Sécurité des logiciels

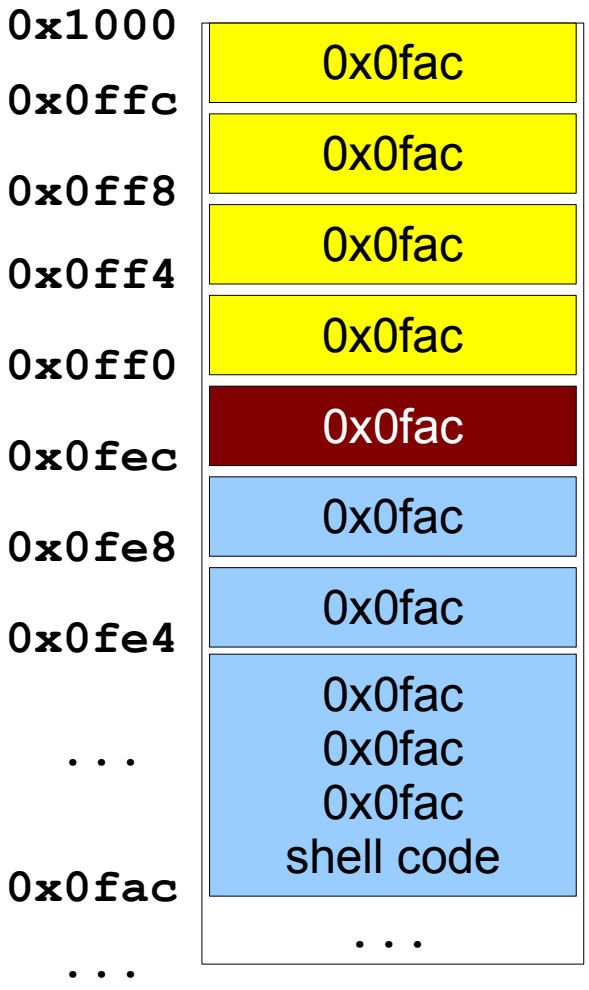
NX? Not on the stack? Still pwnd!

Samuel Thibault <samuel.thibault@u-bordeaux.fr>

Stack overflow exploit needs...

Stack overflow exploit needs

- Executable stack
- Buffer on the stack
- Known position



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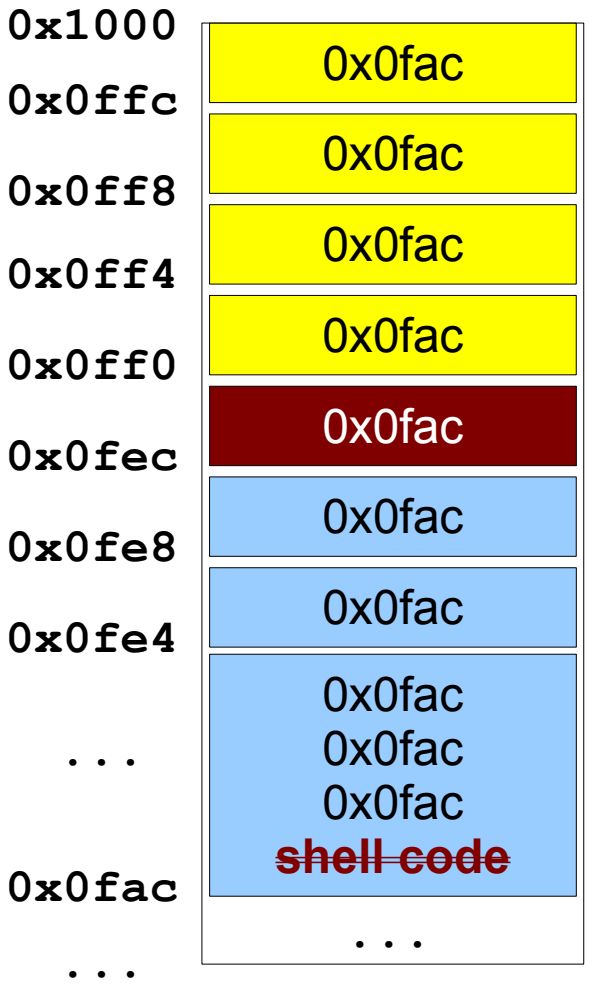

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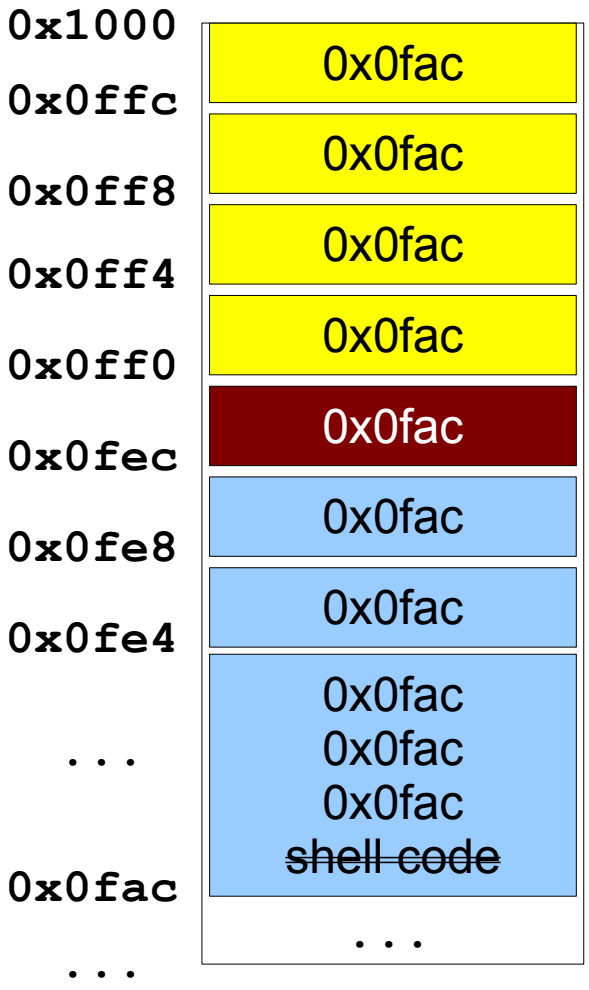
Remember what our shell code was:
Basically
execve(“/bin/sh”, {“/bin/sh”, NULL}, {NULL});

Do we really need to write code for this?



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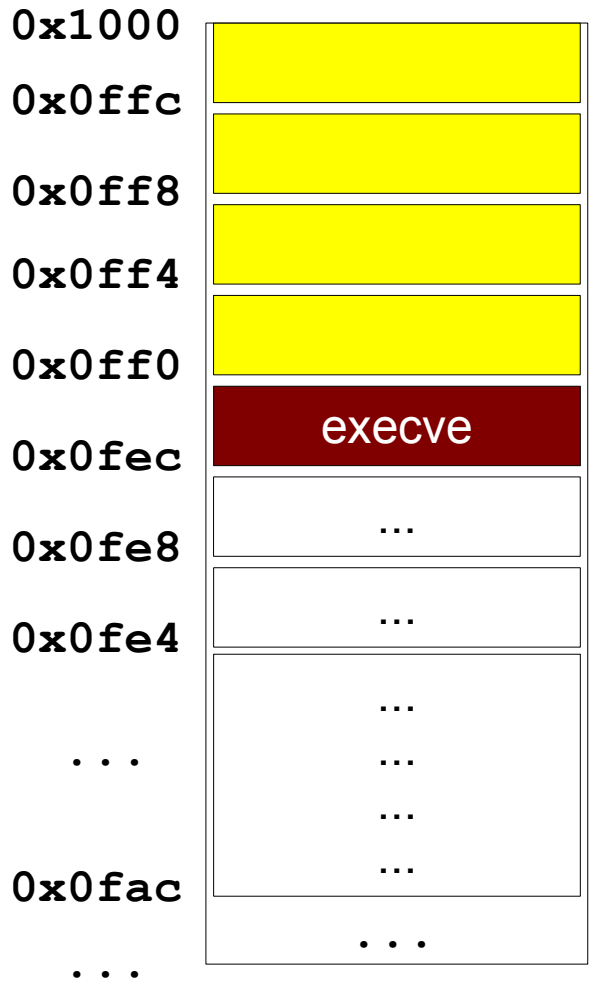

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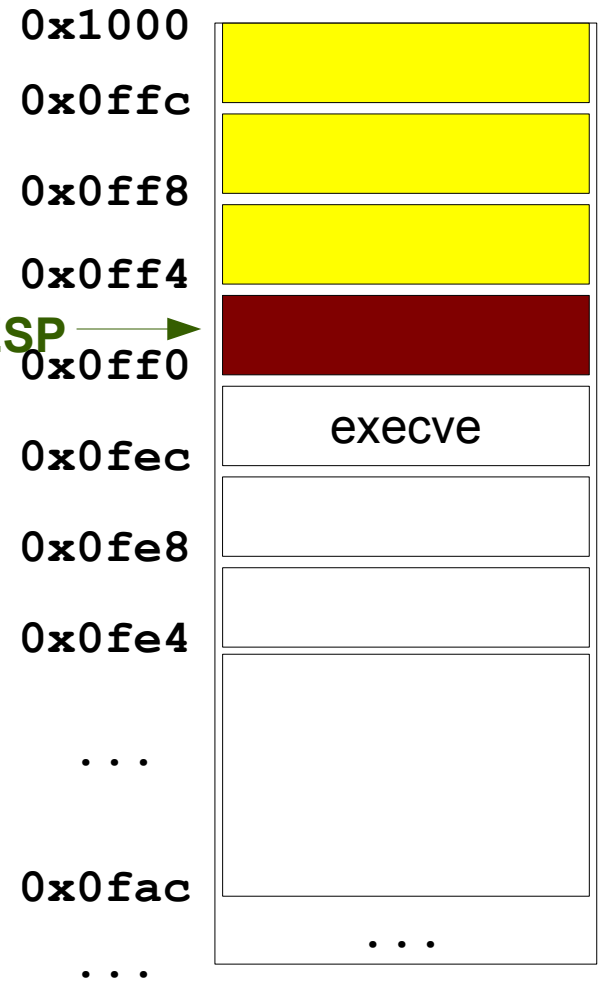

