CS 596 Functional Programming and Design
Fall Semester, 2014
Doc 12 Example, Assignment 3
Oct 14, 2014

Battleship Example

The Problem

Context - Writing a battleship game

Need a function that determines

- Is an enemy ship within range of our ships weapon
- But weapon has a blast area so cannot use weapon if
  - Enemy ship is to close to us or other friendly ships

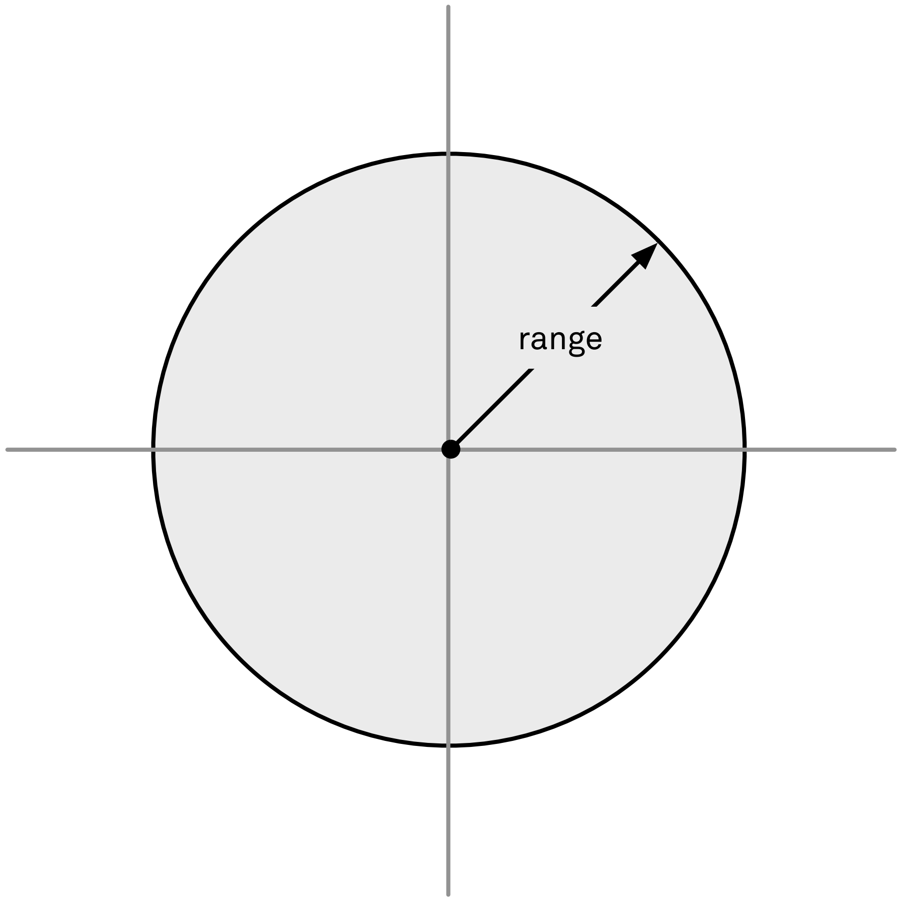
First Pass

Assume we are at origin

Given a point & range

Is point within range

Point - [x y]

