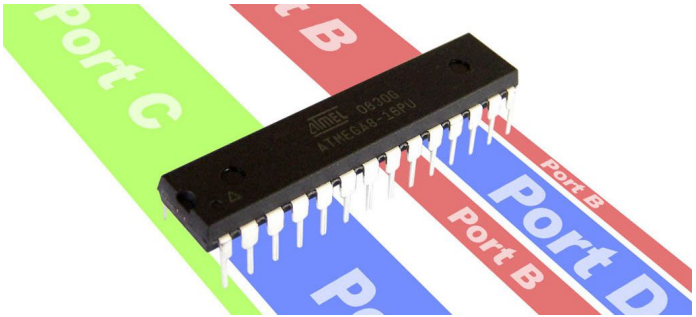
Mikrokontrolcu Portları



Suhap SAHIN

Gelistirme Ortamının Kurulumu

Sanal Makine Programı(VirtualBox)

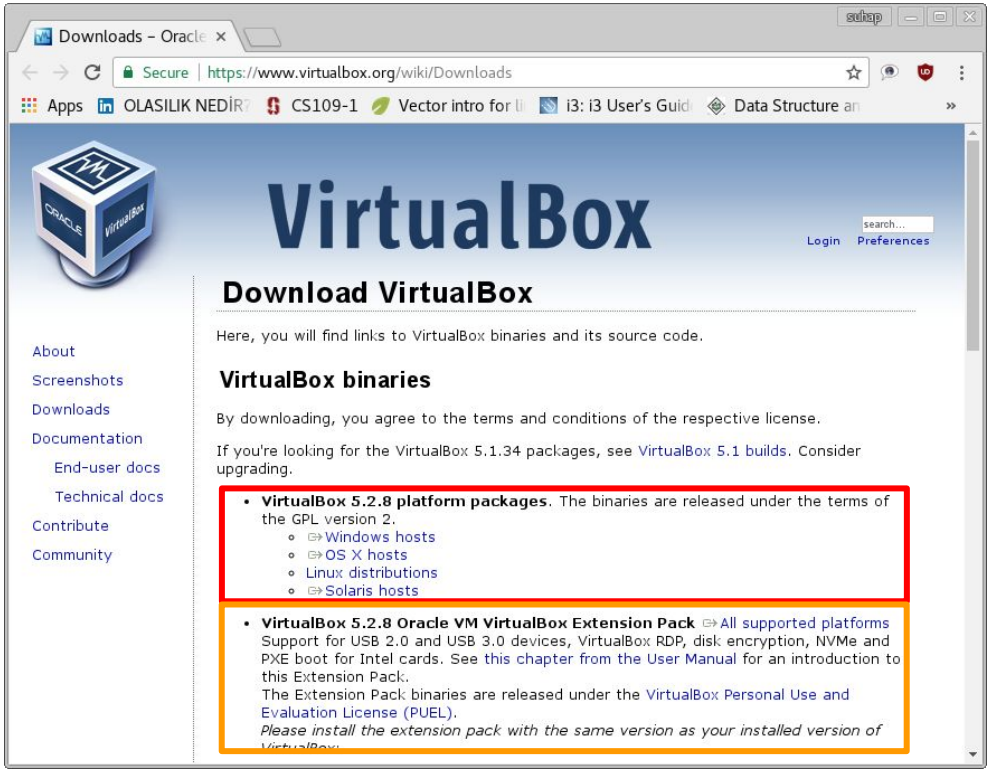
Sanal Makine Dosyasının Kurulumu(xubuntu-kouembedded-v20160217.ova)

Virtualbox kurulumu

https://www.virtualbox.org/

Virtualbox kurulumu

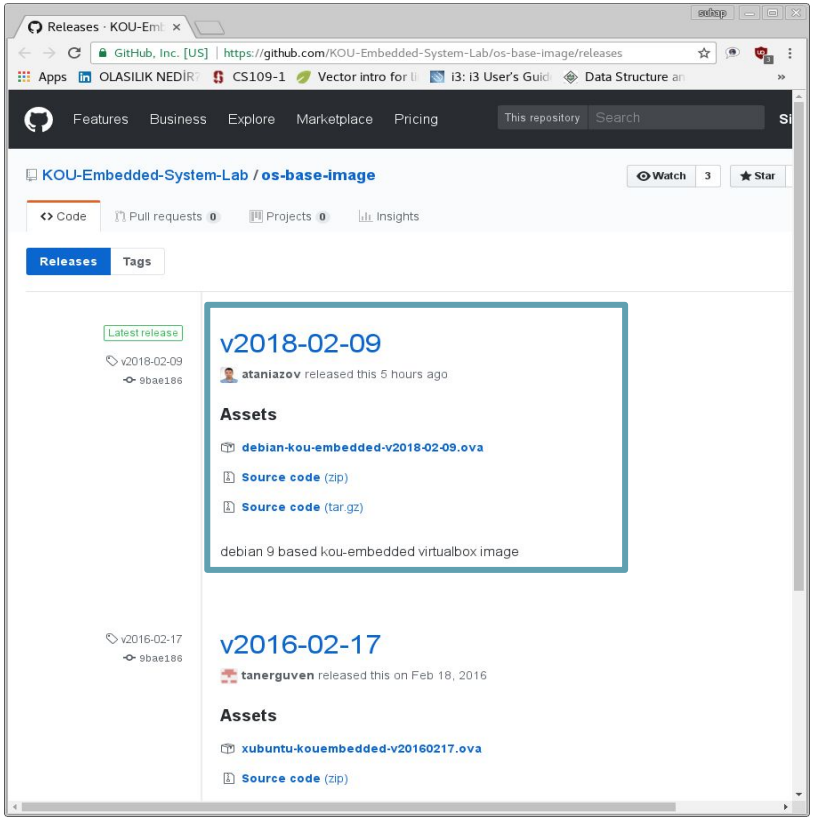
https://www.virtualbox.org/wiki/Downloads



Sanal Makina Dosyası

https://github.com/KOU-Embedded-System-Lab/os-base-image/releases/tag/v2018-02-09
https://github.com/KOU-Embedded-System-Lab/os-base-image/releases

debian-kou-embedded-v2018-02-09.ova



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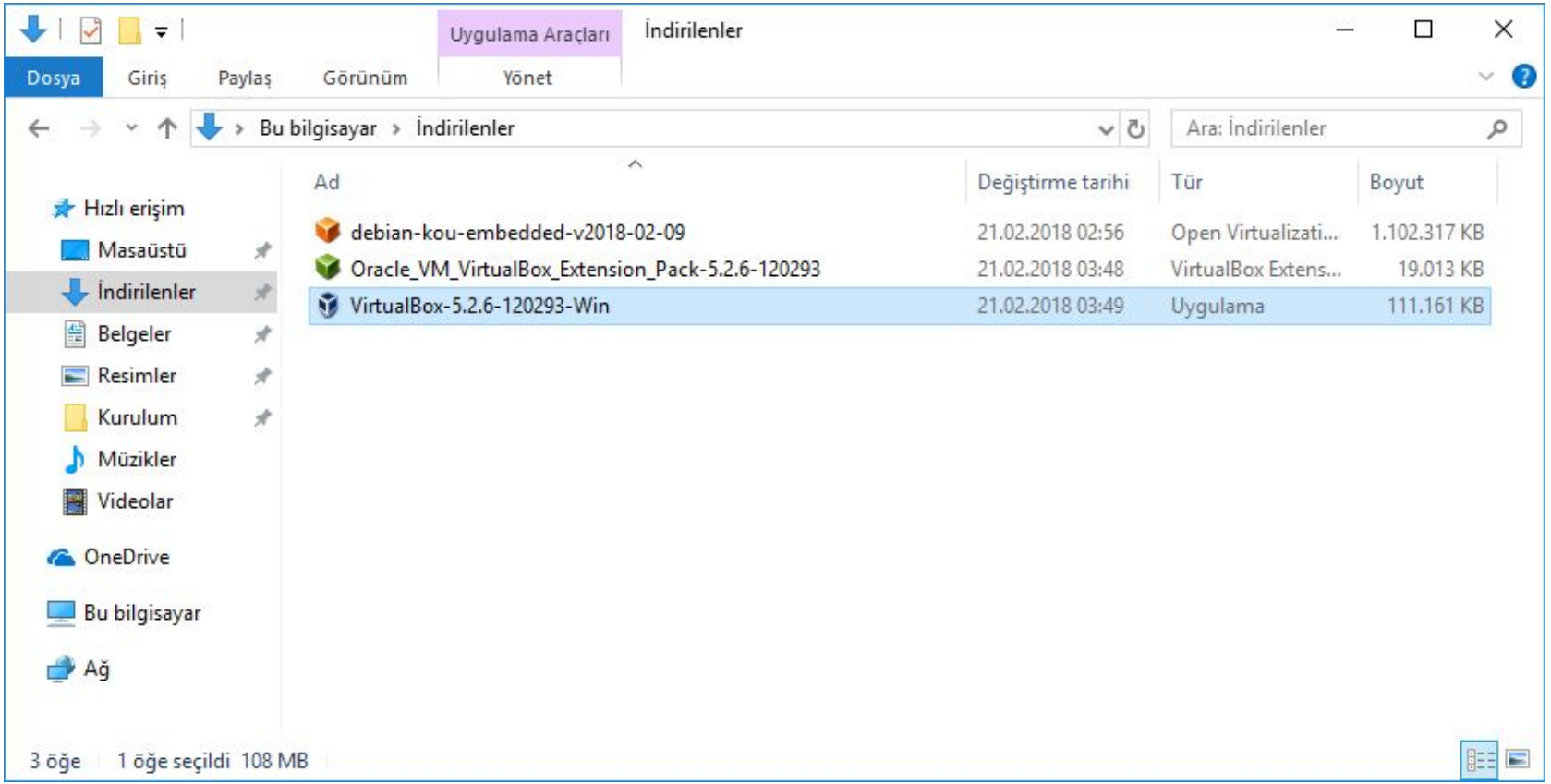
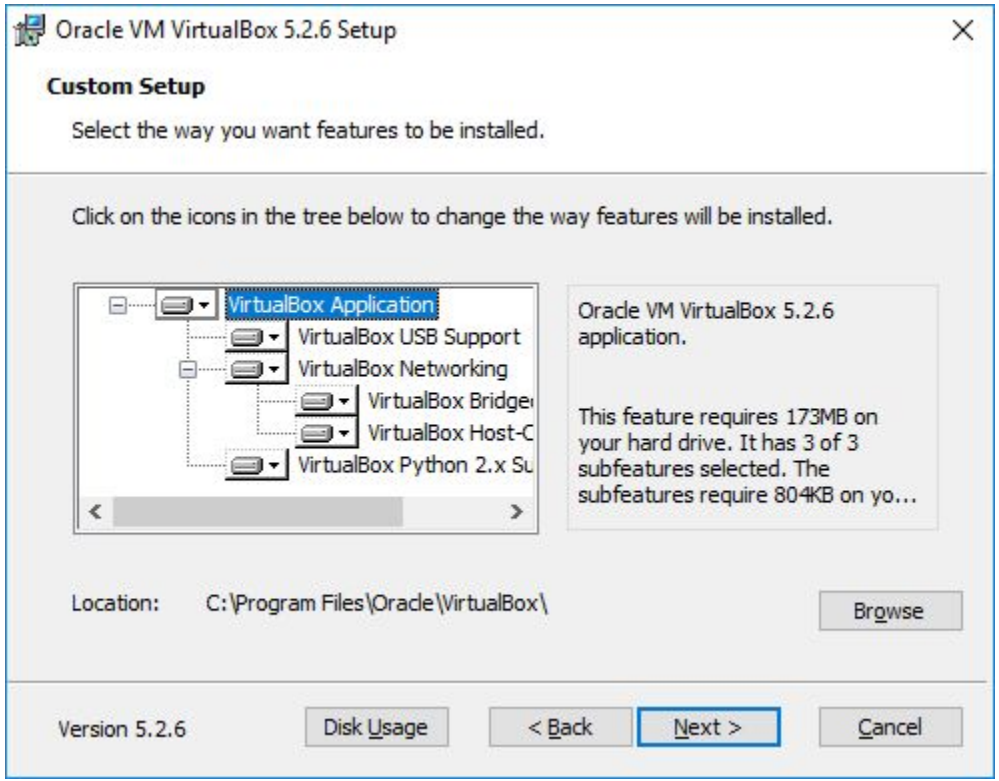


Sanal Makina Kurulumu

Sanal Makina Kurulumu



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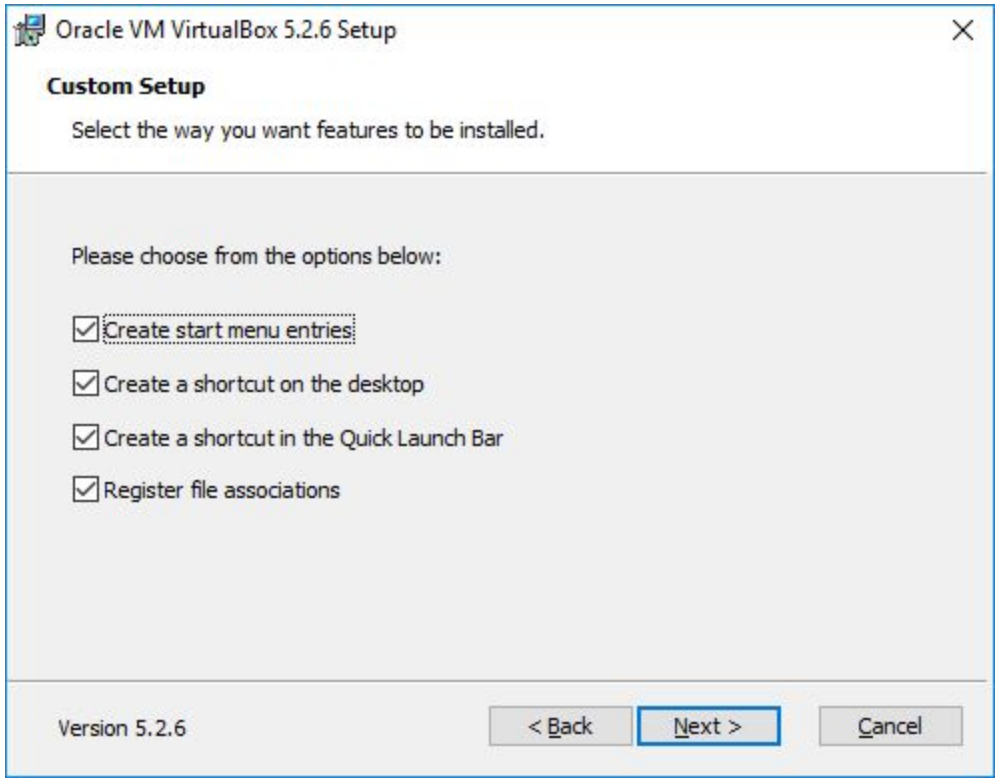

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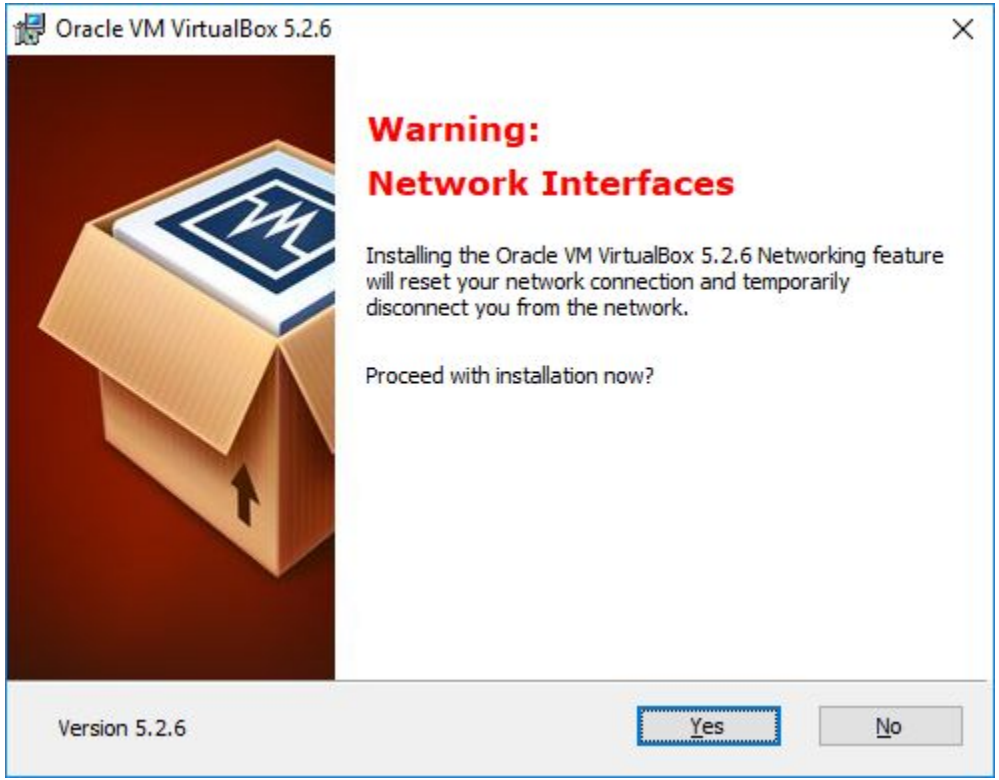

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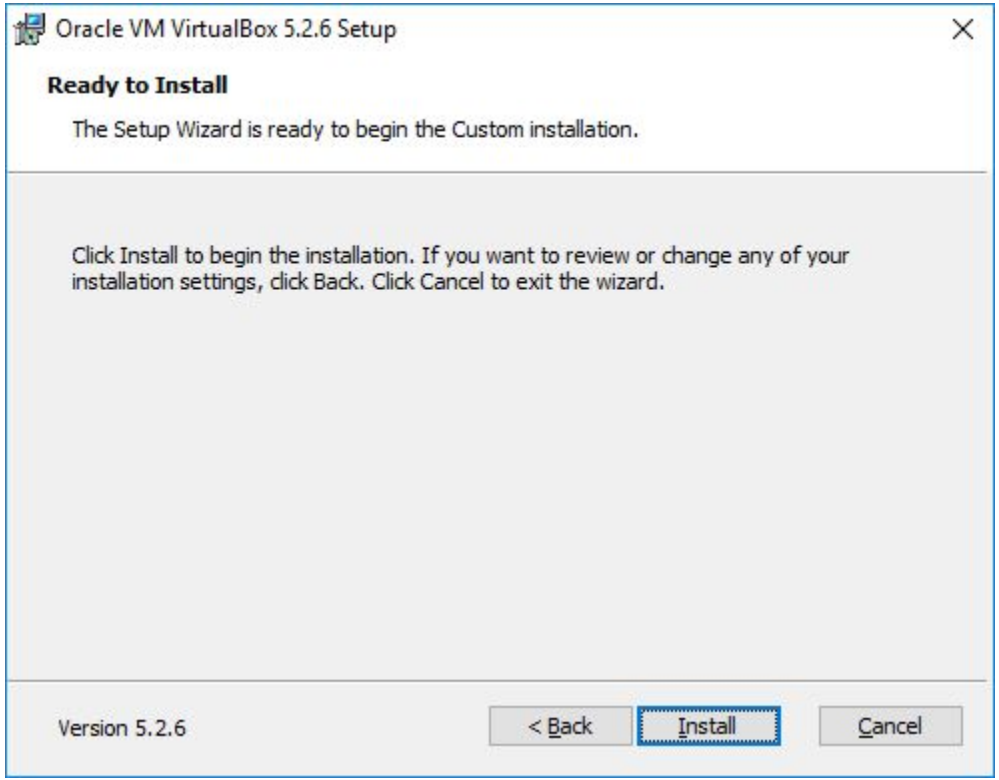

