INFDEV02-2
Homework 4

The DEV Team

Abstraction, functions, recursion, lambdas, and data structures.

Contents

1 Lecture Homework 4 - Drawing with lambdas

1.1 Homework 4 - Grid

Fill in the missing code blocks.

```
1  def draw_grid (x_dim,y_dim,p):
2    res=""
3    x=0
4    y=0
5    while((y<y_dim)):
6      while((x<x_dim)):
7        if(          (x,y)):
8                    =(res+         )
9        else:
10                   =(res+          )
11       x=(x+1)
12     res=(res+"\n")
13             =0
14             =(          +          )
15   return res
16 print (draw_grid(3,3,lambda  x,y:          ))
```

```
globals
stack
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
output                  "###\n###\n###\n"
```

```
globals
stack
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
globals
                    ret     "###\n###\n###\n"
                    x_dim             3
                    y_dim             3
stack               p           lambda -> @3
                    res     "###\n###\n###\n"
                    x                 0
                    y                 3
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"###\n###\n###\n"
	x	0
	y	3
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"###\n###\n###\n"
	x	0
	y	3
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"###\n###\n###\n"
	x	0
	y	2
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"###\n###\n###\n"
	x	3
	y	2
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals			
	ret	null	
	x_dim	3	
	y_dim	3	
stack	p	lambda -> @3	
	res	"###\n###\n###"	
	x	3	
	y	2	
heap			
definitions	draw_grid (x_dim,y_dim,p) => ...		

globals			
	ret	null	
	x_dim	3	
	y_dim	3	
stack	p	lambda -> @3	
	res	"###\n###\n###"	
	x	3	
	y	2	
heap			
definitions	draw_grid (x_dim,y_dim,p) => ...		

globals			
	ret	null	
	x_dim	3	
	y_dim	3	
stack	p	lambda -> @3	
	res	"###\n###\n###"	
	x	2	
	y	2	
heap			
definitions	draw_grid (x_dim,y_dim,p) => ...		

globals			
	ret	null	
	x_dim	3	
	y_dim	3	
stack	p	lambda -> @3	
	res	"###\n###\n##"	
	x	2	
	y	2	
heap			
definitions	draw_grid (x_dim,y_dim,p) => ...		

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"###\n###\n##"
	x	2
	y	2
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

globals		
	ret	null
	x_dim	3
	y_dim	3
	p	lambda -> @3
	res	"###\n###\n##"
stack	x	2
	y	2
	ret	True
	x	2
	y	2
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

globals		
	ret	null
	x_dim	3
	y_dim	3
	p	lambda -> @3
	res	"###\n###\n##"
stack	x	2
	y	2
	ret	null
	x	2
	y	2
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"###\n###\n##"
	x	2
	y	2
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"###\n###\n##"
	x	2
	y	2
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"###\n###\n##"
	x	1
	y	2
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"###\n###\n#"
	x	1
	y	2
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

globals

ret	null
x_dim	3
y_dim	3
p	lambda -> @3
res	"###\n###\n#"
x	1
y	2

stack

heap

definitions draw_grid (x_dim,y_dim,p) => ...

globals

ret	null
x_dim	3
y_dim	3
p	lambda -> @3
res	"###\n###\n#"
x	1
y	2

stack

ret	True
x	1
y	2

heap

definitions draw_grid (x_dim,y_dim,p) => ...

globals

ret	null
x_dim	3
y_dim	3
p	lambda -> @3
res	"###\n###\n#"
x	1
y	2

stack

ret	null
x	1
y	2

heap

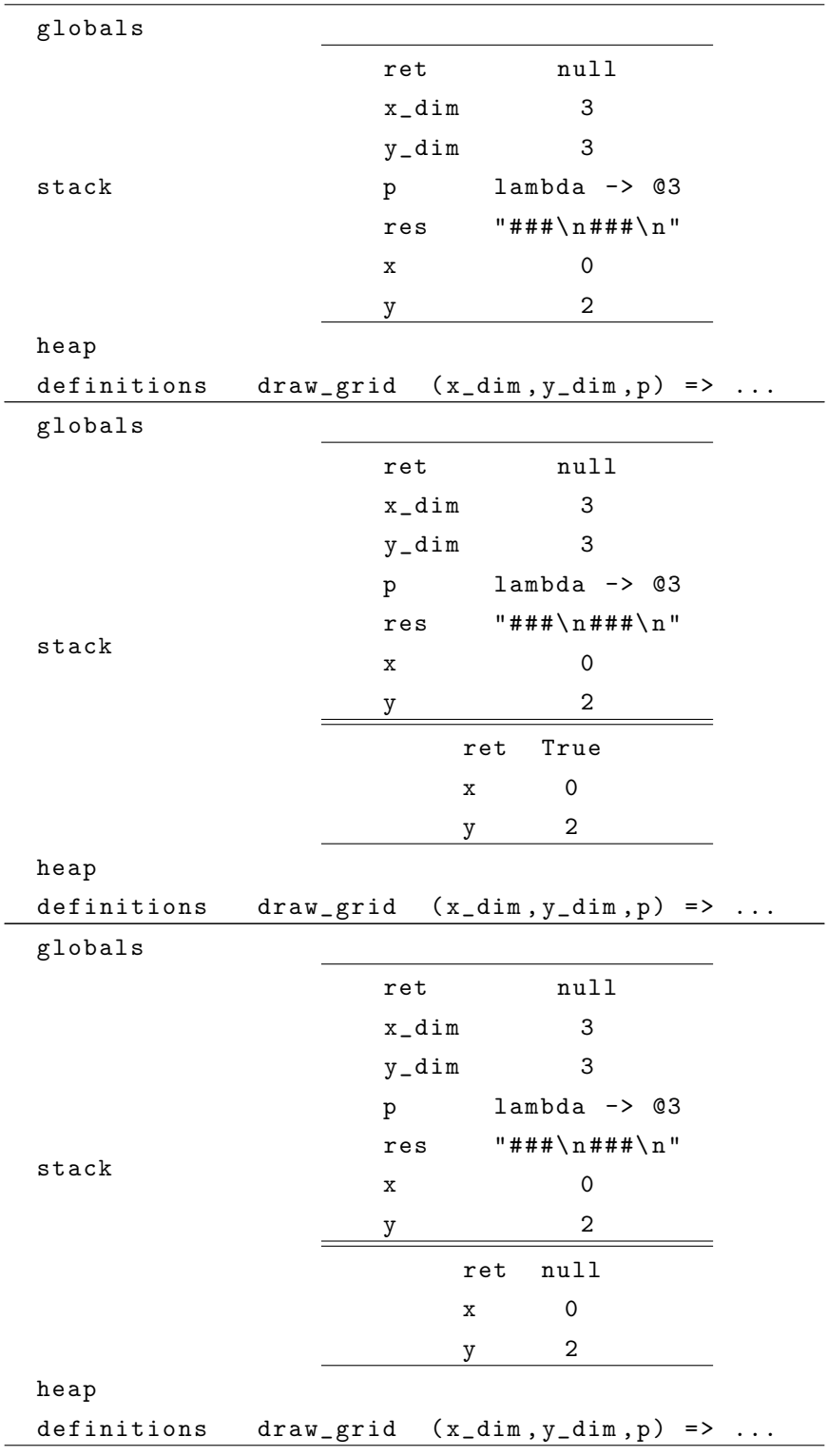
definitions draw_grid (x_dim,y_dim,p) => ...

```
globals
                    ret          null
                    x_dim          3
                    y_dim          3
stack               p        lambda -> @3
                    res     "###\n###\n#"
                    x              1
                    y              2
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
globals
                    ret          null
                    x_dim          3
                    y_dim          3
stack               p        lambda -> @3
                    res     "###\n###\n#"
                    x              1
                    y              2
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
globals
                    ret          null
                    x_dim          3
                    y_dim          3
stack               p        lambda -> @3
                    res     "###\n###\n#"
                    x              0
                    y              2
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
globals
                    ret          null
                    x_dim          3
                    y_dim          3
stack               p        lambda -> @3
                    res     "###\n###\n"
                    x              0
                    y              2
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```


globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res "###\n###\n"
x 0
y 2
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
p lambda -> @3
res "###\n###\n"
stack
x 0
y 2
ret True
x 0
y 2
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
p lambda -> @3
res "###\n###\n"
stack
x 0
y 2
ret null
x 0
y 2
heap
definitions draw_grid (x_dim,y_dim,p) => ...

globals		
stack	ret	null
	x_dim	3
	y_dim	3
	p	lambda -> @3
	res	"###\n###\n"
	x	0
	y	2
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals		
stack	ret	null
	x_dim	3
	y_dim	3
	p	lambda -> @3
	res	"###\n###\n"
	x	0
	y	2
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals		
stack	ret	null
	x_dim	3
	y_dim	3
	p	lambda -> @3
	res	"###\n###\n"
	x	0
	y	2
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

