SSA Form 3

Static Single Assignment Form

CMPT 379: Compilers

Instructor: Anoop Sarkar

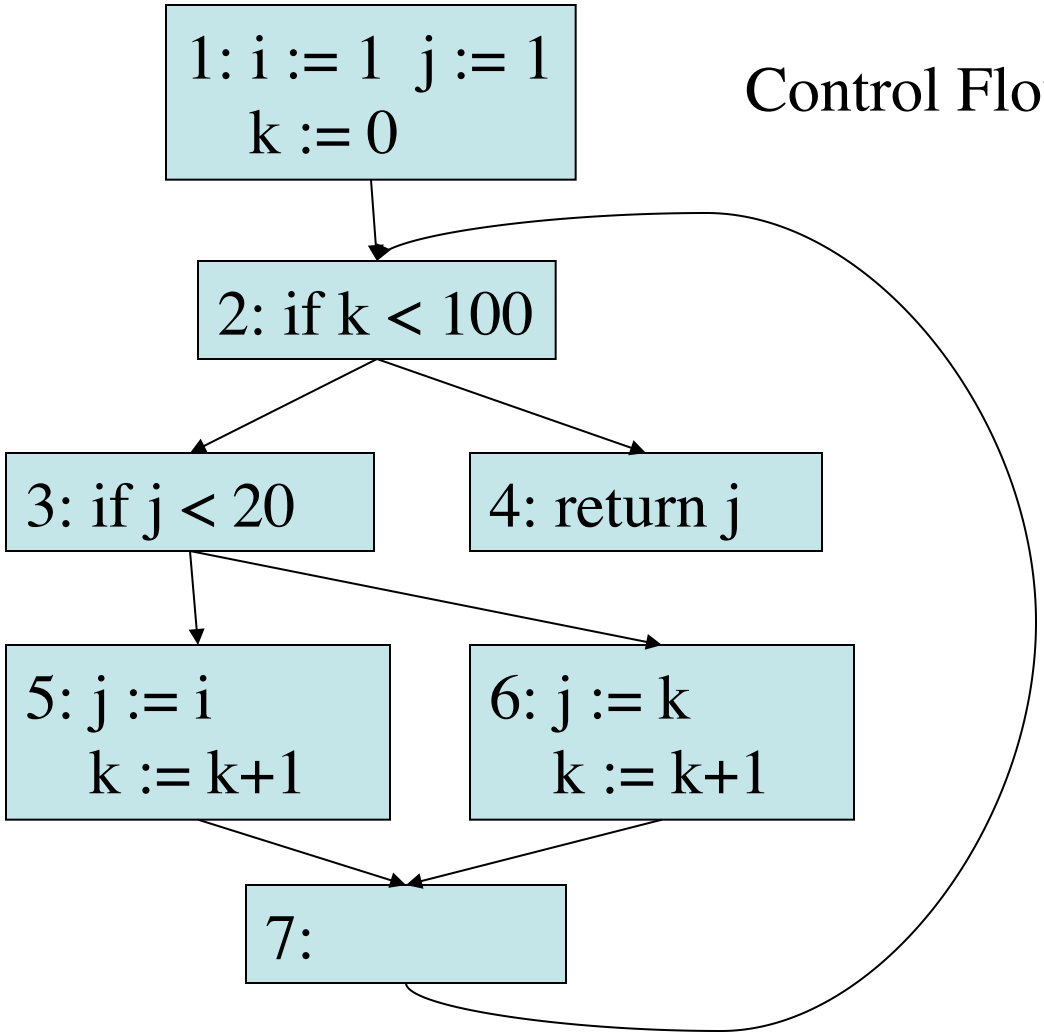
anoopsarkar.github.io/compilers-class

Converting to SSA Form

Program

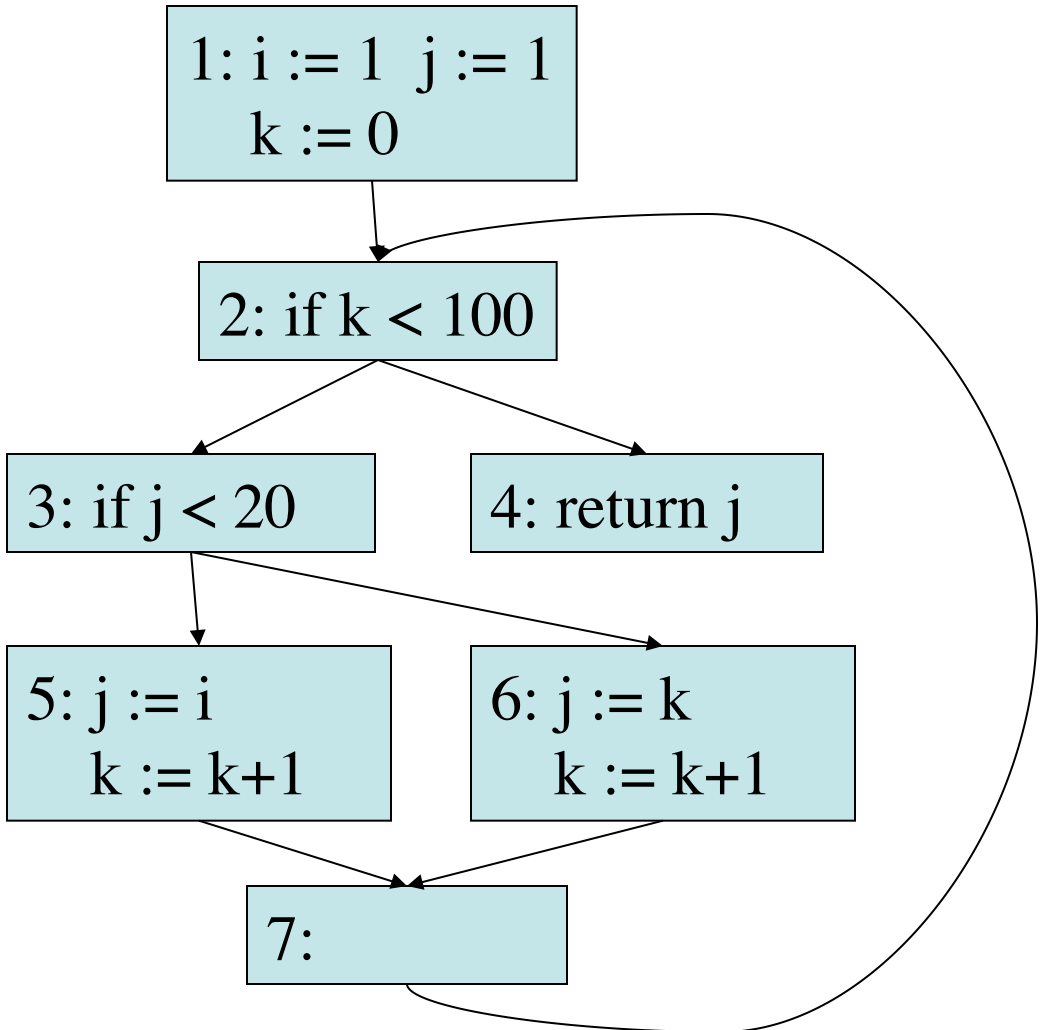
```
i:=1
j:=1
k:=0
while k<100:
    if j < 20:
        j:=i
        k:=k+1
    else:
        j:=k
        k:=k+1
return j
```

