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Introduction

Dr Nguyen Tran

School of Computer Science

Outline

- Why this course ?
- What this course is about?
  - Definitions, Examples and Challenges of Distributed Systems
- Course Logistics
  - Lectures/Tutorials
  - Assessments
- Expectation and Outcomes
- Resources

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What is a Distributed System?

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"A collection of independent computers

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Cloud computing

- **"Anything-as-a-Service"**
  - Software-as-a-Service
  - Platform-as-a-Service
  - Infrastructure-as-a-Service
  - Mobile Backend as-a-Service

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Google Cloud Firebase amazon web services™

Microsoft Azure anypresence Kii Back4App

Cloud computing

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https://cloud.google.com/about/locations/#regions-tab

Cluster

CSIRO Bracewell

114 PowerEdge C4130 servers with Nvidia Tesla P100 GPUs, Nvlink, dual Intel Xeon processors, and 100Gbps EDR InfiniBand interconnect.

1,634,304 Cuda compute cores, 3192 ores, and 29TB of both Linux and

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https://www.csiro.au/en/Research/Technology ting/Bracewell

USYD Artemis

ACCESS TO ARTEMIS

https://sydney.edu.au/research_support/hpc/access/index.shtml

Social Networks

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Chip Multiprocessors

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Sensor Networks

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Personal Area Networks

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Blockchain

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https://www.pwc.com/us/en/industries/financial-services/fintech/bitcoin-blockchain-cryptocurrency.html

Blockchain applications

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Distributed Machine Learning

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Why this course ?

- **Distributed Computing Systems are everywhere !**
  - Practically you can not avoid them.

- Knowledge and experience in Distributed Systems will be useful;
  - For your final y
  - To improve you
  - Pursue your passion as a hobby
  - Just for Fun !
  - **Improve your chances of getting a better job**

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- COMP3221 is about;
  - **What is a distributed system?**
  - **How it works?**
  - **How to run yours?**

COMP3221 – Course Description

- The unit will provide a broad introduction to the principles of distributed systems and their design; provide students the fundamental knowledge required to analyse and construct various types of distributed systems; explain the common architectural principles and approaches used in the design of networks at diff edium access and routing); introdu equired for developing distributed applicati cover the use of Python class libraries and APIs; c n approaches and techniques in distributed resource management (e.g. task scheduling, machine learning)

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What is a Distributed System?

"A collection of independent computers that appears to its users as a single coherent system."

- **Transparency** helps the users observe a single coherent system
- The different forms of transparency in a distributed systems

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Challenges of Distributed Systems

Understanding the associated challenges to learn **how it works** and **how to run yours.**

- **Network communication**
- **Scalability**
- **Consistency**
- **Fault-tolerance**
- **Machine Learning**
- **Security**

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Scalability

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- Scalability of a distributed system is for the system to preserve some properties as the system grows in
  - the number of requests or participants,
  - the distance between resources and users, or
  - the heterogeneity.

Scalability Example – DNS

Hostname to IP address translation

Why not centralize DNS?

- single point of f
- traffic volume
- distant centralized database
- maintenance

A: doesn't scale!

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Scalability Example – Twitter

- **Burst of load:**
  - **456** tweets per second (TPS) when Michael Jackson died (
  - **6,939** 2011 New Year's day.
- **Increase in participation**
  - **+182%**: Increase in number of mobile users in 2010.
  - **>500,000** new accounts created on a single day.

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Source: http://blog.twitter.com/2011/03/numbers.html

Consistency

- *Consistency;* a property applying to a collection of data items that are accessed by distributed participants.

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- Examples of incon, I observe that Djokovic lost against Nadal but th on against Federer in the 2012 French Open.

