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{-
This is a list of selected functions from the standard Haskell modules:

  Prelude
  Data.List
  Data.Maybe
  Data.Char
-}

--------------------------------------------------------------------------
-- standard type classes

class Show a where
  show :: a -> String

class Eq a where
  (==), (/=) :: a -> a -> Bool

class (Eq a) => Ord a where
  (<), (<=), (>=), (>) :: a -> a -> Bool
  max, min             :: a -> a -> a

class (Eq a, Show a) => Num a where
  (+), (-), (*)    :: a -> a -> a
  negate           :: a -> a
  abs, signum      :: a -> a
  fromInteger      :: Integer -> a

class (Num a, Ord a) => Real a where
  toRational       ::  a -> Rational

class (Real a, Enum a) => Integral a where
  quot, rem        :: a -> a -> a
  div, mod         :: a -> a -> a
  toInteger        :: a -> Integer

class (Num a) => Fractional a where
  (/)              :: a -> a -> a
  fromRational     :: Rational -> a

class (Fractional a) => Floating a where
  exp, log, sqrt      :: a -> a
  sin, cos, tan       :: a -> a

class (Real a, Fractional a) => RealFrac a where
  truncate, round  :: (Integral b) => a -> b
  ceiling, floor   :: (Integral b) => a -> b

--------------------------------------------------------------------------
-- numerical functions

even, odd        :: (Integral a) => a -> Bool
even n           = n `rem` 2 == 0
odd              = not . even

--------------------------------------------------------------------------
-- monadic functions

sequence     :: Monad m => [m a] -> m [a]
sequence     = foldr mcons (return [])
                   where mcons p q = do x <- p; xs <- q; return (x:xs)

sequence_    :: Monad m => [m a] -> m ()
sequence_ xs = do sequence xs; return ()

--------------------------------------------------------------------------
-- functions on functions

id               :: a -> a
id x             = x

const            :: a -> b -> a
const x _        = x

(.)              :: (b -> c) -> (a -> b) -> a -> c
f . g            = \ x -> f (g x)

flip             :: (a -> b -> c) -> b -> a -> c
flip f x y       = f y x

($) :: (a -> b) -> a -> b
f $  x           = f x

--------------------------------------------------------------------------
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-- functions on Bools

data Bool = False | True

(&&), (||)       :: Bool -> Bool -> Bool
True  && x       = x
False && _       = False
True  || _       = True
False || x       = x

not              :: Bool -> Bool
not True         = False
not False        = True

------------------------------------------------------------------------
-- functions on Maybe

data Maybe a = Nothing | Just a

isJust                 :: Maybe a -> Bool
isJust (Just a)        =  True
isJust Nothing         =  False

isNothing              :: Maybe a -> Bool
isNothing              =  not . isJust

fromJust               :: Maybe a -> a
fromJust (Just a)      =  a

maybeToList            :: Maybe a -> [a]
maybeToList Nothing    =  []
maybeToList (Just a)   =  [a]

listToMaybe            :: [a] -> Maybe a
listToMaybe []         =  Nothing
listToMaybe (a:_)      =  Just a

------------------------------------------------------------------------
-- functions on pairs

fst              :: (a,b) -> a
fst (x,y)        =  x

snd              :: (a,b) -> b
snd (x,y)        =  y

curry            :: ((a, b) -> c) -> a -> b -> c
curry f x y      =  f (x, y)

uncurry          :: (a -> b -> c) -> ((a, b) -> c)
uncurry f p      =  f (fst p) (snd p)

------------------------------------------------------------------------
-- functions on lists

map :: (a -> b) -> [a] -> [b]
map f xs = [ f x | x <- xs ]

(++) :: [a] -> [a] -> [a]
xs ++ ys = foldr (:) ys xs

filter :: (a -> Bool) -> [a] -> [a]
filter p xs = [ x | x <- xs, p x ]

concat :: [[a]] -> [a]
concat xss = foldr (++) [] xss

concatMap :: (a -> [b]) -> [a] -> [b]
concatMap f = concat . map f

head, last       :: [a] -> a
head (x:_)       = x

last [x]         = x
last (_:xs)      = last xs

tail, init       :: [a] -> [a]
tail (_:xs)      = xs

init [x]         = []
init (x:xs)      = x : init xs

null             :: [a] -> Bool
null []          = True
null (_:_)       = False
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length           :: [a] -> Int
length []        = 0
length (_:l)     = 1 + length l

