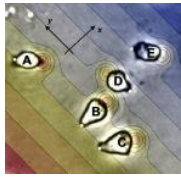
Physics 131-Physics for Biologists I



Professor: Wolfgang Losert
wlosert@umd.edu

Midterm 2: November 8

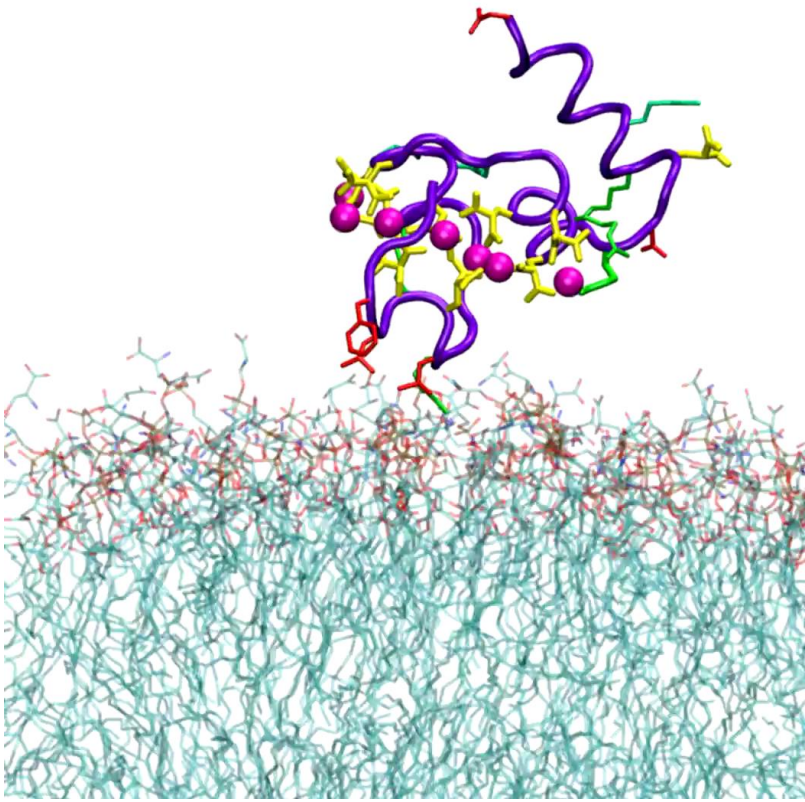
Office Hours before Midterm 2:
Course Center: Monday Nov 4, 11am-12.30pm
3341 AV Williams: Wednesday Nov 6, 11.30am-1pm

Making predictions for Membrane proteins

- Even a complex system such as a membrane and protein follow Newton's laws.
- However, its impossible to predict motion of atoms/molecules accurately after multiple interactions (and interactions are very frequent!)

What could we potentially predict for the motion of the membrane protein?

