

Aarhus Universitet, Science and Technology, Computer Science

## Mock Exam

Introduction to Programming with Scientific Applications

Wednesday 27 June 2018, 9:00-11:00

Allowed aid: **None**

The exam questions are answered on the problem statement that is handed in at the end of the exam

*Tilladte hjælpemidler: **Ingen***

*Eksamensspørgsmålene besvares på opgaveformuleringen, som afleveres ved eksamenens slutning*

Student ID/årskort \_\_\_\_\_

Name/*navn* \_\_\_\_\_

## Information

The exam consists of a set of multiple-choice questions. The questions are answered on the problem statement **that is handed in**. For each question is stated the weight of the question compared to the full exam. Each sub-question has exactly one correct answer. You can select **at most one** answer for each sub-question, by marking the corresponding box with a cross. A sub-question is scored as follows:

- Marking the correct answer gives you 1 point.
- If you do not mark any answer you get 0 points.
- Marking a wrong answer gives you  $-\frac{1}{k-1}$  point, where  $k$  is the number of answer options.

For a question with weight  $v\%$  containing  $n$  sub-questions, where you score a total of  $s$  points, your score for the question will be  $\frac{s}{n} \cdot v\%$ . Note that is possible to get a negative score for a question.

*Dette eksamenssæt består af en mængde multiple-choice-opgaver. Opgaverne besvares på opgaveformuleringen **som afleveres**. For hver opgave er angivet opgavens andel af det samlede eksamenssæt. Hvert delspørgsmål har præcist et rigtigt svar. For hvert delspørgsmål, må man vælge **max ét svar** ved at afkrydse den tilsvarende rubrik. Et delspørgsmål bedømmes som følgende:*

- *Hvis du sætter kryds ved det rigtige svar, får du 1 point.*
- *Hvis du ikke sætter nogen krydser, får du 0 point.*
- *Hvis du sætter kryds ved et forkert svar, får du  $-\frac{1}{k-1}$  point, hvor  $k$  er antal svarmuligheder.*

*For en opgave med vægt  $v\%$  og med  $n$  delspørgsmål, hvor man opnår samlet  $s$  point, beregnes pointene for besvarelse af opgaven som  $\frac{s}{n} \cdot v\%$ . Bemærk at det er muligt at få negative point for en opgave.*

## Python version

In the following Python refers to Python 3.6.

*I det følgende antages at Python refererer til Python 3.6.*

### Question 1 (Basic types, 4 %)

Betragt udførelsen af følgende Python kode,

```
x = input()
y = input()
```

hvor brugeren giver følgende input

```
2
3
```

Hvad svarer Python når vi efterfølgende udfører hver af nedenstående linier?

	5	6	23	33	222	'23'	'33'	'222'	TypeError
<code>x*y</code>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<code>int(x)*int(y)</code>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<code>x*int(y)</code>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<code>x+y</code>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<code>x+int(y)</code>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<code>int(x)+int(y)</code>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### Question 2 (List comprehension, 4 %)

Assume we want to generate a list of the numbers  $1^2, 2^2, 3^2, \dots, 10^2$ . For each of the below expression state if the expression generates this list.

*Antag vi vil genere en liste med tallene  $1^2, 2^2, 3^2, \dots, 10^2$ . For hvert af nedenstående udtryk angiv om udtrykket generer denne liste.*

	Yes/Ja	No/Nej
<code>[x ** 2 in range(10)]</code>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<code>[x ** 2 for x in range(10)]</code>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<code>[x ** 2 for x in range(1, 11)]</code>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<code>[x * y for x, y in enumerate(range(1, 11), start=1)]</code>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

### Question 3 (Types, 4 %)

What is the type of the following expressions?

