

CS 160 Compilers

程序代写代做 CS编程辅导



# Lecture 1: Hello World!

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Yu Feng  
Spring 2023

# Introducing the east



[/cs.ucsb.edu](https://cs.ucsb.edu)

Instructor: Yu Feng

Course website:

<https://github.com/fredfeng/CS160>

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Research areas: programming languages, program analysis,  
program synthesis, software and blockchain security

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# Introducing the east

TA:



Liu ([junrui@ucsb.edu](mailto:junrui@ucsb.edu))

Office ho

Fri TBD

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Office hour:

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Discussion session: Fri 9am - 11:50am

# PL (CS162) vs Compiler (CS160)

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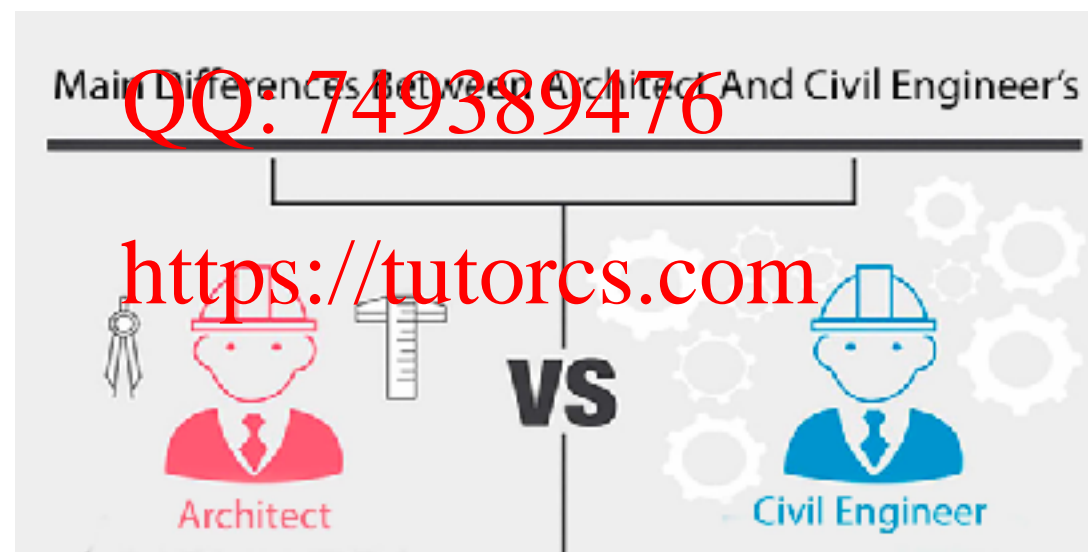
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Main Differences Between Architect And Civil Engineer's

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# What can we learn



You will learn:

- Functional programming in OCaml
- Lexing/Parsing/Codegen
- How high-level languages are implemented in machine language
- A little about programming language semantics & types
- build a compiler (Patina) from scratch
- A deeper understanding of code: a better programmer

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<https://junrui-liu.github.io/patina/>

# What is a compiler



- A compiler is a program that translates from one programming language to another
- High-level source code to low-level machine code

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# History of compilers

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What is the first language?



- Until the 1950's: computers were programmed in assembly.

- 1951—1952: Grace Hopper

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- developed the A-0 system for the UNIVAC I

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- Contributed significantly to the design of COBOL

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- 1957: FORTRAN compiler built at IBM

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- 1960's: development of the first bootstrapping compiler for LISP

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- Today: thousands of languages (most little used)



# Source Code

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Why do we need  
compiler?

- Optimized for human readability
- Expressive: matches human ideas of grammar / syntax / meaning

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- Redundant: more information than needed to help catch errors

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- Abstract: data structures, design patterns, etc.

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```
#include <stdio.h>

int factorial(int n) {
    int acc = 1;
    while (n > 0) {
        acc = acc * n;
        n = n - 1;
    }
    return acc;
}

int main(int argc, char *argv[]) {
    printf("factorial(6) = %d\n", factorial(6));
}
```



# Machine Code

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- Optimized for Hard
- Machine code hard for people to read

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- Reduce redundancy & ambiguity

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- Abstractions & information about intent is lost

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- Assembly language — then machine language

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```
_factorial:
## BB#0:
    pushl   %ebp
    movl    %esp, %ebp
    subl    $8, %esp
    movl    8(%ebp), %eax
    movl    %eax, -4(%ebp)
    movl    $1, -8(%ebp)
LBB0_1:
    cmpl    $0, -4(%ebp)
    jle     LBB0_3
## BB#1:
    movl    -8(%ebp), %eax
    imull   -4(%ebp), %eax
    movl    %eax, -8(%ebp)
    movl    -4(%ebp), %eax
    subl    $1, %eax
    movl    %eax, -4(%ebp)
    jmp     LBB0_1
LBB0_3:
    movl    -8(%ebp), %eax
    addl    $8, %esp
    popl    %ebp
    retl
```

# How to translate



- Mismatch between file and machine code
- Some languages are farther from machine code than others: C++, Java, Lisp, ML, Haskell, Ruby, Python, Javascript...

