COMPUTER SCIENCE IN EVERYDAY LIFE

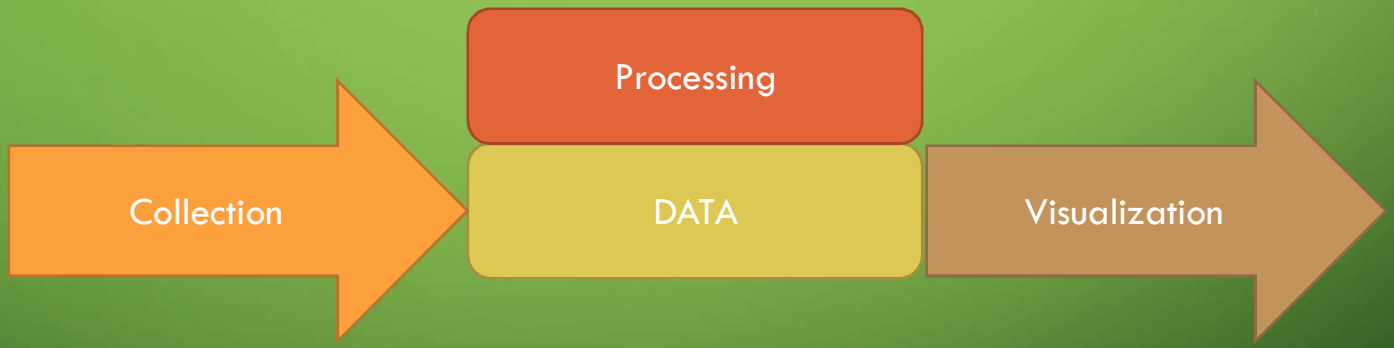
INTEGRATED MATHEMATICAL SCIENCES 1/59

WHY DO WE WANT COMPUTER IN OUR LIFE?

- Work is repetitive
- Work is tedious
- Human is lazy

WHAT IS COMPUTER SCIENCE?

- Computer Science is Science revolving around Data



- Computer Science is not just about Programming/Coding

EXAMPLE OF COMPUTER USAGE

- Weather Forecast

Input from Satellites

Parameterized Partial Differential Equations

Turbulent Diffusion, Radiation, Moist, Heat, …

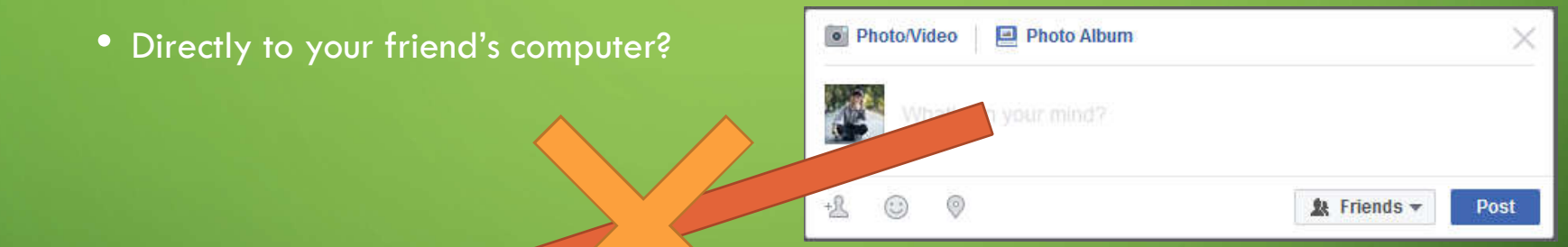
Weather Forecast

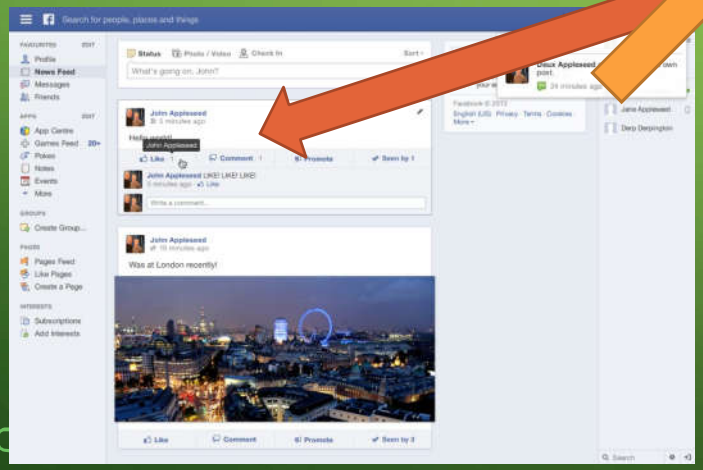
COMPUTER TECHNOLOGY

- There are many topics in Computer Science
- Each topic is developed separately but they can be cross-referenced
- Technology that we use today is a conjunction of several Computer Science topics

FIRST EXAMPLE: HOW DOES FACEBOOK WORK?

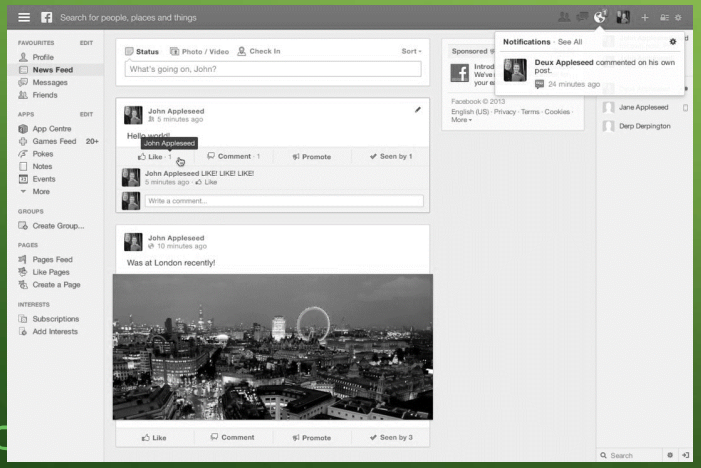
- Write a text and click “Post”
- Where does this text go?
  - Directly to your friend’s computer?

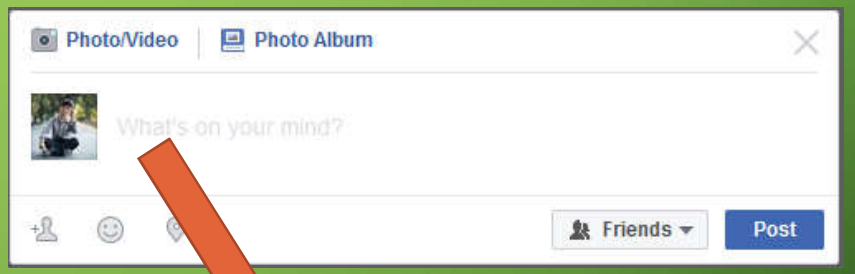




HOW DOES FACEBOOK WORK? (2)

