Teaching Adversarial Thinking for Cybersecurity

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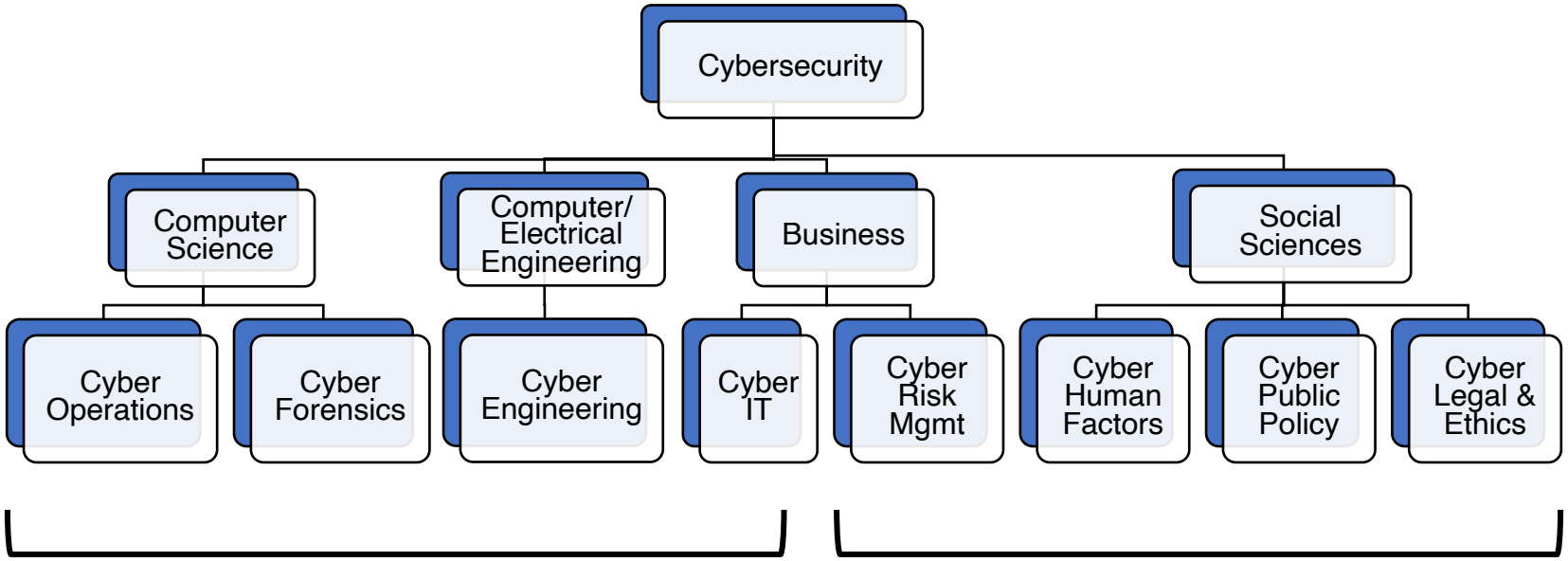
Cybersecurity is IMPORTANT!

Cybersecurity is INCLUSIVE!



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Cybersecurity is INTERESTING!

A new academic discipline is coming of age in our time, and we are right in the thick of it!

This lesson focuses on what makes cybersecurity unique and interesting.

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What is the essence of Cybersecurity?

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Cybersecurity is…

"Strategy, policy, and standards regarding the security of and operations in cyberspace, and encompassing the full range of threat reduction, vulnerability reduction, deterrence, international engagement, incident response, resiliency, and recovery policies and activities, including computer network operations, information assurance, law enforcement, diplomacy, military, and intelligence missions as they relate to the security and stability of the global information and communications infrastructure."

— US Department of Homeland Security

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Cybersecurity is...