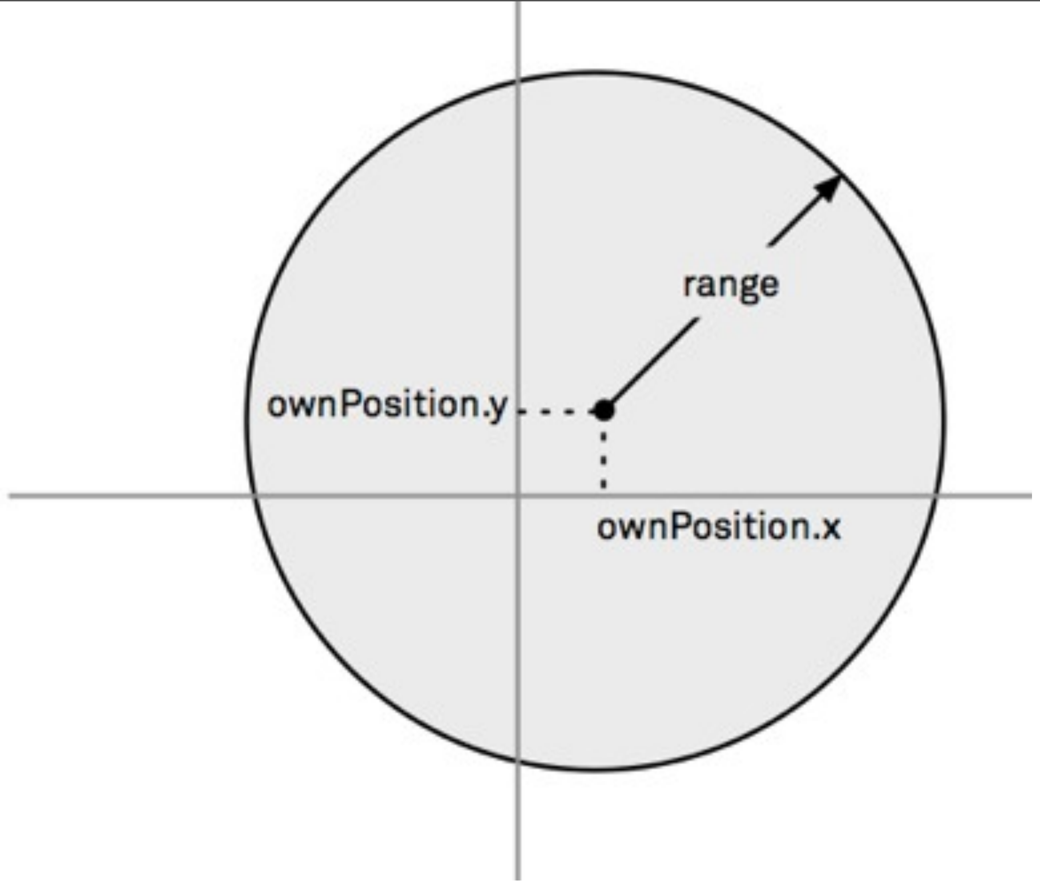


```
(defn in-range-1
  [position range]
  (let [pos-x (first position)
        pos-y (last position)
        target-distance (Math/sqrt (+ (* pos-x pos-x) (* pos-y pos-y)))]
    (< target-distance range)))
```

```
(in-range-1 [1 1] 1)          false

(in-range-1 [1 1] 2)          true
```

