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CMPE 443 PRINCIPLES OF EMBEDDED SYSTEMS DESIGN

LAB #002 “Debug, Memory and Optimization”

1) Debug

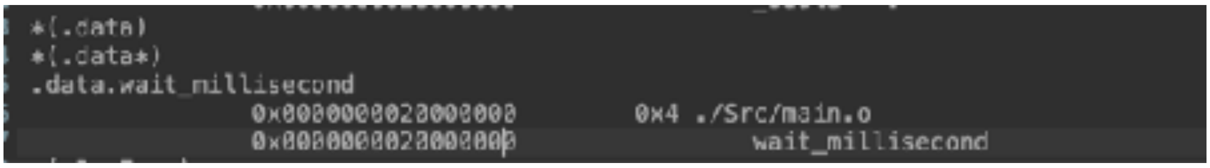
In this prelab, create a project as the PRELAB1 configuration (empty project) and change the main.c file with the file that is available on moodle. You can debug the problem via . There are some debug related buttons, you can use . Add breakpoints near the *“wait_counter = wait_counter + 1;”* lines.

- When you run the code, what happens on the board?
- Red-yellow light switches fastly and repeatedly
- firstly blue light gets on, then flashes twice and stays off.__________

2) Memory Addresses and Registers

While debugging, you can access the memory of the board and can make some changes. In order to look at the variable value on the memory, you need to know the memory address of the variable. Build the project and look at the *{ProjectName}.map* file.

- Find the “wait_millisecond” variable at map file and paste screenshot (only that part): __________



```
 *(.data)
 *(.data*)
 .data.wait_millisecond
                0x0000000020000000        0x4 ./Src/main.o
                0x0000000020000000                wait_millisecond
```

Also you can see the address of the variables at the IDE. *Show View - Expression View*.

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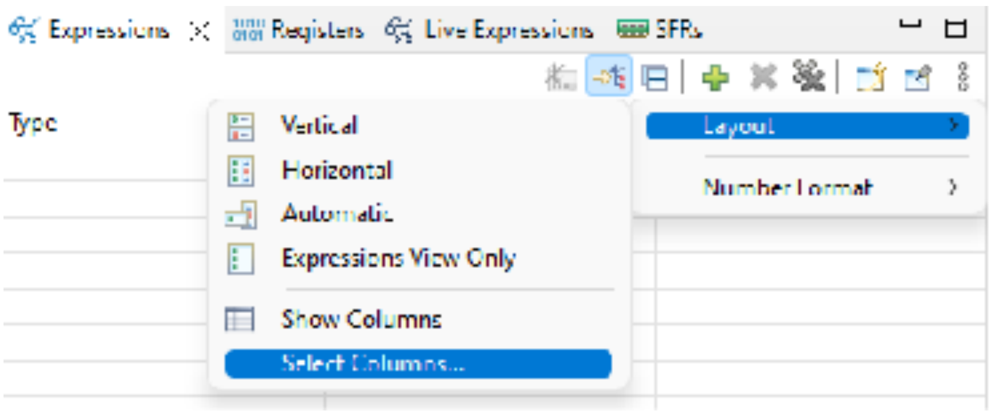
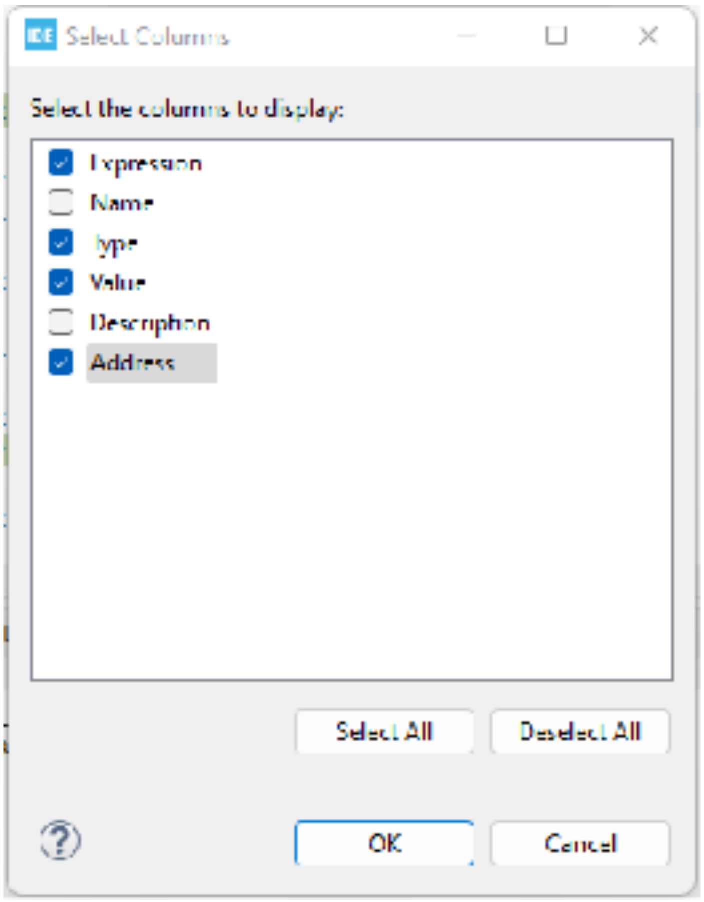




- [✓] Expression
- [ ] Name
- [✓] Type
- [✓] Value
- [ ] Description
- [✓] Address

Add the "wait_millisecond" variable to *Expression*.