"Strategy, poli… regarding th…
operations in cy… ompas… of threat
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assurance, law enforce… …, and intelligence
missions as they re… …f the global
information a…

— US D… …and Security

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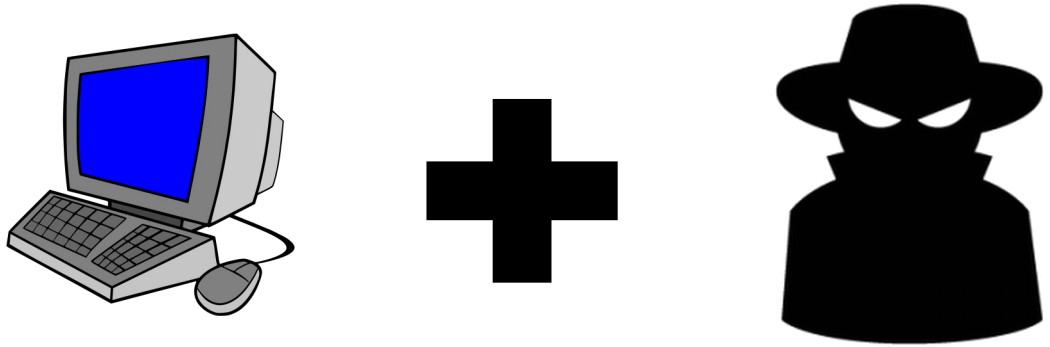
The Essence of Cybersecurity:



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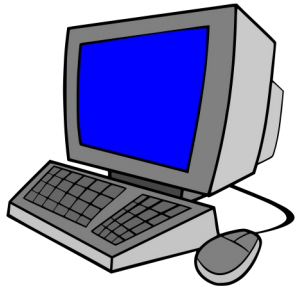
Take Away the Computer…

- Criminal Justice
- Criminology
- Public Policy
- Military Studies
- etc.

Take Away the Attacker…



- Computer Science
- Computer Engineering
- Software Engineering
- Information Technology
- etc.

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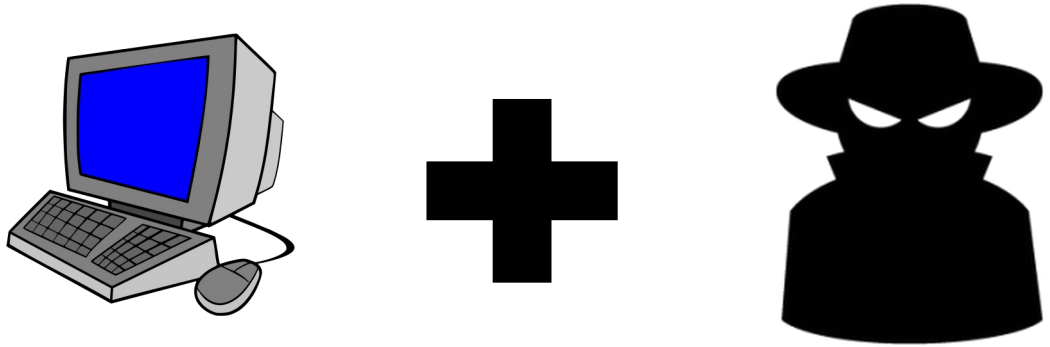
The Essence of Cybersecurity:



