Conception d'un compilateur obfuscateur

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BeerRump 2016

Cadre du projet

- Dernier niveau pour le challenge du SSTIC (épreuve ring)
- "Whitebox" asymétrique (signature de Rabin)
- Source compilé par un compilateur maison
- cf. Fabien Perigaud pour l'algo spécifique et la solution

Bitslice

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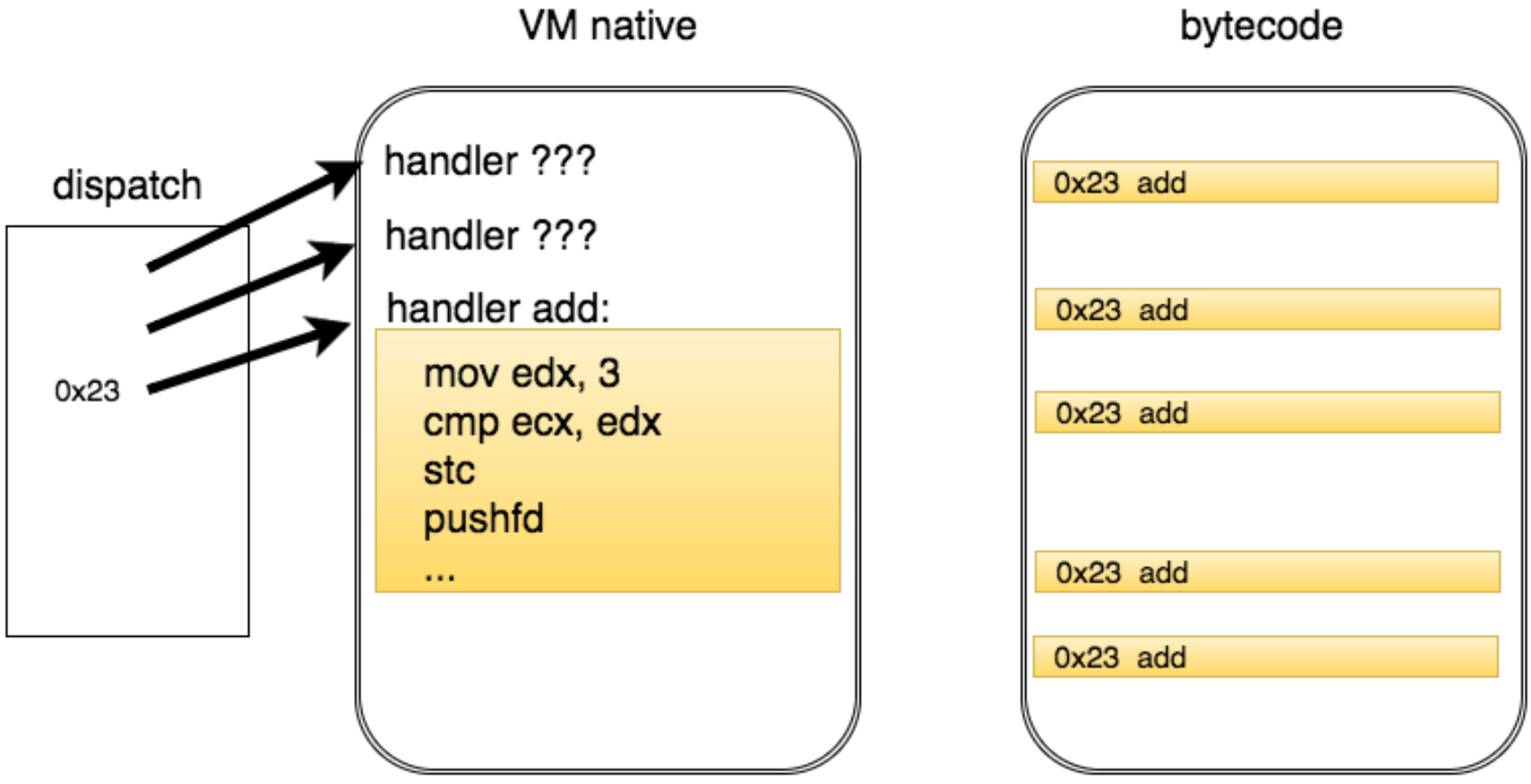
- 1 bit, ça serait top

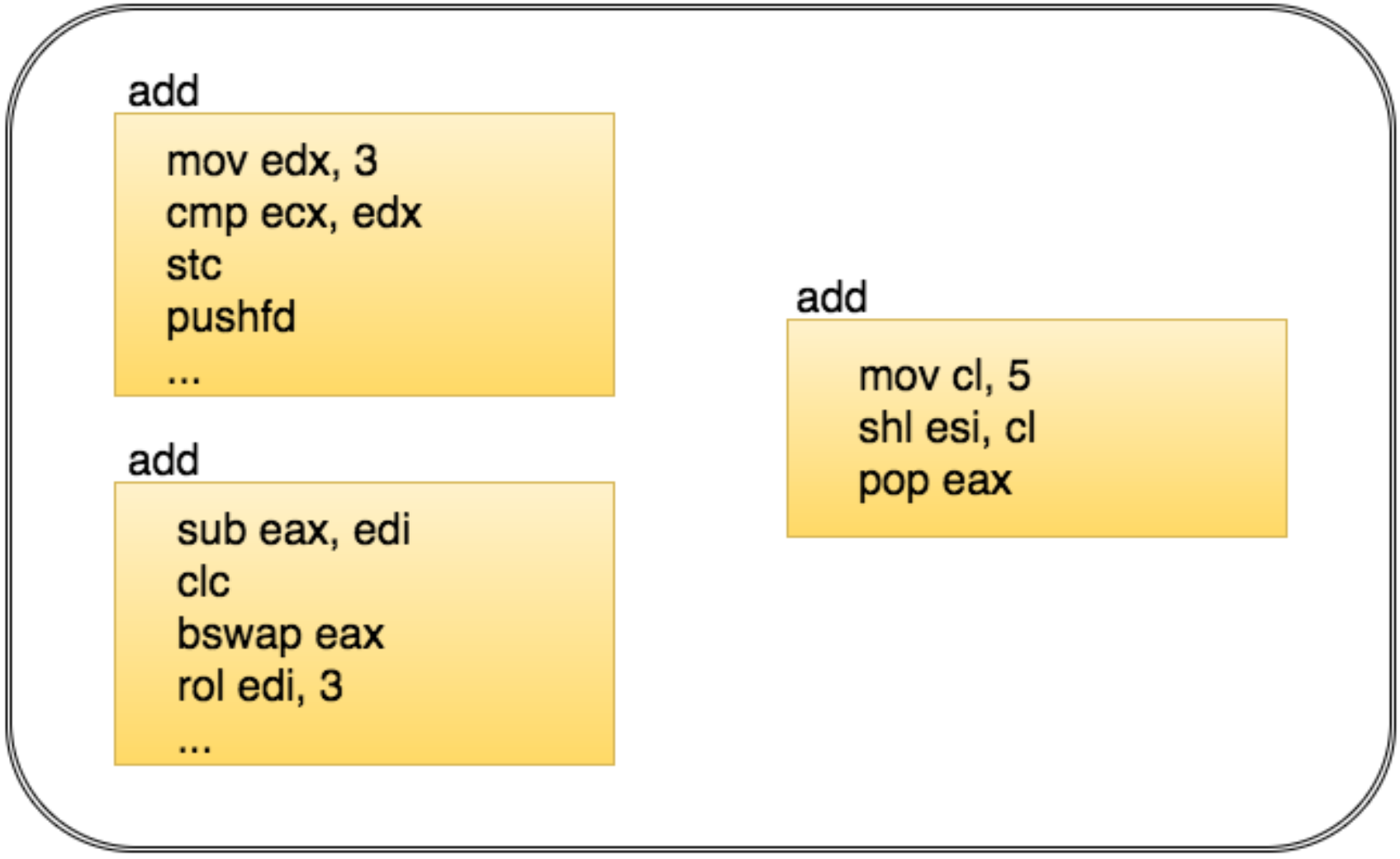
VM en "bitslice", mais dans un but d'obfuscation, pas de performance

