CE 528 Cloud Computing

Lecture 1: Course Introduction
Spring 2026

Prof. Yigong Hu

Slides courtesy of Alan Liu and Chang Lou

About Me

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What is Cloud Computing?

- What do you think?

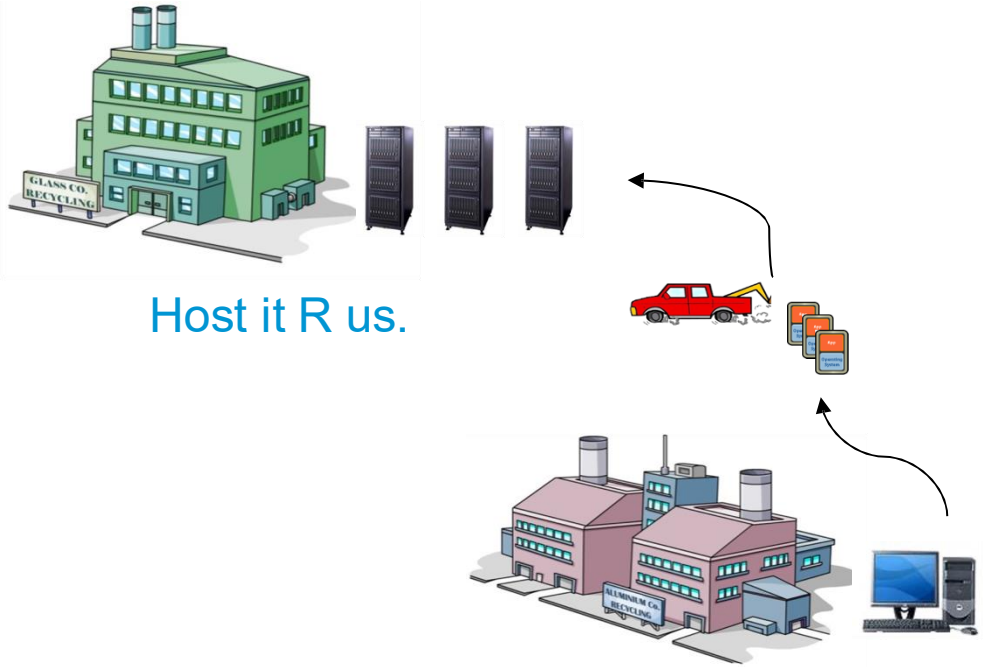
- *"**Cloud computing** is the delivery of computing services – servers, storage, databases, networking, software, analytics and more – over the Internet ("the cloud"). Companies offering these computing services are called cloud providers and typically charge for cloud computing services based on usage, similar to how you're billed for gas or electricity at home."*
  - https://azure.microsoft.com/en-gb/overview/what-is-cloud-computing/

- *Let's ask ChatGPT*

Cloud Computing: A Case

Joe's Widget Co.

Cloud Computing: A Case



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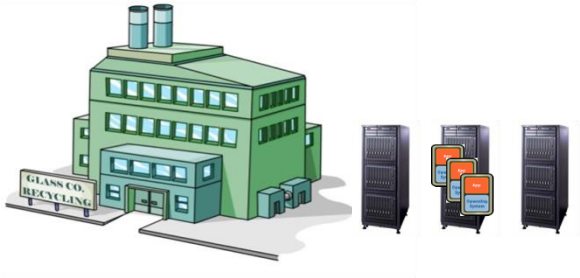

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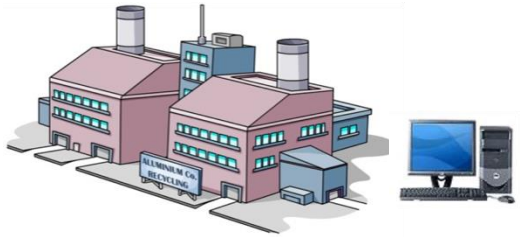

