Iteration (1A)

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Sigma Notation and Flow Chart

$$S_n = \sum_{k=1}^{n} a_k$$

$$= a_1 + a_2 + a_3 + \quad \cdots \quad + a_n$$

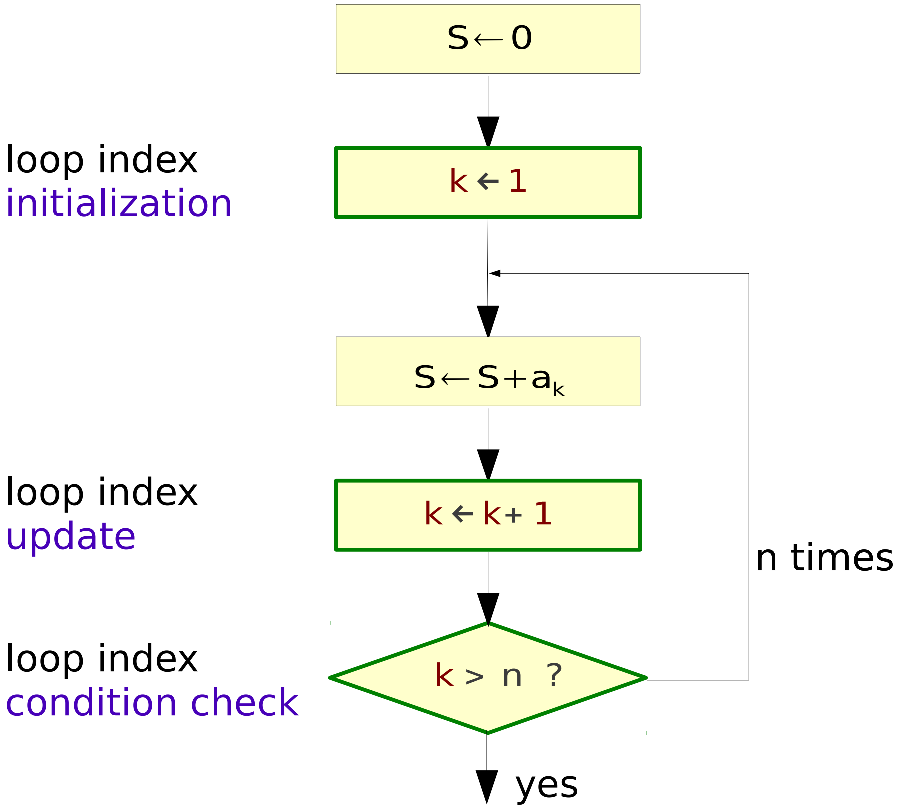
$S \leftarrow 0 + a_1$

