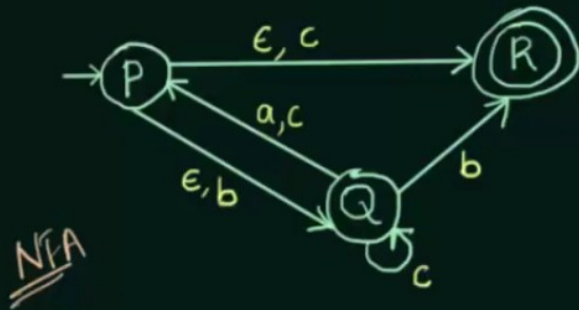


# Epsilon NFA



## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P			
Q			
⊙ R			

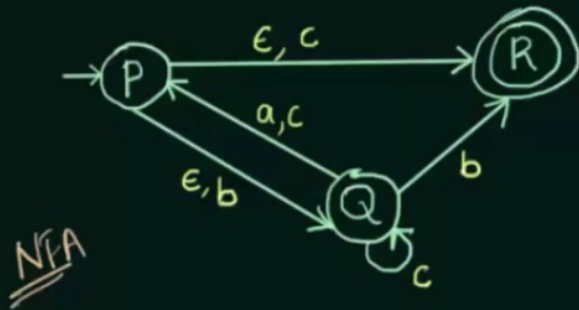
	$\epsilon^*$	a	$\epsilon^*$
P	P		
Q	Q		
R			

	$\epsilon^*$	b	$\epsilon^*$

	$\epsilon^*$	c	$\epsilon^*$

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P			
Q			
Ⓜ R			

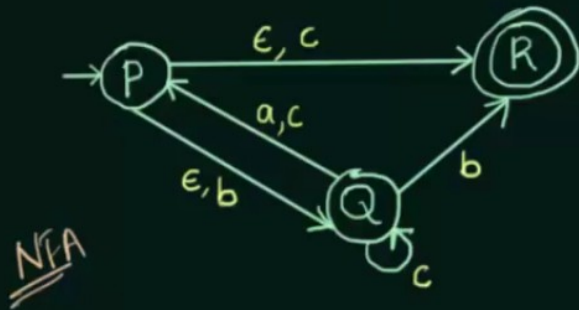
	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	
Q	Q	P	
R	R	$\phi$	

	$\epsilon^*$	b	$\epsilon^*$

	$\epsilon^*$	c	$\epsilon^*$

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P			
Q			
Ⓜ R			

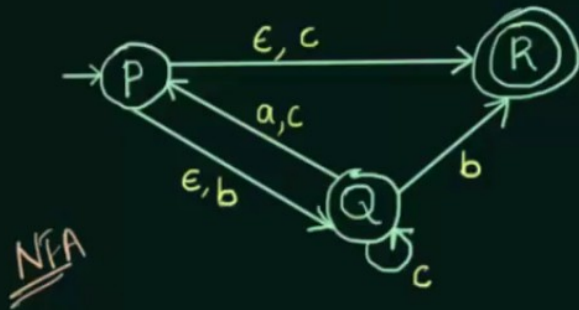
	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	$\phi$
Q	Q	P	$\phi$
R	R	$\phi$	$\phi$

	$\epsilon^*$	b	$\epsilon^*$

	$\epsilon^*$	c	$\epsilon^*$

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P			
Q			
Ⓡ			

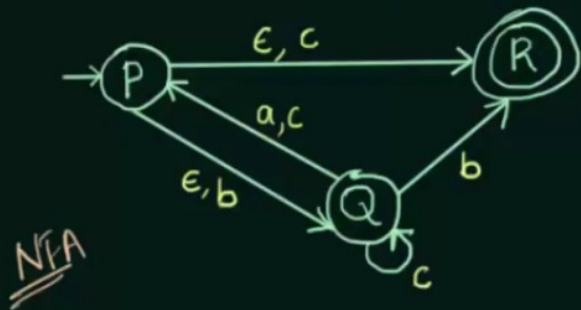
	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	$\phi$
Q	Q	P	P, Q, R
R	R	$\phi$	Q, R