Une VM mais pas une VM

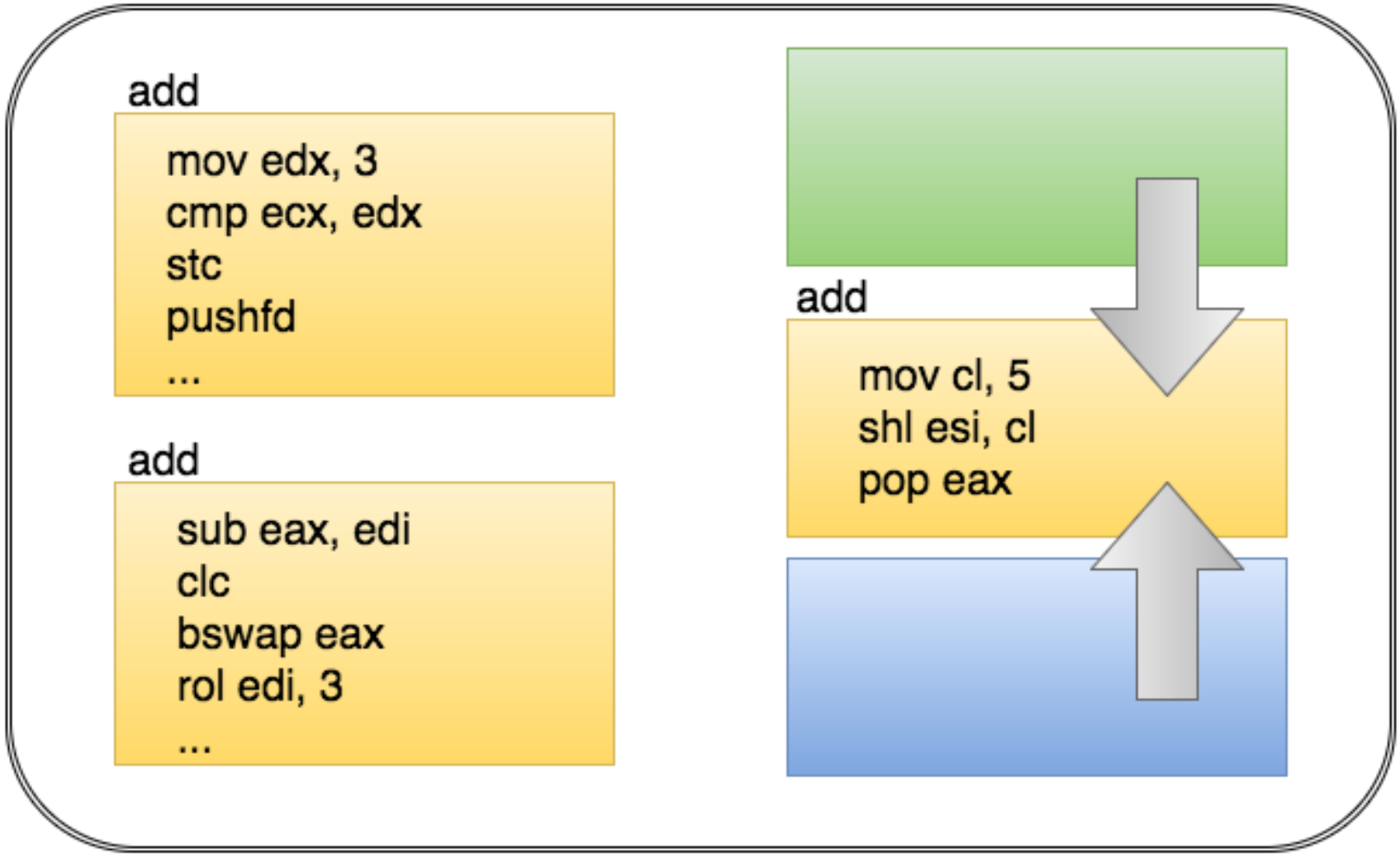
Compilateur > VM interprétée, les handlers d'opcodes sont inlinés



VM compilée


add
mov edx, 3
cmp ecx, edx
stc
pushfd
...
add
sub eax, edi
clc
bswap eax
rol edi, 3
...
add
mov cl, 5
shl esi, cl
pop eax

Shuffling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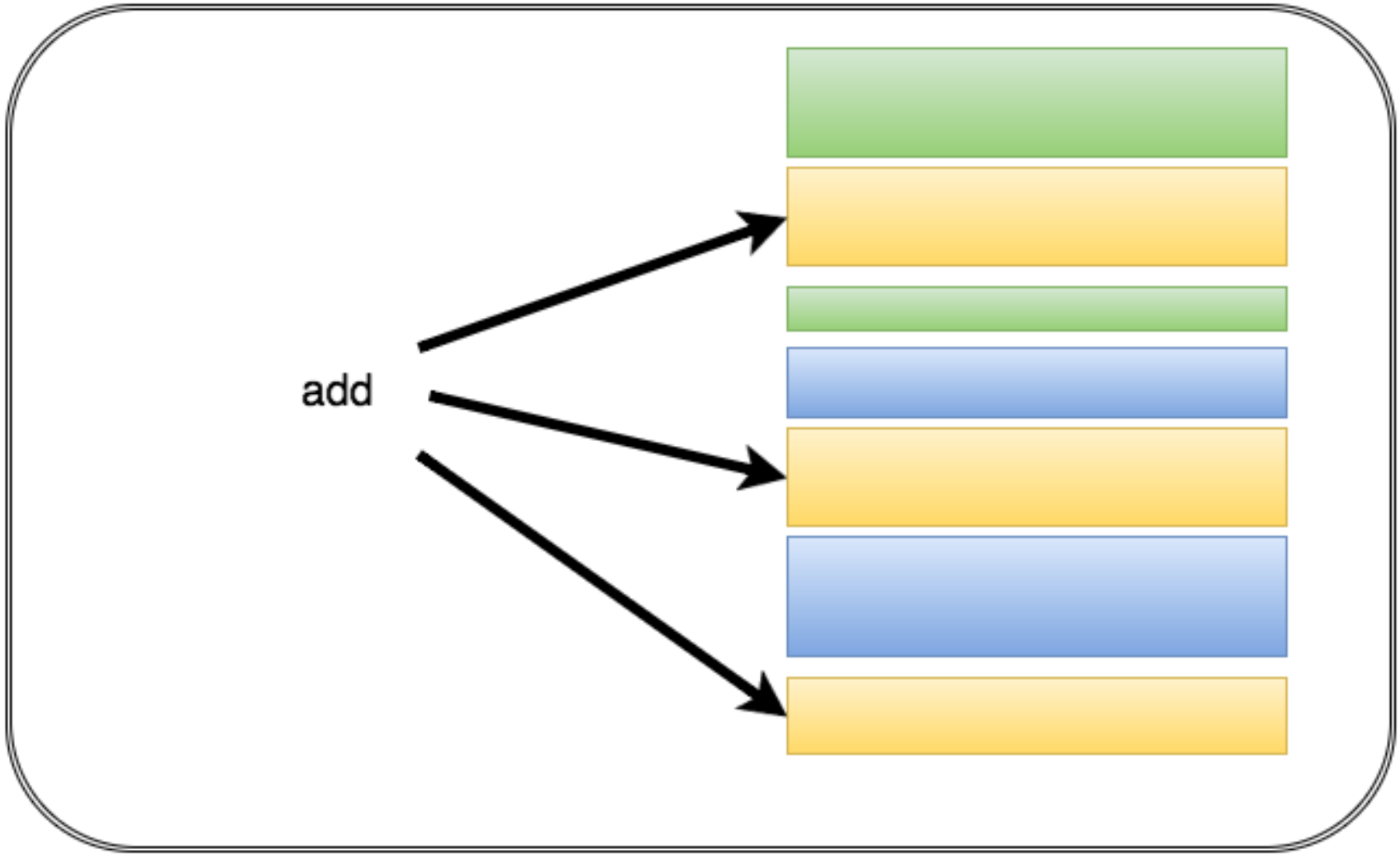
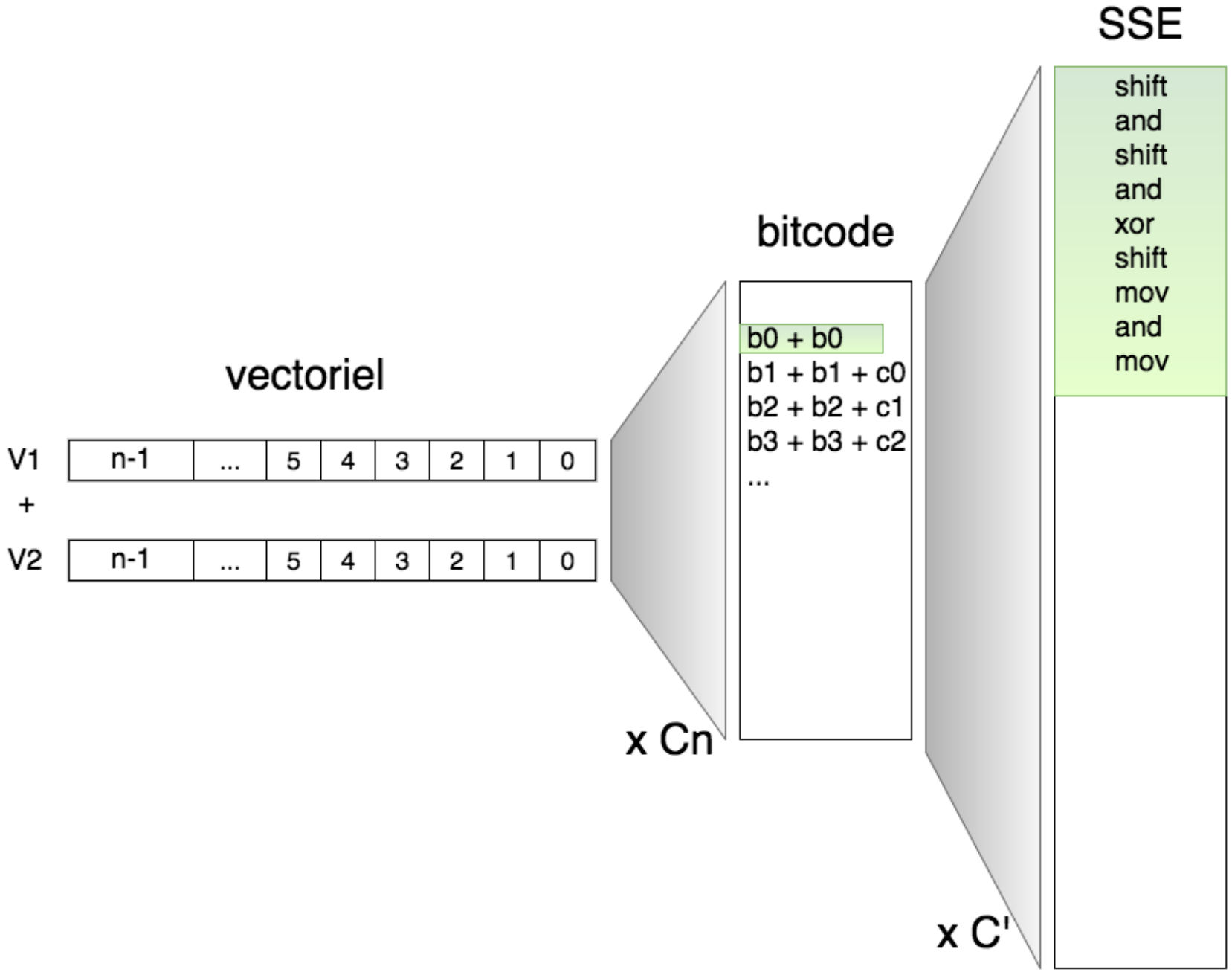


