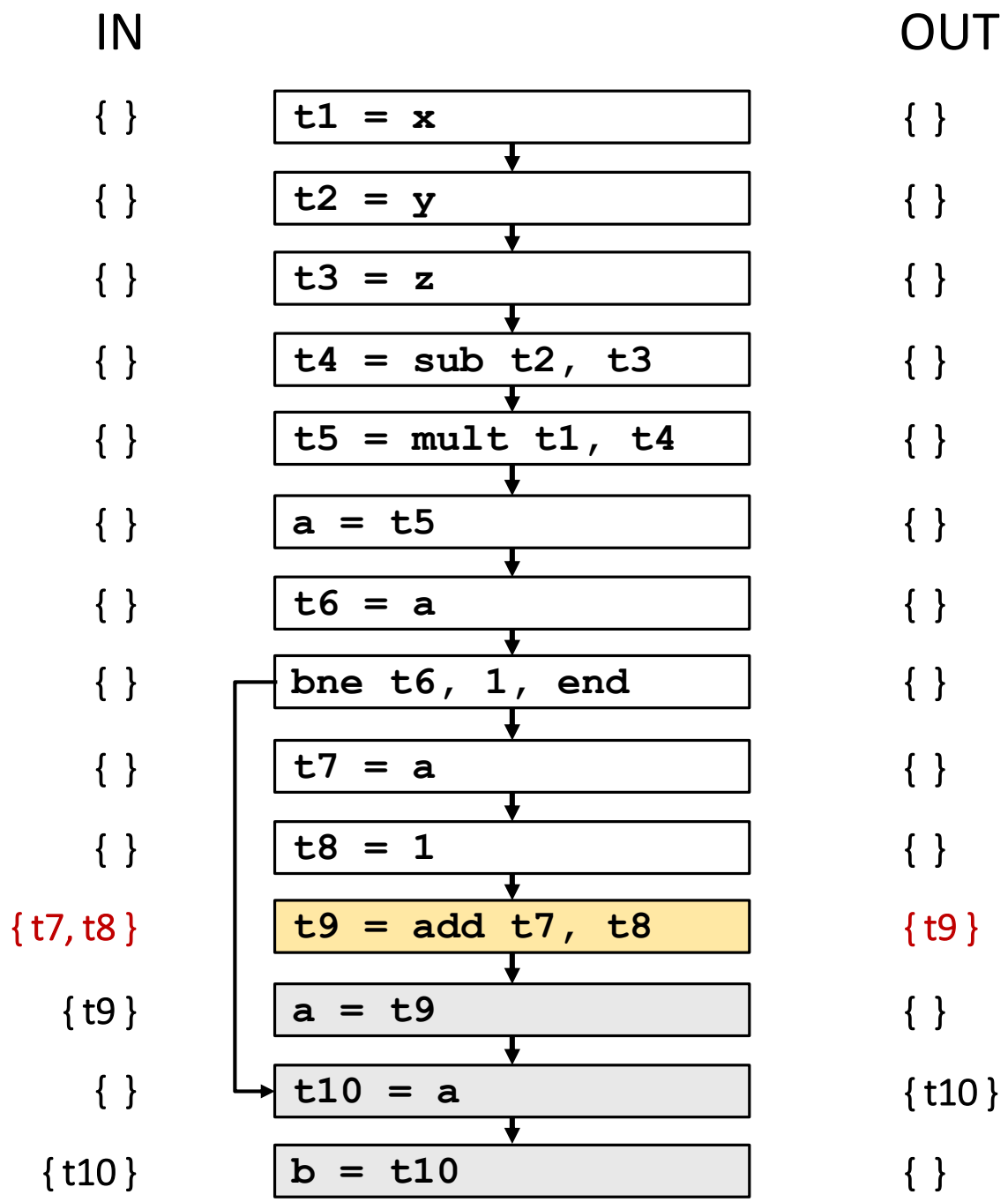
First Iteration…

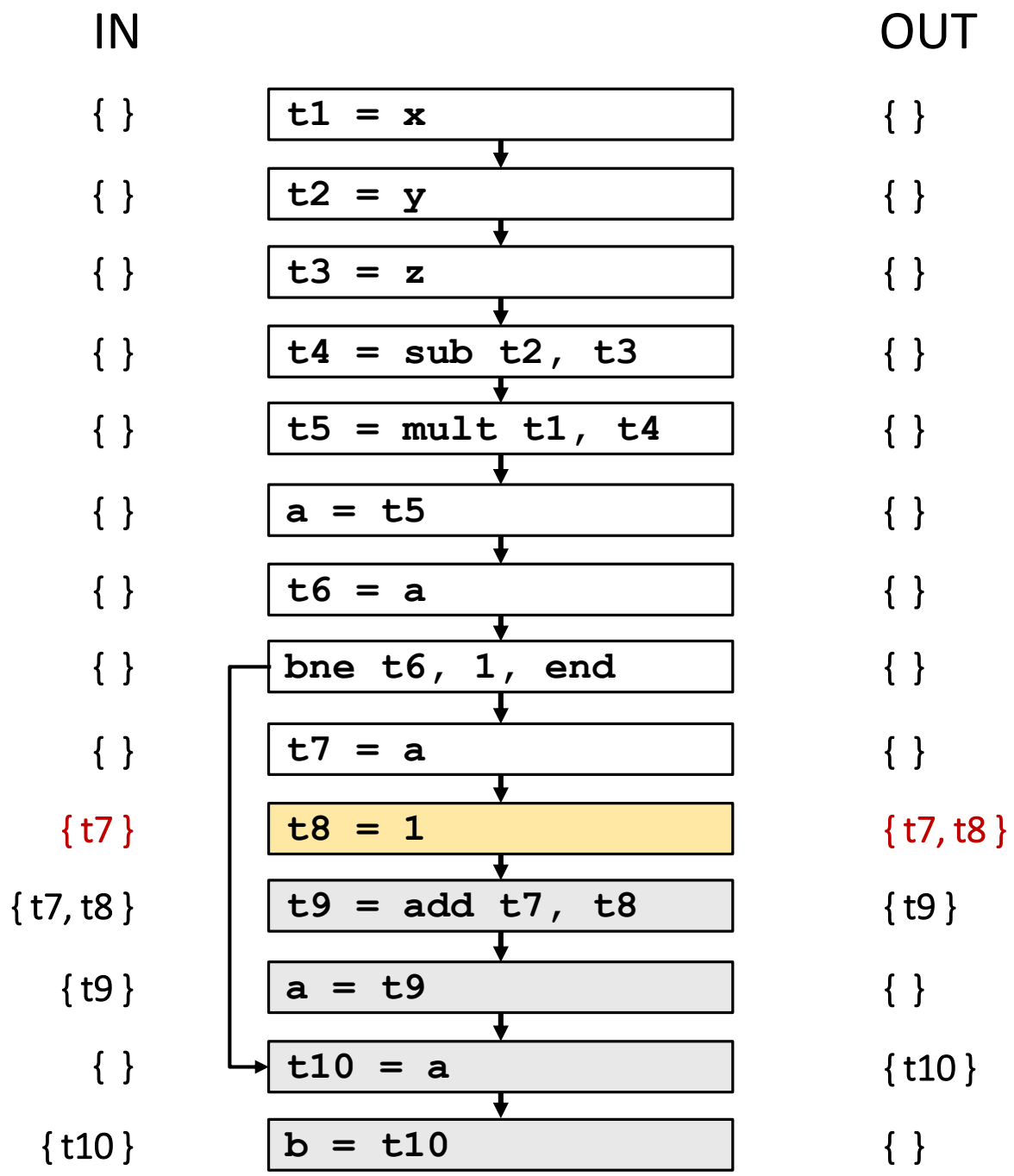

IN
OUT
{ }
t1 = x
t2 = y
t3 = z
t4 = sub t2, t3
t5 = mult t1, t4
a = t5
t6 = a
bne t6, 1, end
t7 = a
t8 = 1
t9 = add t7, t8
a = t9
t10 = a
b = t10

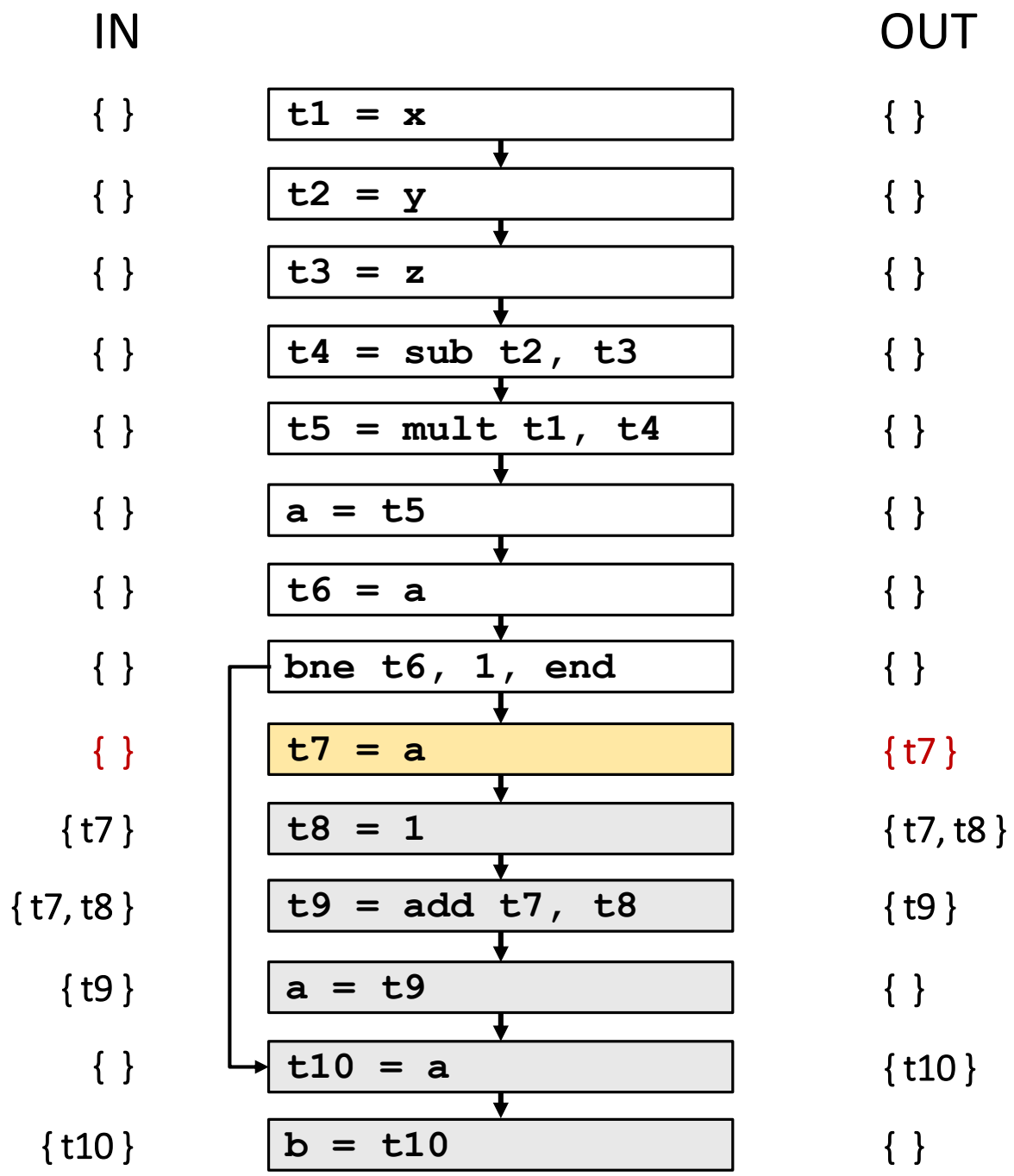

IN
OUT
{ }
t1 = x
{ }
{ }
t2 = y
{ }
{ }
t3 = z
{ }
{ }
t4 = sub t2, t3
{ }
{ }
t5 = mult t1, t4
{ }
{ }
a = t5
{ }
{ }
t6 = a
{ }
{ }
bne t6, 1, end
{ }
{ }
t7 = a
{ }
{ }
t8 = 1
{ }
{ }
t9 = add t7, t8
{ }
{ }
a = t9
{ }
{ }
t10 = a
{ }
{t10}
b = t10
{ }

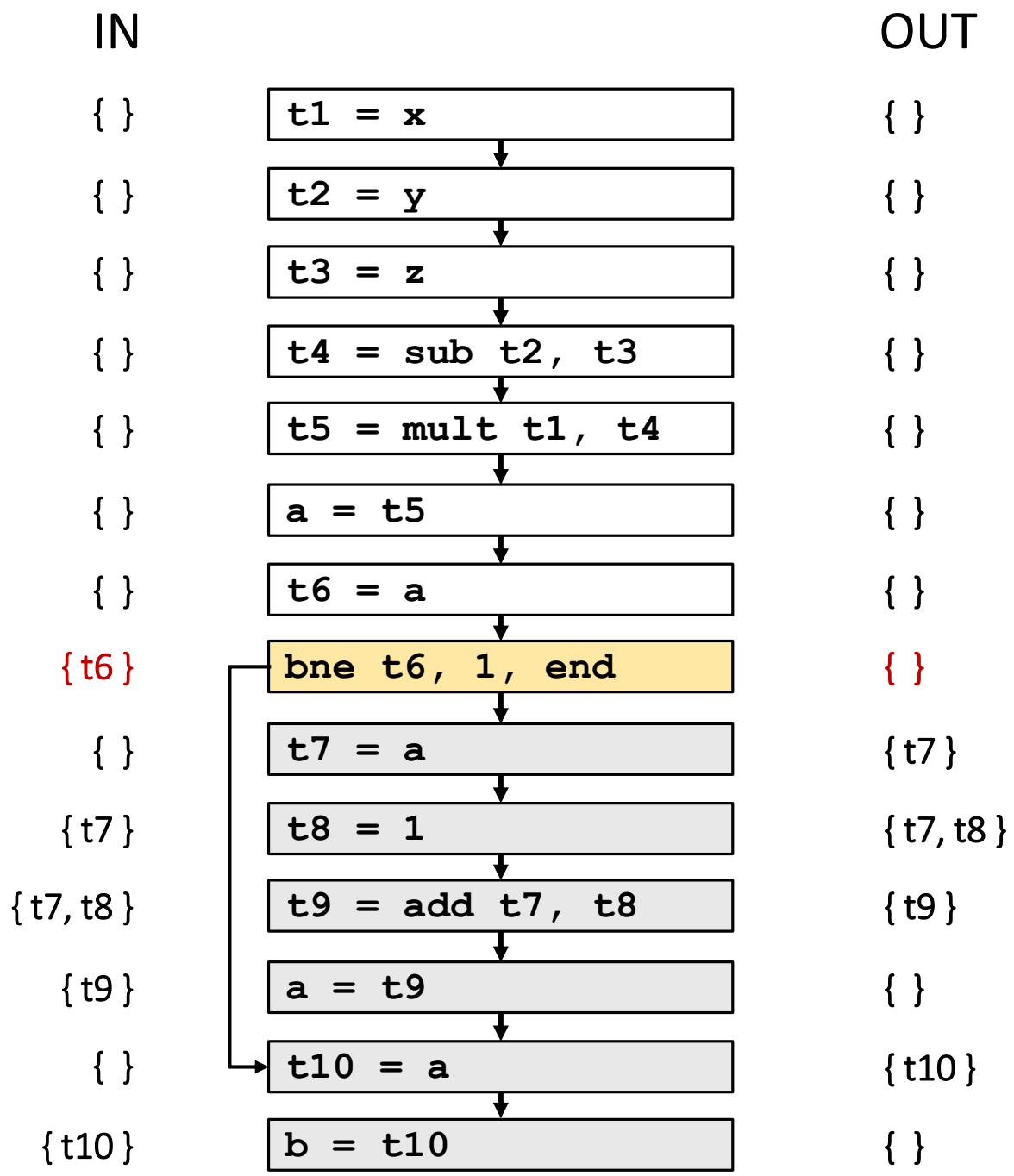

IN
OUT
{ }
t1 = x
{ }
{ }
t2 = y
{ }
{ }
t3 = z
{ }
{ }
t4 = sub t2, t3
{ }
{ }
t5 = mult t1, t4
{ }
{ }
a = t5
{ }
{ }
t6 = a
{ }
{ }
bne t6, 1, end
{ }
{ }
t7 = a
{ }
{ }
t8 = 1
{ }
{ }
t9 = add t7, t8
{ }
{ }
a = t9
{ }
{ }
t10 = a
{t10}
{t10}
b = t10
{ }

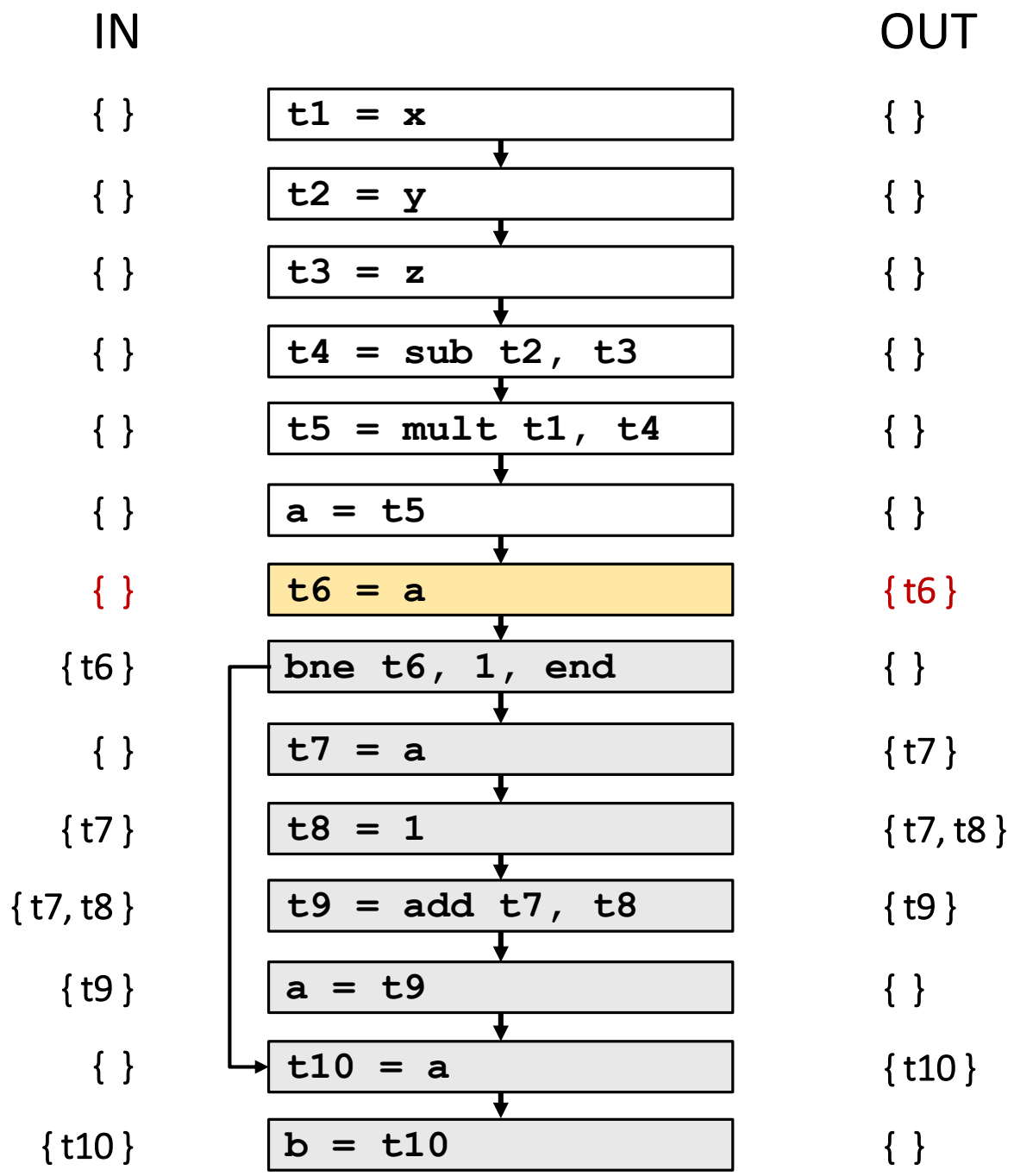

IN
OUT
{ }
t1 = x
{ }
{ }
t2 = y
{ }
{ }
t3 = z
{ }
{ }
t4 = sub t2, t3
{ }
{ }
t5 = mult t1, t4
{ }
{ }
a = t5
{ }
{ }
t6 = a
{ }
{ }
bne t6, 1, end
{ }
{ }
t7 = a
{ }
{ }
t8 = 1
{ }
{ }
t9 = add t7, t8
{ }
{t9}
a = t9
{ }
{ }
t10 = a
{t10}
{t10}
b = t10
{ }

