# Introduction to 8086 Assembly

Lecture 1

Behrooz Nasihatkon

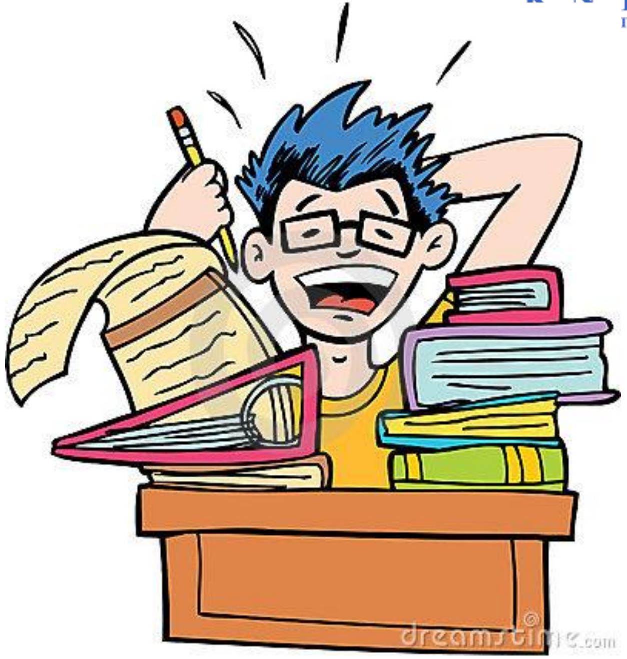
# Introduction to 8086 Assembly Language

K. N. Toosi
University of Technology

- 3 credits
- Saturday, Wednesday 13:30-15:30 AM
- Instructor: Behrooz Nasihatkon
- Email: nasihatkon@kntu.ac.ir

## Grading

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



## Roll call

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## What is considered cheating?

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## Special needs

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# COVID-19

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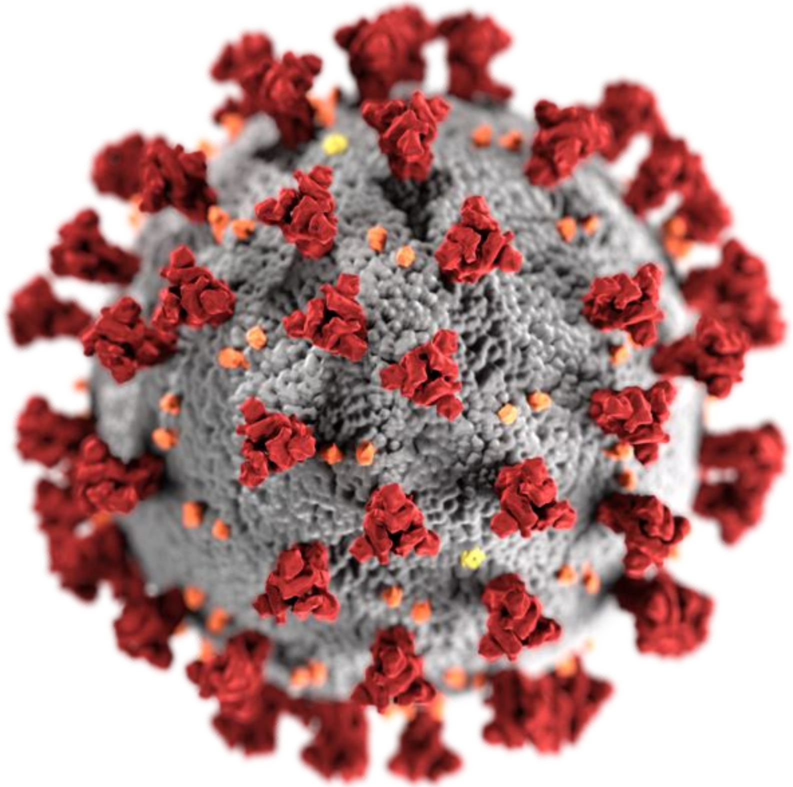

## Auditing the course

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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?

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

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## Join the Telegram Channel

https://t.me/kntuasmf99

## Course Website

- https://wp.kntu.ac.ir/nasihatkon/teaching/asm/f2020/index.html

## Resources

- 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?

