



FIGURE 1. Schematics of a *two element problem*, which is to be solved using two processes; entities owned by process 0 and process 1 are shown in *orange* and *cyan*.

#### 1. SUBDOMAIN: EDGE CASE OF SPECIAL CONSIDERATION

We consider a problem defined on a simple *two element mesh* as shown in Fig. 1, and suppose that we use two processes to solve this problem, and the mesh is partitioned as in Fig. 1. If our subdomain is to include cell 0, but not cell 1, process 0 is to own one cell and process 1 is to own *zero* cell, while process 1 still owning entities 5, 4, and 11. This causes the following issues:

- Boundary conditions can not be applied to the residual/solution vectors on facet 11 (vertices 4 and 5) in *Firedrake* in the current implementation as process 0 does not own these entities.
- We would not obtain this kind of entity distribution if we extracted subdomain first on a root process and then distributed the *dm* to two process (? not sure!)

There are two potential solutions:

- (1) Leave *PETSc* as it is, and fix whatever is related in *Firedrake*.
- (2) In *PETSc* implement some ownership transferring mechanism so that the ownership of entities 4, 5, and 11 can be moved to process 0 in the above example.