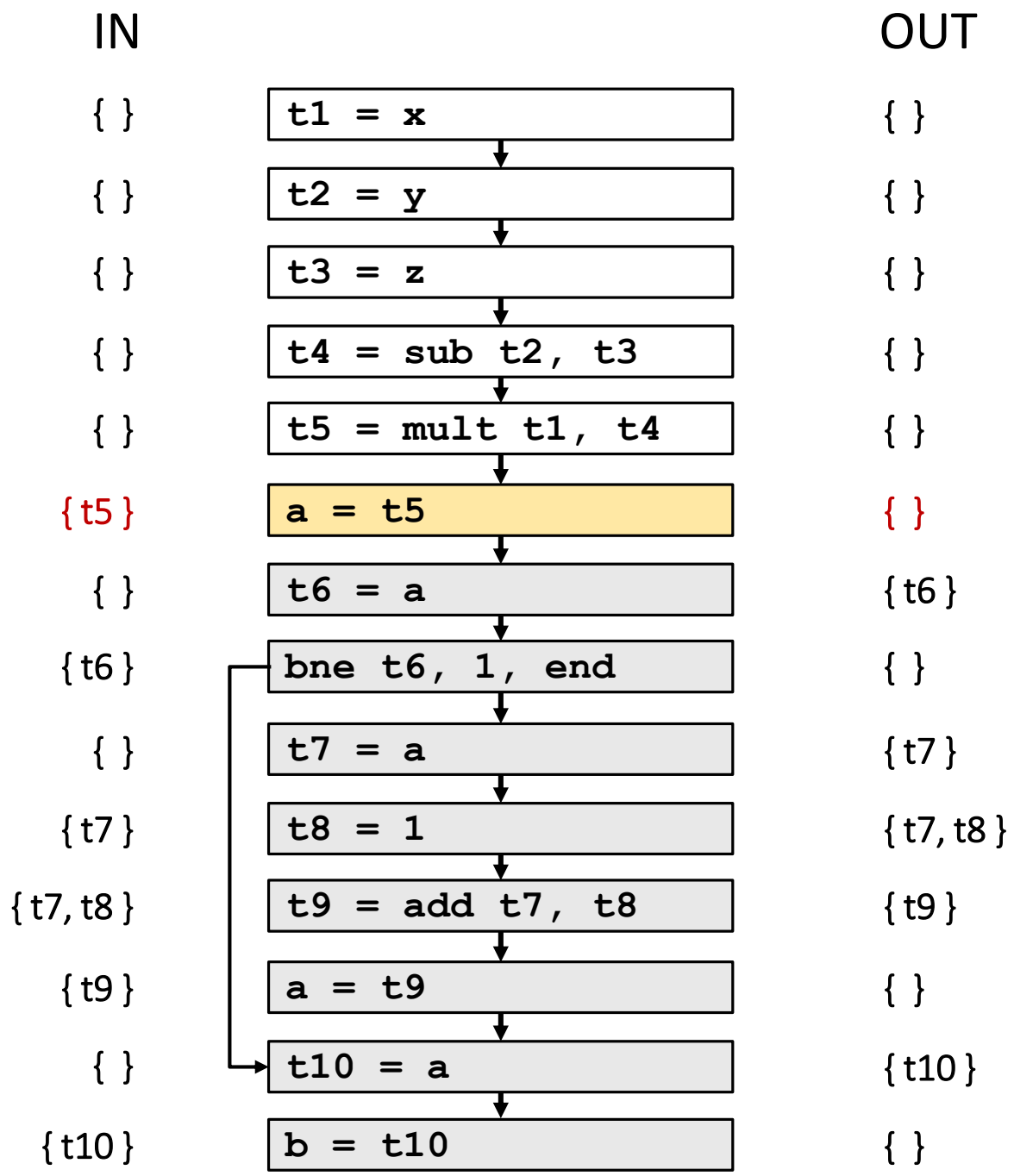

IN
OUT
{ }
t1 = x
{ }
{ }
t2 = y
{ }
{ }
t3 = z
{ }
{ }
t4 = sub t2, t3
{ }
{ }
t5 = mult t1, t4
{ }
{ }
a = t5
{ }
{ }
t6 = a
{ }
{ }
bne t6, 1, end
{ }
{ }
t7 = a
{ }
{ }
t8 = 1
{ }
{t7, t8}
t9 = add t7, t8
{t9}
{t9}
a = t9
{ }
{ }
t10 = a
{t10}
{t10}
b = t10
{ }

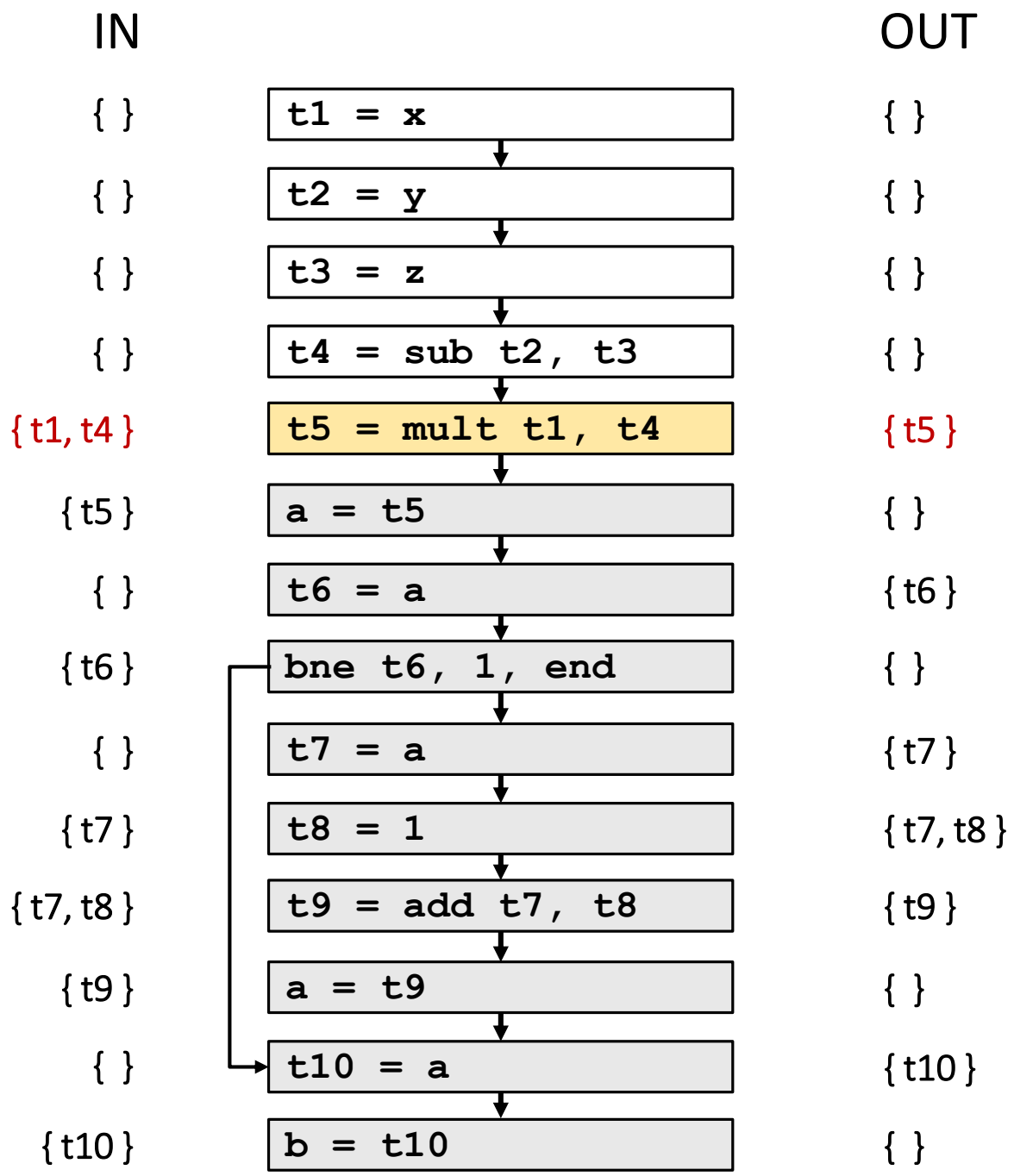

IN
OUT
{ }
t1 = x
{ }
{ }
t2 = y
{ }
{ }
t3 = z
{ }
{ }
t4 = sub t2, t3
{ }
{ }
t5 = mult t1, t4
{ }
{ }
a = t5
{ }
{ }
t6 = a
{ }
{ }
bne t6, 1, end
{ }
{ }
t7 = a
{ }
{t7}
t8 = 1
{t7, t8}
{t7, t8}
t9 = add t7, t8
{t9}
{t9}
a = t9
{ }
{ }
t10 = a
{t10}
{t10}
b = t10
{ }

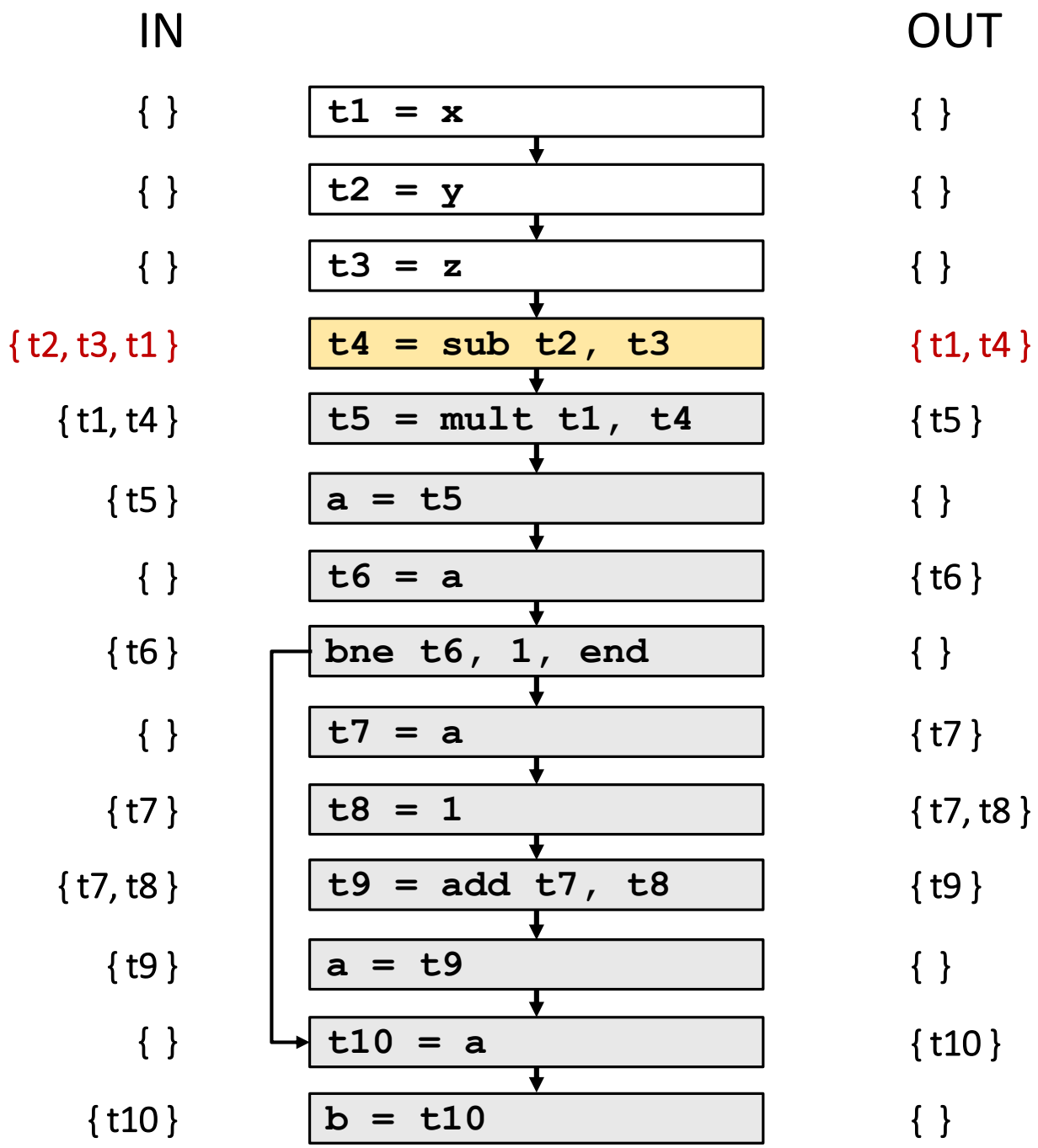

IN
OUT
{ }
t1 = x
{ }
{ }
t2 = y
{ }
{ }
t3 = z
{ }
{ }
t4 = sub t2, t3
{ }
{ }
t5 = mult t1, t4
{ }
{ }
a = t5
{ }
{ }
t6 = a
{ }
{ }
bne t6, 1, end
{ }
{ }
t7 = a
{t7}
{t7}
t8 = 1
{t7, t8}
{t7, t8}
t9 = add t7, t8
{t9}
{t9}
a = t9
{ }
{ }
t10 = a
{t10}
{t10}
b = t10
{ }

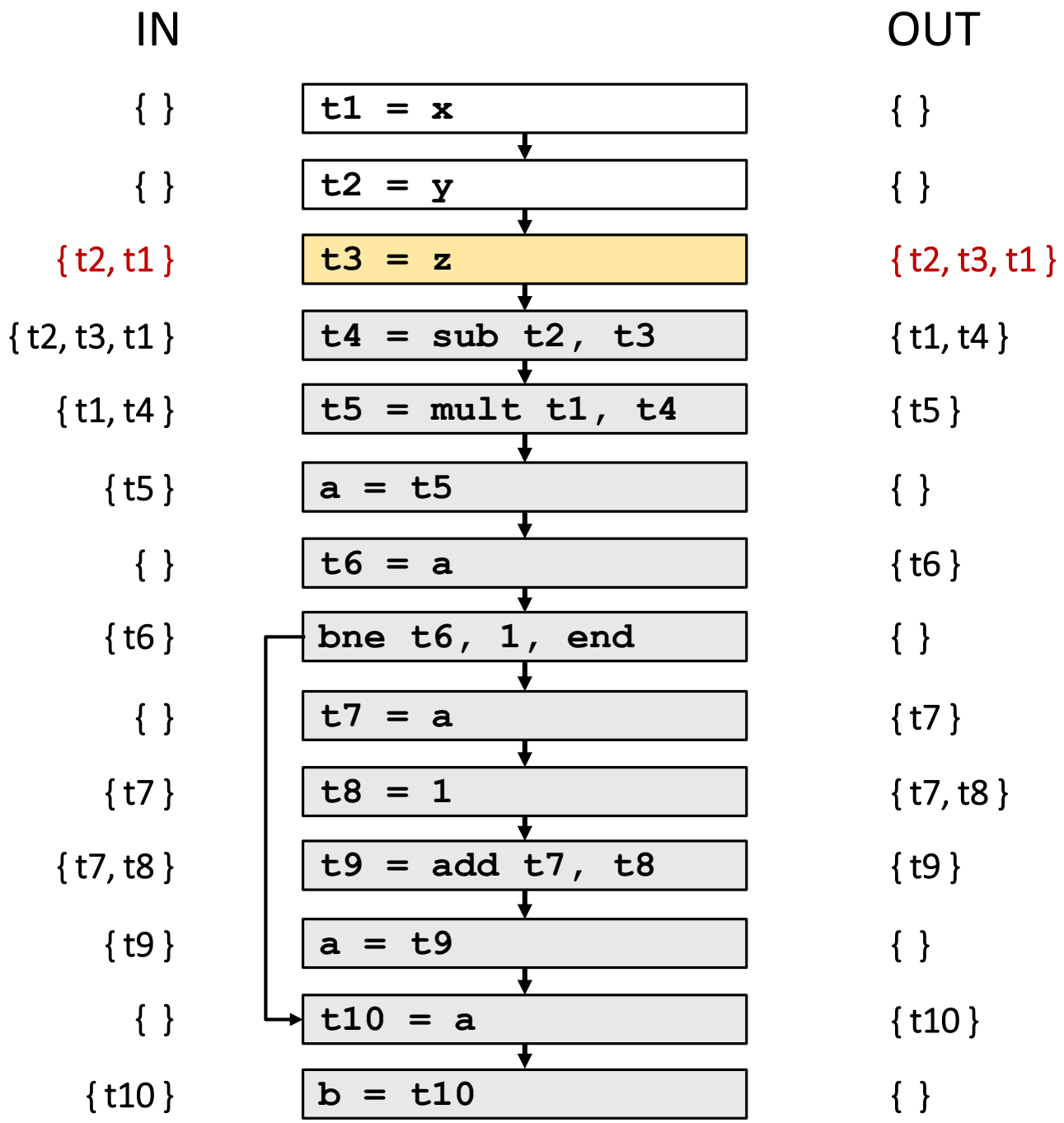

IN
OUT
{ }
t1 = x
{ }
{ }
t2 = y
{ }
{ }
t3 = z
{ }
{ }
t4 = sub t2, t3
{ }
{ }
t5 = mult t1, t4
{ }
{ }
a = t5
{ }
{ }
t6 = a
{ }
{t6}
bne t6, 1, end
{ }
{ }
t7 = a
{t7}
{t7}
t8 = 1
{t7, t8}
{t7, t8}
t9 = add t7, t8
{t9}
{t9}
a = t9
{ }
{ }
t10 = a
{t10}
{t10}
b = t10
{ }

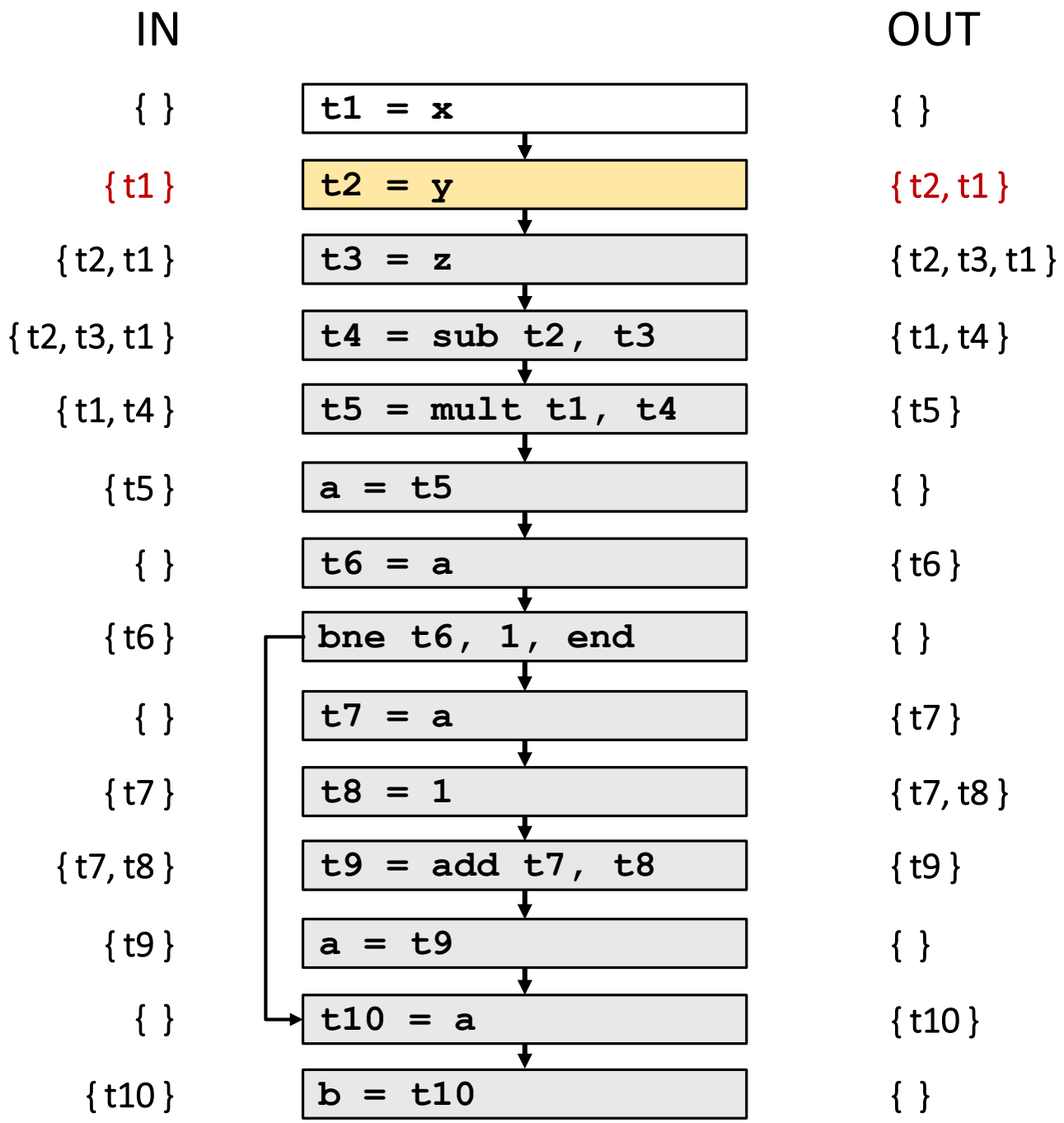

IN
OUT
{ }
t1 = x
{ }
{ }
t2 = y
{ }
{ }
t3 = z
{ }
{ }
t4 = sub t2, t3
{ }
{ }
t5 = mult t1, t4
{ }
{ }
a = t5
{ }
{ }
t6 = a
{t6}
{t6}
bne t6, 1, end
{ }
{ }
t7 = a
{t7}
{t7}
t8 = 1
{t7, t8}
{t7, t8}
t9 = add t7, t8
{t9}
{t9}
a = t9
{ }
{ }
t10 = a
{t10}
{t10}
b = t10
{ }