$S \leftarrow (0 + a_1) + a_2$

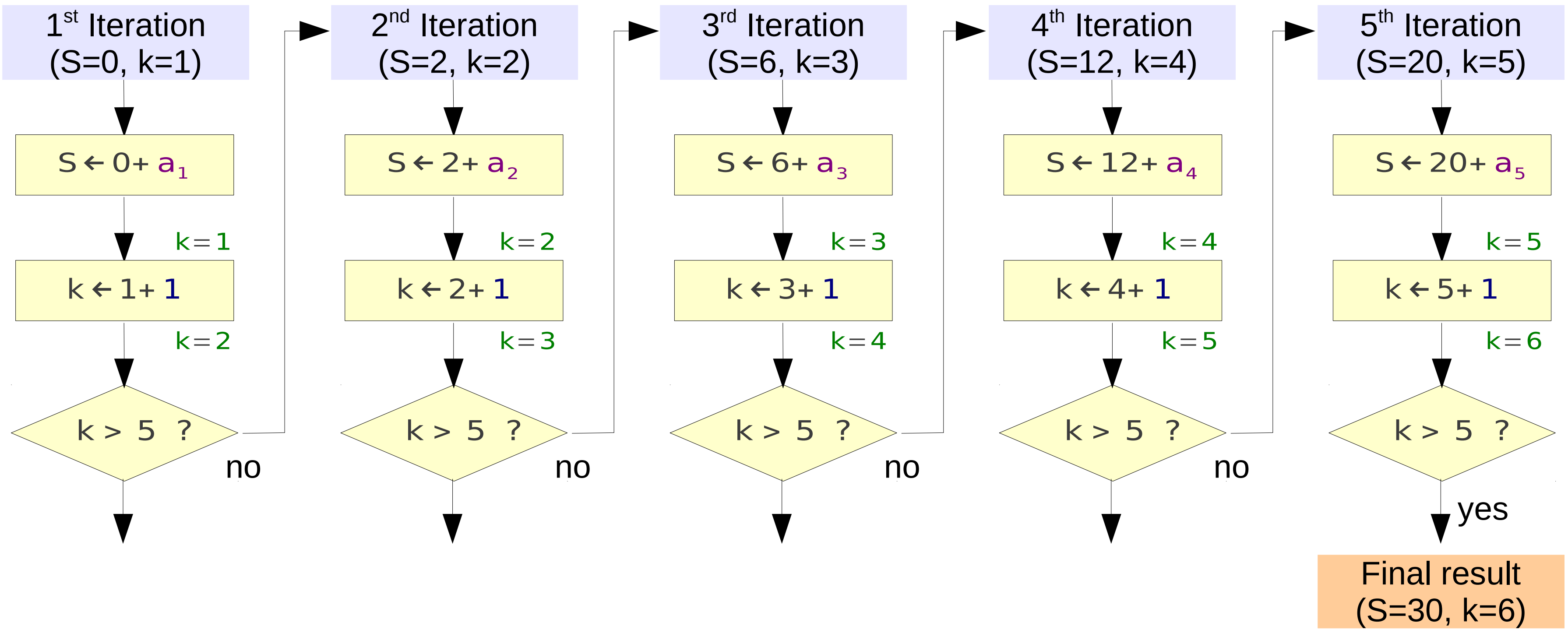
$S \leftarrow (0 + a_1 + a_2) + a_3$

$S \leftarrow (0 + a_1 + a_2 + a_3) + a_4$

$S \leftarrow (0 + a_1 + a_2 + a_3 + a_4) + a_5$

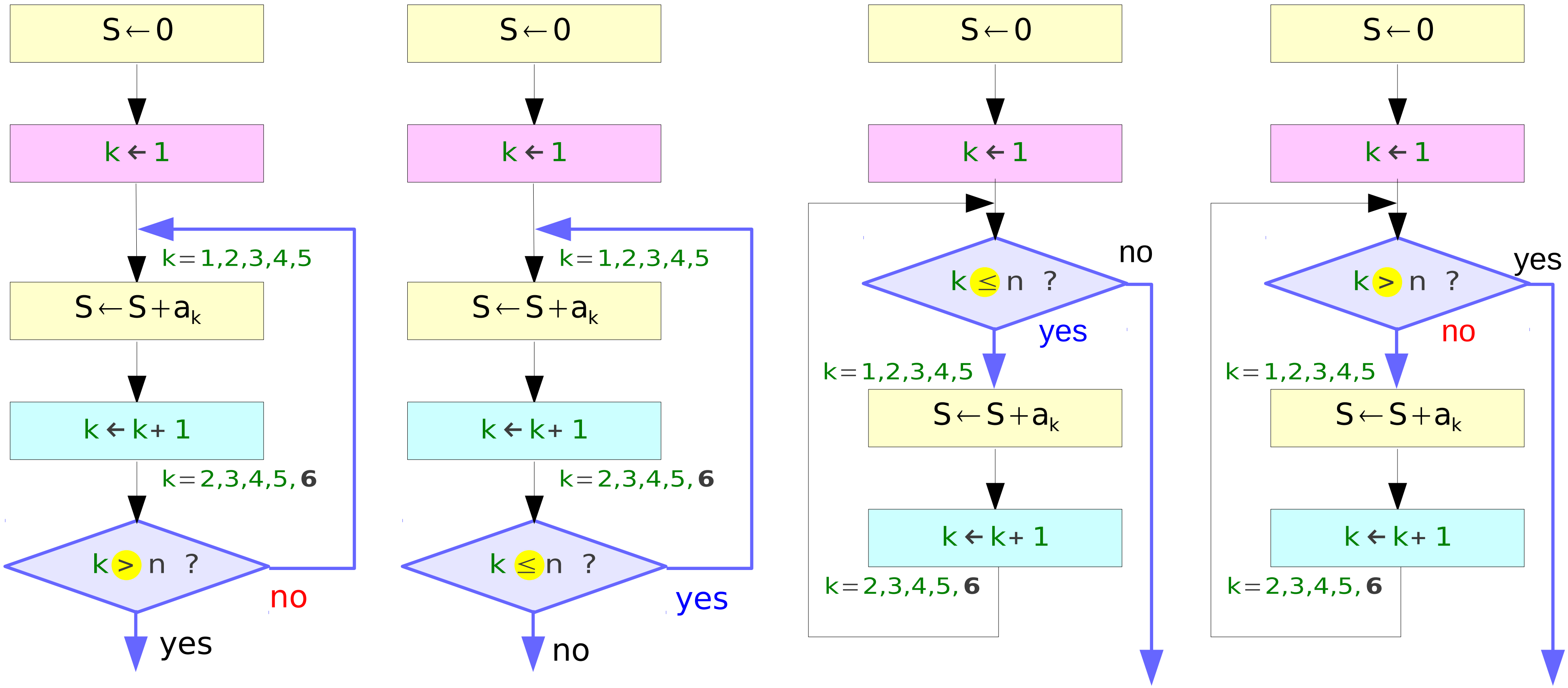


Loop Unrolling