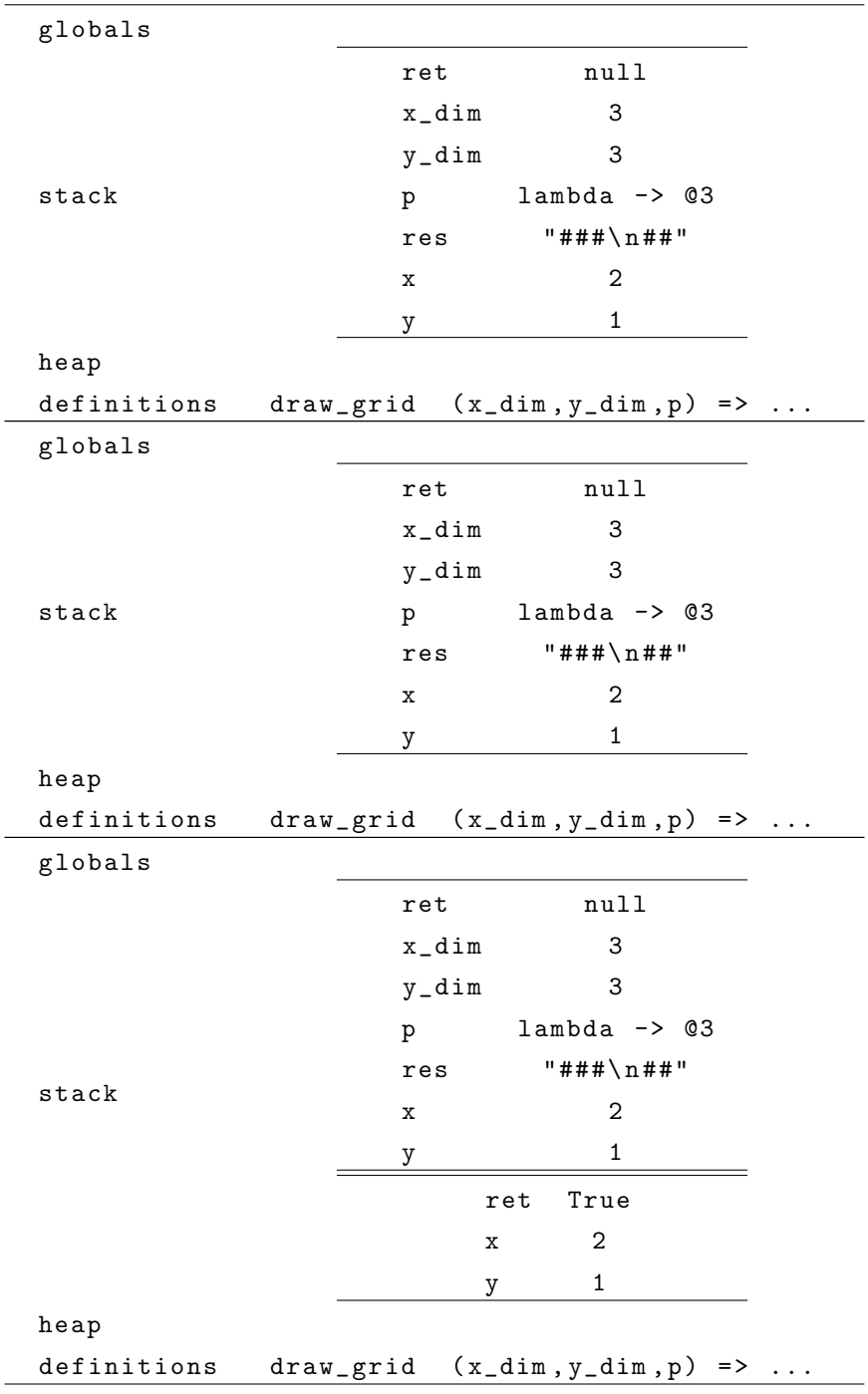
globals		
stack	ret	null
	x_dim	3
	y_dim	3
	p	lambda -> @3
	res	"###\n###\n"
	x	0
	y	1
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

```
globals
                        ret         null
                        x_dim          3
                        y_dim          3
stack                   p       lambda -> @3
                        res     "###\n###\n"
                        x              3
                        y              1
heap
definitions    draw_grid  (x_dim,y_dim,p) => ...
```

```
globals
                        ret         null
                        x_dim          3
                        y_dim          3
stack                   p       lambda -> @3
                        res      "###\n###"
                        x              3
                        y              1
heap
definitions    draw_grid  (x_dim,y_dim,p) => ...
```

```
globals
                        ret         null
                        x_dim          3
                        y_dim          3
stack                   p       lambda -> @3
                        res      "###\n###"
                        x              3
                        y              1
heap
definitions    draw_grid  (x_dim,y_dim,p) => ...
```

```
globals
                        ret         null
                        x_dim          3
                        y_dim          3
stack                   p       lambda -> @3
                        res      "###\n###"
                        x              2
                        y              1
heap
definitions    draw_grid  (x_dim,y_dim,p) => ...
```


globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res "###\n##"
x 2
y 1
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res "###\n##"
x 2
y 1
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
p lambda -> @3
res "###\n##"
stack
x 2
y 1
ret True
x 2
y 1
heap
definitions draw_grid (x_dim,y_dim,p) => ...

globals		
stack	ret	null
	x_dim	3
	y_dim	3
	p	lambda -> @3
	res	"###\n##"
	x	2
	y	1
	ret	null
	x	2
	y	1
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals		
stack	ret	null
	x_dim	3
	y_dim	3
	p	lambda -> @3
	res	"###\n##"
	x	2
	y	1
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals		
stack	ret	null
	x_dim	3
	y_dim	3
	p	lambda -> @3
	res	"###\n##"
	x	2
	y	1
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals		
stack	ret	null
	x_dim	3
	y_dim	3
	p	lambda -> @3
	res	"###\n##"
	x	1
	y	1
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

```
globals
                        ret         null
                        x_dim          3
                        y_dim          3
stack                   p       lambda -> @3
                        res       "###\n#"
                        x              1
                        y              1
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
globals
                        ret         null
                        x_dim          3
                        y_dim          3
stack                   p       lambda -> @3
                        res       "###\n#"
                        x              1
                        y              1
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
globals
                        ret         null
                        x_dim          3
                        y_dim          3
                        p       lambda -> @3
                        res       "###\n#"
stack                   x              1
                        y              1
                              ret   True
                              x       1
                              y       1
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

globals

ret	null
x_dim	3
y_dim	3
p	lambda -> @3
res	"###\n#"

stack

x	1
y	1

ret	null
x	1
y	1

heap

definitions draw_grid (x_dim,y_dim,p) => ...

---

globals

ret	null
x_dim	3
y_dim	3
p	lambda -> @3
res	"###\n#"
x	1
y	1

stack

heap

definitions draw_grid (x_dim,y_dim,p) => ...

---

globals

ret	null
x_dim	3
y_dim	3
p	lambda -> @3
res	"###\n#"
x	1
y	1

stack

heap

definitions draw_grid (x_dim,y_dim,p) => ...

---

globals

ret	null
x_dim	3
y_dim	3
p	lambda -> @3
res	"###\n#"
x	0
y	1

stack

heap

definitions draw_grid (x_dim,y_dim,p) => ...

globals

ret	null
x_dim	3
y_dim	3
p	lambda -> @3
res	"###\n"
x	0
y	1

stack

heap

definitions draw_grid (x_dim,y_dim,p) => ...

globals

ret	null
x_dim	3
y_dim	3
p	lambda -> @3
res	"###\n"
x	0
y	1

stack

heap

definitions draw_grid (x_dim,y_dim,p) => ...

globals

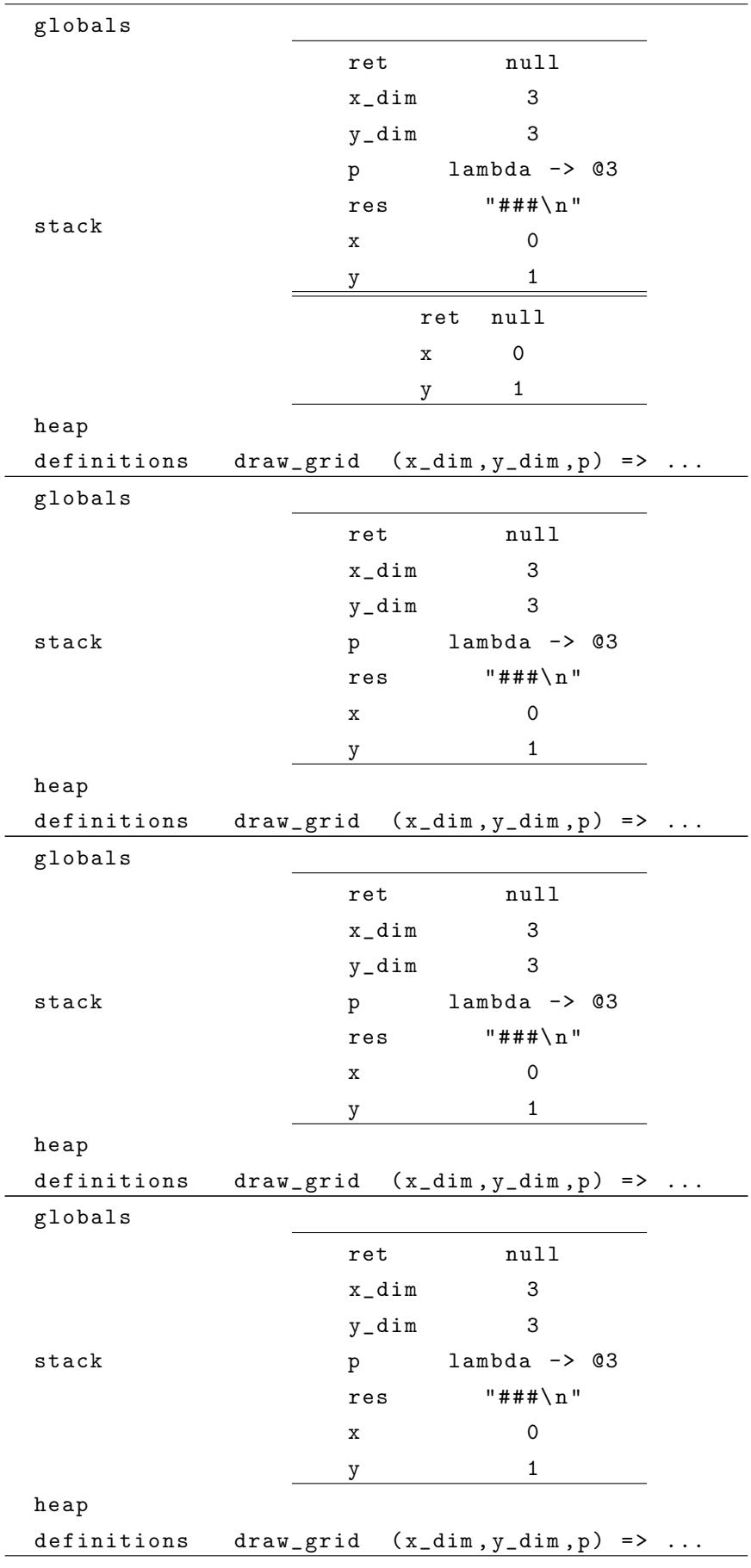
ret	null
x_dim	3
y_dim	3
p	lambda -> @3
res	"###\n"
x	0
y	1

stack

ret	True
x	0
y	1

heap

definitions draw_grid (x_dim,y_dim,p) => ...


globals
ret null
x_dim 3
y_dim 3
p lambda -> @3
res "###\n"
stack
x 0
y 1
ret null
x 0
y 1
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res "###\n"
x 0
y 1
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res "###\n"
x 0
y 1
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res "###\n"
x 0
y 1
heap
definitions draw_grid (x_dim,y_dim,p) => ...

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"###\n"
	x	0
	y	0
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"###\n"
	x	3
	y	0
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"###"
	x	3
	y	0
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

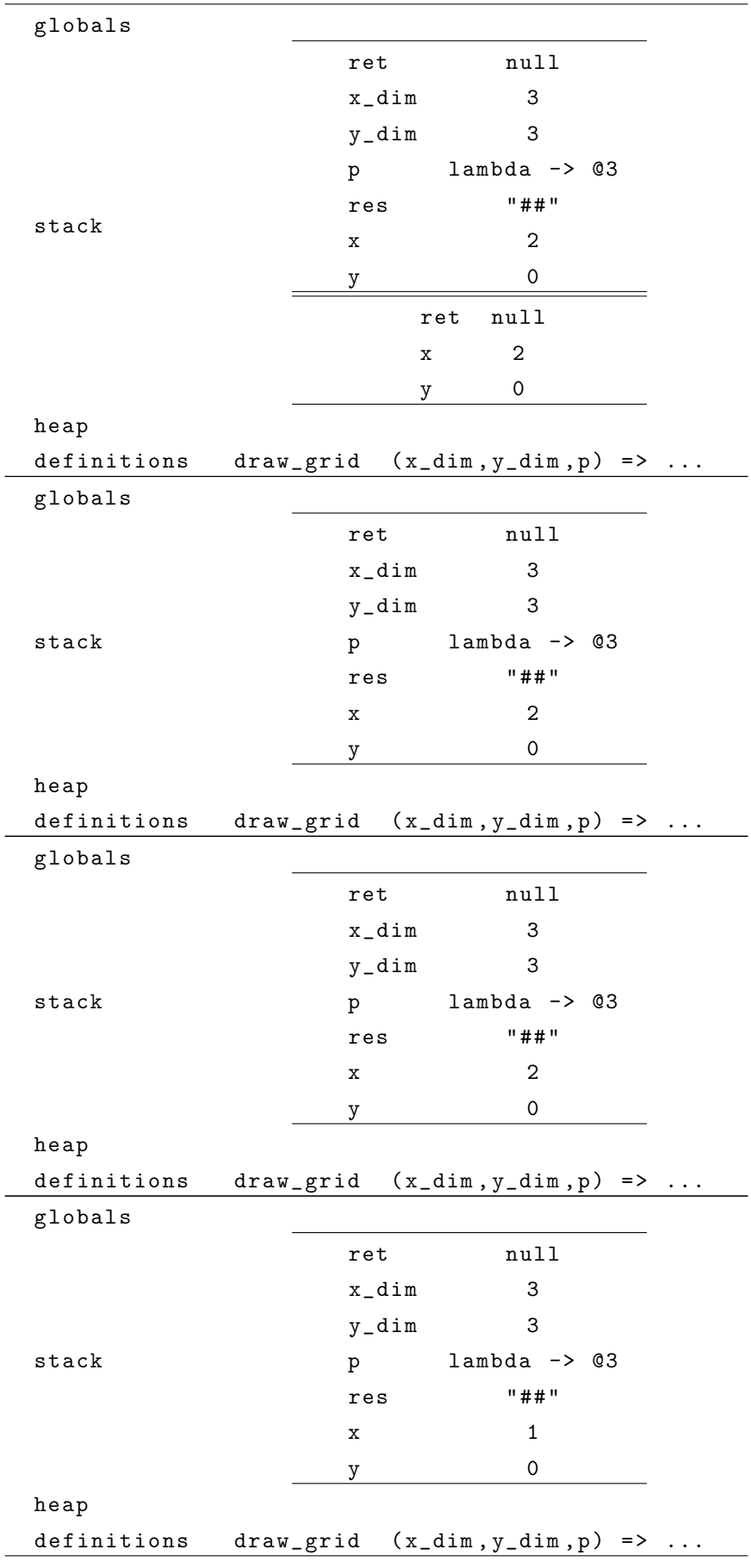
globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"###"
	x	3
	y	0
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

