CS 5254: Concurrent Object-Oriented & Functional Programming

Course Overview (Part 1)

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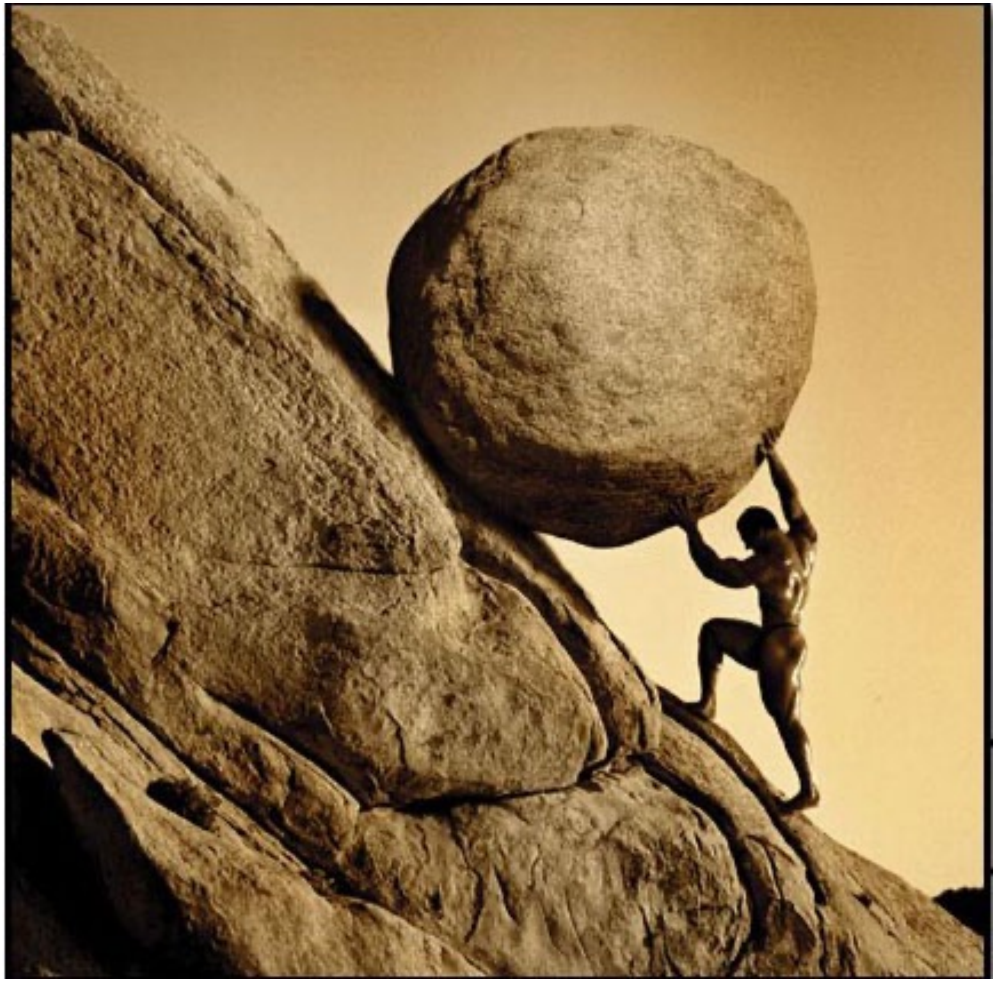
Learning Objectives in this Lesson

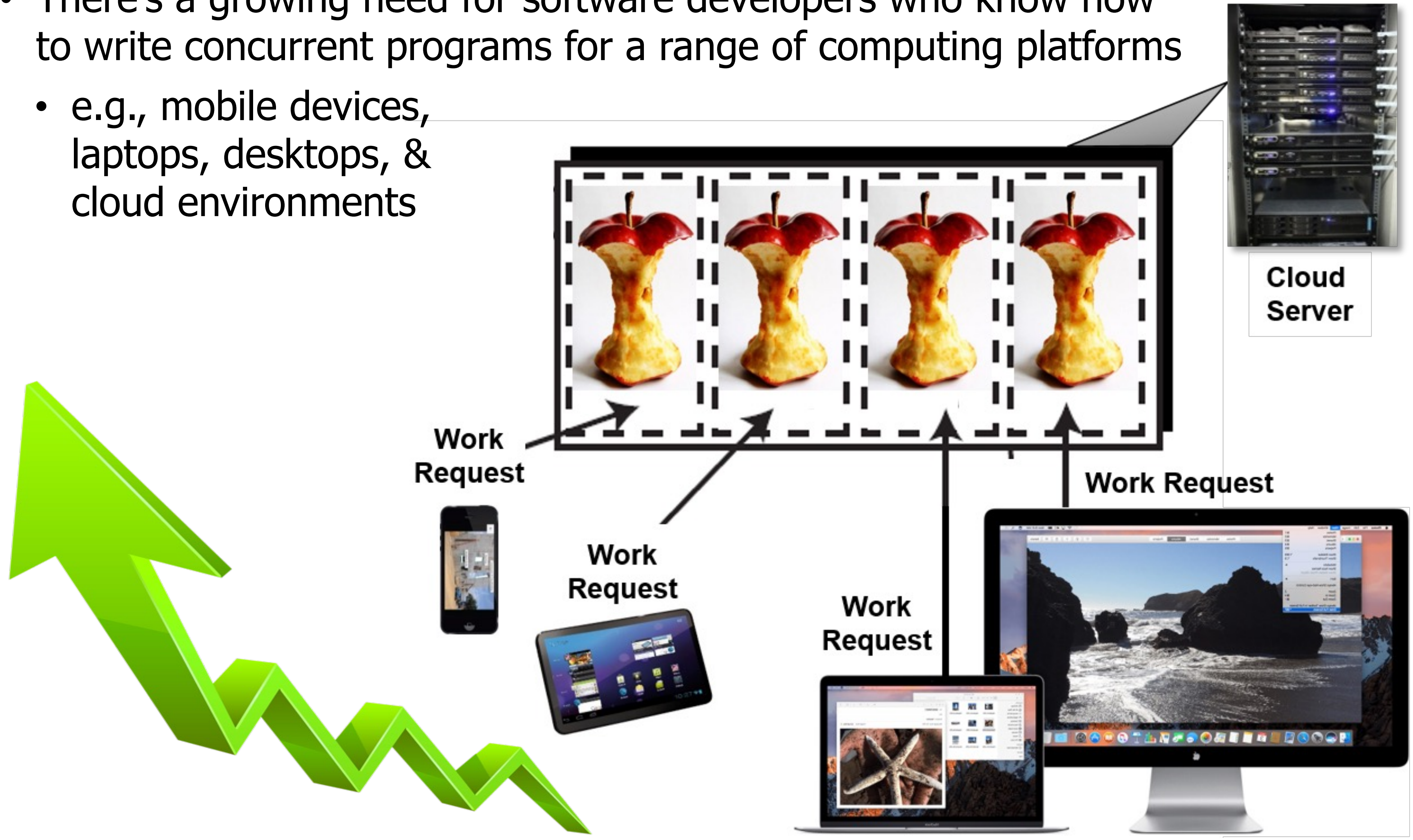
- Understand the course topics & logistics
  - Course philosophy
  - Course contents
  - Structure of the lecture material



