Evolving Security Experts Among Teenagers

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Shlomi Boutnaru

The Presentation Disclaimer

This disclaimer informs that the views, thoughts, and opinions expressed in the text belong solely to the authors/speakers, and not necessarily to the authors'/speakers' employer, organisation, committee or other group or individual.

Who are we?

- Security Researcher @ Rezilion
- Former Security Researcher @ Aqua Security and PayPal
- Founder of security group “noxale”
- 18 years old

Who are we?

- CTO & Co-Founder @ Rezilion
- Former CTO & Co-Founder of CyActive (acquired by PayPal)
- Ph.D. candidate at TAU (Cybersecurity & Education)
- A proud husband & father

Outline

- Introduction
- Overview
- Problem Definition
- Suggested Solution
- What Can Those Kiddies Even Do?
- The Mental Model Problem
- Europe case study
- A Live Proof: noxale Case Study
- Future Thinking
- Blackhat Sound Bytes
- Questions

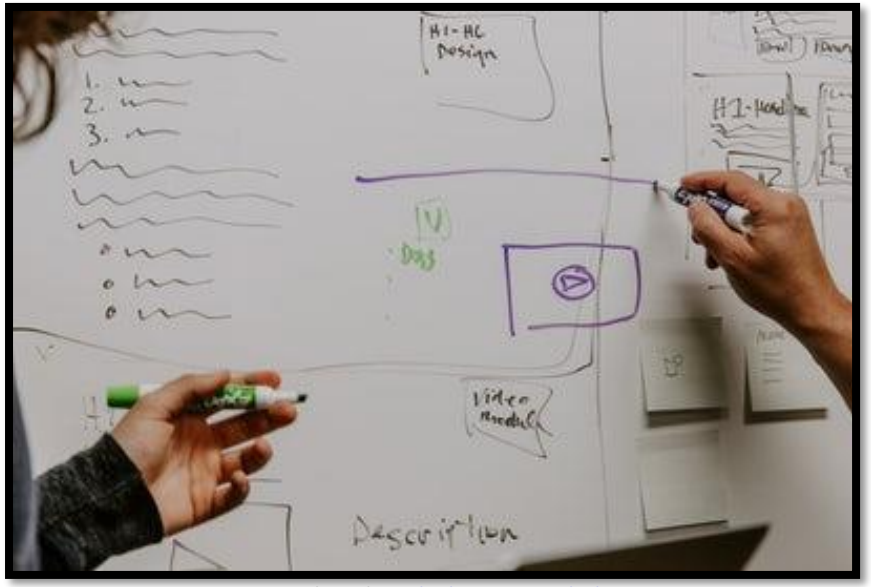


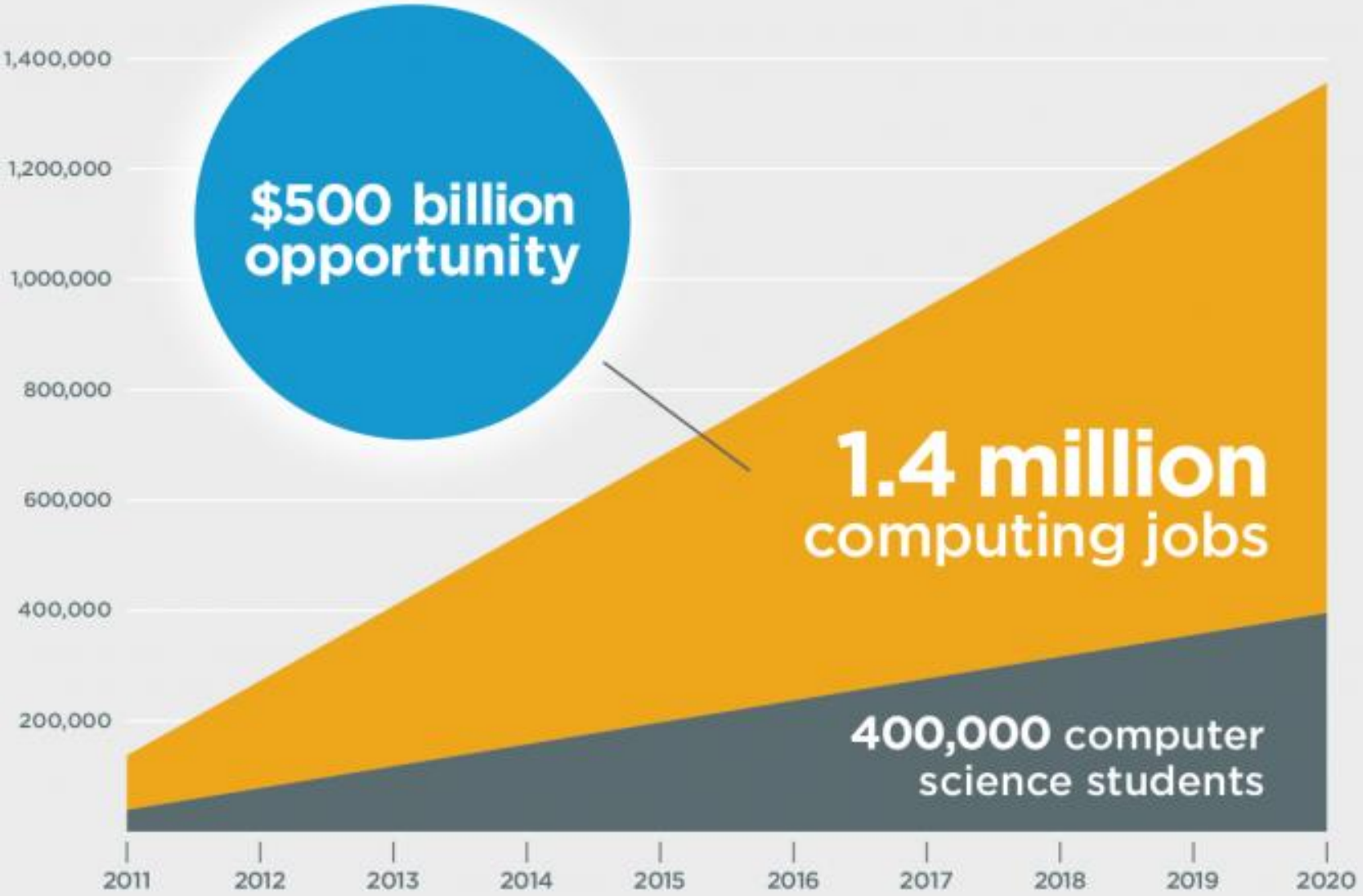
Photo by Kaleidico on Unsplash

Introduction

Growing need for cybersecurity experts

Photo by freestocks.org on Unsplash

Growing Need for Computer Science Experts



Computer science **is a top paying college degree** and computer programming **jobs are growing at 2X the national average.**

sites.uci.edu/cs1c/importance-of-computer-science-education/

Growing Need for Cybersecurity Experts

https://www.forbes.com/sites/jeffkauflin/2017/03/16/the-fast-growing-job-with-a-huge-skills-gap-cyber-security/

45,246 views | Mar 16, 2017, 06:46pm

The Fast-Growing Job With A Huge Skills Gap: Cyber Security

Jeff Kauflin Forbes Staff

I cover fintech, cryptocurrencies, blockchain and investing.

The Evidence Is in the Numbers: We Need More Cyber Security Professionals

TRIPWIRE GUEST AUTHORS

MAR 18, 2018 | SECURITY AWARENESS

https://www.tripwire.com/state-of-security/featured/need-cyber-security-professionals/

CYBERSECURITY SNIPPETS

By Jon Oltsik, CSO |
JAN 11, 2018 11:53 AM PT

About

Jon Oltsik is a principal analyst at Enterprise Strategy Group ESG and has been quoted in the Wall Street Journal, Business Week, and the New York Times.

ANALYSIS

Research suggests cybersecurity skills shortage is getting worse

New data from reveals growing skills gaps that represent an existential threat. What should organizations do?

https://www.csoonline.com/article/3247708/security/research-suggests-cybersecurity-skills-shortage-is-getting-worse.html

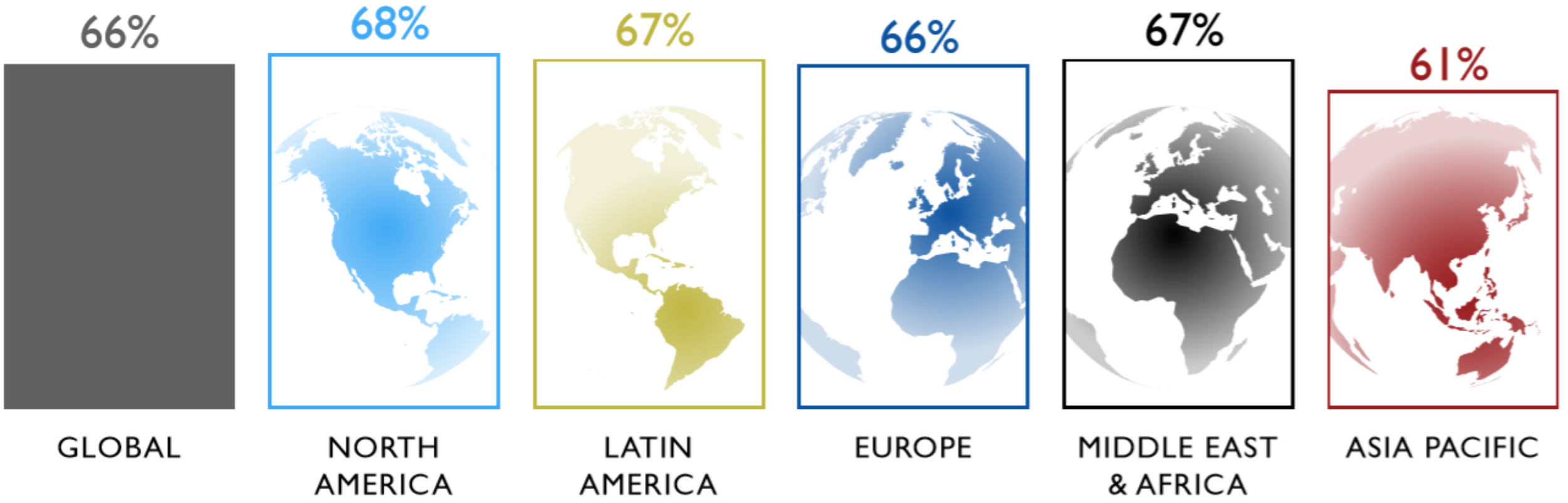
Understanding the Skills Gap

"…**In 2015**, Frost & Sullivan **forecasted** a **1.5 million** worker **shortage** by **2020**. In light of recent events and shifting industry dynamics, that **forecast has been revised to a 1.8 million** worker shortage by **2022**.."