Control Flow Graph



Converting to SSA Form

Control Flow Graph

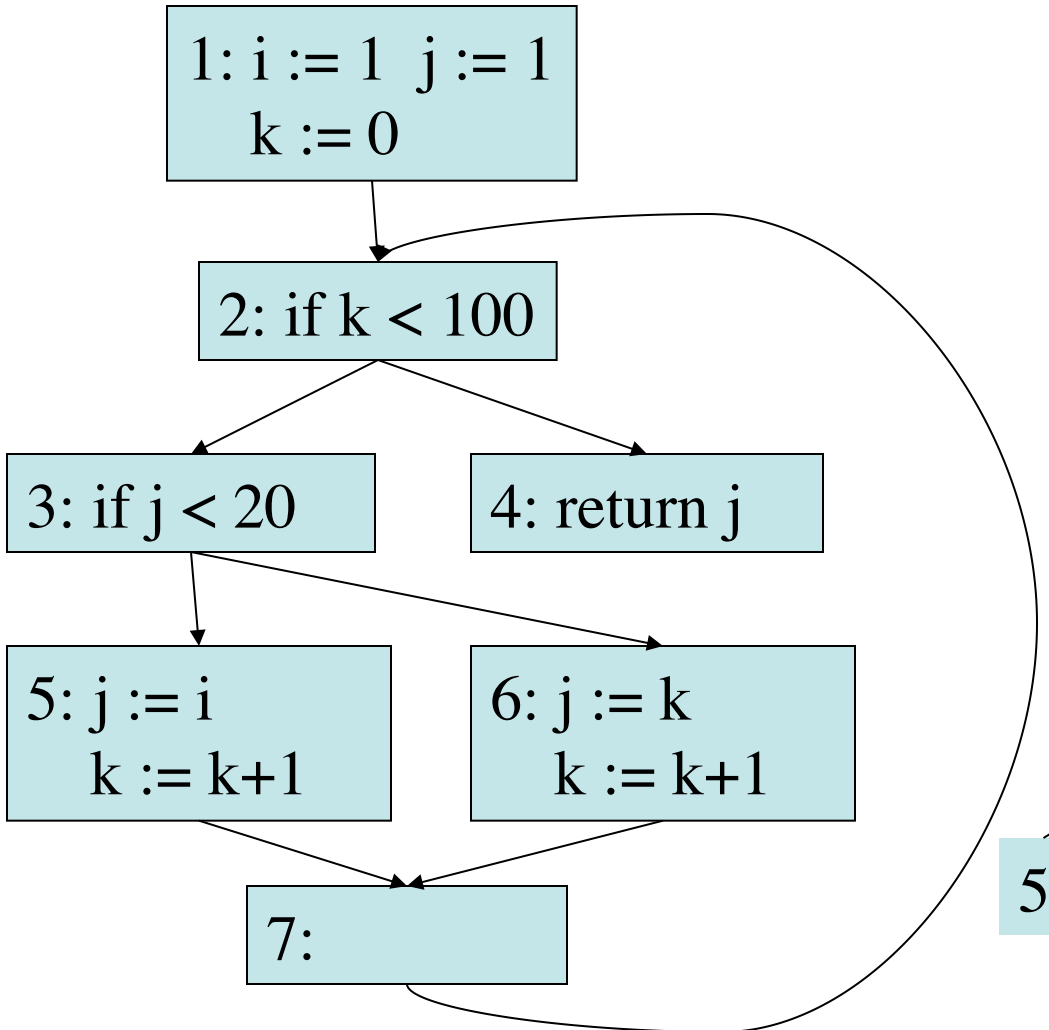


Dominance Relations

- D(1) = {2,3,4,5,6,7}
- D(2) = {3,4,5,6,7}
- D(3) = {5,6,7}
- D(4) = {}
- D(5) = {}
- D(6) = {}
- D(7) = {}

Converting to SSA

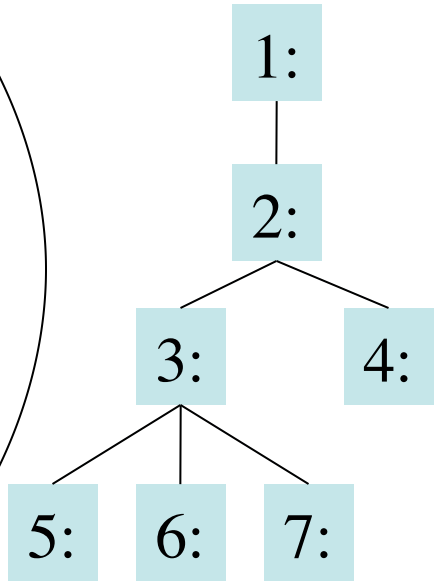
Control Flow Graph



Dominance Relations

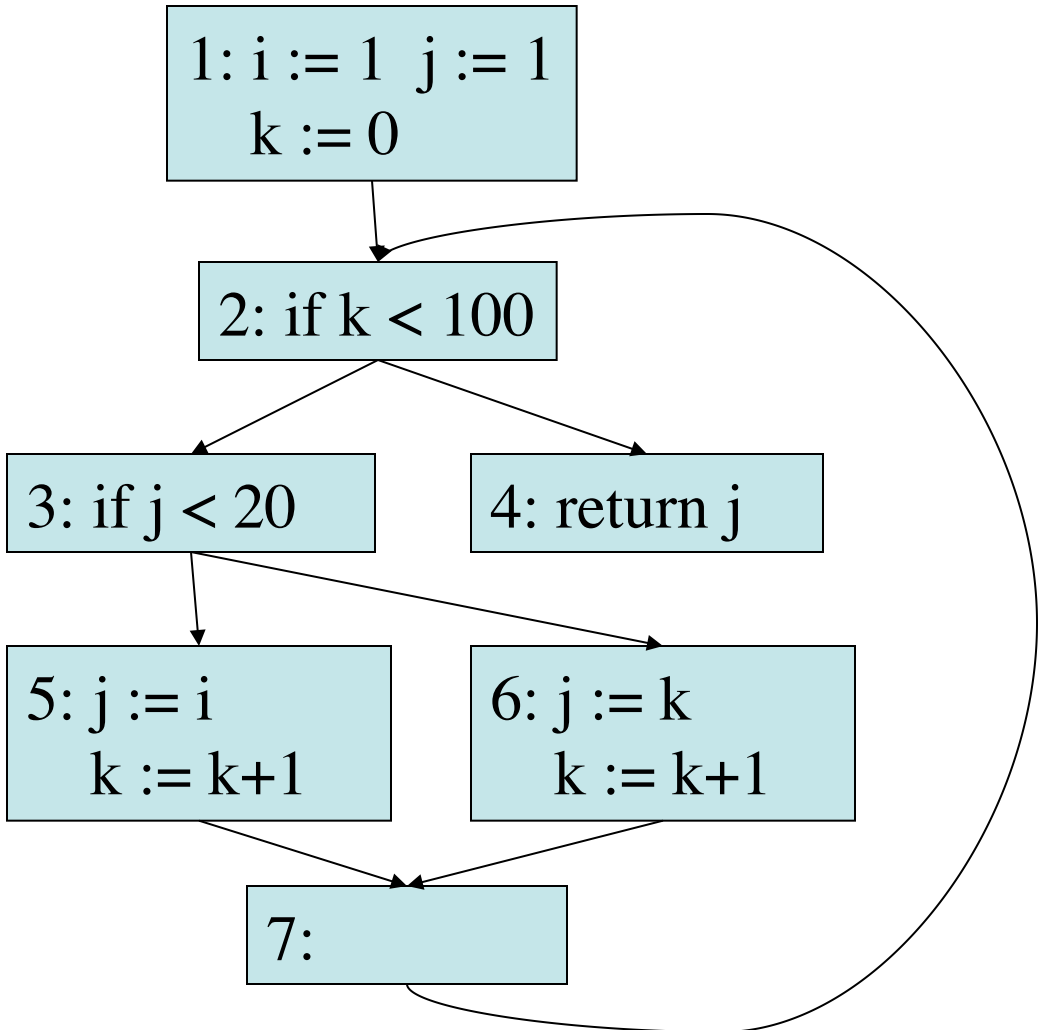
- D(1) = {2,3,4,5,6,7}
- D(2) = {3,4,5,6,7}
- D(3) = {5,6,7}
- D(4) = {}
- D(5) = {}
- D(6) = {}
- D(7) = {}

