

## Ardışıl Devre Tasarımı

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sözel problem tanımı  
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Durum diyagramı  
↓  
Ardışıl devre

## Ardışıl Devre Analizi

↓  
Devre var  
↓  
Durum geçiş diyagramı

FF Tanım Bağlantısı

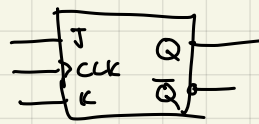
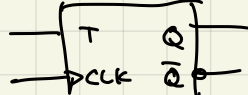
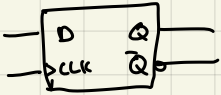
FF Ters tanım bağlantısı

DFF

q: önceki  
Q: sonraki

TFF

JK FF



CLK	D	Q
↑	0	0
↑	1	1
diğer	X	q

CLK	T	Q
↑	0	q
↑	1	$\bar{q}$
diğer	X	q

CLK	J	K	Q
↑	0	0	q
↑	0	1	0
↑	1	0	1
↑	1	1	$\bar{q}$
diğer	X	X	q

sonraki durum  
önceki

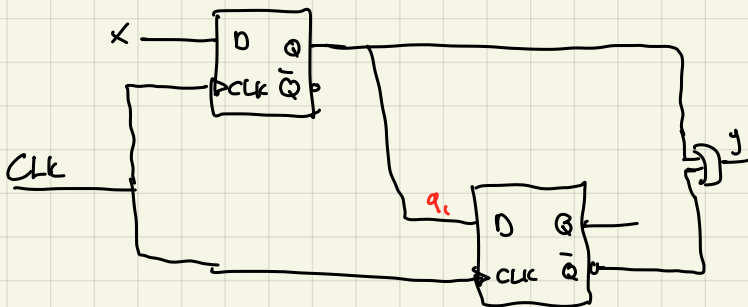
q	Q	D
0	0	0
0	1	1
1	0	0
1	1	1

q	Q	T
0	0	0
0	1	1
1	0	1
1	1	0

q	Q	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

Tüm verilerin elemanları

Senkron → Aynı CLK  
Asenkron → farklı CLK girişleri



X	q <sub>1</sub>	q <sub>2</sub>	Q <sub>1</sub>	Q <sub>2</sub>	y = q <sub>1</sub> + q <sub>2</sub>
0	0	0	0	0	1
0	0	1	0	0	0
0	1	0	0	1	1
0	1	1	0	1	1
1	0	0	1	0	1
1	0	1	1	0	0
1	1	0	1	1	0
1	1	1	1	1	1

