

# CS302: Operating System

Spring 2020     Dr. Bo Tang

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Time:            14:00 – 16:00, every Wednesday

Venue:           Online / Zoom Meeting

# Who am I

- ◆ Bo Tang

- ◆ 1007, A7, iPark

- ◆ Homepage: <http://acm.sustech.edu.cn/btang/>

- ◆ Office hours: make appointment

- ◆ Coach of SUSTech-CPC team

- ◆ Research areas:

- ◆ Data management (Spatial and temporal database)

- ◆ Big data platforms (Spark, Tensorflow)

- ◆ Data-Intensive Systems (DeepInsight, Cheetah)

# CS302 TAs

## TA-in-Chief:

- ◆ Ms Yun SHEN, [sheny@mail.sustc.edu.cn](mailto:sheny@mail.sustc.edu.cn) (Lab tutor in CSE)
- ◆ Wang Teng

## Student Assistant:

- ◆ Wentao Ning
- ◆ Haotian Liu
- ◆ Chuan Yang
- ◆ Qiandong Tang
- ◆ Yi Zhao
- ◆ Jiaping Cao
- ◆ Keming Li

# Why we have to learn OS

- ◆ Work for famous Companies
  - ◆ Google, Facebook, Microsoft, Alibaba, Tencent et, al.
    - ◆ “What is the maximum file size in an USB (FAT32)? Why?”
    - ◆ “What happens when we turn on computer?”
    - ◆ “What happens if all Chinese are in one wechat group?”
- ◆ To be a hacker, or avoid to be hacked
  - ◆ “WannaCry”, hacked Windows' Server Message Block Protocol, from Windows xp to Windows 2012
- ◆ To do system research
  - ◆ Architect new systems, e.g., Spark, Hadoop, Tensorflow
  - ◆ Augment OS core component, e.g., storage recovery
  - ◆ Devise a File System: GPS (HDFS), PolarFS

# Welcome to CS302

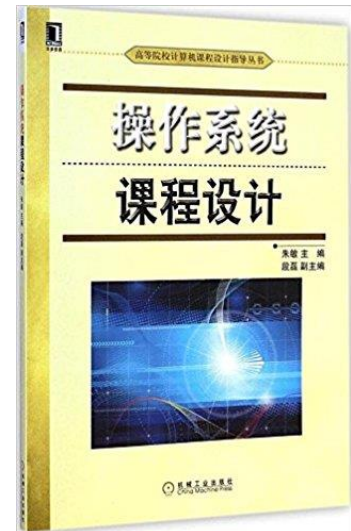
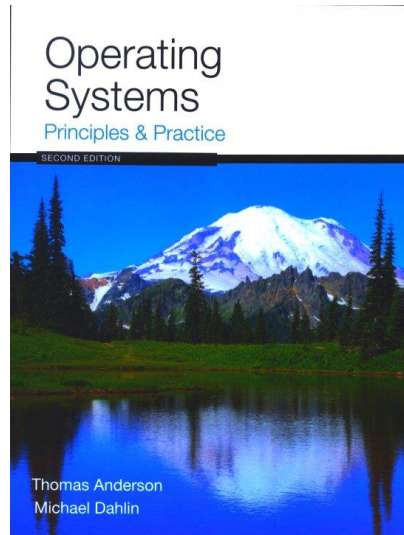
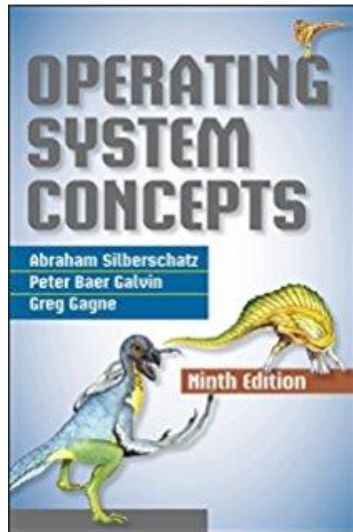
- ◆ We will study Operating System
  - ◆ Concepts & Practice
  - ◆ Overview, Process, Memory, Storage
- ◆ We will also:
  - ◆ Learn the heart of modern operating system
  - ◆ Study the CS knowledge architecture
- ◆ Goals:
  - ◆ To be a system admin
    - ◆ System admin vs. programmer
  - ◆ To let you know what you did not know yet
  - ◆ To help you know what you should know in CS

