6.3 Evaluating results

Results of student lab activity are assigned symbolic names by the results.config file as described above. These results are then referenced in the goals.config to evaluate whether the student obtained expected results. Most lab goals defined in the goals.config file will evaluate to TRUE or FALSE, with TRUE reflecting that the student met the defined goal. In addition to these binary goals, the designer can capture and report on quantities of events, e.g., the number of times a student ran a specific program. Once evaluated, a goal value may affect the value of subsequent goals within the goals.config file, i.e., through use of boolean expressions and temporal comparisons between goals. The evaluated state of each goal can then contribute to an overall student assessment.

Student results may derive from multiple invocations of the same program or system utility. The framework does not discourage students from continuing to experiment and explore aspects of the exercise subsequent to obtaining the desired results. In general, Labtainer assessment determines if the student obtained expected results during any invocation of a program or system utility, or during a time period delineated by timestamp ranges described in 6.3.2. [18]

The goals.config file contains directives, each of which assigns a value to a symbolic name referred to as the `goal_id`. Each goal_id may have multiple instances of timestamped values, with their associated timestamp ranges inherited from results. Examples of assigning values to a goal_id include:

- A goal_id is automatically created for each boolean result from the results.config file. The timestamps are directlly inherited from the results.
- The value of a specific result is compared (e.g., do two strings match?) to a literal expected value. A boolean goal_id value is generated for each referenced result's timestamp.
- The value of a specific result is compared to a parameterized value generated from the student email address as described in section 5. A boolean goal_id value is generated for each referenced result's timestamp.
- A keyed hash of a specific result is compared to the keyed hash of an expected value – to avoid publishing the actual value of the expected result. See 6.3.3.
- Timestamps and boolean values of two different goal_id's are compared. For example, "was a TRUE value for `result A` generated while a TRUE value for `result B` was being generated?" A boolean goal_id is generated for each timestamp range of `result B` within which falls at least one `result A` timestamp.
- A boolean expression consisting of multiple `goal_id`'s and boolean operators such as OR, AND, NOT_AND. A boolean goal_id is generated for each timestamp range for which there is an instance of every goal_id named in the expression.

6.3.1 Goal definitions

The following syntax defines each goal within the goals.config file. While the syntax may appear complex, most goals can be expressed simply as can be seen in section 6.6 and in the Labtainer exercises distributed with the framework.

```
<goal_id> = <type> : [<operator> : <resulttag> : <answertag> | <boolean_expression>
            | goal1 : goal2 | <resulttag> | value : subgoal_list]
```

[18] In those cases where the student is required to obtain the expected results during the final invocation of a program, the *matchlast* goal type may be specified as described below.