Whiteboard, TA & LA

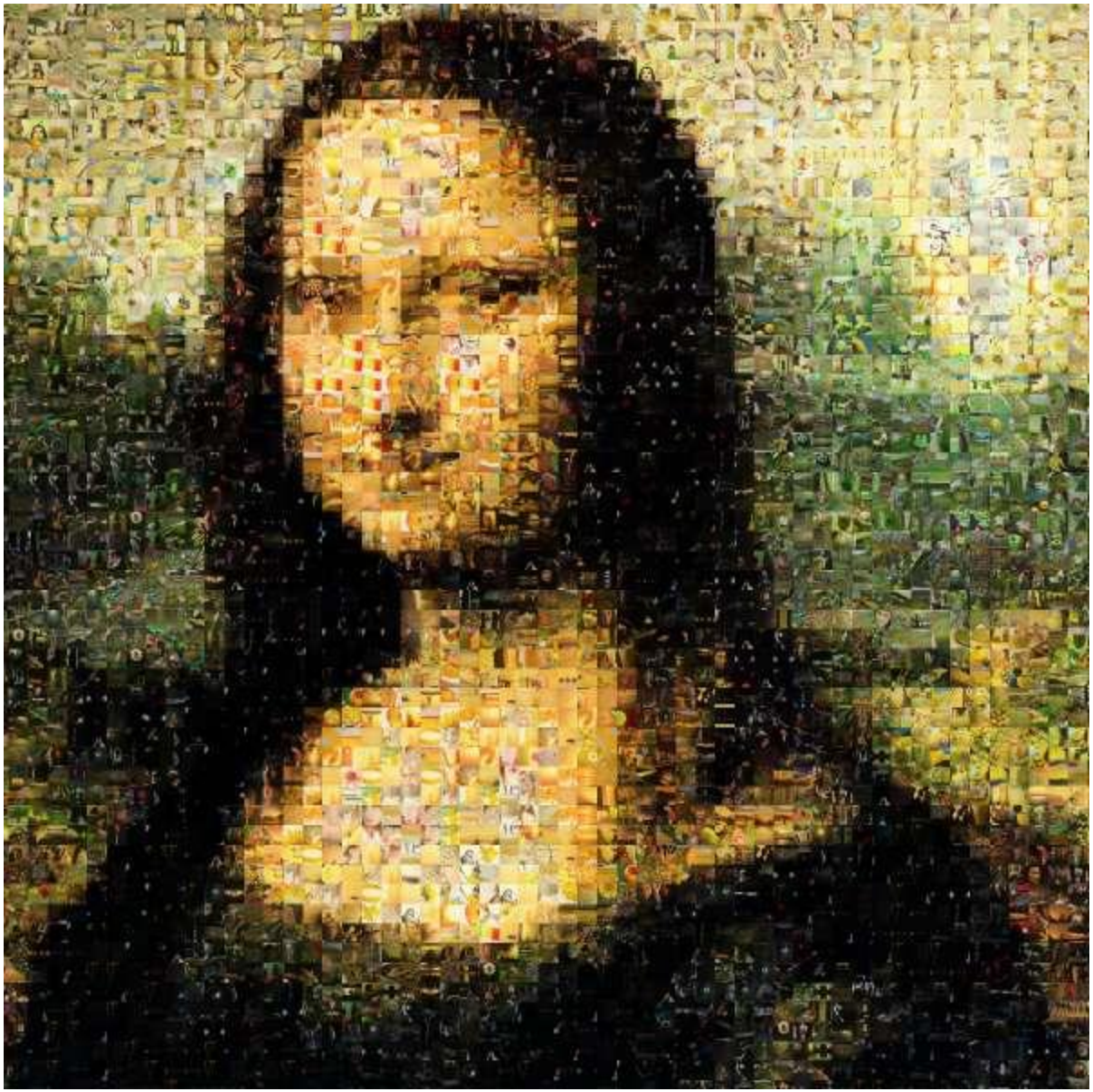


Emergent Properties

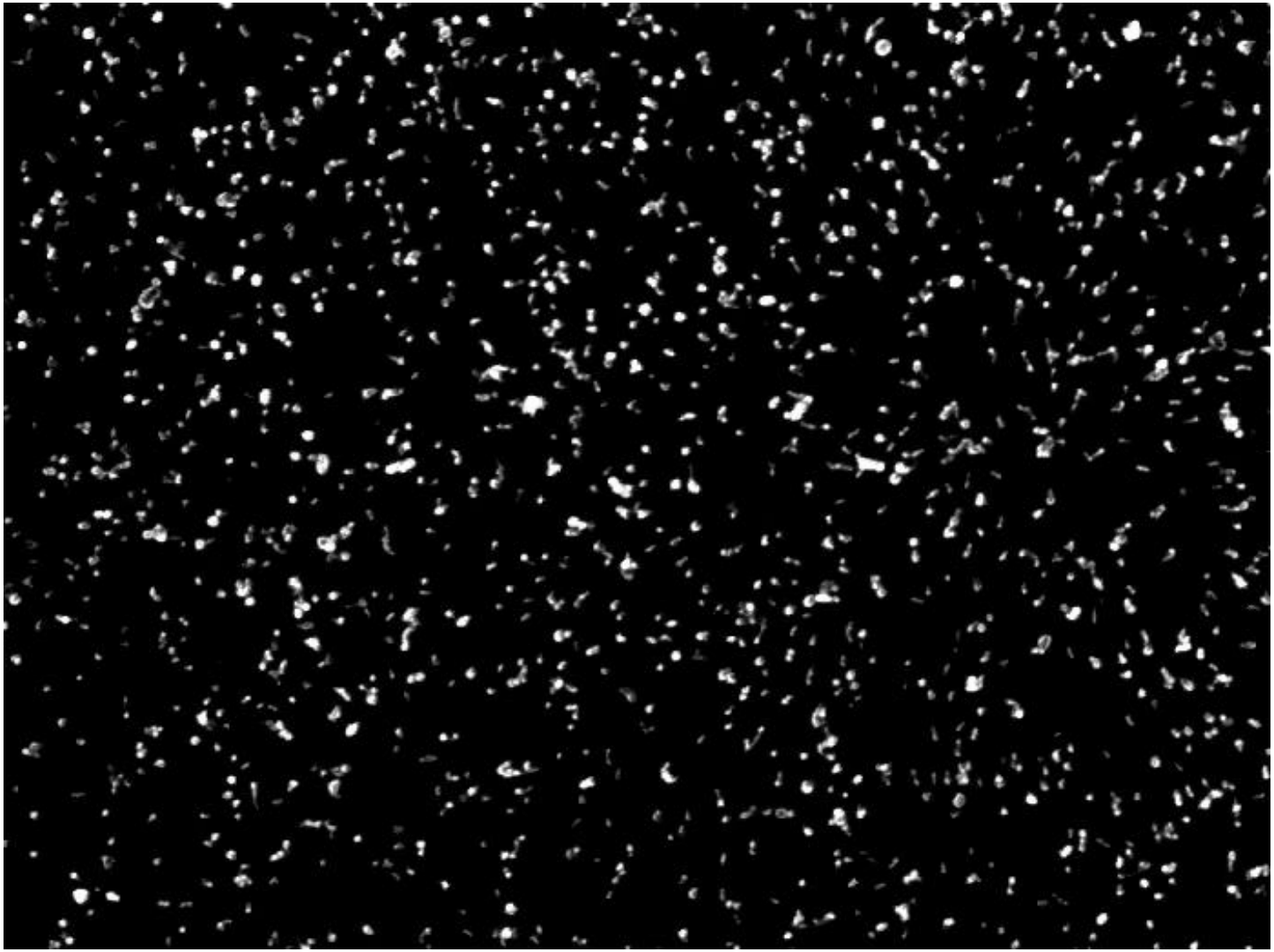
The question: Can the properties of a system can be explained in terms of the properties of its component parts (so, biology can be explained by chemistry, chemistry by physics)?