	$\epsilon^*$	b	$\epsilon^*$

	$\epsilon^*$	c	$\epsilon^*$

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P			
Q			
Ⓜ R			

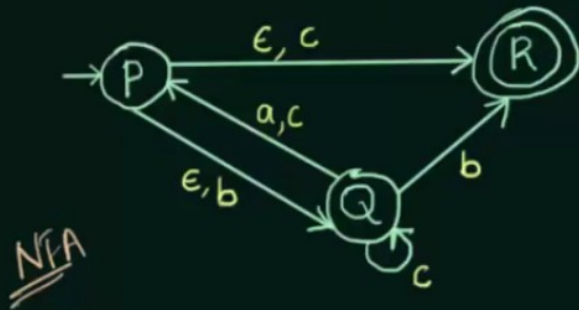
	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	$\phi$
Q	Q	P	$\phi$
R	R	$\phi$	$\phi$

	$\epsilon^*$	b	$\epsilon^*$

	$\epsilon^*$	c	$\epsilon^*$

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P	{P, Q, R}		
Q			
⊙ R			

	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	$\phi$
Q	Q	P	P
R	R	$\phi$	Q
			R
			-

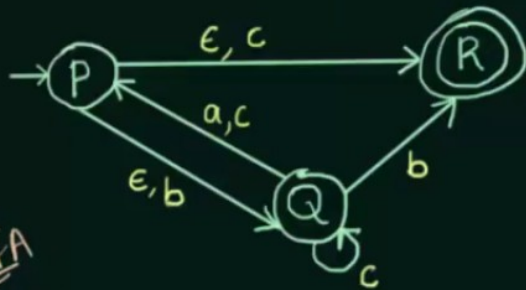
	$\epsilon^*$	b	$\epsilon^*$
P	P		
Q	Q		
R	R		

	$\epsilon^*$	c	$\epsilon^*$



## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



NFA

	a	b	c
→ P	{P, Q, R}		
Q			
Ⓡ			

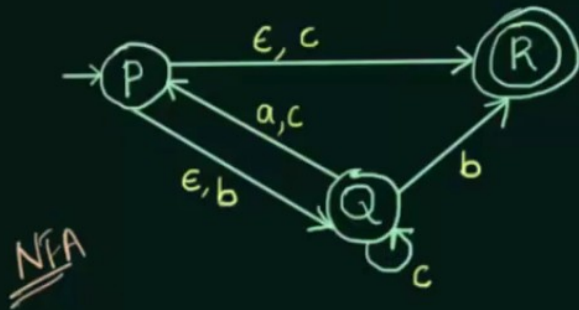
	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	$\phi$
Q	Q	P	P
R	R	$\phi$	Q
			R
			-

	$\epsilon^*$	b	$\epsilon^*$
P	P	Q	
Q	Q	R	
R	R	$\phi$	

	$\epsilon^*$	c	$\epsilon^*$

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P	{P, Q, R}		
Q			
Ⓡ			

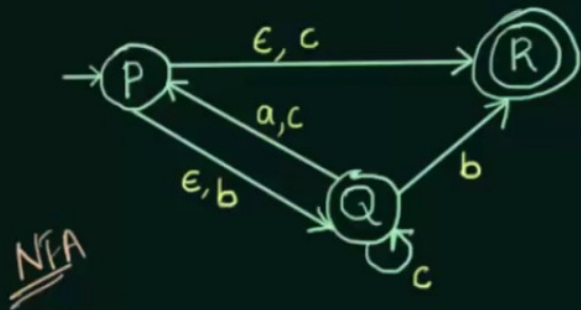
	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	$\phi$
Q	Q	P	P, Q, R
R	R	$\phi$	-