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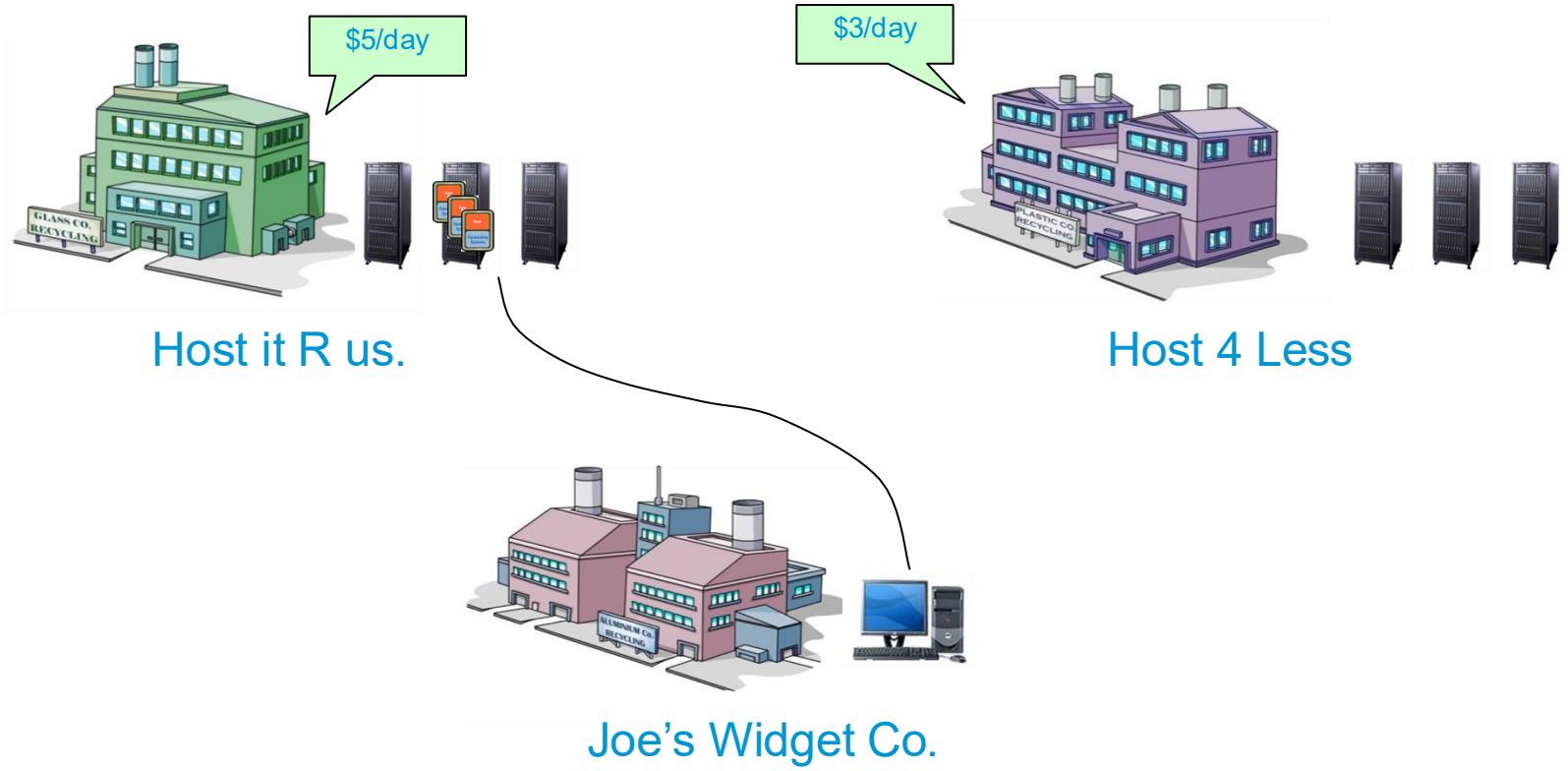

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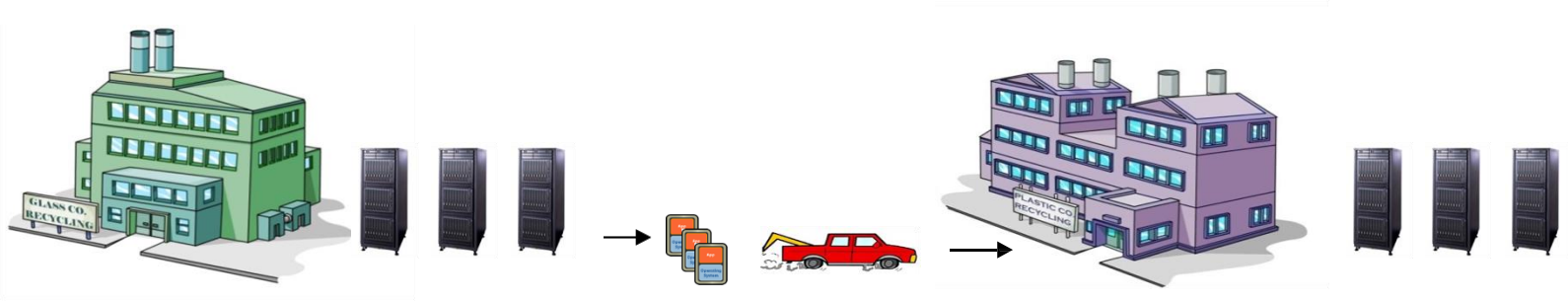

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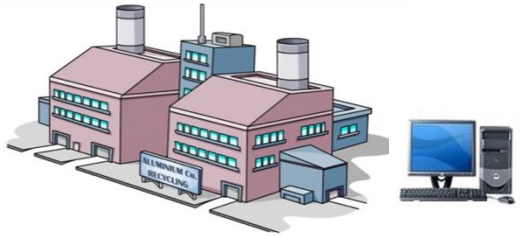

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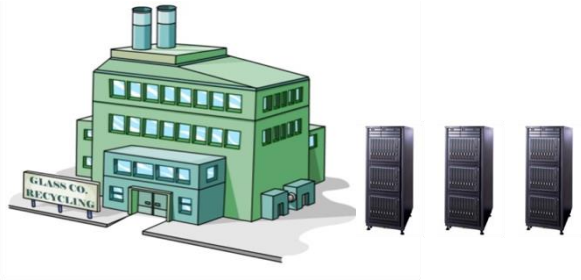

