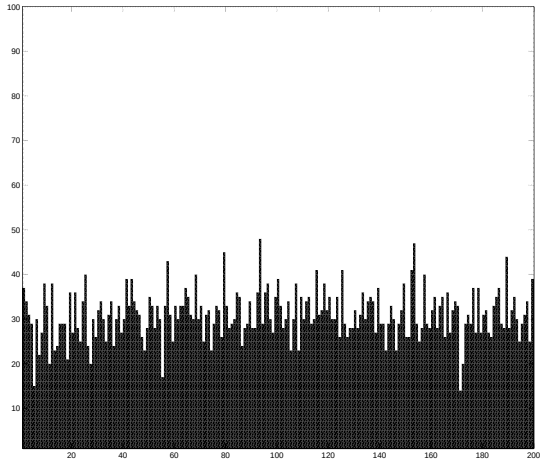
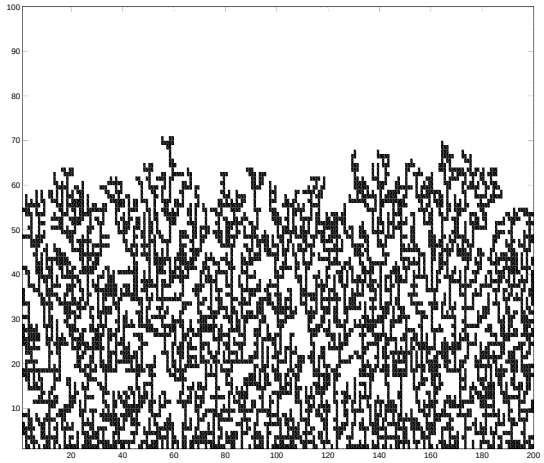
1 Surface growth



(a) Random deposition



(b) Ballistic deposition

Figure 1: RD and BD: 6000 walkers, uniform, no-walk, absorbing

Questions:

- What is the *average height* of the growing surface as a function of time.
- What is the *variance* of the surface height as a function of time.
- What is the fraction of *void space* in the deposited layer.

Very curious!

2 Markov chains: Google's page ranking algorithm

- Basics of Markov chains.
- Relate the Google *PageRank* to the mathematics of Markov chains.

Very lucrative!

3 Biological sequence analysis

- Biology 101: the *Central dogma*; DNA sequencing; DNA mutations.
- Why do sequence comparison (DNA or protein)?
- Needleman-Wunsch and Smith-Waterman sequence alignment algorithms (dynamic programming).
- Similarity to mathematics used for speech recognition.

Very useful!

4 Graph theory and network flows

- Examples: social networks, information networks, technological networks, biological networks.
- Models: random graphs.
- Properties: degree distribution, size of the giant component, clustering, small world property.
- Dijkstra's algorithm: find the minimum weight path.

Very trendy!