EECS 4313 Assignment 3
Data Flow Testing, Slice-Based Testing and Mutation Testing

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1.1 Slice Testing

1.1.1 Chosen Method for Testing

- **Class**: *net.sf.borg.common.DateUtil.java*
- **Method**: *minuteString(int mins)*
- **Method Description**: This method generate a human reable string for a particular number of minutes. It returns the string in terms of hours or minutes or both hours and mintues.
  - **mins** - The first argument is of type integer.

Following is the code of the *minuteString* method:

```
100  public static String minuteString(int mins) {
101
102    int hours = mins / 60;
103    int minsPast = mins % 60;
104
105    String minutesString;
106    String hoursString;
107
108    if (hours > 1) {
109      hoursString = hours + " " +
           Resource.getResourceString("Hours");
110    } else if (hours > 0) {
111      hoursString = hours + " " + Resource.getResourceString("Hour");
112    } else {
113      hoursString = "";
114    }
115
116    if (minsPast > 1) {
117      minutesString = minsPast + " " +
           Resource.getResourceString("Minutes");
118    } else if (minsPast > 0) {
119      minutesString = minsPast + " " +
           Resource.getResourceString("Minute");
120    } else if (hours >= 1) {
121      minutesString = "";
```

```
122     } else {
123       minutesString = minsPast + " " +
              Resource.getResourceString("Minutes");
124     }
125
126     // space between hours and minutes
127     if (!hoursString.equals("") && !minutesString.equals(""))
128       minutesString = " " + minutesString;
129
130     return hoursString + minutesString;
131   }
```

1.1.2 Forward Slicing

1.1.3 Backward Slicing

Backward slicing is in the form of S(v,n) where the slices are code fragments that contribute to variable v at statement n. Slices are only done for primitive values and their All-defs and P-use paths defined in the data flow analysis part.

S(hours, 102)

```
100   public static String minuteString(int mins) {
101
102     int hours = mins / 60;
```

S(minsPast, 103)

```
100   public static String minuteString(int mins) {
101
102
103     int minsPast = mins % 60;
```

The following test case covers the two slices listed above and covers the All-def, P-use for *mins*.

```
assertEquals("1 Hour",DateUtil.minuteString(60));
```

S(hours, 108)

```
100 public static String minuteString(int mins) {
101
102   int hours = mins / 60;
103
104
105
106
107
108   if (hours > 1) {
109   }
```

S(hours, 120)

```
100 public static String minuteString(int mins) {
101
102   int hours = mins / 60;
103   int minsPast = mins % 60;
104
105
106
107
108
109
110
111
112
113
114
115
116   if (minsPast > 1) {
117
118   } else if (minsPast > 0) {
119
120   } else if (hours >= 1) {
121   }
```

The following test case covers the previous two slices for *hours*.

```
assertEquals("3 Hours",DateUtil.minuteString(180));
```

S(minsPast, 118)

```
100  public static String minuteString(int mins) {
101
102
103    int minsPast = mins % 60;
104
105
106
107
108
109
110
111
112
113
114
115
116    if (minsPast > 1) {
117
118    } else if (minsPast > 0) {
119
120
121    }
```

The following test case covers the previous slice for *minsPast*.

```
assertEquals("1 Hour 1 Minute",DateUtil.minuteString(61));
```

S(hours, 110)

```
100  public static String minuteString(int mins) {
101
102    int hours = mins / 60;
103
104
105
106
107
108    if (hours > 1) {
109
110    } else if (hours > 0) {
```

```
111     }
```

The following test case covers the previous slice for *hours*.

```
assertEquals("1 Hour",DateUtil.minuteString(60));
```

This concludes all the backward slices related to the All-defs and P-uses of the primitive types in the *minuteString* function.

1.1.4 Dynamic Slicing

- The data flow analysis you performed and the calculation of the coverage metrics. You must show which test cases are responsible for which dc-paths.
- A description of the test cases you added to improve coverage. If your coverage was already high, discuss how your testing was able to achieve this.
- The slices that you identified and the percentage of slices that your testing covers. You must show which test cases are responsible for which slices.
- A description of the test cases you added to improve slice coverage. If your coverage was already high, discuss how your testing was able to achieve this.
- Evaluate the effectiveness of your test cases using mutation testing. Discuss and address any issues if you have found in your written report.
- Attaching bug reports if bugs are discovered using your testing methods. You should use the same bug report format as in Assignment 1. Do not file these bug reports to the projects bug report system.
- An appendix with the specification of the methods you are testing

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- The test scenarios that you have created;
- The request rates and the duration of the load tests;
- The analysis of your load tests and the description of any problems that you have found (if there are any).