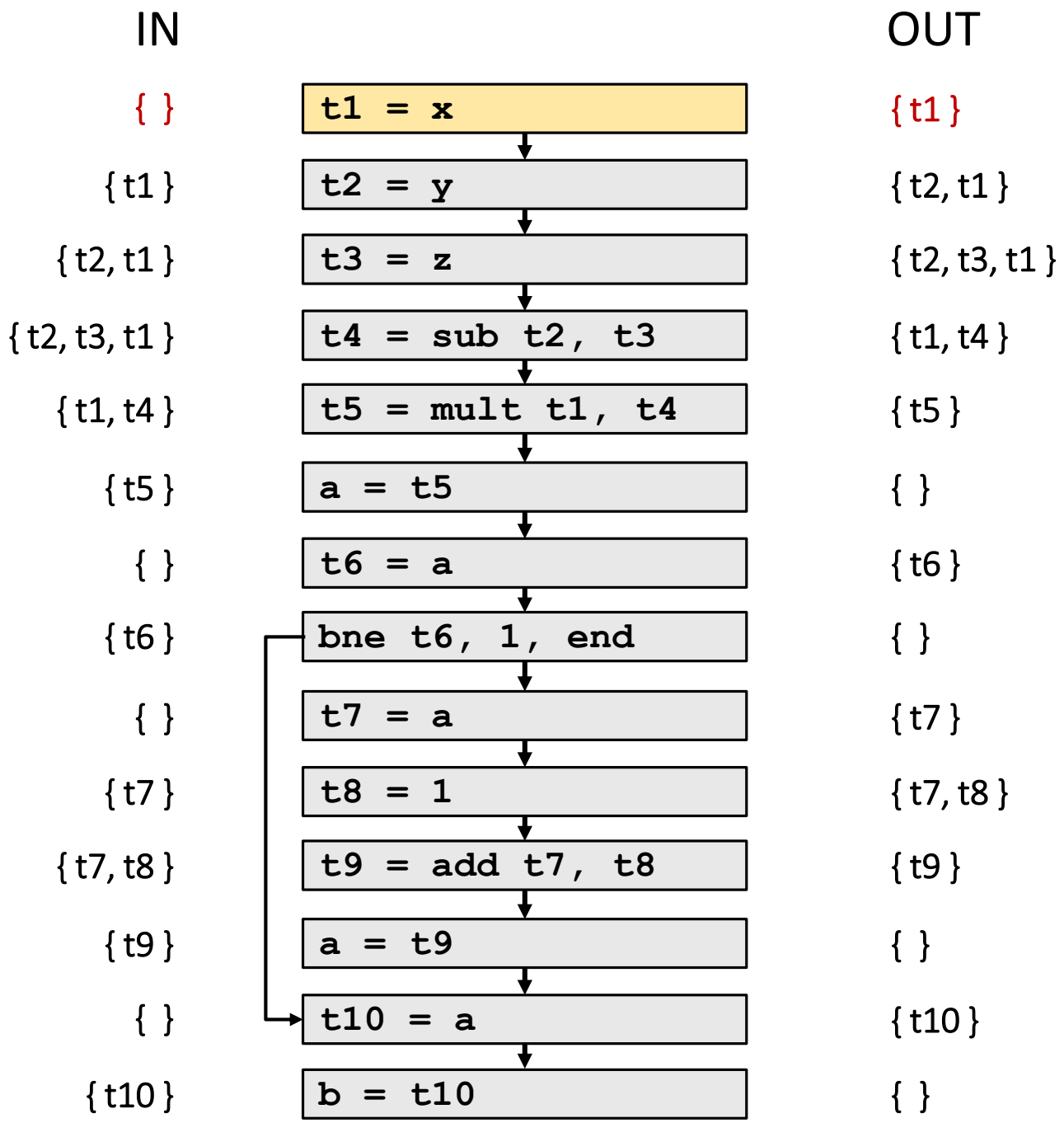

IN
OUT
{ }
t1 = x
{ }
{ }
t2 = y
{ }
{ }
t3 = z
{ }
{ }
t4 = sub t2, t3
{ }
{ }
t5 = mult t1, t4
{ }
{t5}
a = t5
{ }
{ }
t6 = a
{t6}
{t6}
bne t6, 1, end
{ }
{ }
t7 = a
{t7}
{t7}
t8 = 1
{t7, t8}
{t7, t8}
t9 = add t7, t8
{t9}
{t9}
a = t9
{ }
{ }
t10 = a
{t10}
{t10}
b = t10
{ }

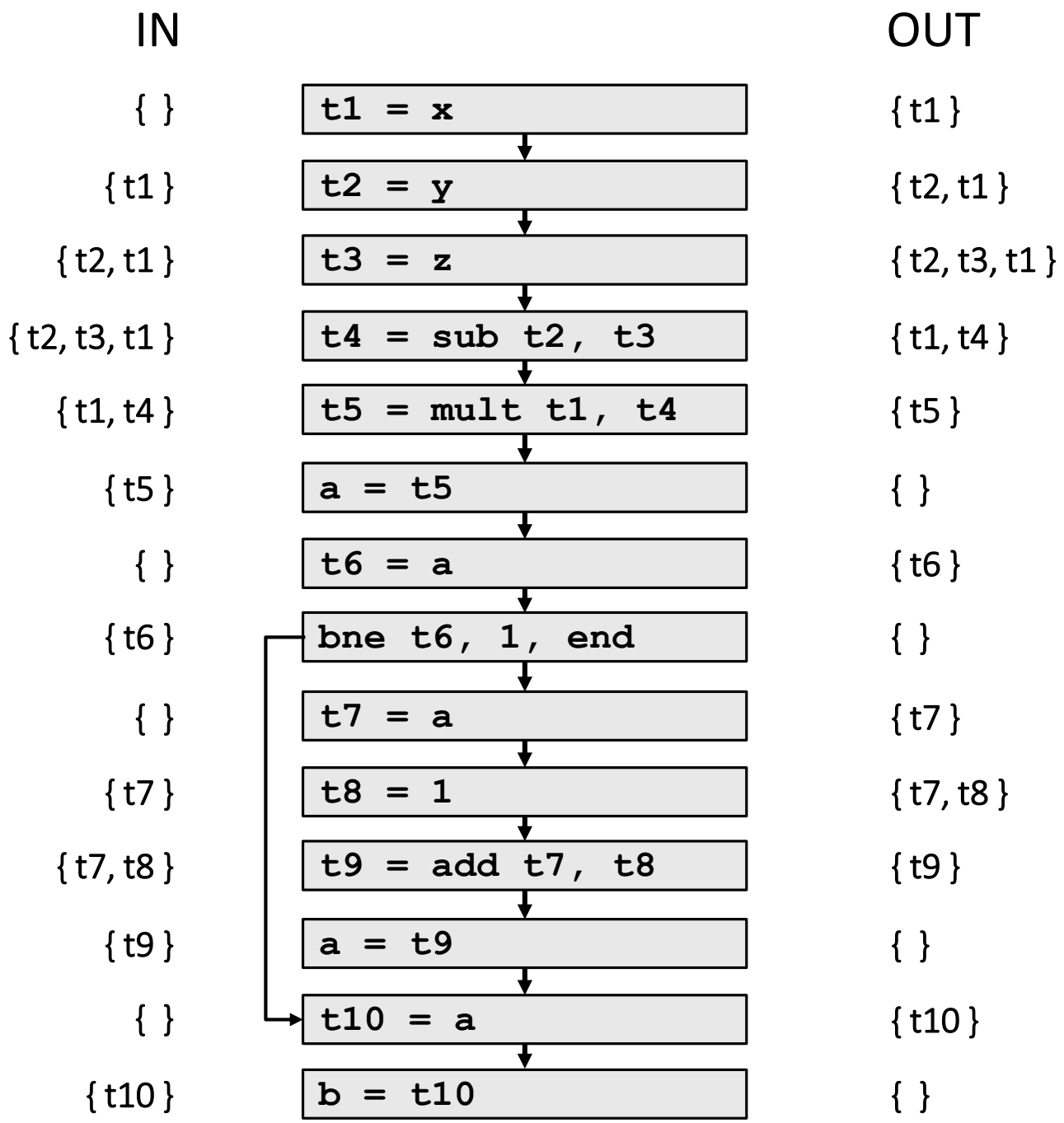

IN
OUT
{ }
t1 = x
{ }
{ }
t2 = y
{ }
{ }
t3 = z
{ }
{ }
t4 = sub t2, t3
{ }
{t1, t4}
t5 = mult t1, t4
{t5}
{t5}
a = t5
{ }
{ }
t6 = a
{t6}
{t6}
bne t6, 1, end
{ }
{ }
t7 = a
{t7}
{t7}
t8 = 1
{t7, t8}
{t7, t8}
t9 = add t7, t8
{t9}
{t9}
a = t9
{ }
{ }
t10 = a
{t10}
{t10}
b = t10
{ }


IN
OUT
{ }
t1 = x
{ }
{ }
t2 = y
{ }
{ }
t3 = z
{ }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }


IN
OUT
{ }
t1 = x
{ }
{ }
t2 = y
{ }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }

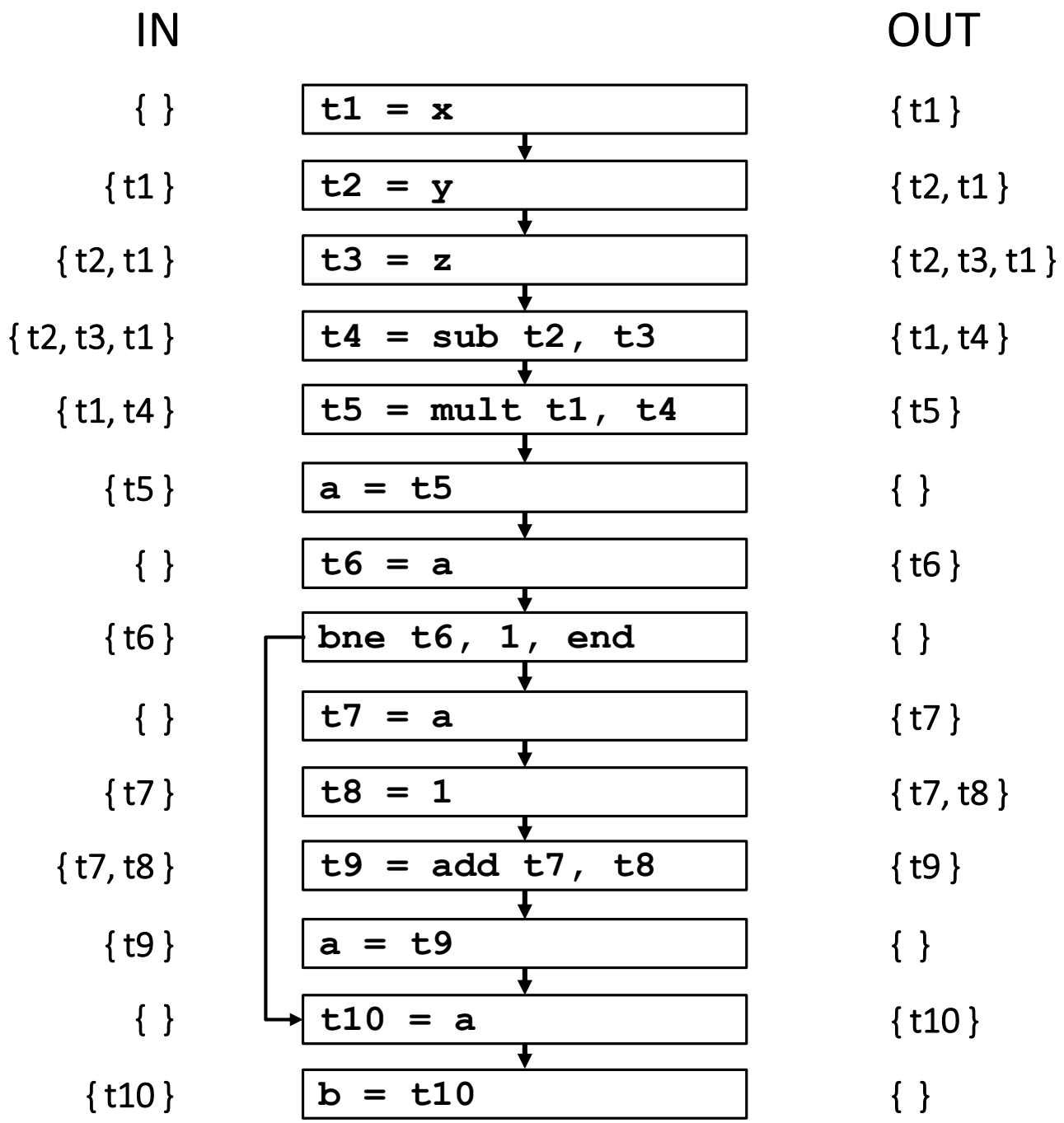

IN
OUT
{ }
t1 = x
{ }
{t1}
t2 = y
{t2, t1}
{t2, t1}
t3 = z
{t2, t3, t1}
{t2, t3, t1}
t4 = sub t2, t3
{t1, t4}
{t1, t4}
t5 = mult t1, t4
{t5}
{t5}
a = t5
{ }
{ }
t6 = a
{t6}
{t6}
bne t6, 1, end
{ }
{ }
t7 = a
{t7}
{t7}
t8 = 1
{t7, t8}
{t7, t8}
t9 = add t7, t8
{t9}
{t9}
a = t9
{ }
{ }
t10 = a
{t10}
{t10}
b = t10
{ }