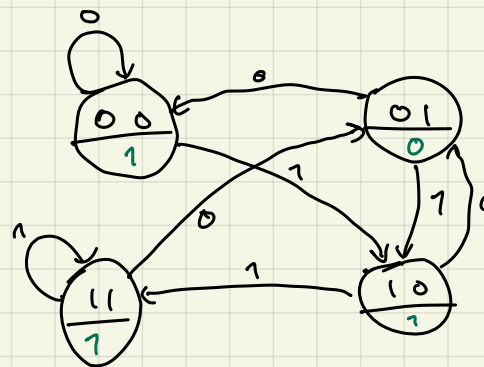
Moore

Mealy

$f(q_i)$

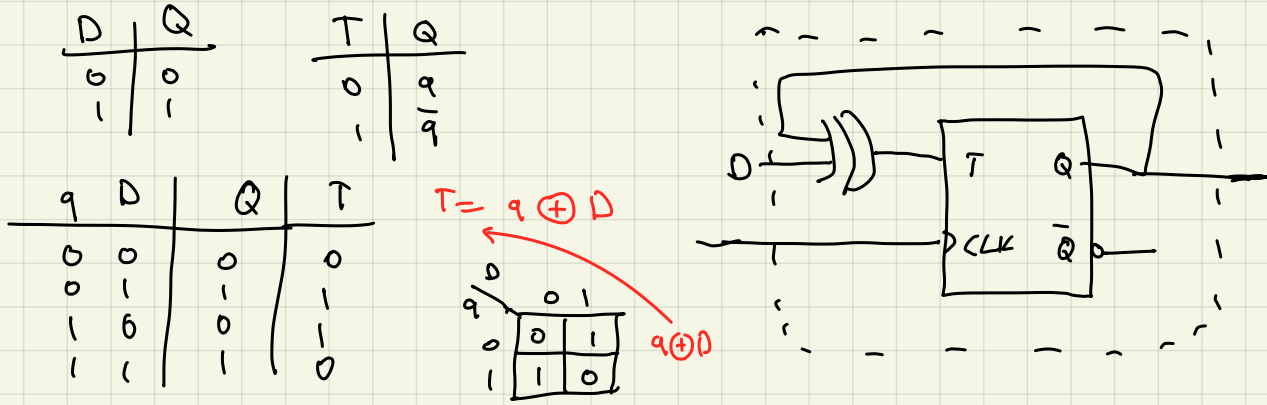
$f(x_i, q_i)$

Cikış sadece duruma bağlı  
eğer girişe bağlı da olsa

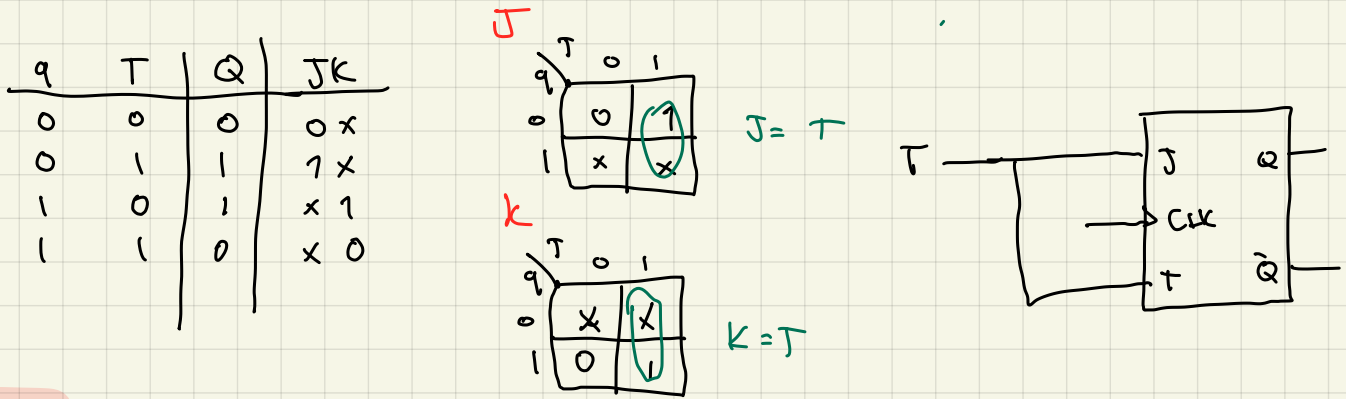


Moore  
Makinesi

## T FF kullanarak DFF gerçekleştiriniz



## JKff kullanarak TFF Gerçekleştiriniz.



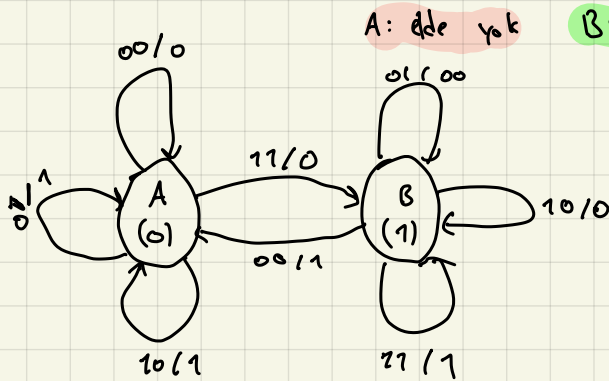
## Örnek

$(X_n \dots X_1 X_0)_2$   
 $(Y_n \dots Y_1 Y_0)_2$

bu sayıların senkron geldiğini varsayarak bu sayıların toplamını DFF kullanarak gerçekleyiniz.

