

## *APPENDIX C*

### *Summary of GBRAM Heuristics*

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Table C.1. Heuristics for Identifying Goals #1-7

Code	Heuristic	Page
HIG 1.	Goals are named in a standardized subset of natural language in which the first word is a verb that describes the kind of goal being named. For example, AVOID denotes one kind of goal. Goals of this kind are satisfied as long as their target conditions remain false.	144
HIG 2.	Abstraction mechanisms may be employed to extract goals from available documentation by asking: What goal(s) does this statement exemplify? and What goal(s) does this statement block or obstruct? If the answer to either of these questions is yes, then express the statement as a goal which represent a state that is desired or achieved within the system. The inquiry points are shown in Figure 5.3.	144
HIG 3.	Action words that point to some state that is or can be achieved once the action is completed are candidates for goals in the system. They are identified by considering each statement in the available documentation by asking: Does this behavior or action denote a state that has been achieved, or a desired state to be achieved? If the answer is yes, then express the answer to these questions as goals which represent a state that is desired or achieved within the system.	146
HIG 4.	An effective way to uncover hidden goals is to consider each action word and every description of behavior and persistently ask “Why?” until all the goal have been ‘treated’ and the analyst is confident that the rationale for each action is understood and expressed as a goal. The action words should be restated so that they denote a state that has been achieved or a desired state.	147
HIG 5.	Key action words such as: track, monitor, provide, supply, find out, know, avoid, ensure, keep, satisfy, complete, allocate, increase, speedup, improve, make, and achieve are useful for pointing to candidate goals.	147
HIG 6.	If a statement seems to guide design decisions at various levels within the system or organization, express it as a goal.	147
HIG 7.	Goals may be uncovered by examining the information available to identify avoidance goals. Avoidance goals are found by identifying bad states or states that should be avoided within the system.	148

Table C.2. Heuristics for Identifying Goals #8-14

Code	Heuristic	Page
HIG 8.	Goals can be uncovered or discovered by considering the goal dependencies for the previously specified goals by asking: What are the pre-conditions of this goal? and What are the post-conditions of this goal? Since preconditions and postconditions are expressed as goals in GBRAM, it is possible to identify new goals that had not been previously considered or identified by considering each goal's dependencies.	148
HIG 9.	Stakeholders tend to express their requirements in terms of operations and actions rather than goals [7, 25]. Thus, when given an interview transcript, it is beneficial to apply the action word strategy to extract goals from stakeholders' descriptions.	149
HIG 10.	Analysts should first seek to understand the stakeholder's application domain and goals before concentrating on the actual or current system so that the system requirements may be adequately specified. Previous research indicates that customers tend to express their goals within the context of their application domain, not in terms of an existing or desired system [7].	149
HIG 11.	Goals are also identified by considering the possible goal obstacles for previously specified goals.	149
HIG 12.	Goals may be identified by considering possible scenarios. Given each goal obstacle, the analyst should determine whether or not the occurrence of the goal obstacle would initiate system failures, these obstacles are key candidates for scenario construction and analysis since the analyst must be sure to specify the goals and requirements to enable the system to handle exceptional cases. Goals may also be identified by considering the normal non-exceptional scenarios.	150
HIG 13.	Goals may be identified by considering constraints.	150
HIG 14.	Goals may be extracted from process diagrams by searching for actions and behaviors, as well as by consistently applying the Inquiry Cycle to clarify the goals and requirements.	151