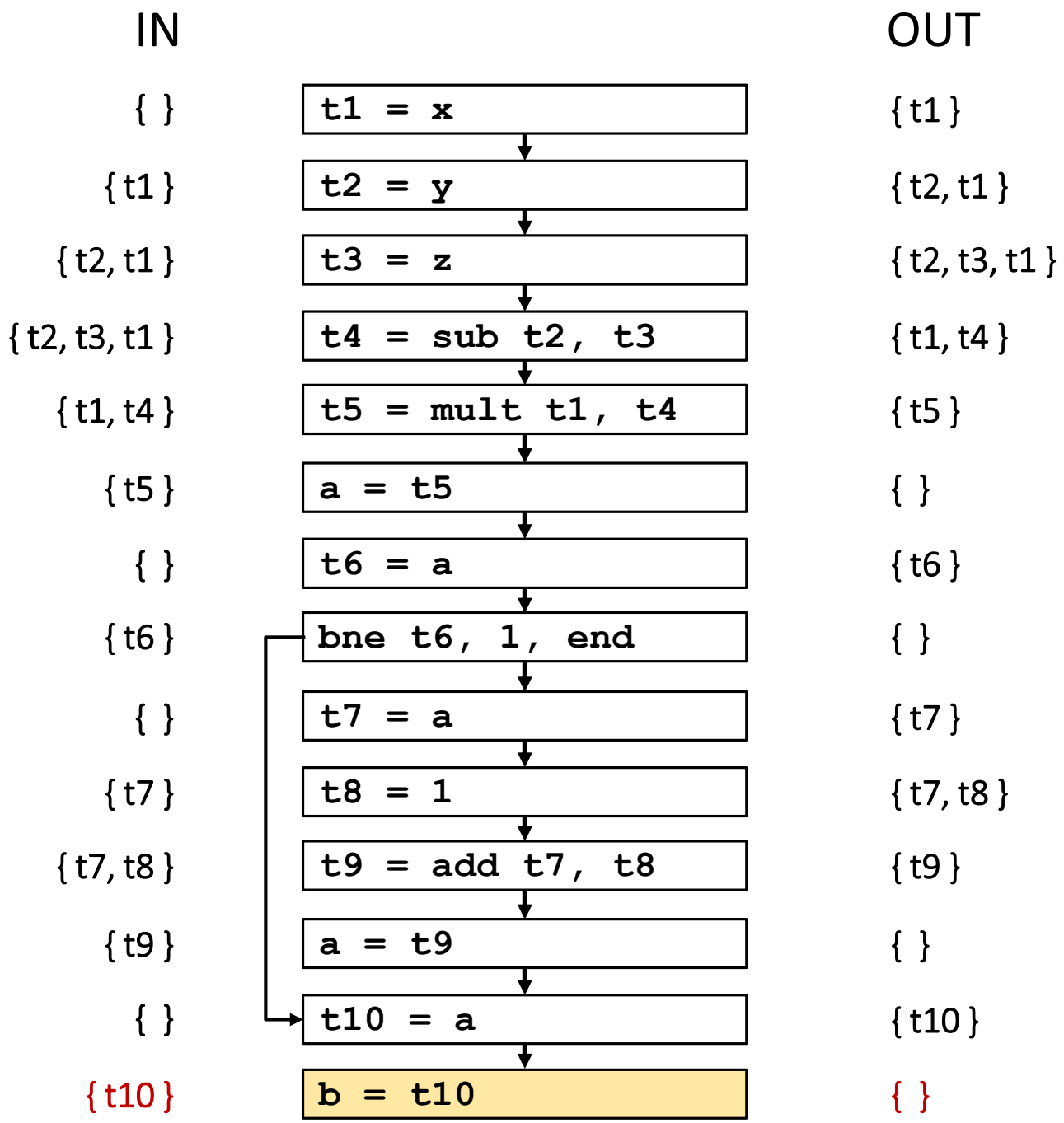

IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }

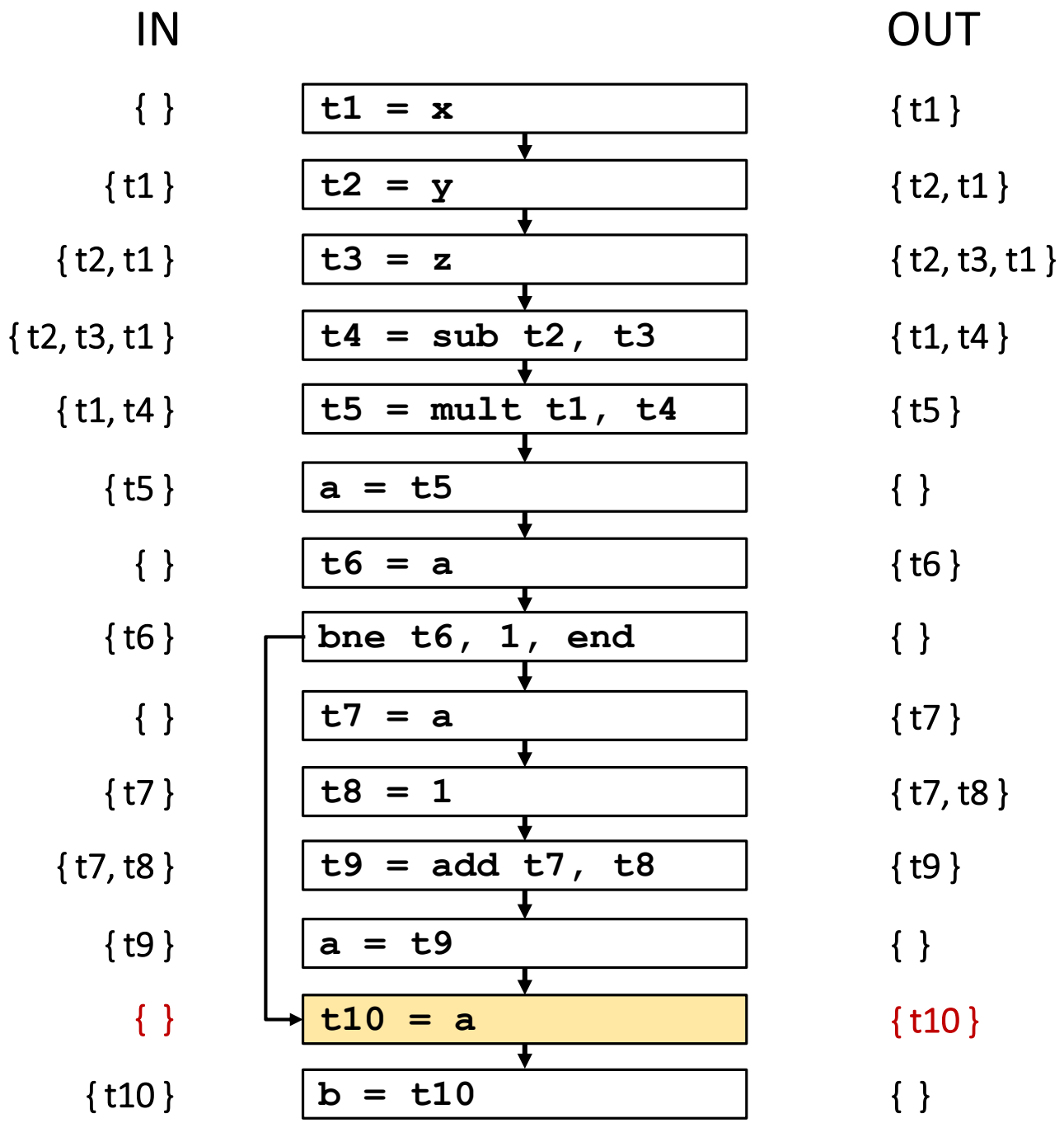

IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }

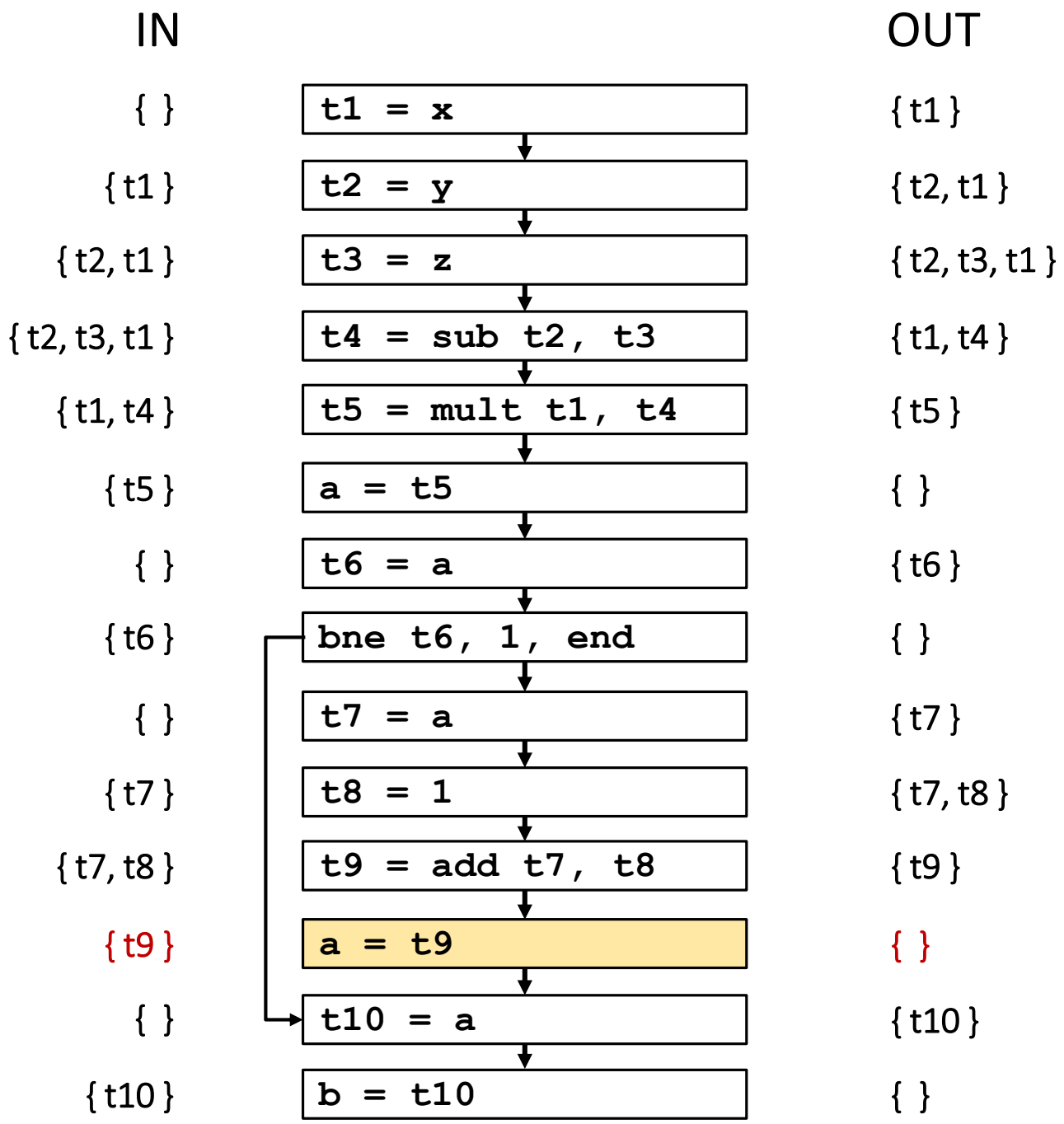
Liveness Analysis

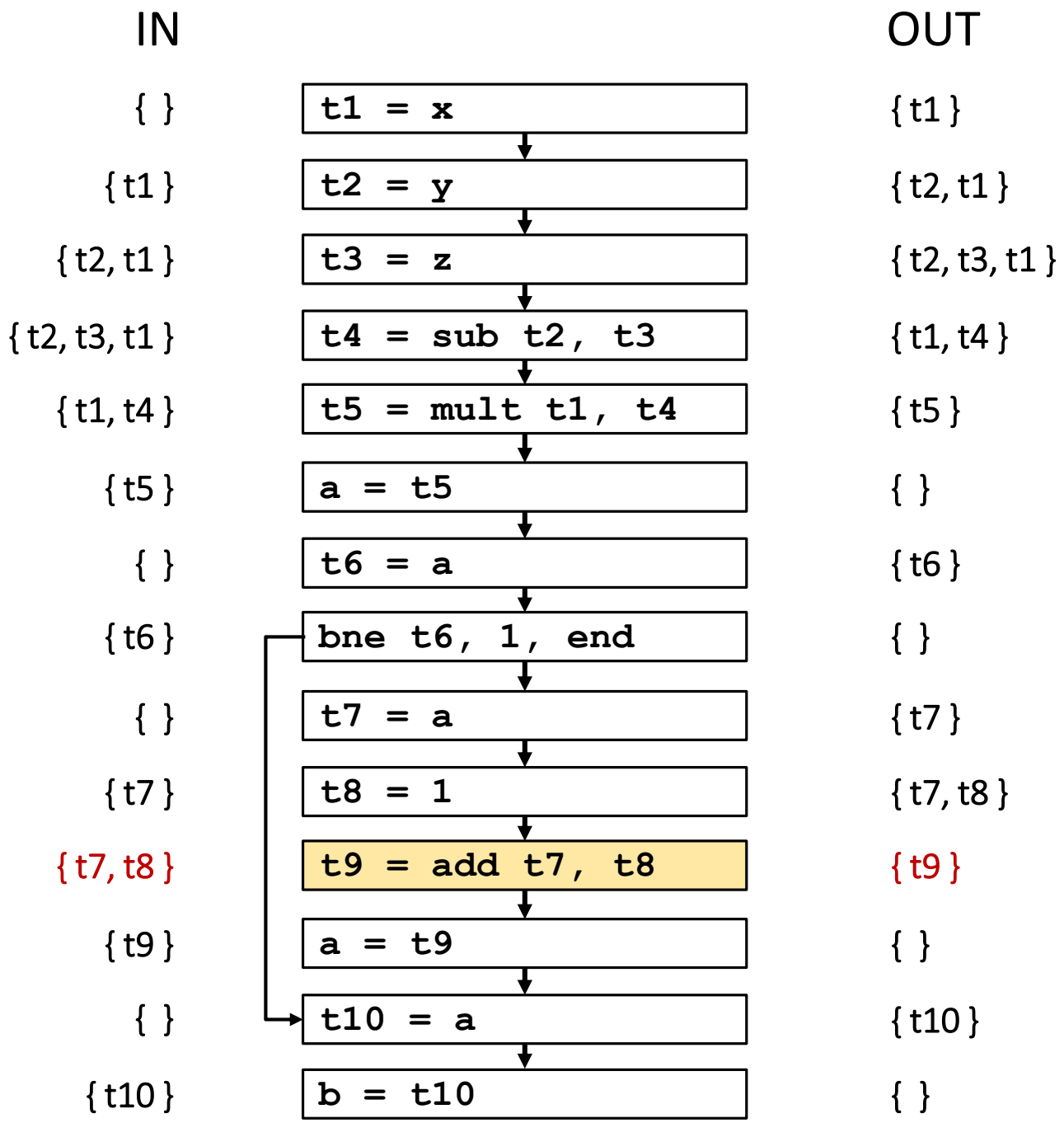
Second Iteration…

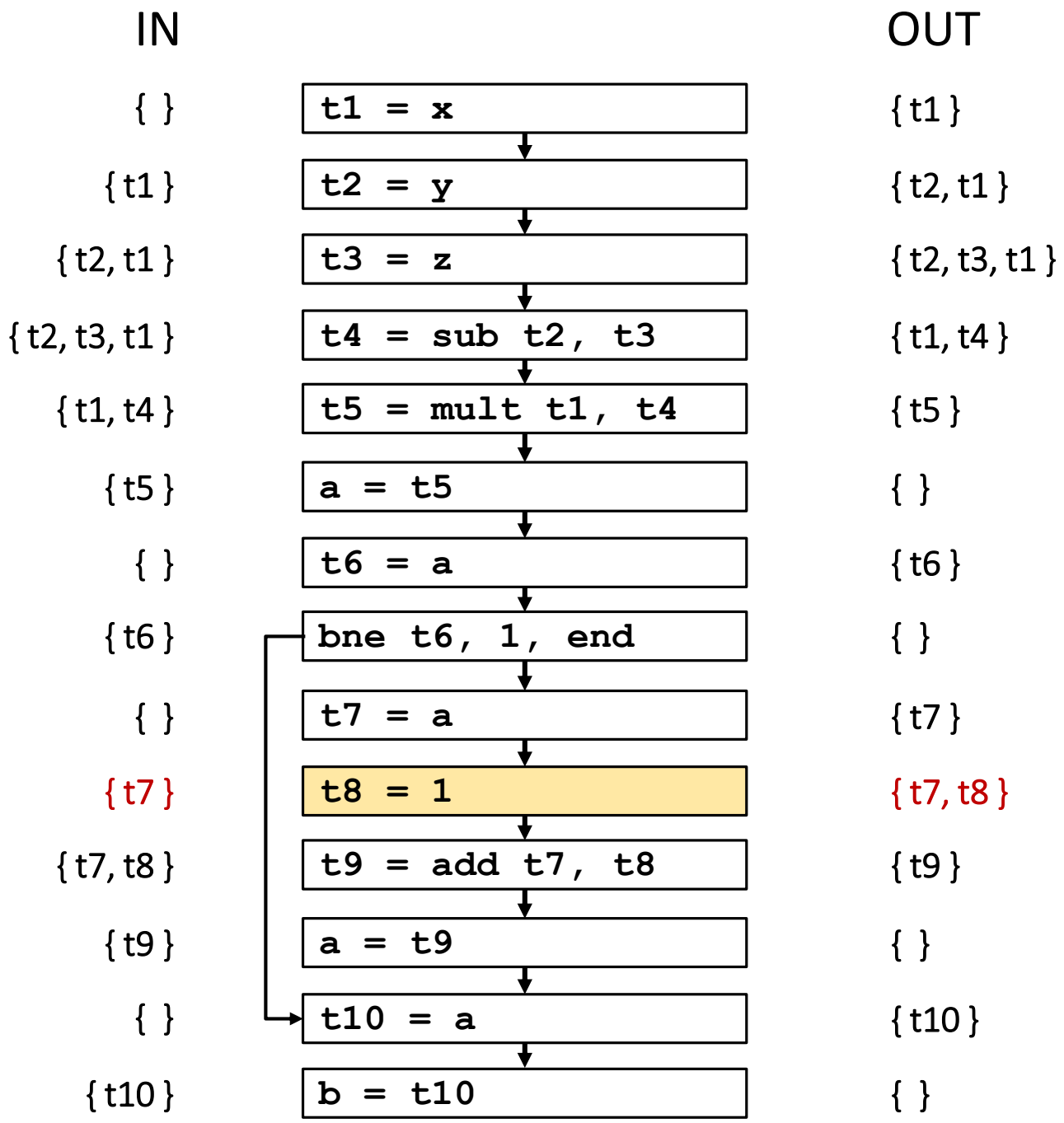

IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }

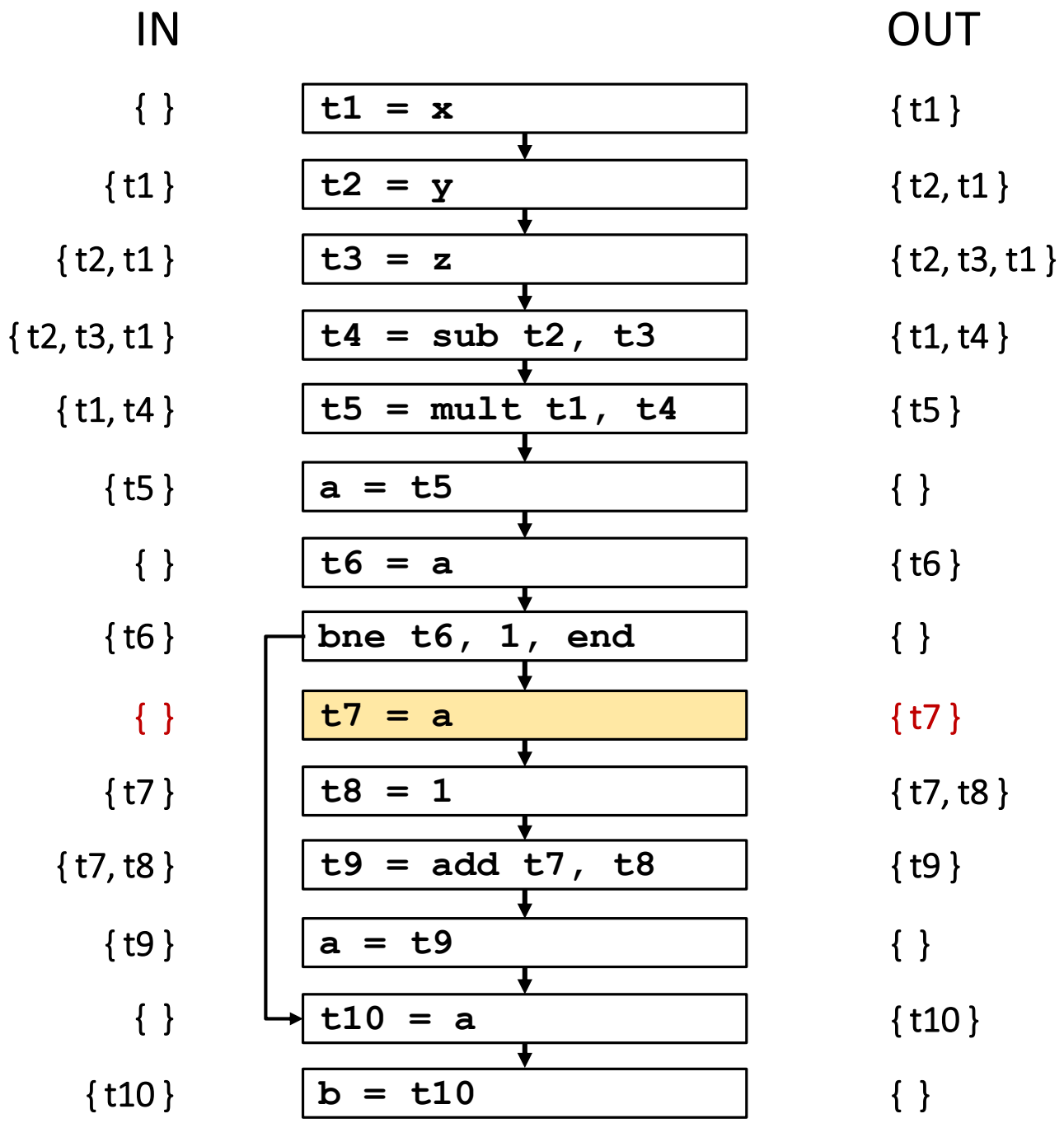

IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }

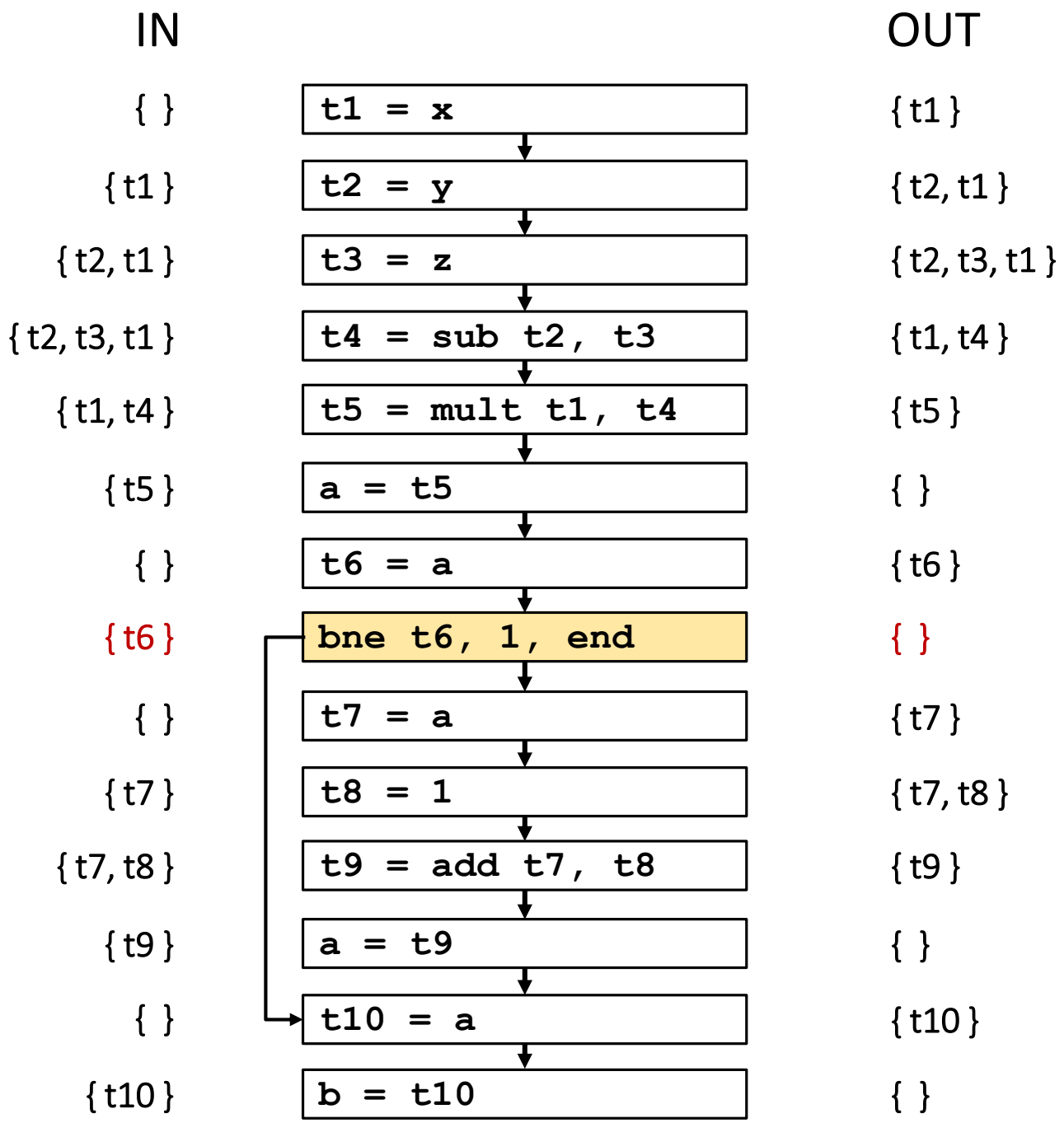

IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }

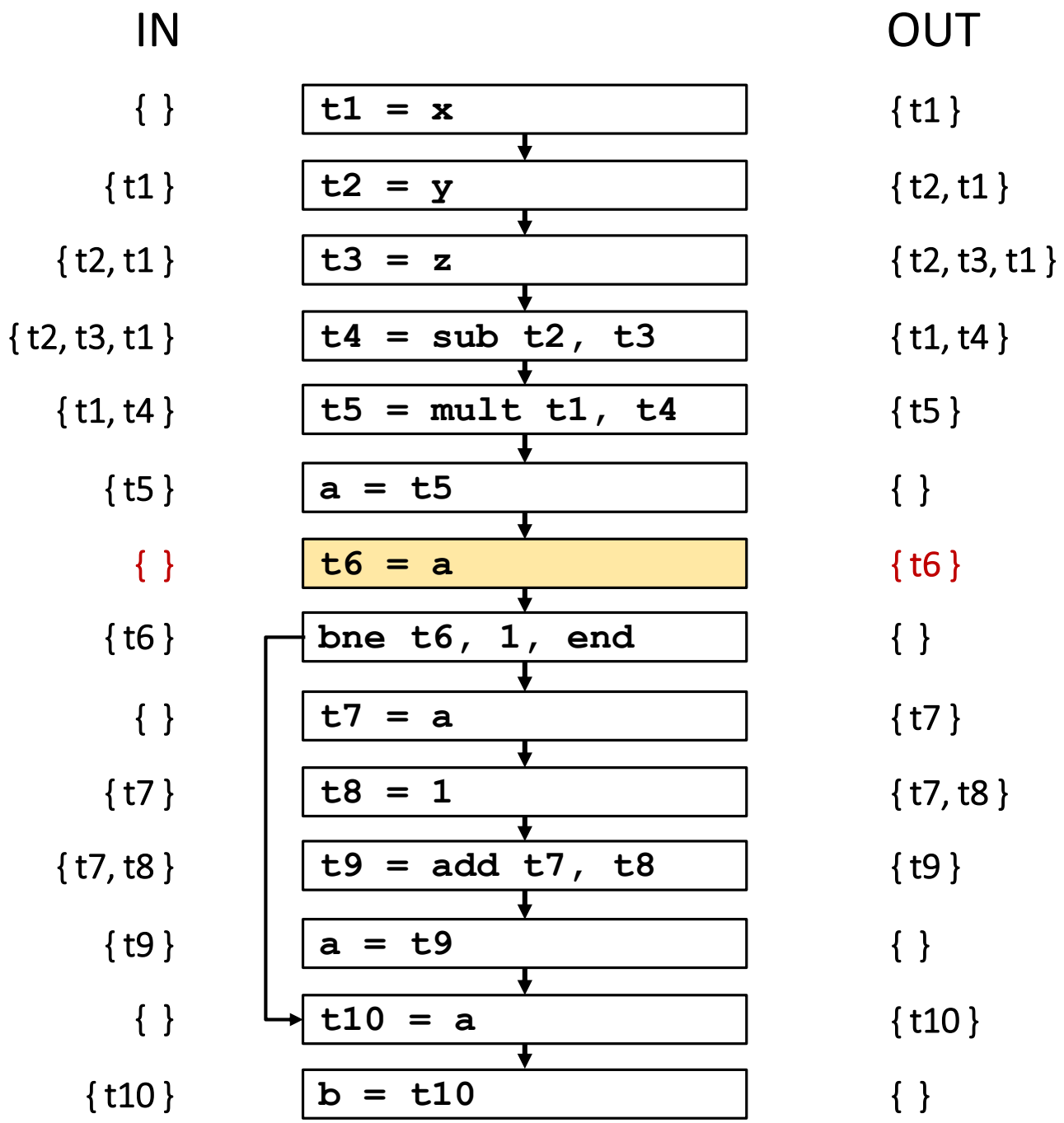

IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }

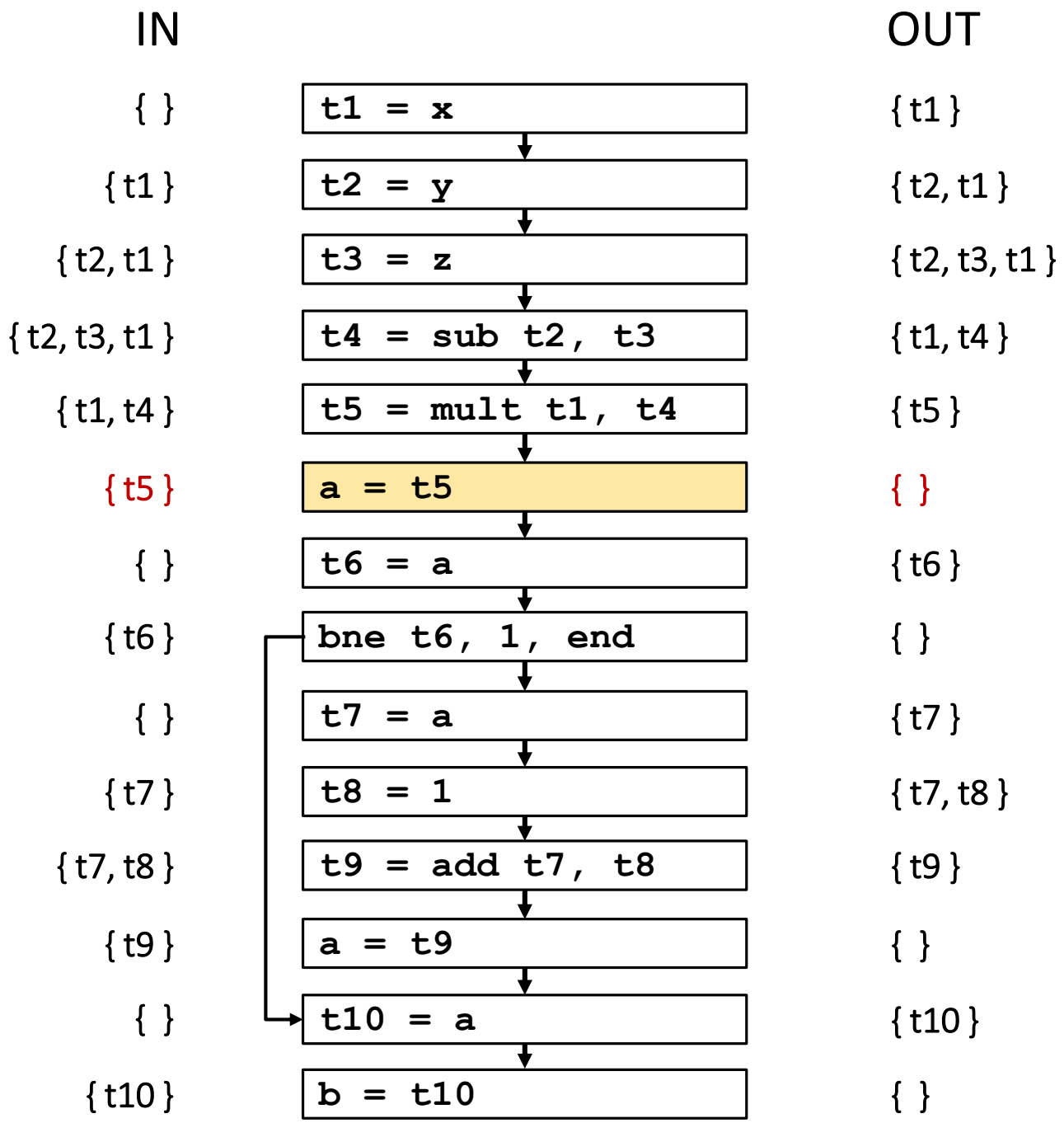

IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }

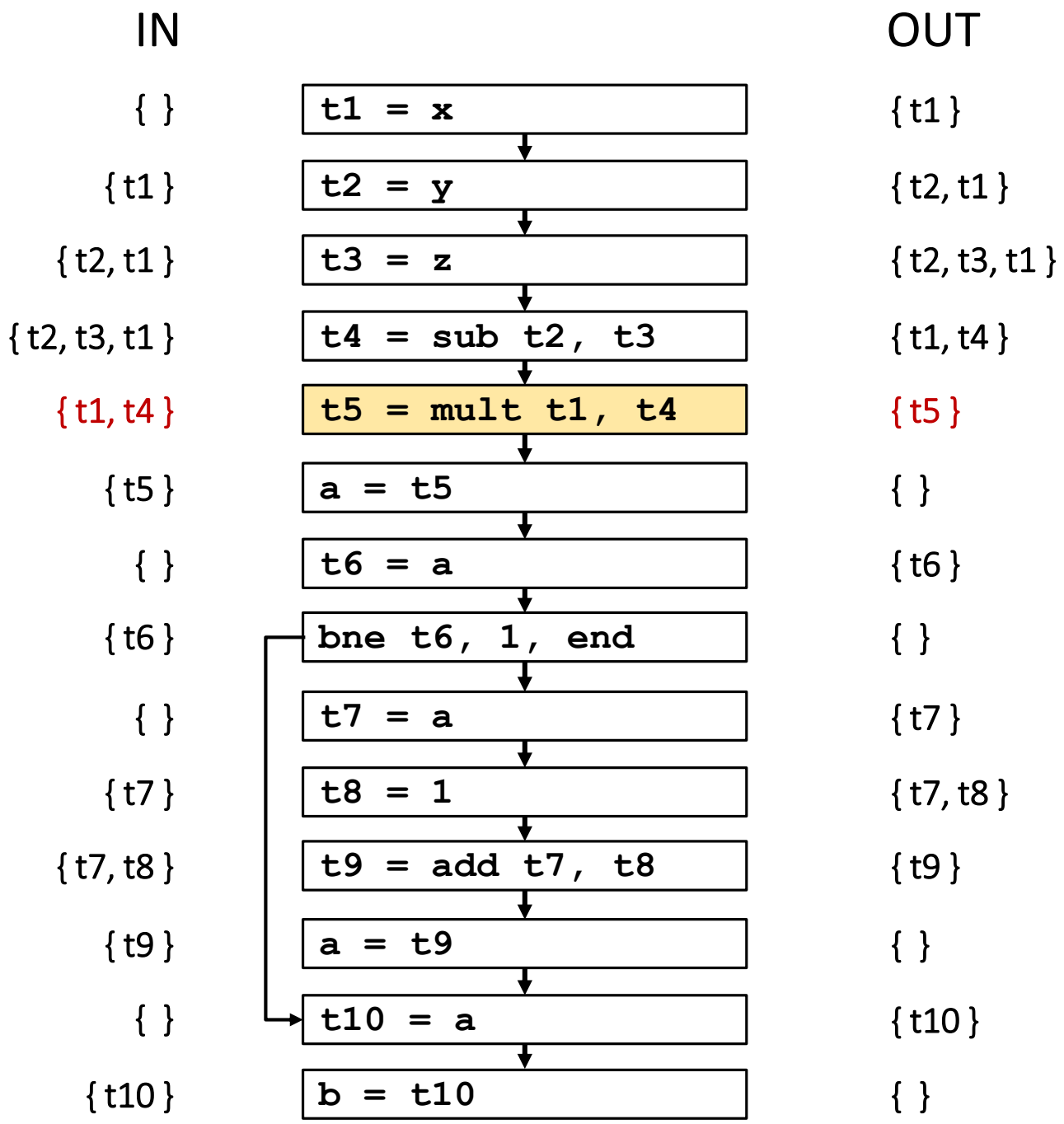

IN
OUT
{ }
t1 = x
{t1}
{t1}
t2 = y
{t2, t1}
{t2, t1}
t3 = z
{t2, t3, t1}
{t2, t3, t1}
t4 = sub t2, t3
{t1, t4}
{t1, t4}
t5 = mult t1, t4
{t5}
{t5}
a = t5
{ }
{ }
t6 = a
{t6}
{t6}
bne t6, 1, end
{ }
{ }
t7 = a