```
globals
stack       ret       null
            x_dim     3
            y_dim     3
            p         lambda -> @3
            res       "###"
            x         2
            y         0
heap
definitions   draw_grid   (x_dim,y_dim,p) => ...
```

```
globals
stack       ret       null
            x_dim     3
            y_dim     3
            p         lambda -> @3
            res       "##"
            x         2
            y         0
heap
definitions   draw_grid   (x_dim,y_dim,p) => ...
```

```
globals
stack       ret       null
            x_dim     3
            y_dim     3
            p         lambda -> @3
            res       "##"
            x         2
            y         0
heap
definitions   draw_grid   (x_dim,y_dim,p) => ...
```

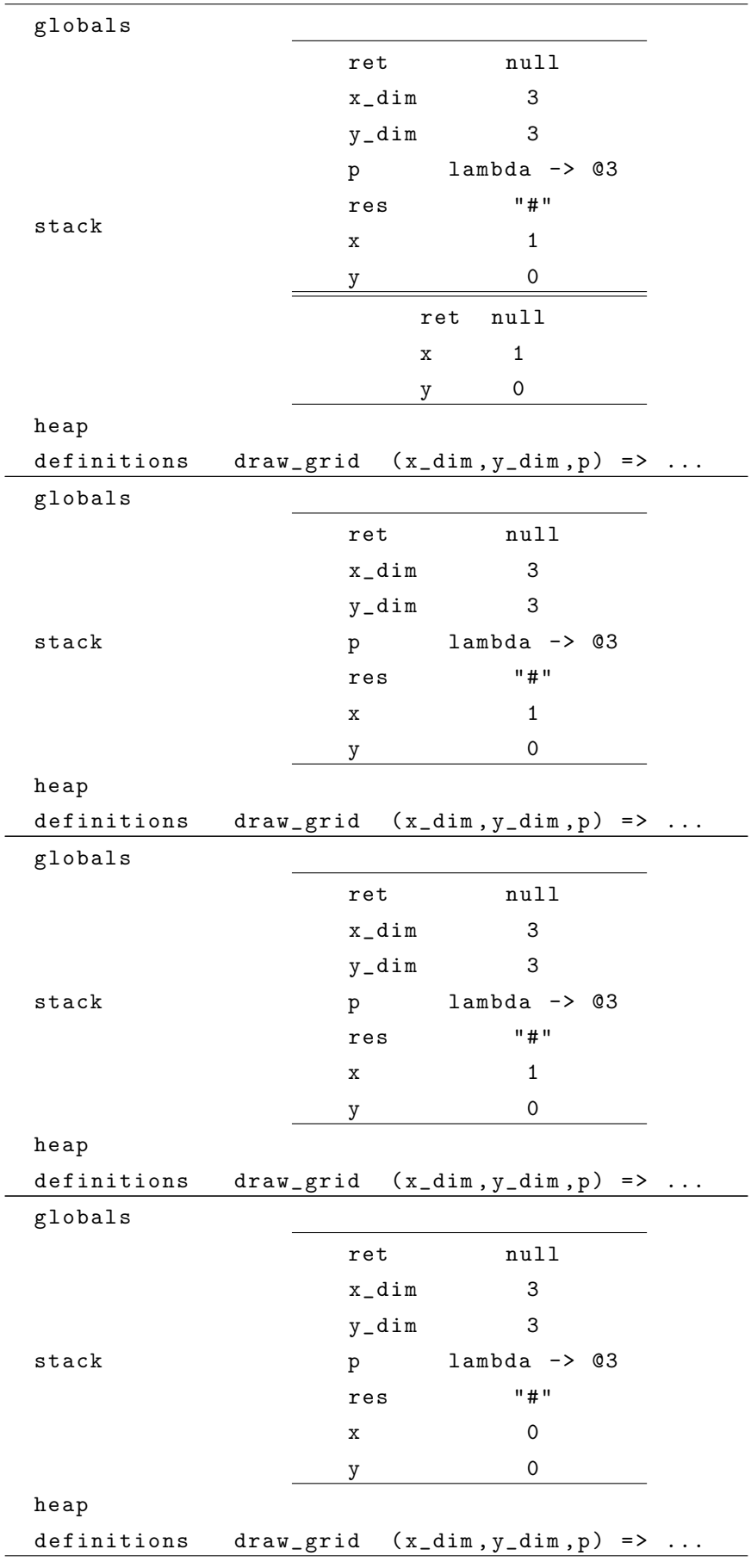
```
globals
stack       ret       null
            x_dim     3
            y_dim     3
            p         lambda -> @3
            res       "##"
            x         2
            y         0
            ===================
                  ret   True
                  x     2
                  y     0
heap
definitions   draw_grid   (x_dim,y_dim,p) => ...
```


globals
ret null
x_dim 3
y_dim 3
p lambda -> @3
res "##"
stack
x 2
y 0
ret null
x 2
y 0
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res "##"
x 2
y 0
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res "##"
x 2
y 0
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res "##"
x 1
y 0
heap
definitions draw_grid (x_dim,y_dim,p) => ...

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"#"
	x	1
	y	0
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	"#"
	x	1
	y	0
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

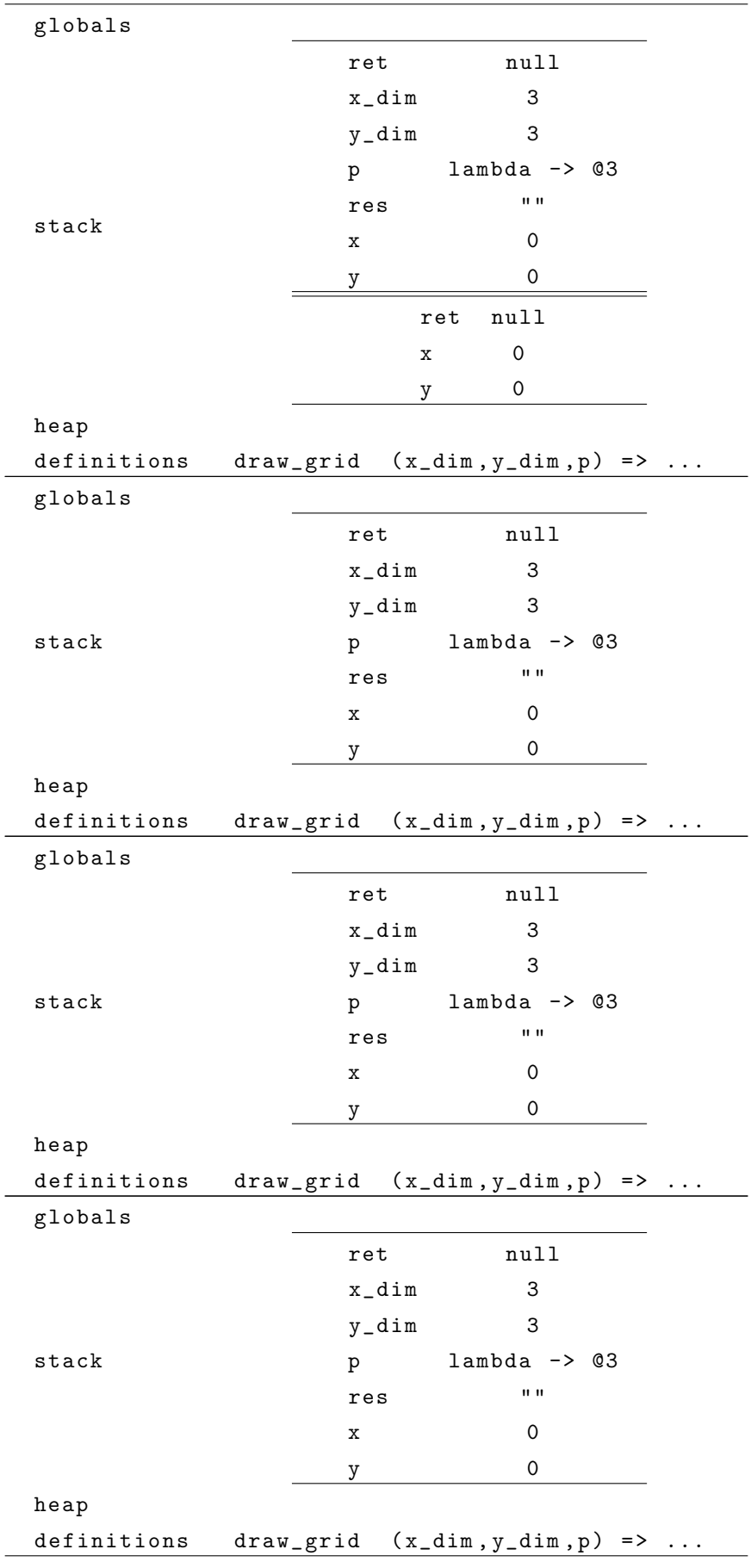
globals		
	ret	null
	x_dim	3
	y_dim	3
	p	lambda -> @3
	res	"#"
stack	x	1
	y	0
	ret	True
	x	1
	y	0
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	


globals
ret null
x_dim 3
y_dim 3
p lambda -> @3
res "#"
stack
x 1
y 0
ret null
x 1
y 0
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res "#"
x 1
y 0
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res "#"
x 1
y 0
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res "#"
x 0
y 0
heap
definitions draw_grid (x_dim,y_dim,p) => ...

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	""
	x	0
	y	0
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

globals		
	ret	null
	x_dim	3
	y_dim	3
stack	p	lambda -> @3
	res	""
	x	0
	y	0
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

globals		
	ret	null
	x_dim	3
	y_dim	3
	p	lambda -> @3
	res	""
stack	x	0
	y	0
	ret	True
	x	0
	y	0
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	


globals
ret null
x_dim 3
y_dim 3
p lambda -> @3
res ""
stack
x 0
y 0
ret null
x 0
y 0
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res ""
x 0
y 0
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res ""
x 0
y 0
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
ret null
x_dim 3
y_dim 3
stack
p lambda -> @3
res ""
x 0
y 0
heap
definitions draw_grid (x_dim,y_dim,p) => ...

