

Aarhus Universitet, Science and Technology, Computer Science

Exam

Introduction to Programming with Scientific Applications

Tuesday 11 June 2019, 14:00–16:00

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 3.7.

I det følgende antages at Python refererer til Python 3.7.

Question 1 (Expressions, 4 %)

What is the result of each of the below expressions ?

Hvad er resultatet af hvert af nedenstående udtryk ?

	0	0.0	1	1.0	ZeroDivisionError
0 / 1	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E
1 / 0	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input checked="" type="checkbox"/> E
0 // 1	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E
1 // 0	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input checked="" type="checkbox"/> E
1 # 0	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E
0 # 1	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E
1 % 0	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input checked="" type="checkbox"/> E
0 % 1	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E

Question 2 (Conditional, 4 %)

```
def f(x):
    if x < 0:
        x = -x
    elif x == -1:
        x = 2
    else:
        x = 2 * x
    return x
```

What is the result of each of the below expressions ?

Hvad er resultatet af hvert af nedenstående udtryk ?

	-5	-4	-3	-2	-1	0	1	2	3	4	5
f(-2)	<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	<input type="checkbox"/> K
f(-1)	<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	<input type="checkbox"/> K
f(0)	<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	<input type="checkbox"/> K
f(1)	<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	<input type="checkbox"/> K
f(2)	<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 type="checkbox"/> I	<input checked="" type="checkbox"/> J	<input type="checkbox"/> K

Question 3 (Boolean operations, 4 %)

What is the result of each of the below expressions ?

Hvad er resultatet af hvert af nedenstående udtryk ?

	True	False	0	1	2	3	ZeroDivisionError
True and False	<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
not True	<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
1 == 2 and 3	<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
1 == 2 or 3	<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
1 == 2 == 3	<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
3 < 2 > 1 / 0	<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

Question 4 (Dictionaries, 4 %)

`D = { 'a key': 'a value' }`

Which of the below are valid dictionary updates ?

Hvilke af nedenstående er lovlige "dictionary" opdateringer ?

	Valid/Lovlig	Invalid/Ulovlig
<code>D['Python'] = 3</code>	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B
<code>D[(1, 2)] = 3</code>	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B
<code>D[[1, 2]] = 3</code>	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B
<code>D[{1, 2}] = 3</code>	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B
<code>D[frozenset({1, 2})] = 3</code>	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B
<code>D[None] = True</code>	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B

Question 5 (for loops, 4 %)

```
for x in range(1, 4):
    for y in range(x, 4):
        print(str(x) + str(y), end=' ')
```

What does the above code print ?

Hvad udskriver ovenstående kode ?

- 11 22 33 12 23 13 ☐ A
- 11 22 22 33 33 33 ☐ B
- 11 12 13 22 23 33 ☒ C
- 13 12 11 23 22 33 ☐ D
- 11 14 44 44 ☐ E

Question 6 (List indexing, 4 %)

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

What is the result of each of the below expressions ?

Hvad er resultatet af hvert af nedenstående udtryk ?

	'a'	'b'	'c'	[]	['a']	['b']	['c']	['a','b']	['b','c']	IndexError
x[1]	<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	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J
x[1:1]	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D	<input type="checkbox"/> E	<input type="checkbox"/> F	<input type="checkbox"/> G	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J
x[1:2]	<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
x[-2]	<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	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J
x[:-2]	<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
x[1::2]	<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
x[3]	<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 type="checkbox"/> I	<input checked="" type="checkbox"/> J

Question 7 (Lists, 4 %)

```
A = [[1,2],[3,4]]
B = A
B[1] = 5
C = A[:]
C[1] = 6
A[0][0] = 7
```

What is the value of A, B and C after executing the above code ?

Hvad er værdien af A, B og C efter udførslen af ovenstående kode ?

	[[7,2],[3,4]]	[[1,2],5]	[[7,2],5]	[[1,2],6]	[[7,2],6]
A	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/>	<input type="checkbox"/> D	<input type="checkbox"/> E
B	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/>	<input type="checkbox"/> D	<input type="checkbox"/> E
C	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input checked="" type="checkbox"/>

Question 8 (List comprehension, 4 %)

```
print([x + x for x in [[1, 2], [3, 4]]])
```

What does the above code print ?

Hvad udskriver ovenstående kode ?

- ☐ [4, 6] ☐ A
- ☐ [3, 6] ☐ B
- ☐ [2, 4, 6, 8] ☐ C
- ☐ [1, 2, 1, 2, 3, 4, 3, 4] ☐ D
- ☐ [[1, 2, 1, 2], [3, 4, 3, 4]] ☒
- ☐ [[1, 2, 3, 4], [1, 2, 3, 4]] ☐ F

Question 9 (Function call, 4 %)

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

What is the result of each of the below expressions ?

Hvad er resultatet af hvert af nedenstående udtryk ?