Second Pass

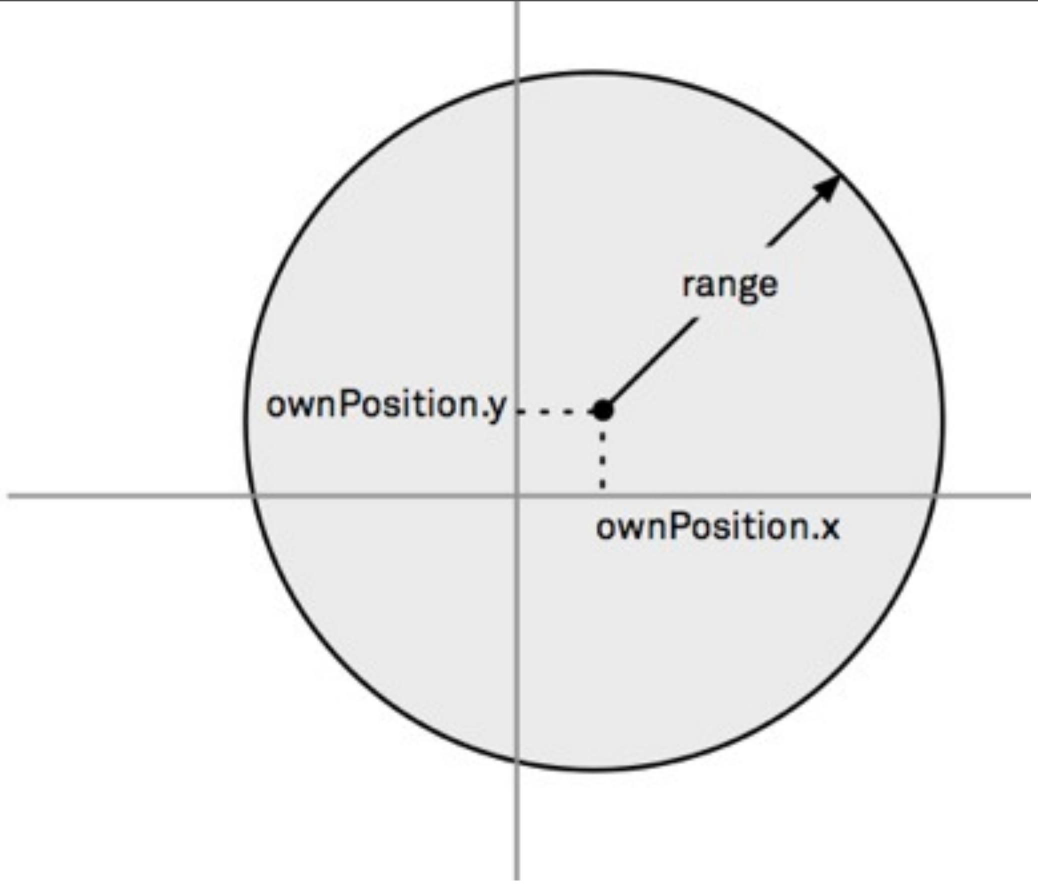


Let our position be any location

```
(defn in-range-2
  [position own-position range]
  (let [pos-x (first position)
        pos-y (last position)
        own-x (first own-position)
        own-y (last own-position)
        dx (- pos-x own-x)
        dy (- pos-y own-y)
        target-distance (Math/sqrt (+ (* dx dx) (* dy dy)))]
    (< target-distance range)))
```

This is a Java program using Clojure syntax

Second Pass - a

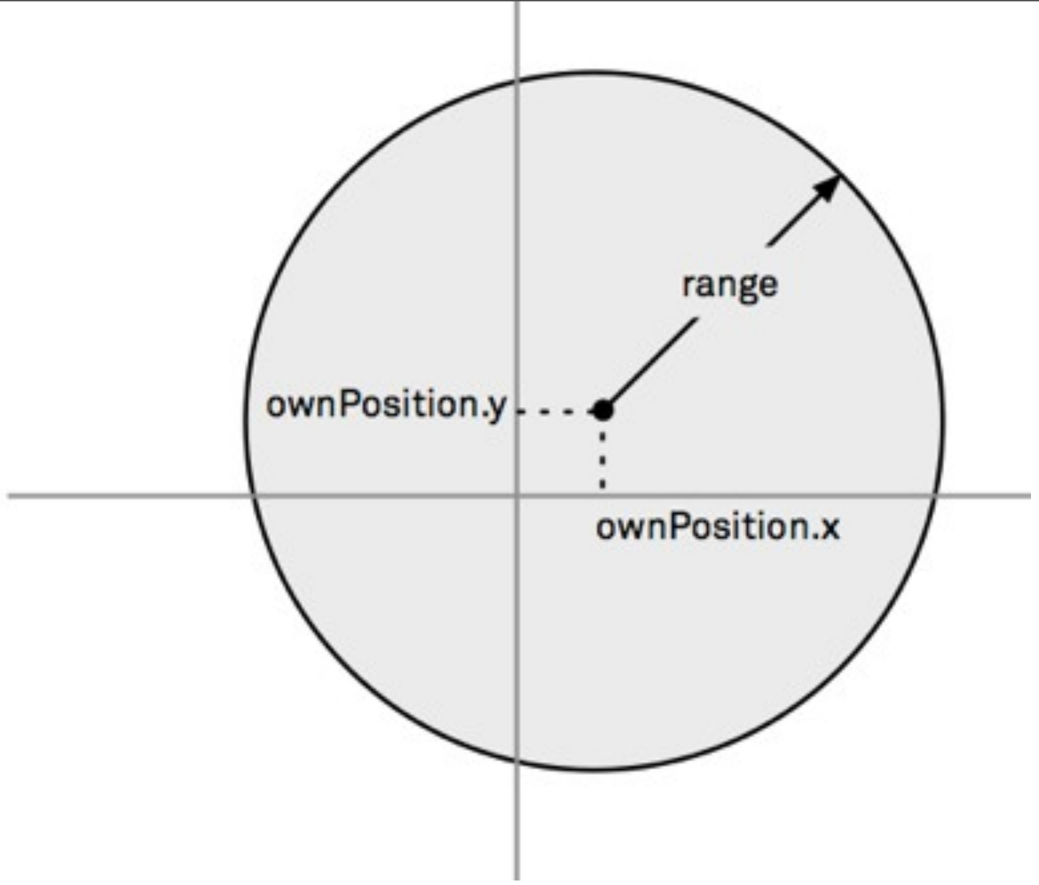


Using destructuring

What do we gain? lose?

```
(defn in-range-2a
  [[pos-x pos-y] [own-pos-x own-pos-y] range]
  (let [dx (- own-pos-x pos-x)
        dy (- own-pos-y pos-y)
        target-distance (Math/sqrt (+ (* dx dx) (* dy dy)))]
    (< target-distance range)))
```