Facteurs d'expansion du code source



Le langage source vectoriel

Vecteurs de bits vus comme des entiers non signés de taille arbitraire

```
function kara38(u38 x, u38 y) -> u76;
{
   ...
   return (ac[0:38] # z38) +
          (qsx # q # z19)  +
          (z36 # bd);
}
```

Le langage intermédiaire ("bitcode")

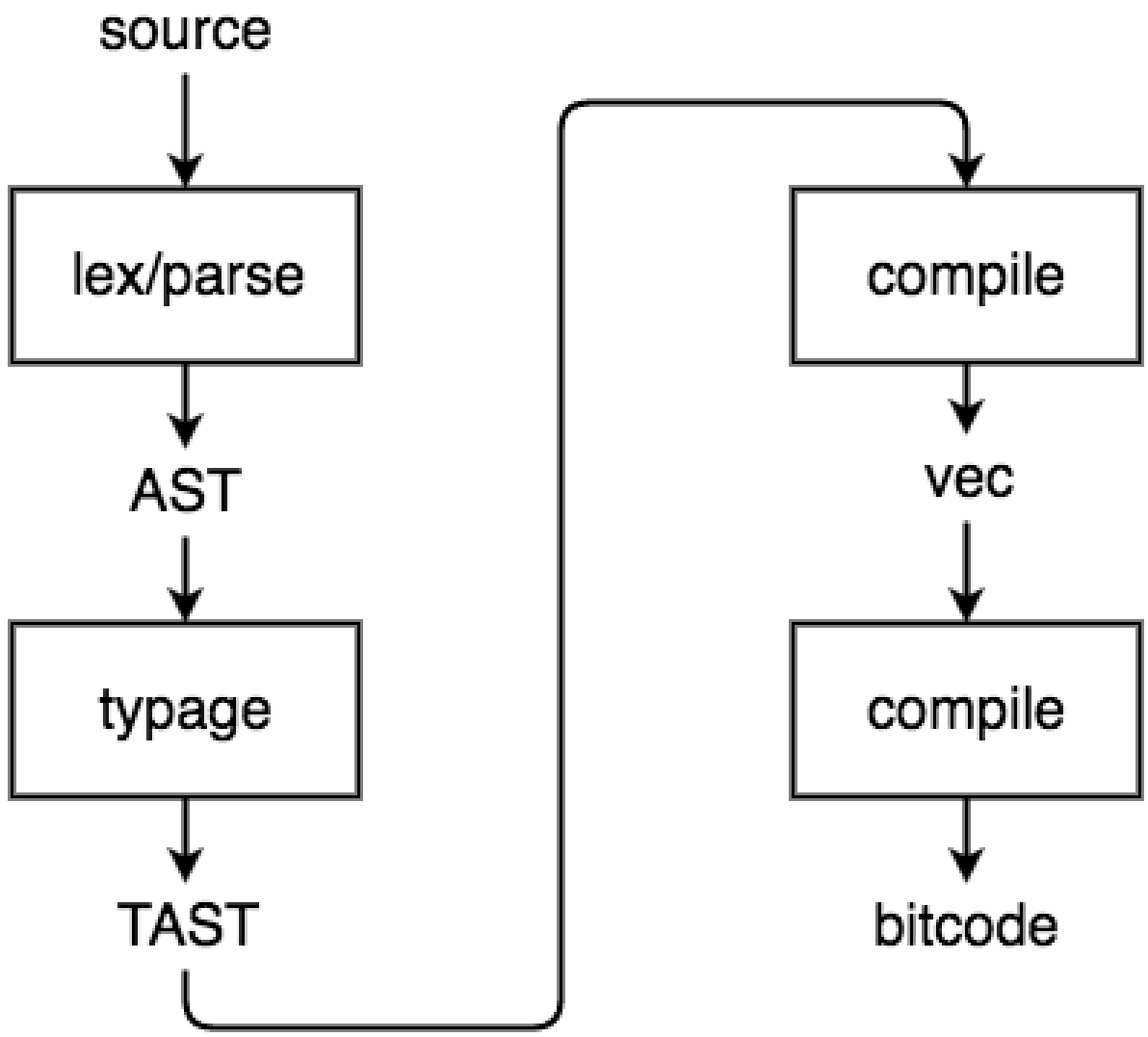
```
type insn =
  | Nop
  | Mov of dst * src
  | Xor of dst * src * src
  | Or of dst * src * src
  | And of dst * src * src
  | Not of dst * src
  | Ld0 of dst
  | Ld1 of dst
  | Ldmem of dst * ptr
  | Stmem of ptr * src
  | Jmp of block
  | Jz of src * block
  | Jnz of src * block
  | Call of funcname * dst list * src list
  | Ldarg of dst * arg
  | Return of src list
```

Le langage de sortie

- x64 (˜30 instructions) + SSE2 (˜20 instructions)

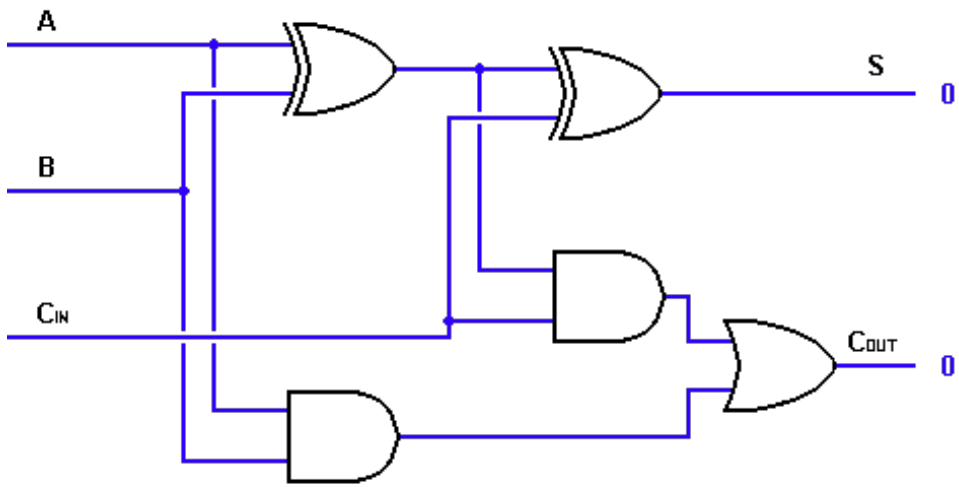
```
pshufb   xmm5, xmm1
movdqa   xmm2, xmm3
psrlq    xmm5, 6
pandn    xmm2, xmm8
pand     xmm3, xmm5
mov      di, 0x3151
por      xmm2, xmm3
mov      rdx, 0x4849686088451088
mov      rax, [rbp+24]
ror      rax, 59
movdqa   [rsp], xmm8
movdqa   xmm8, xmm2
pinsrw   xmm2, di, 4
```

