

## i Forside

UNIVERSITY OF OSLO  
Faculty of mathematics and natural sciences

Mid-term exam IN1900

Date: October 7, 2020

Attachments: None

Permitted aids: None

- The exam set has 19 multiple choice questions. The maximum score is 25.
- All code in the question text is written in Python 3.
- Most of the questions have one correct answer. A correctly marked answer gives 1 point, wrong or missing answer gives 0 points. There are no negative points for wrong answers, so one should always mark an answer.
- Question 19 also has one correct answer, but here a correctly marked answer gives 2 points.
- Question 15, 17 and 18 have one or more correct answers. It is given 1 point for each correctly marked answer, -1 for incorrectly marked answers, and 0 for missing answers. The minimum score for each of these questions is 0. One should always mark at least one answer.
- Question 7 and 8 have 4 answers each. It is given 0.5 points for each correct answer and 0 points for wrong or unmarked answers, maximum 2 points total for each of the two questions.
- Since the maximum total score is 25, one can calculate that there must a total of six correct alternatives for questions 15, 17 and 18. This assumption is correct, but the number of correct alternatives for each of the three questions will not be revealed.

## 1 Hva skrives ut?

What is printed in the terminal window when this code is run?

```
x = 4  
y = 5  
z = x  
x = y + z
```

```
print(x, y, z)
```

Select one alternative:

- 9 5 4
- An error message.
- 4 5 4
- 9 5 9

---

Maximum marks: 1

## 2 Hva skrives ut?

What is printed in the terminal window when the following code is run?

```
a = []  
for i in range(11):  
    a.append(i*2)  
  
print(len(a), a[-1])
```

Select one alternative:

- 10 20
- An error message
- 10 0
- 11 20

---

Maximum marks: 1

## 3 Hva skrives ut?

What is printed in the terminal window when the following code is run?

```
s = 0  
for i in range(1,7,2):  
    s += i  
  
print(s)
```

Select one alternative:

- 16
- 9
- An error message
- 22

---

Maximum marks: 1

**4 Hva skrives ut?**

What is printed in the terminal window when the following code is run?

```
x = 4  
y = 2  
a = True  
b = (x > 4 and y <= 2)
```

```
print(a or b)
```

Select one alternative:

- True
- An error message
- True or False
- False

---

Maximum marks: 1

**5 Hva skrives ut?**

What is printed in the terminal window when the following code is run?

```
import numpy as np  
  
w = np.linspace(0,3,31)  
print(w[2:-2:4])
```

Select one alternative:

- [0.2 0.6 1.0 1.4 1.8 2.2 2.6]
- [0.2 0.6 1.0 1.4 1.8 2.2 2.6 3. ]
- [0.0 0.4 0.8 1.2 1.6 2.0]
- [0.1 0.5 0.9 1.3 1.7 2.1 2.5]

---

Maximum marks: 1

## 6 Hva skrives ut?

What is printed in the terminal window when the following code is run?

```
def odd_sum(n):
    s = 0
    for i in range(1,n,2):
        s += i
    return s

def test_odd_sum():
    expected = 1 + 3 + 5
    computed = odd_sum(5)
    msg = f'expected {expected}, got {computed}'
    assert expected == computed, msg
```

test\_odd\_sum()

Select one alternative:

- Ingenting skrives ut.
- Assertion error: expected 9, got 4
- NameError: name 'n' is not defined
- False, expected 9, got 4

Maximum marks: 1

## 7 Boolske uttrykk

Indicate for each of the boolean expression if it gives the result True, False, or if it will result in an error message. 0.5 points for each correct answer, maximum 2 points.

Please match the values:

	False	Gives an error	True
not (False or True)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
False or (False or True)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
True == True	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
False and (False or True)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Maximum marks: 2

## 8 Lister og boolske uttrykk

Assume that the following code is run:

```
def list_adder(a,b):  
    return [a_i + b_i for (a_i,b_i) in zip(a,b)]
```

```
x = [0,1,2]  
y = [3,4,5]  
c = list_adder(x,y)  
z = x + y
```

What are the values of the boolean expressions? 0.5 points for each correct answer, maximum 2 points.

Please match the values:

	True	False	Gives an error
<code>c == zip(x,y)</code>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<code>len(c) &lt; len(z)</code>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<code>c == z</code>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<code>c[0] == z[0]+z[len(c)]</code>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Maximum marks: 2

## 9 Exceptions

The following code is saved in a file named "barometric0.py":

```
import sys
from math import exp

try:
    h = float(sys.argv[1])
except IndexError:
    print("Missing input argument.")
    exit()
except ValueError:
    print("The argument is not a number.")
    exit()

p0 = 100
h0 = 8400

print(p0*exp(-h/h0))
```

What is printed in the terminal window if the code is run in the following way?