Second Pass - b

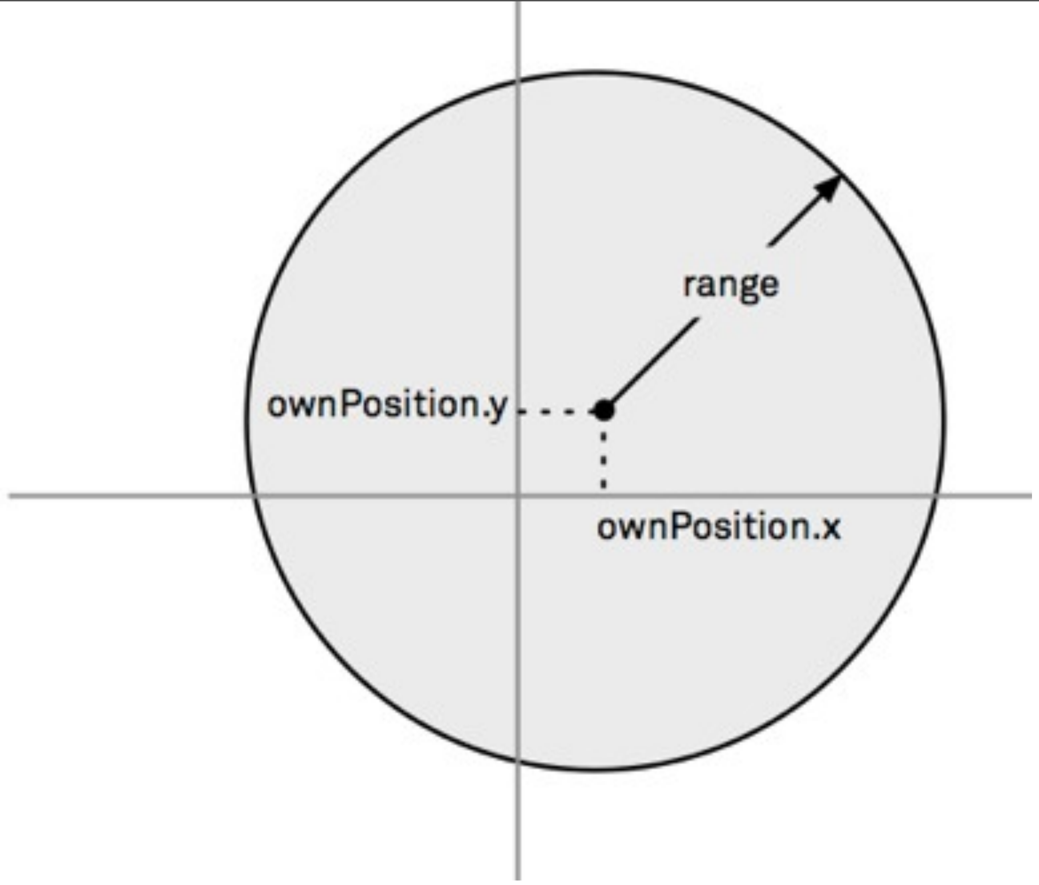


With map

What do we gain? lose?

```
(defn in-range-2b
  [position own-position range]
  (let [[dx dy] (map - position own-position)
        target-distance (Math/sqrt (+ (* dx dx) (* dy dy)))]
    (< target-distance range)))
```