{t7}
{t7}
t8 = 1
{t7, t8}
{t7, t8}
t9 = add t7, t8
{t9}
{t9}
a = t9
{ }
{ }
t10 = a
{t10}
{t10}
b = t10
{ }

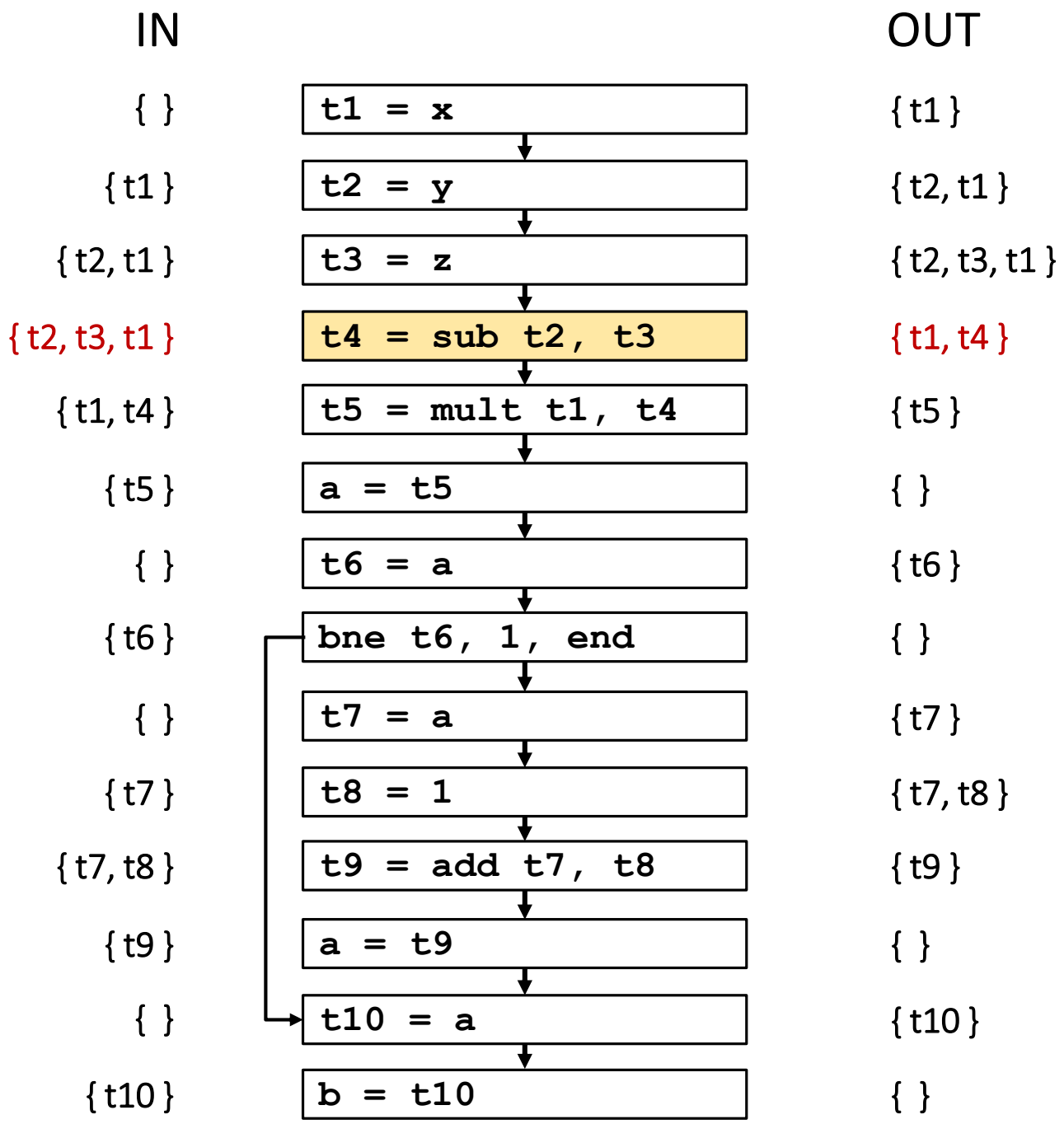

IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }

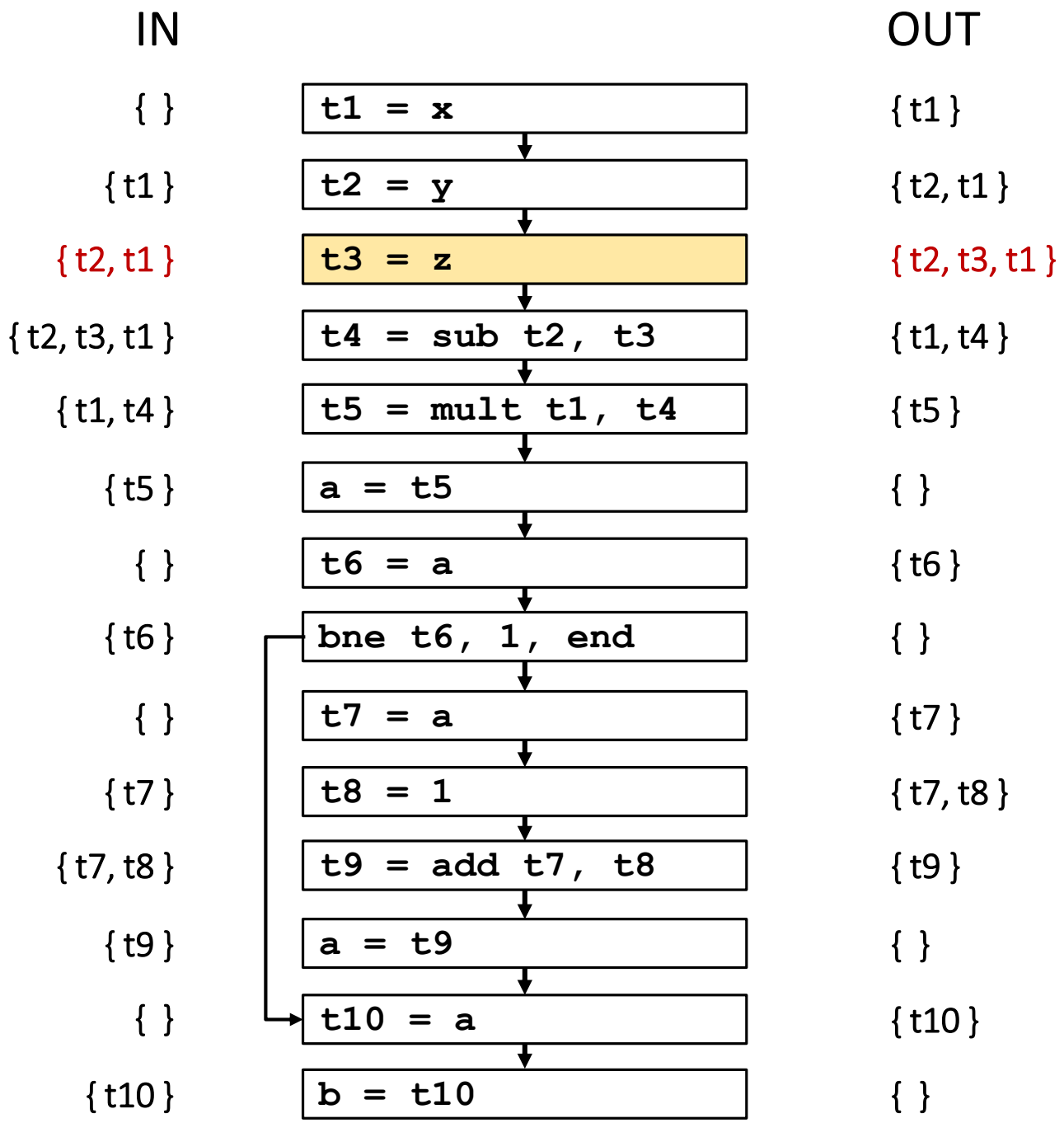

IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }

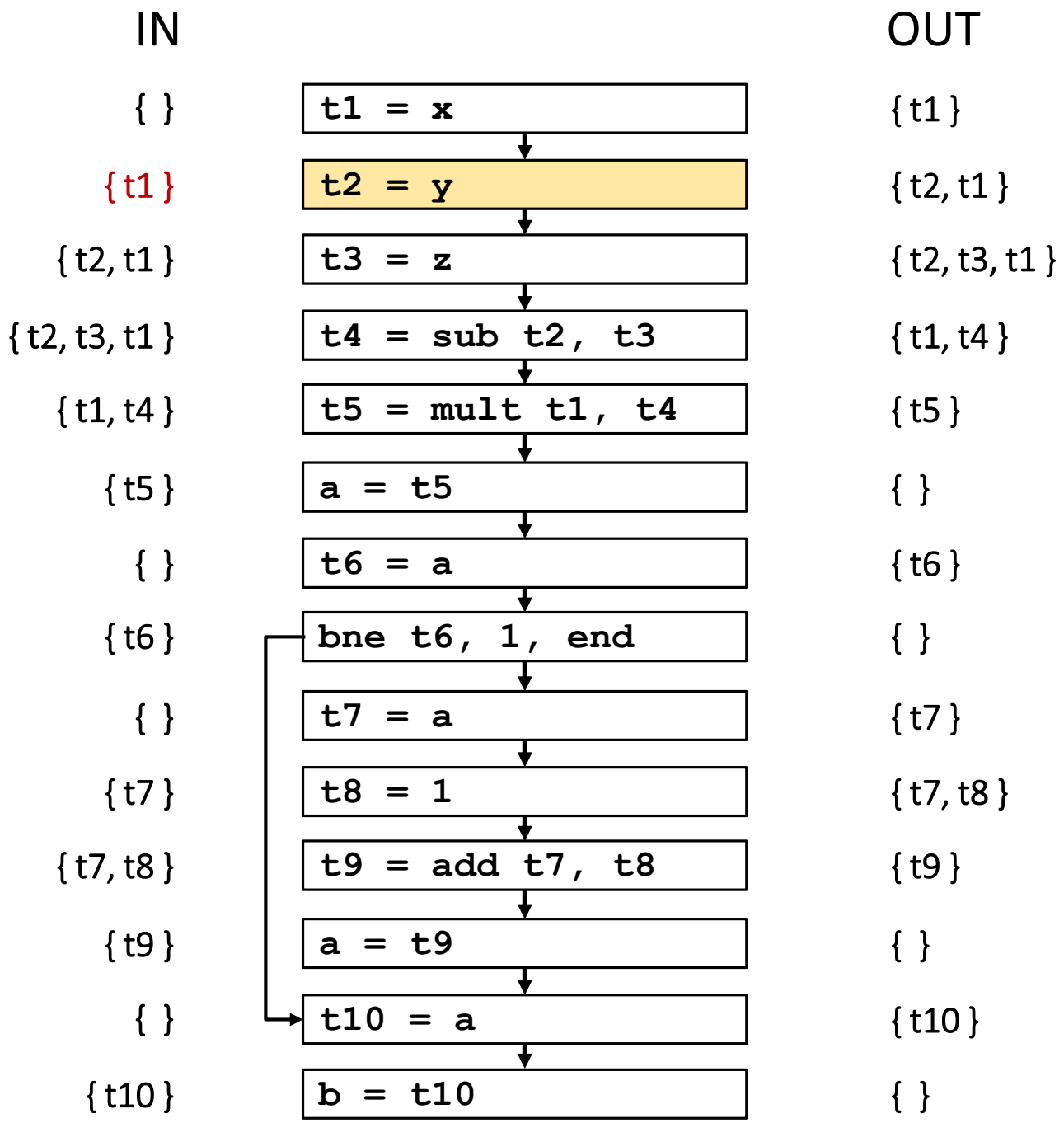

IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }

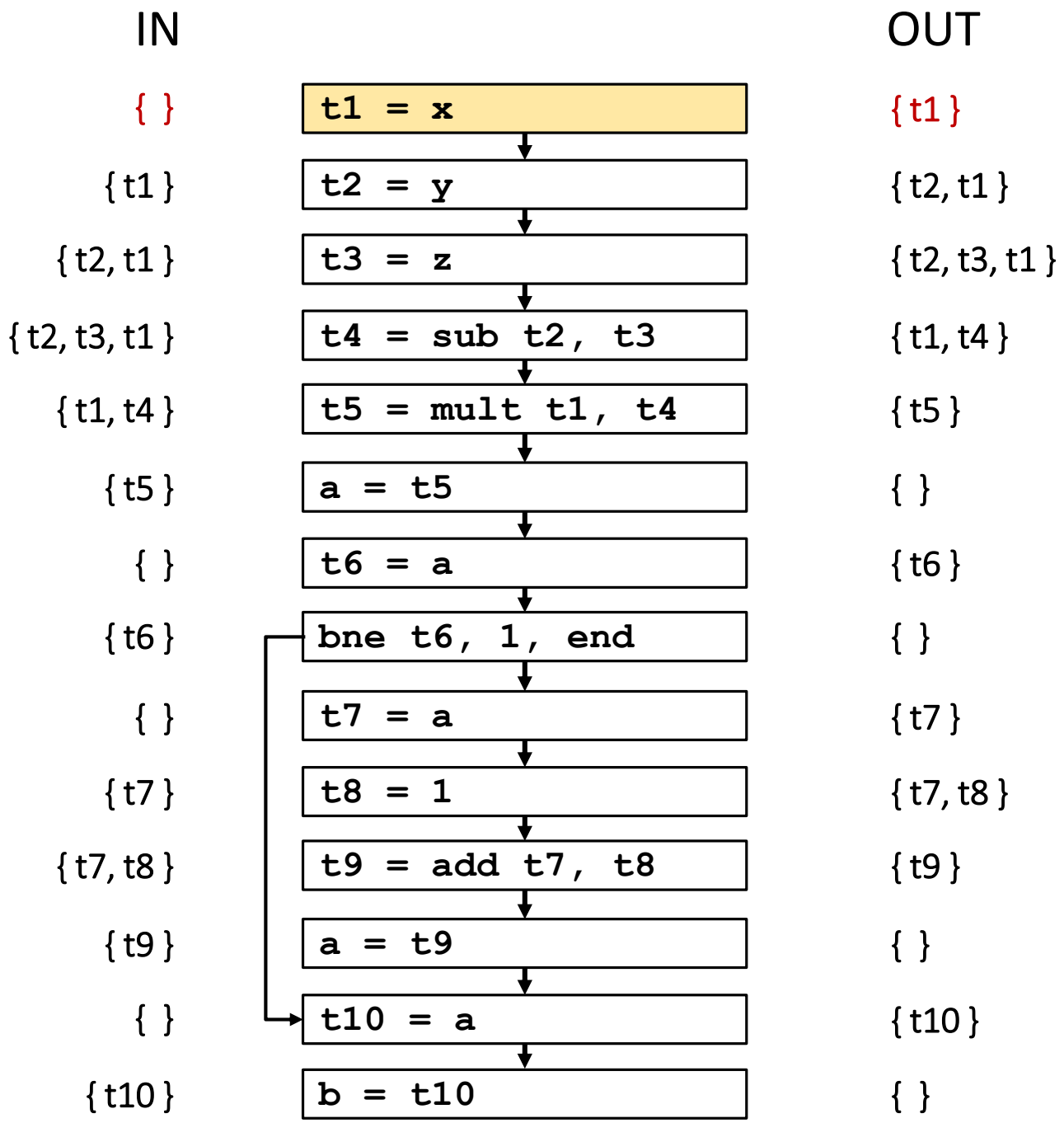

IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }


IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }


IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }


IN
OUT
{ }
t1 = x
{ t1 }
{t1}
t2 = y
{ t2, t1 }
{t2, t1}
t3 = z
{ t2, t3, t1 }
{t2, t3, t1}
t4 = sub t2, t3
{ t1, t4 }
{t1, t4}
t5 = mult t1, t4
{ t5 }
{t5}
a = t5
{ }
{ }
t6 = a
{ t6 }
{t6}
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{t7}
t8 = 1
{ t7, t8 }
{t7, t8}
t9 = add t7, t8
{ t9 }
{t9}
a = t9
{ }
{ }
t10 = a
{ t10 }
{t10}
b = t10
{ }


IN
OUT
{ }
t1 = x
{ t1 }
{t1}
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }