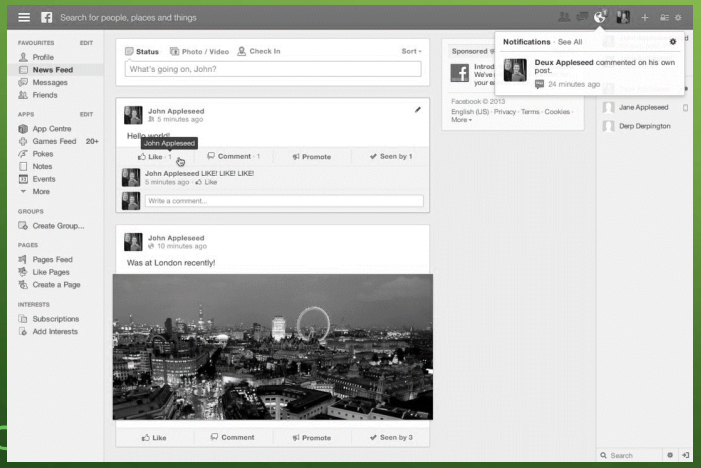
- This text goes to Database Server
- In fact, all texts around the world go to this Database Server

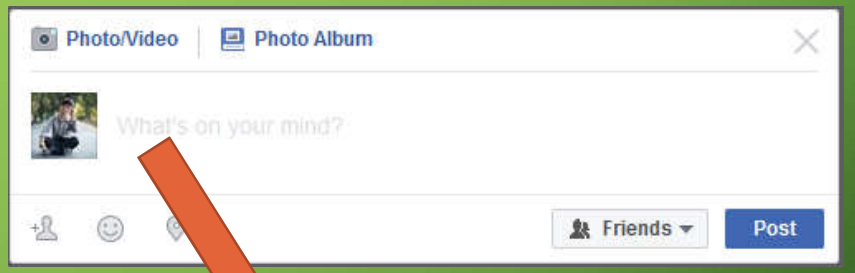




DATABASE MANAGEMENT SYSTEM

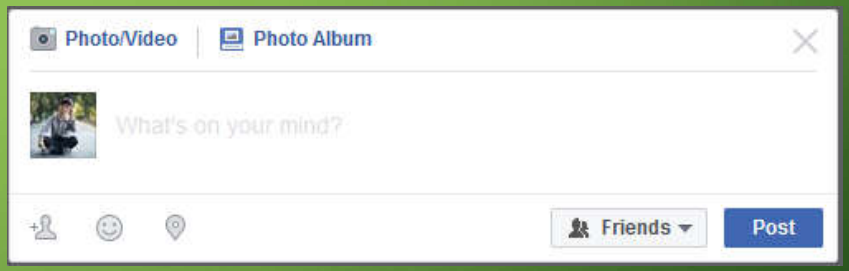
- How to store data efficiently?
- How to retrieve data swiftly?
- How to maintain data properly?

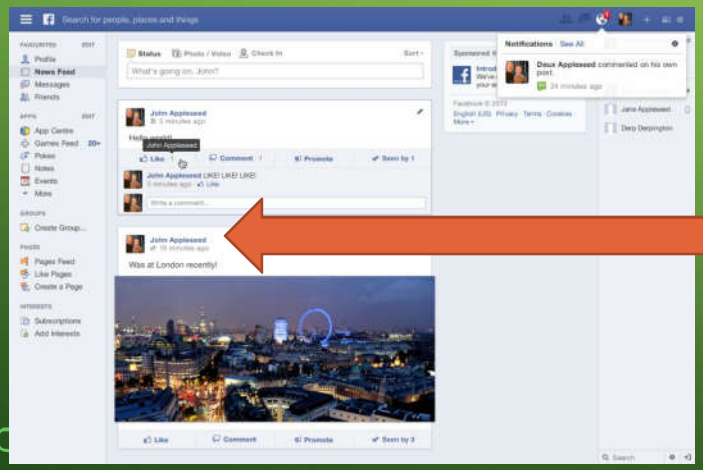




HOW DOES FACEBOOK WORK? (3)

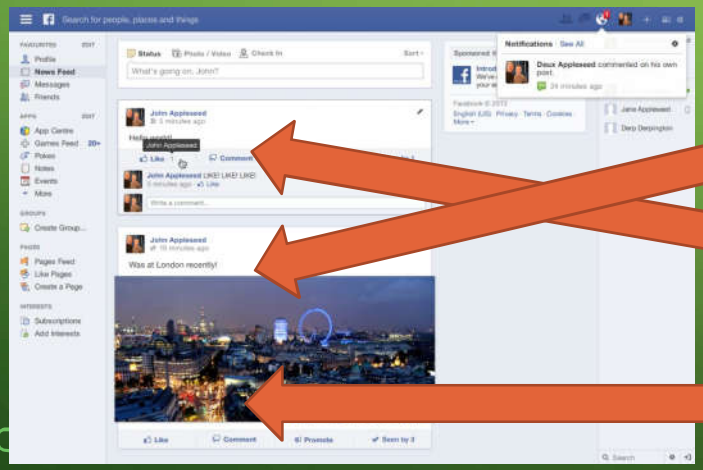
- Are all texts from Database Server displayed on the screen?
- How does Facebook sort newsfeed?





ARTIFICIAL INTELLIGENCE

- Collect your likes/shares/posts information
  - (or even the time you pause on a particular post)
- Predict your interest based on that information