*Hvad er typen af følgende udtryk?*

	List	Tuple	Dictionary	Set	Int
{}	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E
{42}	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D	<input type="checkbox"/> E
{42, 42}	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D	<input type="checkbox"/> E
{42: 42}	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E
()	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E
(42)	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input checked="" type="checkbox"/> E
(42,)	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E
(42, 42)	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E
[42]	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E
[42, 42]	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E

### Question 4 (Mutability, 4 %)

State for each of the below Python types if values of the type are mutable or not.

*Angiv for hver af nedenstående Python typer om værdier af typerne er muterbare eller ej.*

	Mutable	Immutable
Integers ( <b>int</b> )	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B
Strings ( <b>str</b> )	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B
Floating point numbers ( <b>float</b> )	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B
Lists ( <b>list</b> )	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B
Tuples ( <b>tuple</b> )	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B
Sets ( <b>set</b> )	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B
Dictionaries ( <b>dict</b> )	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B
Boolean ( <b>bool</b> )	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B

### Question 5 (Lists, 4 %)

```
x = ['a', 'b']
y = x
z = x + ['c']
y.append('c')
```

What is the value of `x`, `y` and `z` after executing the above code?

*Hvad er værdien af `x`, `y` og `z` efter udførelsen af ovenstående kode?*

	<code>['a', 'b']</code>	<code>['a', 'b', 'c']</code>	<code>['a', 'b', 'c', 'c']</code>
<code>x</code>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<code>y</code>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<code>z</code>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

### Question 6 (Boolean, 4 %)

What is the result of each of the below boolean expressions?

*Hvad er resultat af hvert af nedenstående boolske udtryk?*

	True	False	ZeroDivisionError
<code>1 == '1' and 1/0 == 0</code>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<code>1 == '1' or 1/0 == 0</code>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<code>False or not False</code>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### Question 7 (Recursion, 4 %)

```
def rec_print(x):
    print(x, end=' ')
    if x > 1:
        rec_print(x - 1)
        rec_print(x - 1)
```

What does `rec_print(3)` print?

*Hvad udskriver `rec_print(3)`?*

3 2 2	3 2 2 1 1	3 2 1 2 1	3 2 1 1 2 1 1	3 2 2 1 1 1 1
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

### Question 8 (for loops, 4%)

```
for x in range(3):  
    for y in range(2):  
        print(x, y, sep=',', end=',.')
```

What does the above code print?

*Hvad udskriver ovenstående kode?*

11.21.31.12.22.32.    11.12.21.22.31.32.    00.01.10.11.20.21.    00.10.20.01.11.21.

### Question 9 (Keyword arguments, 4%)

```
def f(x, y=3, z=5):  
    print(x + y + z)
```

For each of the below function calls state the value is returned or if the call is illegal.

*Angiv for hvert af nedenstående funktionskald returværdien eller om kaldet er ulovligt.*

	5	6	7	8	9	10	TypeError
f()	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f(1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f(1, 2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f(1, x=2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f(1, y=2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f(1, z=2)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f(1, 2, 3)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f(1, 2, z=3)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f(1, 2, y=3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

### Question 10 (zip, 4 %)

What does `list(zip((1, 2), (3, 4)))` return?

*Hvad returnerer `list(zip((1, 2), (3, 4)))`?*

- `[((1,2),(3,4))]`  `[(1,3),(2,4)]`  `[1,2,3,4]`  `[1,3,2,4]`

### Question 11 (Conditional expressions, 4 %)

```
print(sum([2 * x if x % 2 == 0 else 3 * x for x in [2, 3]]))
```

What does the above program print?

*Hvad udskriver ovenstående program?*

- 2 3 5 4 6 9 12 13 15

### Question 12 (sorted, 4 %)

```
print(sorted(["abx", "CDK", "Ghy"],  
            key=lambda x: sorted(x.lower(), reverse=True)))
```

What does the above program print?

*Hvad udskriver ovenstående program?*

- `["abx", "CDK", "Ghy"]`   
`["CDK", "abx", "Ghy"]`   
`["CDK", "Ghy", "abx"]`   
`["abx", "Ghy", "CDK"]`   
`["Ghy", "abx", "CDK"]`   
`["Ghy", "CDK", "abx"]`

Question 13 (matplotlib, 4%)

```
import matplotlib.pyplot as plt
plt.plot([0, 1], [2, 3], ".")
plt.show()
```

What are the two points plotted by the above program?

