

CS 2500, Spring 2014
Problem Set 1

Due date: 5:00pm, Tuesday January 14, 2013

Programming Language: BSL

Purpose: The purpose of this problem set is to remind you of the pattern-matching skills that your elementary-school teachers tried to teach you and to get you to “play” with BSL and DrRacket.

Finger Exercises: Run a program from the HtDP/2e Prologue. Modify it and watch how its behaviors changes. HtDP/2e: exercises 1, 2, 3, 5, 8, 9, 10.

This is the only problem set to be handed in on paper. Solutions must be submitted to Prof. Razzaq’s office, 310B WVH, before 5PM. You may put it under the door if she is not in.

Problem 1. A boy gets retained by a neighborhood association to mow the grass and trim hedges, collect dues, and do miscellaneous chores. Just to make sure he is around when needed, he gets 50 dollars a month (he doesn't have to work for that). For every hour he works, he gets \$9.75.

How much does he get if he works 5 hours? 10 hours? 25 hours? per month.

Make a table that shows the results. Use the Interactions area in DrRacket as a calculator.

Write a formula for calculating how much the boy earns if he works H hours.

Using your formula, find out how much the boy earns when a major event forces him to work for 100, 122, and 135 hours in a single month.

Problem 2. A typical exercise in an algebra book asks the reader to evaluate an expression like

$$\frac{n}{3} + 2$$

for $n = 2$, $n = 5$, and $n = 9$. Using Racket, we can formulate such an expression as a program and use the program as many times as necessary. Here is the program that corresponds to the above expression:

```
(define (f n)
  (+ (/ n 3) 2))
```

You can determine the result of the expression at $n = 2$, $n = 5$, and $n = 9$ in DrRacket by typing in the interaction window:

```
(f 2)
(f 5)
(f 9)
```

Formulate the following three expressions as programs in Racket:

- a) $100/n - 35$
- b) $(n^2 + 300) / (13n)$
- c) $(1/n) * (5/n)$

Determine their results for $n = 5$ and $n = 12$ with DrRacket.

Problem 3. A clothing store is having a sale on its products. Customers will get 20% off of the most expensive item, 30% off of the second most expensive item and 50% off of the third most expensive item. No other discounts will be applied. The store needs a program that can compute the value of the discount applied to each customer. Define the program `total-discount`. It consumes three numbers: the price of the most expensive item, the price of the second most expensive item (or zero if only one item is bought) and the price of the third most expensive item (or zero if only one or two items are bought) in that order. It produces the value of the discount.

Problem 4. Define the program `meters->miles` that converts meters/second to miles/hour. The function consumes a velocity in meters/second and produces the velocity in miles/hour. Look up the conversion factor to convert from meters/second to miles/hour.

Problem 5. Develop a function called `distance-traveled`. The function consumes an initial velocity, v_0 , a final velocity, v_t , (velocity units are ft/sec) and time, t , (in seconds). The function produces the distance traveled in feet at time t .

Some background information: we assume a constant acceleration. Acceleration, a , is calculated by finding the change in velocity divided by the time elapsed. Distance traveled, x , is found by:

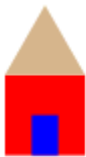
$$x = v_0t + \frac{1}{2}at^2$$

You should develop a helper function called `acceleration` which calculates a constant acceleration given an initial velocity, a final velocity and time elapsed.

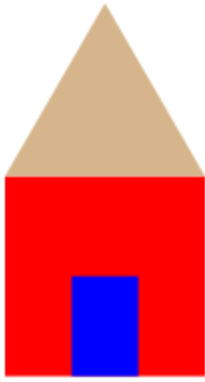
Problem 6. Define the program `draw-house` which draws a house from a triangle, square and rectangle. The function consumes one number and draws the shapes and places them using values derived from this one number.

For instance,

`(draw-house 40)` produces the image:



And `(draw-house 100)` produces the image:



Use the DrRacket help desk to find functions (available in the 2htdp/image library) that you might consider using for this problem such as `triangle`, `above`, `overlay/xy`...