

Aarhus Universitet, Science and Technology, Computer Science

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 it 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 (Variable names, 5 %)

Which of the below are valid variable names?

Hvilke af nedenstående er lovlige variabelnavne?

	Yes/Ja	No/Nej
x	<input checked="" type="checkbox"/>	<input type="checkbox"/>
for	<input type="checkbox"/>	<input checked="" type="checkbox"/>
_10	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1A_B	<input type="checkbox"/>	<input checked="" type="checkbox"/>
__if__	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Question 2 (Indexing, 5 %)

What is the result of each of the below expressions?

Hvad er resultatet af hvert af nedenstående udtryk?

	0	1	2	3	4	some error/en fejl
[1, 2, 3][3]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
[3][1, 2, 3]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
{1:2, 3:4}[0]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
[0][0]	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
{1, 2, 3}[0]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
[[1, 2, 3][1]][0]	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
{1:2, 3:4}[1]	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Question 3 (Slicing, 5 %)

What is the result of each of the below expressions?

Hvad er resultatet af hvert af nedenstående udtryk?

	()	(1)	(2)	(3)	(4)	(1,2)	(2,3)	(3,4)	(1,2,3)	(2,3,4)
(1,2,3,4)[1:3]	<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"/>	<input type="checkbox"/>	<input type="checkbox"/>
(1,2,3,4)[3:1]	<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"/>	<input type="checkbox"/>
(1,2,3,4)[1:-1]	<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"/>	<input type="checkbox"/>	<input type="checkbox"/>
(1,2,3,4)[2:-2]	<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"/>	<input type="checkbox"/>
(1,2,3,4)[-4:-2]	<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"/>	<input type="checkbox"/>

Question 4 (Boolean operations, 5 %)

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

Hvad er resultatet af hvert af nedenstående boolske udtryk?

	False	True	"False"	"True"	None
False and True	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
None or True	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
"False" and "True"	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
"False" or "True"	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
"False" and not "True"	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Question 5 (Conditionals, 4 %)

```
x = 1
if x == 1:
    x += 2
    if x == 1:
        x += 3
    else:
        x += 2
else:
    x += 1
print(x)
```

What does the above code print?

1 2 3 4 5 6 7 8 9

Hvad udskriver ovenstående kode?

A B C D E F G H I

Question 6 (Loop, 4 %)

```
x = 1
while True:
    if x > 3:
        break
    x += 1
else:
    1
print(x)
```

What does the above code print?

1 2 3 4 5 6 7 8 9

Hvad udskriver ovenstående kode?

A B C D E F G H I

Question 7 (Function, 4 %)

```
def f(x, y):  
    return x ** y  
  
x = 2  
y = 3  
print(f(y, x))
```

What does the above code print?

2 3 4 6 8 9

Hvad udskriver ovenstående kode?

A B C D E F

Question 8 (Recursion, 4 %)

```
def f(x):  
    if x >= 1:  
        f(x - 1)  
        print(x, end='')  
        f(x - 1)  
  
f(3)
```

What does f(3) print?

3211211 1121123 1213121 12321 232

Hvad udskriver f(3)?

A B C D E

Question 9 (List comprehension, 5 %)

What is the result of each of the below expressions?

Hvad er resultatet af hvert af nedenstående udtryk?

	1	2	3	4	5	6	7	8	9	10
<code>sum([x*x for x in [1,2,1]])</code>	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E	<input checked="" type="checkbox"/> F	<input type="checkbox"/> G	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J
<code>sum([y for x in (1, 2, 3) for y in (1, 2)])</code>	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E	<input type="checkbox"/> F	<input type="checkbox"/> G	<input type="checkbox"/> H	<input checked="" type="checkbox"/> I	<input type="checkbox"/> J
<code>sum([x*y for x,y in zip([1,2,3],[3,1,1])])</code>	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E	<input type="checkbox"/> F	<input type="checkbox"/> G	<input checked="" type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J
<code>sum([y for x,y in [(1,2),(3,4),(2,1)])]</code>	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E	<input type="checkbox"/> F	<input checked="" type="checkbox"/> G	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J
<code>sum([x*x for x in [1,2,3] if x < 3])</code>	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input checked="" type="checkbox"/> E	<input type="checkbox"/> F	<input type="checkbox"/> G	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J

Question 10 (sorted, 4 %)

```
print(sorted(("pab","kd","defg","s"), key=len, reverse=True))
```

What does the above program print?