Emergence –means that some phenomena are undetectable when looked at "in the small". They emerge only when looking at the system as a whole rather than its parts.

Example of emergence

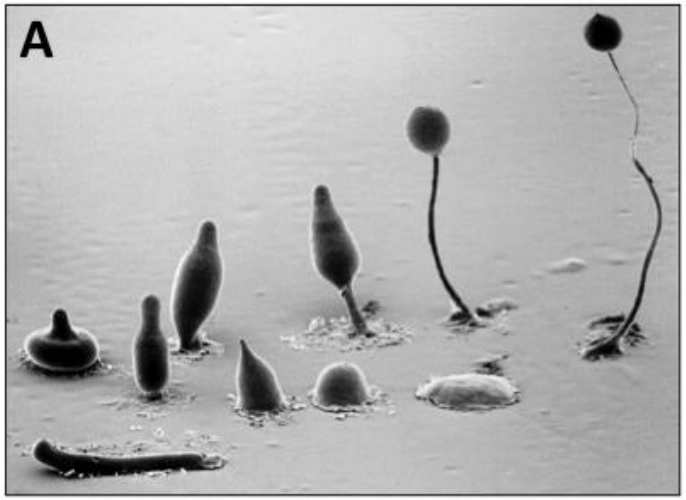


Biological Example of Emergence

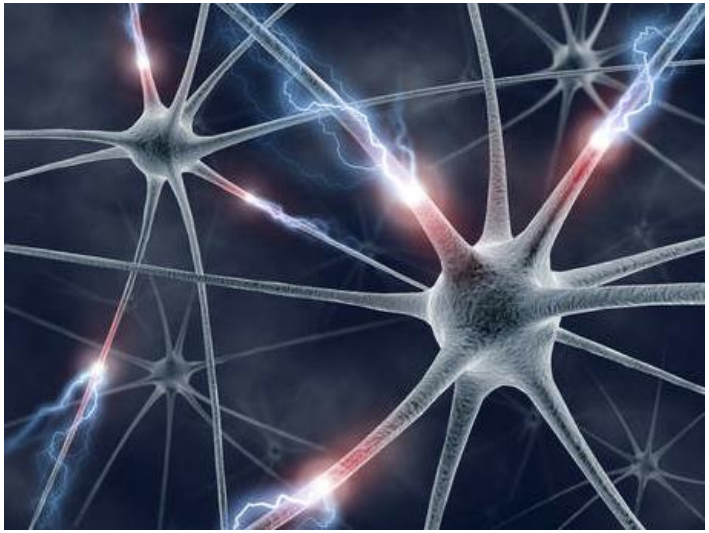


Biological Example of Emergence

Spores

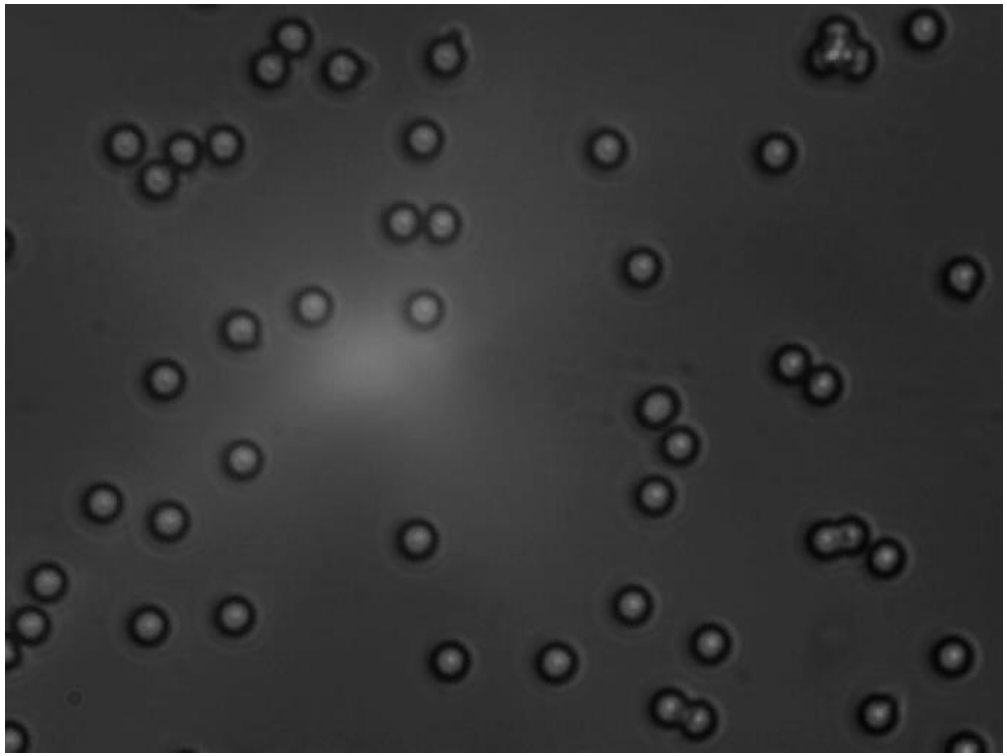


Brain



Does random motion have emergent properties?

(properties that emerge only when looking at the system as a whole rather than its parts)

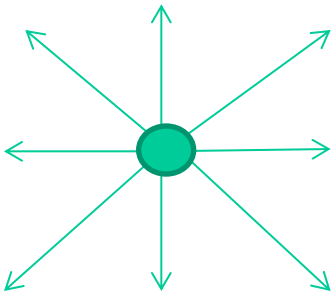


1. **Yes**
2. No
3. The answer has not yet emerged

Whiteboard, TA & LA

How could we determine whether the observed motion is consistent with random motion?