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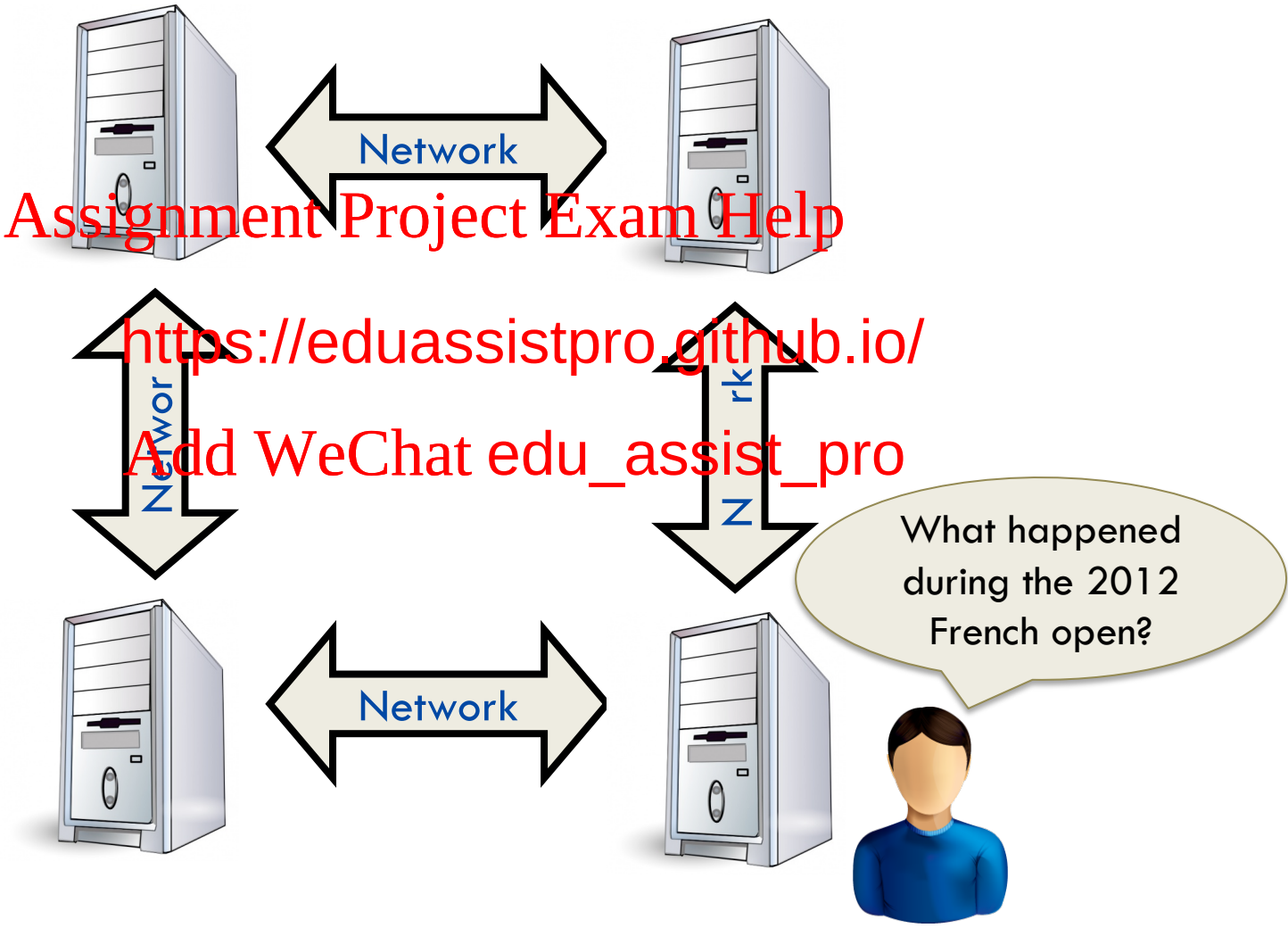
Consistency Example

