Sample exam 3

The INFDEV team

1 Question 1

Given the following block of code, fill in the stack, heap, and PC with all the steps taken by the program at runtime.

- Points: *4 (50% of total).*
- Grading: one point per correctly filled-in execution step.
- Associated learning objective: *abstraction.*

```
1  interface MovableObject {
2  }
3  class Car : MovableObject {
4    private float direction = 3.14;
5    public Car() {
6    }
7    static public void move(Car car,float direction) {
8      car.direction = direction;
9    }
10 }
11 class Particle : MovableObject {
12   private float direction = 0;
13   public Particle() {
14   }
15 }
16 MovableObject mo = new Car();
17 Car.move(mo,1);
```

1. Stack:

PC
1

2. Stack:

PC
16

3. Stack:

PC
16

Heap:

1
direction=

4. Stack:

PC	...		PC	ret	this
16	...		6	null	ref 1

Heap:

1
direction=

5. Stack:

PC	...		PC	ret
16	...		6	ref 1

Heap:

1
direction=

6. Stack:

PC	mo
17	ref 1

Heap:

1
direction=

7. Stack:

PC	...		PC	ret	car	direction
17	...		8	null	ref 1	1

Heap:

1
direction=

8. Stack:

PC	...		PC	ret
17	...		8	null

Heap:

1
direction=1

9. Stack:

PC	mo
18	ref 1

Heap:

1
direction=1

2 Question 2

Given the following block of code, fill in the declarations, class definitions, and PC with all steps taken by the compiler while type checking.

- Points: *4 (50% of total).*
- Grading: one point per correctly filled-in type checking step.
- Associated learning objective: *type checking.*

```
1  interface IntList {
2    bool isEmpty();
3    int getValue();
4  }
5  class IntNode : IntList {
6    private int value;
7    private IntList tail;
8    public IntNode(int value,IntList tail) {
9      this.value = value;
10     this.tail = tail;
11   }
12   public bool isEmpty() {
13     return false;
14   }
15   public int getValue() {
16     return this.value;
17   }
```

```
18 }
19 class IntEmpty : IntList {
20   public IntEmpty() {
21   }
22   public bool isEmpty() {
23     return true;
24   }
25   public int getValue() {
26     return 0;
27   }
28 }
29 ...
30 IntList list = new IntNode(5,new IntEmpty());
```

1. Declarations:

PC
1

2. Declarations:

PC
5

Classes:

IntList
getValue=getValue → int isEmpty=isEmpty → bool

3. Declarations:

PC
18

Classes:

IntList	IntNode
getValue=getValue → int isEmpty=isEmpty → bool	IntNode=(IntNode×int×IntList) → IntNode getValue=getValue → int isEmpty=isEmpty → bool tail=IntList value=int

4. Declarations:

PC
28

Classes:

IntEmpty	IntList	IntNode
IntEmpty=IntEmpty → IntEmpty getValue=getValue → int isEmpty=isEmpty → bool	getValue=getValue → int isEmpty=isEmpty → bool	IntNode=(IntNode×int×IntList) → IntNode getValue=getValue → int isEmpty=isEmpty → bool tail=IntList value=int

5. Declarations:

PC
30

Classes:

IntEmpty	IntList	IntNode
IntEmpty=IntEmpty → IntEmpty getValue=getValue → int isEmpty=isEmpty → bool	getValue=getValue → int isEmpty=isEmpty → bool	IntNode=(IntNode×int×IntList) → IntNode getValue=getValue → int isEmpty=isEmpty → bool tail=IntList value=int

6. Declarations:

PC	list
31	IntList

Classes:

IntEmpty	IntList	IntNode
IntEmpty=IntEmpty → IntEmpty getValue=getValue → int isEmpty=isEmpty → bool	getValue=getValue → int isEmpty=isEmpty → bool	IntNode=(IntNode×int×IntList) → IntNode getValue=getValue → int isEmpty=isEmpty → bool tail=IntList value=int