Puzzle Based Learning for Cyber-Security Problems
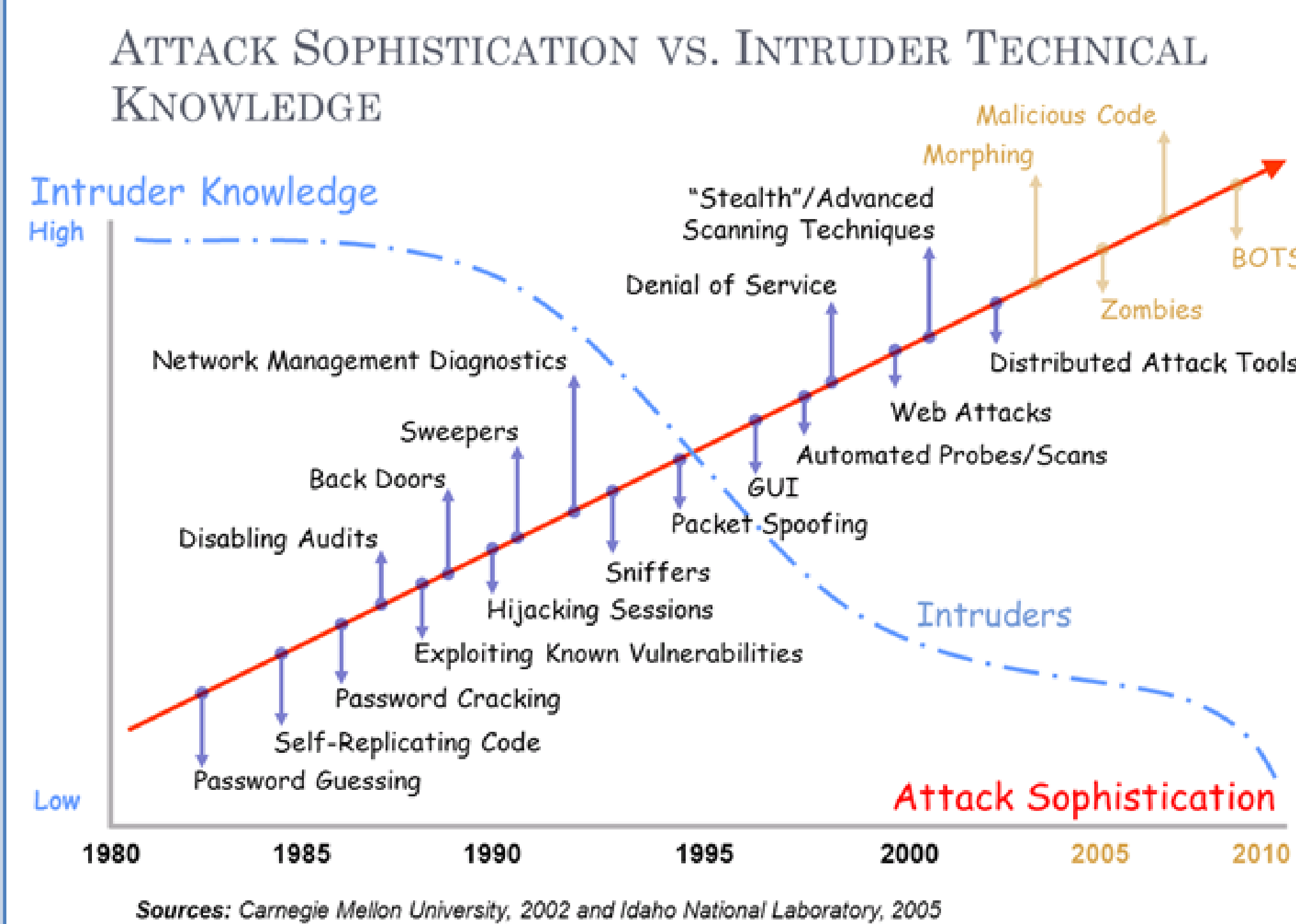## Sanjib Kumar Saha and Dr. Dipankar Dasgupta