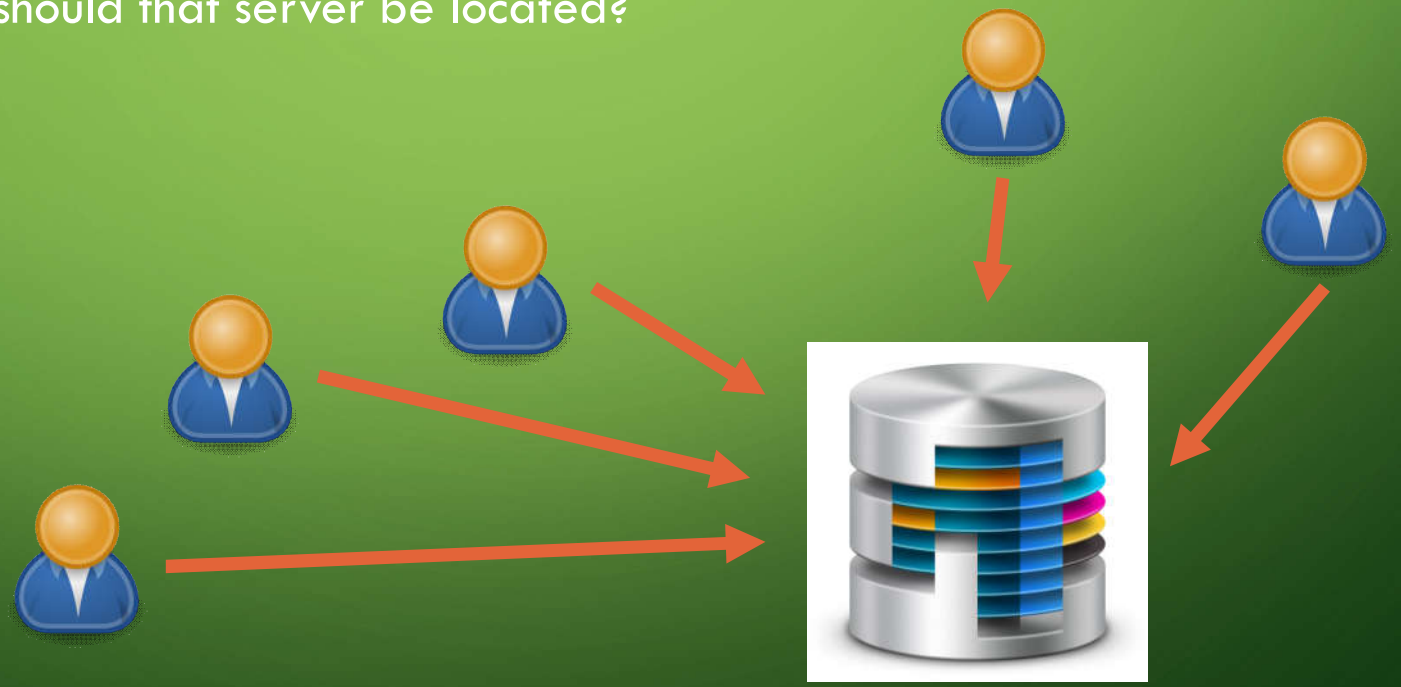
TEXT 1
Score: 0.7

TEXT 2
Score: 0.9

TEXT 3
Score: 0.5

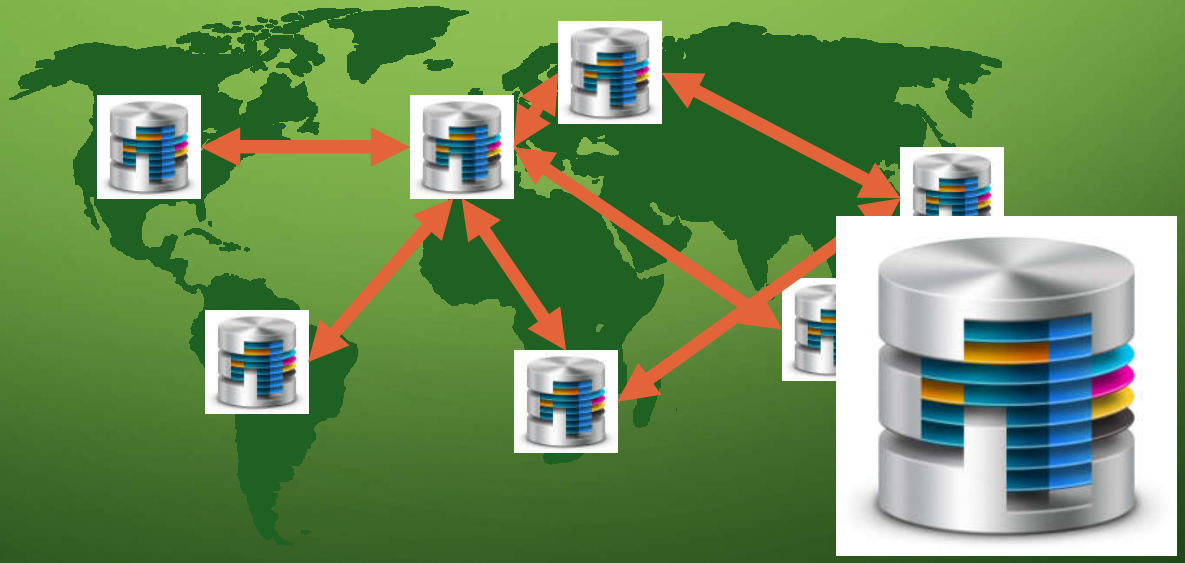
HOW DOES FACEBOOK WORK? (4)

- Are all texts saved on a single Database Server?
- If so, where should that server be located?



DISTRIBUTED SYSTEM

- A large number of computers help each other to do the work
- Texts are stored in multiple servers across the globe to prevent system failure

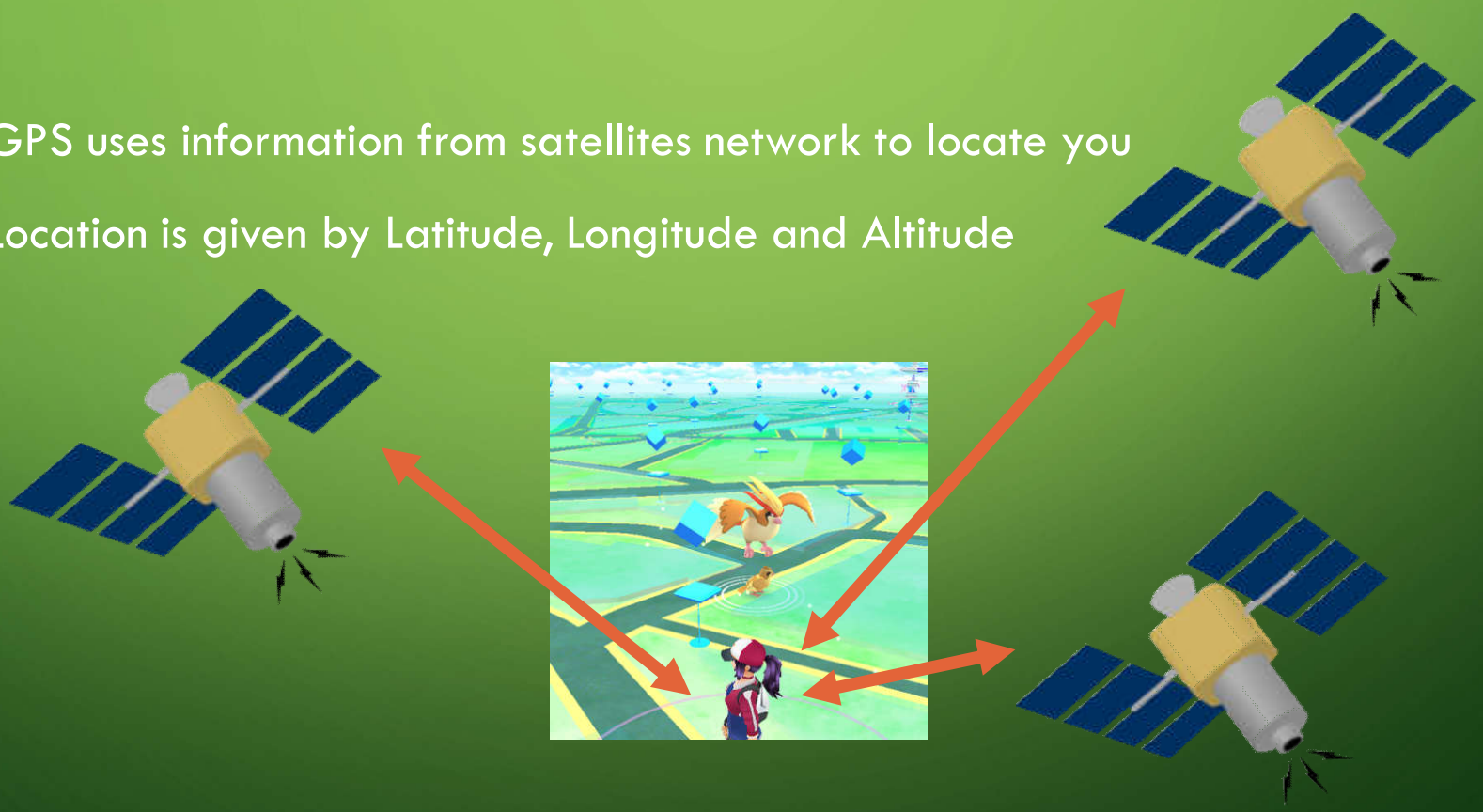


SECOND EXAMPLE: POKÉMON GO

- How does the game know where you are?
- Where does Pokémon come from?