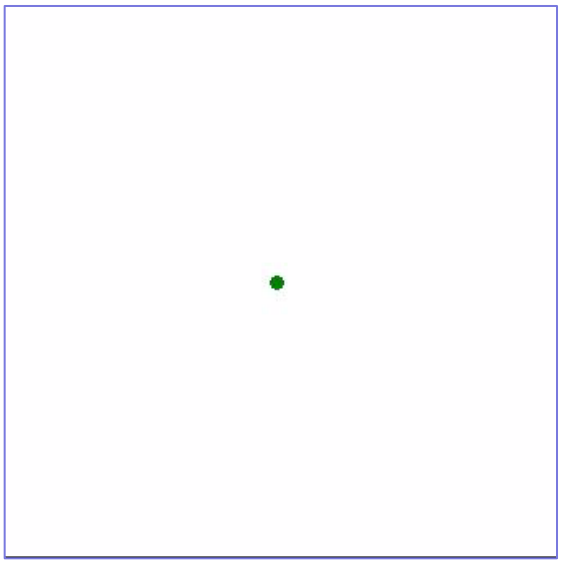
Simulate a truly random process with simple rules

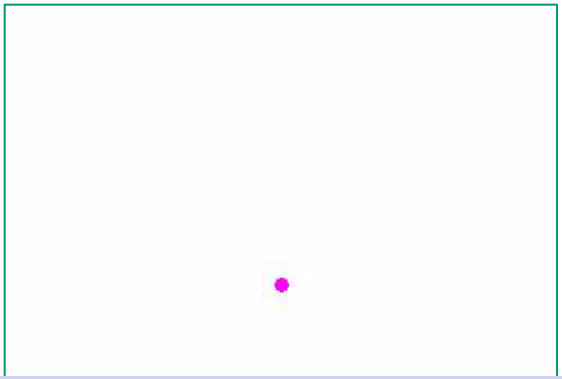


The average distance travelled is

1. Zero
2. Close to zero, does not depend on time
3. **Non-zero, increases with time**
4. Non-zero, decreases with time
5. Not enough information

Random Motion in two dimensions





If I wait four times as long, the trajectory is how much longer?

4 times

If I wait four times as long, the distance between start and end point is how much longer?

2 times

Whiteboard, TA & LA

How can we compare this simulation to experiments?

1) Visually look at trajectories
2) Plot both on log-log scales to see whether distance squared increases linearly with time