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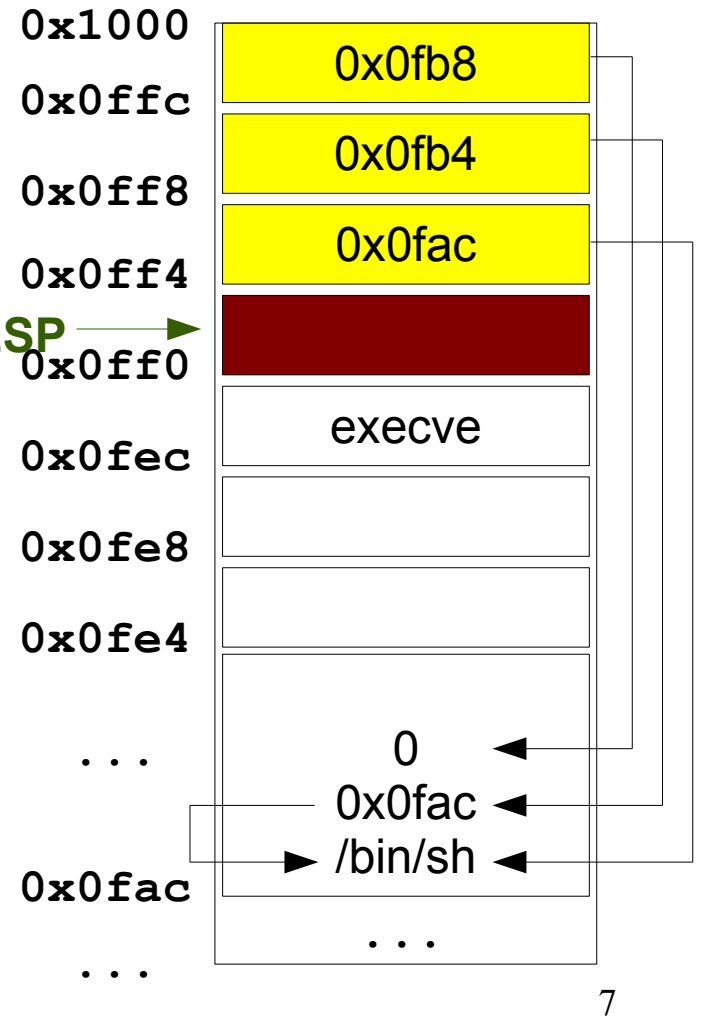
Result of ret to execve

So we have to set parameters accordingly



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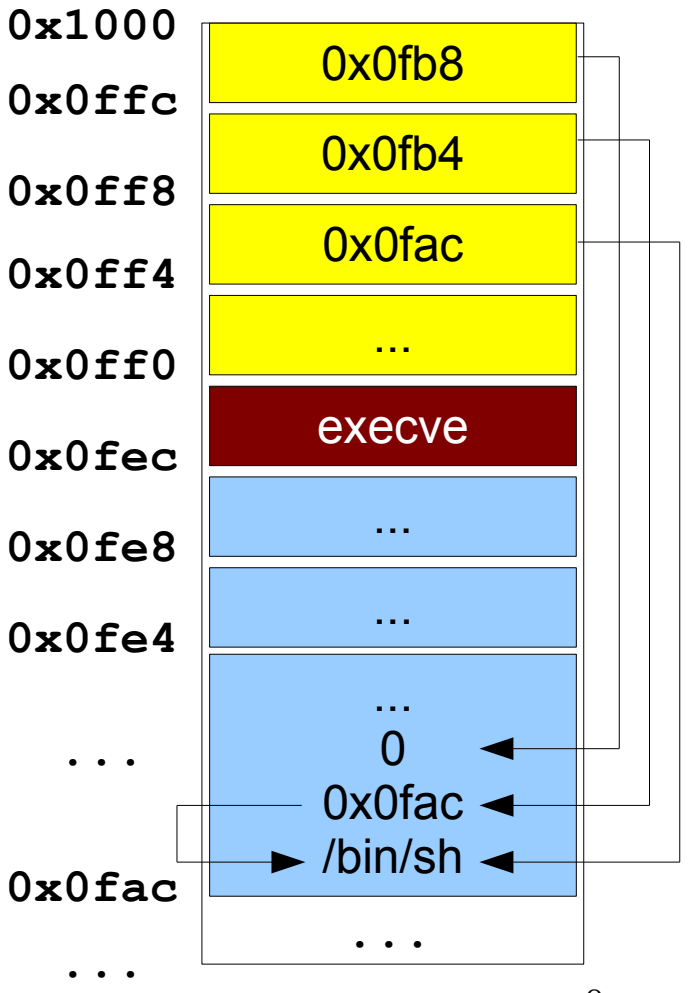
Overflow **exactly** like this!

Ret-into-libc hack

What if we want to do more than just one system call?



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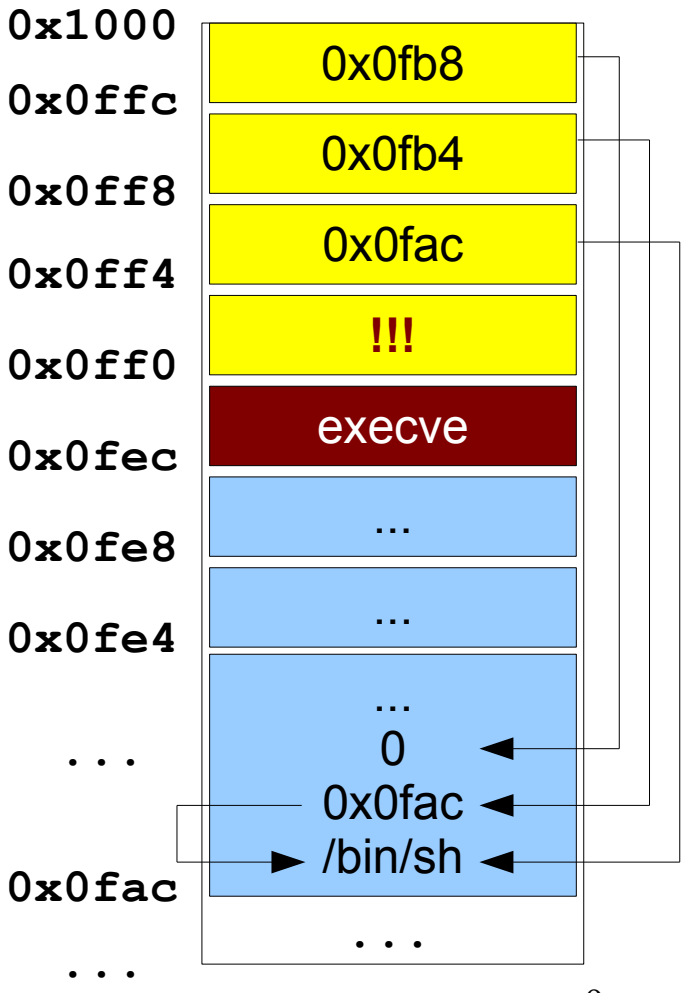

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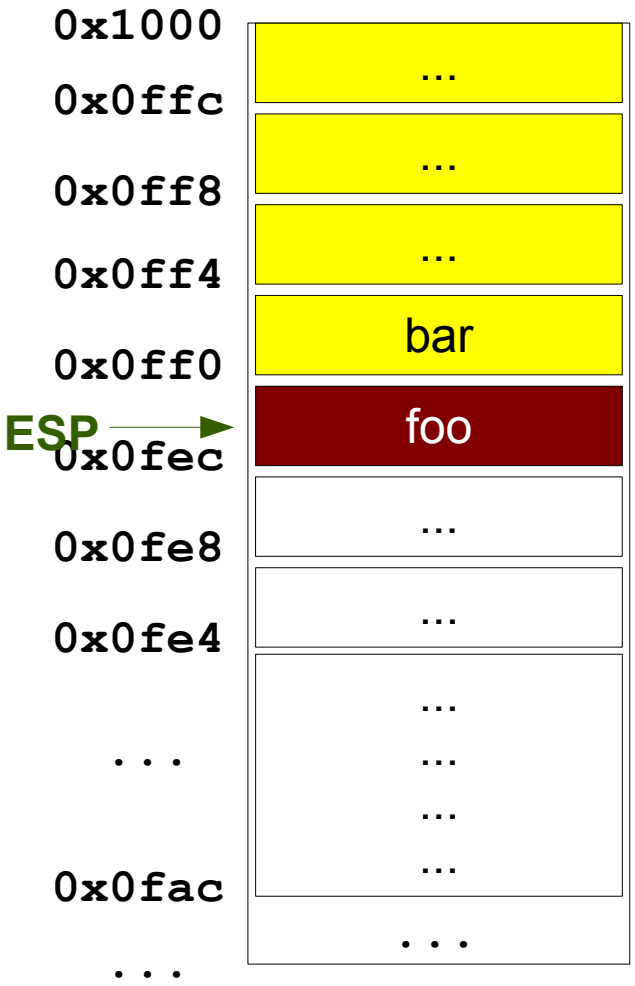
A second chance...