Second Pass - c

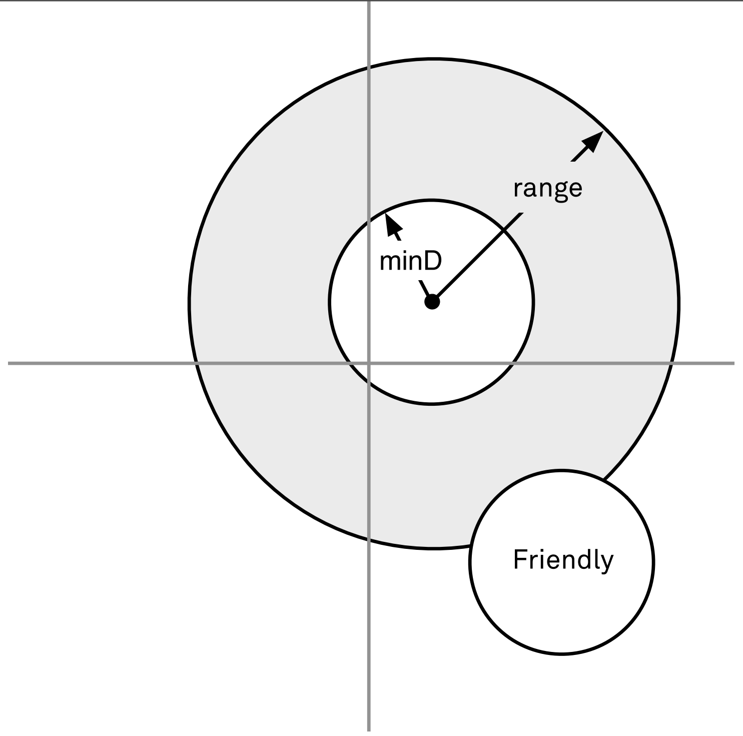


Using map & reduce

What do we gain? lose?

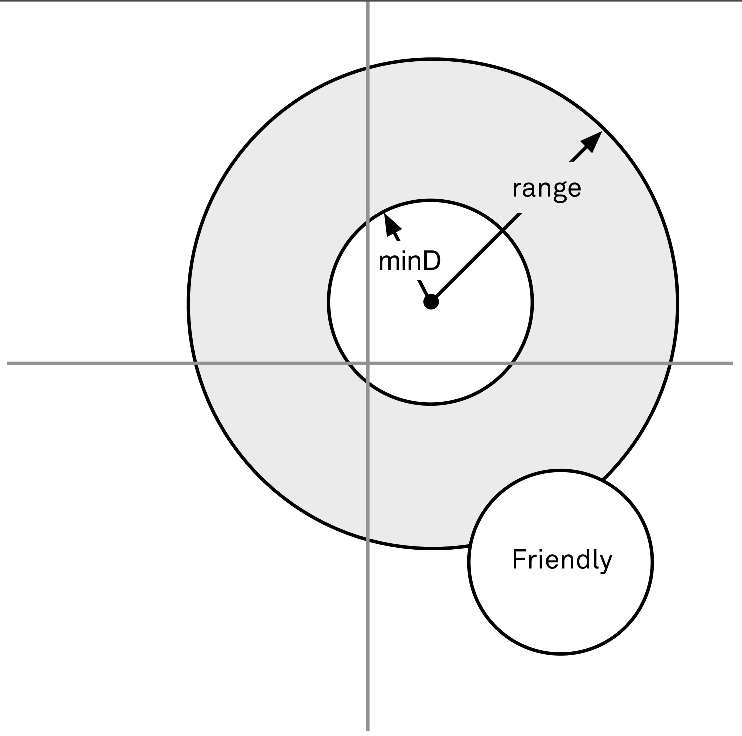
```
(defn in-range-2c
  [position own-position range]
  (let [delta (map - position own-position)
        target-distance (Math/sqrt (reduce + (map * delta delta)))]
    (< target-distance range)))
```

Third Pass



```
(defn in-range-3
  [safe-distance range own-position position friend-position]
  (let [delta (map - position own-position)
        target-distance  (Math/sqrt (reduce + (map * delta delta)))
        friend-delta (map - position friend-position)
        target->friend  (Math/sqrt (reduce + (map * friend-delta friend-delta)))]
    (and
     (< safe-distance target->friend)
     (< safe-distance target-distance  range))))
```

Third Pass



```
(defn distance-between
  [a b]
  (let [delta (map - a b)]
    (Math/sqrt (reduce + (map * delta delta)))))


(defn in-range-3a
  [safe-distance range self target friend]
  (and
     (< safe-distance (distance-between friend target))
     (< safe-distance (distance-between self target)  range)))


(def in-torpedo-range (partial in-range-3a 1.5 20))
(def in-cannon-range (partial in-range-3a 3 500))
```

What is the Abstraction?

