

Teaching Adversarial Thinking for Cybersecurity

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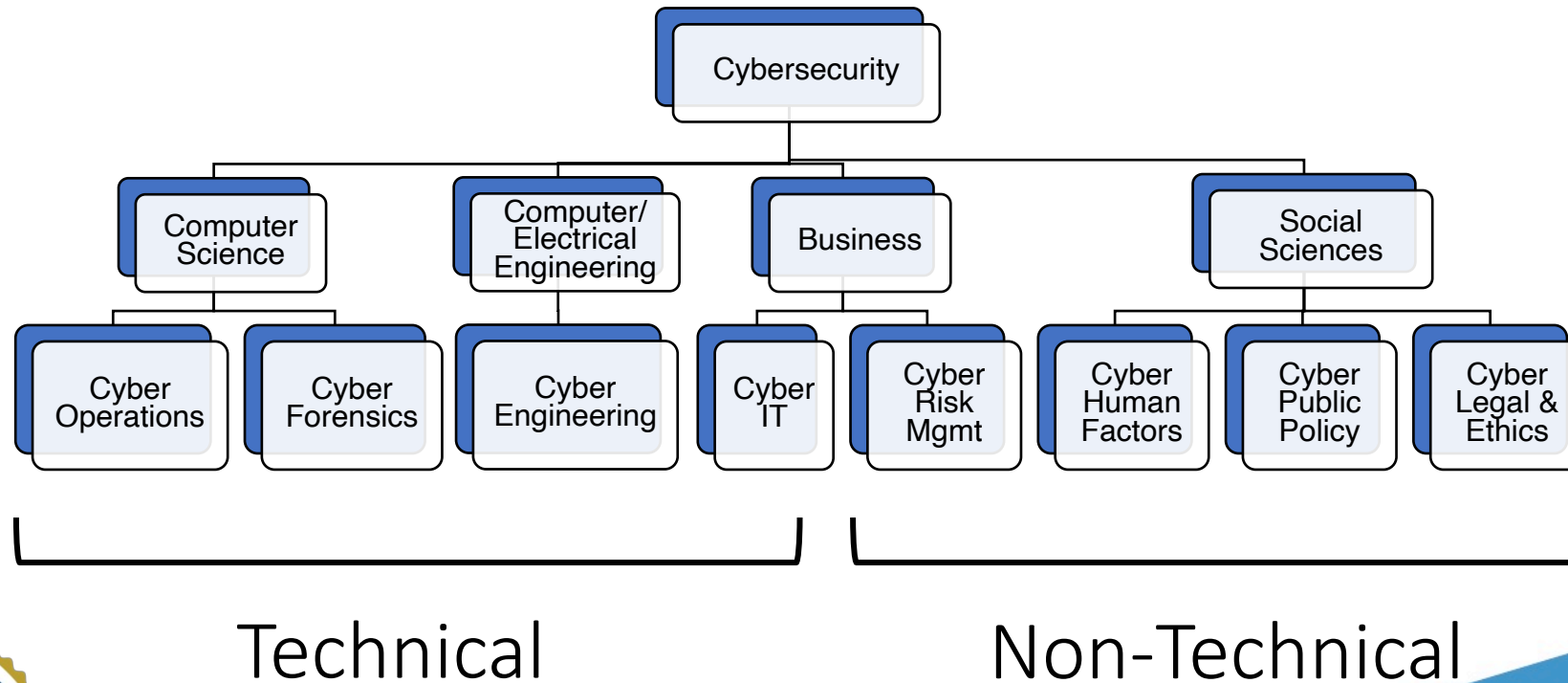


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Cybersecurity is IMPORTANT!



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...

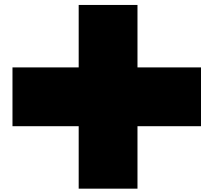
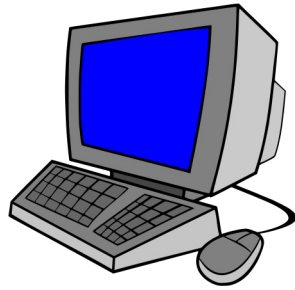
“Strategy, policy, and operations regarding the operations in cyberspace, including threat reduction, vulnerability management, international engagement, incident response, recovery policies and activities, including communications, information assurance, law enforcement, and intelligence missions as they relate to the global information and communications environment.”

— US Department of Homeland Security



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The Essence of Cybersecurity:



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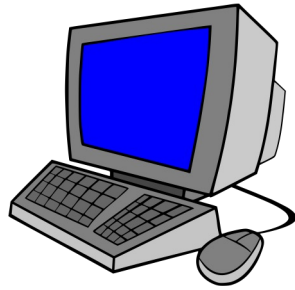
Take Away the Computer...

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



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Take Away the Attacker...

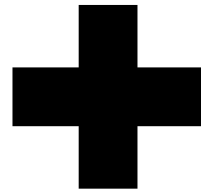
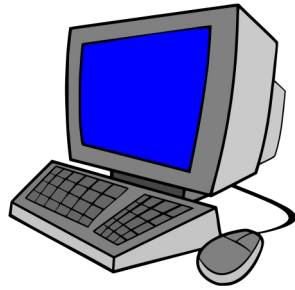


- Computer Science
- Computer Engineering
- Software Engineering
- Information Technology
- etc.