First “return to” foo



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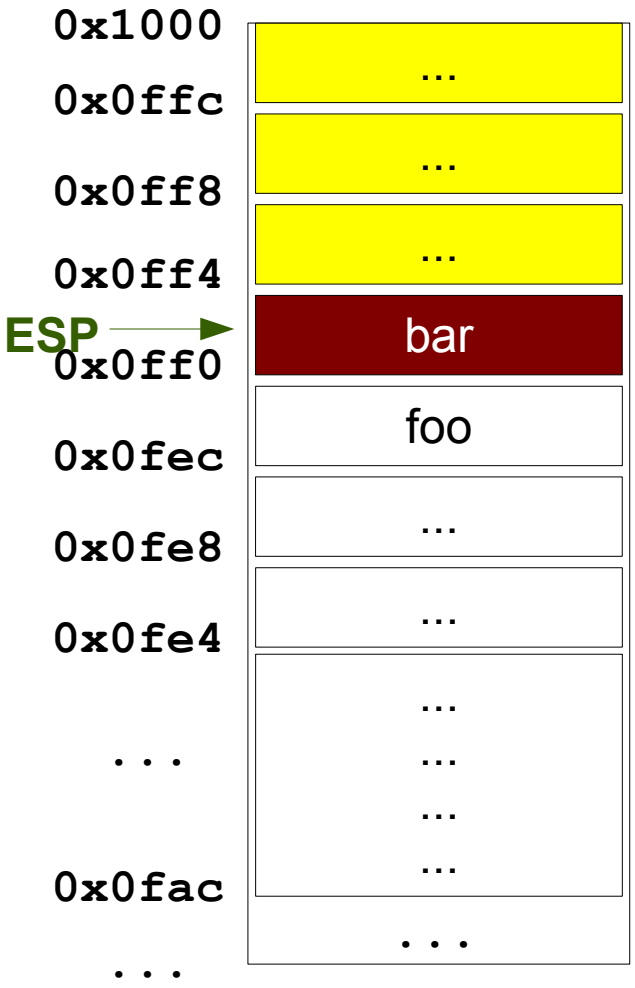
A second chance...

First “return to” foo
Now in foo, then “return to” bar



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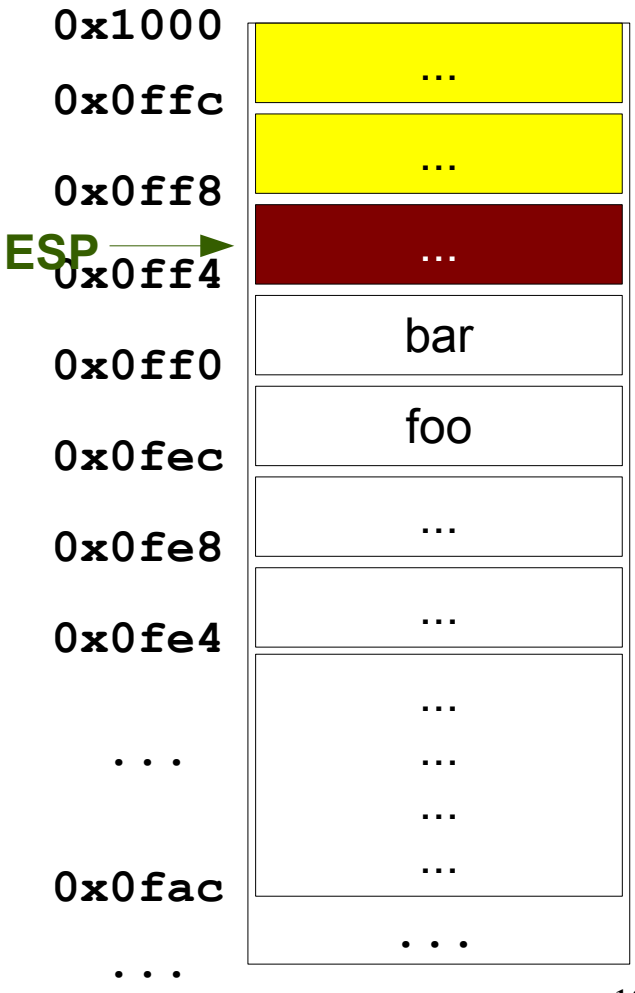
A second chance...

First “return to” foo
Now in foo, then “return to” bar
Now in bar

Err, but then bar’s parameters need to be almost the same as foo’s...

But bar does not have to be a **proper function!**



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How to execute stuff
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SP lifting hack