What are we doing?

Dealing with circles shapes

Union
Intersection
Complement

Is a point in a shape

circle - returns a function

```
(defn circle
  ([radius]
   (circle [0 0] radius))
  ([center radius]
  (fn
    [point]
    (<= (distance-between center point) radius))))


(def small-circle (circle 1))

(small-circle [0.5 0])          true
(small-circle [1 2])            false
```

outside

```
(defn outside
  [shape]
  (complement shape))



(def small-circle (circle 1))

((outside small-circle) [0.5 0])              false
((outside small-circle) [1 2])                true
```

union

```
(defn union
  ([shape]
   shape)
  ([shape-a shape-b]
  (fn [point]
    (or (shape-a point) (shape-b point))))
  ([shape-a shape-b & shapes]
   (fn [point]
     (let [all-shapes (conj shapes shape-a shape-b)]
       (reduce #(or %1 (%2 point)) false all-shapes)))))
```

Higher Level in range

```
(defn in-range-4
  [safe-distance range self target friend]
  (let [self-safe-zone (outside (circle self safe-distance))
        friend-safe-zone (outside (circle friend safe-distance))
        weapon-area (circle self range)
        target-zone (intersection weapon-area friend-safe-zone self-safe-zone)]
   (target-zone target)))
```

Assignment 3

```
(def sdsu-roman-numeral
  (partial clojure.pprint/cl-format nil "~@R"))
```

```
(defn sdsu-rotate [n lst]
  (if (neg? n)
    (sdsu-rotate-helper (* n -1) (reverse lst) true)
    (sdsu-rotate-helper n lst false)))

(defn sdsu-rotate-helper [n lst rev]
  (if (list? lst)
    (sdsu-rotate-helper n (vec lst) rev)
    (if (zero? n)
      (if rev
        (vec (reverse lst))
        lst)
      (sdsu-rotate-helper (dec n) (conj (subvec lst 1) (first lst)) rev))))
```

```
(require '[clojure.set :refer [union]])

(defn sdsu-sum [num01 num02 maxMultiple]
  (reduce + (union (set (multiplesOfXUnderMax num01 maxMultiple))
            (set (multiplesOfXUnderMax num02 maxMultiple)))))

(defn multiples [resultMultiples n currMultiple maxMultiple]
  (let [currResult (* n currMultiple)]
    (if (or (>= currResult maxMultiple) (< currResult 0) (>= currMultiple maxMultiple))
      resultMultiples
      (multiples (cons currResult resultMultiples) n (inc currMultiple) maxMultiple))))

(defn multiplesOfXUnderMax [x maxMultiple]
  (if (or (< x 0) (< maxMultiple x))
    (list 0)
    (multiples (list x) x x maxMultiple)))
```

```
(defn find-hundreds-place [number]
  (cond
    (= (first number) \1) "C"
    (= (first number) \2) "CC"
    (= (first number) \3) "CCC"
    (= (first number) \4) "CD"
    (= (first number) \5) "D"
    (= (first number) \6) "DC"
    (= (first number) \7) "DCC"
    (= (first number) \8) "DCCC"
    (= (first number) \9) "CM"))
```

```
(defn find-hundreds-place [number]
  (condp = (first number)
    \1 "C"
    \2 "CC"
    \3 "CCC"
    \4 "CD"
    \5 "D"
    \6 "DC"
    \7 "DCC"
    \8 "DCCC"
    \9 "CM"))
```

```
(def replace-chars

  {\A :A, \B :B, \C :C, \D :D, \E :E, \F :F, \G :G, \H :H \I :I, \J :J, \K :K,, \L :L, \M :M,
   \N :N, \O :O, \P :P, \Q :Q, \R :R, \S :S, \T :T, \U :U, \V :V, \W :W, \X :X, \Y :Y, \Z :Z,
   \! :!, \@ :@, \# :#, \$ :$, \% :%, \^ :^, \& :&, \* :*, \- :-, \_ :_, \+ :+, \= :=, \. :.,
   \< :<, \> :>, \? :?, \\ :\, \" :", \' :',\/ :/, \` :`, \~ :~,
   }

 )



(defn sdsu-dna-count [dna]



(let [str-dna (replace replace-chars dna)]
 (frequencies str-dna)  )

 )
```

```
(defn sdsu-palindrome
  "Higher order function calling palindrome function by passing palindrome-value into it."
  [value]
  (cond
    (> value 1)
      (last (sort (filter (complement nil?)
                     (into [] (palindrome value)))))

   :else "Please enter number greater than 1"))
```