	$\epsilon^*$	b	$\epsilon^*$
P	P	Q	Q
Q	Q	R	
R	R	$\phi$	

	$\epsilon^*$	c	$\epsilon^*$

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P	{P, Q, R}		
Q			
⊙ R			

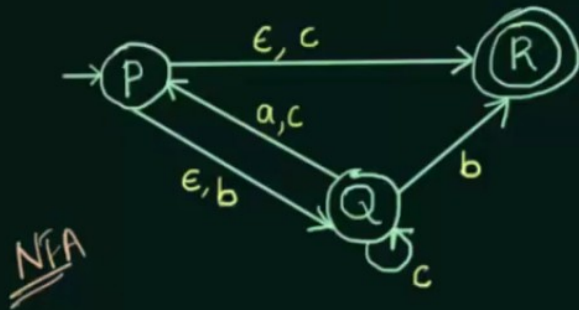
	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	$\phi$
Q	Q	P	P, Q, R
R	R	$\phi$	-

	$\epsilon^*$	b	$\epsilon^*$
P	P	Q	Q
Q	Q	R	R
R	R	$\phi$	-

	$\epsilon^*$	c	$\epsilon^*$

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P	{P, Q, R}	{Q, R}	
Q			
⊙ R			

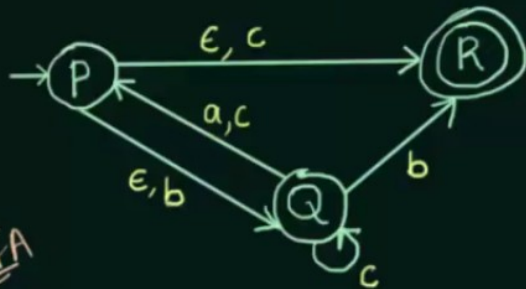
	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	$\phi$
Q	Q	P	P
R	R	$\phi$	Q
			R
			-

	$\epsilon^*$	b	$\epsilon^*$
P	P	Q	Q
Q	Q	R	R
R	R	$\phi$	-

	$\epsilon^*$	c	$\epsilon^*$

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	$\epsilon^*$	a	$\epsilon^*$
P	P Q R	$\phi$ P $\phi$	$\phi$ P Q R -

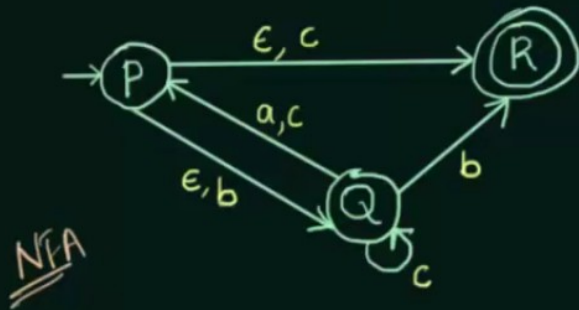
	$\epsilon^*$	b	$\epsilon^*$
P	P Q R	Q R $\phi$	Q R -

	$\epsilon^*$	c	$\epsilon^*$
P	P Q R		

	a	b	c
$\rightarrow$ P	{P, Q, R}	{Q, R}	
Q			
Ⓡ			

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P	{P, Q, R}	{Q, R}	
Q			
⊙ R			

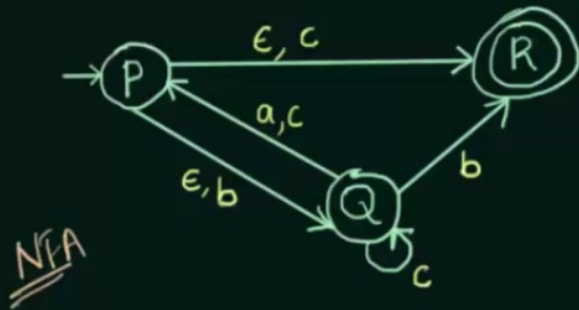
	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	$\phi$
Q	Q	P	P
R	R	$\phi$	Q
			R
			-

