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Worksheet 1

MSc/ICY Software Workshop

Non-Assessed Exercise. Hand in: Thursday 5 October 2017 2pm.
Follow the submission guidelines on
`https://birmingham.instructure.com/files/3232090`.

Exercise 1: (Basic, 30%) 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, 20%)

(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, 20%) 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, 10%) 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, 10%)
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. Use only concepts introduced in the lecture so far (that is, no loops and no conditionals).
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 255°, respectively).