2017 Global Information Security Workforce Study Benchmarking
Workforce Capacity and Response to Cyber Risk

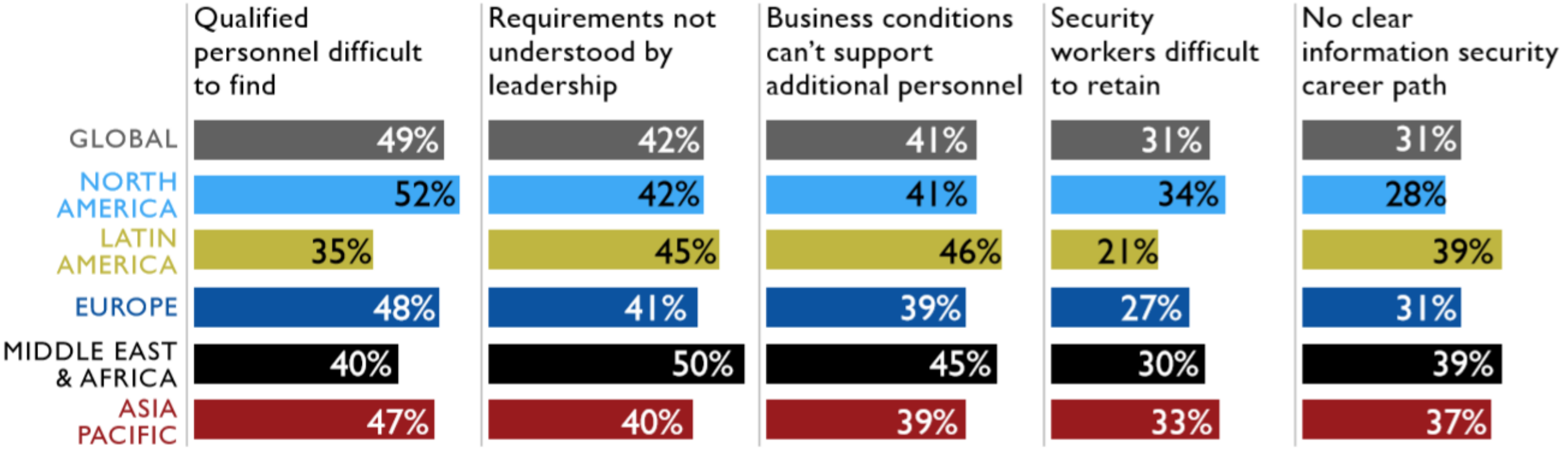
https://iamcybersafe.org/wp-content/uploads/2017/06/Europe-GISWS-Report.pdf

Understanding the Skills Gap



Source: 2017 Global Information Security Workforce Study. (n = 19,175)

Shortage Reasons by Region



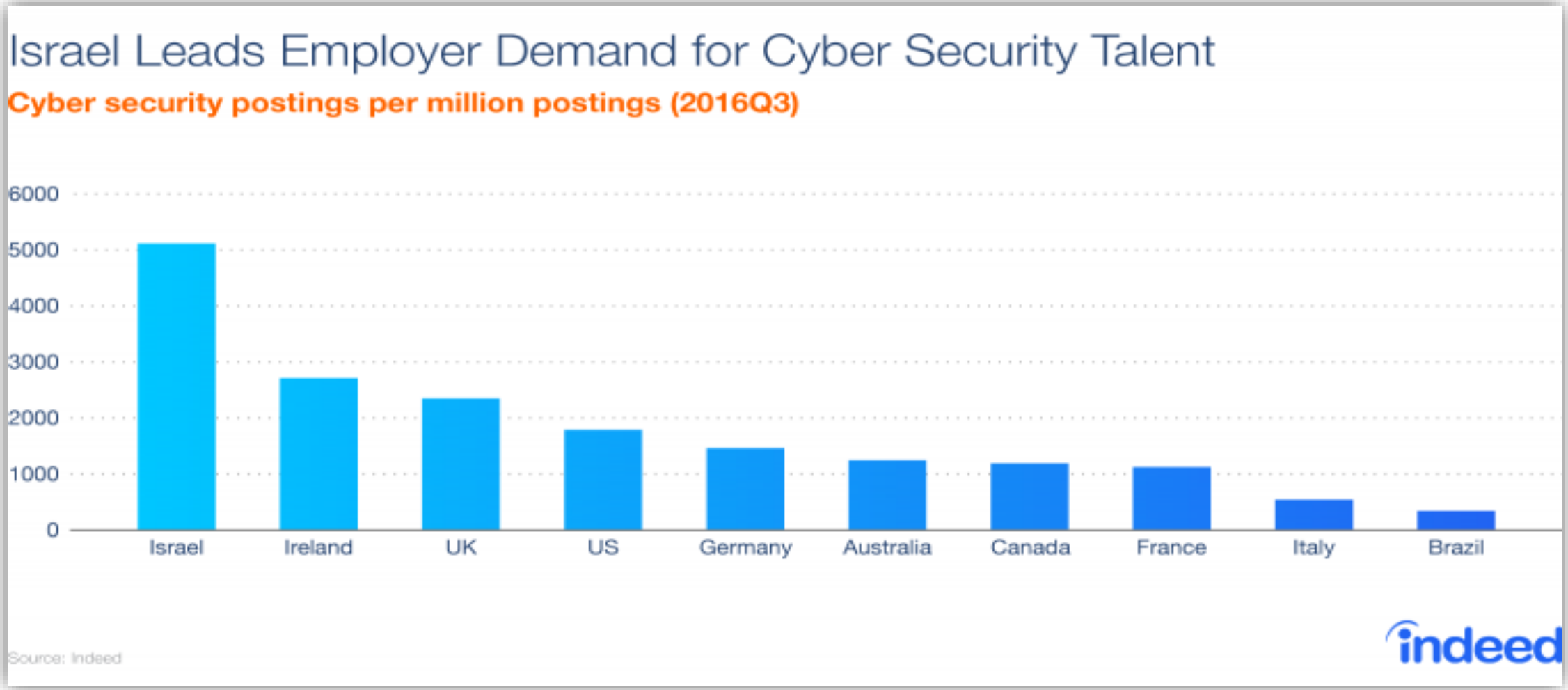
Source: 2017 Global Information Security Workforce Study, (n = 12,709)

What About Israel?

"… **Israel** - the **world's second largest exporter** of **cybersecurity** technology behind the U.S. - **leads employer demand** for **cybersecurity talent** by a wide margin, according to a 2016 report from Indeed, one of the world's largest job sites.."

https://cybersecurityventures.com/jobs/

What About Israel?



http://blog.indeed.com/2017/01/17/cybersecurity-skills-gap-report/

Security Experts - Main Characteristics

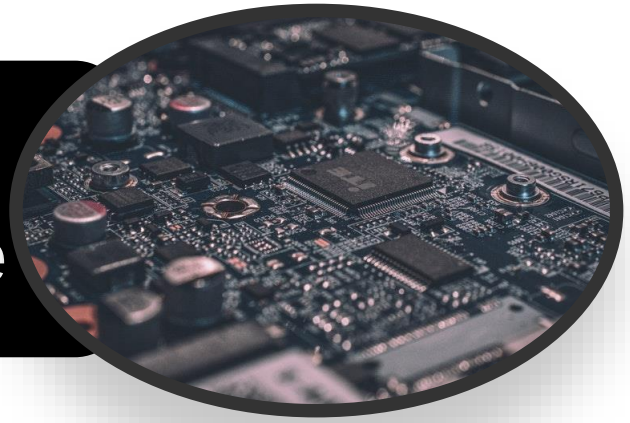
Thinking Outside the Box

(1)

Adversarial Thinking

(2)

Technical Knowledge



(3)

(1) Photo by Erda Estremera on Unsplash
(2) Photo by James Pond on Unsplash
(3) Photo by Alexandre Debiève on Unsplash

10,000 Hour Rule

"…the key to achieving world-class expertise in any skill, is, to a large extent, a matter of practicing the correct way, for a total of around 10,000 hours…"

Gladwell, M. (2008). *Outliers: The story of success*. Hachette UK.

https://en.wikipedia.org/wiki/Outliers_(book)