Department of Computer Science
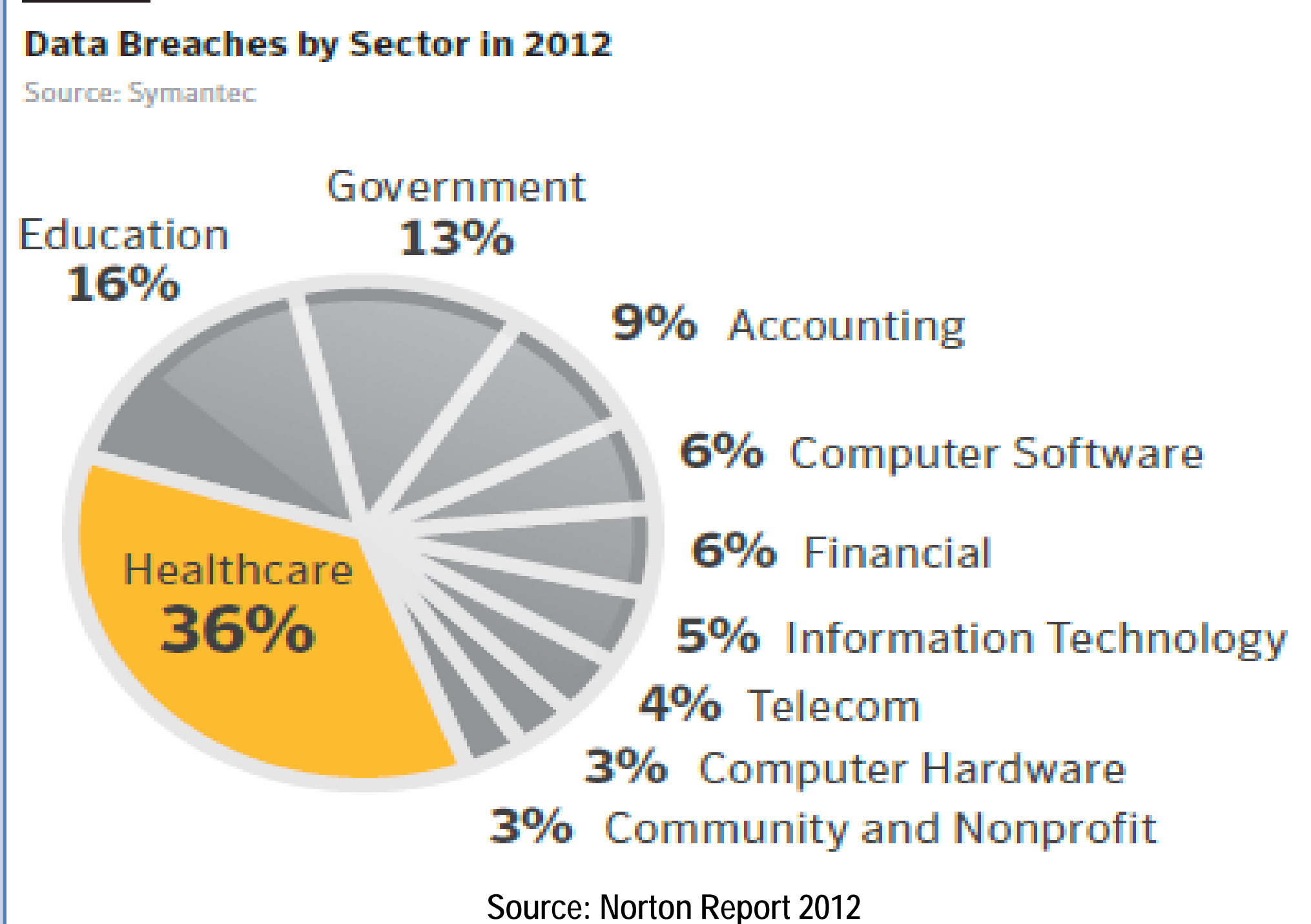
