

***Geometric properties of elliptic and parabolic PDE's:
time-invariant level surfaces and critical points***
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Lecture 1. *Motivations*. Time-invariant level surfaces of caloric functions: the *matzoh ball soup* problem. Time-invariant *hot spots* in a grounded heat conductor. Complete characterization of caloric functions satisfying the matzoh ball soup problem.

Lecture 2. *Tools 1*. Asymptotic behaviour of caloric functions for short times. Varadhan's theorem. Level surfaces parallel to the boundary.

Lecture 3. *Tools 2*. Balance laws. Short-time behaviour of the heat content of a ball. Polygonal heat conductors having a time-invariant hot spot.

Lecture 4. *Symmetry of time-invariant level surfaces*. A proof by Aleksandrov's *soap bubble theorem*. A proof by the *parallel surface problem* and the method of moving planes.

Lecture 5. *Stability*. A proof of symmetry (and stability) for Serrin's over-determined problem by the stability of the parallel surface problem.