Introduction

CS 6501: Serverless AI

Fall 2025

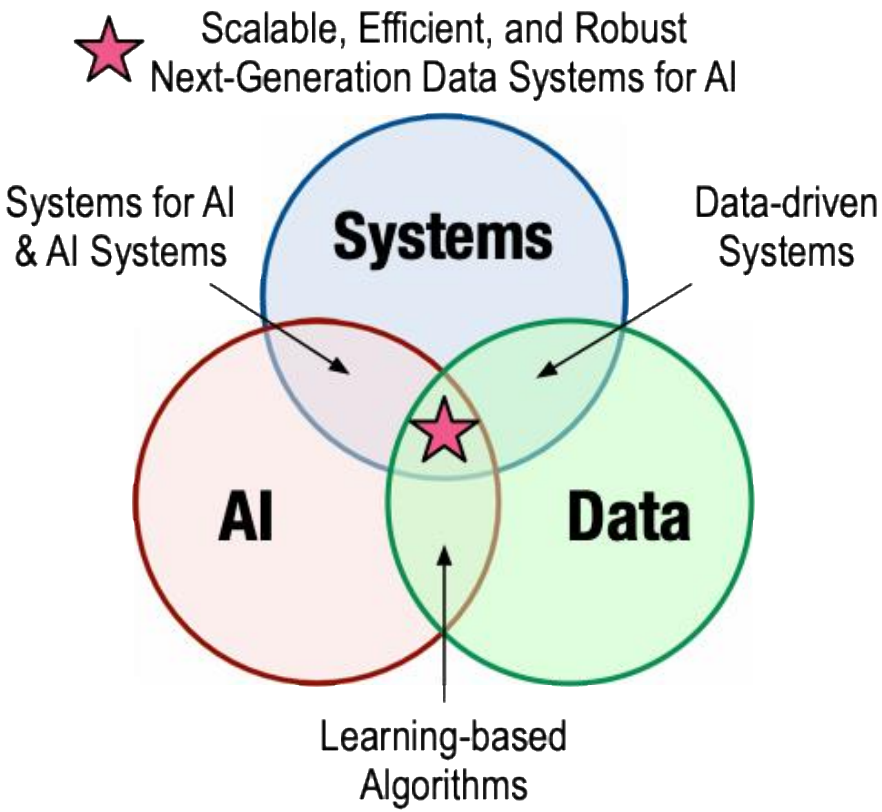
Lecture 1

Yue Cheng

University of Virginia

Introduction

- Yue Cheng
  - Associate professor of Data Science & Computer Science
  - Web: https://tddg.github.io
  - Email: mrz7dp@virginia.edu



- Current research: Designing better data systems for AI
  - (Storage) Systems for AI
  - (Affordable) Serverless AI

Course staff and office hours

- Instructor: Yue Cheng
  - Office hours: M/W, 2:30pm-3:30pm on Zoom

- GTA:
  - TBD

Discussion and getting help

- Discussion, questions: Ed
  - https://edstem.org/us/dashboard
  - Alternative place to ask questions, brainstorming, and discussing anything related to course topics
  - No anonymous posts or questions
  - Can use private posts to instructor/GTA
  - We are monitoring Ed several times a day
  - We will respond to questions in a batch manner

Today's agenda

- Why are we studying Serverless + AI? What is this course about?
  - What is Serverless and FaaS?
  - What are serverless AI applications?

- What will you do in this course?

What is serverless?

- Operationally
  - "No-ops" – (almost) no configuration
  - Autoscaling down to 0
  - Closer to pay-per-use (rather than pay-per-allocation)
  - Fine-grained billing

- Popular offering: serverless **custom** code
  - Function-as-a-Service (FaaS)

What is FaaS?