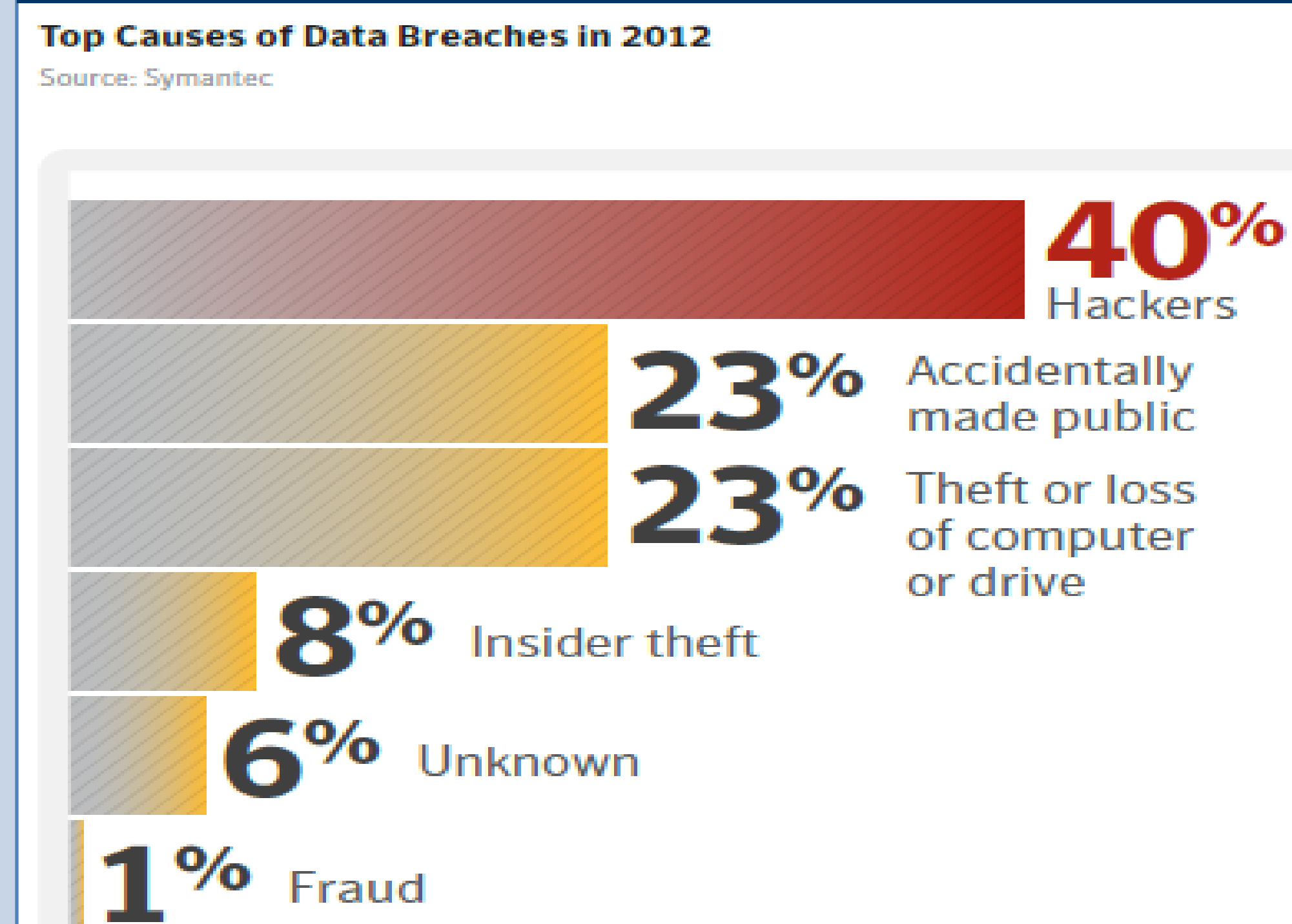THE UNIVERSITY OF MEMPHIS® | Center for Information Assurance