```
globals
stack        ret      null
             x_dim    3
             y_dim    3
             p        lambda -> @3
             res      ""
             x        0
heap
definitions  draw_grid  (x_dim,y_dim,p) => ...
```

```
globals
stack        ret      null
             x_dim    3
             y_dim    3
             p        lambda -> @3
             res      ""
heap
definitions  draw_grid  (x_dim,y_dim,p) => ...
```

```
globals
stack        ret      null
             x_dim    3
             y_dim    3
             p        lambda -> @3
heap
definitions  draw_grid  (x_dim,y_dim,p) => ...
```

```
globals
stack
heap
definitions  draw_grid  (x_dim,y_dim,p) => ...
```

```
globals
stack
heap
definitions
```

2 Lecture Homework 4 - High order predicate combinators

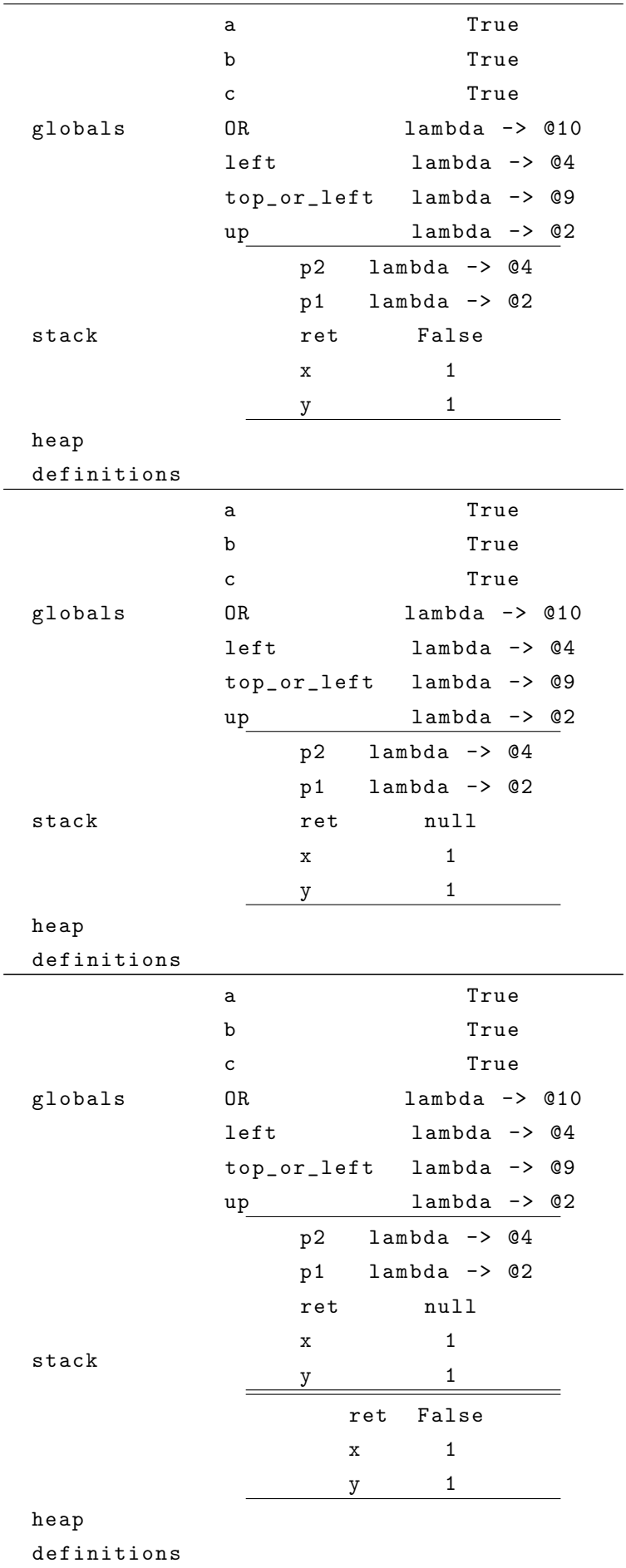
2.1 Or

Fill in the missing code blocks.