	$\epsilon^*$	b	$\epsilon^*$
P	P	Q	Q
Q	Q	R	R
R	R	$\phi$	-

	$\epsilon^*$	c	$\epsilon^*$
P	P	P	
Q	Q	Q	
R	R	$\phi$	

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P	{P, Q, R}	{Q, R}	
Q			
⊙ R			

	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	$\phi$
Q	Q	P	P
R	R	$\phi$	Q
			R
			-

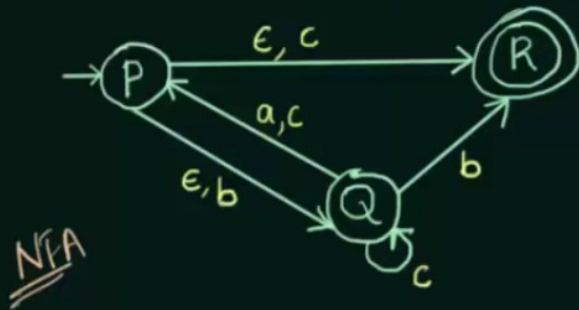
	$\epsilon^*$	b	$\epsilon^*$
P	P	Q	Q
Q	Q	R	R
R	R	$\phi$	-

	$\epsilon^*$	c	$\epsilon^*$
P	P	R	R
Q	Q	Q	Q
R	R	$\phi$	-



## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P	{P, Q, R}	{Q, R}	
Q			
⊙ R			

	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	$\phi$
Q	Q	P	P
R	R	$\phi$	Q
			R
			-

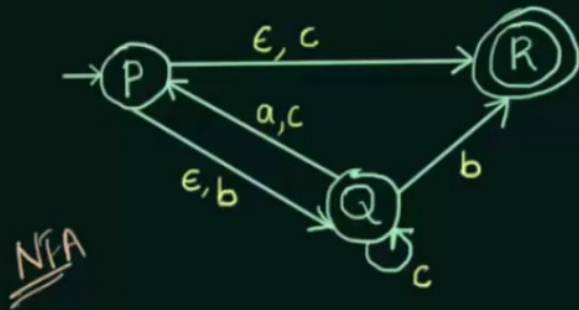
	$\epsilon^*$	b	$\epsilon^*$
P	P	Q	Q
Q	Q	R	R
R	R	$\phi$	-

	$\epsilon^*$	c	$\epsilon^*$
P	P	R	R
Q	Q	Q	Q
R	R	$\phi$	-



## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q			
R			

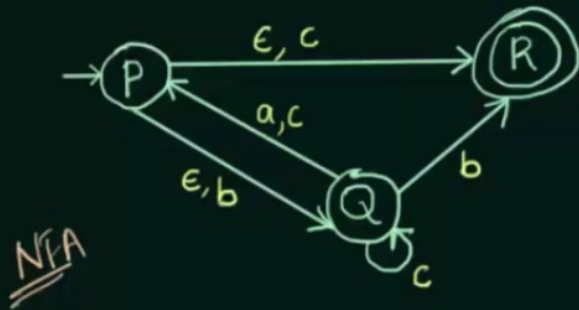
	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	$\phi$
	Q	P	P
	R	$\phi$	Q
			R
			-

	$\epsilon^*$	b	$\epsilon^*$
P	P	Q	Q
	Q	R	R
	R	$\phi$	-

	$\epsilon^*$	c	$\epsilon^*$
P	P	R	R
	Q	Q	Q
	R	$\phi$	-

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}		
Ⓜ R			

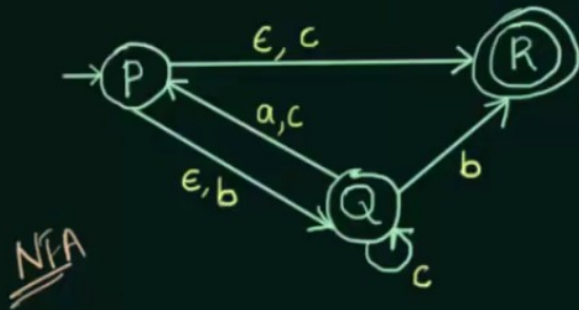
	$\epsilon^*$	a	$\epsilon^*$
P	P Q R	$\phi$ P $\phi$	$\phi$ P Q R -
Q	Q	P	P Q R

