Lecture 1

ECS 289C: Seminar in Programming Languages

Original plan

What is a programming language, anyway?

Areas of PL

Paper assignments starting next week

New plan

~~What is a programming language, anyway?~~

~~Areas of PL~~

(Happy to talk about these sometime!)

General advice on how to think about research papers

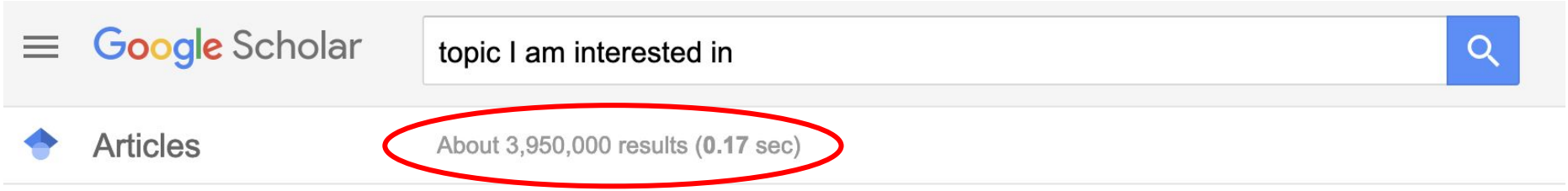
- With this advice, you can honestly figure out the areas on your own
- I think it will help with your presentations and summaries

If we have time (or bleeds into next time):

2 Activities

Paper assignments soon after

Motivation 1: Reading literature is discouraging



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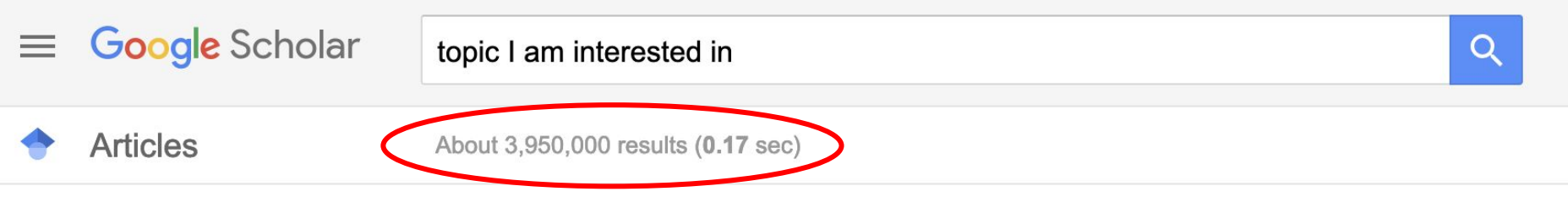