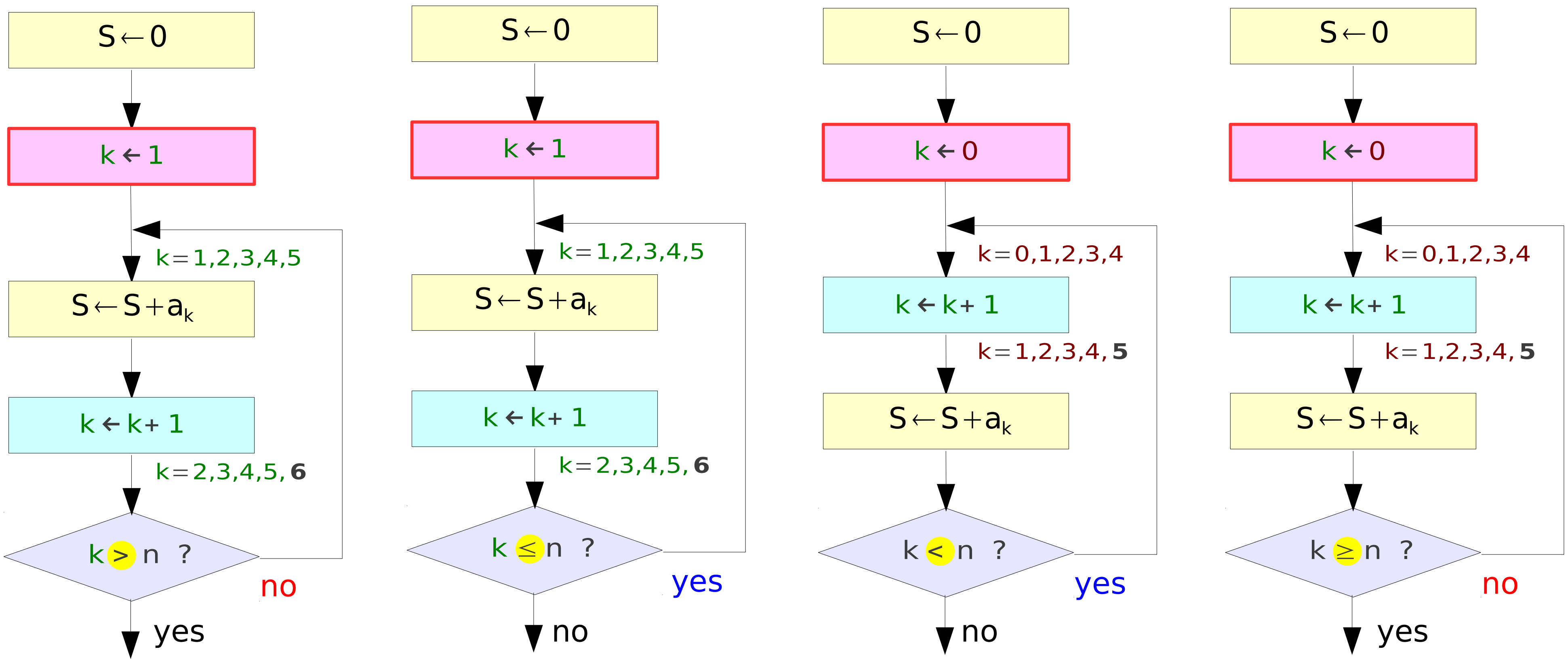


$a_1=2$,
$a_2=4$,
$a_3=6$,
$a_4=8$,
$a_5=10$

Check Conditions



Initial Conditions



$S \leftarrow 0$

$k \leftarrow 1$

$k = 1,2,3,4,5$

$S \leftarrow S + a_k$

$k \leftarrow k + 1$

$k = 2,3,4,5,\mathbf{6}$

$k > n$?

