DESIGN, BUILD OR BREAK CYBER GAMES FOR K-12 EDUCATION

Technology, Cybersecurity and Policy
UNIVERSITY OF COLORADO **BOULDER**

Technology, Cybersecurity and Policy

(formerly the Interdisciplinary Telecom Program)

- **10,000** unfilled Cybersecurity jobs in CO
- **3.5 million** globally by 2021
- **MS**, **BA/MS**, **BS/MS** and **Cyber Minor** degree offerings
  - 10 new cybersecurity courses
  - "**CYBR**" at **classes.colorado.edu** for Fall 2019
  - currently "TLEN"

Cybersecurity | Network Engineering | Wireless Engineering
IoT | Blockchain | Cloud Computing | Policy | Law | Economics
Entrepreneurship

Design-Build-Break Cyber Games for K-12

- **Challenge Summary**
- **Cyber Game Examples**
- **Prompts**
  - Topic Ares
  - More Ideas
- **Project Format**
- **Prizes**

Design-Build-Break Cyber Games for K-12

- **Educational Need for Cyber Foundational Skills**
- **Games support learning**
- **Options in Cyber Game Challenge**
  - *Design* – Game Design Document (GDD)
  - *Build* – Mock Up, or Mobile/Desktop Prototype
  - *Break* – Create game to teach how to break them

Examples

https://cybergames.circadence.com/

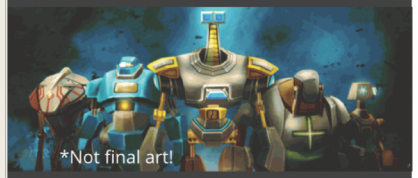
Regular Expressions

- **Practical Uses in Cyber**
  - Gathering data from large data store
  - Eliminating extra data from search
  - IDS Log query

- **Examples**
  - www.regexone.com

RegEXile

GAME PROPOSAL BY
HECTOR G. ROBLES
CIRCADENCE



Game Analysis

RegEXile is a fast-paced pattern recognition game that teaches the concepts of regular expression while exercising trainees muscle memory and reaction time. The game will challenge players while immersing them in light narrative driven gameplay that will keep seasoned and beginner analyst coming back for more.

Mission

The main campaign will be level driven and once the player completes the requirements for successful understanding of major Regular Expression concepts they will gain access to endless mode.

Genre

Action, Education, Typing

Platforms

PC, Mac, Linux, and Web

Target Audience

This game will be targeted at those with an interest in cyber security. Be it beginners or seasoned pros.

Control Scheme

By using the keyboard the player will use Regular Expression techniques to take out the robots.
The player must recognize patterns in the enemy names and type out proper RegEX techniques to eliminate robots before they destroy the colony.

Game Concept

Welcome to Planet Regulon Exior the last human colony escaping the robot apocalypse. Unfortunately, the robots have finally reached your colony. You are the last line of defense against the rogue drones that are attacking the exiled colony which is the last hope for humanity. Your mission as a cyber security expert is to figure out the RegEX patterns that will destroy the invading horde of metal and circuits.

Use your keyboard to type the proper pattern using real world regular expression techniques. Available on Mac, PC, Linux

Gameplay

Fast paced gameplay that test the player's Knowledge of regular expressions. The only Input required is a keyboard and mouse.
Using the concepts of regular expressions award bons points for using techniques like wild card or capture all. The Drones approach the base and the player must find the patterns in their names, finding the best way to neutralize them. The drone type determines how they attack. The type also determines the complexity of the pattern. The goal is to clear all waves and go to the next level. Each new level introduces a new concept. At the end the player is given a medal that is based on their performance, they then unlock endless mode and time trials.

Inspiration

RegEXile is inspired by games like Mario teaches Typing, Typing of the Dead, Ztype, many Tower defense, and Shoot 'em up games.

