Organizacija računalnikov

Laboratorijske vaje

R. Rozman 2026

Vsebina vaj

Trije tematski sklopi :

1. **Programiranje v zbirnem jeziku ARM (3 vaje) - *STM32H750B-DK Discovery***
   - Ponovitev RA, razširitev, nadgradnja:
     - Delo z biti, sklad, podprogrami

2. **Sistemske naprave v zbirniku (7 vaj) - *STM32H750B-DK Discovery***
   - Paralelni vhod/izhod: GPIO
   - Časovniki: TIM, SysTick
   - Serijske povezave: U(S)ART, USB VCOM port
   - Prekinitve, prekinitveni krmilnik, SDRAM, Mini RTOS (AIC)

Primeri in osnove tudi v jeziku C (neobvezno)

3. **MiMo lab. vaja (v1, v2 - v skladu s predavanji nekje vmes)**

2 obvezni (po 80%) in 2 neobvezni domači nalogi (po 20%):

1. MiMo, osnovna (obv.), MiMo dodatno delo (neobv.)
2. ARM,STM32 - aplikacija (obv.), ARM,STM-Dodatna (razširitve, aplikacija, senzorji) (neobv.)

- Vsako dodatno delo šteje v neobvezni del za višjo oceno !!!

Vsebina vaj

Primer zadnje vaje – Mini RTOS :

1. Mini RTOS

- Preprost operacijski sistem za več procesov
  - 1000x v sekundi preklopi med procesoma
- Task0: Blink LED1
- Task1: Blink LED2

```
TASK0_Start:

bl LED1_ON
mov r0,#0
mov r1,#'1'
bl ITM_Send
mov r0,#'0'
bl SEND_UART

mov r0,#500
bl DELAY // Zakasnitev SW Delay: r0 x 1msec

bl LED1_OFF
mov r0,#0
mov r1,#'0'
bl ITM_Send

mov r0,#500
bl DELAY // Zakasnitev SW Delay: r0 x 1msec

b TASK0_Start
```

```
TASK1_Start:

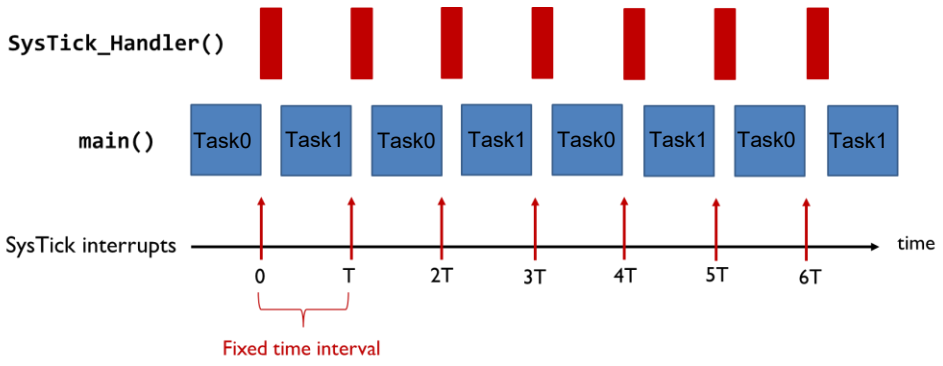
bl LED2_OFF
mov r0,#1
mov r1,#'+'
bl ITM_Send
mov r0,#'1'
bl SEND_UART

mov r0,#500
bl DELAY // Zakasnitev SW Delay: r0 x 1msec

bl LED2_ON
mov r0,#1
mov r1,#'-'
bl ITM_Send

mov r0,#500
bl DELAY // Zakasnitev SW Delay: r0 x 1msec

b TASK1_Start
```



Ocenjevanje OR

- Vaje prispevajo 50% h končni oceni in morajo biti opravljene:
  - Pozitivne domače naloge (obvezni del, 80%, ocena do 8),
  - Dodatne domače naloge (neobvezni del, 20%, višja ocena 8+).
    - Se prišteje obveznemu delu

  - *2022: Vzporedno uvajanje STM32F4, STM32H7 Discovery*
  - *2023: Vzporedno: STM32H7, STM32F4, FRI-SMS*
  - *2024, 25, 26: Osrednja platforma: STM32H7*