Table C.3. Heuristics for Identifying Stakeholders and Agents

Code	Heuristic	Page
HIS 1.	Systems or subsystems which do not involve multiple stakeholders may not require stakeholder identification; analysts may choose to skip stakeholder identification entirely in these systems.	154
HIS 2.	Multiple stakeholders may be associated with one goal. If different stakeholders are associated with a goal, but their associations occur at different times within the life of the system, the analyst should document these variances to ensure that the role of stakeholders throughout the lifetime of a goal or the system is well understood.	156
HIS 3.	Any representative affected by the completion or prevention of a goal is a stakeholder. A customer or person representing the enterprise requesting the system or an analysis effort is a stakeholder. Users of the proposed system are stakeholders. Stakeholders are thus identified by asking: Who or what claims a stake in this goal? Who or what stands to gain or lose by the completion or prevention of this goal? Who will use the system?	156
HIA 1.	At least one agent must be responsible for the completion of each goal. If the analyst is unable to allocate responsibility for a goal to any agent, then the analyst can assume that the goal lies outside the scope of the proposed system. If the analyst believes there is a responsible agent, but doesn't know who or what, then the inquiry cycle should be applied using the Who-is question.	157
HIA 2.	Responsible agents may be identified by considering each goal and asking: Who or what agent <i>is</i> , <i>could be</i> , or <i>should be</i> responsible for this goal? The answer to this question will be the name of the responsible agent. The agent name should be 'attached' to the goal for which it is responsible. Table 4.4 on page 81 illustrates how agents can be attached to goals using a tabular notation.	157
HIA 3.	Different agents can be responsible for the completion of the same goal at different times.	158
HIA 4.	Agents may be either the system, organization, or a human agent.	158

Table C.4. Heuristics for Identifying Constraints

Code	Heuristic	Page
HIC 1.	Constraints can be identified by considering each statement and asking: Does this fragment impose some constraint on the goal(s)? Does this statement specify some requirement that must be met? Given an answer of 'yes' to either of these two questions, restate as a constraint every statement that exemplifies or states a requirement which must be met to achieve some goal.	159
HIC 2.	Constraints can be identified by searching for temporal connectives (i.e., <i>during</i> , <i>before</i> , <i>after</i> , etc.). Restate statements that describe <i>when</i> some condition is true or <i>when</i> a goal can be completed as a constraint.	159
HIC 3.	Constraints can be identified by searching statements which place limits on the completion of a goal.	160
HIC 4.	Since constraints may place a condition on the achievement of a goal, they should be restated as goal obstacles to allow for subsequent elaboration of the obstacle using scenario. This enables the consideration of exception cases which the system is required to handle.	160

Table C.5. Heuristics for Classifying Goals

Code	Heuristic	Page
HCA 1.	Goals are classified as achievement goals by considering each goal and asking: Is completion of this goal self-contained? Does this goal denote a state that has been achieved or a desired state? Does the completion of this goal depend on the completion of another goal? Is the ability of another goal to complete depend upon the completion of this goal? Given an answer of 'yes' to any of the questions above, classify the goal as an achievement goal.	161
HCA 2.	Achievement goals can be identified by searching for key words representing desired behaviors within the system (i.e., <i>make, improved, speed up, increase, satisfied, completed, allocated, etc.</i> )	162
HCA 3.	Achievement goals are relatively self-contained. While other goals may depend on the completion of the given goal, achievement goals rarely impose constraints upon an entire class of goals (e.g. a group of security and access goals). In contrast, a Maintenance goal is likely to impose a constraint upon an entire class of achievement goals.	163
HCM 1.	Goals are classified as maintenance goals by considering each identified goal and asking: Does this goal ensure that some condition is held true throughout all other goal operationalizations? Does this goal affect decisions at various levels within the organization? Is continuous achievement of this goal required?	164
HCM 2.	Maintenance goals can be identified by searching for key words that suggest a continuous state within the system (i.e., <i>keep, ensure, avoid, know, monitor, track, provide, supply, etc.</i> ).	164
HCM 3.	Maintenance goals tend to be operationalized as actions that prevent certain states from being reached within the system. Since maintenance goals are those goals which are satisfied while their target condition remains true, they are named using the verbs <b>MAINTAIN, KEEP, AVOID</b> and <b>ENSURE</b> .	164

