MICROS-1

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With materials from slides by Dr. Sasan Golchin

MICROS-1

- In MEMOS-2 we got to know which regions of memory are usable and how big they are
- This information is important if you are building something that requires a lot of code and/or data
- But before doing anything in the kernel we need to setup the GDT

Global Descriptor Table

- GRUB sets up a default GDT, but we cannot rely on that, so we set up our own
- GDT defines specific segments of memory for specific purposes
- In operating systems, this is used to establish user-kernel separation
- For now, only the kernel segments are sufficient

Global Descriptor Table

Segment Descriptor

63 56	55 52	51 48	47 40	39 32
Base 31 24	**Flags** 3 0	**Limit** 19 16	**Access Byte** 7 0	**Base** 23 16

31 16	15 0
Base 15 0	**Limit** 15 0

- Base: A 32-bit value indicating the linear address where the segment begins
- Limit: A 20-bit value indicating size of the segment with a granularity specified by the flags
- Flags: Granularity (Bit 55), CodeSize (Bit 54) and Reserved (Bits 52 to 53)

Global Descriptor Table

- Has at least 3 entries: NULL descriptor, kernel code segment, and kernel data segment
- Defining GDT can be done in C or ASM; but you will need ASM to load it (LGDT)
- After setting up the GDT, you need to reload all the segment registers to point to the GDT entry
- Neither POP nor MOV can place a value in the code-segment register CS; only the far control transfer (JMP) instructions can change CS

MICROS-1

- In MEMOS-2 we got to know which regions of memory are usable and how big they are
- This information is important if you are building something that requires a lot of code and/or data
- But before doing anything in the kernel we need to setup the GDT
- Detect memory to see which regions are free (already done in MEMOS-2)
- Finally, assign work to the threads and call the scheduler to run the first task

Task Control Block

- A thread is a function with a private stack, characterized by the TCB
- TCB stores
  - State: New, Ready, Active, Dead, etc.
  - Next Instruction to run: EIP
  - Stack top: ESP
  - Machine State (minimally the following): General registers: EAX, EBX, ECX, EDX, ESI, EDI, EBP (pushl/popl, pushal/popal) and Flags: EFLAGS (pushf/popf)