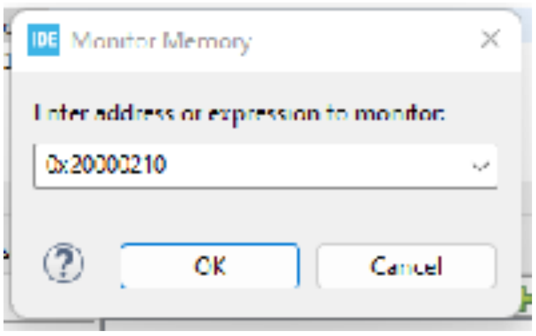
- What is the address of the "wait_millisecond" variable: 0x20000000__________

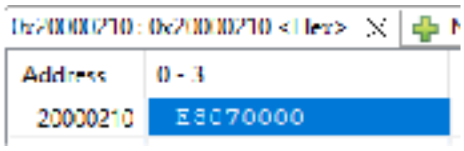
Not all the expressions are stored in the memory. *Show View - Registers*:

- Which register stored the wait_millisecond*333 value: r2__________

3) Memory

You can change the variable values on the memory during debugging. *Show View - Memory*, Add Memory Monitor and write the address of the variable.





- Variable type is uint32 and if you see E8010000 in the memory, what is the value of the variable: ___488_______

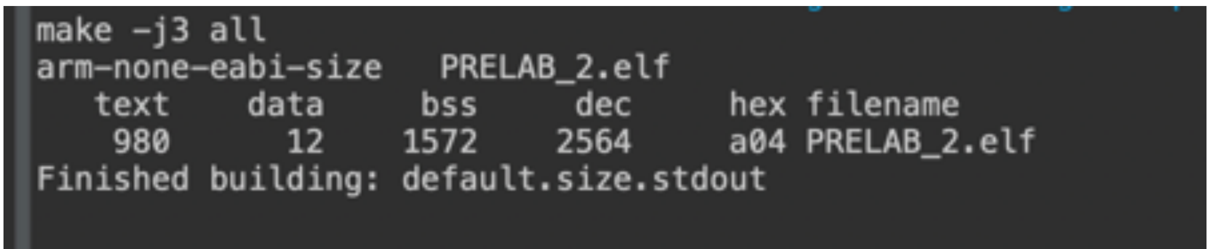
- Change the “wait_millisecond” value on the memory with E8070000, what changes on the board?

- frequency of blue light almost got halved because we changed wait_milisecond from 1000 to 2024.__________

4) Compiler Optimization

When you build your code, on the console (text data bss dec hex) will be written.

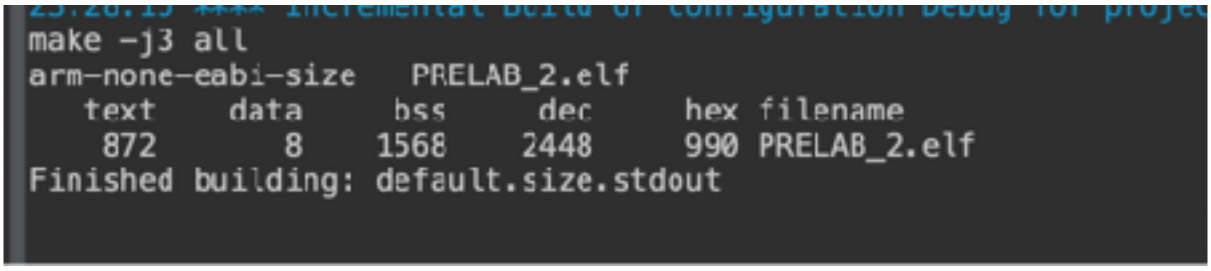
- What are these values for your projects?
- text 980__________
- Data 12
- Bss 1572
- Dec 2564
- Hex a04



```
make -j3 all
arm-none-eabi-size   PRELAB_2.elf
   text    data     bss     dec     hex filename
    980      12    1572    2564     a04 PRELAB_2.elf
Finished building: default.size.stdout
```

Open the properties of the project and change the Optimization to -Ofast.

- What are these (text data bss dec hex) values for this new setting? _
- Text 872
- Data 8
- Bss 1568
- Hex 990_________



```
23:28:15 **** Incremental Build of configuration Debug for projec
make -j3 all
arm-none-eabi-size   PRELAB_2.elf
   text    data     bss     dec     hex filename
    872       8    1568    2448     990 PRELAB_2.elf
Finished building: default.size.stdout
```

- Run your optimized code on the board, what changes on the board?
  at not optimized code, blue light consantly lights on and off after run;
- Whereas at ofast optimized code, blue light stays on after the run
- (Because optimized code act different on for loop)
- Change *int index;* with *volatile int index;* what changes on the board?