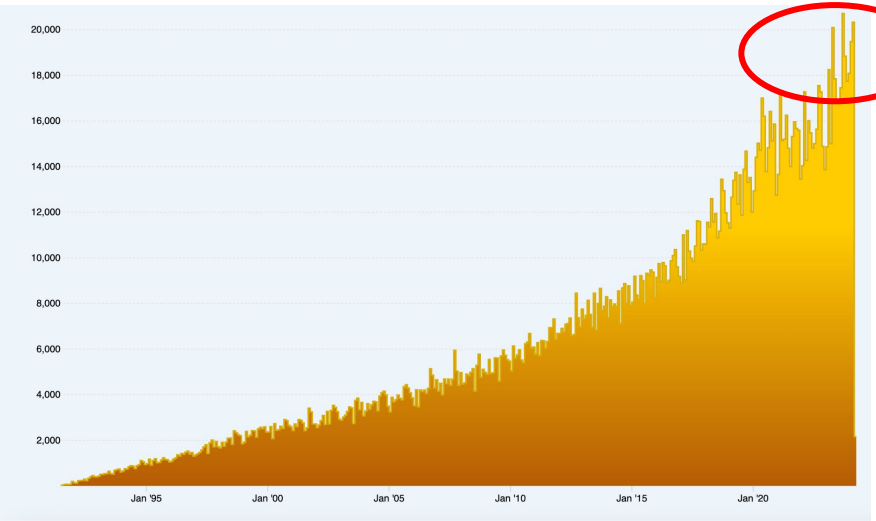

About **20,000** papers posted to arXiv every month

… or over **600/day**

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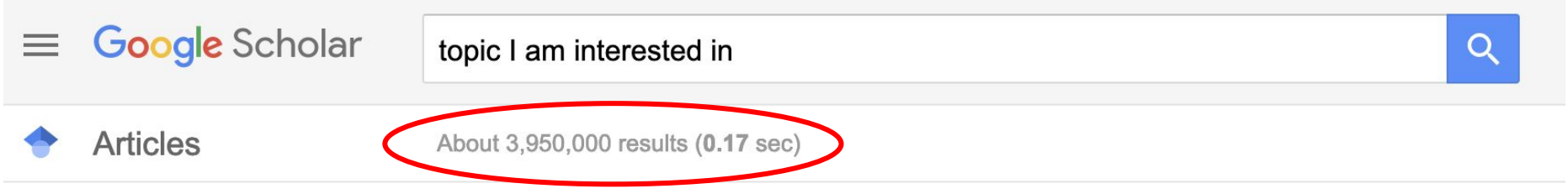

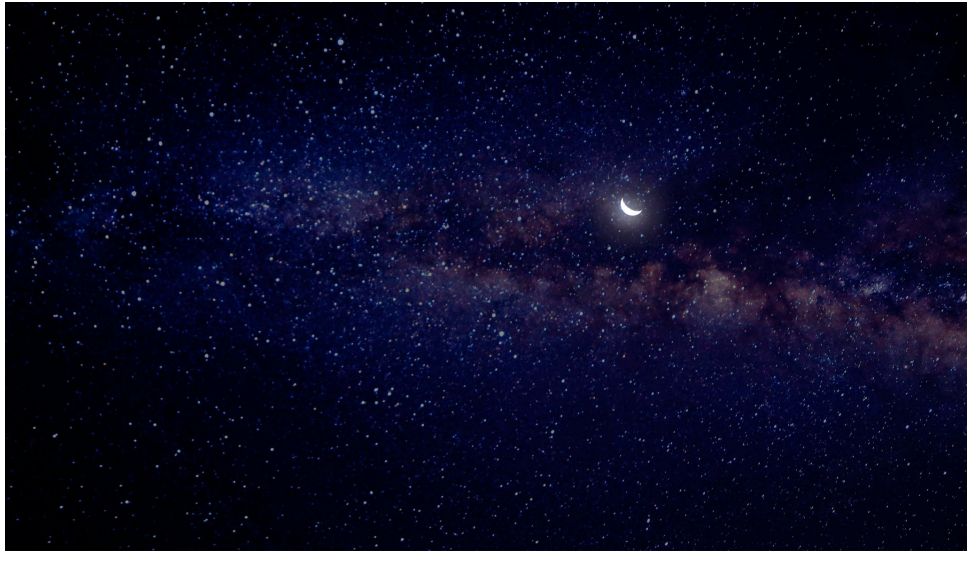

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Too-easy conclusion: why does what I **(you)** do/think make any difference?

