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Humans have preferences - things they like but do not require. Most planning considers any goal state to be equal to any other of the same cost, but if these options are presented to a human they often will prefer one over another. The reasons can be quite varied, e.g. "this one seems less complicated", "well we are short on X and plan A uses less X than B", "I've done this one before".

Capturing these preferences is a challenging task, but not outside of the realm of planning. In fact, the Planning Domain Definition Language v3.0 has syntax specifically for preferences [1]. However, PDDL just defines a way to define the preferences, but gives no suggestions on an algorithm that works with them.

HTNPLAN-P is a solver for a problem definied in PDDL v3.0 [2]. This method uses a best-first search with four different heuristics. They are combined (see figure 2 in the paper) to result in a final heuristic.

The first is an optimistic metric. This assumes that no preferences will have their preconditions violated, and every unresolved preference is considered to be satisfied. This provides an upper bound. The second is a pessimistic metric. This does the opposite of the optimistic metric - it assumes that all unresolved preferences will be unsatisfied. This naturally provides a lower bound. Third is a look-ahead metric, which effectively samples the next step of the search space and uses that. This ends up being non-admissable. Finally is simply considering the depth of the plan. This doesn't factor in preferences, but does guide the planner to find a resolution quickly.

A common theme in preference planners is that preferences don't actually need to be mapped to a number. The only required is that there is a well defined ordering, that is you can easily compare two preferences and say "X < Y, X = Y, or X > Y". Numbers of course have this property, but simply defining this binary operation is sufficient for preference definition [3].

Applications of preference based planning are easy to imagine: airplane seats, routes when driving, shipping and logistic planning, etc. Paying attention to advancements in this space will prove particularly valuable as planning becomes a larger component of our lives.

[1] http://www.cs.yale.edu/homes/dvm/papers/pddl-ipc5.pdf
[2] http://www.cs.toronto.edu/kr/publications/1242050782_Sohrabi-IJCAI09.pdf
[3] https://www.aaai.org/ojs/index.php/aimagazine/article/view/2204/2032