Course Philosophy

Course Philosophy

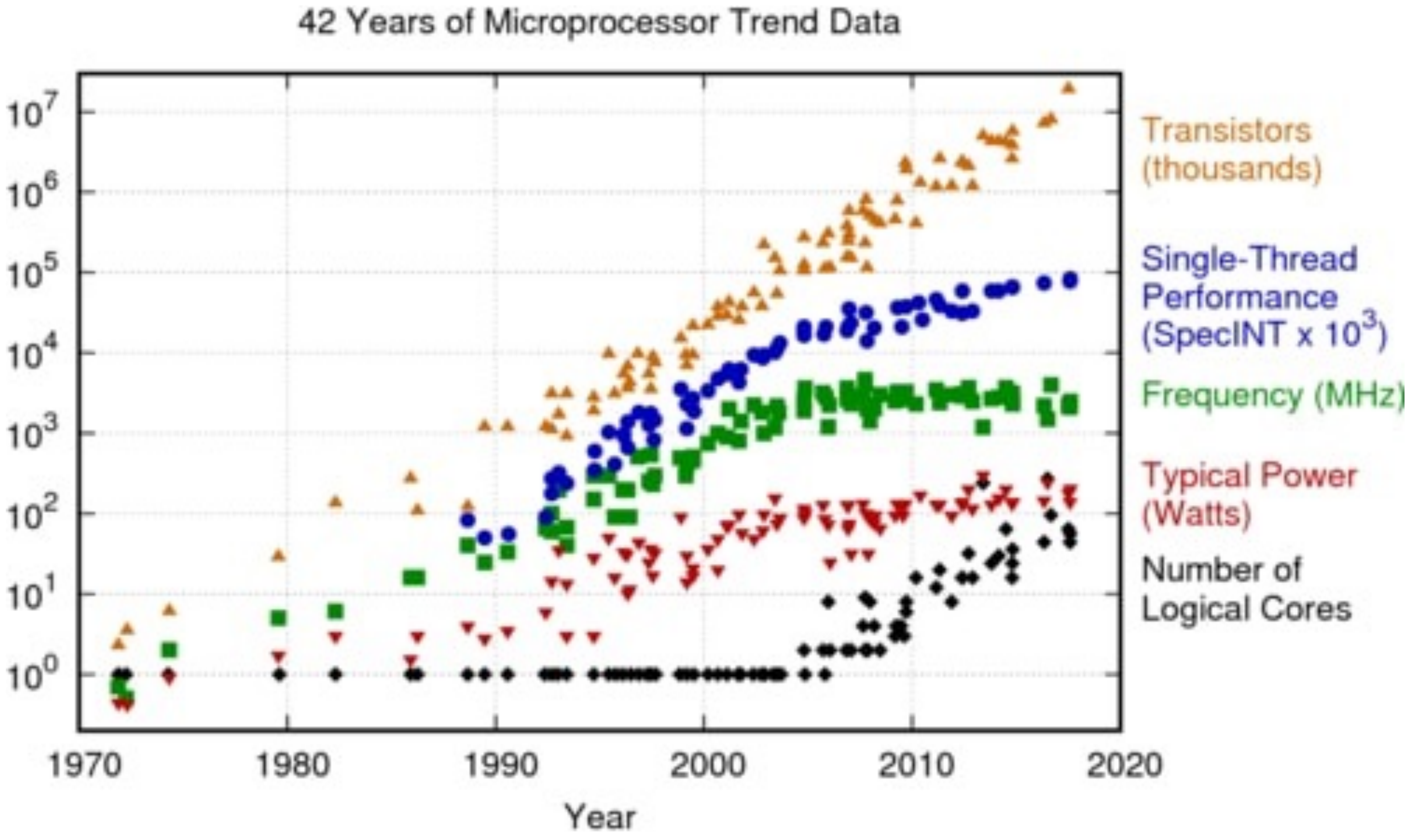
- There’s a growing need for software developers who know how to write concurrent programs for a range of computing platforms
    - e.g., mobile devices, laptops, desktops, & cloud environments