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The Essence of Cybersecurity:



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It all Boils Down to
Authorization

Defenders

C
I
A

Attackers

D
A
D

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...

Accidents and hardware failures
cause you to lose your data

Your computer is slow and buggy

A world WITH hackers...

Ransomware attacks take your
data captive!

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	<u>Adversarial Thinking</u>



Adversarial Thinking

Do you see a person skilled in his
work? He will stand in the presence
of kings.
(Ancient Jewish Proverb)



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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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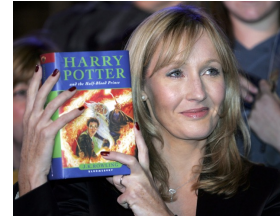
Sternberg's Triarchic Theory

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

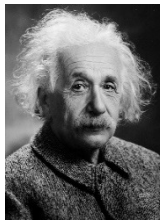


Thinking Like a Hacker

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**)

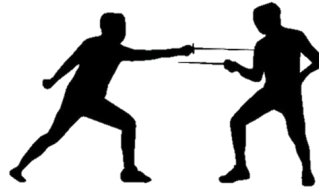


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A solid cybersecurity education must equip you for...



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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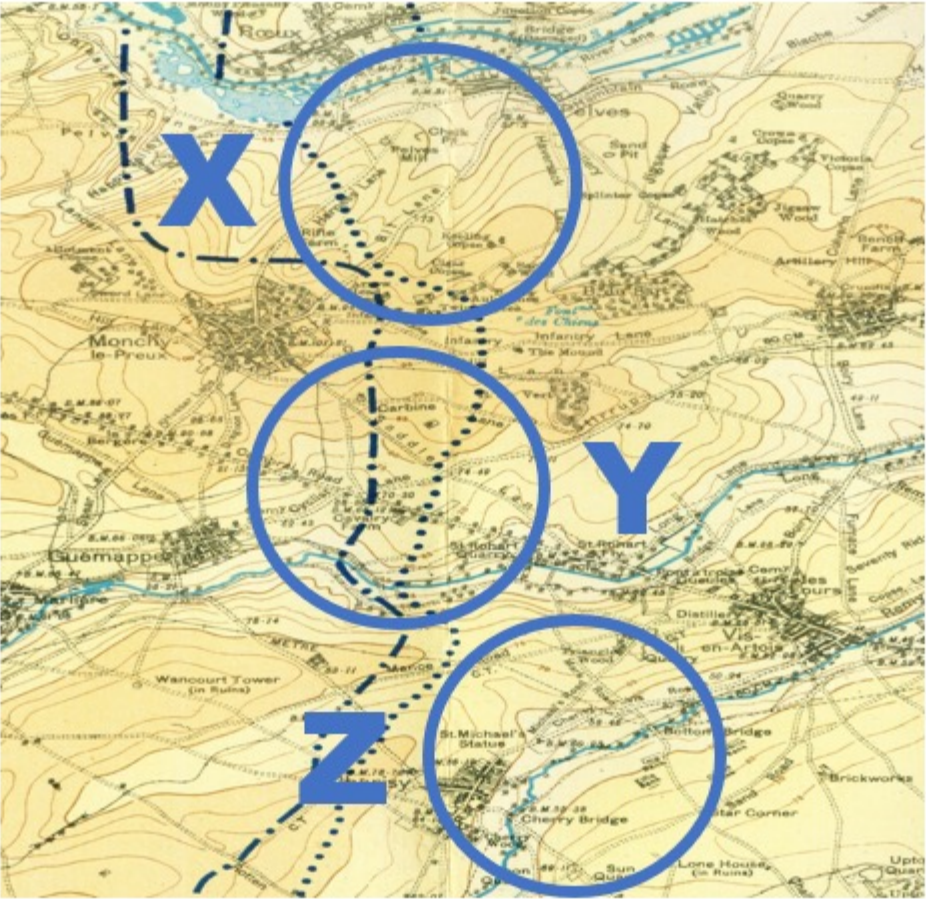
Thinking About What Your Adversary is Thinking About