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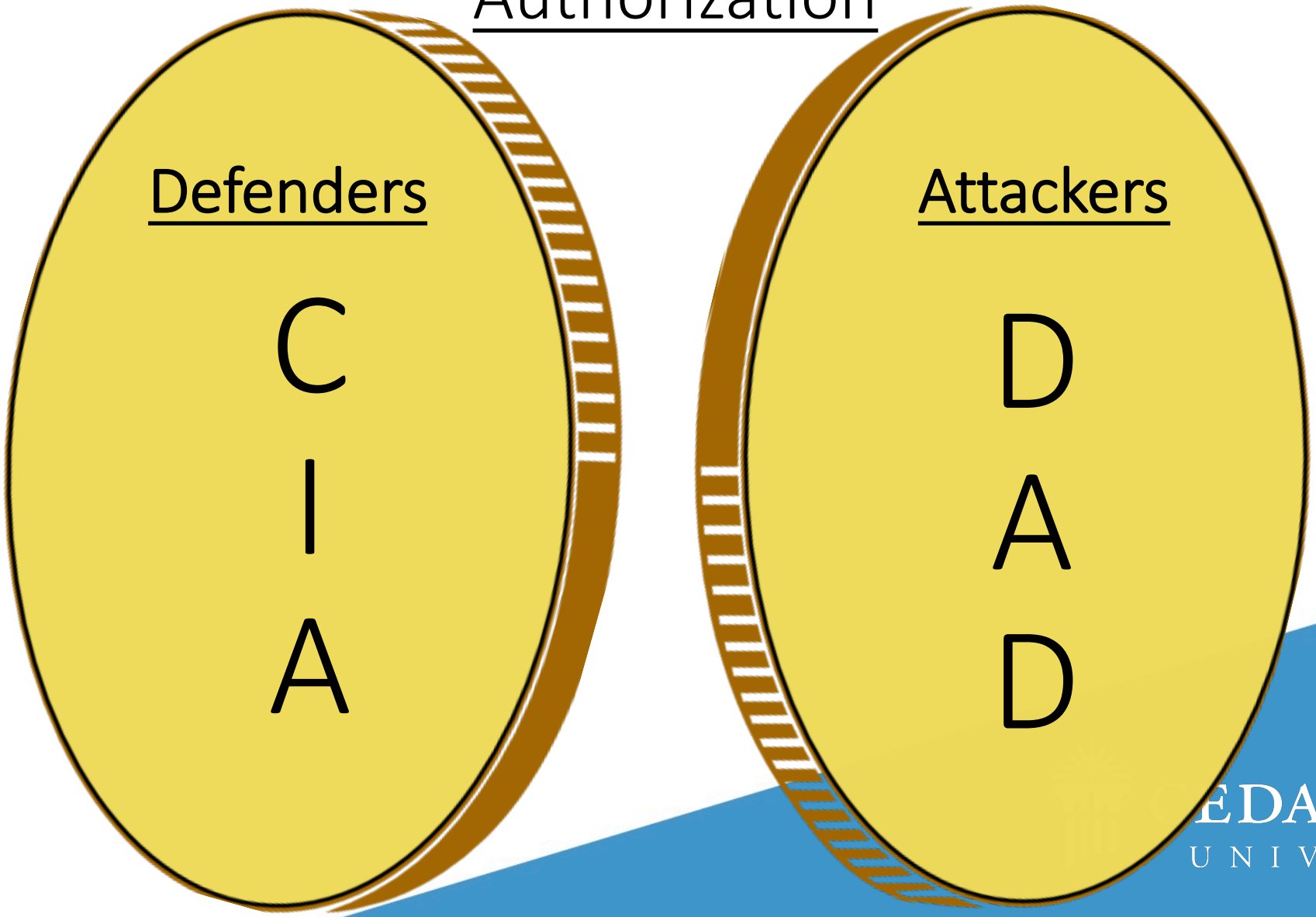
It all Boils Down to Authorization



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Bottom Line

Cybersecurity is only necessary because of the existence of people who deliberately attack computer systems and networks.

We call these people **HACKERS**.

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What a Difference Hackers Make!

A world WITHOUT hackers...	A world WITH hackers...
Accidents and hardware failures cause you to lose your data	Ransomware attacks take your data captive!
Your computer is slow and buggy	Attackers use trojan horse malware to hide in your computer

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The Hallmark of the Discipline of Cybersecurity

Discipline	Approach	Fundament Mindset
Mathematics	Constructing Proofs	Logical Thinking
Computer Science	Writing Programs	Algorithmic Thinking
Cybersecurity	Security Practices	Adversarial Thinking

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Adversarial Thinking

Do you see a person skilled in his work? He will stand in the presence of kings.

(Ancient Jewish Proverb)

But what exactly does **adversarial thinking** mean?

In order to be sure we are imparting it to our students, we have to be able to define it.

It comes down to the **definition of thinking**...

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Sternberg's Triarchic Theory

Area	Description	Popular Conception
Analytical	Mathematical ability and logical reasoning	Book smarts
Creative	The ability to make unique connections and original insights	Creative ability
Practical	The ability to plan, strategize, and accomplish goals	Street smarts

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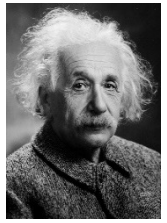
Thinking Like a Hacker

Q2: What enables him to identify innovative ways to break software and subvert security measures?

Creative



Analytical

Practical

Q1: How do his book smarts contribute to his hacking prowess?

Q3: How does he plan attacks and overcome obstacles so he can succeed without getting caught?

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Adversarial Thinking Defined

Definition:

Adversarial thinking is the ability to embody the ***technological capabilities****, the* ***unconventional perspectives****, and the* ***strategic reasoning*** *of hackers.*

To the extent a person can do this, that person will be able to:

- Compete with hackers on a level playing field (**analytical**)
- Find and fix vulnerabilities before hackers have an opportunity to exploit them (**creative**)
- Anticipate future attacks, thwart attacks in progress (**practical**)

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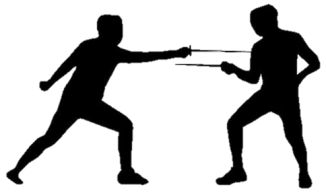
A solid cybersecurity education must equip you for...