A lot of glibc functions end with cleaning the stack, e.g.:

```
bar:
addl $12,%esp
ret
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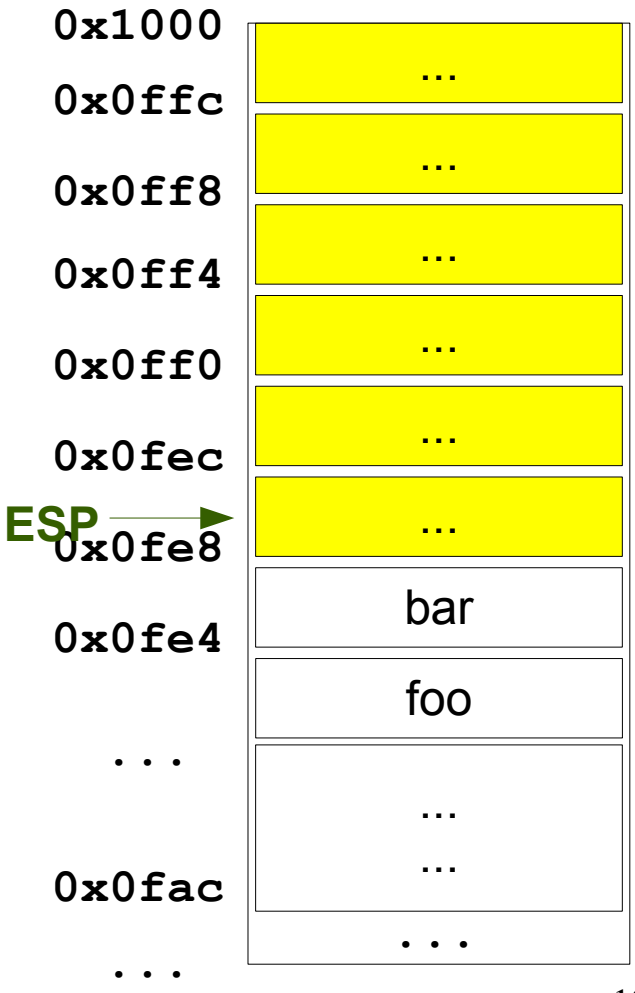

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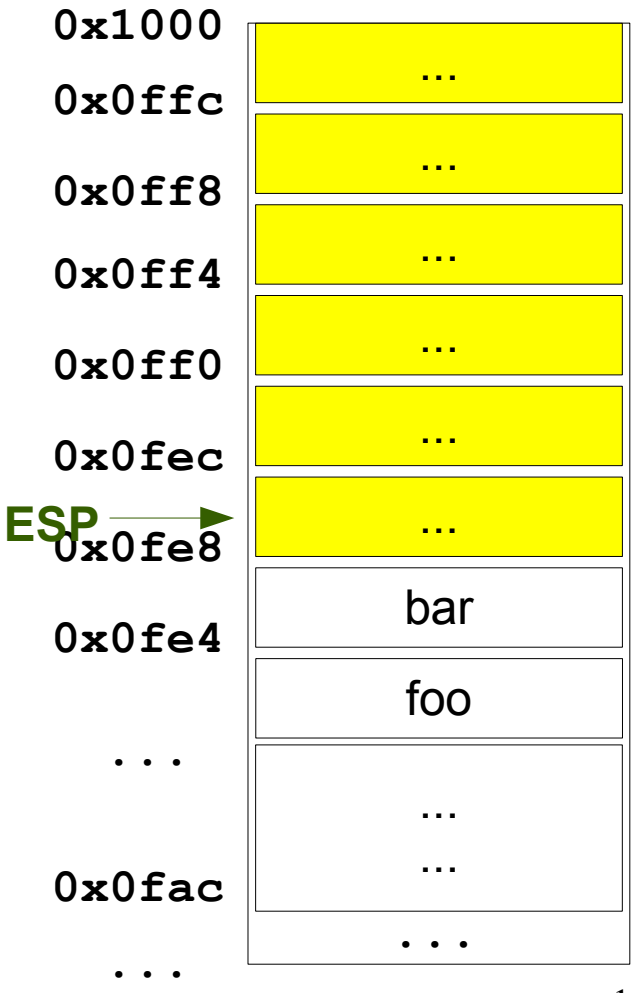

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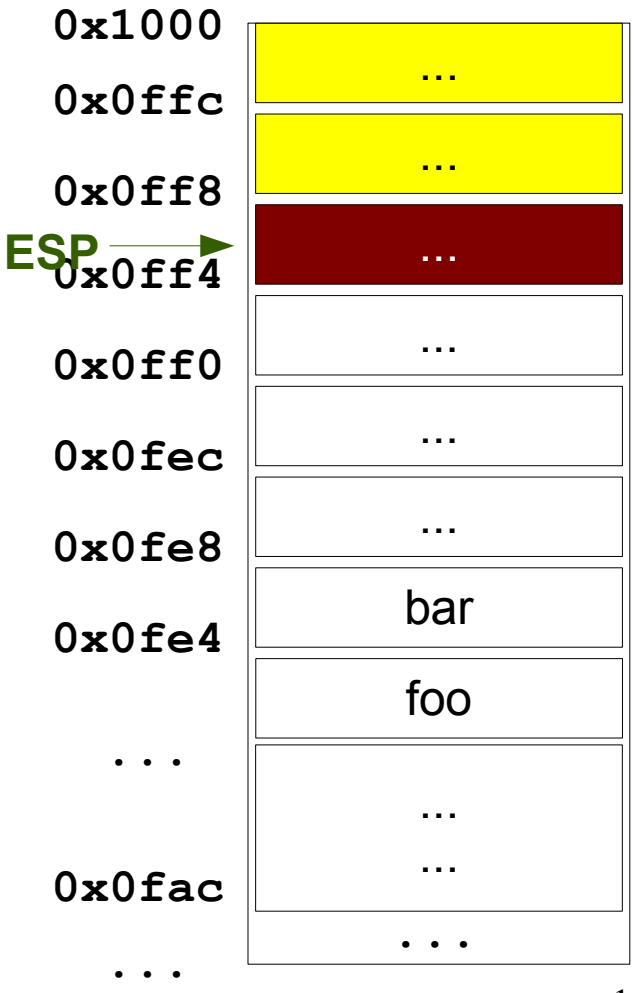

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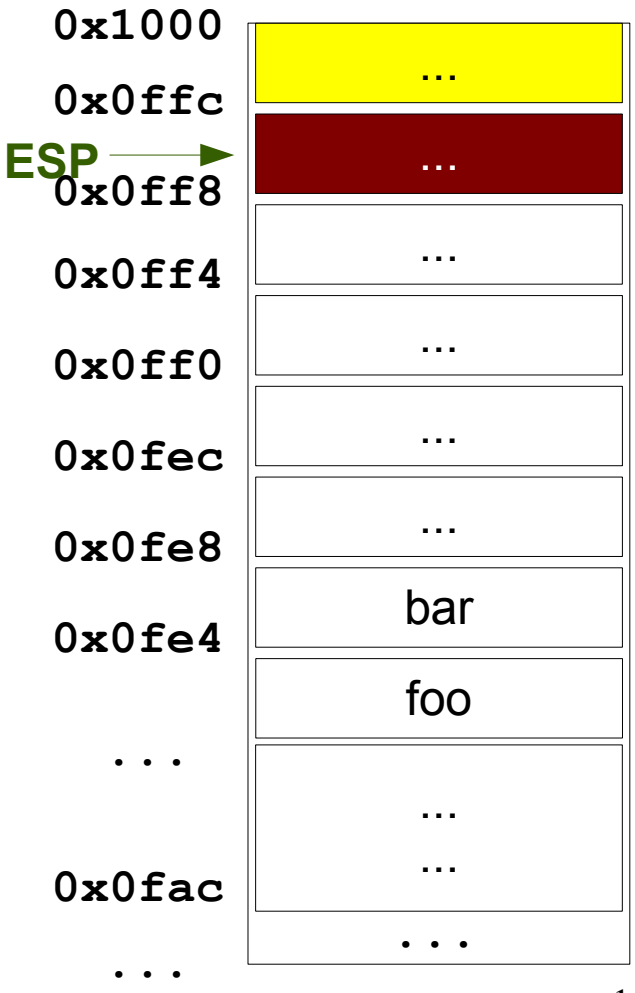

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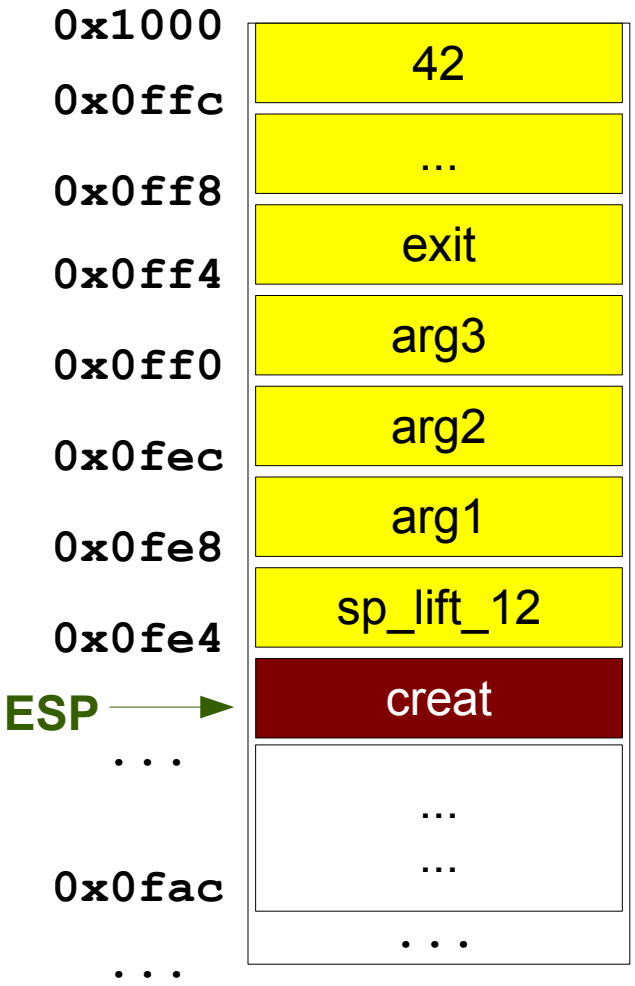
SP lifting hack, complete story:

First ret-into-libc



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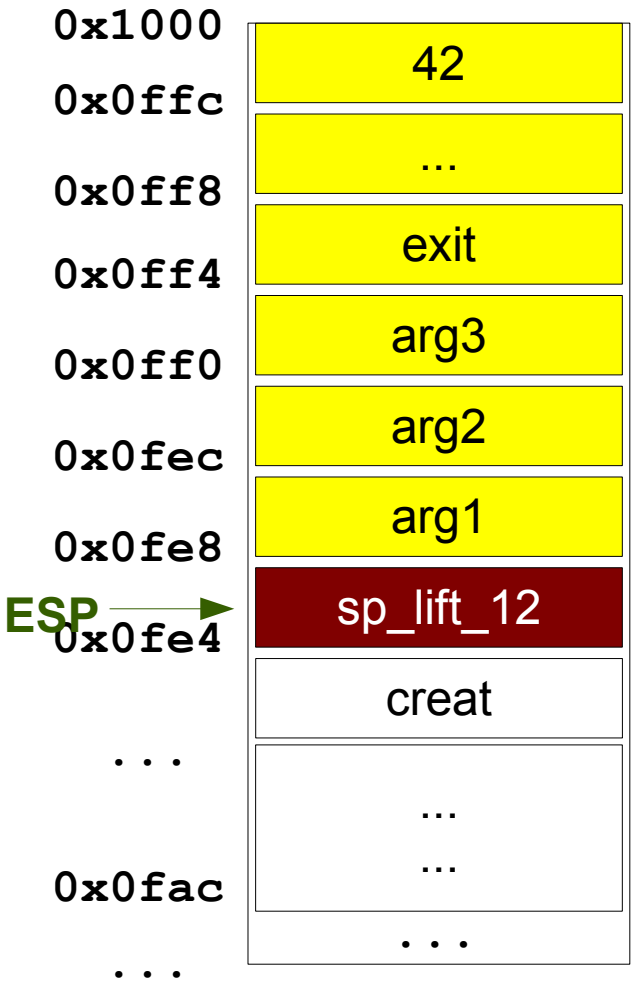
SP lifting hack, complete story:

First ret-into-libc
Now in creat, ..., returns to sp_lift_12



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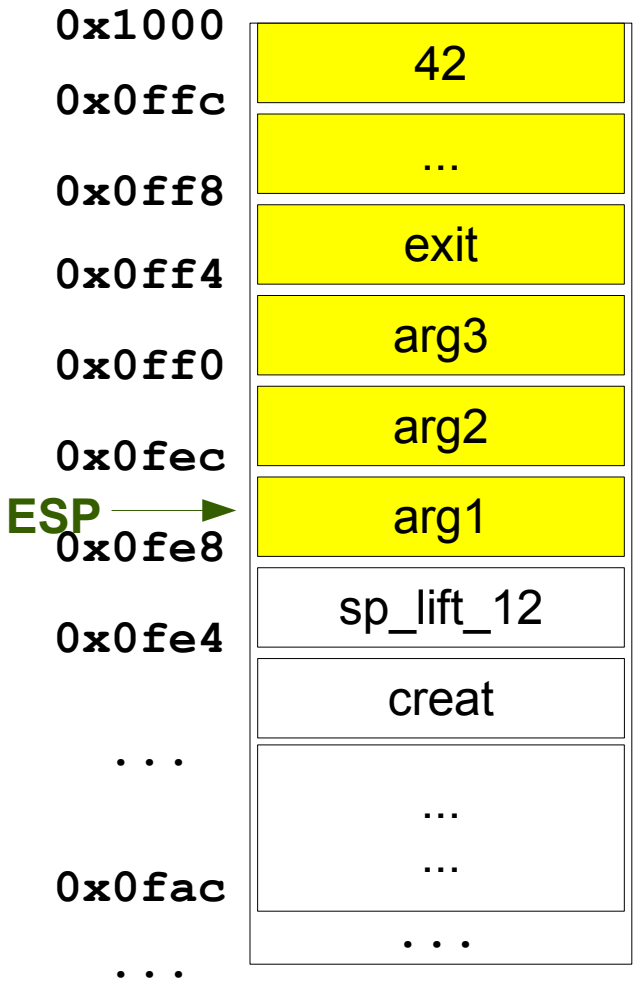

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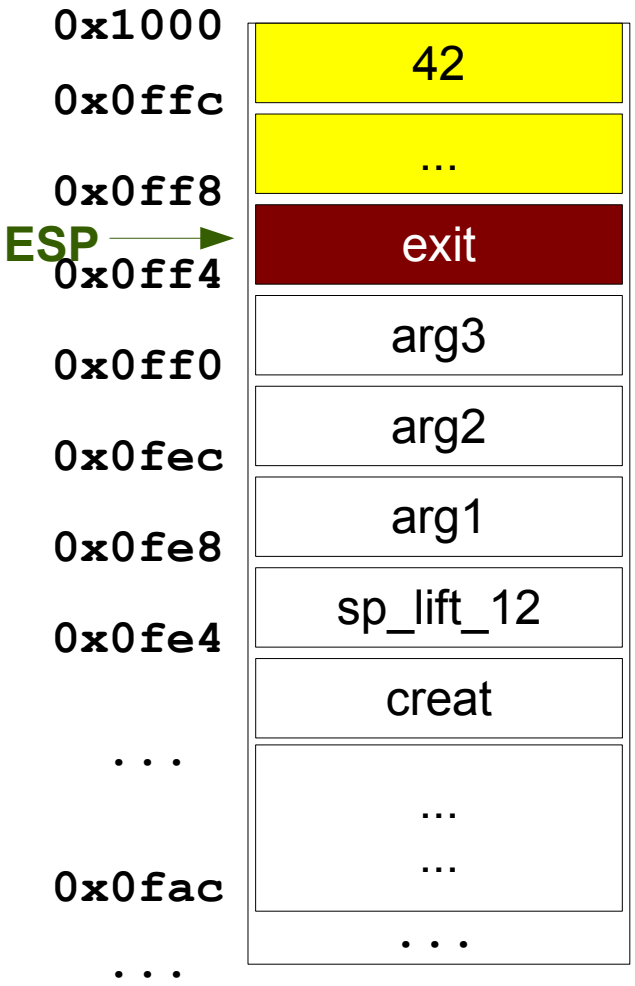
Stack cleaned, returns to exit