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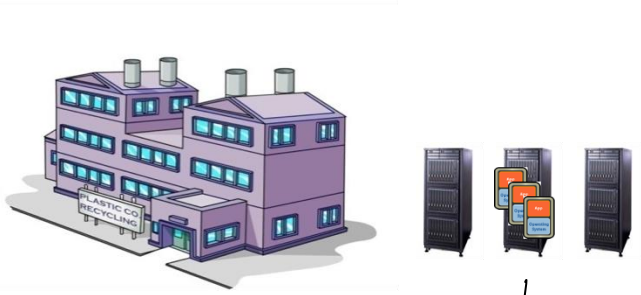

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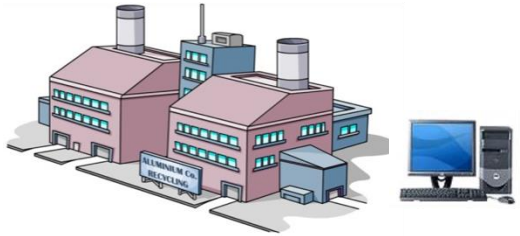

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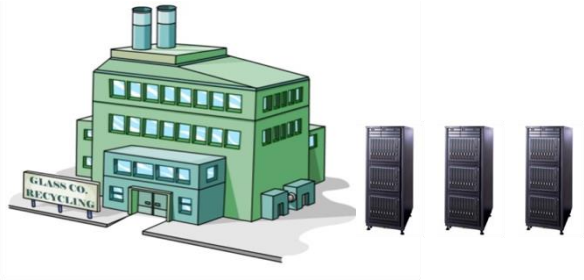

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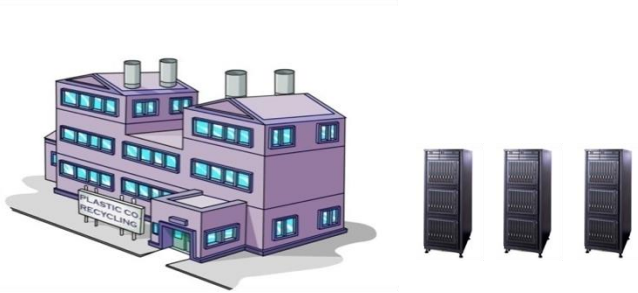

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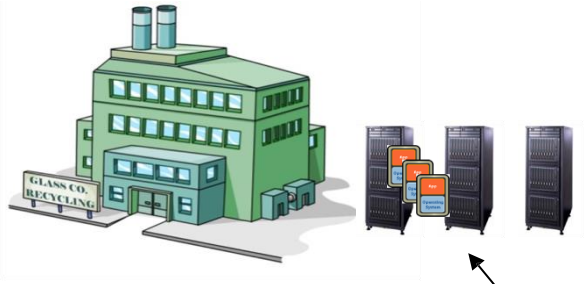
Cloud Computing: A Case



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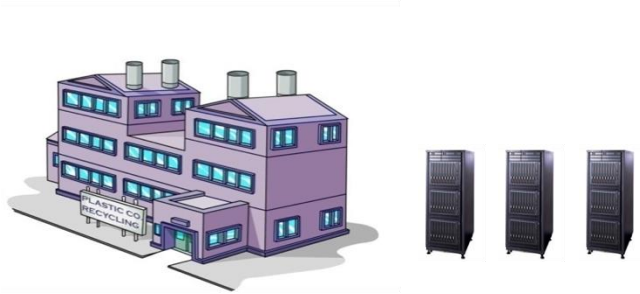

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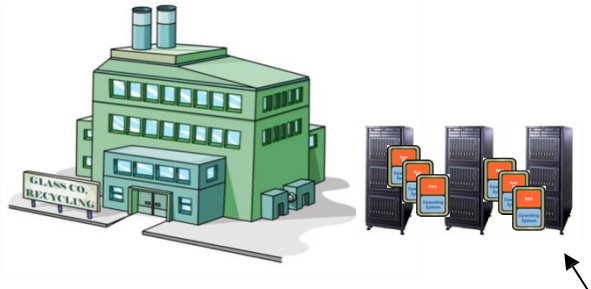

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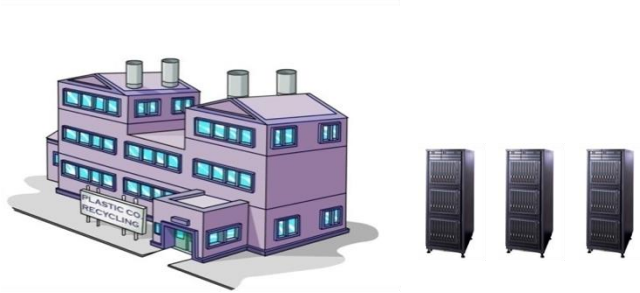

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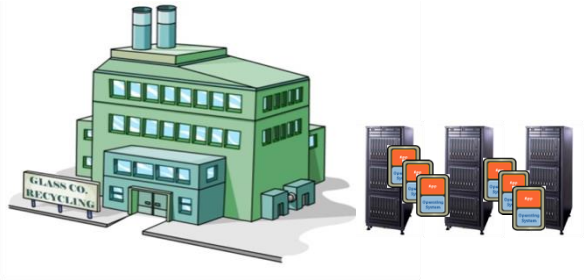