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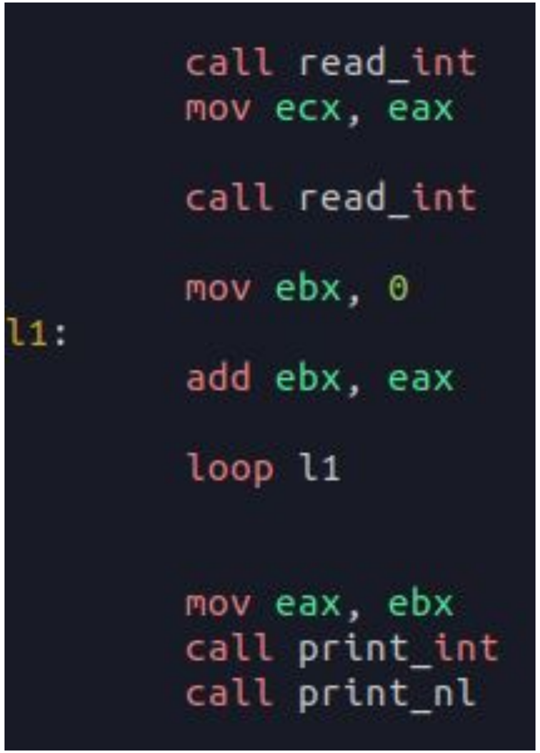
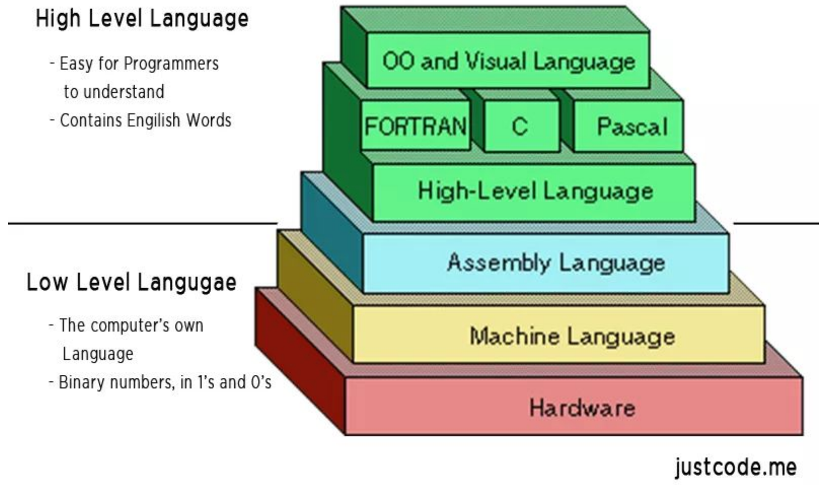
https://me.me/i/ssembly-gu-ge-cs-student-llove-programming-5644fb641baa4609aec4adc8ff5742cf

## What is Assembly language?



```
        call read_int
        mov ecx, eax

        call read_int

        mov ebx, 0
l1:
        add ebx, eax

        loop l1


        mov eax, ebx
        call print_int
        call print_nl
```

## What is Assembly language?



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

## How many assembly languages are there?

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## How many assembly languages are there?

