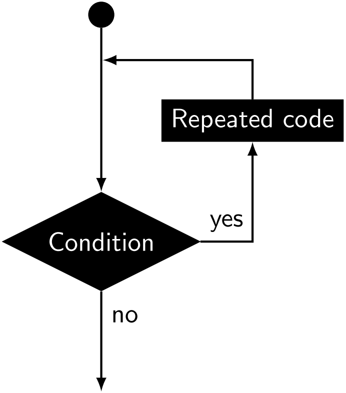
Lecture 5 - running in circles

Repeat instructions



- Block of code needs to be repeated
- Execution is sequential, e.g.: first instruction first, than second ...
- Loops allow to execute a statement, or a group of statements a number of times

Computer Science I

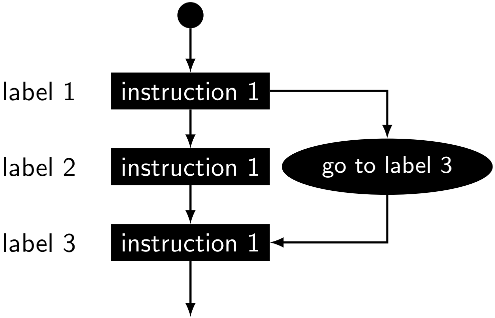
Example 1

Write 100 consecutive numbers ...

Bad idea:

```
...
printf("%d\n", 0);
printf("%d\n", 1);
printf("%d\n", 2);
...
printf("%d\n", 100);
```

GO TO



label 1 — instruction 1

label 2 — instruction 1

label 3 — instruction 1

go to label 3

- Provides a jump to from *goto* to a labeled statment
- Although avalible in many languages the use is **highly discouraged**, and is a mark of poor programming skills
- Makes program hard to follow and modify
- Any algorithm that uses *goto* can, and should be rewriten to avoid it!

I COULD RESTRUCTURE THE PROGRAM'S FLOW OR USE ONE LITTLE 'GOTO' INSTEAD.
EH, SCREW GOOD PRACTICE. HOW BAD CAN IT BE?
goto main_sub3;
COMPILE

XKCD

Computer Science I

Out first repeated statement

Better to forget this one!

```
...
int i=0;
start:
printf("%d\n",i);
++i;
if(i<=100) goto start;
...
```

Computer Science I

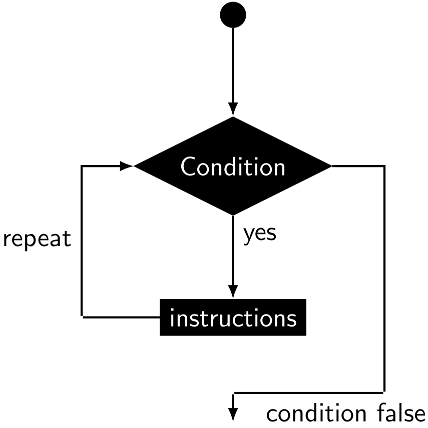
while loop

```
...
while(condition)
{
  instructions;
}
...
while(condition)
  1 instruction;
```

- Executes as long as condition is *true*
- Condition is checked **befere** execution
- ... might not execute at all if condition is *false*!
- When finished passes to the line immediately following the loop

Computer Science I

while loop



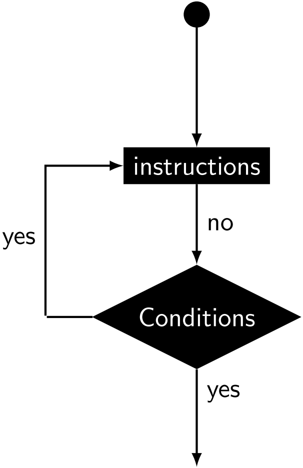
- Executes as long as condition is *true*
- Condition is checked **befere** execution
- ... might not execute at all if condition is *false*!
- When finished passes to the line immediately following the loop

do … while loop

```
...
do
{
  instructions;
} while(condition)
...
do
  1 instruction;
while(condition)
```

- Executes as long as condition is *true*
- Condition is checked **after** execution
- … executes at leas one time, even if condition is *false*!
- When finished passes to the line immediately following the loop

do ... while loop



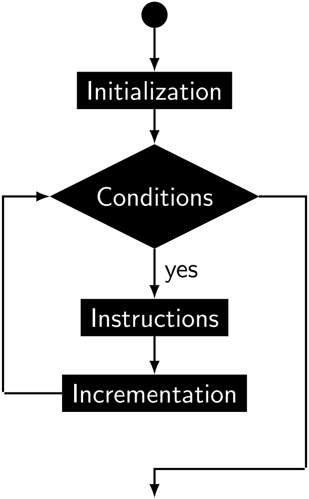
- Executes as long as condition is *true*
- Condition is checked **after** execution
- ... executes at leas one time, even if condition is *false*!
- When finished passes to the line immediately following the loop

for

```
...
for ( init; condition; incr ) {
  instructions
}
...
for ( init; condition; incr )
  instructions
...
for(;;) {} //forever
```

- The **init** step is executed first, and only once.
- ... not requiered as long as ; is in
- Condition is checked **before** execution
- ... will not execute if initially condition is *false*!
- **incr** is performed after the instructions are executed, as a last step,
- ... not requiered as long as ; is in
- Condition is checked again
- ...

for



- The **init** step is executed first, and only once.
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- Condition is checked **before** execution
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- **incr** is performed after the instructions are executed, as a last step,
- ... not requiered as long as ; is in
- Condition is checked again
- ...

Nested loops

Lopp in a loop in a loop in a ...

```
...
for ( init; condition; incr ) {
   for ( init; condition; incr ){
    for ( init; condition; incr ){
      instructions
}}}
...
```

- C allows to use loops inside another loops
- Can get tricky

Infinite Loop

Loop that runs forever ...

```
...
for(;;) {} //forever
...
while (true){}
...
```

- The program never ends

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break

Terminates the loop

```
...
break;
...
```

- The loop is terminated and the code following the loop is executed

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continue

Start the next run immediately

```
...
continue;
...
```

- The loop execution is stooped, and started from the beginning

Example with functions

Write a program, calculating the Fourier expansion of a square wave. Use a function to calculate the values.

$$f(x) = \frac{4}{\pi}\sum_{n=1}^{\infty}\frac{1}{n}sin(\frac{n\pi x}{L}) \tag{1}$$