Regular Expressions

https://www.youtube.com/watch?v=AbSdKm5JNSo

PROMPTS

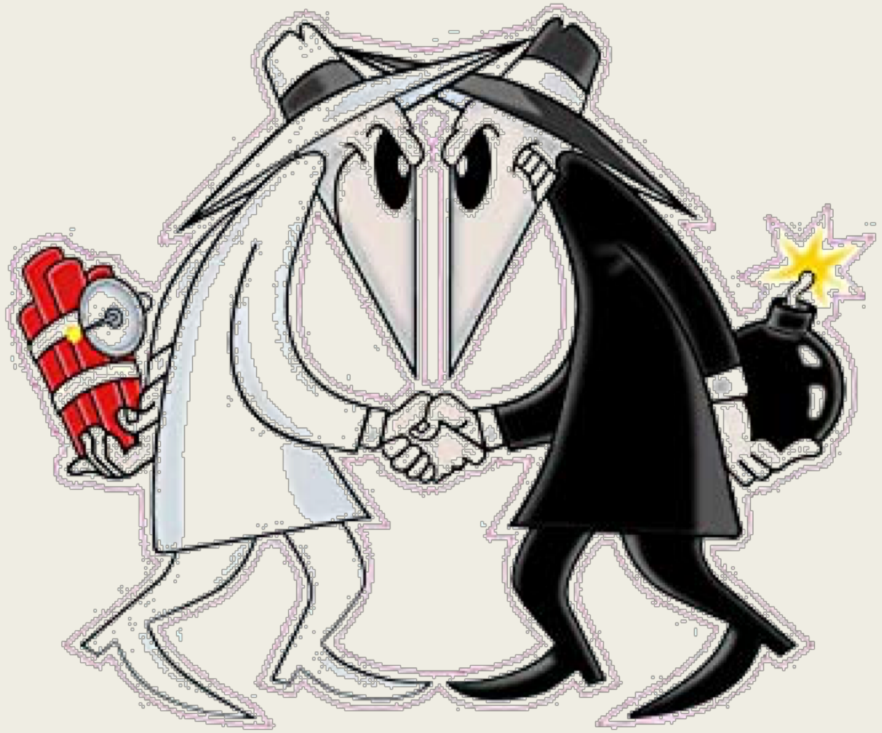
TCP Cyber Game Challenge

Cyber Game Topics

1. Cryptography
2. PowerShell/Scripting
3. Cyber risk (Probability/Confidence Levels)
4. Authentication/Authorization
5. Cyber Key Terrain
6. Code hacking
7. Network mapping
8. Passwords
9. Firewalls
10. IDS Rules
11. Malware Analysis
12. Incident Response Process
13. Network Subnetting Design (CIDR)
14. Network Analysis
15. General Cyber Hygiene

PowerShell/Scripting

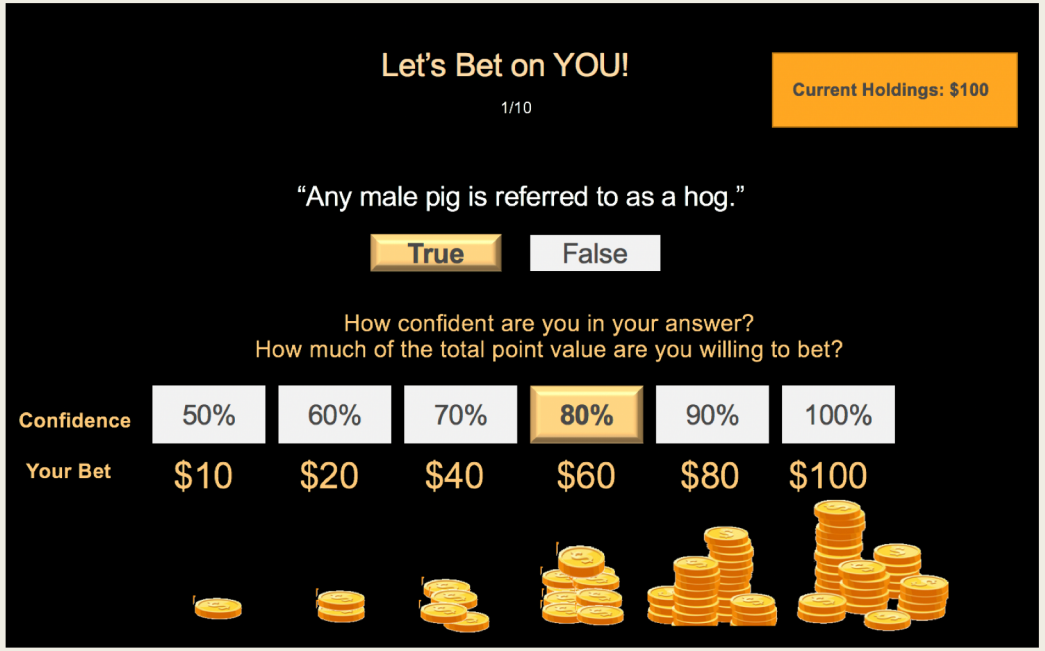
- ***Practical Uses in Cyber***
  - Used by both system administrators and hackers
  - Gather list of devices on network (or monitor when new one is added)
  - Comparing files
  - Reconnaissance of users, files and processes
  - Monitoring of Active Directory (user accounts) for changes

