

# Sample exam 1

The INFDEV team

# 1 Question 1

Given the following block of code, fill in the stack, heap, and PC with all 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 A {
2     int M(int x);
3 }
4 class C : A {
5     public C() {
6     }
7     public int M(int x) {
8         return (x + 2);
9     }
10 }
11 class D : A {
12     public D() {
13     }
14     public int M(int x) {
15         return (x + 2);
16     }
17 }
18 ...
19 A myA = new C();
20 Console.WriteLine(myA.M(5));
```

1. Stack:

PC
1

2. Stack:

PC
18

3. Stack:

PC
19

4. Stack:

PC
19

Heap:

1
__type=C

5. Stack:

PC	...		PC	ret	this
19	...		6	null	ref 1

Heap:

1
__type=C

6. Stack:

PC	...		PC	ret
19	...		6	ref 1

Heap:

1
__type=C

7. Stack:

PC	myA
20	ref 1

Heap:

1
__type=C

8. Stack:

PC	...		PC	ret	this	x
20	...		8	null	ref 1	5

Heap:

1
__type=C

9. Stack:

PC	...		PC	ret
20	...		8	7

Heap:

1
__type=C

10. Stack:

PC	myA
21	ref 1

Heap:

1
__type=C

Output:

7

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 A {
2     int M(int x);
3 }
4 class C : A {
5     public C() {
6     }
7     public int M(int x) {
8         return (x + 2);
9     }
10 }
```

```
11 class D : A {
12     public D() {
13     }
14     public int M(int x) {
15         return (x + 2);
16     }
17 }
18 ...
19 A myA = new C();
20 Console.WriteLine(myA.M(5));
```

1. Declarations:

PC
1

2. Declarations:

PC
4

Classes:

A
$M=(A \times \text{int}) \rightarrow \text{int}$

3. Declarations:

PC
10

Classes:

A	C
$M=(A \times \text{int}) \rightarrow \text{int}$	$C=C \rightarrow C$ $M=(C \times \text{int}) \rightarrow \text{int}$

4. Declarations:

PC
18

Classes:

A	C	D
$M=(A \times \text{int}) \rightarrow \text{int}$	$C=C \rightarrow C$ $M=(C \times \text{int}) \rightarrow \text{int}$	$D=D \rightarrow D$ $M=(D \times \text{int}) \rightarrow \text{int}$

5. Declarations:

PC
19

Classes:

A	C	D
$M=(A \times \text{int}) \rightarrow \text{int}$	$C=C \rightarrow C$ $M=(C \times \text{int}) \rightarrow \text{int}$	$D=D \rightarrow D$ $M=(D \times \text{int}) \rightarrow \text{int}$

6. Declarations:

PC	myA
20	A

Classes:

A	C	D
$M=(A \times \text{int}) \rightarrow \text{int}$	$C=C \rightarrow C$ $M=(C \times \text{int}) \rightarrow \text{int}$	$D=D \rightarrow D$ $M=(D \times \text{int}) \rightarrow \text{int}$

7. Declarations:

myA		PC	ret	arg <sub>1</sub>	this
A		20	null	int	A

Classes:

A	C	D
M=(A×int) → int	C=C → C M=(C×int) → int	D=D → D M=(D×int) → int

8. Declarations:

myA		PC	ret	arg <sub>1</sub>	this
A		20	int	int	A

Classes:

A	C	D
M=(A×int) → int	C=C → C M=(C×int) → int	D=D → D M=(D×int) → int

9. Declarations:

PC	myA
21	A

Classes:

A	C	D
M=(A×int) → int	C=C → C M=(C×int) → int	D=D → D M=(D×int) → int