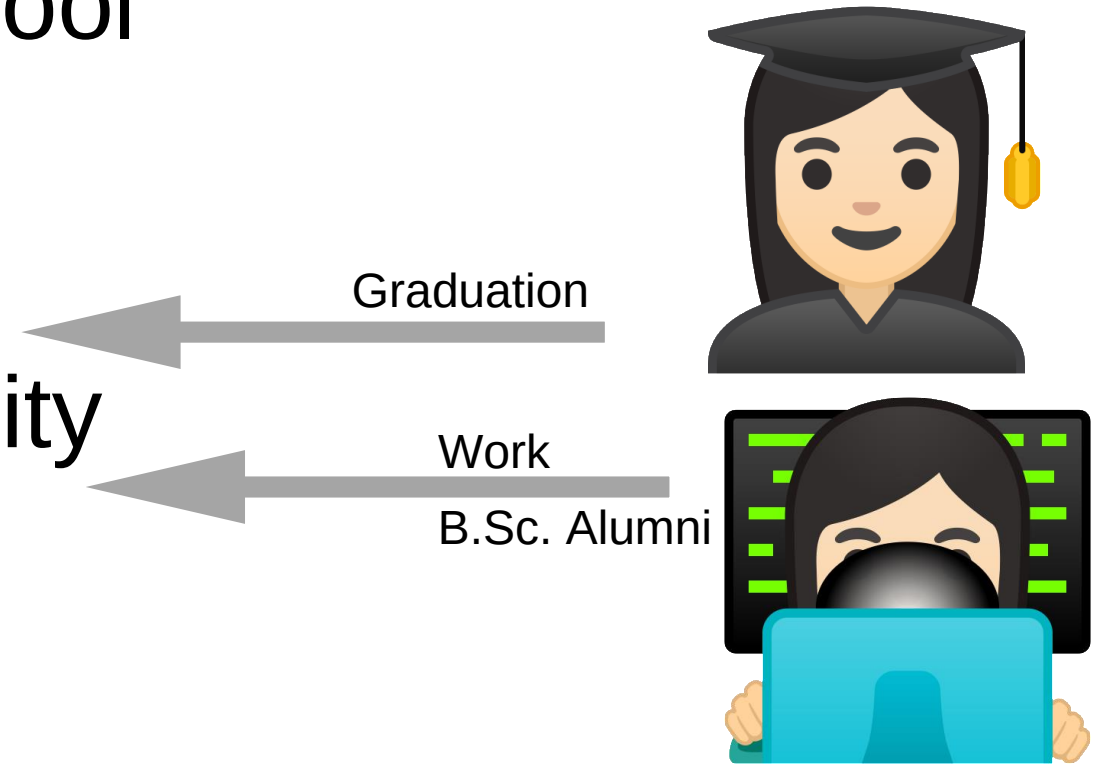
Overview

Current cybersecurity education landscape

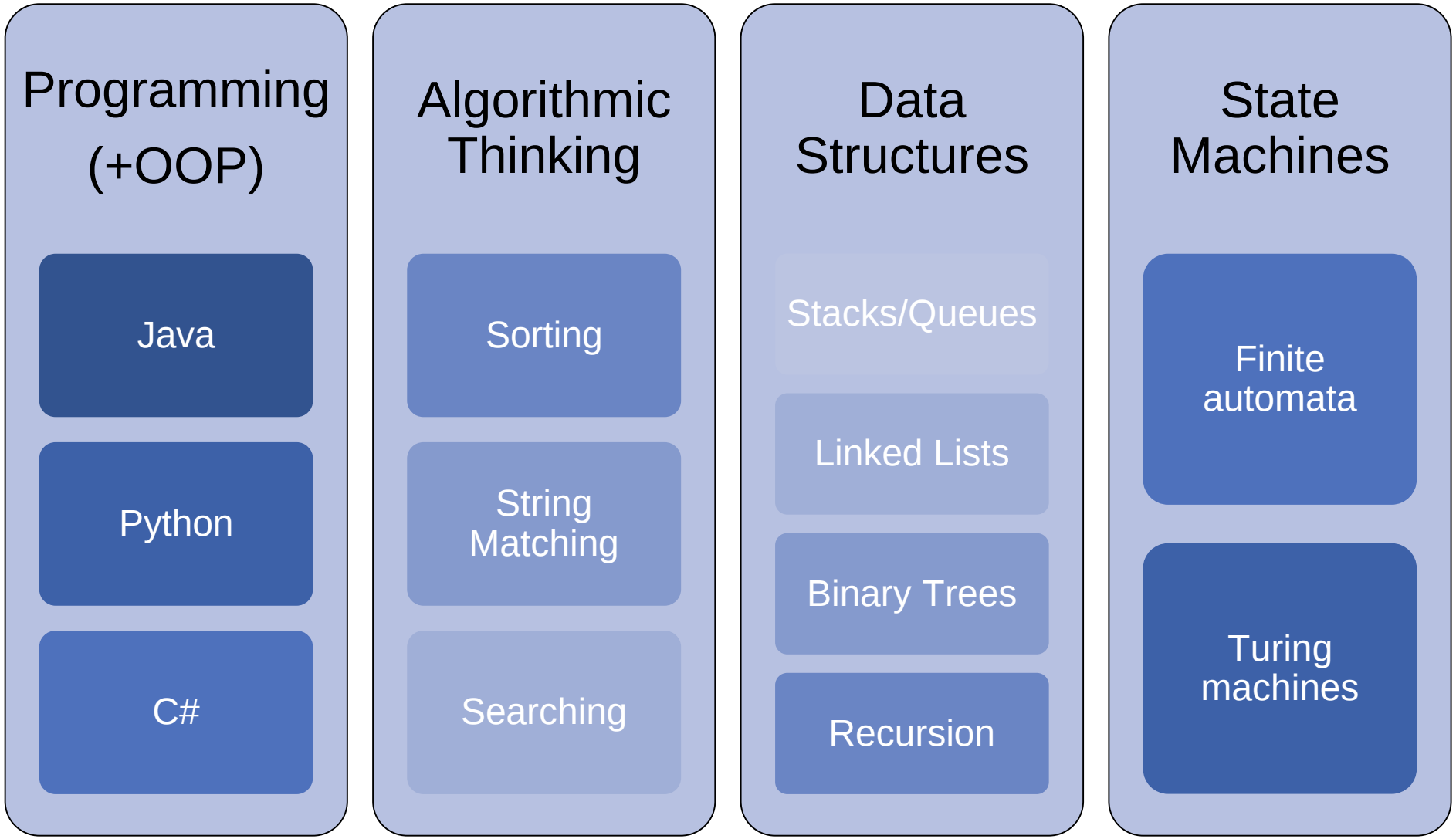
Photo by Jonas Jacobsson on Unsplash

Current Educational System

Elementary School
Middle School
High School
College/University



Computer Science Education for Teenagers - Computational Thinking



http://cms.education.gov.il/NR/rdonlyres/D8844943-D6DF-4D20-B3AB-F946018A9F6C/175898/2013.pdf

Cybersecurity Education Landscape

Academia(1)

Industry(2)

Kids/Teenagers(3)

(1) Photo by Vasily Koloda on Unsplash
(2) Photo by Maxwell Ridgeway on Unsplash
(3) Photo by Nikoline Arns on Unsplash

Disclaimer

Different certifications, academic tracks will be shown as examples in the following slides.
The speakers/authors by no means recommend or prefer them in any way, they act only as an examples to demonstrate the cybersecurity education landscape.

Academia - Cybersecurity M.Sc. Program

Cyber Security M.Sc. Program at Ben-Gurion University

Commercial and Military Hackers, Beware!

The world is full of cyber criminals – thieves of personal identities and financial information or hackers who wish to reveal state or business secrets. In July 2014, during Operation Protective Edge, several Israeli commercial, news and state-official websites have been hacked as part of the fight against the State of Israel. Such cases were a reminder to the important role of cyber security.

Cyber security specialists protect more than websites; they also protect bank databases that hold financial information of millions of people, or military software that could cause huge destruction if it were in the wrong hands. As the world becomes increasingly more hi-tech, the role of these professional is becoming exponentially more important.

https://en.universities-colleges.org.il/Israel-Degree-Programs-Undergraduate-Degree-Programs/

Most 9th/10th grade can't apply for a M.Sc.
They don't have a B.Sc. yet

https://www.york.ac.uk/study/postgraduate-taught/courses/msc-cyber-security/

MSc in Software and Systems Security

CYBER SECURITY OXFORD

MSc in Software and Systems Security

Home page: MSc in Software and Systems Security

A security professional needs to understand principles of architecture, design, management, interoperability, and evolution, and to apply them effectively in a world of rapidly-changing technologies and expectations. The MSc in Software and Systems Security teaches these principles and their application.

This Programme teaches the principles of systems security, together with the tools, methods, and techniques that support their application. It spans the technical and organisational aspects of the practice of information security in an up-to-date context.

It offers working professionals the opportunity to learn more about the technological advances that are changing their lives, through a course of part-time study at one of the world's leading universities.

https://www.cybersecurity.ox.ac.uk/education/msc-courses

Academia - More Examples

MASTER PROGRAMS THEIR AFFILIATION, COUNTRY AND FACULTY.

Name	Institute	Country	Faculty
1. MSc in Computer Science	University of Nicosia	Cyprus	
2. Master of Science in Cybersecurity in Computer Science	The George Washington University	USA	School of Engineering & Applied Science
3. Master in Digital Security	Eurecom	France	
4. Master of Engineering in Cybersecurity	University of Maryland	USA	A. James Clark School of Engineering
5. Master of Science in Computer, Communication and Information Sciences - Security and Mobile Computing	Aalto University	Finland	
6. Mastère Spécialisé SIS : Sécurité de l'Information et des Systèmes	Esiea Graduate Engineering School	France	
7. Master of Information Systems	University Of San Francisco	USA	School of Management
8. Masters of Science in Engineering in Artificial Intelligence and Robotics	Sapienza University of Rome	Italy	
9. Digital Forensics and Cybersecurity programs	John Jay College of Criminal Justice	USA	
10. Master of Technology in Cyber Security and Digital Forensics	K L University	India	
11. Network Security and Pen Testing MSc	Middlesex University London	UK	
12. MSc Cyber Security	Northumbria University London Campus	UK	

https://www.researchgate.net/profile/Evon_Abu-Taieh2/publication/323629371_Cyber_Security_Body_of_Knowledge/links/5aa111ae45851543e639852c/Cyber-Security-Body-of-Knowledge.pdf

Abu-Taieh, E. M. (2017, November). Cyber Security Body of Knowledge. In *Cloud and Service Computing (SC2), 2017 IEEE 7th International Symposium on* (pp. 104-111). IEEE.

Academia - More Examples

13. Master of Cyber Security	The University of Waikato	New Zealand	
14. Master of Science in Applied Security and Analytics	The University of Findlay	USA	
15. Master in Security and Privacy (S&P)	Eit Digital Master School	Germany	
16. Master's Degree Programme in Information Security and Cryptography	University of Turku	Finland	
17. Computer Engineering	International University Alliance	USA	
18. MSc Cyber Security and Forensics	University of Westminster	UK	Faculty of Science and Technology
19. Electronic Warfare, Information and Cyber Degrees	Cranfield University	UK	
20. International Security Degrees	Cranfield University	UK	
21. Resilience, Counter Terrorism and Organized Crime Degrees	Cranfield University	UK	
22. MSc Computer Forensics & Cyber Security	University of Greenwich	UK	
23. MSc Advanced Security and Digital Forensics	Edinburgh Napier University	UK	
24. Master of Science in Cyber Security	Tallinn University of Technology	Estonia	
25. MSc Information Security and Biometrics	University of Kent	UK	
26. Master in Cyber Security and Management (CSM)	The University of Warwick	UK	Warwick Manufacturing Group Wmg
27. Master in Information Security	Harbour.Space	Spain	
28. Master of Information and Information Technologies Security	Vilnius Gediminas Technical University	Lithuania	
29. MSc System and Network Engineering: Security	University of Amsterdam	Netherlands	
30. MSc in Digital Security and Forensics	Asia Pacific University of Technology & Innovation (APU)	Malaysia	
31. MA Intelligence and Security Studies (Distance Learning)	Brunel University	UK	College of Business, Arts and Social Sciences
32. Master in Cybersecurity	St.Mary's University	USA	
33. Master in Cybersecurity	University of Central Missouri	USA	
34. MS Cybersecurity	Webster University Leiden	Netherlands	
35. MSc Cyber Security Engineering (CSE)	The University of Warwick	UK	Warwick Manufacturing Group Wmg
36. MSc in Information Security & Privacy	Cardiff University	UK	
37. Master in Embedded Systems	Masaryk University	Czech Republic	
38. MSc Digital Forensics and Security	Leeds Beckett University	U K	
39. Master of Science in Cyber Security	Saint Peter's University	USA	
40. MSc in Cybersecurity (Information Assurance)	University of Dallas	USA	College of Business
41. MSc in Network Security and Pen Testing	Middlesex University Malta	Malta	
42. MSc in Information Security and Intelligence	Ferris State University	USA	
43. Masters in Cyber Security Engineering		Estonia	Estonian Information Technology College
44. MSc Network & Information Security	Kingston University London	UK	
45. Máster en Ciberseguridad UCAV-DELOITTE *	Universidad Católica De Ávila	Spain	
46. Master of Science: Cybersecurity	Sacred Heart University	USA	
47. Master of Science in Cybersecurity	Johns Hopkins	USA	Johns Hopkins Engineering
48. Master of Engineering in Cybersecurity	University of Maryland	USA	Computer Science
49. Master of Science Cyber Security Engineering	University of Southern California	USA	Viterbi School of Engineering
50. Cybersecurity Online	NYU Tandon School of Engineering	USA	
51. Cybersecurity Master's Degree	University of South Florida	USA	
52. Master of Science in Cybersecurity	Fordham University	USA	
53. Master of Science in Cyber Security Operations and Leadership	The University of San Diego	USA	
54. Master of Science in Cybersecurity	University of Dallas	USA	College of Business
55. Master of Science in Cyber Security	Wright State University	USA	The College of Engineering & Computer Science
56. Master of Science in Cybersecurity	Villanova University	USA	College of Engineering
57. MSc in Cyber Security	University of York	UK	Department of Comp. Sci.
58. Master of Science (Cyber Security and Forensic Computing)	University of South Australia	Australia	
59. IT Auditing and Cyber Security	Temple University	USA	Fox School of Business
60. Applied Information Technology, Cyber Security Concentration (MS)	George Mason University	USA	Volgenau School of Engineering
61. Master of Science in Cybersecurity Engineering	Embry-Riddle Aeronautical University	USA	Department of Electrical, Computer, Software, And Systems Engineering In The College of Engineering.

https://www.researchgate.net/profile/Evon_Abu-23629371_Cyber_Security_Body_of_Knowledge/links/5aa111ae45851543e639852c/Cyber-Security-Body-of-Knowledge.pdf

Abu-Taieh, E. M. (2017, November). Cyber Security Body of Knowledge. In *Cloud and Service Computing (SC2), 2017 IEEE 7th International Symposium on* (pp. 104-111). IEEE.