	$\epsilon^*$	b	$\epsilon^*$
P	P Q R	Q R $\phi$	Q R -

	$\epsilon^*$	c	$\epsilon^*$
P	P Q R	R Q $\phi$	R Q -

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
$\rightarrow$ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	
R			

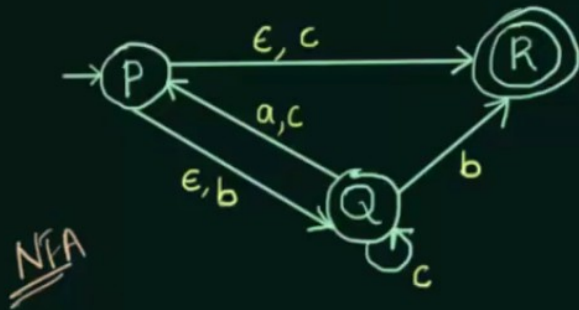
	$\epsilon^*$	a	$\epsilon^*$
P	P	$\phi$	$\phi$
	Q	P	P
	R	$\phi$	Q
			R
Q	Q	P	P
			Q
			R

	$\epsilon^*$	b	$\epsilon^*$
P	P	Q	Q
	Q	R	R
	R	$\phi$	-
Q	Q	R	R

	$\epsilon^*$	c	$\epsilon^*$
P	P	R	R
	Q	Q	Q
	R	$\phi$	-

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{ $\emptyset$ }
Ⓜ R			

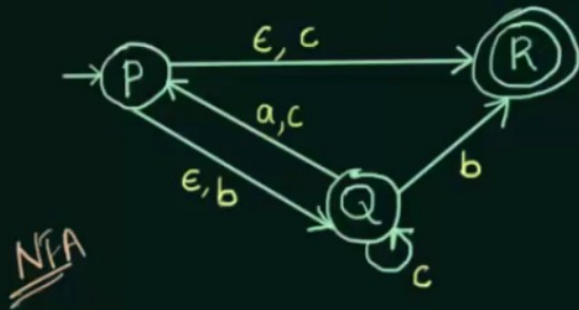
	$\epsilon^*$	a	$\epsilon^*$
P	P	$\emptyset$	$\emptyset$
	Q	P	P
	R	$\emptyset$	Q
			R
Q	Q	P	P
			Q
			R

	$\epsilon^*$	b	$\epsilon^*$
P	P	Q	Q
	Q	R	R
	R	$\emptyset$	-
Q	Q	R	R

	$\epsilon^*$	c	$\epsilon^*$
P	P	R	R
	Q	Q	Q
	R	$\emptyset$	-
Q	Q	Q	Q

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
Ⓜ R			

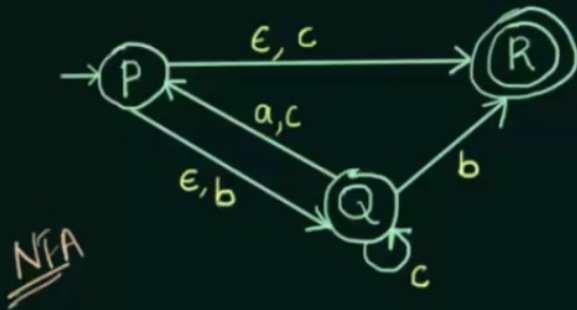
	$\epsilon^*$	a	$\epsilon^*$
P	P Q R	$\phi$ P $\phi$	$\phi$ P Q R -
Q	Q	P	P Q R