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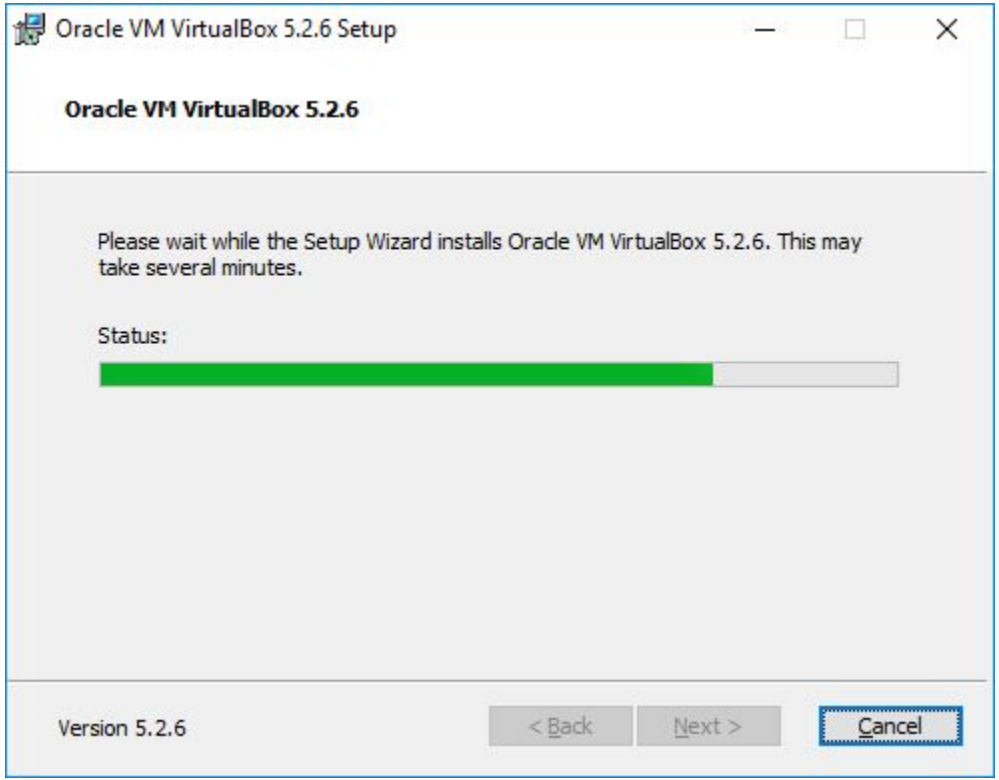

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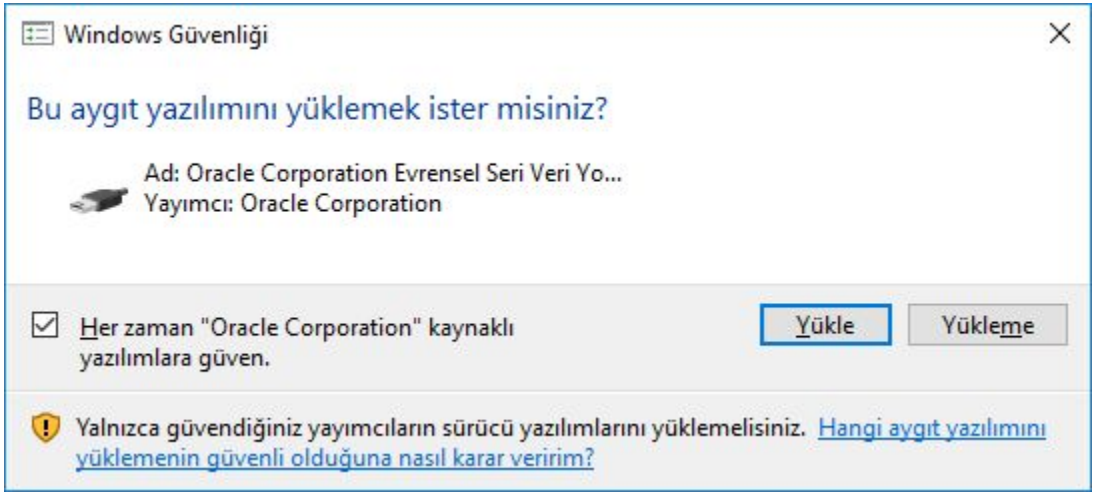

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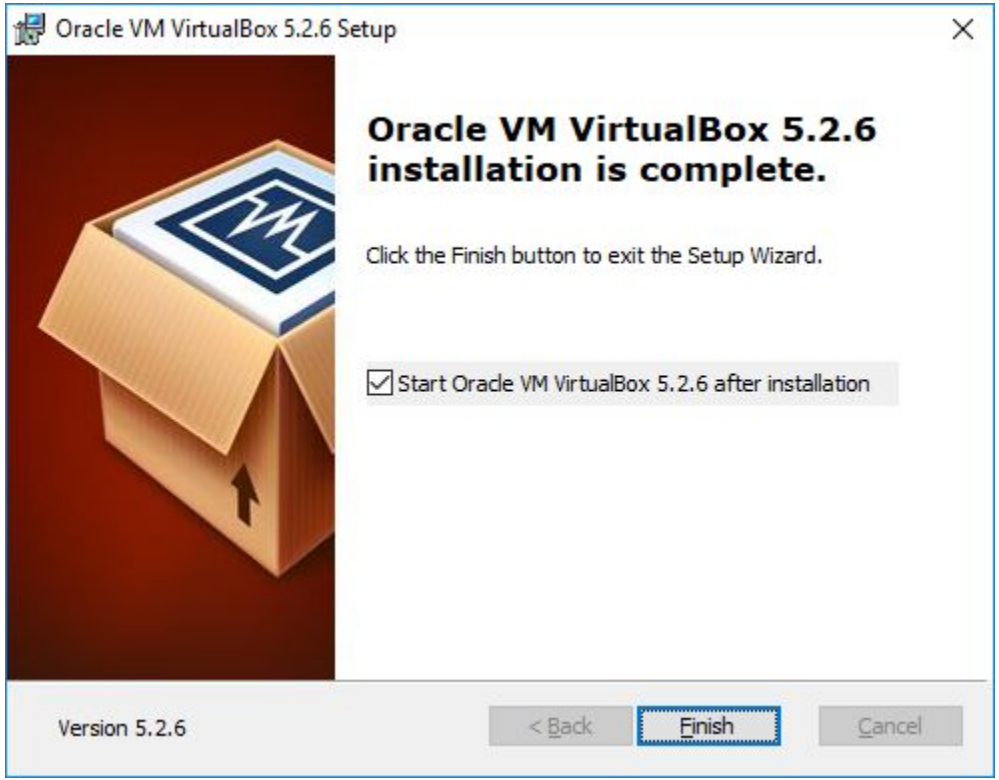
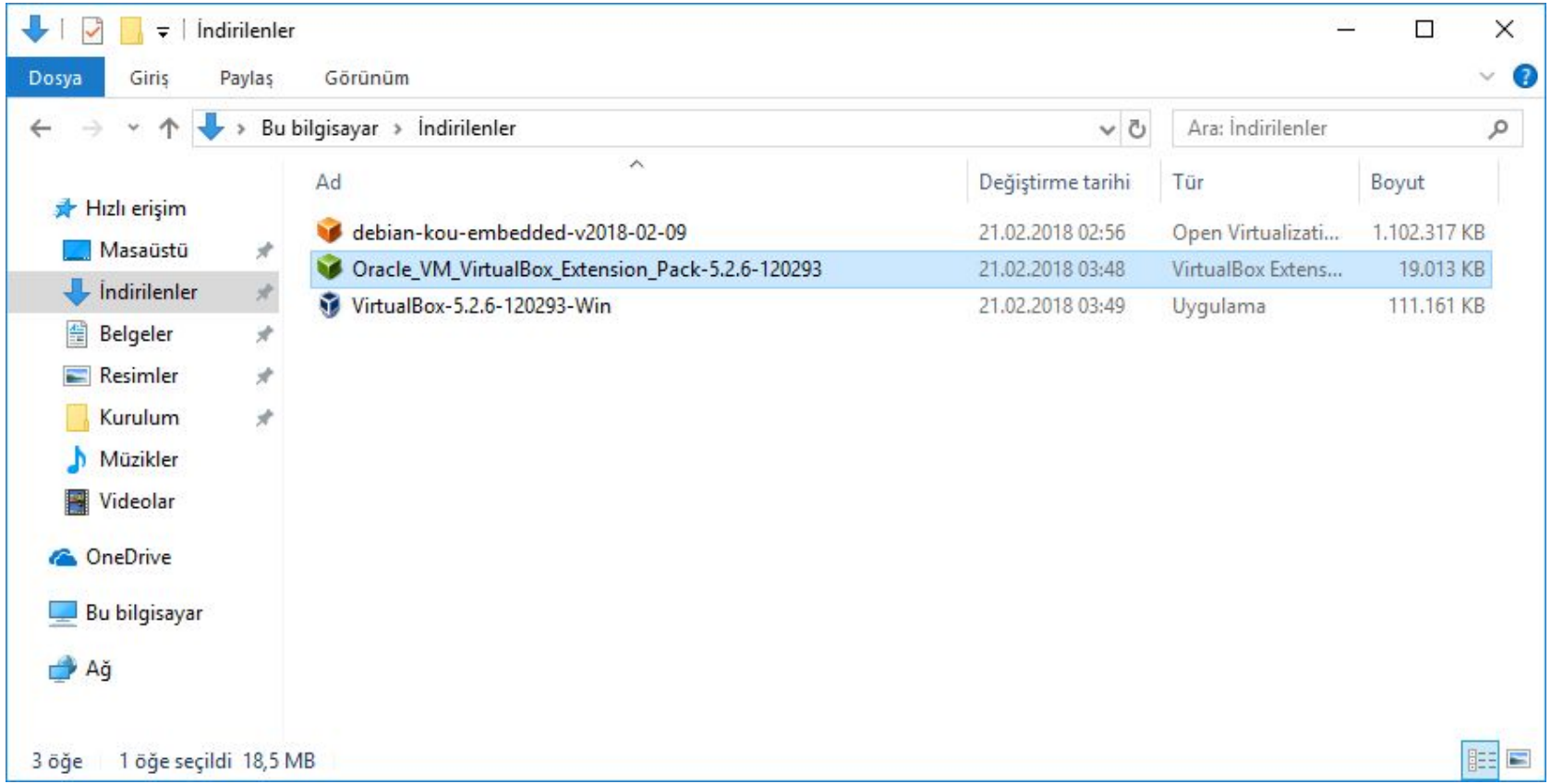


Sanal Makina Kurulumu

Sanal Makina Kurulumu



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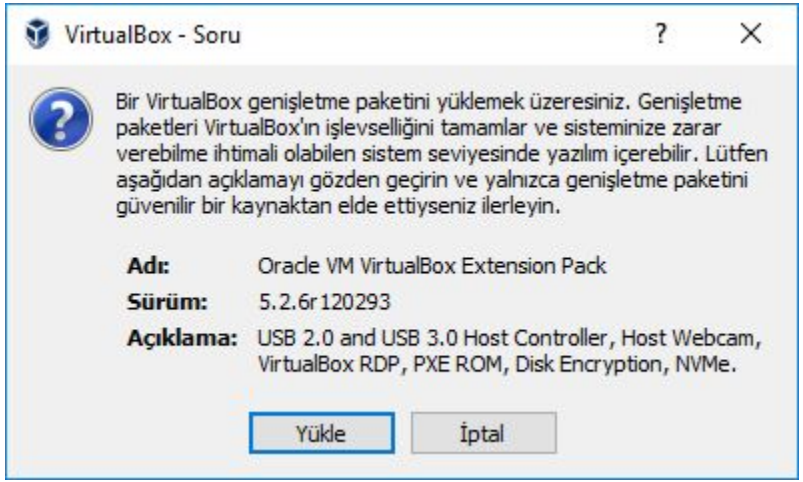

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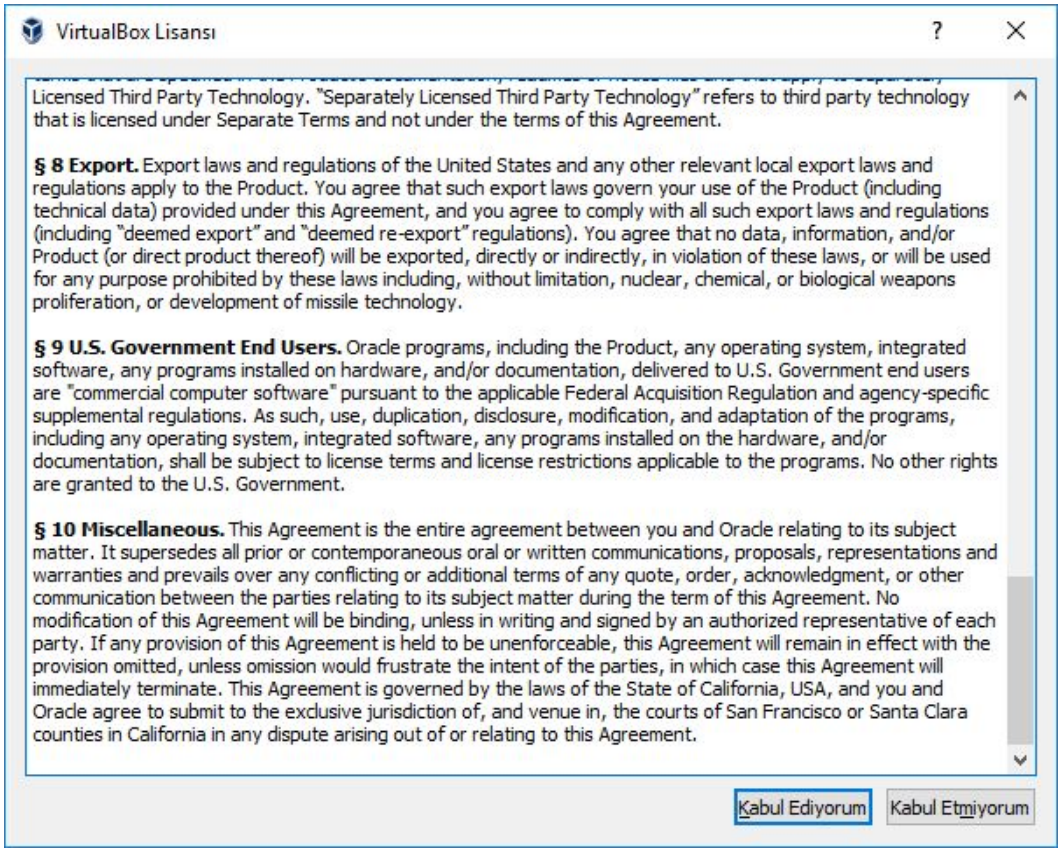

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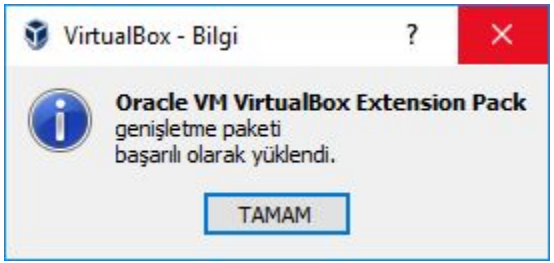

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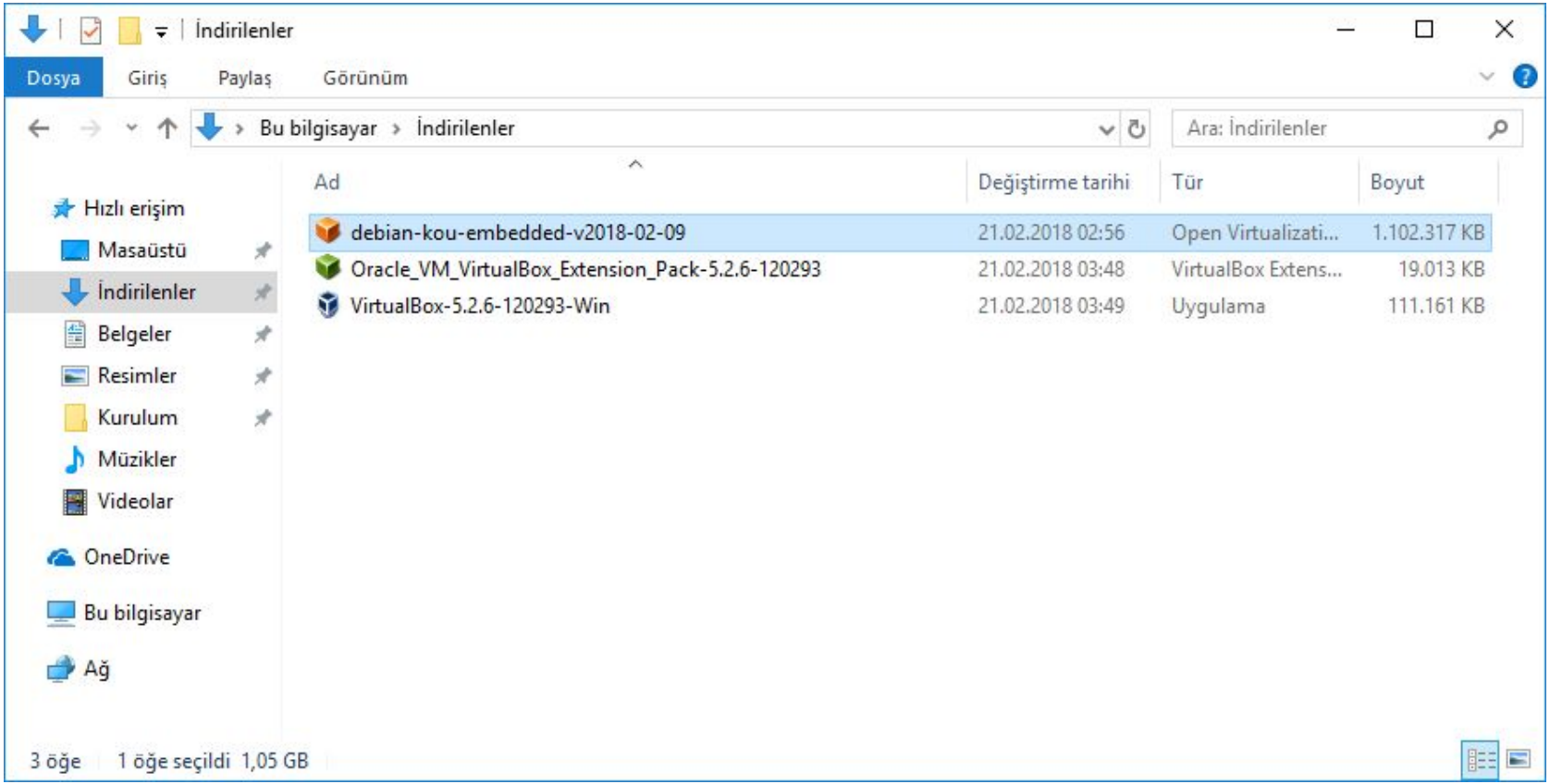