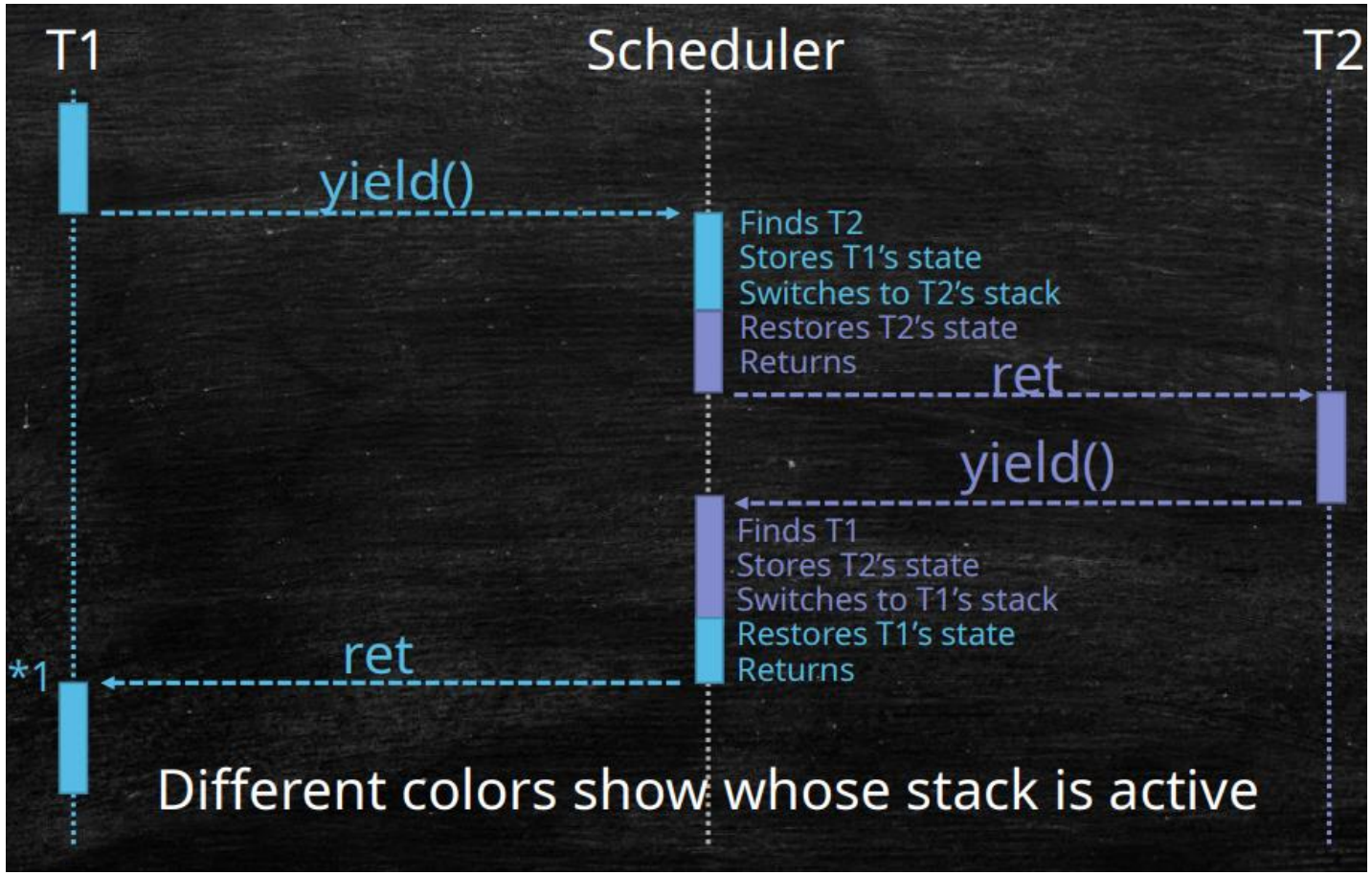
Scheduler Functionality

- Thread creation: we have a predefined pool of threads, so the only thing to do is assign work to a free thread
  - Note that the functions assigned to thread can be as simple as an empty while loop running for a predetermined number of iterations
  - Thus, the stack size need not be very big
- Delete threads when they complete assigned work: this only involves changing state of the thread to free as we do not want to delete threads
- Support task switches

Non-Preemptive Context Switch

- A context switch happens when the current running task either finishes execution or explicitly yields
- Control passes to the scheduler which
  - Chooses the next task (FIFO ordering)
  - Pushes the machine state on the stack
  - Updates the TCB of the current task (ESP, EIP, State)
  - Switches to the stack of the next thread (mov next->esp, %esp)
  - Pops the machine state from the new stack
  - Returns to the new current task

Example (T1 to T2 and back to T1)



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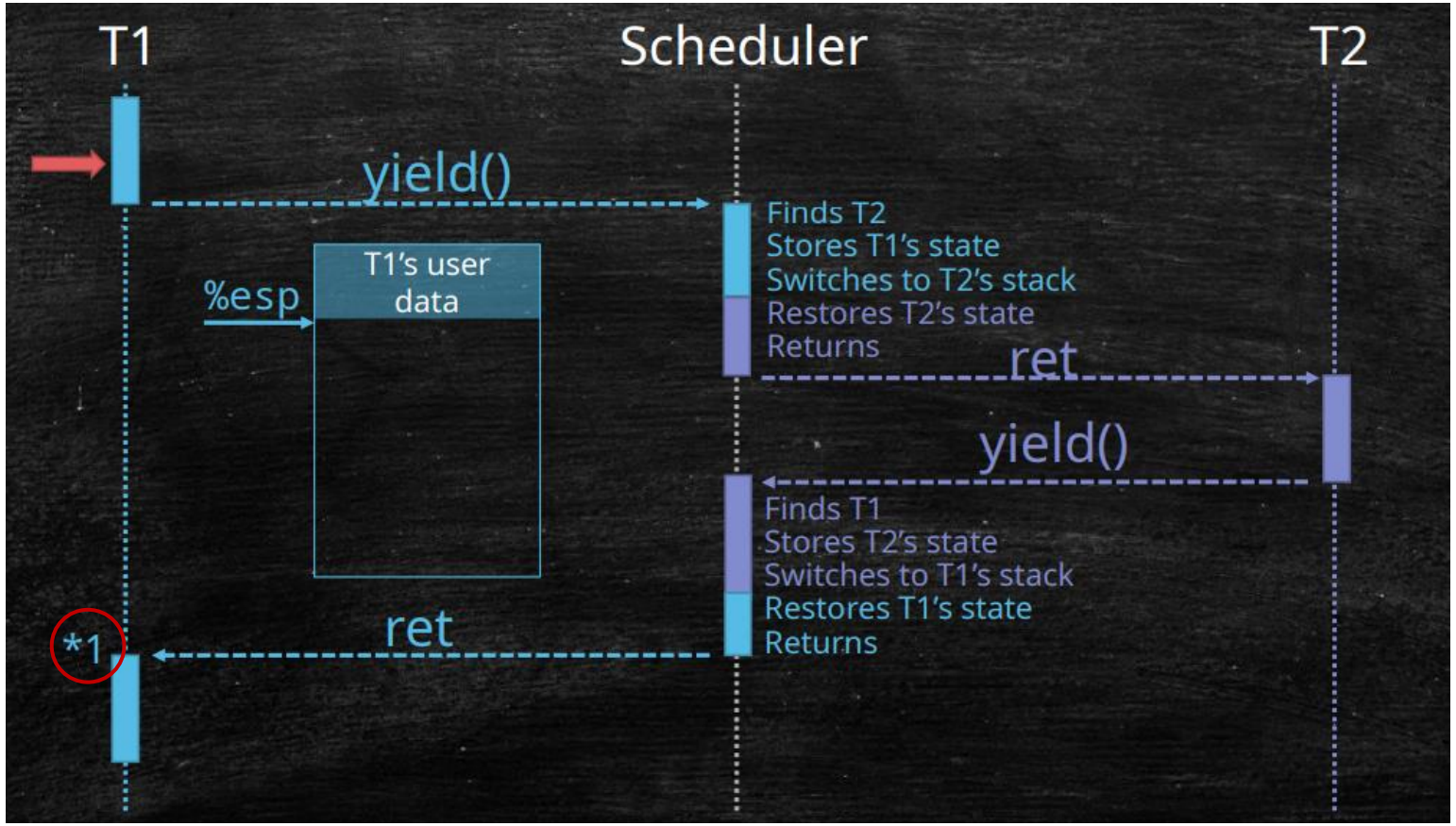