Commodity clusters



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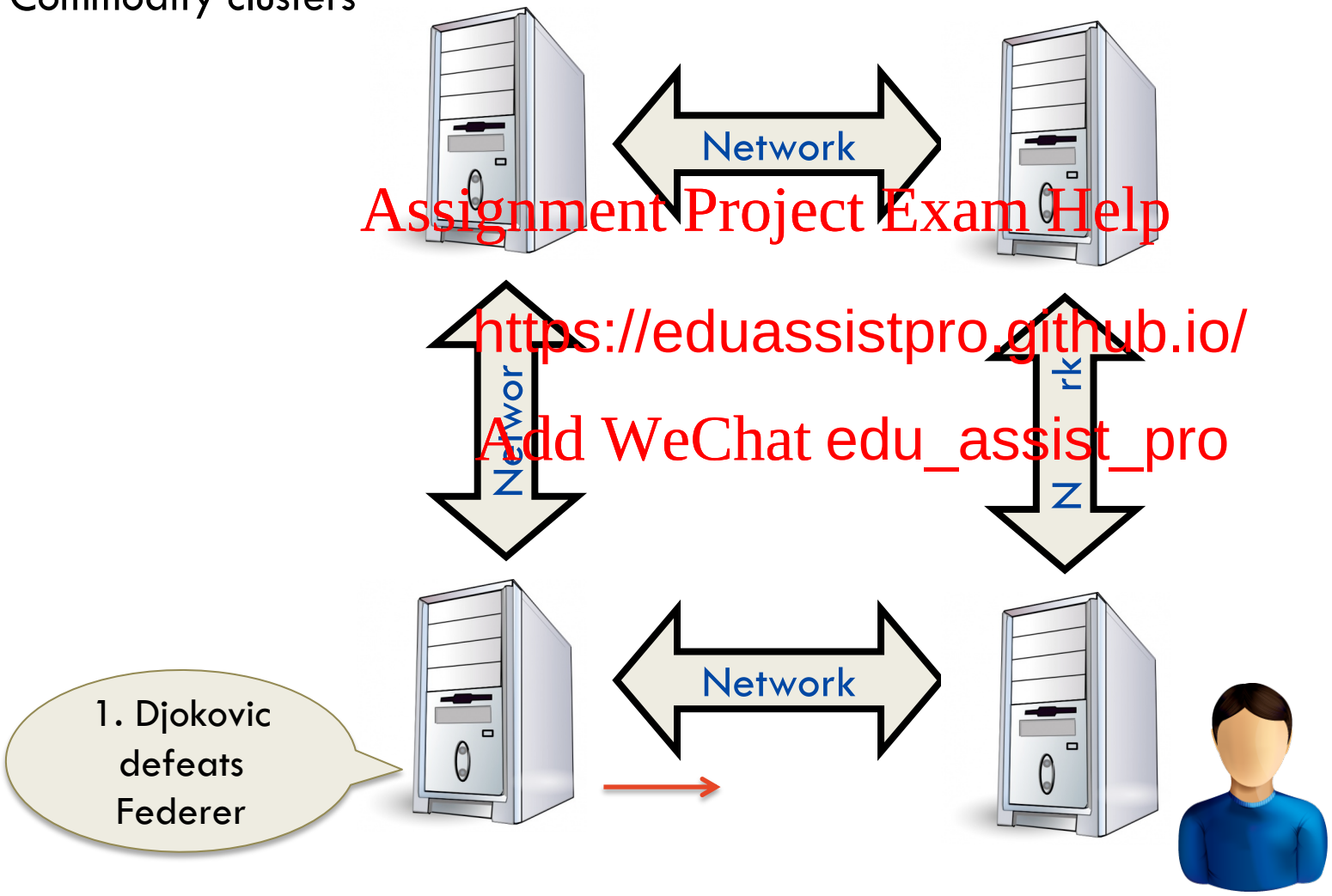
Consistency