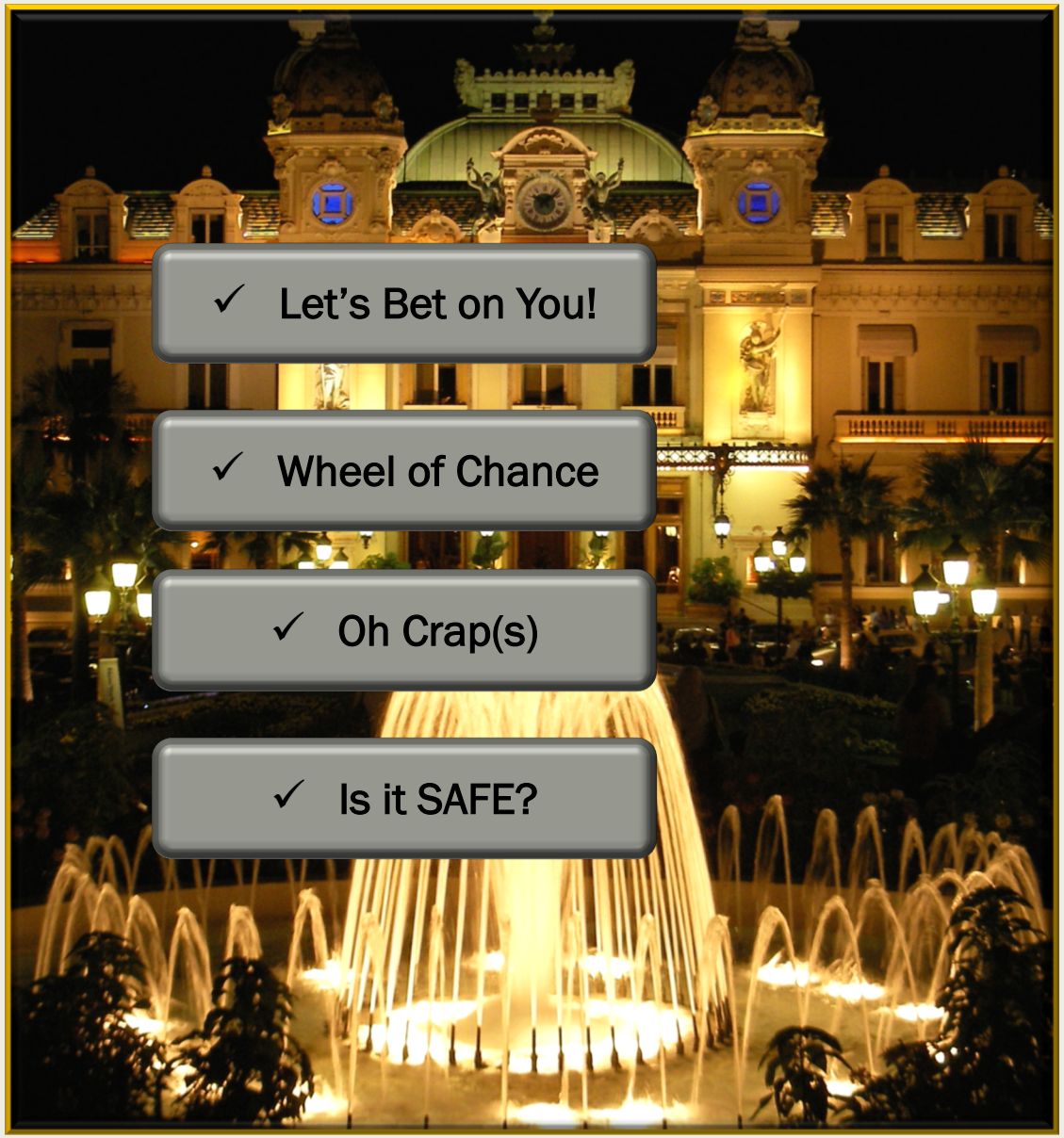


- **References and Examples**
  - PowerShellv4 *http://technet.microsoft.com/en-us/library/hh857339.aspx*
  - Cyber Aces Scripting (Free, on-line) for basic scripting and programming

