



LABORATORIO DI ARCHITETTURE E PROGRAMMAZIONE DEI SISTEMI ELETTRONICI INDUSTRIALI

Laboratory Lesson 1:

- Introduction to System Workbench for STM32
- Programming and debugging

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Course Organization

- Hands-on session LAB1 **Thursday 15.00 – 19.00**
- Prof Benini Friday **9.00 – 11.00** room 5.5
- Lab is available **Friday 11.00 – 13.00**
- Check website for **announcements, course material:**
<http://www-micrel.deis.unibo.it/LABARCH>
- Final Exam:
 - Homeworks (**to be checked weekly**)
 - Final project
 - Final discussion (homeworks + final project)

Group Organization

- Each group is composed by 2 people
- Each group is provided with a **development board** and a USB cable
- Student can use personal Laptop with Windows or Ubuntu (LTS 14.04)
- Please, register your group and your development kit: <http://goo.gl/forms/rYuXRVempA>
- All material is returned during the final discussion

Equipment checklist

- Personal Computer with:
 - Windows (Vista / 7 / 8)
 - Ubuntu LTS 14.04 + Eclipse CDT (8.5.0 Luna)
- Development Board (STM32F401)
- Micro USB Cable
- System Workbench for STM32 (openstm32.org)

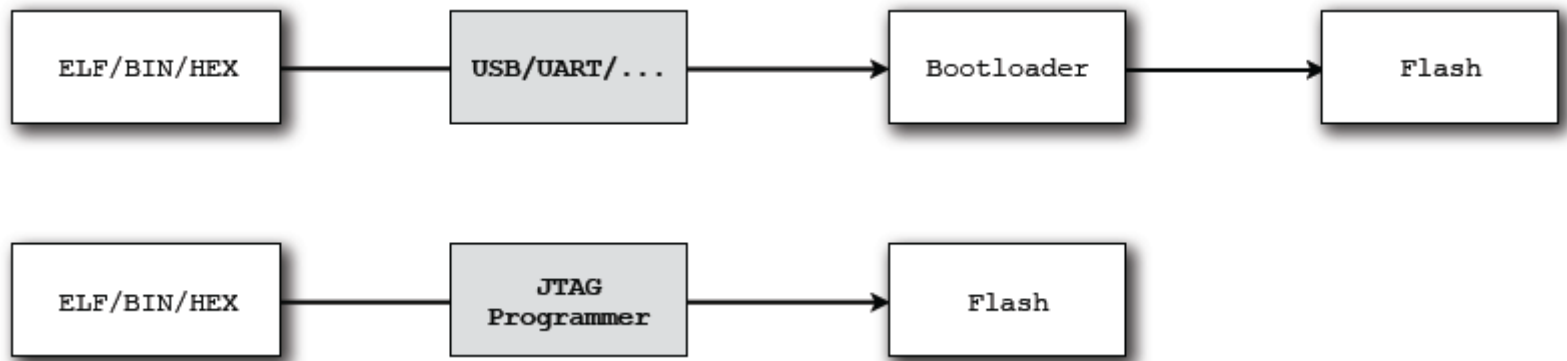
JTAG



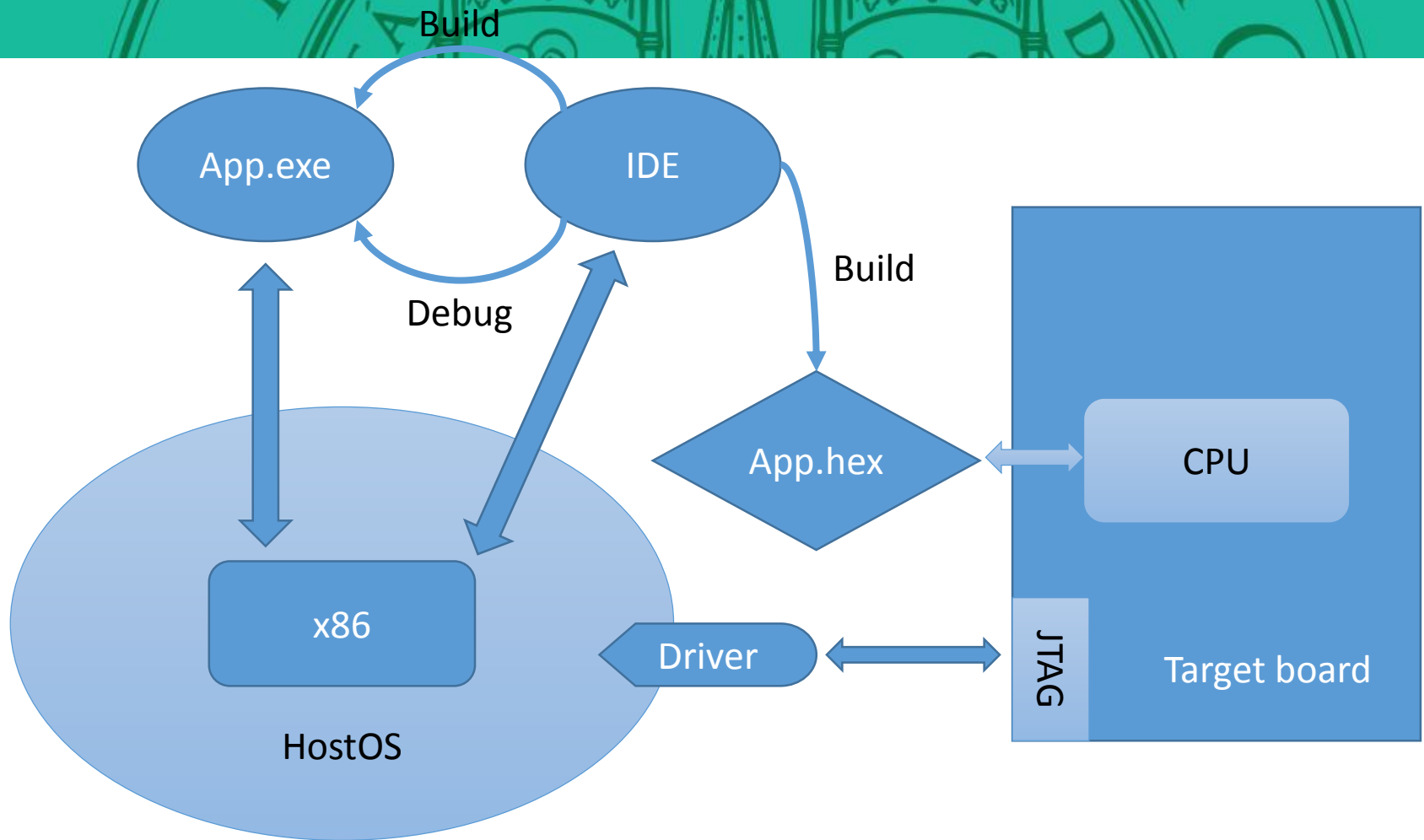
- **Integrated Debug Circuitry / On-Chip Debug:** every chip shipped contains the debug functionality. A serial communication channel is used to connect the debug circuitry to a host debugger
- Besides debugging, another application of JTAG is allowing **device programmer** to transfer data into internal memory

JTAG for programming

- To program a device we have two alternatives:
 - Using a USB / UART / ... connection in **bootloader mode**
 - Using JTAG and programmer **to write flash memory**

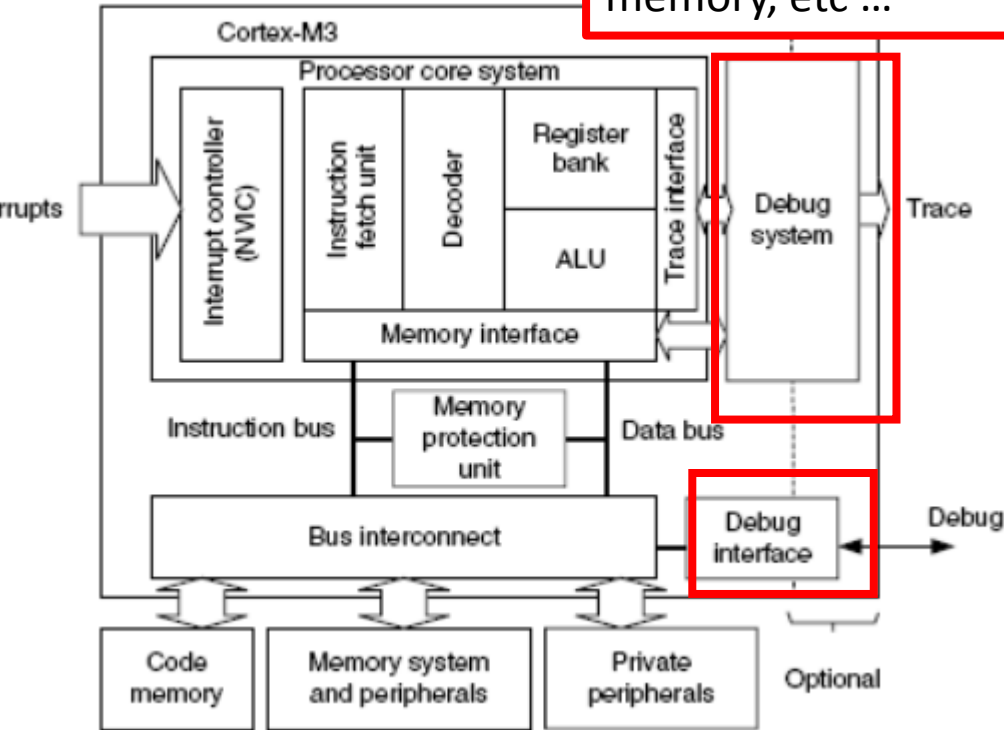


JTAG for debugging



JTAG for debugging

The HW debug support block is **within** the cortex-M3 core. The debug interface has access to the register bank, ALU, memory, etc ...



