Basic Idea:
Given an initial cell that contains isosurface, the remainder of the isosurface can be found by propagation.

Contour Propagation

A
B
C
D
E
F

BFS Queue
Initial cell: A
Enqueue: B, C
Dequeue: B
Enqueue: D...

Challenges
Need to know the initial cells!
For any given isovalue C, finding the initial cells to start the propagation is almost as hard as finding the isosurface cells.
You could do a global search, but ...

Solutions
(1) Extrema Graph (Itoh vis'95)
(2) Seed Sets (Bajaj volvis'96)

Problem Statement:
Given a scalar field with a cell set G, find a subset S ⊆ G such that for any given isovalue C, the set S contains initial cells to start the propagation.

We need search through S, but S is usually (hopefully) much smaller than G.

We will only talk about extrema graph due to time constraint.

Extrema Graph (1)

Extrema Graph (2)

Basic Idea:
If we find all the local minimum and maximum points (Extrema), and connect them together by straight lines (Arcs), then any closed isocontour is intersect by at least one of the arcs.

Extrema Graph (3)

Extreme Graph:
E, A: E: extrema points
A: Arcs connects E

An ‘arc’ consists of cells that connect extrema points (we only store mini max of the arc though)
Algorithm:
Given an isovalue
1) Search the arcs of the extrema graph (to find the arcs that have min/max contains the isovalue
2) Walk through the cells along each of the arcs to find the seed cells
3) Start to propagate from the seed cells
4) ....

There is something more needs to be done...

We are not done yet ...

What ?!

We just mentioned that all the closed isocontours will intersect with the arcs connecting the extrema points
How about non-closed isocontours? (or called open isocontours)

Algorithm (continued)
Given an isovalue
1) Search the arcs of the extrema graph (to find the arcs that have min/max contains the isovalue
2) Walk through the cells along each of the arcs to find the seed cells
3) Start to propagate from the seed cells
4) Search the cells along the boundary and find seed cells from there
5) Propagate open isocontours

Contours missed
These open isocontours will intersect with ?? cells
 Boundary Cells!!