

16.410-13 Principles of Autonomy and Decision Making

Assignment #7, tutorial.

Due: LEC #15

Problem PS.7.1.1: value-tuples

A crucial function for encoding a planning problem in propositional logic is to generate all possible tuples of values as arguments to an action or a proposition. Write the function `value-tuples` which takes as input a list of lists of values and returns a list of possible n-tuples (where n is the number of lists in the argument). For example, `(value-tuples '((a b) (c d)))` should return `((a c) (a d) (b c) (b d))`. The order of the tuples in the list does not matter, but the order of the values in each tuple does matter. For example, `((b c) (b d) (a d) (a c))` is a valid answer to the above, but `((c b) (d b) (a d) (a c))` is not a valid answer.

```
;; domains is a list of lists of values
(define (value-tuples domains)
  ;; YOUR CODE HERE
)
```

Problem PS.7.2.1: Action Exclusion Axioms

As discussed in class and in Chapter 11 of Russell and Norvig, action exclusion axioms prevent conflicting actions from occurring simultaneously. Following is the outline of an algorithm for generating action exclusion axioms, as discussed in class.

```
for each action (act x y ...) (pre_1 ...) (post_1 ...), arity n
  for each n-tuple , subst=[a/x,b/y,...]
    for each action (act' x' y' ...) (pre'_1 ...) (post'_1 ...),
arity m
  for each m-tuple , subst'=[a'/x',b'/y',...]
    if (act a b ...) <> (act' a' b' ...)
      if exists s.t. pre_i, pre'_j, post_k, post'_l
        (or subst(post_k) conflicts subst'(pre'_j)
            subst'(post'_l) conflicts subst(pre_i)
            subst'(post'_l) conflicts subst(post_k))
        conflicting actions - generate action-exclusion axioms
for t in [1..max_t]
  [1] (t . act a b ...) => (not (t . act' a' b' ...))
  [2] (t . act' a' b' ...) => (not (t . act a b ...))
```

Implement the function `problem-action-exclusion-axioms` to take a problem and a number of timesteps, and to return a list of action-exclusion axioms. You may want to examine the code in `ps7`.

Problem PS.7.3.1: Hours

We want to understand how much time it took students to answer the questions on the problem sets.

Approximately how many hours did you spend really working on this problem set?