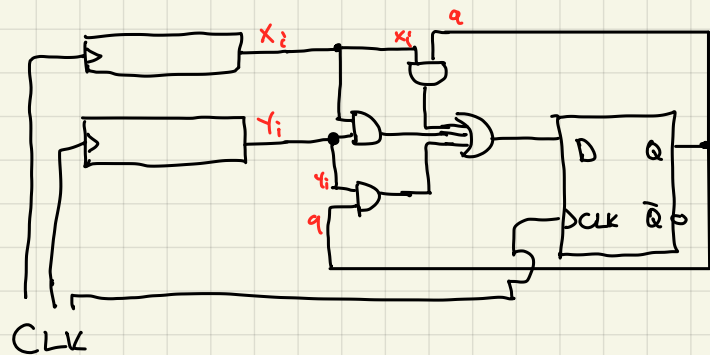
Kaç giriş var?  $\rightarrow 2$  ( $X_i, Y_i$ )  
 kaç farklı durum var?  $\rightarrow 1$  elde  $\rightarrow 1$  1FF yeterli.  
 Durum diyagramı nasıl?  
 Mealy mi Moore mu?  $\rightarrow$  Mealy

$X_i$	$Y_i$	q	Q	Z	D
0	0	0	0	0	0
0	0	1	0	1	0
0	1	0	0	1	0
0	1	1	1	0	1
1	0	0	0	1	0
1	0	1	1	0	1
1	1	0	1	0	1
1	1	1	1	1	1



$X_i, Y_i$	q	Q
00	0	0
01	0	1
11	1	1
10	0	1

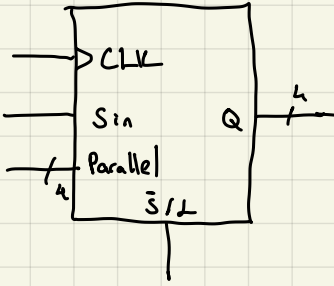
$X_i, Y_i + q, Y_i + q, X_i$



# Register (Yazma)

Seri ve Paralel yazmaları gördük

## Parallel Access Shift Register



CLK	$\bar{S}/L$	$Q(Q_3, Q_2, Q_1, Q_0)$
$\uparrow$	$\bar{S}/L = 1$	$P_3 P_2 P_1 P_0$
$\uparrow$	$\bar{S}/L = 0$	$Sin q_3 q_2 q_1$ (sağ öteleme)

Shift ya da load olduğunu anlıyoruz

Senkron Asenkron Sayıcı gördük

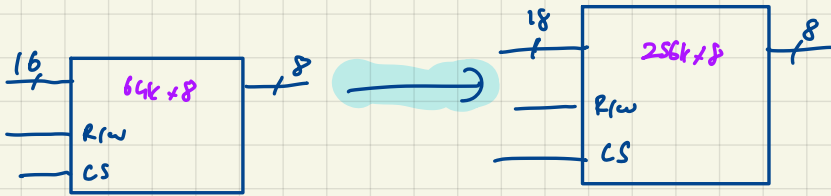
ROM PAL PLA örnekleri  
Slaytta

## Making Larger Memories

**ÖR** 64k x 8 kapasitesindeki SRAM bloklarını kullanarak 256k x 8 kapasitesindeki RAM bloğunu tasarlıyoruz.

$$64k = 64 \cdot 2^{10} = 2^{16}$$

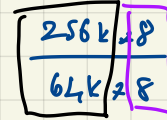
$A_0 - A_{15} \rightarrow 16$  adres ucu  
 $D_0 - D_7 \rightarrow 8$  data



$$(\log_2 256k) = 2^8 \cdot 2^{10} = 2^{18}$$

kac SRAM gerekir?

