```
;;; -*- Mode: Lisp; Syntax: Common-Lisp; -*-
;;; Code from Paradigms of Artificial Intelligence Programming
;;; Copyright (c) 1991 Peter Norvig

;;;from auxfns.lisp ==============================
(defun find-all (item sequence &rest keyword-args
                 &key (test #'eql) test-not &allow-other-keys)
  "Find all those elements of sequence that match item,
 according to the keywords.  Doesn't alter sequence."
  (if test-not
      (apply #'remove item sequence
             :test-not (complement test-not) keyword-args)
      (apply #'remove item sequence
             :test (complement test) keyword-args)))

;;; File gps1.lisp: First version of GPS (General Problem Solver)
(defvar *state* nil "The current state: a list of conditions.")

(defvar *ops* nil "A list of available operators.")

(defstruct op "An operation"
  (action nil) (preconds nil) (add-list nil) (del-list nil))

(defun GPS (*state* goals *ops*)
  "General Problem Solver: achieve all goals using *ops*."
  (if (every #'achieve goals) 'solved))

(defun achieve (goal)
  "A goal is achieved if it already holds,
 or if there is an appropriate op for it that is applicable."
  (or (member goal *state*)
      (some #'apply-op
            (find-all goal *ops* :test #'appropriate-p))))

(defun appropriate-p (goal op)
  "An op is appropriate to a goal if it is in its add list."
  (member goal (op-add-list op)))

(defun apply-op (op)
  "Print a message and update *state* if op is applicable."
  (when (every #'achieve (op-preconds op))
    (print (list 'executing (op-action op)))
    (setf *state* (set-difference *state* (op-del-list op)))
    (setf *state* (union *state* (op-add-list op)))
    t))

;;;The historical domain example  ================================
(defparameter *school-ops*
  (list
    (make-op :action 'drive-son-to-school
         :preconds '(son-at-home car-works)
         :add-list '(son-at-school)
         :del-list '(son-at-home))
    (make-op :action 'shop-installs-battery
         :preconds '(car-needs-battery shop-knows-problem shop-has-money)
         :add-list '(car-works))
    (make-op :action 'tell-shop-problem
         :preconds '(in-communication-with-shop)
         :add-list '(shop-knows-problem))
    (make-op :action 'telephone-shop
         :preconds '(know-phone-number)
         :add-list '(in-communication-with-shop))
    (make-op :action 'look-up-number
         :preconds '(have-phone-book)
         :add-list '(know-phone-number))
    (make-op :action 'give-shop-money
         :preconds '(have-money)
         :add-list '(shop-has-money)
         :del-list '(have-money))))
```