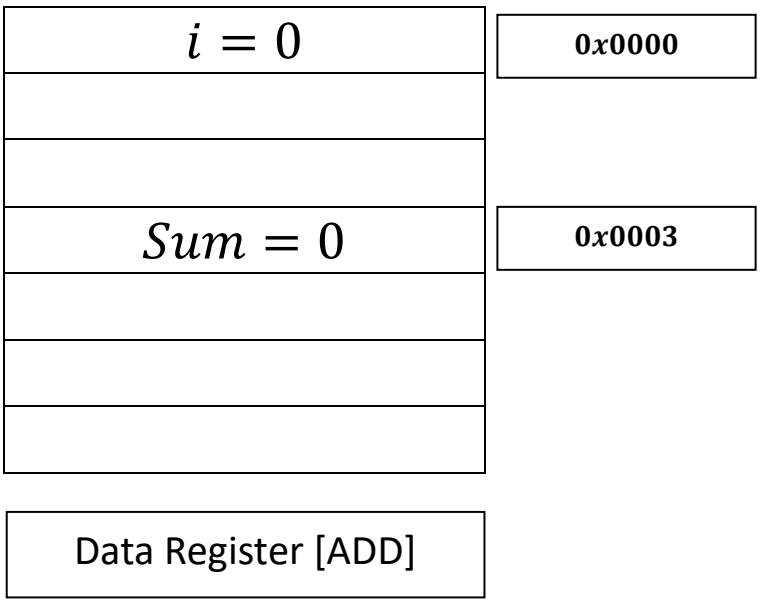
Stack Operation Vs Loop Operation in Memory.

$$int\ sum = 0;$$
$$for(int\ i = 0; i < n; i++){$$
$$sum = sum + i;$$
$$}$$



- ***i and sum are local variables.***
- ***They are created once inside the function's stack frame[say inside main function's stack frame].***

- ***Their memory location remains the same throughout the loop.***
- ***Only their values change during each iteration.***
- ***The statement sum = sum + i executes*** *n times.*

→ ***Read value of i***

→ ***Read value of sum***

→ ***Compute Result***

→ ***ADD i, 1 [Sent to Instruction Register]***

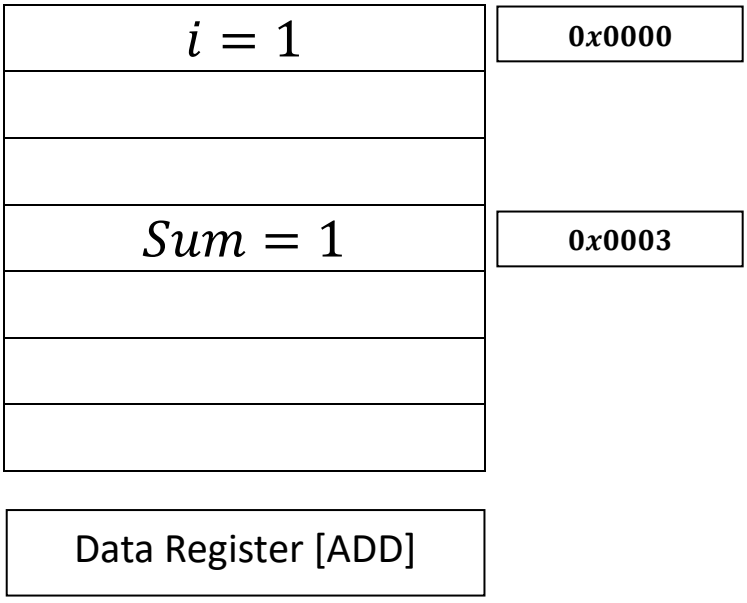
→ ***ADD SUM, i [Sent to Instruction Register]***

[Note: This is simpler version]

→ ***We get i = 1 and Sum = 1 , therefore :***

→ ***Write i = 1 to the reserved memory for i.***

→ ***Write Sum = 1 to the reserved memory for Sum.***



Hence the process will continue up to n times at same location. We can state that the statement or operation $sum = sum + i$ runs up to $i = n$ i.e., $n\ times$.

$Generating\ Time\ Complexity : O(n)$.

***Where as in Push and Pop operation*:**

Stack Push Operation [Time Complexity]

$[Single\ Element\ Pushed]$	$\rightarrow O(1)$
$[Single\ Element\ Pushed]$	$\rightarrow O(1)$
$[Single\ Element\ Pushed]$	$\rightarrow O(1)$
$[Single\ Element\ Pushed]$	$\rightarrow O(1)$
$[Single\ Element\ Pushed]$	$\rightarrow O(1)$
$[Single\ Element\ Pushed]$	$\rightarrow O(1)$
.....	
$[Single\ Element\ Pushed]$	$\rightarrow O(1)$

i.e., Push will be inserted at each Top of the stack.

i.e., At each location the Push operation will be performed at $O(1)$ complexity.

$$\textbf{Also, if we see there is lower bound } (1) \textbf{ and upper bound}(n \textbf{ i.e. size of the stack} = n):$$

$$1 \leq \ f(n) \leq n$$

$$\textbf{Here if we do average if it runs up to n times}:$$

$$\frac{1 + 1 + 1 + 1 \ldots + n \textbf{ times}}{n} = \frac{n}{n} = 1 = O(1).$$

Stack Pop Operation [Time Complexity]

[Single Element Popped]	$\rightarrow O(1)$
[Single Element Popped]	$\rightarrow O(1)$
[Single Element Popped]	$\rightarrow O(1)$
[Single Element Popped]	$\rightarrow O(1)$
[Single Element Popped]	$\rightarrow O(1)$
[Single Element Popped]	$\rightarrow O(1)$
.....	
[Single Element Popped]	$\rightarrow O(1)$

$$i.e., \textbf{Pop of element will be done at each Top } (\textbf{First Element}) \textbf{of the stack.}$$

$i.e., At\ each\ location\ the\ Pop\ operation\ will\ be\ performed\ at\ O(1)\ complexity.$

$Also, if\ we\ see\ there\ is\ lower\ bound\ (1)\ and\ upper\ bound(n\ i.e.\ size\ of\ the\ stack = n)$:

$1 \leq \ f(n) \leq n$

$Here\ if\ we\ do\ average\ if\ it\ runs\ up\ to\ n\ times$:

$$\frac{1 + 1 + 1 + 1 \ldots + n\ times}{n} = \frac{n}{n} = 1 = O(1).$$

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