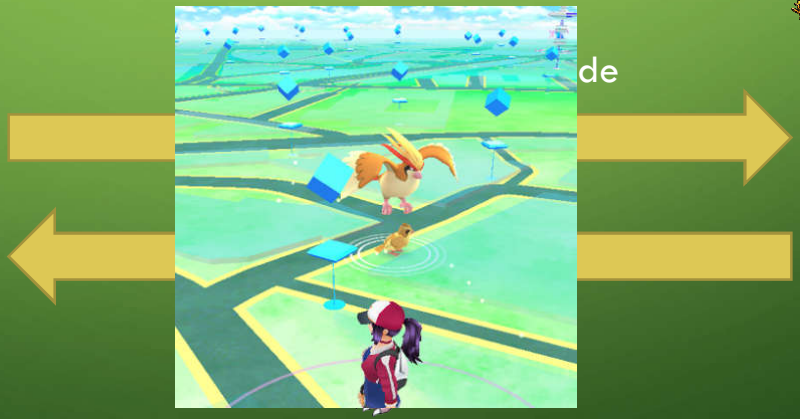
GLOBAL POSITIONING SYSTEM (GPS)

- GPS uses information from satellites network to locate you
- Location is given by Latitude, Longitude and Altitude



COMPUTER NETWORK

- Player sends GPS information to Server
- Server sends back Pokémon information
- Focus on fast response time to prevent latency



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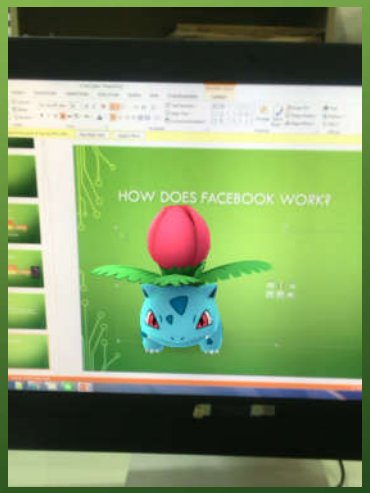
COMPUTER GRAPHIC

- Initially create artificial object in artificial world with semi-real physics
- Virtual Reality – Bring real person to artificial world via sensors
- Augmented Reality – Bring artificial object to the real world via cameras

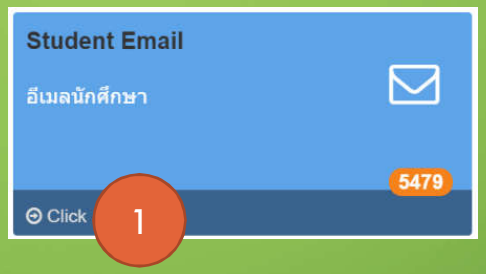


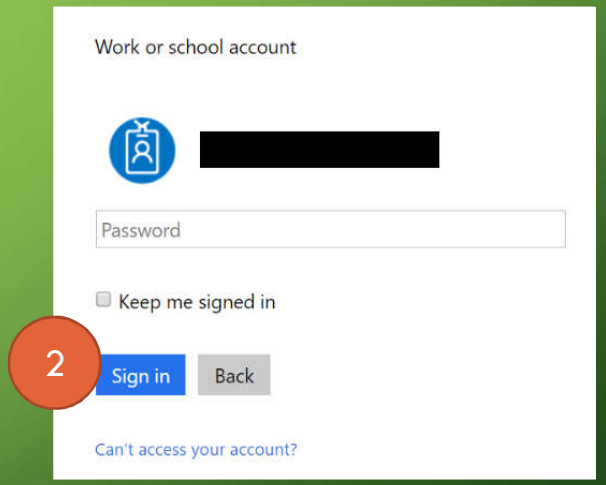
COMPUTER SECURITY

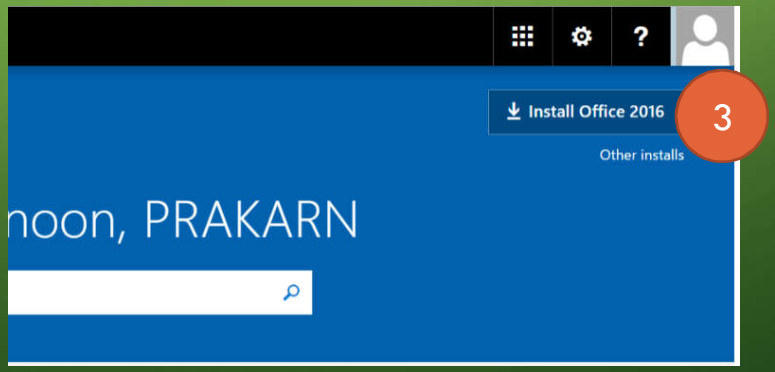
- Encrypt message so no one understand except senders and receivers
- Prevent unauthorized access
- Detect anomaly activities (virus, malware, Trojan)

USEFUL TOOLS: MICROSOFT OFFICE

- Free for CMU students!!!
- Go to https://portal.cmu.ac.th/
- Click on “Student Email” and login
- Select “Install Office 2016”, save and run the installer