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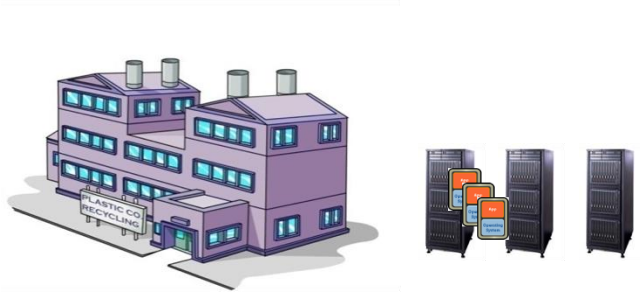

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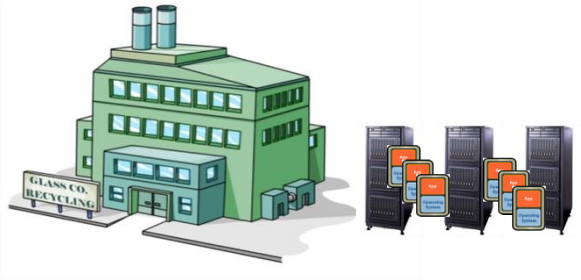

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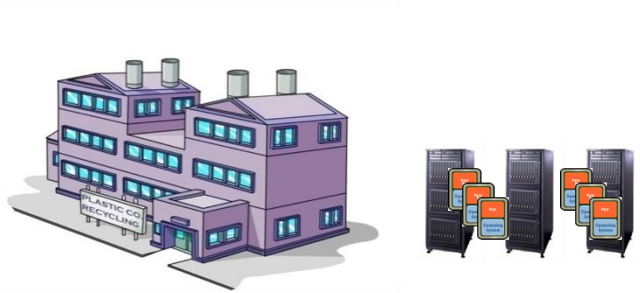

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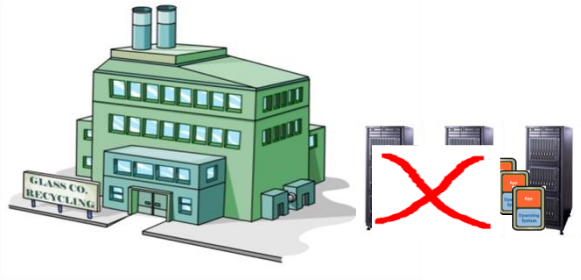

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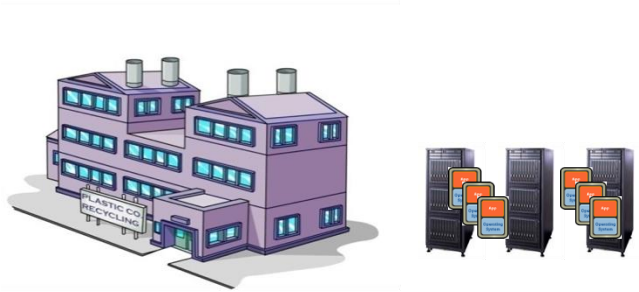

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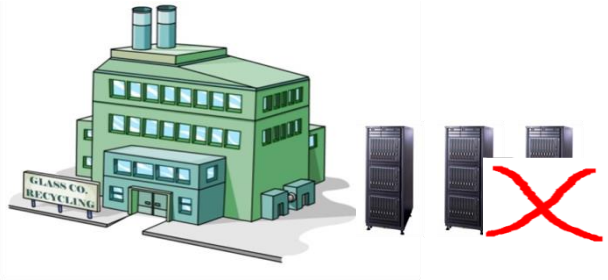

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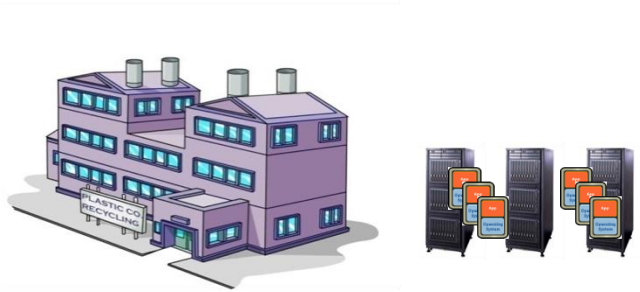

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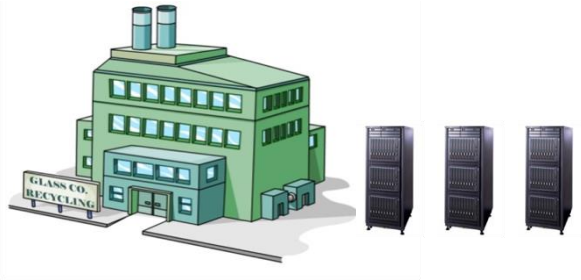

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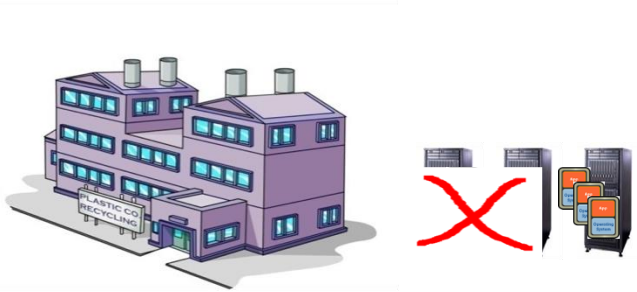

