Aarhus Universitet, Science and Technology, Computer Science

Exam

Introduction to Programming with Scientific Applications

Friday 9 August 2019, 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 3.7.
I det følgende antages at Python refererer til Python 3.7.

Question 1 (Types, 4 %)

What is the type of each of the below expressions ?
Hvad er typen af hvert af nedenstående udtryk ?

	int	float	string	tuple	list	None
`1`	A	B	C	D	E	F
`1.0`	A	B	C	D	E	F
`'1.0'`	A	B	C	D	E	F
`(1,)`	A	B	C	D	E	F
`4 / 2`	A	B	C	D	E	F
`4 // 2`	A	B	C	D	E	F
`1e1`	A	B	C	D	E	F

Question 2 (Ranges, 4 %)

What is the result of each of the below expressions ?
Hvad er resultatet af hvert af nedenstående udtryk ?

	0	1	2	3	4	5	6	7	8	9
`len(range(5))`	A	B	C	D	E	F	G	H	I	J
`len(range(2, 8, 3))`	A	B	C	D	E	F	G	H	I	J
`max(range(1, 5))`	A	B	C	D	E	F	G	H	I	J
`min(range(1, 5, 1))`	A	B	C	D	E	F	G	H	I	J
`min(range(5, 1, −1))`	A	B	C	D	E	F	G	H	I	J

Question 3 (Indexing, 4 %)

```
L = ['a', 'b', 'c']
```

What is the result of each of the below expressions ?
Hvad er resultatet af hvert af nedenstående udtryk ?

	'a'	'b'	'c'	IndexError
`L[0]`	A	B	C	D
`L[1]`	A	B	C	D
`L[2]`	A	B	C	D
`L[3]`	A	B	C	D
`L[−1]`	A	B	C	D
`L[−3]`	A	B	C	D

Question 4 (Conditional, 4 %)

```
def f(x):
    answer = None
    if x == 1:
        if x == 2:
            answer = 'a'
        else:
            answer = 'b'
    else:
        if x >= 2:
            answer = 'c'
        if x >= 3:
            answer = 'd'
    return answer
```

What is the result of each of the below expressions ?
Hvad er resultatet af hvert af nedenstående udtryk ?

	'a'	'b'	'c'	'd'	None
f(0)	A	B	C	D	E
f(1)	A	B	C	D	E
f(2)	A	B	C	D	E
f(3)	A	B	C	D	E
f(4)	A	B	C	D	E

Question 5 (Boolean, 4 %)

What is the result of each of the below expressions ?
Hvad er resultatet af hvert af nedenstående udtryk ?

	False	True	0	1	ZeroDivisionError
False or True	A	B	C	D	E
not False	A	B	C	D	E
not not 0	A	B	C	D	E
0 // 1 and 1 // 0	A	B	C	D	E
1 // 0 and 0 // 1	A	B	C	D	E

Question 6 (for loops, 4 %)

```
for x in 'abc':
    for y in [1, 2, 3]:
        print(str(x) + str(y), end=' ')
```

What does the above code print ?
Hvad udskriver ovenstående kode ?

`abc1 abc2 abc3`	A
`a1 b1 c1 a2 b2 c2 a3 b3 c3`	B
`a1 a2 a3 b1 b2 b3 c1 c2 c3`	C
`'a'1 'a'2 'a'3 'b'1 'b'2 'b'3 'c'1 'c'2 'c'3`	D
`'abc'1 'abc'2 'abc'3`	E

Question 7 (while loops, 4 %)

```
x = 1
while x < 42:
    x *= 2
print(x)
```

What does the above code print ?
Hvad udskriver ovenstående kode ?

1	2	32	42	64	82	84
A	B	C	D	E	F	G

Question 8 (Dictionaries, 4 %)

```
D = {1: 2, 2: None, None: 'Nothing'}
```

What is the result of each of the below expressions ?
Hvad er resultatet af hvert af nedenstående udtryk ?