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SP lifting hack, complete story:

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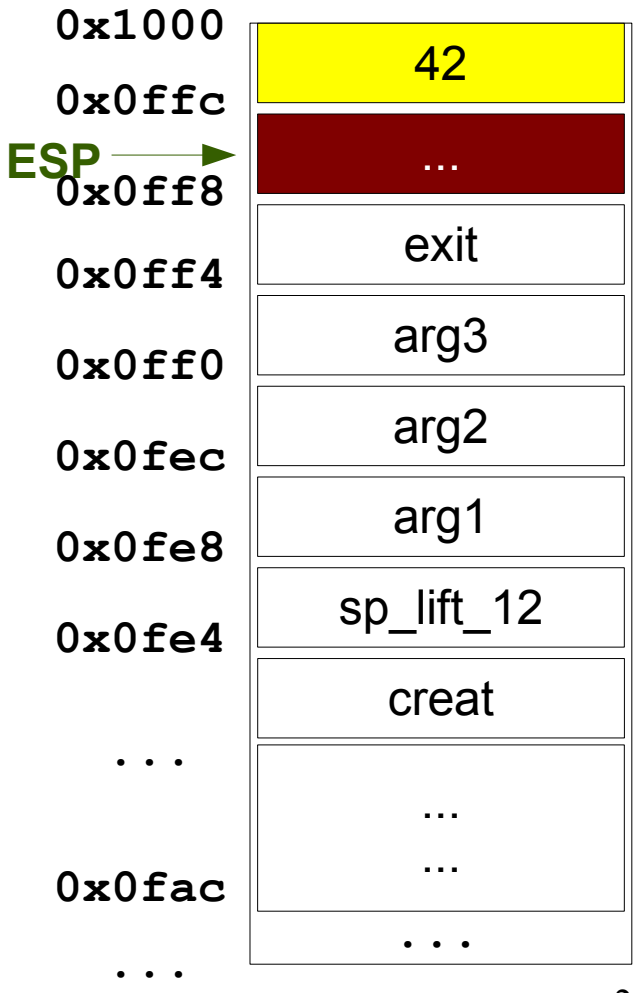
Now in creat, ..., returns to sp_lift_12
Now in sp_lift, cleans stack
Stack cleaned, returns to exit
Now in exit, exits nicely
pwnd!



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How to execute stuff
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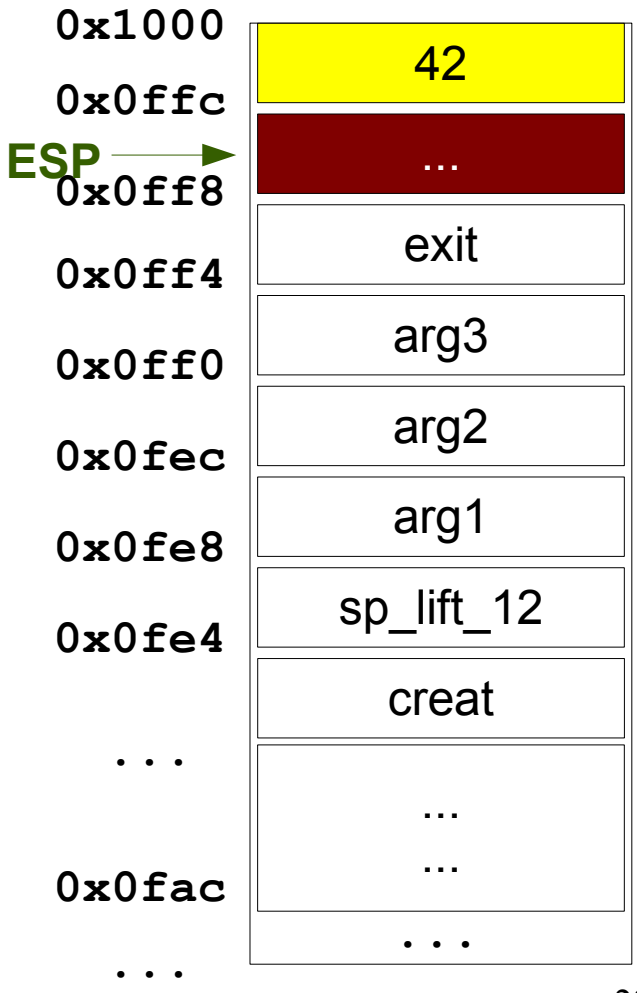
SP lifting hack

- Call chain can be arbitrarily long
- Just need to find in libc what you need



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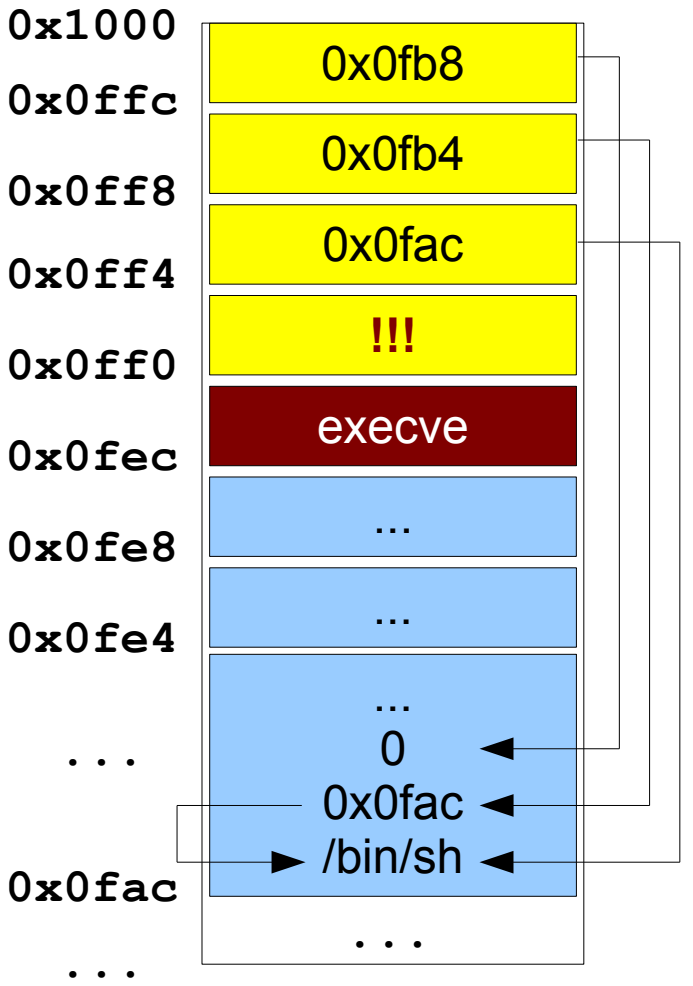
What is the basic problem?

We can overflow

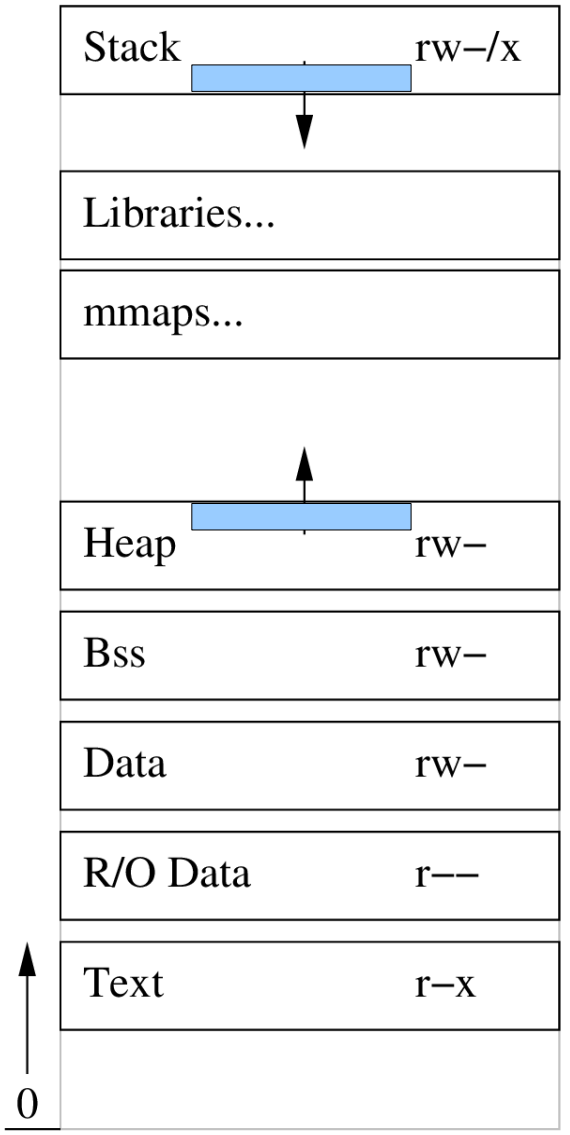
- from a **data** buffer
- into a **control** area



Stack overflow exploit needs...

Stack overflow exploit needs

- Executable stack
- Buffer on the ~~stack~~ **heap**
- Known position



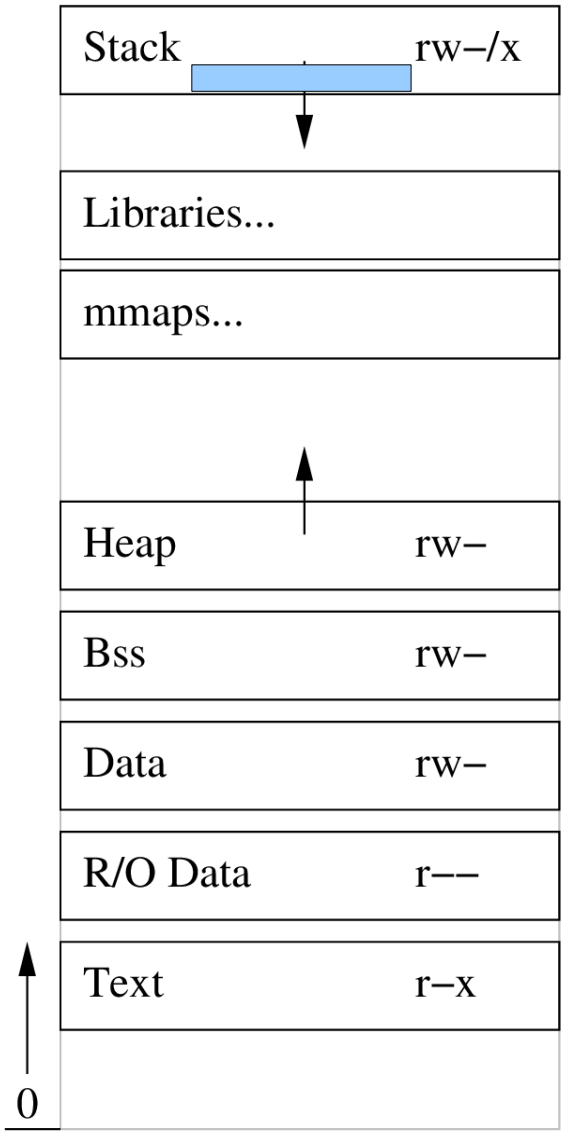
Heap overflow?