Primitive Numeric Data Types

Data Type		Size	Range
byte	u8/s8	1 byte	Integers in the range of -128 to +128
short	u16/s16	2 bytes	Integers in the range of -32,768 to +32,767
int	u32/s32	4 bytes	Integers in the range of -2,147,483,648 to +2,147,483,647
long	u64/s64	8 bytes	Integers in the range of -9,223,372,036,854,775,808 to +9,223,372,036,854,775,807
float	float	4 bytes	Floating-point numbers in the range of $\pm 3.4 \times 10^{-38}$ to $\pm 3.4 \times 10^{38}$ with 7 digits of accuracy
double	double	8 bytes	Floating-point numbers in the range of $\pm 1.7 \times 10^{-308}$ to $\pm 1.7 \times 10^{308}$ with 15 digits of accuracy

Arrays

- Array declaration and usage

```
double balance[] = {1000.0, 2.0, 3.4, 7.0, 50.0};
```

```
double balance[10];
```

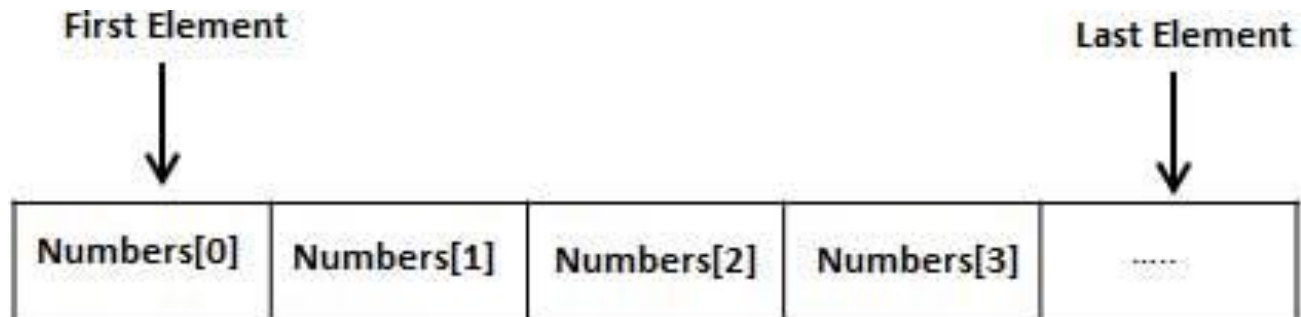
```
balance [0] = 3,2;
```

```
balance [1] = 3,12:
```

```
....
```

```
....
```

```
balance [9] = 36,2:
```



Structures

```
#include <stdio.h>
#include <string.h>

struct Books
{
    char title[50];
    char author[50];
    char subject[100];
    int book_id;
};

/* function declaration */
void printBook( struct Books book );
int main( )
{
    struct Books Book1;          /* Declare Book1 of type Book */
    struct Books Book2;          /* Declare Book2 of type Book */

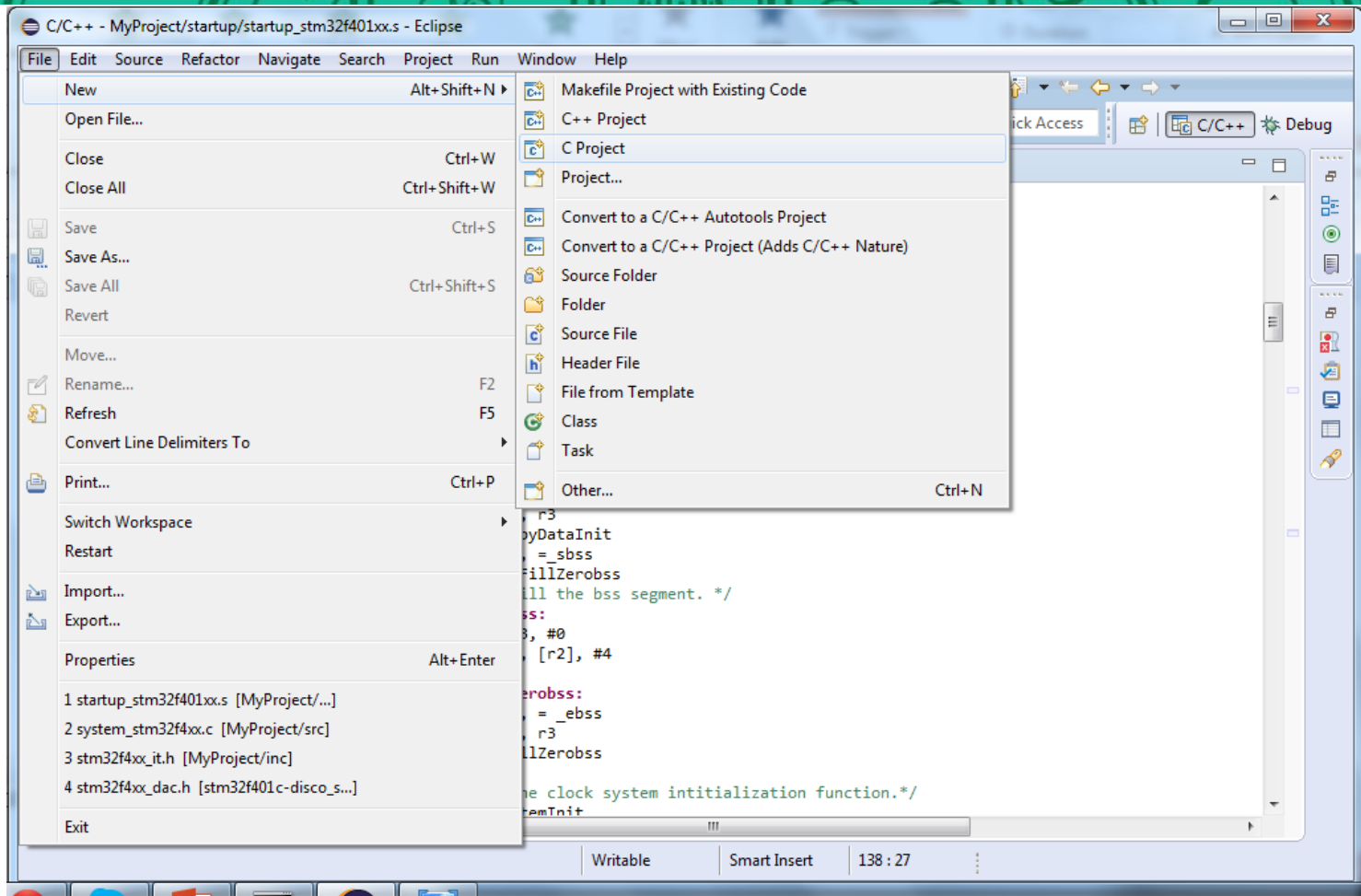
    /* book 1 specification */
    strcpy( Book1.title, "C Programming");
    strcpy( Book1.author, "Nuha Ali");
    strcpy( Book1.subject, "C Programming Tutorial");
    Book1.book_id = 6495407;
```