Phases du Front end

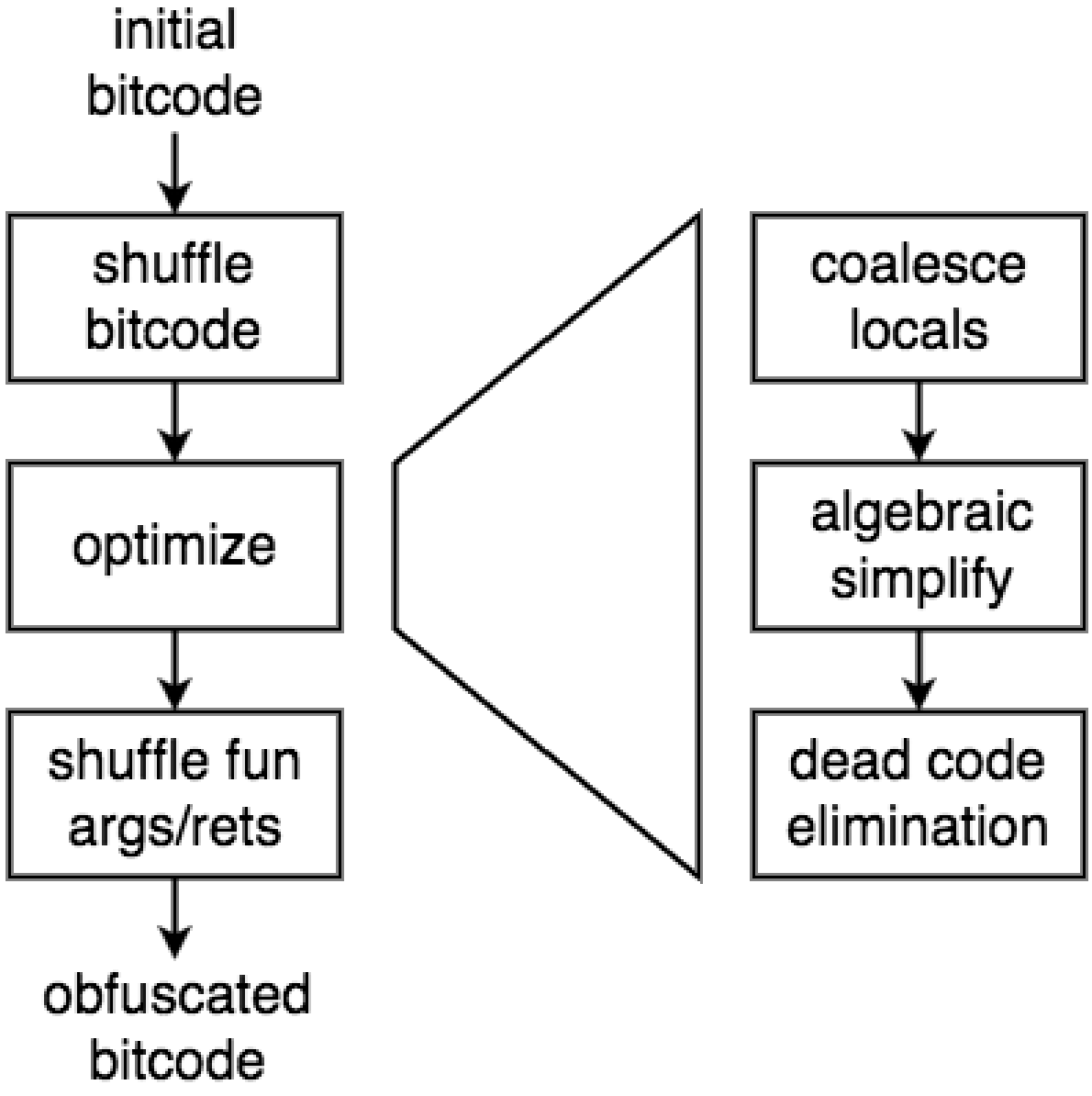


Vectoriel vers bitcode

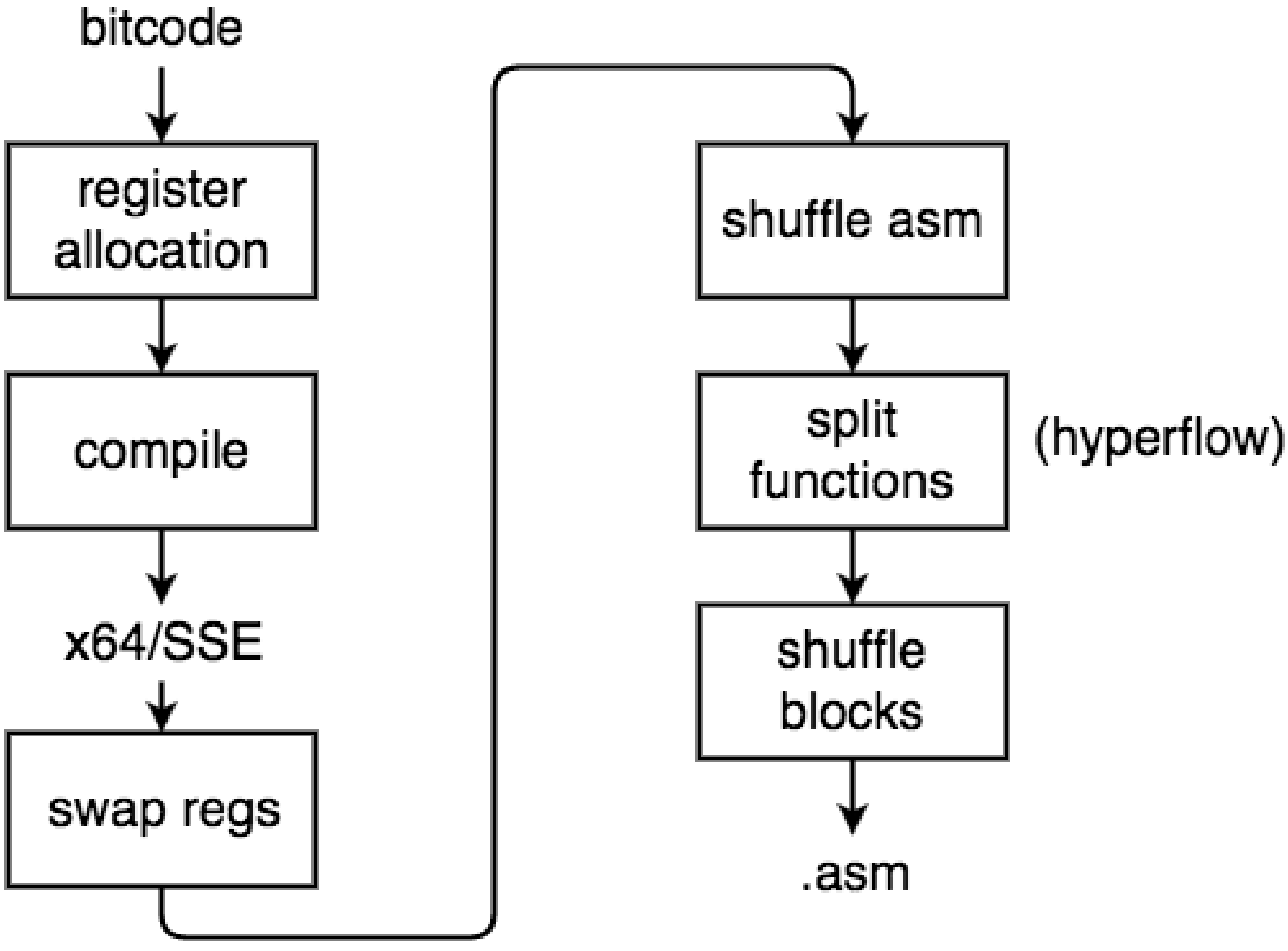
- and, or, xor, not, shift, extract, concat: parallélisme trivial
- add est le seul cas intéressant (circuit full adder)



