Homework problem HW 2 due Monday, Sept. 10: Under the standardized interface between C functions in the x86 (Pentium/IBM PC etc.) instruction set architecture, parameters are passed on the stack in reverse order, so the first parameter is pushed last and it appears at the top of the stack, just under the return address. (The return address is pushed on the stack by the call instruction that passes control to the callee code.) This standard interface is called the “Application Binary Interface” or ABI.

The standard C library function printf uses a variable length parameter or argument list. A typical example of calling printf is

```c
printf("Lumber size: %d inches by %d inches.\n", 2, 4);
```

which prints

Lumber size: 2 inches by 4 inches.

and goes to the next line. The first parameter is a pointer to a null-terminated character string (in short, a “C-string”). That string is called the “format or template string”. printf prints the template string character by character except for characters in “format specifications”. A format specification is introduced by the percent character ‘%’ and ends with one of the a dozen or so format specification letters, such as ‘d’ for printing integers in decimal.

printf requires a variable argument list because the template string determines how many parameters are in the function call beyond the format string.

**Homework 2 Question:** (1) Answer: Which function, the callee (in this case, printf) or the caller (in this case, the function that calls printf) has the code to pop the arguments off the stack? Analyze pages 35 and beyond of the ABI specification linked from the course home page to help you figure this out. (2) Suppose the people who wrote the ABI had chosen the other order for C function arguments: The last argument is pushed last. Write an explanation in English of what an implementation of printf would have to do. (Since printf is already specified, the template string must be the first argument.) (3) In your opinion, is it feasible, to implement printf in a system whose ABI requires the arguments be pushed in forward order? What limitations or constraints might be required on how printf could be used?

**Additional Homework 2 for 500 Students:** Find out and report in 1/2 page the portable way to (1) declare and (2) code the bodies of C functions with variable length argument lists. Cite your sources.

1. ( ) Answered below. ( ) Below I wrote where to find needed information and how to use it. ( ) I have no clue. Below is what puzzles me.

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