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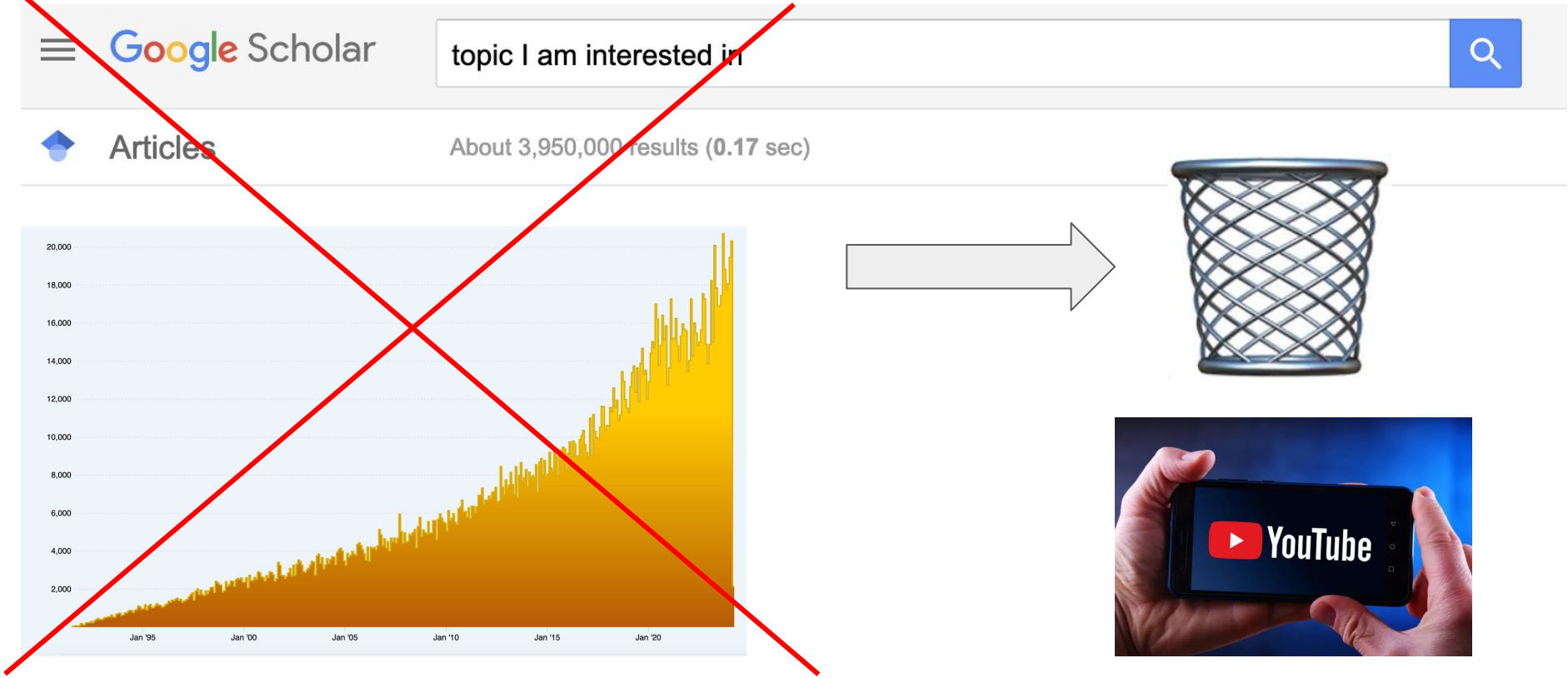
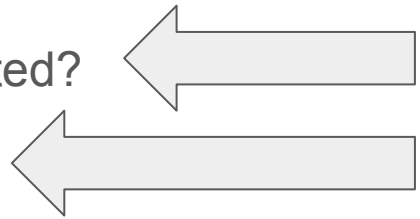


Motivation 2: knowing **why** is critical

Why are you reading this paper?

2 parts:

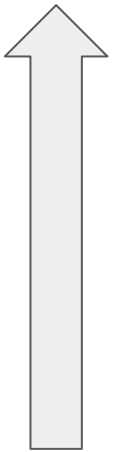
1. Why are you interested?
2. Why is it important?



research area

contribution

The way I've come to think about this
Or: Caleb's tree model of research



Applies to both reading literature + coming up with new research problems!)