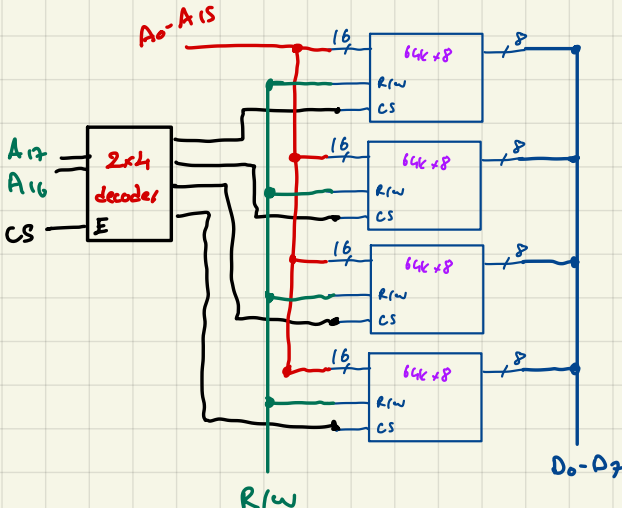
Veri yolu genişletmeye ihtiyac yok



4 adet SRAM'i kapasite genişletme yönünde kullanmalıyız.

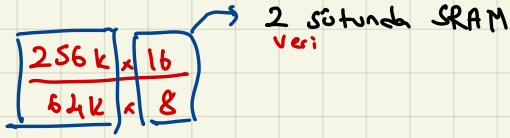
Bu 4 blok aynı anda seçilmemeli

2x4 decoder

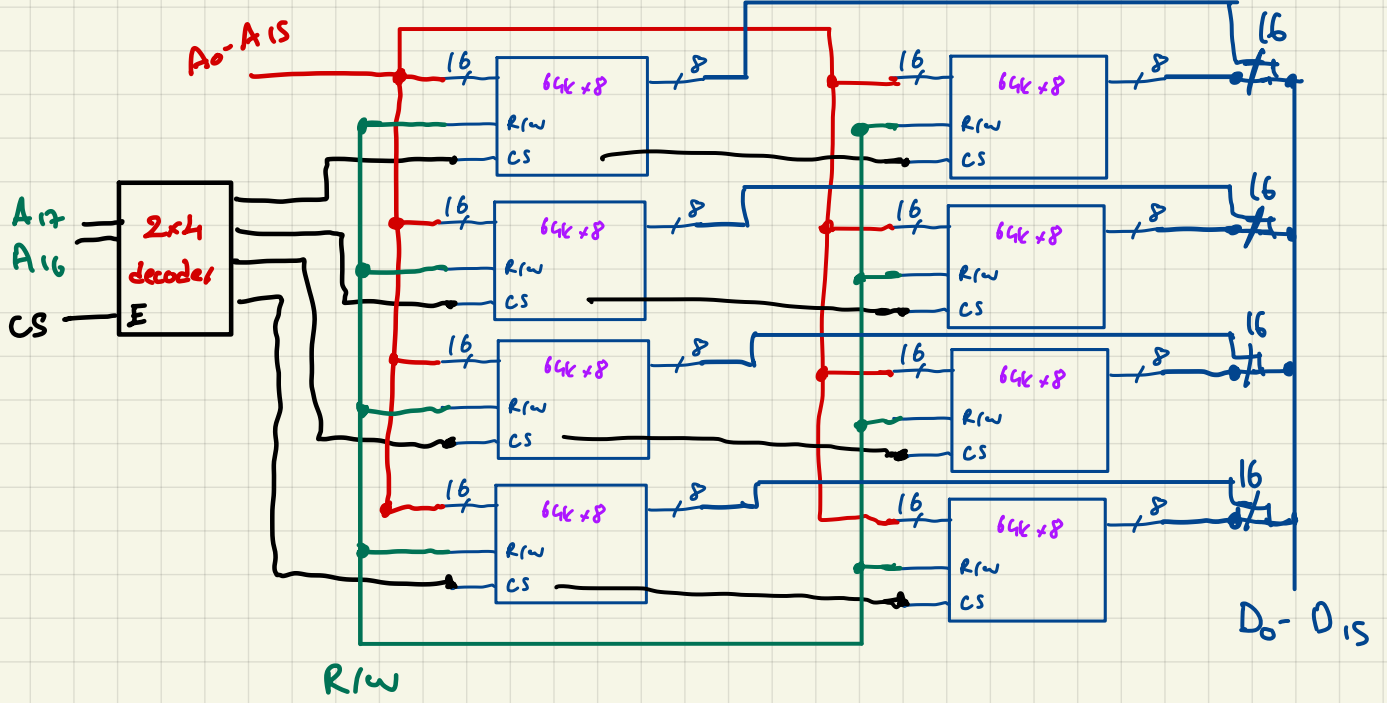


## ÖRNEK

64x8 SRAM bloklarını kullanarak 256x16'lık kapasiteli RAM bloğu tasarlayınız.