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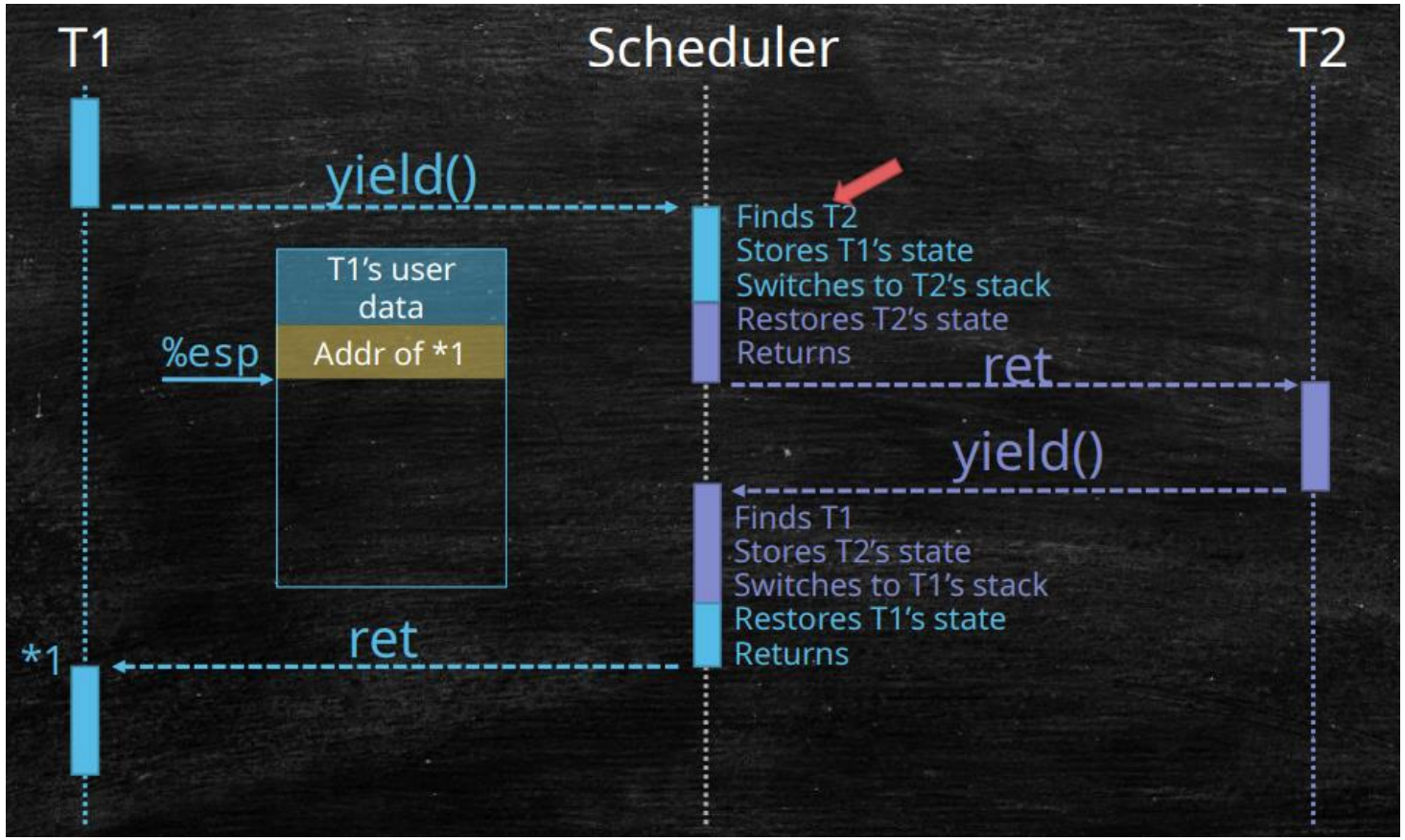