IN
OUT
{ }
t1 = x
{t1}
{t1}
t2 = y
{t2, t1}
{t2, t1}
t3 = z
{t2, t3, t1}
{t2, t3, t1}
t4 = sub t2, t3
{t1, t4}
{t1, t4}
t5 = mult t1, t4
{t5}
{t5}
a = t5
{ }
{ }
t6 = a
{t6}
{t6}
bne t6, 1, end
{ }
{ }
t7 = a
{t7}
{t7}
t8 = 1
{t7, t8}
{t7, t8}
t9 = add t7, t8
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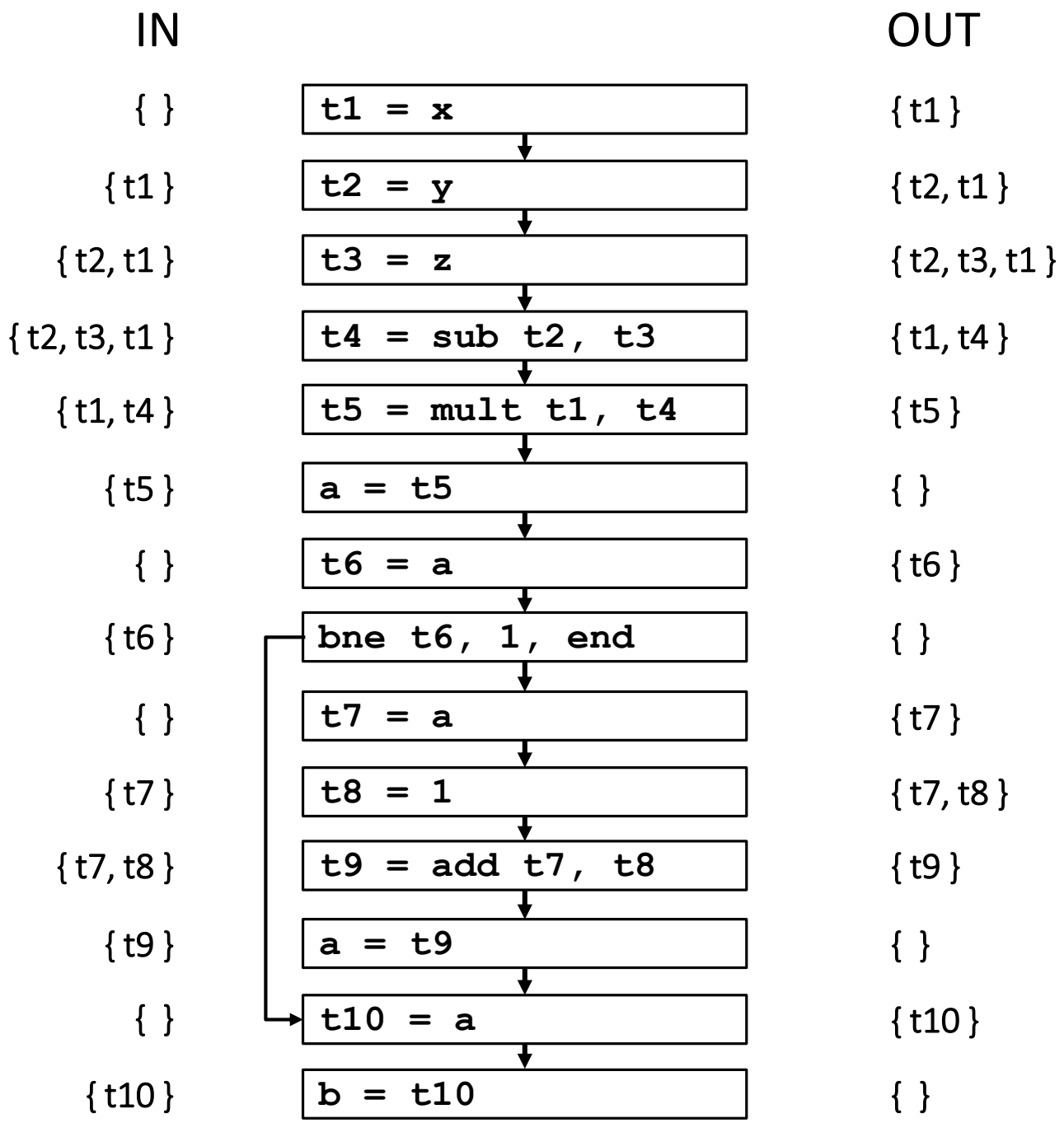
{t9}
a = t9
{ }
{ }
t10 = a
{t10}
{t10}
b = t10
{ }


IN
OUT
{ }
t1 = x
{ t1 }
{ t1 }
t2 = y
{ t2, t1 }
{ t2, t1 }
t3 = z
{ t2, t3, t1 }
{ t2, t3, t1 }
t4 = sub t2, t3
{ t1, t4 }
{ t1, t4 }
t5 = mult t1, t4
{ t5 }
{ t5 }
a = t5
{ }
{ }
t6 = a
{ t6 }
{ t6 }
bne t6, 1, end
{ }
{ }
t7 = a
{ t7 }
{ t7 }
t8 = 1
{ t7, t8 }
{ t7, t8 }
t9 = add t7, t8
{ t9 }
{ t9 }
a = t9
{ }
{ }
t10 = a
{ t10 }
{ t10 }
b = t10
{ }

Interference Graph

- Use liveness analysis to construct the **interference graph**
- Create a node for each IR register (t1, t2, …)
- Create an edge between t1 and t2 if:
  - They appear together in one of the liveness sets

Interference Graph

{ t1 }

{ t2, t1 }

{ t2, t3, t1 }

{ t1, t4 }

{ t5 }

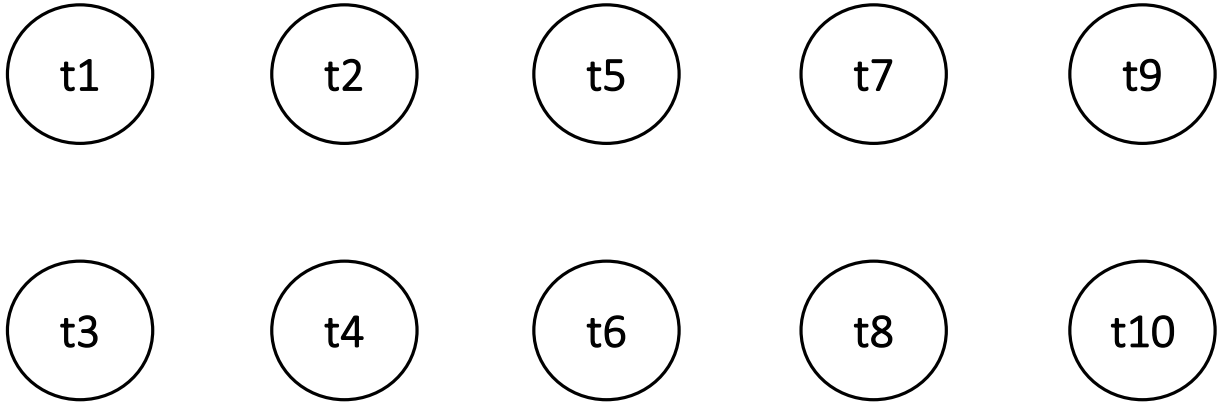
{ t6 }

{ t7 }

{ t7, t8 }

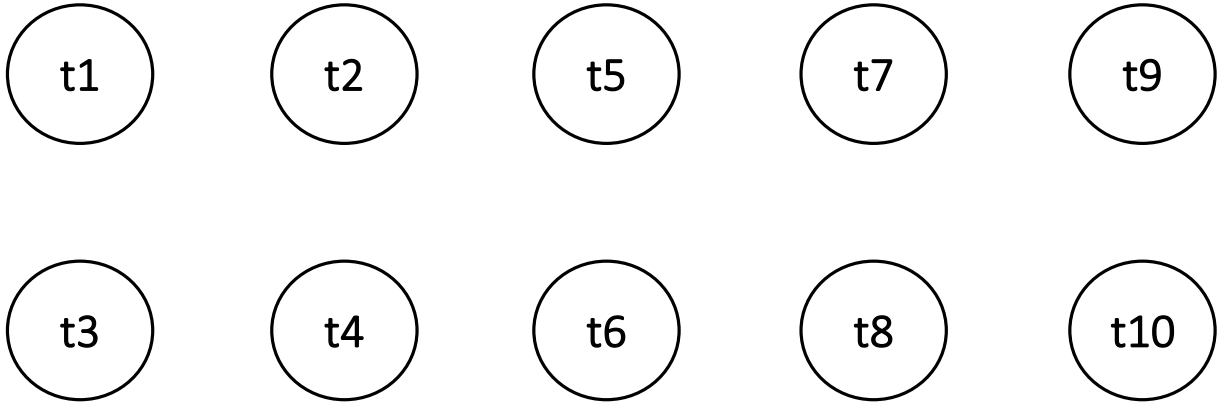
{ t9 }

{ t10 }



Interference Graph

{ t1 }
{ t2, t1 }
{ t2, t3, t1 }
{ t1, t4 }
{ t5 }
{ t6 }
{ t7 }
{ t7, t8 }
{ t9 }
{ t10 }



