ProCo 2018 Round 2

Ancient Greek Tales

This year's Round 2 packet will include problems in a Capture the Flag (CTF) style. These problems will be covered in a variety of topics which include **cryptography, websites, reverse engineering, script writing,** and **miscellaneous**.

The stories of Ancient Greece have long been passed down through millennia. As you navigate through the labyrinths of what has been left behind, you begin to learn more and more about their mythology. Oddly enough, some of the gods have even gained the power of modern technology and have encrypted their information. Crack their codes to reveal the truth. Note that the flags are **case sensitive** unless otherwise stated.

Ciphers

Vision of Ares (400)

The legend of Ares speaks volumes about his wrath as the god of war. Born from Zeus and Hera, warriors prayed to him for his blessing during their battles. One day, an Athenian stumbles across a message written in fire in the ceiling of the Temple of Ares. He's unsure what it means and shifts uncomfortably as he writes down the letters:

tyqdwfbsizwlvqimjnprbuckrlwkprlainpvnyuy

He thinks that his scroll dictating Ares' origins will help him in this quest: https://bit.ly/2HjmwCv. He's also pretty confident that the word "flag" is in the answer, and that the answer is in lower case.

Hoarse Code (200, 400)

Hermes, the messenger of the Gods, wakes up one day and finds that his throat is sore! This means he won't be able to use his voice to communicate his messages. To get around this, he devises a "hoarse code" to encode his messages, which are in lower case:

a: *--	j: *---*	s: ***-
b: -****	k: -*--	t: --
c: -*-**	l: *-***	u: **--
d: -***	m: ---	v: ***-*
e: **	n: -*-	w: *---
f: **-**	o: ----	x: -**--
g: --*-	p: *--**	y: -*--*
h: *****	q: --*-*	z: --**-
i: **-	r: *-*-	

1. What does this message encode?
-- -- -*-** **- ** -*- -- -- ** *-*** ** --*- *-*- *-- *--** *****

2. Be careful with this one -- Hermes forgot to include the spaces! Luckily, you have here a list of words that you know Hermes will choose from: https://bit.ly/2KZ4rIi
-*****-***-***--*-**--*-*-**--*-**-*--***---***-*-

Aphrodite Sees Cinematic Ionian Islands I (100)

Aphrodite, Greek goddess of love, mulls over the recent scandal between her and her husband Hephaestus. To think it over, she decides to take some time in the Ionian Islands and dresses as a old, frail mortal. While there, she decides to leave a message in lower case to her worshippers. A worshipper, passing along, stumbles across the following numbers etched into the stone:

XCVII CXVII CXVI CIV CXI CXIV CXI CII CXVI CIV CI CXV CXVI CXI CXIV CXXI CXI CII CI CXIV CXI CXV XCVII CX C CXII CXV CXXI XCIX CIV CI

Aphrodite Sees Cinematic Ionian Islands II (300)

Seven days after Aphrodite visited, the women of the Ionian Islands received another message in lower case from her. As a favor for their devout worship, she would grant them seven fertile lambs who would breed a new generation of bigger, fatter lambs so that the entire island could live comfortably off the animals. Within weeks, each of the seven lambs produced another seven lambs for a total of 49 lambs. On one of the lambs, a birthmark appeared:

DCCCXII DCCXXVIII DCCVII DCCXIV DCCLVI DCLXXIX DCCXXI DCCXXXV DCCCV DCCCXII DCCXXVIII DCCVII DCLXXIX DCCLXX DCXCIII DCCXXXV DCCVII DCCLXX DCCCXII DCCXXI DCCXCVIII DCCVII DCCVII DCCXLIX DCCCXXXIII DCCLXXVII DCCXCVIII DCC DCCXIV DCCLXXVII DCCXCVIII DCC DCCLXXVII DCCCXXVI DCCVII

Reverse Engineering

Reverse World Entering (100, 300, 500)

Hades hates it when people enter the subterranean realm without his permission. As a result, he has set up a series of locked barriers, and only by inputting the correct code to the locks can you enter the realm. Fortunately, you have the code describing each of the locks; can you determine the inputs that will cause the locks to return true and open?