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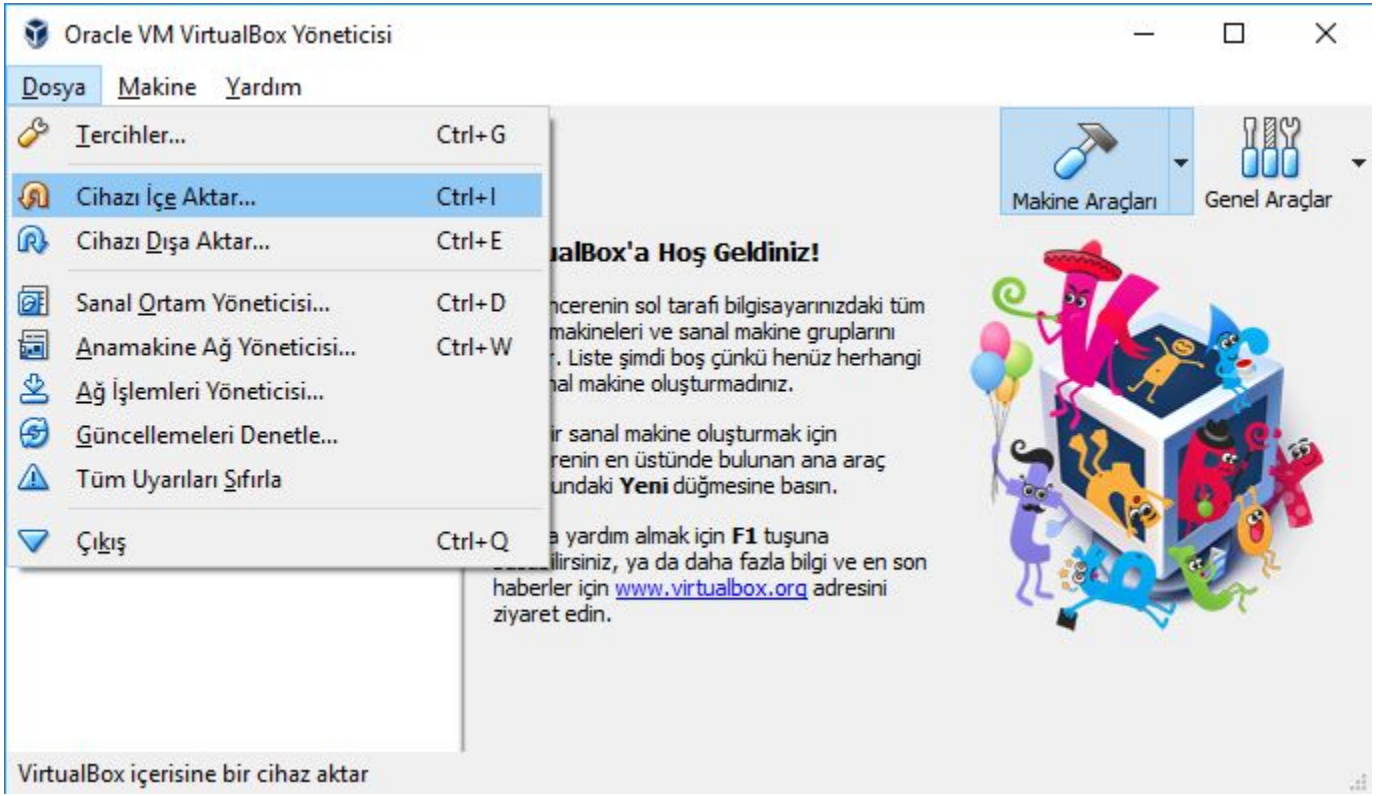

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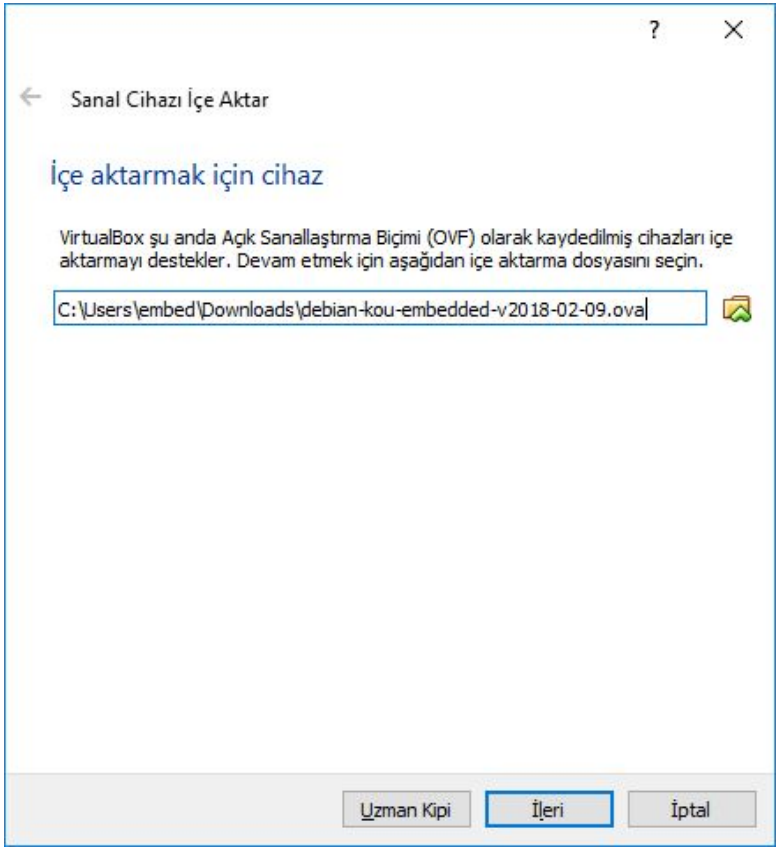

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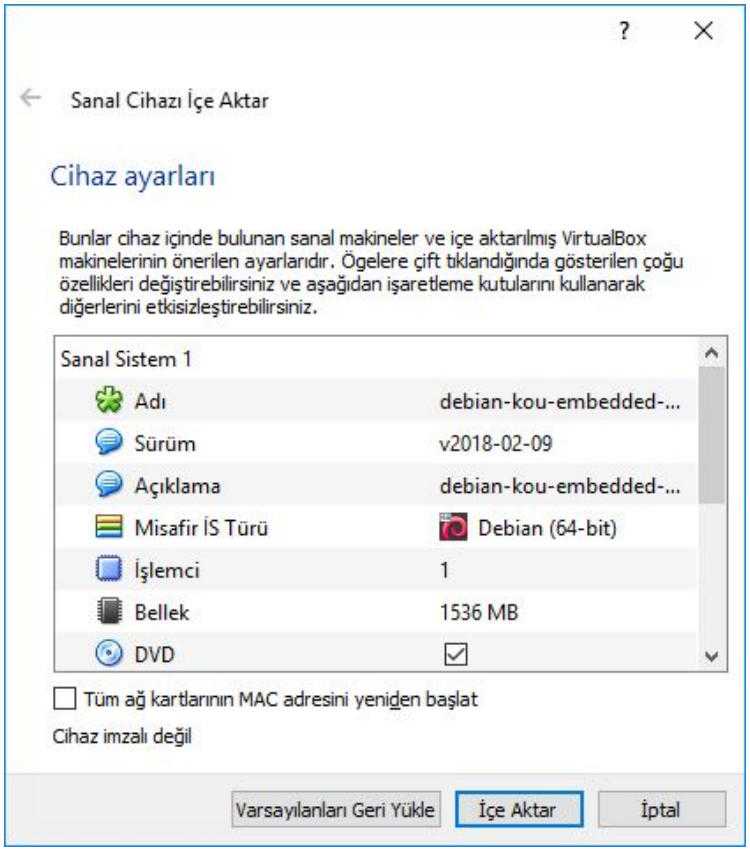

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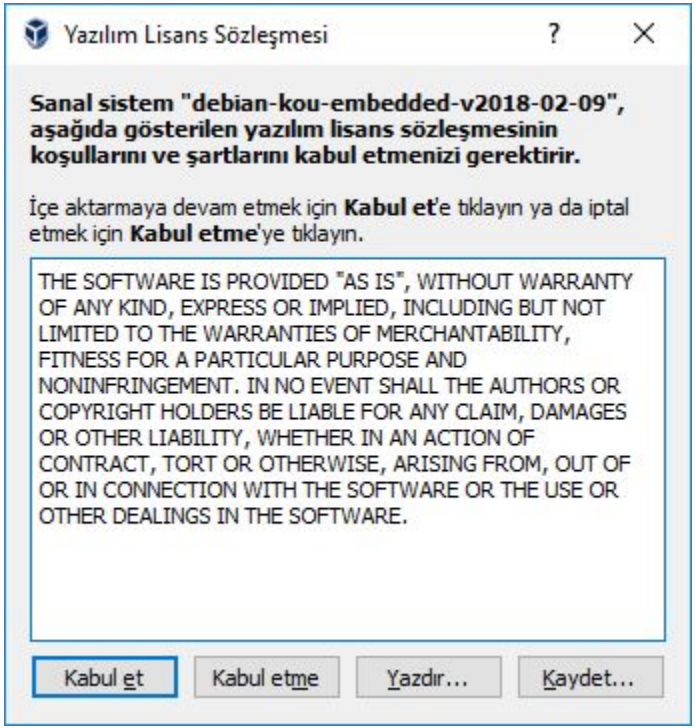

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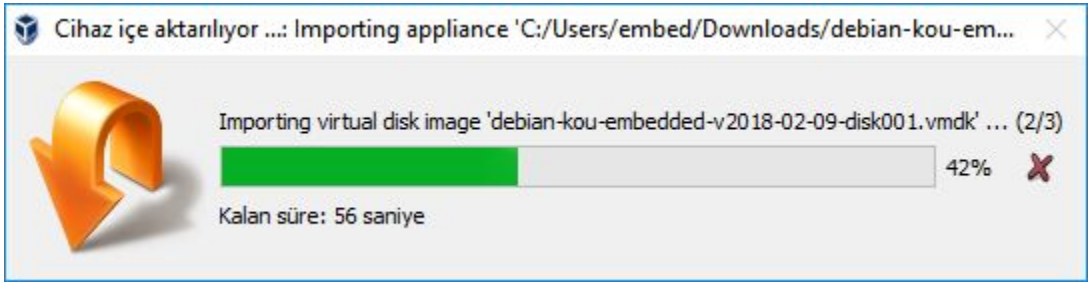
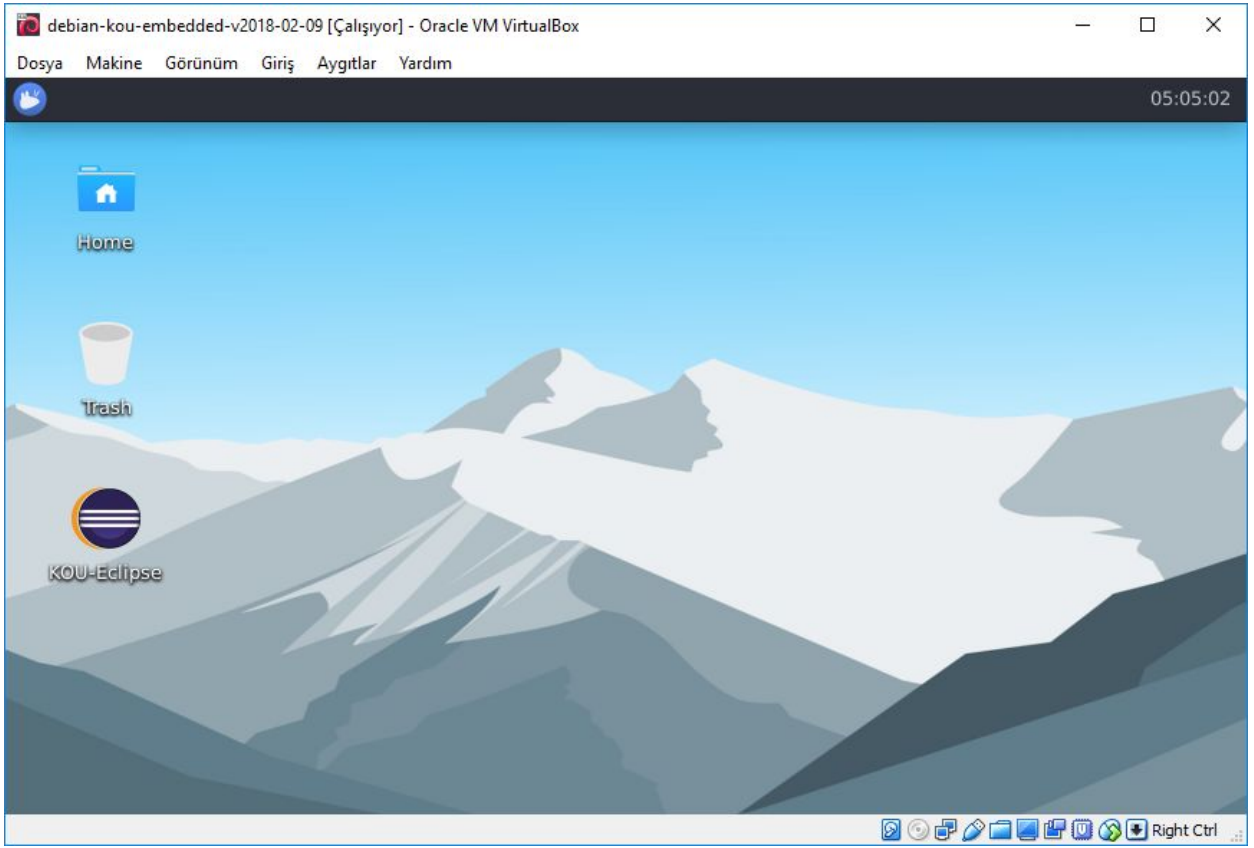


Sanal Makina Kurulumu

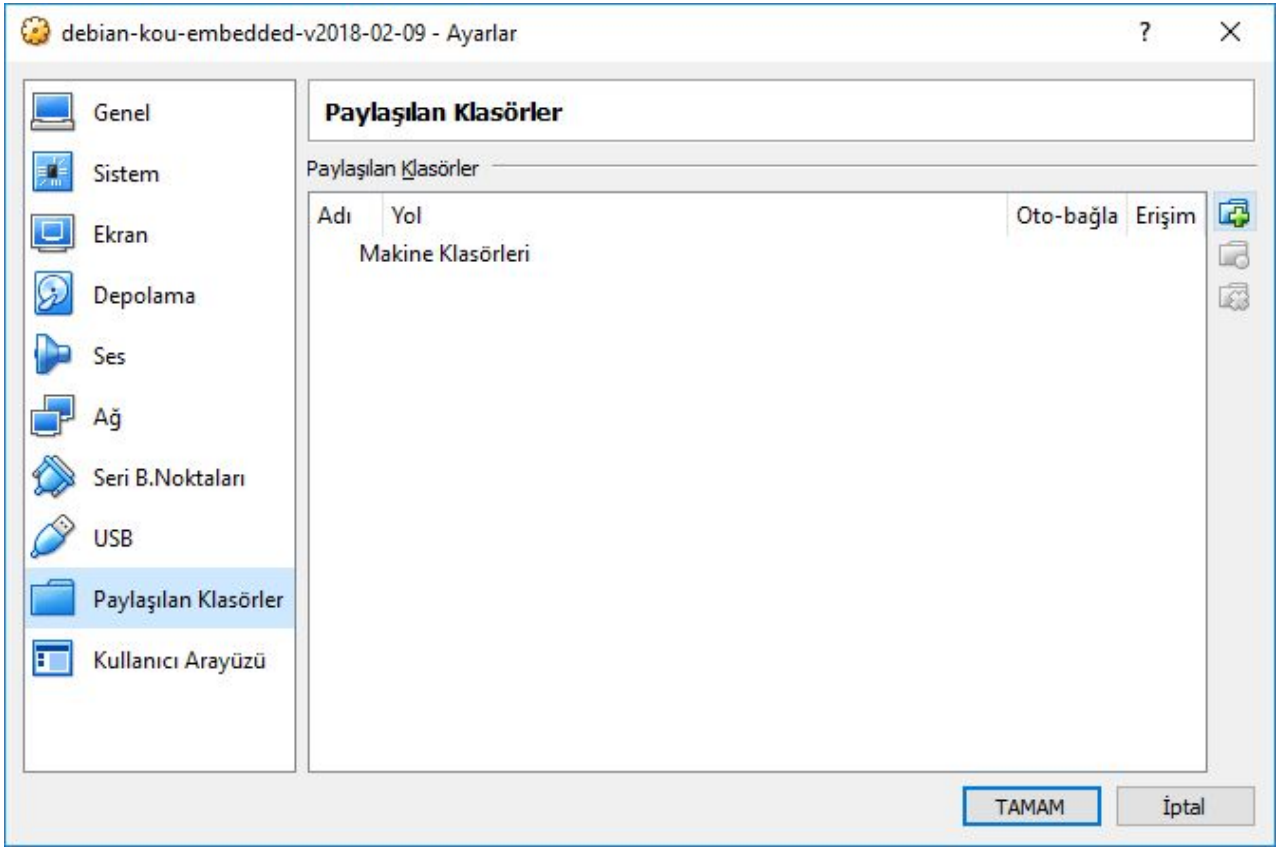
Sanal Makina Baslatma

Sanal Makina Baslatma



Sanal Makina Ayarlanması

Sanal Makina Ayarlanması



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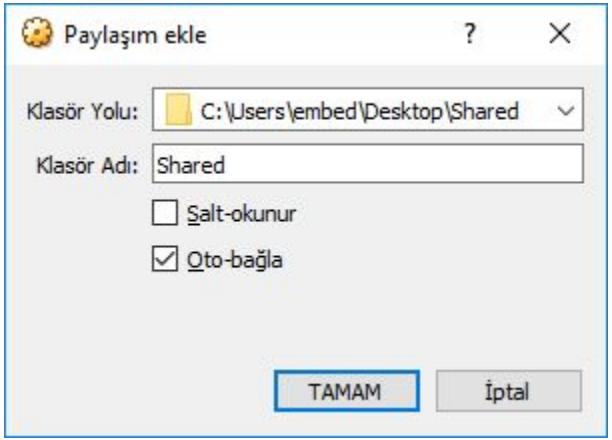