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- Goals of translation:  
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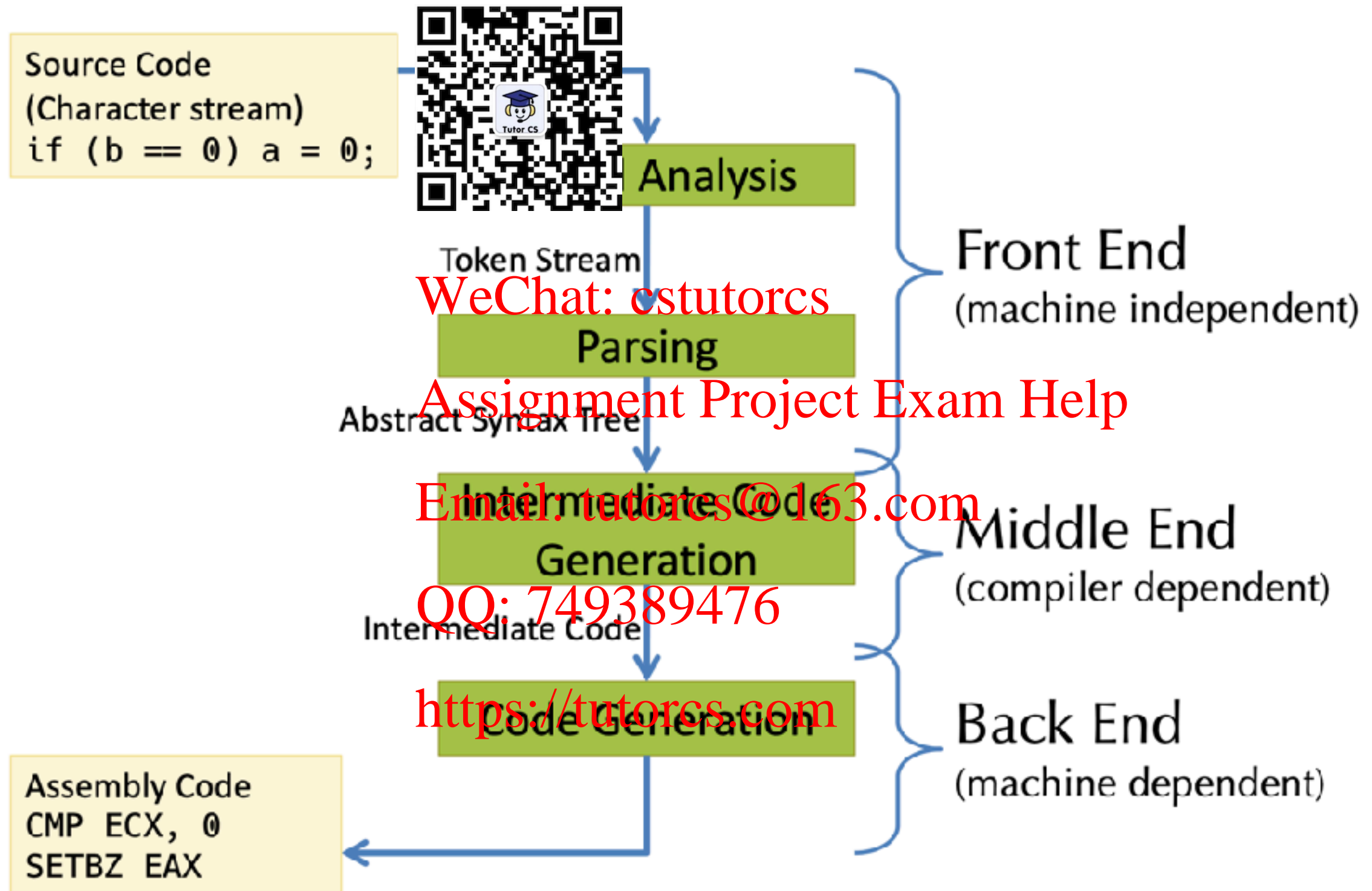
- Source level expressiveness for the task  
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- Best performance for the concrete computation  
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- Reasonable translation efficiency  
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- Maintainable code – Correctness!

# Compiler Structure



# Red or Blue

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THE PRICE IS YOURS

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# Grading

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- Programming assistance 100%
- 5 (PA1-PA5) programming assignments, 20% each

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# Programming assignments



- Please check the v regularly
- Deadline extension:

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- Ten “late days”

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- Plan ahead, no other extensions

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# Programming assignments

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Unfamiliar language

OCaml is hard

+ Unfamiliar environments

+ Racket is @!#@%

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Start early!

Start early!

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Free your mind



# Academic integrity



- All assignments should be done ALONE

- We use MOSS to detect plagiarism

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- Have code from public repos

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- Make sure your repo is private

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- “F” if you violate the honor code

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# Course logistics



Website: <https://github.com/fredfeng/CS160>

Q&A: Please join us ASAP via this QR code

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# TODOs by next lecture



- Join Slack for CS1
  - Install/try OCaml on your laptop
  - Get familiar with your new friend: Patina manual
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