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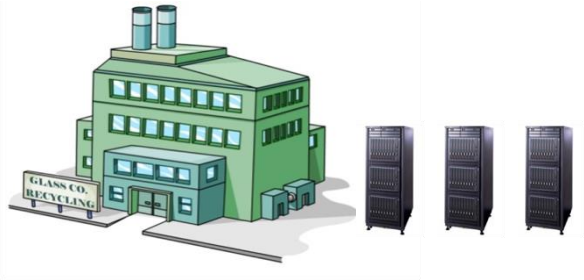

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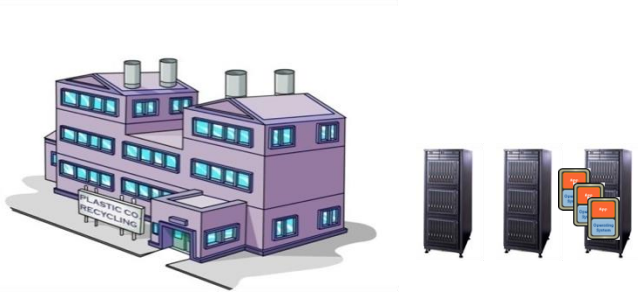

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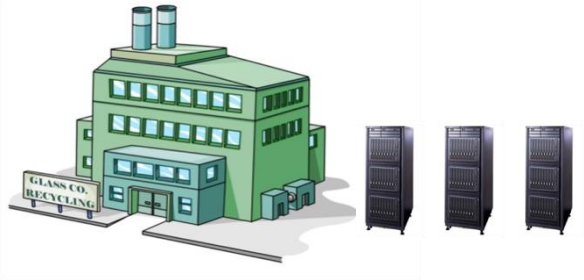

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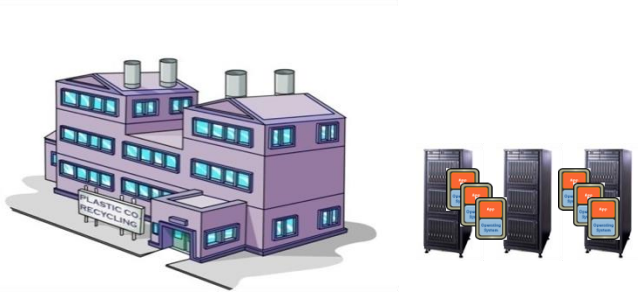

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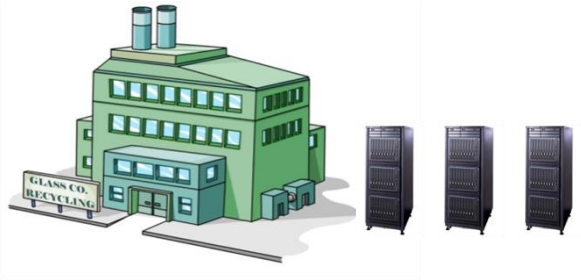

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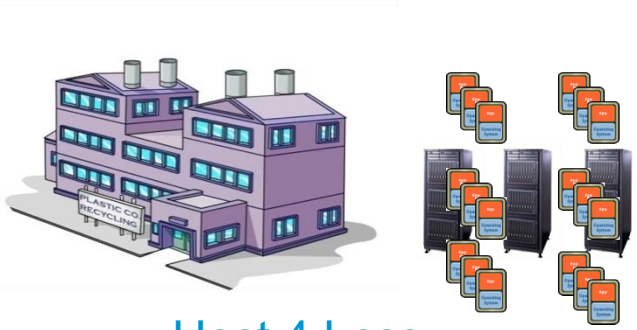

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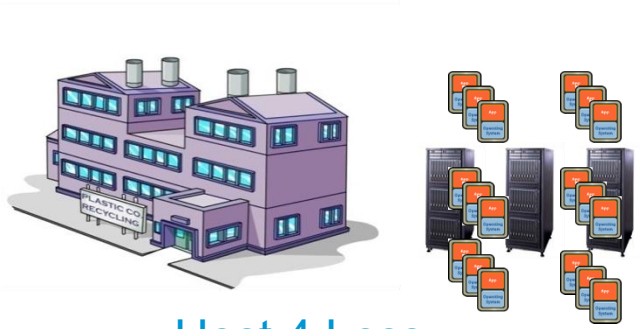

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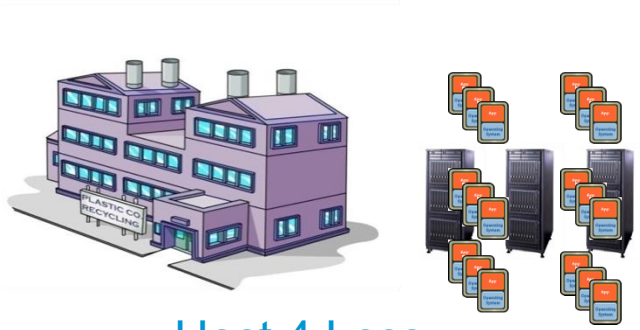