The Technological Battle of

Might



The Creative Battle of

Skill

The Strategic Battle of

Wits

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Adversarial Thinking Learning Outcomes

Dimension	Learning Outcome	Example	All About
Technological Capabilities	Understand computer technology at a deep level (e.g., networking protocols, programming languages, and operating systems)	Command-line Kung Fu	Leveling the playing field
Unconventional Perspectives	Identify unconventional uses of software and protocols that could be exploited as attack vectors by hackers	XSS Attacks	Employing the “hacker mindset”
Strategic Reasoning	Anticipate the strategic actions of hackers, including where, when, and how they might attack, and their tactics for evading detection	Trojan Horse Malware	Anticipating and thwarting attacks

Strategic Reasoning

Of the three dimensions of adversarial thinking, the one most likely to be overlooked is the strategic dimension

Game theory is the study of strategic reasoning

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Thinking About What Your Adversary is Thinking About

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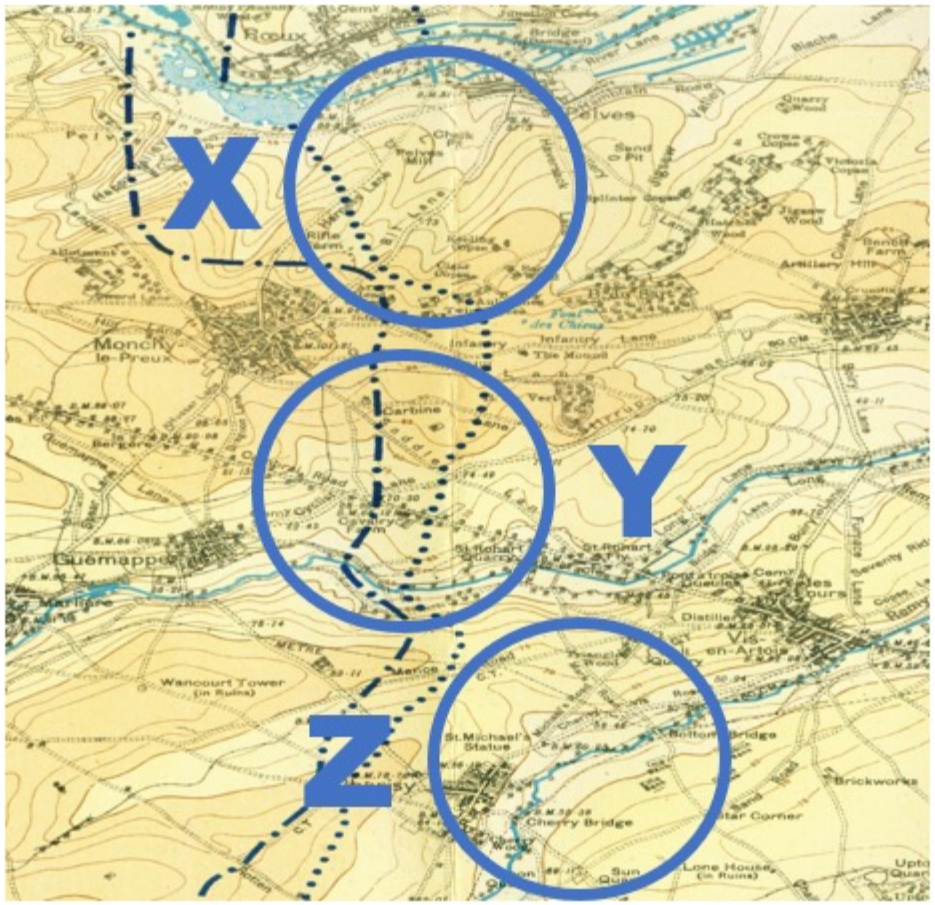
The Colonel Blotto Game

