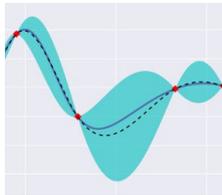


# *R244: Large-Scale Data Processing and Optimisation*

## *Course Guide*



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## *R244 Course Objectives*

- Understand key concepts of dataflow programming
- Understand how to build distributed systems
- Understand a large and complex parameter space in computer system's optimisation and applicability of Machine Learning approach
- Research skills
  - Establish basic **research domain knowledge** in large data processing and Optimisation with ML
  - Obtain **your view** of research area for **thinking forward**
  - **NOT to learn ML tools for ML applications**

## Course Schedule

[https://www.cl.cam.ac.uk/~ey204/teaching/ACS/R244\\_2025\\_2026](https://www.cl.cam.ac.uk/~ey204/teaching/ACS/R244_2025_2026)

Session 1: Introduction

Session 2: Data Flow Programming: Map/Reduce to TensorFlow to ML

Session 3: Hands-on Tutorial: Data Flow Programming

Session 4: Large-scale Graph Data Processing / Search Space

Session 5: Probabilistic Programming + BO : Guest lecture (Brooks Paige)

Session 6: Optimisation of Computer Systems

Session 7: Optimisation in ML Compiler (Superoptimisation...)

Session 8: Project Study Presentation

3

## Reading Club

- Reading Club (not Lecture Class!)
  - 4~5 Paper review presentations and discussion per session
    - Full presentation for core papers + Focused presentation for additional papers
  - Each of you will present ~2 reviews during the course
    - Presented slides need to be emailed to me by the following day
  - *Review\_Log*: minimum 1 log per session
    - Email me by noon Tuesday every week
    - Template of review log on the webpage
    - Prepare questions
  - Active participation to review discussion!



4

## Review\_Log

### Paper Review Log: Session x

Name and (crsid):

Paper Title and Authors

1. Paper Summary (<100 words)  
Describe a brief summary (extract essentials)

2. Punch-line of the Paper (<200 words):  
What is the significant contribution?  
What is the difference from the existing work?

3. Any major criticism to the authors (<150 words)  
Any criticism and suggestions to the authors?

5

## Course Work: Reports 1&2

- **Review report** on full length of paper (<1800 words)
  - Pick a paper from listed papers in R244
  - Describe the contribution of paper in depth with criticism
  - Crystallise the significant novelty in contrast to the other related work
  - Suggestion for future work

Submission Deadline: 2025.11.14 16:00
- **Survey report** on sub-topic in data centric networking (<2000 words)
  - Pick up ~5 papers as core papers in your survey scope
  - Read them and expand your reading through related works
  - Comprehend your view and finish as your survey paper

Submission Deadline: 2025.12.12 16:00

6

## *Study of Open Source Project*

- Pick an open source project from R244 scope
- Open Source project normally comes with new proposal of system/networking architecture
- Understand the prototype of proposed architecture, algorithms, and systems through running an actual prototype
- Any additional work
  - Writing applications
  - Extending prototype to another platform
  - Benchmarking using online large dataset
- Some projects are rather large and may require extensive environment and time; make sure you are able to complete this assignment
- If you really need GPUs for the project, contact me.

7

## *Course Work: Reports 3*

- **Report on project study** and exploration of a prototype (<2500 words)
  - Project selection by **November 21, 2025 (16:00)**
    - Title and brief description (>150 words) by email to me
  - Project presentation on **December 3, 2025**
  - Final report on the project study by **January 20, 2026**

Try to finish by the end of 2025!

8

## Plan Reading Papers for Reports

- Through October and November, pick/read papers from all sessions with your interests.
- Scope in the survey topic towards the end of November for writing up a survey report by December 12.
- Think through potential open-source projects in November, present initial study/plan on December 3. Actual implementation/experiment work possibly after December 3.

October							November							December						
M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
		1	2	3	4	5					1	2	1	2	3	4	5	6	7	
6	7	8	9	10	11	12	3	4	5	6	7	8	9	8	9	10	11	12	13	14
13	14	15	16	17	18	19	10	11	12	13	14	15	16	15	16	17	18	19	20	21
20	21	22	23	24	25	26	17	18	19	20	21	22	23	22	23	24	25	26	27	28
27	28	29	30	31			24	25	26	27	28	29	30	29	30	31				

Review Report
Survey Report

## Candidates of Open Source Project

[http://www.cl.cam.ac.uk/~ey204/teaching/ACS/R244\\_2025\\_2026/opensource\\_projects.html](http://www.cl.cam.ac.uk/~ey204/teaching/ACS/R244_2025_2026/opensource_projects.html)

- List is not exhausted and discuss with me if you find more interesting one for you
- Expectation of workload on open source project study is about intensive 3-7 full days work except writing up report
- One approach: pick one in the session topic, which you are interested in along your survey report

## *Important Dates*

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- November 14 (Friday) 16:00
  - Review report
- November 21 (Friday) 16:00
  - Mini Project selection
- December 12 (Friday) 16:00
  - Survey report
- January 20, 2025 (Tuesday)  
Try to finish by the end of 2025!
  - Open-source project study report

11

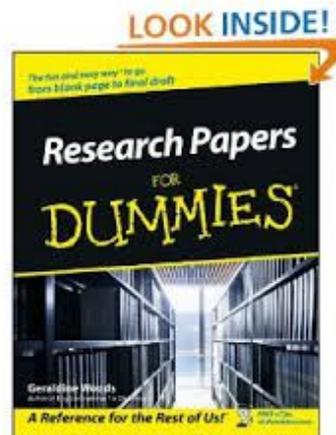
## *Assessment*

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- The final grade for the course will be provided as a letter grade or percentage. Use of AI tools to generate the course work is not permitted.
- 25%: for a reading club (presentation, participation, tutorial session exercise and *review\_log* – *no mark*):
  - 10%: Presentation
  - 15%: Participation
- 75%: for the three reports: with marks
  - 15%: Intensive review report
  - 25%: Survey report
  - 35%: Project study