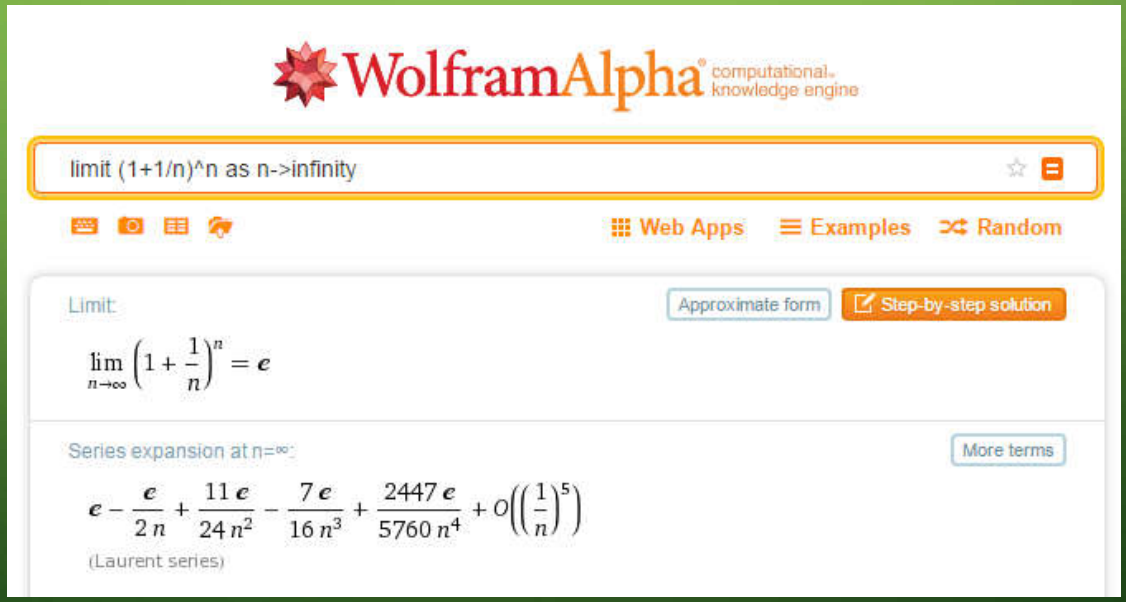






USEFUL TOOLS: WOLFRAM ALPHA

- Go to https://www.wolframalpha.com/
- Ask any Math-related problems



USEFUL TOOLS: CLOUD STORAGE

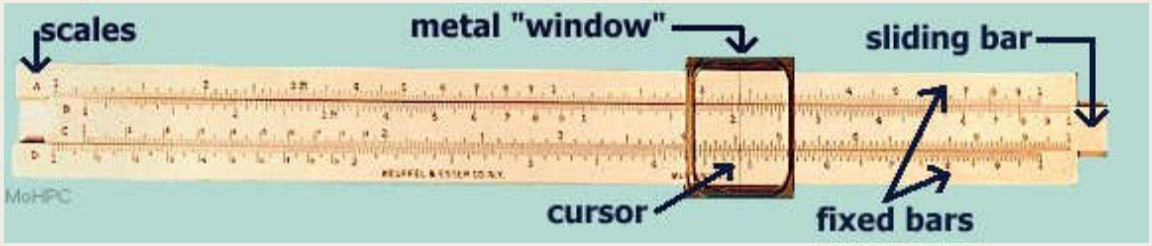
- https://www.dropbox.com/ (2 GB Free)
- https://onedrive.live.com/ (5 GB Free)
- https://www.google.com/drive/ (15 GB Free)
- https://www.box.com/ (10 GB Free)

HISTORY OF CALCULATION

Evolution of Computation

Mechanical Era

- Slide Rule is the first mechanical device for numeric calculation
- Slide Rule can do Multiplication, Division, Power, Root and Trigonometry
- Slide Rule works in 2 Steps
  - *Set initial configuration (calibration) between two bars*
  - *Read the value on fixed bar that matches the desire value on sliding bar*



Mechanical Era (2)

What is good about this Slide Rule?

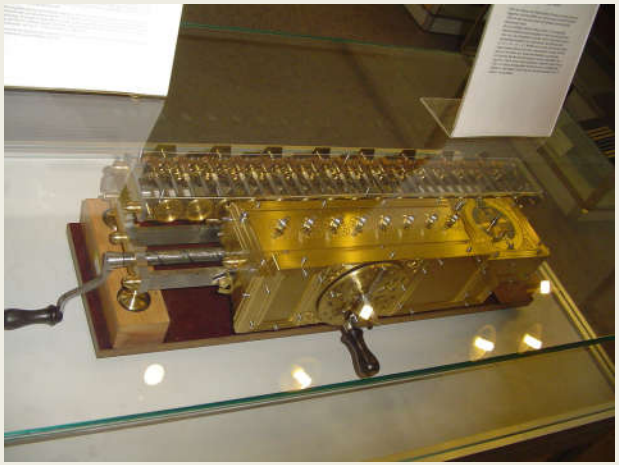
- It can perform many complex calculations, without needing electricity!
- It has visited the moon
- Astronauts in Apollo 11 brought Slide Rule during the trip to the moon in 1969

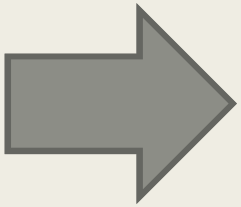
Limitation of Mechanical Devices

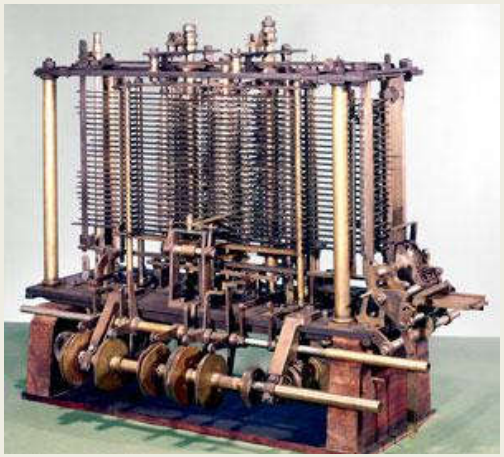
- Although they are fast (such as Abacus), they lack some basic things of computer
- No memory
- Not customizable
- Require human in every step (remember that we are lazy!!!)

Pre-World War 2 Era

- Transition from small mechanical device to a (very) large machine that consisted of several moving parts
- They are very fast and powerful but require a physical space







Jacquard's Loom (1801)

- Developed by Joseph-Marie Jacquard
- Create a complex knitting very fast using a set of punches cards
- Weavers hate this machine for obvious reason
- Jacquard's Loom at work:
  - https://www.youtube.com/watch?v=OlJns3fPltE
- These earlier machines use *punch card* for data

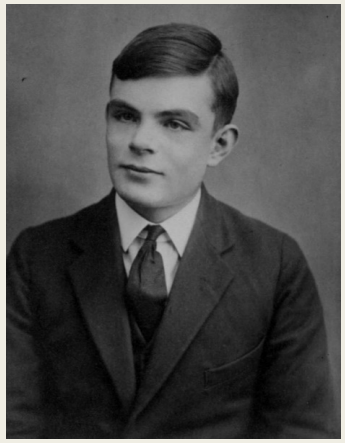
Hollerith's Census Machine (1890)

- USA wants to record all population data of its people (called US Census)
- At that time, there are about 62 million people
- Inspired by Jacquard's Loom, Herman Hollerith built a machine that processed census data
- The machine processed 1890 data within 3 months and result was published in 1892
- He found a company which later becomes IBM
- https://www.youtube.com/watch?v=9HXjLW7v-II

World War 2 Era

- Introduce new complicated problems
- How should troop be deployed?
- How can the secret code be cracked?
- Everything must be automated
- Military was willing to spend a large sum of money on creating automated machine

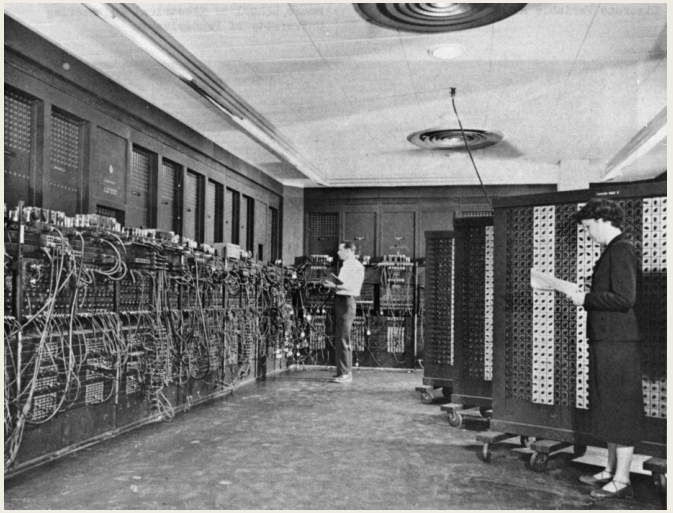
Alan Turing



- Formularize the notions of computation and computability
- Work for UK in developing a machine that can crack German Enigma code during World War 2, helping the Allies to defeat Nazis
- Some said that his work had shortened the war by 4 years
- After World War 2, he developed a test for machine intelligence now called Turing Test
- The Turing Award is the highest award in computing (2016 award winner is the inventor of World Wide Web and the first web browser)