- A programming abstraction that enables users to upload code, run them at (virtually) any scale, and pay only for the resources used
- First model of mostly general computing to have all those properties → **AWS Lambda**
- Well-defined life-cycle: trigger, invocation
- Quite many limitations in duration, memory, communication, state

  short small

  indirect stateless

A marketing term

Serverless industry trend

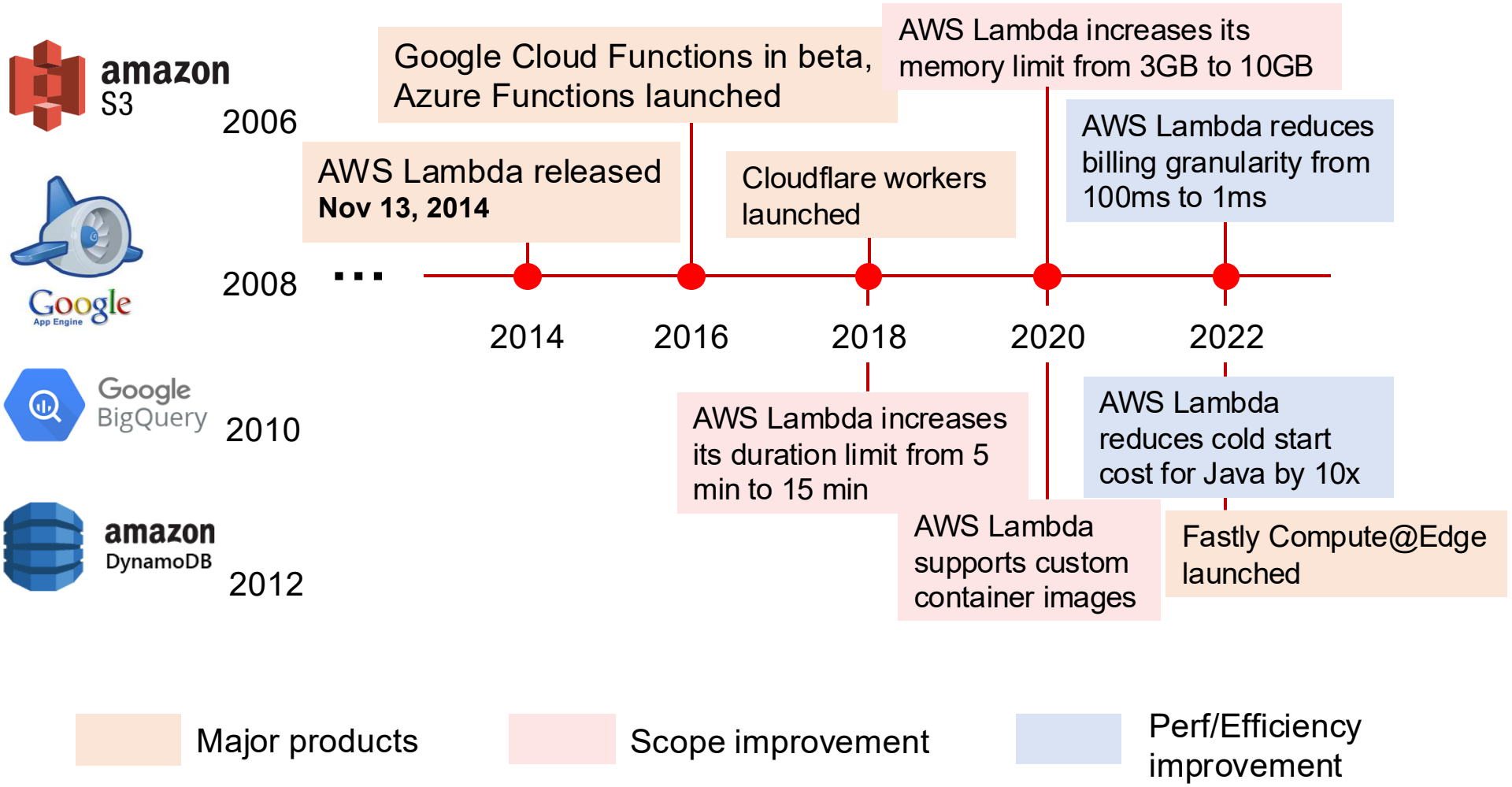
amazon S3 2006

Google App Engine 2008

Google BigQuery 2010

amazon DynamoDB 2012