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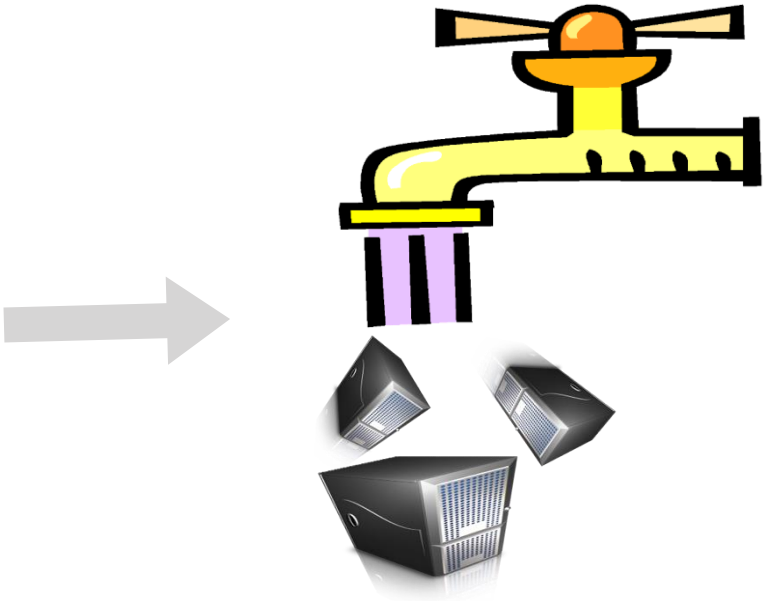
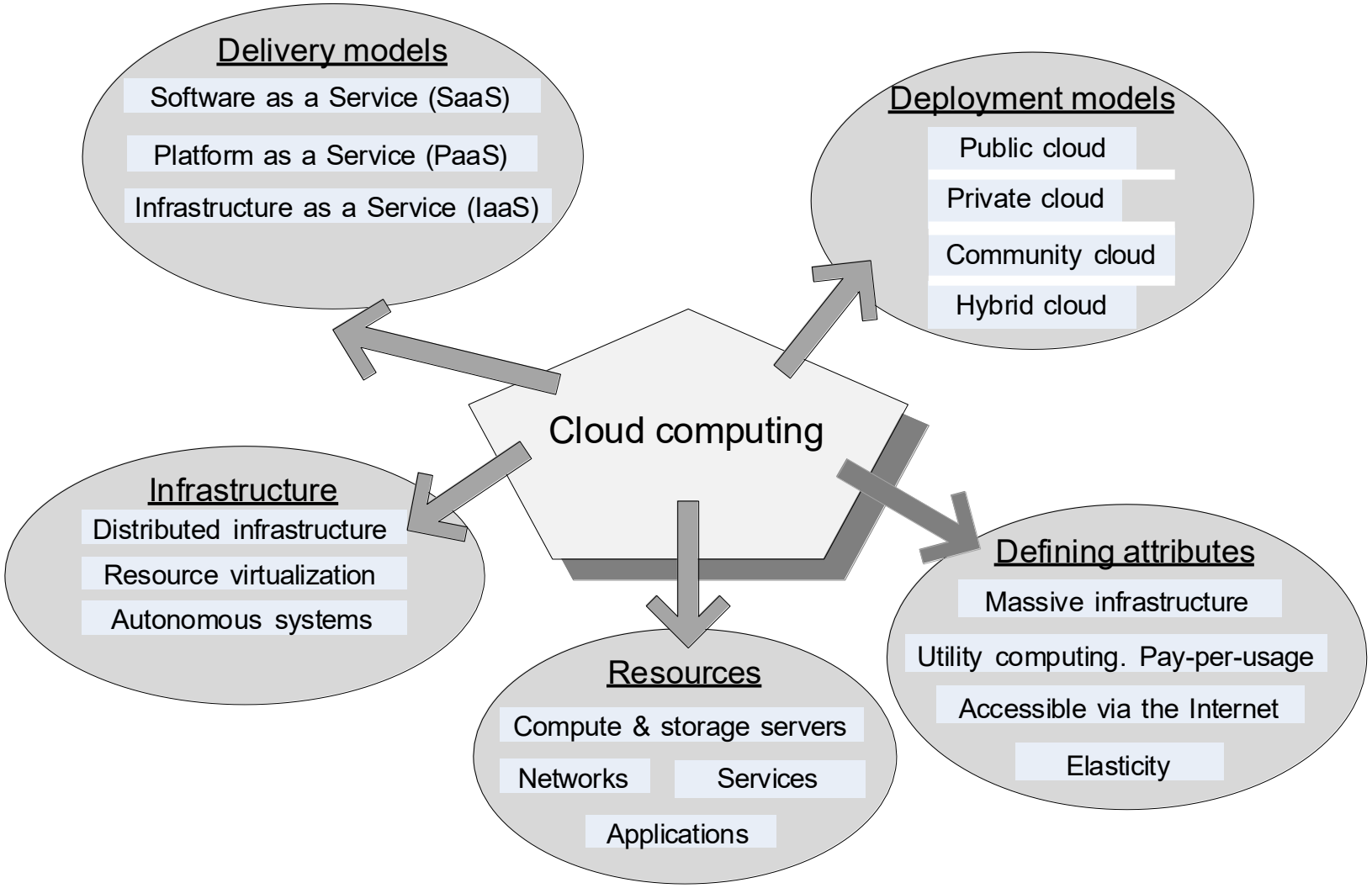
What We Want?