4 satırda SRAM  
Kapasite genişletme

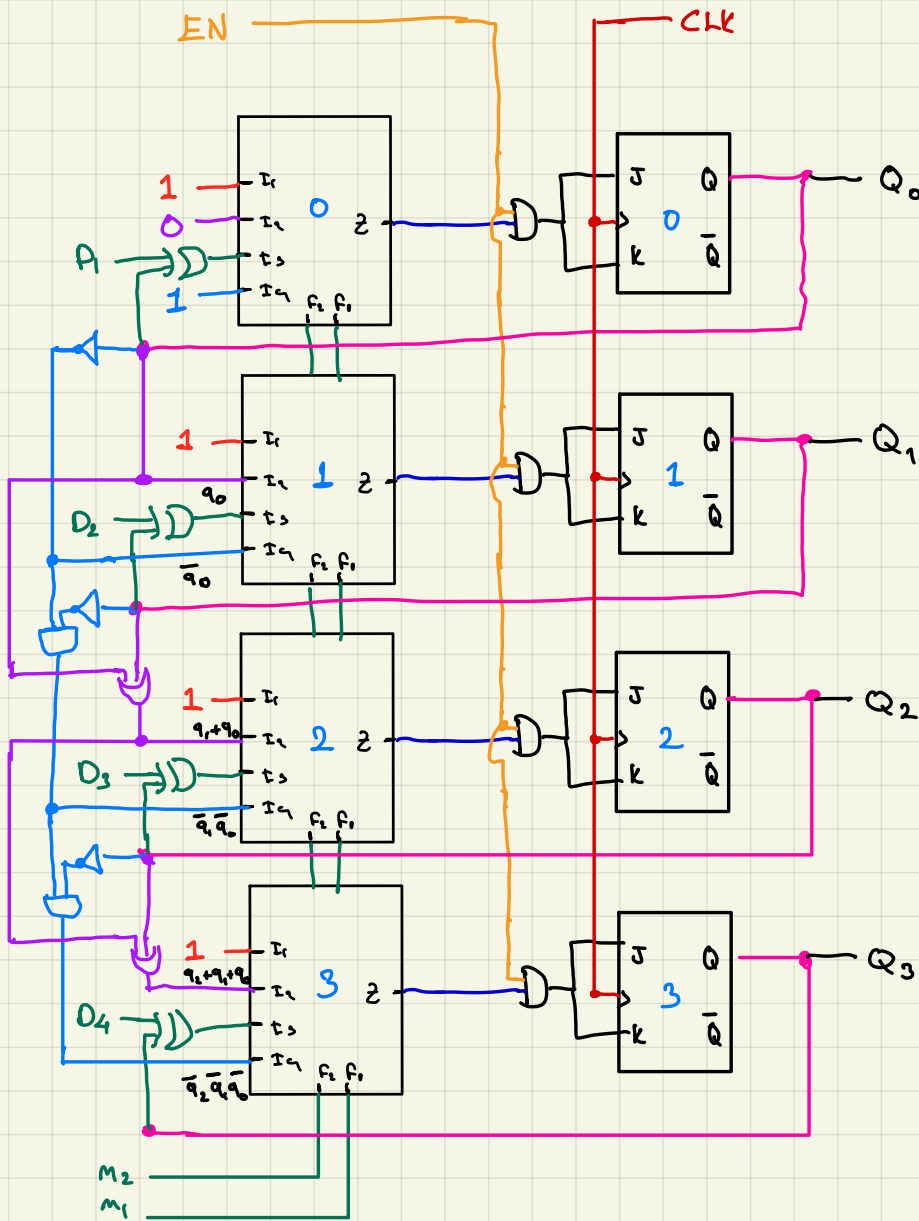


ÖDEV

1. Soru Cevabı ↓

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*[Handwritten signature]*



I<sub>2</sub>

$q_3$	$q_2$	$q_1$	$q_0$	$Q_3$	$Q_2$	$Q_1$	$Q_0$	$JK_3$	$JK_2$	$JK_1$	$JK_0$
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1	1	1	1	0
0	0	1	0	1	1	1	0	1	1	0	0
0	0	1	1	1	1	0	1	1	1	0	0
0	1	0	0	1	1	0	0	1	0	0	0
0	1	0	1	1	0	1	1	1	1	0	0
0	1	1	0	1	0	1	0	1	1	0	0
0	1	1	1	1	0	0	1	1	1	0	0
1	0	0	0	1	0	0	0	0	0	0	0
1	0	0	1	0	1	1	1	1	1	1	0
1	0	1	0	0	1	1	0	1	1	0	0
1	0	1	1	0	1	0	1	1	1	0	0
1	1	0	0	0	1	0	0	1	0	0	0
1	1	0	1	0	0	1	1	1	1	0	0
1	1	1	0	0	0	1	0	1	1	0	0
1	1	1	1	0	0	0	1	1	1	1	0

$JK_3$

$q_3 \backslash q_2 q_1 q_0$	00	01	11	10
00	0	1	1	1
01	1	1	1	1
11	1	1	1	1
10	0	1	1	1

$q_2 + q_1 + q_0$

$JK_2$

$q_3 \backslash q_2 q_1 q_0$	00	01	11	10
00	0	1	1	1
01	0	1	1	1
11	0	1	1	1
10	0	1	1	1

$q_1 + q_0$

$JK_1$

$q_3 \backslash q_2 q_1 q_0$	00	01	11	10
00	0	1	1	0