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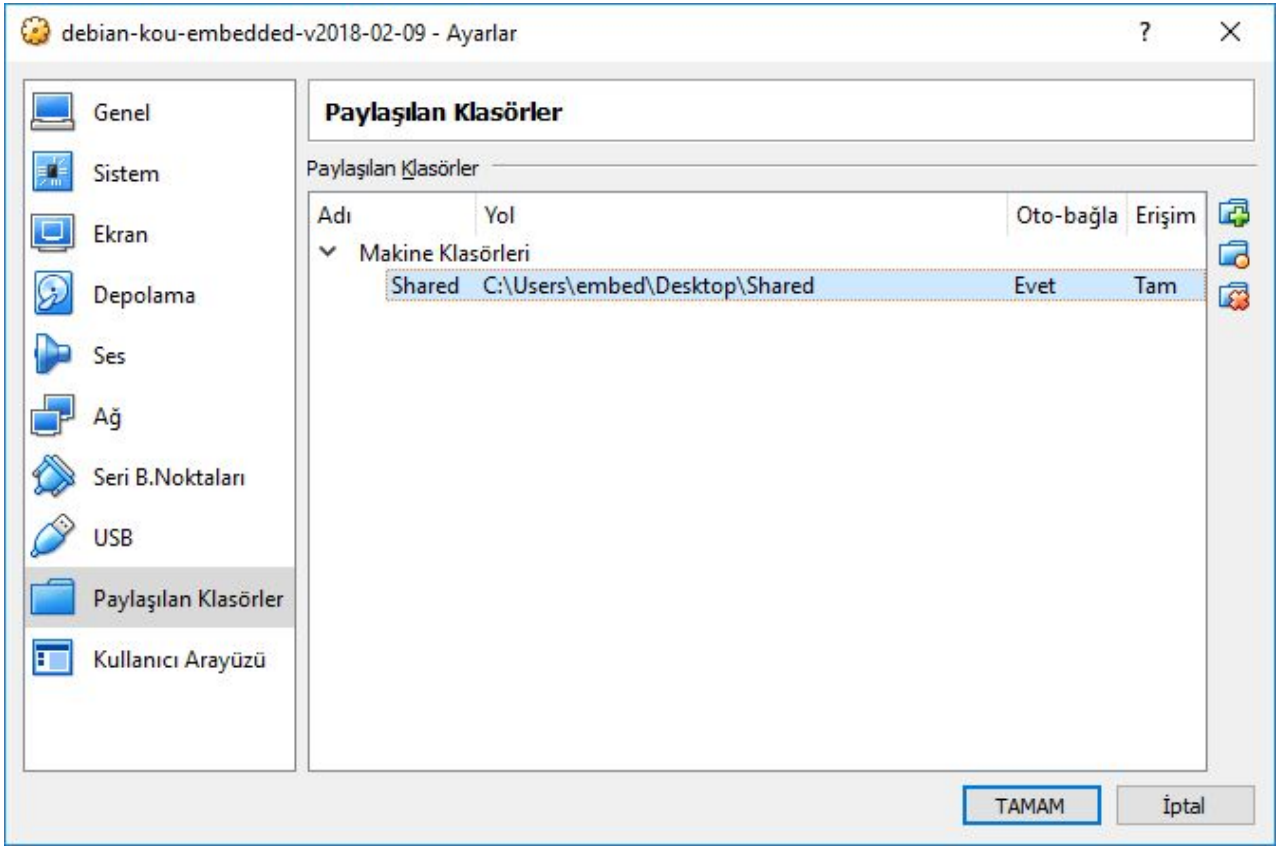
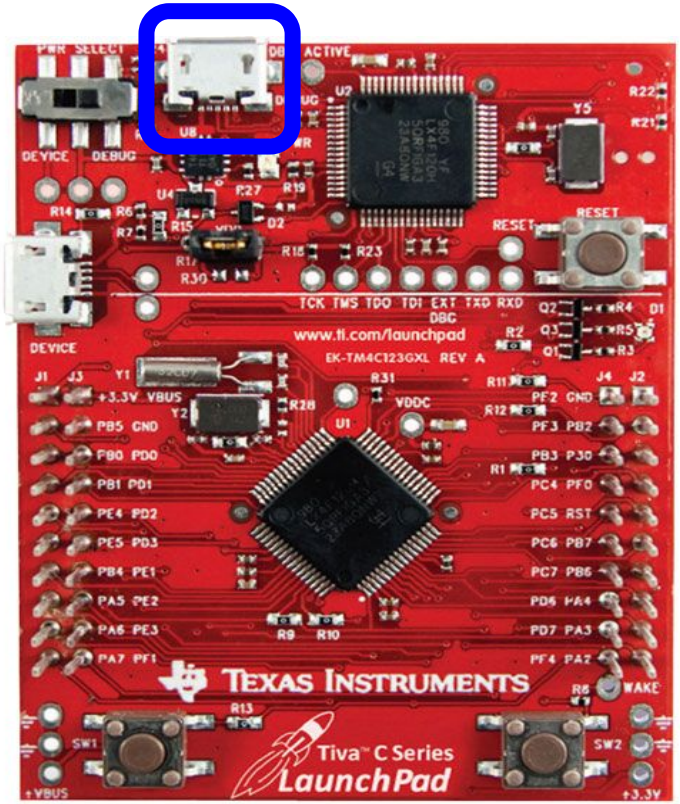
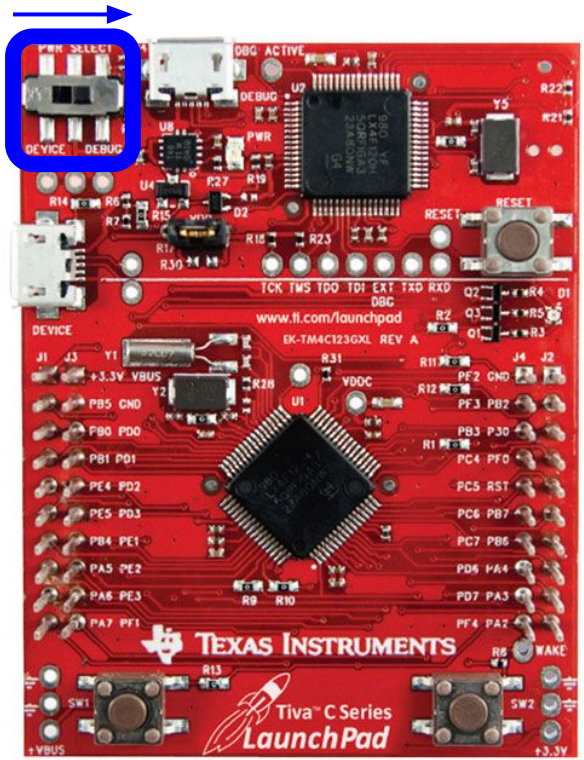
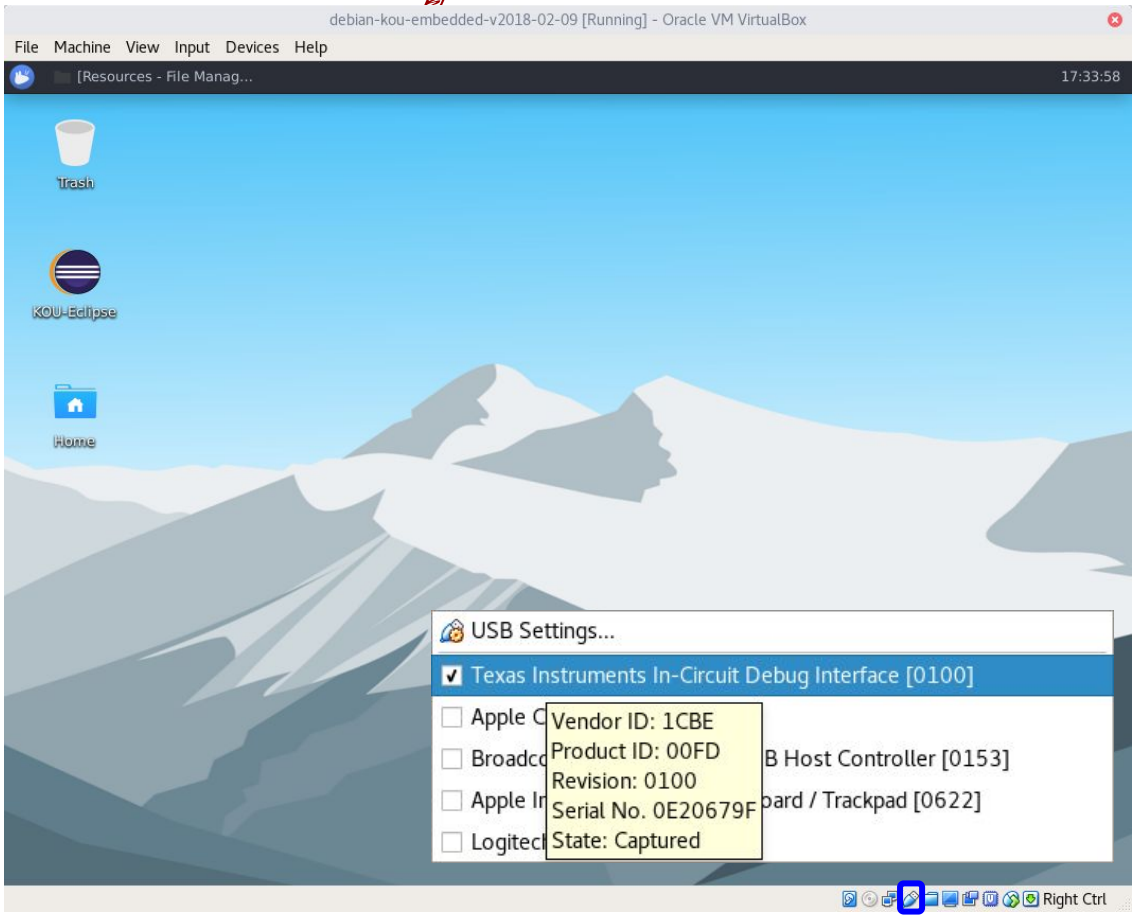


Kartın Sanal Makinaya Aktarılması

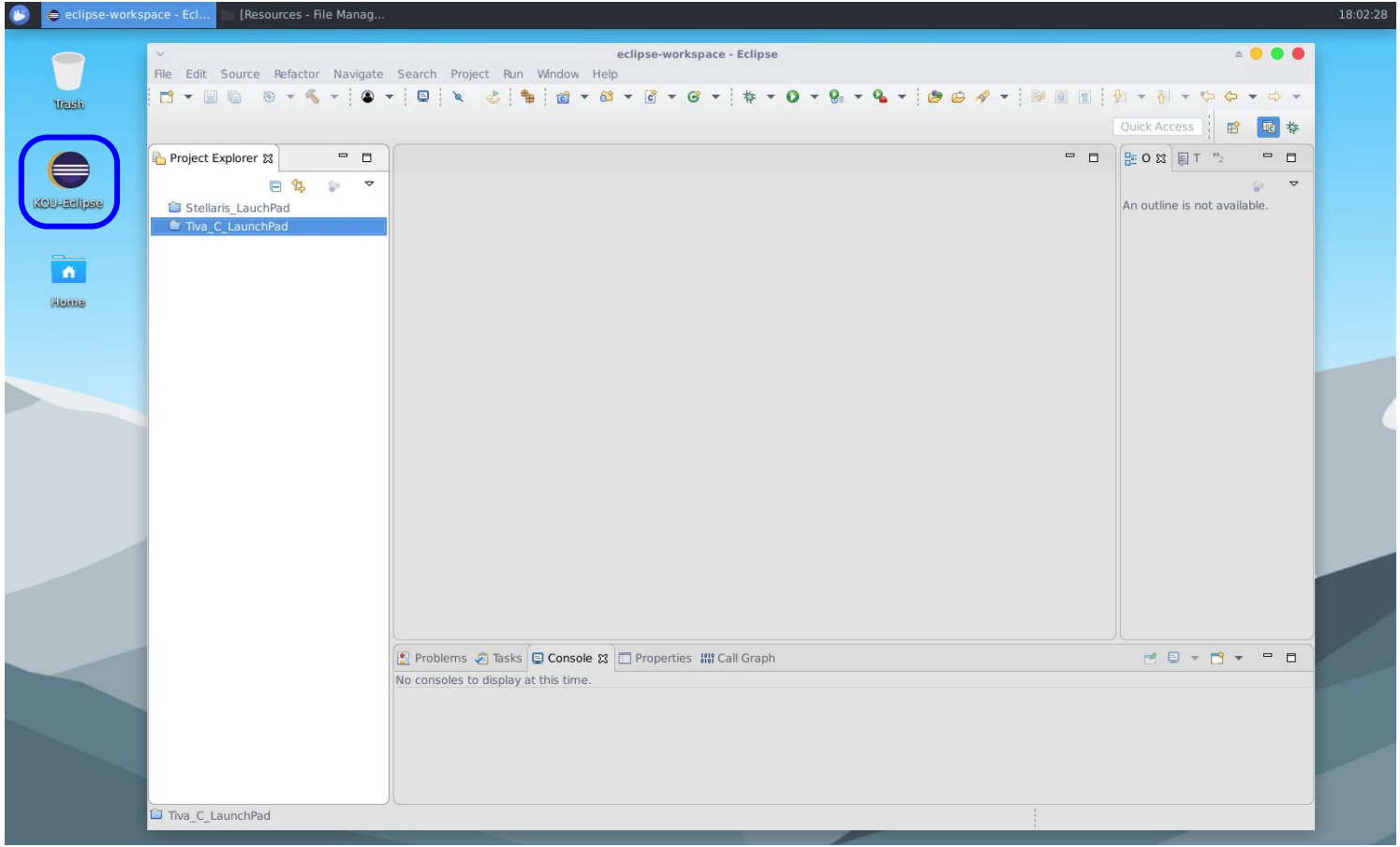


Kartın Sanal Makinaya Aktarılması





İlk Projenin Çalıştırılması



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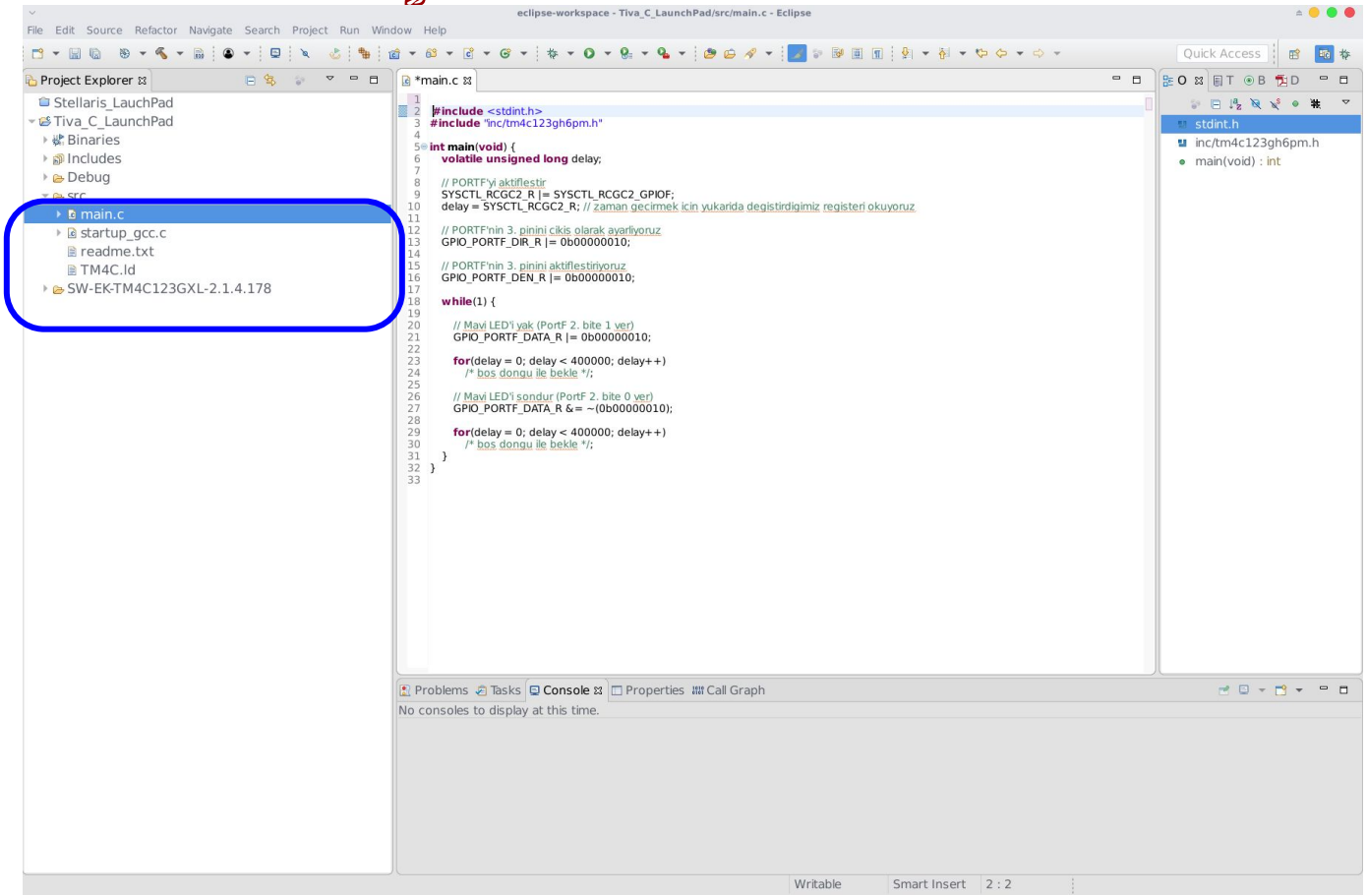