Commodity clusters



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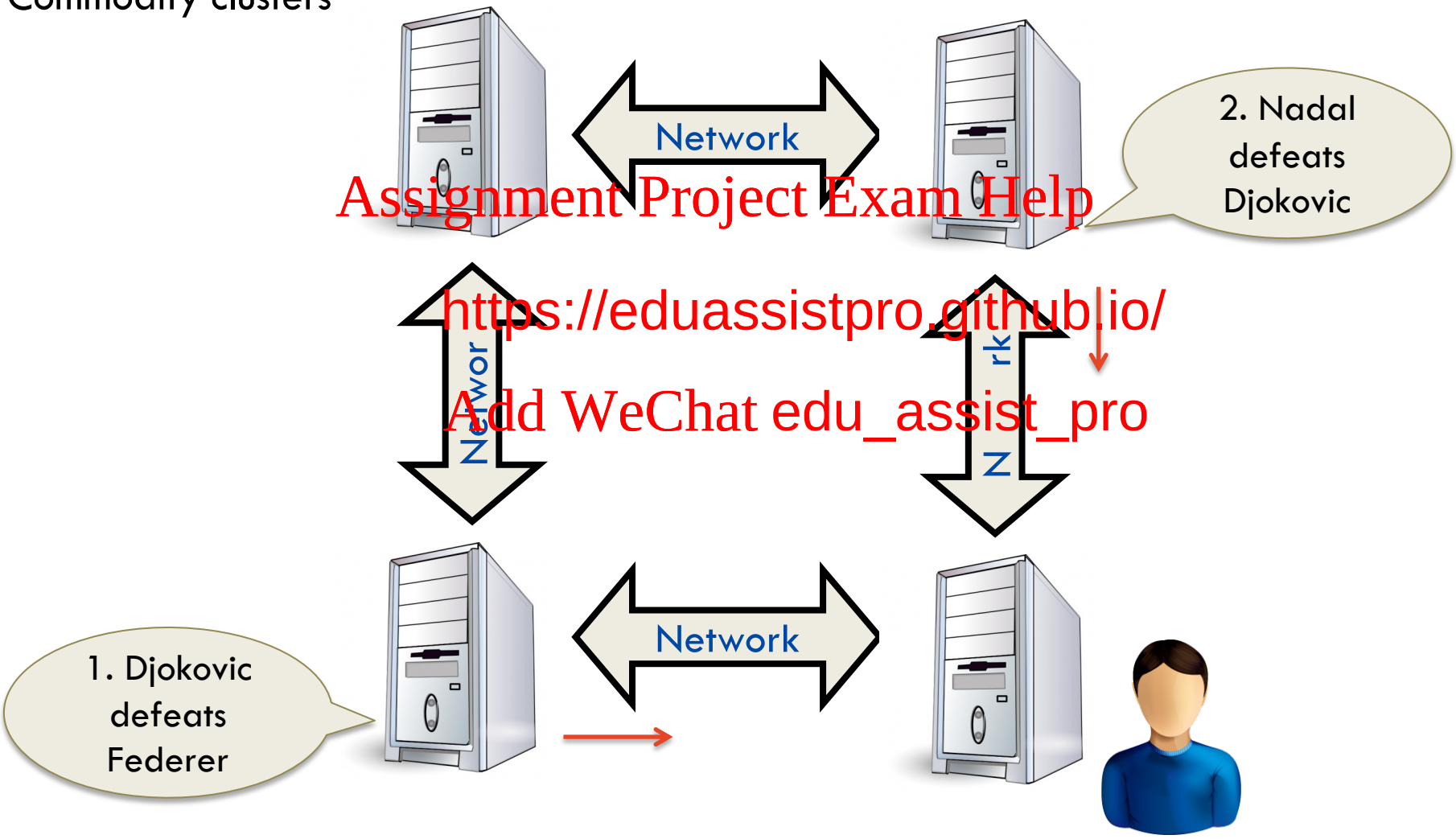
Consistency