Serverless industry trend

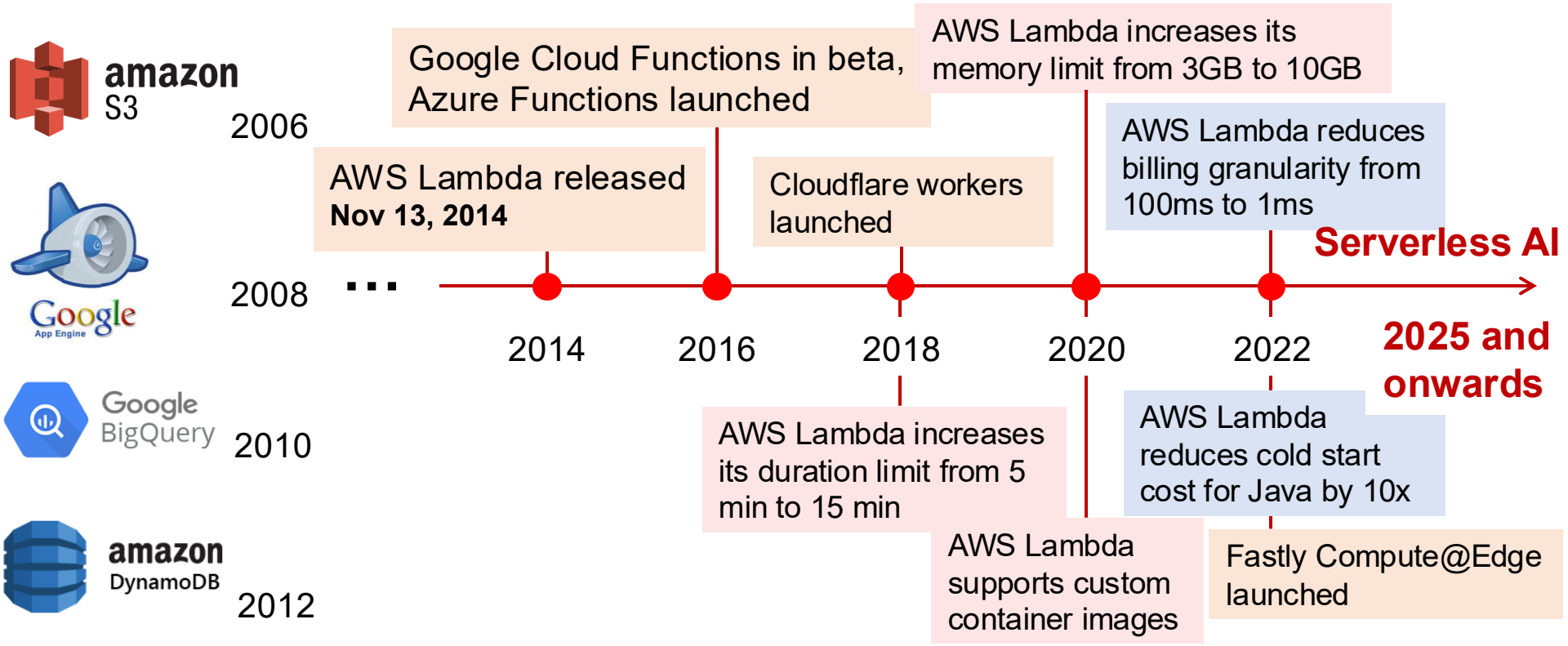


Major products

Scope improvement

Perf/Efficiency improvement

Serverless industry trend: 2025 and onwards …



Major products

Scope improvement

Perf/Efficiency improvement

When AI meets serverless

- Users don't need to manage AI hardware or infrastructure
  - but can run/use AI applications on demand (anytime)

SaaS

MaaS

Inference Endpoints
Transformers in production: *solved*

Workers AI
CLOUDFLARE

Zero
BETA

Serverless GPU FaaS (GPUaaS)