Cyber World: Security Threats

Targeted Attacks: Organizational Funding; Worm, Viruses; Adware, Malware; Sniffing, Phishing, Trojan, Key Logger; Identity Theft; Botnet, Spam; DoS/ DDoS Attacks; Backdoor, Spyware; Cyber espionage

Attack Sophistication Trend

ATTACK SOPHISTICATION VS. INTRUDER TECHNICAL KNOWLEDGE

Sources: Carnegie Mellon University, 2002 and Idaho National Laboratory, 2005

Targeted Attacks

Data Breaches by Sector in 2012
Source: Symantec

- Education 16%
- Government 13%
- Accounting 9%
- Computer Software 6%
- Financial 6%
- Information Technology 5%
- Telecom 4%
- Computer Hardware 3%
- Community and Nonprofit 3%
- Healthcare 36%

Source: Norton Report 2012

Causes of Breaches

Top Causes of Data Breaches in 2012
Source: Symantec

- 40% Hackers
- 23% Accidentally made public
- 23% Theft or loss of computer or drive
- 8% Insider theft
- 6% Unknown
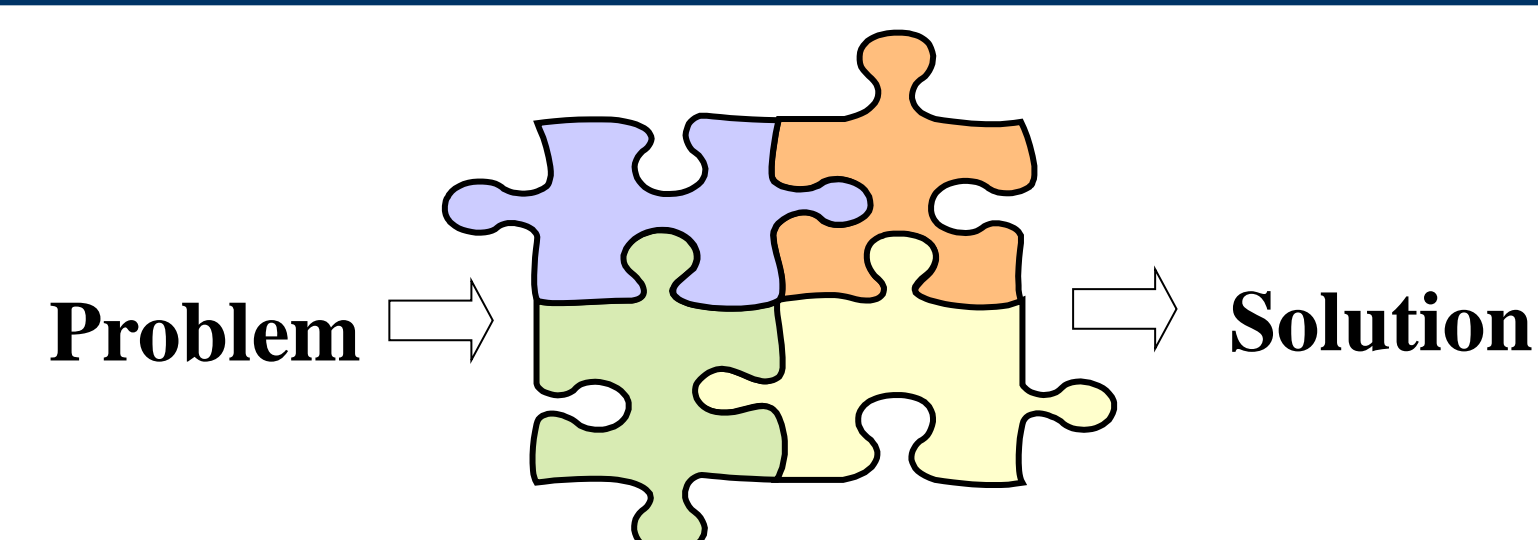- 1% Fraud