01	0	1	1	0
11	0	1	1	0
10	0	1	1	0

$q_0$

$JK_0$

$q_3 \backslash q_2 q_1 q_0$	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	0	0	0	0
10	0	0	0	0

0

I<sub>3</sub>

D <sub>i</sub>	q	Q	JK
0	0	0	0x→0
0	1	0	1x→1
1	0	1	x1→1
1	1	1	x0→0

JK = D<sub>i</sub> ⊕ q

don't care durumlarını  
yanındaki giriş neyse ona  
göre aldım

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I<sub>4</sub>

q <sub>3</sub> q <sub>2</sub> q <sub>1</sub> q <sub>0</sub>	Q <sub>3</sub> Q <sub>2</sub> Q <sub>1</sub> Q <sub>0</sub>	JK <sub>3</sub>	JK <sub>2</sub>	JK <sub>1</sub>	JK <sub>0</sub>
0 0 0 0	1 1 1 1	1	1	1	1
0 0 0 1	0 0 0 0	0	0	0	1
0 0 1 0	0 0 0 1	0	0	1	1
0 0 1 1	0 0 1 0	0	0	0	1
0 1 0 0	0 0 1 1	0	1	1	1
0 1 0 1	0 1 0 0	0	0	0	1
0 1 1 0	0 1 0 1	0	0	1	1
0 1 1 1	0 1 1 0	0	0	0	1
1 0 0 0	0 1 1 1	1	1	1	1
1 0 0 1	1 0 0 0	0	0	0	1
1 0 1 0	1 0 0 1	0	0	1	1
1 0 1 1	1 0 1 0	0	0	0	1
1 1 0 0	1 0 1 1	0	1	1	1
1 1 0 1	1 1 0 0	0	0	0	1
1 1 1 0	1 1 0 1	0	0	1	1
1 1 1 1	1 1 1 0	0	0	0	1