```
int litentier(void) {
  int i;
  char buf[64];

  printf("> ");
  fflush(stdout);

  gets(buf);
  i=atoi(buf);

  return i;
}
```



Heap overflow?

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int litentier(void) {
   int i;
   char *buf = malloc(64);

   printf("> ");
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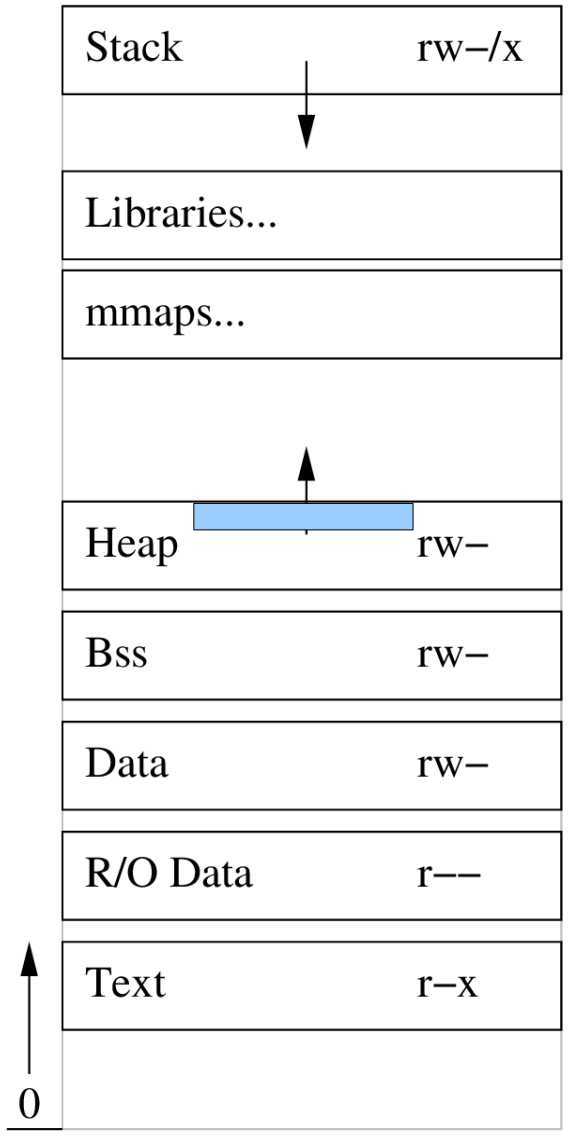
```

No way to overflow into the stack

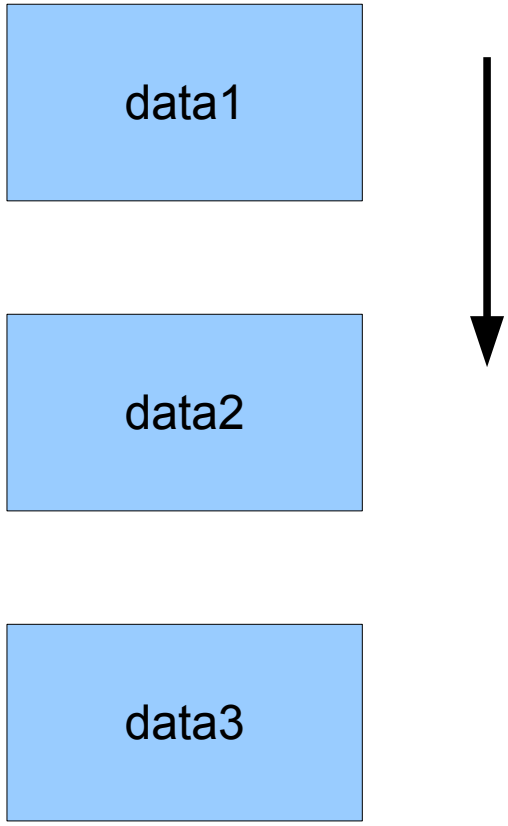
Something else?



Heap overflow?

Heap structure (simplified)

When you call **`malloc`** three times



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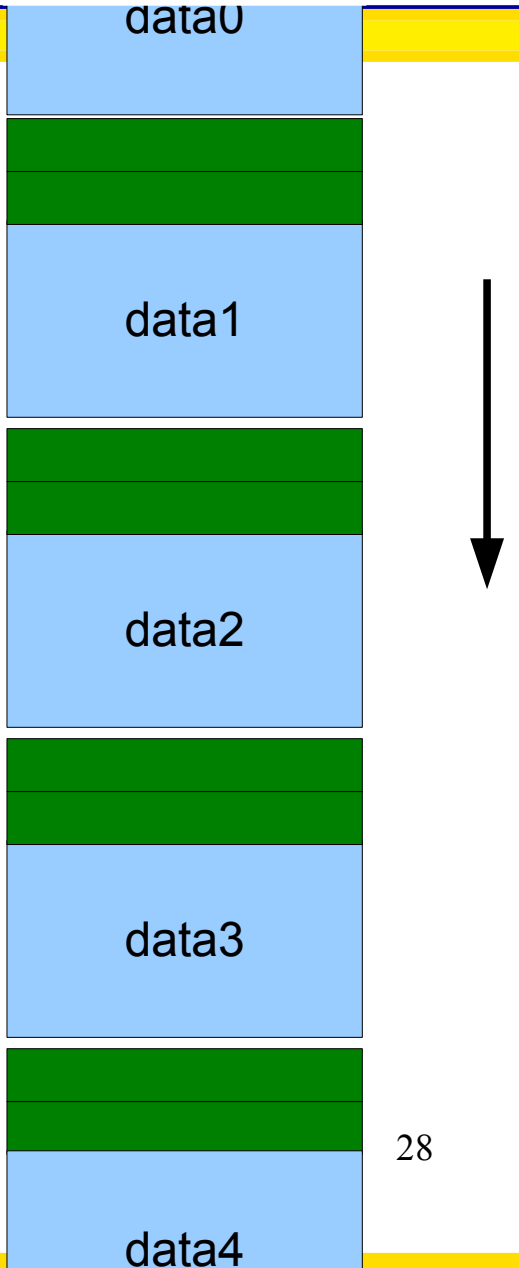
There are actually some additional headers



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Which allow to jump between allocations:

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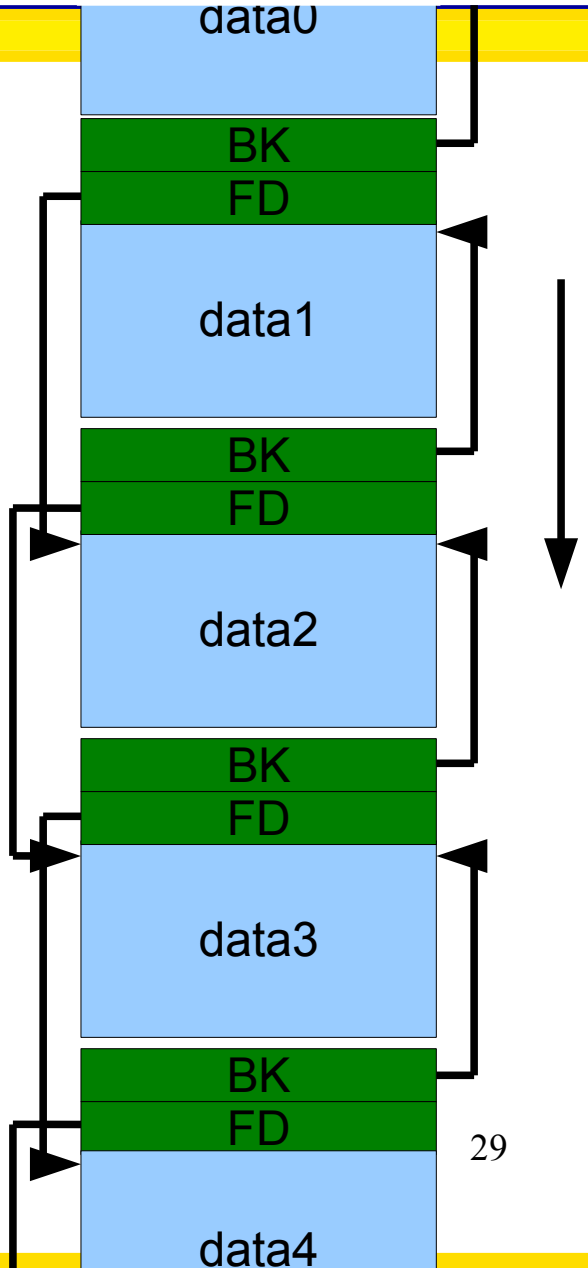