Commodity clusters



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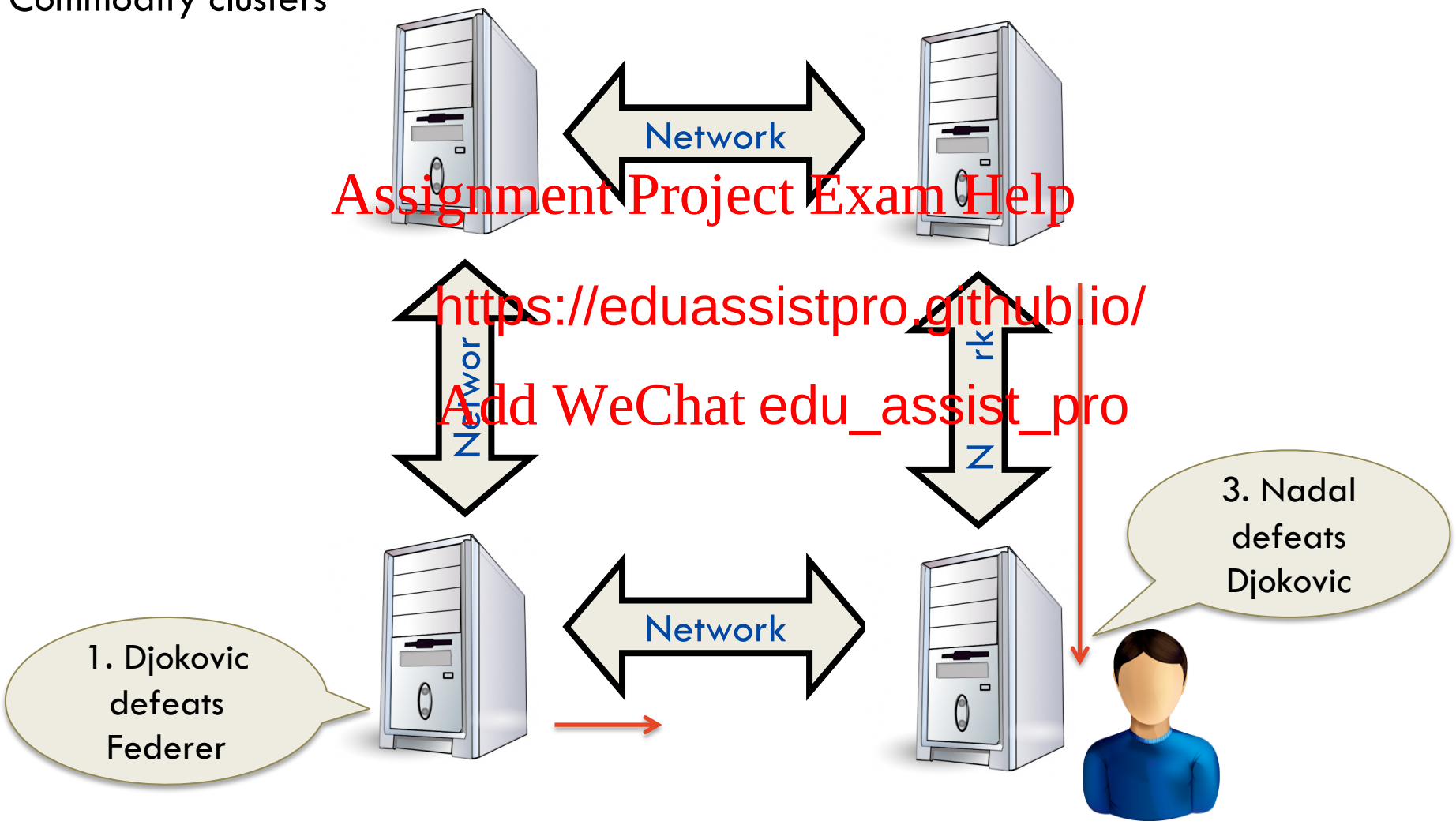
Consistency

