

Pointer Stew

This is a puzzle that uses pointers and arrays in a complex manner. If you completely understand how this works, you definitely know your C pointers and arrays.

The Program

Line numbers are included for reference; they don't appear in the source code, of course.

```

1 #include <stdio.h>
2 char *c[] = {
3     "ENTER",
4     "NEW",
5     "POINT",
6     "FIRST"
7 };
8 char **cp[] = { c+3, c+2, c+1, c };
9 char ***cpp = cp;
10 int main(void)
11 {
12     printf("%s", ****cpp );
13     printf("%s_", *--*++cpp+3 );
14     printf("%s", *cpp[-2]+3 );
15     printf("%s\n", cpp[-1][-1]+1 );
16     return (0);
17 }

```

Analysis

Line 12: ****cpp

Here, `cpp` points to `cp`. As `cp` is an array of pointers to pointers to characters, the “++” changes `cpp` to point to `cp + 1`. Then the first dereference (“*”) is to `c + 2`, and the second dereference (“*”) is to `*(c + 2)`, or `c[2]`, or the string “POINT”.

So the `printf` on line 12 prints the string POINT with no trailing newline.

After this, `cpp` points to `cp + 1`. The other variables are unchanged.

Line 13: *--*++cpp+3

First, we apply the rules of precedence to parenthesize this expression. This produces “`(* (-- (* (++cpp)))) + 3`”. Now, `cpp` points to `cp + 1`. After applying the “++” operator, `cpp` points to `cp + 2`. Then the first dereference (“*”) is to `c + 1`, and applying the decrement operator “--” changes the entry in the location `cp + 2` to be `c + 1 - 1`, or `c`. The second dereference (“*”) thus is `*c`, or `c[0]`, or the string “ENTER”. Adding 3 to this value takes us to `c[0] + 3`, which is the string “ER”.

So the `printf` on line 13 prints the string ER with a trailing blank and no trailing newline.

After this, `cpp` points to `cp + 2` and `cp[2]` points to `c`. The other variables are unchanged.

Line 14: *cpp[-2]+3

Again, we fully parenthesize this to get `(* (cpp[-2])) + 3`.

As `cpp` points to `cp + 2`, the dereference “`cpp[-2]`” is to `*(cp + 2 - 2)` or `*cp`, or `c + 3`. Then the dereference “*” takes us to `*(c + 3)`, or `c[3]`, or the string “FIRST”. Adding 3 to this takes us to `c[3] + 3`, or which is the string “ST”.

So the `printf` on line 14 prints the string ST with no trailing newline.

Line 15: `cpp[-1][-1]+1`

As `cpp` still points to `cp + 2`, the dereference “`cpp[-1]`” is to `*(cp + 2 - 1)` or `*(cp+1)`, or `c + 2`. Then the next “`[-1]`” takes us to `*(c + 2 - 1)`, or `*(c + 1)`, or `c[1]`, or the string “`NEW`”. Adding 1 to this takes us to `c[1] + 1`, or which is the string “`EW`”.

So the `printf` on line 15 prints the string `EW` with a trailing newline.

Result

So the result of this program is the line

```
POINTER STEW
```

Credit

This problem is from Alan Feuer’s excellent book *The C Puzzle Book* (Addison-Wesley Professional, Boston, MA; ©1998; ISBN 978-0-201-60461-0). This document has a slightly modified version by Matt Bishop. Only changes necessary to get it to compile without warnings were made. The C code analyzed above is as in the original.