Interference Graph

{ t1 }

{ t2, t1 }

{ t2, t3, t1 }

{ t1, t4 }

{ t5 }

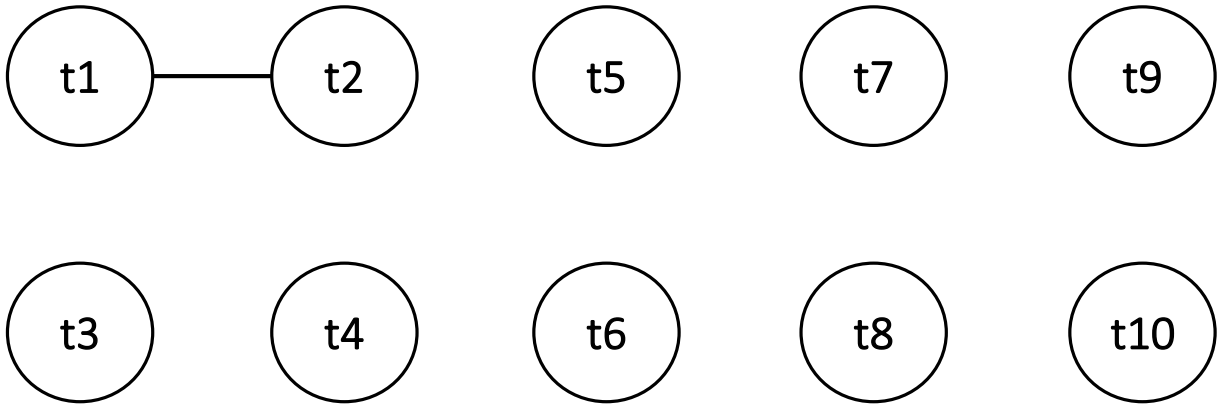
{ t6 }

{ t7 }

{ t7, t8 }

{ t9 }

{ t10 }



Interference Graph

{ t1 }

{ t2, t1 }

{ t2, t3, t1 }

{ t1, t4 }

{ t5 }

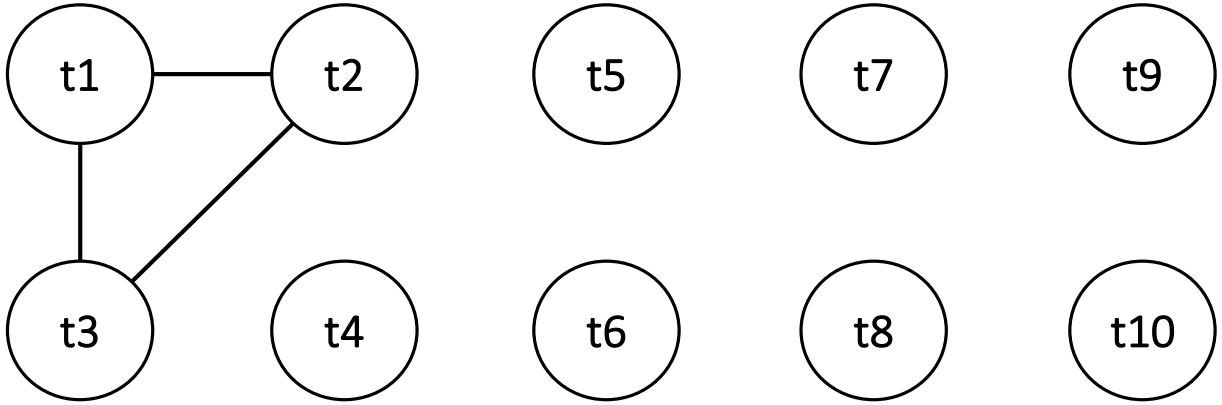
{ t6 }

{ t7 }

{ t7, t8 }

{ t9 }

{ t10 }



Interference Graph

{ t1 }

{ t2, t1 }

{ t2, t3, t1 }

{ t1, t4 }

{ t5 }

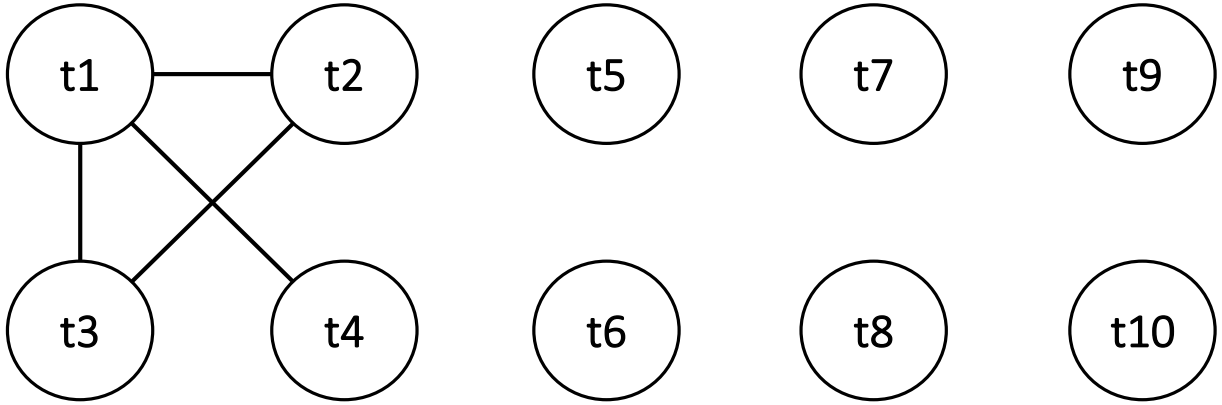
{ t6 }

{ t7 }

{ t7, t8 }

{ t9 }

{ t10 }



Interference Graph

{ t1 }

{ t2, t1 }

{ t2, t3, t1 }

{ t1, t4 }

{ t5 }

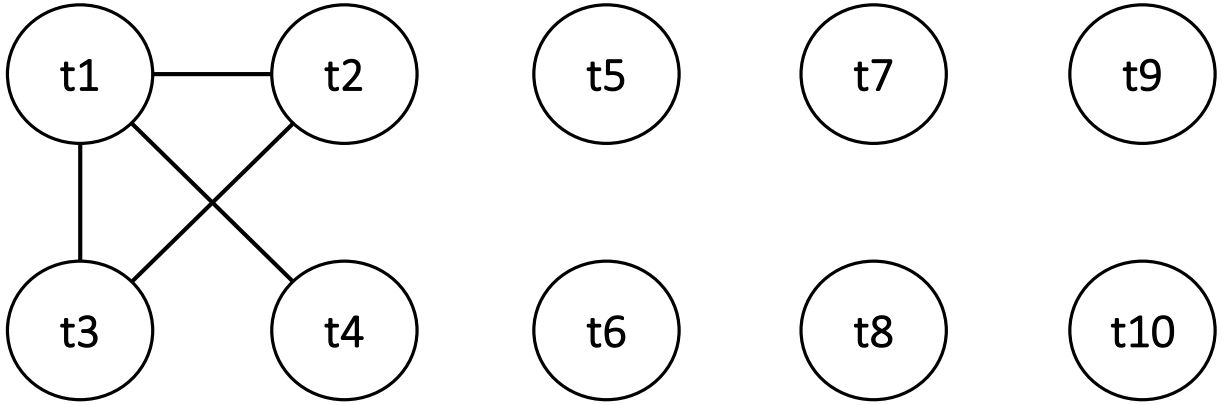
{ t6 }

{ t7 }

{ t7, t8 }

{ t9 }

{ t10 }



Interference Graph

{ t1 }

{ t2, t1 }

{ t2, t3, t1 }

{ t1, t4 }

{ t5 }

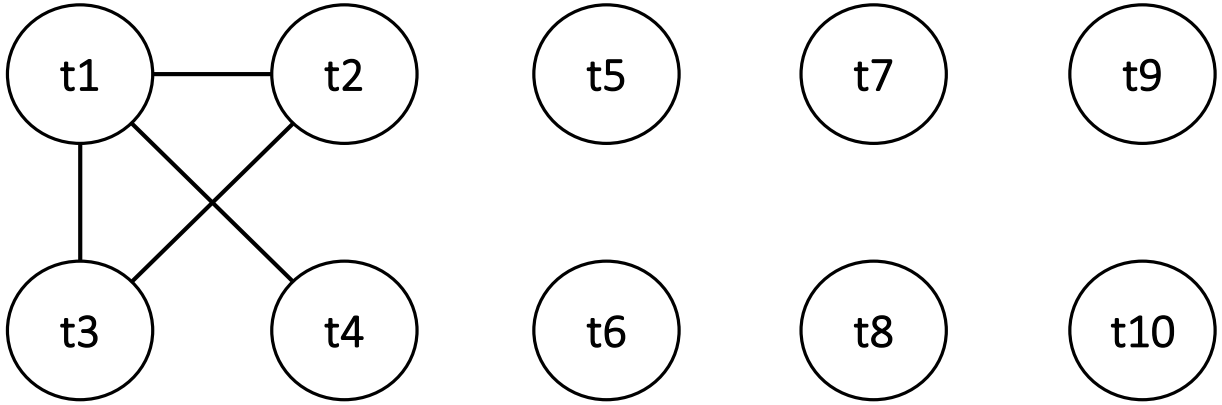
{ t6 }

{ t7 }

{ t7, t8 }

{ t9 }

{ t10 }



Interference Graph

{ t1 }

{ t2, t1 }

{ t2, t3, t1 }

{ t1, t4 }

{ t5 }

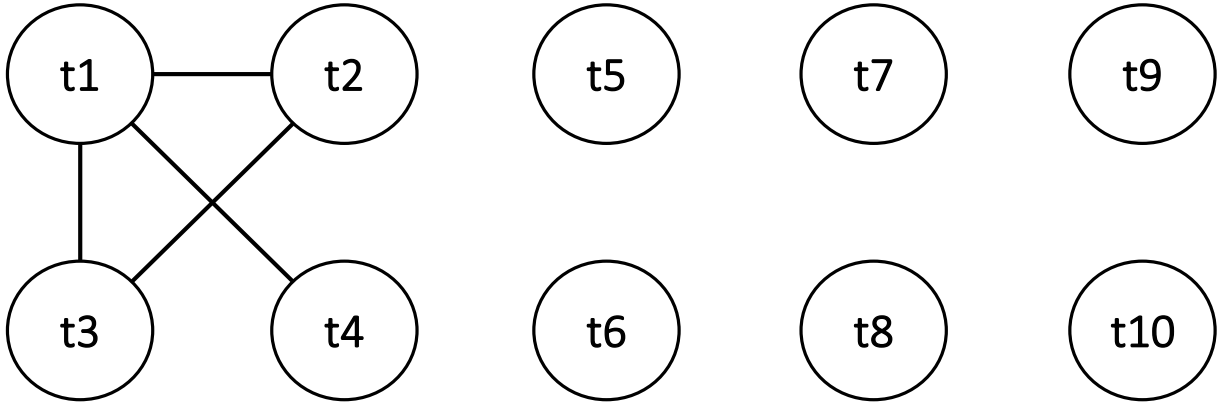
{ t6 }

{ t7 }

{ t7, t8 }

{ t9 }

{ t10 }



Interference Graph

{ t1 }

{ t2, t1 }

{ t2, t3, t1 }

{ t1, t4 }

{ t5 }

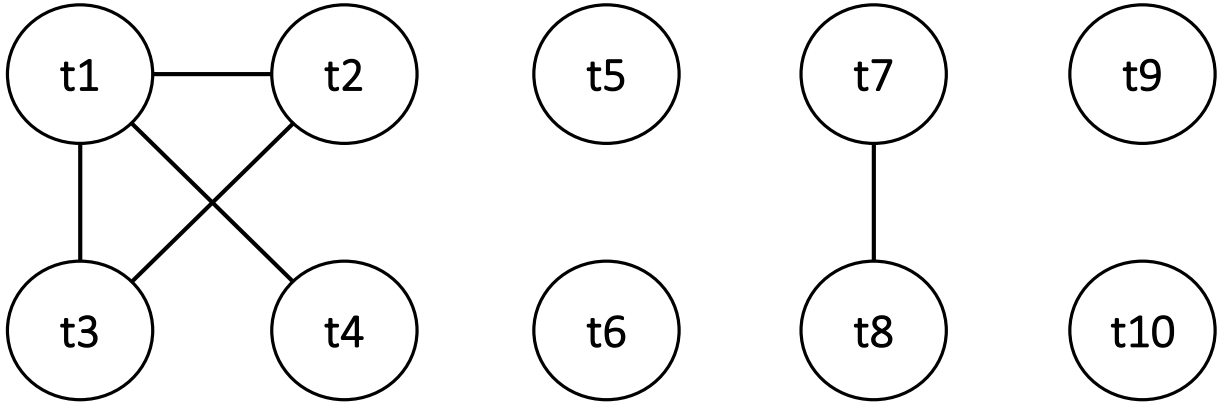
{ t6 }

{ t7 }

{ t7, t8 }

{ t9 }

{ t10 }



Interference Graph

{ t1 }

{ t2, t1 }

{ t2, t3, t1 }

{ t1, t4 }

{ t5 }

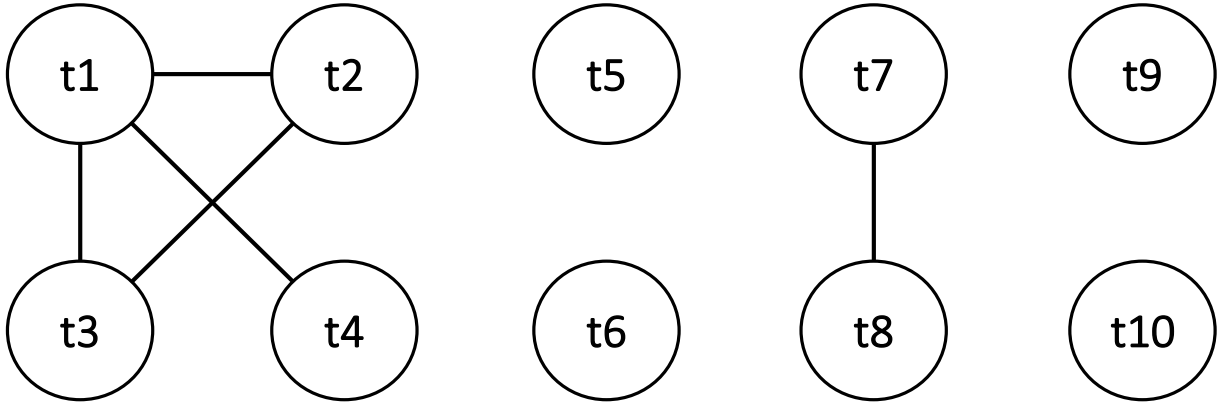
{ t6 }

{ t7 }

{ t7, t8 }

{ t9 }

{ t10 }



Interference Graph

{ t1 }

{ t2, t1 }

{ t2, t3, t1 }

{ t1, t4 }

{ t5 }

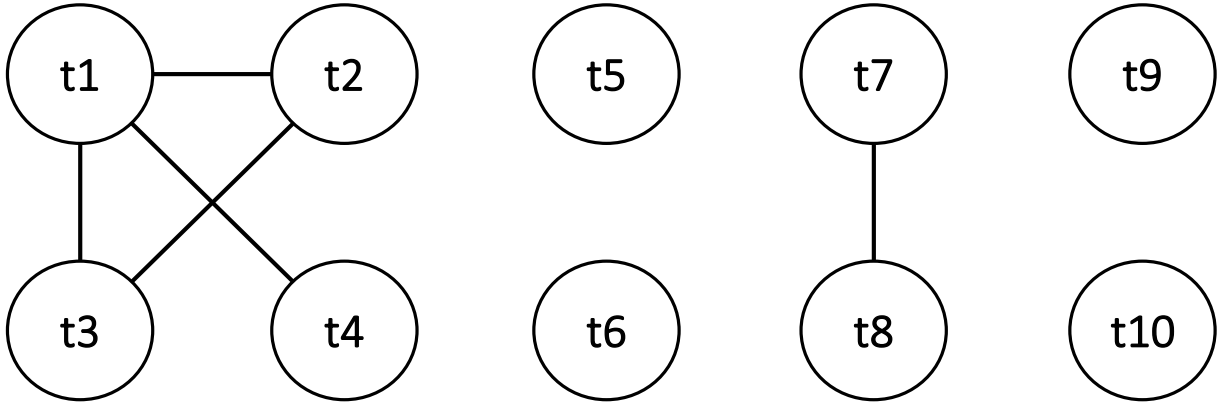
{ t6 }

{ t7 }

{ t7, t8 }

{ t9 }

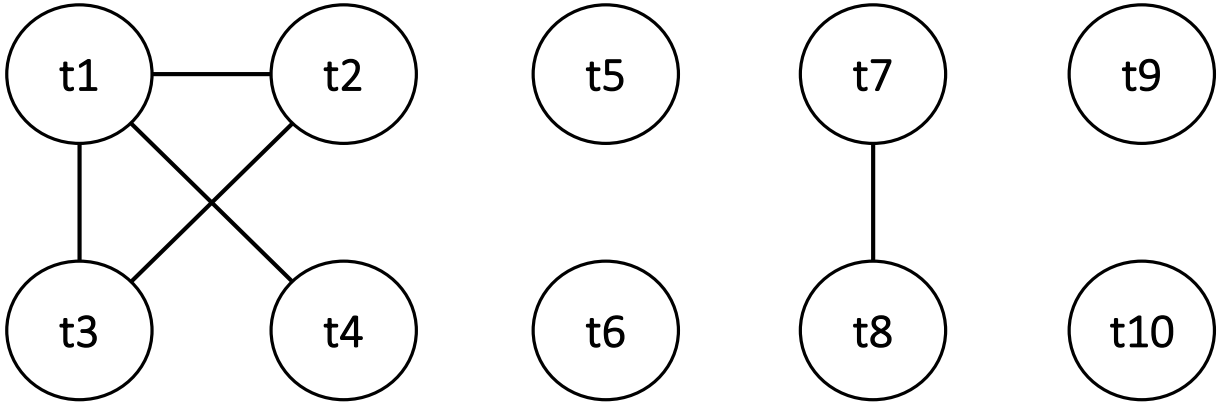
{ t10 }



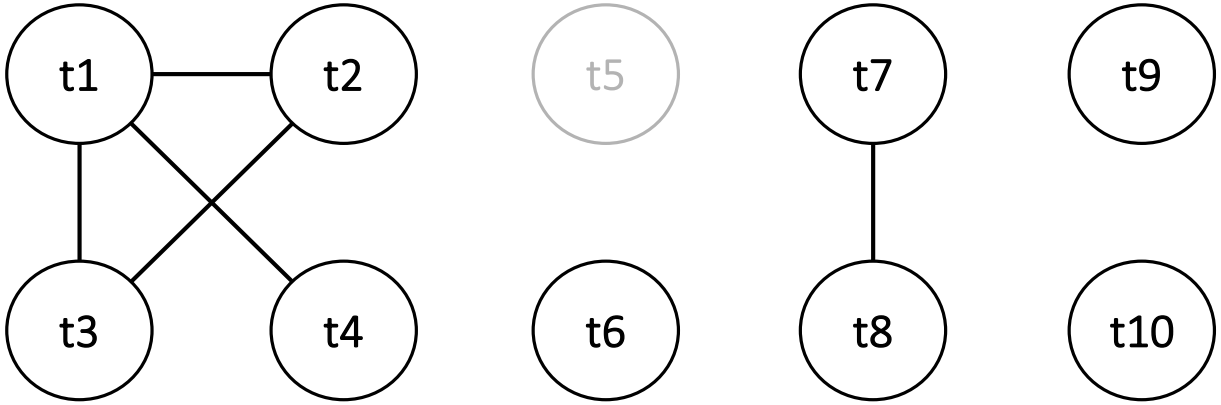
Graph Coloring

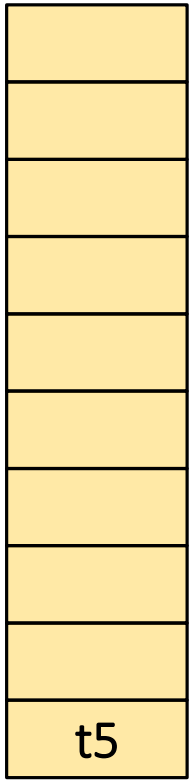
- TODO

Graph Coloring (k = 3)

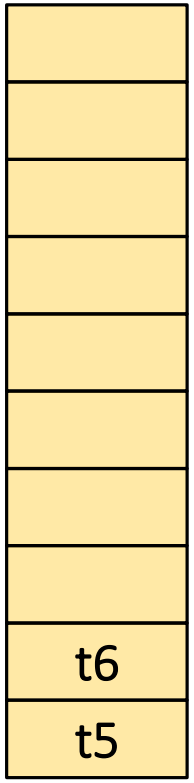


Graph Coloring (k = 3)

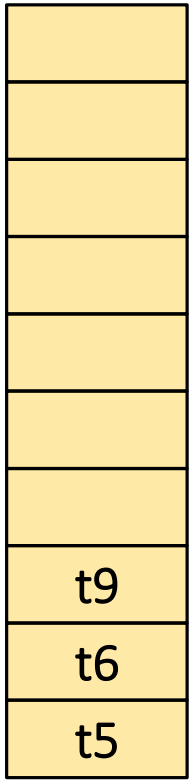




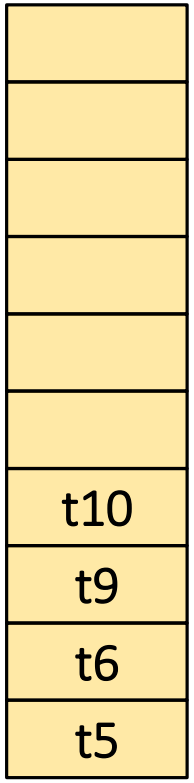
Graph Coloring (k = 3)



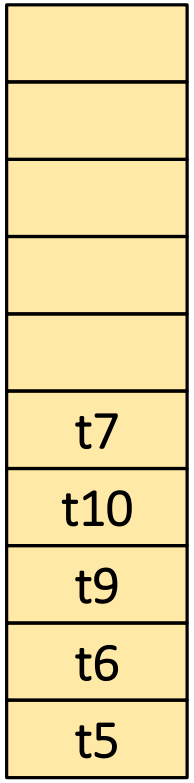
Graph Coloring (k = 3)



Graph Coloring (k = 3)



Graph Coloring (k = 3)



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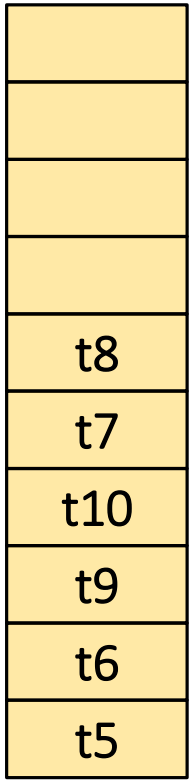

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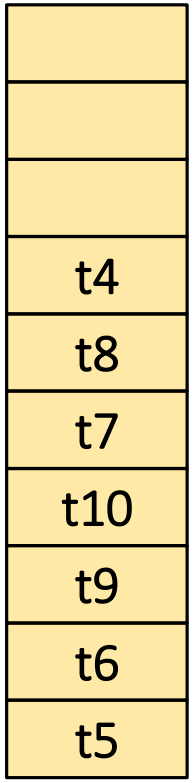

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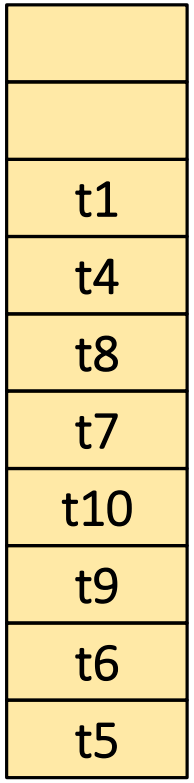

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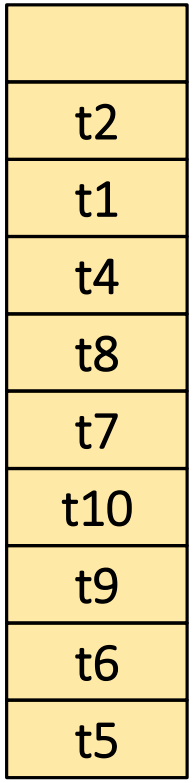


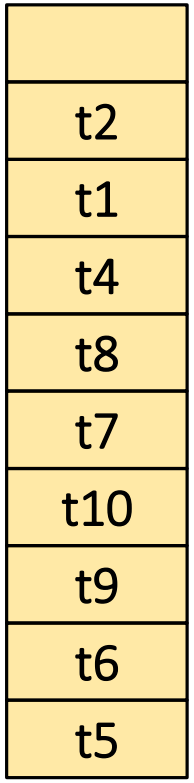
Graph Coloring (k = 3)

t3
t2
t1
t4
t8
t7
t10
t9
t6
t5

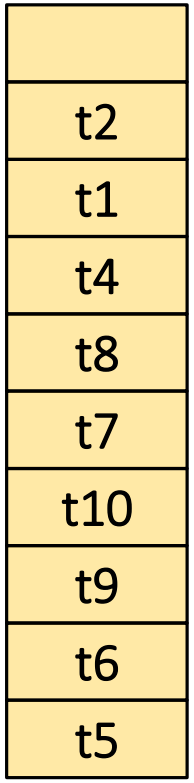
Graph Coloring (k = 3)

Pop nodes and assign colors…

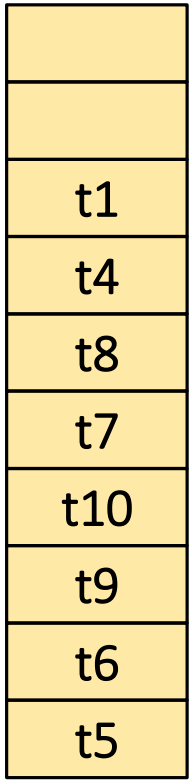
Graph Coloring (k = 3)



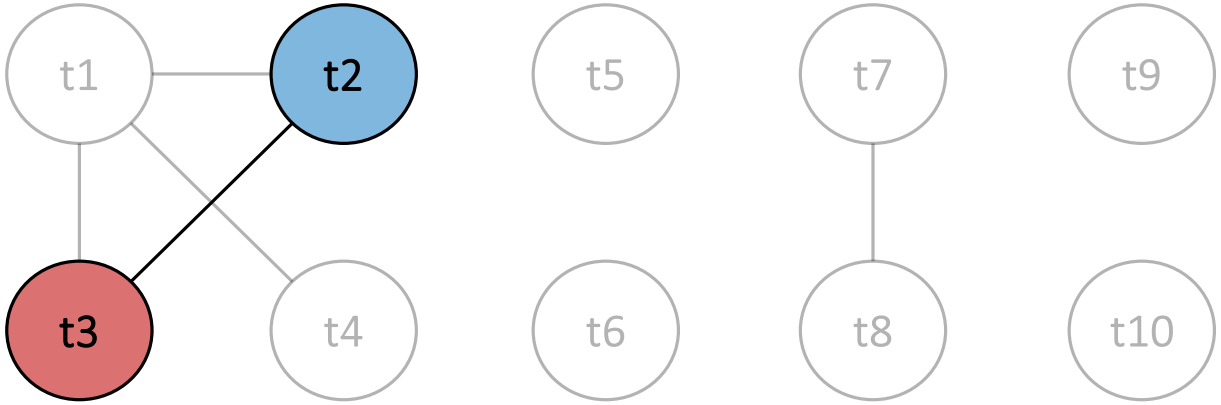
Graph Coloring (k = 3)

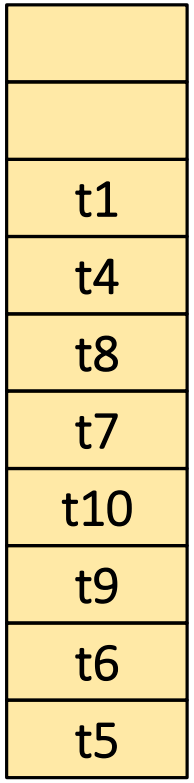


Graph Coloring (k = 3)



Graph Coloring (k = 3)





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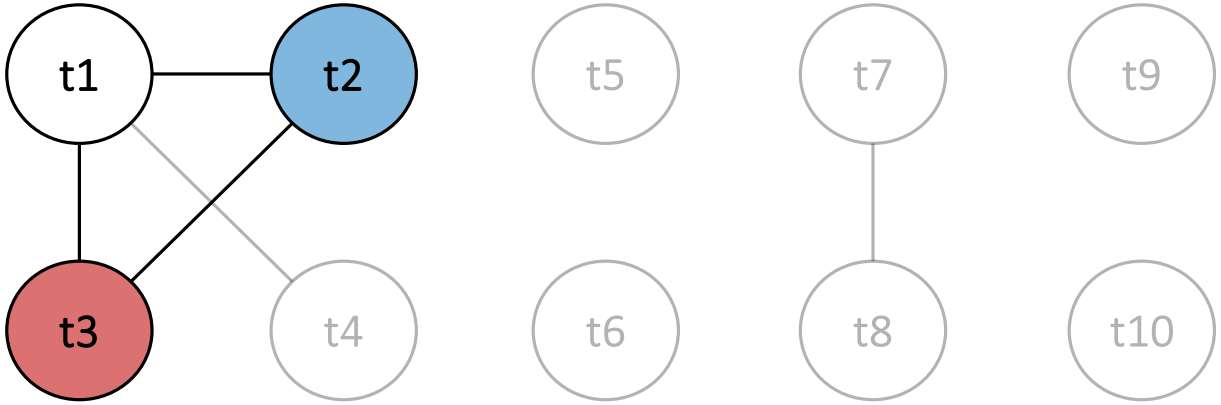
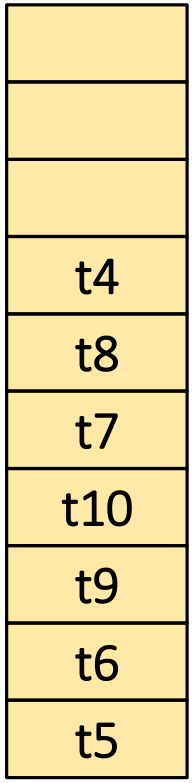
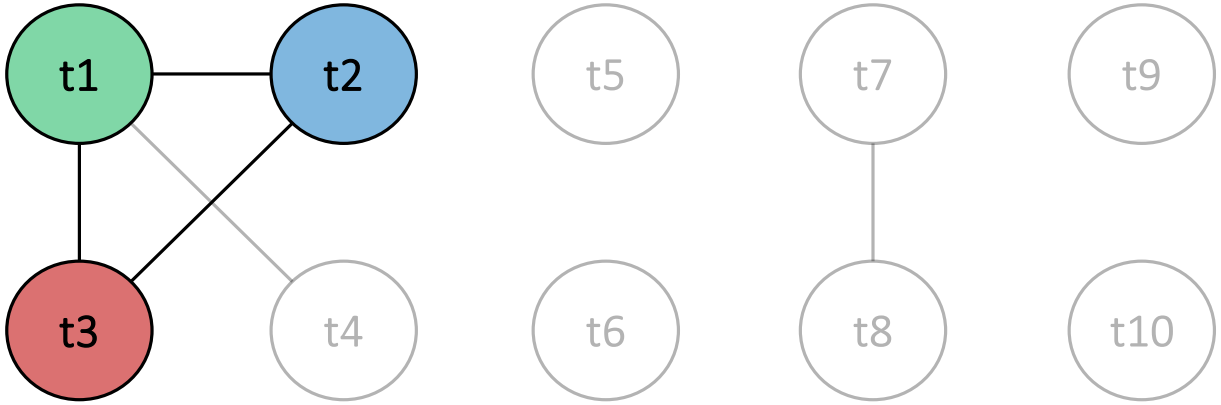
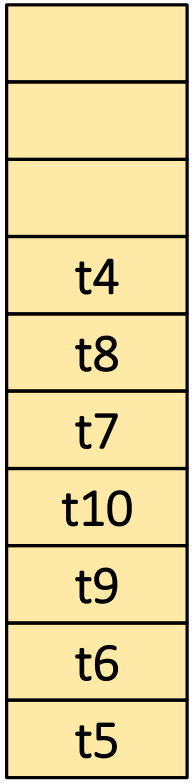


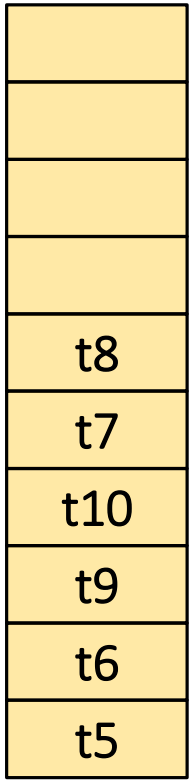


Graph Coloring (k = 3)

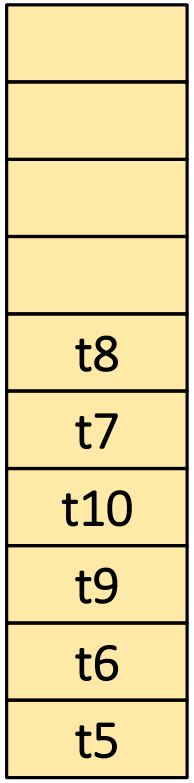




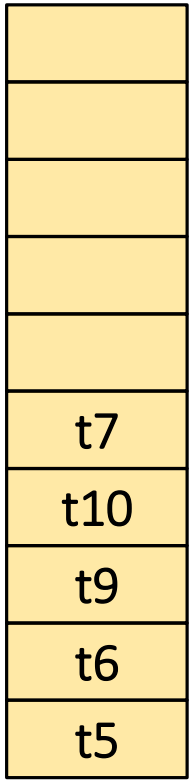
Graph Coloring (k = 3)



Graph Coloring (k = 3)



Graph Coloring (k = 3)



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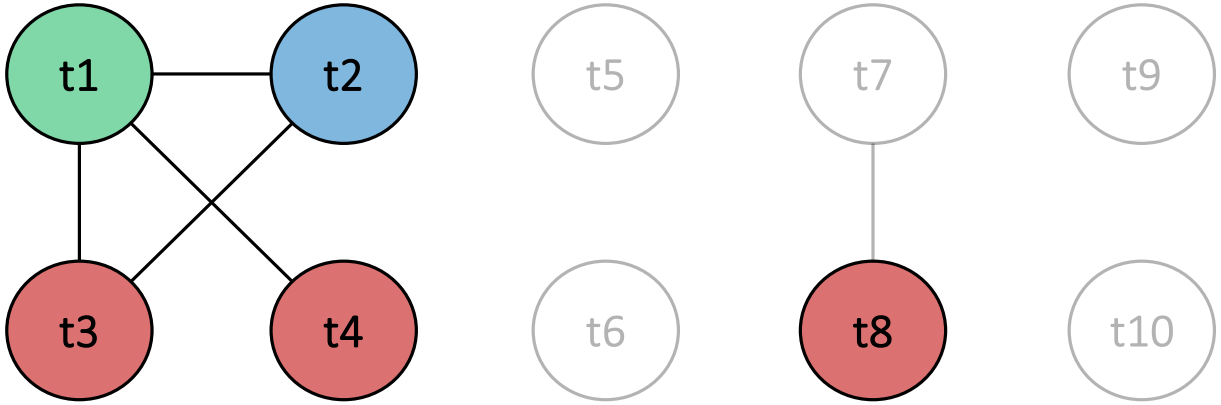
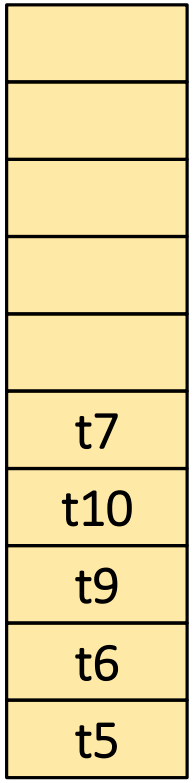
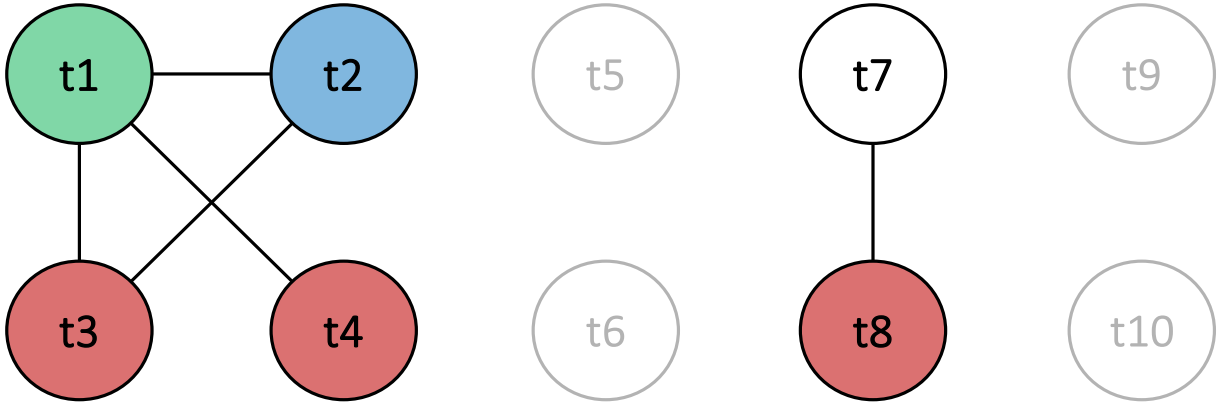
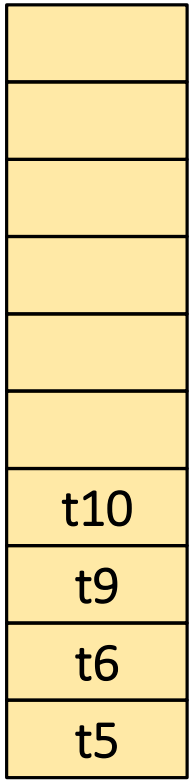