Commodity clusters



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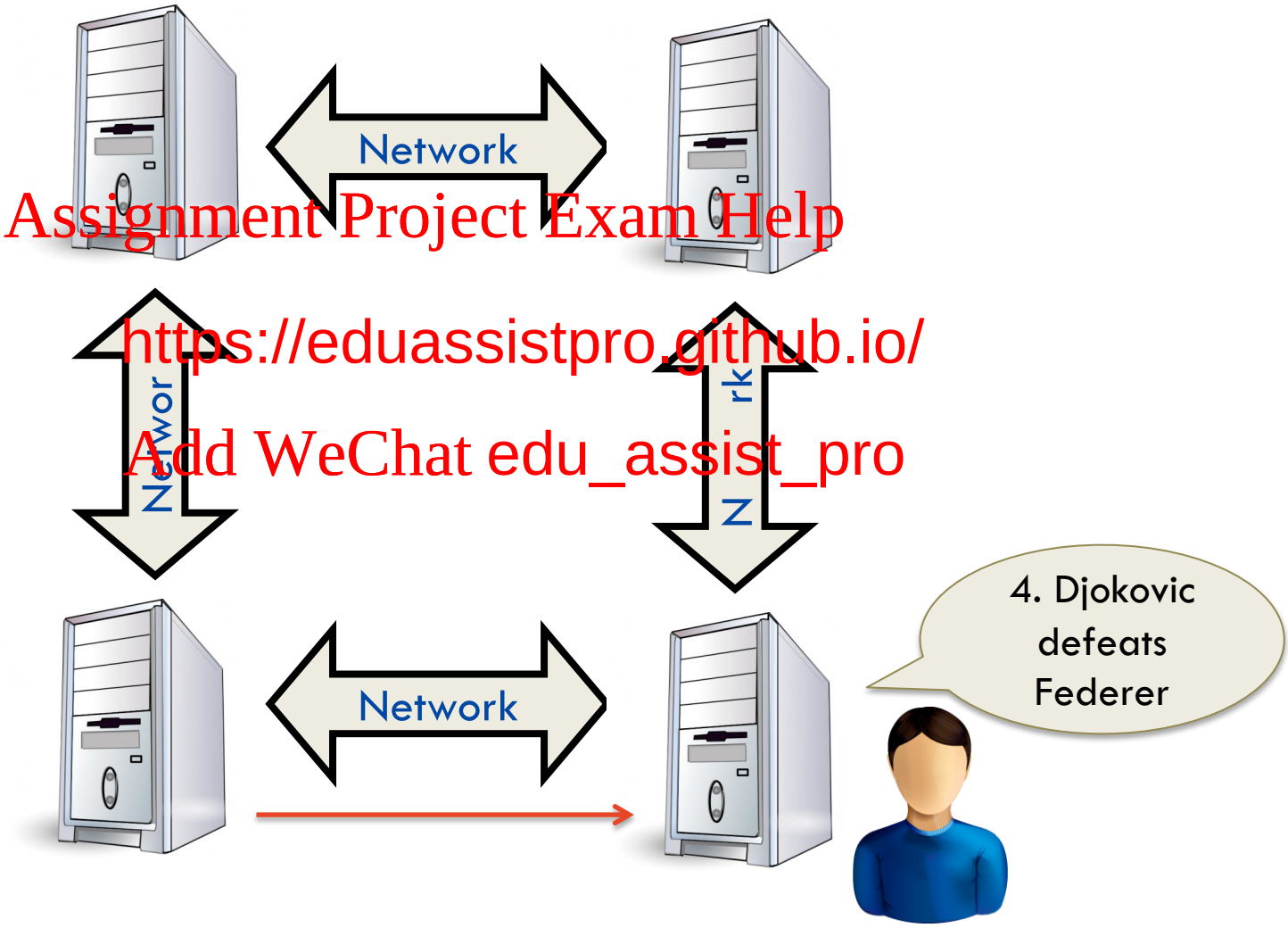
Consistency