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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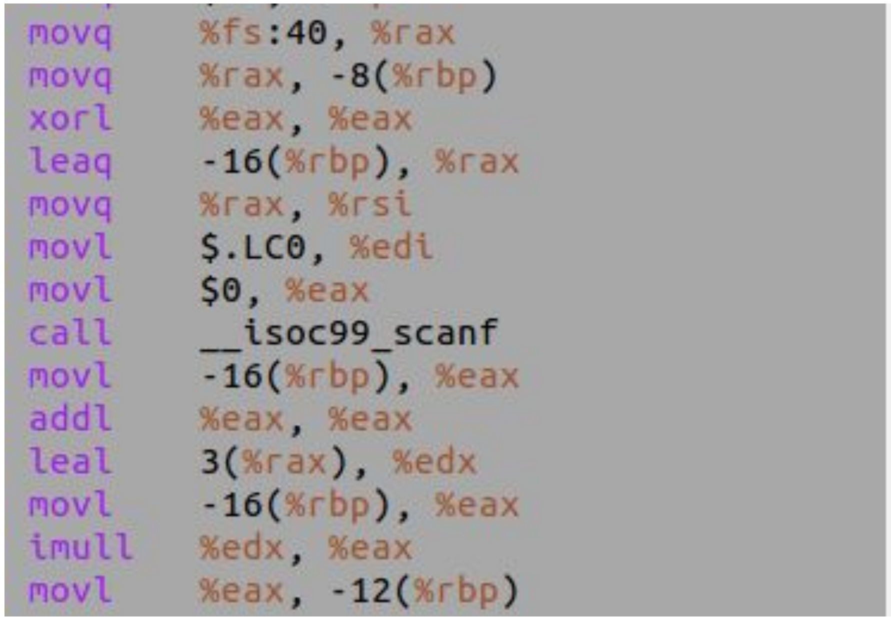
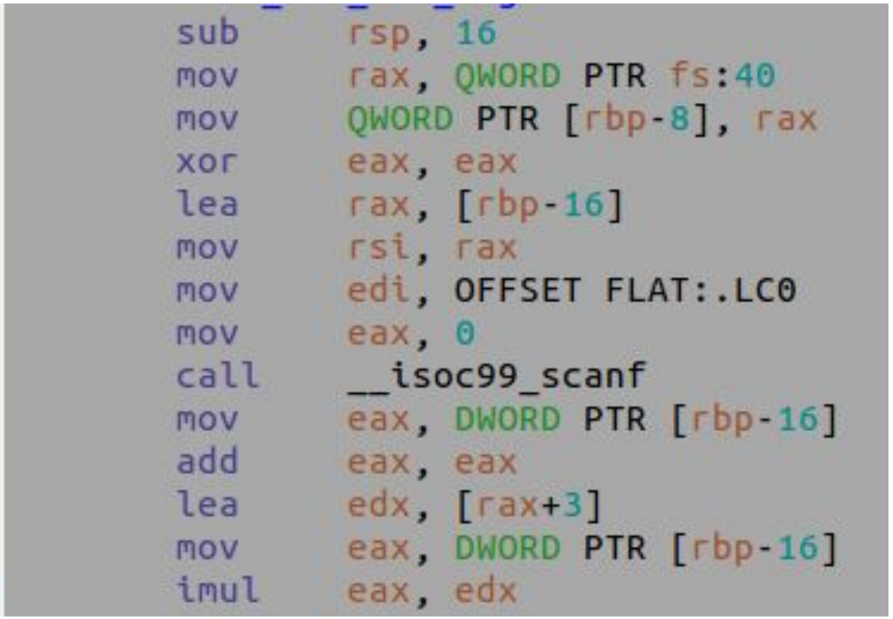
## AT&T vs Intel Syntax

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**?

$$\begin{tikzcd}
\texttt{test.c} \arrow[r, "\text{compiler (gcc)}"] & \texttt{executable} \\
\texttt{test.asm} \arrow[r, "\text{assembler (gas, nasm)}"] & \texttt{executable}
\end{tikzcd}$$

## Major Assemblers

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

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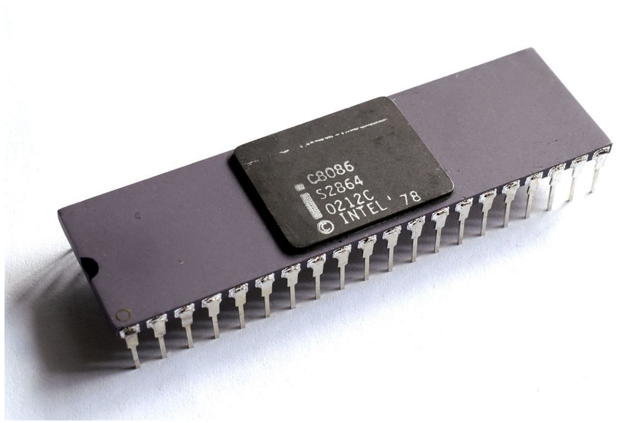
# Backward compatibility

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



## Our platform

- **Hardware:** 80x86 processor (**32**, 64 bit)

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- **Hardware**: 80x86 processor (32, 64 bit)
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## Our platform

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- **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)