UNIVERSITY OF IBRA
Department of Numeracy, Computation, and Probability

CSC108H5 F– (Not) Penultimate Examamination
Introduction to Computer Programming

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Duration: Good Luck.
Aids Allowed: God Himself.
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Name: _____
Student Number: _____

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Please note, once this exam has begun, you ***CANNOT*** *undo the mental damange it will inflict.*

This exam contains 11 pages (including this cover page) and 14 questions. Please ensure all pages are present before starting this final examination.

Part I: Multiple Choice

Answer each question to the best of your abilities. Each question has exactly one answer.

1. (2 points) **Python Data Structures**
   Which of the following is **not** a valid type in Python?

   A. `type`

   B. `bytes`

   C. `Set`

   D. `NoneType`

   E. `None of the above`

2. (2 points) **Code Tracing I**
   Consider the following Python function:

```
def cursed_funct_junior(i : int) -> int:
    lst = [0, 0, 1]
    for _ in range(i):
        lst.append(lst[-2])
        lst.append(lst[-2])
        lst.append(lst[-2] + lst[-1])
    return lst[-1]
```

   What is the value of `cursed_funct_junior(3)`?

   A. 0

   B. 1

   C. 2

   D. 3

   E. An `Exception` of some kind is raised

3. (2 points) **Code Tracing II**
   Consider the following Python function:

```
def cursed_funct_1(a: callable, b: callable, c: int, d:int) -> int
:
    if c > d:
        increment = lambda x: 2*x
        return a(c//2) + b(d//2)
    else:
        increment = lambda x: 4*x
        return a(c//2) - b(d//2)

def increment(x: int) -> int:
    return x + 1
```

```
def decrement(x: int) -> int:
    return x - 1

def cursed_funct_2(a: callable, b: callable, c: int, d: int):
    a = cursed_funct_1 if a else increment
    b = b if a else a
    return a(b, decrement, c if a else c//2, d)


print(cursed_funct_2(increment, decrement, 7, 10))
```

What is the output of this code?

A. -9

B. -2

C. 2

D. An `Exception` of some kind

E. None of the above

4. (2 points) **Code Tracing III**
Consider the following Python function which operates on a list:

```
def cursed_list_1(lst1: list, lst2: list, call: callable) -> list:
    lst1 = [x for x in lst2[:1:-2]]
    lst2 = [x for x in lst1[1::2]]
    if lst1 == lst2:
        return lst1
    if len(lst1) > len(lst2):
        cursed_list_2 = lambda x, y: [x for x in y[:1:-2]]
    return call(lst1, lst2)

def cursed_list_2(lst1: list, lst2: list, call: callable) -> list:
    if len(lst1) >= (len(lst2)):
        cursed_list_1 = lambda x, y, z: [x for x in y[3::2]]
    return call(lst1, lst2, cursed_list_2)

print(cursed_list_2([1, 2, 3, 4, 5][::-1], [1, 2, 3, 4, 5][:2:-2],
cursed_list_1))
```

What is the output of this code?

A. `[4, 2]`

B. `[1, 3, 5]`

C. `[2, 4, 3, 5]`

D. An `Exception` of some kind is raised

E. None of the above

5. (4 points) **Code Tracing IV**

`Ibra.java` works on a startup called TTBTrackr. Unfortunately, his code was leaked by a rogue employee, ibra.himo. Fortunately for IbraSoft™, all their code is obfuscated. Consider the following Python method extracted from the leaked code:

```
def mystery(arr: list[int]):
    n = len(arr)
    size = 1
    while size < n:
        for left in range(0, n - 1, 2 * size):
            mid = min(left + size - 1, n - 1)
            right = min(left + 2 * size - 1, n - 1)

            scooby_doo(arr, left, mid, right)
        size *= 2


def scooby_doo(arr: list[int], a: int, b: int, c: int):
    i = a
    j = b + 1

    while i <= b and j <= c:
        if arr[i] <= arr[j]:
            i += 1
        else:
            temp = arr[j]
            for k in range(j, i, -1):
                arr[k] = arr[k - 1]
            arr[i] = temp

            i += 1
            b += 1
            j += 1

    while j <= c:
        arr[b + 1] = arr[j]
        j += 1
        b += 1
```

Question continued on next page

(a) (2 points) Is this a mutating or non-mutating method?

A. Mutating

B. Non-mutating

(b) (2 points) Assume this function is called on the following list: `[69, 420, 3.14159365, 474, 666]`. What is the output of this function, or the final state of the list? (Depending on your answer to part (a))

A. `[69, 420, 3.14159365, 474, 666]`

B. `[3.14159365, 69, 420, 474, 666]`

C. `[3.14159365, 69, 420, 474, 666, 69, 420, 474, 666]`

D. An `Exception` of some kind is raised

E. None of the above

6. (5 points) **Correctness**
Nugget has developed the following block of Python code:

```
import random

def mystery():
    a = random.randint(0, 5)
    b = random.randint(0, 5) / 2
    if a < b:
        return a
    else:
        return b

print("The number is " + mystery() + ".")
```

Nugget thinks this code is correct, while UTM Victim argues the code has at least one case where it fails. Who is correct, and why?

A. Nugget is correct

B. UTM Victim is correct

Why: _____

Part II: Short Answer

Answer each question to the best of your abilities. Partial marks will be awarded for partial answers.

1. (5 points) **Object-Oriented Programming**
   Briefly explain the difference between a class and an object.

2. (5 points) **Object-Oriented Programming**
   Briefly explain what it means to be a *mutable* vs. *immutable* object.

3. (5 points) **Regex**
   Briefly explain what the following regular expression matches: `[a-zA-Z0-9]+`

4. (5 points) **Regex**
   Ibrahim is working on a new `UserContact` module for `TTBTrackr`. He needs a regex that will validate a phone number. The phone number must be in the format `xxx-xxx-xxxx`, where `x` is a digit between 0 and 9. Write a regex that will validate this phone number. Your regex should also validate the area code and should work regardless of hyphens being included.

5. (5 points) **Logic and Variables**
   Simplify the following expression as much as possible. Your expression should be logically equivalent to the original expression.
   `not (True or X and (True or x and (not y or z)) or (z and Y or (not x and not y)))`

   Note: You may recieve partial credit should you decide to show your work

6. (10 points) **Code Tracing**
   Refer back to the `scooby_doo` function from **Code Tracing IV**. Consider the following code:

Part III: Long Answer

Answer each question to the best of your abilities. Partial answers $\implies$ partial marks. Breaking any restrictions in the question will result in a mark of 0.

1. (10 points) **The Happy List**
Let L be a list. We say that L is **happy** if L is in ascending order and contains at least 2 elements which add up to an arbitrary value k. Implement the following method to determine if a list is happy. You may assume that the list is non-empty, sorted, and contains only integers.

RESTRICTIONS:

- You may **NOT** use `sets`
- Your method **MUST** be $\mathcal{O}(n)$ time (i.e. linear time). Any answer that is not $\mathcal{O}(n)$ time will receive a mark of 0.
- You may **NOT** use concepts taught outside of the scope of CSC108

```
def is_happy(L: list[int], k: int) -> bool:
    """
    Given a list, returns whether or not the list is happy.
    Precondition: L is a list of integers in ascending
    order. k is an integer.
    """
    # TODO: Implement this method
```

2. (10 points) **The Secret**
   `Ibra.Java` is hosting a secret MAT102 lecture. This lecture is so secret. that he only tells one student about it. However, his student is

Rough Work

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