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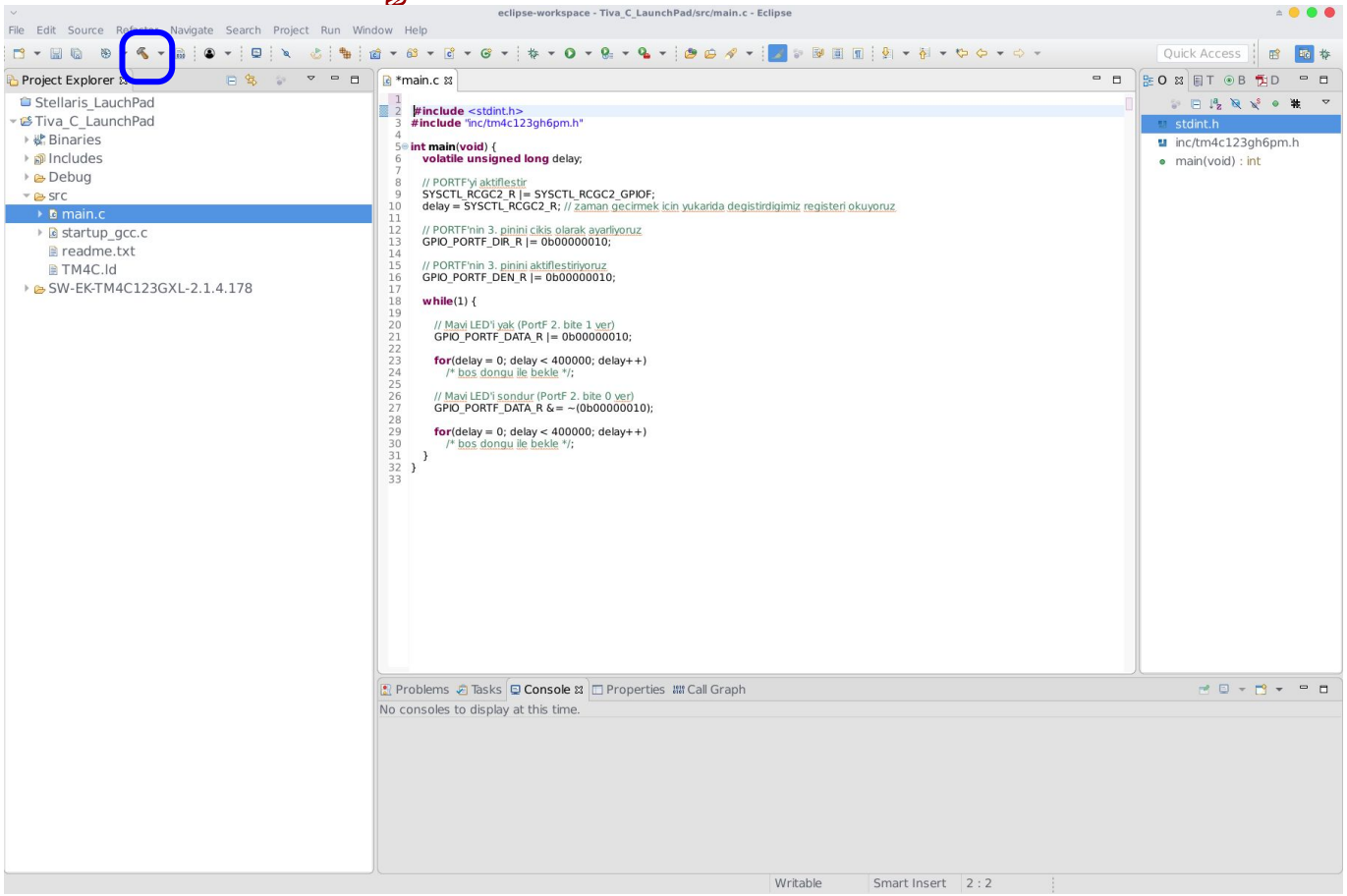

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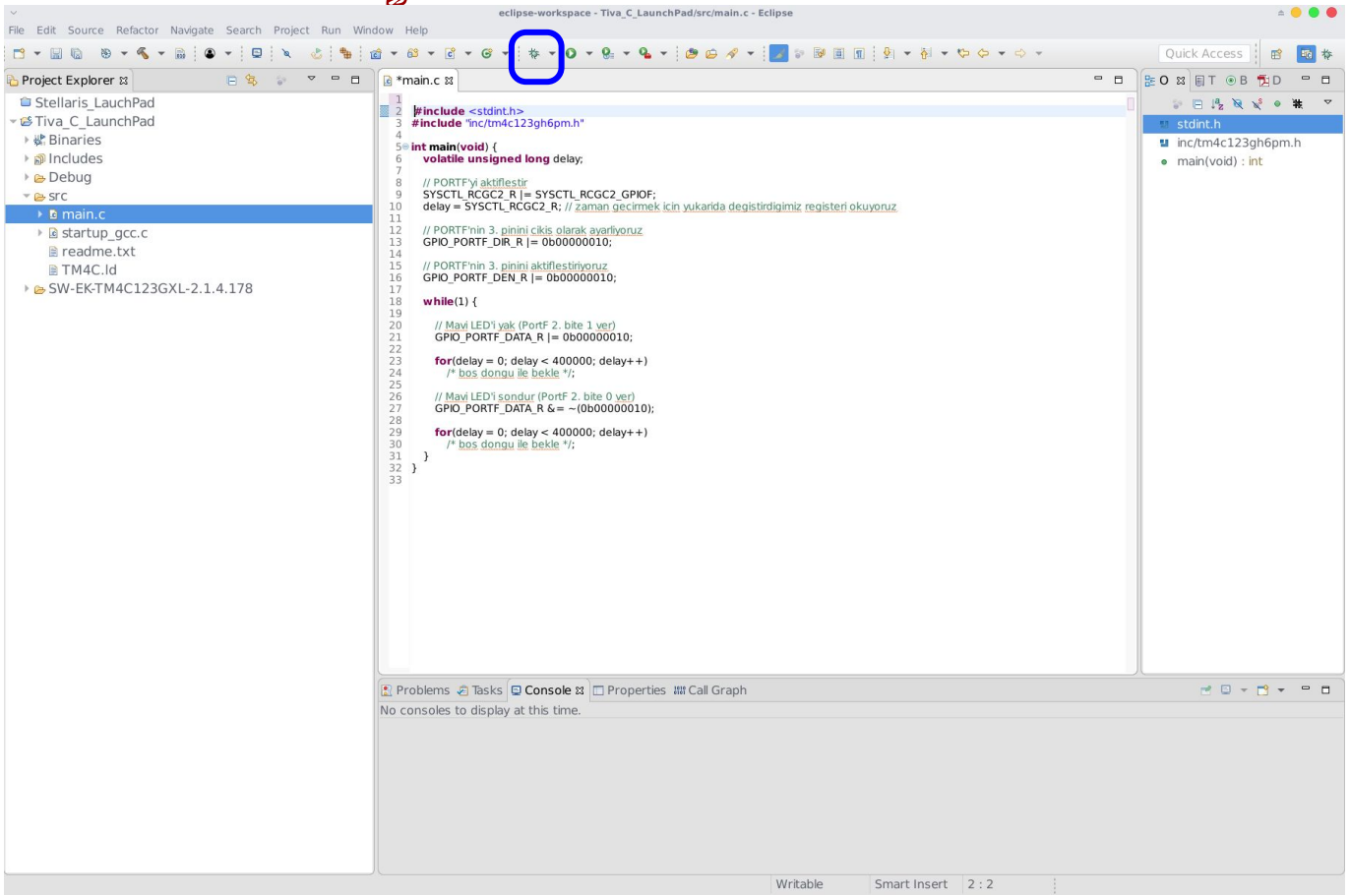

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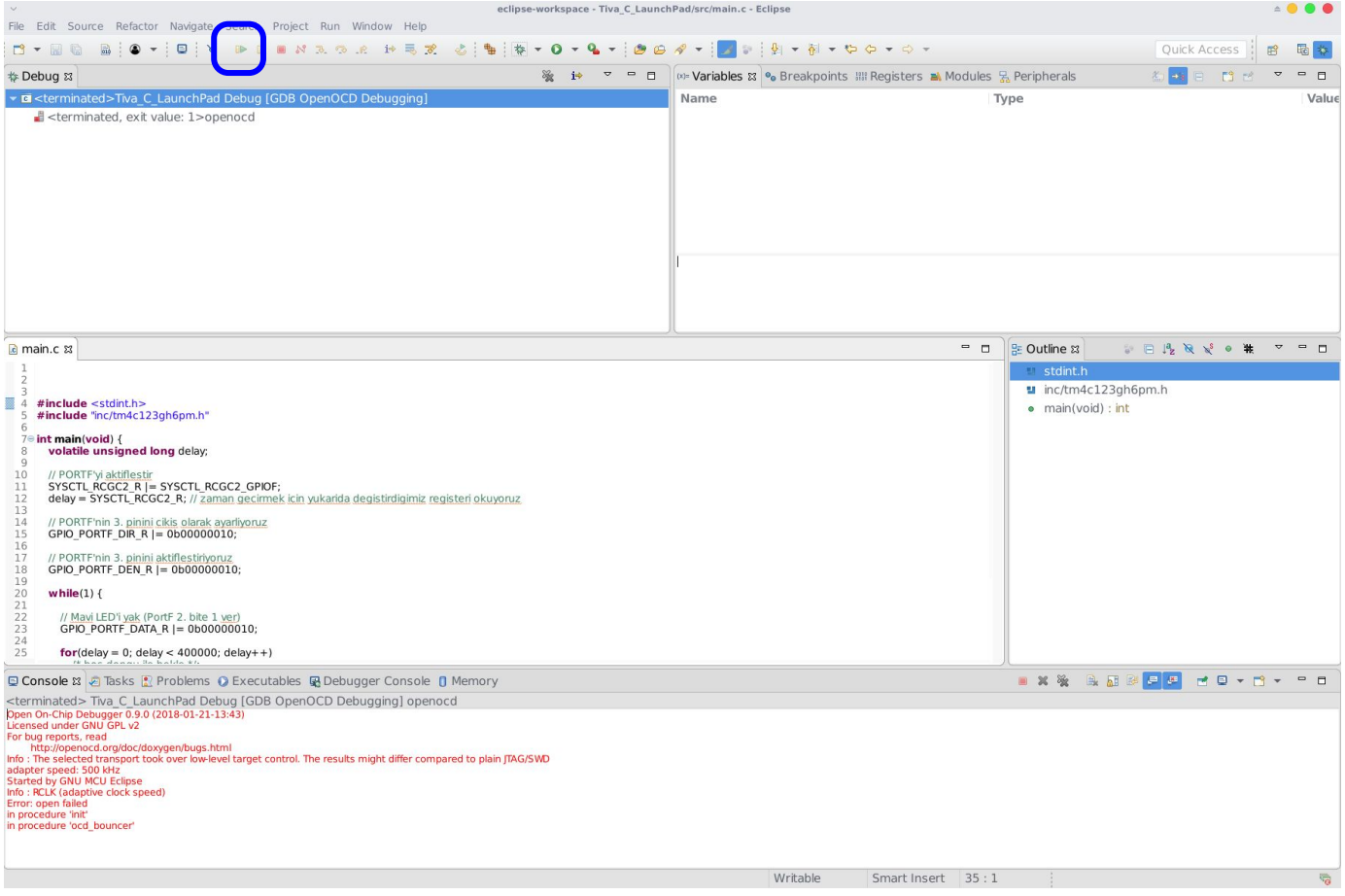

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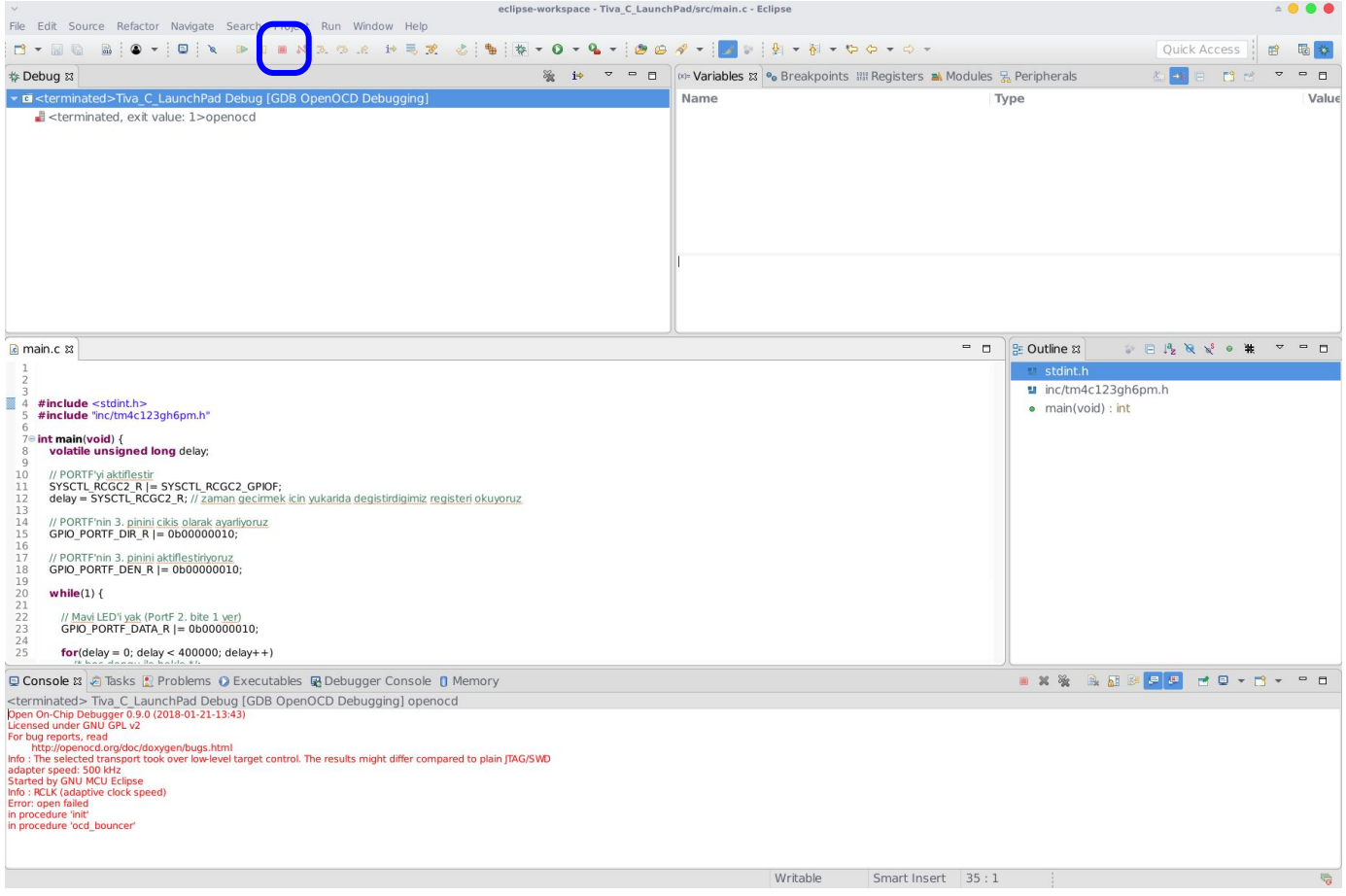
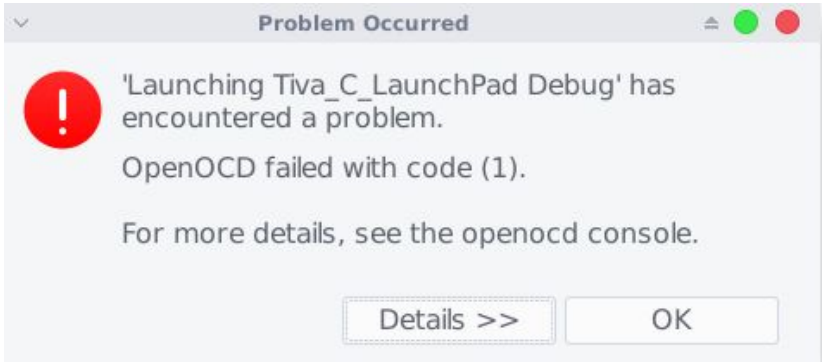


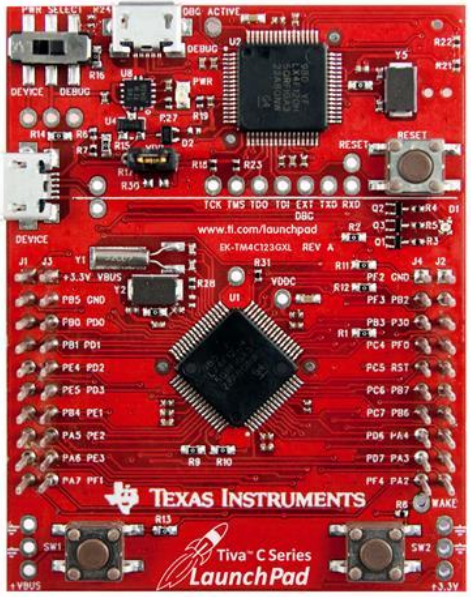
Hatalar

1. Stellaris/Tiva donanımları bilgisayara bagli mı?
2. Donanımlar sanal makinaya aktarıldı mı?
3. “DEBUG” islemi açık unutuldu mu?