- Ustni izpit 50%

Spletni simulator cpulator – RA

- **https://cpulator.01xz.net/?sys=arm**
- **začetni projekt OR:**
  - https://cpulator.01xz.net/?sys=arm&loadasm=share/sN7suQe.s

```
        .data
@spremenljivke
STEV1:  .word   0x10
STEV2:  .word   0x40
REZ:    .word   0

        .text
        .org 0x20
        .align

        .global _start
_start:

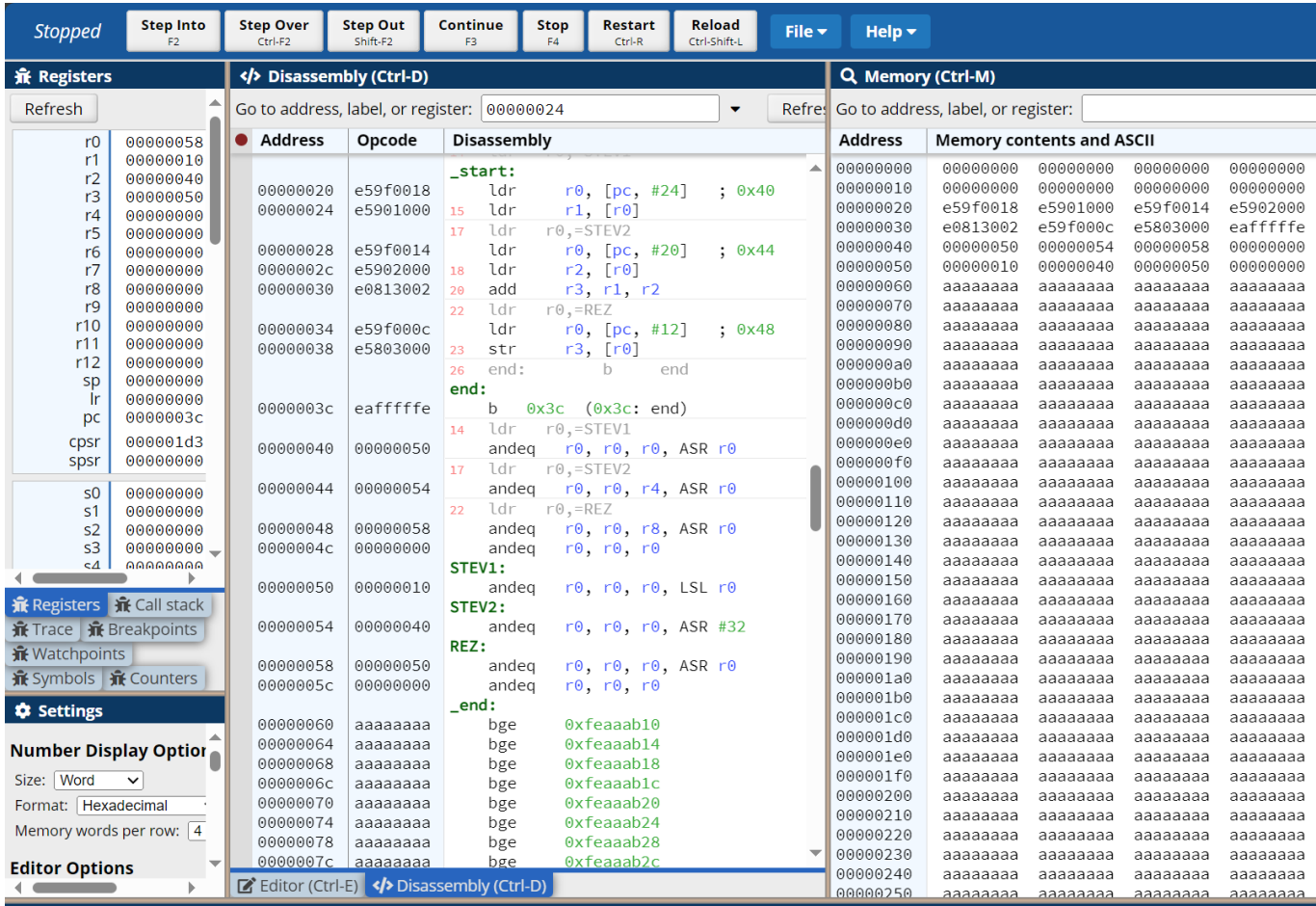
        ldr     r0,=STEV1
        ldr     r1,[r0]

        ldr     r0,=STEV2
        ldr     r2,[r0]

        add     r3,r1,r2

        ldr     r0,=REZ
        str     r3,[r0]


end:    b       end
```



RA - Praktično delo: vsota dveh števil

https://cpulator.01xz.net/?sys=arm&loadasm=share/sN7suQe.s

```
        .text
        .org 0x20
        .align

        .global _start
_start:

        ldr     r0,=STEV1
        ldr     r1,[r0]

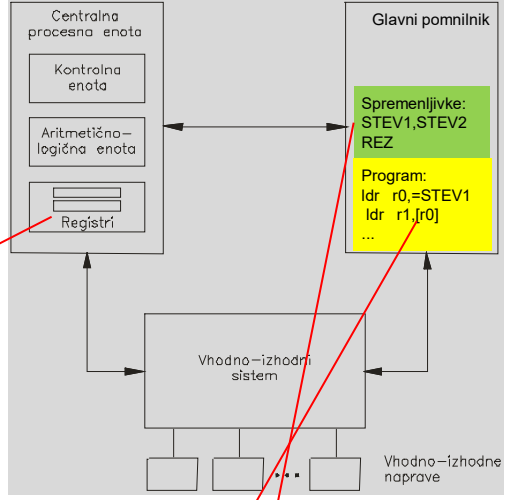
        ldr     r0,=STEV2
        ldr     r2,[r0]

        add     r3,r1,r2

        ldr     r0,=REZ
        str     r3,[r0]


end:    b       end
```