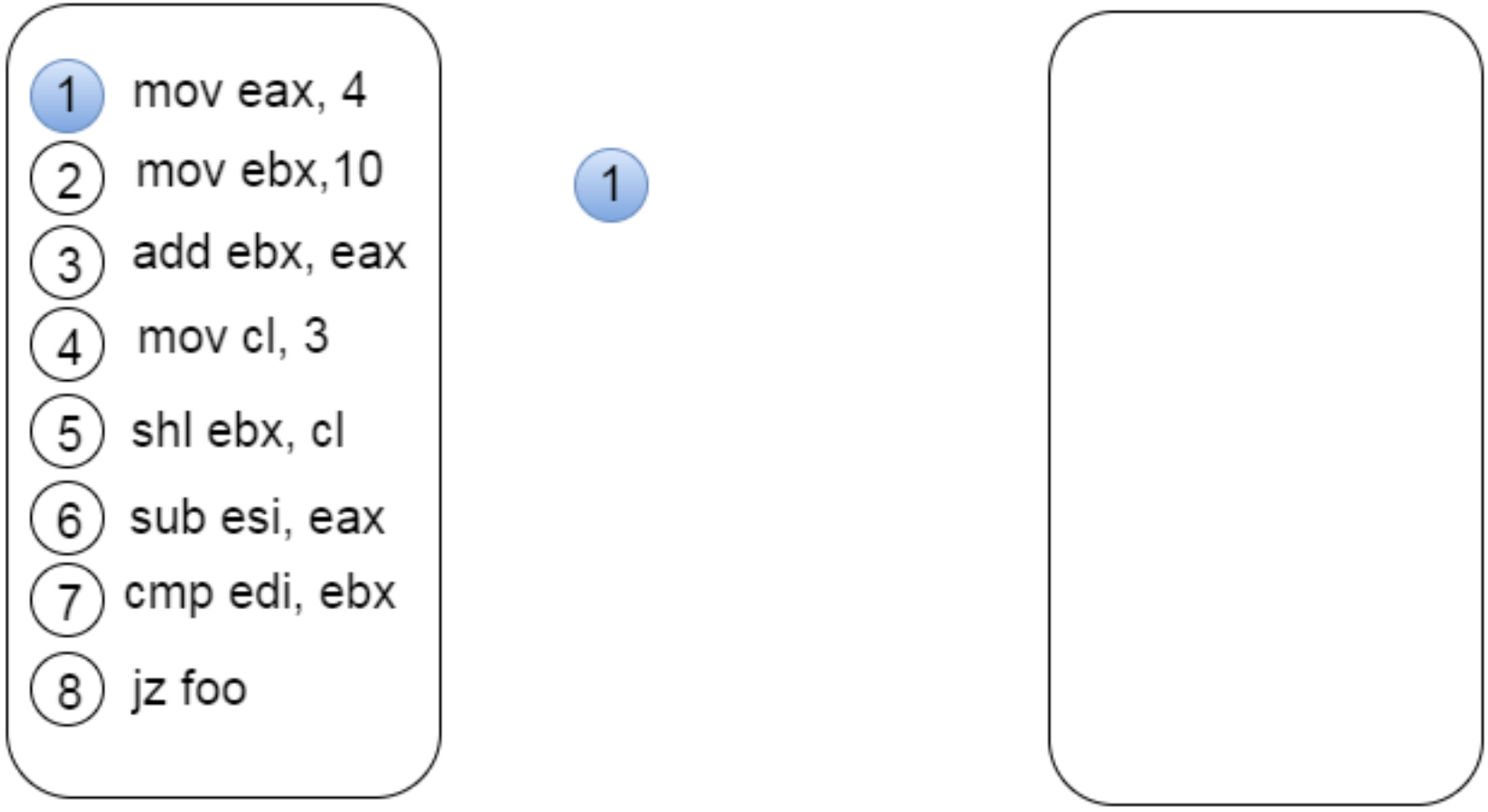
Phases du Middle end



Phases du Back end



Graphe de dépendance et shuffling



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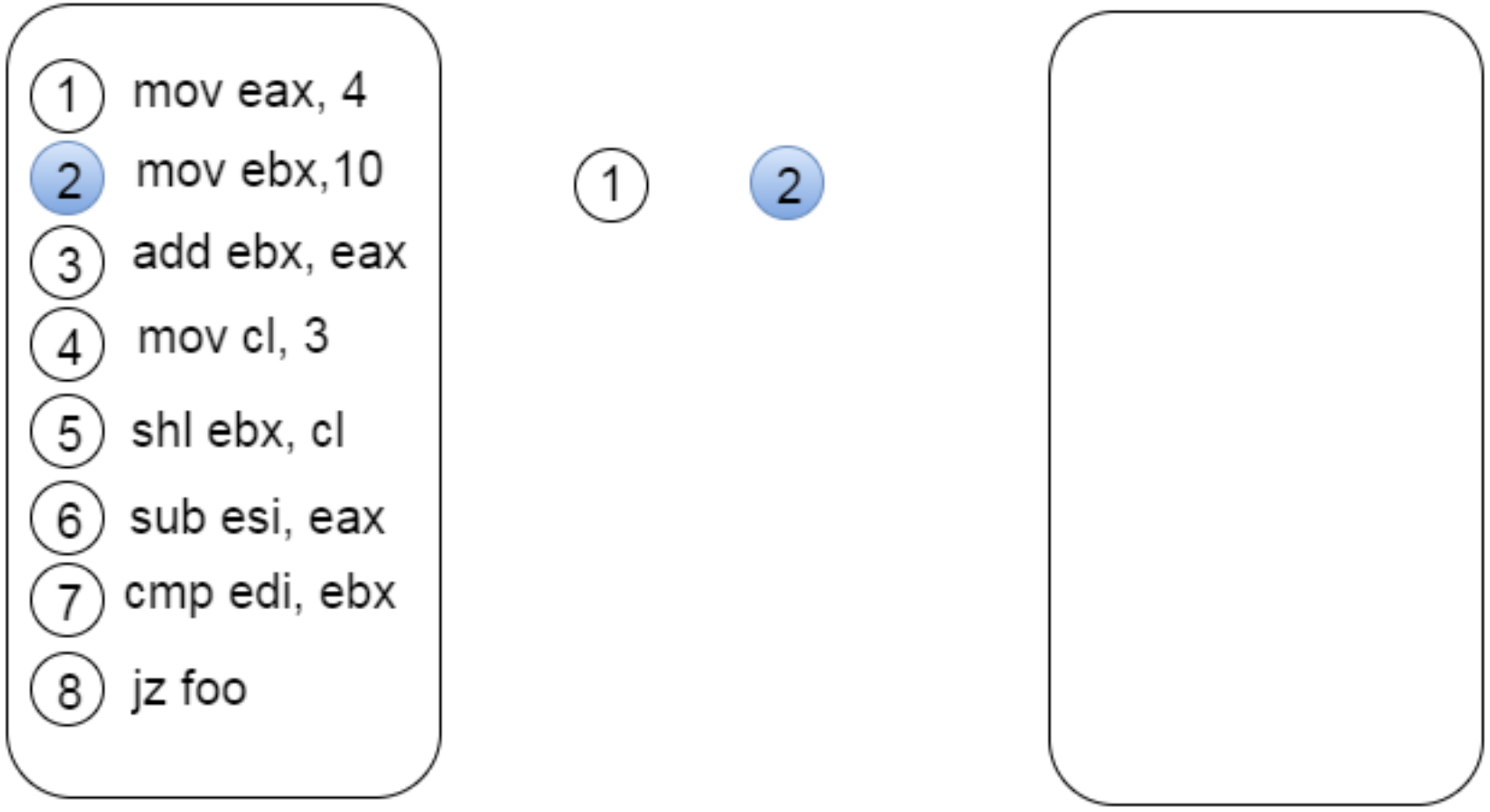

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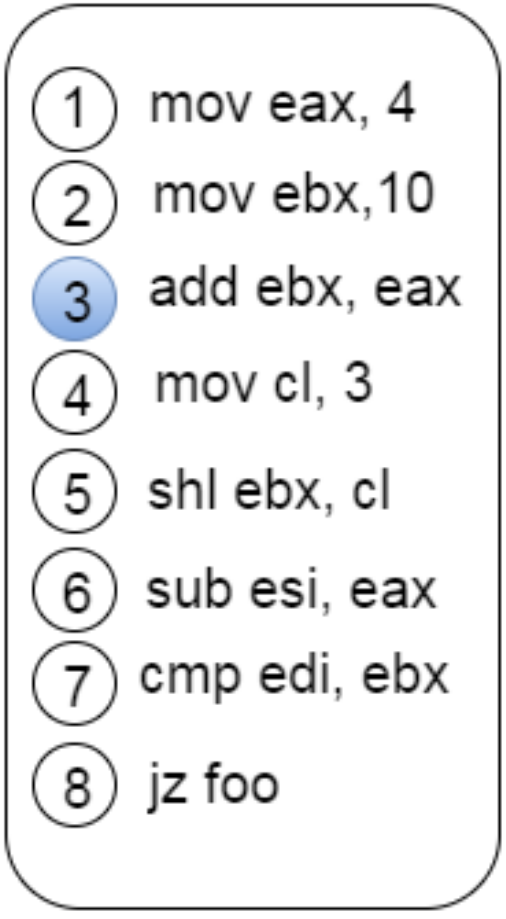

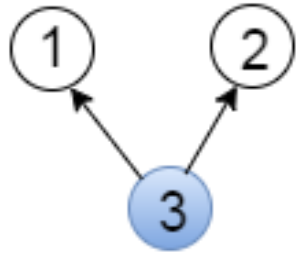

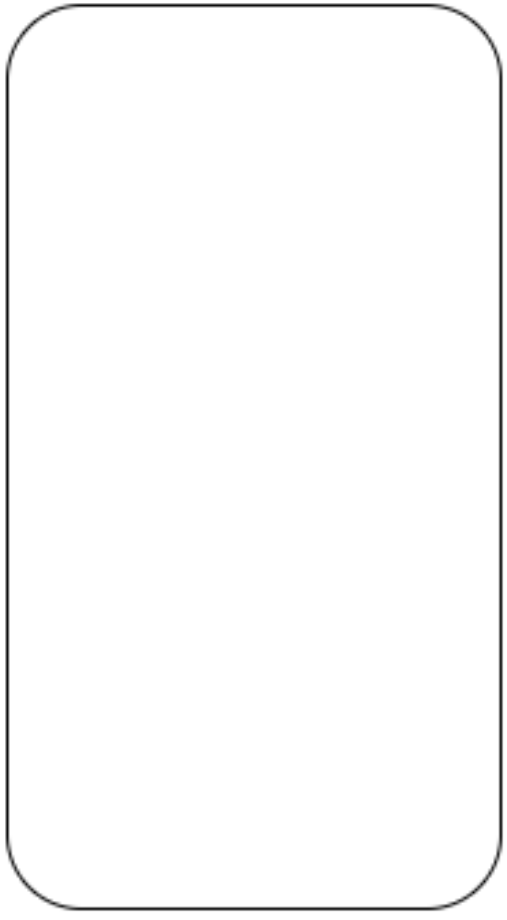

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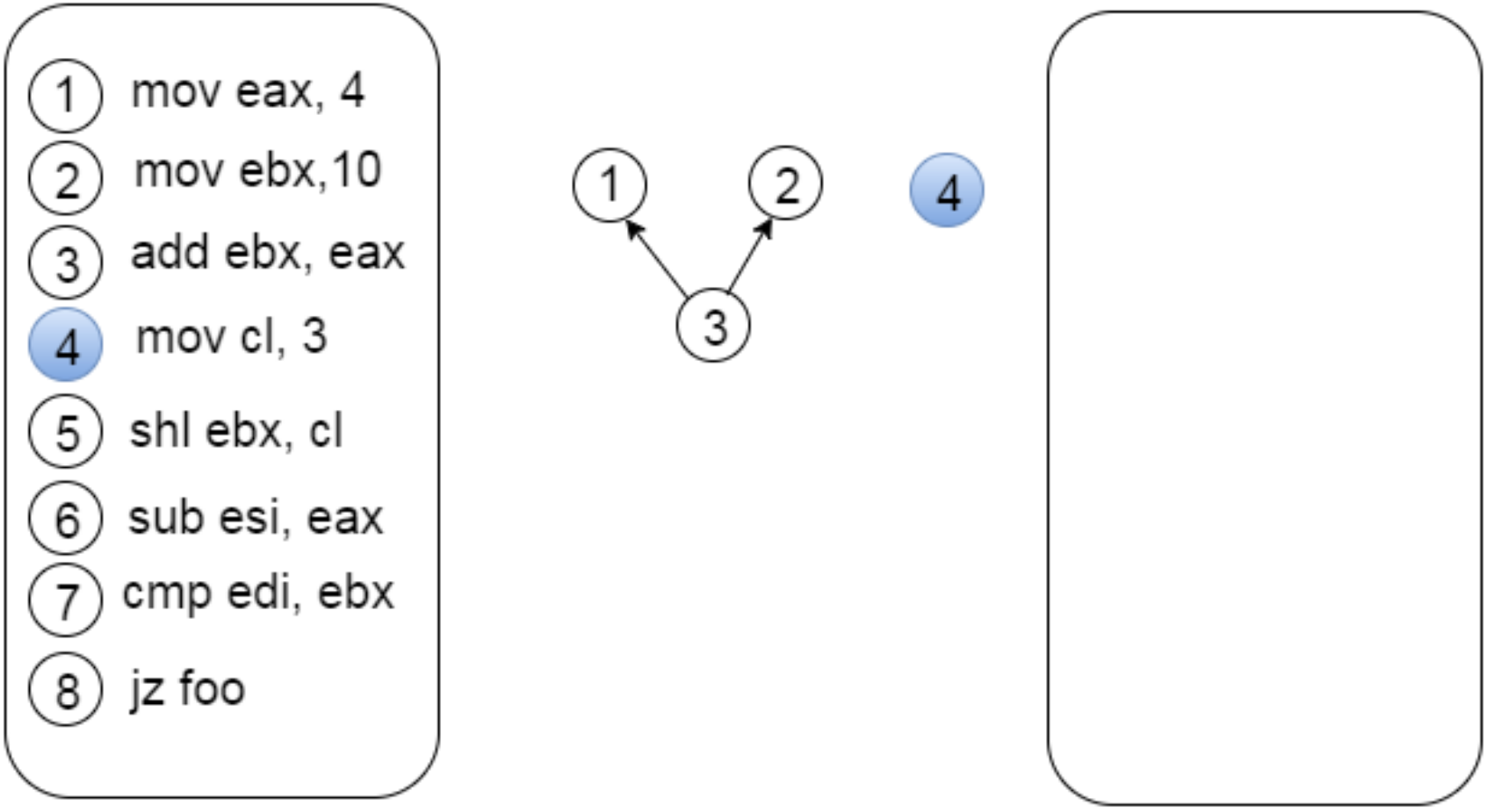