- Structure fields

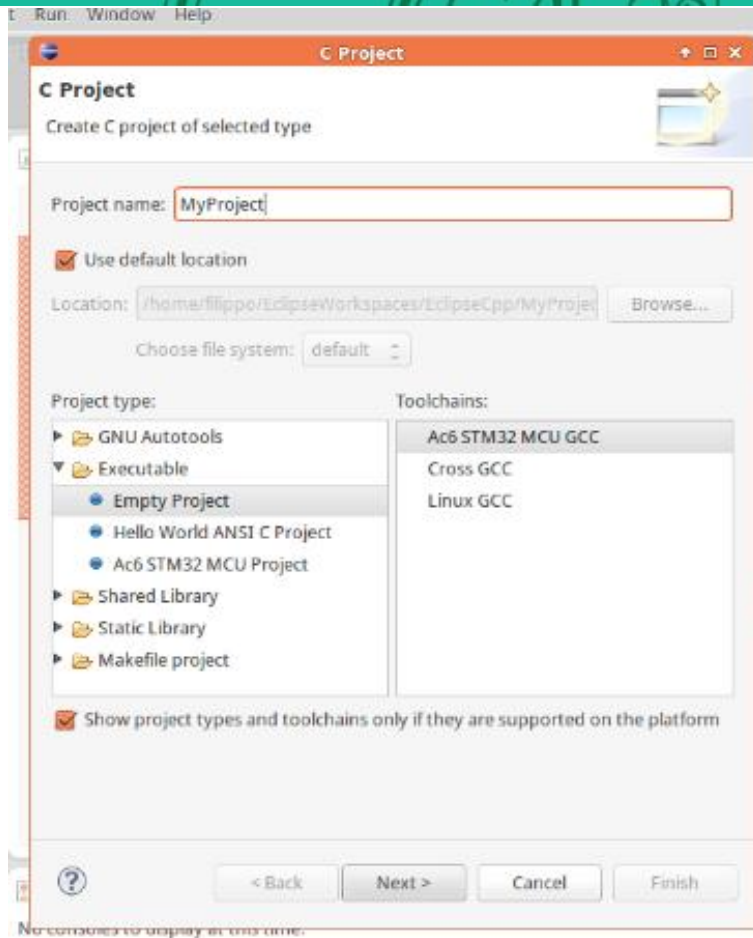
- Variable structure declaration

- Data assignment

New Project Creation 1

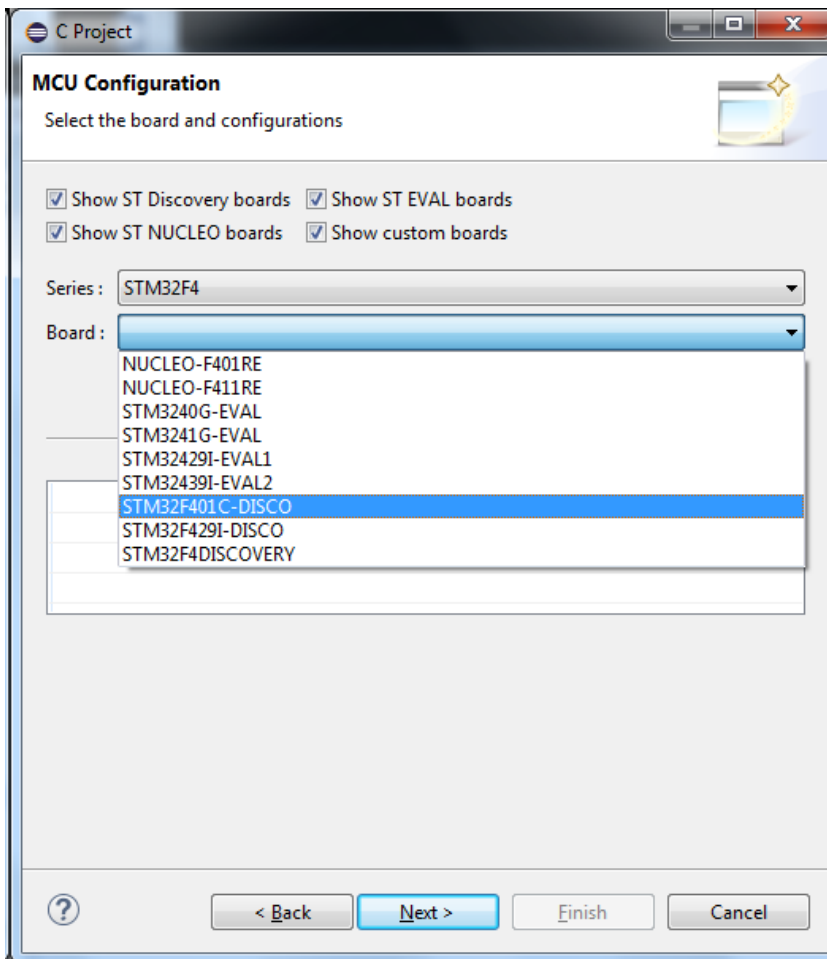


New Project Creation 2



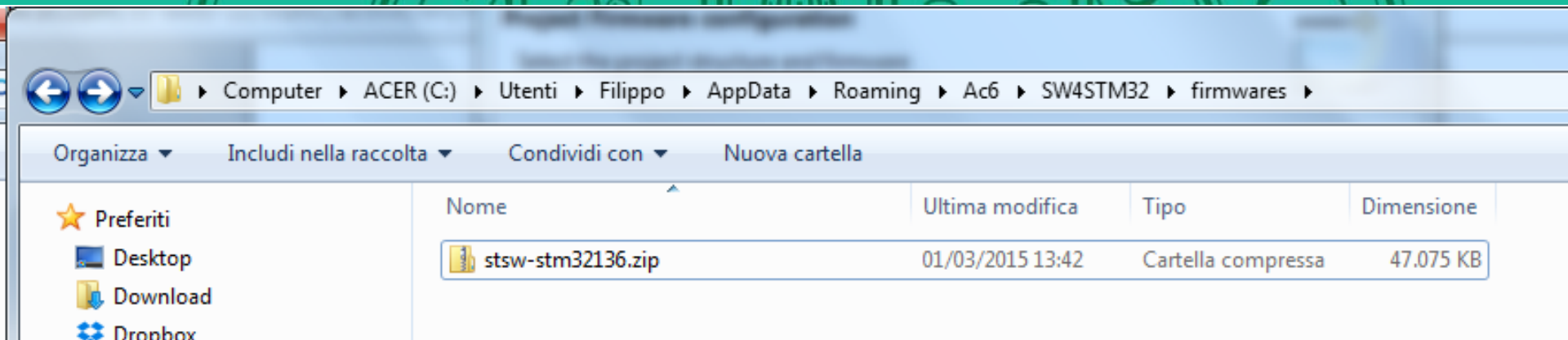
- Insert Project Name
- Choose Executable ->
Empty Project ->
AC6 STM32 MCU GCC
- next

New Project Creation 3



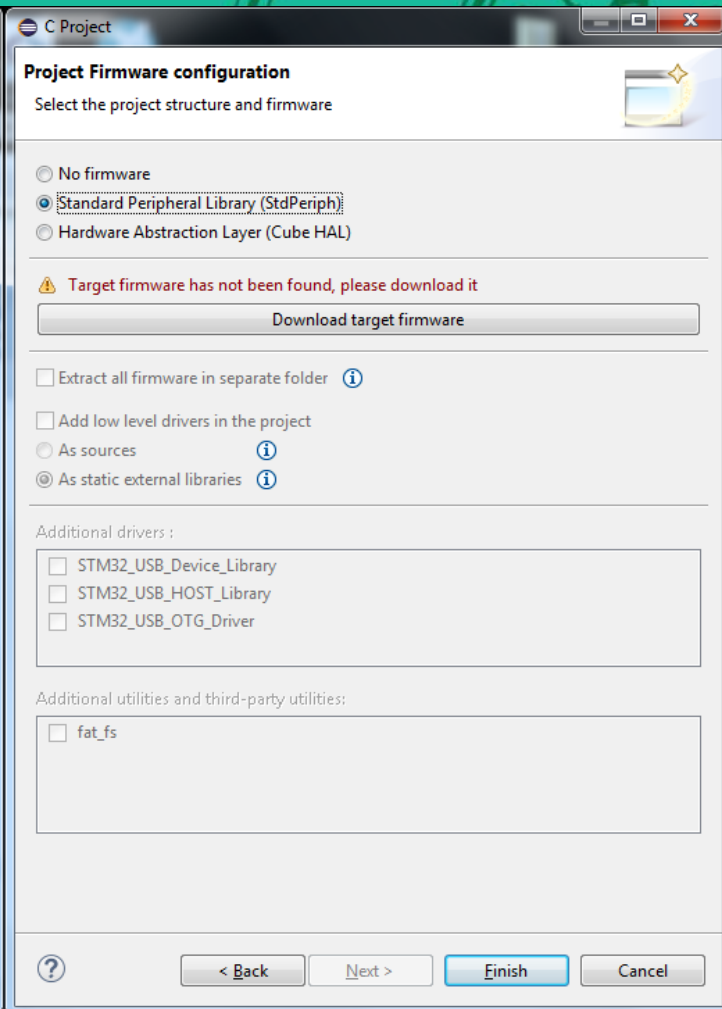
- Select your board:
 - Series STM32F4
 - STM32F401C-DISCO

New Project Creation 4



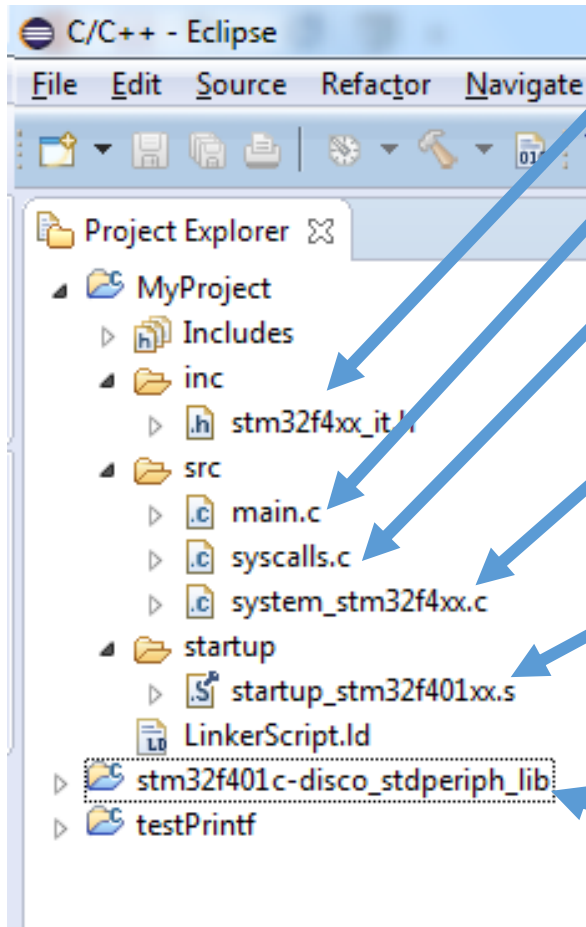
- Copy stsw-stm32136.zip from Z:LAPSEI to:
C:Utenti/student/AppData/Roaming/Ac6/SW4STM32/firmwares/
- If the folder “Ac6/SW4STM32/firmwares” does not exist, create it
- This step is necessary if you do not have Internet connection

New Project Creation 3



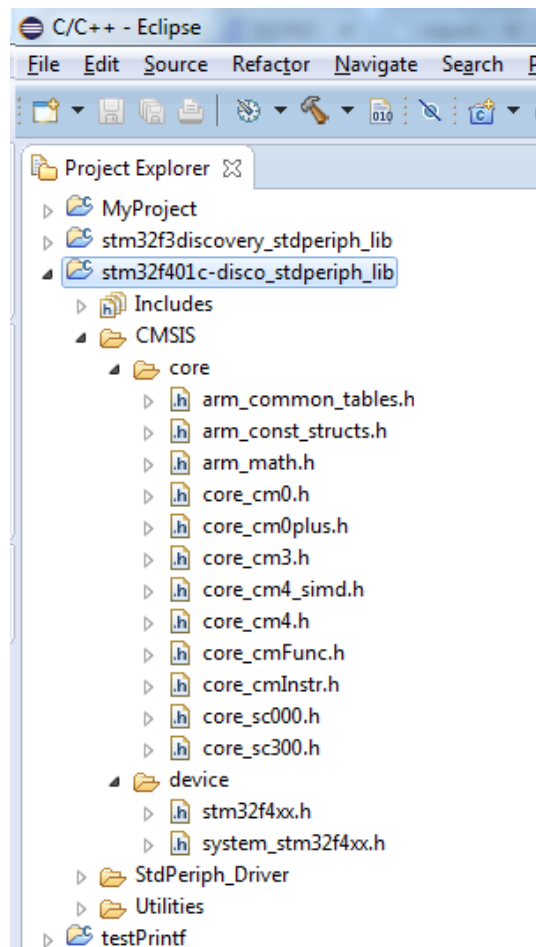
- Select “Standard Peripheral Library”
- If you do not have the library the tool will ask you to download it, alternatively you can copy it to:
C:\Utenti\student\AppData\Roaming\Ac6\SW4STM32\firmwares/

Project Structure



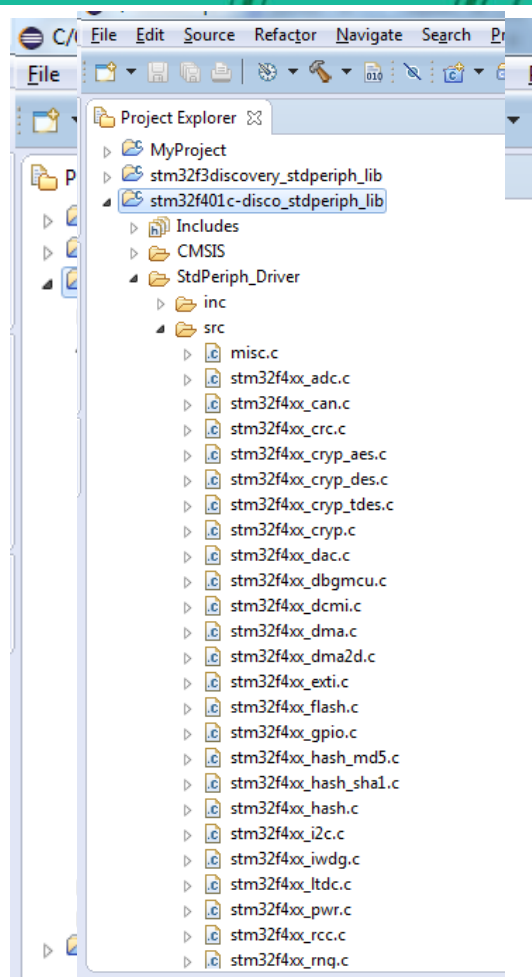
- Interrupt definition Header File
- Main with your code
- System calls (redefinition of stdio.h calls)
- STM32 System initialization (executed before main)
- Assembly startup file, the very first code executed by MCU and **interrupt prototypes**
- Standard peripheral Library