**Terminal> python barometric0.py 2469m**

**Select one alternative:**

- Value error: cannot convert 2469m to float.
- The argument is not a number.
- Missing input argument.
- Index error: list index out of range

---

Maximum marks: 1

## 10 Exceptions

The following code is saved in a file named "barometric1.py":

```
import sys
from math import exp

def barometric(h,p0=100,h0=8400):
    return p0*exp(-h/h0)

try:
    h_vals = [float(h) for h in sys.argv[1:]]
except IndexError:
    print("Incorrect number of input arguments.")
    exit()
except ValueError:
    print("The arguments are not numbers.")
    exit()

result = []
for h in h_vals:
    result.append((h,barometric(h)))

for h,p in result:
    print(f'{h:.0f} {p:.0f}', end = ' ')
```

The argument "end = ' '" to the print-function makes each print end with a space ( ' ') instead of of a linebreak.

What is printed in the terminal window if the code is run in the following way?

**Terminal> python barometric1.py 2469 8848**

**Select one alternative:**

- 2469 75 8848 35
- The arguments are not numbers.
- 2469 8848
- Incorrect number of input arguments.
- ValueError: cannot convert 2469 8848 to float.

---

Maximum marks: 1

**11 Finn feilen i koden**

In what line will this code stop and print an error message?

```
import numpy as np
```

```
x = np.linspace(0,2,21)
```

```
y = np.zeros(len(x))
```

```
f = lambda x: x**2 -4
```

```
for x_ in x:
```

```
    y.append(f(x_))
```

Select one alternative:

- for x\_ in x:
- y.append(f(x\_))
- f = lambda x: x\*\*2 - 4
- y = np.zeros(len(x))

---

Maximum marks: 1



12 **Hvilket funksjonskall?**

The function `bisection(f,a,b,tol)` implements the bisection method to find a solution of the equation  $f(x) = 0$  in the interval  $[a,b]$ :

```
def bisection(f,a,b,tol= 1e-3):
    if f(a)*f(b) > 0:
        print(f'No roots or more than one root in [{a},{b}]')
        return
    m = (a+b)/2
    while abs(f(m)) > tol:
        if f(a)*f(m) < 0:
            b=m
        else:
            a=m
        m = (a+b)/2
    return m
```

We want to use the function to find a solution of the equation

$$x^3 - 4x - 3 = 0$$

in the interval  $2 < x < 3$ .

Which function call is correct?

**Select one alternative:**

- `sol = bisection(f = x**3-4*x-3,2,3)`
- `sol = bisection(lambda x: x**3-4*x-3,2,3)`
- `sol = bisection(f(x) = x**3-4*x-3,2,3)`
- `sol = bisection(x**3-4*x-3,2,3)`

---

Maximum marks: 1

**13 Hvilken linje mangler?**

The function `distance(p1, p2)` calculates the distance between two points `p1` and `p2`. Which line is missing for the code below to run without errors?

```
from math import sqrt
```

```
def distance(p1, p2):  
    ## Missing line goes here ##  
    return sqrt((x2-x1)**2 + (y2-y1)**2)
```

```
def test_distance():  
    p1 = (0,0)  
    p2 = (4,3)  
    expected = 5  
    computed = distance(p1,p2)  
    assert expected == computed
```

```
test_distance()
```

Which line is missing?

**Select one alternative:**

- `x1,y1 = p1; x2,y2 = p2`
- `x, y = p1, p2`
- `x1 = p1; x2 = p2`
- `x = (p1[0], p2[0]); y = (p1[1],p2[1])`

---

Maximum marks: 1

**14 Hvilken linje mangler?**

Which line is missing in the function `count(dna,base)` for the code below to run without errors?

```
def count(dna, base):  
    i = 0 # counter  
    ## missing line goes here##  
    if dna[j] == base:  
        i += 1  
    return i  
  
def test_count():  
    dna = 'ATTTGCGGTCCAAA'  
    expected = 4  
    success = count(dna, 'A') == expected  
    msg = 'count returns the wrong number'  
    assert success, msg
```

`test_count()`

Which line is missing?

**Select one alternative:**

- for i in range(len(dna)):
- for j in range(len(dna)):
- for base in dna:
- for j in dna:

---

Maximum marks: 1

15 **Hvilken linje mangler?**

The function below returns the value of the mathematical expression  $v_0 t - (1/2)gt^2$ , as well as the derivative of the expression.

```
def yfunc(t, v0=5, g=9.81):  
    y = v0*t - 0.5*g*t**2  
    dydt = v0 - g*t  
    return y, dydt
```

We want to plot the function with t in the interval from 0 to 10, v0 = 10 and g = 9.81. Which line is missing to make the code below work?

```
import numpy as np  
import matplotlib.pyplot as plt
```

```
t = np.linspace(0,10,101)
```

```
##Missing line goes here ##
```

```
plt.plot(t,y)  
plt.show()
```

Which line must be inserted? One or more of the alternatives can be correct.