12

## How to Read a Paper?



13

## How to Read a Paper?

- Scope of R244 is wide
- ...includes distributed systems, OS, networking, programming language, database, ML...
- Type of papers
  - Building a real system
  - Proposing algorithm/logic on architecture design
  - Optimising computer systems
  - New idea

14

## *Critical Thinking*

- Reading research paper is not like reading a textbook
- Most importantly the paper may not show the *truth*
  - there is no right and wrong, just good and bad
  - There are inherently subjective qualities...but you can't get away with just your opinion: must argue
- Critical thinking is the skill of marrying subjective and objective judgment of a piece of work

## *First Let's Argue for...*

- What is the problem?
- What is important?
- Why isn't it solved in previous work?  
e.g. Why graph specific parallel processing? MapReduce is not good enough?
- What is the approach?  
e.g. Graph specific MapReduce
- Why is this novel/innovative?  
e.g. Iterative operation for graph parallel

## *And Now against...*

- Problem is overstated (or oversold)
- Problem does not exist
- Approach is broken
  - It does not work for all the algorithms...
  - It does not scale...
- Solution is insufficient
  - Only works when data is in memory...
- Evaluation is unfair/biased
  - Use HPC for experiment

## *So Which is RIGHT Answer?*

- There isn't one!
  - Most of arguments are mostly correct...
- Your judge on what is valuable on topic
- In this course, we'll be reviewing a selection of 20+ papers (4-5 per week)
  - All of these papers were peer-reviewed and published
  - **However you can pick your opinion on papers!**

## *Reviewing Tips & Tricks*

- Identify a **core/major idea** of the topic
- Read **related work and/or background** section and read key other papers on the topic
- Capture the author's claim of **contribution** in *introduction* section and judge if it is delivered
- Understand the **methodology** that demonstrates paper's approach
- Capture **what authors evaluate** and judge if that is a **good way to evaluate** the proposed idea
- For theory/algorithm paper, capture what it produces as a result (rather than how)

19

## *Key in Review Comments*

- What do **YOU** think?
  - Where you finally get to explain your opinion!
  - You should aim to give *a judgement* on the work
  - Your judgement should be backed by your argument
- Questions for the authors

S. Hand'10

20

## *How to Review a Paper Aid...*

- S. Keshav: How to Read a Paper, ACM SIGCOMM Computer Communication Review 83 Volume 37, Number 3, July 2007.
- T. Roscoe: Writing Reviews for Systems Conferences, 2007.
- Simon Peyton-Jones: How to write a great paper and give a great talk about it, Microsoft Research Cambridge.
- David A. Patterson: How to Have a Bad Career in Research/Academia, 2001.

[See course web page for the paper links.](#)

## *Structure of Presentation*

- Cover 3 things in your presentation
  1. Background/context
    - What motivated the authors?
    - What else was going on in the research community?
    - How have things changed since?
  2. What is problem to be tackled?
    - What is the problem they tried to solve?
    - What are the key ideas?
    - What did the authors actually do?
    - What were the results?
  3. Your opinion of the paper
    - What you agree and what you disagree?
    - What is the strength and weakness of their approach?
    - What are the key takeaway?
    - What was the impact (possible impact)?

## Preparing...

- Not too much basics: remember, others would have read the paper
  - Brief overview
  - Do not make exact repeat of the paper
- Aim: generate discussion – spit your straight opinion about the paper to stir the discussion
  - Explore the arguments they make and the conclusions they draw. What is your opinion on it?
  - When you argue, state clearly the point of argument



## Presenting...

- Practice beforehand to ensure length of your presentation
- Getting nervous is normal!
  - We are in the same boat and we help each other to understand the paper
  - Presentation is a tool to provide a discussion forum
- Try not to get defensive or angry at questions
  - It is not your paper !



## Listening Presentation...

- You need to get involved



- Ask questions from your review – bring your *review\_log* copy
- Always be respectful of the speaker



S. Hand'10

25

## How to Write Reviews (Report 1)

- Paper Summary
  - Provide a brief summary of the paper
  - At this stage you should try to be objective
- Problem
  - What is the problem? Why is it important? Why is previous work insufficient?
- Solution or Approach
  - What is their approach?
  - How does it solve the problem?
  - How is the solution unique and/or innovative?
  - What are the details?
- Evaluation is unfair/biased
  - How do they evaluate their solution?
  - What questions do they answer?
  - What are the strength/weakness of the system and evaluation itself?

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26

## *How to write Survey paper (Report 2)*

- Demonstrate a summary of recent research results in a novel way that integrates and adds understanding to work in the research area
- Must expose relevant details associated, but it is important to keep a consistent level of details and to avoid simply listing the different works
- For example:
  - Define the scope of your survey
  - Classify and organize the trend
  - Critical evaluation of approaches (pros/cons)
  - Add your analysis or explanation (e.g. table, figure)
  - Add reference and pointer to further in-depth information



27

## *Summary*

- R244 course web page:  
[http://www.cl.cam.ac.uk/~ey204/teaching/ACS/R244\\_2025\\_2026](http://www.cl.cam.ac.uk/~ey204/teaching/ACS/R244_2025_2026)  
Email: [eiko.yoneki@cl.cam.ac.uk](mailto:eiko.yoneki@cl.cam.ac.uk)
- Slides of presentation, forms, other information will be on the web
- **Please email me your presentation slides after the session**

28