	$\epsilon^*$	b	$\epsilon^*$
P	P Q R	Q R $\phi$	Q R -
Q	Q	R	R

	$\epsilon^*$	c	$\epsilon^*$
P	P Q R	R Q $\phi$	R Q -
Q	Q	Q	Q

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
Ⓜ R			

	$\epsilon^*$	a	$\epsilon^*$
P	P Q R	$\phi$ P $\phi$	$\phi$ P Q R -
Q	Q	P	P Q R
R	R	$\phi$	-

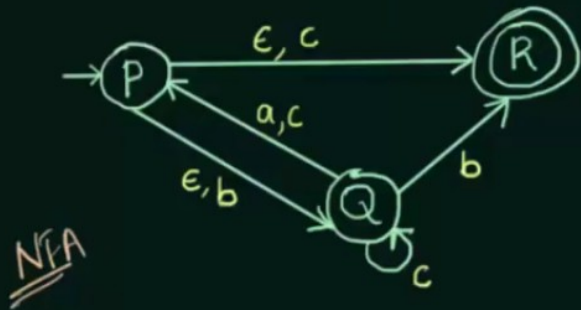
	$\epsilon^*$	b	$\epsilon^*$
P	P Q R	Q R $\phi$	Q R -
Q	Q	R	R

	$\epsilon^*$	c	$\epsilon^*$
P	P Q R	R Q $\phi$	R Q -
Q	Q	Q	Q



## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



	a	b	c
$\rightarrow$ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
Ⓜ R	$\emptyset$		

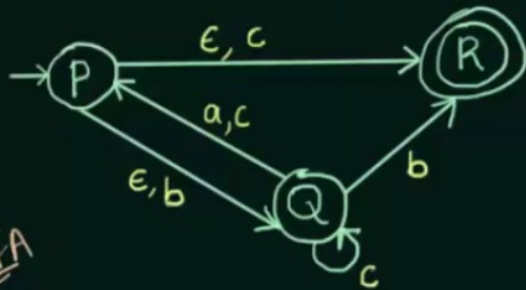
	$\epsilon^*$	a	$\epsilon^*$
P	P Q R	$\emptyset$ P $\emptyset$	$\emptyset$ P Q R -
Q	Q	P	P Q R
R	R	$\emptyset$	-

	$\epsilon^*$	b	$\epsilon^*$
P	P Q R	Q R $\emptyset$	Q R -
Q	Q	R	R
R	R		

	$\epsilon^*$	c	$\epsilon^*$
P	P Q R	R Q $\emptyset$	R Q -
Q	Q	Q	Q

## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



NFA

	a	b	c
$\rightarrow$ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
R	$\emptyset$	$\emptyset$	

	$\epsilon^*$	a	$\epsilon^*$
P	P Q R	$\emptyset$ P $\emptyset$	$\emptyset$ P Q R -
Q	Q R	P $\emptyset$	P Q R
R	R	$\emptyset$	-

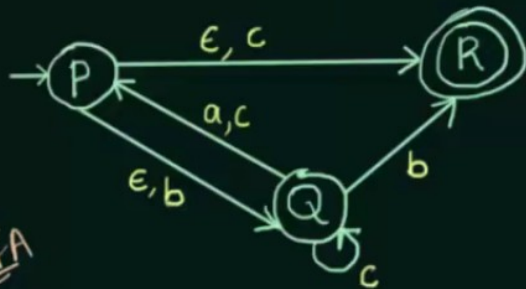
	$\epsilon^*$	b	$\epsilon^*$
P	P Q R	Q R $\emptyset$	Q R -
Q	Q R	R R	R R
R	R	$\emptyset$	-

