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On the Successive Refinement of Information

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We will say that a description is successively refinable if the description can be stopped at any point and the resulting distortion achieves the distortion-rate bound associated with the number of bits in the description so far. We find that one dimensional problems are not generally successively refinable. But for large block lengths, Gaussian sources with squared error loss criterion and discrete sources with Hamming loss criterion are both successively refinable. That is, there exists an encoding scheme which achieves the entire rate distortion curve at once. However, there are also simple problems which are not successively refinable. We prove that necessary and sufficient conditions for successive refinability are that the pair-wise marginals solving the rate distortion problem for given distortions can be written as a Markov chain.