Modal

RunPod

Serverless GPU demo

Course syllabus

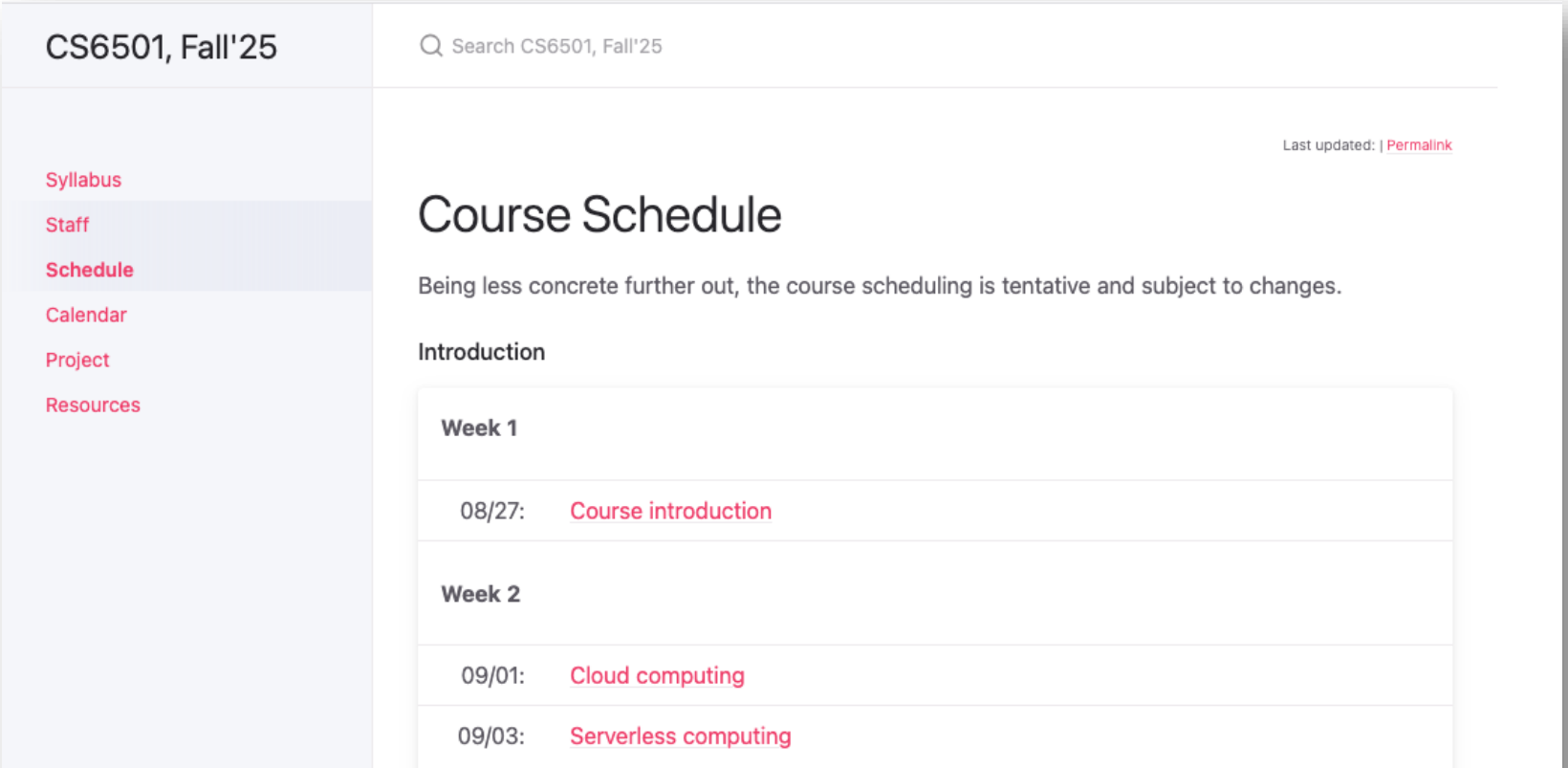
Big picture course goals

- Learn key works in serverless and modern AI systems
- Learn how to read, present, and evaluate a systems research paper
- Learn how to manage project and write code with AI coding tools
  - Sharpen your AI coding skill: an exciting time to do so
- Learn how to approach, discuss, and communicate about technical subject matter

Schedule (tentative)

- Readings, project due dates, resources
- Less concrete further out

https://tddg.github.io/cs6501-serverless-ai-fall25/



Schedule (tentative)

- Most lectures will have two paper presentations, each led by one of us (including me :-)