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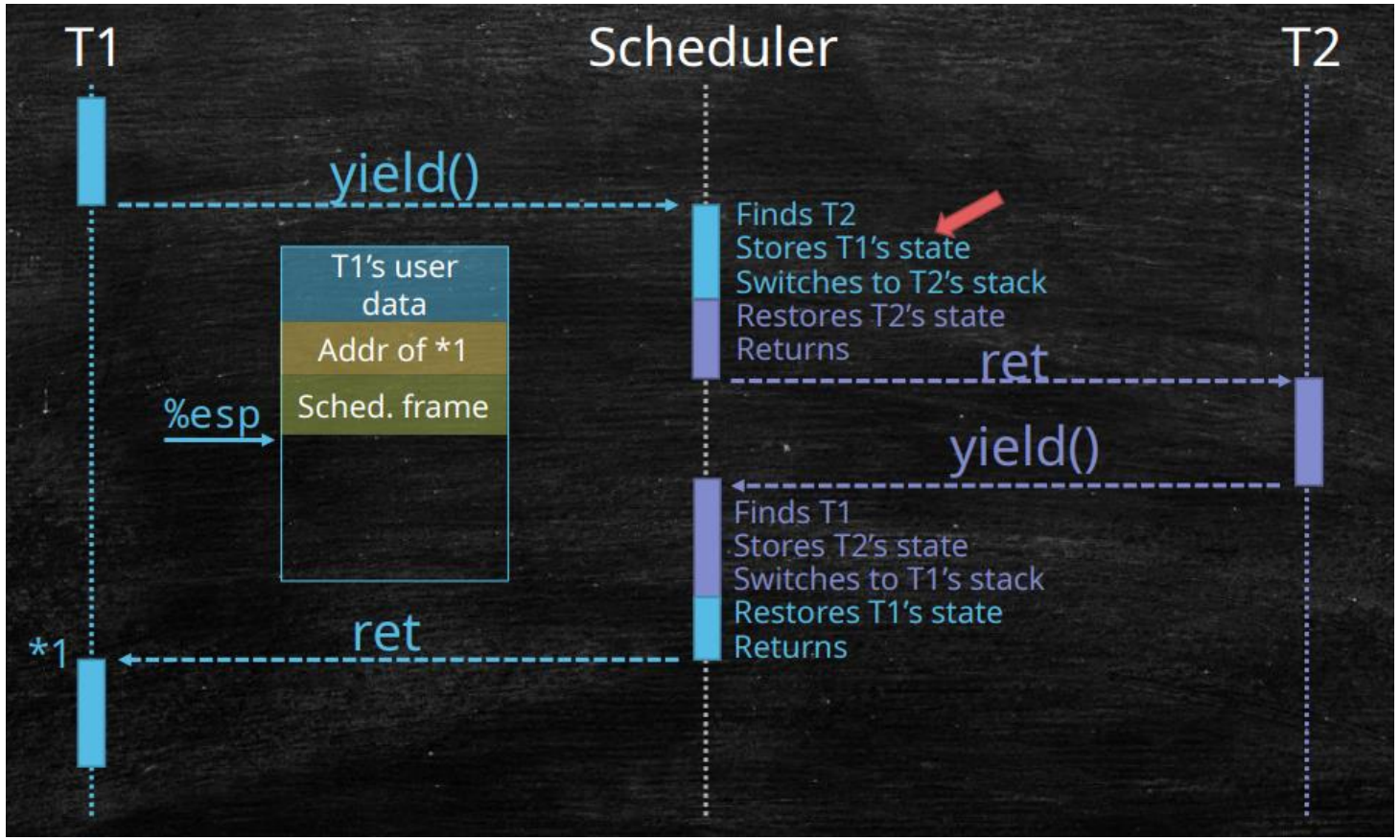

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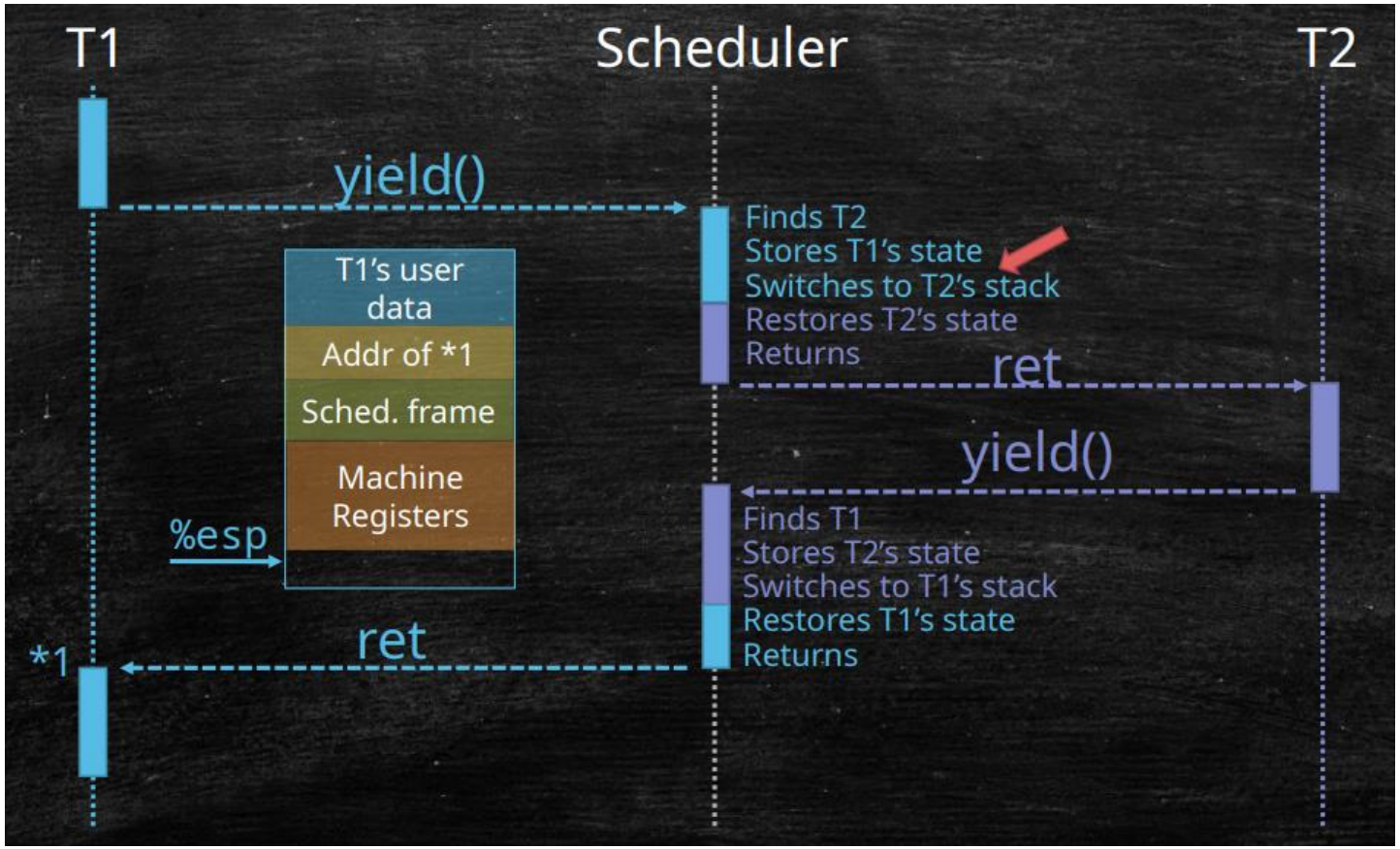