JK<sub>3</sub>

q <sub>3</sub> q <sub>2</sub>	00	01	11	10
00	1			
01				
11				
10	1			

$$JK_3 = \overline{q_2} \overline{q_1} \overline{q_0}$$

JK<sub>2</sub>

q <sub>3</sub> q <sub>2</sub>	00	01	11	10
00	1			
01	1			
11	1			
10	1			

$$JK_2 = \overline{q_1} \overline{q_0}$$

JK<sub>1</sub>

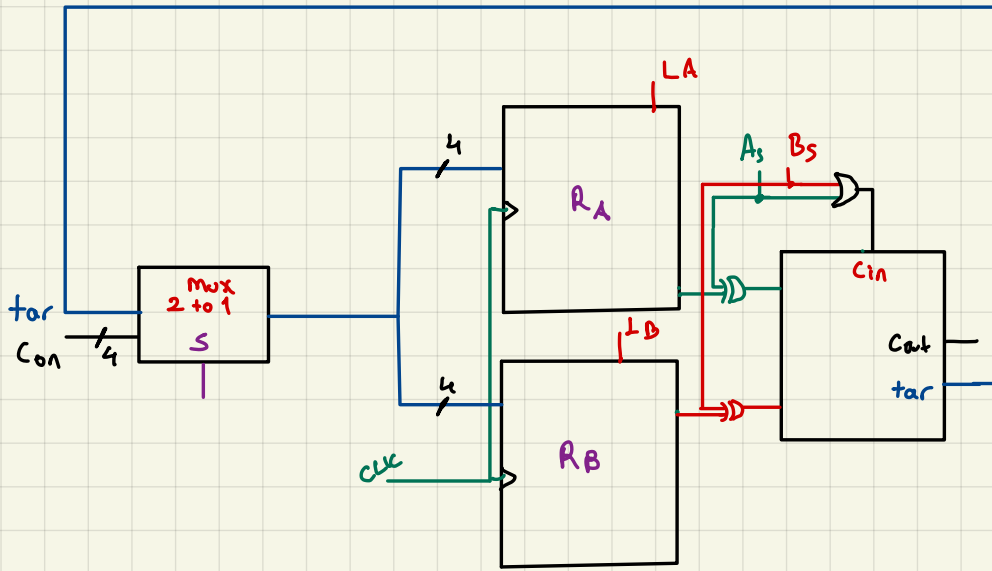
q <sub>3</sub> q <sub>2</sub>	00	01	11	10
00	1			1
01	1			1
11	1			1
10	1			1

$$JK_1 = \overline{q_0}$$

JK<sub>0</sub>

q <sub>3</sub> q <sub>2</sub>	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	1	1	1	1
10	1	1	1	1

$$JK_0 = 1$$



2 clock cycle'da  
yapılır

Adder / Subtractor yerine  
Adder kullanılır

Muhammed Nasir Sabir

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*(Signature)*

$\overline{src}$	$S = A + 0, A_5 = 0, B_5 = 0$	$0 + B, A_5 = 0, B_5 = 0$
$\overline{src} + 1$	$S = A + 0, A_5 = 1, B_5 = 0$	$0 + B, A_5 = 0, B_5 = 1$
$\overline{src}$	$S = A + (1), A_5 = 1, B_5 = 1$	$(1) + B, A_5 = 1, B_5 = 1$
$src + 1$	$S = A + (1), A_5 = 0, B_5 = 0$	$(1) + B, A_5 = 0, B_5 = 0$
$src - 1$	$S = A + (1), A_5 = 0, B_5 = 1$	$(1) + B, A_5 = 1, B_5 = 0$
$A + B$	$S = A + B, A_5 = 0, B_5 = 0$	
$A - B$	$S = A + B, A_5 = 0, B_5 = 1$	
$B - A$	$S = B + A, A_5 = 1, B_5 = 0$	