Industry - Examples

(ISC)² Certifications

CISSP®
Certified Information Systems Security Professional

SSCP®
IT/ICT Security Administration

CAP®
Security Assessment and Authorization

CSSLP®
Secure Software Development

HCISPP®
Healthcare Security & Privacy

https://www.isc2.org/Certifications

OFFENSIVE security

https://www.offensive-security.com/

OSCP
Offensive Security Certified Professional

OSCE
Offensive Security Certified Expert

OSWP
Offensive Security Wireless Professional

OSEE
Offensive Security Exploitation Expert

OSWE
Offensive Security Web Expert

Partial List of Security Certifications

Certification Provider	Certifications' Examples
ISC2	CISSP, SSCP, CAP, CSLP and HCISPP
Offensive Security	OSCP, OSCE, OSWP, OSEE and OSWE
EC-Council	CEH, CCISO, CES, CHFI, CND and APT
CompTIA	CompTIA Security+
ISACA	CISA, CRISC, CISM and CGEIT

https://networkel.com/top-15-cyber-security-certifications-get-ahead-2018/

https://www.isc2.org/Certifications
https://www.offensive-security.com/information-security-certifications/
https://cert.eccouncil.org/certifications.html
http://www.isaca.org/CERTIFICATION/Pages/default.aspx
https://certification.comptia.org/certifications/security#overview

Academia & Industry - Hybrid Example

EC-COUNCIL UNIVERSITY

Enables students to transfer credit, and turn certification into a degree

EC-Council Certifications

All the programs contain core cyber security content that maps to EC-Councils industry certifications, which can be tested for at the completion of each the five courses that contain the material for the certification exams. These will be provided at no cost to students who successfully complete the associated graduate course. The certifications are:

C|ND Certified Network Defender

C|EH™ Certified Ethical Hacker

C|HFI™ Computer Hacking Forensic INVESTIGATOR

ECSA™ EC-Council Certified Security Analyst

LPT LICENSED PENETRATION TESTER MASTER

https://www.eccu.edu/

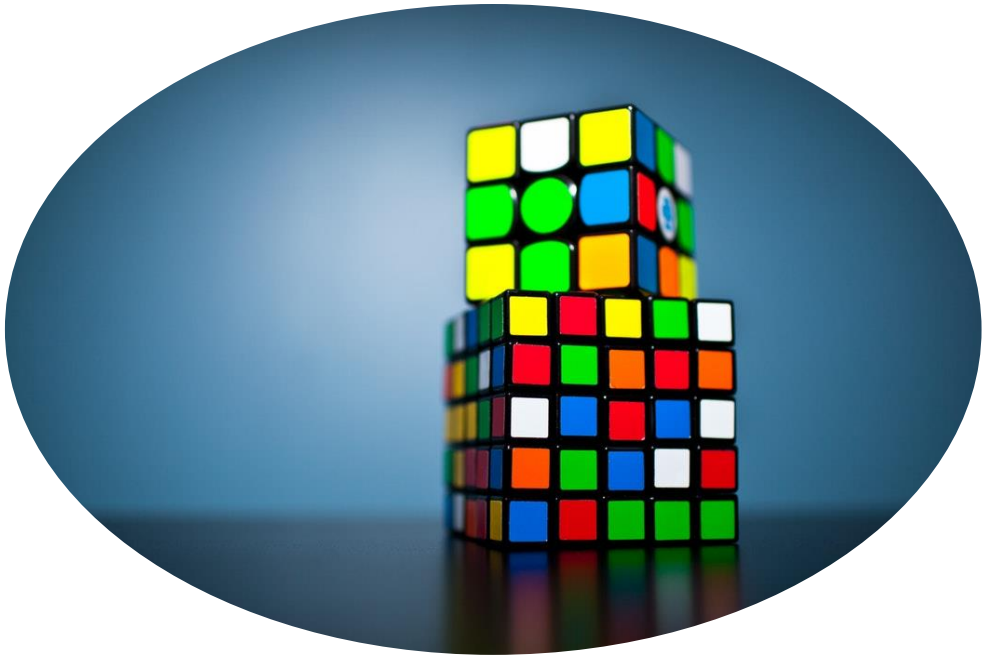
Cybersecurity Education for Kids

- Mostly “safe Internet” training
- Privacy controls
- Awareness
- Password safety
- Social media safety
- Computer safety (like camera cover for webcam)

Less technical material

Problem Definition

What's the problem? (Beside lack of personnel)

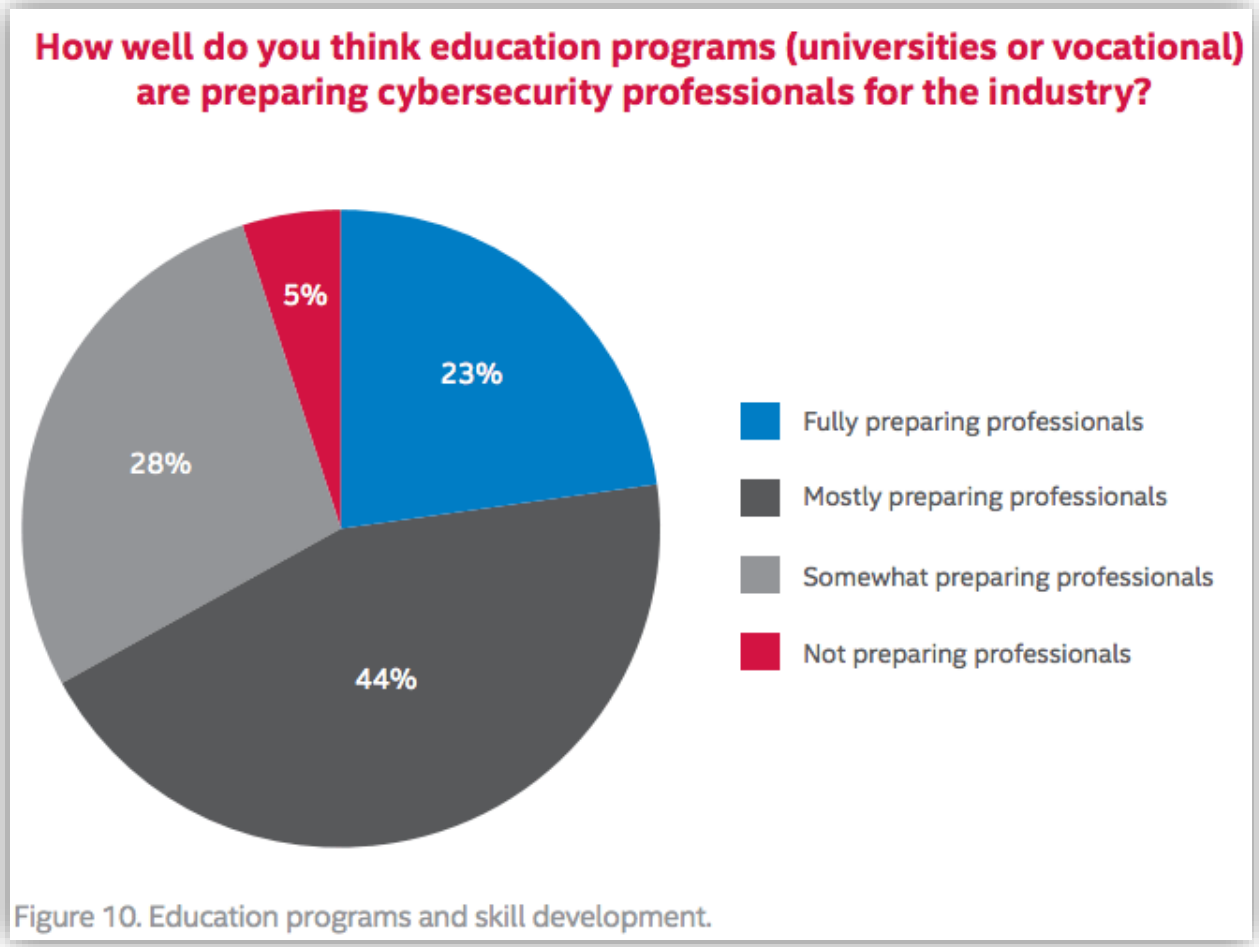


Unskilled Workforce

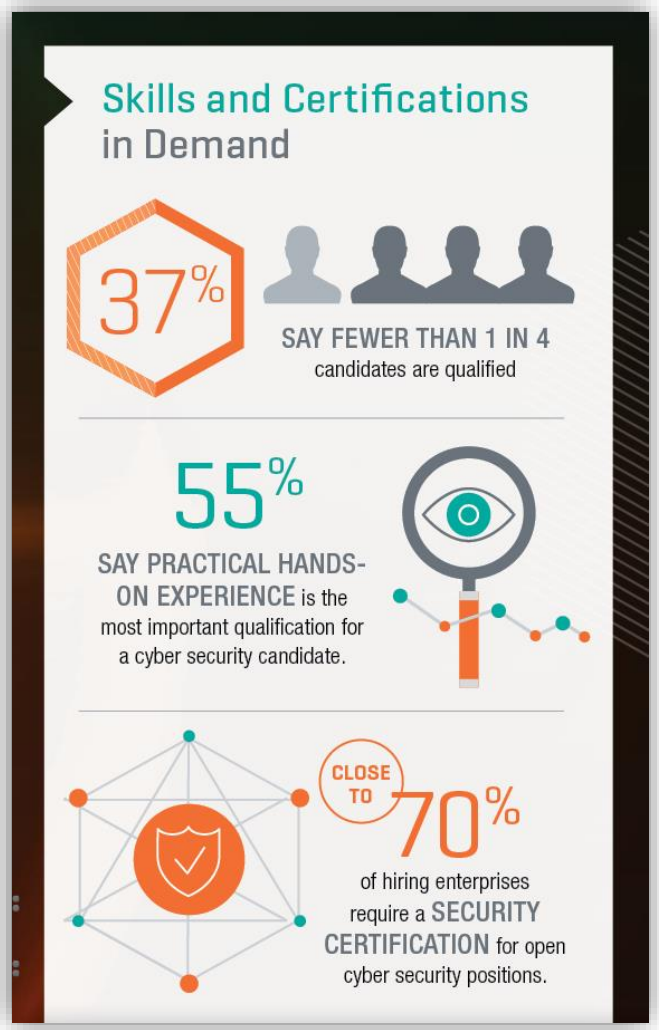
"…**None** of the **top 10 U.S. computer science programs require** a cybersecurity course for **graduation**. In fact, **three** of the top 10 university programs **don't even offer** an elective course in **cybersecurity**…"

https://www.cloudpassage.com/company/press-releases/cloudpassage-study-finds-u-s-universities-failing-cybersecurity-education/

Unskilled Workforce



https://www.tripwire.com/state-of-security/security-data-protection/universities-can-help-fill-security-skills-gap/



https://www.businesswire.com/news/home/20170213005553/en/ISACA-Survey-Cyber-Security-Skills-Gap-Leaves

Limitations of Educational System

Lack of experience in complex projects and real-world technologies

Limitations of Educational System

Teenagers' Cybersecurity Education

"Internet Safety"

Women in Tech

"…In middle school, **74%** of girls express interest in **STEM subjects**, but when choosing a college major, just **0.4%** of high school girls select **computer science**, according to Girls Who Code…."