Cloud Computing Models, Resource, Attributes



Types of Clouds

1. **Public Cloud** - the infrastructure is made available to the general public or a large industry group and is owned by the organization selling cloud services.

2. **Private Cloud** – the infrastructure is operated solely for an organization.

3. **Hybrid Cloud** - composition of two or more Clouds (public, private, or community) as unique entities but bound by a standardized technology that enables data and application portability.

4. **Other types: e.g., Community/Federated Cloud** - the infrastructure is shared by several organizations and supports a community that has shared concerns.

Course Structure

- Distribute Systems Foundation
- Cloud Computing Foundation
- Advance topic on Cloud Computing
- Projects mentored by the industry

You can get to course website. This will be kept up to date, has all deadlines, demos…

Piazza is the source of truth.

Useful Link: http://nil.csail.mit.edu/6.824/2020/schedule.html
https://web.eecs.umich.edu/~manosk/eecs591-f21.html

Course Logistics

- Good News: no exam in this class

- Paper readings
  - 1–2 papers per week.
  - You do not need to write reviews, but you are expected to read them.

How You Are Evaluated

- Project: 70%
  - Project description: 5%
  - 3 project demo: 30%
  - Final project result and report: 30%
  - Project quizzes 5%
  - Project scores are scaled based on team & mentor evaluation

- Paper quizzes: 30%
  - Paper quizzes will be run in the class
  - There are around 14 quizzes in class:
    - MS/Ph.D. students must complete 12 out of 14 quizzes.
    - Undergraduate students must complete 10 out of 14 quizzes.
    - Only the highest-scoring quizzes will be counted.

How You Are Evaluated

- In-class Questions: Bonus
  - A correct answer receives 0.5 bonus point, and an insightful answer receives 1 bonus point.
  - A wrong answer does not incur any penalty
  - Each student may receive at most one bonus per class
  - If no one volunteers to answer, a student will be selected at random.
  - If a selected student is not present in class, a –1 point penalty will be applied.

Peer Scoring

There will be an anonymous peer scoring process

- All team members receive the same project grade.
- Each team member assigns an involvement score to their peers based on their contributions to the project.

Involvement Scores

- Range: **50% to 150%**
- Minimum increment: **1%**
- Scores reflect relative contribution to the team effort
- The average involvement score across team members should be **100%**
- Peer scores will be used to adjust individual project grades

Only your initial score and final grade will be visible.

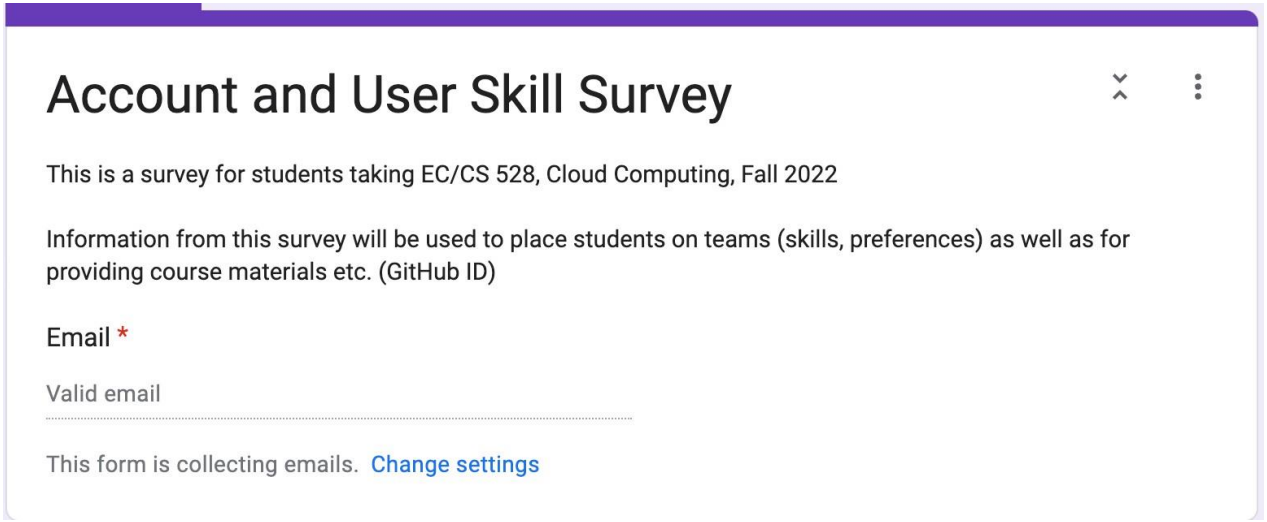
Course Project

- There is one major project in the course.
- Each team will be assigned a mentor from industry or a senior graduate student.
- Project teams will consist of **4–6 students**.
- Projects are proposed by mentors, and you may indicate your preferences among them.
- In addition to the listed projects, you may propose your own project.
  - Self-proposed projects are limited to **up to 3 students**
  - No mentor
  - These projects will be graded using the same criteria as other projects.
  - A **20% bonus** will be applied to the final project score for self-proposed projects.