The topics covered in this course apply to many platforms, not just Android

Course Philosophy

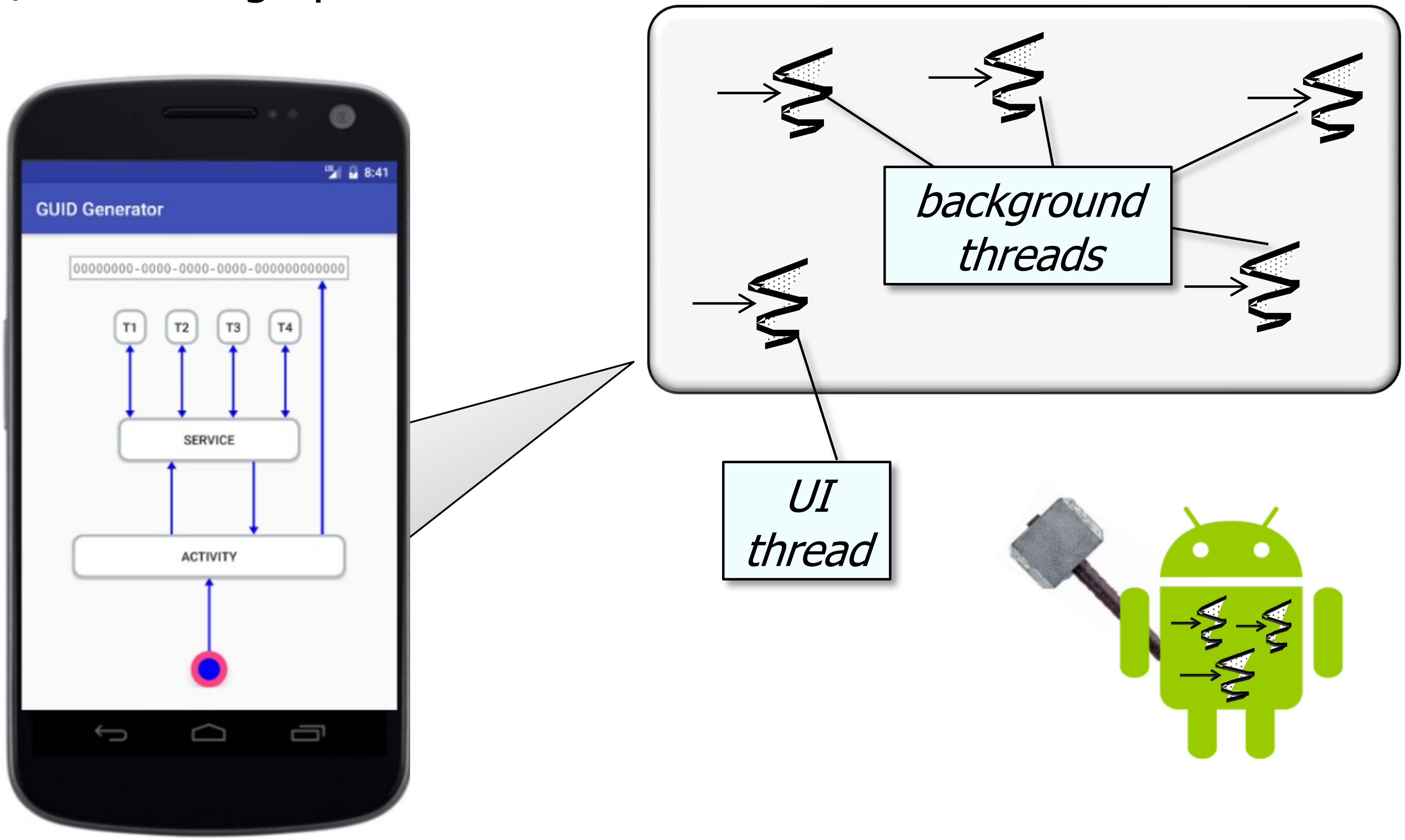
- This demand is driven by advances in software & hardware infrastructure
  - e.g., multi-core & many core processors, mass storage, ubiquitous network connectivity, & commodity hardware & software platforms



See www.gotw.ca/publications/concurrency-ddj.htm

Course Philosophy

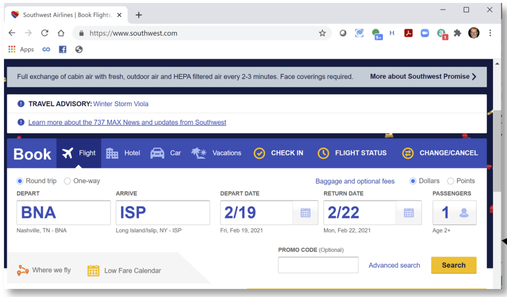
- Concurrency is commonly used in mobile devices to offload work from the user interface (UI) thread to background thread(s) that perform long-running and/or blocking operations



See developer.android.com/training/multiple-threads/communicate-ui.html

Course Philosophy

- Concurrency is also commonly used to process client requests in multi-core backend computing environments, such as data centers or cloud servers