RA - Ponovitev



Step Into F2 | Step Over Ctrl-F2 | Step Out Shift-F2 | Continue F3 | Stop F4 | Restart Ctrl-R | Reload Ctrl-Shift-L | File | Help

Registers

Refresh

r0	00000058
r1	00000010
r2	00000040
r3	00000050
r4	00000000
r5	00000000
r6	00000000
r7	00000000
r8	00000000
r9	00000000
r10	00000000
r11	00000000
r12	00000000
sp	00000000
lr	00000000
pc	0000003c
cpsr	000001d3
spsr	00000000
s0	00000000
s1	00000000
s2	00000000
s3	00000000
s4	00000000

Registers | Call stack | Trace | Breakpoints | Watchpoints | Symbols | Counters

Disassembly (Ctrl-D)

Go to address, label, or register: 00000024 Refres

Address	Opcode	Disassembly
		_start:
00000020	e59f0018	ldr r0, [pc, #24] ; 0x40
00000024	e5901000	15 ldr r1, [r0]
		17 ldr r0,=STEV2
00000028	e59f0014	ldr r0, [pc, #20] ; 0x44
0000002c	e5902000	18 ldr r2, [r0]
00000030	e0813002	20 add r3, r1, r2
		22 ldr r0,=REZ
00000034	e59f000c	ldr r0, [pc, #12] ; 0x48
00000038	e5803000	23 str r3, [r0]
		26 end: b end
		end:
0000003c	eafffffe	b 0x3c (0x3c: end)
		14 ldr r0,=STEV1
00000040	00000050	andeq r0, r0, r0, ASR r0
		17 ldr r0,=STEV2
00000044	00000054	andeq r0, r0, r4, ASR r0
		22 ldr r0,=REZ
00000048	00000058	andeq r0, r0, r8, ASR r0
0000004c	00000000	andeq r0, r0, r0
		STEV1:
00000050	00000010	andeq r0, r0, r0, LSL r0
		STEV2:
00000054	00000040	andeq r0, r0, r0, ASR #32
		REZ:
00000058	00000050	andeq r0, r0, r0, ASR r0

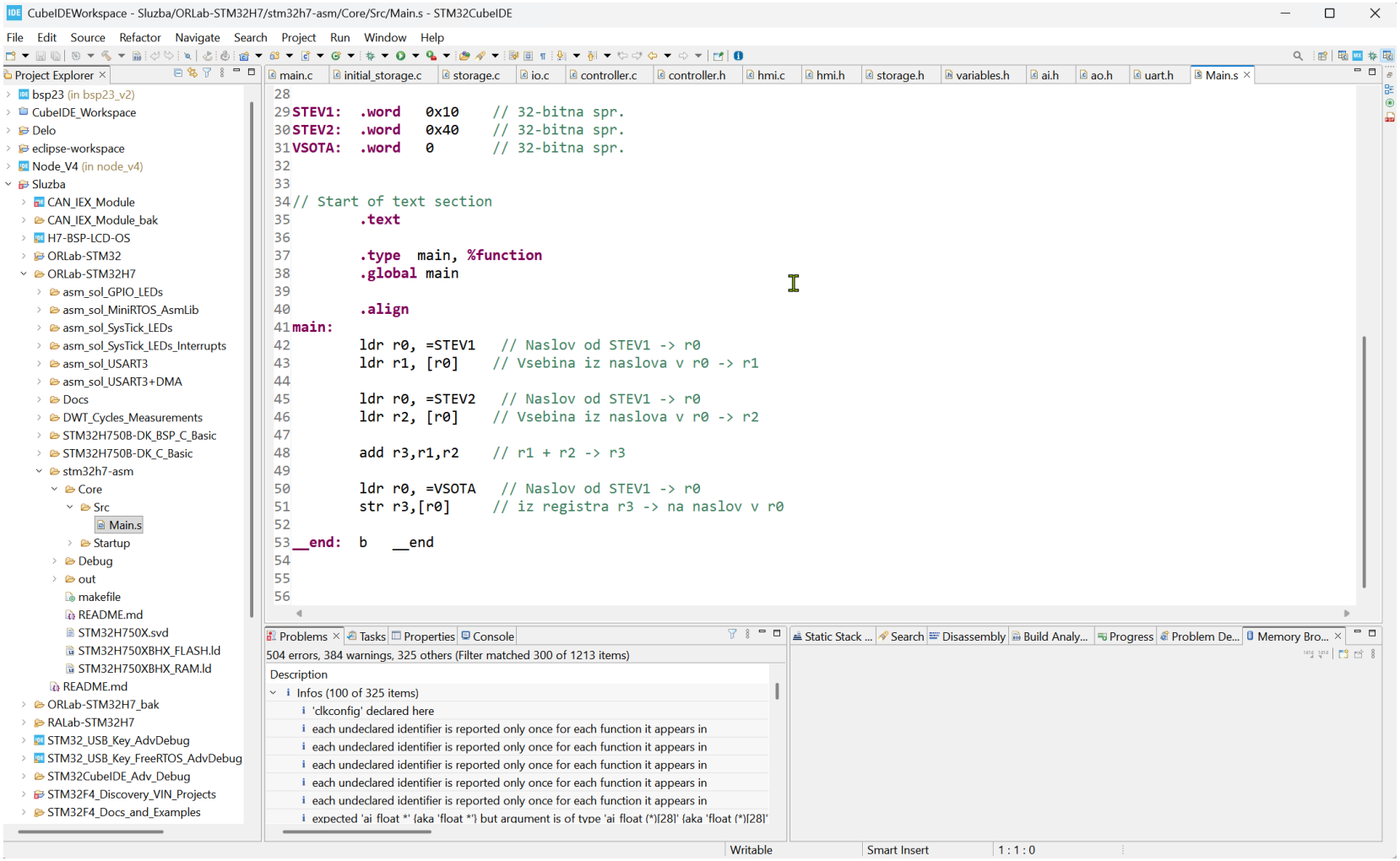
Memory (Ctrl-M)