Table C.6. Heuristics for Refining Goals

Code	Heuristic	Page
HRR 1.	If the same goal appears more than once AND the same agent is responsible for the goal on each occurrence, then all but one of the goals may be eliminated.	167
HRR 2.	If the same goal appears more than once BUT two or more different agents are responsible for the same goal at different times, then all but one occurrence of the goal should be eliminated. However, to prevent the loss of information the analyst must keep track of all current and future agents who assume responsibility for the goal.	167
HRS 1.	If two goals are synonymous, reconcile the duplication by eliminating the goal which can be semantically subsumed by the other.	168
HRS 2.	If two goals are heterogeneous (e.g. one is an achievement goal and the other is a maintenance goal), then it is likely that the maintenance goal was classified incorrectly. If a maintenance goal is synonymous with an achievement goal, then the maintenance goal should be decomposed into an achievement goal. If the maintenance goal is decomposed into more than one achievement goal, then at least one of the goals should be synonymous with the original achievement goals, and thus synonymous with the maintenance goal.	168
HRS 3.	Consolidate and refine goals by merging synonymous goals.	168
HRS 4.	Since synonymous goals tend to share precedence relations, they appear clustered together when ordered. Ordering goals according to their precedence relations thus facilitates the identification of synonymous goals.	168
HRSS 1.	Individual information dissemination goals may be refined by asking: What is 'information' and why is it significant or important? Do any goals depend on the availability of this information for goal achievement? Restate goals based on system-specific entities to capture the essence of the goal without including any system-specific information. When an implementation bias exists (i.e., if the customer has requested a certain implementation platform) then it may not be possible to ignore system-specific information. When an implementation bias exists (i.e., if the customer has requested a certain implementation platform) then it may not be possible to ignore system-specific information.	169
HRSS 2.	Restate routing goals to avoid emphasizing the receiving party and so that the underlying process and activity is represented.	170

Table C.7. Heuristics for Goal Elaboration via Dependencies and Obstacles

Code	Heuristic	Page
HED 1.	An effective way to discover precedence dependencies between goals is to consider each goal and ask: What goals are prerequisites for this goal? What goals must follow this goal? The answer to these questions indicate the given goal's precedence relations. They should be documented by the analyst so that the goal may be subsequently ordered according to these relationships. Chapter 4 on page 88 which analysts may employ for these annotations, or a tabular notation as shown in Table 5.3.	173
HED 2.	An effective way to identify contract dependencies is to consider each goal and ask: What goal(s) <i>must</i> be completed if this goal is achieved?	175
HED 3.	An effective way to identify agent dependencies between goals is to consider each goal and ask: What agent must complete the goal(s) they are responsible for before the agent responsible for this goal can achieve this goal?	176
HED 1.	There is at least one goal obstacle for every goal. This is informally referred to as the trivial obstacle and formally referred to as the normal first case goal obstacles. These obstacles are worded by negating the verb in the goal name.	177
HED 2.	A statement that illustrates a condition which prevents the completion of a goal or which illustrates an example of a goal being blocked by another goal is indicative of an obstacle and should be expressed as an obstacle.	179
HED 3.	An effective way to identify goal obstacles is to consider each goal and ask: What other goal(s) or condition(s) does this goal depend on? What other goal(s) must be completed or achieved in order for this goal to be achieved? What goal(s) depend on this goal? What goal(s) must follow from this goal? Can the failure of another goal to complete cause this goal to be blocked? If this goal is blocked, what are the consequences? The answer to the questions above should be worded to emphasize the state that is true, thereby denoting a goal obstacle.	179
HED 4.	A prerequisite failure obstacle occurs when a goal having a precedence relation is obstructed because the precedence goal fails. Prerequisite failures are identified by considering each goal and asking: What other goal(s) does this goal depend on?	180
HED 5.	An agent failure obstacle occurs when a goal fails because the responsible agent fails to achieve the goal. Agent failures are identified by considering each goal and asking: Can the failure of an agent to fulfill their responsibilities cause this goal to fail?	180
HED 6.	An contract failure obstacle occurs when a goal which holds a contract with another goal fails. Contract failure obstacles are identified by considering each goal and asking: Does this goal share a contractual relation with another goal?	181



**Table C.8. Heuristics for Goal Elaboration via Scenarios**

Code	Heuristic	Page
HES 1.	An effective way to identify candidate scenarios for construction is to consider each goal and ask: What happens if this goal is not achieved? What are the circumstances under which this obstacle can occur? The identified scenarios are elaborated by listing the activities that must occur should the scenario actually take place.	181
HES 2.	Another effective way to identify candidate scenarios is to consider each obstacle and ask: Why did this obstacle occur? Why was this goal not achieved? Under what circumstances would this obstacle occur?	183
HES 3.	The scenarios which analysts should provide particular or special attention to are those which violate goals or obstacles. Scenarios should be analyzed by considering the possible ways in which goal obstacles could be prevented. This process leads to the identification of new goals and requirements for the system.	183