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Learn more about the 737 MAX News and updates from Southwest

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DEPART	ARRIVE	DEPART DATE	RETURN DATE	PASSENGERS
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Nashville, TN - BNA	Long Island/Islip, NY - ISP	Fri, Feb 19, 2021	Mon, Feb 22, 2021	Age 2+

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Boarding Group **A 15** Boarding Position

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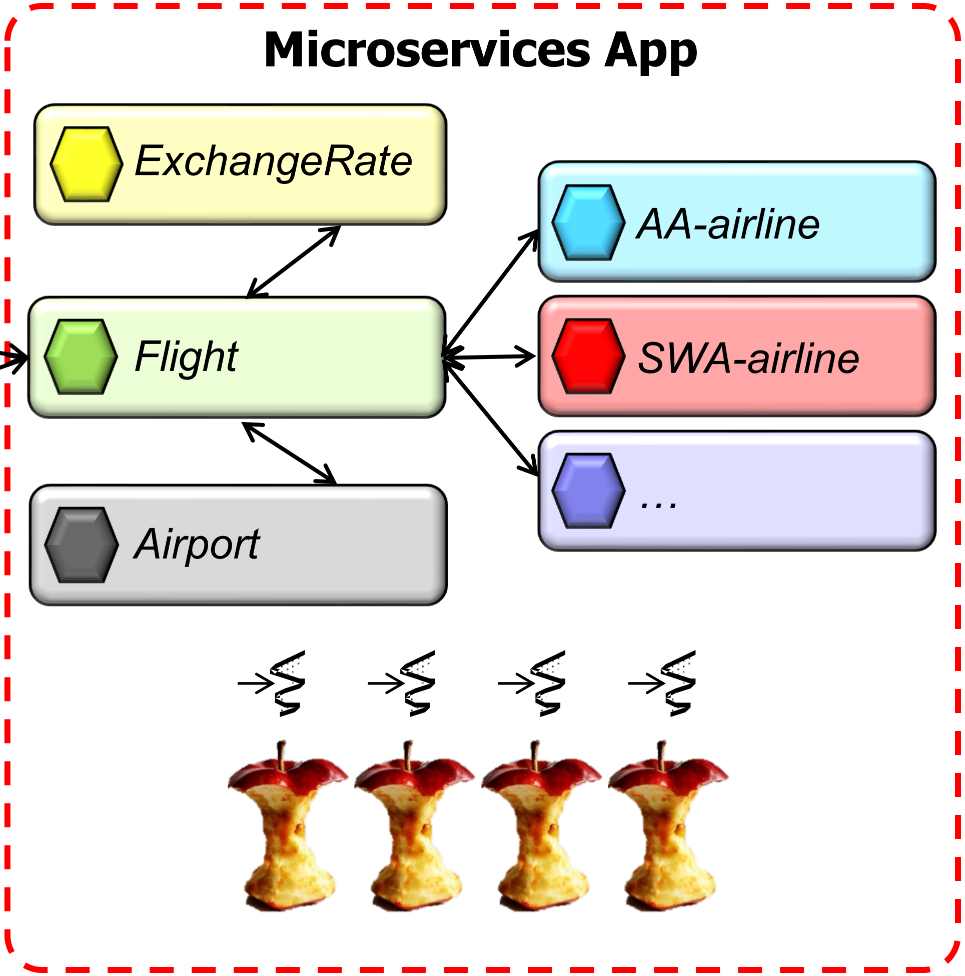

See www.dre.vanderbilt.edu/~schmidt/cs891

Course Philosophy

- Effective techniques & practices for designing & programming concurrent (mobile) apps are *not* best learned through generalities & platitudes