Dominator Tree



Converting to SSA

Control Flow Graph



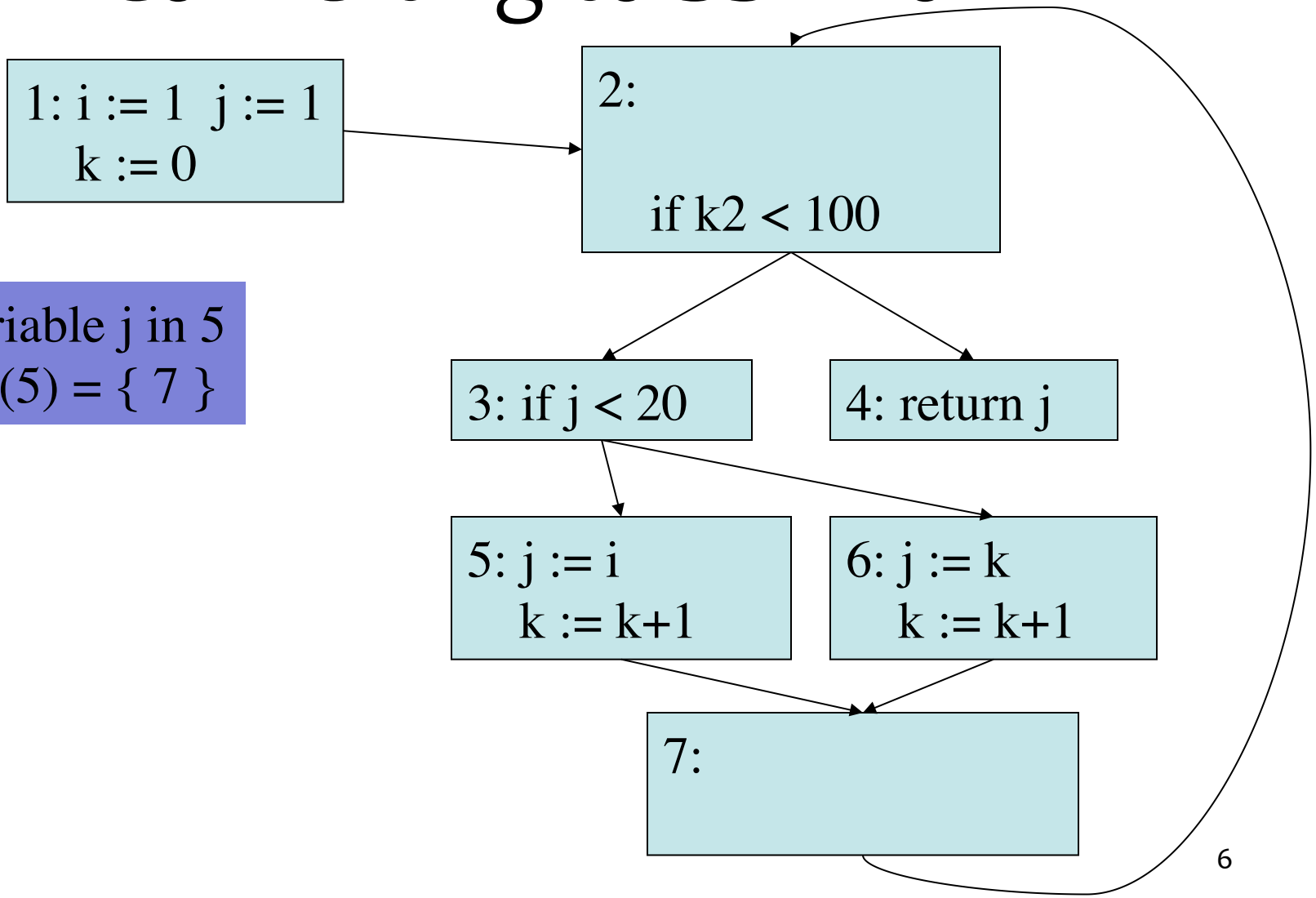
Dominance Relations

- D(1) = {2,3,4,5,6,7}
- D(2) = {3,4,5,6,7}
- D(3) = {5,6,7}
- D(4) = {}
- D(5) = {}
- D(6) = {}
- D(7) = {}

Dominance Frontier

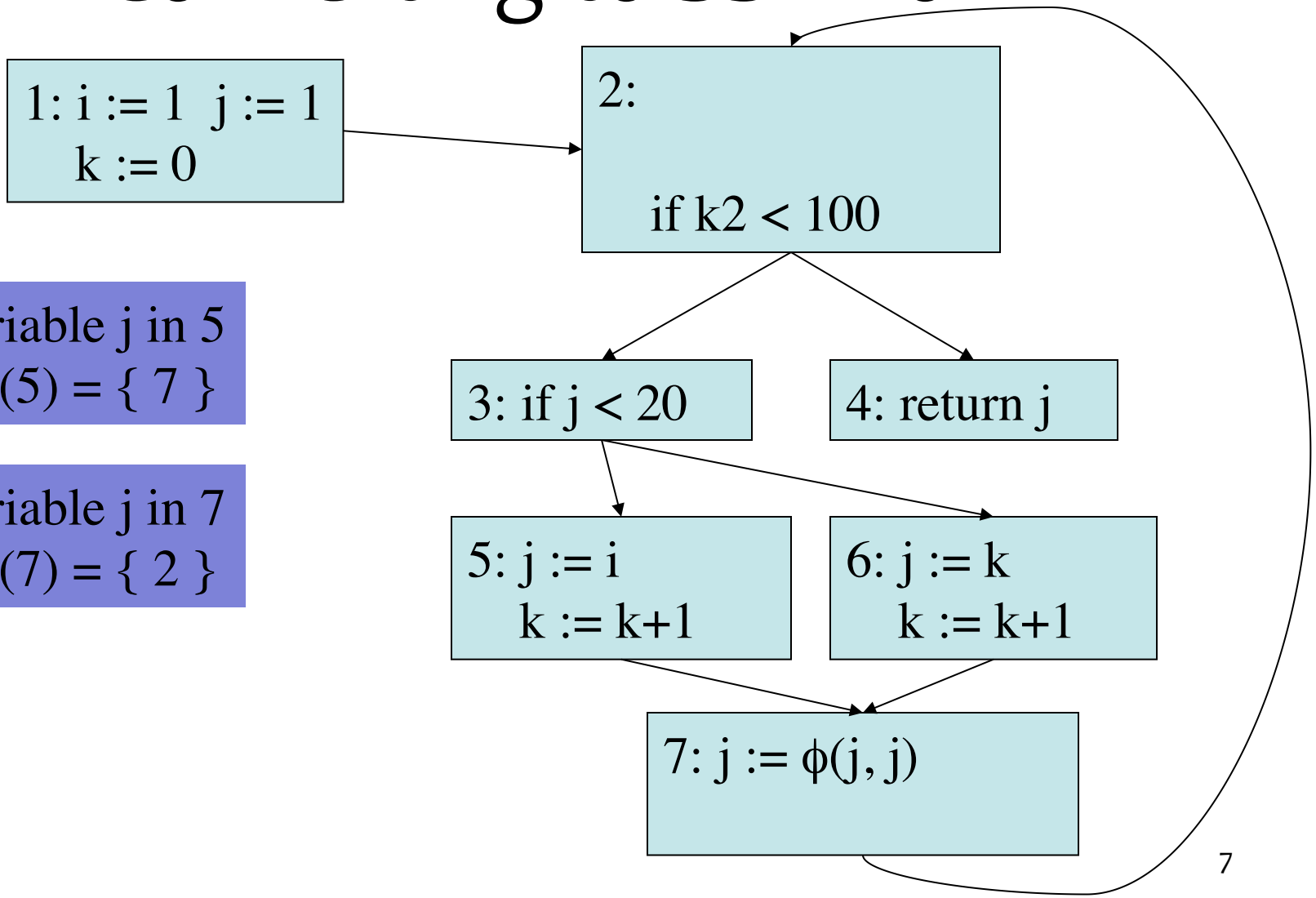
- DF(1) = {}
- DF(2) = {2}
- DF(3) = {2}
- DF(4) = {}
- DF(5) = {7}
- DF(6) = {7}
- DF(7) = {2}