Colonel Alto



Colonel Blotto

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The Colonel Blotto Game

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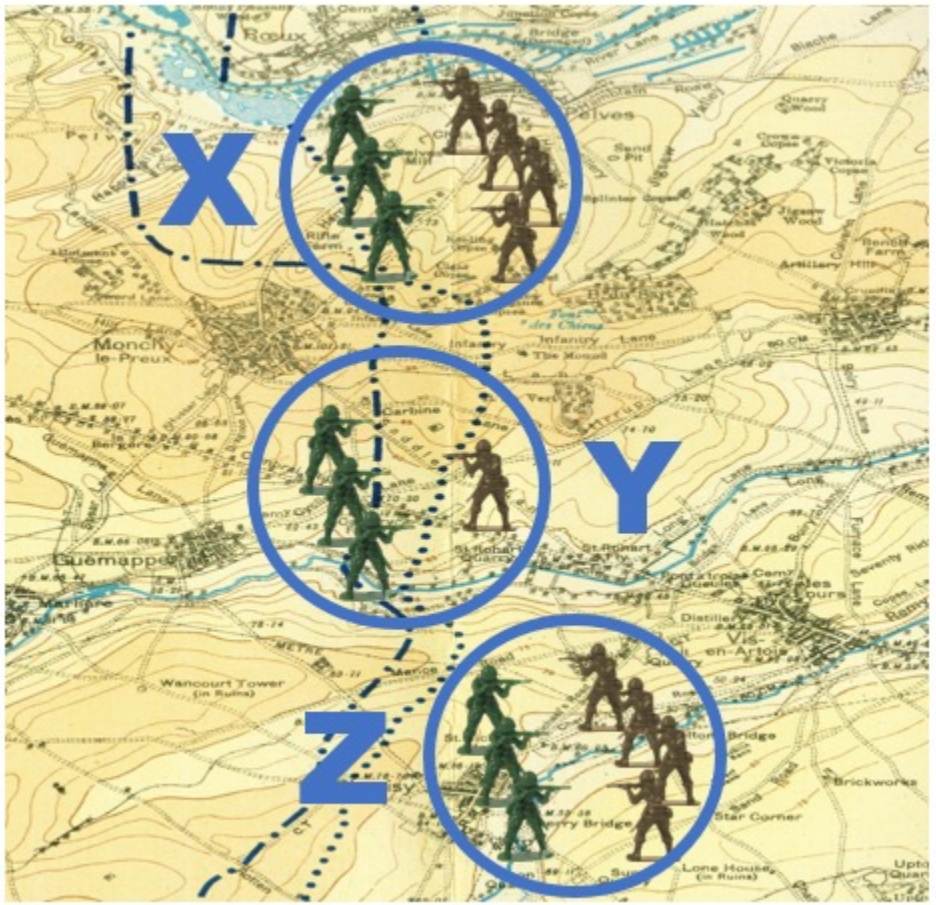

Colonel Blotto

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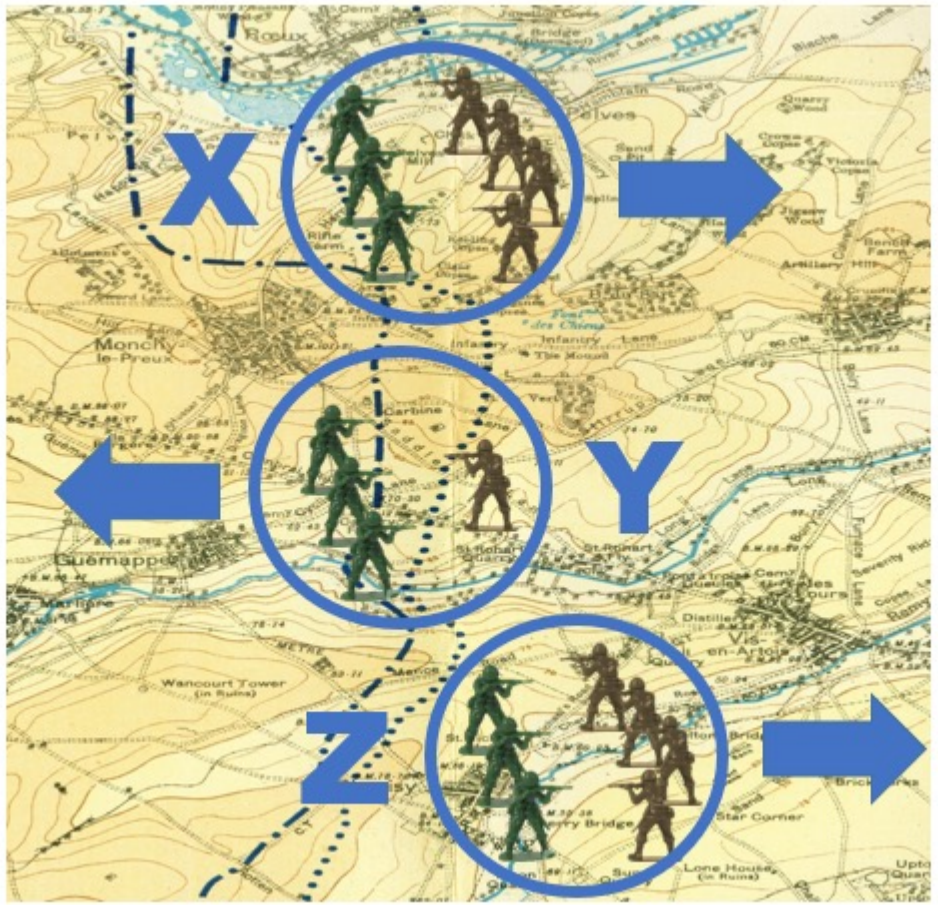