Go to address, label, or register:

Address	Memory contents and ASCII			
00000000	00000000	00000000	00000000	00000000
00000010	00000000	00000000	00000000	00000000
00000020	e59f0018	e5901000	e59f0014	e5902000
00000030	e0813002	e59f000c	e5803000	eafffffe
00000040	00000050	00000054	00000058	00000000
00000050	00000010	00000040	00000050	00000000
00000060	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
00000070	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
00000080	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
00000090	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
000000a0	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
000000b0	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
000000c0	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
000000d0	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
000000e0	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
000000f0	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
00000100	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
00000110	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
00000120	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
00000130	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
00000140	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
00000150	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
00000160	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
00000170	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
00000180	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
00000190	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa
000001a0	aaaaaaaa	aaaaaaaa	aaaaaaaa	aaaaaaaa

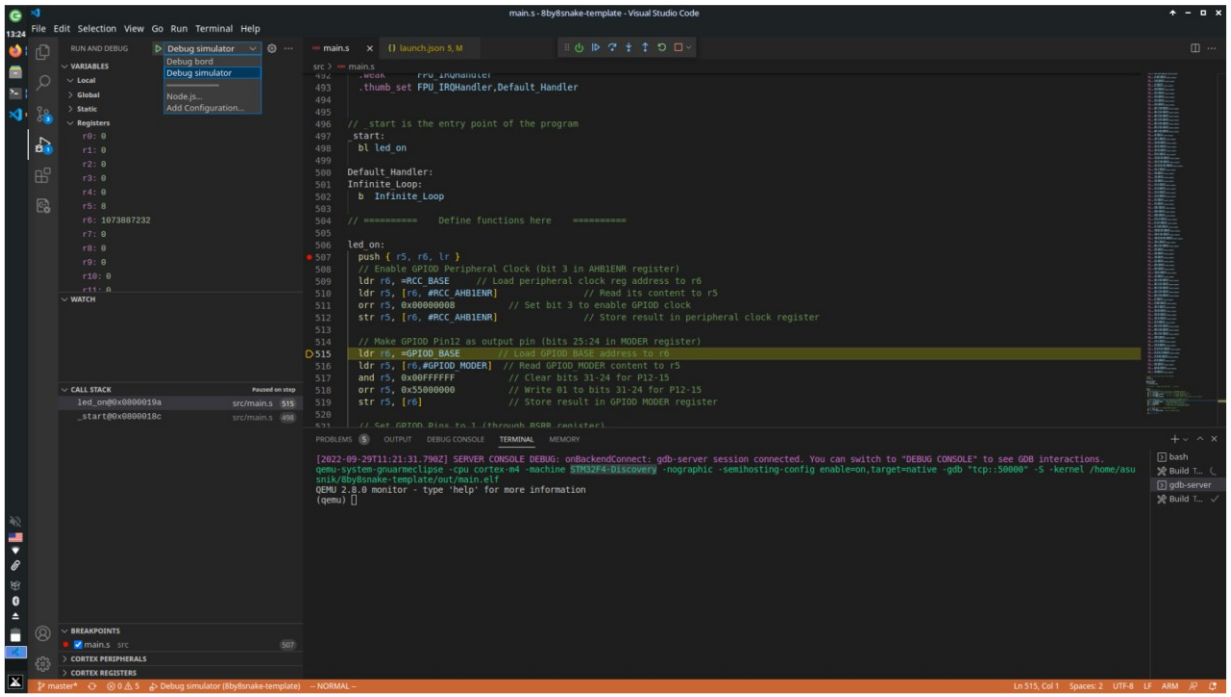
Razvojno okolje: CubeIDE

Delo s ploščami: STM32H7, STM32F4, STM32XX



Razvojno okolje: VSCode (opcija)

Delo s ploščami: STM32H7, STM32F4 , STM32XX
(ni „uradno“ podprt, je pa zanimiv)



