CS 220 - Fall 2024
Instructors: Mike Doescher and Louis Oliphant

Exam 1 — 10%

(Last) Surname: _____ (First) Given name: _____

NetID (email): _____ @wisc.edu

Fill in these fields (left to right) on the scantron form (use #2 pencil):
1. LAST NAME (surname) and FIRST NAME (given name), fill in bubbles
2. IDENTIFICATION NUMBER is your Campus ID number, fill in bubbles
3. Under *ABC* of SPECIAL CODES, write your lecture number, fill in bubbles:
   - 001 - MWF 08:50 AM (Mike)
   - 002 - MWF 11:00 AM (Mike)
   - 003 - MWF 09:55 AM (Louis)
   - 004 - MWF 01:20 PM (Louis)
4. Under **F** of SPECIAL CODES, write *C* and fill in bubble **8**

If you miss step 4 above (or do it wrong), the system may not grade you against the correct answer key, and your grade will be no better than if you were to randomly guess on each question. So don't forget!

You may only reference your note sheet. You cannot use books, your neighbors, calculators, or other electronic devices during this exam. Please place your student ID face up on your desk. Turn off and put away portable electronics (including smart watches) now.

Use a #2 pencil to mark all answers. When you're done, please hand in the exam, note sheet, and filled-in scantron form. The note sheet will not be returned.

General

1. What does the following `test_function` do?

```
def test_function(num1, num2, num3):
    if num1 >= num2 and num1 >= num3:
        if num2 >= num3:
            return num2
        else:
            return num3
    elif num2 >= num1 and num2 >= num3:
        if num1 >= num3:
            return num1
        else:
            return num3
    else:
        if num1 >= num2:
            return num1
        else:
            return num2
```

    A. Returns the largest number among the three inputs.

    B. Returns the sum of the three numbers.

    C. Returns the second largest number among the three inputs.

    D. Returns the smallest number among the three inputs.

2. What is the output of this following code?

```python
def func(x, y=0):
    x = x / 2
    if x > 0:
        y = y - x
    else:
        y = x - y
    z = x ** 2
    result = (z / (y + 1))
    return result

number = 2
output = func(number)
```

   A. Semantic error

   B. Runtime error

   C. Syntax error

   D. No error

3. How many **TRUE** statements are there in the following?

   1. Multiple return statements may execute in a single function invocation

   2. Passing arguments to parameters with default arguments is optional

   3. The same function cannot be invoked multiple times in a program

   4. Functions in Python must always have a return statement, otherwise they will raise an error.

   5. If a function does not use the global keyword, it cannot modify any global variables.

   6. Positional arguments must be passed after keyword arguments when calling a function

   A. 1

   B. 4

   C. 3

   D. 2

4. What will be printed after running the following code?

```
x = 8
y = 9

def f():
    x = 1
    x = g()
    print(x, y)

def g():
    global x
    x = x * 6
    y = h()
    x = x * y
    return h(3) + x

def h(x = 9):
    x = x / 3
    return x

f()
```

   A. 8 3

   B. 145 9

   C. 145 3

   D. 145.0 9

   E. None of the above

5. What is the output of this following code?

```
base_text = "Hello"
append_char = "!"

def append_text(text, char):
    result = text + char
    append_char = result + text
    return append_char

print(append_text(base_text, "CS220"))
print(append_char)
```

    A. HelloCS220Hello
       HelloCS220Hello

    B. HelloCS220
       !

    C. HelloCS220Hello
       !

    D. HelloCS22
       HelloCS220Hello

6. What is the output of the following code?

```
type(6 % 3.0)
```

    A. `2`

    B. `2.0`

    C. `float`

    D. `int`

7. What is the value of `result` in the following code?

```
a = True
b = False
c = True
d = False

result = (a and not b) or not (c and d)
result
```

    A. `True`

    B. `False`

8. What can replace the **???** so that this function correctly determines if **x** is even or odd?

```
def is_even(x):
    if ??? != 0:
        print("This number is odd")
    else:
        print("This number is even")
```

  A. `is_even(x)`

  B. `x % 2`

  C. `2 % x`

  D. `x // 2`

9. What is the return value of `evaluate_three_booleans(False, True, True)`?

```
def evaluate_three_booleans(a, b, c):
    if a and b:
        if not c:
            return True
        else:
            return False
    elif not a and b:
        if not c:
            return False
        else:
            return True
    else:
        if c:
            return False
        else:
            return True
```

  A. `True`

  B. `False`

  C. Syntax error

Use the following function for the next two questions. This function determines how much of a discount a member gets based on their membership status and how much money they spent on their purchase.

```
def calculate_discount(purchase_amount, is_member):
    if is_member and (purchase_amount > 1000):
        return 0.20
    elif is_member and (purchase_amount > 500):
        return 0.15
    elif is_member and (purchase_amount > 200):
        return 0.10
    elif is_member and (purchase_amount <= 200):
        return 0.05
    elif not is_member and (purchase_amount > 1000):
        return 0.10
    elif not is_member and (purchase_amount > 500):
        return 0.05
    else:
        return 0.00
```

10. Which of the following statements accurately describes the discount calculation for a purchase amount of $700 and membership status `True`?