# Prerequisites

- ◆ C Programming
  - ◆ All course projects will use C or C++
  - ◆ Linux kernel is written by C
  - ◆ Do not worry, we have tutorial for C.
- ◆ Data structure and algorithm analysis
  - ◆ It helps you to understand OS concepts, e.g., LRU
  - ◆ It assists you to design efficient OS components
- ◆ Optional: computer organization principle
  - ◆ How do computers work?
  - ◆ Hardware and software collaboration

# Reference Books

- ◆ **Operating System Concepts**, 9<sup>th</sup> Edition, Abraham Silberschatz et. al.
- ◆ **Operating Systems Principles & Practice**, 2<sup>nd</sup> Edition, Thomas Anderson et. al.
- ◆ **操作系统课程设计**, 机械工业出版社, 朱敏, 唐博等



# How do you understand better

- ◆ Lectures (2 hours)
  - ◆ Get the main ideas and concepts
  - ◆ Try to be active and THINK about the questions
- ◆ Tutorial / Lab (2 hours)
  - ◆ Tutorial is helping you to understand concepts in lectures.
  - ◆ Do the lab exercises / assignments
  - ◆ Do not be shy to ask questions
- ◆ Read Linux kernel code after each class
  - ◆ <https://github.com/torvalds/linux>
- ◆ Try to be a contributor of Linux Kernel:
  - ◆ Improve power management support of systems
  - ◆ Allow direct writes to persistent memory managed by filesystems
  - ◆ Develop new drivers for new devices

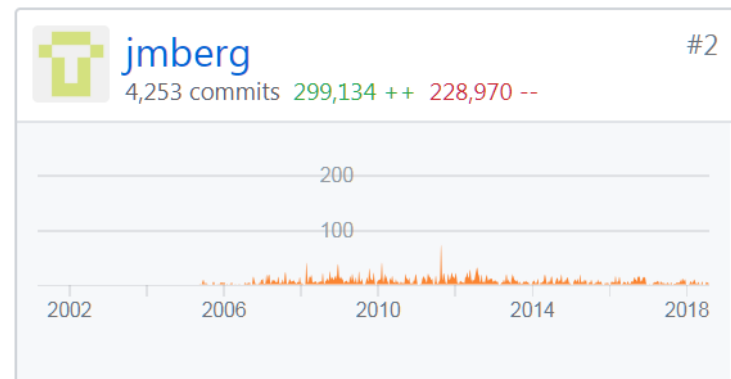
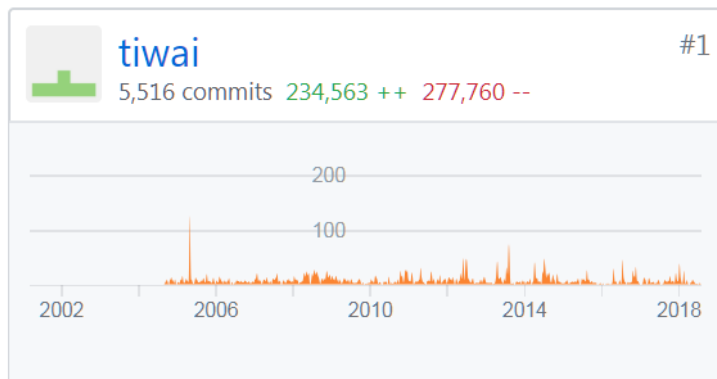
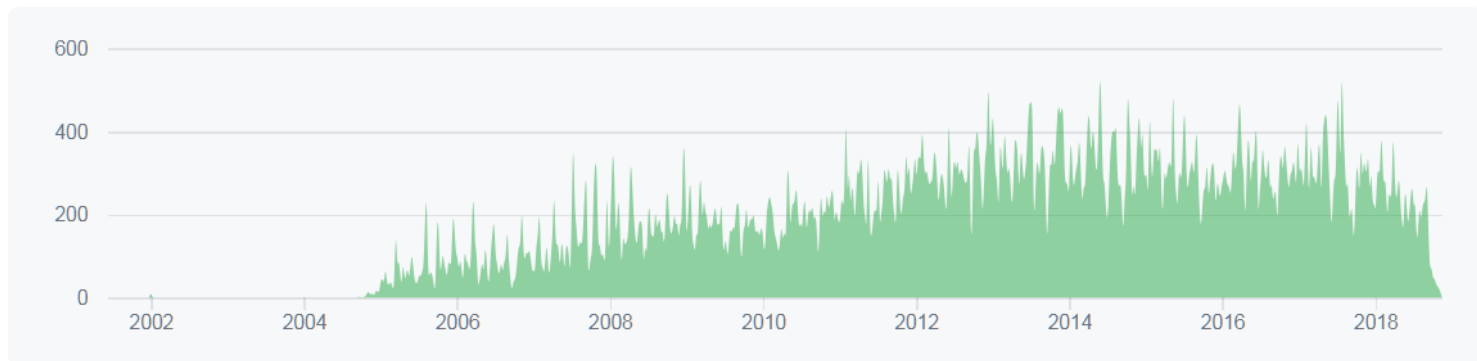