Very First Computer

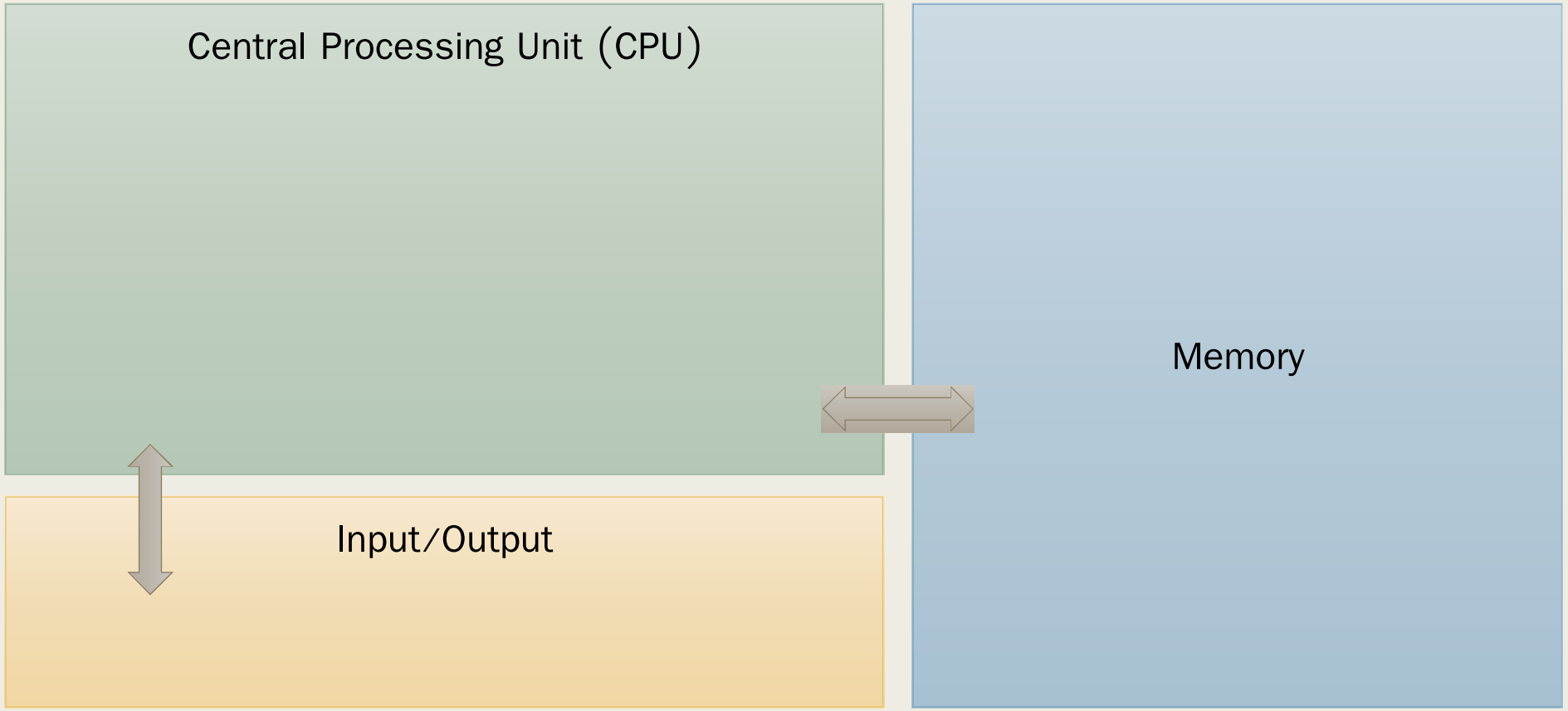
- Harvard Mark I
  - *Electromechanical machine*
- ENIAC
  - *Fully electronic machine*
- They were programmed externally
  - *Programs determined by wiring*



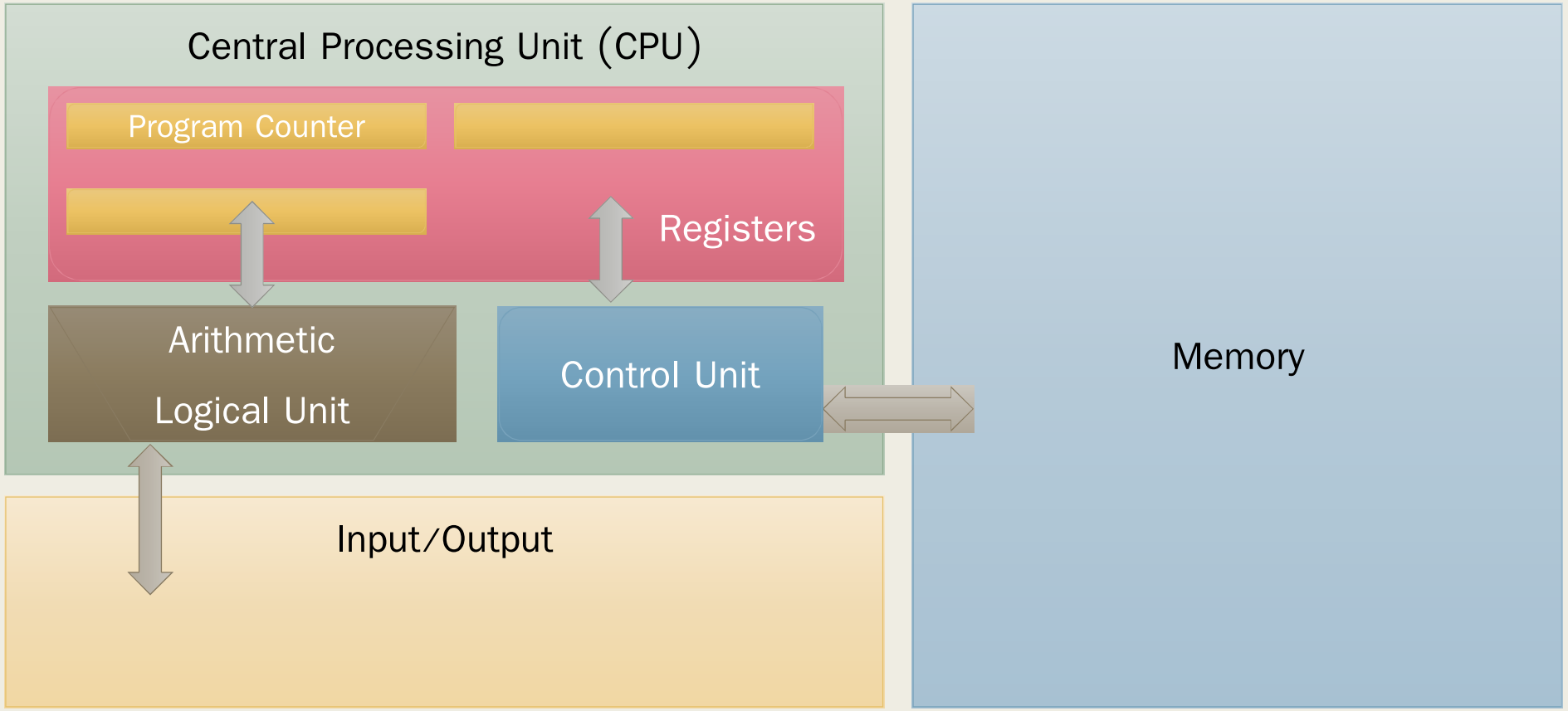
Von Neumann Architecture

- Programs are considered data so they are stored along with data
- Mauchy and Eckert were the first ones to come up with stored-program but John von Neumann publishes the concept and gained recognition
- Machine are partitioned into 3 parts
  - *Control Processing Unit*
  - *Memory*
  - *Input/Output*