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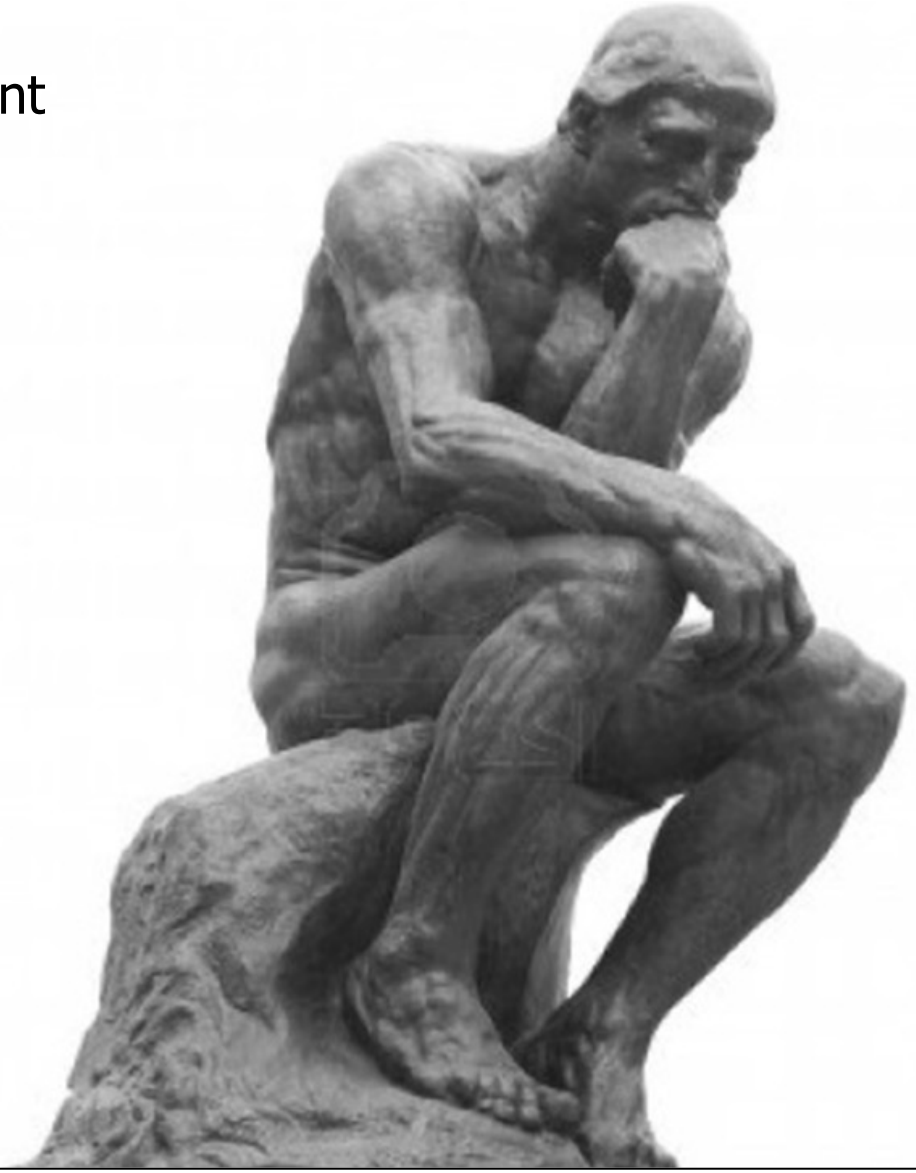

"Sitting & thinking" is not sufficient…

Course Philosophy

- Instead, it's better to see *by example* how concurrent programs can be made
  - *easier* to write & read,
  - *easier* to maintain & modify,
  - *more* efficient & resilient

  by applying time-proven software patterns, as well as object-oriented, & functional design & programming techniques

This course involves lots of hands-on software development & testing!

Summary of the Course Contents

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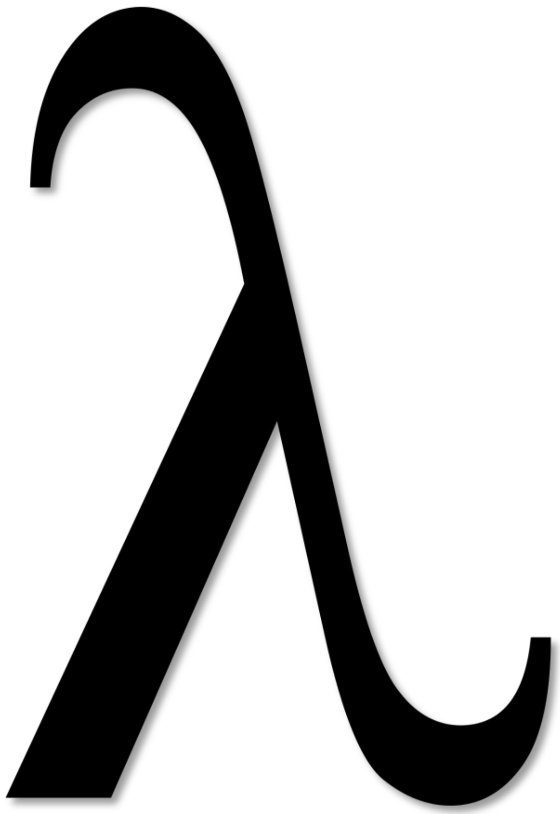
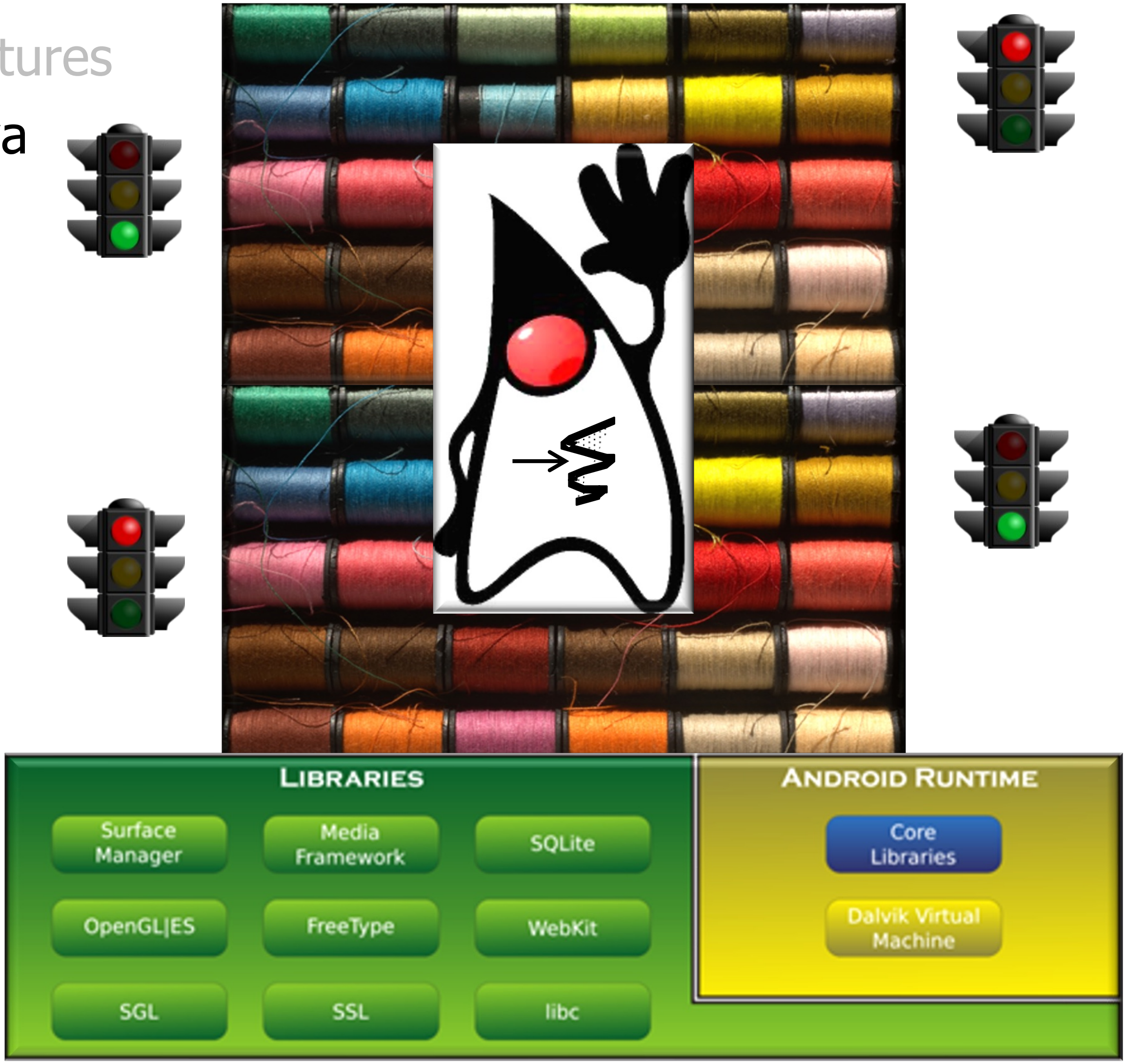
- Foundational Java functional programming concepts & features
  - e.g., lambda expressions, method references, & functional interfaces



