







*ab*  
*ba*

*aaabbb*  
*abb*

*aab*  
*baab*

*ba*  
*baa*

*abab*  
*ababaa*

*aa*  
*a*

*abab*  
*ababaa*

*aaabbb*  
*abb*

*aab*  
*baab*

*ba*  
*baa*

*ab*  
*ba*

*ab*  
*ba*

*aa*  
*a*

abab	aaabbb	aab	ba	ab	ab	aa
ababaa	bb	baab	baa	ba	ba	a

abab	aaabbb	aab	ba	ab	ab	aa
ababaa	bb	baab	baa	ba	ba	a



a  
ab

baa  
aab

then  $f(I)$  would be the *PCP* instance

$a^*$   
 $*a^*b$

$b^*a^*a^*$   
 $*a^*a^*b$

$*a^*$   
 $*a^*b^*$

\$  
\*\$

start	1	#	$K + 1$ halt
start 1	1	#	halt

$i$	
$1$	$i + 1$

$i$	
$\#$	$i + 1$

$$\begin{array}{c} i \\ i+k \end{array}$$

$$\begin{array}{c} i \\ i-k \end{array}$$

$i$	$i \quad 1$	$i \quad \#$
$i + 1$	$i + 2$	$i + 3$

start	1	#	2 halt	1
start 1	1	#	halt	1 2

start	1	#	3 <i>halt</i>	1	2
start 1	1	#	<i>halt</i>	1 2	# 3

start	1	#	7 halt
start 1	1	#	halt
1	2		
1 2	# 3		
4	5	6	
7	3	3	
3	3 1	3 #	
4	5	6	











start	1	1	2	1	#
start 1	1 2	1	# 3	1	#
3 1	#	5	#		
5	#	3	#		
3 #	6				
6	3				
3	4	7 halt			
4	7	halt			

*start 11 21# 31# 5# 3# 6 3 4 7*

start	
start	1

start	
start	1

	1
1	2



start	
start	1

1	
1	2

start	1	1	2
start 1	1 2	1	# 3

start	1	1	2	1	#
start 1	1 2	1	# 3	1	#

start	1	1	2	1	#	
start 1	1 2	1	# 3	1	#	
3	1	#	#	4 1	#	#
# 4	1	#	#	3	#	#
3	#	#	#			
# 4	#	#	#			
4 #	#	#	4 #	#	4 #	4 halt
4	#	#	4	#	4	halt

...	<div> <div>?</div> <div><math>k</math></div> </div>	<div> <div><math>k</math></div> <div><math>N + 1</math></div> </div>	
...	<div> <div>?</div> <div><math>k</math></div> </div>	<div> <div><math>k</math></div> <div><math>N + 1</math></div> </div>	<div> <div><math>N + 1</math> <i>halt</i></div> <div><i>halt</i></div> </div>

$n$
$1 \ n+1$

$n$	$1$
$n+2$	

$n$	$\#$
$n+3$	

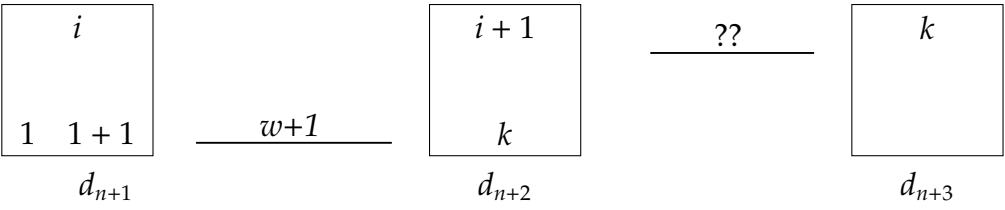














$i$	$1$
$i+2$	

$i$	$\#$
$i+3$	



$i$
$i + 1$





start	1	#
start <i>1</i>	1	#

$i$	
$1$	$i + 1$

$i$	
$\#$	$i + 1$

$$\begin{array}{c} i \\ i+k \end{array}$$

$$\begin{array}{c} i \\ i-k \end{array}$$

$i$
$i + 1$

$i \quad 1$
$i + 2$

$i \quad \#$
$i + 3$



start	1	1	2	1	#	
start 1	1 2	1	# 3	1	#	
3	1	#	#	4 1	#	#
# 4	1	#	#	3	#	#
3	#	#	#			
# 4	#	#	#			
4 #	#	#	4 #	#	4 #	4 halt
4	#	#	4	#	4	halt

