Design P-S: Task Analysis

B. Chandrasekaran, 1990 (AI Mag.)

- Large search space of designs
  - Small number satisficing.

- Design is "recursive"

- Functions provided,
  Constraints satisfied.

- Constraints about
  - Artifact
  - Process

- Design problem - \( f^n \) needed, technology
  (possible components + relations),
  constraints.
TASK STRUCTURE

T (problem-solving task)

M (method)

operators
objects
knowledge
- eg. operator selection

T

M

T_1, T_2, T_3

M
**PCM FAMILY OF METHODS**

Propose $S o l^n \rightarrow$ none

Verify proposal $\rightarrow$ ok

Critique $\rightarrow$ none

Modify proposal

$p, v, c, m$ are subtasks
  - each have methods.
  - may have default.
Design Proposal Methods

- Problem decomposition
  + Solution composition.
- Case retrieval (designs)
- Constraint satisfaction.

Case retrieval (plans)
- Special case of problem decomp./comp.
Decomp-comp. (P)

- form of Kn
  \[ D \rightarrow D_1, \ldots, D_n \]
  - subproblem
    - smaller search space.

- selection knowledge
  - i.e., which decomp. to use?

- design hierarchies (subproblems)
  (parts) (fns) (goals)

- reqs on D \rightarrow reqs on D_i

- solution composition

- subproblem soln may generate new reqs.
Control of Comp-decomp.

AND/OR nodes - alternative decomps.

Use of selection Kn
  - preferences
  - context dependent.

Subproblem solving order
  - dependencies

Top down or bottom up? (Yes)

Plans - compiled control
  - abstract decisions possible
  - indexed by part, goal, problem.
  - plan hierarchy
CBR (P)

Proposal by case retrieval.
episodic - t particular case.
generalized

Issues — Matching
- index cases
  - features
  - function
  - behavior (influences)
- design goals
CSP (P)

Proposal by constraint satisfaction

csp.

dynamic CSP.

good for small spaces.
- direct calculation/estimation
- simulation
  - quantitative
  - qualitative
    - eg. fnl simulation based on state transition model.
- compiled tests
map from undesirable behavior
to parts of structure responsible.
(credit assignment)

- often precompiled
- could map from intended fn,
to behavior, to mismatch,
to structure (Goel)
Proposal Modification Methods

change \{ remove \} component/param./value
add

could be driven by MEA
hill climbing (eg. dominic)
dependency directed

precompiled – fixes, suggestions, operators.