Converting to SSA Form



Variable j in 5
DF(5) = { 7 }

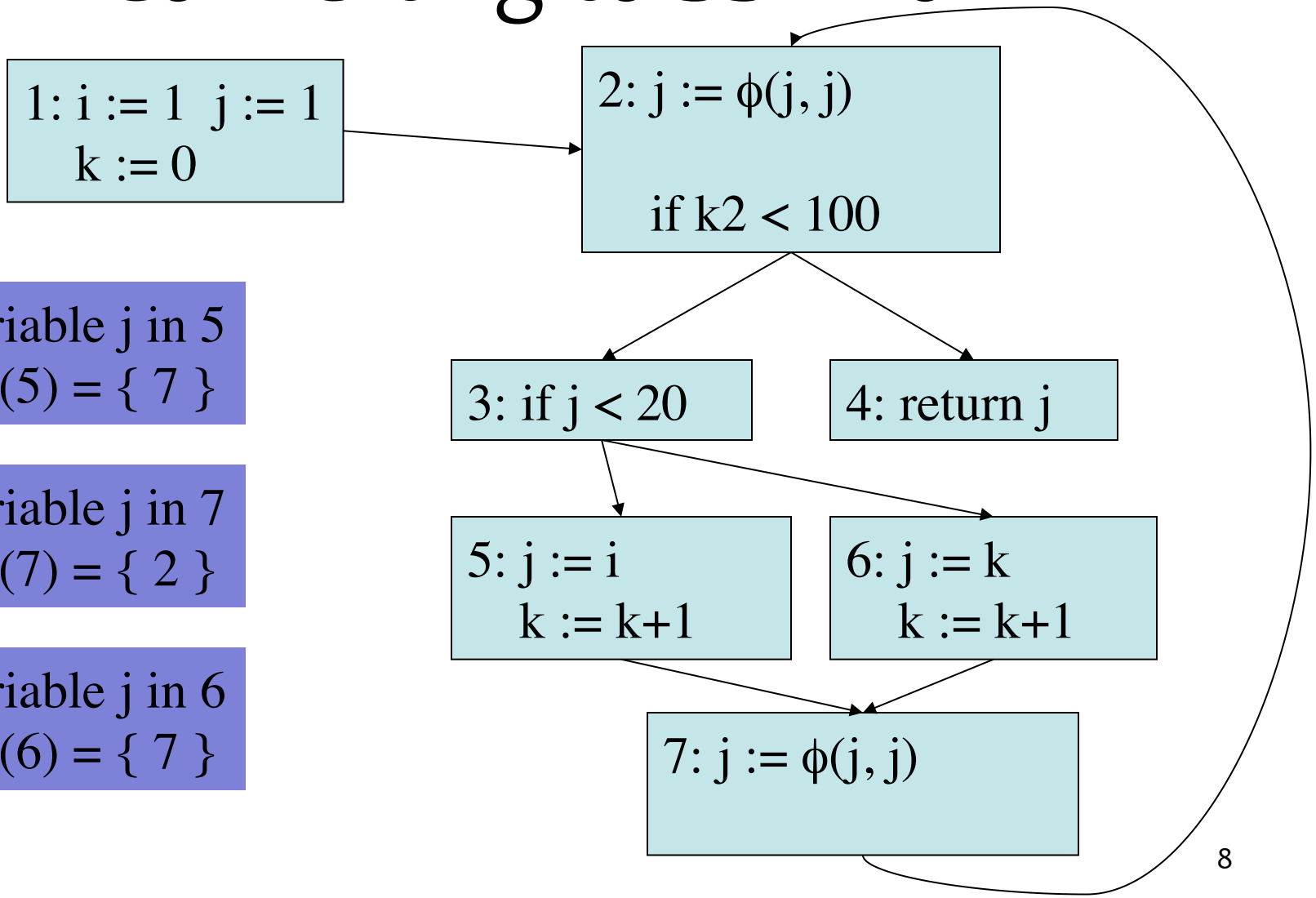
Converting to SSA Form



Variable j in 5
DF(5) = { 7 }

Variable j in 7
DF(7) = { 2 }

Converting to SSA Form

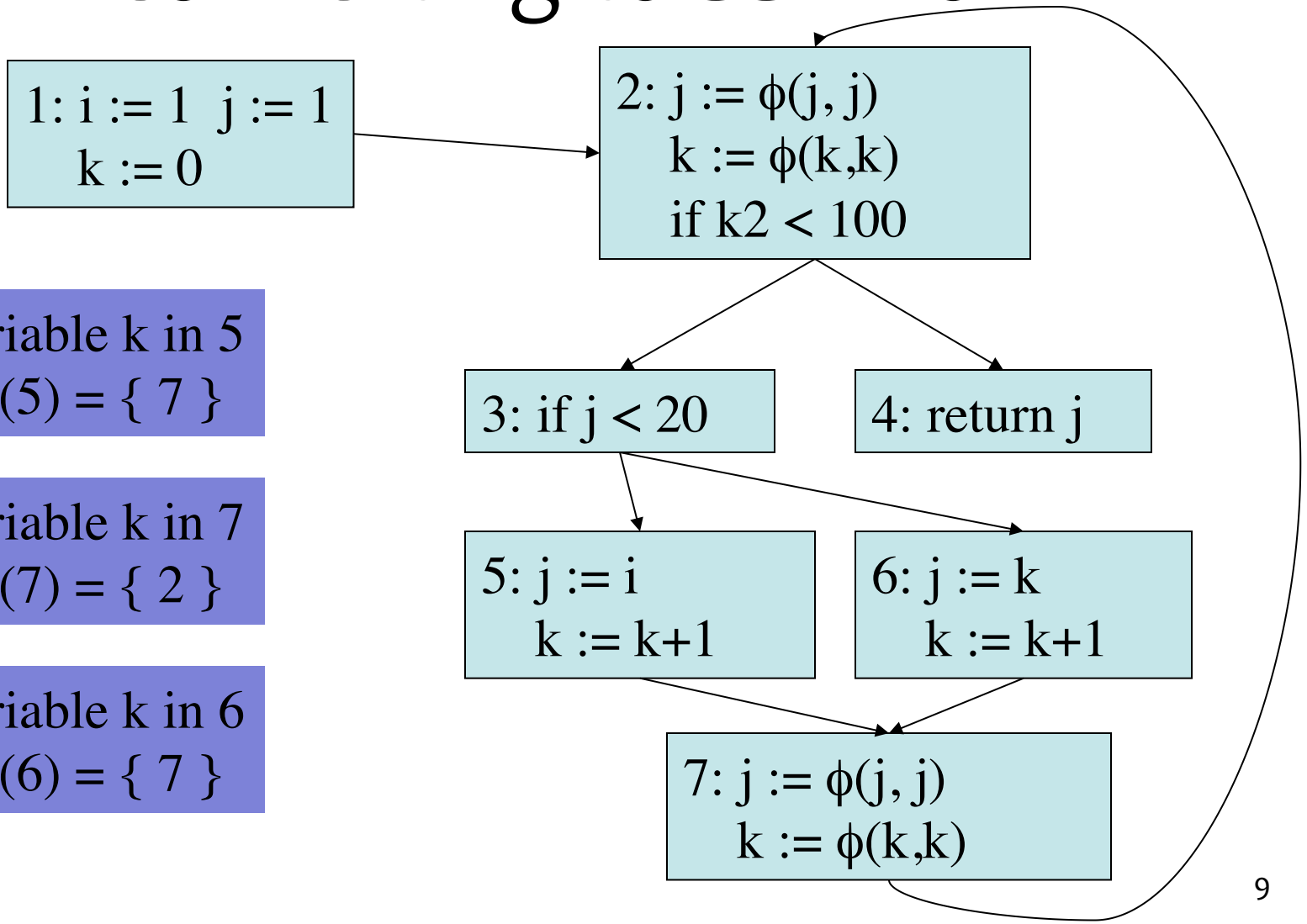


Variable j in 5
DF(5) = { 7 }

Variable j in 7
DF(7) = { 2 }

Variable j in 6