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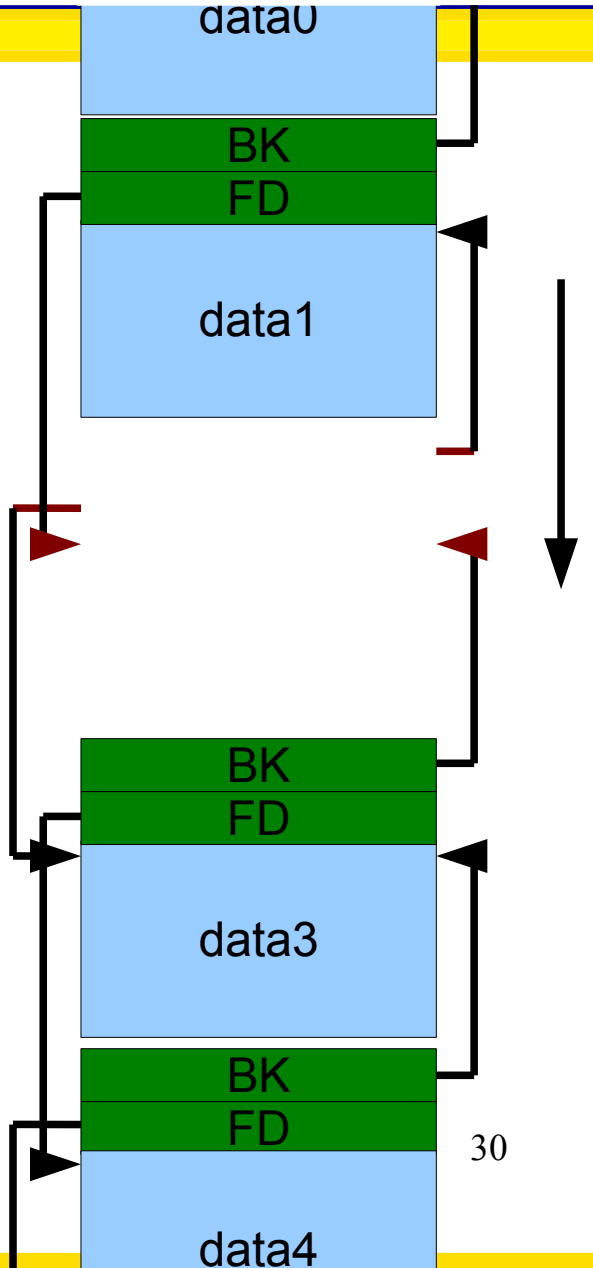
- Have to update BK/FD



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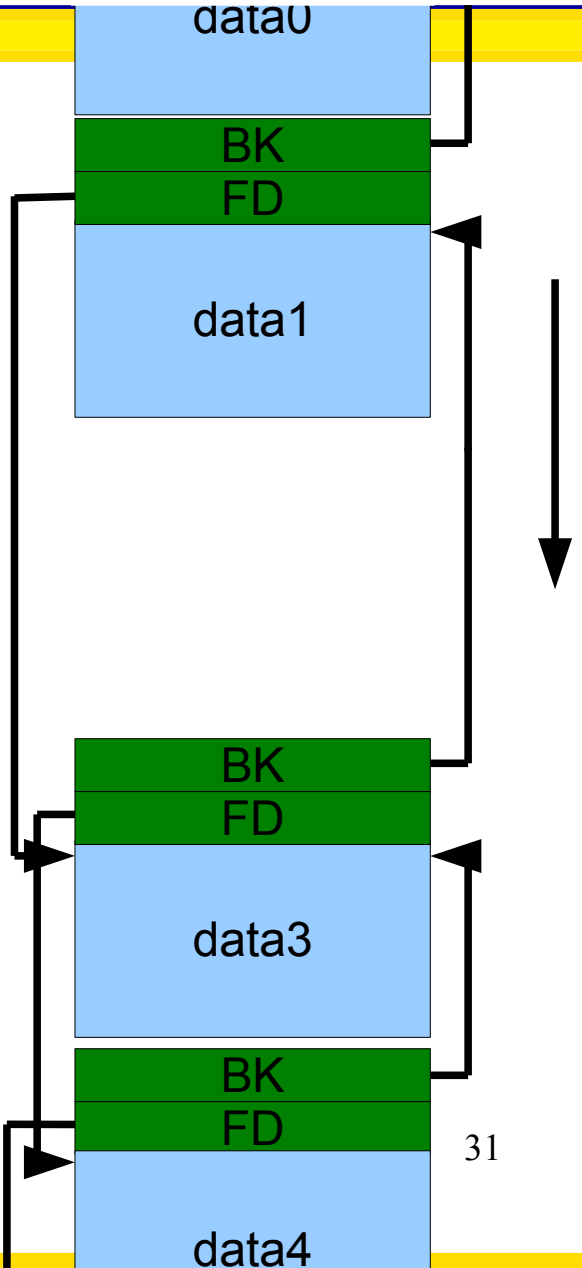

