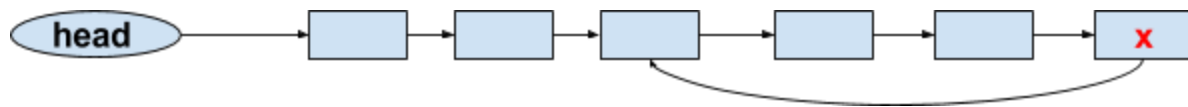


# CS3110: Assignment 2

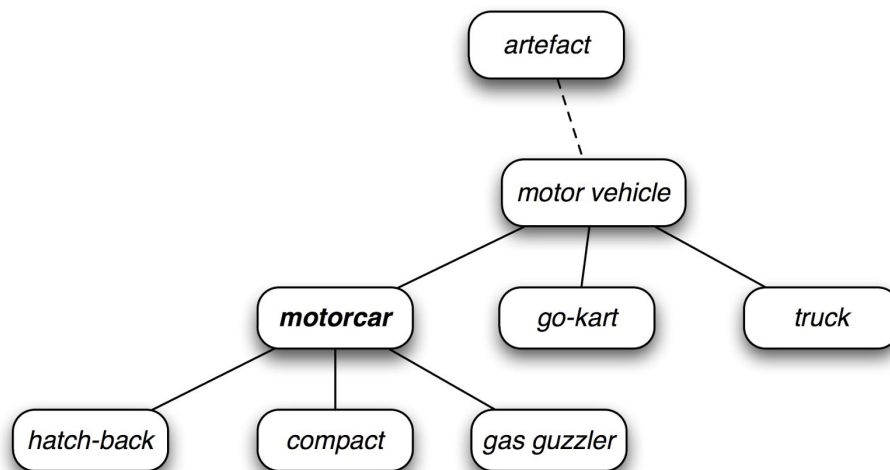
## May 15 2017

1. Design a stack that has a `min()` method (in addition to `push` and `pop`) that can retrieve the minimum in  $O(1)$  time. (25)

2. Given a Linked List, provide a  $O(n)$  ( $n$  is the number of nodes in the list) algorithm that can detect whether the linked list has a loop, and find the node that starts it (node  $x$  in the following picture)? (25)



3. The following image is a snapshot of a very tiny part of [WordNet](#) (the original tree is many times bigger than this). The nodes of the tree have a **-is-a** relationship with their parent. (*hatch-back* is a *motorcar*). Design an algorithm that given a tree  $T$  and two nodes  $(u,v)$ , finds the first type that can describe both, that is, the **closest** node to  $a$  and  $b$  that “ $a$  is-a  $v$ ” and “ $b$  is-a  $v$ ”. For example, given *compact* and *truck*, it should return *motor vehicle*. What is the complexity of the algorithm? (25)



4. Design an algorithm that given a graph and two nodes ( $a$  and  $b$ ), returns a path from  $a$  to  $b$ , or null if no such path exists. (25)