Graphe de dépendance et shuffling

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7. cmp edi, ebx
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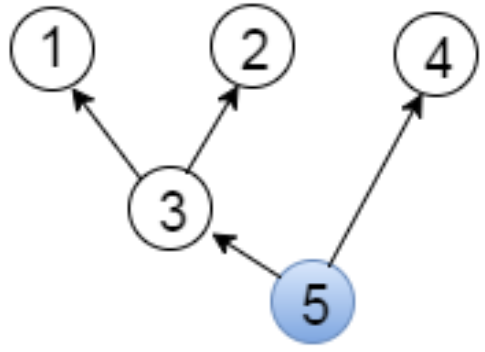

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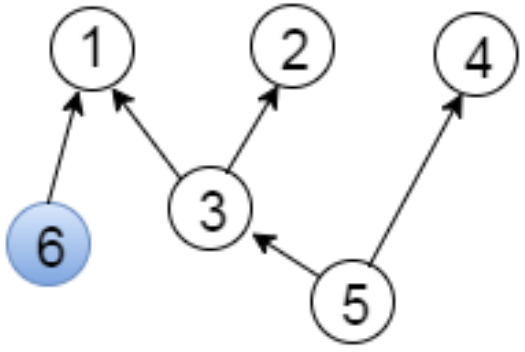

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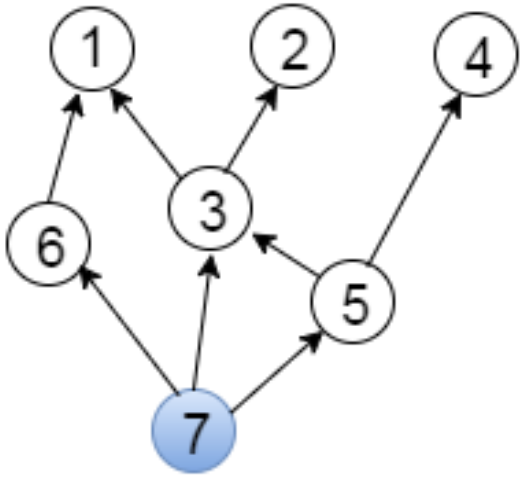

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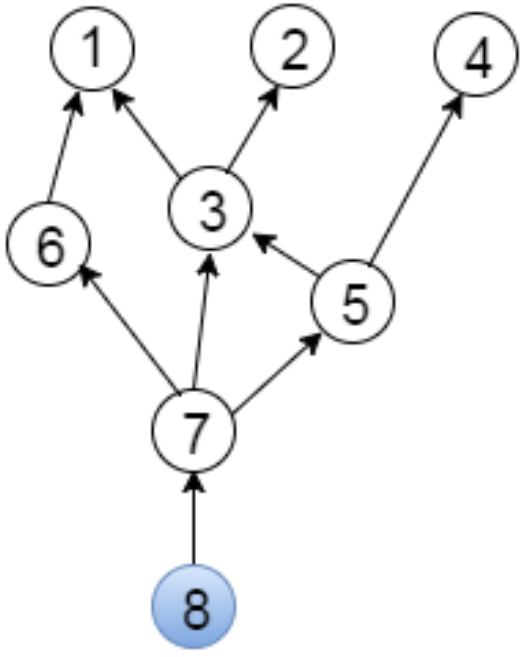

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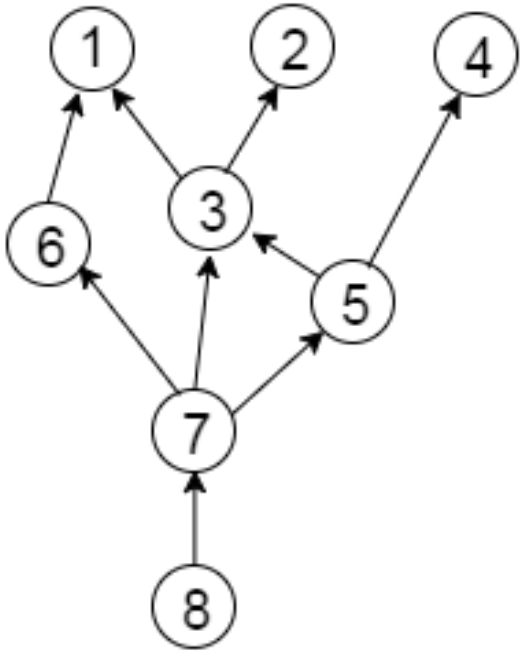

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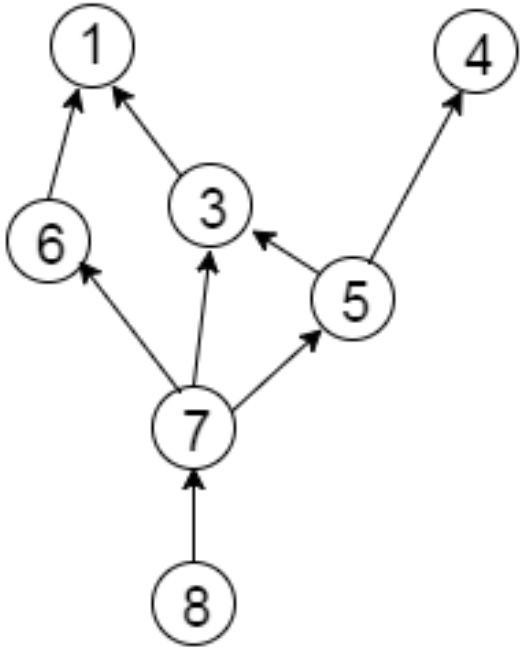

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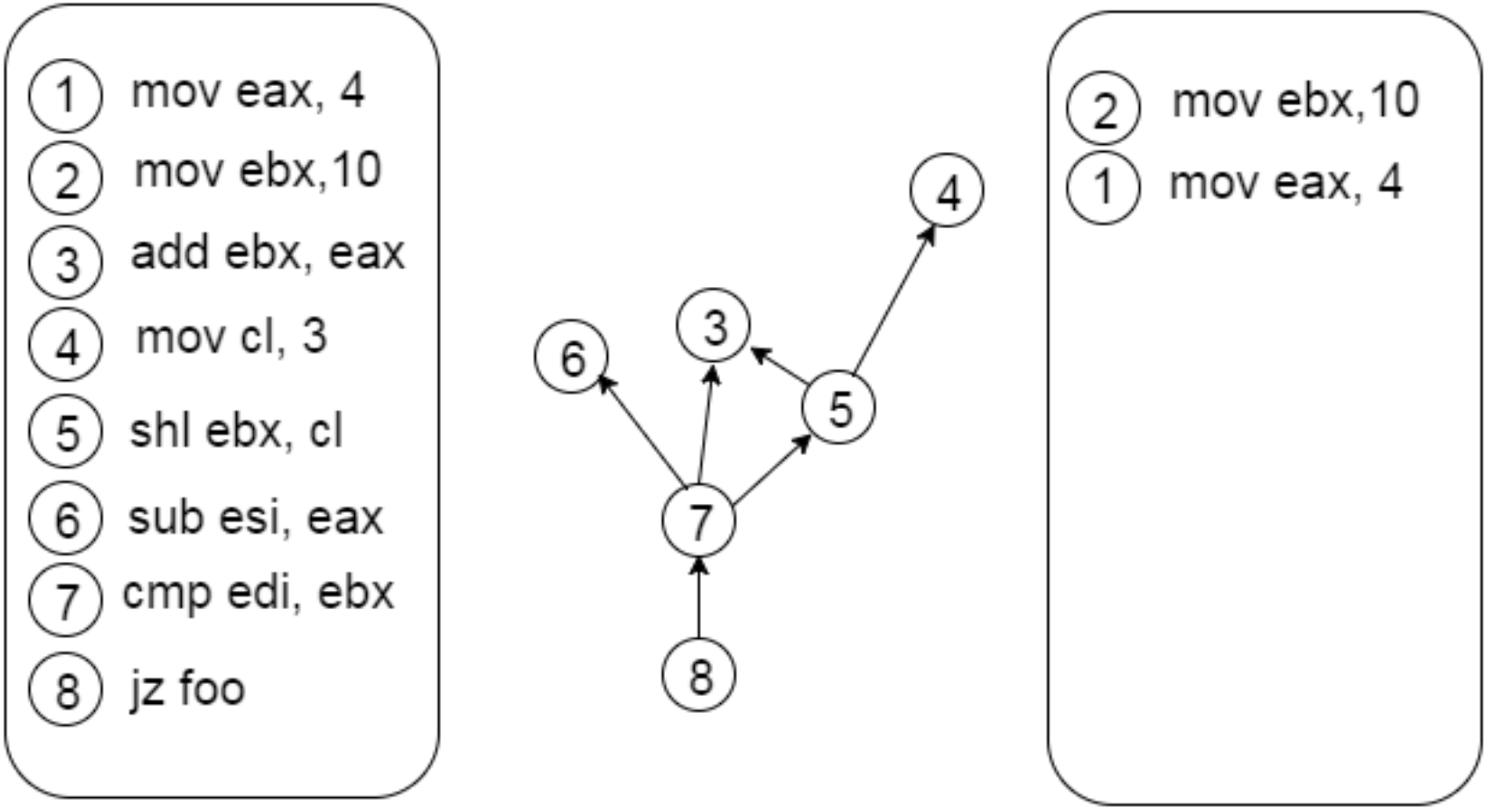