Von Neumann Architecture (2)



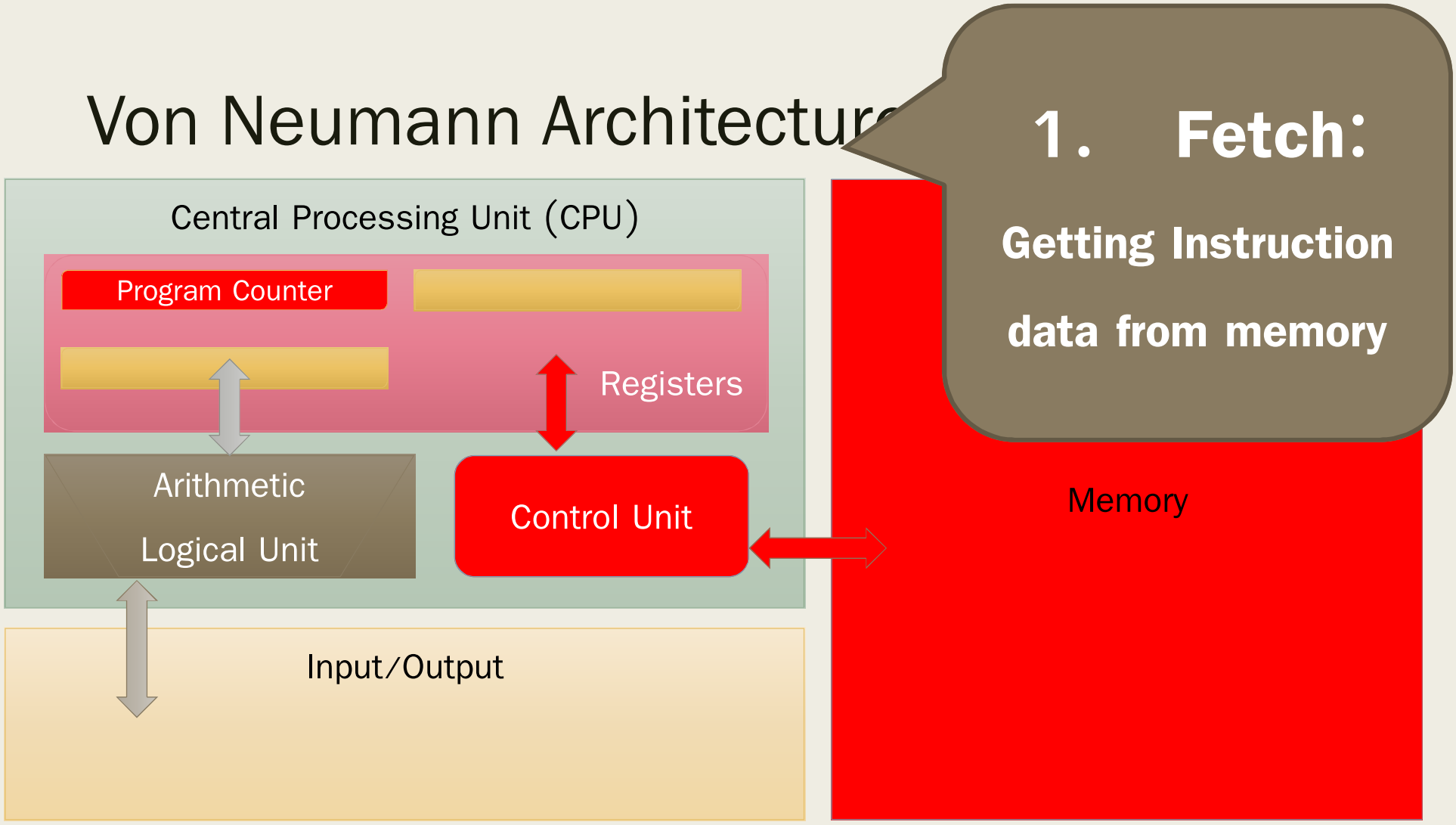
Von Neumann Architecture (3)