Standard Peripheral Library Description



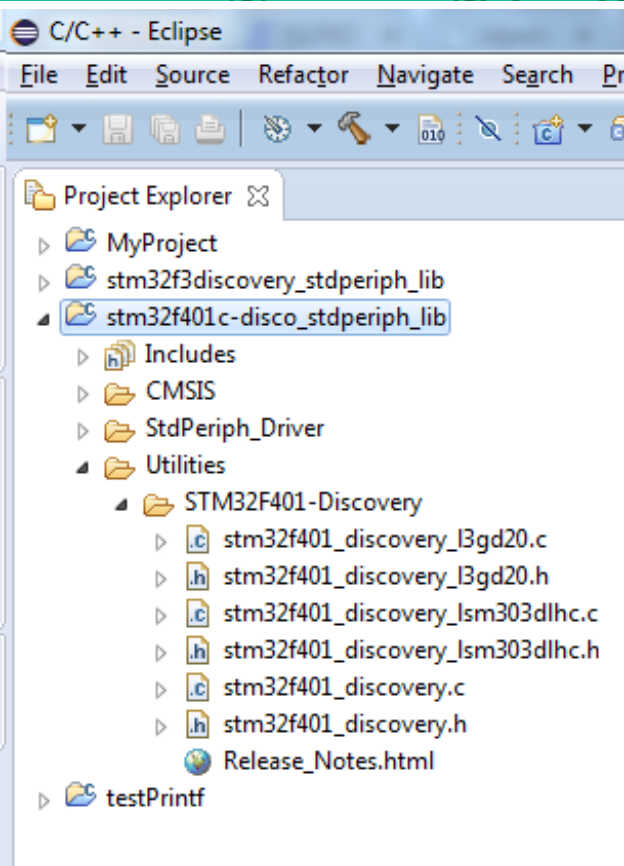
- Have a look at UM1061 (ST website pp 27-35)
- CMSIS – developed by ARM give access to Cortex M CORE registers

Standard Peripheral Library Description



- Have a look at UM1061 (ST website pp 27-35)
- CMSIS – developed by ARM give access to Cortex M CORE registers
- StdPeriph Driver – developed by ST, deliver high level function to access peripherals (one file each periph.)

Standard Peripheral Library Description

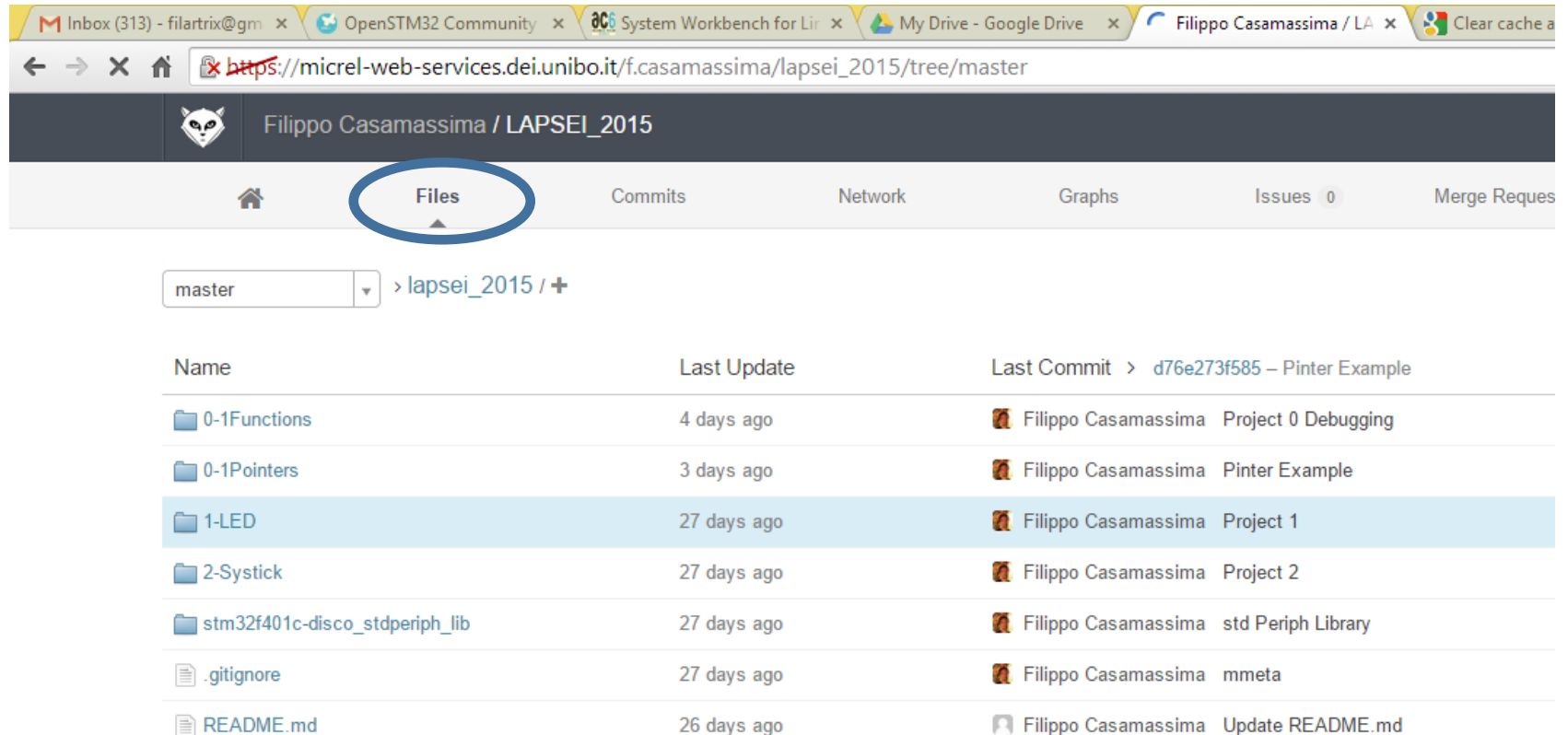


- Have a look at UM1061 (ST website pp 27-35)
- CMSIS – developed by ARM give access to Cortex M CORE registers
- StdPeriph Driver – developed by ST, deliver high level function to access peripherals (one file each periph.)
- Utilities: Developed by ST, useful to access board external devices (sensors, LEDs, etc...)

Your First project

- Go to code repository:
- https://micrel-web-services.dei.unibo.it/f.casamassima/lapsei_2015/
- Ignore security warning
- Click Files
- Choose first project 0-1Functions -> src -> main.c

Check Project Files



Browser tabs: Inbox (313) - filartrix@gm, OpenSTM32 Community, ac6 System Workbench for Lir, My Drive - Google Drive, Filippo Casamassima / LA, Clear cache a

URL: https://micrel-web-services.dei.unibo.it/f.casamassima/lapsei_2015/tree/master

Repository: Filippo Casamassima / LAPSEI_2015

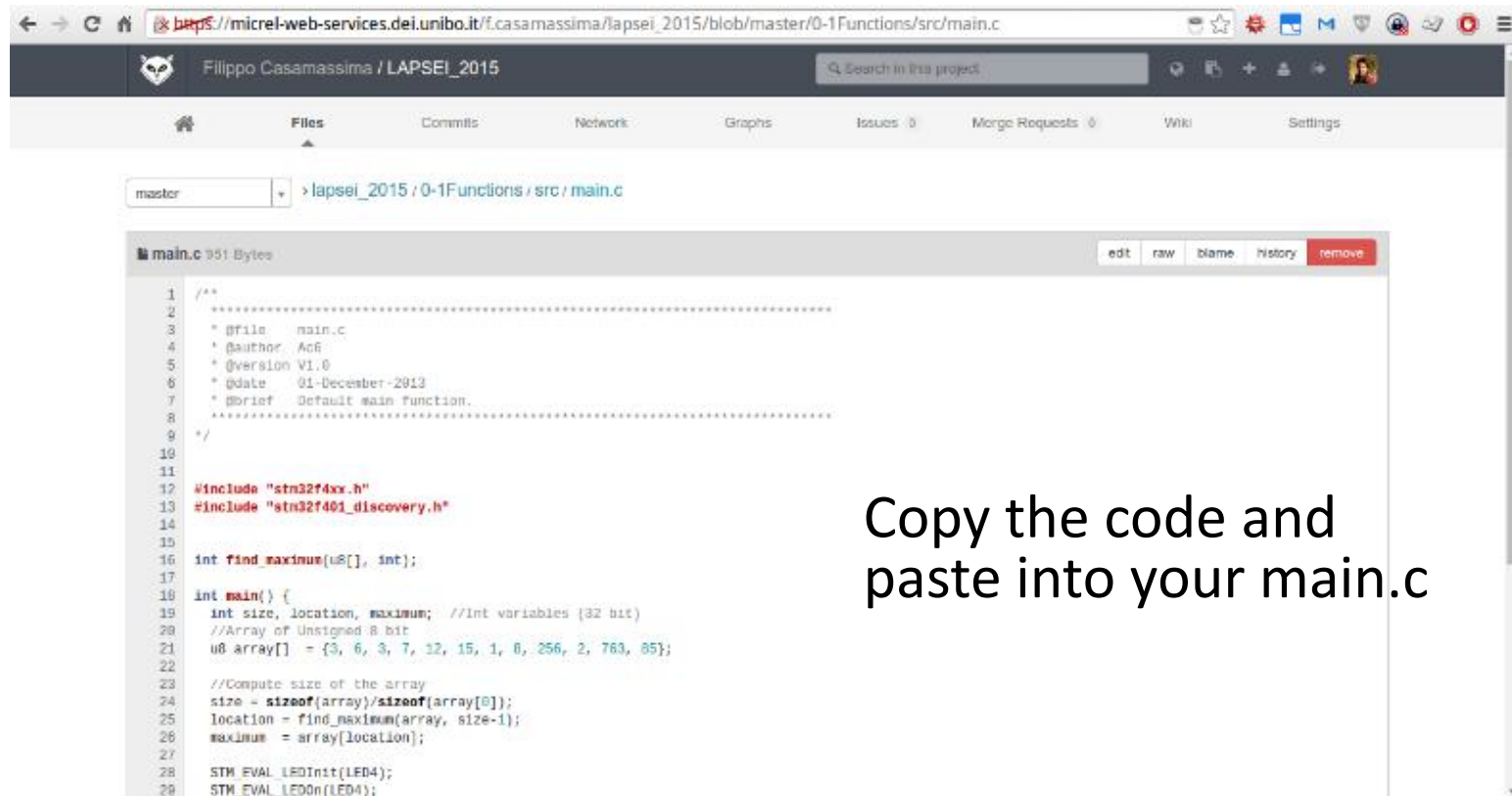
Navigation: Home, **Files** (circled), Commits, Network, Graphs, Issues 0, Merge Reques