These features were added in Java 8 & expanded thereafter

Summary of Course Contents

- Foundational Java functional programming concepts & features
- Coverage of foundational Java concurrency mechanisms
  - e.g., Java threading & synchronizer mechanisms



See www.orctom.com/2017/04/21/java-locks-and-concurrency

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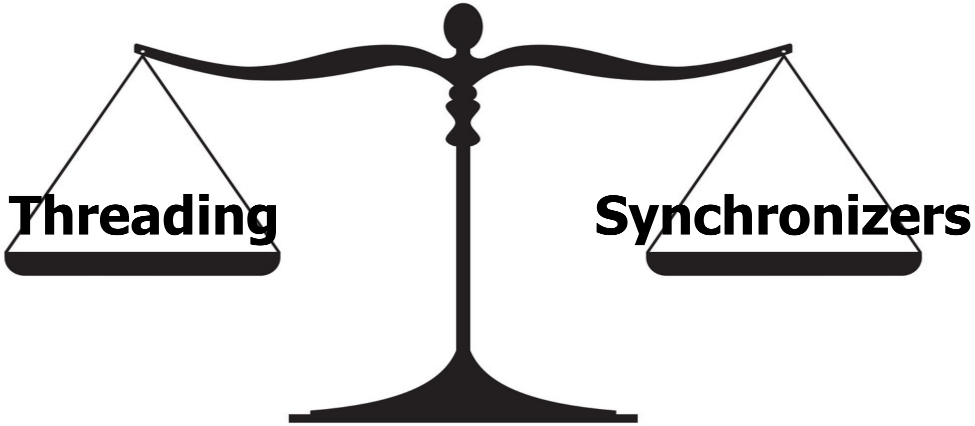


Threading mechanisms

- Thread
- Runnable
- Executor
- ExecutorService
- ScheduledExecutorService
- ExecutorCompletionService
- Future
- FutureTask
- ThreadPoolExecutor
- ForkJoinPool

