

Loops

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looping statements, counted loops, conditional loops, action, iterate, loop or iterator variable, running sum, running product, factorial, preallocate, echo printing, nested loop, outer loop, inner loop, infinite loop, counting, error-checking

Looping Statements

- Loops are used to repeat actions.
- Counted Loops
 - for
- Conditional Loops
 - while

for loop

```
for loopvar = range  
    action  
end
```

```
for i = 1:6  
    fprintf('hello');  
end
```

```
for i = [ 1 2 3 4 5 6 ]  
    fprintf('hello');  
end
```

```
for i = 1:5; fprintf('hello'); end
```

```
for i = 1:6  
    disp(i);  
end
```

```
for i = [ 1 2 3; 4 5 6 ]  
    disp(i)  
end
```

Exercise: runningsum

- Write a function `runningsum.m` that takes an integer `n`, and returns the sum of numbers from 1 to `n`.
- Change the function `runningsum` so it takes 2 arguments "lower" and "upper" and returns the sum of numbers "lower" to "upper".
- If only "lower" is provided, return the sum of numbers from 1 to "lower".
 - Important programming concept: specifying default function arguments.
- Change the function `runningsum` so that the arguments "lower" and "upper" can be specified in any order.

Exercise: myfactorial

- Write a function `myfactorial(n)` that returns $n!$. You must use for loops. Do not use the built-in `factorial()` function.
- Change the `myfactorial` function so that it can take a vector of integers, and return a vector where each element is the factorial of the corresponding input element.
 - Important concept: recursive call
 - Important concept: pre-allocation

Exercise: myprod

- Write a function `myprod(v)` that returns the product of the elements in `v`. Do not use the built-in `prod()` function.

Combining loops with ifs.

- Exercise: Write a function `mymin(v)` that returns the minimum value in the vector `v`. Use a for loop. Do not use `min()` function.

Input in a for loop

- Write a function `inputnumbers(n)` that asks the user to enter a number `n` times, and returns a vector of all the numbers the user enters.
 - Hint: pre-allocate

Nested for loops

```
for loopvarone = rangeone ← outer loop

    % actionone includes the inner loop

    for loopvartwo = rangetwo ← inner loop
        actiontwo
    end
end
```

- Exercise: write a function `printrectangle(R,C)` that prints a box of stars, with height R and width C .

```
>> printrectangle(3,4)
```

```
****
```

```
****
```

```
****
```

Exercise

- Write a function `printtriangle(R)` that prints a triangle of height `R`, with 1 star in the first row, and `R` stars in the last row.

```
>> printtriangle(4)
```

```
*
```

```
**
```

```
***
```

```
****
```

Exercise

- What will the following code print?

```
for i = 1:3
  for j = 1:2
    fprintf('i=%d, j=%d\n', i, j);
  end
end
```

Exercise: multtable

- Write a function `multtable(R,C)` that returns a matrix `m` where `m(i,j)` is equal to $i*j$.

Exercise

- Write a function `mymatsum(m)` that returns the sum of all elements in the matrix `m`. Use nested for loops.
- Create a random 10000×10000 matrix `m` in command window. calculate `mymatsum(m)`. How long does it take matlab to calculate this?
 - Programming concept: `tic`, `toc`
- Can you re-write your function to run faster?
 - Programming concept: proximal/linear memory indexing
- Can you re-write your function to contain a single for loop?

Exercise: combining nested loops and if

- Write a function `mymatsumifpos(m)` that returns the sum of positive elements in the matrix `m`.

while loops

```
while condition  
    action  
end
```

- while loops are used when you don't know or cannot determine ahead of time how many times the loop will be executed.
- the action should at some point alter the condition to be false. otherwise you get an "infinite loop"
 - while true ; end
 - Use Ctrl+C to break out of an infinite loop. (Ctrl+C can also be used to stop execution of any long-running matlab command).

Exercise

- Write a function `[n,f]=factgthigh(high)` that returns the first integer `n` and its factorial that is greater than the input "high".

```
>> [n,f] = factgthigh (5000)
```

```
n =
```

```
7
```

```
f =
```

```
5040
```

Exercise

- Rewrite the following for loop using a while loop.

```
for i=1:5:100
    fprintf('i=%d\n', i);
end
```

Error checking user input in a while loop

- Exercise: Write a function `inputposnumber()` that asks the user for a positive number and returns it.

```
>> x = inputposnumber
```

```
Enter a positive number: -5
```

```
Invalid! Enter a positive number: 5
```

```
OK!
```

```
x =
```

```
5
```

- Exercise: Write a function `inputposint()` that asks the user for a positive integer number and returns it.

Flow control: continue, break

for range / while condition

[statements A]

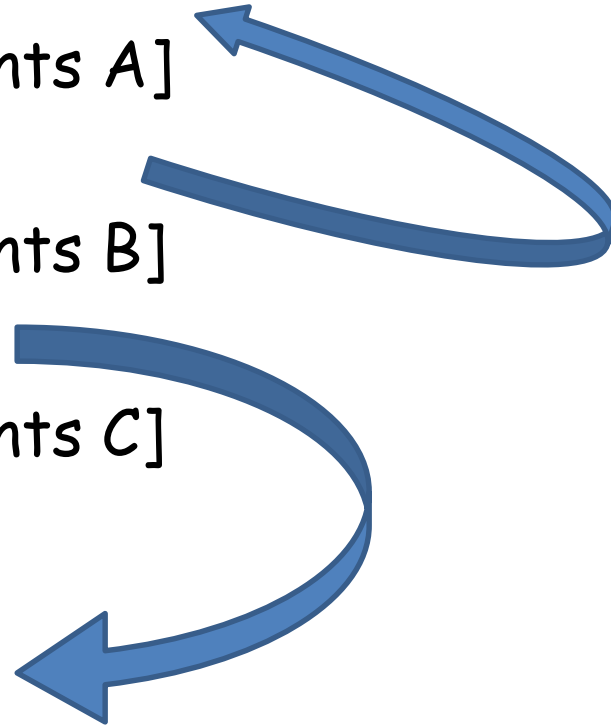
continue

[statements B]

break

[statements C]

end



Exercise

```
a='x';  
while ~strcmp(a,'y')&&~strcmp(a,'n')  
    a=input('Enter (y/n) :','s');  
end
```

- Fill-in the body of the while loop so that the code is equivalent to above.

```
while true  
    a=input('Enter (y/n) :','s');  
    ....  
    ....
```

Tips for Speed: "Preallocate" and/or "Avoid loops"

```
a=[];  
for i=1:10000  
    a(i)=log(i);  
end
```

```
a=zeros(1,10000);  
for i=1:10000  
    a(i)=log(i);  
end
```

```
a=log(1:10000);
```

```
tic; a=[]; for i=1:10000; a(i)=log(i); end; toc  
tic; a=zeros(1,10000); for i=1:10000; a(i)=log(i); end; toc  
tic; a=log(1:10000); toc
```