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The Colonel Blotto Game

Colonel Alto



Colonel Blotto



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The Colonel Blotto Game

Colonel
Alto



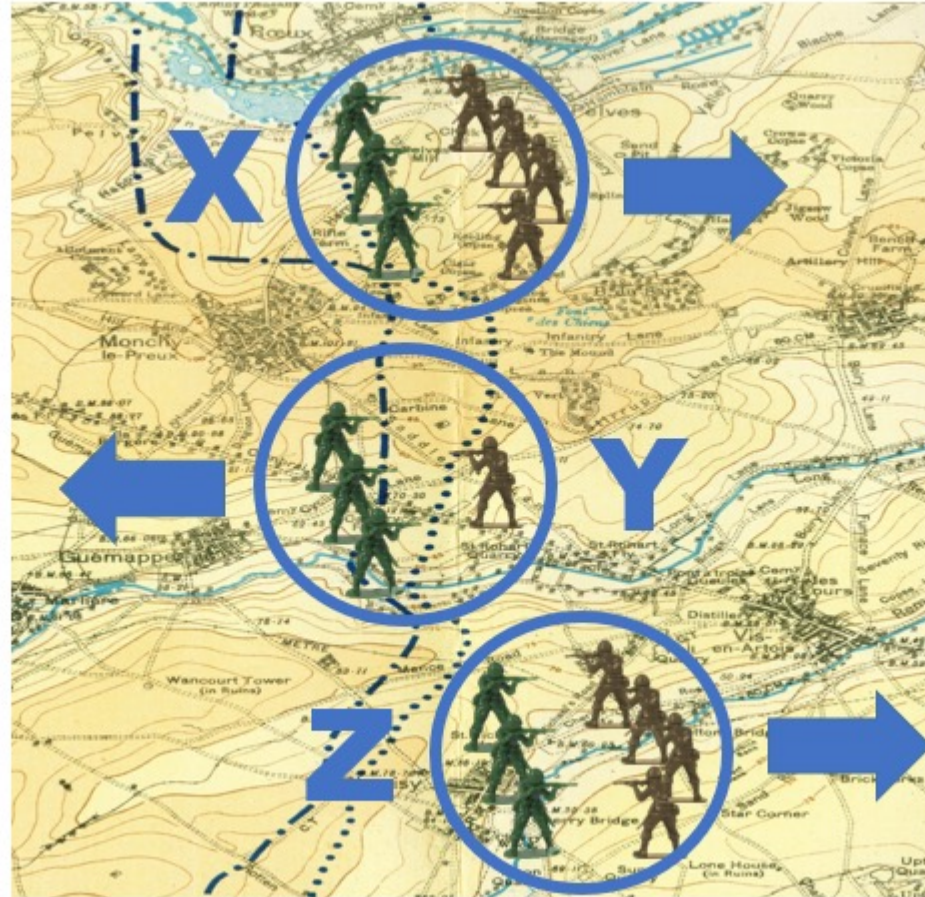
Colonel
Blotto



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The Colonel Blotto Game

Colonel Alto



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 enduring strategic-mindedness** in cybersecurity students

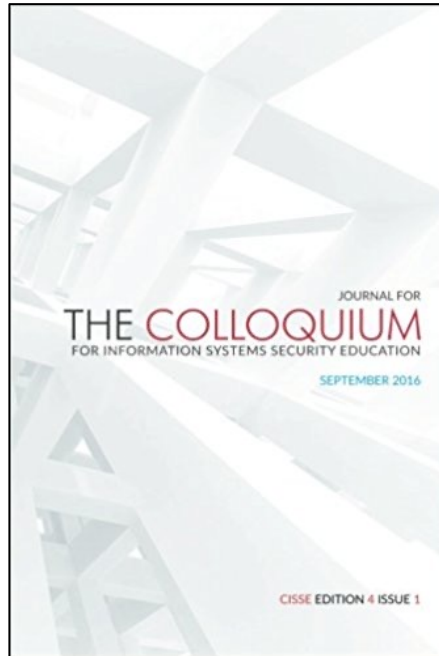


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Further Reading

Teaching Adversarial Thinking for Cybersecurity

Teaching Game Theory to Improve Adversarial Thinking in Cybersecurity Students



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APPLYING BEHAVIORAL GAME THEORY TO CYBER-PHYSICAL SYSTEMS PROTECTION PLANNING

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adversarial thinking

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Teach Cyber Today, Secure Tomorrow.

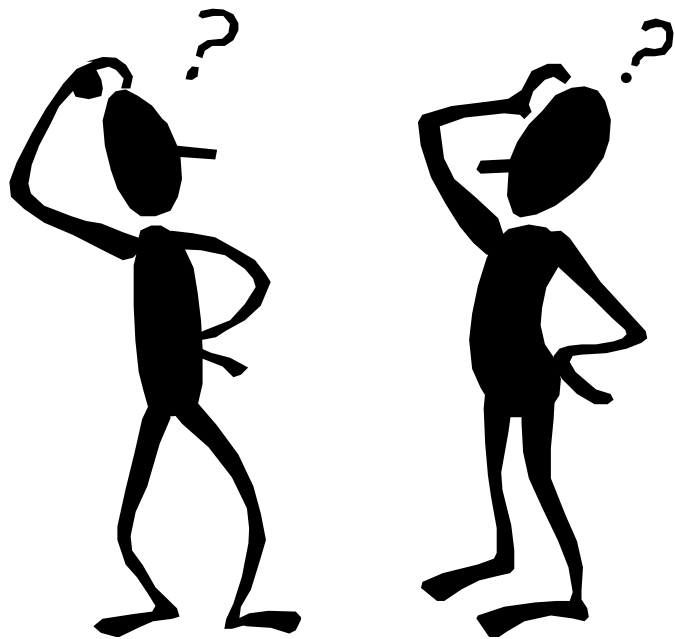
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