Hardware

The Stack

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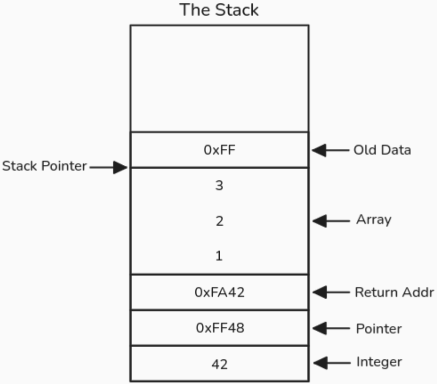
General Case

The Stack



The stack is:

- An in memory reserved zone
- A LIFO
- Managed by a pointer: the stack pointer
- A temporary storage by nature

The Context

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Solution: **save the context** then **restore it**.

The **stack** can be used for that.

M68000 Case

The M68000 Stack

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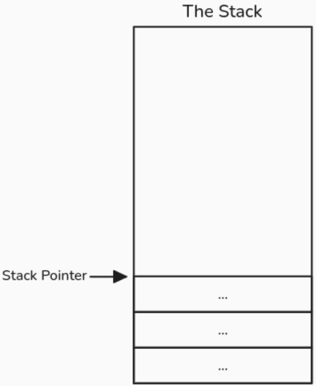
The stack can be accessed by user to store data.

It is generally used to store the **context**.

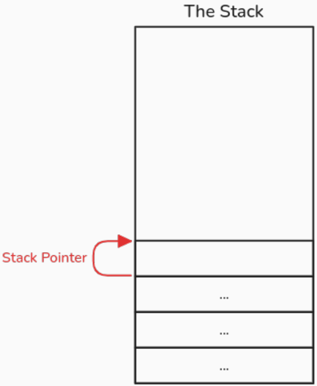
It is also involved in interrupt handling (not discussed in this lesson).

Push / Pop



Pushing to the stack:

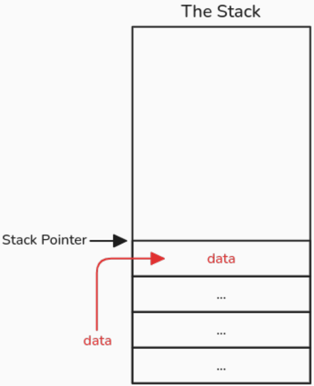
Push / Pop



Pushing to the stack:

```
suba.l      #2,A7           ; Decrement stack pointer
```

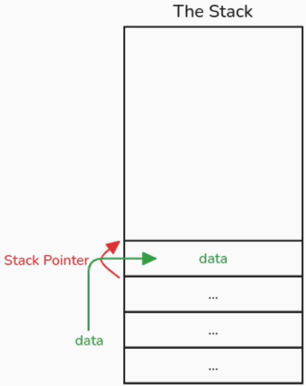
Push / Pop



Pushing to the stack:

```
suba.l      #2,A7           ; Decrement stack pointer
move.w      #data,(A7)      ; Move data to the stack
```

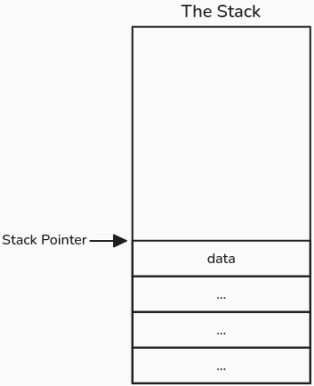
Push / Pop



Pushing to the stack:

```
move.w   #data,-(A7) ; Decrement SP then move data
```

Push / Pop



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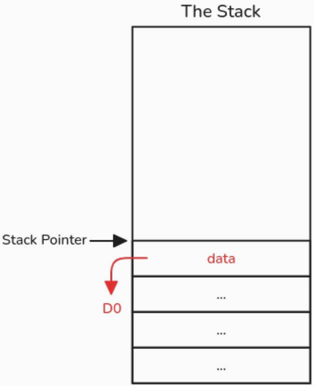

Pushing to the stack:

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move.w   #data,-(A7) ; Decrement SP then move data
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Popping from the stack:

```
move.w      (A7),D0    ; Retrieve data
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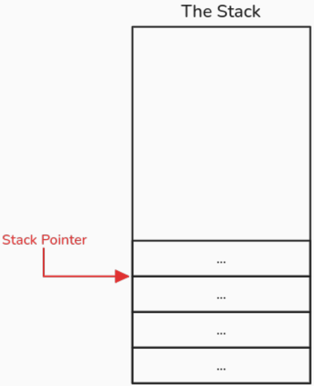


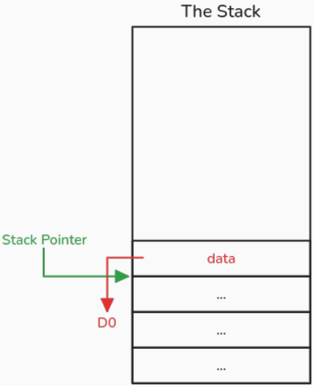
Pushing to the stack:

```
move.w   #data,-(A7) ; Decrement SP then move data
```

Popping from the stack:

```
move.w      (A7),D0    ; Retrieve data
adda.l      #2,A7     ; Increment stack pointer
```

Push / Pop



Pushing to the stack:

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move.w   #data,-(A7) ; Decrement SP then move data
```
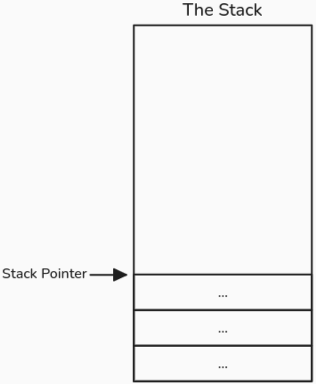

Popping from the stack:

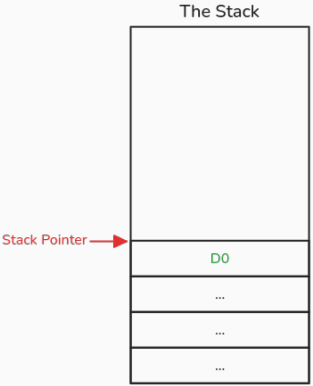
```
move.w      (A7)+,D0    ; Retrieve + Increment SP
```

Context Switch



Saving context:

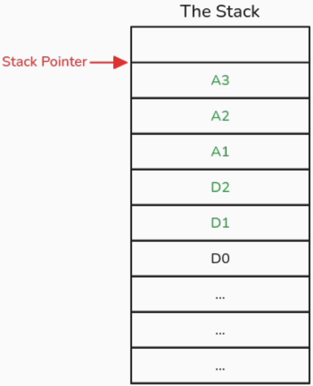
Context Switch



Saving context:

```
move.l    D0,-(A7)                ; Single register
```

Context Switch

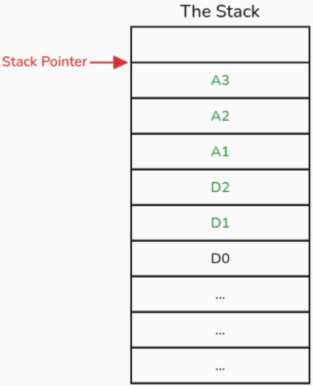


Saving context:

```
move.l   D0,-(A7)              ; Single register
movem.l  D1/D2/A1-A3,-(A7)     ; Multiple registers
```

- movem is equivalent to multiple move

Context Switch



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move.l   D0,-(A7)              ; Single register
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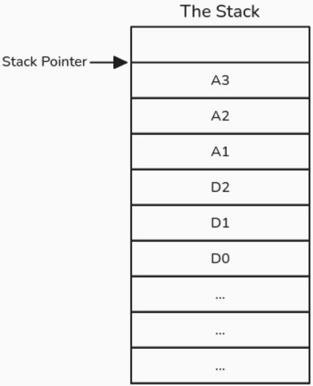
- movem is equivalent to multiple move
- move order is managed automagically (by the assembler)

Context Switch



The Stack

Stack Pointer

A3

A2

A1

D2

D1

D0

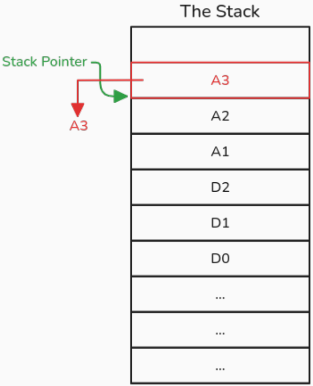
...

...

...