	1	2	None	'Nothing'	(2, None)	KeyError
`D[1]`	A	B	C	D	E	F
`D[None]`	A	B	C	D	E	F
`D[D[D[1]]]`	A	B	C	D	E	F
`D['Nothing']`	A	B	C	D	E	F
`D[(1, 2)]`	A	B	C	D	E	F

Question 9 (List slice, 4 %)

```
L = [0, 1, 2, 3, 4, 5]
```

What is the result of each of the below expressions ?
Hvad er resultatet af hvert af nedenstående udtryk ?

	[1]	[1,2]	[1,3]	[1,2,3]	[1,2,3,4]	[1,2,3,4,5]	[1,3,5]	[1,5]
L[1:3]	A	B	C	D	E	F	G	H
L[1:3:2]	A	B	C	D	E	F	G	H
L[1::2]	A	B	C	D	E	F	G	H
L[1::2][::2]	A	B	C	D	E	F	G	H
L[5::−2][::−2]	A	B	C	D	E	F	G	H

Question 10 (Lists, 4 %)

```
A = [1]
B = A + A
C = B
A.append(2)
B.append(3)
```

What is the result of each of the below expressions ?
Hvad er resultatet af hvert af nedenstående udtryk ?

	[1]	[1,1]	[1,2]	[1,3]	[1,2,1,2]	[1,1,2]	[1,1,3]	[1,2,1,2,3]
A	A	B	C	D	E	F	G	H
B	A	B	C	D	E	F	G	H
C	A	B	C	D	E	F	G	H

Question 11 (Comprehension, 4 %)

What kind of expression is each of the below expressions ?
Hvilken slags udtryk er hvert af nedenstående udtryk ?

	list comprehension	tuple comprehension	set comprehension	dictionary comprehension	generator expression
`(x for x in (1,2,3))`	A	B	C	D	E
`[x for x in (1,2,3)]`	A	B	C	D	E
`{x for x in (1,2,3)}`	A	B	C	D	E
`{x: x for x in (1,2,3)}`	A	B	C	D	E
`{(x, x) for x in (1,2,3)}`	A	B	C	D	E

Question 12 (Conditional expression, 4 %)

```
def f(x):
    return x + 1 if x % 3 else x - 1
```

What is the result of each of the below expressions ?
Hvad er resultatet af hvert af nedenstående udtryk ?

	0	1	2	3	4	5	6	7	8	9	10
`f(1)`	A	B	C	D	E	F	G	H	I	J	K
`f(3)`	A	B	C	D	E	F	G	H	I	J	K
`f(5)`	A	B	C	D	E	F	G	H	I	J	K
`f(7)`	A	B	C	D	E	F	G	H	I	J	K
`f(9)`	A	B	C	D	E	F	G	H	I	J	K

Question 13 (Function call, 4 %)

```
def f(x, y, z):
    return x + 2 * y - 2 ** z

print(f(1, 2, 3))
```

What does the above code print ?
Hvad udskriver ovenstående kode ?

−5	−4	−3	−2	−1	0	1	2	3	4	5
A	B	C	D	E	F	G	H	I	J	K

Question 14 (Function arguments, 4 %)

```
def f(x, y, *z):
    return x * y * z

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

What does the above code print ?
Hvad udskriver ovenstående kode ?

6	24	(6, 8)	(3, 4, 3, 4)
A	B	C	D

Question 15 (Function scope, 4 %)

```
def f(x, y):
    def g(x, z):
        return (x, y, z)

    return g(2 * x, 3 * y)

z = 0
print(f(1, 2))
```

What does the above code print ?
Hvad udskriver ovenstående kode ?

(1, 2, 0)	(2, 6, 0)	(2, 2, 6)	(2, None, 6)
A	B	C	D

Question 16 (Recursive function, 4 %)

```
def f(x):
    if x > 0:
        print(x, end='')
        f(x - 1)
        print(x, end='')
f(3)
```

What does the above code print ?
Hvad udskriver ovenstående kode ?

32123	321123	332211	33221	32100123	3210123
A	B	C	D	E	F

Question 17 (Recursive data, 4 %)

