Data Structure:
Homework for C++ Review

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- The deadline is Saturday, October 19, 2024, at 11:00 PM.
- Submit your solutions as a PDF and your source code (in .h, .cpp, or .ipynb format) to the course e-learning platform. Make sure your source code includes the main function.

1 Question and answer

1. (5 points) Which of the following is not a valid C++ variable name? (There may be more than one.)

d

   (a) i_think_i_am_valid
   (b) i_may_have_2_many_digits_2_be_valid
   (c) I_start_and_end_with_underscores
   (d) I_Have_A_Dollar_$ign
   (e) I_AM_LONG_AND_HAVE_NO_LOWER_CASE_LETTERS

2. (5 points) Draw a class inheritance diagram for the following set of classes.

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   - Class Goat extends Object and adds a member variable tail and functions milk and jump.
   - Class Pig extends Object and adds a member variable nose and functions eat and wallow.
   - Class Horse extends Object and adds member variables height and color, and functions run and jump.
   - Class Racer extends Horse and adds a function race.
   - Class Equestrian extends Horse and adds a member variable weight and functions trot and isTrained.

3. (5 points) Consider the inheritance of classes from the above exercise, and let d be an object variable of type Horse. If d refers to an actual object of type Equestrian, can it be cast to the class Racer? Why or why not?

4. (5 points) What (if anything) is different about the behavior of the following two functions f and g that increment a variable and print its value?

```
void f(int x)
{ std::cout << ++x; }
void g(int& x)
{ std::cout << ++x; }
```

is the same

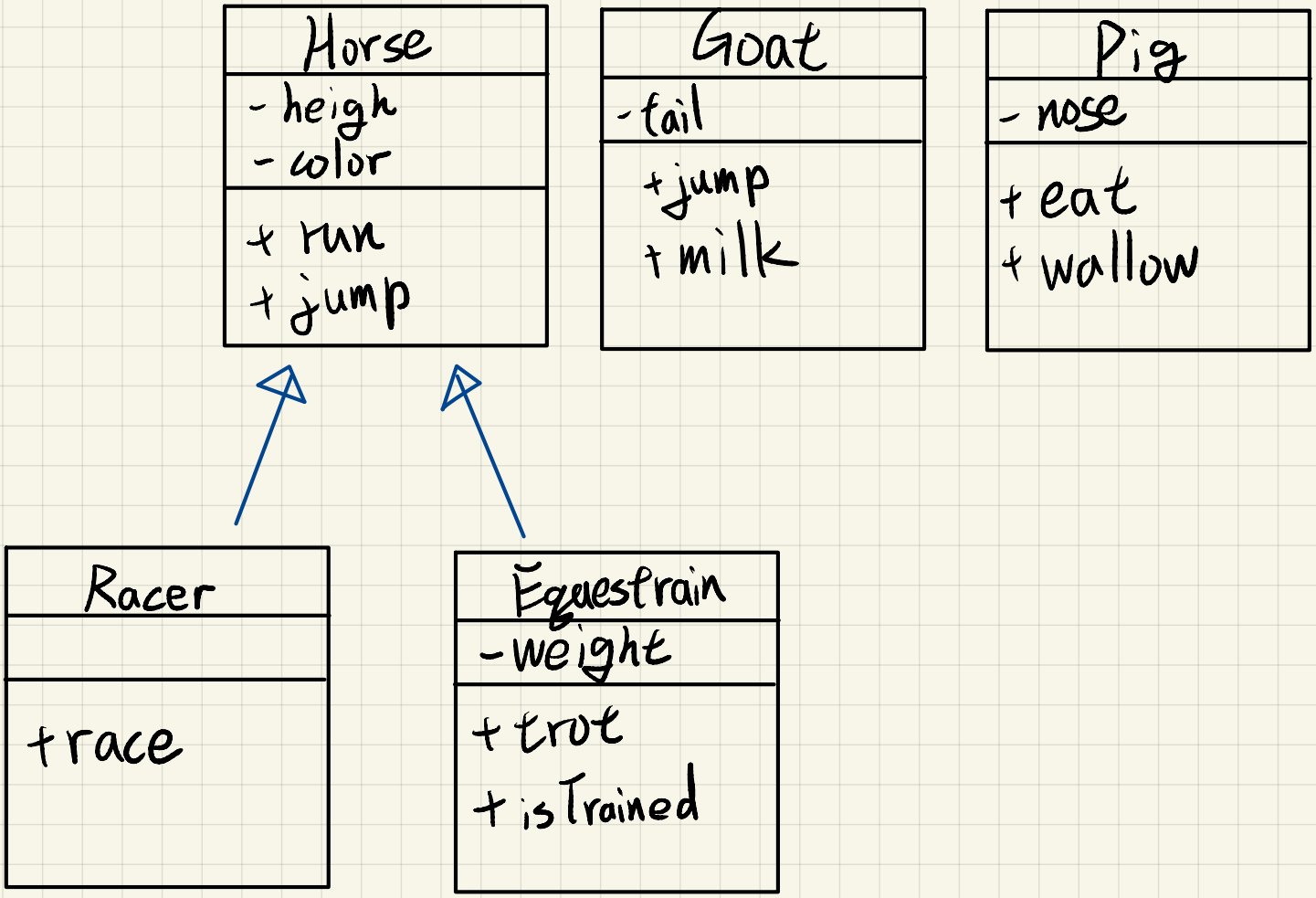
5. (5 points) What are the contents of string s after executing the following statements.

```
string s = "cnn";
string t = "rnn";
s += s + t[2] + s;
```

s = s + s + t[2] + s

= cnncnnncnn

2.



3.

NO, because maybe Equestrain and Racer is same level class they both inherit from horse but they don't inherit from each other.

2 Programming assignment

1. (30 points) Write a program that consists of three classes, A, B, and C, such that B is a subclass of A and C is a subclass of B. Each class should define a member variable named "x" (that is, each has its own variable named x). Describe a way for a member function in C to access and set A's version of x to a given value, without changing B or C's version.

2. (45 points) The roots of the quadratic equation $ax^2 + bx + c = 0, a \neq 0$ are given by the following formula:

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

In this formula, the term $b^2 - 4ac$ is called the **discriminant**. If $b^2 - 4ac = 0$, the equation has a single (repeated) root. If $b^2 - 4ac > 0$, the equation has two real roots. If $b^2 - 4ac < 0$, the equation has two complex roots. Design and implement the *class quadraticEq* so that an object of this class can store the coefficients of a quadratic equation. Overload the operators + and – to add and subtract, respectively, the corresponding coefficients of two quadratic equations. Overload the relational operators == and != to determine if two quadratic equations are the same. Add appropriate constructors to initialize objects. Overload the stream extraction and insertion operator for easy input and output. Also, include function members to determine and output the type and the roots of the equation. Write a program to test your class.