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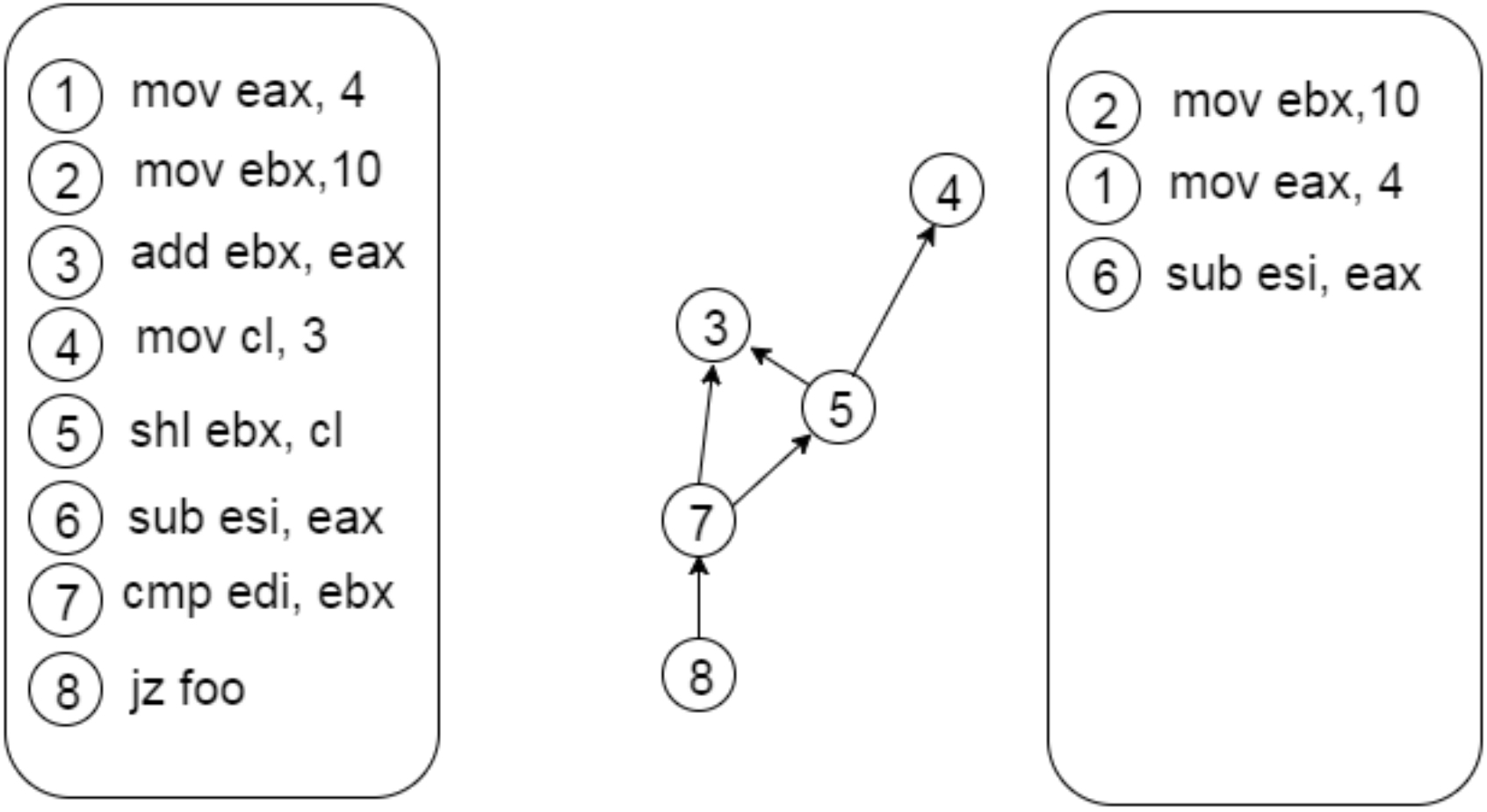

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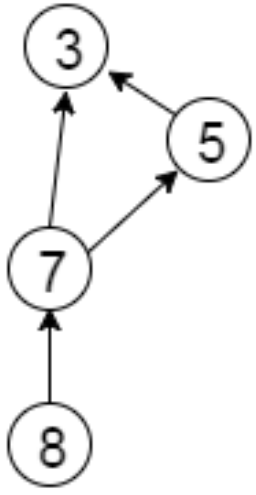

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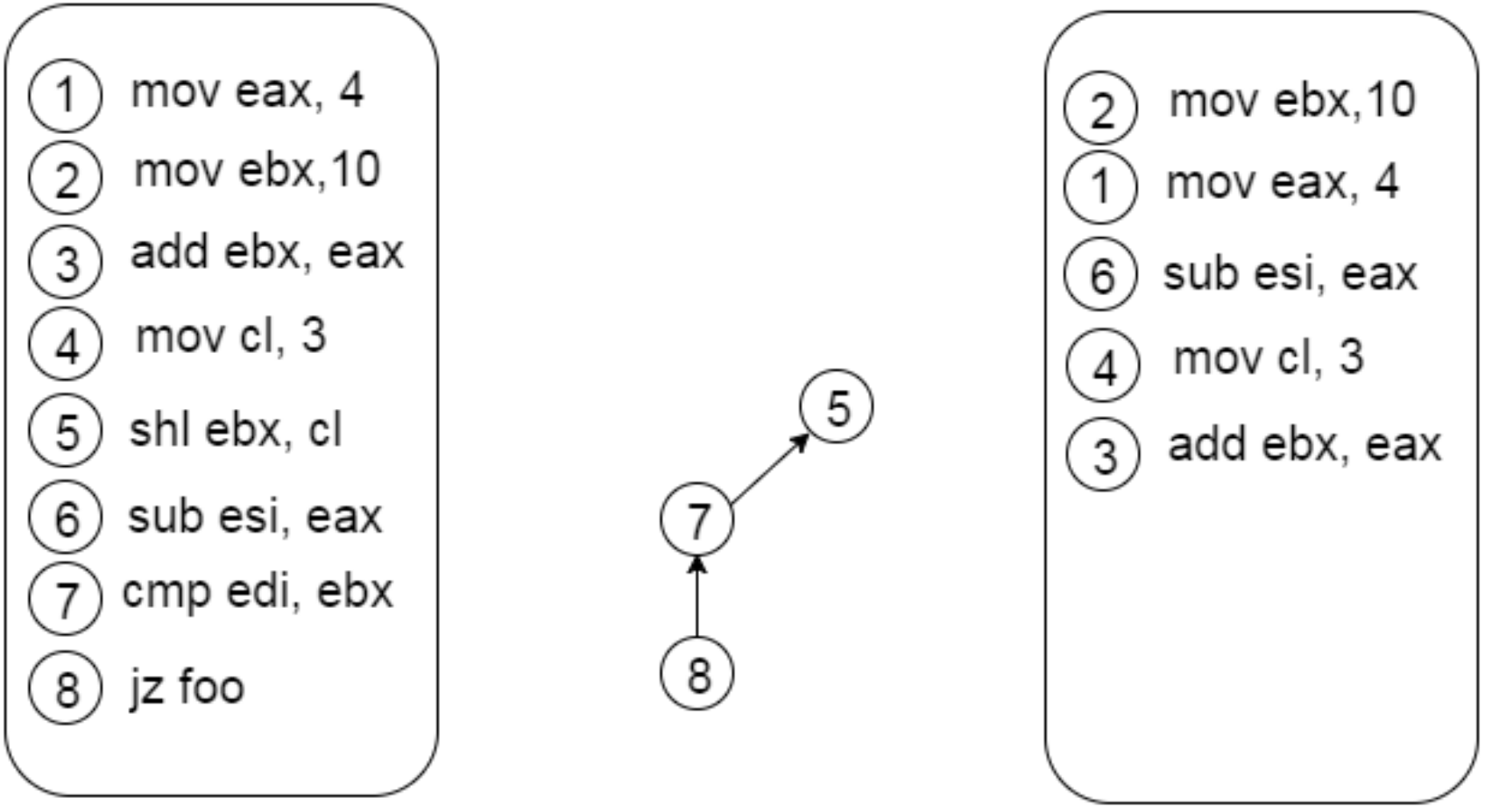