    A. The discount will be 20%.

    B. The discount will be 15%.

    C. The discount will be 10%.

    D. The discount will be 5%.

11. What can replace the ??? to make the following refactor of the `calculate_discount()` function perform equivalently?

```
def calculate_discount_refactored(purchase_amount, is_member):
    if ???:
        if purchase_amount > 1000:
            return 0.10
        elif purchase_amount > 500:
            return 0.05
        else:
            return 0.00
    else:

        if purchase_amount > 1000:
            return 0.20
        elif purchase_amount > 500:
            return 0.15
        elif purchase_amount > 200:
            return 0.10
        else:
            return 0.05
```

A. `is_member == False`

B. `is_member == True`

C. `not is_member`

D. b and c

E. **a and c**

12. What is the output of the following code?

```
x = 0
while x < 5:
    print(x)
    x += 1
    if x == 2:
        print("x is currently 2")
print("Done!")
```

   A. 0
   1
   x is currently 2
   2
   3
   4
   Done!

   B. 0
   1
   x is currently 2
   2
   3
   Done!

   C. 0
   1
   2
   3
   4
   Done!

   D. 0
   1
   x is currently 2
   3
   4
   Done!

13. How many times will "hello world" be printed out?

```
x = -2
y = -3

while x < 0:
    while y < 0:
        y += 1
        print("hello world")
    x += 1
    print("hello world")
```

    A. 3 times

    B. 4 times

    C. 5 times

    D. Syntax error

    E. Infinite loop

14. Based on the following code, how many times is line 2 evaluated?

```
n = 8           # line 1
while n >= 6:    # line 2
    print(n)    # line 3
    n -= 1      # line 4
```

    A. 1 time

    B. 2 times

    C. 3 times

    D. 4 times

    E. 5 times

15. Based on the previous code, how many times is line 3 executed?

    A. 1 time

    B. 2 times

    C. 3 times

    D. 4 times

    E. 5 times

16. What is the volume of a cylinder with a height of 5 and radius of 7? Pick values for x and y to answer this question.
The equation for the volume of a cylinder is $V = \pi r^2 h$.

```
pi = 3.14

x = ???
y = ???
cylinder_volume = pi * (x ** 2) * y
cylinder_volume
```

   A. x=5, y=5

   B. x=7, y=7

   C. x=5, y=7

   D. x=7, y=5

   E. None of the above

17. What does the following code output?

```
print(type(222 / 5))
```

   A. int

   B. string

   C. float

   D. boolean

   E. None of the above

18. What if the code is changed to the following?

```
print(type(222.0 // 5))
```

   A. int

   B. string

   C. float

   D. boolean

   E. None of the above

19. Consider the following pseudocode and the initial state of the variables:
Initial State:

```
A = 3
B = 4
```

Pseudocode:

1. Multiply A by 2 and store the result in A.

2. Add the value of B to A.

3. If A is greater than 10, subtract 5 from A.

4. Multiply A by the value of B and store the result in A.

5. If A is less than or equal to 20, set A to 0.

What will be the value of `A` after evaluating the above pseudocode?

    A. 0

    B. 40

    C. 16

    D. 28

    E. 36

20. Consider the following code snippet:

```
a = 12
a -= 5
b = 0
c = a // b + 3
```

Which of the following best describes the issue in the code?

    A. The code will run successfully, and `c` will be assigned the value 3.

    B. The code contains a Semantic Error, as the expression does not produce the expected value for `c`.

    C. The code will result in a Runtime Error due to integer division by zero.

    D. The code will result in a Runtime Error due to an invalid assignment statement.

    E. The code will not run due to a Syntax Error in the subtraction assignment.

21. Consider the following pseudocode and the initial state of the variables:
    Initial State:

    ```
    X = 3
    Y = 8
    Z = 3
    ```

    Pseudocode:

    1. If X is less than Y, subtract 1 from Z. Otherwise, add 1 to Z.

    2. Add the value of Z to X.

    3. If X is equal to 6, subtract 2 from Y, and skip to step 4. Otherwise, go back to step 1.

    4. Stop.

    What will be the values of X and Y after evaluating the above pseudocode?