	$\epsilon^*$	c	$\epsilon^*$
P	P Q R	R Q $\emptyset$	R Q -
Q	Q R	Q Q	Q Q



## Conversion of $\epsilon$ -NFA to NFA -Examples (Part-2)

Convert the following  $\epsilon$ -NFA to its equivalent NFA



NFA

	a	b	c
$\rightarrow$ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
R	$\emptyset$	$\emptyset$	$\emptyset$

	$\epsilon^*$	a	$\epsilon^*$
P	P	$\emptyset$	$\emptyset$
	Q	P	P
	R	$\emptyset$	Q
			R
Q	Q	P	P
			Q
			R
R	R	$\emptyset$	-

	$\epsilon^*$	b	$\epsilon^*$
P	P	Q	Q
	Q	R	R
	R	$\emptyset$	-
Q	Q	R	R
R	R	$\emptyset$	-

	$\epsilon^*$	c	$\epsilon^*$
P	P	R	R
	Q	Q	Q
	R	$\emptyset$	-
Q	Q	Q	Q
R	R	$\emptyset$	-

	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
R	∅	∅	∅

a	Q	P	P Q R
R	R	∅	-

a	Q	P	R
R	R	∅	-

a	Q	P	R
R	R	∅	-

	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
R	∅	∅	∅

a	Q	P	P Q R
R	R	∅	-

a	Q	P	R
R	R	∅	-

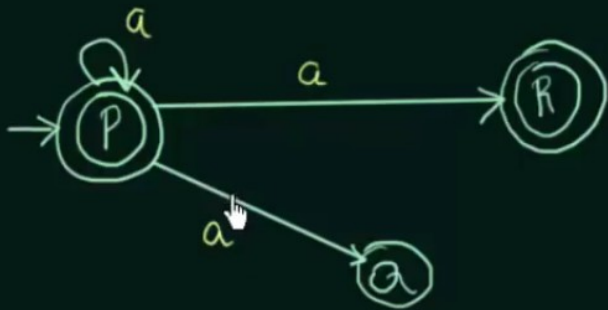
a	Q	P	R
R	R	∅	-

	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
R	∅	∅	∅

a	Q	P	PQR
R	R	∅	-

a	Q	P	R
R	R	∅	-

a	Q	P	R
R	R	∅	-