```
1  up=lambda  x,y:(y==0)
2  left=lambda  x,y:(x==0)
3  OR=lambda           ,          :
4        lambda             ,          :
5          (          (          ,          ) or          (          ,          ))
6
7
8  top_or_left=          (          ,          )
9
10 a=top_or_left(0,0)
11 b=top_or_left(0,1)
12 c=top_or_left(1,0)
13 d=top_or_left(1,1)
```

	a	True
	b	True
	c	True
	OR	lambda -> @10
globals	d	False
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack		
heap		
definitions		

	a	True
	b	True
	c	True
globals	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack		
heap		
definitions		


a True
b True
c True
globals
OR lambda -> @10
left lambda -> @4
top_or_left lambda -> @9
up lambda -> @2
p2 lambda -> @4
p1 lambda -> @2
stack
ret False
x 1
y 1
heap
definitions
a True
b True
c True
globals
OR lambda -> @10
left lambda -> @4
top_or_left lambda -> @9
up lambda -> @2
p2 lambda -> @4
p1 lambda -> @2
stack
ret null
x 1
y 1
heap
definitions
a True
b True
c True
globals
OR lambda -> @10
left lambda -> @4
top_or_left lambda -> @9
up lambda -> @2
p2 lambda -> @4
p1 lambda -> @2
ret null
x 1
stack
y 1
ret False
x 1
y 1
heap
definitions

globals	a	True
	b	True
	c	True
	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	1
heap definitions	ret	null
	x	1
	y	1

globals	a	True
	b	True
	c	True
	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	1
heap definitions		

globals	a	True
	b	True
	c	True
	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	1
heap definitions	ret	False
	x	1
	y	1

globals	a	True
	b	True
	c	True
	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	1
heap definitions	ret	null
	x	1
	y	1

	a	True
	b	True
	c	True
globals	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
	p2	lambda -> @4
	p1	lambda -> @2
stack	ret	null
	x	1
	y	1
heap		
definitions		

	a	True
	b	True
	c	True
globals	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack		
heap		
definitions		

	a	True
	b	True
	OR	lambda -> @10
globals	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack		
heap		
definitions		

globals	a	True
	b	True
	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	True
	x	1
	y	0
heap definitions		

globals	a	True
	b	True
	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
heap definitions		

globals	a	True
	b	True
	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
	ret	False
	x	1
	y	0
heap definitions		

globals	a	True
	b	True
	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
	ret	null
	x	1
	y	0
heap		
definitions		

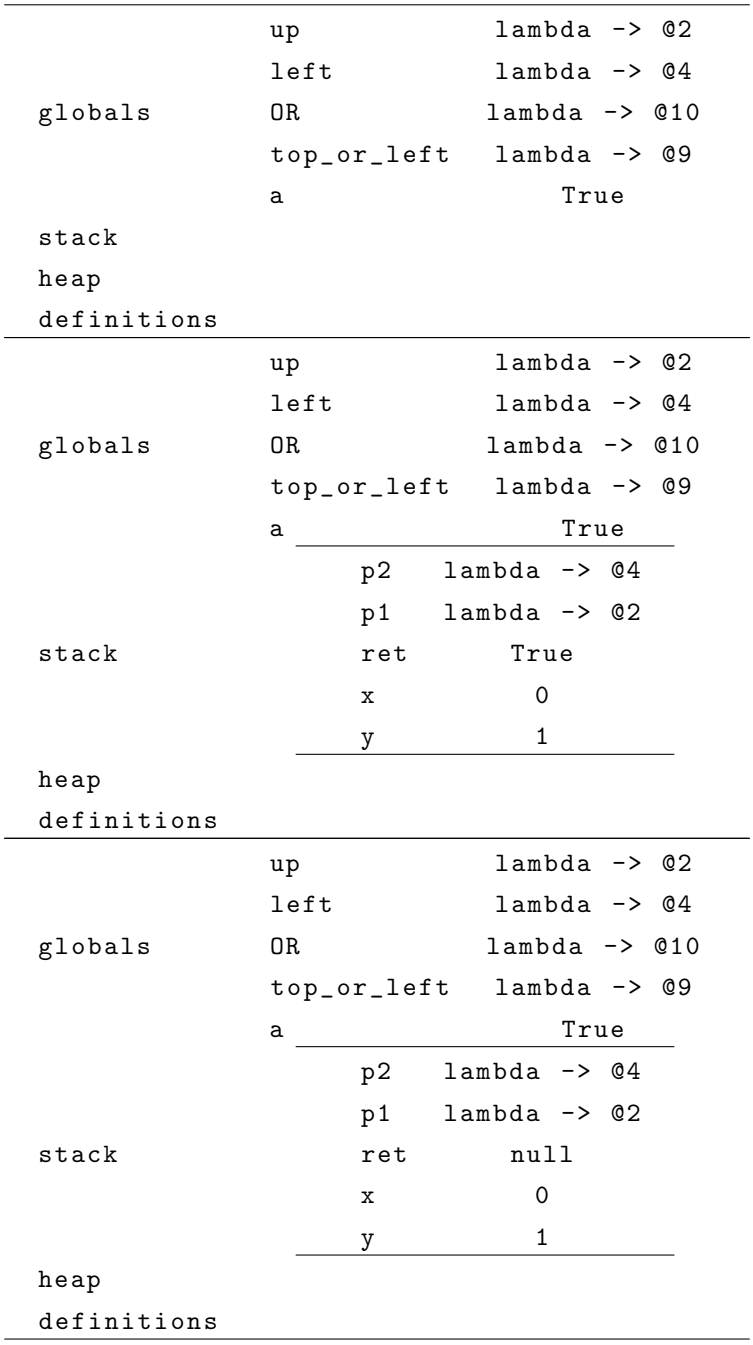
globals	a	True
	b	True
	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
heap		
definitions		

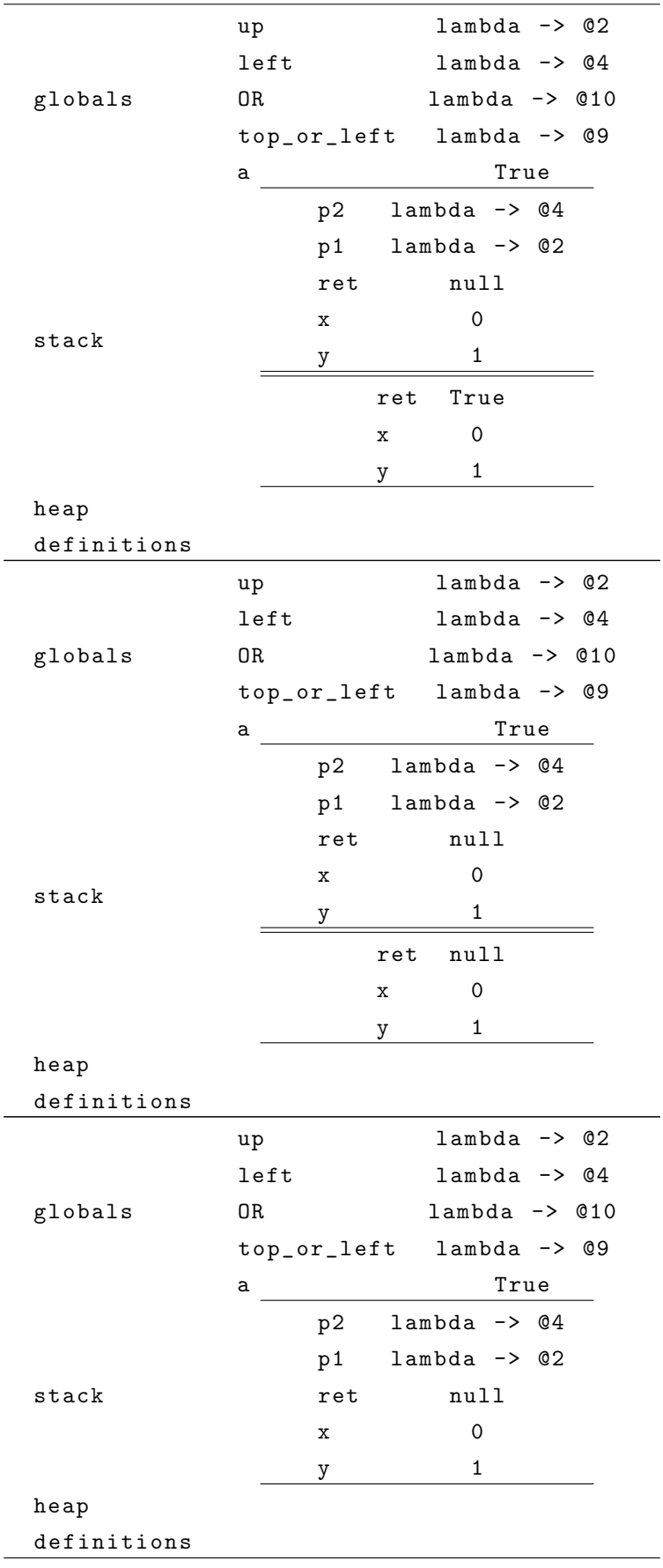
globals	a	True
	b	True
	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
	ret	True
	x	1
	y	0
heap		
definitions		

globals	a	True
	b	True
	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
heap	ret	null
	x	1
	y	0
definitions		

globals	a	True
	b	True
	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
heap		
definitions		

globals	a	True
	b	True
	OR	lambda -> @10
	left	lambda -> @4
	top_or_left	lambda -> @9
	up	lambda -> @2
stack		
heap		
definitions		


up lambda -> @2
left lambda -> @4
globals OR lambda -> @10
top_or_left lambda -> @9
a True
stack
heap
definitions
up lambda -> @2
left lambda -> @4
globals OR lambda -> @10
top_or_left lambda -> @9
a True
p2 lambda -> @4
p1 lambda -> @2
stack ret True
x 0
y 1
heap
definitions
up lambda -> @2
left lambda -> @4
globals OR lambda -> @10
top_or_left lambda -> @9
a True
p2 lambda -> @4
p1 lambda -> @2
stack ret null
x 0
y 1
heap
definitions


globals
up lambda -> @2
left lambda -> @4
OR lambda -> @10
top_or_left lambda -> @9
a True
stack
p2 lambda -> @4
p1 lambda -> @2
ret null
x 0
y 1
ret True
x 0
y 1
heap
definitions
globals
up lambda -> @2
left lambda -> @4
OR lambda -> @10
top_or_left lambda -> @9
a True
stack
p2 lambda -> @4
p1 lambda -> @2
ret null
x 0
y 1
ret null
x 0
y 1
heap
definitions
globals
up lambda -> @2
left lambda -> @4
OR lambda -> @10
top_or_left lambda -> @9
a True
stack
p2 lambda -> @4
p1 lambda -> @2
ret null
x 0
y 1
heap
definitions

globals	up	lambda -> @2
	left	lambda -> @4
	OR	lambda -> @10
	top_or_left	lambda -> @9
stack	a	True
	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	1
	ret	False
	x	0
	y	1
heap definitions		

globals	up	lambda -> @2
	left	lambda -> @4
	OR	lambda -> @10
	top_or_left	lambda -> @9
stack	a	True
	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	1
	ret	null
	x	0
	y	1
heap definitions		

globals	up	lambda -> @2
	left	lambda -> @4
	OR	lambda -> @10
	top_or_left	lambda -> @9
stack	a	True
	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	1
heap definitions		

globals	up	lambda -> @2
	left	lambda -> @4
	OR	lambda -> @10
	top_or_left	lambda -> @9
	a	True
stack		
heap		
definitions		

globals	up	lambda -> @2
	left	lambda -> @4
	OR	lambda -> @10
	top_or_left	lambda -> @9
stack		
heap		
definitions		

globals	up	lambda -> @2
	left	lambda -> @4
	OR	lambda -> @10
	top_or_left	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	True
	x	0
	y	0
heap		
definitions		

globals	up	lambda -> @2
	left	lambda -> @4
	OR	lambda -> @10
	top_or_left	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
heap		
definitions		

globals	up	lambda -> @2
	left	lambda -> @4
	OR	lambda -> @10
	top_or_left	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
heap	ret	True
	x	0
	y	0
definitions		

globals	up	lambda -> @2
	left	lambda -> @4
	OR	lambda -> @10
	top_or_left	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
heap	ret	null
	x	0
	y	0
definitions		

globals	up	lambda -> @2
	left	lambda -> @4
	OR	lambda -> @10
	top_or_left	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
heap		
definitions		

globals	up	lambda -> @2
	left	lambda -> @4
	OR	lambda -> @10
	top_or_left	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
	ret	True
	x	0
	y	0
heap definitions		

globals	up	lambda -> @2
	left	lambda -> @4
	OR	lambda -> @10
	top_or_left	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
	ret	null
	x	0
	y	0
heap definitions		

globals	up	lambda -> @2
	left	lambda -> @4
	OR	lambda -> @10
	top_or_left	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
heap definitions		

globals	up lambda -> @2 left lambda -> @4 OR lambda -> @10 top_or_left lambda -> @9
stack	
heap	
definitions	

globals	up lambda -> @2 left lambda -> @4 OR lambda -> @10
stack	
heap	
definitions	

globals	up lambda -> @2 left lambda -> @4 OR lambda -> @10
stack	ret lambda -> @9 p1 lambda -> @2 p2 lambda -> @4
heap	
definitions	

globals	up lambda -> @2 left lambda -> @4 OR lambda -> @10
stack	ret null p1 lambda -> @2 p2 lambda -> @4
heap	
definitions	

globals	up lambda -> @2 left lambda -> @4 OR lambda -> @10
stack	
heap	
definitions	

globals	up lambda -> @2 left lambda -> @4
stack	
heap	
definitions	

globals	up lambda -> @2
stack	
heap	
definitions	