no

yes

$S \leftarrow 0$

$k \leftarrow 1$

$k = 1,2,3,4,5$

$S \leftarrow S + a_k$

$k \leftarrow k + 1$

$k = 2,3,4,5,\mathbf{6}$

$k \leq n$?

yes

no

$S \leftarrow 0$

$k \leftarrow 0$

$k = 0,1,2,3,4$

$k \leftarrow k + 1$

$k = 1,2,3,4,\mathbf{5}$

$S \leftarrow S + a_k$

$k < n$?

yes

no

$S \leftarrow 0$

$k \leftarrow 0$

$k = 0,1,2,3,4$

$k \leftarrow k + 1$

$k = 1,2,3,4,\mathbf{5}$

$S \leftarrow S + a_k$

$k \geq n$?

no

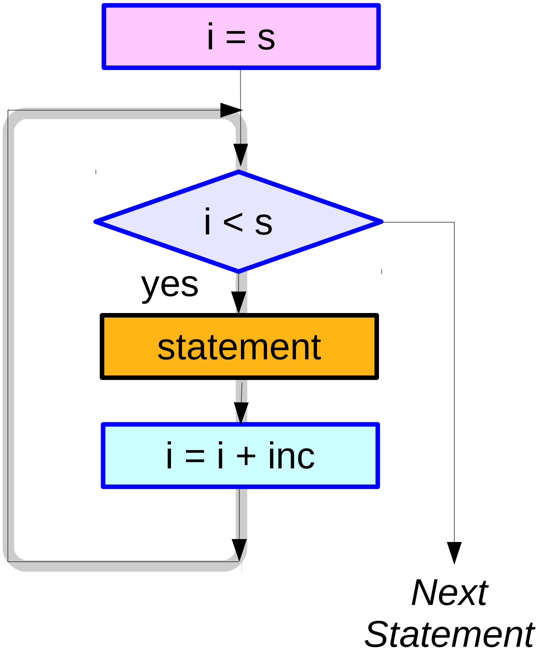
yes

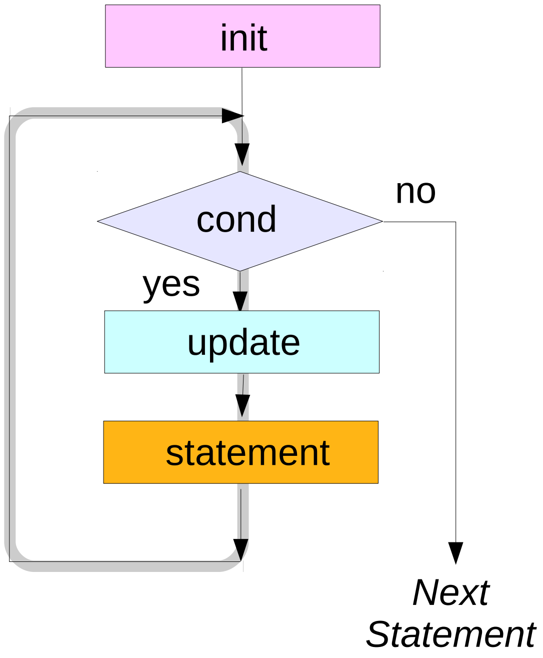
Loop Statements

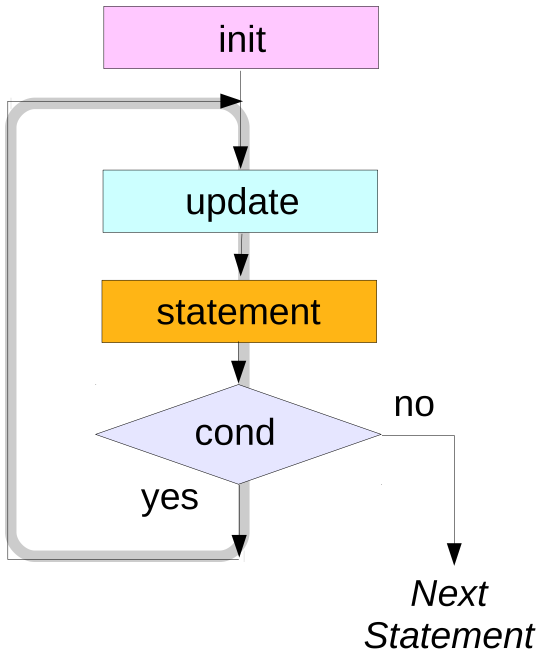
```
for i = s : inc : e
  statements
endfor
```

```
init
while (cond)
  update
  statements
endwhile
