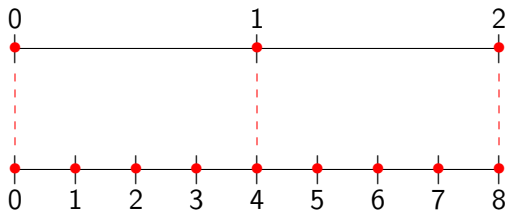
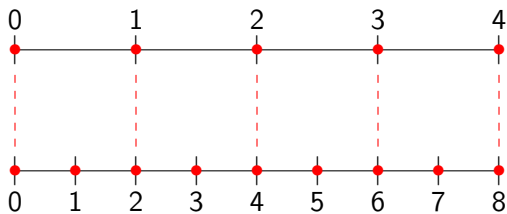


# Interpolation between grids with arbitrary index type and mesh refinement ratio, for I/O and MR

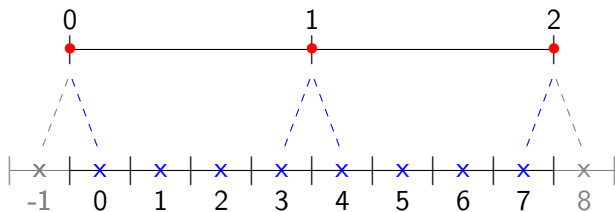
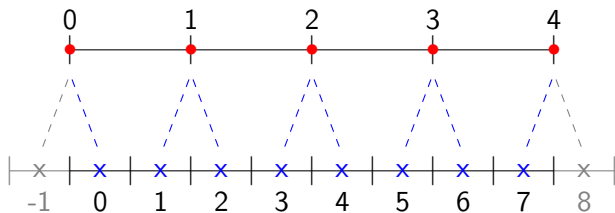
Edoardo Zoni

April 2020

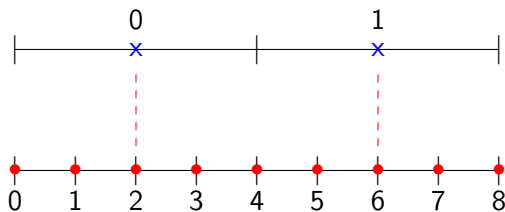
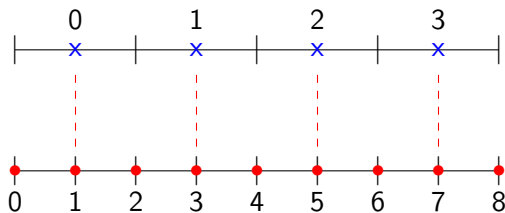
I/O: fine to coarse, nodal to nodal



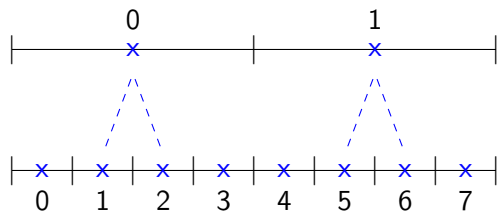
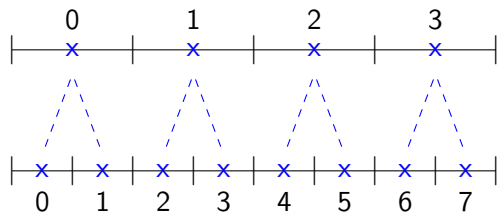
I/O: fine to coarse, cell-centered to nodal



I/O: fine to coarse, nodal to cell-centered



I/O: fine to coarse, cell-centered to cell-centered



## MR: fine to coarse, some math

- number of points to interpolate over:

$$n_p = c_r (1 - s_f)(1 - s_c) + (2(c_r - 1) + 1)s_f s_c$$

- index of starting point in fine array:

$$i_m = i_c c_r (1 - s_f)(1 - s_c) + (i_c c_r - c_r + 1)s_f s_c$$

- interpolation weights:

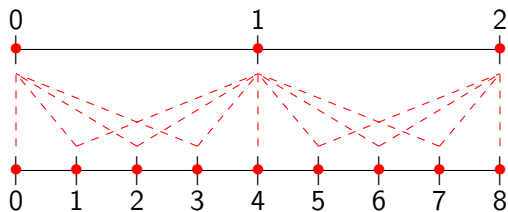
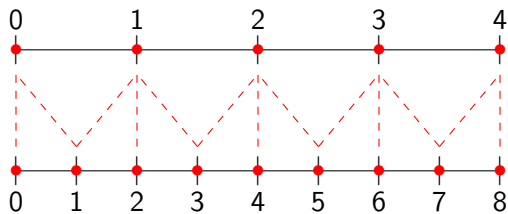
$$w_f(i_c, i_f) = \frac{1}{c_r}(1 - s_f)(1 - s_c) + \frac{1}{c_r} \frac{|c_r - |i_f - i_c c_r||}{c_r} s_f s_c$$

- interpolation formula:

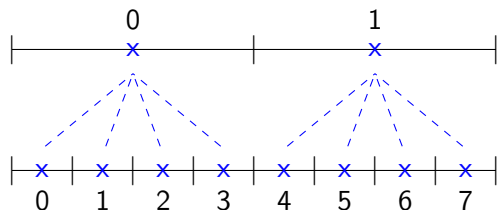
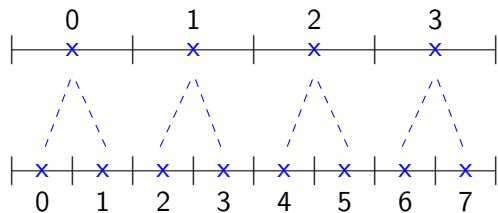
$$g_c(i_c) = \sum_{i_r=0}^{n_p-1} w_f(i_c, i_m + i_r) g_f(i_m + i_r)$$

setting  $g_f(i_m + i_r) = 0$  outside the grown domain

MR: fine to coarse, nodal to nodal



MR: fine to coarse, cell-centered to cell-centered



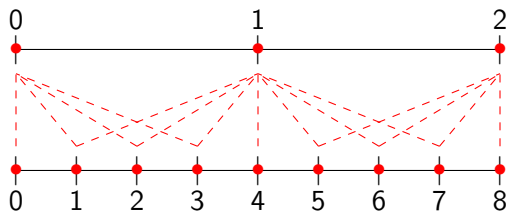
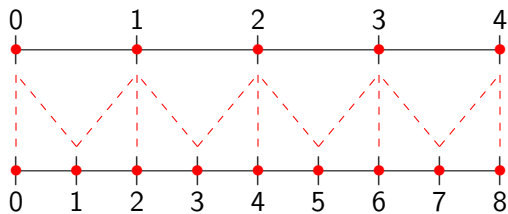


## MR: coarse to fine, some math

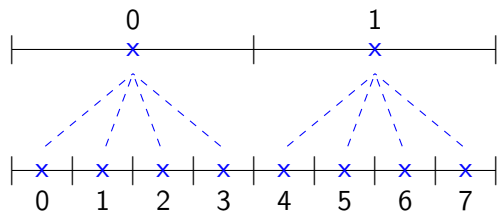
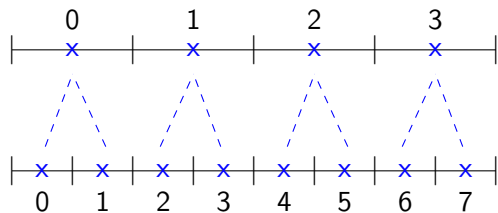
- number of points: 1 for cell-centered, 2 for nodal
- index of starting point in fine array: `amrex::coarsen`
- interpolation weights:

$$w_c(i_c, i_f) = (1 - s_f)(1 - s_c) + \frac{|c_r - |i_f - i_c c_r||}{c_r} s_f s_c$$

MR: coarse to fine, nodal to nodal



MR: coarse to fine, cell-centered to cell-centered



MR: coarse to fine, cell-centered to nodal