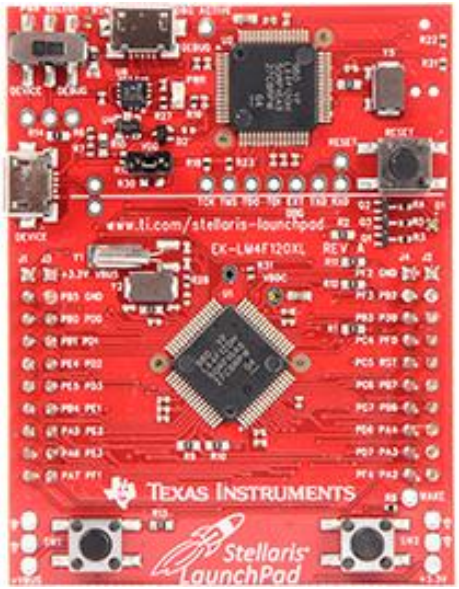


Gelistirme Kartları

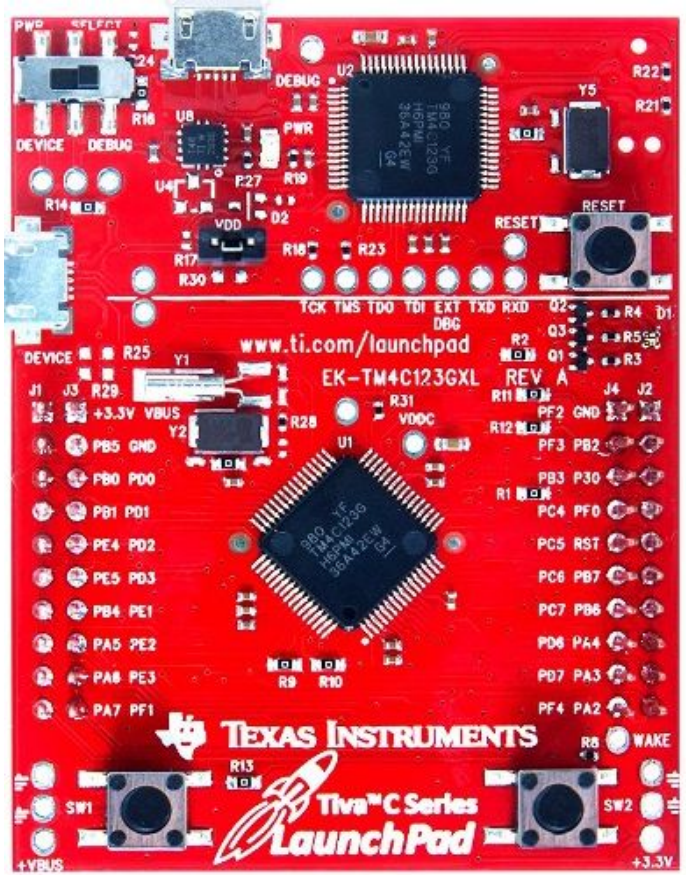
Tiva C Series EK-TM4C123GXL
http://www.ti.com/litv/pdf/spmu296



Stellaris EK-LM4F120XL
http://www.ti.com/lit/ug/spmu289c/spmu289c



Tiva & Stellaris Port Baglantıları



Hardware

digitalRead() and digitalWrite() PORTS

analogRead()

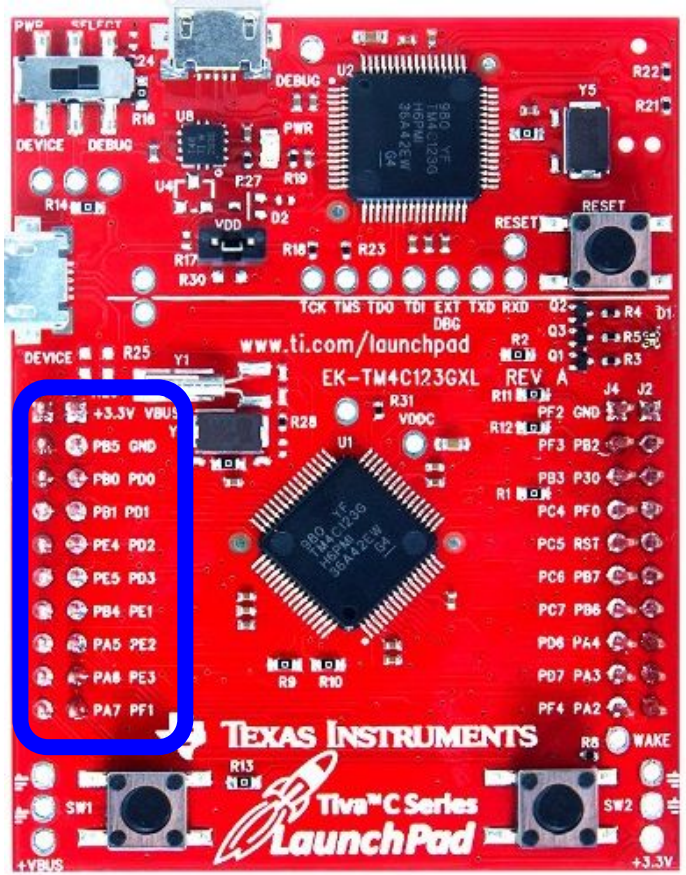
analogWrite()

I²C (TWI)

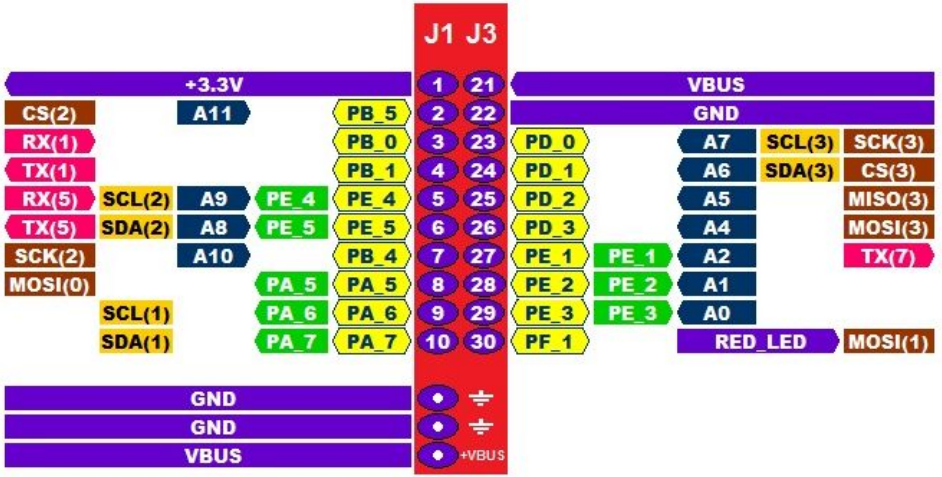
SPI

Hardware Serial

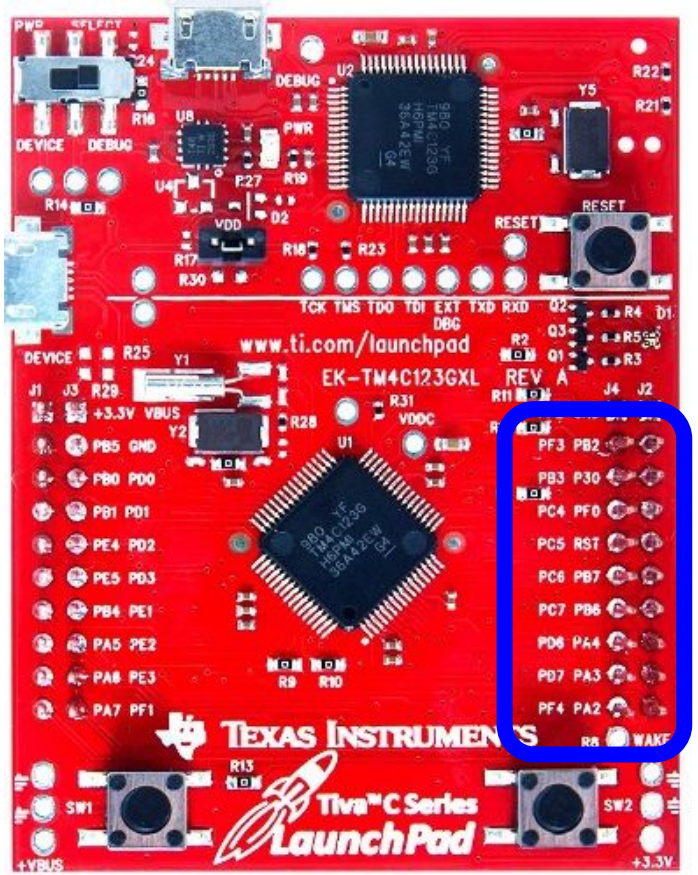
Tiva & Stellaris Port Baglantıları



Hardware
digitalRead() and digitalWrite() PORTS
analogRead()
analogWrite()
I²C (TWI)
SPI
Hardware Serial



Tiva Port Baglantıları



Hardware
digitalRead() and digitalWrite() PORTS
analogRead()
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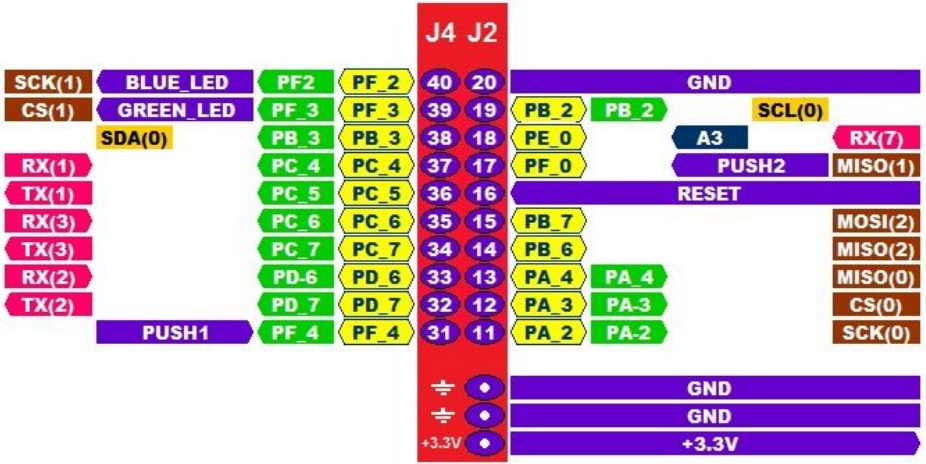
I²C (TWI)
SPI
Hardware Serial



Tiva & Stellaris Port Baglantıları

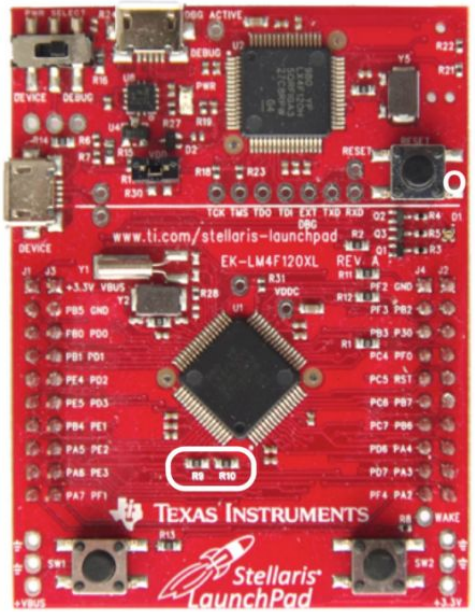
Flash	256	KB
SRAM	32	KB

Serial	hardware
ADC	12 bits
Use pins numbers only!	

Hardware
Pin number
Other pin number

I²C
Serial UART
SPI

analogRead()
digitalRead() and digitalWrite()
digitalRead(), digitalWrite() and analogWrite()



			J1	J3				
		+3.3V	1	21		VBUS		
CS (2)		A11	PB_5	2	22		GROUND		
RX (1)			PB_0	3	23	PD_0	A7	SCL (3)	SCK (3)
TX (1)			PB_1	4	24	PD_1	A6	SDA (3)	CS (3)
RX (5)	SCL (2)	A9	PE_4	5	25	PD_2	A5		MISO (3)
TX (5)	SDA (2)	A8	PE_5	6	26	PD_3	A4		MOSI (3)
SCK (2)		A10	PB_4	7	27	PE_1	A2		TX (7)
MOSI (0)			PA_5	8	28	PE_2	A1		
	SCL (1)		PA_6	9	29	PE_3	A0		
	SDA (1)		PA_7	10	30	PF_1	RED_LED		MOSI (1)
							GROUND		
							GROUND		
							VBUS		

			J4	J2				
SCK (1)		BLUE_LED	PF_2	40	20		GROUND		
CS (1)		GREEN_LED	PF_3	39	19	PB_2		SCL (0)	
	SDA (0)		PB_3	38	18	PE_0	A3		RX (7)
RX (1)			PC_4	37	17	PF_0	PUSH2		MISO (1)
TX (1)			PC_5	36	16		RESET		
RX (3)			PC_6	35	15	PB_7		SDA (3)	MOSI (2)
TX (3)			PC_7	34	14	PB_6		SCL (3)	MISO (2)
RX (2)			PD_6	33	13	PA_4			MISO (0)
TX (2)		Detection	PD_7	32	12	PA_3			CS (0)
		PUSH1	PF_4	31	11	PA_2			SCK (0)
		GROUND				PA_0			RX (0)
		GROUND				PA_1			TX (0)
		+3.3V				PD_4			RX (6)
						PD_5			TX (6)

0Ω shunt

23	SCL (3)	PD_0	R9	PB_6	14
24	SDA (3)	PD_1	R10	PB_7	15

VBUS detection PD_7

Tiva & Stellaris Port Baglantıları

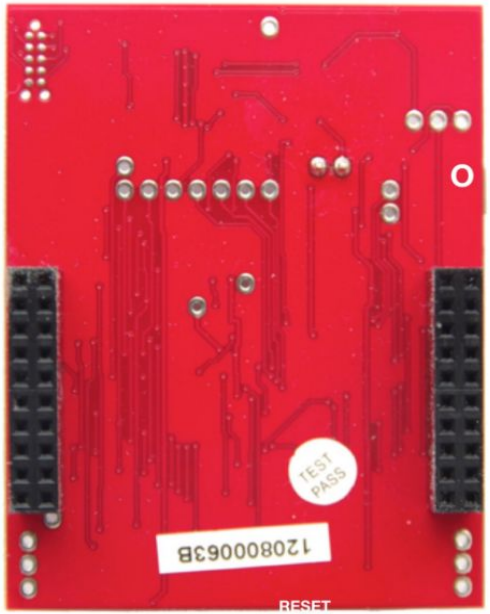
Flash	256	KB
SRAM	32	KB

Serial	hardware	
ADC	12	bits
Use pins numbers only!		

Hardware
Pin number
Other pin number

I²C
Serial UART
SPI

analogRead()
digitalRead() and digitalWrite()
digitalRead(), digitalWrite() and analogWrite()



			J2	J4				
		GROUND		20	40	PF_2	BLUE_LED	SCK (1)
	SCL (0)		PB_2	19	39	PF_3	GREEN_LED	CS (1)
RX (7)		A3	PE_0	18	38	PB_3		SDA (0)
MISO (1)		PUSH2	PF_0	17	37	PC_4		RX (1)
		RESET		16	36	PC_5		TX (1)
MOSI (2)			PB_7	15	35	PC_6		RX (3)
MISO (2)			PB_6	14	34	PC_7		TX (3)
MISO (0)			PA_4	13	33	PD_6		RX (2)
CS (0)			PA_3	12	32	PD_7	Detection	TX (2)
SCK (0)			PA_2	11	31	PF_4	PUSH1	
							GROUND	
							GROUND	
							VBUS	

				J3	J1				
			VBUS		21	1		+3.3V	
			GROUND		22	2	PB_5	A11	CS (2)
SCK (3)	SCL (3)	A7	PD_0		23	3	PB_0		RX (1)
CS (3)	SDA (3)	A6	PD_1		24	4	PB_1		TX (1)
MISO (3)		A5	PD_2		25	5	PE_4	A9	SCL (2) RX (5)
MOSI (3)		A4	PD_3		26	6	PE_5	A8	SDA (2) TX (5)
TX (7)		A2	PE_1		27	7	PB_4	A10	SCK (2)
		A1	PE_2		28	8	PA_5		MOSI (0)
		A0	PE_3		29	9	PA_6		SCL (1)
MOSI (1)		RED_LED	PF_1		30	10	PA_7		SDA (1)
		GROUND					PA_0		RX (0)
		GROUND					PA_1		TX (0)
		VBUS					PD_4		RX (6)
							PD_5		TX (6)

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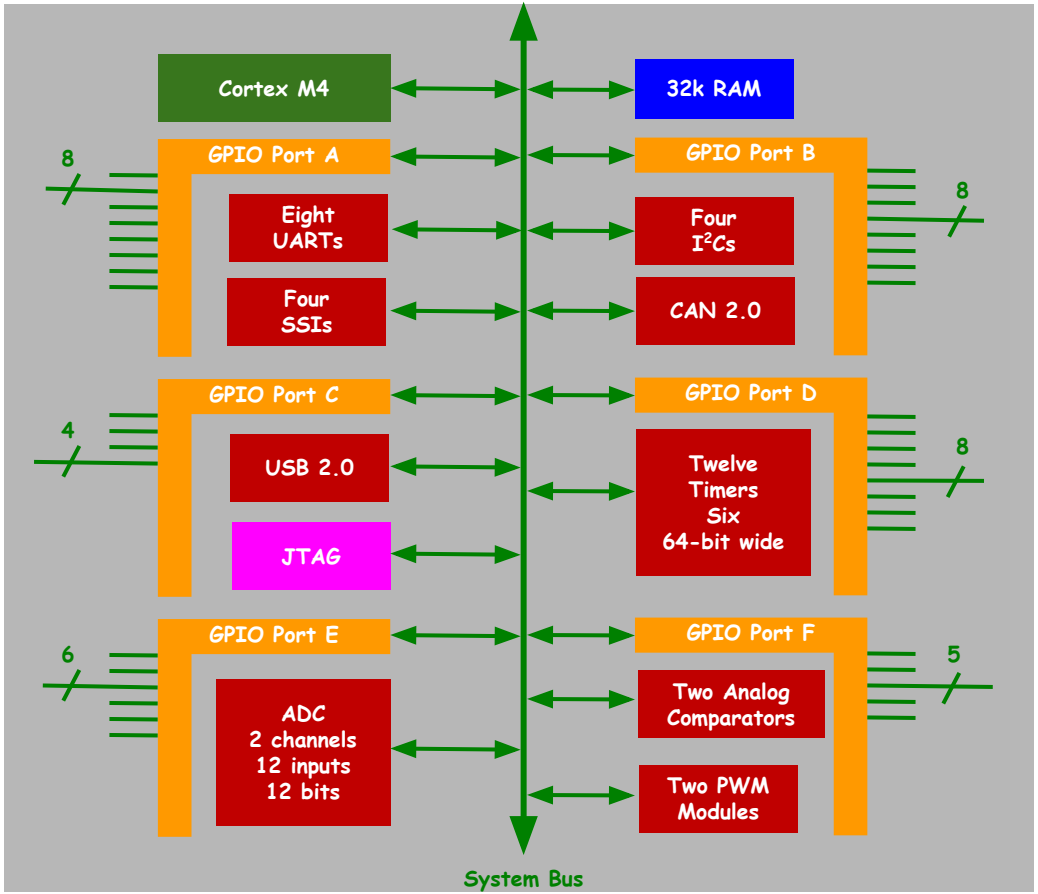
0Ω shunt