Instalirate dodatek

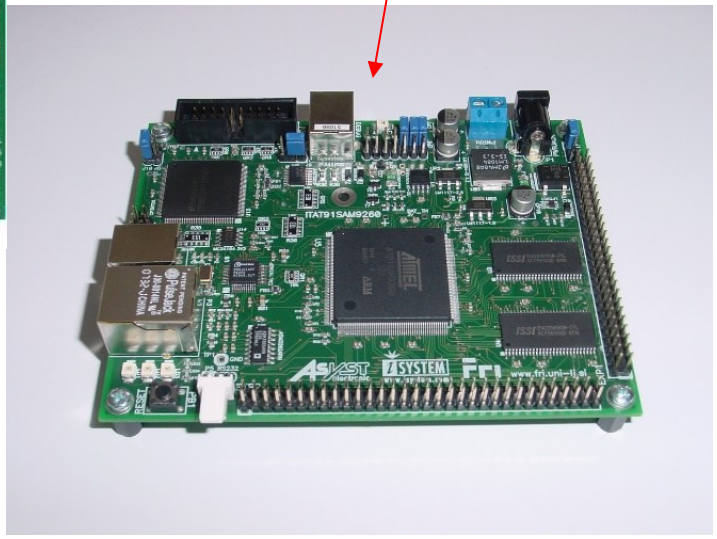


Delo s sistemi

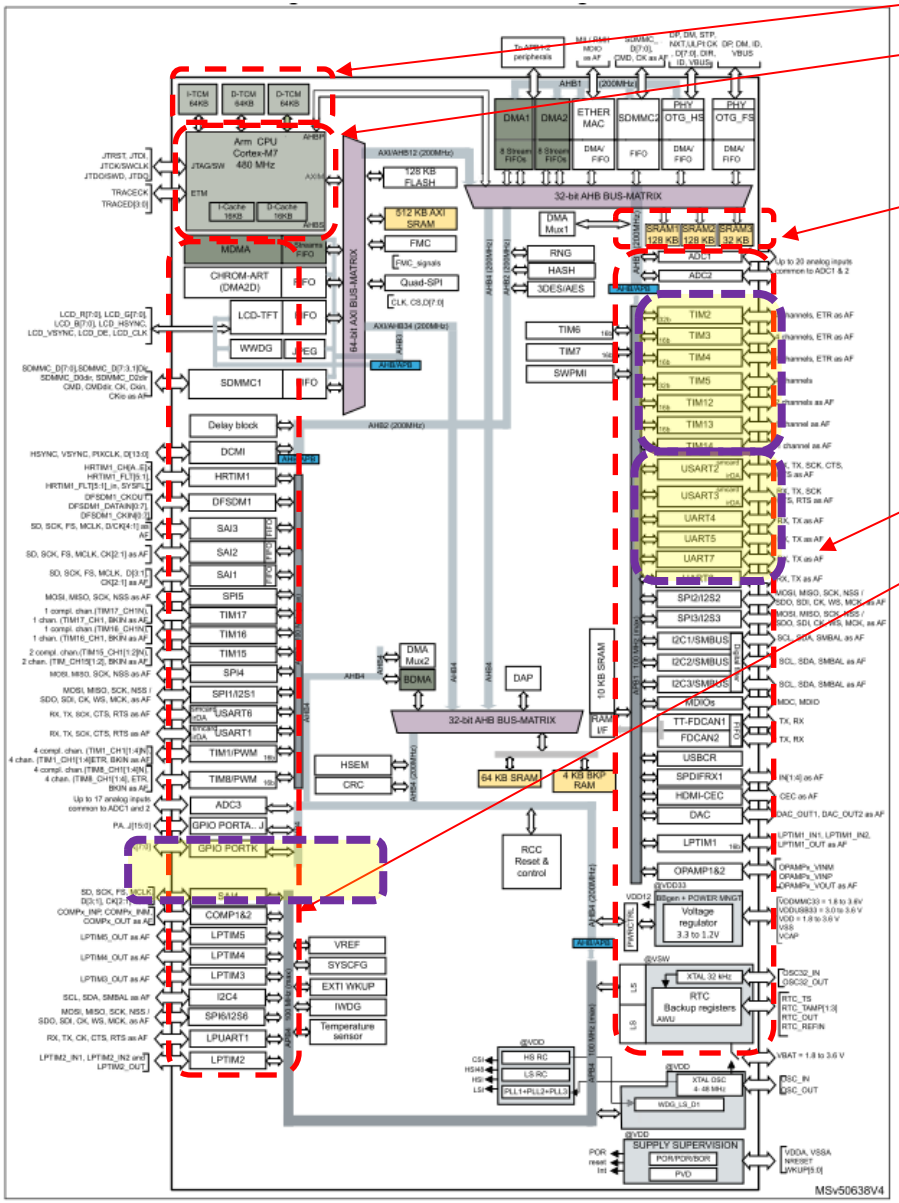
STM32H7 (osrednji), STM32F4 , FRI SMS

