**Longest path and longest cycle.** Consider the following two problems

* LongestPath: Given an undirected graph *G* and two distinct vertices s*s* and *t*, find a simple path (no repeated vertices) between s*s* and *t* with the most edges.
* LongestCycle: Given an undirected graph *G*′, find a simple cycle (no repeated vertices or edges except the first and last vertex) with the most edges.

Show that LongestPath linear-time reduces to LongestCycle.

**3Sum and 4Sum.** Consider the following two problems:

* *3Sum*: Given an integer array *a*, are there three distinct indices *i*, *j*, and *k* such that *ai*​+*aj*​+*ak*​=0?
* *4Sum*: Given an integer array *b*, are there four distinct integers *i*, *j*, *k*, and ℓ such that *bi*​+*bj*​+*bk*​+*b*ℓ​=0?

Show that *3Sum* linear-time reduces to *4Sum*.

**3Sum and 3Linear.** Consider the following two problems:

* *3Linear*: Given an integer array *a*, are there three indices (not necessarily distinct)
* *i*, *j*, and *k* such that *ai*​+*aj*​=8*ak*​?
* *3Sum*: Given an integer array b*b*, are there three indices (not necessarily distinct) *i*, *j*, and *k* such that *bi*​+*bj*​+*bk*​=0?

Show that *3Linear* linear-time reduces to *3Sum*.