Hvad udskriver ovenstående program?

- `['defg', 'kd', 'pab', 's']` A
- `['s', 'pab', 'kd', 'defg']` B
- `['s', 'kd', 'pab', 'defg']` C
- `['defg', 'pab', 'kd', 's']` D
- `['pab', 'defg', 'kd', 's']` E

Question 11 (map, 4 %)

```
print(tuple(map(lambda x : x + x, range(3))))
```

What does the above program print?

Hvad udskriver ovenstående program?

- `(0, 1, 2)` A
- `(3)` B
- `(0, 1, 3)` C
- `(0, 1, 2, 3)` D
- `(0, 2, 4)` E
- `(0, 2, 4, 9)` F

Question 12 (Types, 5 %)

What is the resulting type of each of the below expression?

For hvert af nedenstående udtryk hvilken type har resultatet?

	int	float	str	list	tuple	bool
<code>1 + 2.0</code>	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E	<input type="checkbox"/> F
<code>3 / 2</code>	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E	<input type="checkbox"/> F
<code>3 // 2</code>	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E	<input type="checkbox"/> F
<code>'abc' + 'def'</code>	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E	<input type="checkbox"/> F
<code>'abc' * 3</code>	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E	<input type="checkbox"/> F
<code>len(('a', 'b'))</code>	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E	<input type="checkbox"/> F

Question 13 (yield, 4%)

```
def f(x):  
    yield 1  
    while x > 0:  
        yield x  
        x -= 1  
    yield 1  
  
print(list(f(3)))
```

What list does the above program print?

Hvilken liste udskriver ovenstående program?

- [1] [1,1] [1,3,2,1,1] [1,3,3,3,1] [1,3,2,1,0,1] [1,3,2,1]

Question 14 (Recursive data, 4%)

```
def traverse(T):  
    if type(T) is not tuple:  
        return T + T  
    else:  
        return tuple(traverse(c) for c in T)  
  
print(traverse(((3, (2, 5)), 4)))
```

What does the above program print?

Hvad udskriver ovenstående program?

- ((3, 3, (2, 2, 5, 5)), 4, 4) **A**
(((3, 3), ((2, 2), (5, 5))), (4, 4)) **B**
(3, 2, 5, 4) **C**
(6, 4, 10, 8) **D**
((6, (4, 10)), 8) **E**
(3, 3, 2, 2, 5, 5, 4, 4) **F**

Question 15 (Generator expressions, 4 %)

```
g = (x * 2 for x in range(1, 6))

print(next(g), next(g), list(g))
```

What does the above program print?

Hvad udskriver ovenstående program?

- 2 2 [2, 4, 6, 8, 10] A
- 2 4 [2, 4, 6, 8, 10] B
- 2 4 [6, 8, 10] C
- 2 2 [6, 8, 10] D
- 2 None [] E

Question 16 (* notation, 4 %)

```
x, y, *z, w = 1, 2, 3, 4, 5, 6
```

What is the value of z?

Hvilken værdi har z?

- 3 A
- [3] B
- [3,4,5] C
- [3,4,5,6] D
- 12 E

Question 17 (Sets, 5 %)

What is the value of the following expressions?

Hvilken værdi har følgende udsagn?

- | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|--|---------------------------------------|---------------------------------------|---------------------------------------|----------------------------|----------------------------|---------------------------------------|----------------------------|
| | [] | [1] | [2] | [3] | [2,2] | [1,2,3] | [1,2,2,3] |
| <code>list({1, 2} {2, 3})</code> | <input type="checkbox"/> A | <input type="checkbox"/> B | <input type="checkbox"/> C | <input type="checkbox"/> D | <input type="checkbox"/> E | <input checked="" type="checkbox"/> F | <input type="checkbox"/> G |
| <code>list({1, 2} & {2, 3})</code> | <input type="checkbox"/> A | <input type="checkbox"/> B | <input checked="" type="checkbox"/> C | <input type="checkbox"/> D | <input type="checkbox"/> E | <input type="checkbox"/> F | <input type="checkbox"/> G |
| <code>list({1, 2} - {2, 3})</code> | <input type="checkbox"/> A | <input checked="" type="checkbox"/> B | <input type="checkbox"/> C | <input type="checkbox"/> D | <input type="checkbox"/> E | <input type="checkbox"/> F | <input type="checkbox"/> G |
| <code>list({1, 2} - {1, 2})</code> | <input checked="" type="checkbox"/> A | <input type="checkbox"/> B | <input type="checkbox"/> C | <input type="checkbox"/> D | <input type="checkbox"/> E | <input type="checkbox"/> F | <input type="checkbox"/> G |
| <code>list({1, 2} - {1, 2, 3})</code> | <input checked="" type="checkbox"/> A | <input type="checkbox"/> B | <input type="checkbox"/> C | <input type="checkbox"/> D | <input type="checkbox"/> E | <input type="checkbox"/> F | <input type="checkbox"/> G |

Question 18 (zip, 4 %)

```
list(zip([1,2], zip([3,4], [5,6])))
```

What is the value of the above expressions?

Hvilken værdi har ovenstående udsagn?

- [(1, 2), (3, 4), (5,6)] A
- [1, 3, 5, 2, 4, 6] B
- (1, 3, 5), (2, 4, 6) C
- [(1, (3, 5)), (2, (4, 6))] D
- [((1, 3), 5), ((2, 4), 6)] E

Question 19 (numpy, 4 %)

```
import numpy as np
print(np.array([1,2,3]) + np.array([4,5,6]))
print(np.array([1,2,3]) * np.array([4,5,6]))
print(3 * np.array([1,2,3]))
print(np.array([1,2,3]) @ np.array([4,5,6]))
```

What does the above program print?

Hvad udskriver ovenstående program?

- [1 2 3 4 5 6]
32
[1 2 3 1 2 3 1 3 3]
4 A
- [1 2 3 4 5 6]
[4 10 18]
[1 2 3 1 2 3 1 3 3]
4 B
- [5 7 9]
[4 10 18]
[3 6 9]
32 C
- [1 2 3 4 5 6]
[4 10 18]
[3 6 9]
32 D

Question 20 (lambda, 4 %)

```
def f(g, h, L):  
    return [g(x) if x % 2 == 0 else h(x) for x in L]  
  
print(f(lambda x : 3 * x, lambda x : 2 * x, [1, 2, 3, 5]))
```

What list does the above program print?

Hvilken liste udskriver ovenstående program?

- | | | | | |
|----------------------------|----------------------------|----------------------------|---------------------------------------|----------------------------|
| [1,0,1,1] | [3,6,9,10] | [3,4,9,15] | [2,6,6,10] | [2, 6, 6, 15] |
| <input type="checkbox"/> A | <input type="checkbox"/> B | <input type="checkbox"/> C | <input checked="" type="checkbox"/> D | <input type="checkbox"/> E |

Question 21 (Assertions, 4 %)

```
def f(x):  
    assert type(x) == int  
  
    return 3 * x
```

What does each of the below function calls return?

Hvad returnerer hvert af nedenstående funktionskald?

	6	6.0	'222'	AssertionError
f(2)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f(2.0)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f('2')	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Question 22 (Inheritance, 5 %)

```
class A:
    def say(self):
        print("Hello")

class B:
    def greet(self):
        print("Welcome")

class C(A, B):
    pass
```

What does each of the below metode calls print?

Hvad udskriver hvert af nedenstående metodekald?

	Hello	Welcome	AttributeError
A().say()	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B().say()	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
C().say()	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A().greet()	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
B().greet()	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
C().greet()	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Question 23 (Decorator, 4%)

```
def d(x):
    def y(z):
        print(type(x))
        x(z+z)

    return y

@d
def f(x):
    print("value = " + str(x))

f(21)
```

What does the above program print?

Hvad udskriver ovenstående program?

- `<class 'int'>`
value = 21 A
- `<class 'int'>`
value = 42 B
- `<class 'function'>`
value = 21 C
- `<class 'function'>`
value = 42 D
- `<class 'str'>`
value = 21 E
- `<class 'str'>`
value = 42 F