Branch: master > lapsei_2015 / +

Name	Last Update	Last Commit > d76e273f585 – Pinter Example
0-1Functions	4 days ago	Filippo Casamassima Project 0 Debugging
0-1Pointers	3 days ago	Filippo Casamassima Pinter Example
1-LED	27 days ago	Filippo Casamassima Project 1
2-Systick	27 days ago	Filippo Casamassima Project 2
stm32f401c-disco_stdperiph_lib	27 days ago	Filippo Casamassima std Periph Library
.gitignore	27 days ago	Filippo Casamassima mmeta
README.md	26 days ago	Filippo Casamassima Update README.md

Click 0-1Functions -> src -> main.c

Copy - paste code



```
1  /**
2
3  * @file    main.c
4  * @author  Ac6
5  * @version V1.0
6  * @date    01-December-2013
7  * @brief   Default main function.
8  */
9
10
11
12 #include "stm32f4xx.h"
13 #include "stm32f401_discovery.h"
14
15
16 int find_maximum(u8[], int);
17
18 int main() {
19     int size, location, maximum; //Int variables (32 bit)
20     //Array of Unsigned 8 bit
21     u8 array[] = {3, 6, 3, 7, 12, 15, 1, 0, 256, 2, 763, 85};
22
23     //Compute size of the array
24     size = sizeof(array)/sizeof(array[0]);
25     location = find_maximum(array, size-1);
26     maximum = array[location];
27
28     STM_EVAL_LEDInit(LED4);
29     STM_EVAL_LEDOn(LED4);
30 }
```

Copy the code and
paste into your main.c

Look at the code

```
C/C++ - 0-1Functions/src/main.c - Eclipse
File Edit Source Refactor Navigate Search Project Run Window Help

main.c main.c x
3+ | * @file main.c
10
11
12 #include "stm32f4xx.h"
13 #include "stm32f401_discovery.h"
14
15
16 int find_maximum(u8[], int);
17
18 int main() {
19     int size, location, maximum; //Int variables (32 bit)
20     //Array of Unsigned 8 bit
21     u8 array[] = {3, 6, 3, 7, 12, 15, 1, 8, 256, 2, 763, 85};
22
23     //Compute size of the array
24     size = sizeof(array)/sizeof(array[0]);
25     location = find_maximum(array, size-1);
26     maximum = array[location];
27
28     STM_EVAL_LEDInit(LED4);
29     STM_EVAL_LEDon(LED4);
30
31     while(1);
32 }
```

Include Microcontroller library
and board library

Function prototype

Variables declaration

Find maximum in an array

Board function called here

Never exit from the Main!!!

Look at the code

```
19  int size, location, maximum; //Int variables (32 bit)
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21  u8 array[] = {3, 6, 3, 7, 12, 15, 1, 8, 256, 2, 763, 85};
22
23  //Compute size of the array
24  size = sizeof(array)/sizeof(array[0]);
25  location = find_maximum(array, size-1);
26  maximum = array[location];
27
28  STM_EVAL_LEDInit(LED4);
29  STM_EVAL_LEDOn(LED4);
30
31  while(1);
32 }
33
34 int find_maximum(u8 a[], int n) {
35     int c, max, index;
36     max = a[0];
37     index = 0;
38
39     for (c = 1; c < n; c++) {
40         if (a[c] > max) {
41             index = c;
42             max = a[c];
43         }
44     }
45     return index;
46 }
```

Function parameters

Local variables

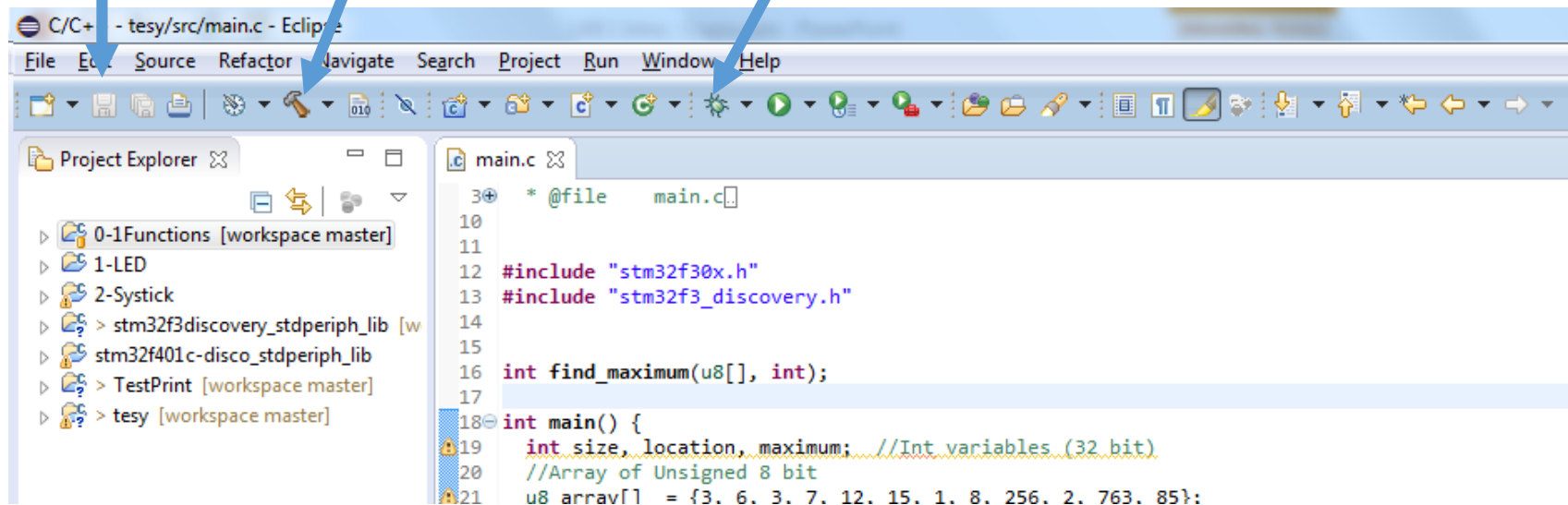
Return result

Eclipse Commands:

1. Save

2. Build
(compile)

3. Debug (do not click now)



Eclipse Commands:

warnings

Breakpoint

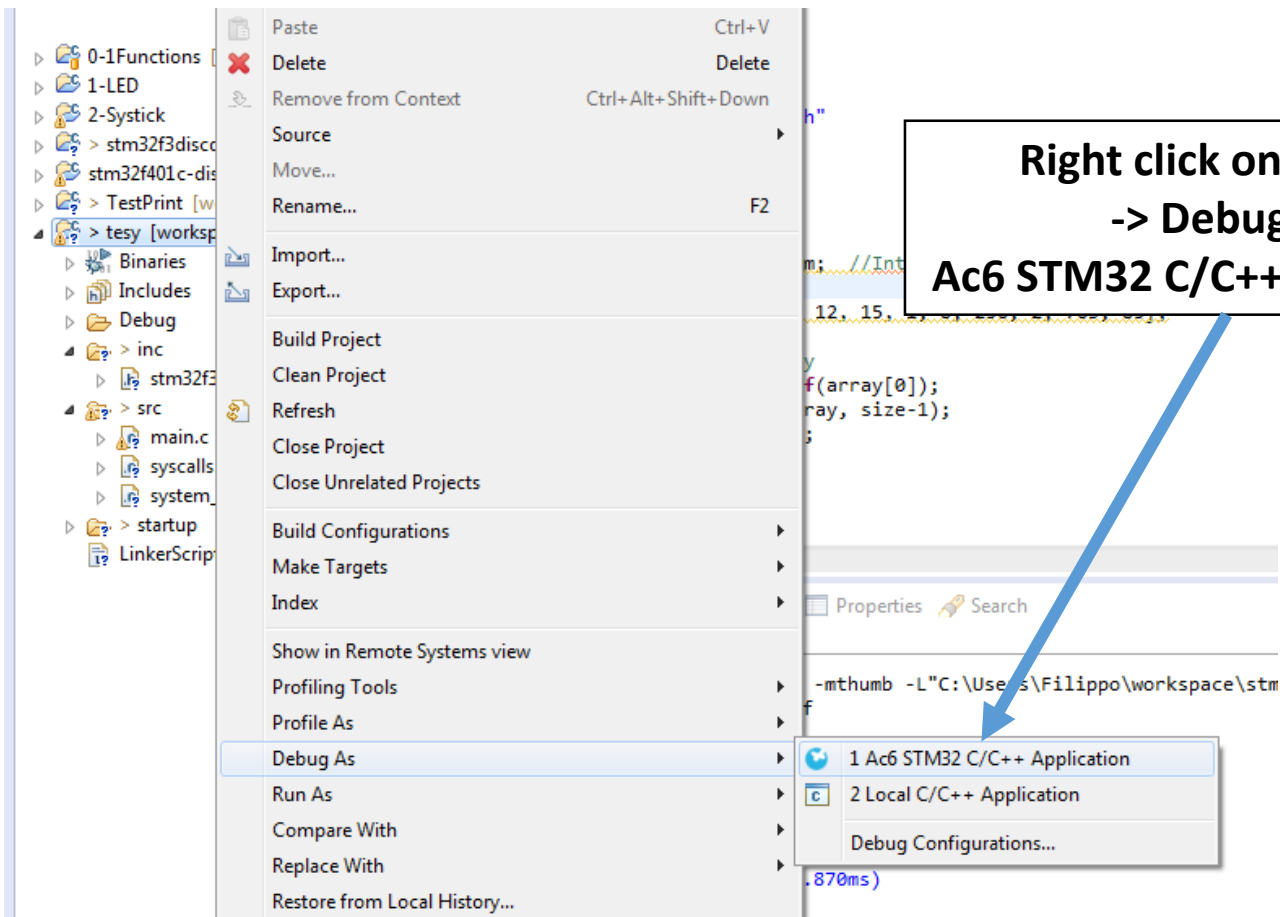
(code execution during debug pauses here)