```

```
init
do
  update
  statements
until (cond)
```







for loop

```
S = 0;
for k = 0:4
        S = S + k+1;
endfor
```

```
S = 0;
for k = 0:4
        S = S + k;
endfor
```

for loop's expressions

```
for k = [ 1, 3, 2, 4]
  k;
endfor
```

```
k = 1
k = 3
k = 2
k = 4
```

```
for k = [ 1, 3; 2, 4]
  k;
endfor
```

```
k = [1; 2]
k = [3, 4]
```

Range Expression

```
1 :  1  : 4

⇨ [ 1, 2, 3, 4]
```

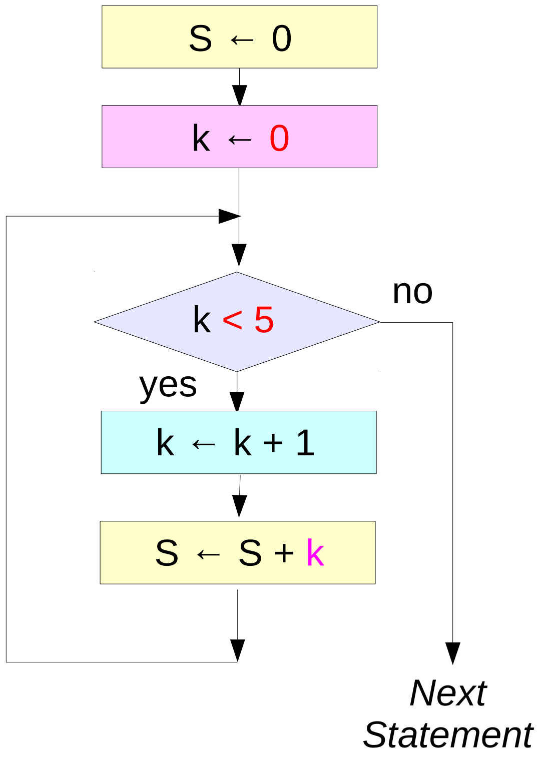
```
4 :  -1  : 1

⇨ [ 4, 3, 2, 1]
```

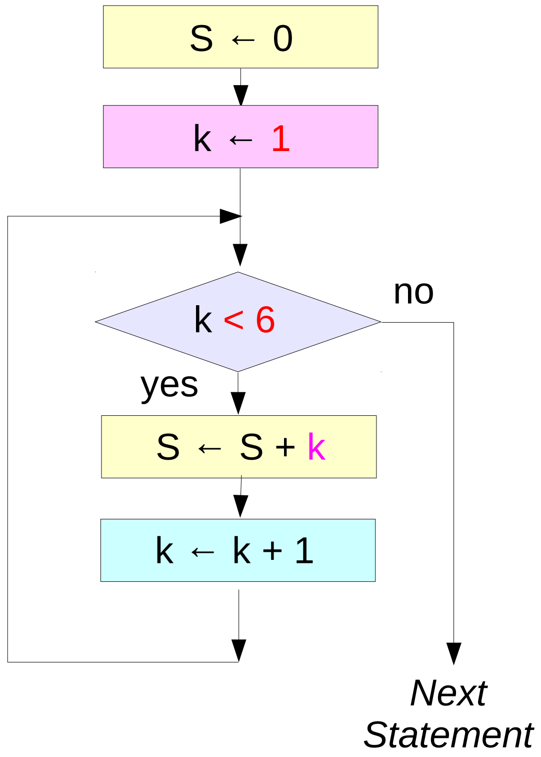
while loop

```
S = 0; k=0;
while (k<5)
      k = k+1;
      S = S+k;
endwhile
```

```
S = 0; k=1;
while (k<6)
      S = S+k;
      k = k+1;
endwhile
```