Retreiving context:

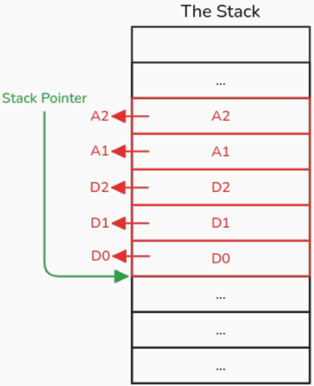
Context Switch



Retreiving context:

```
move.l      (A7)+,A3            ; Single retrieve
```

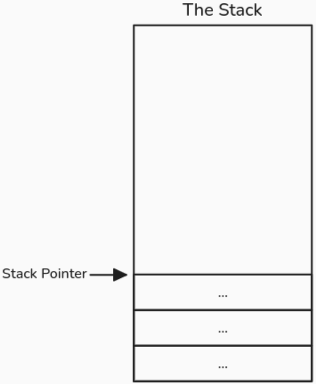
Context Switch



Retreiving context:

```
move.l      (A7)+,A3           ; Single retrieve
movem.l     (A7)+,D0-D2/A1/A2  ; Multiple retrieve
```

Routines



Function calls are done with the **jsr** and **rts** instructions.

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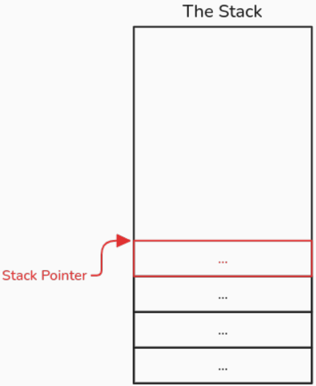

Function calls are done with the **jsr** and **rts** instructions.

jsr jumps to a label's address, it is equivalent to:

```
move.l      PC,-(A7) ; Save the return address
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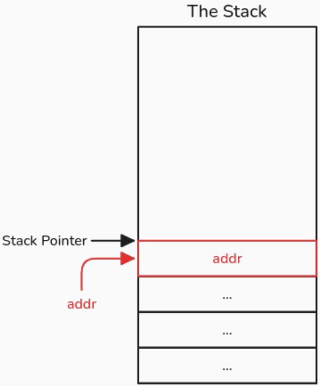

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move.l      #addr,PC ; Jump to label
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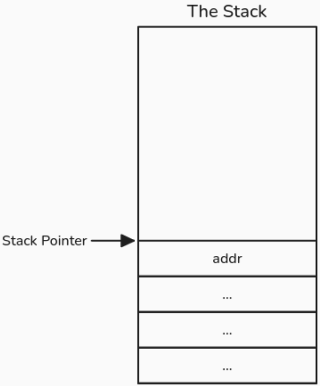

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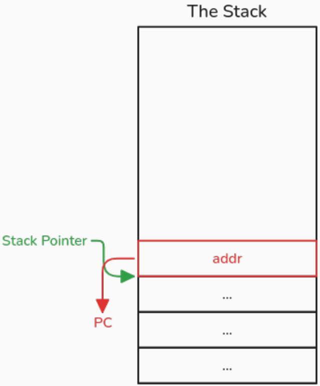

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```
move.l      (A7)+,PC  ; Retrieve return address
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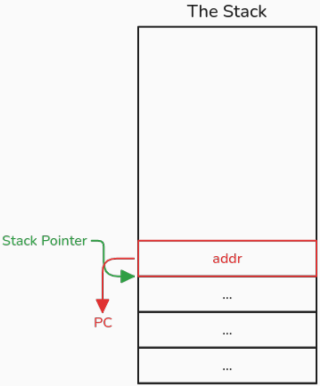

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move.l      PC,-(A7) ; Save the return address
move.l      #addr,PC ; Jump to label
```

rts jumps back to the caller's location. it is equivalent to:

```
move.l      (A7)+,PC ; Retrieve return address
add.l       #2,PC    ; Jump to next instruction (
    variable size)
```

Routines

rts instruction expects the return address to be at the top of the stack.

It is **your** responsibility to ensure it is the case.

Any data pushed to the stack during a routine **must** be poped **before** the **rts** instruction.

Standard Routine Layout

Here is the look your routines may have during the practicals:

```
label                           ; Routine's label
    movem.l  D0/D1/A0-A2,-(A7) ; Save previous context

    ; ------------------ ;
    ; - Routine's body - ;
    ; ------------------ ;

    movem.l  (A7)+,D0/D1/A0-A2 ; Retrieve context
    rts                         ; Return to caller
```

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This is **automatic** if you are using **pre-decrementation** addressing mode.

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To ensure that next stack pushes **are** aligned, all byte pushes must move A7 by **two** bytes.

This is **automatic** if you are using **pre-decrementation** addressing mode.

Misaligned stack **will** cause the CPU to **raise** an interrupt and will **crash** the simulator.