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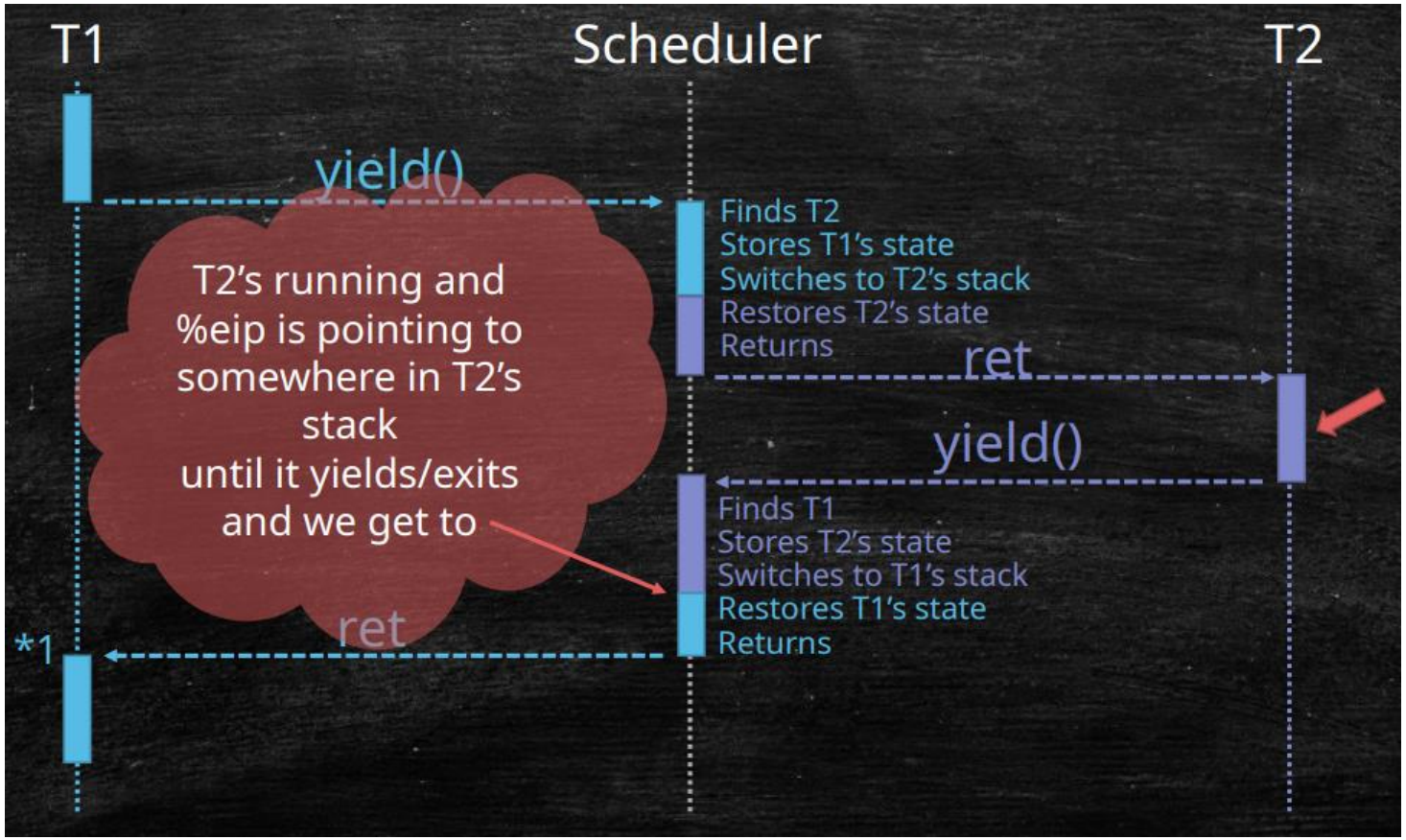

