

CSE 30
Spring 2021
Quiz 3

Solutions

1. (30 Points) The python class below represents vectors in the x - y plane. Fill in the definitions of the member functions `__str__(self)`, `__eq__(self, other)`, `__add__(self, other)`, `__sub__(self, other)`, and `dot(self, other)`. Your definitions should satisfy the conditions in the accompanying doc strings. If the functions are correctly defined, the print statements in the following program will have the output given in the corresponding comments. (Each function is worth 6 points.)

```
from vector import *
u = Vector(2, 5)
v = Vector(-1, 7)
print(u==v)      # False
print(u+v)       # (1, 12)
print(u-v)       # (3, -2)
print(v-u)       # (-3, 2)
print(u.dot(v))  # 33
```

Implementation file: vector.py

Solutions:

```
class Vector(object):
    def __init__(self, a, b):
        self.xcomp = a
        self.ycomp = b

    def __str__(self):
        """str(Vector(a, b)) returns the string '(a, b)'."""
        a = self.xcomp; b = self.ycomp
        return '({}, {})'.format(a, b)

    def __eq__(self, other):
        """u==v returns True if and only if vectors u and v have
        equal x-components and equal y-components."""
        a = self.xcomp; b = self.ycomp
        c = other.xcomp; d = other.ycomp
        return (a==c and b==d)

    def __add__(self, other):
        """Returns the vector sum: (a,b)+(c,d)=(a+c,b+d)."""
        a = self.xcomp; b = self.ycomp
        c = other.xcomp; d = other.ycomp
        return Vector(a+c, b+d)

    def __sub__(self, other):
        """Returns the vector difference: (a,b)-(c,d)=(a-c,b-d)."""
        a = self.xcomp; b = self.ycomp
        c = other.xcomp; d = other.ycomp
        return Vector(a-c, b-d)
```

```
def dot(self, other):
    """Returns the vector dot product: (a,b).dot(c,d)=ac+bd."""

    a = self.xcomp; b = self.ycomp
    c = other.xcomp; d = other.ycomp
    return a*c+b*d
```

2. (20 Points) Continuing the Vector class from the previous problem, define two additional built in functions called `__lt__(self, other)` and `__le__(self, other)` that implement the operations $u < v$ (less than) and $u \leq v$ (less than or equal to), respectively, for vectors u and v . The order relation $<$ is called lexicographic order: $(a,b) < (c,d)$ if $a < c$ or if $a = c$ and $b < d$. The relation \leq is the weak version of lexicographic order: $u \leq v$ if either $u < v$ or $u = v$. Write the complete definitions of these two functions below.

Solutions:

```
def __lt__(self, other):
    a = self.xcomp; b = self.ycomp
    c = other.xcomp; d = other.ycomp
    return ((a < c) or (a == c and b < d))

def __le__(self, other):
    return self < other or self == other
```