Advanced: Stack Frame

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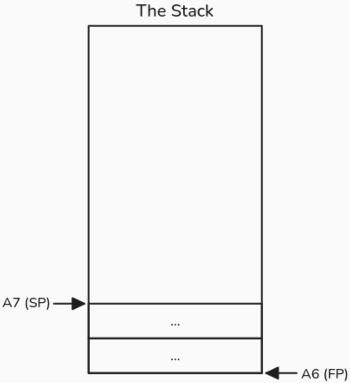
By convention, **A6** is used as the frame pointer.

Advanced: Stack Frame Example



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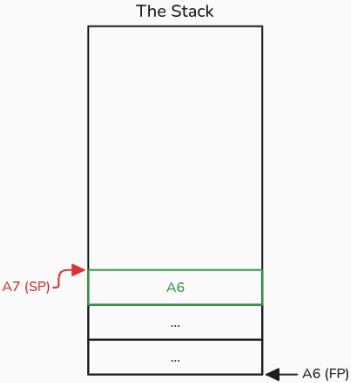

```
move.l  A6,-(A7) ; Push previous frame pointer
```

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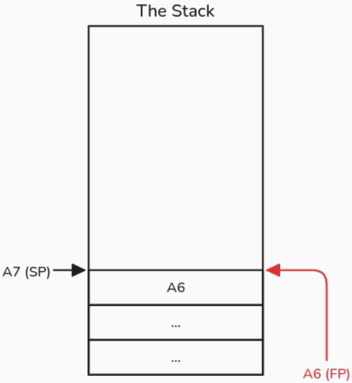

```
move.l   A6,-(A7)  ; Push previous frame pointer
movea.l  A7,A6     ; Get new frame origin
```

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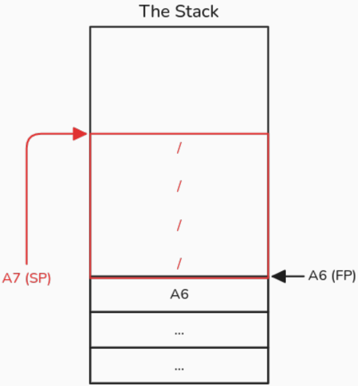

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move.l   A6,-(A7)  ; Push previous frame pointer
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suba.l   #8,A7     ; Reserve 8 bytes
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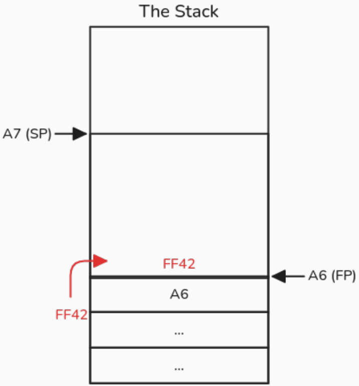

```
move.l   A6,-(A7) ; Push previous frame pointer
movea.l  A7,A6    ; Get new frame origin
suba.l   #8,A7    ; Reserve 8 bytes

move.w   #$FF42,-2(A6) ; Store something

; - Routine's body - ;
```

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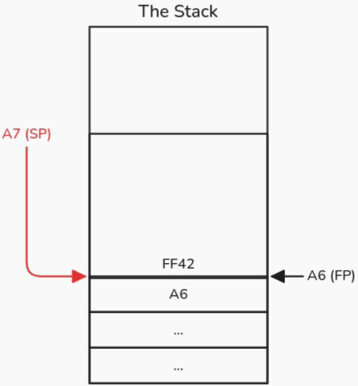

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movea.l  A6,A7    ; Remove stack frame
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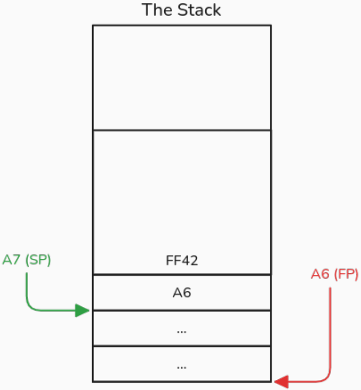

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movea.l  A6,A7     ; Remove stack frame
movea.l  (A7)+,A6  ; Restore old frame pointer
```

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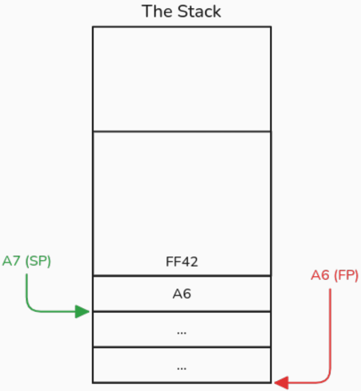

```
link     A6,#-8     ; Create stack frame

suba.l   #8,A7      ; Reserve 8 bytes

move.w   #$FF42,-2(A6) ; Store something

; - Routine's body - ;

unlk     A6         ; Remove stack frame
```