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IP36-1. PSEUDO-RANDOM GENERATORS FROM ONE-WAY FUNCTIONS

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One of the basic primitives in cryptography and other areas of computer science is a pseudo-random generator. The usefulness of a pseudo-random generator is demonstrated by the fact that it can be used to construct a private key cryptosystem that is secure even against chosen plain-text attack. A pseudo-random generator can also be used to conserve random bits and allows reproducibility of results in Monte Carlo simulation experiments. Intuitively, a *pseudo-random generator* is a polynomial time computable function g that stretches a short random string x into a much longer string $g(x)$ that "looks" just like a random string to *any* polynomial time adversary that is allowed to examine $g(x)$. [This should be contrasted with the classical definition of a pseudo-random generator. A classical pseudo-random generator is required to pass a particular set of statistical tests, but does not necessarily satisfy the more general requirement that it pass all polynomial-time tests. This is a particularly important distinction in the context of cryptography, where the adversary must be assumed to be as malicious as possible, with the only restriction on tests being computation time.]

It follows then that a pseudo-random number generator can be used to efficiently convert a small amount of true randomness into a much longer string that is indistinguishable from a truly random string of the same length to any polynomial time adversary. On the other hand, there seem to be a variety of natural examples of another basic primitive; the one-way function. Intuitively, a function f is one-way if: (1) given any x, $f(x)$ can be computed in polynomial time; (2) given $f(x)$ for a randomly chosen x, it is not possible on average to find an inverse x' such that $f(x') = f(x)$ in polynomial time. It has not been proven that there are any one-way functions, but there are a number of problems from number theory, coding theory, graph theory, and combinatorial theory that are candidates for problems that might eventually be proven to be one-way functions. We show how to construct a pseudo-random generator from *any* one-way function. [Received: 15 March 1990.]

IP36-2. KOLMOGOROV COMPLEXITY AND ALGORITHMIC RANDOMNESS: RECENT DEVELOPMENTS

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(1) Connections between frequency and complexity approaches to randomness. (2) Algorithmic definition of randomness as a tool for analysing classical results in probability theory. (3) Some mathematical questions and philosophical speculations about algorithmic complexity and information theory. [Received: 26 April 1990.]