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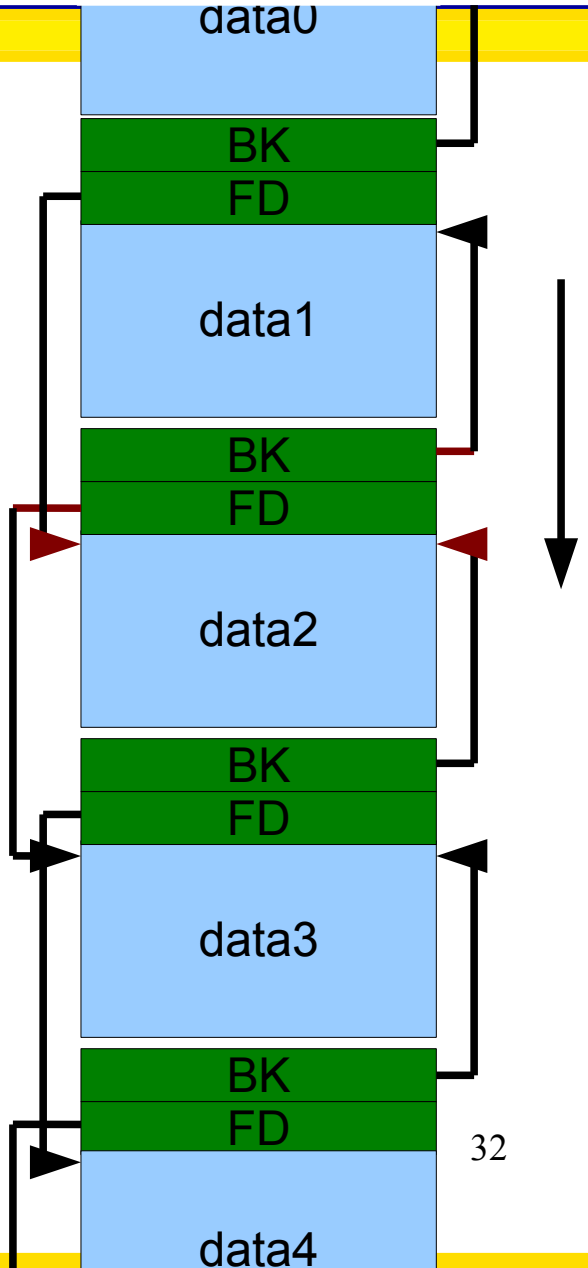
BK = data2->BK;
FD = data2->FD;
BK->FD = FD;
FD->BK = BK;
```



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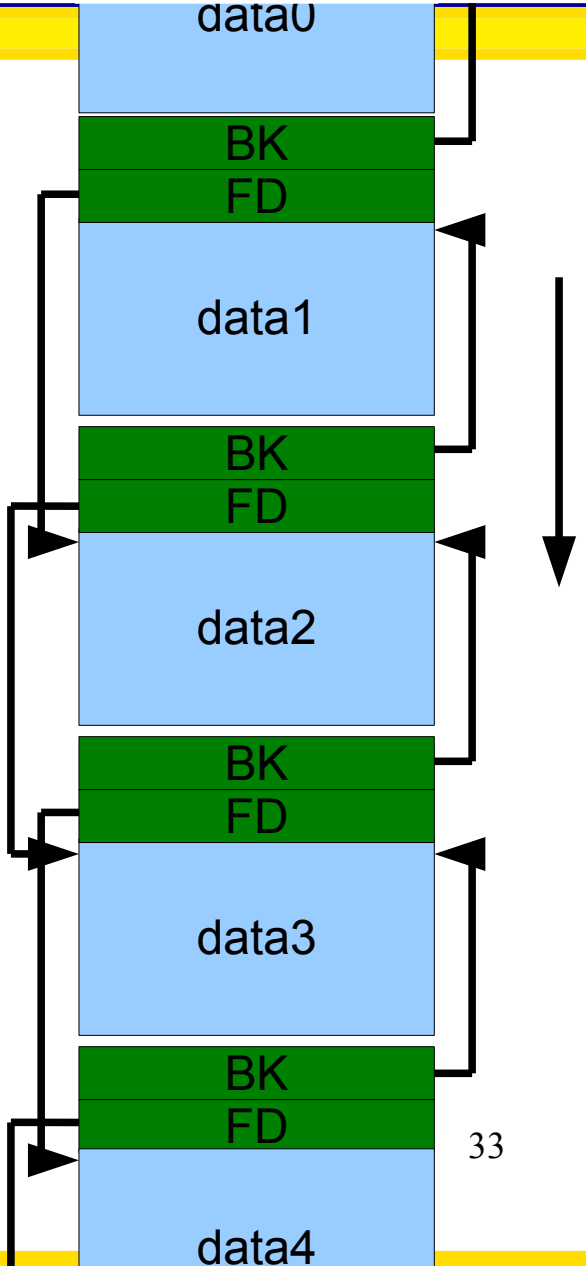

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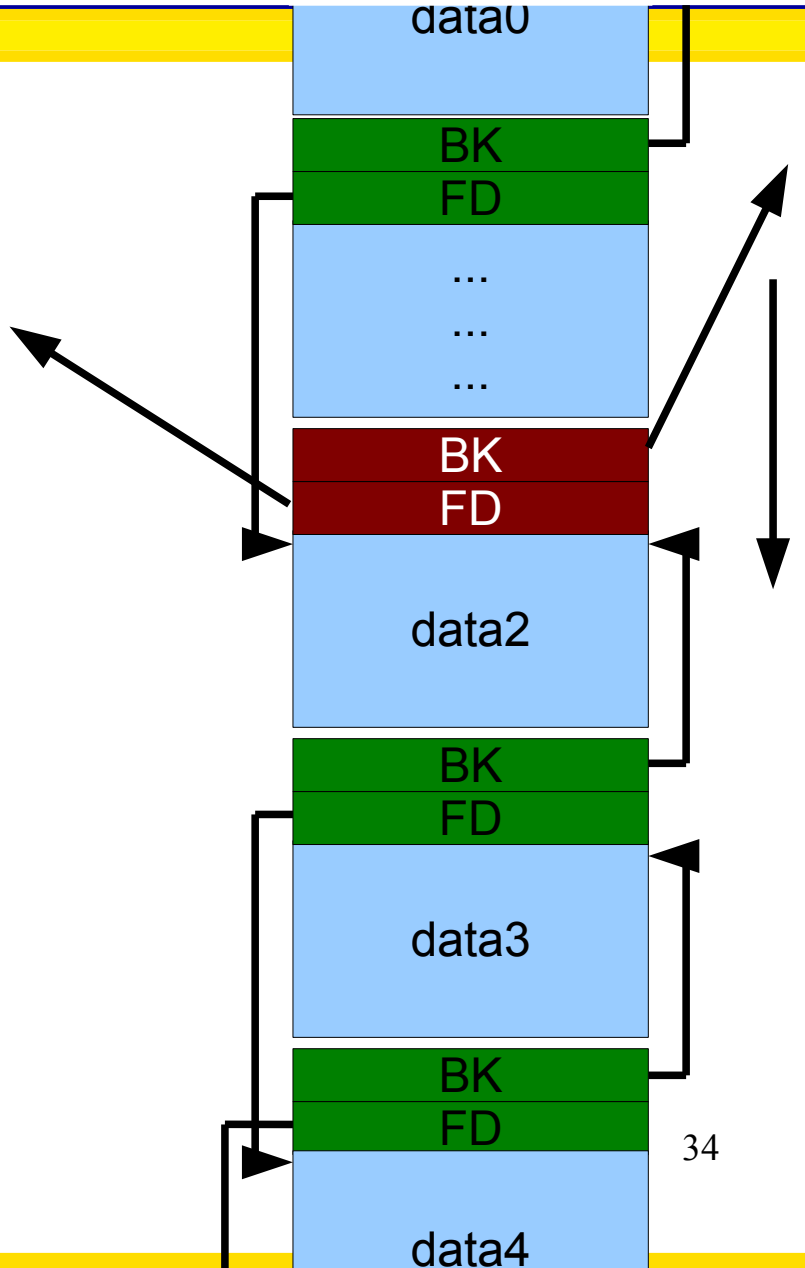
Now, what if I overflow data1?

- I can choose data2's BK at will
- I can choose data2's FD at will



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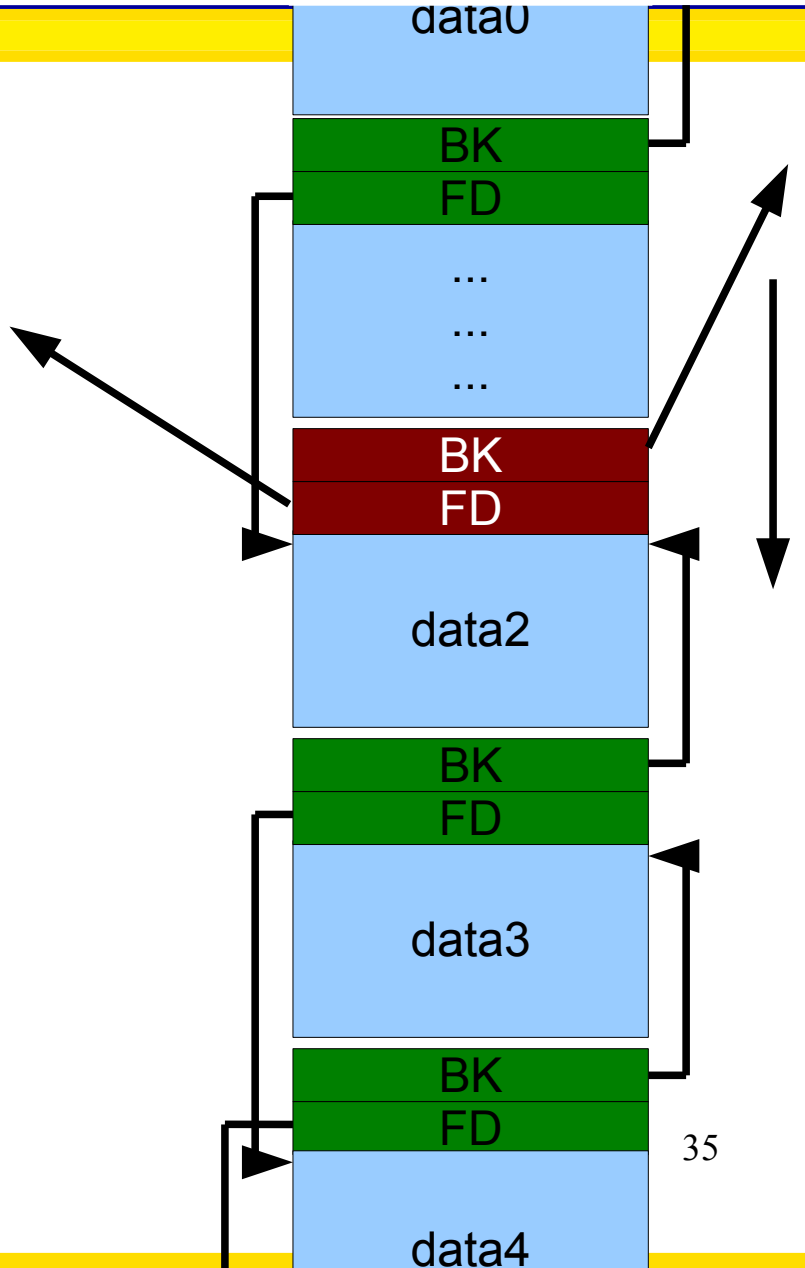

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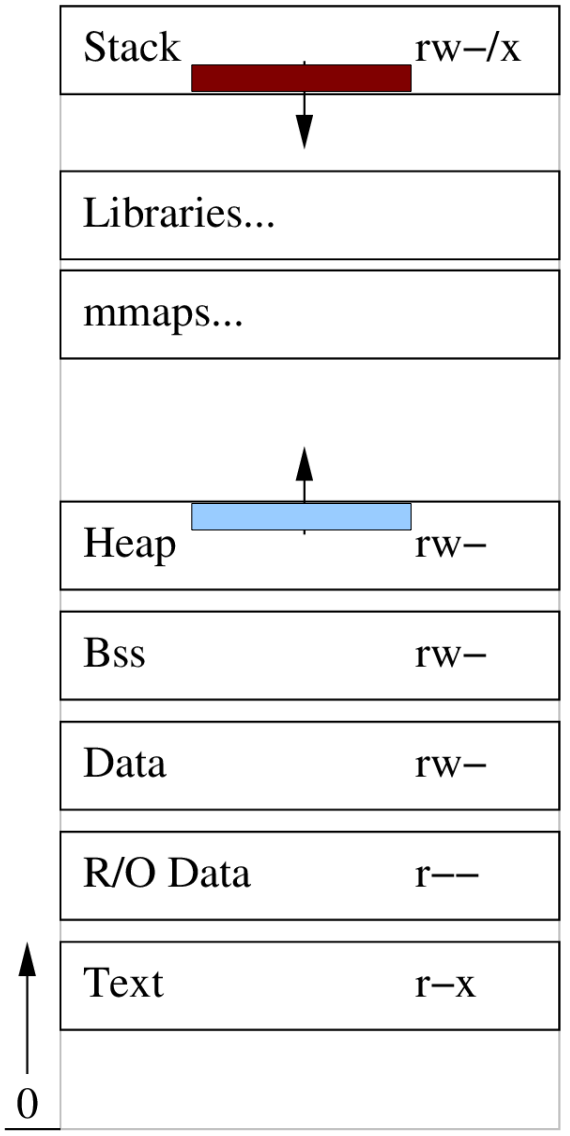
In the end, I can divert the **control** in the stack



Countermeasures

Libc checks for coherency of headers

- More expensive free

Static code analysis / compiler-provided information

- Check for array bounds

Stack overflow exploit needs...

Stack overflow exploit needs

- Executable stack
- Buffer on the stack
- **Known position**
  - Next time!