This appendix provides detailed data for the experiments described in Section 4. Each table in this appendix gives information about the performance of monolithic verification, assume-guarantee reasoning using the generalized decompositions based on the best decomposition from size 2, and assume-guarantee reasoning using the best decomposition we were able to find. Recall that we imposed a time bound when exploring some decompositions, as described in Section 4.4.1, and for those subjects where this bound was reached, the best-known decomposition may not be the best decomposition that exists for that subject.

The Time rows give the number of seconds needed for verification. The \(|P|\) rows give the number of states in the property that was checked. The States rows give the number of states explored during verification. For the generalized decomposition and the best decomposition, this number is the maximum number of states explored by a verifier when answering a query or a conjecture of the L* algorithm. If the number of the states used by the best decomposition is preceded by a star, this means that the number of states is for the best-known decomposition, but there may be a better decomposition that explores fewer states.

In the data for FLAVERS for subject 23 at size 3, the number of states explored by the best decomposition at size 3 is preceded by a greater than sign. This denotes the fact that while none of the decompositions at size 3 completed within the time bound we used, we know that the best decomposition for this property explores at least 100,000 states. We show the number of states as “OOM” in the cases where the verifier ran out of memory. For the Best decomposition columns, we show the number of states as “—” in those cases where we did not attempt to find the best decomposition.

Some rows show data specific to assume-guarantee reasoning. The Premise 1 States and Premise 2 States rows give the number of states explored while verifying Premise 1 and Premise 2, respectively. The \(|A|\) rows give the size of the learned assumption. The \(|S_1|\) and \(|S_2|\) rows give the number of node in \(|S_1|\) and \(|S_2|\) respectively. We do not report the size of \(|S_1|\) and \(|S_2|\) for LTSA because the LTSA models are built on the fly. Thus, \(S_1\) and \(S_2\) are never built independently, but are always built composed with some other assumption or property.
The majority of these experiments were run on an Intel Xeon 2.2GHz machine with 4Gb of memory (although a single process could only access 2Gb of memory). This system was running RedHat Linux version 8.0 with Sun’s JDK version 1.5.0.04-b05. The LTSA data for the Chiron multiple, Gas Station, Relay, and Smokers systems were from executions on an Intel Pentium 4 3.2GHz machine with 2Gb of memory. This system was running Fedora Core 2 with Sun’s JDK version 1.5.0.06-b05.

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### A.3 Subject 3

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<p>| Time:       | 0.93    | 1.38    | 1.38 |
| States:     | 877     | 1,316   | 1,316 |
| Premise 1 States: | 1,316 | 1,316 |
| Premise 2 States: | 74 | 74 |
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Breaking Up is Hard to Do · App–7

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A.17 Subject 17

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## Verifier: FLAVERS

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## Verifier: FLAVERS

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| **States:** | 656,059 | 34,711 | — |
| **Premise 1 States:** | — | 28,462 | — |
| **Premise 2 States:** | — | 14,725 | — |
| $|A|$: | — | 11 | — |
| $|S_1|$: | — | 306 | — |
| $|S_2|$: | — | 96 | — |

| Verifier: FLAVERS | Subject: 22 | Size: 8 | $|P|$: 3 |
|---|---|---|---|
| **Monolithic** | **Generalized** | **Best** |
| **Time:** | 71.64 | 541.39 | — |
| **States:** | 997,768 | 45,208 | — |
| **Premise 1 States:** | — | 36,855 | — |
| **Premise 2 States:** | — | 18,283 | — |
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| $|S_2|$: | — | 104 | — |

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|---|---|---|---|
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| <strong>Time:</strong> | 132.60 | 788.78 | — |
| <strong>States:</strong> | 1,441,023 | 57,089 | — |
| <strong>Premise 1 States:</strong> | — | 46,324 | — |
| <strong>Premise 2 States:</strong> | — | 22,207 | — |
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| Premise 2 States: | 29,600  |

| $|A|$: | 67 |
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| $|S_2|$: | 75 |

| Subject: | Verifier: | Size: | $|P|$: |
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| Premise 2 States: | 1,711 | 1,711 |  |
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| $|S_1|$:     | 56 | 56 |  |
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| $|S_2|$:     | 43 | 43 |  |
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App–68 · Jamieson M. Cobleigh et al.
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Breaking Up is Hard to Do · App–vo

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Verifier: LTS
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Breaking Up is Hard to Do

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| Time:      | 1.40 | 1.63 | 1.62 |
| States:    | 4,905 | 26,624 | 11,882 |
| Premise 1 States: | 2,745 | 11,882 |
| Premise 2 States: | 26,624 | 3,776 |
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| Verifier:   | LTSA     |
| Subject:   | 20       |
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| Monolithic | Generalized | Best |
| Time:      | 1.91 | 4.22 | — |
| States:    | 25,893 | 249,856 |
| Premise 1 States: | 6,311 |
| Premise 2 States: | 249,856 |
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| Verifier:   | LTSA     |
| Subject:   | 20       |
| Size:      | 6        |
| $|P|$:       | 3        |
| Monolithic | Generalized | Best |
| Time:      | 3.42 | 42.78 | — |
| States:    | 125,469 | 2,293,760 |
| Premise 1 States: | 12,577 |
| Premise 2 States: | 2,293,760 |
| $|A|$:       | 1 |

| Verifier:   | LTSA     |
| Subject:   | 20       |
| Size:      | 7        |
| $|P|$:       | 3        |
| Monolithic | Generalized | Best |
| Time:      | 8.72 | 1,759.91 | — |
| States:    | 570,321 | 20,709,376 |
| Premise 1 States: | 22,653 |
| Premise 2 States: | 20,709,376 |
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### Breaking Up is Hard to Do · App

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| Time:     | 36.03 |
| States:   | 2,467,665 |

#### B.19 Subject 21

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| Time:       | 1.95 | 4.26 | —  |
| States:     | 25,893 | 249,856 | |
| Premise 1 States: | 6,311 | |
| Premise 2 States: | 249,856 | |
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| Time:       | 3.49 | 42.92 | —  |
| States:     | 125,469 | 2,293,760 | |
| Premise 1 States: | 12,577 | |
| Premise 2 States: | 2,293,760 | |
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| Time:       | 8.92 | 1,751.77 | —  |
| States:     | 570,321 | 20,709,376 | |
| Premise 1 States: | 22,653 | |
| Premise 2 States: | 20,709,376 | |
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### B.20 Subject 22

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| States:        | 52          | 130    |     |
| Premise 1 States: | 111       |        |     |
| Premise 2 States: | 36        |        |     |
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| Verifier: LTSA | Subject: 23 | Size: 3 | $|P|$: 3 |
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| Monolithic     | Generalized | Best   |     |
| Time:          | 3.68        | 359.20 | 359.20 |
| States:        | 2,857       | 924,345 | 924,345 |
| Premise 1 States: | 39        | 39     |     |
| Premise 2 States: | 924,345   | 924,345 |     |
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Breaking Up is Hard to Do · App-ono

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### B.30 Subject 32

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