*Hvilke to punkter plottes med ovenstående program?*

- |                          |                          |                                     |                          |
|--------------------------|--------------------------|-------------------------------------|--------------------------|
| (0,1)                    | (0,1)                    | (0,2)                               | (0,2)                    |
| (2,3)                    | (2,4)                    | (1,3)                               | (1,5)                    |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Question 14 (List arithmetic, 4%)

```
print(3 * [1, 2, 3])
```

What does the above program print?

*Hvad udskriver ovenstående program?*

- |                          |                          |                                     |                          |                          |
|--------------------------|--------------------------|-------------------------------------|--------------------------|--------------------------|
| [3,2,3]                  | [3,6,9]                  | [1,2,3,1,2,3,1,2,3]                 | [1,1,1,2,2,2,3,3,3]      | TypeError                |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Question 15 (lambda, 4%)

```
def square(x):
    return x * x

g = lambda f: (lambda x: f(f(x)))

print(g(square)(3))
```

What does the above program print?

*Hvad udskriver ovenstående program?*

- |                          |                          |                          |                          |                                     |
|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------------------|
| 3                        | 6                        | 9                        | 18                       | 81                                  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |



### Question 16 (Decorator, 4 %)

```
def f(g):  
    def h(x):  
        return g(g(x))  
    return h  
  
@f  
def p(s):  
    print(s)  
    return s + s  
  
p("say!")
```

What does the above program print?

*Hvad udskriver ovenstående program?*

- say!  A
- say!  
say!  B
- say!  
say!say!  C
- say!say!  D
- say!say!  
say!say!  E

### Question 17 (Characters, 4 %)

```
def f(s):  
    a = ord('a')  
    return ''.join(chr(((ord(c) - a) + 1) % 26 + a) for c in s)  
  
print(f('zebra'))
```

What does the above program print?

*Hvad udskriver ovenstående program?*

- zebra  A
- ebraz  B
- azebr  C
- afcsb  D
- ydaqz  E

### Question 18 (Generator, 4 %)

---

```
def gen(s):
    reported = set()
    for x in s:
        if x not in reported:
            reported |= set(x)
            yield x

print(list(gen('hello_world'))[0:7])
```

---

What does the above program print?

*Hvad udskriver ovenstående program?*

- 'helo\_wr'  A
- ['helo\_wr']  B
- ['h', 'e', 'l', 'l', 'o', '-', 'w']  C
- ['h', 'e', 'l', 'o', '-', 'w', 'r']  D
- [{'h'}, {'e'}, {'l'}, {'o'}, {'-'}, {'w'}, {'o'}]  E

### Question 19 (Class, 4 %)

---

```
class C:
    def __init__(self, x=1, y=2):
        self.x = x
        self.y = y

    def sum(self):
        return self.x + self.y

print(C(y=3).sum())
```

---

What does the above program print?

*Hvad udskriver ovenstående program?*

- 1  A
- 2  B
- 3  C
- 4  D
- 5  E
- TypeError  F

### Question 20 (Recursive generator, 4 %)

---

```
def f(x):
    if type(x) is not tuple:
        yield x
    else:
        for c in x:
            for z in f(c):
                yield z

print(list(f(((1, 2), 3), (4, 5))))
```

---

What does the above program print?

*Hvad udskriver ovenstående program?*

- [1] [3,5] [[1,2],3],[4,5] [1,2,3,4,5] [5]
- A  B  C  D  E

### Question 21 (Method calls, 4 %)

---

```
class A:
    name = "My name"

    def __init__(self, s):
        self.name = s

a = A('Hugo')
print(a.name)
print(A.name)
```

---

What does the above program print?