DF(6) = { 7 }

Converting to SSA Form

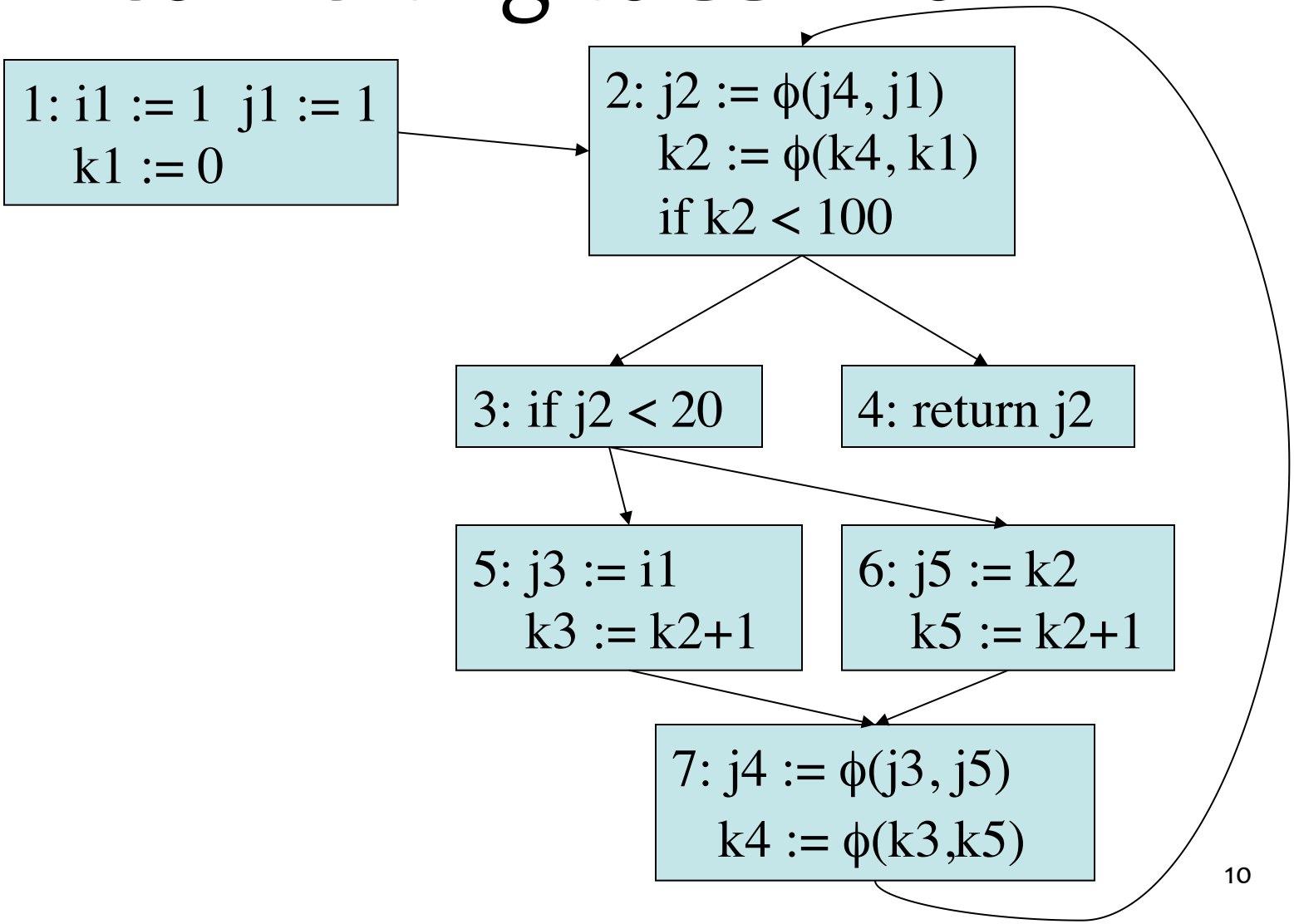


Variable k in 5
DF(5) = { 7 }

Variable k in 7
DF(7) = { 2 }

Variable k in 6
DF(6) = { 7 }

Converting to SSA Form

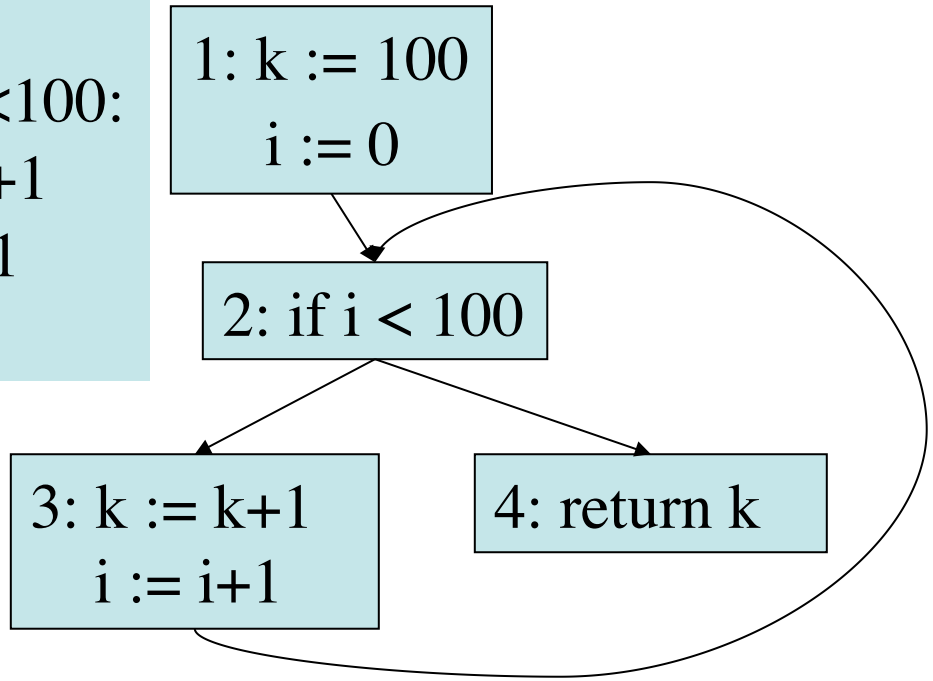


Converting to SSA Form

Program

```
k:=100
i:=0
while i<100:
    k:=k+1
    i:=i+1