Cyber Risk

- **Learning Goals/Messages**
  - Cyber Risk = Probability X Impact
  - Players need to be comfortable in estimating probability and confidence level





Cryptography

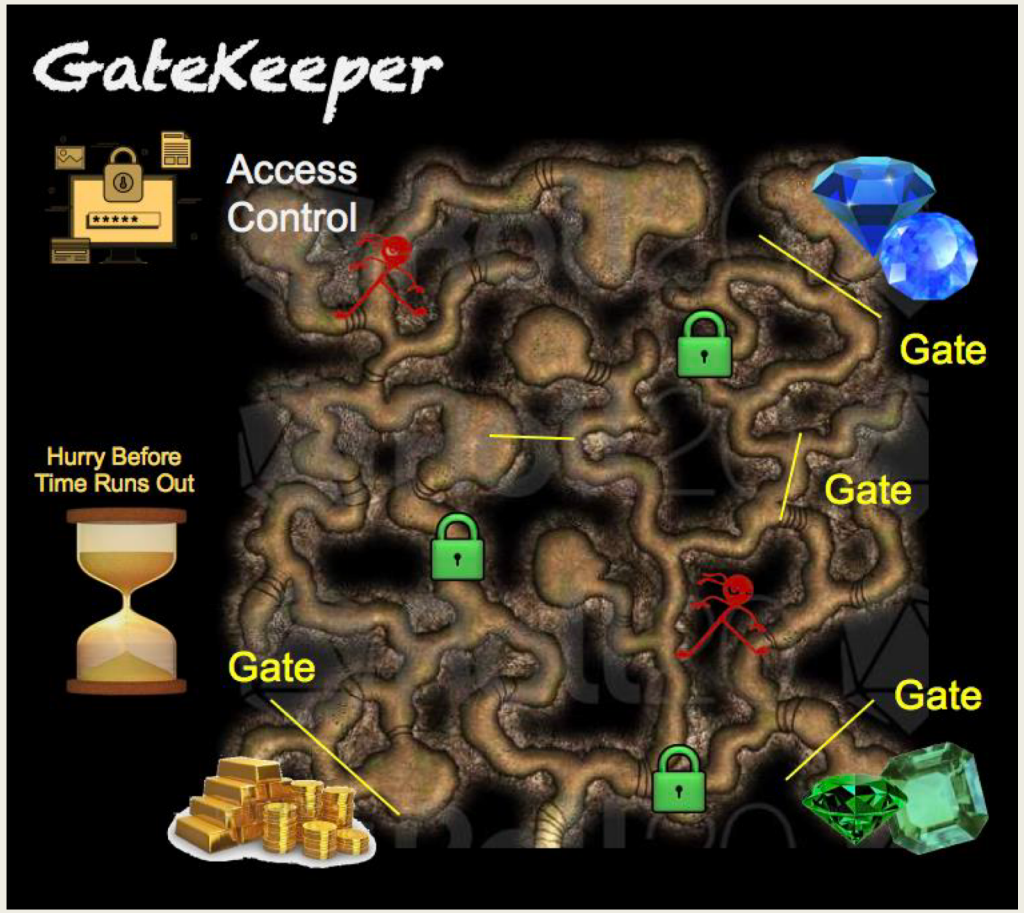
- **Learning Goals/ Messages**
  - Understand what encryption/cryptography is. It's just math to hide create a secret code. Historically, there have been examples for 1000's of years. Explain Scytale (rhymes with Italy).
    - *how frequency analysis (e.g., which requires more data) to solve puzzles*
  - Technology progress in computing have made it easier/faster to break codes (always evolving, never perfect).
  - It takes time (availability concerns) to encrypt/decrypt everything! Use it wisely.
  - It takes management overhead with key management nightmares. Use it wisely.
- **References**
  - http://www.maths.manchester.ac.uk/cryptography_competition_the_imitation_game/index.php
  - https://www.cryptoclub.org/#vDesertOasis

