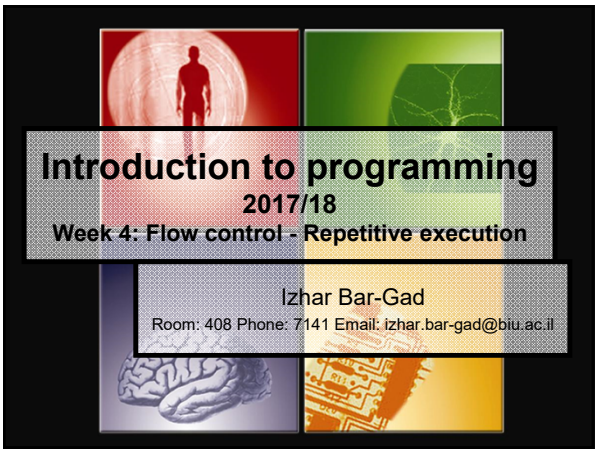
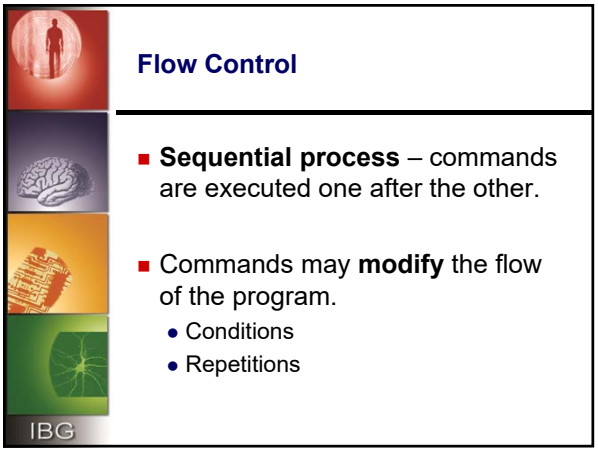

Introduction to programming
2017/18
Week 4: Flow control - Repetitive execution
Izhar Bar-Gad
Room: 408 Phone: 7141 Email: izhar.bar-gad@biu.ac.il


Flow Control
Sequential process – commands are executed one after the other.
Commands may modify the flow of the program.
Conditions
Repetitions
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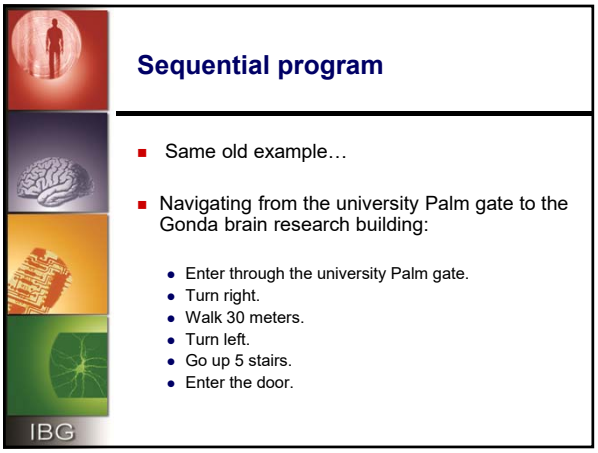
Sequential program
Same old example…
Navigating from the university Palm gate to the Gonda brain research building:
Enter through the university Palm gate.
Turn right.
Walk 30 meters.
Turn left.
Go up 5 stairs.
Enter the door.
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Example: Repetition

- Handling an unknown number of stairs!
  - Enter through the university Palm gate.
  - Turn right.
  - Walk 30 meters.
  - Turn left.
  - Is there a stair in front of you?
    - Go up 1 stair.
    - Redo the question
  - Enter the door.

Repetitive execution

- Perform the code multiple times.
- Two main commands:
  - 'for' – iterate over a list of values.
  - 'while' – iterate until a condition is met.

The 'for' loop - simple case

- The 'for' loop repeats a group of commands a fixed, predetermined number of times.
- Simple syntax (default increment is 1):

```
for var = start : end,
      commands…
end
```

- Example:

```
a = 1;
for i = 1 : 5
    a = a * i;
end
a = a + 3;
```

What is *a* ?

The 'for' loop - still simple case

- Simple syntax (variable increment):

```
for var = start : change : end,
      commands…
end
```

- Example:

```
V = zeros(1,500);
scalar = 8;
for i = 1000 : -2 : 1
    V(501-i/2) = scalar * i;
end
```

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Nested 'for' Loops I

- We can use *for* loops inside each other.
- Example:

```
for i = 1:m
      for j = 1:n
            H(i,j) = i * j;
      end
end
```

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Nested 'for' Loops II

- We can use *for* loops inside each other.
- Example:

```
for i = 1:m
      for j = i:n
            H(i,j) = i * j;
      end
end
```

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'for' Loops - Notes

- Increment can be negative ('going down loop').
- 'for' loops are much less efficient compared to MATLAB built-in commands and matrices operations.
- Use 'for' loop only when you can't do your calculations by built-in commands or matrices operations.
- Use correct indentation for readable code.

'for' Loops - efficiency

- a – vector with 1000 elements
- s – scalar
- Good:
  b=a+s;
- Bad:
  for i=1:1:1000
  b(i) = a(i) + s;
  end

Efficiency and timing

- **tic** & **toc** function as a stopwatch.
- The simplest way of assessing performance.
  - Not the net time
  - Affected by other processes

```
>> a=[1:1000000];
>> tic;a=a+5;toc;
Elapsed time is 0.042763 seconds.

>> tic;for i=1:1000000;a(i)=a(i)+5;end;toc;
Elapsed time is 1.728194 seconds.
```

Efficiency and timing

- Good (5msec)

```
a=rand(100000,1);
```

- Bad (200msec)

```
a=zeros(100000,1);
for i=1:100000
    a(i)=rand;
end
```

- Worse (112,500msec)

```
for i=1:100000
    a(i)=rand;
end
```

- Reallocations are devastating !

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Command: *for*
The complex scenario

The actual syntax of the *for* command is much more general

Syntax:

```
for var = array
      commands…
end;
```

Example:

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

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'while' Loop

- Repeat a group of statements an indefinite number of times under control of a logical condition.
- **Syntax:**

```
while condition,
    commands…
end
```

- **Operation:**
  1) Check condition.
  2) If condition is TRUE than execute commands otherwise exit loop.
  3) Goto 1

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Example: ***while***

```
while a < b,
    a = a + 2;
    b = b – 3;
end
```

1. If initially a is 71 and b is 82, what is their final value?
2. If initially a is 82 and b is 71, what is their final value?

‘while’ Loop - Notes

- Use ‘*while*’ loop only when you can’t do your calculations by built-in commands or matrices operations.
- Use correct indentation for readable code.
- ‘while’ loops may be nested (also within ‘*if*’, ‘*switch*’ and ‘*for*’ blocks).
- The commands should change the condition value in order not get into an infinite loop (another option – ‘*break*’).