Some Solutions

rotate

```
(defn sdsu-rotate
 [n sequ]
  {:pre [(integer? n) (or (seq? sequ) (vector? sequ) (nil? sequ))]}
  (let [sequ-len (count sequ)]
   (if (zero? sequ-len)
    sequ
    (if (neg? n)
     (sdsu-rotate (- sequ-len (mod (- n) sequ-len)) sequ)
      (concat (drop (mod n sequ-len) sequ)(take (mod n sequ-len) sequ))))))
```

rotate

```
(defn sdsu-rotate
  [n xs]
  (let [z (mod n (count xs))]
    (concat (drop z xs) (take z xs))))
```

```
(defn sdsu-rotate
  [n xs]
  (apply concat (reverse (split-at (mod n (count xs)) xs))))
```

Sum multiples of 3 & 5 less then 1000

```
(defn multiple-of-3-or-5? [n]
  (or (= 0 (mod n 3))
      (= 0 (mod n 5))))

(apply + (filter multiple-of-3-or-5? (range 1000)))


(defn multiple-of-3-or-5? [n]
  (or (zero? (rem n 3))
      (zero? (rem n 5))))

(reduce + (filter multiple-of-3-or-5? (range 1000)))
```

Using Lazy

```
(defn sdsu-sum
  [n1 n2 max]
  (reduce + (distinct (concat (range n1 max n1) (range n2 max n2)))))
```

Palindrome

```
(defn palindrome?
  [n]
  (let [string-n (str n)]
  (= (seq string-n) (reverse string-n))))



(defn- generate-numbers
  [digits]

   (for [x (range (int (Math/pow 10 digits)) (Math/pow 10 (dec digits)) -1 )
        y (range  (int (Math/pow 10 digits)) (dec x) -1 )]
        (* x y)))

(defn sdsu-palindrome
  [number]
  (let [numbers (generate-numbers number)]
    (reduce max (filter palindrome? numbers))))
```

DNA

```
(defn sdsu-dna-count
  [s]
  (when (string? s)
    (into {}
       (for [[k v] (frequencies s)]
         [(keyword (str k)) v]))))
```

digits

```
(defn sdsu-digits
 [n b]
 {:pre [(integer? n) (>= n 0) (integer? b) (pos? b)]}
 (if (zero? n)
  [0]
  ((fn acc
   [number base-b-representation]
   (if (zero? number)
    (vec base-b-representation)
    (acc (int (/ number b)) (conj base-b-representation (mod number b))))) n ())))
```

```
(defn sdsu-roman-numeral
  [n]
  {:pre [(integer? n) (< n 4000) (pos? n)]}
  ((fn acc [
      remainder      ; Remaining (unrepresented) decimal part of the number
      roman-rep      ; Roman numeral representation built so far
    ]
    (cond
      (>= remainder 1000) (acc (- remainder 1000) (str roman-rep "M" ))
      (>= remainder  900) (acc (- remainder  900) (str roman-rep "CM"))
      (>= remainder  500) (acc (- remainder  500) (str roman-rep "D" ))
      (>= remainder  400) (acc (- remainder  400) (str roman-rep "CD"))
      (>= remainder  100) (acc (- remainder  100) (str roman-rep "C" ))
      (>= remainder   90) (acc (- remainder   90) (str roman-rep "XC"))
      (>= remainder   50) (acc (- remainder   50) (str roman-rep "L" ))
      (>= remainder   40) (acc (- remainder   40) (str roman-rep "XL"))
      (>= remainder   10) (acc (- remainder   10) (str roman-rep "X" ))
      (>= remainder    9) (acc (- remainder    9) (str roman-rep "IX"))
      (>= remainder    5) (acc (- remainder    5) (str roman-rep "V" ))
      (>= remainder    4) (acc (- remainder    4) (str roman-rep "IV"))
      (>= remainder    1) (acc (- remainder    1) (str roman-rep "I" ))
      :else roman-rep)) n ""))
```