Commodity clusters



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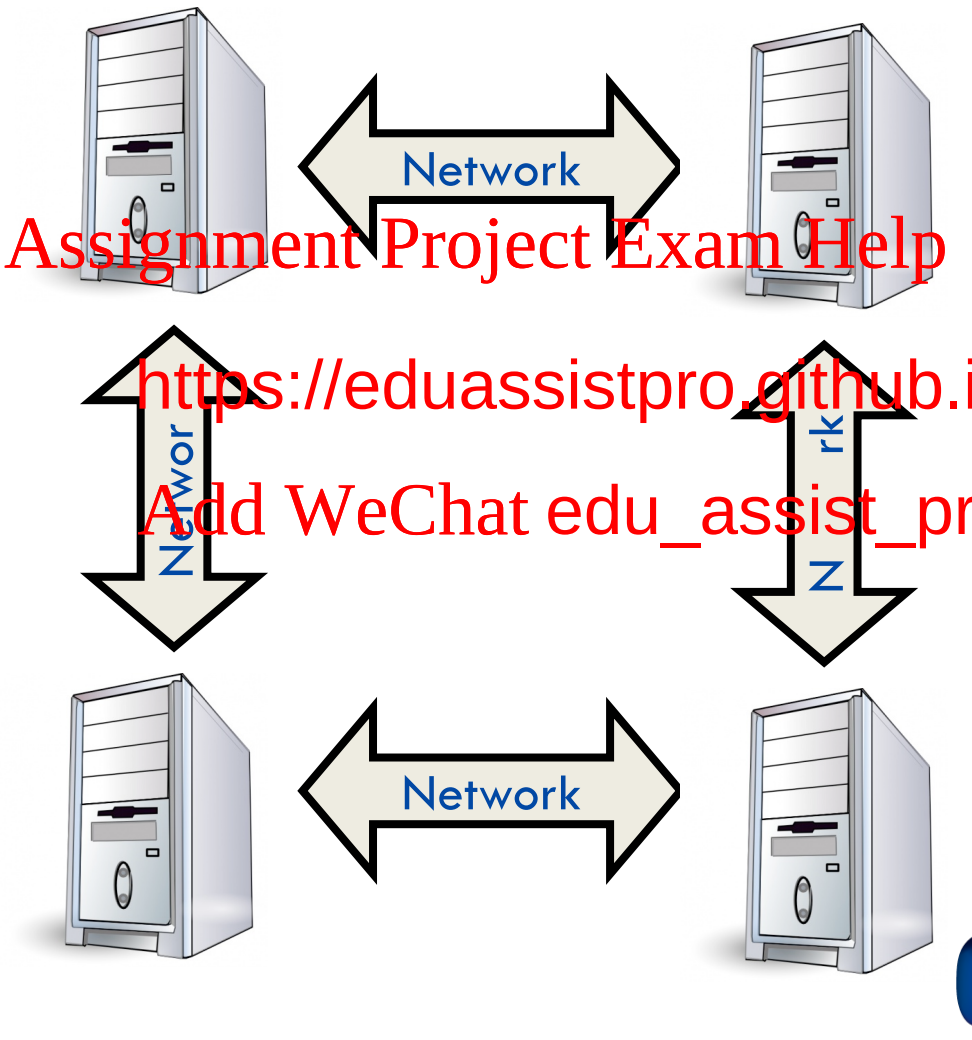
Consistency

Commodity clusters



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Fault-Tolerance

- *Fault-tolerance of a distributed system:* the ability for the system to recover from partial failures.
- How to keep the distributed system up and running, thereby appearing as a single running system to its users?