    A. X = 4, Y = 6

    B. X = 5, Y = 4

    C. X = 6, Y = 6

    D. X = 7, Y = 8

    E. X = 8, Y = 4

22. Given the following code snippet, which of the variable names is **invalid** in Python?

    ```
    var1 = 10
    Var_2 = 20
    _3var = 30
    4var = 40
    ```

    A. var1

    B. Var_2

    C. _3var

    D. 4var

    E. All of them are valid.

Madison City Budget

For the following questions, you can assume that all member functions of the project module are correctly defined and will behave exactly as they did in P3.

23. The `change_budget_per_year` function returns the average yearly change in the budget for a specified agency between the given start and end years:

```
def change_budget_per_year(agency, start_year=2020, end_year=2024):
    agency_id = project.get_id(agency)
    budget_start_year = project.get_budget(agency_id, start_year)
    budget_end_year = project.get_budget(agency_id, end_year)
    budget_difference = budget_end_year - budget_start_year
    average_change = budget_difference / (end_year - start_year)
    return average_change
```

Given that:

```
x = change_budget_per_year("Library", 2020, 2024)
y = change_budget_per_year("Library", 2024, 2020)
```

Which of the following statements is True?

- **A. x and y will always be equal regardless of the agency.**
- B. `x` will be the negative of `y`.
- C. The code will raise an error because `end_year` is less than `start_year` in the second function call.
- D. `y` will represent the budget difference between 2024 and 2020 without averaging.
- E. `x` and `y` will only be equal for "Library" agency.

24. Assume that the function `agency_avg(agency)` has been defined and will return the average budget for a specified agency from 2020 to 2024. Which of the following code snippets will return the highest average budget among the agencies `"Police"`, `"Fire"`, and `"Library"`?

- A. `max(project.get_budget("Police"), project.get_budget("Fire"), project.get_budget("Library"))`
- B. `max(agency_avg("Police") + agency_avg("Fire") + agency_avg("Library"))`
- C. `max(agency_avg("Police"), project.get_budget("Fire", 2024), project.get_budget("Library", 2020))`
- D. `max(agency_avg("Police") + agency_avg("Fire"), agency_avg("Library"))`
- **E. `max(agency_avg("Police"), agency_avg("Fire"), agency_avg("Library"))`**

25. Consider the code below:

```python
def total_budget_in_year(year):
    finance_budget = project.get_budget(finance_id, year)
    library_budget = project.get_budget(library_id, year)
    fire_budget = project.get_budget(fire_id, year)

    return ???
```

Which of the following options correctly fills in **???** to calculate the total budget across all agencies for a given year? You can assume that the agency IDs are correctly defined.

     A. `sum(finance_budget, library_budget, fire_budget)`

     B. `finance_budget + library_budget + fire_budget`

     C. `max(finance_budget, library_budget, fire_budget)`

     D. `(finance_budget + library_budget + fire_budget) / 3`

     E. `mean(finance_budget + library_budget + fire_budget)`

26. The `extrapolate` function estimates the budget of an agency in a future year based on start and end years:

```python
def extrapolate(agency, target_year, start_year=2020, end_year=2024):
    rate_of_change = change_budget_per_year(agency, start_year, end_year)
    budget_in_end_year = project.get_budget(project.get_id(agency), end_year)
    year_difference = target_year - end_year
    estimated_budget_in_target_year = budget_in_end_year + \
        year_difference * rate_of_change
    return estimated_budget_in_target_year
```

Which of the following statements about the call `extrapolate("Metro Transit", 2026)` is correct?

     A. The function uses the budget change from 2020 to 2026 to calculate the estimated budget.

     B. The function requires specifying both `start_year` and `end_year` to calculate the budget for 2026.

     C. The function directly returns the 2026 budget from the dataset without calculation.

     D. The function uses the rate of budget change between 2020 and 2024 to estimate the 2026 budget.

     E. The function calculates the average rate of budget change per month instead of per year.

Pokémon

Below are function definitions for `get_stat_total` and `friendship_score`:

```python
def get_stat_total(pkmn):
    stat_total = project.get_attack(pkmn) + project.get_defense(pkmn)
    stat_total += project.get_special_attack(pkmn)
    stat_total += project.get_special_defense(pkmn)
    stat_total += project.get_hp(pkmn) + project.get_speed(pkmn)
    return stat_total

def friendship_score(pkmn1, pkmn2 = "Venusaur"):
    friendship = 0
    pkmn1_region = project.get_region(pkmn1)
    pkmn2_region = project.get_region(pkmn2)

    if pkmn1_region == pkmn2_region:
        friendship += 1

    if abs(get_stat_total(pkmn1) - get_stat_total(pkmn2)) <= 100:
        friendship += 1

    pkmn1_type1 = project.get_type1(pkmn1)
    pkmn1_type2 = project.get_type2(pkmn1)
    pkmn2_type1 = project.get_type1(pkmn2)
    pkmn2_type2 = project.get_type2(pkmn2)

    if pkmn1_type1 == pkmn2_type1:
        if pkmn1_type2 != "DNE" and pkmn1_type2 == pkmn2_type2:
            friendship += 2
        else:
            friendship += 1
    elif pkmn1_type2 != "DNE" and pkmn1_type2 == pkmn2_type2:
        friendship += 1

    if pkmn1_type1 == pkmn2_type2 and pkmn1_type2 == pkmn2_type1:
        friendship += 1

    return friendship
```