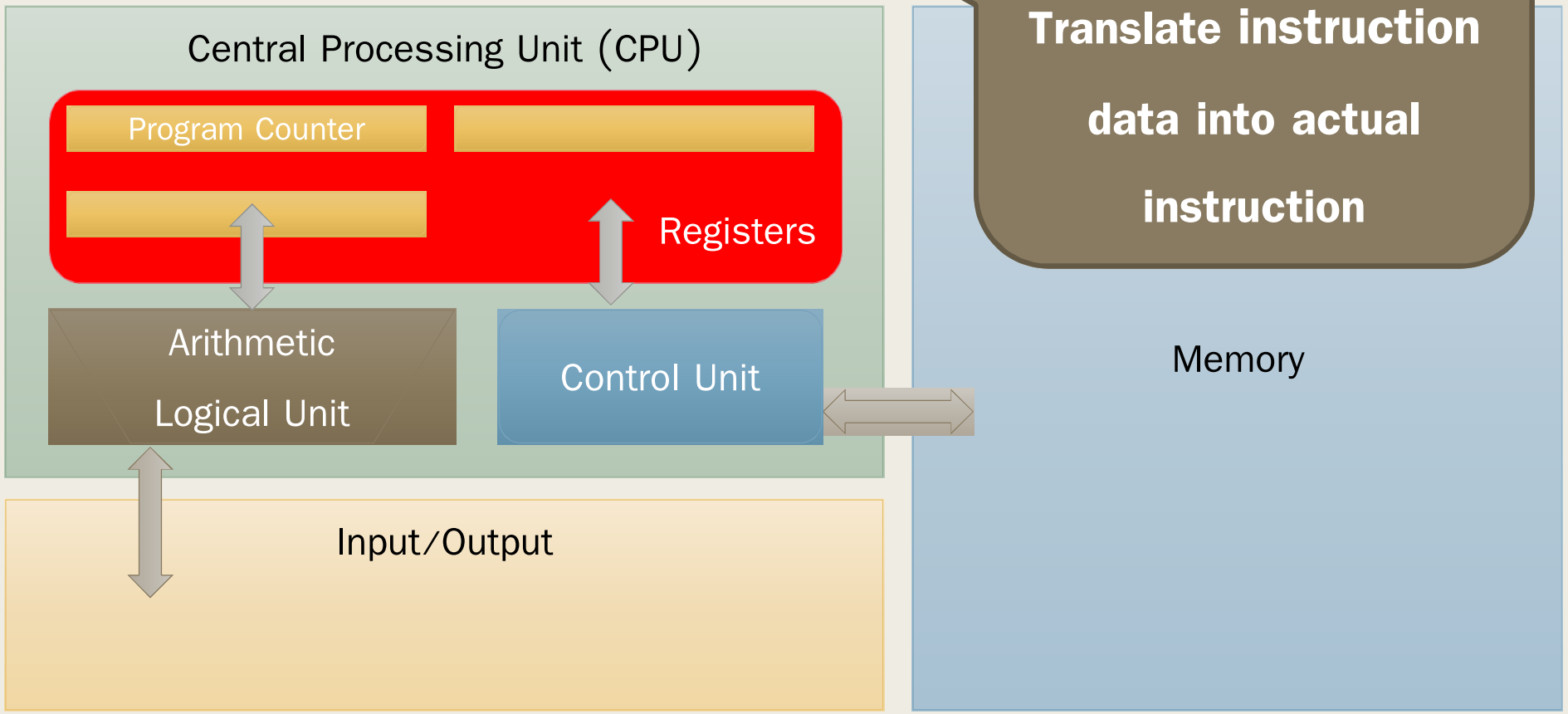
Inside the CPU

- Control Unit
  - *Tell the other parts what to do*
- Arithmetic Logic Unit
  - *Perform calculations and logical operations*
- Registers
  - *Fast storage inside the CPU*
  - *One of them is program counter, which tell the CPU where the current instruction is in the memory (and where the next one can be retrieved)*

Von Neumann Architectur



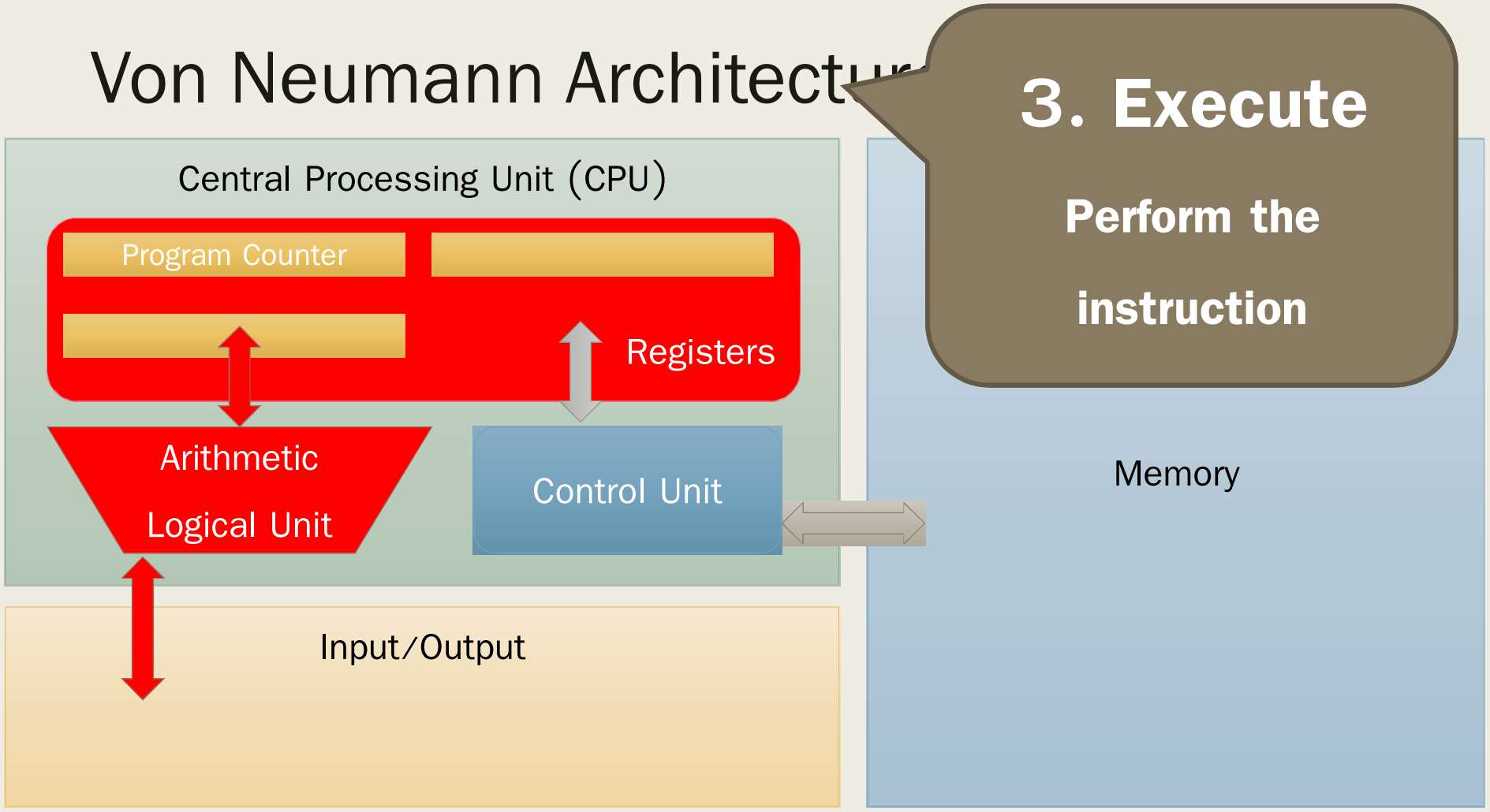
Von Neumann Architect



2. Decode:

Translate instruction data into actual instruction

Von Neumann Architectur

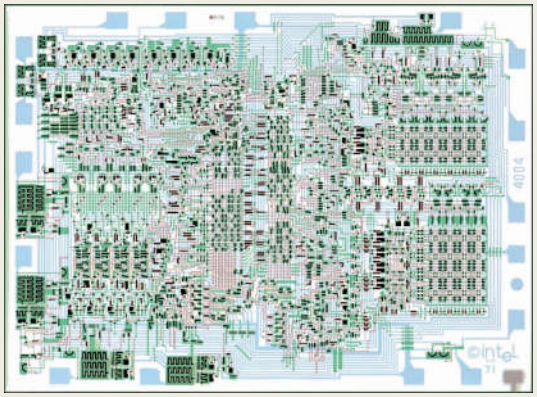


Transistors Era (1947)

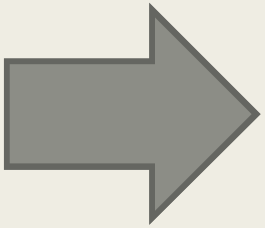
- Replace Vacuum Tubes with Transistors
- More reliable, Smaller size
- Lead to Integrated Circuit (Today's CPU)

Microprocessor Era (1971)

- Intel created the first microprocessor which is a CPU on a small chip (CPU used to live in a standalone box)
- Personal computer revolution happened shortly after



1971



2016

Modern Era (Present)

- All-in-one machine that can do almost everything
- Everyone household own at least one computer
- Mobile phone becomes a larger market than computer (Advertisement needs to be optimized on mobile device, e.g., vertical screen)

Future (of Computing) Era

- Devices do not need to be powerful
- Most computation will be performed on “the Cloud”
- Google launches Google Cloud Platform
- Microsoft launches Microsoft Azure