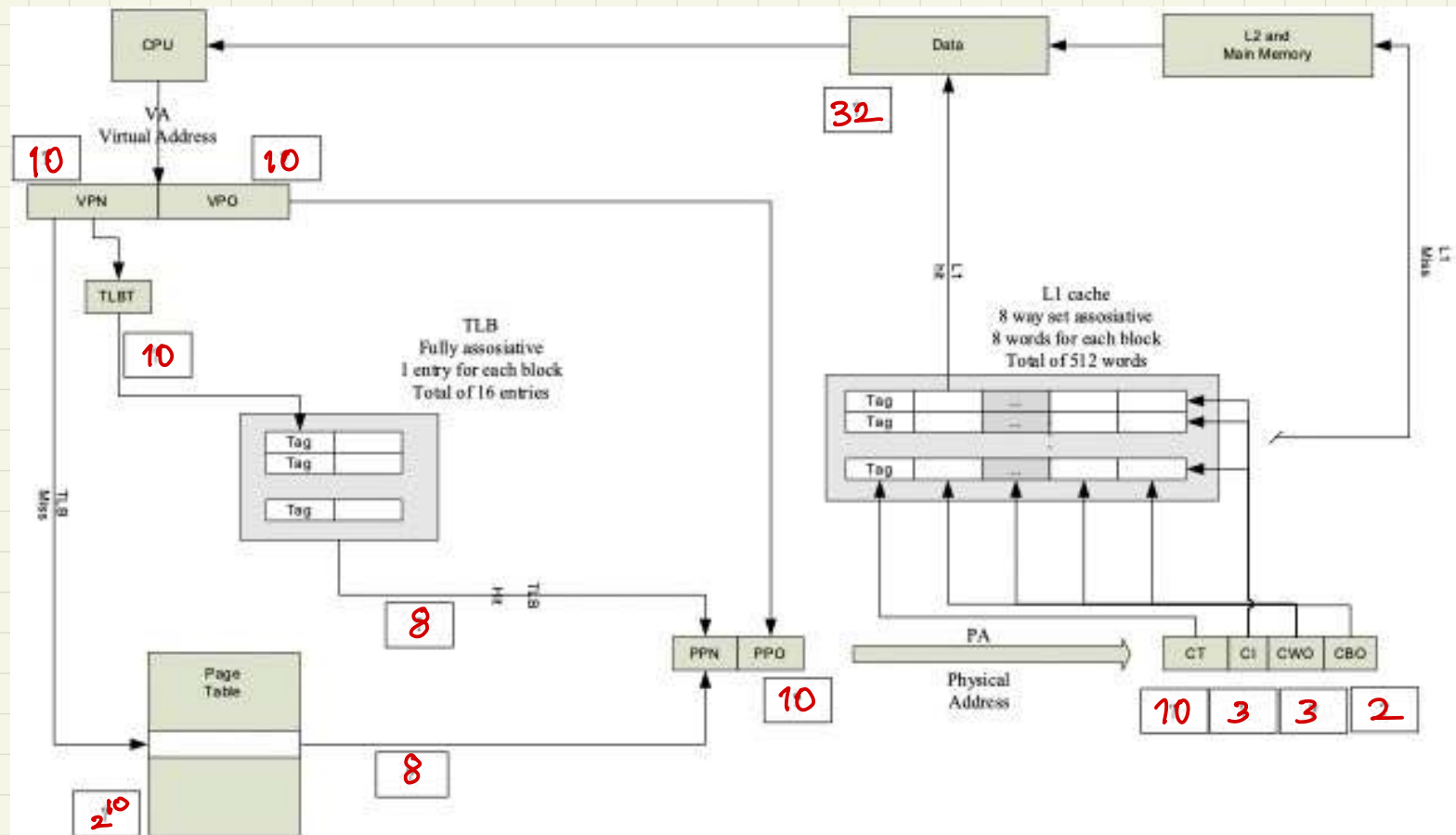
SORU 1

Page Size : 1KB

Virtual Address : 20 bit

Data width : 32 bit

Physical Address : 18 bit



$$1K = 2^{10} \rightarrow 10 \text{ bit} \rightarrow \text{VPO}$$

$$20 - 10 = 10 \rightarrow \text{VPN}$$

way  $\times$  words each block  
 $8 \times 8 = 64$  word bir satırda

$$\frac{512}{64} = 8 \text{ satır}$$

$$\log_2 8 = 3 \text{ bit index için}$$

$$\frac{\text{Data width}}{\text{words}} = \text{word genişliği}$$

$$32 / 8 = 4 \text{ byte}$$

$$\log_2 4 = 2 \text{ bit}$$

$$\log_2 8 = 3 \text{ bit}$$

word için offset

byte için offset

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19011904

*[Signature]*

$$\text{Physical Address} - \text{Index} - \text{word Offset} - \text{byte Offset}$$

$$18 - 3 - 3 - 2 = 10 \text{ bit tag alanı}$$