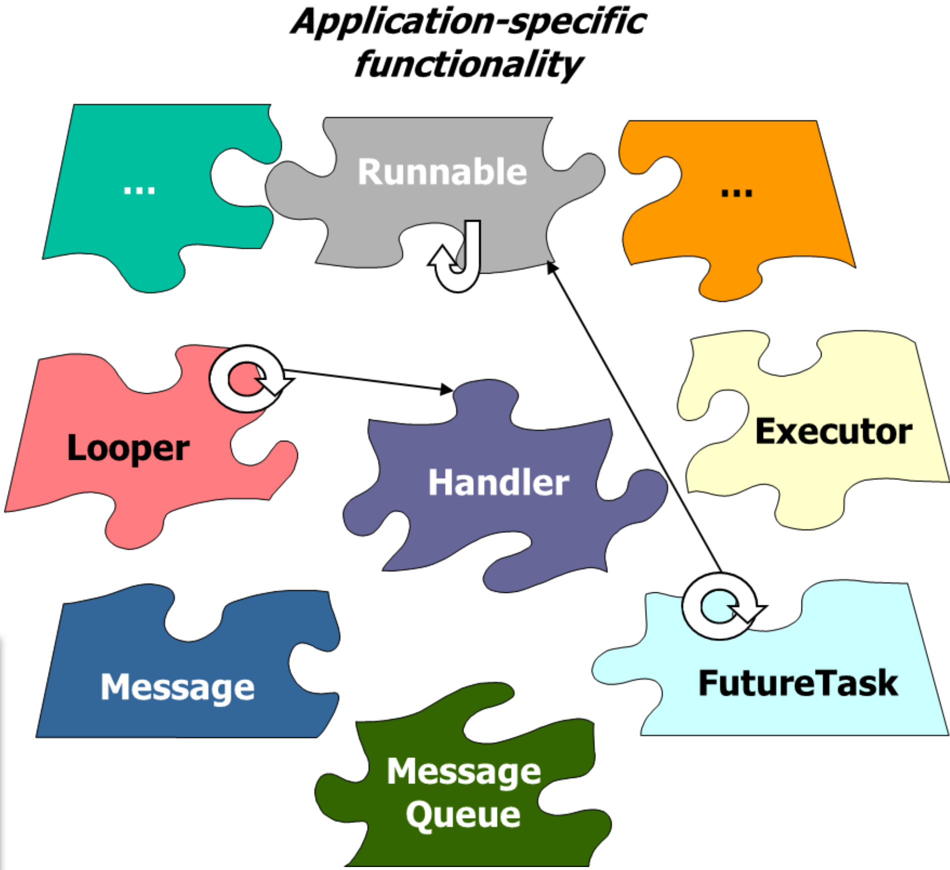
Synchronizer mechanisms

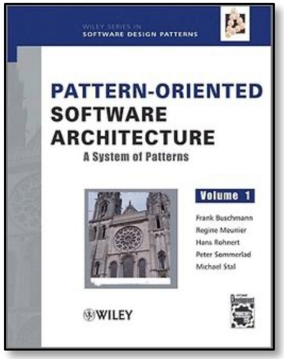
- Synchronized methods & statements
- Notification methods
- ReentrantLock
- ReentrantReadWriteLock
- StampedLock
- ConditionObject
- Semaphore
- CountDownLatch
- CyclicBarrier
- Phaser

We provide roughly equal focus on Java synchronization mechanisms & Java threading mechanisms in this course

Summary of Course Contents

- Foundational Java functional programming concepts & features
- Coverage of foundational Java concurrency mechanisms
- Patterns/frameworks for concurrent programming

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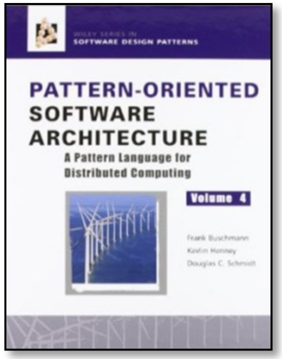
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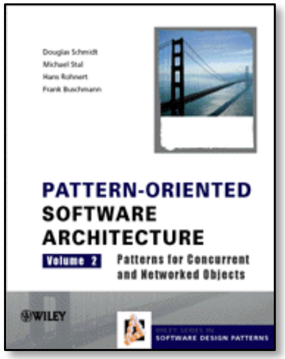
Frank Buschmann
Kevlin Henney
Douglas C. Schmidt


Douglas Schmidt
Michael Stal
Hans Rohnert
Frank Buschmann

PATTERN-ORIENTED SOFTWARE ARCHITECTURE

Volume 2 Patterns for Concurrent and Networked Objects

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WILEY SERIES IN SOFTWARE DESIGN PATTERNS

See en.wikipedia.org/wiki/Concurrency_pattern

Summary of Course Contents

- Foundational Java functional programming concepts & features
- Coverage of foundational Java concurrency mechanisms
- Patterns/frameworks for concurrent programming
- We assume you know (or can quickly learn) Android, Android Studio, Modern Java, & Git

See item #12 at github.com/douglascraigschmidt/CS5254/wiki/CS-5254-FAQ

Structure of the Lecture Material

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- This course has four main topics

Section	Topics
Java Functional Programming	• Coverage of basic & advanced Java functional programming features, e.g. • Lambda expressions & method references • Functional interfaces

See www.youtube.com/playlist?list=PLZ9NgFYEMxp57EQIDnyQ3F-8EqW4ejz8V for more videos on Java functional programming

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Software Patterns	• Concurrency patterns

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Software Patterns	• Concurrency patterns

We'll bounce around when covering these topics to facilitate assignments

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  - Each topic is composed of lessons

