Worksheet 1

MSc/ICY Software Workshop

Non-Assessed Exercise. Hand in: Thursday 6 October 2016 2pm.
Follow the submission guidelines on
`https://birmingham.instructure.com/files/3232090`.

Exercise 1: (Basic)   The area A of the circle is computed by $\pi \cdot r^2$. Write a `Java`-program that makes this computation, initialize the variable r to 5 and print the result. Which types do you use for the variables A and r? (Hint: Use `Math.PI` and compute r^2 as $r * r$.)

Exercise 2: (Basic)

(a) Write a `Java`-program that converts masses given in the imperial system into kilograms. Make use of the following conversions:

1 ton	2240 pounds
1 hundredweight	112 pounds
1 quarter	28 pounds
1 stone	14 pounds
1 ounce	1/16 pounds
1 drachm	1/256 pounds
1 grain	1/7000 pounds
1 pound	0.45359237 kilograms

(b) A person's weight corresponds to 11 stones and 6 pounds. Concretely the weight is stored by the two variables `stones = 11;` and `pounds = 6;` (all other variables such as `tons` are 0). Use your program to determine how many kilograms this is.

Exercise 3: (Medium)   A capital of £ 100 is invested at a fixed interest rate of 2.3 per cent. The interest is added to the capital at the end of each year. Use the formula

$$\texttt{total} = \texttt{capital} * (1 + 0.01 * \texttt{interest\_rate})^{\texttt{years}}$$

to print the balance after each of the first 5 years and after 500 years.

Exercise 4: (Advanced) In the following `e1` and `d1` represent the fraction $\frac{e_1}{d_1}$ and correspondingly `e2` and `d2` the fraction $\frac{e_2}{d_2}$, where `e1` and `e2` are integers and `d1` and `d2` positive integers. Write a `Java` program which computes numbers `es`, `ds` and `ep`, `dp`, which stand for the sum and the product of the two fractions, respectively. (E.g., $\frac{1}{2} + \frac{1}{3} = \frac{5}{6}$, and $\frac{1}{2} * \frac{1}{3} = \frac{1}{6}$.)

Note that addition and multiplication on fractions are defined by:

$$\frac{e_1}{d_1} + \frac{e_2}{d_2} = \frac{e_1 * d_2 + e_2 * d_1}{d_1 * d_2} \qquad \frac{e_1}{d_1} * \frac{e_2}{d_2} = \frac{e_1 * e_2}{d_1 * d_2}$$

Test your program for $\frac{1}{2} + \frac{1}{3}$, $\frac{1}{3} + \frac{3}{4}$, $\frac{1}{2} * \frac{2}{3}$, and $\frac{1}{4} * \frac{2}{3}$.

Exercise 5: (Advanced)

The time is 11:49. We represent the time by two variables `hours` and `minutes`, that is, `hours = 11;` and `minutes = 49;`. Write a `Java` program that computes the angle between the hour hand and the minute hand on a traditional analogue clock. Angles should be measured counterclockwise from hour to minute hand. The result should be rounded and normalized so that it is between 0 and 359 (inclusively). For instance the angles at 3:00 and 9:00 hours should be 90° and 270°, respectively:

(Hint: 1 minute $\simeq$ 6°, 1 hour $\simeq$ 30°. Start from 12 o'clock.)

Note that your program must be able to compute the output for arbitrary inputs, in which hours may take values from 0 through 24 and minutes from 0 to 60. Furthermore, note that the hour hand moves also when the minute hand moves, e.g., at 0:20 the hour hand will have moved by 10°. Do not forget to write comments which explain why your program is correct.

Test your program for the following times: 9:00, 3:00, 18:00, 1:00, 2:30, and 4:41 (with results 270°, 90°, 180°, 30°, 255°, and 254°, respectively).