The goal of testing is to discriminate between multiple hypotheses about a system - for example, different fault diagnoses - by applying input patterns and verifying or falsifying the hypotheses from the observed outputs. Definitely discriminating tests (DDTs) are those input patterns that are guaranteed to discriminate between different hypotheses of non-deterministic systems. Finding DDTs is important in practice, but can be very expensive. Even more challenging is the problem of finding a DDT that minimizes the cost of the testing process, i.e., an input pattern that can be most cheaply enforced and that is a DDT. This paper addresses both problems. We show how we can transform a given problem into a Boolean structure in decomposable negation normal form (DNNF), and extract from it a Boolean formula whose models correspond to DDTs. This allows us to harness recent advances in both knowledge compilation and satisfiability for efficient and scalable DDT computation in practice. Furthermore, we show how we can generate a DNNF structure compactly encoding all DDTs of the problem and use it to obtain a cost-optimal DDT in time linear in the size of the structure. Experimental results from a real-world application show that our
method can compute DDTs in less than 1 second for instances that were previously intractable, and cost-optimal DDTs in less than 20 seconds where previous approaches could not even compute an arbitrary DDT.