$n$
$1 \ n+1$



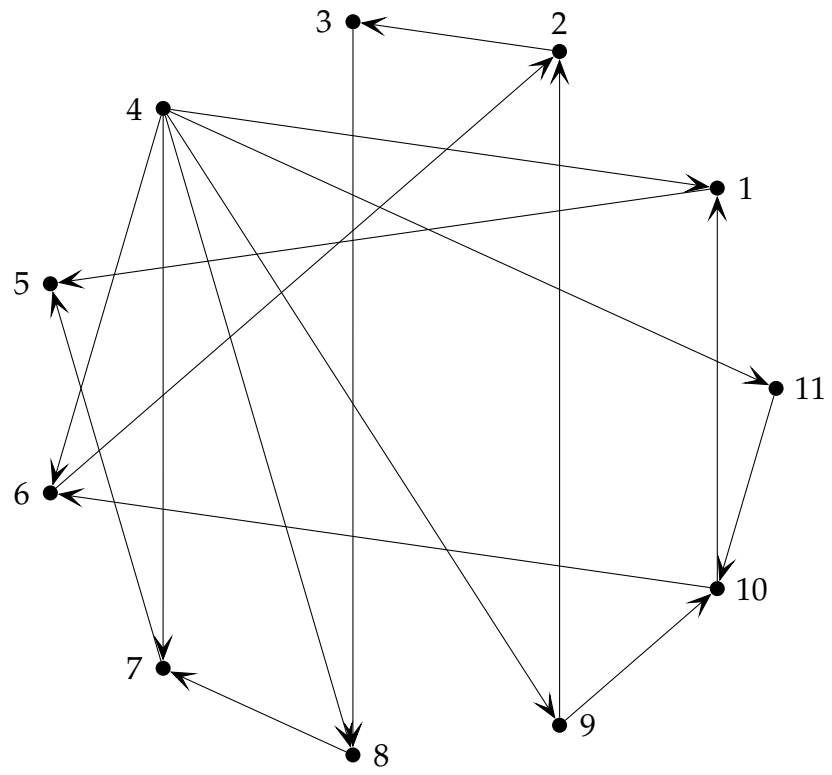
$n$ 1	$n$ #
next(n+2)	next(n+3)