Lets look at the projects

Project Match

- Project matching
  - We will send out a user skill survey and a project preference form this week.



  - Fill out these forms by 11:59 PM on 01/28.
  - We will assign project teams and please reach out to your team member asap

Project Presentation

- There are 3 in-classe presentation, all groups present/demo their projects.

- By 11AM the morning before demos, you will submit the slides used in the presentation, and a quiz for your fellow students:
  - remember you are teaching us about the project and what you have learned
  - minimize acronyms
  - try to get everyone to talk
  - try to make sure you review it with the mentor

- Each team will have 10 minutes to present the work.
  - At most two team members may present in a single presentation. However, every team member must present at least once across the different presentation sessions

But, Why Should You Stay in This Class, and This Field?

We Will Discuss

- This is the future of all computing

- It has profound impact on:
  - how hardware is developed
  - how software is developed
  - the computer industry
  - society as a whole

Course Contents: A Variety of Topics

- Overview of Cloud Computing
- Virtualization
- Distributed systems systems
- Datacenter architectures
- Storage systems
- Resource management
- Big data processing
- Datacenter networking
- System Reliability
- Other research topics

So, Why is Cloud Computing Cool?

- Shared Resources and Resource Management
  - Cloud uses a shared pool of resources
  - Uses Internet to offer **scalable** and **elastic** services.
  - The term "**elastic computing**" refers to the ability of dynamically and on-demand acquiring computing resources and supporting a variable workload.
  - Resources are metered and users are charged accordingly.
  - It is more cost-effective due to resource-multiplexing. Lower costs for the cloud service provider are past to the cloud users.

Cloud Infra Might Be Running Under the Water

Cloud Computing Benefits?

- Resources, such as CPU cycles, storage, network bandwidth, are shared.
- When multiple applications share a system, their peak demands for resources are not synchronized thus, **multiplexing** leads to a higher resource utilization.
- Resources can be **aggregated** to support data-intensive applications.
- Data sharing facilitates **collaborative** activities. Many applications require multiple types of analysis of shared data sets and multiple decisions carried out by groups scattered around the globe.

Cloud Computing Benefits(cont'd)

- Eliminates the **initial investment costs** for a private computing infrastructure and the maintenance and operation costs.

- **Cost reduction:** concentration of resources creates the opportunity to pay as you go for computing.

- **Elasticity:** the ability to accommodate workloads with very large peak-to-average ratios.

- **User convenience:** virtualization allows users to operate in familiar environments rather than in idiosyncratic ones.

Emulating the Real World

- Agile software development team.

- Learning by doing.
  - How to use cloud resources.
  - Programming and running real systems.

- Many of the projects relate to
  - state-of-the-art systems running in the cloud.
  - latest systems research.

- There are all kinds of internship opportunities and ways to engage if you are doing well!

Some Suggestions

- Working as a team:
  - Some of your team members will flake out
  - Some of your mentors will flake out
  - Some of your mentors will have unrealistic expectations

- Come to office hours for help with detailed coding problems.

- Be in touch with your mentors.
  - Focus on the high-level questions
  - Let the instructors know early if there are problems

How to Read

You May Think You Already Know How To READ, But…

Why Do We Need to Read Paper?

- Reading for classes
- Reach the edge of human knowledge
- Keeping up with your field
- Transitioning into a new areas
- Learning how to write better papers

Keshav's Three-Pass Approach: Step 1

- A ten-minute scan to get the general idea
  - Title, abstract, and introduction
  - Section and subsection titles
  - Conclusion and bibliography

- What to learn: the five C's
  - Category: What type of paper is it?
  - Context: What body of work does it relate to?
  - Correctness: Do the assumptions seem valid?
  - Contributions: What are the main research contributions?
  - Clarity: Is the paper well-written?

- Decide whether to read further…

Keshav's Three-Pass Approach: Step 2

- A more careful, one-hour reading
  - Read with greater care, but ignore details like proofs
  - Figures, diagrams, and illustrations
  - Mark relevant references for later reading

- Grasp the content of the paper
  - Be able to summarize the main idea
  - Identify whether you can (or should) fully understand

- Decide whether to
  - Abandon reading in greater depth
  - Read background material before proceeding further
  - Persevere and continue for a third pass

Keshav's Three-Pass Approach: Step 3

- Several-hour virtual re-implementation of the work
  - Making the same assumptions, recreate the work
  - Identify the paper's innovations and its failings
  - Identify and challenge every assumption
  - Think how you would present the ideas yourself
  - Jot down ideas for future work

- When should you read this carefully?
  - Reviewing for a conference or journal
  - Giving colleagues feedback on a paper
  - Understanding a paper closely related to your research
  - Deeply understanding a classic paper in the field

Other Tips for Reading Papers

- Read at the right level for what you need
  - “Work smarter, not harder”
- Read at the right time of day
  - When you are fresh, not sleepy
- Read in the right place
  - Where you are not distracted, and have enough time
- Read actively
  - With a purpose (what is your goal?)
  - With a pen or computer to take notes
- Read critically
  - Think, question, challenge, critique, …