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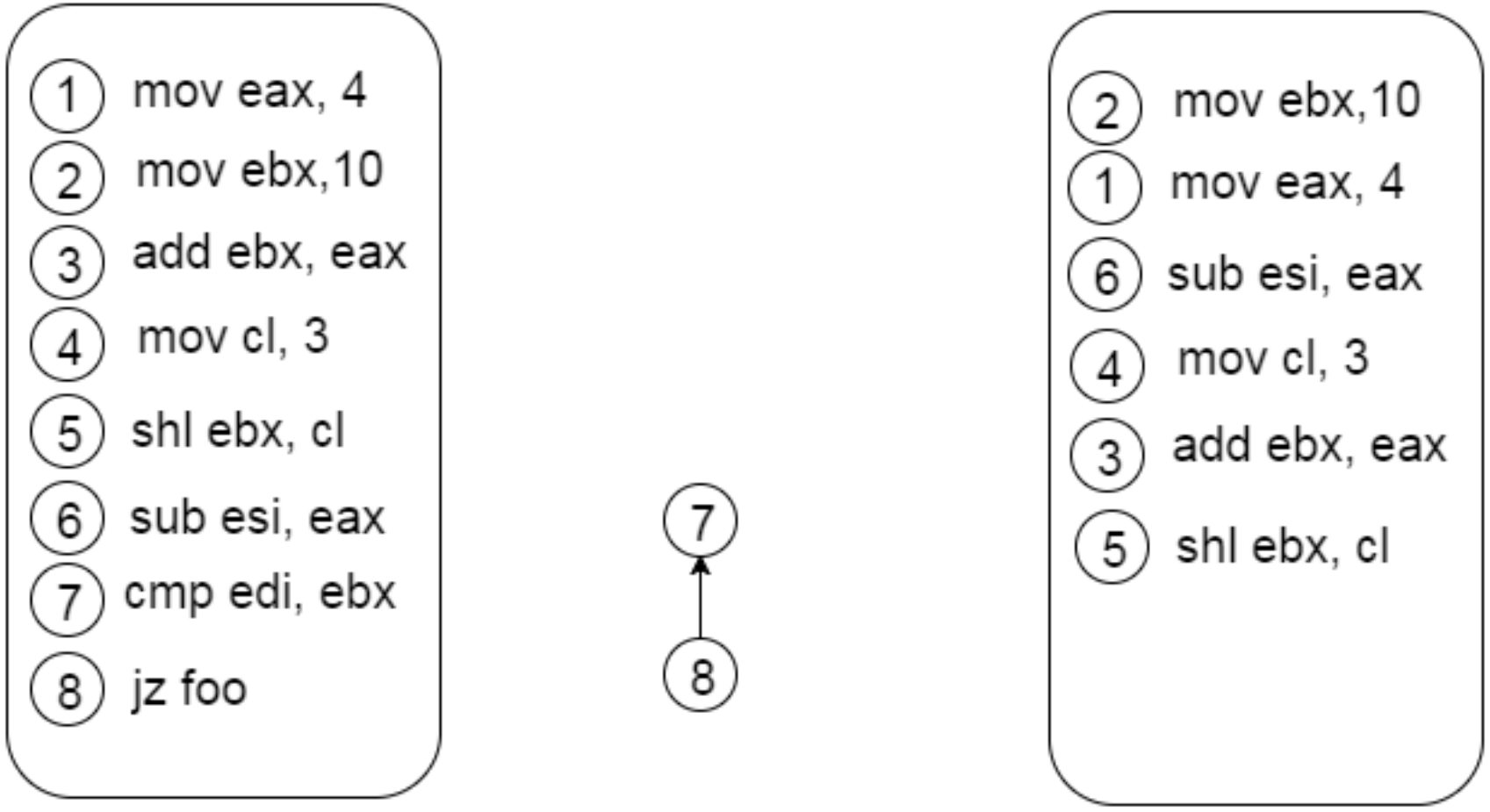

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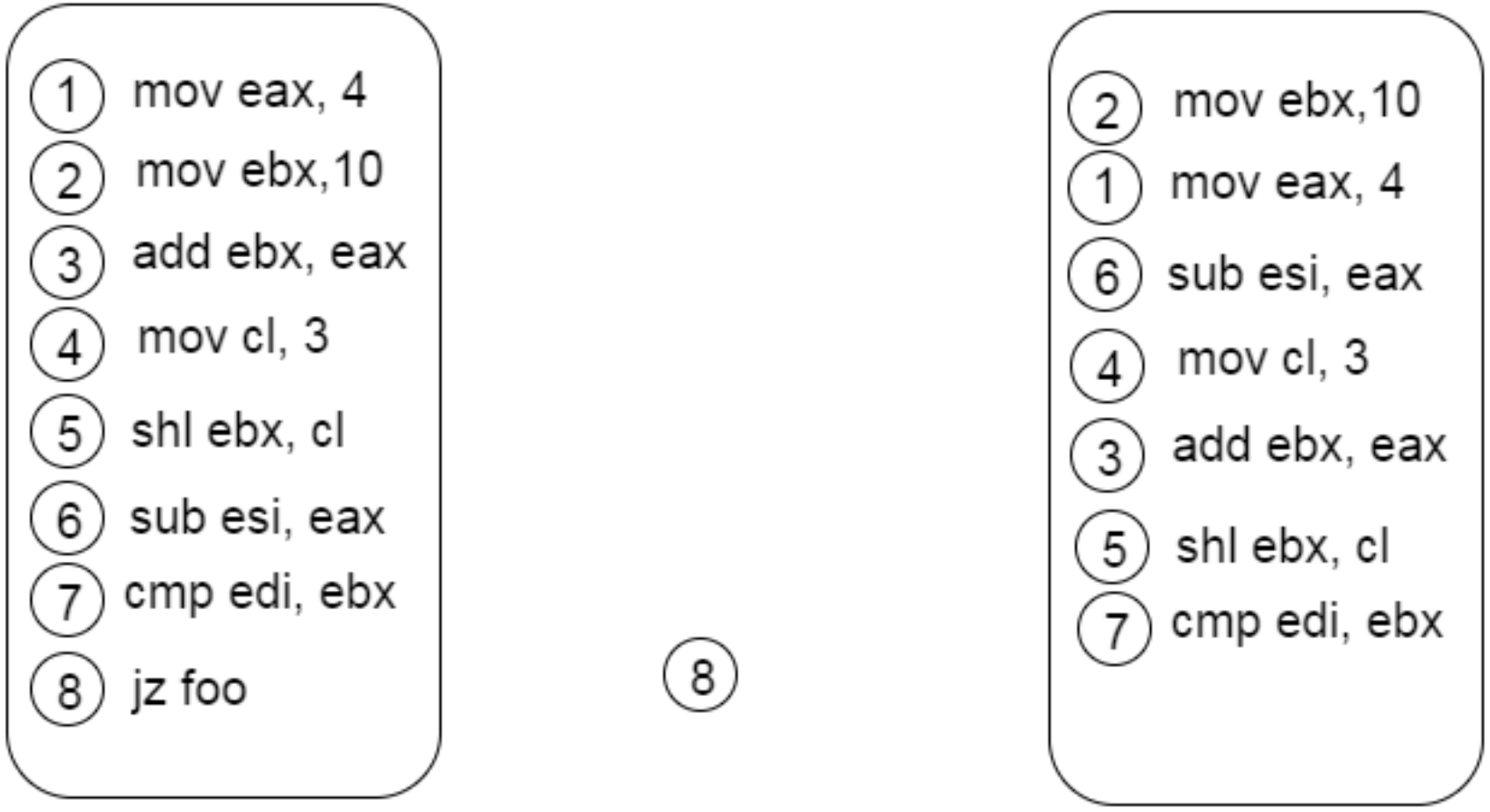

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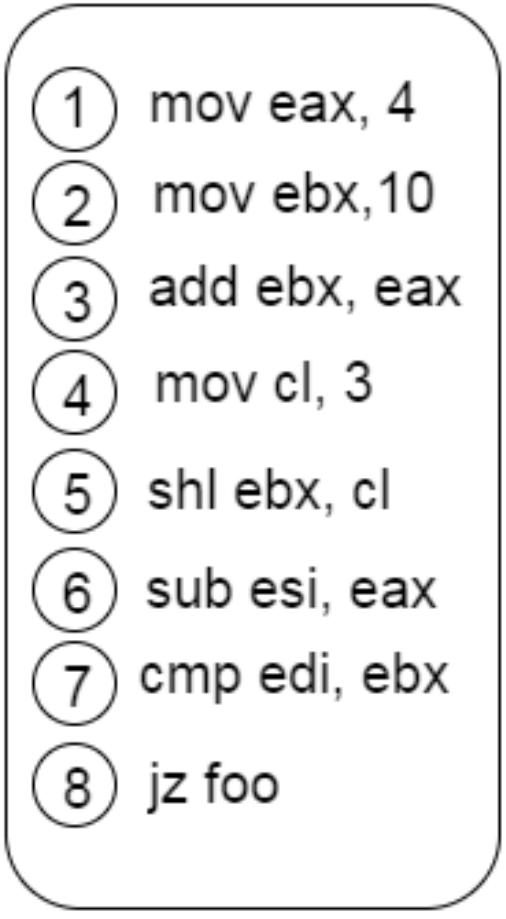

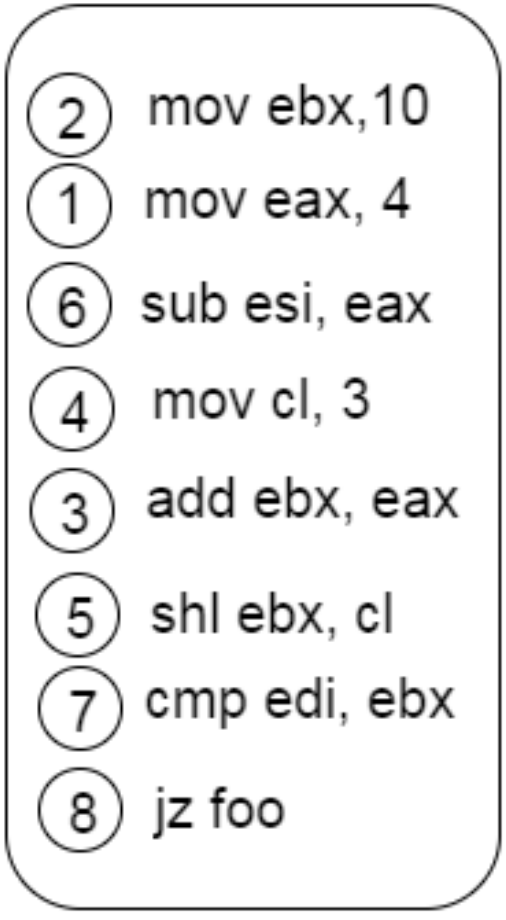

Graphe de dépendance et shuffling

Deux problèmes:

- Taille du graphe quadratique en la taille du bloc
- Equiprobabilité des sorties valides?

Options du compilateur (1)

```
Usage: hlvc [options] <file.hlv> <file.asm>
Options:
 -r mask: randomization options mask
        1 = randomize register masks
        2 = randomize scratch registers
        4 = shuffle instructions in assembly blocks
        8 = randomize opcode choice
       16 = shuffle instructions in bitcode blocks
       32 = shuffle function arguments/returns
       64 = randomize locals registers
      128 = dynamically swap registers
      256 = shuffle code blocks
```

Options du compilateur (2)

```
-o mask: optimization options mask
        1 = coalesce non-interfering locals
        2 = algebraic simplifications
        4 = dead code elimination
-c mask: code generation options mask
        1 = hyperflow
        2 = produce trace
-bc <file.bc>: save bitcode to file
```

Merci!