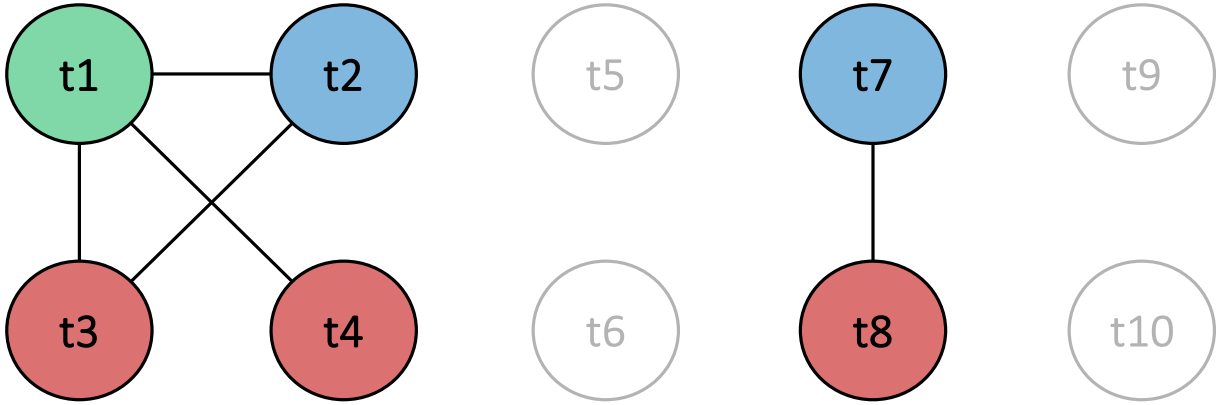


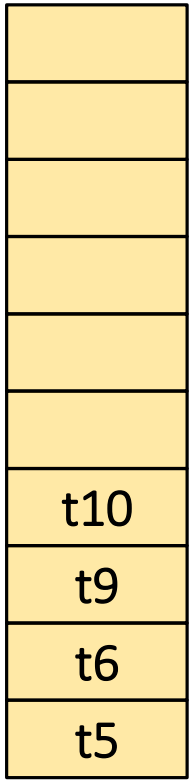
Graph Coloring (k = 3)



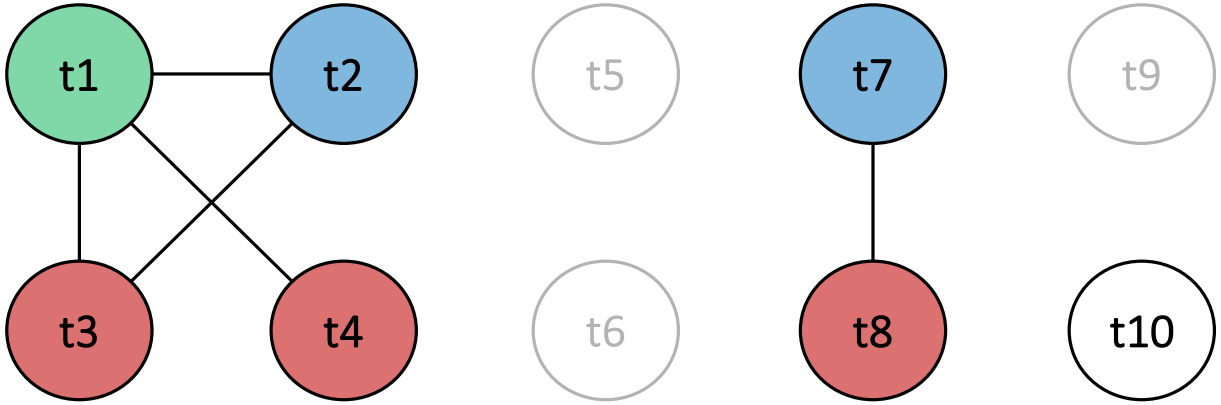


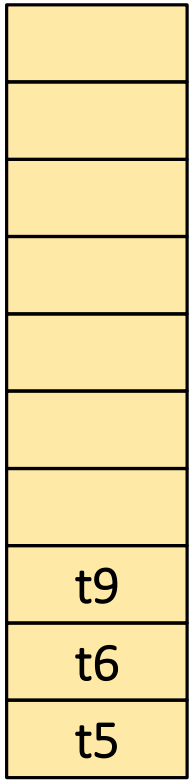
Graph Coloring (k = 3)





Graph Coloring (k = 3)





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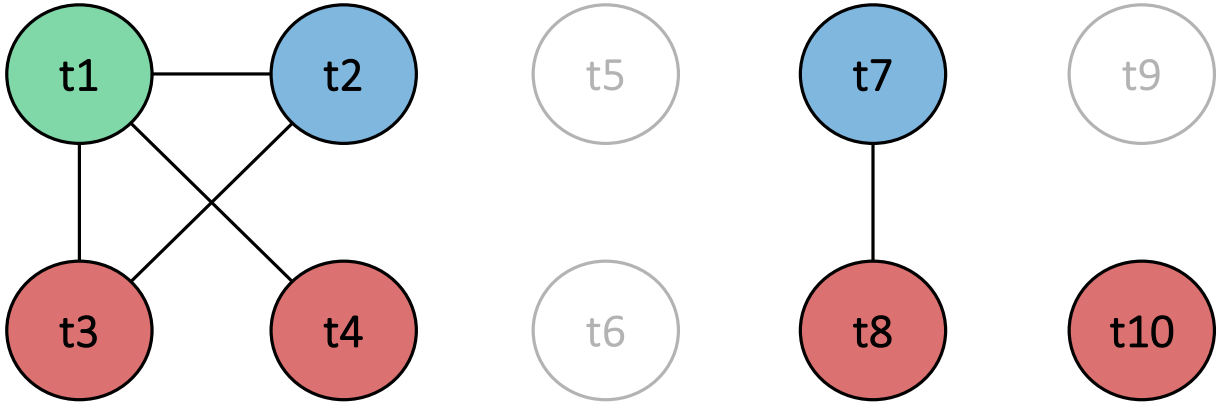

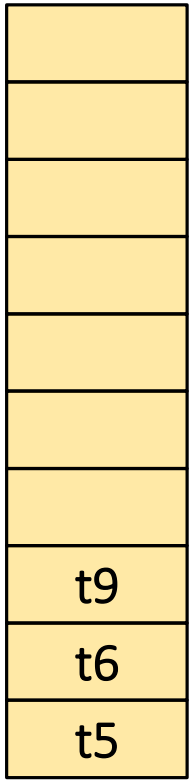

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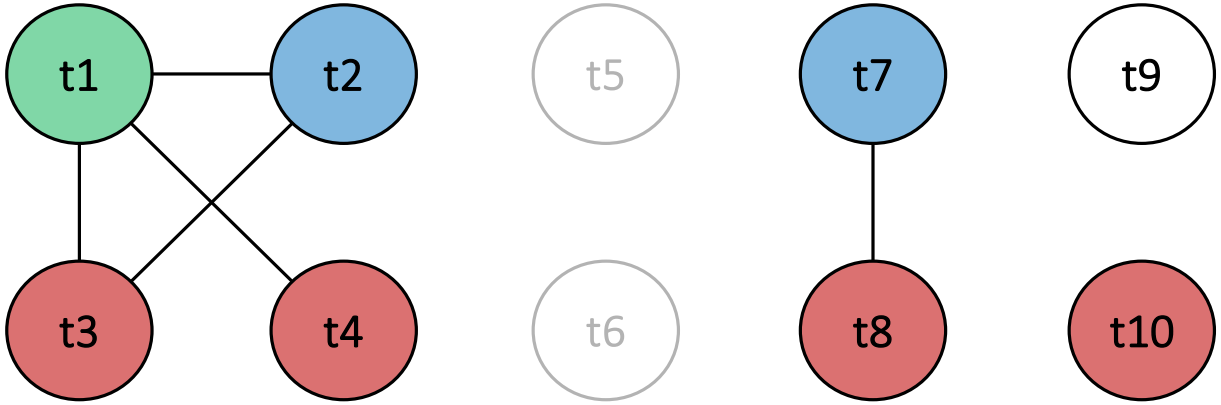
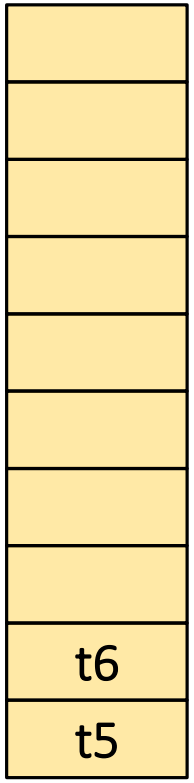
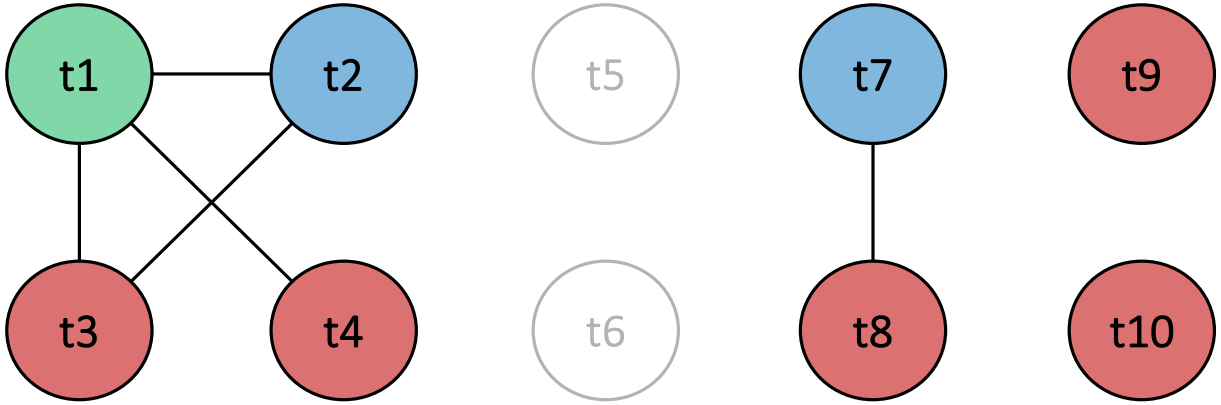
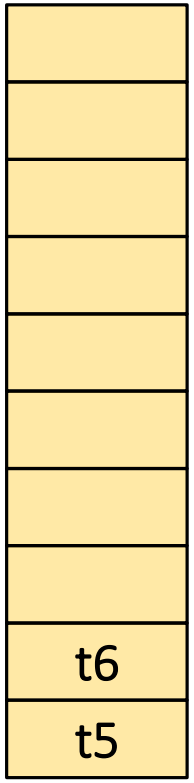


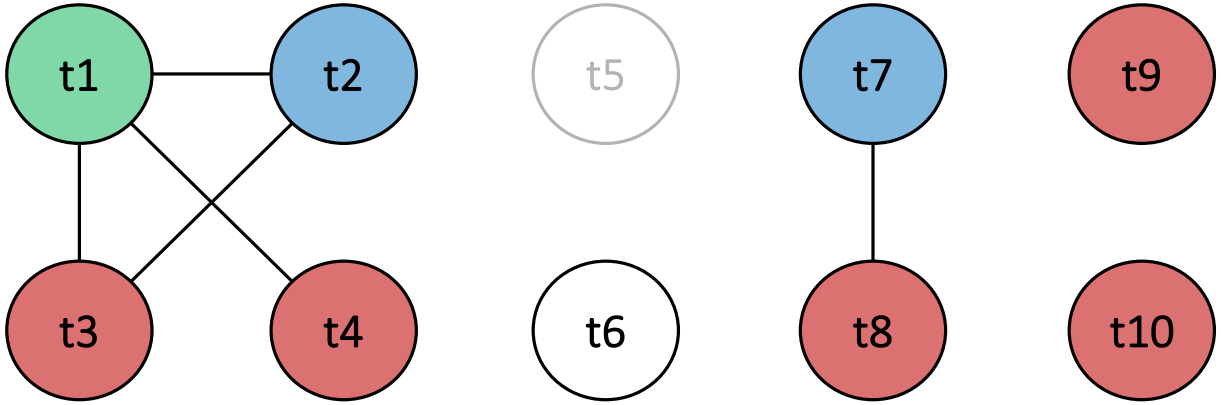


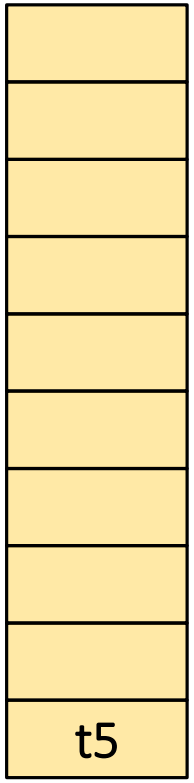
Graph Coloring (k = 3)



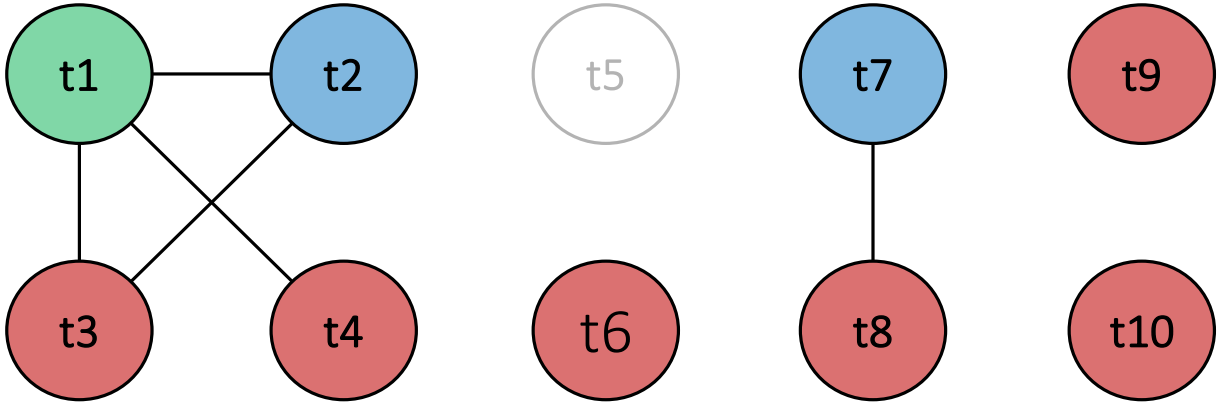


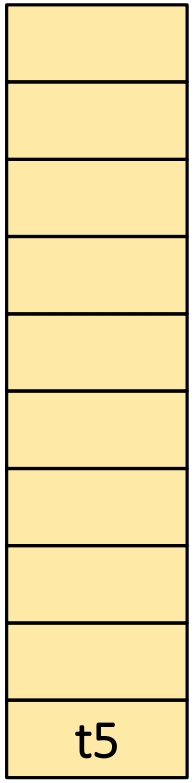
Graph Coloring (k = 3)



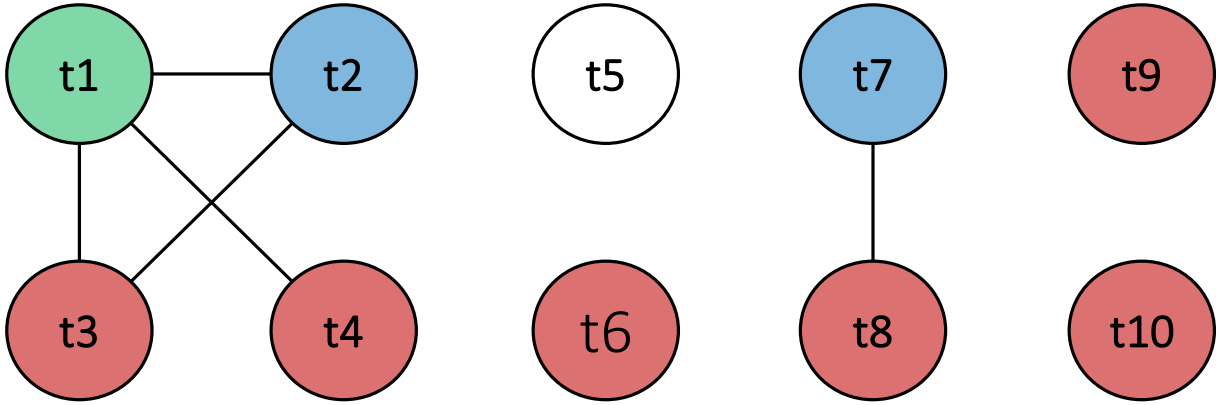


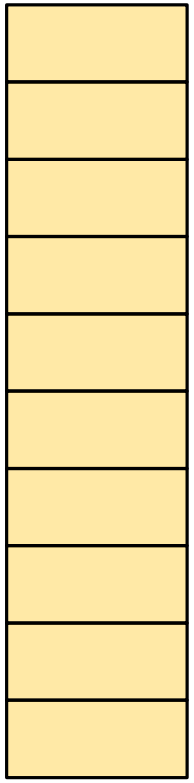
Graph Coloring (k = 3)



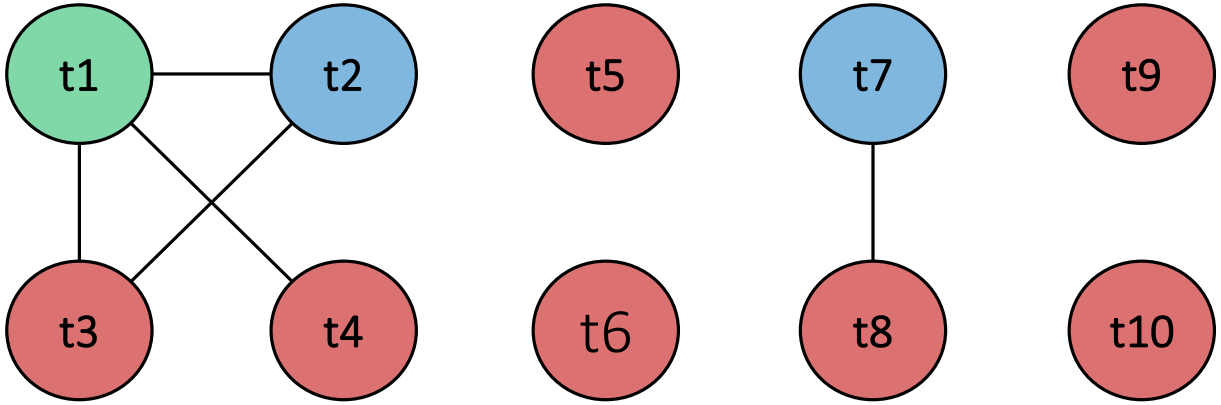


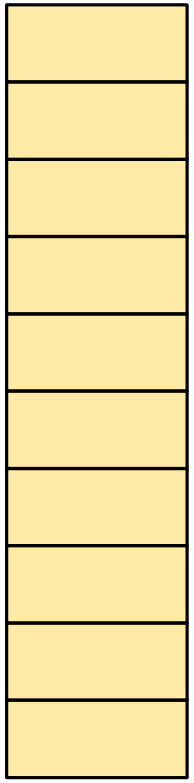
Graph Coloring (k = 3)





Graph Coloring (k = 3)





Register allocation

According to the coloring, our register allocation is:

IR Register	Color	MIPS Register
t1	R3	t2
t2	R2	t1
t3	R1	t0
t4	R1	t0
t5	R1	t0
t6	R1	t0
t7	R2	t1
t8	R1	t0
t9	R1	t0
t10	R1	t0

Register allocation

```
t1 = x
t2 = y
t3 = z
t4 = sub t2, t3
t5 = mult, t1, t4
a = t5
t6 = a
bne t6, 1, end
t7 = a
t8 = 1
t9 = add t7, t8
a = t9
end:
t10 = a
b = t10
```

IR Register	MIPS Register
t1	t2
t2	t1
t3	t0
t4	t0
t5	t0
t6	t0
t7	t1
t8	t0
t9	t0
t10	t0

```
lw $t2, 8($fp)
lw $t1, 12($fp)
lw $t0, 16($fp)
sub $t0, $t1, $t0
mul $t0, $t2, $t0
sw $t0, -4($fp)
lw $t0, -4($fp)
bne $t0, 1, end
lw $t1, -4($fp)
li $t0, 1
add $t0, $t1, $t0
sw $t0, -4($fp)
end:
lw $t0, -4($fp)
sw $t0, -8($fp)
```