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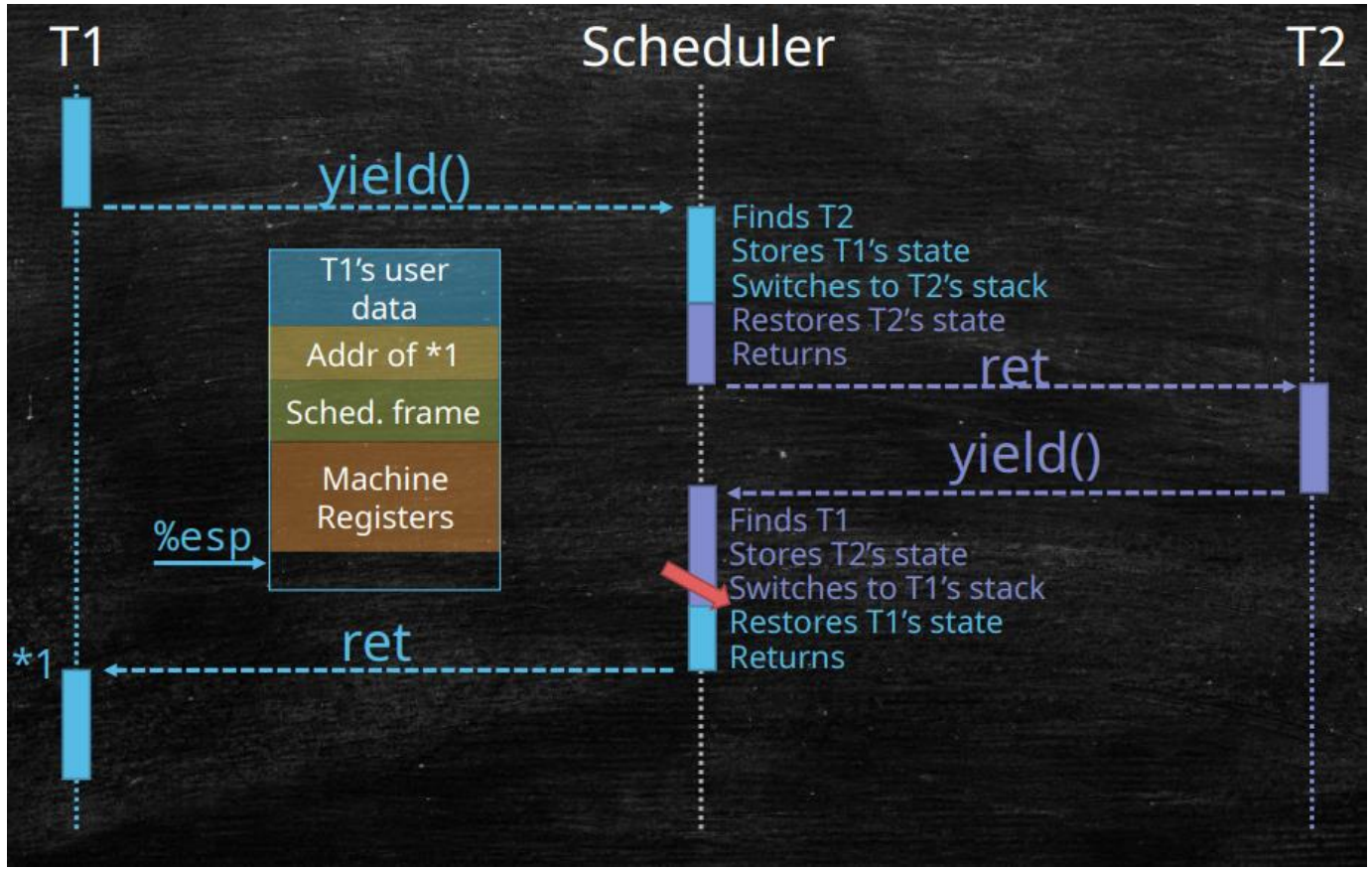