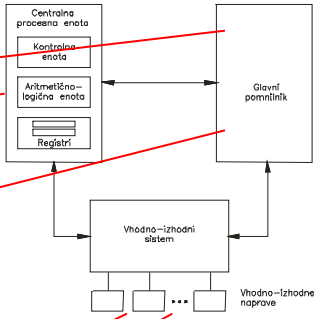




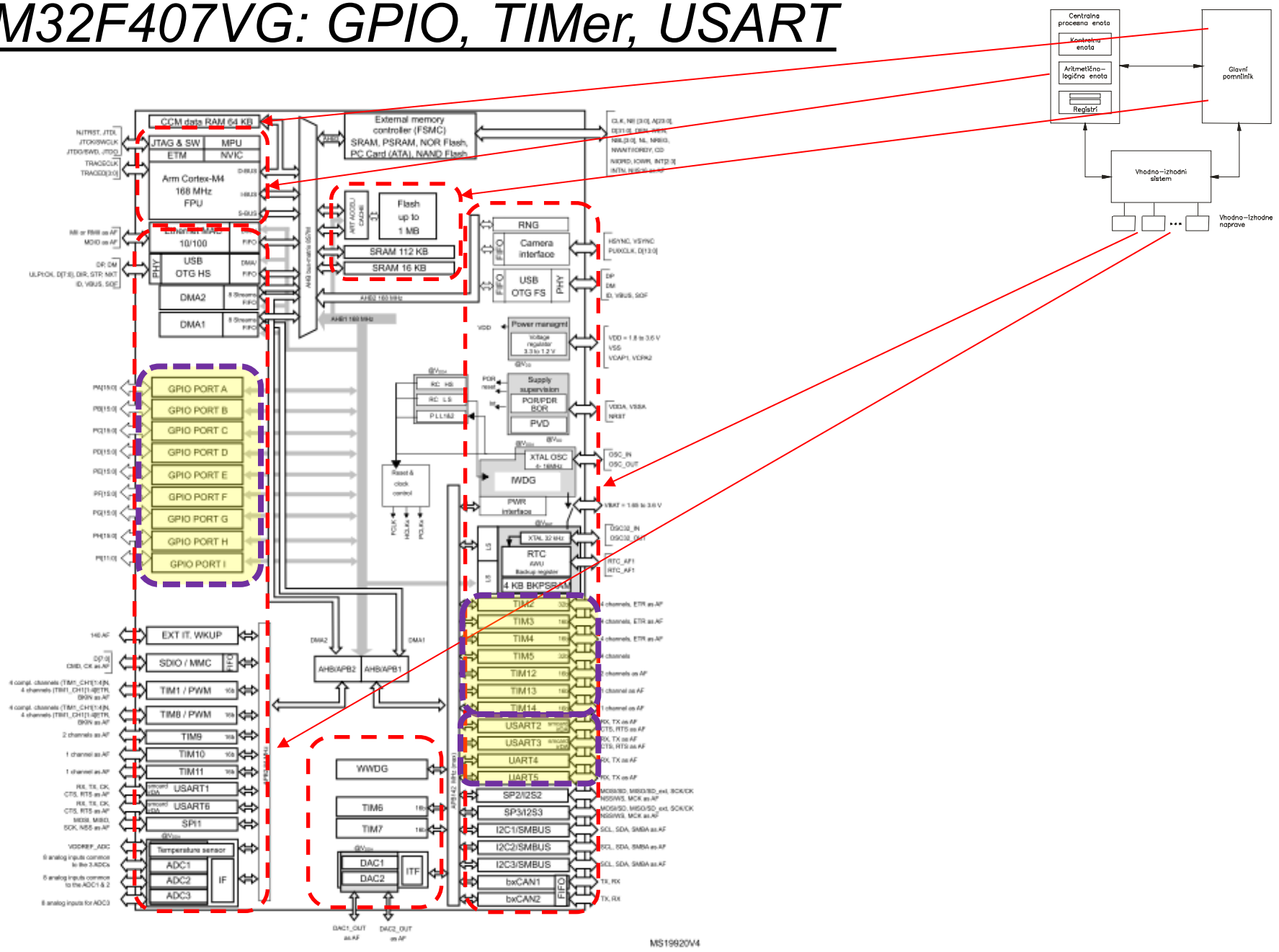


STM32H750: GPIO, TIMer, USART

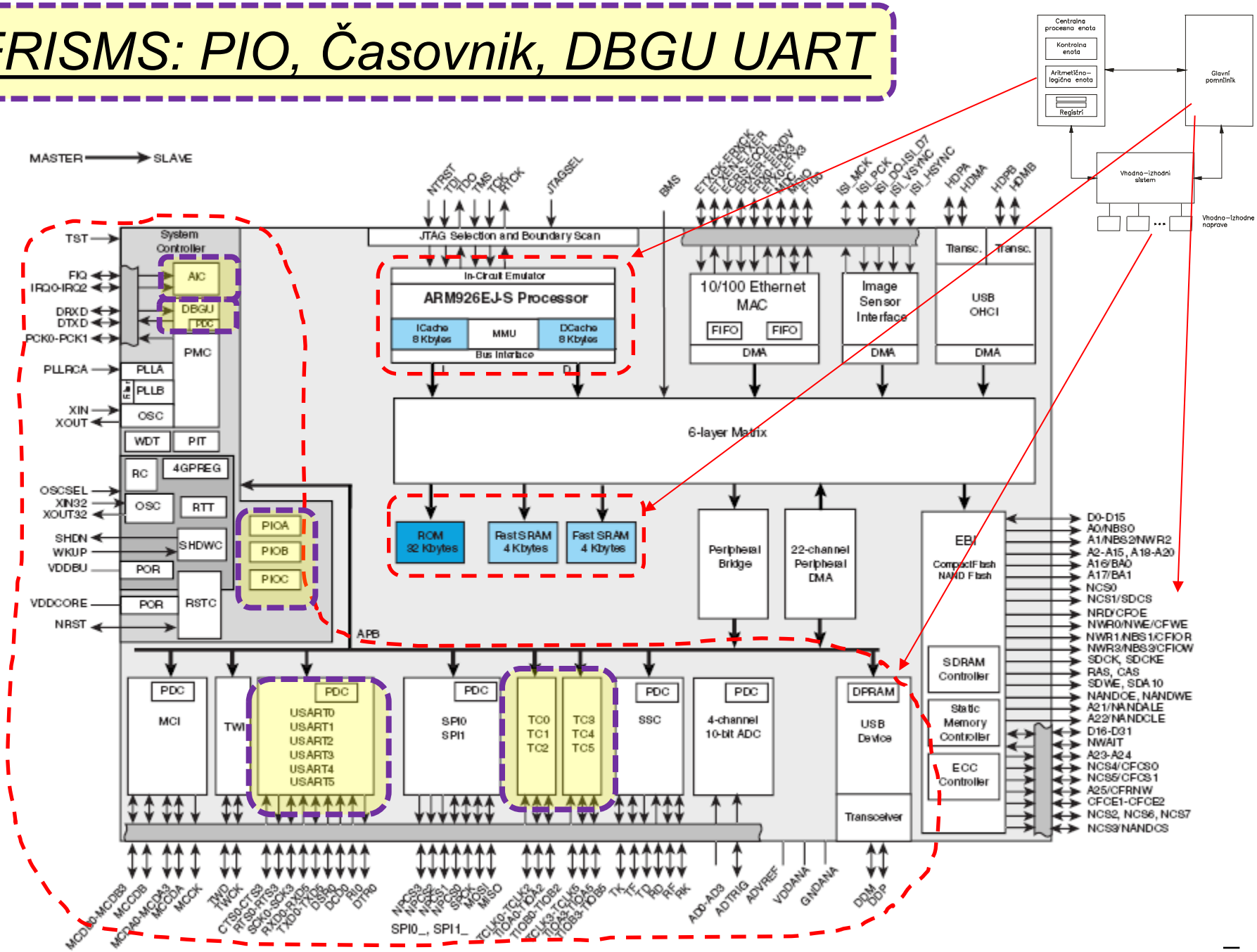




STM32F407VG: GPIO, TIMer, USART



FRISMS: PIO, Časovnik, DBGU UART



Iščete vsebine vaj, dodatne izzive, pomoč, ideje za projekte ?