Not really mine – this has been expressed in many ways before. But I hope it will help us address some of the motivations earlier

(Work in progress)

Caleb’s tree model of research

Research literature is like a tree

Level 0: Trunk

Computer science

~100,000 active computer science researchers

(ref: 100K ACM members)
(ref: 28.5K PIs on csrankings)

Level 1: Limb

Major area
(Flagship conference)

~10,000 researchers
per major area

(ref: 27 areas acc. to csrankings,
but not all of them major)
(ref: 2743 SIGPLAN members)

Level 2: Branch

Subarea
(Conference session)

~1,000 researchers
per subarea

Level 3: Twig

Research topic

~100 researchers
per research topic

Level 4: Leaf

Research problem

~10 researchers
thinking about a specific
research problem

Level 5: Bud

Potential solution

~1 researcher investigating
a specific solution

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Fig. A: graduate student

My hypothesis:

Any research idea can be completely identified by a list of nodes

5 levels deep

In the tree. (No more levels are needed!)

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Corollaries

If you want to understand a paper…

- You **don’t** have to understand the whole tree

According to this model, the tree of computer science has 10,000 active research problems and 100,000 potential solutions.

Corollaries

If you want to understand a paper…

- You **don’t** have to understand the whole tree

- You **do** have to understand how to “climb” the tree **5 levels** to get to the point you are interested in

According to this model, the tree of computer science has 10,000 active research problems and 100,000 potential solutions.

Corollaries

If you want to make a new research contribution...

- You **don’t** have to convince the whole tree

- You **do** have to convince the **10 researchers** in your leaf that your idea is useful
  - and maybe one or two in the same twig

Corollaries

If you want to give a talk at a conference...

- You **don’t** have to address the whole tree

- You **do** have to explain to the **1000 researchers** in your branch what your twig/leaf/bud is up to

Corollaries

If a paper does this successfully…

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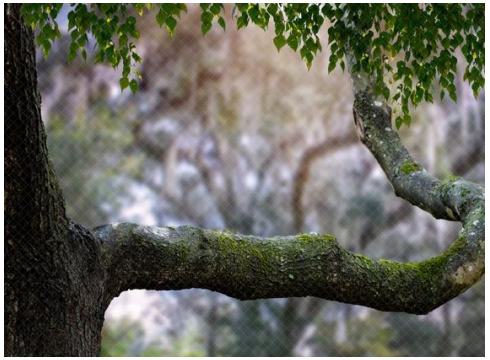

(if you happen to get really, really lucky)

Why is this relevant to reading research papers?

1. Every peer-reviewed research paper successfully went through this process

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1. Every peer-reviewed research paper successfully went through this process

2. If you know which 5 levels **you** care about, you know which papers to read carefully – and which to **skim/ignore**

3. “Foundational” papers are ones that generated a new branch!

Questions when reading a research paper

1. What **area** is it in?

   (This is the **5 levels deep** part)

2. What **contribution** does it make?

   (This is the **“convince the surrounding neighbors”** part)

Activity 1

Pick a paper that catches your eye:

PLDI Research Papers - PLDI 2023

Answer the 2 questions

- What are the 5 levels?
- How does it convince the reader that it succeeded?

Activity 2: PL active research topics

From PLDI 2023:

- Verification (x3)
- PL + ML
- Compilers (x2)
- Concurrency & Parallelism
- Security
- Synthesis
- Probabilistic Programming
- Program Analysis
- Testing
- Types
- Program Logics
- Parsing
- Systems

From POPL 2024:

- Synthesis (x2)
- Types (x5)
- Side effects (x2)
- Verification (x3)
- Regular Expressions & Automata
- Program Logics (x3)
- Concurrency & Parallelism (x2)
- DSLs
- Probabilistic Programming
- Quantum
- Program Analysis
- PL + ML

My answers

Consolidated

- Logic + Semantics (x8)
- Verification and Testing (x7)
- Types (x6)
- Domain Specific Languages (x6)
- ML and Synthesis (x5)
- Compilers + Program Analysis (x4)
- Concurrency + Parallelism (x3)