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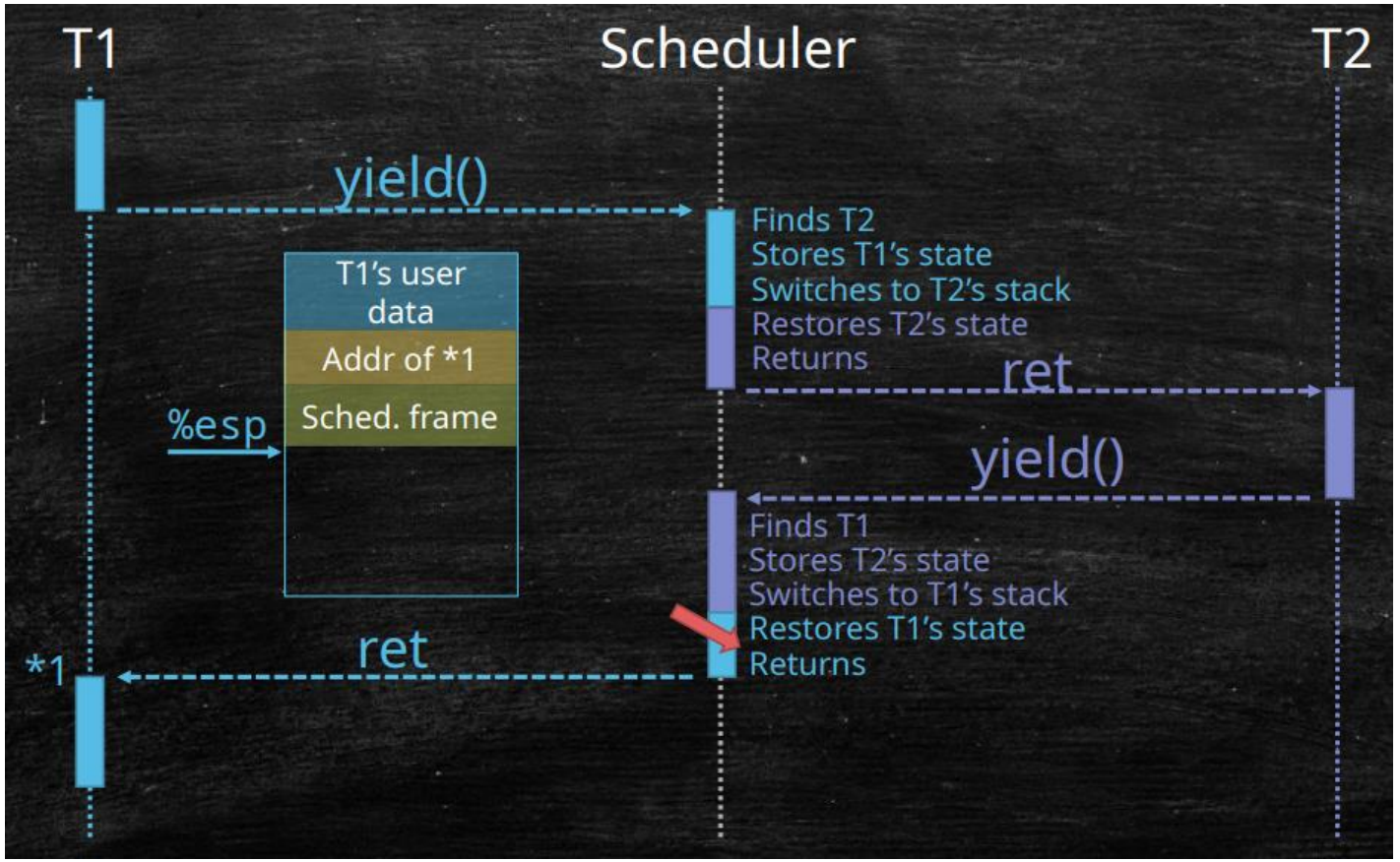

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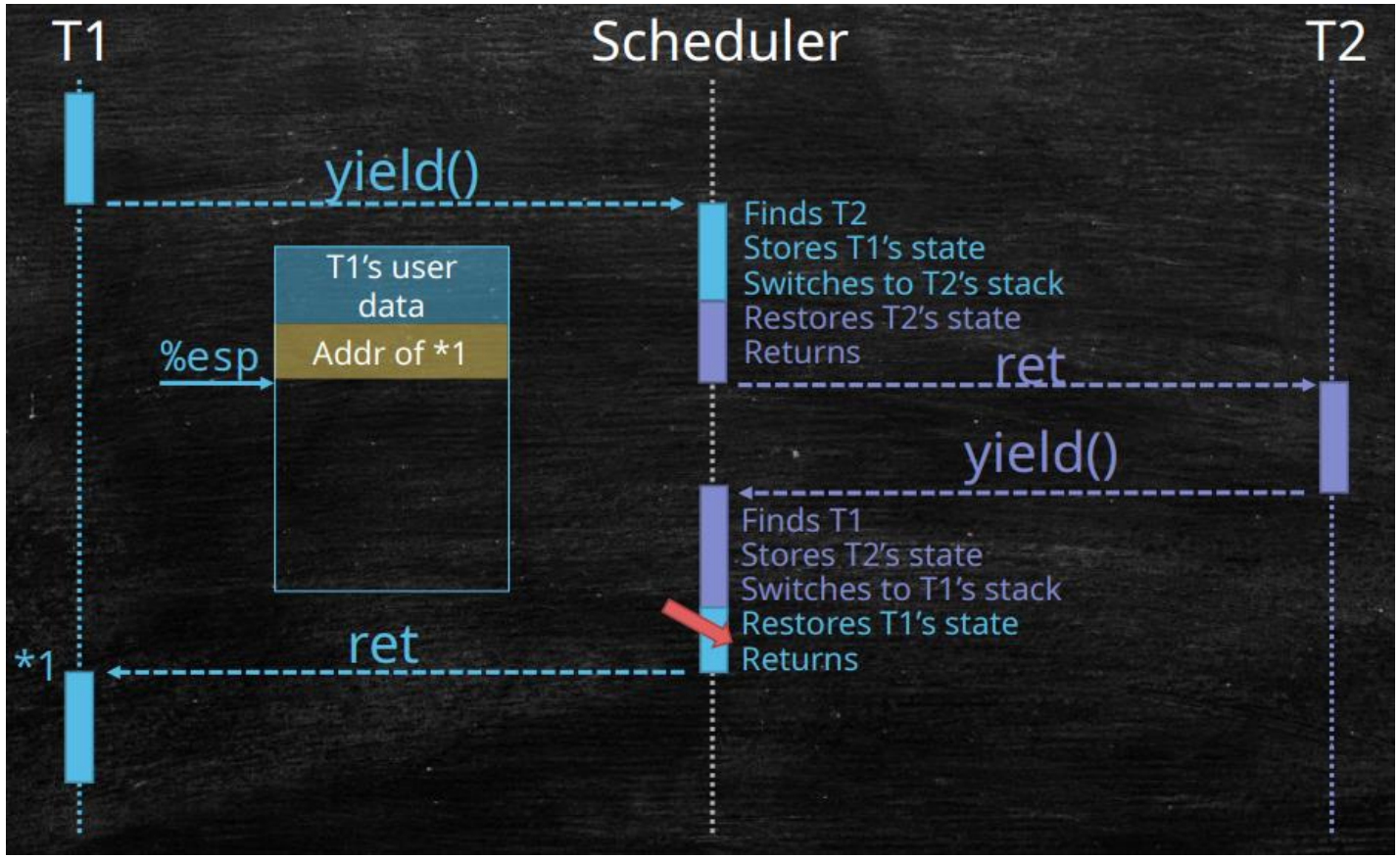