```
def profile(tree):
    if type(tree) is tuple:
        return [d + 1 for child in tree for d in profile(child)]
    else:
        return [0]

print(profile((((1, 2), 3), 4, (5, (6, 7)))))
```

What does the above program print?
Hvad udskriver ovenstående program?

`[[[3, 3], 2], 1, [2, [3, 3]]]`	A
`[3, 3, 2, 1, 2, 3, 3]`	B
`[[[2, 2], 1], 0, [1, [2, 2]]]`	C
`[2, 2, 1, 0, 1, 2, 2]`	D

Question 18 (Generator, 4 %)

```
def fix(seq):
    for x in seq:
        if x >= 0:
            yield x

seq = fix((2, -3, 1, 0, -2, 4))

print(next(seq), end=' ')
print(next(seq), end=' ')
print(tuple(seq), end=' ')
```

What does the above code print ?
Hvad udskriver ovenstående kode ?

`2 1 0 4`	A
`2 1 (0, 4)`	B
`2 2 (2, 1, 0, 4)`	C
`2 2 2 1 0 4`	D

Question 19 (Generator expression, 4 %)

```
squares = (x * x for x in range(1, 5))

print(sum(squares) + sum(squares))
```

What does the above code print ?
Hvad udskriver ovenstående kode ?

10	15	20	30	55	60	110
A	B	C	D	E	F	G

Question 20 (lambda, 4 %)

```
def compose(f, h):
    return lambda *args : f(h(*args))

square = lambda x: x ** 2
inc = lambda x: x + 1

print(compose(inc, compose(square, inc))(1))
```

What does the above code print ?
Hvad udskriver ovenstående kode ?

1	2	3	4	5	6	7	8	9	10
A	B	C	D	E	F	G	H	I	J

Question 21 (Classes, 4 %)

```
class A:
    count = 0

    def __init__(self, value=0):
        self.element = self.count + value
        A.count += 1

a = A(3)
b = A()
```

What is the result of each of the below expressions ?
Hvad er resultatet af hvert af nedenstående udtryk ?

	0	1	2	3	4	5	AttributeError
A.count	A	B	C	D	E	F	G
A.element	A	B	C	D	E	F	G
a.count	A	B	C	D	E	F	G
a.element	A	B	C	D	E	F	G
b.count	A	B	C	D	E	F	G
b.element	A	B	C	D	E	F	G

Question 22 (Inheritance, 4 %)

```
class A:
    def f(self, x):
        return self.g(x) * self.g(x)

    def g(self, x):
        return x + 1

class B(A):
    def f(self, x):
        return x + super().f(x)

    def g(self, x):
        return x - 1
```

What is the result of each of the below expressions ?
Hvad er resultatet af hvert af nedenstående udtryk ?

	0	1	2	3	4	5	6	7	8	9	10	AttributeError
A().f(2)	A	B	C	D	E	F	G	H	I	J	K	L
B().f(2)	A	B	C	D	E	F	G	H	I	J	K	L

Question 23 (Decorator, 4 %)

```
def S(prefix, suffix):
    def decorator(fn):
        def wrapper(*args):
            return prefix + str(fn(*args)) + suffix
        return wrapper
    return decorator

@S('<', '>')
def square(x):
    return x * x

result = square(2) + square(3)
```

What value has `result` ?
Hvilken værdi har `result` *?*

13	'13'	'49'	'<13>'	'<49>'	'<4><9>'
A	B	C	D	E	F

Question 24 (Exceptions, 4 %)

```
try:
    print('A', end='')
    x = 1 / 0
    print('B', end='')
except Exception:
    print('C', end='')
except ZeroDivisionError:
    print('D', end='')
finally:
    print('E', end='')
```

What does the above code print ?
Hvad udskriver ovenstående kode ?

A	AB	AC	AD	AE	ACE	ADE	ACD	ACDE
A	B	C	D	E	F	G	H	I

Question 25 (Numpy, 4 %)

```
import numpy as np

A = np.zeros((3, 2))
B = np.zeros((2, 7))
C = A @ B

print(C.shape)
```

What does the above code print ?
Hvad udskriver ovenstående kode ?

0	(6, 14)	(5, 9)	(3, 7)	(3, 2, 2, 7)
A	B	C	D	E