Today:

Admin
Finish First Assignments
Start Overview: Choices in imaging

Put signed Use Agreement, Syllabus Agreement, on piles up front.

ITLL orientations: For after-hours access and computer login, attend a 1/2 hr tour. Find out what resources are here, agree to not spill drinks on the keyboards.
Lecture notes will be posted on the Flow Vis site. Feel free to nag me.
First Assignments
http://www.colorado.edu/MCEN/flowvis/course/initialassignments.pdf

Overview 1: Topics will be presented iteratively.

Previsualization: Have a goal, think about what you want it to look like.

Make CHOICES:
1. Flow phenomenon: Water boiling? Faucet dripping?
2. Visualization technique: Add dye? See light distorted by air/water surface?
3. Lighting (source of worst image problems)
5. Post processing, final output. Edit, at least crop the image and set contrast.

1. Flow phenomenon: Why does it look like that?

What are the forces? = a framework for interpretation of the image

Minute paper. In groups (3 or so) list all the forces that can act on a fluid.

Write on a scrap of paper.

Gravity
Buoyancy
Intermolecular
Pressure
Temperature
Kinetic energy/potential energy
Surface tension
Magnetism
Viscous force
Centripetal
Coriolis
drag
### Minute paper results:

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscous</td>
<td>Air resistance, composition</td>
</tr>
<tr>
<td>Shear</td>
<td>Cohesion, densities of fluids</td>
</tr>
<tr>
<td>Gravitational</td>
<td>Adhesion (capillary action),</td>
</tr>
<tr>
<td>Buoyancy</td>
<td>Chemical reactions, impact</td>
</tr>
<tr>
<td>Magnetic</td>
<td>Normal force, wind</td>
</tr>
<tr>
<td>Inertial</td>
<td>Stress, wind</td>
</tr>
<tr>
<td>Centripetal/centrifugal</td>
<td>Strain, mass</td>
</tr>
<tr>
<td>Pressure</td>
<td>Thermodynamic, acceleration</td>
</tr>
<tr>
<td>Body forces: gravity, buoyancy,</td>
<td>Strong, weak nuclear forces</td>
</tr>
<tr>
<td>EM</td>
<td>Cavitation, vortex structures</td>
</tr>
<tr>
<td>Viscosity, shear, friction</td>
<td>Vortex stretching</td>
</tr>
<tr>
<td>Thermal diffusivity</td>
<td>Concentration gradient</td>
</tr>
<tr>
<td>Interaction with other fluids</td>
<td>Marangoni forces; surface</td>
</tr>
<tr>
<td>Surface tension</td>
<td>tension</td>
</tr>
</tbody>
</table>

Good, inclusive list. Not all are forces, but all can 'drive' a flow via a set of physics or mechanism. Heat, for example.

All forces can be categorized like this: 2 types of forces

- **Body**
  - Acts directly on every molecule equally
  - a) Gravity
  - b) Electromagnetics

- **Surface**
  - Acts on the surface of a volume of fluid
  - Pressure: always perpendicular to surface
  - Shear: always parallel to surface

Any surface force can be decomposed into a shear plus pressure.

Note: these are actually STRESSES = Force acting on an area.
The only force that is not so easily categorized is SURFACE TENSION

It's the result of intermolecular forces, so it affects every molecule, like a body force

But it is only obvious at interfaces between fluids, kind of like a surface force.

Conclusion: Whenever you are observing fluids, list the forces that may be acting, *that make it look like that.*