	-2	-1	0	1	2	3	4	5	6	7	SyntaxError/ TypeError
f(1, 2, 3)	<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	<input type="checkbox"/> K
f(1, z=2, y=3)	<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	<input type="checkbox"/> K
f(x=1, 2, 3)	<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 type="checkbox"/> I	<input type="checkbox"/> J	<input checked="" type="checkbox"/> K
f(z=1, y=2, x=3)	<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	<input type="checkbox"/> K
f(1, 2, x=3)	<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 type="checkbox"/> I	<input type="checkbox"/> J	<input checked="" type="checkbox"/> K

Question 10 (Recursion, 4 %)

```
def f(x):
    return 0 if x == 0 else x + f(x - 1)
```

What is the result of each of the below expressions ?

Hvad er resultatet af hvert af nedenstående udtryk ?

	-1	0	1	2	3	4	5	6	7	8	9	RecursionError
f(-1)	<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 type="checkbox"/> I	<input type="checkbox"/> J	<input type="checkbox"/> K	<input checked="" type="checkbox"/> L
f(0)	<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	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J	<input type="checkbox"/> K	<input type="checkbox"/> L
f(1)	<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	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J	<input type="checkbox"/> K	<input type="checkbox"/> L
f(2)	<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	<input type="checkbox"/> K	<input type="checkbox"/> L
f(3)	<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	<input type="checkbox"/> K	<input type="checkbox"/> L

Question 11 (Scope, 4 %)

```
def fn(x):
    def fn(x):
        return 2 * fn(x - 1) if x > 1 else 1
    return fn(x) + fn(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	RecursionError
fn(1)	<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	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J	<input type="checkbox"/> K	<input type="checkbox"/> L
fn(2)	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D	<input type="checkbox"/> E	<input type="checkbox"/> F	<input type="checkbox"/> G	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J	<input type="checkbox"/> K	<input type="checkbox"/> L
fn(3)	<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	<input type="checkbox"/> K	<input type="checkbox"/> L

Question 12 (Recursive data, 4 %)

```
def flip(tree):
    if type(tree) is not tuple:
        return tree
    else:
        return tuple(flip(c) for c in reversed(tree))

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

What does the above program print?

Hvad udskriver ovenstående program?

- ☐ ((5, (6, 7)), 4, ((1, 2), 3)) A
- ☒ (((7, 6), 5), 4, (3, (2, 1))) B
- ☐ (((7, 6), 5), 4, (3, (1, 2))) C
- ☐ (((6, 7), 5), 4, (3, (1, 2))) D
- ☐ (((7, 6), 5), 4, 3), (2, 1)) E

Question 13 (Generators, 4 %)

```
def a(n):
    for x in range (1, n + 1):
        yield x * x

def b(a):
    for x in a:
        yield x
        yield x * x

print(list(b(a(3))))
```

What does the above code print ?

Hvad udskriver ovenstående kode ?

- ☐ [1, 2, 3, 1, 4, 9] A
- ☐ [1, 4, 9, 1, 16, 81] B
- ☐ [1, 1, 2, 4, 3, 9] C
- ☒ [1, 1, 4, 16, 9, 81] D
- ☐ [(1, 1), (2, 4), (3, 9)] E
- ☐ [(1, 1), (4, 16), (9, 81)] F

Question 14 (Generator expression, 4 %)

```
g = (x**2 for x in range(1, 5))

print(next(g), end=' ')
for e in g:
    print(e, end=' ')
print(list(g))
```

What does the above code print ?

Hvad udskriver ovenstående kode ?

- | | |
|--------------------------|-------------------------------------|
| 1 1 4 9 16 [1, 4, 9, 16] | <input type="checkbox"/> A |
| 1 1 4 9 16 [4, 9, 16] | <input type="checkbox"/> B |
| 1 1 4 9 16 [] | <input type="checkbox"/> C |
| 1 4 9 16 [1, 4, 9, 16] | <input type="checkbox"/> D |
| 1 4 9 16 [4, 9, 16] | <input type="checkbox"/> E |
| 1 4 9 16 [] | <input checked="" type="checkbox"/> |

Question 15 (lambda, 4 %)

```
def partial(f, *args):
    return lambda *more_args : f(*args, *more_args)

def linear(a, b, x):
    return a + b * x

f = partial(linear, 1)
```

What is the result of each of the below expressions ?

Hvad er resultatet af hvert af nedenstående udtryk ?

	5	7	TypeError
f(2, 3)	<input type="checkbox"/> A	<input checked="" type="checkbox"/>	<input type="checkbox"/> C
f(1, 2, 3)	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/>

Question 16 (Class, 4 %)

```
class A():
    x = 0

    def __init__(self, x=1):
        self.x = x

a = A()
b = A(x=2)
```

What is the result of each of the below expressions ?

Hvad er resultatet af hvert af nedenstående udtryk ?