Build Output Console

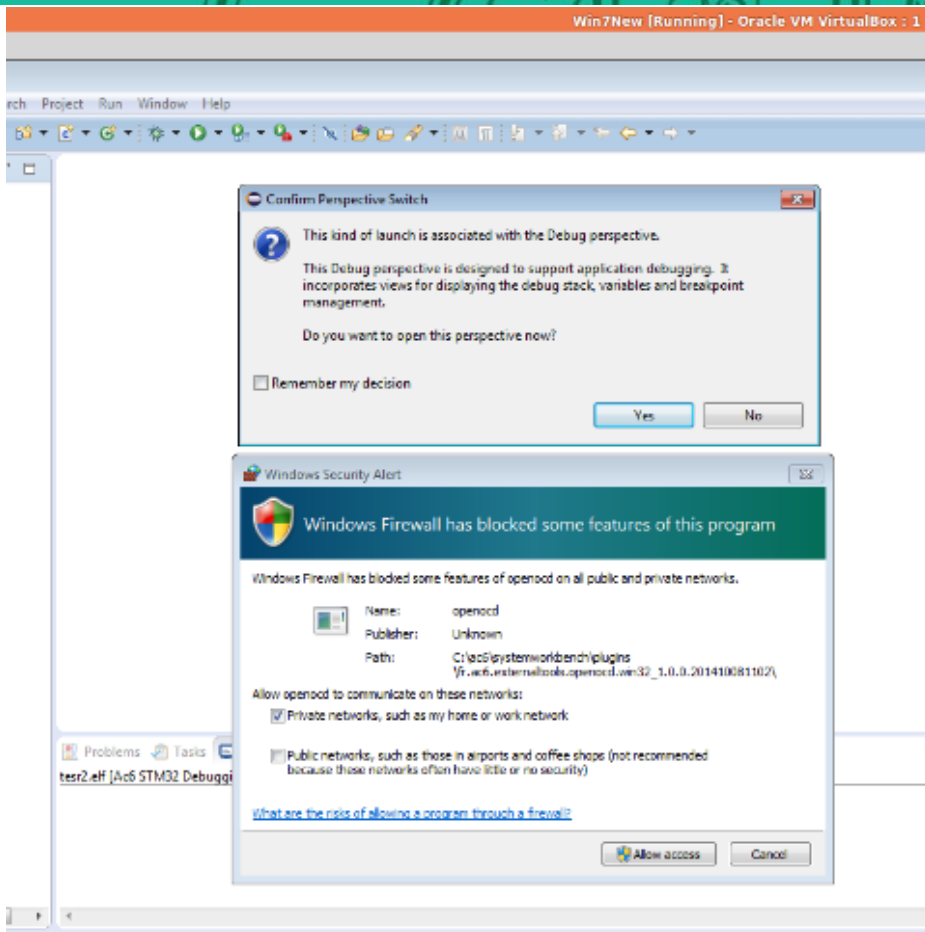
The screenshot displays the Eclipse IDE interface. The top editor window shows a C program with the following code:

```
15
16 int find_maximum(u8[], int);
17
18 int main() {
19     int size, location, maximum;
20     //Array of Unsigned 8 bit
21     u8 array[] = {3, 6, 3, 7, 12, 10, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45, 48, 51, 54, 57, 60, 63, 66, 69, 72, 75, 78, 81, 84, 87, 90, 93, 96, 99, 102, 105, 108, 111, 114, 117, 120, 123, 126, 129, 132, 135, 138, 141, 144, 147, 150, 153, 156, 159, 162, 165, 168, 171, 174, 177, 180, 183, 186, 189, 192, 195, 198, 201, 204, 207, 210, 213, 216, 219, 222, 225, 228, 231, 234, 237, 240, 243, 246, 249, 252, 255, 258, 261, 264, 267, 270, 273, 276, 279, 282, 285, 288, 291, 294, 297, 300, 303, 306, 309, 312, 315, 318, 321, 324, 327, 330, 333, 336, 339, 342, 345, 348, 351, 354, 357, 360, 363, 366, 369, 372, 375, 378, 381, 384, 387, 390, 393, 396, 399, 402, 405, 408, 411, 414, 417, 420, 423, 426, 429, 432, 435, 438, 441, 444, 447, 450, 453, 456, 459, 462, 465, 468, 471, 474, 477, 480, 483, 486, 489, 492, 495, 498, 501, 504, 507, 510, 513, 516, 519, 522, 525, 528, 531, 534, 537, 540, 543, 546, 549, 552, 555, 558, 561, 564, 567, 570, 573, 576, 579, 582, 585, 588, 591, 594, 597, 600, 603, 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1668, 1671, 1674, 1677, 1680, 1683, 1686, 1689, 1692, 1695, 1698, 1701, 1704, 1707, 1710, 1713, 1716, 1719, 1722, 1725, 1728, 1731, 1734, 1737, 1740, 1743, 1746, 1749, 1752, 1755, 1758, 1761, 1764, 1767, 1770, 1773, 1776, 1779, 1782, 1785, 1788, 1791, 1794, 1797, 1800, 1803, 1806, 1809, 1812, 1815, 1818, 1821, 1824, 1827, 1830, 1833, 1836, 1839, 1842, 1845, 1848, 1851, 1854, 1857, 1860, 1863, 1866, 1869, 1872, 1875, 1878, 1881, 1884, 1887, 1890, 1893, 1896, 1899, 1902, 1905, 1908, 1911, 1914, 1917, 1920, 1923, 1926, 1929, 1932, 1935, 1938, 1941, 1944, 1947, 1950, 1953, 1956, 1959, 1962, 1965, 1968, 1971, 1974, 1977, 1980, 1983, 1986, 1989, 1992, 1995, 1998, 2001, 2004, 2007, 2010, 2013, 2016, 2019, 2022, 2025, 2028, 2031, 2034, 2037, 2040, 2043, 2046, 2049, 2052, 2055, 2058, 2061, 2064, 2067, 2070, 2073, 2076, 2079, 2082, 2085, 2088, 2091, 2094, 2097, 2100, 2103, 2106, 2109, 2112, 2115, 2118, 2121, 2124, 2127, 2130, 2133, 2136, 2139, 2142, 2145, 2148, 2151, 2154, 2157, 2160, 2163, 2166, 2169, 2172, 2175, 2178, 2181, 2184, 2187, 2190, 2193, 2196, 2199, 2202, 2205, 2208, 2211, 2214, 2217, 2220, 2223, 2226, 2229, 2232, 2235, 2238, 2241, 2244, 2247, 2250, 2253, 2256, 2259, 2262, 2265, 2268, 2271, 2274, 2277, 2280, 2283, 2286, 2289, 2292, 2295, 2298, 2301, 2304, 2307, 2310, 2313, 2316, 2319, 2322, 2325, 2328, 2331, 2334, 2337, 2340, 2343, 2346, 2349, 2352, 2355, 2358, 2361, 2364, 2367, 2370, 2373, 2376, 2379, 2382, 2385, 2388, 2391, 2394, 2397, 2400, 2403, 2406, 2409, 2412, 2415, 2418, 2421, 2424, 2427, 2430, 2433, 2436, 2439, 2442, 2445, 2448, 2451, 2454, 2457, 2460, 2463, 2466, 2469, 2472, 2475, 2478, 2481, 2484, 2487, 2490, 2493, 2496, 2499, 2502, 2505, 2508, 2511, 2514, 2517, 2520, 2523, 2526, 2529, 2532, 2535, 2538, 2541, 2544, 2547, 2550, 2553, 2556, 2559, 2562, 2565, 2568, 2571, 2574, 2577, 2580, 2583, 2586, 2589, 2592, 2595, 2598, 2601, 2604, 2607, 2610, 2613, 2616, 2619, 2622, 2625, 2628, 2631, 2634, 2637, 2640, 2643, 2646, 2649, 2652, 2655, 2658, 2661, 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3162, 3165, 3168, 3171, 3174, 3177, 3180, 3183, 3186, 3189, 3192, 3195, 3198, 3201, 3204, 3207, 3210, 3213, 3216, 3219, 3222, 3225, 3228, 3231, 3234, 3237, 3240, 3243, 3246, 3249, 3252, 3255, 3258, 3261, 3264, 3267, 3270, 3273, 3276, 3279, 3282, 3285, 3288, 3291, 3294, 3297, 3300, 3303, 3306, 3309, 3312, 3315, 3318, 3321, 3324, 3327, 3330, 3333, 3336, 3339, 3342, 3345, 3348, 3351, 3354, 3357, 3360, 3363, 3366, 3369, 3372, 3375, 3378, 3381, 3384, 3387, 3390, 3393, 3396, 3399, 3402, 3405, 3408, 3411, 3414, 3417, 3420, 3423, 3426, 3429, 3432, 3435, 3438, 3441, 3444, 3447, 3450, 3453, 3456, 3459, 3462, 3465, 3468, 3471, 3474, 3477, 3480, 3483, 3486, 3489, 3492, 3495, 3498, 3501, 3504, 3507, 3510, 3513, 3516, 3519, 3522, 3525, 3528, 3531, 3534, 3537, 3540, 3543, 3546, 3549, 3552, 3555, 3558, 3561, 3564, 3567, 3570, 3573, 3576, 3579, 3582, 3585, 3588, 3591, 3594, 3597, 3600, 3603, 3606, 3609, 3612, 3615, 3618, 3621, 3624, 3627, 3630, 3633, 3636, 3639, 3642, 3645, 3648, 3651, 3654, 3657, 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4158, 4161, 4164, 4167, 4170, 4173, 4176, 4179, 4182, 4185, 4188, 4191, 4194, 4197, 4200, 4203, 4206, 4209, 4212, 4215, 4218, 4221, 4224, 4227, 4230, 4233, 4236, 4239, 4242, 4245, 4248, 4251, 4254, 4257, 4260, 4263, 4266, 4269, 4272, 4275, 4278, 4281, 4284, 4287, 4290, 4293, 4296, 4299, 4302, 4305, 4308, 4311, 4314, 4317, 4320, 4323, 4326, 4329, 4332, 4335, 4338, 4341, 4344, 4347, 4350, 4353, 4356, 4359, 4362, 4365, 4368, 4371, 4374, 4377, 4380, 4383, 4386, 4389, 4392, 4395, 4398, 4401, 4404, 4407, 4410, 4413, 4416, 4419, 4422, 4425, 4428, 4431, 4434, 4437, 4440, 4443, 4446, 4449, 4452, 4455, 4458, 4461, 4464, 4467, 4470, 4473, 4476, 4479, 4482, 4485, 4488, 4491, 4494, 4497, 4500, 4503, 4506, 4509, 4512, 4515, 4518, 4521, 4524, 4527, 4530, 4533, 4536, 4539, 4542, 4545, 4548, 4551, 4554, 4557, 4560, 4563, 4566, 4569, 4572, 4575, 4578, 4581, 4584, 4587, 4590, 4593, 4596, 4599, 4602, 4605, 4608, 4611, 4614, 4617, 4620, 4623, 4626, 4629, 4632, 4635, 4638, 4641, 4644, 4647, 4650, 4653, 4656, 4659, 4662, 4665, 4668, 4671, 4674, 4677, 4680, 4683, 4686, 4689, 4692, 4695, 4698, 4701, 4704, 4707, 4710, 4713, 4716, 4719, 4722, 4725, 4728, 4731, 4734, 4737, 4740, 4743, 4746, 4749, 4752, 4755, 4758, 4761, 4764, 4767, 4770, 4773, 4776, 4779, 4782, 4785, 4788, 4791, 4794, 4797, 4800, 4803, 4806, 4809, 4812, 4815, 4818, 4821, 4824, 4827, 4830, 4833, 4836, 4839, 4842, 4845, 4848, 4851, 4854, 4857, 4860, 4863, 4866, 4869, 4872, 4875, 4878, 4881, 4884, 4887, 4890, 4893, 4896, 4899, 4902, 4905, 4908, 4911, 4914, 4917, 4920, 4923, 4926, 4929, 4932, 4935, 4938, 4941, 4944, 4947, 4950, 4953, 4956, 4959, 4962, 4965, 4968, 4971, 4974, 4977, 4980, 4983, 4986, 4989, 4992, 4995, 4998, 5001, 5004, 5007, 5010, 5013, 5016, 5019, 5022, 5025, 5028, 5031, 5034, 5037, 5040, 5043, 5046, 5049, 5052, 5055, 5058, 5061, 5064, 5067, 5070, 5073, 5076, 5079, 5082, 5085, 5088, 5091, 5094, 5097, 5100, 5103, 5106, 5109, 5112, 5115, 5118, 5121, 5124, 5127, 5130, 5133, 5136, 5139, 5142, 5145, 5148, 5151, 5154, 5157, 5160, 5163, 5166, 5169, 5172, 5175, 5178, 5181, 5184, 5187, 5190, 5193, 5196, 5199, 5202, 5205, 5208, 5211, 5214, 5217, 5220, 5223, 5226, 5229, 5232, 5235, 5238, 5241, 5244, 5247, 5250, 5253, 5256, 5259, 5262, 5265, 5268, 5271, 5274, 5277, 5280, 5283, 5286, 5289, 5292, 5295, 5298, 5301, 5304, 5307, 5310, 5313, 5316, 5319, 5322, 5325, 5328, 5331, 5334, 5337, 5340, 5343, 5346, 5349, 5352, 5355, 5358, 5361, 5364, 5367, 5370, 5373, 5376, 5379, 5382, 5385, 5388, 5391, 5394, 5397, 5400, 5403, 5406, 5409, 5412, 5415, 5418, 5421, 5424, 5427, 5430, 5433, 5436, 5439, 5442, 5445, 5448, 5451, 5454, 5457, 5460, 5463, 5466, 5469, 5472, 5475, 5478, 5481, 5484, 5487, 5490, 5493, 5496, 5499, 5502, 5505, 5508, 5511, 5514, 5517, 5520, 5523, 5526, 5529, 5532, 5535, 5538, 5541, 5544, 5547, 5550, 5553, 5556, 5559, 5562, 5565, 5568, 5571, 5574, 5577, 5580, 5583, 5586, 5589, 5592, 5595, 5598, 5601, 5604, 5607, 5610, 5613, 5616, 5619, 5622, 5625, 5628, 5631, 5634, 5637, 5640, 5643, 5646, 5649, 5652, 5655, 5658, 5661, 5664, 5667, 5670, 5673, 5676, 5679, 5682, 5685, 5688, 5691, 5694, 5697, 5700, 5703, 5706, 5709, 5712, 5715, 5718, 5721, 5724, 5727, 5730, 5733, 5736, 5739, 5742, 5745, 5748, 5751, 5754, 5757, 5760, 5763, 5766, 5769, 5772, 5775, 5778, 5781, 5784, 5787, 5790, 5793, 5796, 5799, 5802, 5805, 5808, 5811, 5814, 5817, 5820, 5823, 5826, 5829, 5832, 5835, 5838, 5841, 5844, 5847, 5850, 5853, 5856, 5859, 5862, 5865, 5868, 5871, 5874, 5877, 5880, 5883, 5886, 5889, 5892, 5895, 5898, 5901, 5904, 5907, 5910, 5913, 5916, 5919, 5922, 5925, 5928, 5931, 5934, 5937, 5940, 5943, 5946, 5949, 5952, 5955, 5958, 5961, 5964, 5967, 5970, 5973, 5976, 5979, 5982, 5985, 5988, 5991, 5994, 5997, 6000, 6003, 6006, 6009, 6012, 6015, 6018, 6021, 6024, 6027, 6030, 6033, 6036, 6039, 6042, 6045, 6048, 6051, 6054, 6057, 6060, 6063, 6066, 6069, 6072, 6075, 6078, 6081, 6084, 6087, 6090, 6093, 6096, 6099, 6102, 6105, 6108, 6111, 6114, 6117, 6120, 6123, 6126, 6129, 6132, 6135, 6138, 6141, 6144, 6147, 6150, 6153, 6156, 6159, 6162, 6165, 6168, 6171, 6174, 6177, 6180, 6183, 6186, 6189, 6192, 6195, 6198, 6201, 6204, 6207, 6210, 6213, 
```

