# *From Computing to Computational Thinking*

## Introduction

# Textbook

## *From Computing to Computational Thinking*

- Why Did the Chicken Cross the Road?—Entering the land of digital computing (CT).
- Bits, Bytes, and Words—Computer memory and digital data
- True Or False—Electronic circuits and digital logic
- Who Is the Master?—The operating system
- Hello There!—Networking

- Home Sweet Homepage :-)—The World Wide Web
- Keeping It Safe—Security and data encryption
- Solve That Problem—Problem solving skills
- Data Everywhere—Data representation, structure, and compression
- Get That App—Understanding application programs

# Computing and CT

- Citizens of information age need to understand and effectively use computers, and the Internet.
- They also need to gain *computational thinking*.
- Computational thinking is the mental skill to apply fundamental concepts and reasoning, derived from modern digital computers and computer science, in all areas, including day-to-day activities.
- CT is thinking inspired by an understanding of computers and information technologies, and the advantages, limitations, and problems they bring.

- CT also encourages us to keep asking questions like: "*What if we automate this?*" "*What instructions and precautions would we need if we were asking young children to do this?*" "*How efficient is this?*" and "*What can go wrong with this?*"
- CT can expand your mind, help you solve problems, increase efficiency, avoid mistakes, and anticipate pitfalls, as well as better interact and communicate with others, people or machines. CT can make you more successful and even save lives!
- Gain CT by understanding computing.

# Background

- Back in March 2006, Dr. Jeannette M. Wing boldly advocated CT as a skill for everyone!
- Within the academic research community, there have been significant discussions on computational thinking, what it encompasses, and its role inside the education system.
- Importance in education: "Computational thinking is a fundamental analytical skill that everyone, not just computer scientists, can use to help solve problems, design systems, and understand human behavior."
- Ought to teach/learn CT at college, high school, middle school, and even elementary schools.
- CT is important in all areas including daily living.

# Apply CT

# Discovering the Secrets of CT

- Simplification through abstraction
- Power of automation
- Iteration and recursion
- An eye and a mind for details
- Precision in communication
- Logical deductions
- Breaking out of the box
- Anticipating problems

# Chicken and Egg

- Which comes first, computing or computational thinking?
- Computing did not develop from vacuum. It evolved from the long history of human civilization.
- Yet, computer science has also generated many unique concepts, techniques, and problem-solving ideas.
- Computing has given rise to a digital ecosystem, called *cyberspace*, that includes us all.
- By learning computing, we can discover/rediscover powerful ideas for CT, that can be applied widely.
- As we gain more understanding of computing and its various aspects, we will raise CT ideas and their meaning throughout this course.

# CT Is Not Unusual

- Knowledge about modern computing. You'll be exposed to new notions and perspectives that not only enrich your thinking but also make you more successful.
- Without the notion of *germs*, people won't achieve proper hygiene practices or effectively prevent disease transmission.
- Understanding of the automobile and things associated with it, is very important for everyone.
- Taking ideas from one field and applying them in another is not new. In fact, many breakthroughs came from such interdisciplinary endeavors. For example, the new biomimicry science studies nature's models and then applies these designs, processes, and inspirations to solve our own problems.

# Computize

- Definition: **computize**, verb. To apply computational thinking. To view, consider, analyze, design, plan, work, and solve problems from a computational perspective.
- When considering, analyzing, designing, formulating, or devising a solution/answer to some specific problem, computizing becomes an important additional dimension of deliberation.

# An Example

- The New York City subway entrances and air vents are at street level. What if streets are flooded? What if flood water enters the subway?
- What if we need to fight fires in a flooded area? Do we have fire boats in addition to fire trucks? Do we have firefighters trained for boats?
- Most portable emergency power generators run on gasoline. What happens if gas runs out and gas stations are flooded?
- What if drinking water supply stops? Can we provide emergency water from fire hydrants? In that case, can we use a mobile contraption that connects to a hydrant, purifies the water, and provides multiple faucets?
- What if emergency power generators are flooded? Should we

waterproof generators in designated at-risk buildings?

- What if cell towers lose power? How hard is it to deploy airborne (drone?) cell relays in an emergency?
- What if we simulate storm damage with computer modeling and find out ahead of time what to prepare for?

# Online Resources

- Textbook website: `computize.org`
- Interactive demos, cross-referenced inside the text, providing hands-on experience
- A place to share views, experiences, and insights on CT
- Information updates
- See page 251 for acess to the online demos