*Hvad udskriver ovenstående program?*

- Hugo Hugo My name Hugo  
Hugo My name My name AttributeError
- A  B  C  D

## Question 22 (Attributes, 4%)

```
class A:
    name = "My name"

    def __init__(self, s):
        self.name = s

a = A('Hugo')
```

Which of the below terms apply to `A.name`?

*Hvilke af nedenstående beskrivelser er korrekt for `A.name`?*

	Yes/ <i>Ja</i>	No/ <i>Nej</i>
attribute	<input checked="" type="checkbox"/>	<input type="checkbox"/>
class attribute	<input checked="" type="checkbox"/>	<input type="checkbox"/>
data attribute	<input checked="" type="checkbox"/>	<input type="checkbox"/>
method attribute	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Which of the below terms apply to `a.name`?

*Hvilke af nedenstående beskrivelser er korrekt for `a.name`?*

	Yes/ <i>Ja</i>	No/ <i>Nej</i>
attribute	<input checked="" type="checkbox"/>	<input type="checkbox"/>
class attribute	<input type="checkbox"/>	<input checked="" type="checkbox"/>
data attribute	<input checked="" type="checkbox"/>	<input type="checkbox"/>
method attribute	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Which of the below terms apply to `A.__init__`?

*Hvilke af nedenstående beskrivelser er korrekt for `A.__init__`?*

	Yes/ <i>Ja</i>	No/ <i>Nej</i>
attribute	<input checked="" type="checkbox"/>	<input type="checkbox"/>
class attribute	<input checked="" type="checkbox"/>	<input type="checkbox"/>
data attribute	<input type="checkbox"/>	<input checked="" type="checkbox"/>
method attribute	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Question 23 (super, 4%)

---

```
class A:
    def say(self):
        print("Hi there")

class B(A):
    def say(self):
        print("Howdy")

    def __init__(self):
        self.say()
        super().say()
```

- A()  
B()
- 

What does the above program print?

*Hvad udskriver ovenstående program?*

- |                                  |                               |                               |                            |                                       |
|----------------------------------|-------------------------------|-------------------------------|----------------------------|---------------------------------------|
| Hi there<br>Hi there<br>Hi there | Hi there<br>Hi there<br>Howdy | Hi there<br>Howdy<br>Hi there | Hi there<br>Howdy          | Howdy<br>Hi there                     |
| <input type="checkbox"/> A       | <input type="checkbox"/> B    | <input type="checkbox"/> C    | <input type="checkbox"/> D | <input checked="" type="checkbox"/> E |

Question 24 (Precedence, 4%)

---

```
print(2 + 2 * 2 ** 2)
```

---

What does the above program print?

*Hvad udskriver ovenstående program?*

- 8   10   16   18   64
- A    B    C    D    E

### Question 25 (Decorators, 4%)

---

```
import os

class Logger:
    logs = []
    def __init__(self):
        pass
    def log(self, key, value):
        self.logs.append((key, value))
    def print(self):
        for k,v in self.logs:
            print(k, ":", v)

def log_call(logger):
    def decorator(func):
        def wrapper(*args, **kwargs):
            logger.log("call", func.__name__)
            return func(*args, **kwargs)
        wrapper.__name__ = func.__name__
        return wrapper
    return decorator

def log_output(logger):
    def decorator(func):
        def wrapper(*args, **kwargs):
            s = func(*args, **kwargs)
            logger.log("output(" + func.__name__ + ")", s)
            return s
        wrapper.__name__ = func.__name__
        return wrapper
    return decorator

mlog = Logger()

@log_output(mlog)
@log_call(mlog)
def test(string):
    return string

test("This is my personal string")
mlog.print()
```

---

What does the above program print?

*Hvad udskriver ovenstående program?*

output(test) : This is my personal string  
call : test

A

call : test  
output(test) : This is my personal string

B

test  
This is my personal string

C

call : test  
output(wrapper) : This is my personal string

D

call : wrapper  
output(wrapper) : This is my personal string

E