- Blue light keeps flashing (lights on lights off consantly) after the run

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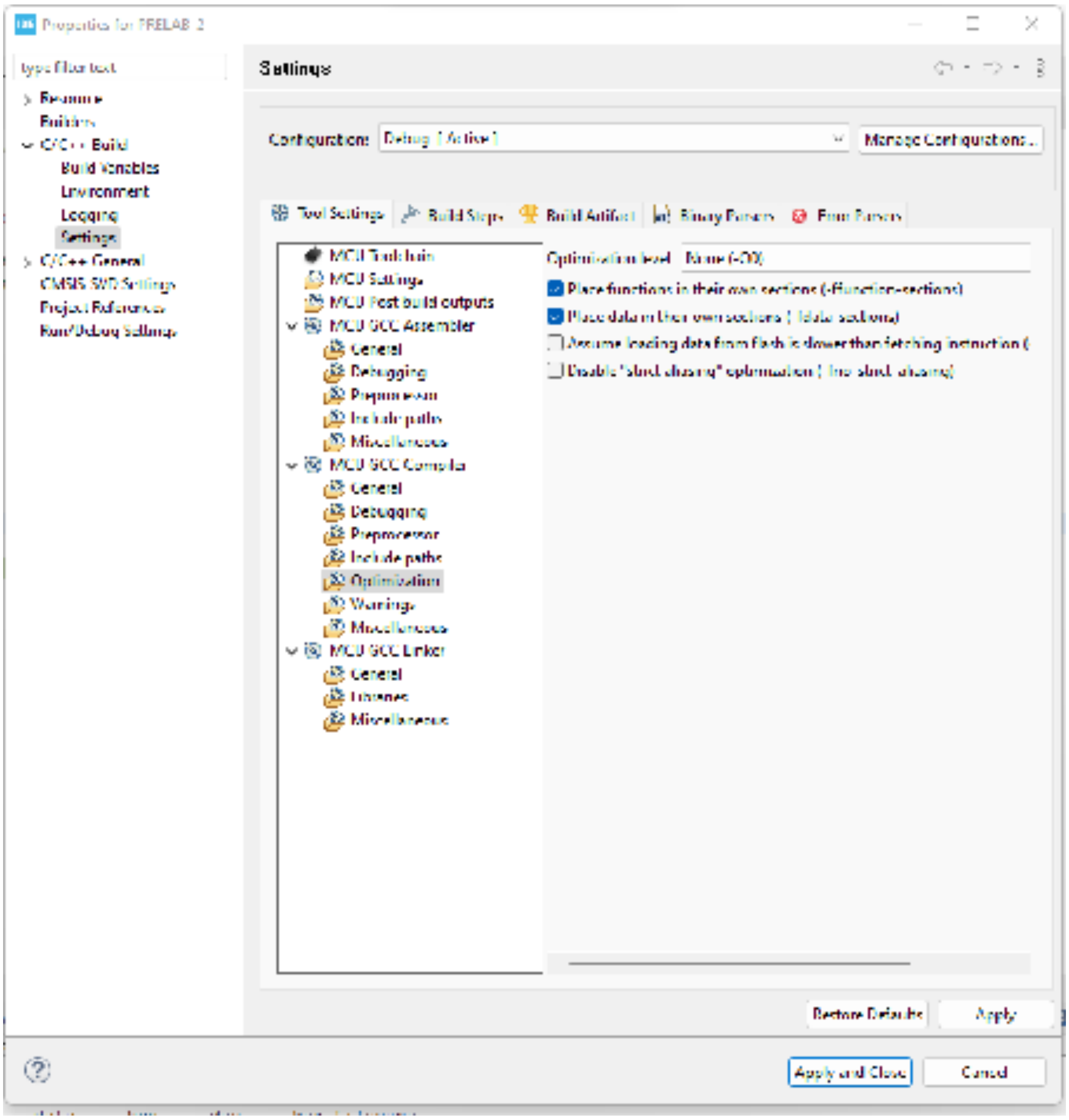

Settings

Configuration: Debug [Active]

Optimization level: None (-O0)

[✓] Place functions in their own sections (-ffunction-sections)

[✓] Place data in their own sections (-fdata-sections)

[ ] Assume loading data from flash is slower than fetching instruction (

[ ] Disable "strict aliasing" optimization (-fno-strict-aliasing)

5) Submission

You will submit one zip file which contains this document and your project (all the files with the last configuration)

The naming of the zip file should be:

PRELAB<exp num>_<StudentID>.zip

6) Related Videos and Links

For *text data bss dec hex* meaning:

https://mirzafahad.github.io/2021-05-08-text-data-bss/

For debugging:

https://www.youtube.com/watch?v=BVC7KaUNCS8

Volatile Keyword:

https://www.youtube.com/watch?v=W3pFxSBkeJ8