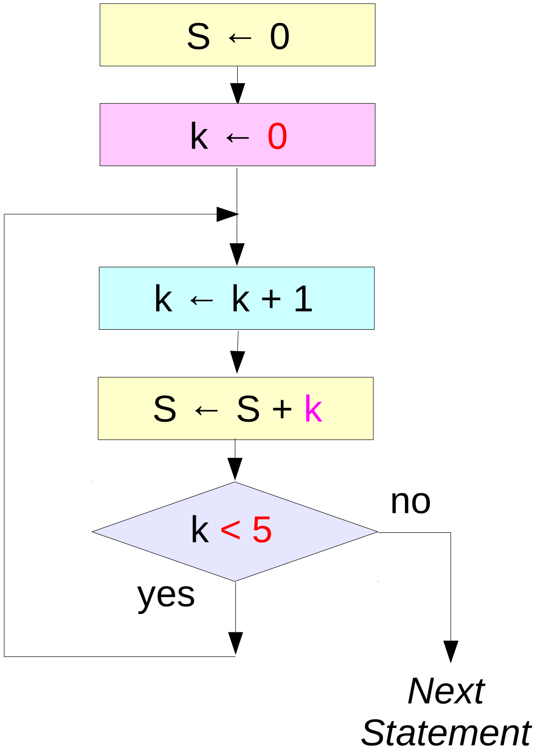
flexible



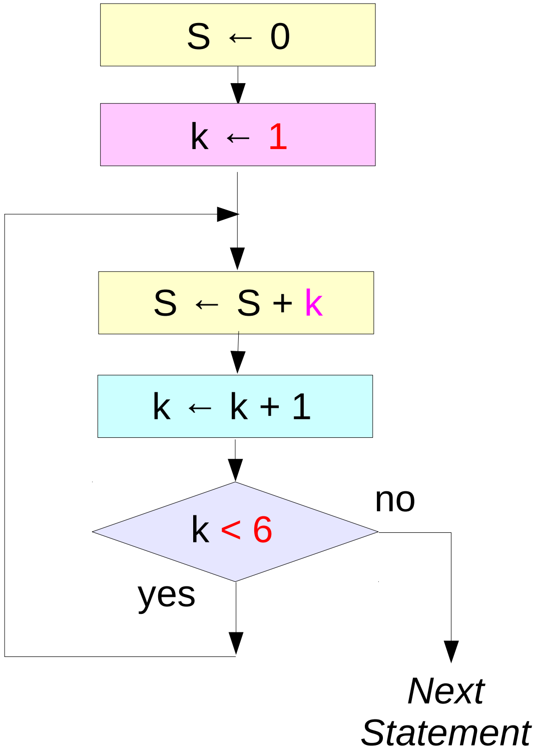
do-while loop

```
S = 0; k=0;
do
      k = k+1;
      S = S+k;
until (k<5)
```

```
S = 0; k=1;
do {
      S = S+k;
      k = k+1;
until (k<6)
```



flexible, at least once



Nested For Loop Examples

```
for i = 0 : 2
printf(“St1 \n”); endfor
for j = 0 : 3
printf(“St2 \n”); endfor
printf(“St3 \n”);
```

```
for i = 0 : 2
printf(“St1 \n”);
for j = 0 : 3
printf(“St2 \n”); endfor endfor
printf(“St3 \n”);
```

```
for i = 0 : 2
printf(“St1 \n”); endfor
for j = 0 : 3
printf(“St2 \n”);
printf(“St3 \n”); endfor
```

```
for i = 0 : 2
        printf(“St1 \n”);
endfor
for j = 0 : 4
        printf(“St2 \n”);
endfor
printf(“St3 \n”);
```

```
for i = 0 : 2
        printf(“St1 \n”);
        for j = 0 : 3
                printf(“St2 \n”);
        endfor
endfor
printf(“St3 \n”);
```

```
for i = 0 : 2
        printf(“St1 \n”);
endfor
for j = 0 : 3
        printf(“St2 \n”);
        printf(“St3 \n”);
endfor
```

References

[1] Essential C, Nick Parlante
[2] Efficient C Programming, Mark A. Weiss
[3] C A Reference Manual, Samuel P. Harbison & Guy L. Steele Jr.
[4] C Language Express, I. K. Chun