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| **Architetture dei Sistemi di Elaborazione** | Delivery date:  7th December 2023 |
| **Laboratory**  **7** | Expected delivery of lab\_07.zip must include:   * zipped project folder of the exercises 1 and 2 * this document compiled possibly in pdf format. |

Immagine che contiene sport, gioco atletico, tennis, giocatore

Description automatically generated

**Exercise 1)**

A tennis player is following a strict food diet, in which she must count the number of calories taken in from the food eaten and the sport performed. Write a program in **ARM assembly** language that counts the **number of total daily calories**, subtracting from those taken in through food, those consumed through sports.

Days DCB 0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x07

Calories\_food DCD 0x06, 1300, 0x03, 1700, 0x02, 1200, 0x04, 1900,

DCD 0x05, 1110, 0x01, 1670, 0x07, 1000

Calories\_sport DCD 0x02, 500, 0x05, 800, 0x06, 400

Num\_days DCB 7

Num\_days\_sport DCB 3

Days is a table where each entry consists of a day of the week (e.g., 0x01 is Monday, 0x02 Tuesday, ..)

Calories\_food is a table where each entry consists of two integer values: the ID of the day (4 bytes) and the quantity of calories assumed with food (4 bytes).

Calories\_sport is a table where each entry consists of two integer values: the ID of the day (4 bytes) and the quantity of calories consumed with sport activities (4 bytes). Notice that not all days she plays sport.

Num\_days is a 1-byte constant and indicates the number of days in a week.

Num\_days\_sport is a 1-byte constant and indicates the number of days she plays tennis.

Compute the **total number of days** she takes in less than 500 calories per day and store it in register R11.

**Note:** The constant data section must be defined in the code section, with a 2byte alignment and 4096 boundary zero bytes.

Example:

…

// ALIGNMENT

// BOUNDARY (SPACE ….)

MY DATA

// BOUNDARY (SPACE ….)

..

**Exercise 2)**

Save in two separate vectors Calories\_food\_ordered and Calories\_sport\_ordered, the ID of the days in descending order by calories assumed or consumed, respectively.

The output will be, for example:

Calories\_food\_ordered DCD 0x04,0x03,0x01,0x06,0x02,0x05, 0x07

Calories\_sport\_ordered DCD 0x05,0x02,0x06

Then, save in R11 the ID of the least “caloric” day.

Compute the needed bytes for the above vectors.

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| Vector | Size [bytes] |
| Calories\_food\_ordered | 28 |
| Calories\_sport\_ordered | 12 |

Report the following program characteristics (Hint: See the build output window in Keil).

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|  | Size [bytes] |
| Program Size | 8532 |
| Read Only data | 764 |
| Read Write data | 40 |
| Zero Initialized data | 512 |

And provide a brief explanation about which directives can influence the previous program characteristics.

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| Direttive:   * LTORG: permette di salvare i dati costanti nel literal pool, posizionandolo in un punto arbitrario del codice, anziché al termine * DATA: permette di salvare variabili read-writable in un’area dati in posizione arbitraria; è utilizzata per i vettori risultato *Calories\_food\_ordered* e *Calories\_sport\_ordered* * ALIGN: permette di allineare i dati a multipli di un certo indirizzo: in questo caso, si usa half-word alignment, quindi, il programma aggiunge un padding dove necessario * READONLY: indica un’area (in questo caso di codice) che non può essere modificata * READWRITE: indica un’area (in questo caso contenente i vettori risultato) il cui contenuto può essere modificato |