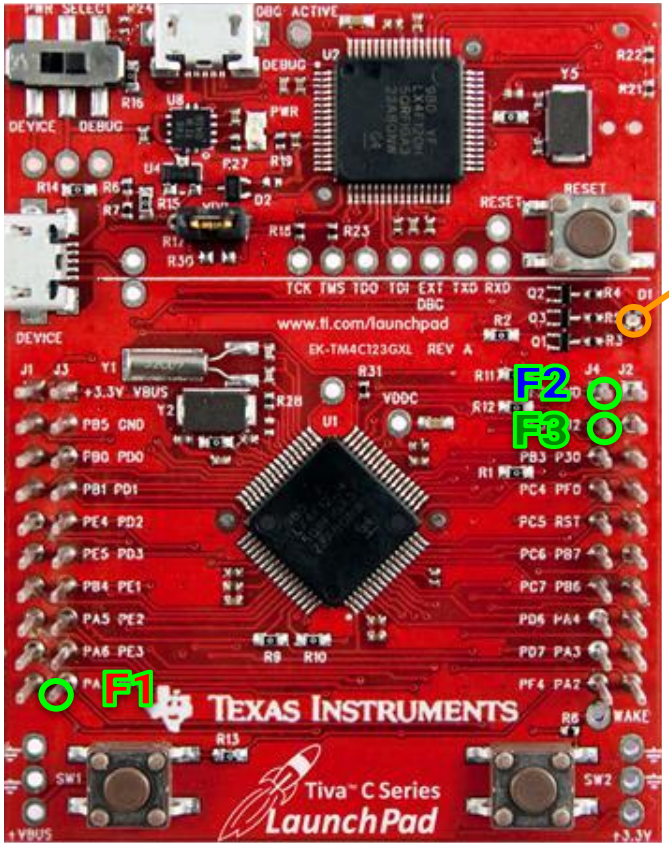
23	SCL (3)	PD_0	R9	PB_6	14
24	SDA (3)	PD_1	R10	PB_7	15

VBUS	detection	PD_7

I/O Portları


Cortex M4
32k RAM
GPIO Port A
GPIO Port B
8
Eight UARTs
Four I²Cs
8
Four SSIs
CAN 2.0
GPIO Port C
GPIO Port D
4
USB 2.0
Twelve Timers Six 64-bit wide
8
JTAG
GPIO Port E
GPIO Port F
6
ADC 2 channels 12 inputs 12 bits
Two Analog Comparators
5
Two PWM Modules
System Bus

Kartın üzerindeki ledi yakma



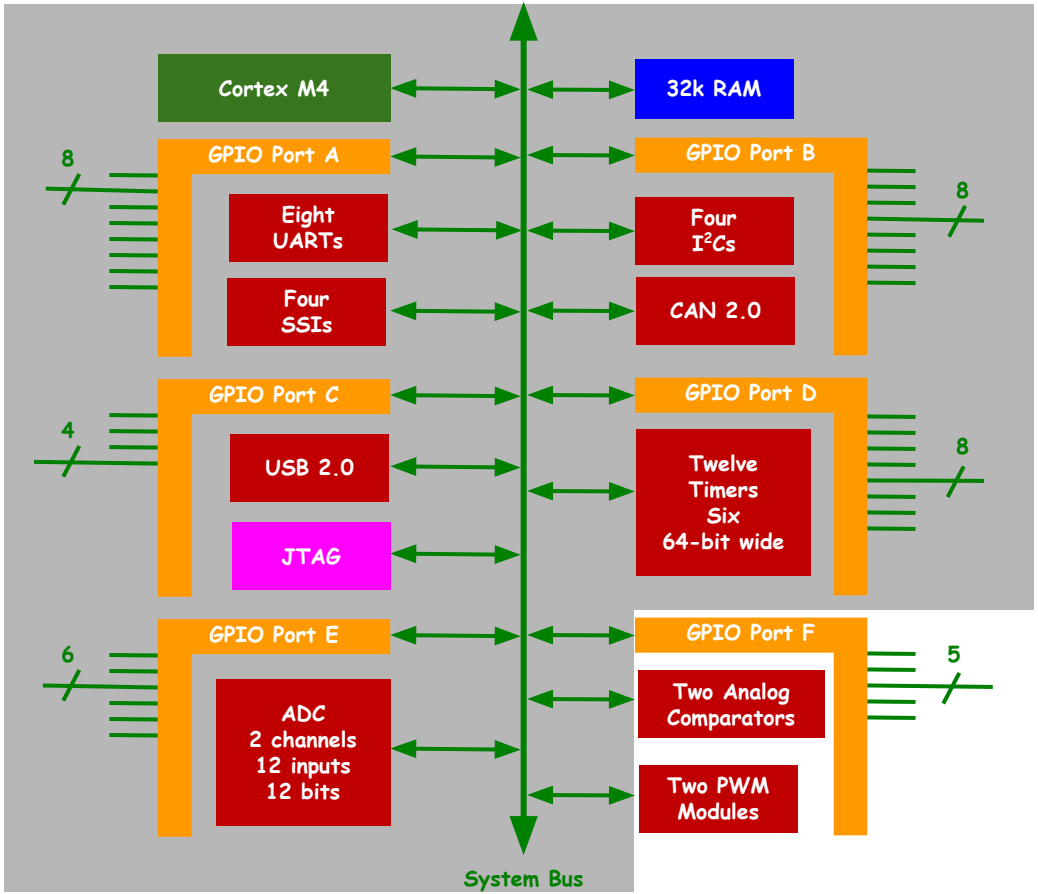
Kırmızı LED
Mavi LED
Yesil LED

Port F1 ---> Kırmızı LED

Port F2 ---> Mavi LED

Port F3 ---> Yesil LED

Kartın üzerindeki ledi yakma



Kartın üzerindeki ledi yakma

```
#include <stdint.h>
#include "inc/tm4c123gh6pm.h"
int main(void) {




}
```

Gerekli Kütüphanelerin Eklenmesi

(int8_t, int16_t, int32_t, uint8_t, uint16_t, uint32_t) tipindeki tamsayı değerlerinin kullanılmasını sağlar

```
#include <stdint.h>
```

Gerekli Kütüphanelerin Eklenmesi

(int8_t, int16_t, int32_t, uint8_t, uint16_t, uint32_t) tipindeki tamsayı değerlerinin kullanılmasını sağlar

```
#include <stdint.h>
```

tiva kütüphanesi

```
#include "inc/tm4c123gh6pm.h"
```

Gerekli Kütüphanelerin Eklenmesi

(int8_t, int16_t, int32_t, uint8_t, uint16_t, uint32_t) tipindeki tamsayı değerlerinin kullanılmasını sağlar

```
#include <stdint.h>
```

tiva kütüphanesi

```
#include "inc/tm4c123gh6pm.h"
```

stellaris kütüphanesi

```
#include "inc/lm4f120h5qr.h"
```

Kartın üzerindeki ledi yakma

```
#include <stdint.h>
#include "inc/tm4c123gh6pm.h"
int main(void) {
        volatile unsigned long delay;









}
```

“volatile” (uçucu) degisken

```
int delay = 0;
while(delay == 0);
```

"volatile" (uçucu) degisken

Degiskenin degerini donanım degistirebilir;

```
int delay = 0;
while(delay == 0);
```

“volatile” (uçucu) degisken

Degiskenin degerini donanım degistirebilir;

```
int delay = 0;
while(delay == 0);
```

!!!!!!!!!!

Derleyici donanım sevyesine inmeden degiskeni kaldırır:

"volatile" (uçucu) degisken

Degiskenin degerini donanım degistirebilir;

```
int delay = 0;
while(delay == 0);
```

!!!!!!!!!!

Derleyici donanım sevyesine inmeden degiskeni kaldırır:

Derleyicinin degiskene müdahil olmasını engellemek için;

```
volatile int delay = 0;
while(delay == 0);
```

Kartın üzerindeki ledi yakma

```
#include <stdint.h>
#include "inc/tm4c123gh6pm.h"
int main(void) {
        volatile unsigned long delay;

        SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;









}
```

System Control Run Mod Clock Gate Control Register

```
// Port F sayacını aktifleştirir
SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;
```

System Control Run Mod Clock Gate Control Register

Adres	7	6	5	4	3	2	1	0	İsim
$400F.E108	...	...	GPIOF	GPIOE	GPIOD	GPIOC	GPIOB	GPIOA	SYSCTL_RCGC2_R

0b00000001 = 0x01
0b00000010 = 0x02
0b00000100 = 0x04
0b00001000 = 0x08
0b00010000 = 0x10
0b00100000 = 0x20

System Control Run Mod Clock Gate Control Register

Adres	7	6	5	4	3	2	1	0	İsim
$400F.E108	...	...	GPIOF	GPIOE	GPIOD	GPIOC	GPIOB	GPIOA	SYSCTL_RCGC2_R

```
0b00000001  =  0x01   SYSCTL_RCGC2_R |= 0x01;   // Port A sayacını aktifleştirir
0b00000010  =  0x02   SYSCTL_RCGC2_R |= 0x02;   // Port B sayacını aktifleştirir
0b00000100  =  0x04   SYSCTL_RCGC2_R |= 0x04;   // Port C sayacını aktifleştirir
0b00001000  =  0x08   SYSCTL_RCGC2_R |= 0x08;   // Port D sayacını aktifleştirir
0b00010000  =  0x10   SYSCTL_RCGC2_R |= 0x10;   // Port E sayacını aktifleştirir
0b00100000  =  0x20   SYSCTL_RCGC2_R |= 0x20;   // Port F sayacını aktifleştirir
```

System Control Run Mod Clock Gate Control Register

```
// Port F sayacını aktifleştirir
SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;
```

SYSCTL_RCGC2_R x x x x x x x x

System Control Run Mod Clock Gate Control Register

```
// Port F sayacını aktifleştirir
SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;
```

SYSCTL_RCGC2_R	x x x x x x x x
SYSCTL_RCGC2_GPIOF	0 0 1 0 0 0 0 0

System Control Run Mod Clock Gate Control Register

```
// Port F sayacını aktifleştirir
SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;
```

SYSCTL_RCGC2_R	x x x x x x x x
SYSCTL_RCGC2_GPIOF	0 0 1 0 0 0 0 0

OR

System Control Run Mod Clock Gate Control Register

// Port F sayacını aktifleştirir

```
SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;
```

SYSCTL_RCGC2_R	x x x x x x x x
SYSCTL_RCGC2_GPIOF	0 0 1 0 0 0 0 0
OR	
SYSCTL_RCGC2_R	x x 1 x x x x x

System Control Run Mod Clock Gate Control Register

Adres	7	6	5	4	3	2	1	0	İsim
$400F.E108	...	...	GPIOF	GPIOE	GPIOD	GPIOC	GPIOB	GPIOA	SYSCTL_RCGC2_R

```
SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOA;     // Port A clock aktifleştirir
SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOB;     // Port B clock aktifleştirir
SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOC;     // Port C clock aktifleştirir
SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOD;     // Port D clock aktifleştirir
SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOE;     // Port E clock aktifleştirir
SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;     // Port F clock aktifleştirir
```

Kartın üzerindeki ledi yakma

```
#include <stdint.h>
#include "inc/tm4c123gh6pm.h"
int main(void) {
        volatile unsigned long delay;

        SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;

        delay = SYSCTL_RCGC2_R;









}
```

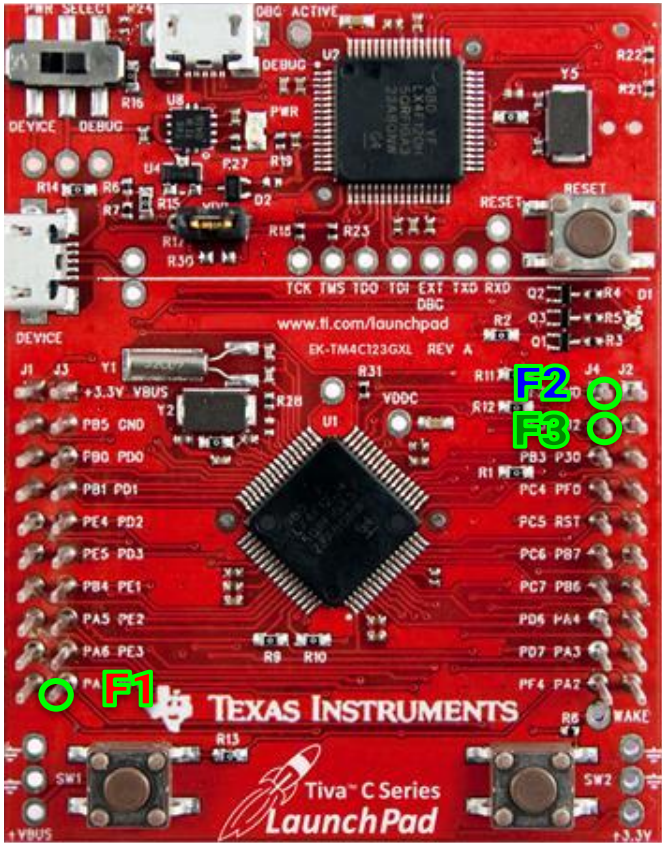
Kartın üzerindeki ledi yakma

```
// zaman gecirmek icin yukarida degistirilen saklayıcı okunur
delay = SYSCTL_RCGC2_R;
```

Kartın üzerindeki ledi yakma

```
#include <stdint.h>
#include "inc/tm4c123gh6pm.h"
int main(void) {
        volatile unsigned long delay;

        SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;

        delay = SYSCTL_RCGC2_R;

        GPIO_PORTF_DIR_R |= 0b00000100;









}
```

Kartın üzerindeki ledi yakma



Port F1 ---> Kırmızı LED

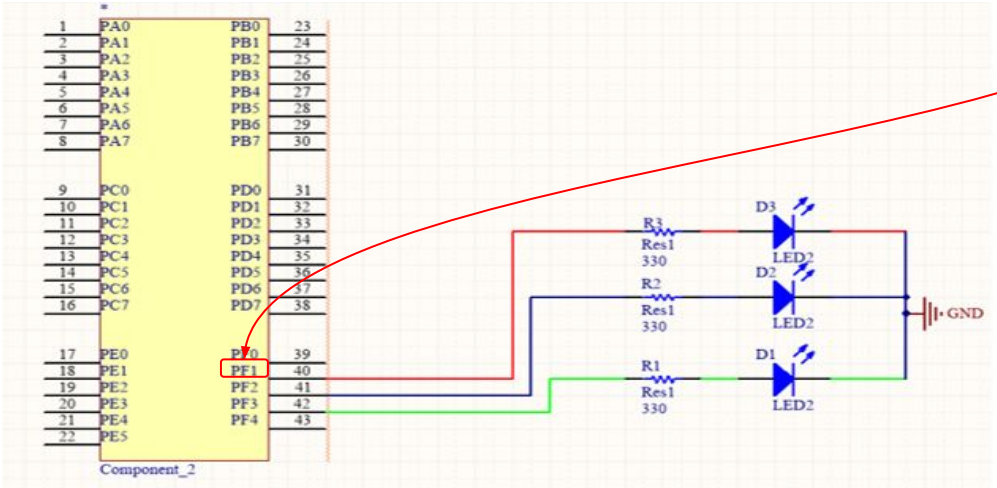
Port F2 ---> Mavi LED

Port F3 ---> Yesil LED

Kartın üzerindeki ledi yakma

GPIO_PORTF_DIR_R

31	30	29	28	27	. . .	3	2	1	0
x	x	x	x	x	. . .	0	0	1	0



Direction Register

```
GPIO_PORTF_DIR_R |= 0b00000010;   // PF1 pinini cikis yap
```

Direction Register

```
GPIO_PORTF_DIR_R |= 0b00000010;   // PF1 pinini cikis yap
```

GPIO_PORTF_DIR_R x x x x x x x x

Direction Register

```
GPIO_PORTF_DIR_R |= 0b00000010;   // PF1 pinini cikis yap
```

GPIO_PORTF_DIR_R x x x x x x x x

0 0 0 0 0 0 1 0

OR

Direction Register

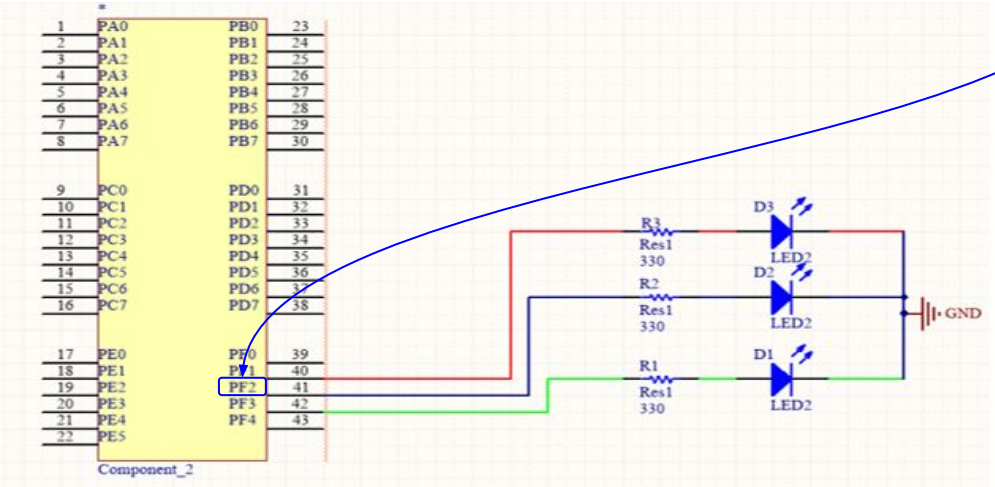
```
GPIO_PORTF_DIR_R |= 0b00000010;   // PF1 pinini cikis yap
```

GPIO_PORTF_DIR_R	x x x x x x x x
	0 0 0 0 0 0 1 0
OR	
GPIO_PORTF_DIR_R	x x x x x x 1 x

Direction Register

GPIO_PORTF_DIR_R

31	30	29	28	27	. . .	3	2	1	0
x	x	x	x	x	. . .	0	1	0	0



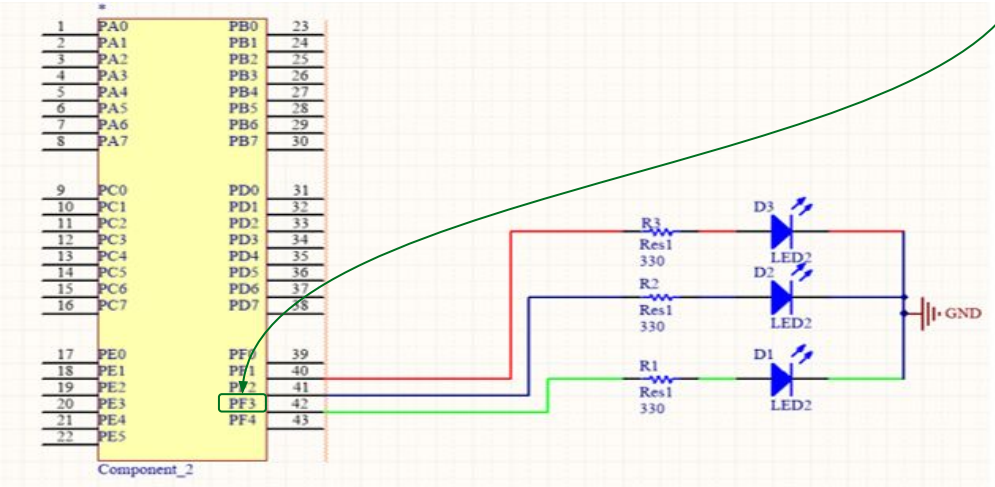
Direction Register

```
GPIO_PORTF_DIR_R |= 0b00000010;   // PF1 pinini cikis yap
GPIO_PORTF_DIR_R |= 0b00000100;   // PF2 pinini cikis yap
```