Hackers continue to be responsible for the largest number of data breaches, making up 40 percent of all breaches.
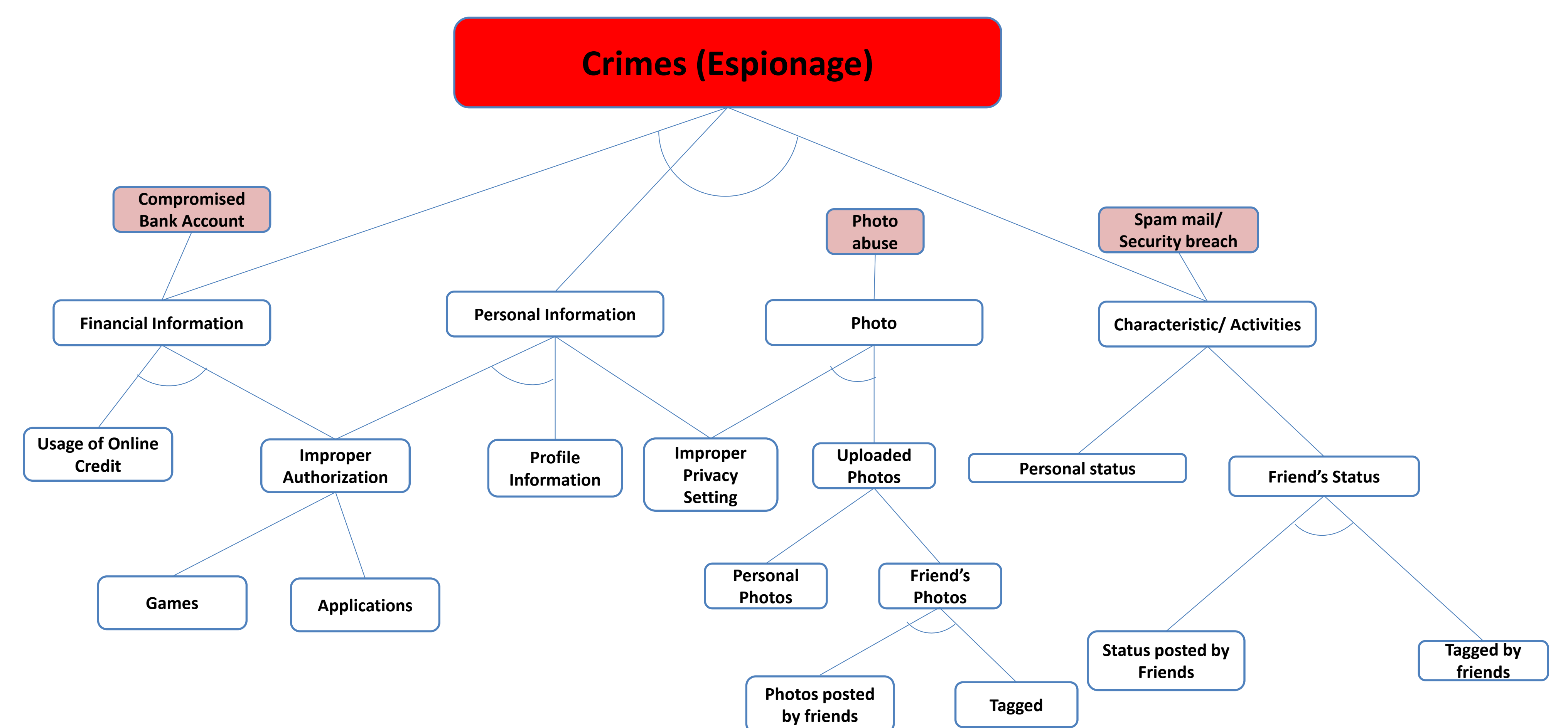
Source: Norton Report 2012

Puzzle

Problem ⇒ Solution

"A puzzle is a problem or enigma that tests the ingenuity of the solver." – Wikipedia

- **Generality**   - **Simplicity**
- **Eureka Factor**   - **Entertainment Factor**

- ❖ A new way of learning
- ❖ Better productivity than traditional learning - About 500% (Ref: Michalewicz Z, Michalewicz M, Puzzle Based learning)
- ❖ Increase critical thinking skills and participation

Puzzle Based Learning

❖Steps
- ❖ Introduction of the topic through communicating lectures
- ❖ Interactive Story with problems
- ❖ Story can be lead to different directions in accordance to feedback to the problems

