

Heuristic Approach to TCG

- **Heuristic**
 - Webster dictionary
 - involving or serving as an aid to learning, discovery, or problem-solving by experimental and especially trial-and-error methods
- **Examples**
 - Discussion

Search Examples

- Looking for a solution in a search space
- Known techniques
 - Depth-first
 - Breadth-first
 - Binary search for certain structures
- Others?
 - Large branching factor
 - Very deep

Do we need a Heuristic?

- To generate test cases that achieve maximal branch coverage

Example Flow-chart

The flowchart starts at a terminal symbol (circle with a vertical line) and proceeds to a decision diamond labeled 'I'. From diamond 'I', the 'T' branch leads to a process block, then to decision diamond '2'. From diamond '2', the 'F' branch leads to a process block, and the 'T' branch leads to decision diamond '3'. From diamond '3', the 'T' branch leads to a process block, and the 'F' branch leads to decision diamond '4'. From diamond '4', the 'T' branch leads to a process block, and the 'F' branch leads to decision diamond '5'. From diamond '5', the 'T' branch leads to a process block, and the 'F' branch leads to decision diamond '6'. From diamond '6', the 'T' branch leads to a process block, and the 'F' branch leads to a process block. All process blocks eventually lead to a final terminal symbol (circle with a vertical line).

Branch		
Condition	T	F
1	X	X
2	X	X
3	X	
4	X	
5		X
6		

Condition	Branch	
	T	F
1	X	X
2	X	X
3	X	
4	X	
5		X
6		

Observations

- 1T, 1F, 2T, 2F have been covered
- 3T has been covered
- To cover 3F, can we tweak the test case for 3T?
- Also, what do we do when multiple test cases are available for tweaking?
 - Need a way to compare

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“Best Test Case”

- If (Exp) THEN __ ELSE __;
- Exp can be (LHS <op> RHS)
- The “goodness” of a test case t_1
$$\frac{|LHS(t_1) - RHS(t_1)|}{(2 * \max(|LHS(t_1)|, |RHS(t_1)|))}$$
- Should we rely on only local information?
 - What are the risks?

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Better "Best Test Case"

$$G(t,D) = w * L(t,D) + (1-w) * P(t,D) \quad (2)$$

where:

$G(t,D)$: Goodness of test case t at condition D .

$L(t,D)$: Freedom space of t at D .

$P(t,D)$: Sum of freedom space reciprocals of t along the path toward D .

w : Weighting factor between $L(t,D)$ and $P(t,D)$, $0 < w < 1$.

$L(t,D)$ is defined as in formula (1), and $P(t,D)$ is defined as:

$$P(t,D) = \sum_{\text{all } D_i} 1 / (n * L(t,D_i)) \quad (3)$$

- Smallest value indicates the best test case