Direction Register

GPIO_PORTF_DIR_R

31	30	29	28	27	. . .	3	2	1	0
x	x	x	x	x	. . .	1	0	0	x



Direction Register

```
GPIO_PORTF_DIR_R |= 0b00000010;   // PF1 pinini cikis yap
GPIO_PORTF_DIR_R |= 0b00000100;   // PF2 pinini cikis yap
GPIO_PORTF_DIR_R |= 0b00001000;   // PF3 pinini cikis yap
```

Kartın üzerindeki ledi yakma

```
#include <stdint.h>
#include "inc/tm4c123gh6pm.h"
int main(void) {
        volatile unsigned long delay;

        SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;

        delay = SYSCTL_RCGC2_R;

        GPIO_PORTF_DIR_R |= 0b00000100;
        GPIO_PORTF_DEN_R |= 0b00000100;









}
```

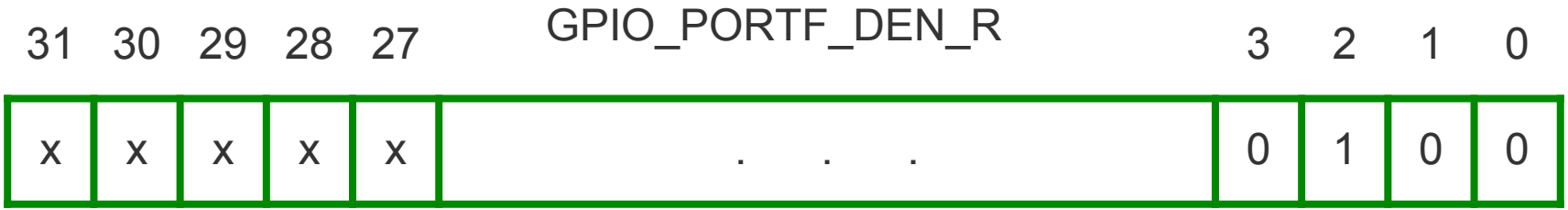
Digital Enable Register

```
GPIO_PORTF_DEN_R |= 0b00000100; // PF2 pinini aktiflestir
```

Digital Enable Register

```
GPIO_PORTF_DEN_R |= 0b00000100; // PF2 pinini aktiflestir
```

GPIO_PORTF_DEN_R

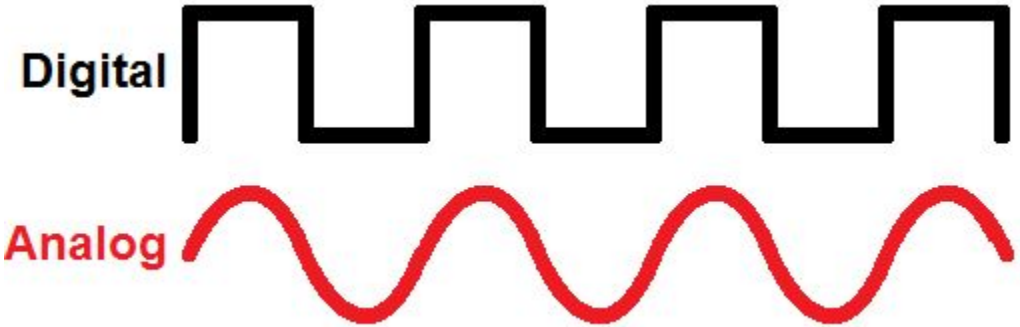


Digital Enable Register

```
GPIO_PORTF_DEN_R |= 0b00000100; // PF 3 pinini aktiflestir
```

GPIO_PORTF_DEN_R

31	30	29	28	27	. . .	3	2	1	0
x	x	x	x	x	. . .	0	1	0	0



Digital Enable Register

```
GPIO_PORTF_DEN_R |= 0b00000100; // PF2 pinini aktiflestir
```

GPIO_PORTF_DEN_R x x x x x x x x

Digital Enable Register

```
GPIO_PORTF_DEN_R |= 0b00000100; // PF2 pinini aktiflestir
```

GPIO_PORTF_DEN_R	x x x x x x x x
	0 0 0 0 0 10 0
OR	

Digital Enable Register

```
GPIO_PORTF_DEN_R |= 0b00000100; // PF2 pinini aktiflestir
```

GPIO_PORTF_DEN_R	x x x x x x x x
	0 0 0 0 0 10 0
OR	
GPIO_PORTF_DEN_R	x x x x x 1 x x

Kartın üzerindeki ledi yakma

```
#include <stdint.h>
#include "inc/tm4c123gh6pm.h"
int main(void) {
        volatile unsigned long delay;

        SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;

        delay = SYSCTL_RCGC2_R;

        GPIO_PORTF_DIR_R |= 0b00000100;
        GPIO_PORTF_DEN_R |= 0b00000100;

        while(1) {









}
```

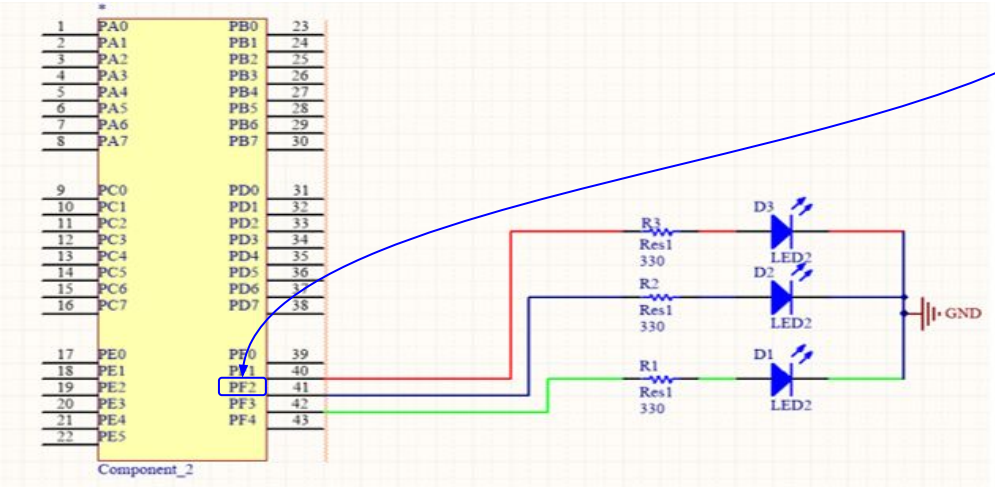
Kartın üzerindeki ledi yakma

```
#include <stdint.h>
#include "inc/tm4c123gh6pm.h"
int main(void) {
	volatile unsigned long delay;

	SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;

	delay = SYSCTL_RCGC2_R;

	GPIO_PORTF_DIR_R |= 0b00000100;
	GPIO_PORTF_DEN_R |= 0b00000100;

	while(1) {
		GPIO_PORTF_DATA_R |= 0b00000100;









}
```

Data Register

GPIO_PORTF_DATA_R

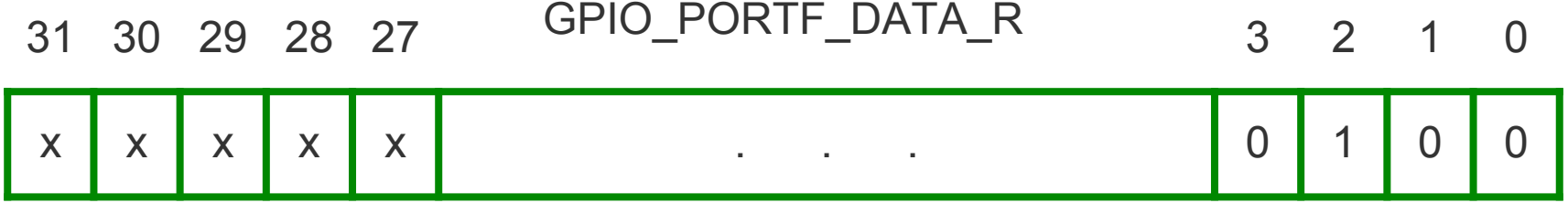
31	30	29	28	27	. . .	3	2	1	0
x	x	x	x	x	. . .	0	1	0	0



Data Register

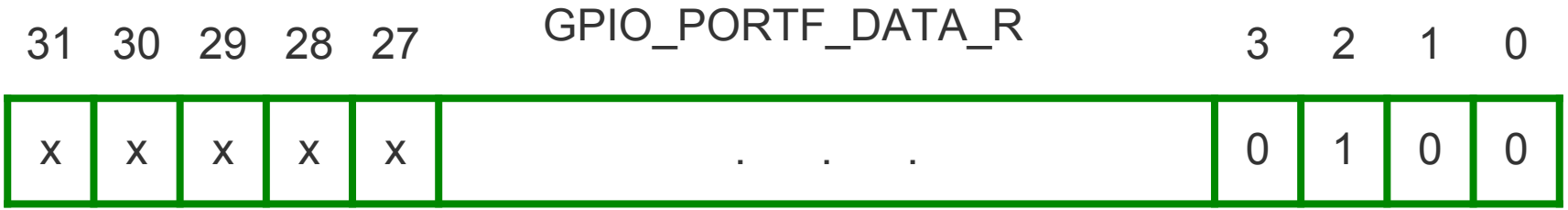
```
GPIO_PORTF_DATA_R |= 0b00000100;
```

GPIO_PORTF_DATA_R



Data Register

```
GPIO_PORTF_DATA_R |= 0b00000100;
```



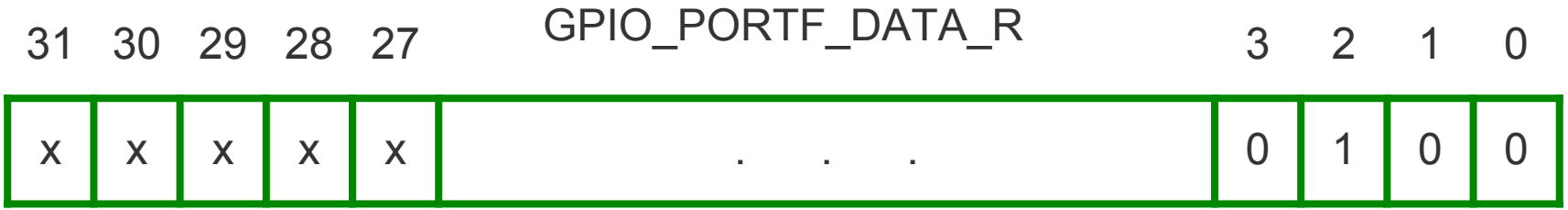
GPIO_PORTF_DATA_R x x x x

0 10 0

OR

Data Register

```
GPIO_PORTF_DATA_R |= 0b00000100;
```



GPIO_PORTF_DATA_R x x x x

0 10 0

OR

GPIO_PORTF_DATA_R x 1 x x

Data Register

```
GPIO_PORTF_DATA_R |= 0b00000100;
```

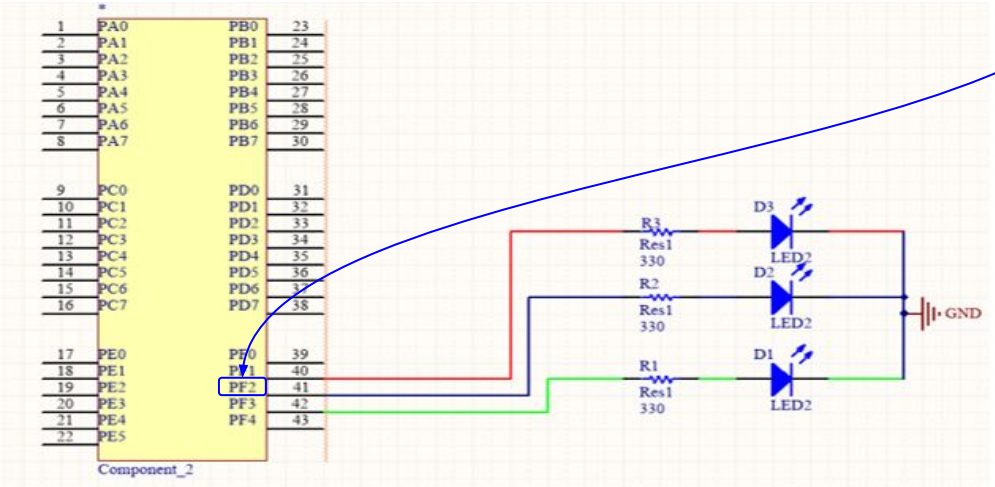
Kartın üzerindeki ledi yakma

```
#include <stdint.h>
#include "inc/tm4c123gh6pm.h"
int main(void) {
        volatile unsigned long delay;

        SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;

        delay = SYSCTL_RCGC2_R;

        GPIO_PORTF_DIR_R |= 0b00000100;
        GPIO_PORTF_DEN_R |= 0b00000100;

        while(1) {
                GPIO_PORTF_DATA_R |= 0b00000100;



                GPIO_PORTF_DATA_R &= ~(0b00000100);


        }
}
```

Data Register

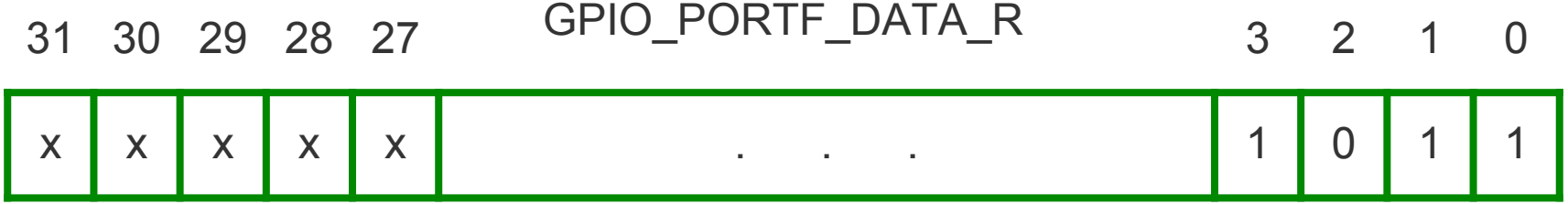
GPIO_PORTF_DATA_R

31	30	29	28	27	. . .	3	2	1	0
x	x	x	x	x	. . .	1	0	1	1



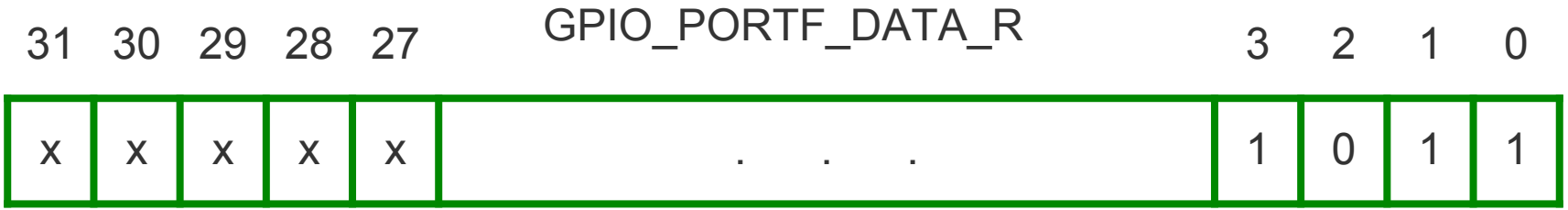
Data Register

```
GPIO_PORTF_DATA_R &= ~(0b00000100);
```



Data Register

```
GPIO_PORTF_DATA_R &= ~(0b00000100);
```



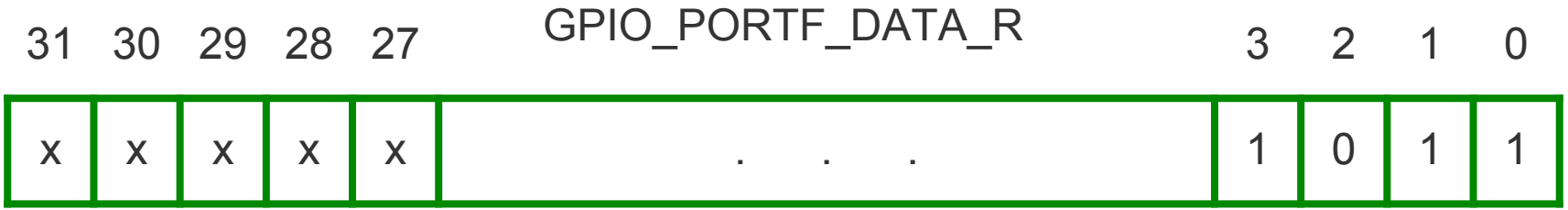
GPIO_PORTF_DATA_R x x x x

1 0 1 1

AND

Data Register

```
GPIO_PORTF_DATA_R &= ~(0b00000100);
```



GPIO_PORTF_DATA_R x x x x

1 0 1 1

AND

GPIO_PORTF_DATA_R x 0 x x

Data Register

```
GPIO_PORTF_DATA_R &= ~(0b00000100);
```

Kartın üzerindeki ledi yakma

```
#include <stdint.h>
#include "inc/tm4c123gh6pm.h"
int main(void) {
        volatile unsigned long delay;

        SYSCTL_RCGC2_R |= SYSCTL_RCGC2_GPIOF;

        delay = SYSCTL_RCGC2_R;

        GPIO_PORTF_DIR_R |= 0b00000100;
        GPIO_PORTF_DEN_R |= 0b00000100;

        while(1) {
                GPIO_PORTF_DATA_R |= 0b00000100;
                for(delay = 0; delay < 400000; delay++)
                        /* bos dongu ile bekle */;

                GPIO_PORTF_DATA_R &= ~(0b00000100);
                for(delay = 0; delay < 400000; delay++)
                        /* bos dongu ile bekle */;
        }
}
```

Data Register

```
while(1) {
        GPIO_PORTF_DATA_R |= 0b00000100;
        for(delay = 0; delay < 400000; delay++)
            /* bos dongu ile bekle */;

        GPIO_PORTF_DATA_R &= ~(0b00000100);
        for(delay = 0; delay < 400000; delay++)
            /* bos dongu ile bekle */;
    }
```

Sorular