

### Project 1 d: Bessel fctn rec. rel

Consider the Bessel Functions  $J_v(x)$ , where  $v = 0, 1, 2, \dots$  is the index, and  $x$  is the variable. These functions obey the upward recursion relations

$$J_{v+1}(x) = -J_{v-1}(x) + 2 * (v/x) * J_v(x); \quad v = 1, 2, 3, \dots \quad (1)$$

and the downward recursion relations

$$J_{v-1}(x) = -J_{v+1}(x) + 2 * (v/x) * J_v(x); \quad v = v_{\max}, v_{\max}-1, v_{\max}-2, \dots 1. \quad (2)$$

Explore numerically whether these two recursion relations are stable, i.e., give errors that remain small.

Note that in MATLAB these Bessel functions can be called by *besselj*( $v, x$ ), where  $v$  can also be non-integer, and  $x$  can be a vector. For example, for  $x = 0.2$

$v$	$J_v(x = 0.2)$
0	0.990024972239576
1	0.099500832639236
2	0.00498335415278357
3	0.000166250416435268
4	4.15834027447194e-006
5	8.31945436094694e-008
6	1.38690600152496e-009
7	1.98164820280361e-011
8	2.47740437568484e-013
9	2.75297744273373e-015
10	2.7532277551303e-017