	0	1	2	NameError
a.x	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
a.__class__.x	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
b.x	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D
A.x	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D

Question 17 (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 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)	<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 type="checkbox"/> I	<input checked="" type="checkbox"/> J	<input type="checkbox"/> K	<input type="checkbox"/> L
B().f(2)	<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	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J	<input type="checkbox"/> K	<input type="checkbox"/> L
A().g(2)	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D	<input type="checkbox"/> E	<input type="checkbox"/> F	<input type="checkbox"/> G	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J	<input type="checkbox"/> K	<input type="checkbox"/> L
B().g(2)	<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	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J	<input type="checkbox"/> K	<input type="checkbox"/> L

Question 18 (Sorted, 4 %)

```
S = [{1, 2}, {3, 4}, {2}, {2, 3}, {1}, {2, 1}, {1, 1}]
S = { frozenset(s) for s in S }
S = sorted(S, key=sorted)
S = [ set(s) for s in S ]
print(S)
```

What does the above code print ?

Hvad udskriver ovenstående kode ?

- | | |
|--|---------------------------------------|
| [{1}, {2}, {1, 2}, {2, 3}, {3, 4}] | <input type="checkbox"/> A |
| [{1}, {1, 2}, {2}, {2, 3}, {3, 4}] | <input checked="" type="checkbox"/> B |
| [{1}, {1, 1}, {1, 2}, {2}, {2, 3}, {3, 4}] | <input type="checkbox"/> C |
| [{1}, {2}, {1, 1}, {1, 2}, {2, 3}, {3, 4}] | <input type="checkbox"/> D |
| [{1}, {1, 1}, {1, 2}, {1, 2}, {2}, {2, 3}, {3, 4}] | <input type="checkbox"/> E |
| [{1}, {2}, {1, 1}, {1, 2}, {1, 2}, {2, 3}, {3, 4}] | <input type="checkbox"/> F |

Question 19 (Decorator, 4 %)

```
def adjust(f):
    return lambda x: 1 + f(x - 1)

@adjust
def square(x):
    return x ** 2
```

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
square(1)	<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	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J	<input type="checkbox"/> K
square(2)	<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	<input type="checkbox"/> H	<input type="checkbox"/> I	<input type="checkbox"/> J	<input type="checkbox"/> K
square(3)	<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	<input type="checkbox"/> K

Question 20 (float, 4 %)

```
def f(alpha):
    apx = 1.0
    i = 1
    while True:
        if apx == apx + alpha ** i:
            break
        apx += alpha ** i
        i += 1
    return apx
```

f tries to approximate $\sum_{i=0}^{\infty} \alpha^i = \frac{1}{1-\alpha}$ for $|\alpha| < 1$.

What is the result of each of the below expressions ?

f forsøger at beregne en tilnærmelse til $\sum_{i=0}^{\infty} \alpha^i = \frac{1}{1-\alpha}$ for $|\alpha| < 1$.

Hvad er resultatet af hvert af nedenstående udtryk ?

	0.0	1.0	2.0	OverflowError	Infinite loop/ Uendelige løkke
$f(0.0)$	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E
$f(0.5)$	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E
$f(2.0)$	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D	<input type="checkbox"/> E

Question 21 (Exceptions, 4 %)

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

What does the above code print ?

Hvad udskriver ovenstående kode ?

ABC	ABCD	ABD	AC	ACD	AD
<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

Question 22 (zip, 4 %)

```
print(list(zip(*enumerate(['a', 'b', 'c']))))
```

What does the above code print ?

Hvad udskriver ovenstående kode ?

- `[((0, 'a'),), ((1, 'b'),), ((2, 'c'),)]` ☐ A
- `[('a', 'b', 'c'), (0, 1, 2)]` ☐ B
- `[(0, 1, 2), ('a', 'b', 'c')]` ☒ C
- `[(0, 'a'), (1, 'b'), (2, 'c')]` ☐ D
- `[('a', 0), ('b', 1), ('c', 2)]` ☐ E
- `[(0, 1, 2, 'a', 'b', 'c')]` ☐ F
- `[('a', 'b', 'c', 0, 1, 2)]` ☐ G

Question 23 (numpy, 4 %)

```
import numpy as np

a = np.array(range(4)).reshape((2, 2))
b = np.array(range(1, 3)).reshape((2, 1))

print(a @ b)
```

What does the above code print (newlines omitted) ?

Hvad udskriver ovenstående kode (linjeskift undladt) ?

- `[[4] [7]]` ☐ A
- `[4 7]` ☐ B
- `[[4 7]]` ☐ C
- `[[2] [8]]` ☒ D
- `[2 8]` ☐ E
- `[[2 8]]` ☐ F

Question 24 (Ordering, 4 %)

What is the result of each of the below expressions ?

Hvad er resultatet af hvert af nedenstående udtryk ?

	True	False	TypeError
$(3, 2) < (1, 4, 5)$	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C
<code>'coke' < 'pepsi'</code>	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C
<code>set('coke') < set('pepsi')</code>	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C
$\{1, 3\} < \{1, 2, 3\}$	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C
$\{1, 3\} < \{1, 2\}$	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C
$3 < 3.5$	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C
$3 < '3.5'$	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C

Question 25 (list, 4 %)

```
x = [0]
x[0] = x
x[0][0] = 1
print(x)
```

What does the above code print ?

Hvad udskriver ovenstående kode ?

[1]	[[1]]	[[...]]	[0, [1, [...]]]	[0, [1]]	IndexError
<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