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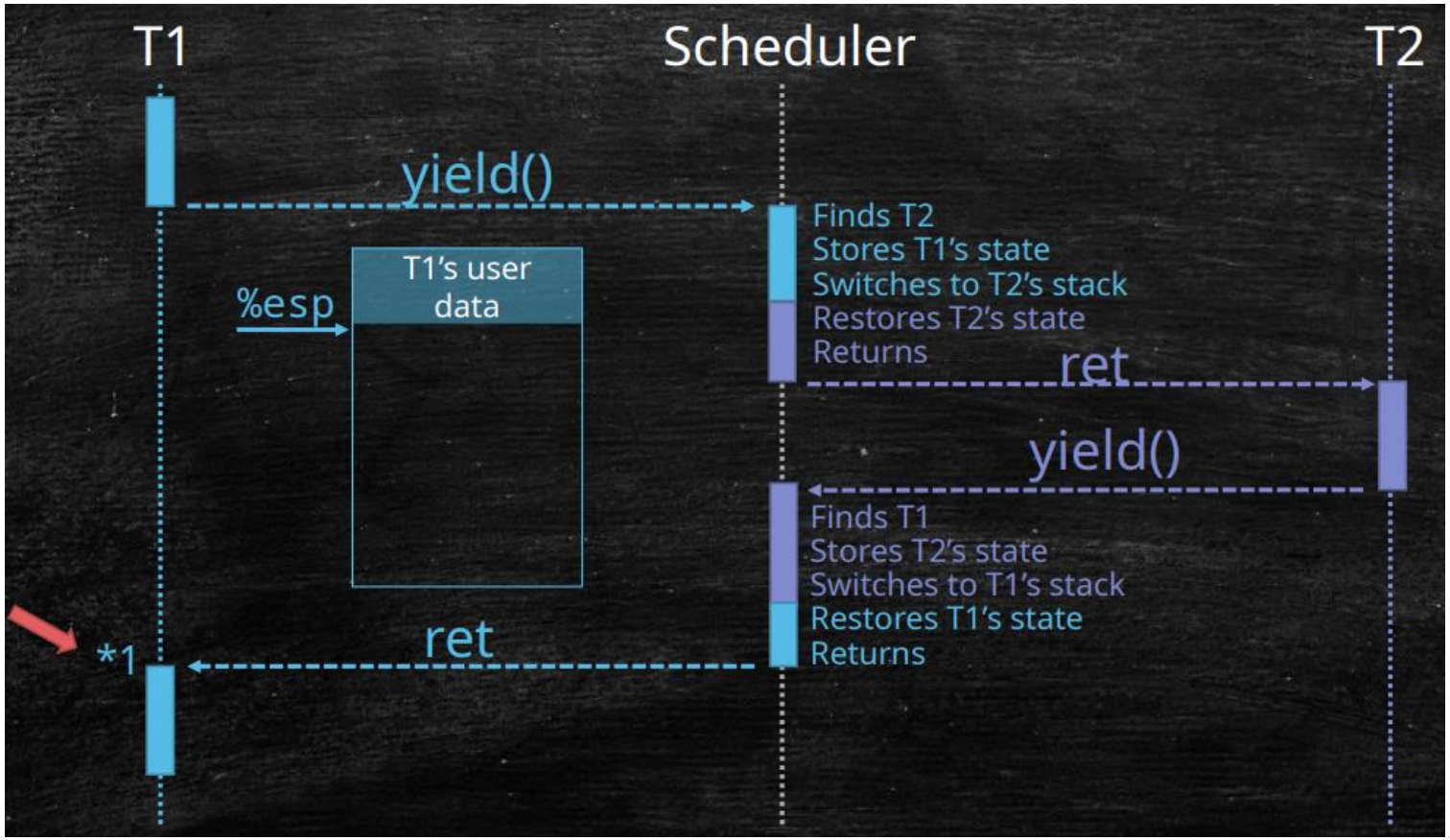

References

1. GDT - Overview, Tutorial, Packed structs
2. Inline Assembly - OSDev, gcc
3. Felix Cloutier - LGDT/LIDT, PUSHA