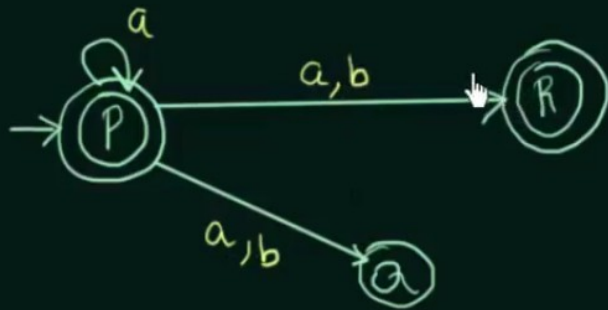


	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
R	∅	∅	∅

a	Q	P	P
Q	R	R	∅
R	R	∅	-

a	Q	P	P
Q	R	R	∅
R	R	∅	-

a	Q	P	P
Q	R	R	∅
R	R	∅	-

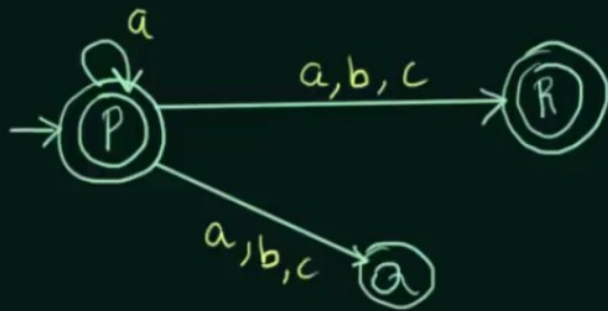


	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
R	∅	∅	∅

a	Q	P	P
Q	R	R	∅
R	R	∅	-

a	Q	P	P
Q	R	R	∅
R	R	∅	-

a	Q	P	P
Q	R	R	∅
R	R	∅	-

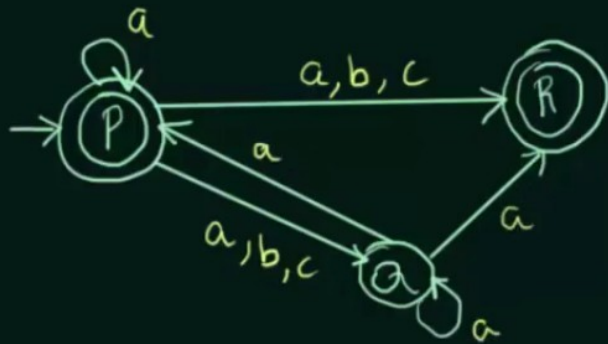


	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
R	∅	∅	∅

a	Q	P	PQR
R	R	∅	-

a	Q	P	R
R	R	∅	-

a	Q	P	R
R	R	∅	-

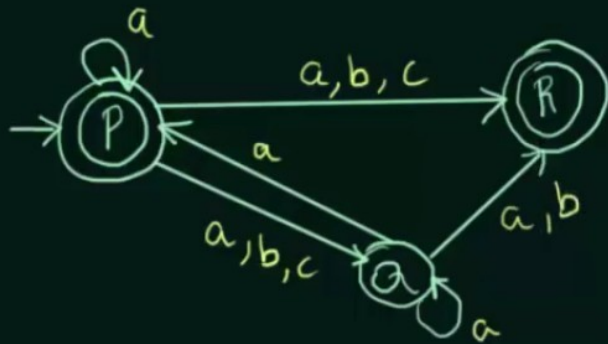


	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
R	∅	∅	∅

a	Q	P	PQR
R	R	∅	-

a	Q	P	R
R	R	∅	-

a	Q	P	R
R	R	∅	-



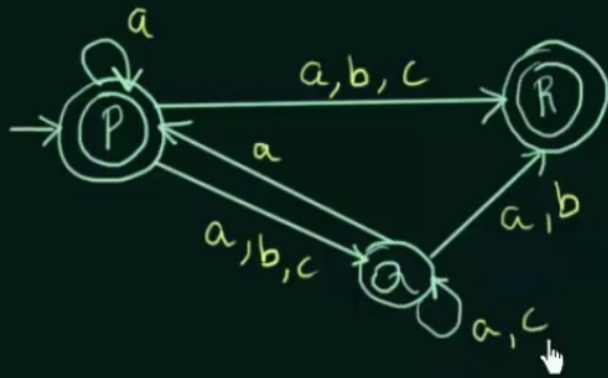


	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
R	∅	∅	∅

a	Q	P	P
Q	R	R	∅
R	∅	-	-

a	Q	P	P
Q	R	R	∅
R	∅	-	-

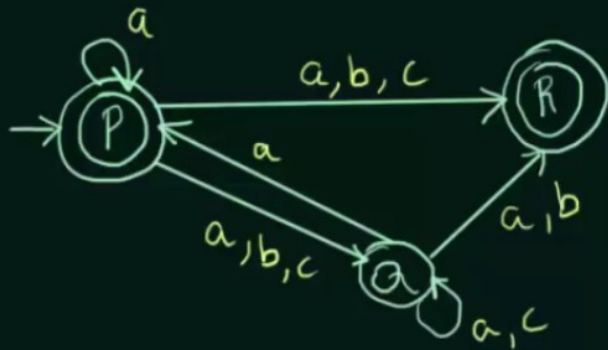
a	Q	P	P
Q	R	R	∅
R	∅	-	-



	a	b	c
→ P	{P, Q, R}	{Q, R}	{Q, R}
Q	{P, Q, R}	{R}	{Q}
R	∅	∅	∅

a	Q	P	P
Q	R	R	∅
R	∅	-	

a	Q	P	P
Q	R	R	∅
R	∅	-	



NFA

• **Questions????**