# UNIVERSITETET I OSLO

## Det matematisk-naturvitenskapelige fakultet

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| Examination in: | INF1100 — Introduction to programming with scientific applications |
| Day of examination: | Tuesday, October 12, 2010 |
| Examination hours: | 15.00 – 19.00. |
| This examination set consists of 5 pages. | |
| Appendices: | None. |
| Permitted aids: | None. |

Make sure that your copy of the examination set is complete before you start solving the problems.

- Read through the complete exercise set before you start solving the individual exercises. If you miss information in an exercise, you can provide your own reasonable assumptions as long as you explain that in detail.
- The maximum possible score on the exam is 25 points. The maximum number of points is listed for each exercise (a correct answer of a subquestion ((a), (b), etc.) gives 1 point).

### Exercise 1 (10 points)

What will be the output of the `print` statement in the programs below?

(a)

```
q = 3.141
print '%.1f' % q
```

(b)

```
for i in range(2, 6, 2):
    print i-1
```

*(Continued on page 2.)*

(c)

```
a = 4
b = 10/a + 1
print b
```

(d)

```
A = [14] + [16, 18] + [25, 40]
del A[1]
print A
```

(e)

```
A = [-1, 9, 2, 5, 19, 21, 33]
print A[4:-1]
```

(f)

```
values = []
value = 0
stop = 1
incr = 0.2
while value <= stop:
    values.append(value)
    value += incr
for v in values:
    print v
```

(g)

```
print [0.2*i for i in range(6)]
```

(h)

```
def f(x):
    return a*x**2

x = 3; a = -2
print '%g' % f(x + a)
```

(i)

```
for i in range(2, 5):
    for j in range(i-1, i+3):
        if i != j:
            print i, j+1
```

*(Continued on page 3.)*

(j)

```
def branch(argument):
    r = 0
    if argument == -1:
        r = -1
    elif argument == 3:
        r = 3
    elif argument > 3:
        r = -2
    else:
        r = 10
    return r

print branch(6)
```

## Exercise 2 (2 points)

What is wrong with the programs below?

(a)

```
a = 9.1
b = raw_input('Give b: ')
print a*b
```

(b)

```
1plus1 = 1 + 1
print 1plus1
```

## Exercise 3 (1 point)

The following program aims to sum the integers $1, 2, \ldots, n$: $\sum_{i=1}^{n} i$. Explain if the result `s` is correct or not.

```
import sys
n = int(sys.argv[1])
s = 0                        # sum of integers
for i in range(1, n, 1):
    s += i
print s
```

*(Continued on page 4.)*

## Exercise 4 (4 points)

A function $p(x)$ is given as

$$p(x) = Ae^{-ax}\sin(wx),$$

with $A > 0$ and $a \geq 0$. Make a program that prints out a table of $x$ and $p(x)$ values. Let the $x$ coordinates in the table be uniformly distributed in $[0, 5/a]$. Read the number of $x$ coordinates in the table, $A$, $a$, and $w$ from the command line. Use exception handling to ensure that the user provides enough command-line arguments and that the values are legal.

## Exercise 5 (1 point)

Extend the program from Exercise 4 with statements for plotting the $p(x)$ function. (You may use the same coordinates as in the table.)

## Exercise 6 (4 points)

An arbitrary triangle can be described by the coordinates of its three vertices: $(x_1, y_1)$, $(x_2, y_2)$, $(x_3, y_3)$. The area of the triangle is given by the formula

$$A = \frac{1}{2}\left|x_2y_3 - x_3y_2 - x_1y_3 + x_3y_1 + x_1y_2 - x_2y_1\right|,$$

while the circumference ("omkrets" på norsk) is computed as

$$\begin{aligned} C &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} + \sqrt{(x_3 - x_2)^2 + (y_3 - y_2)^2} + \\ &\quad \sqrt{(x_1 - x_3)^2 + (y_1 - y_3)^2}\,. \end{aligned}$$

Write a function `triangle(corners)` that returns the area $A$ and the circumference $C$ of a triangle whose vertices are specified by the argument `corners`, which is a nested list of the vertex coordinates. For example, `corners` can be `[[0,0], [1,0], [0,2]]` if the three corners of the triangle have coordinates $(0, 0)$, $(1, 0)$, and $(0, 2)$. Demonstrate how to call the `triangle` function to compute the area and the circumference of the triangle with vertices $(-3, 0)$, $(3, 0)$, and $(0, 4)$.

## Exercise 7 (3 points)

Make a function for solving the system of difference equations

$$\begin{aligned} s_j &= s_{j-1} + a_{j-1}, && (1)\\ a_j &= -x^2\left((2j+1)2j\right)^{-1} a_{j-1}, && (2) \end{aligned}$$

*(Continued on page 5.)*

with initial conditions $s_0 = 0$ and $a_0 = x$. In the function, store only the newest two $s_j$ and $a_j$ values (i.e., do not store all the $s_j$ and $a_j$ values in arrays). The function should take two arguments, $x$ and $N$, and return the two values $s_N$ and $|a_N|$. Write a main program that prints out the value of $s_{20}$ for $x = \pi$.

END