```
globals
stack
heap
definitions
```

2.2 And

Fill in the missing code blocks

```
left=lambda  x,y:(x==0)
top=lambda  x,y:(y==0)

AND=lambda           ,         :
    lambda           ,         :
      (          (          ,          ) and          (          ,          ))

left_and_top=AND(left,top)

a=left_and_top(0,0)
b=left_and_top(0,1)
c=left_and_top(1,0)
d=left_and_top(1,1)
```

globals	a	True
	b	False
	c	False
	d	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack		
heap		
definitions		

globals	a	True
	b	False
	c	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack		
heap		
definitions		

globals	a	True
	b	False
	c	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	False
	x	1
	y	1
heap		
definitions		

globals	a	True
	b	False
	c	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	1
heap		
definitions		

globals	a	True
	b	False
	c	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	1
	ret	False
	x	1
	y	1
heap		
definitions		

globals	a	True
	b	False
	c	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	1
heap	ret	null
	x	1
	y	1
definitions		

globals	a	True
	b	False
	c	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	1
heap		
definitions		

globals	a	True
	b	False
	c	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	1
heap	ret	False
	x	1
	y	1
definitions		

globals	a	True
	b	False
	c	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	1
heap	ret	null
	x	1
	y	1
definitions		

	a	True
	b	False
	c	False
globals	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
	p2	lambda -> @4
	p1	lambda -> @2
stack	ret	null
	x	1
	y	1
heap		
definitions		

	a	True
	b	False
	c	False
globals	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack		
heap		
definitions		

	a	True
	b	False
globals	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack		
heap		
definitions		

globals	a	True
	b	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	False
	x	1
	y	0
heap definitions		

globals	a	True
	b	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
heap definitions		

globals	a	True
	b	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
	ret	True
	x	1
	y	0
heap definitions		

globals	a	True
	b	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
	ret	null
	x	1
	y	0
heap definitions		

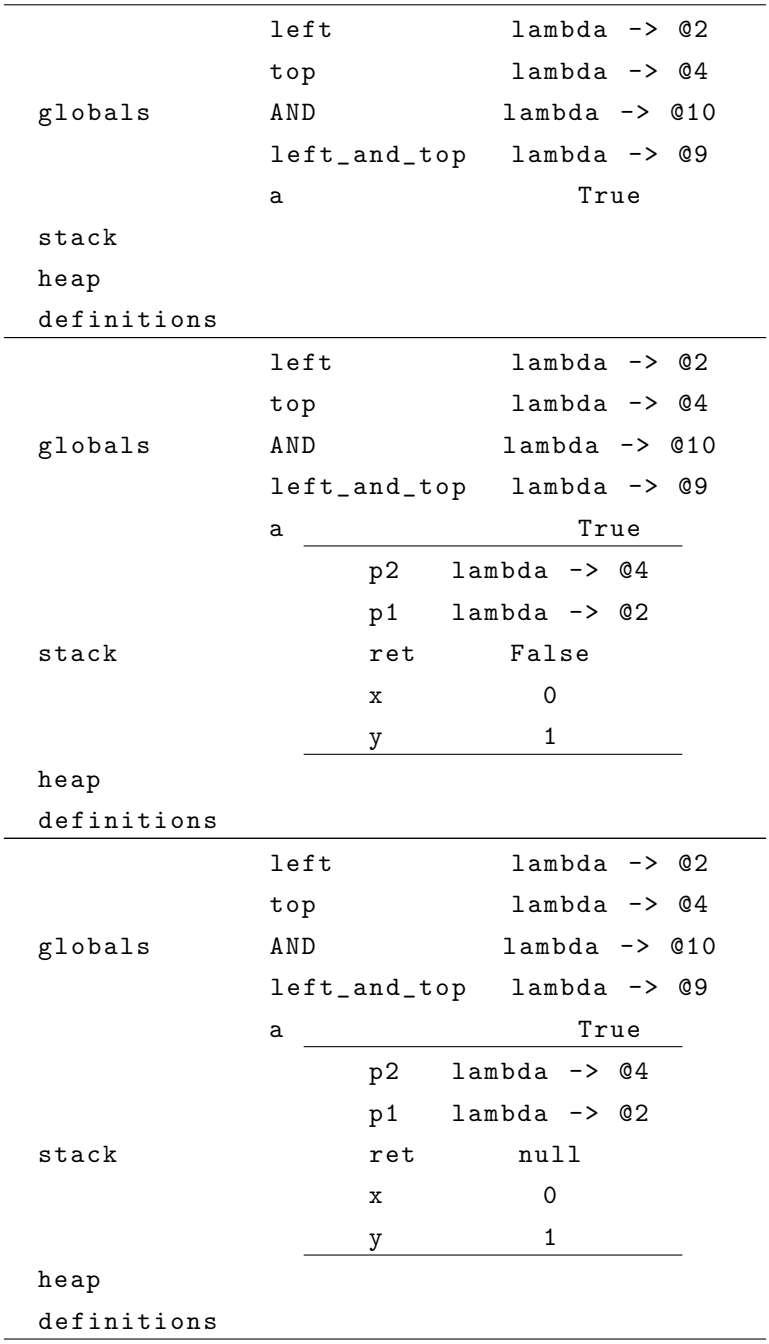
globals	a	True
	b	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
heap definitions		

globals	a	True
	b	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
	ret	False
	x	1
	y	0
heap definitions		

globals	a	True
	b	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
heap	ret	null
	x	1
	y	0
definitions		

globals	a	True
	b	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	1
	y	0
heap		
definitions		

globals	a	True
	b	False
	left	lambda -> @2
	top	lambda -> @4
	left_and_top	lambda -> @9
	AND	lambda -> @10
stack		
heap		
definitions		


globals
left lambda -> @2
top lambda -> @4
AND lambda -> @10
left_and_top lambda -> @9
a True
stack
heap
definitions
globals
left lambda -> @2
top lambda -> @4
AND lambda -> @10
left_and_top lambda -> @9
a True
p2 lambda -> @4
p1 lambda -> @2
ret False
x 0
y 1
stack
heap
definitions
globals
left lambda -> @2
top lambda -> @4
AND lambda -> @10
left_and_top lambda -> @9
a True
p2 lambda -> @4
p1 lambda -> @2
ret null
x 0
y 1
stack
heap
definitions

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
	a	True
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	1
	ret	False
	x	0
	y	1
heap definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
	a	True
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	1
	ret	null
	x	0
	y	1
heap definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
	a	True
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	1
heap definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
	a	True
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	1
heap	ret	True
	x	0
	y	1
definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
	a	True
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	1
heap	ret	null
	x	0
	y	1
definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
	a	True
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	1
heap		
definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
	a	True
stack		
heap		
definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
stack		
heap		
definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	True
	x	0
	y	0
heap		
definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
heap		
definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
	ret	True
	x	0
	y	0
heap definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
	ret	null
	x	0
	y	0
heap definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
heap definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
	ret	True
	x	0
	y	0
heap definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
	ret	null
	x	0
	y	0
heap definitions		

globals	left	lambda -> @2
	top	lambda -> @4
	AND	lambda -> @10
	left_and_top	lambda -> @9
stack	p2	lambda -> @4
	p1	lambda -> @2
	ret	null
	x	0
	y	0
heap definitions		

globals	left lambda -> @2 top lambda -> @4 AND lambda -> @10 left_and_top lambda -> @9
stack	
heap	
definitions	

globals	left lambda -> @2 top lambda -> @4 AND lambda -> @10
stack	
heap	
definitions	

globals	left lambda -> @2 top lambda -> @4 AND lambda -> @10
stack	ret lambda -> @9 p1 lambda -> @2 p2 lambda -> @4
heap	
definitions	

globals	left lambda -> @2 top lambda -> @4 AND lambda -> @10
stack	ret null p1 lambda -> @2 p2 lambda -> @4
heap	
definitions	

globals	left lambda -> @2 top lambda -> @4 AND lambda -> @10
stack	
heap	
definitions	

globals	left lambda -> @2 top lambda -> @4
stack	
heap	
definitions	

globals	left lambda -> @2
stack	
heap	
definitions	

```
globals
stack
heap
definitions
```

2.3 Not

Fill in the missing state blocks.

