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 = 1:6; 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: 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 10000x10000 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

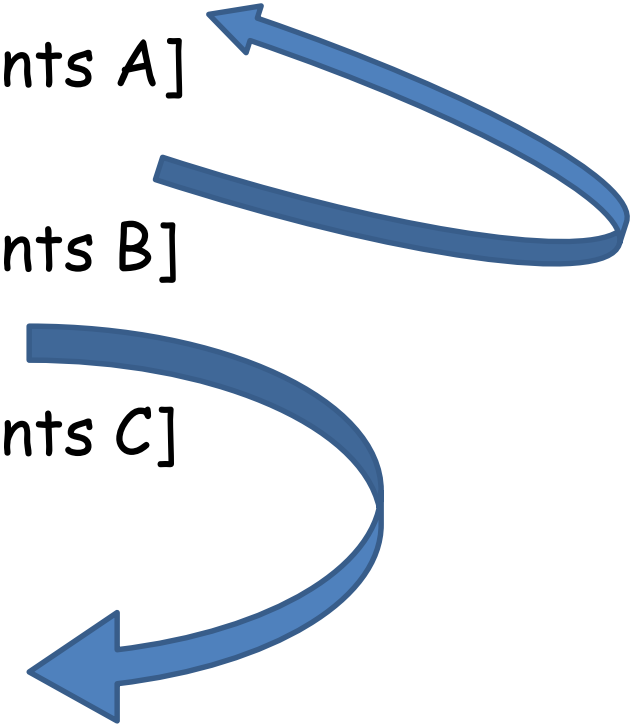
- Exercise: Write a function inputposnumber() that asks the user for a positive number and returns it.

```
>> x = inputposnumber
Enter a positive number: -5
Invalid! Enter a positive number: 5
OK!
x =
  5
```

- Programming Concept: "Error Handling"
  - What to do on error?
  - Do nothing
  - NaN / zero / default value
  - Raise error()

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
```