Introduction to 8086 Assembly

Lecture 1

Behrooz Nasihatkon

Introduction to 8086 Assembly Language

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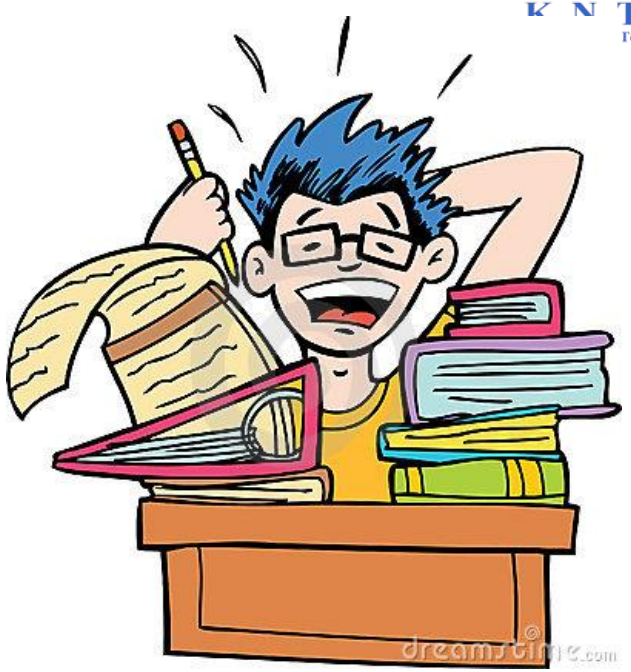
- 3 credits
- Saturday, Wednesday
  - Group 1: 10:30-12:30 AM
  - Group 2: 13:30-15:30 AM
- Instructor: Behrooz Nasihatkon
- Email: nasihatkon@kntu.ac.ir
- Room: EC building, level 3

Grading

- Homework Assignments
- Project(s)
- Midterm Exam
- Final Exam



What is considered cheating?

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Roll call

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Special needs

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Auditing the course

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Recording the lectures

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Eating in class

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How to get help?

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Asking questions!

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How to give feedback?

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Anonymous form:
https://goo.gl/zPxBAS

Join the Telegram Channel

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https://t.me/asmkntuf98

Course Website

- https://wp.kntu.ac.ir/nasihatkon/teaching/asm/f2019/index.html

Previous offerings:

- https://wp.kntu.ac.ir/nasihatkon/teaching/asm/s2019/index.html
- https://wp.kntu.ac.ir/nasihatkon/teaching/asm/f2018/index.html
- https://wp.kntu.ac.ir/nasihatkon/teaching/asm/s2018/index.html
- https://wp.kntu.ac.ir/nasihatkon/teaching/asm/f2017/index.html

Resources

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- Carter, Paul A. ***PC Assembly Language***, 2007
  - http://pacman128.github.io/pcasm/
- **NASM tutorial**
  - http://cs.lmu.edu/~ray/notes/nasmtutorial/
- **TutorialsPoint**
  - https://www.tutorialspoint.com/assembly_programming
- ***GOOGLE!***

Further study:

- Hyde, Randall. ***The art of assembly language***. No Starch Press, 2010.
  - **Linux:** http://www.plantation-productions.com/Webster/www.artofasm.com/Linux
  - **Windows:** http://www.plantation-productions.com/Webster/www.artofasm.com/Windows/
- Blum, Richard. ***Professional assembly language***. John Wiley & Sons, 2007.

What is Assembly language?

What is Assembly language?

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https://me.me/i/ssembly-gu-ge-cs-student-llove-programming-5644fb641baa4609aec4adc8ff5742cf

What is Assembly language?

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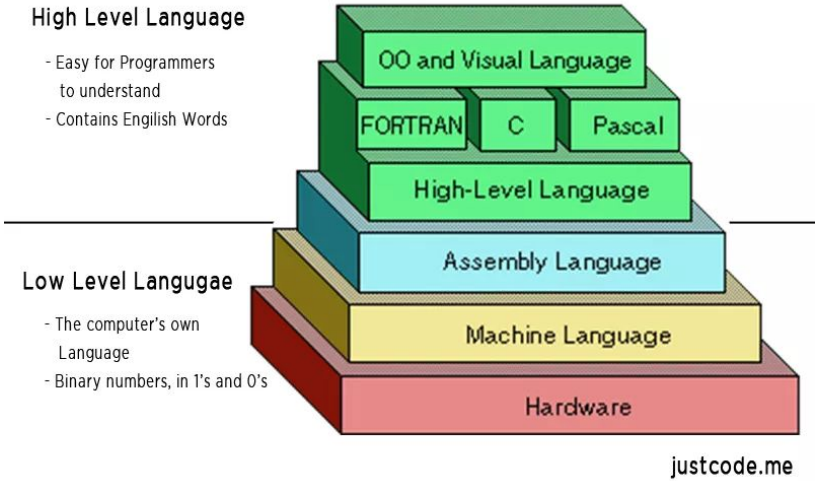

http://justcode.me/assembly/introduction-assembly-language-examples/

How many assembly languages are there?