```
1  def draw_grid (x_dim,y_dim,p):
2    res=""
3    x=0
4    y=0
5    while((y<y_dim)):
6      while((x<x_dim)):
7        if(p(x,y)):
8          res=(res+"#")
9        else:
10         res=(res+" ")
11       x=(x+1)
12     res=(res+"\n")
13     x=0
14     y=(y+1)
15   return res
16
17 NOT=lambda  p:lambda  x,y:(not p(x,y))
18
19 left=lambda  x,y:(x==0)
20 right=NOT(left)
21 res=draw_grid(2,2,right)
```

```
                        NOT     lambda -> @6
                        left    lambda -> @8
  globals               right   lambda -> @5
                        res      " #\n #\n"
  stack
  heap
  definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
res=" #\n #\n"
```

```
                        NOT     lambda -> @6
  globals               left    lambda -> @8
                        right   lambda -> @5
  stack
  heap
  definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                        NOT     lambda -> @6
  globals               left    lambda -> @8
                        right   lambda -> @5
                         ret      " #\n #\n"
                         x_dim         2
                         y_dim         2
  stack                  p       lambda -> @5
                         res      " #\n #\n"
                         x             0
                         y             2
  heap
  definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT     lambda -> @6
globals             left    lambda -> @8
                    right   lambda -> @5
                    ret          null
                    x_dim          2
                    y_dim          2
stack               p        lambda -> @5
                    res       " #\n #\n"
                    x              0
                    y              2
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
                    NOT     lambda -> @6
globals             left    lambda -> @8
                    right   lambda -> @5
                    ret          null
                    x_dim          2
                    y_dim          2
stack               p        lambda -> @5
                    res       " #\n #\n"
                    x              0
                    y              2
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
                    NOT     lambda -> @6
globals             left    lambda -> @8
                    right   lambda -> @5
                    ret          null
                    x_dim          2
                    y_dim          2
stack               p        lambda -> @5
                    res       " #\n #\n"
                    x              0
                    y              1
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT    lambda -> @6
globals             left   lambda -> @8
                    right  lambda -> @5
                    ret       null
                    x_dim       2
                    y_dim       2
stack               p      lambda -> @5
                    res     " #\n #\n"
                    x           2
                    y           1
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT    lambda -> @6
globals             left   lambda -> @8
                    right  lambda -> @5
                    ret       null
                    x_dim       2
                    y_dim       2
stack               p      lambda -> @5
                    res      " #\n #"
                    x           2
                    y           1
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT    lambda -> @6
globals             left   lambda -> @8
                    right  lambda -> @5
                    ret       null
                    x_dim       2
                    y_dim       2
stack               p      lambda -> @5
                    res      " #\n #"
                    x           2
                    y           1
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

	NOT	lambda -> @6
globals	left	lambda -> @8
	right	lambda -> @5
	ret	null
	x_dim	2
	y_dim	2
stack	p	lambda -> @5
	res	
	x	1
	y	1
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

	NOT	lambda -> @6
globals	left	lambda -> @8
	right	lambda -> @5
	ret	null
	x_dim	2
	y_dim	2
stack	p	lambda -> @5
	res	
	x	1
	y	1
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

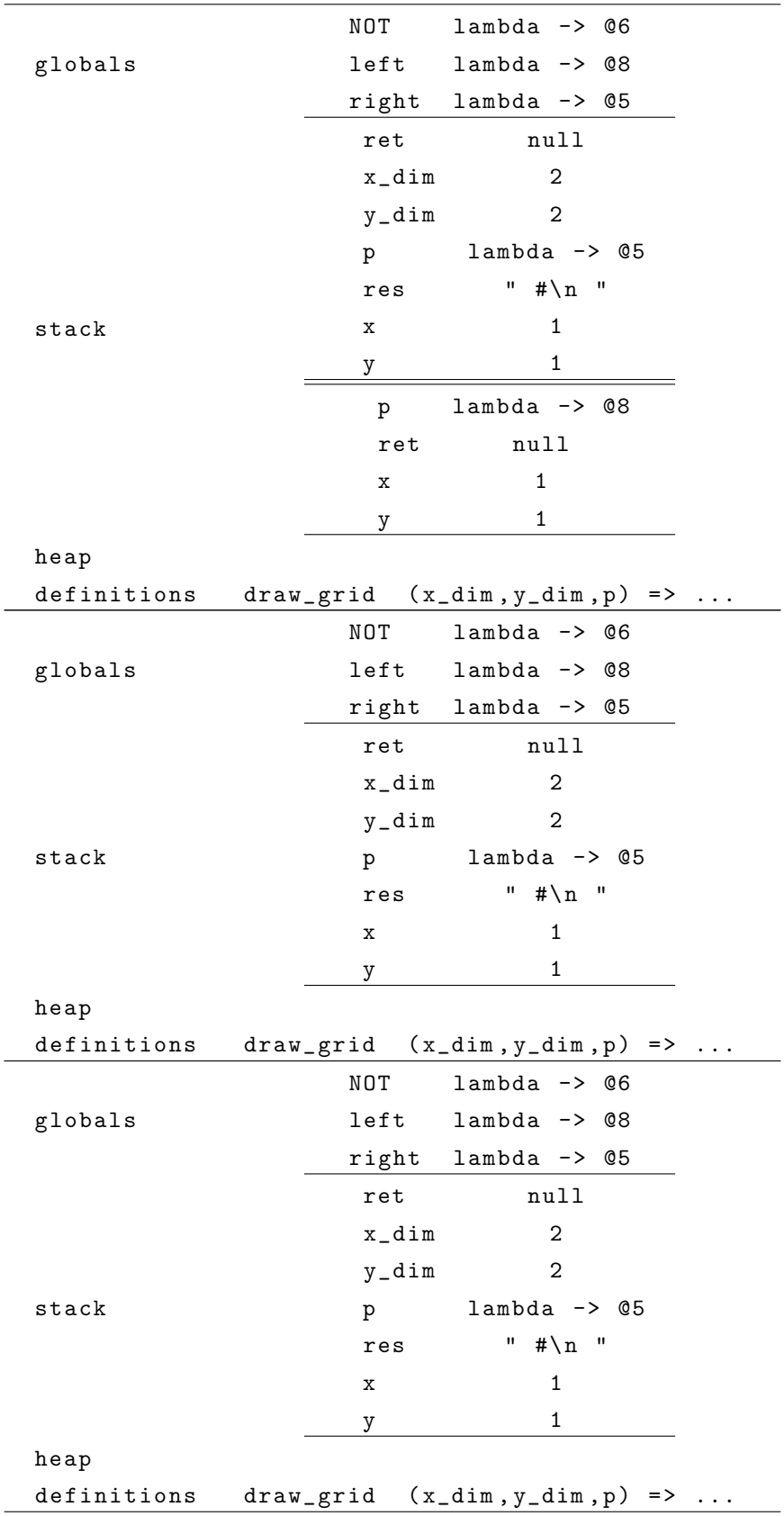
	NOT	lambda -> @6
globals	left	lambda -> @8
	right	lambda -> @5
	ret	null
	x_dim	2
	y_dim	2
stack	p	lambda -> @5
	res	" #\n "
	x	1
	y	1
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	" #\n "
	x	1
	y	1
heap	p	lambda -> @8
	ret	True
	x	1
	y	1
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	" #\n "
	x	1
	y	1
heap	p	lambda -> @8
	ret	null
	x	1
	y	1
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	" #\n "
	x	1
	y	1
	p	lambda -> @8
	ret	null
	x	1
	y	1
	ret	False
	x	1
	y	1
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	" #\n "
	x	1
	y	1
	p	lambda -> @8
	ret	null
	x	1
	y	1
	ret	null
	x	1
	y	1
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...


NOT lambda -> @6
globals
left lambda -> @8
right lambda -> @5
ret null
x_dim 2
y_dim 2
p lambda -> @5
res " #\n "
stack
x 1
y 1
p lambda -> @8
ret null
x 1
y 1
heap
definitions draw_grid (x_dim,y_dim,p) => ...
NOT lambda -> @6
globals
left lambda -> @8
right lambda -> @5
ret null
x_dim 2
y_dim 2
stack
p lambda -> @5
res " #\n "
x 1
y 1
heap
definitions draw_grid (x_dim,y_dim,p) => ...
NOT lambda -> @6
globals
left lambda -> @8
right lambda -> @5
ret null
x_dim 2
y_dim 2
stack
p lambda -> @5
res " #\n "
x 1
y 1
heap
definitions draw_grid (x_dim,y_dim,p) => ...