- Week 1-2: Cloud & serverless computing (Foundations)
- Week 3-5: FaaS platforms, workloads, cold starts
- Week 6: Stateful serverless computing (Serverless & FaaS)
- Week 7-9: Serverless applications
- Week 10-11: LLM serving and inference (Serverless AI)
- Week 12-14: Serverless AI
- Week 15-16: Final project presentation

Readings

- Mostly papers, occasionally blog articles
  - As most topics are not directly covered by a text

- Slides/lecture notes

- Optional textbooks (both are free)
  - "**Operating Systems: Three Easy Pieces (OSTEP)**" by Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau
  - "**Distributed Systems (3rd edition)**" by van Steen and Tenenbaum will supply optional alternate explanations

Paper reviews and presentations

- Three roles: Audience, Scribers, Presenters

- **Audience:** Read both papers for that class
  - Ensure to understand key ideas, designs, findings
  - Fill the survey for that day (5 wild cards)
- **Scribers:** Capture in-class discussions
  - Sign up as scriber for at least 3 presentations
- **Presenters:** Prepare slides and present the paper of your choice in class
  - Presenter doesn't need to submit survey for that class
  - Send your slides to the instructor at least 3 days before the class

Projects

- A term-long, research / development project
  - I'll supply ideas (and codebase for some)
  - You'll build the idea into an MVP (minimum viable product) with AI assisted coding

- Week 2: Team signup (size up to two)
- Week 4: Proposal report due
- Week 8: Midterm project reflection
- Week 9: Checkpoint report due
- Week 15-16: Project presentation and everything due
- My experience of working with AI coding tools
  - Started earlier this summer, tried many tools
  - Actively driving three projects in parallel

Me before AI coding is a thing

Summer experiments supercharged by AI tools

Teaching

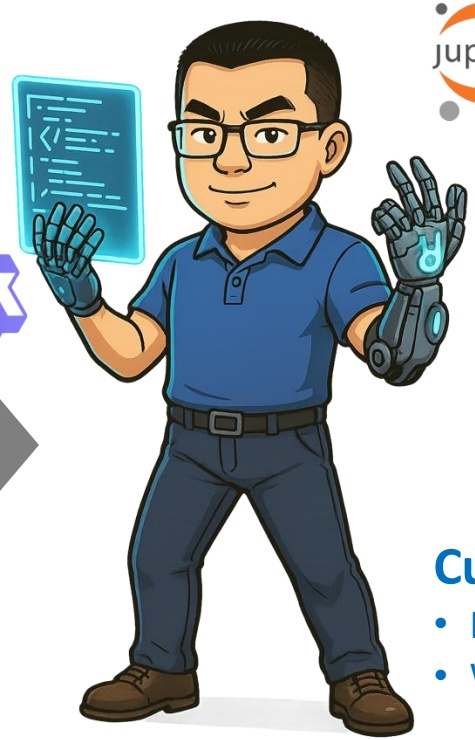
Writing papers

Managing students

Writing proposals

Endless meetings

Not enough time for coding…



Serverless GPU notebooks
derived from NotebookOS

jupyter + λ

A better compressor
atop ZipLLM

+ .ZIP

Customized Qwen CLI
- Reflective learning
- Workload tracing

Qwen3-Coder

[Experience so far] AI coding:
- Excellent for rapid prototyping & hypothesis validation
- But gets confused easily – requires smart user management

By the end of the semester...

Hopefully, you will have built some sophisticated, functional **MVP** that addresses an important real-world painpoint

Grading

- Paper reviews (10% total)
- Class participation (10%)
- Presentation (30%)
- Project (50%)

Resources and TODOs

- Sign-ups
  - Sign up for **Ed** (enrollment email sent)
  - Sign up for **paper presentations & scribing**
  - Redeem **Google Cloud edu credit** ($50 each)
  - Install **Qwen Code CLI** customized for this class
    - Interfaces Qwen 3 Coder Plus (reasonably powerful LLM)
    - Offers 2,000 free requests per day for free-tier users
    - Provides dashboard visualization for historical prompts

- Next week
  - Fundamentals of cloud & serverless computing