Start Debugger



Open Debug Perspective



- Click Allow access for Windows firewall
- Click Yes to open Debug Perspective (you can tick 'Remember my decision' to automatically open debug perspective)

Debug Interface

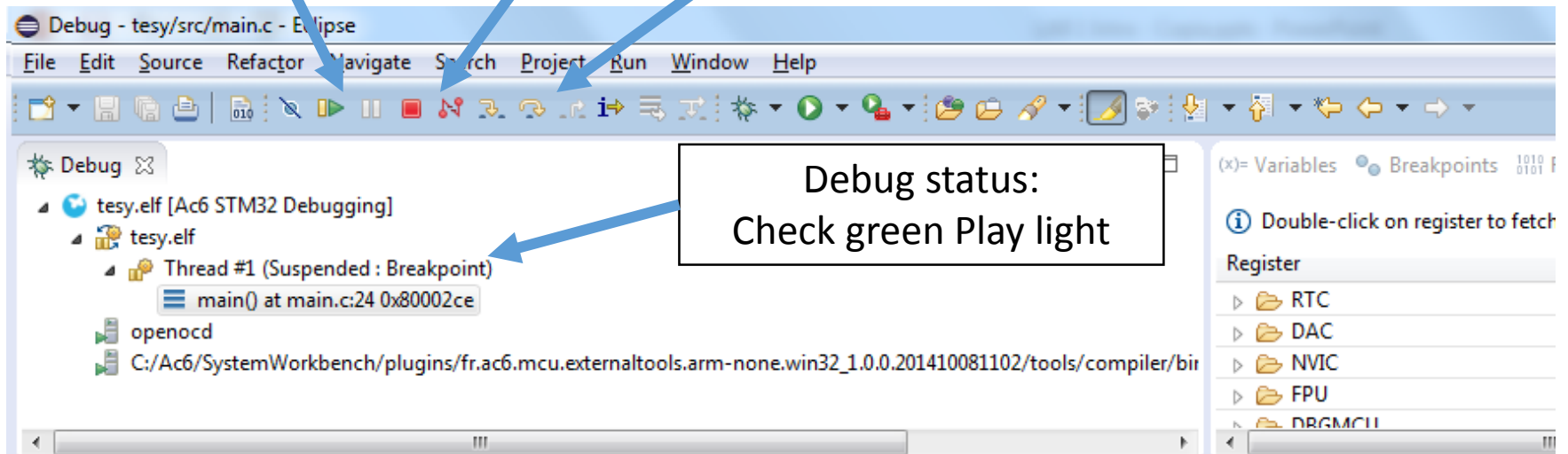
Start / pause
code execution

Stop /
disconnect
debugger

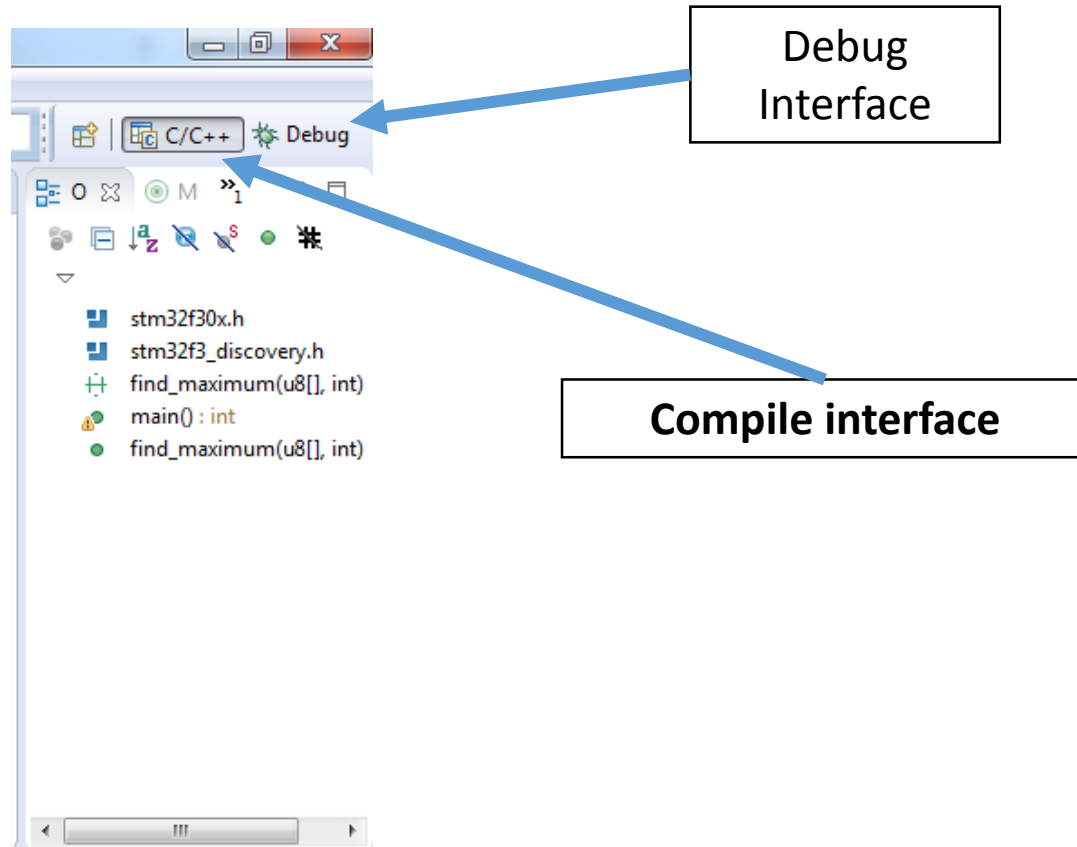
Debug steps:

- Step Into
- Step Over
- Step Out

Debug status:
Check green Play light

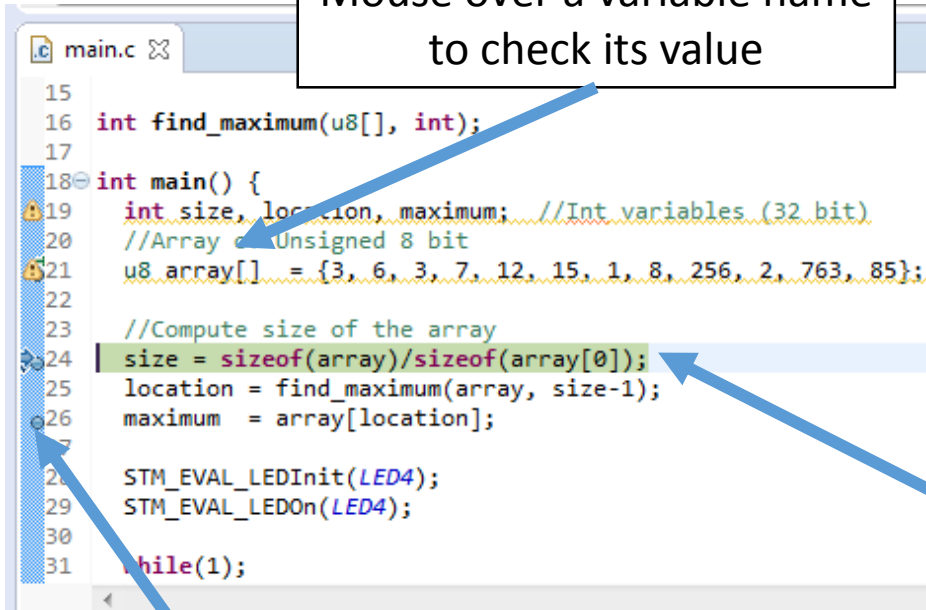


Eclipse Commands:



Debug Interface

Mouse over a variable name
to check its value



The screenshot shows a C code editor with a file named 'main.c'. The code is as follows:

```
15
16 int find_maximum(u8[], int);
17
18 int main() {
19     int size, location, maximum; //Int variables (32 bit)
20     //Array of Unsigned 8 bit
21     u8 array[] = {3, 6, 3, 7, 12, 15, 1, 8, 256, 2, 763, 85};
22
23     //Compute size of the array
24     size = sizeof(array)/sizeof(array[0]);
25     location = find_maximum(array, size-1);
26     maximum = array[location];
27
28     STM_EVAL_LEDInit(LED4);
29     STM_EVAL_LEDOn(LED4);
30
31     while(1);
```

Annotations in the image include:

- A blue arrow pointing from the text box 'Mouse over a variable name to check its value' to the variable 'maximum' on line 19.
- A blue arrow pointing from the text box 'Current debugger location' to the line number '24' on the left margin.
- A blue arrow pointing from the text box 'Breakpoints (code execution pauses here)' to a breakpoint icon on the left margin next to line 24.

Current debugger
location

Breakpoints
(code execution pauses here)

Variables monitoring

Debug - tesy/src/main.c - Eclipse

File Edit Source Refactor Navigate Search Project Run Window Help

Debug tesy.elf [Ac6 STM32 Debugging]

- tesy.elf
 - Thread #1 (Suspended : Step)
 - find_maximum() at main.c:39 0x8000338
 - main() at main.c:25 0x80002e0
 - openocd
 - C:/Ac6/SystemWorkbench/plugins/fr.ac6.mcu.externaltools.arm-none.win32_1.0.0.201410081102/tools/compile

Breakpoints Registers I/O Registers Modules

Name	Value
r2	536911836
r3	6
r4	0
r5	0
r6	0
r7	536911804
r8	0

main.c 0x0

```
33
34 int find_maximum(u8 a[], int n) {
35     int c, max, index;
36     max = a[0];
37     index = 0;
38
39     for (c = 1; c < n; c++) {
40         if (a[c] > max) {
41             index = c;
42             max = a[c];
43         }
44     }
45     return index;
46 }
47
```

Outline Disassembly (x)= Variables

Name	Type	Value
a	u8 *	0x20009fdc "\003\006\003\a\f\017\001\...
(x)= n	int	11
(x)= c	int	1
(x)= max	int	6
(x)= index	int	1

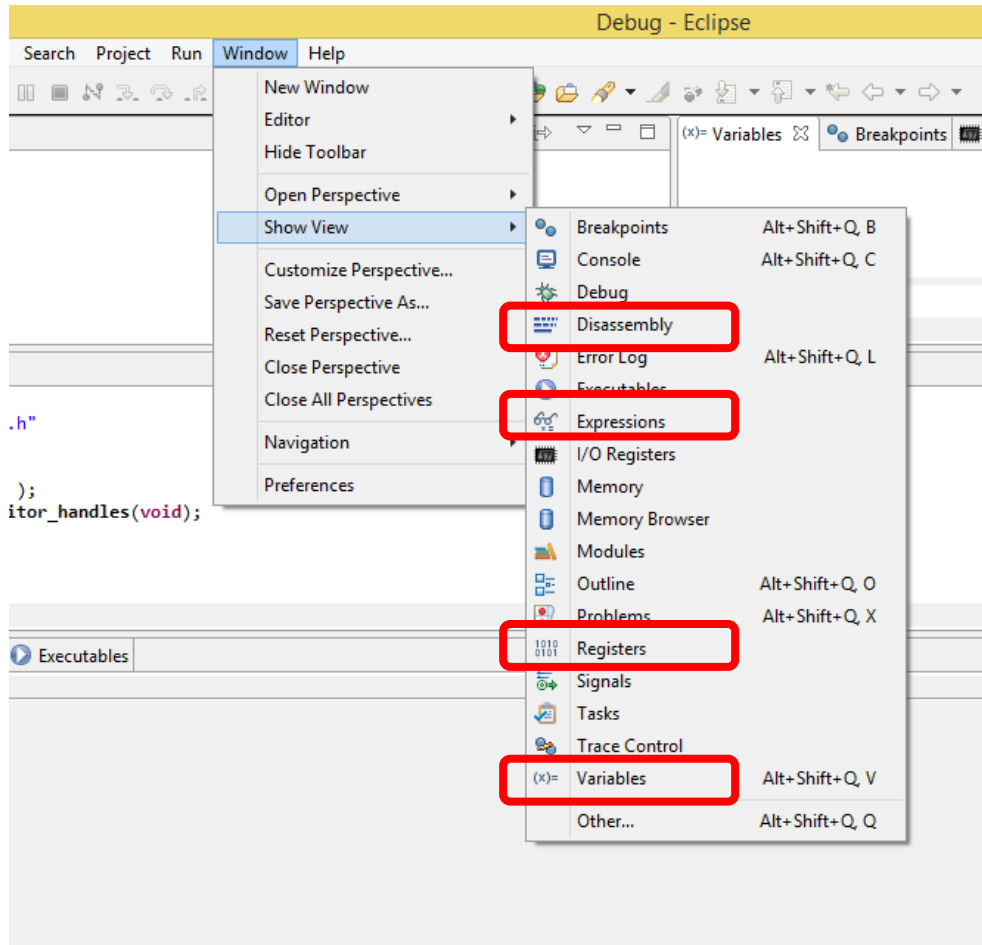
Console Tasks Problems Executables Memory

Debug youeself

The background of the slide is a solid teal color. Overlaid on this background is a large, faint, circular seal. The seal is the coat of arms of the University of Cambridge, featuring a shield with a cross and four lions, surrounded by the Latin motto 'HANC ACADEMIAM FUNDIT' and the word 'LIBERTAS'.

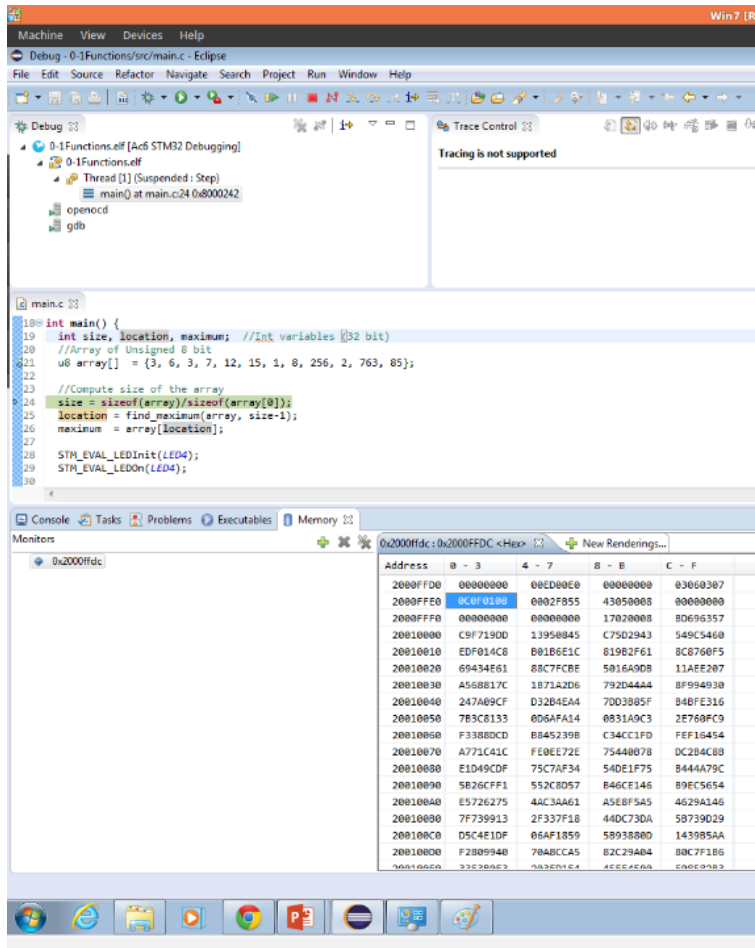
- Try to debug code on the board
- Monitor variables
- Check debug steps buttons
- Is everything working correctly?
- Do the functions works properly?
- Are the results correct?

More Views



- You can add more view to monitor:
 - Assembly code
 - Memory addresses
 - Global variables
 - Microcontroller's registers

Memory View



- Explore Memory Values
- Click New Readings
- Add memory address to monitor (you can check pointer values to detect which address monitor)



Exercises:

- Gli esercizi vanno consegnati entro la lezione di laboratorio successiva.
- Compilare il questionario online (se presente)
- Consegnare via mail I diversi file main.c degli esercizi (un solo file per esercizio!!) inserendo il nome dell'esercizio



Exercise:

- Creare un programma che verifica se una stringa e' palindroma (es AVALLAVA, OTTETTO)
 - Tip: fare un ciclo per meta' della lunghezza della stringa e controllare partendo dal primo indice all'ultimo, incrementando il primo e decrementando l'ultimo