Cryptography Curriculum

- Encryption/decryption, sender authentication, data integrity, non-repudiation
- Attack classification (ciphertext-only, known plaintext, chosen plaintext, chosen ciphertext)
- Secret key (symmetric), cryptography and public-key (asymmetric) cryptography
- Information-theoretic security (one-time pad, Shannon Theorem)
- Historical Ciphers
  - Shift cipher, affine cipher, substitution cipher, Vigenere cipher
  - Hill cipher, Enigma machine

Authentication and Authorization

- **Learning Goals/ Messages**
  - Know the difference between Identity, AuthN, AuthZ
  - Authentication Types
    - *PINs, Passwords, Token/Key*
    - *Plusses and minuses of each*
  - Authorization schemes
    - *Role*
    - *Comes with a cost of complexity!*



CHALLENGE FORMAT

TCP Cyber Game Challenge

Challenge Format – Design

- **Game Title**
- **Summary**
  - The Elevator Pitch
  - Theme/Genre
  - Audience
  - Game Flow Summary
- **Educational Design**
  - Learning Objectives
  - Puzzle/Challenge Structure
  - Play Flow
- **Storyline**
  - Setting
  - Characters
  - Visuals
- **Game Play Mechanics**
  - Controls
  - Levels
  - Technical Requirements: AI, Art Assets
- **Scoring Method**

Game Design Document (GDD)

Challenge Format - Build

- **Mock up (chart flip through)**
- **Physical game play (e.g., cards)**
- **Unity3D or UnReal Game Prototype**
- **Mobile App**

Just about anything that gets across the game play and learning method!

Challenge Format - Break

- **Example game that can be hacked**
  - Appropriate to age group
  - Teaches cybersecurity principles through ”hacking”
- **Process that demonstrates hacking**
  - For example, improper inputs cause unintended results
  - OWASP Top 10 for Web Apps
  - Essentially Reverse Engineering/Pentesting for Kids

Judging Criteria

Judges will include experts in cybersecurity, game prototyping, and K-12 education from TCP, Circadence, and the St. Vrain Valley School District.

- **Educational Merit**
  - Does it teach a topic relevant to Cyber
- **Fun and Engaging**
  - Does it fit the target audience
- **Realistic/Complete**
  - Is the design or prototype sufficient to plan the MVP

PRIZES

TCP Cyber Game Challenge

Prizes for TCP Cyber Game Challenge

Winning projects will be selected for potential future development and use for K-12 education with the TCP Program and Circadence in local school districts.

- **First Place – choice of:**
  - Free trip to the Pentagon (DoD Headquarters) with the TCP Program
    - *Paid airfare, lodging, and custom tour for 3 days, 2 nights*
  - Nintendo Switch Game Consoles

- **Second Place – choice of:**
  - Circadence Project Ares Licenses
  - Google Home Minis - Smart Speakers with Google Assistant
- **Third Place:**
  - Tile Mate Item Trackers (2/person)
- **All: Pride and TCP SWAG**

PROJECT ARES™
NEXT GENERATION CYBERSECURITY TRAINING

Mentors

Daniel Massey, PhD – Director, TCP Program; Neutral Vehicle research project; K-12 Cybersecurity Education in St. Vrain Valley School District

Laura Lee, JD, MA – Executive Vice President of Rapid Prototyping, Circadence

Daniel Manson, PhD – Instructor, TCP Program; Western Region Collegiate Cyber Defense Competition; CyberPatriot Competition

Lijun Chen, PhD – Asst. Professor, TCP Program & Dept. of Comp. Sci.

Sangtae Ha, PhD – Asst. Professor, TCP Program & Dept. of Comp. Sci.

Will Temple – PhD Candidate, CU's Dept. of Comp. Sci.; Dr. Ben Shaprio's Laboratory for Playful Computation

CU's Cybersecurity Club and Collegiate Cyber Defense Competition Team's students are willing to assist with projects as needed.

Department of Computer Science
UNIVERSITY OF COLORADO **BOULDER**

CU Cybersecurity Club

CIRCADENCE
TECHNOLOGY POWERED BY TOMORROW

Technology, Cybersecurity and Policy

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