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https://knowyourhandheld.weebly.com/blog/what-are-the-necessary-features-in-latest-smartphones

Why assembly?

Why assembly?

- Going low-level!
- **Getting insight**
  - **How programming languages are implemented (code, variables, arrays, functions, etc.)!**
  - **How compilers work**
- Writing efficient programs (?)
- System programming
- Writing device drivers
- Interfacing with high-level languages like C
- Reverse engineering
- New CPU features

x86 & x86-64 Assembly

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AT&T vs Intel Syntax

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https://en.wikipedia.org/wiki/X86_assembly_language#Syntax

```
movq    %fs:40, %rax
movq    %rax, -8(%rbp)
xorl    %eax, %eax
leaq    -16(%rbp), %rax
movq    %rax, %rsi
movl    $.LC0, %edi
movl    $0, %eax
call    __isoc99_scanf
movl    -16(%rbp), %eax
addl    %eax, %eax
leal    3(%rax), %edx
movl    -16(%rbp), %eax
imull   %edx, %eax
movl    %eax, -12(%rbp)
```

```
sub     rsp, 16
mov     rax, QWORD PTR fs:40
mov     QWORD PTR [rbp-8], rax
xor     eax, eax
lea     rax, [rbp-16]
mov     rsi, rax
mov     edi, OFFSET FLAT:.LC0
mov     eax, 0
call    __isoc99_scanf
mov     eax, DWORD PTR [rbp-16]
add     eax, eax
lea     edx, [rax+3]
mov     eax, DWORD PTR [rbp-16]
imul    eax, edx
```

What is an **Assembler**?

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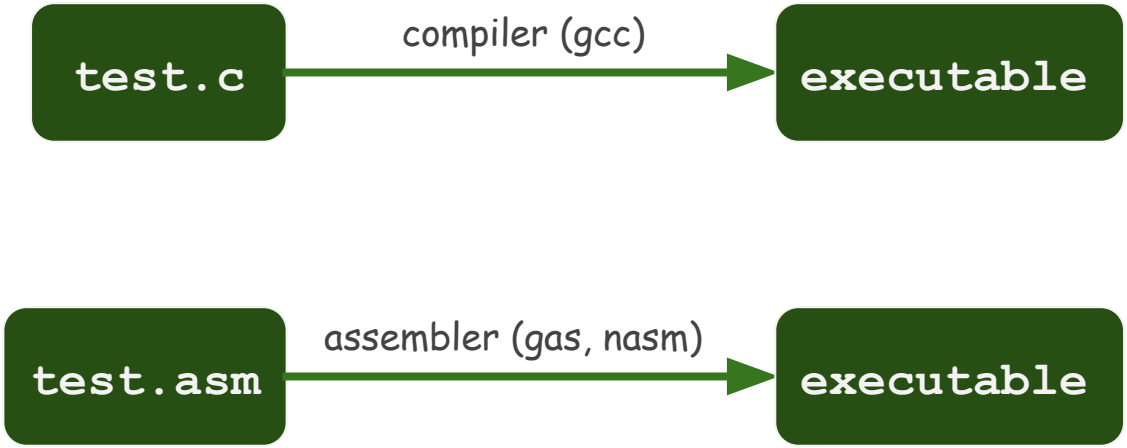
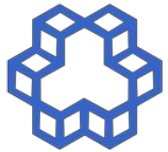


Major Assemblers



- Microsoft Assembler (MASM)
- GNU Assembler (GAS)
- Flat Assembler (FASM)
- Turbo Assembler (TASM)
- **Netwide Assembler (NASM)**

Backward compatibility

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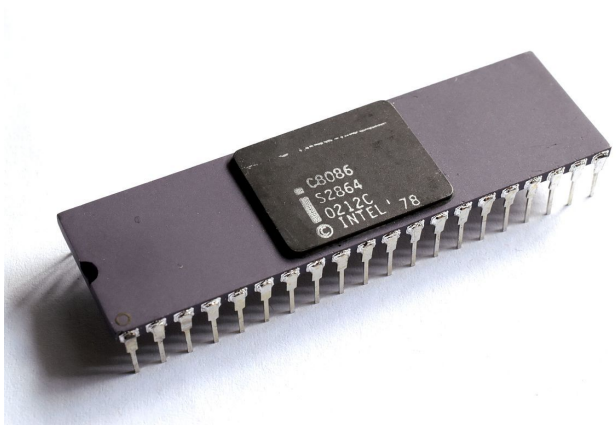
- Look at
  - https://en.wikipedia.org/wiki/X86



Our platform

- **Hardware**: 80x86 processor (**32**, 64 bit)
- **OS**: Linux
- **Assembler**: Netwide Assembler (NASM)
  - + GNU Assembler (GAS)
- **C Compiler**: GNU C Compiler (GCC)
- **Linker**: GNU Linker (LD)

How does an assembly code look like?

Write a C program named **test.c**.

Compile it to x86 assembly language, the **AT&T syntax**

>>> gcc -S -o att.s test.c

Now compile to the **Intel syntax**:

>>> gcc -S -masm=intel -o intel.s test.c

Compare the two assembly syntaxes (output files att.s and intel.s)