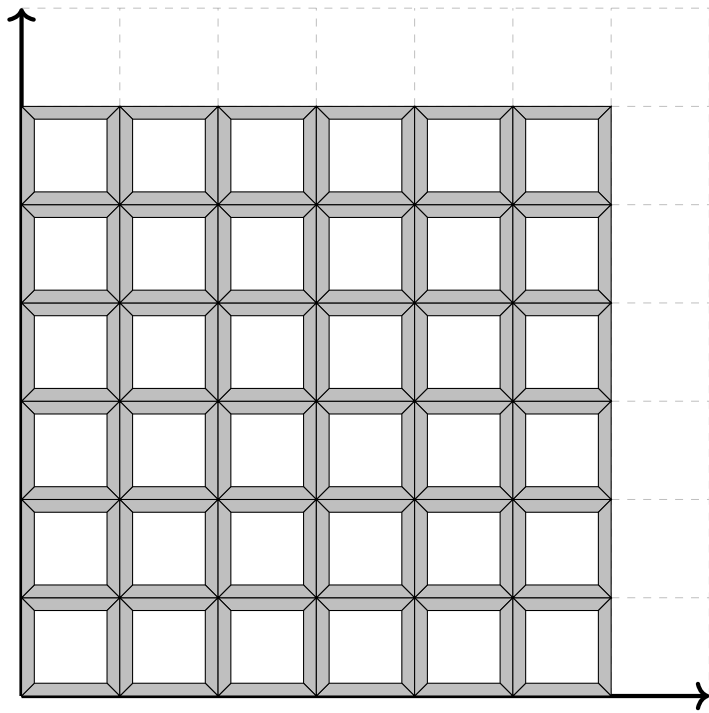


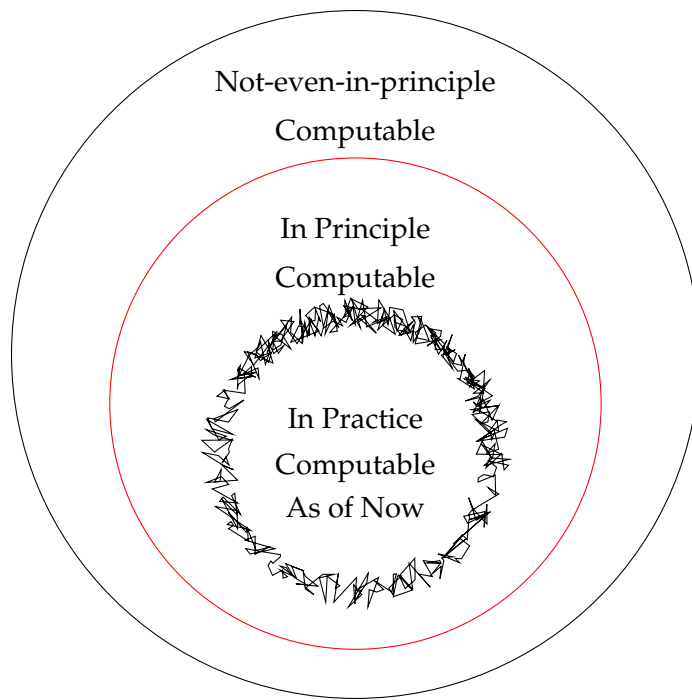
	#	1	$x$	#	1	1	$y$
$x$	#	1	1 $y$	#	1	1	# $z$



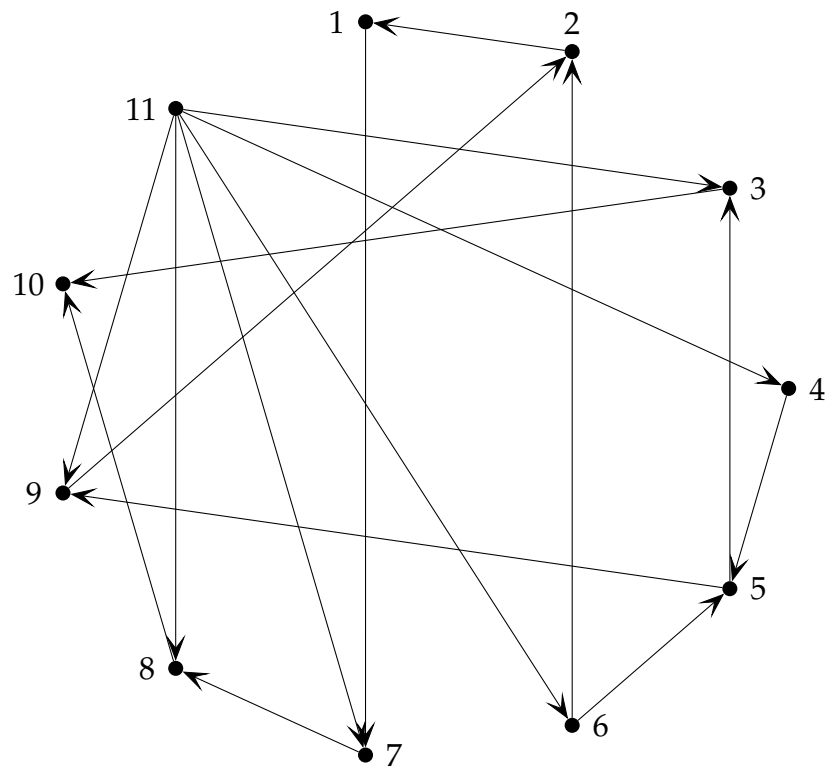
	#	1	$x$ #		$y$
$x$	#	1	$y$	?	1 $z$











a  
ab

baa  
aab

$a \blacksquare$   
 $\blacksquare a \blacksquare b$

$b \blacksquare a \blacksquare a \blacksquare$   
 $\blacksquare a \blacksquare a \blacksquare b$

$\blacksquare a \blacksquare$   
 $\blacksquare a \blacksquare b$

$\$$   
 $\blacksquare \$$