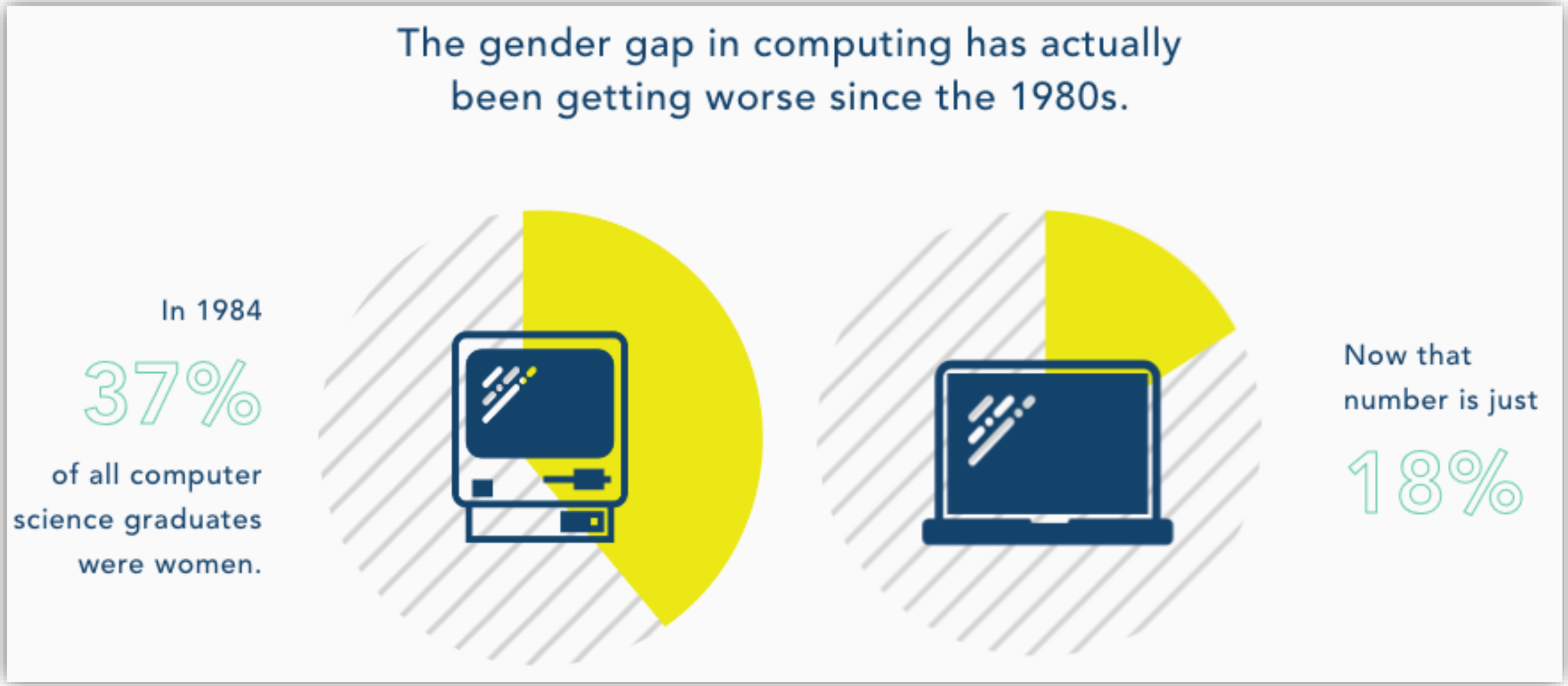
https://techcrunch.com/2016/04/14/women-in-tech-whats-the-real-problem/

Women in Tech

"...Even with projected **growth of 15-20%** between **2012** and **2022**, the **vast majority** of computer science jobs will be **pursued and filled by men**..."

https://www.computerscience.org/resources/women-in-computer-science/

Women in Tech



https://fairygodboss.com/articles/women-in-tech-facts-figures-and-percentages

Women in Cybersecurity

CYBERSECURITY VENTURES

Women Represent 20 Percent Of The Global Cybersecurity Workforce In 2018

Number of women in the cybersecurity field is recalculated and rising

– *Steve Morgan, Editor-in-Chief*

Sausalito, Calif. – Jul. 21, 2018

https://cybersecurityventures.com/women-in-cybersecurity/

https://www.forbes.com/sites/quora/2018/01/29/why-so-few-women-work-in-cyber-security-and-how-can-we-change-it/

Forbes

9,471 views | Jan 29, 2018, 11:04am

Why So Few Women Work In Cyber Security (And How We Can Change It)

Quora Contributor

nature
International journal of science

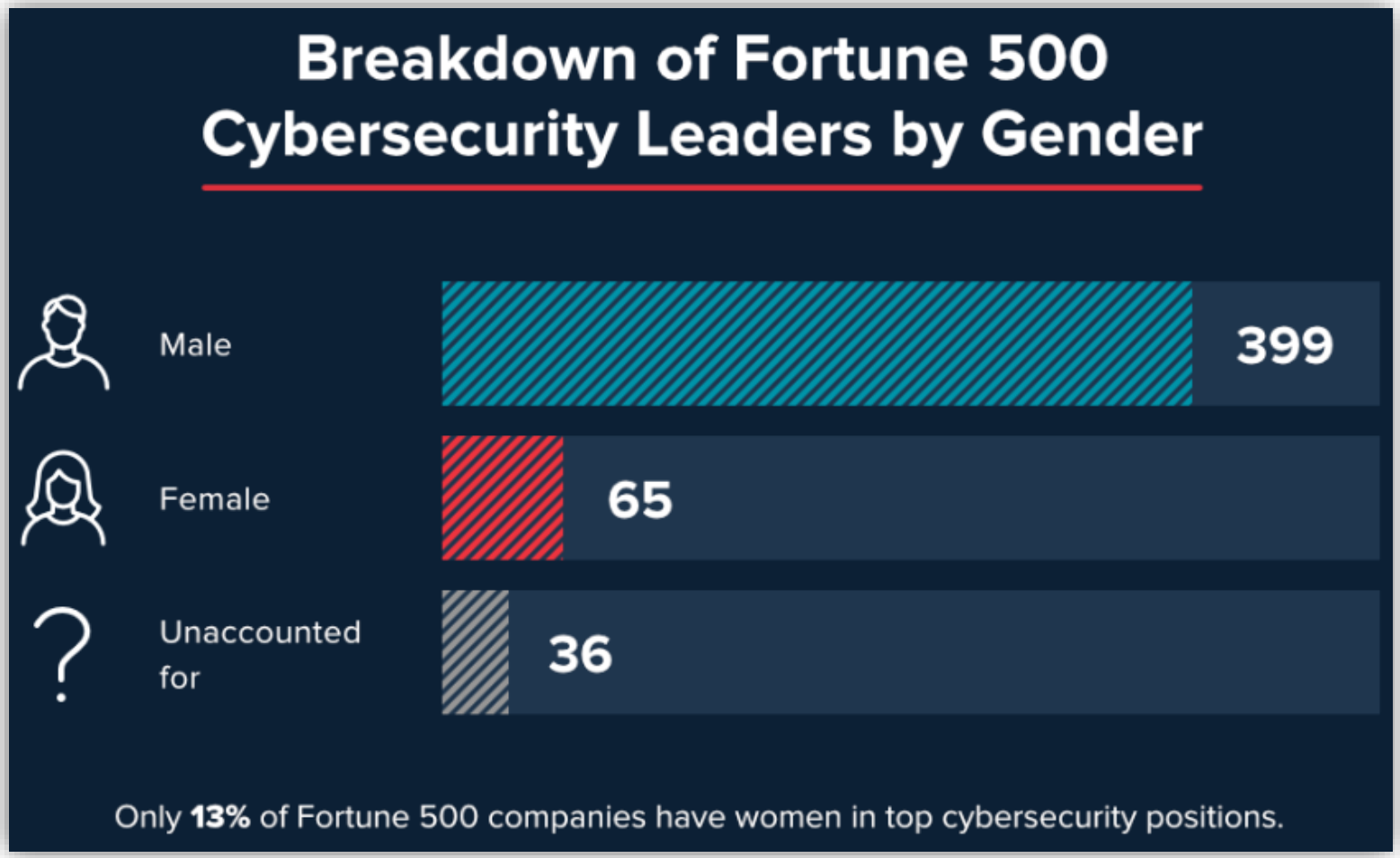
COMMENT · 26 MARCH 2018 · CORRECTION 16 MAY 2018

Cybersecurity needs women

Safeguarding our lives online requires skills and experiences that lie beyond masculine stereotypes of the hacker and soldier, says Winifred R. Poster.

https://www.nature.com/articles/d41586-018-03327-w

Women in Cybersecurity



https://theundercoverrecruiter.com/women-in-cyberscurity/

Author: Sarah Hospelhorn, Director of Product Marketing @ Varonis

Suggested Solution

How Can We Face This Issue?

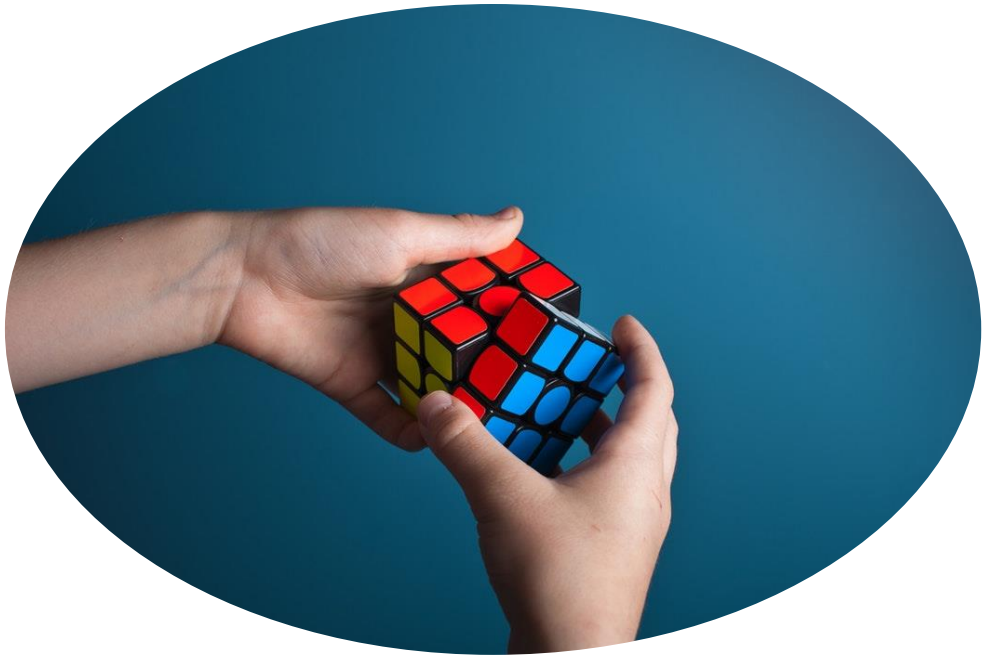


Photo by Olav Ahrens Røtne on Unsplash

Israeli Cybersecurity Educational System

- Elementary School
- Middle School
- High School
- University

6th grade
Introduction to Technology

7th-9th grade
Introduction to Programming

10th-12th grade
National Cyber Education Program

Work

8th-12th grade
Academia in High Schools

PiXELZ
הדור הבא של הטכנולוגיה
https://www.pixelz.cyber.org.il/

st@rTech
<לגלות את מה שאוהבים!>
https://www.startech.cyber.org.il/

מגשימים
תכנית הסייבר הלאומית
https://www.magshimim.cyber.org.il

אודיסיאה
תכנית ללימודים אקדמיים במדעים
https://www.madaney.net/site/programs/odyssey/

Israeli Cybersecurity Educational System

http://cyber-girlz.org/

CyberGirlz == Community which focuses on technology, computers and cyber

https://www.mehamemet.cyber.org.il/

פרויקט מהממ"ט

לבנות מהממות בהנדסה, מדעים, מתמטיקה וטכנולוגיה

בשיתוף המרכז לחינוך סייבר

Started a couple of months ago

The goal is to encourage girls to select computer science/technology as a course of study

Local Israeli Competitions

https://codeguru.co.il

1st-6th grade

7th-8th grade

10th-12th grade

7th-12th grade

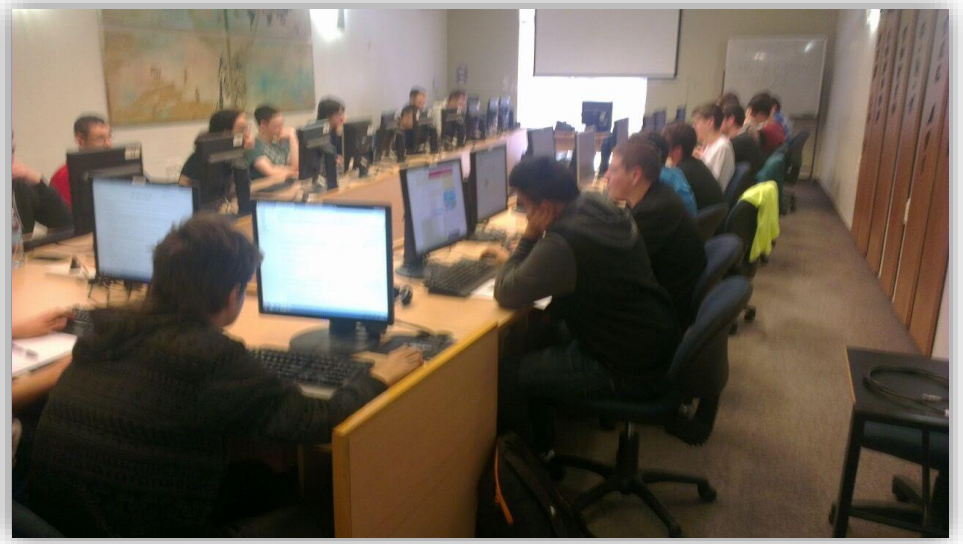
https://pub.skillz-edu.org/portal/results