# How do you understand better

Sep 16, 2001 – Feb 20, 2019

Contributions: Commits ▼

Contributions to master, excluding merge commits



# Assessment (tentative)

- ◆ Continuous Assessment: 50%
  - ◆ Class participations: 20%
  - ◆ Lab exercises: 20%
  - ◆ Project tutorial: 10%
- ◆ Exam: 50%
  - ◆ Mid-term Examination: 20%
  - ◆ Final Examination: 30%

# Assessment (cont'd)

## ◆ Class participation

- ◆ Both lecture and lab are taking into account
- ◆ The easiest part in all assessments

## ◆ Lab exercise

- ◆ Once per week, you need submit your report for each lab
- ◆ 100 marks for each lab

## ◆ Examination

- ◆ Mid-term 20%
- ◆ Final Exam 30%

# OS Project

**Option 1:** I will give a list of system papers, you read some of it and give a **hands-on** tutorial to the students in the same lab session.

- ◆ **Hadoop:** Dean, Jeffrey, and Sanjay Ghemawat. "MapReduce: Simplified data processing on large clusters." OSDI, 2004
- ◆ **Hive:** Thusoo, Ashish, et al. "Hive: a warehousing solution over a map-reduce framework." VLDB, 2009
- ◆ **Spark:** Zaharia, Matei, et al. "Resilient distributed datasets: A fault-tolerant abstraction for in-memory cluster computing." NSDI, 2012
- ◆ **Flink:** Alexandrov, Alexander, et al. "The stratosphere platform for big data analytics." VLDBJ, 2014
- ◆ **Heron:** Kulkarni, Sanjeev, et al. "Twitter heron: Stream processing at scale." SIGMOD, 2015.
- ◆ **Tensorflow:** Abadi, Martín, et al. "Tensorflow: A system for large-scale machine learning." OSDI. 2016.

Tutorial example: <https://github.com/ISG-ICS/cloudberry/wiki/quick-start>

# OS Project

## Option 1: more papers

- ◆ **Hive v2:** Huai, Yin, et al. “Major technical advancements in apache hive”, SIGMOD, 2014
- ◆ **Google Goods:** Halevy, Alon, et al. "Goods: Organizing Google's Datasets." SIGMOD, 2016
- ◆ **Apache Tez: Saha, Bikas, et al.** “Apache Tez: A Unifying Framework for Modeling and Building Data Processing Applications“, SIGMOD, 2015
- ◆ **SparkSQL:** Armbrust, Michael, et al. "Spark sql: Relational data processing in spark." SIGMOD, 2015.

# OS Project

**Option 2:** Build a File System / Storage System by a published research paper.

- ◆ (1) **PloarFS:** An Ultra-low Latency and Failure Resilient Distributed File System for Shared Storage Cloud Database, PVLDB'2018, Alibaba File System for PolarDB
- ◆ (2) **PaxosStore:** High-availability Storage Made Practical in WeChat, PVLDB'2017, Tencent Storage for Wechat.
- ◆ **Team size:** 4-5 per group, assigned by email application.
- ◆ **Bonus:**
  - ◆ Got A or A+ directly (published as an open-source version, e.g., HDFS for GFS), or bonus marks (up to 12%)
  - ◆ One-to-one guidance (at least one afternoon discussion per week)

# Grading Policy

- ◆ Later policy:
  - ◆ No later submission allow
- ◆ Guidelines on collaboration
  - ◆ Write up the assignment **ON YOUR OWN**
  - ◆ If you discuss with your classmates on assignments, make sure you throw away written work from the discussion
- ◆ Zero tolerance on plagiarism
  - ◆ Software will be used to detect plagiarism cases!
  - ◆ Serious cases will be reported to university
  - ◆ Sign cheating agreement with CSE Department in next week

# Tentative Schedule

No.	Topic
1	Introduction
2	OS Structures
3	Processes
4	Threads
5	Synchronization
6	Scheduling
7	Main Memory

No.	Topic
8	Virtual Memory
9	Storage Structure
10	I/O
11	File System II
12	File System I
13	Linux System
14	Advanced topics



# Course Materials

- ◆ Blackboard
- ◆ Please check course website regularly
  - ◆ Announcement
  - ◆ Lecture slides
  - ◆ Tutorial / lab exercises
  - ◆ Solutions