return k
```

Control Flow Graph



Dominance Relations

- D(1) = {2,3,4}
- D(2) = {3,4}
- D(3) = {}
- D(4) = {}

Dominance Frontier

- DF(1) = {}
- DF(2) = {2}
- DF(3) = {2}
- DF(4) = {}

Variable i,k in 1
DF(1) = {}

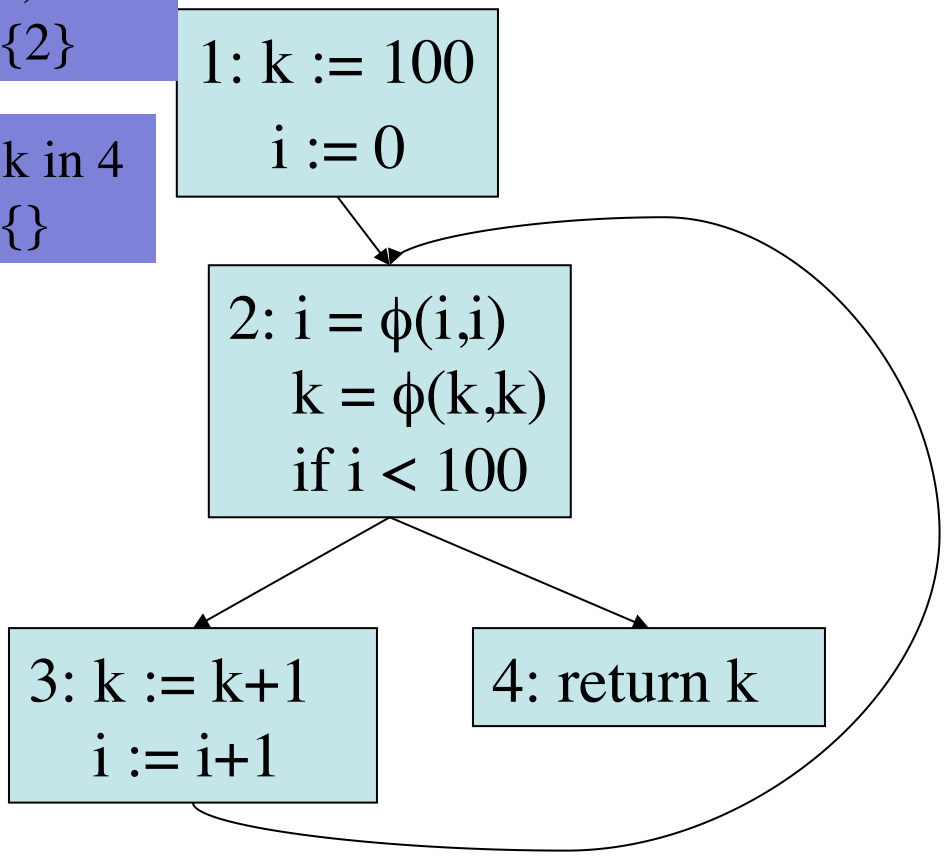
Variable i in 2
DF(2) = {2}

Variable i,k in 3
DF(3) = {2}

Variable k in 4