*We'll not go over all of them

CodeGuru

- Math & Computer science personal competition for teenagers
- Based mostly on closed question
- Operating since 2000 (total of 19 competitions)

https://photos.google.com/share/AF1QipNE01GOSPLuIXeWrLWJzs1fk-uOSxeD2Ev17otGmroitU6DYSrAsuzLT_Z_9D3Vqw/photo/AF1QipNYVP5xapoXludHdiHNzOAzaGLddiDweKdWZszj?key=bEVTN2YwTUlYNlozMXZPQjRCQUxqc3E2Y05EUnNn



CodeGuru Extreme

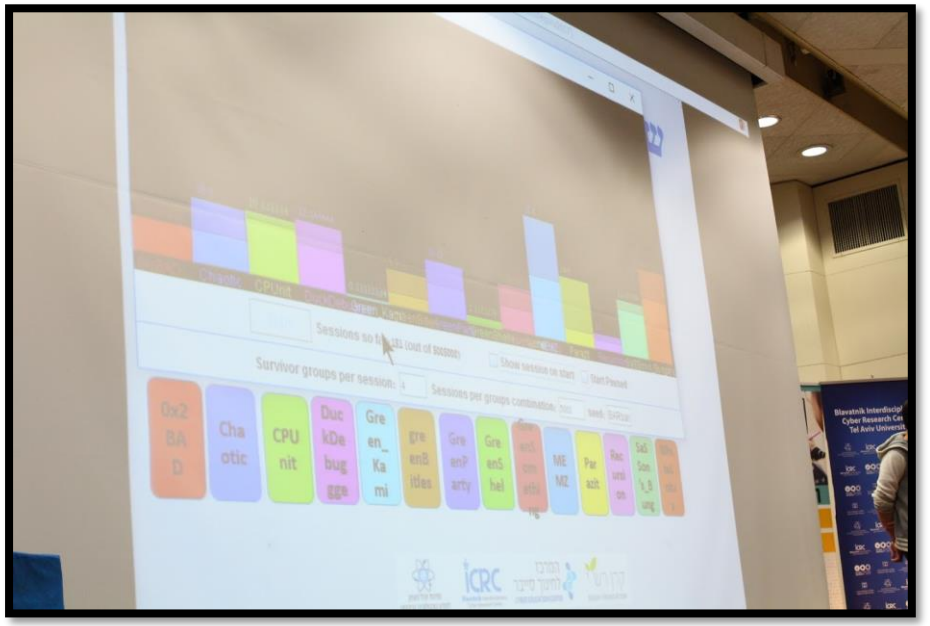
- Based on COREWARS
- “Survivors” are written in assembly 8086
- Total of 13 competitions until now
- Team based

```
@start:
mov bx, ax              ; on startup, AX holds our load-address
add bx, (@end - @start) ; BX is now the first offset after our own code
mov al, 0CCh            ; AL = our bomb data (0xCC, see above)

;
; 2. bombing loop
;
@loop:
mov [bx], al            ; write the value in AL to the offset BX points to
add bx, 8               ; add our bombing jump size to BX (we use a jump size
                        ; of 8 bytes, since it's longer than our code size and
                        ; divides with the arena's size. think why ... :)
jmp @loop
@end:
```

https://code.google.com/archive/p/corewars8086/downloads

https://photos.google.com/share/AF1QipO3M6YtepJRC--uZntYVW8lhwpaQd8-89tKNQQJ3_lG7-Da9fULetZOv6GC6N0rLw/photo/AF1QipPERSvdpRrynZHGKCpq2L7fHOF0KDLXULR0vIUW?key=cGUya3NkYmxpYjhKenI1YjFYNHpyblFIekY2TG9n



https://codeguru.co.il/Xtreme

SkillZ - Israel's Cybersecurity Championship

- Since 2015
- Gamification (code vs code)
- Team based (High school students)
- Each team has a mentor
- Operated with the ministry of education

http://edu.gov.il/special/skillz/Secondary-School/Pages/Secondary.aspx

SkillZ - Israel's Cybersecurity Championship

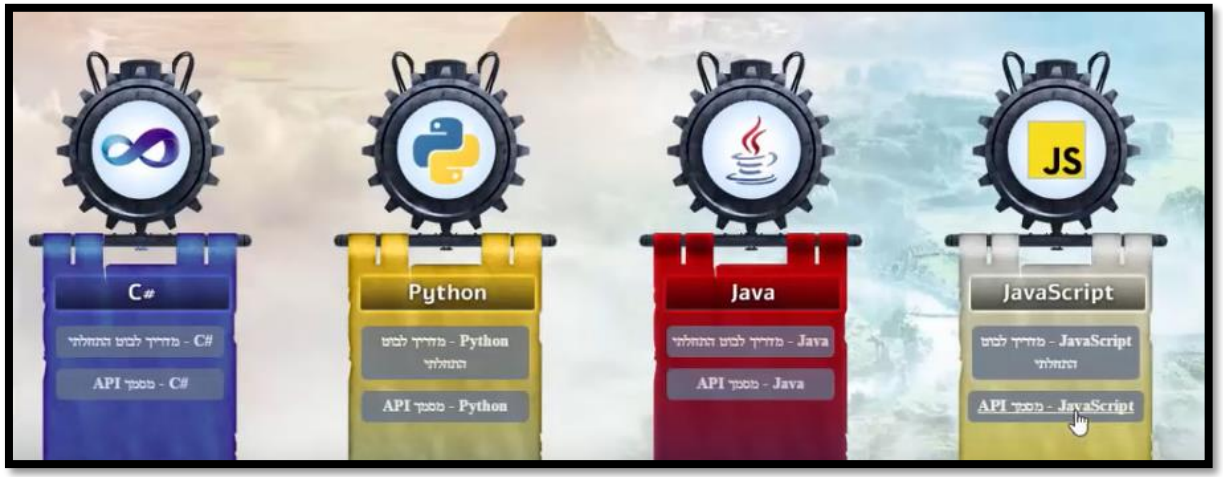
SkillZ 2016

https://www.youtube.com/watch?v=eENGU921-Ts

SkillZ 2017

https://www.youtube.com/watch?v=4WF3LOqg1fc

Supported Languages



https://www.youtube.com/watch?v=JtDYs6aj9ow

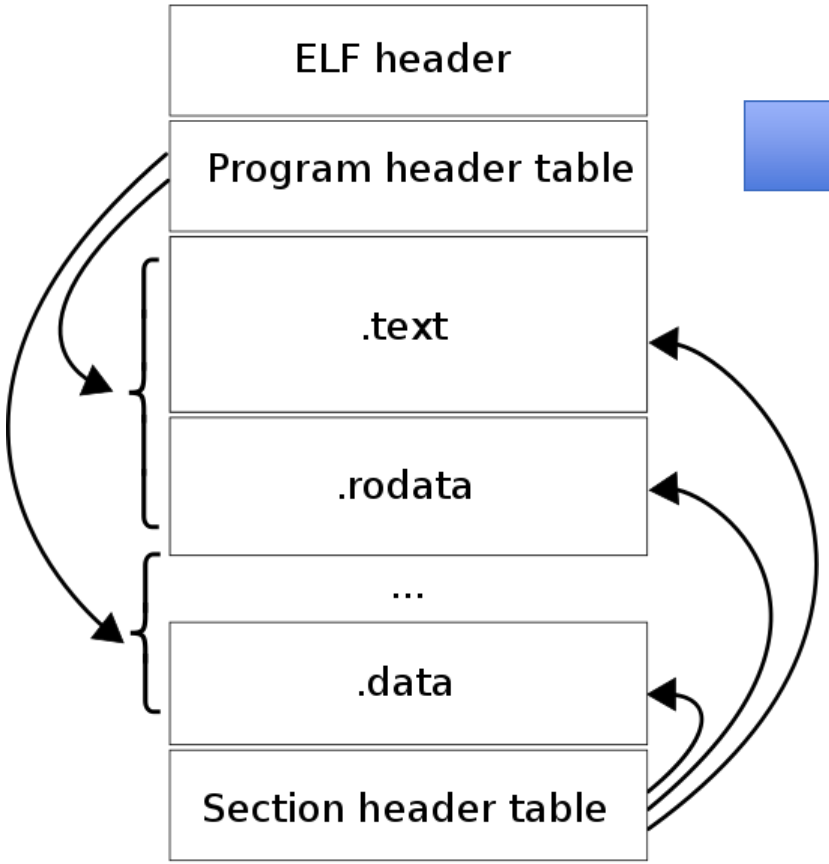
New Educational Approach

- Teach various technical topics
- Mentoring while working on real-world
- Encourage excellence in technical areas
- Internship in different cybersecurity/hi-tech companies

What Can Those Kiddies Even Do?