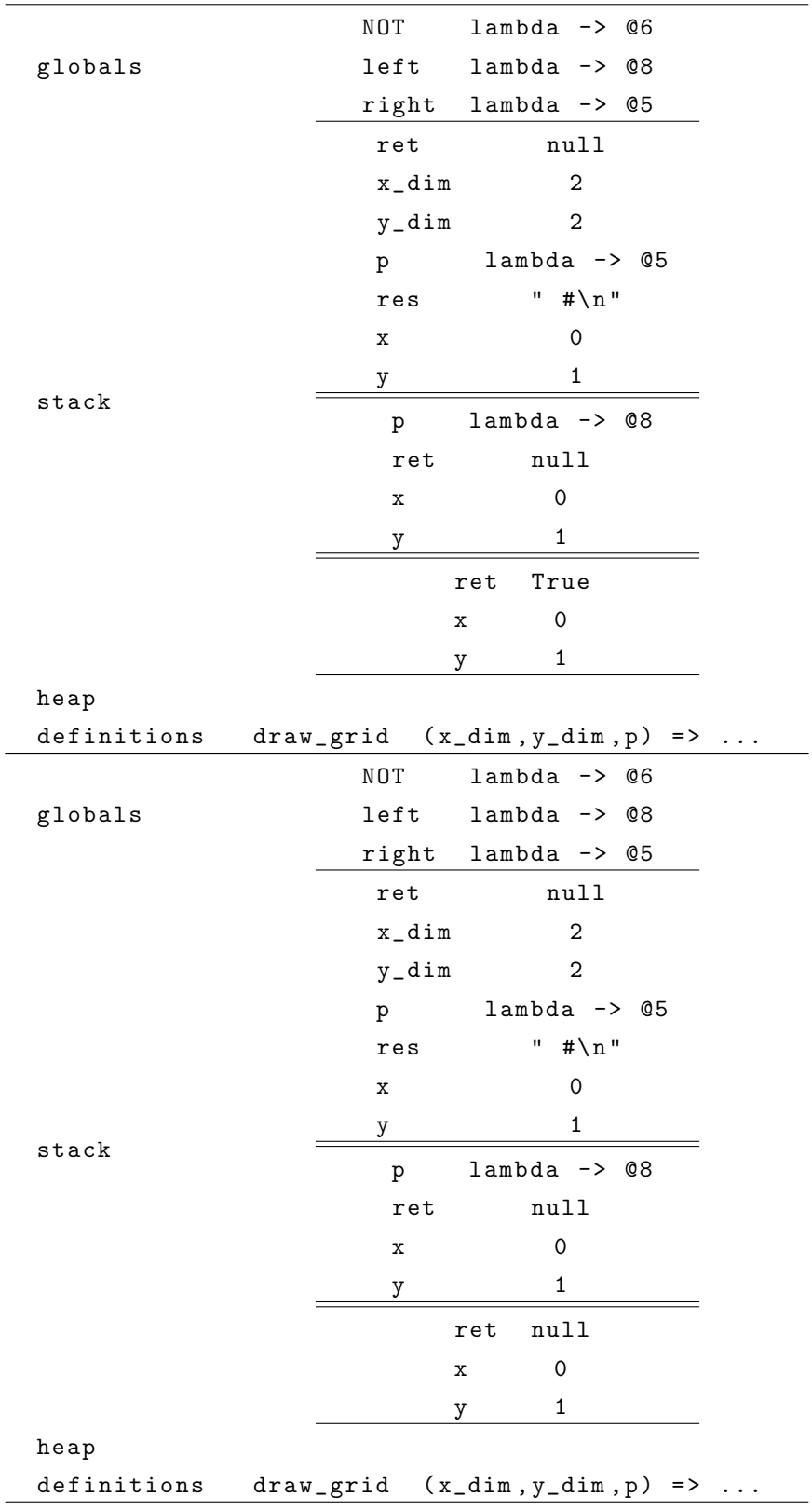
```
                    NOT    lambda -> @6
globals             left   lambda -> @8
                    right  lambda -> @5
                     ret        null
                     x_dim        2
                     y_dim        2
stack                p       lambda -> @5
                     res       " #\n "
                     x            0
                     y            1
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT    lambda -> @6
globals             left   lambda -> @8
                    right  lambda -> @5
                     ret        null
                     x_dim        2
                     y_dim        2
stack                p       lambda -> @5
                     res       " #\n"
                     x            0
                     y            1
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT    lambda -> @6
globals             left   lambda -> @8
                    right  lambda -> @5
                     ret        null
                     x_dim        2
                     y_dim        2
stack                p       lambda -> @5
                     res       " #\n"
                     x            0
                     y            1
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	" #\n"
	x	0
	y	1
heap	p	lambda -> @8
	ret	False
	x	0
	y	1
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	" #\n"
	x	0
	y	1
heap	p	lambda -> @8
	ret	null
	x	0
	y	1
definitions	draw_grid	(x_dim,y_dim,p) => ...


globals
NOT lambda -> @6
left lambda -> @8
right lambda -> @5
ret null
x_dim 2
y_dim 2
p lambda -> @5
res " #\n"
x 0
y 1
stack
p lambda -> @8
ret null
x 0
y 1
ret True
x 0
y 1
heap
definitions draw_grid (x_dim,y_dim,p) => ...
globals
NOT lambda -> @6
left lambda -> @8
right lambda -> @5
ret null
x_dim 2
y_dim 2
p lambda -> @5
res " #\n"
x 0
y 1
stack
p lambda -> @8
ret null
x 0
y 1
ret null
x 0
y 1
heap
definitions draw_grid (x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	" #\n"
	x	0
	y	1
heap	p	lambda -> @8
	ret	null
	x	0
	y	1
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	" #\n"
	x	0
	y	1
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	" #\n"
	x	0
	y	1
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

```
                    NOT     lambda -> @6
globals             left    lambda -> @8
                    right   lambda -> @5
                    ret          null
                    x_dim          2
                    y_dim          2
stack               p        lambda -> @5
                    res         " #\n"
                    x              0
                    y              1
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT     lambda -> @6
globals             left    lambda -> @8
                    right   lambda -> @5
                    ret          null
                    x_dim          2
                    y_dim          2
stack               p        lambda -> @5
                    res         " #\n"
                    x              0
                    y              0
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT     lambda -> @6
globals             left    lambda -> @8
                    right   lambda -> @5
                    ret          null
                    x_dim          2
                    y_dim          2
stack               p        lambda -> @5
                    res         " #\n"
                    x              2
                    y              0
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT    lambda -> @6
globals             left   lambda -> @8
                    right  lambda -> @5
                     ret        null
                     x_dim        2
                     y_dim        2
stack                p       lambda -> @5
                     res         " #"
                     x            2
                     y            0
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
                    NOT    lambda -> @6
globals             left   lambda -> @8
                    right  lambda -> @5
                     ret        null
                     x_dim        2
                     y_dim        2
stack                p       lambda -> @5
                     res         " #"
                     x            2
                     y            0
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
                    NOT    lambda -> @6
globals             left   lambda -> @8
                    right  lambda -> @5
                     ret        null
                     x_dim        2
                     y_dim        2
stack                p       lambda -> @5
                     res
                     x            1
                     y            0
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT     lambda -> @6
globals             left    lambda -> @8
                    right   lambda -> @5
                     ret          null
                     x_dim          2
                     y_dim          2
stack                p        lambda -> @5
                     res
                     x              1
                     y              0
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT     lambda -> @6
globals             left    lambda -> @8
                    right   lambda -> @5
                     ret          null
                     x_dim          2
                     y_dim          2
stack                p        lambda -> @5
                     res           " "
                     x              1
                     y              0
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT     lambda -> @6
globals             left    lambda -> @8
                    right   lambda -> @5
                     ret          null
                     x_dim          2
                     y_dim          2
                     p        lambda -> @5
                     res           " "
stack                x              1
                     y              0
                      p     lambda -> @8
                      ret       True
                      x            1
                      y            0
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	" "
	x	1
	y	0
heap	p	lambda -> @8
	ret	null
	x	1
	y	0
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	" "
	x	1
	y	0
heap	p	lambda -> @8
	ret	null
	x	1
	y	0
	ret	False
	x	1
	y	0
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	" "
	x	1
	y	0
	p	lambda -> @8
	ret	null
	x	1
	y	0
heap	ret	null
	x	1
	y	0
definitions	draw_grid (x_dim,y_dim,p) => ...	

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	" "
	x	1
	y	0
	p	lambda -> @8
	ret	null
	x	1
	y	0
heap		
definitions	draw_grid (x_dim,y_dim,p) => ...	

	NOT	lambda -> @6
globals	left	lambda -> @8
	right	lambda -> @5
	ret	null
	x_dim	2
	y_dim	2
stack	p	lambda -> @5
	res	" "
	x	1
	y	0
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

	NOT	lambda -> @6
globals	left	lambda -> @8
	right	lambda -> @5
	ret	null
	x_dim	2
	y_dim	2
stack	p	lambda -> @5
	res	" "
	x	1
	y	0
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

	NOT	lambda -> @6
globals	left	lambda -> @8
	right	lambda -> @5
	ret	null
	x_dim	2
	y_dim	2
stack	p	lambda -> @5
	res	
	x	0
	y	0
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

	NOT	lambda -> @6
globals	left	lambda -> @8
	right	lambda -> @5
	ret	null
	x_dim	2
	y_dim	2
stack	p	lambda -> @5
	res	
	x	0
	y	0
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

	NOT	lambda -> @6
globals	left	lambda -> @8
	right	lambda -> @5
	ret	null
	x_dim	2
	y_dim	2
stack	p	lambda -> @5
	res	""
	x	0
	y	0
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

	NOT	lambda -> @6
globals	left	lambda -> @8
	right	lambda -> @5
	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	""
stack	x	0
	y	0
	p	lambda -> @8
	ret	False
	x	0
	y	0
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	""
	x	0
	y	0
heap	p	lambda -> @8
	ret	null
	x	0
	y	0
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	""
	x	0
	y	0
heap	p	lambda -> @8
	ret	null
	x	0
	y	0
	ret	True
	x	0
	y	0
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	""
	x	0
	y	0
	p	lambda -> @8
	ret	null
	x	0
	y	0
heap	ret	null
	x	0
	y	0
definitions	draw_grid	(x_dim,y_dim,p) => ...

globals	NOT	lambda -> @6
	left	lambda -> @8
	right	lambda -> @5
stack	ret	null
	x_dim	2
	y_dim	2
	p	lambda -> @5
	res	""
	x	0
	y	0
	p	lambda -> @8
	ret	null
	x	0
	y	0
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

	NOT	lambda -> @6
globals	left	lambda -> @8
	right	lambda -> @5
	ret	null
	x_dim	2
	y_dim	2
stack	p	lambda -> @5
	res	""
	x	0
	y	0
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

	NOT	lambda -> @6
globals	left	lambda -> @8
	right	lambda -> @5
	ret	null
	x_dim	2
	y_dim	2
stack	p	lambda -> @5
	res	""
	x	0
	y	0
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

	NOT	lambda -> @6
globals	left	lambda -> @8
	right	lambda -> @5
	ret	null
	x_dim	2
	y_dim	2
stack	p	lambda -> @5
	res	""
	x	0
	y	0
heap		
definitions	draw_grid	(x_dim,y_dim,p) => ...

```
                    NOT    lambda -> @6
globals             left   lambda -> @8
                    right  lambda -> @5
                     ret        null
                     x_dim       2
                     y_dim       2
stack                p      lambda -> @5
                     res         ""
                     x           0
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT    lambda -> @6
globals             left   lambda -> @8
                    right  lambda -> @5
                     ret        null
                     x_dim       2
stack                y_dim       2
                     p      lambda -> @5
                     res         ""
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT    lambda -> @6
globals             left   lambda -> @8
                    right  lambda -> @5
                     ret        null
                     x_dim       2
stack                y_dim       2
                     p      lambda -> @5
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT    lambda -> @6
globals             left   lambda -> @8
                    right  lambda -> @5
stack
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

```
                    NOT   lambda -> @6
globals             left  lambda -> @8
stack
heap
definitions   draw_grid  (x_dim,y_dim,p) => ...
```

globals	NOT lambda -> @6 left lambda -> @8
stack	ret lambda -> @5 p lambda -> @8
heap	
definitions	draw_grid (x_dim,y_dim,p) => ...

globals	NOT lambda -> @6 left lambda -> @8
stack	ret null p lambda -> @8
heap	
definitions	draw_grid (x_dim,y_dim,p) => ...

globals	NOT lambda -> @6 left lambda -> @8
stack	
heap	
definitions	draw_grid (x_dim,y_dim,p) => ...

globals	NOT lambda -> @6
stack	
heap	
definitions	draw_grid (x_dim,y_dim,p) => ...

globals	
stack	
heap	
definitions	draw_grid (x_dim,y_dim,p) => ...

globals	
stack	
heap	
definitions	