(!!)             :: [a] -> Int -> a
(x:_)  !! 0      = x
(_:xs) !! n      = xs !! (n-1)

foldr            :: (a -> b -> b) -> b -> [a] -> b
foldr f z []     =  z
foldr f z (x:xs) =  f x (foldr f z xs)

foldl            :: (a -> b -> a) -> a -> [b] -> a
foldl f z []     =  z
foldl f z (x:xs) =  foldl f (f z x) xs

iterate          :: (a -> a) -> a -> [a]
iterate f x      =  x : iterate f (f x)

repeat           :: a -> [a]
repeat x         =  xs where xs = x:xs

replicate        :: Int -> a -> [a]
replicate n x    =  take n (repeat x)

cycle            :: [a] -> [a]
cycle []         =  error "Prelude.cycle: empty list"
cycle xs         =  xs' where xs' = xs ++ xs'

take, drop             :: Int -> [a] -> [a]
take n _      | n <= 0 =  []
take _ []              =  []
take n (x:xs)          =  x : take (n-1) xs

drop n xs     | n <= 0 =  xs
drop _ []              =  []
drop n (_:xs)          =  drop (n-1) xs

splitAt                :: Int -> [a] -> ([a],[a])
splitAt n xs           =  (take n xs, drop n xs)

takeWhile, dropWhile    :: (a -> Bool) -> [a] -> [a]
takeWhile p []          =  []
takeWhile p (x:xs)
            | p x       =  x : takeWhile p xs
            | otherwise =  []

dropWhile p []          =  []
dropWhile p xs@(x:xs')
            | p x       =  dropWhile p xs'
            | otherwise =  xs

lines, words     :: String -> [String]
-- lines "apa\nbepa\ncepa\n" == ["apa","bepa","cepa"]
-- words "apa  bepa\n cepa"  == ["apa","bepa","cepa"]

unlines, unwords :: [String] -> String
-- unlines ["apa","bepa","cepa"] == "apa\nbepa\ncepa"
-- unwords ["apa","bepa","cepa"] == "apa bepa cepa"

reverse          :: [a] -> [a]
reverse          =  foldl (flip (:)) []

and, or          :: [Bool] -> Bool
and              =  foldr (&&) True
or               =  foldr (||) False

any, all         :: (a -> Bool) -> [a] -> Bool
any p            =  or . map p
all p            =  and . map p

elem, notElem    :: (Eq a) => a -> [a] -> Bool
elem x           =  any (== x)
notElem x        =  all (/= x)

lookup           :: (Eq a) => a -> [(a,b)] -> Maybe b
lookup key []    =  Nothing
lookup key ((x,y):xys)
    | key == x   =  Just y
    | otherwise  =  lookup key xys

sum, product     :: (Num a) => [a] -> a
sum              =  foldl (+) 0
product          =  foldl (*) 1
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maximum, minimum :: (Ord a) => [a] -> a
maximum []       =  error "Prelude.maximum: empty list"
maximum xs       =  foldl1 max xs

minimum []       =  error "Prelude.minimum: empty list"
minimum xs       =  foldl1 min xs

zip              :: [a] -> [b] -> [(a,b)]
zip              =  zipWith (,)

zipWith          :: (a->b->c) -> [a]->[b]->[c]
zipWith z (a:as) (b:bs)
                 =  z a b : zipWith z as bs
zipWith _ _ _    =  []

unzip            :: [(a,b)] -> ([a],[b])
unzip            =  foldr (\(a,b) ~(as,bs) -> (a:as,b:bs)) ([],[])

nub              :: Eq a => [a] -> [a]
nub []           = []
nub (x:xs)       = x : nub [ y | y <- xs, x /= y ]

delete           :: Eq a => a -> [a] -> [a]
delete y []      = []
delete y (x:xs)  = if x == y then xs else x : delete y xs

(\\)             :: Eq a => [a] -> [a] -> [a]
(\\)             = foldl (flip delete)

union            :: Eq a => [a] -> [a] -> [a]
union xs ys      = xs ++ (ys \\ xs)

intersect        :: Eq a => [a] -> [a] -> [a]
intersect xs ys  = [ x | x <- xs, x `elem` ys ]

intersperse      :: a -> [a] -> [a]
-- intersperse 0 [1,2,3,4] == [1,0,2,0,3,0,4]

transpose        :: [[a]] -> [[a]]
-- transpose [[1,2,3],[4,5,6]] == [[1,4],[2,5],[3,6]]

partition        :: (a -> Bool) -> [a] -> ([a],[a])
partition p xs   = (filter p xs, filter (not . p) xs)

group            :: Eq a => [a] -> [[a]]
-- group "aapaabbbeee" == ["aa","p","aa","bbb","eee"]

isPrefixOf, isSuffixOf   :: Eq a => [a] -> [a] -> Bool
isPrefixOf []     _      =  True
isPrefixOf _      []     =  False
isPrefixOf (x:xs) (y:ys) =  x == y && isPrefixOf xs ys

isSuffixOf x y           =  reverse x `isPrefixOf` reverse y

sort             :: (Ord a) => [a] -> [a]
sort             = foldr insert []

insert           :: (Ord a) => a -> [a] -> [a]
insert x []      = [x]
insert x (y:xs)  = if x <= y then x:y:xs else y:insert x xs

--------------------------------------------------------------------------
-- functions on Char

type String = [Char]

toUpper, toLower :: Char -> Char
-- toUpper 'a' == 'A'
-- toLower 'Z' == 'z'

digitToInt :: Char -> Int
-- digitToInt '8' == 8

intToDigit :: Int -> Char
-- intToDigit 3 == '3'

ord :: Char -> Int
chr :: Int  -> Char

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