DF(4) = {}

Converting to SSA Form

Control Flow Graph



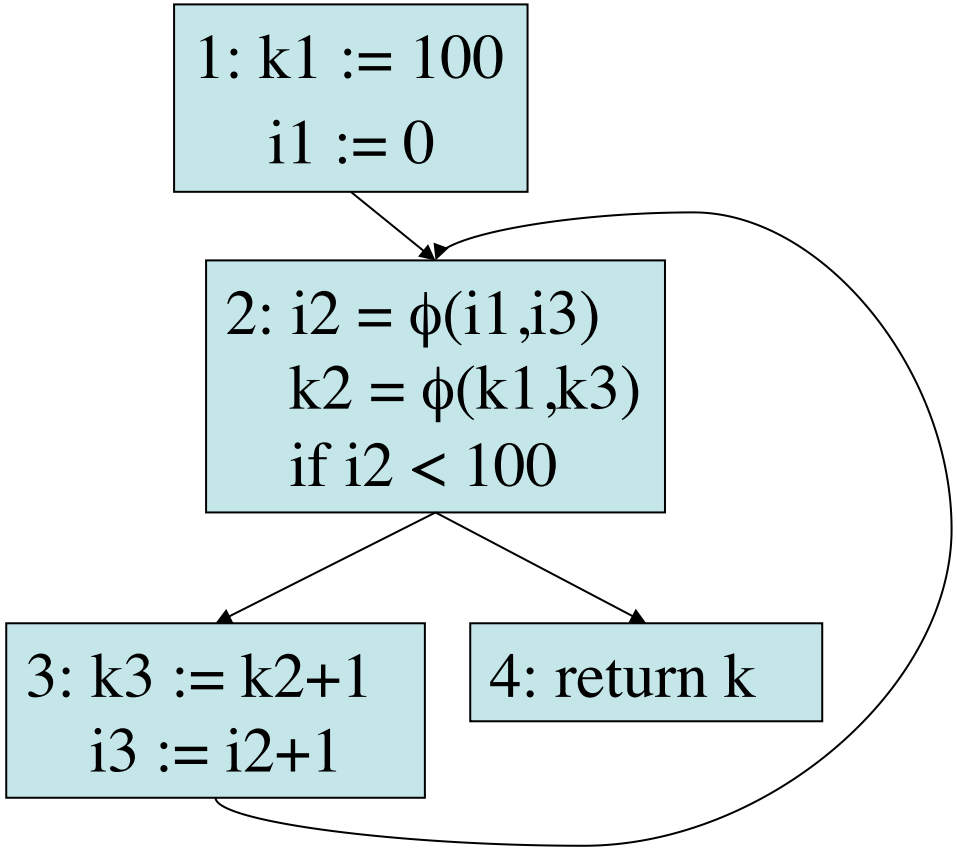
Dominance Relations

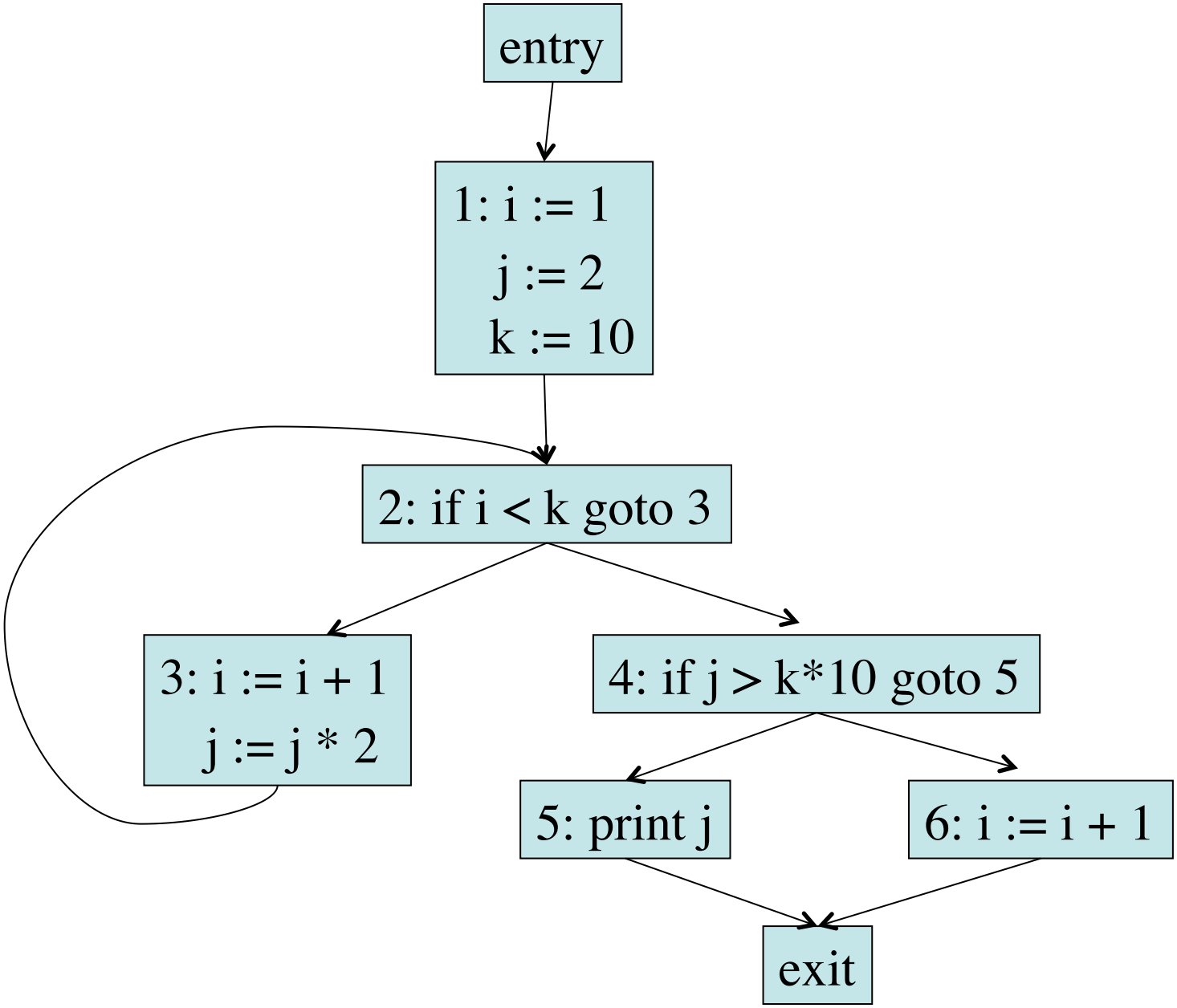
- D(1) = {2,3,4}
- D(2) = {3,4}
- D(3) = {}
- D(4) = {}

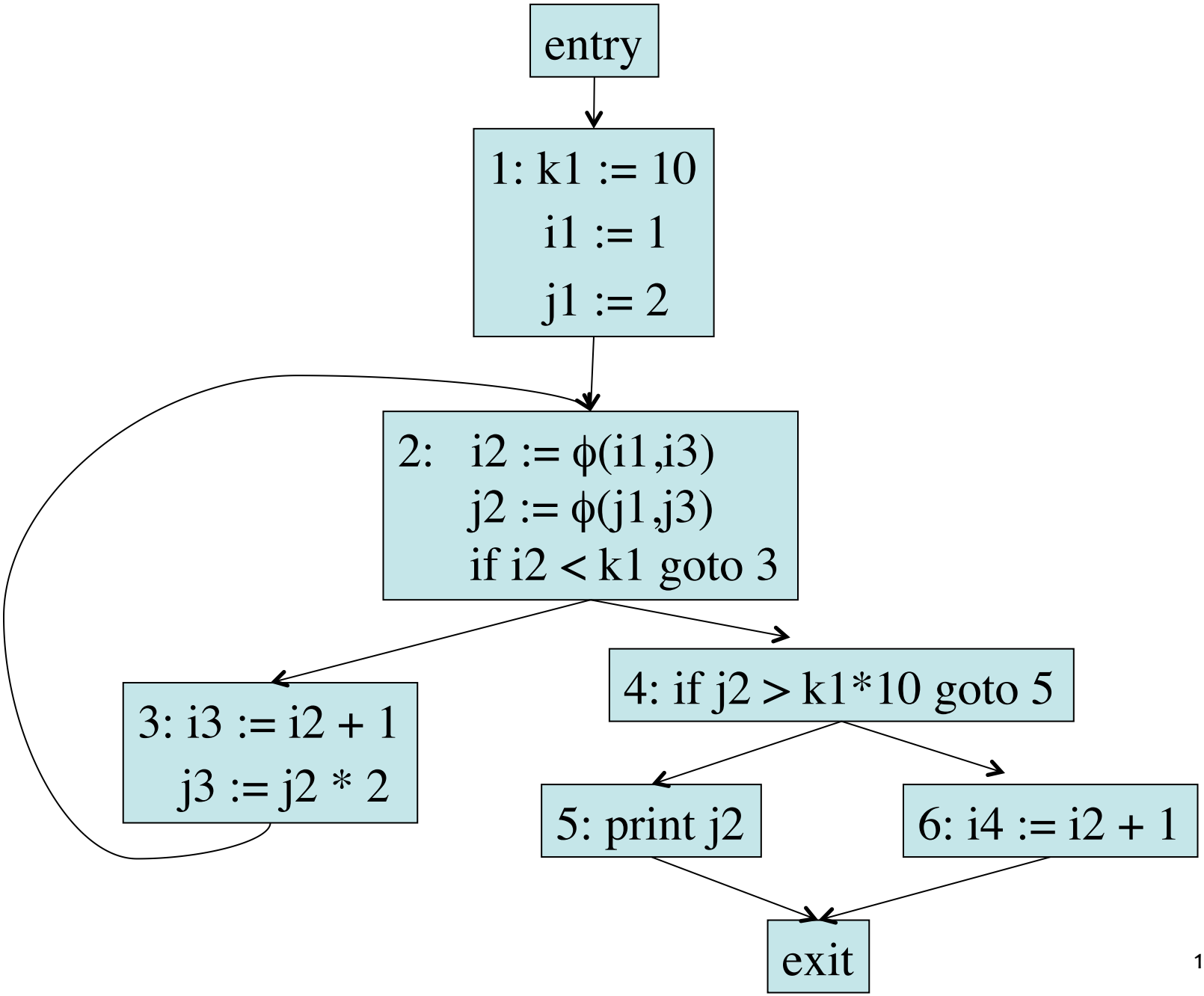
Dominance Frontier

- DF(1) = {}
- DF(2) = {2}
- DF(3) = {2}
- DF(4) = {}

Converting to SSA Form




entry
1: i := 1
j := 2
k := 10
2: if i < k goto 3
3: i := i + 1
j := j * 2
4: if j > k*10 goto 5
5: print j
6: i := i + 1
exit


entry
1: k1 := 10
i1 := 1
j1 := 2
2: i2 := ϕ(i1,i3)
j2 := ϕ(j1,j3)
if i2 < k1 goto 3
3: i3 := i2 + 1
j3 := j2 * 2
4: if j2 > k1*10 goto 5
5: print j2
6: i4 := i2 + 1
exit