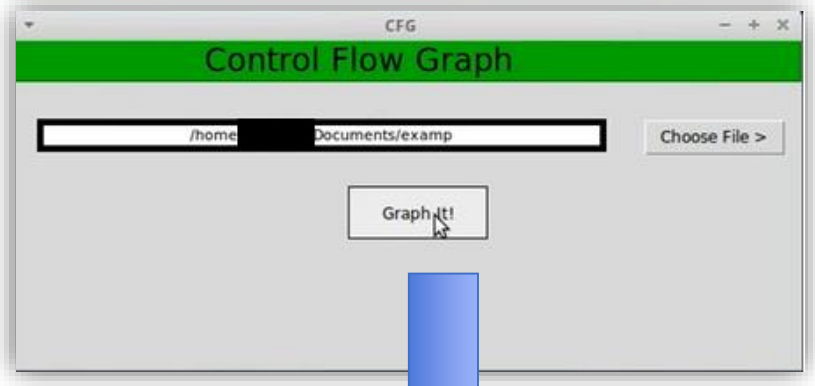
Photo by li tzuni on Unsplash

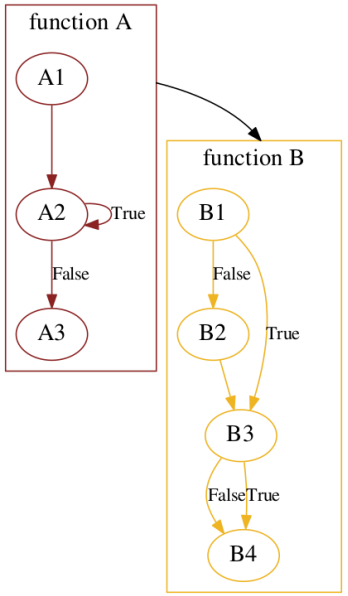
Project Examples - CFG for ELF Files



By Surueña

https://commons.wikimedia.org/wiki/File:Elf-layout--en.svg





Project Examples - Network Mapping

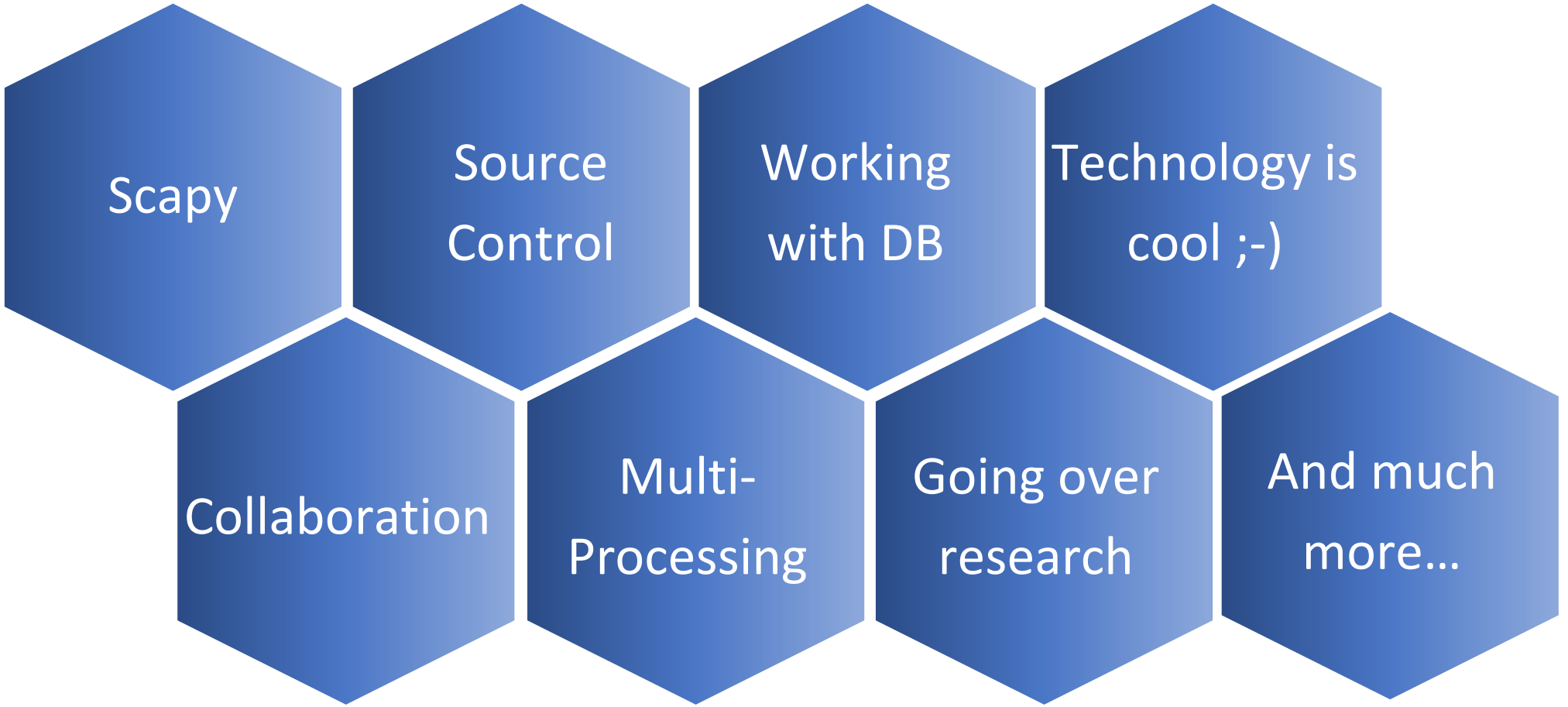
- Passive & Active OS Fingerprinting (Orange==Linux, Blue==Win)
- UI based on flask

And There Are Many More…

Project Name	Description	Age
Suspicious Users Detection	Network anomaly detection	15 years old
You Can't See Me	VMI based sandbox implementation	15 years old
Syntaxipot	Honeypot for web based applications	16 years old
hackermen	Identifying key network elements from passive sniffing (DGW, DNS, DHCP, etc)	15 years old
Cryptonic	Stopping process based on executed syscalls	15 years old
Matlac	Binary analysis based on histograms of library calls	15 years old

9th grade ~=15
10th grade ~=16

What Did They Learn?

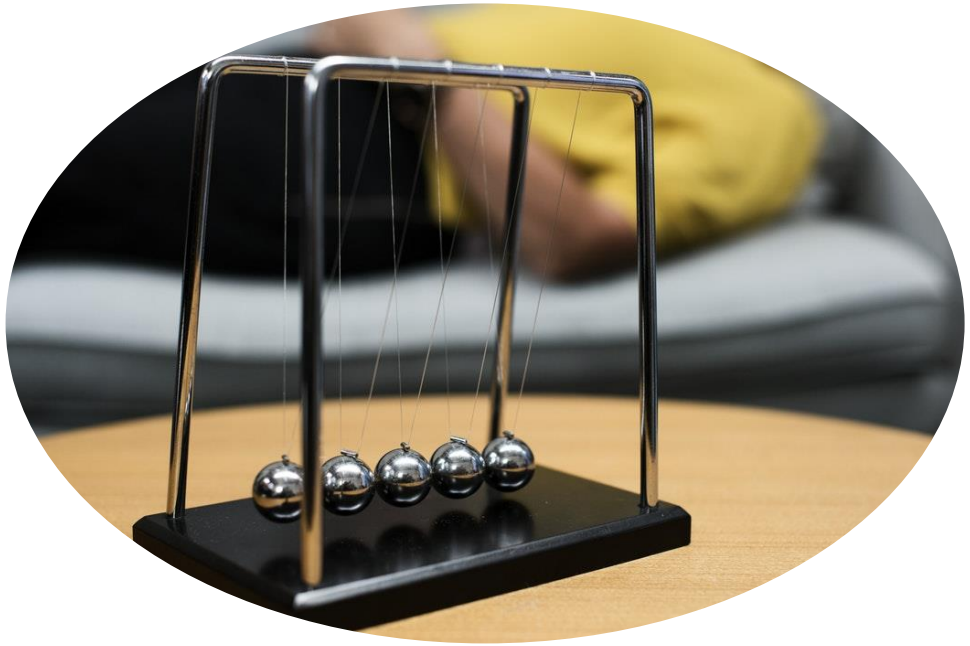


#MagTF 2017

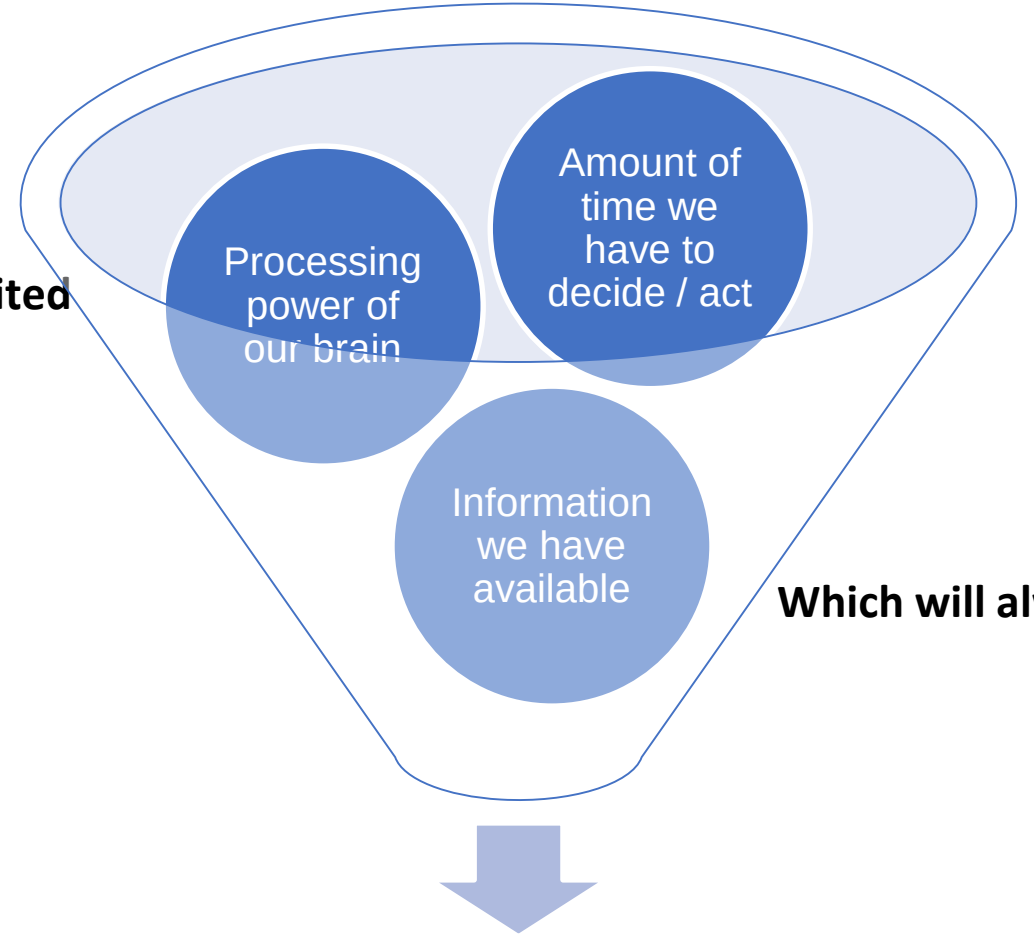
- A CTF event organized for Magshimim
- Graduates (18+) by noxale
- Organized by 17 years old teenagers

https://m.facebook.com/Magshimim/albums/1740624735948663/

The Mental Model Problem



Decision Making Process



Which will always be limited

Which will always be finite

Which will always be incomplete

Decision

Simon (1955)

Cognitive Conflicts

In case of discrepancy between two cognitive entities cognitive development emerges (Piaget, 1970)

Solution - Conflict Based Learning

```
readelf -p .interp challenge0x03 && readelf -p .interp /bin/echo
```

Changed the target loader of the ELF

```
String dump of section '.interp':
  [     0]  /lib64/ld-linux-x8&-64.so.2


String dump of section '.interp':
  [     0]  /lib64/ld-linux-x86-64.so.2
```

The students needed to identify that and fix it

```
00000220  F0 01 00 00 00 00 00 00 F0 01 00 00 00 00 00 00  ð.......ð.......
00000230  01 00 00 00 00 00 00 00 2F 6C 69 62 36 34 2F 6C  ......../lib64/l
00000240  64 2D 6C 69 6E 75 78 2D 78 38 36 2D 36 34 2E 73  d-linux-x86-64.s
00000250  6F 2E 32 00 04 00 00 00 10 00 00 00 01 00 00 00  o.2.............
00000260  47 4E 55 00 00 00 00 00 02 00 00 00 06 00 00 00  GNU.............
```