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Distributed Machine Learning

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COMP3221: Resources

- Canvas: https://canvas.sydney.edu.au/
  - Login using Unikey and password
  - Link to Units website: https://sydney.edu.au/units/
    - Official schedule, list of learning outcomes, etc
  - Copies of slides
  - Lab instructio
  - Assignment in
  - Lecture videos
    - We will record the lectures, ology is not reliable
  - *Submit official assignment work here*;
  - see your grades; etc
  - Discussion forum: on Edstem, link from Canvas site

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Prerequisites

- Python Programming
  - (INFO1103 or INFO1113) OR (INFO1105 or INFO1905)

- Algorithms and Data Structures
  - COMP2123 OR

- Prohibitions
  - COMP2121 – Older version of this c

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- You need to go through Special Permission to enroll if you do not have the above requirements

COMP3221 - Schedule

Week	Lectures	Labs/Tutorials
1	Introduction	-
2	Architecture & Processes	Multithreading
3	Communication (Routing)	Routing
4	Communication (TCP) & Naming	Client - Server
5	Synchronization	
6	Consistency	ency
7	Blockchain	Quiz
8	Fault tolerance	
9	Distributed Linear Regression	Linear Regression
10	Distributed Optimization	Distributed Optimization
11	Distributed Logistic Regression	Logistic Regression
12	Security	Security
13	Course Review	-

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Schedule may Change

Assessment

Task	When	Marks
Mid-term Quiz	Week 07 Tutorial Time	15%
Final Exam	TBA	50%

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- The mid-semest l test the students' understanding o and concepts and ability to put it in the appropria f solving problems.

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  - What I hear, I forget;
  - What I read, I remember;
  - What I do, I understand.

-- Confucius

Academic Dishonesty & Plagiarism

- Academic Integrity
  - Plagiarism: NO
  - Outsourcing: NO

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  - Academic dishonesty means seeking to obtain or obtaining academic advantage for o he assessment or publication of w .
  - Plagiarism mean rk as one's own work by presenting, copying or reproducing it priate acknowledgement of the source.

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- Submitted work is compared against other work (from students, the internet, etc.)
  - Turnitin for textual tasks (through eLearning), other systems for code

- Penalties for academic dishonesty or plagiarism can be severe

Resources

Textbook

Distributed Systems – Principles and paradigms by *Tanenbaum and Van Steen. 2nd Edition.*

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- This and other relevant works can be found in the university library and also in the bookshop.

Resources

- Canvas UoS website: https://canvas.sydney.edu.au/
  - Login using Unikey and password
  - Submit official assignment work here or on PASTA
  - Copies of slides and tutorials
  - Assignment instructions
  - Lecture recordin
- Discussion forum is linked on the website (invitations sent):
  - Ed
  - Post questions online (on this forum)
  - Everyone is welcome to answer and rate answers

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Expectations

- Students attend scheduled classes, and devote an *extra* 6-9 hours per week
  - doing assessments
  - preparing and reviewing for classes
  - revising and integrating the ideas
  - practice and sel
- Pre-requisites
  - All programming will be done in Python and knowledge and experience in Python programming is expected

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Expectations

- Students are responsible learners
  - Participate in classes, constructively
    - Respect for one another (criticize ideas, not people)
    - Humility: no knows valuable things
  - Check Ed and C k
  - Notify academics whenever there
  - Notify group partners honestly and ut difficulties

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Get help... !

- Consultation
  - By appointment

- Tutors:
  - Check on Canva

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Advice

- Lectures notes are for help
- You should understand in-depth
- Practice your re amples at home
- Think about implications, ask que
- Re-read your notes or the lecture notes at home after the class to memorize easily

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What's Next ?

- Time management
  - Watch the due dates
  - Start work early, submit early
- Networking and
  - Make friends a
  - Know your tutor, lecturer, coordina
  - Keep them informed, especially if y
    - Don't wait to get help
- Enjoy the learning!

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