The stats of the four Pokémon listed below will be used for the next four questions:

Name	Attack	Defense	HP	Region	Sp. Atk	Sp. Def	Speed	Type 1	Type 2
Ivysaur	62	63	60	Kanto	80	80	60	Grass	Poison
Charmander	52	43	39	Kanto	60	50	65	Fire	DNE
Venusaur	82	83	80	Kanto	100	100	80	Grass	Poison
Charizard	84	78	78	Kanto	109	85	100	Fire	Flying

27. What is the output of `friendship_score("Charmander")`?

      A. 3

      B. 1

      C. 2

      D. None of the above

28. What is the output of `friendship_score(pkmn1 = "Charizard", "Venusaur")`?

      A. 3

      B. 1

      C. 2

      D. None of the above

29. What is the output of `friendship_score(pkmn2 = "Venusaur", pkmn1 = "Ivysaur")`?

      A. 3

      B. 1

      C. 2

      D. None of the above

Below is the function definition for `advantage` that is used in the next 2 questions:

```python
def advantage(pkmn1, pkmn2):
    Atk1 = project.get_attack(pkmn1)
    Atk2 = project.get_attack(pkmn2)

    Def1 = project.get_defense(pkmn1)
    Def2 = project.get_defense(pkmn2)

    Speed1 = project.get_speed(pkmn1)
    Speed2 = project.get_speed(pkmn2)

    if Atk1 > Atk2:
        if Def1 > Def2:
            return True
        else:
            if Speed1 > 2 * Def2:
                return True
            return False
    else:
        if Def2 > Def1:
            return False
        else:
            if Speed2 > 2 * Def1:
                return False
            return True
```

30. Which of the following options would simplify the body of the advantage function?

    A. `(Atk1 > Atk2 and (Def1 > Def2 or Speed1 > 2 * Def2)) or (Atk1 <= Atk2 and not (Def2 > Def1 or Speed2 > 2 * Def1))`

    B. `(Atk1 > Atk2 or (Def1 >= Def2 and Speed1 > 2 * Def2)) or (Atk1 <= Atk2 and (Def2 <= Def1 and Speed2 < 2 * Def1))`

    C. `(Atk1 >= Atk2 and (Def1 < Def2 and Speed1 <= 2 * Def2)) or (Atk1 < Atk2 and (Def2 > Def1 or Speed2 <= 2 * Def1))`

    D. `(Atk1 < Atk2 and (Def1 >= Def2 or Speed1 < 2 * Def2)) or (Atk1 > Atk2 and not (Def2 < Def1 and Speed2 > 2 * Def1))`

Tic-tac-toe

Reference the following code for the next 5 questions. The draw function **attempts** to print a tic-tac-toe game and place either an 'X' or 'O'.

```
X| |
-+-+-
 | |
-+-+-
 | |
```

```python
def draw(x = 0, y = 0, move = "X"):
    i = 1
    for i in range(1, 6):
        if i % 2 == 0:
            print("-+-+-", end = "")
        else:
            j = 0
            for j in range(0, 5):
                if j % 2 != 0:
                    print("|", end = "")
                elif i == 2 * x + 1 and j == 2 * y:
                    print(move, end="")
                else:
                    print(" ", end = "")
                j += 1
        print()
        i += 1
x = int(input("Enter x: "))
y = int(input("Enter y: "))
move = input("Enter move (X or O): ")
draw(x, y, move)
```

31. Assume the user provides `2.1`, `0`, and `X` as inputs to `x`, `y`, and `move` respectively. What will be the types of the values in global variables `x`, `y`, and `move`?

     A. float, int, string

     B. string, string, string

     C. int, int, int

     D. int, float, string

     E. None of the above

32. Which of the following function calls would place an "X" at the bottom-middle square of the board?

      A. `draw(1, 0)`

      B. `draw(3, 2)`

      C. `draw(0, 2)`

      D. `draw(2, 1)`

      E. None of the above

Blank Page: this page is intentionally blank