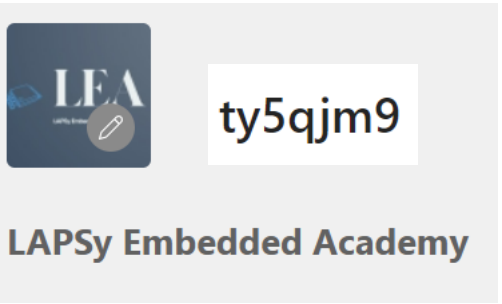
Dobrodošli:

- e-učilnica



- MS Teams
  - Komunikacija (govorilne ure, pogovor, pomoč),
  - OneNote zvezek z zapiski predavanj
  - Discord(https://discord.gg/RYd36J7zQc)

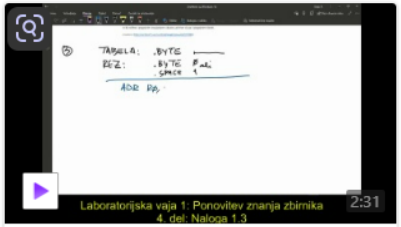
- LEA - Lapsy Embedded Academy
  - Projekt spletnega izobraževalnega portala z vsebinami RA, OR in VIN (ter ostalimi projekti, diplomami, tečaji, …)
  - https://unilj.sharepoint.com/sites/LAPSYEmbeddedAcademy/



LEA - Lapsy Embedded Academy

- https://unilj.sharepoint.com/sites/LAPSYEmbeddedAcademy/

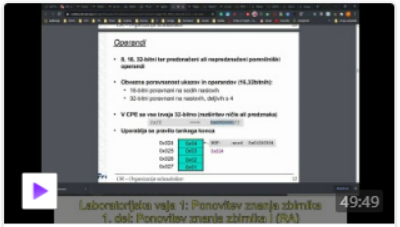
Programiranje v zbirniku ARM II (OR LAB I)



LAPSy Embedded Academy

_OR LAB 01-04 Programiranje v zbirniku II (OR LAB)_Krajši izseki.mp4

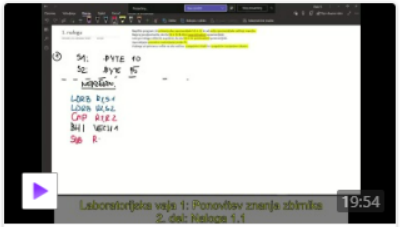
Rozman, Robert
Edited April 13, 2024



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OR LAB 01.1 Ponovitev znanja zbirnika_Ponovitev znanja zbirnika I...

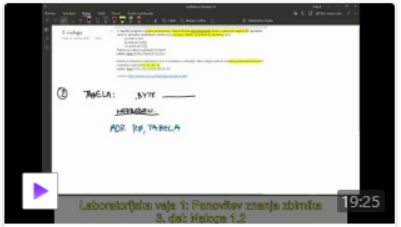
Rozman, Robert
Edited March 19, 2024



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OR LAB 01.2 Ponovitev znanja zbirnika_Naloga 1.1.mp4

Rozman, Robert
Edited March 19, 2024



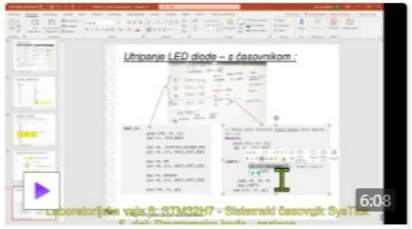
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OR LAB 01.3 Ponovitev znanja zbirnika_Naloga 1.2.mp4

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Programiranje v zbirniku ARM III - STM32H7 (OR LAB II)

See all



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_OR LAB 06-12 Programiranje v zbirniku III (OR-LAB II-STM32H7)_Krajši...

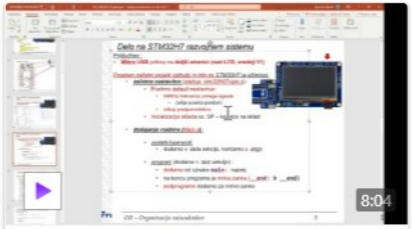
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OR LAB 06.1 STM32H7 - Osnovni projekt, GPIO in LED I_Predstavitev...

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OR LAB 06.2 STM32H7 - Osnovni projekt, GPIO in LED I_Projekt v zbirnik...

Rozman, Robert
Edited March 20, 2024



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OR LAB 06.3 STM32H7 - Osnovni projekt, GPIO in LED I_Osnovni projekt ...

Rozman, Robert
Edited March 20, 2024