Colonel Blotto

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Exercise: DDoS Attack

To play, visit https://cyberops.cedarville.edu/cb

Website	A	B	C	D	E	F
Value	**1**	**1**	**1**	**1**	**1**	**1**
Protection (must sum to 120)	?	?	?	?	?	?

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Wait, what does game theory have to do with cybersecurity again?

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Conclusion

- Cybersecurity, at its essence, is an adversarial conflict – without adversaries, there is no such thing as cybersecurity
- Therefore, **adversarial thinking is central to cybersecurity**
- Learning about game theory for cybersecurity makes sense because **adversarial thinking requires strategic reasoning**, and game theory is the study of strategic reasoning
- The major takeaway from game theory is that **one must consider strategic situations primarily from the perspective of the adversary**, not primarily from one's own perspective
- The overarching goal of this lesson is two-fold:
  - To make indelible the association between **strategic reasoning and cybersecurity**
  - To **produce enduing strategic-mindedness** in cybersecurity students

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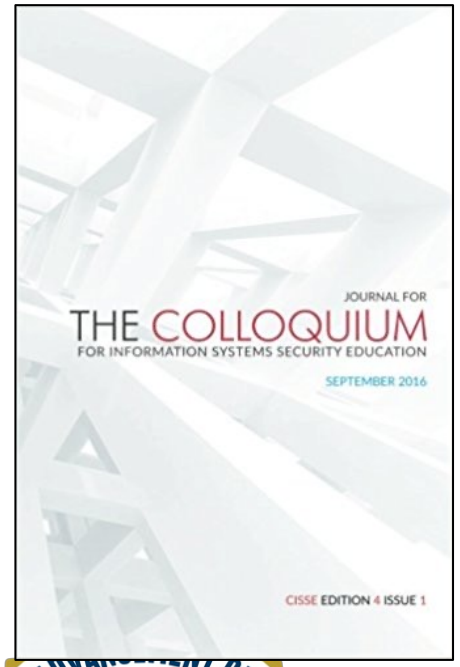
Further Reading