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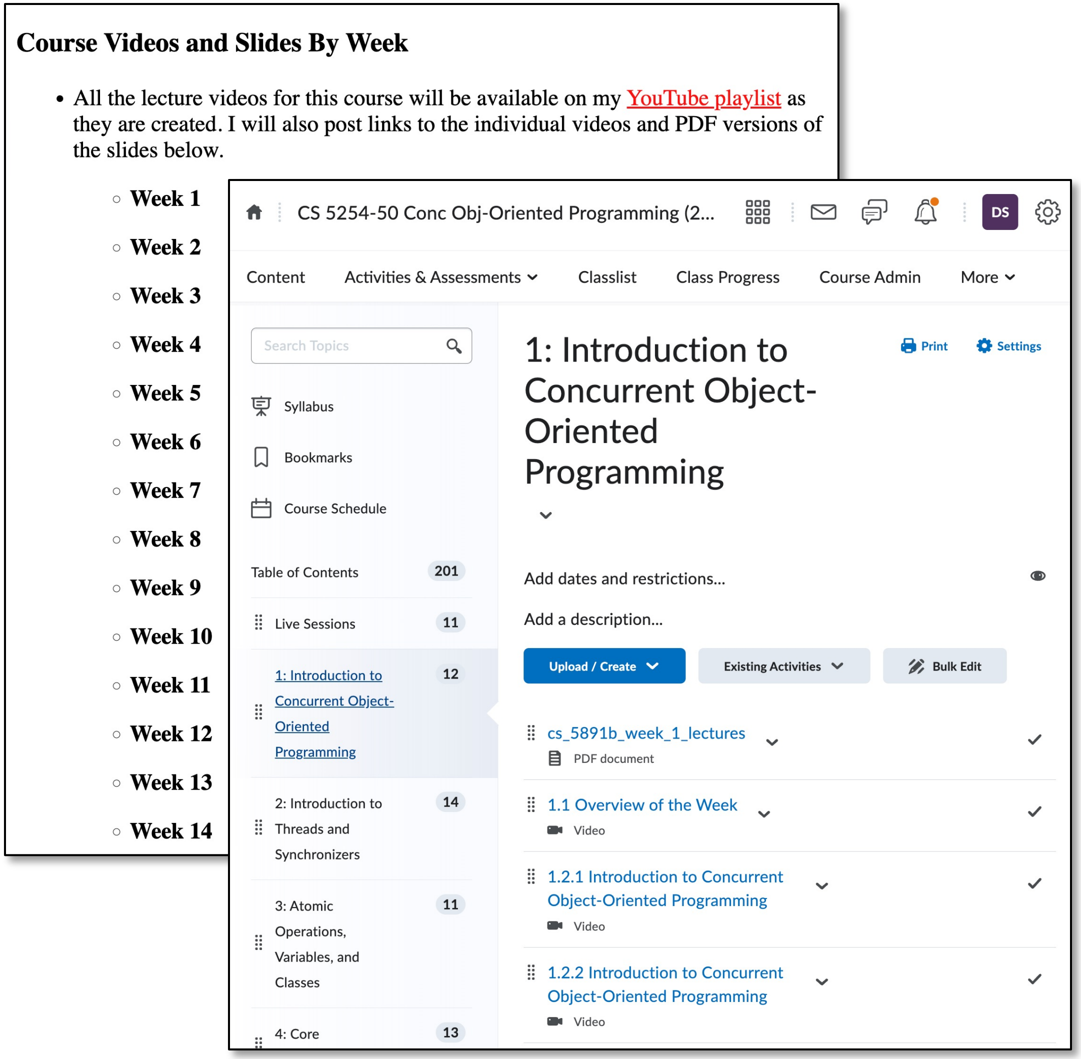

Course Videos and Slides By Week

- All the lecture videos for this course will be available on my YouTube playlist as they are created. I will also post links to the individual videos and PDF versions of the slides below.
  - **Week 1**
  - **Week 2**
  - **Week 3**
  - **Week 4**
  - **Week 5**
  - **Week 6**
  - **Week 7**
  - **Week 8**
  - **Week 9**
  - **Week 10**
  - **Week 11**
  - **Week 12**
  - **Week 13**
  - **Week 14**

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2: Introduction to Threads and Synchronizers	14
3: Atomic Operations, Variables, and Classes	11
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1: Introduction to Concurrent Object-Oriented Programming

Add dates and restrictions...

Add a description...

- cs_5891b_week_1_lectures — PDF document
- 1.1 Overview of the Week — Video
- 1.2.1 Introduction to Concurrent Object-Oriented Programming — Video
- 1.2.2 Introduction to Concurrent Object-Oriented Programming — Video

Videos of each lecture are available on brightspace & at www.dre.vanderbilt.edu/~schmidt/cs254

Structure of the Lecture Material

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1st monthly exam will be on Tuesday, June 5th via Brightspace

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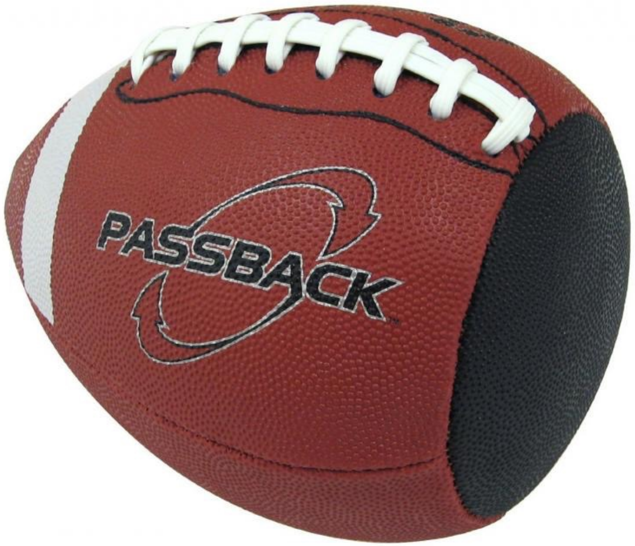
  - We'll try to grade & review the tests by the next class



One of the benefits of a smaller class ;-)

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I recommend you study for exams by reviewing slides & (re)watching the videos on brightspace & youtube

Structure of the Lecture Material

- There *may* be a final exam that can cover all the lectures
  - The focus will be on the last week(s) of the semester

CS 5254: Concurrent Object-Oriented & Functional Programming: Overview (Part 1)