

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 }
```

```

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 |