

Exam

Advanced R programming (732A50)

Time: 8-12, 2015-10-14
Material: The extra material is included in the zip-file **exam_material.zip**.
Grades: A = 19-20 points.
B = 17-18 points.
C = 12-16 points.
D = 10-11 points.
E = 8-9 points.
F = 0-7 points.

Instructions

Write your code in an R script file named **Main.R**. The R code should be complete and readable code, possible to run by copying directly into a script. Comment directly in the code whenever something needs to be explained or discussed. Follow the instructions carefully.

Problem 1 (5 p)

a) Create the following mathematical function as a function in R (called **f**)

$$f(\mathbf{x}) = \frac{\sum_i^n |x_i - \bar{x}|}{n}$$

where \bar{x} is $\frac{1}{n} \sum_i x_i$ and n is the length of the vector \mathbf{x} . You are not allowed to use any vectorized functions such as **sum()** or **mean()**.

```
f(1:5)
[1] 1.2

f(c(7,2,2,1,-4))
[1] 2.48
```

b) What is the computational complexity of this algorithm based on the input length?

c) Visualize the value of $f(\mathbf{x})$ as \mathbf{x} is growing by drawing 1,2,3,...,200 draws from a $\mathcal{N}(0,1)$ distribution and visualize the value of $f(\mathbf{x})$ using a linegraph in **ggplot2**.

Problem 2 (5 p)

a) Create a function you call `hilbert(n,m)` that creates a Hilbert matrix. The element (i, j) of the Hilbert matrix is defined as follows

$$H_{ij} = \frac{1}{i + j - 1}$$

where i is the row and j is the column in the matrix. The size of the matrix should be $n \times m$.

```
hilbert(1,4)
```

```
      [,1] [,2]      [,3] [,4]
[1,]      1  0.5 0.333333 0.25
```

```
hilbert(2,2)
```

```
      [,1] [,2]
[1,]  1.0 0.500000
[2,]  0.5 0.333333
```

b) Calculate $\det(\mathbf{H}^T \mathbf{H})$ where \mathbf{H} is a 5×5 Hilbert matrix.

c) Create a test suite for this function (using `testthat`) that checks that (1) the result of the function is a matrix and (2) that one of the examples above will be returned using the function.

Problem 3 (5 p)

a) Create a function you call `my_tidy_titanic_data()` that should return a tidy dataset from the Titanic dataset in R. You should use `tidyr` and `dplyr` in the function.

The `Titanic` dataset is a three dimensional table, below is how you should convert it to a `data.frame` (and then make it tidy).

```
# Load and convert the titanic dataset
data("Titanic")
x <- as.data.frame(as.matrix(ftable(Titanic)))
# The resulting function
head(my_tidy_titanic_data())
```

	class	sex	age	survived	counts
1	1st	Male	Child	No	0
2	1st	Male	Adult	No	118
3	1st	Female	Child	No	0
4	1st	Female	Adult	No	4
5	2nd	Male	Child	No	0
6	2nd	Male	Adult	No	154

b) Create a new function you call `aggregate_away_sex(x)` that takes a tidy titanic dataset as variable `x` and returns a dataset where the variable `sex` has been aggregated together in each group. See the example below. You should use `dplyr` functions.

```
tita<- my_tidy_titanic_data()
head(aggregate_away_sex(tita))
```

	class	age	survived	counts
1	1st Adult		No	122
2	1st Adult		Yes	197
3	1st Child		No	0
4	1st Child		Yes	6
5	2nd Adult		No	167
6	2nd Adult		Yes	94

Problem 4 (5 p)

a) Create a function you call `counter_factory()` that generates counter functions/clojures. The factory function should take two arguments, `start` and `max`. The `start` argument should set the starting value of the counter and `max` should be the maximum value of the counter (so when called afterwards, the maximum value will be return each time).

```
cnt <- counter_factory(start = 2, max = 4)
cnt()

[1] 3

cnt()

[1] 4

cnt()

[1] 4
```

b) Make the counter a counter object and implement a `summary()` method that returns the current value of the counter and the `max` value of the counter. You can choose to use either a S3 or RC type classes.

```
cnt <- counter_factory(start = 2, max = 4)
summary(cnt())

Count object
i: 3
max: 4

summary(cnt())
```

```
Count object  
i: 4  
max: 4
```

c) Document the function using roxygen type documentation. The documentation should include a title, a short description, the input arguments and the return value of the function.

Good luck!