Solution - Conflict Based Learning

Changed the syscall opcode to sysret

```
0000000000444840 <__nanosleep>:
  444840:       83 3d 95 c9 28 00 00    cmpl   $0x0,0x28c995(%rip)        # 6d11dc <__libc_multiple_threads>
  444847:       75 14                   jne    44485d <__nanosleep_nocancel+0x14>

0000000000444849 <__nanosleep_nocancel>:
  444849:       b8 23 00 00 00          mov    $0x23,%eax
  44484e:       0f 07                   sysret
  444850:       48 3d 01 f0 ff ff       cmp    $0xfffffffffffff001,%rax
  444856:       0f 83 14 5b 00 00       jae    44a370 <__syscall_error>
  44485c:       c3                      retq
  44485d:       48 83 ec 08             sub    $0x8,%rsp
  444861:       e8 8a 3f 00 00          callq  4487f0 <__libc_enable_asynccancel>
  444866:       48 89 04 24             mov    %rax,(%rsp)
  44486a:       b8 23 00 00 00          mov    $0x23,%eax
  44486f:       0f 05                   syscall
  444871:       48 8b 3c 24             mov    (%rsp),%rdi
  444875:       48 89 c2                mov    %rax,%rdx
  444878:       e8 d3 3f 00 00          callq  448850 <__libc_disable_asynccancel>
  44487d:       48 89 d0                mov    %rdx,%rax
  444880:       48 83 c4 08             add    $0x8,%rsp
  444884:       48 3d 01 f0 ff ff       cmp    $0xfffffffffffff001,%rax
  44488a:       0f 83 e0 5a 00 00       jae    44a370 <__syscall_error>
  444890:       c3                      retq
  444891:       66 2e 0f 1f 84 00 00    nopw   %cs:0x0(%rax,%rax,1)
  444898:       00 00 00
  44489b:       0f 1f 44 00 00          nopl   0x0(%rax,%rax,1)

00000000004448a0 <_exit>:
  4448a0:       48 63 d7                movslq %edi,%rdx
  4448a3:       49 c7 c1 d0 ff ff ff    mov    $0xffffffffffffffd0,%r9
  4448aa:       41 b8 e7 00 00 00       mov    $0xe7,%r8d
  4448b0:       be 3c 00 00 00          mov    $0x3c,%esi
  4448b5:       eb 19                   jmp    4448d0 <_exit+0x30>
  4448b7:       66 0f 1f 84 00 00 00    nopw   0x0(%rax,%rax,1)
```

Conflict Based Learning - Results

- The students (9^{th}/10^{th} grade) have a better understating of:
  - The ELF file format
  - How system calls work
  - Using gdb
  - Using objdump
  - Using readelf
  - Operating system fundementals
  - etc

Europe Case Study

TeenTech

"…**TeenTech** runs lively initiatives with a supporting Award scheme to **help young teenagers** see the wide range of **career possibilities** in **Science, Engineering and Technology**. We work collaboratively with companies, Universities, business organizations and education business partnerships to build sustainable and imaginative programmers focusing on regions of greater social need in the **UK and Europe**…"

http://www.teentech.com/about-teentech/

TEENTECH®

TeenTech - Cybersecurity

"…With the support of leading organizations working in **cyber security**, TeenTech are **producing a series of films and events** to help **students**, **parents** and **teachers** understand the **opportunities** in an **industry** set to offer over 4.5 million more jobs worldwide by 2019…"

http://www.teentech.com/cybersecurity/

British Teenagers

INDEPENDENT

British teenagers to be taught 'cyber curriculum' to defend UK against threat of hacking attacks

Isis-inspired hackers contributing to rising threat amid warnings over Russia and China

Lizzie Dearden | @lizziedearden | Saturday 11 February 2017 09:00 | 16 comments

Like Click The Ir

Thousands of British teenagers are to be given training in cyber security to boost the UK's defences against the rising threat of online attacks.

The new Cyber Schools Programme aims to teach pupils some of the skills they would need to help defend Britain's businesses and institutions against online threats.

The scheme, led by the Department for Culture, Media and Sport (DCMS), is aimed at those aged between 14 and 18, with a target for at least 5,700 teenagers to be trained by 2021.

Matt Hancock, the digital and culture minister, said: "This forward-thinking programme will see thousands of the best and brightest young minds given the opportunity to learn cutting-edge cyber security skills alongside their secondary school studies.

https://www.independent.co.uk/news/uk/home-news/cyber-attacks-security-uk-russia-china-isis-terrorist-nhs-websites-curriculum-school-teenagers-a7574611.html

National College of Cyber Security (UK)

School for teenage codebreakers to open in Bletchley Park

Sixth-form College of National Security will teach cyber skills to some of Britain's most gifted youngsters to fight growing threat

▲ Keira Knightley and Benedict Cumberbatch as Bletchley Park codebreakers Joan Clarke and Alan Turing in the 2014 film The Imitation Game. Photograph: Allstar/Black Bear Pictures

https://www.theguardian.com/technology/2016/nov/24/college-of-national-security-teenage-codebreakers-school-open-bletchley-park

Spy kids: UK's first cybersecurity college for teens to open at Bletchley Park

The boarding school will be free to attend and will select students on talent, regardless of family background or wealth.

By Hyacinth Mascarenhas

Updated November 24, 2016 11:25 GMT

https://www.ibtimes.co.uk/uks-first-cybersecurity-college-open-historic-bletchley-park-1593212

BIZ & IT —

Cyber college for wannabe codebreakers planned at UK's iconic Bletchley Park

Plan is to enroll 500 students each year and put them on a heavy diet of infosec.

TOM MENDELSOHN - 11/25/2016, 6:55 AM

https://arstechnica.com/information-technology/2016/11/cyber-college-wannabe-codebreakers-earmarked-bletchley-park-site/

A Live Proof: noxale Case Study

www.noxale.com

noxale – Teenagers' Security Team

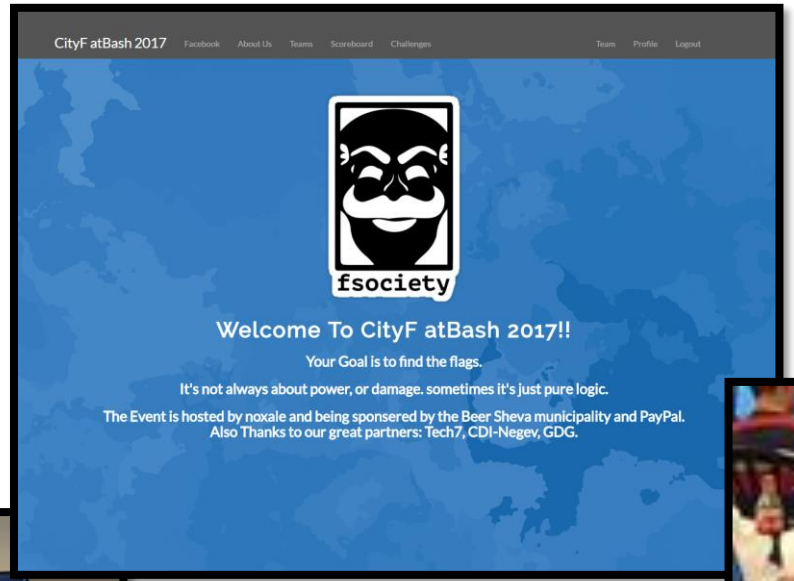
noxale is a **local Israeli** security team which includes **passionate teenagers** that is engaged in the **creation/participation** of **CTFs** and **spreading** of **cybersecurity knowledge** among the **Israeli community**

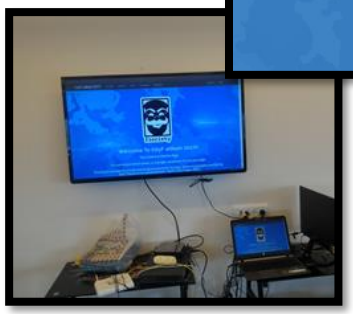
noxale ID

Founded	2016
Number of Members	50 – Global group 35 - CTF team
Age Range	17-18
Activities	Blog & Weekly challenges CTF creation & participation Security tools development Community education Conferences
CTF Rating 2018	Overall 74 (156.738 points)

CityF atBash 2017

- First CTF organized by teenagers in Israel
- Created with the support of **industry, community and municipality**





#noxCon 0x01 - Teenagers Teach Teenagers

Security conference organized by teenagers for teenagers

https://youtu.be/RXB-C1Sks8k

Community education - Tech7Juniors

30+ programs
100+ lectures & events
3000+ teenagers exposed

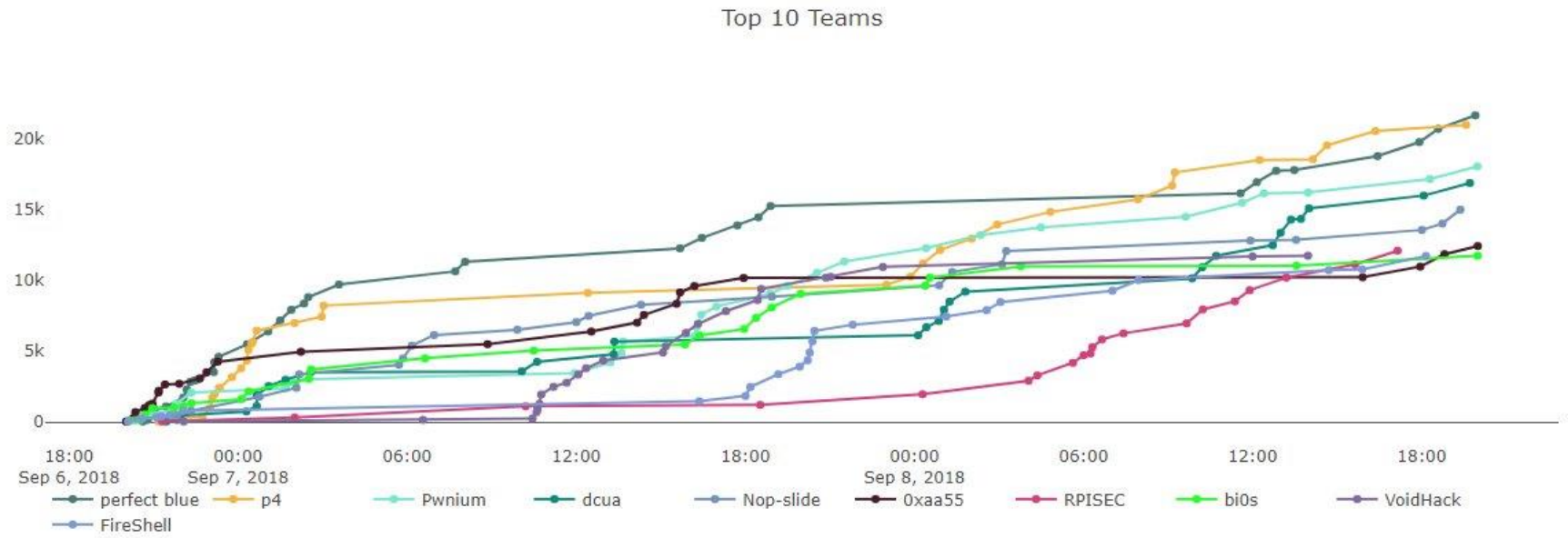
Photos by Tech7Juniors

#noxCTF - 1st Online CTF

CTF's Headquarters

https://ctf.noxale.com/

#noxCTF – 1st Online CTF



Place	Team	Score
1	perfect blue	21687
2	p4	21011
3	Pwnium	18078
4	dcua	16908
5	Nop-slide	15026

909 teams registered

4676 IP addresses

42 challenges

Discord has the most solves with 395 solves

SUBliminal and the shadow has the least solves with 1 solves

Future Thinking

Photo by Tom Grimbert on Unsplash

What Can You Do?

- Organize practical learning events (CTFs, trainings, competitions, etc)
- Mentor teenagers

- Help teenagers security groups in your community
- Collaborate with educational system to expose:

Teenagers → Industry & Industry → Teenagers

Upgrade the Current Approach

- Add practical cybersecurity training in schools as earlier as possible (1st grade?)
- Expose girls in middle school to female cybersecurity leaders systematically
- Teach cutting edge technology with hands on experience
- Investing in more in pedagogical concepts

Blackhat Sound Bytes

- Youth age is most suitable for education in cybersecurity

- A full-package education system in cybersecurity for teenagers can aid in solving the workforce shortage

- **Cooperation**, **Cooperation**, **Cooperation**. Cooperation between community and industry is the key

Final Note

Make sure you learn something new everyday

Final Note

If I don't learn something every single day, it's a wasted day

Leonard Lauder

https://www.brainyquote.com/quotes/leonard_lauder_549521

Questions?

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