**Select one or more alternatives:**

- y = yfunc(t, v0 = 10)
- y, dydt = yfunc(t)
- y, dy = yfunc(t,10)
- y = yfunc(t,v0=10,g=9.81)

---

Maximum marks: 1

**16 Hva skrives ut?**

What is printed in the terminal when the following code is run?

```
for i in range(2,5):  
    print(i,end=' '  
    for j in range(i-1):  
        print(j,end=' ')
```

The argument "end = ' '" to the print function makes each print end with a space ( ' ') instead of a linebreak.

**Select one alternative:**

- 2 0 3 0 1 4 0 1 2
- 2 3 4 2 3 4
- 2 0 1 3 0 1 2 4 0 1 2 3
- 1 0 2 0 1 3 0 1 2

---

Maximum marks: 1

## 17 Beregning av sum

We want to compute the sum

$$\sum_{k=0}^N \frac{x^k}{k!}$$

for  $N = 4$  and  $x = 0.5$ .

Here are some alternative codes to compute the sum. Which alternatives are correct? You can assume that the following three lines have been run before each alternative:

```
from math import factorial
```

```
N = 4
```

```
x = 0.5
```

**Alternative A:**

```
s = sum([x**k/factorial(k) for k in range(N+1)])
```

**Alternative B:**

```
s = 0
```

```
for k in range(N):
```

```
    term = x**k/factorial(k)
```

```
    s = s + term
```

**Alternative C:**

```
s = 0; i = 0
```

```
while i <= N:
```

```
    s += x**i/factorial(i)
```

```
    i += 1
```

**Alternative D:**

```
s = 0
```

```
for k in range(N+1):
```

```
    s += x**k/factorial(k)
```

Which alternatives are correct?

**Select one or more alternatives:**

- Alternative D is correct.
- Alternative A is correct.
- Alternative C is correct.
- Alternative B is correct.

---

Maximum marks: 3

## 18 Hvilken funksjon?

We want to implement a function that takes a list as input and returns the largest element in the list. The elements in the list are numbers, which can be positive or negative, and we want to be able to use the function in the following way:

```
>>> print(my_max([1,4,5,-1]))
```

```
5
```

```
>>> print(my_max([-1,-2,-5]))
```

Which implementations of the function `my_max(a)` are correct?

**Alternativ A:**

```
def my_max(a):
    max_found = a[0]
    for i in range(1,len(a)):
        if a[i] > max_found:
            max_found = a[i]
    return max_found
```

**Alternativ B:**

```
def my_max(a):
    max_found = 0
    for e in a:
        if e > max_found:
            max_found = e
    return max_found
```

**Alternativ C:**

```
def my_max(a):
    max_found = a[0]
    i = 0
    while i < len(a):
        if a[i] >= max_found:
            max_found = a[i]
        i += 1
    return max_found
```

**Alternativ D:**

```
def my_max(a):
    for i in range(1,len(a)):
        if a[i] > a[i-1]:
            max_found = a[i]
        else:
            max_found = a[i-1]
    return max_found
```

Select one or more alternatives:

- Alternativ C er riktig
- Alternativ D er riktig
- Alternativ A er riktig
- Alternativ B er riktig

---

Maximum marks: 2

19 **Hva skrives ut?**

What is printed in the terminal when the following code is run? Two points for the correct answer.

```
def freq_lists(dna_list):
    n = len(dna_list[0])
    A = [0]*n
    T = [0]*n
    G = [0]*n
    C = [0]*n
    for dna in dna_list:
        index = 0
        for base in dna:
            if base == 'A':
                A[index] += 1
            elif base == 'C':
                C[index] += 1
            elif base == 'G':
                G[index] += 1
            elif base == 'T':
                T[index] += 1
            index += 1
    return A, C, G, T
```

```
dna_list = ['TCGCT', 'GGACT', 'GCTGC']
```

```
A, C, G, T = freq_lists(dna_list)
print(G)
```

Hint: a string variable behaves almost approximately like a list when used in a for loop. For instance, the loop

```
for c in "IN1900":
```

```
    print(c,end= ' ')
```

will print the following:

```
I N 1 9 0 0
```

What is printed by the code above?

**Select one alternative:**

- [0,1,2,1,0]
- ['G', 'G', 'G', 'G', 0]
- ['T', 'C', 'G', 'T']
- [2,1,1,1,0]

---

Maximum marks: 2