❖Learning
- ❖ Participants interactively communicate with the story and also the problem
- ❖ Challenges stimulate participants to use their reasoning and knowledge learned from classes
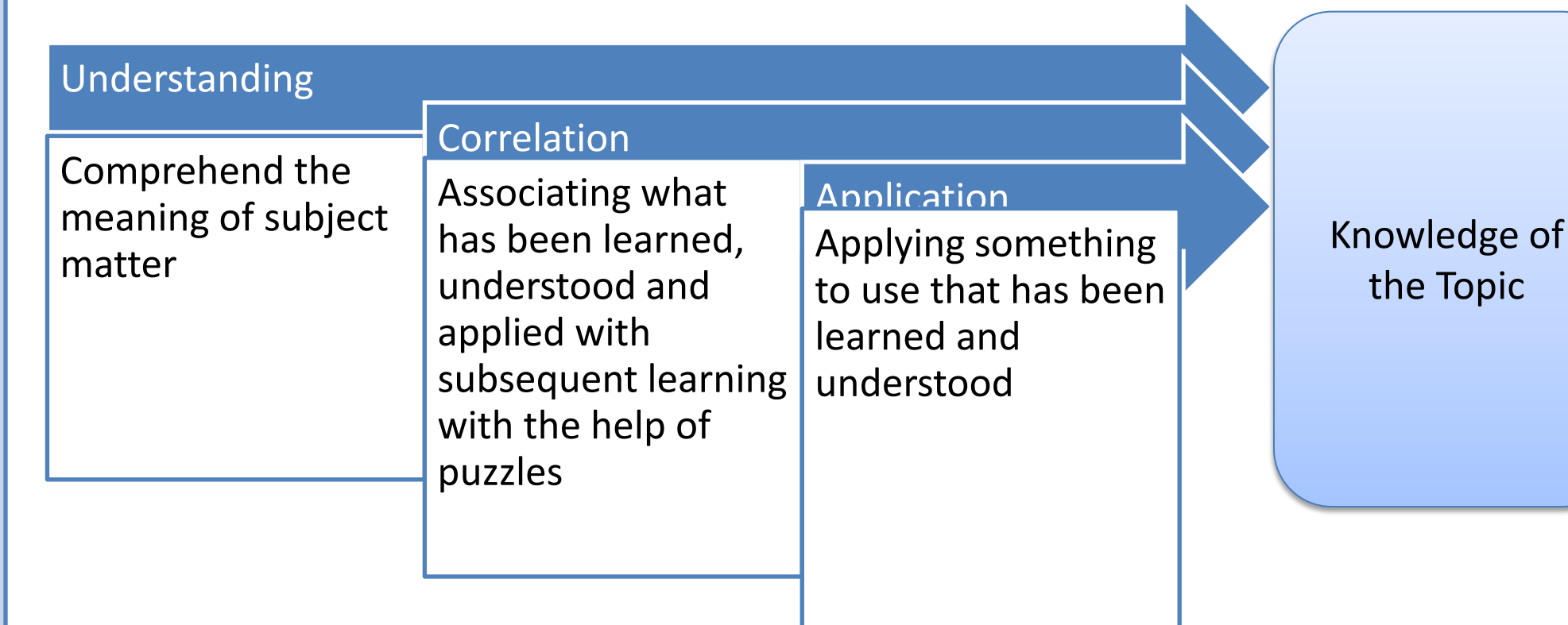- ❖Participants become aware of the consequences of their responses as the responses leads the story ahead

Cyber Attack Landscape

Crimes (Espionage); Compromised Bank Account; Photo abuse; Spam mail/ Security breach; Financial Information; Personal Information; Photo; Characteristic/ Activities; Usage of Online Credit; Improper Authorization; Profile Information; Improper Privacy Setting; Uploaded Photos; Personal status; Friend's Status; Games; Applications; Personal Photos; Friend's Photos; Status posted by Friends; Tagged by friends; Photos posted by friends; Tagged

Why Puzzles?

Puzzle Based Learning
- Critical Thinking
- Logical & Abstract Reasoning
- Domain Independent

Project or Problem Based Learning
- Identifying the Question
- Dealing with Uncertainty
- Reasoning with Domain-specific Methods

Learning Process

Understanding: Comprehend the meaning of subject matter

Correlation: Associating what has been learned, understood and applied with subsequent learning with the help of puzzles

Application: Applying something to use that has been learned and understood

Knowledge of the Topic

Implementation

- ❖ Some scenarios are implemented using Articulate Storyline.

Guidance and Feedback

- ❖ Scenario with a story guides the user step by step.

- ❖ Users are provided with feedback based on their action.

Conclusion & Future Works

- ❖ Provokes the *thinking process* by providing challenges.
- ❖ *Interactive process* to engage participants in the story or the problem.
- ❖ Participants see the *future consequences* of their *actions*, makes the learning process interesting.
- ❖ Full course design using this method is underway.

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