Note: the functions are implemented the **same** across each language.

Problem 1

```
# Python
def reverse1(x):
    if x < 1000 or x > 2000:
        return False
    if (x + 3) % 10 != 0:
        return False
```

```
    return x / 100 == x % 100

// C++
bool reverse1(int x) {
    if (x < 1000 || x > 2000)
        return false;
    if ((x + 3) % 10 != 0)
        return false;
    return x / 100 == x % 100;
}

// Java
public static boolean reverse1(int x) {
    if (x < 1000 || x > 2000)
        return false;
    if ((x + 3) % 10 != 0)
        return false;
    return x / 100 == x % 100;
}
```

Problem 2

```
# Python
def reverse2(s):
    if len(s) != 24:
        return False
    for a in s:
        if a != '1' and a != '8':
            return False
    c = []
    for b in range(8):
        c.append(s[3*b:3*b+3])
        if b > 0 and c[b] <= c[b-1]:
            return False
    return True

// C++
bool reverse2(string s) {
    if(s.length() != 24)
        return false;
    for(int a = 0; a < 24; a++) {
        if(s.at(a) != '1' && s.at(a) != '8')
            return false;
```

```
    }
    string c[8];
    for(int b = 0; b < 8; b++) {
        c[b] = s.substr(3*b, 3*b+3);
        if(b > 0 && c[b] <= c[b-1])
            return false;
    }
    return true;
}

// Java
public static boolean reverse2(String s) {
    if(s.length() != 24)
        return false;
    for(int a = 0; a < 24; a++) {
        if(s.charAt(a) != '1' && s.charAt(a) != '8')
            return false;
    }
    String[] c = new String[8];
    for(int b = 0; b < 8; b++) {
        c[b] = s.substring(3*b, 3*b+3);
        if(b > 0 && c[b].compareTo(c[b-1]) <= 0)
            return false;
    }
    return true;
}
```

Problem 3

The functions are in the following files: https://bit.ly/2rDLnaq

Optimization

Infinite Time (300)

Chronos, the god of Time, can't keep his hands off of other gods' stuff. Now, these programs take forever to run! What were they supposed to return?

Note: each program has the **same** output across each language.
https://bit.ly/2KYmbDx

Decompilation

Uncrafting (200, 200, 200)

Hephaestus, the god of crafting, was so blindly eager to craft programs that he accidentally misplaced his secrets in the code. And now, he lost the source code to his programs! Can you help him retrieve his secrets?

Note: the binaries have a **different** secret for each of Java, C++, and Python.
https://bit.ly/2IG4Cd1

Web Programming

Hermes' Structured Query Language I (300)

Hermes has decided to adapt to the modern times and store data about his messages into an SQL table. Unfortunately, Hermes never really took a web programming class so he does not know how to properly secure his table. See if you can break into it to get his secret message:
http://35.230.117.50/c0/

Hermes' Structured Query Language II (400)

Hermes is teaching classes at the prestigious Athenian University and decides that with all the students he has, he should create a table of their names and private emails. He is teaching a couple of classes: Classical Studies 999 (not Computer Science), Math 999, and Hack 999. A mischievous child has realized that there might be secrets in the emails of the students. But he has no idea has to get them.
http://35.230.117.50/c1/

Hermes' List of Requests (300)

Hermes has a long list of messages he has to send to his fellow gods. Unfortunately, his secretary has decided to chain the requests together such that each request will link to another request and so on. Hermes, visibly frustrated, decides to hand you the requests so that you can find what his final message must be.
http://35.230.117.50/c2/start

Cryptography

Hercules’ Many Time Pad of Labors (500)

Of all the stories of Hercules, the most important are his twelve labors. Someone has decided to encrypt his labors using the many time pad scheme, but one should know that this is not secure. Crack the ciphertext to find out the flag. (Hint: 'a' xor ' ' = 'A')
https://bit.ly/2wFpVXq

Miscellaneous

Proteus (300)

The Greek god Proteus has been known to take many different forms. In this form, he appears to be a Portable Document Format, but there seems to be a bit more under the surface. Perhaps there’s another element underneath the surface?
https://bit.ly/2KkYCDL