Teaching Adversarial Thinking for Cybersecurity

Teaching Game Theory to Improve Adversarial Thinking in Cybersecurity Students

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CHAPTER

17 APPLYING BEHAVIORAL GAME THEORY TO CYBER-PHYSICAL SYSTEMS PROTECTION PLANNING

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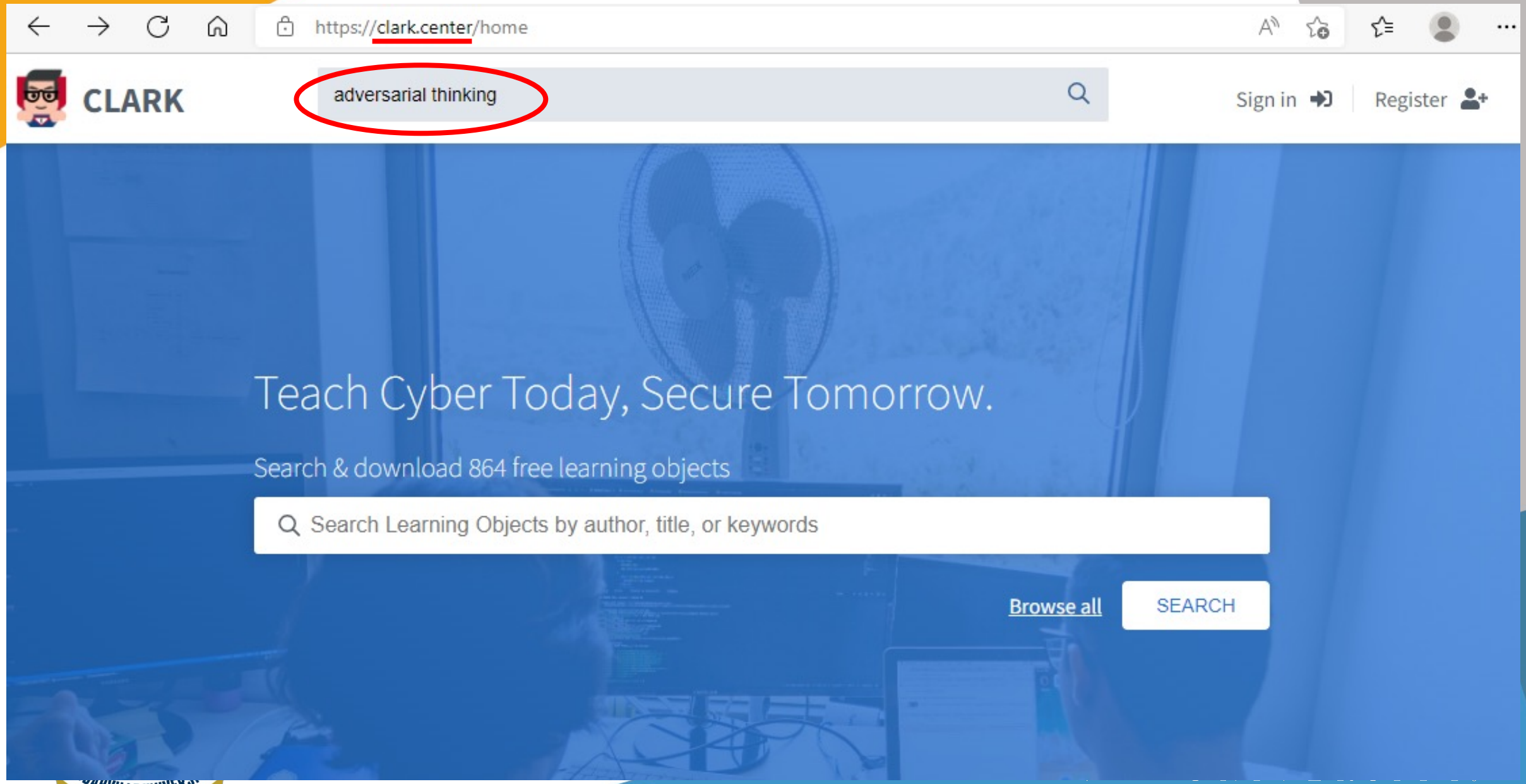
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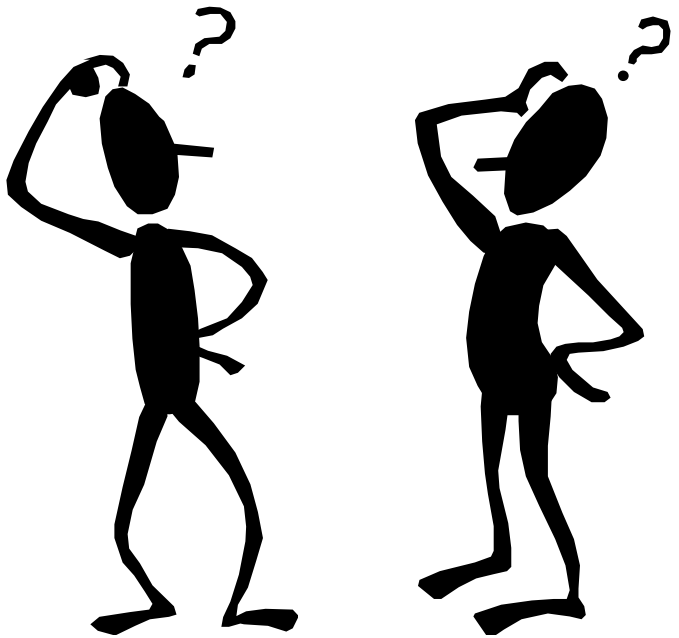

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