Lab 05 - Introduction to the Raspberry Pi 3 Model B & 16GB NOOBS – ASSIGNMENT

Step 3: Checking the Endian-ness of the RPi

What is the endian-ness of the Raspberry Pi? Try also the same program in lore.cs.purdue.edu and in data.cs.purdue.edu (lore is not equipped with `gcc`, use `c99` instead.). Type "`uname -a`" to know what processor each machine uses. Fill in the following table and turn it in during lab next week.

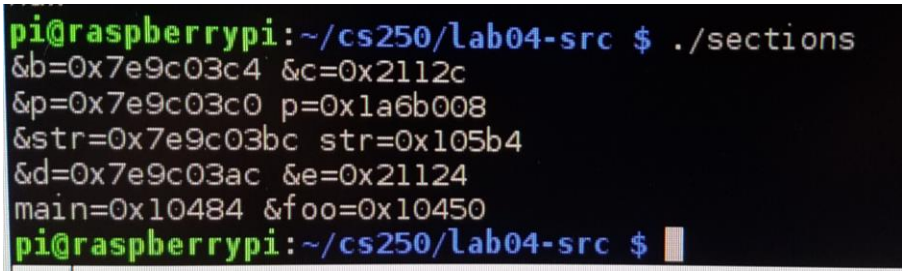
Host Name	Architecture (x86, ARM, SPARC)	Endian-ness
RPI	**ARM**	Little Endian
lore.cs.purdue.edu	Generic_150400-44 sun4u **SPARC** SUNW,Sun-Fire-V445	Big Endian
data.cs.purdue.edu	**x86_64** Intel(R) Xeon(R) CPU E5-2650	Little Endian

Step 4. To Do at Home: Program Memory Sections

The memory usage (footprint) of a program is comprised of the following memory sections:

Memory Section Name	Description	Allowed Access Modes
text (or code segment)	This area of memory contains the machine instructions that correspond to the compiled program and also contains constants such as string literals and variables defined using the `const` keyword. If there are multiple instances of a running program then typically all instances share this memory area.	Read, Execute
data	This region of memory for a running program contains storage for initialized global variables and static variables that are explicitly initialized to a non-zero value. There must be a separate data segment for each running instance of a program.	Read, Write

bss	This memory area contains storage for uninitialized global variables and `static` variables that are not explicitly initialized or initialized to zero. It is also separate for each running instance of a program.	Read, Write
stack	This region of the memory image of a running program contains storage for the automatic (non-static, local) variables of the program. It also stores context-specific information before a function call, e.g. the value of the Instruction Pointer (Program Counter) register before a function call is made. For most architectures the stack grows from higher memory addresses to lower memory addresses. A running instance of a program may have multiple stacks (as in a multi-threaded program)	Read, Write
heap	This memory region is reserved for dynamically allocating memory for variables at run time. Dynamic memory allocation is done by using the `malloc()` or `calloc()` functions.	Read, Write
shared libraries	This region contains the executable image of shared libraries being used by the program.	Read, Execute



Using the table above as a guide, draw an approximate map of the memory of the program indicating the text, data, bss, stack, heap of the program. Also draw where each variable is located as well as the address as indicated by the program.

(lowest address) (highest address)

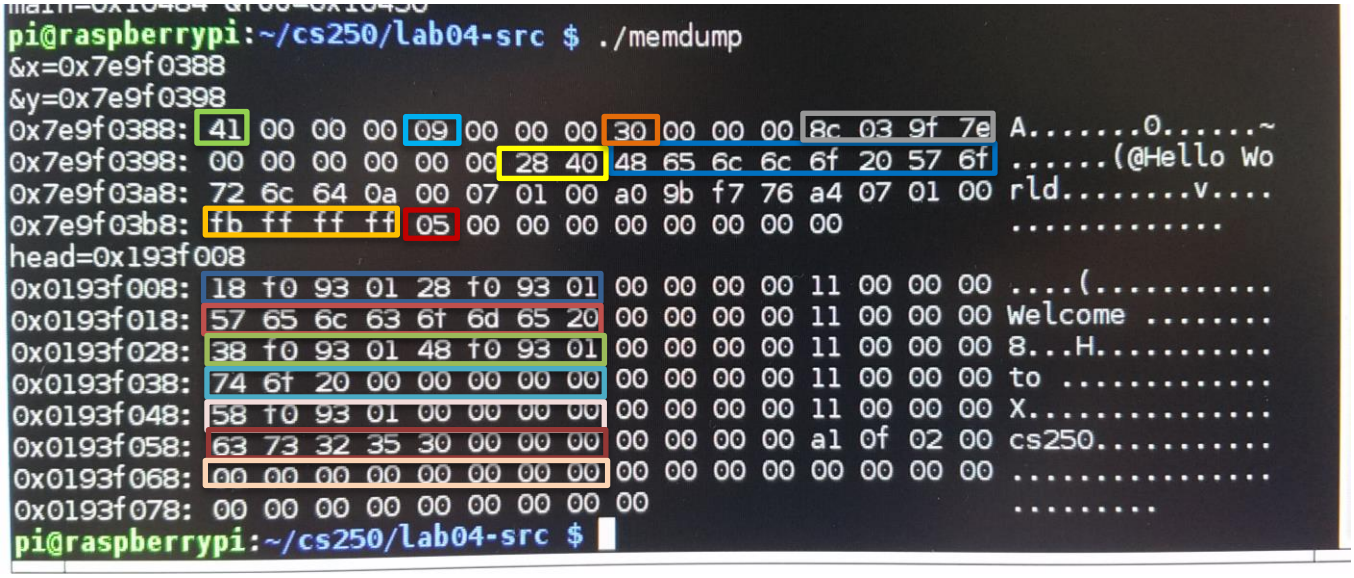
text	data	bss	heap	stack
main (0x10484) &foo (ox10450) str (0x105b4)	&c (0x2112c)	&e (0x21124)	p (0x1a6b008)	&d (0x7e9c03ac) &p (0x7e9c03c0) &b (0x7e9c03c4) &p (0x7e9c03c0)

Step 5. To Do at Home: Memory Dump

Run your version of `memdump`. On the output, indicate where the following items are located:

- `str`
- `a`
- `b`
- `y`
- `x.a`
- `x.i`
- `x.b`
- `x.p`
- `head`
- `head->str`
- `head->next`
- `head->next->str`
- `head->next->next`
- `head->next->next->str`
- `head->next->next->next`

Also, show the binary value of -5 (two's complements of 5).
Also show the value of y for the sign, mantissa, and exponent. Verify that the value stored in memory is correct.



To turn in next week

Upload your answers in a PDF file to Blackboard.

1. The endian-ness table of Step 3.
2. The map of the sections in memory in Step 4.
3. A printout of your `memdump` program.
4. The output of your `memdump` program in Section 5 indicating where the items indicated are found in the output.
5. Two's complement of -5 as stored in memory on the RPi.

   11111111111111111111111111111011 is 5 in two's complement. This is represented via the **"FF FF FF FB"** in the memdump

6. Sign, mantissa, exponent of "y" in `memdump` program and verification that the value stored in memory is correct.

   The sign, mantissa, and exponent of 'y' are all stored in the **"40 28"** of the memdump

sign	exponent	mantissa
0	**100 0000 0010**	**10000000000000000000**

   This is stored correctly in memory.

   Verification:

   4 0 2 8

   0100 0000 0010 0100

   Extend for 32 bits and we get the above statment