Homework 3
Chaotic Dynamics - CSCI 4446

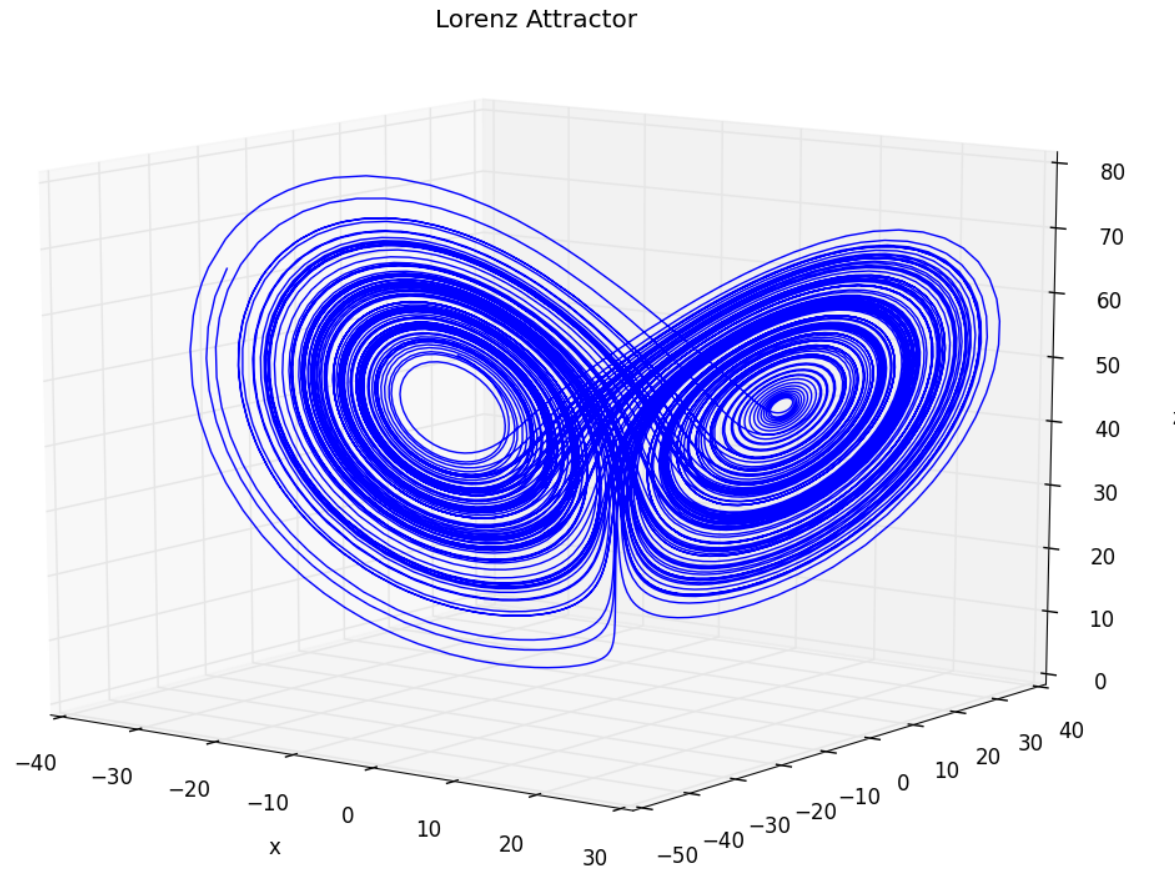Denis Kazakov

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2

2.1 a

Figure 1: Lorenz system using [a,r,b] = [16, 45, 4]. Initial guess [x,y,z] = [-13, -12, 52], Using adaptive RK4
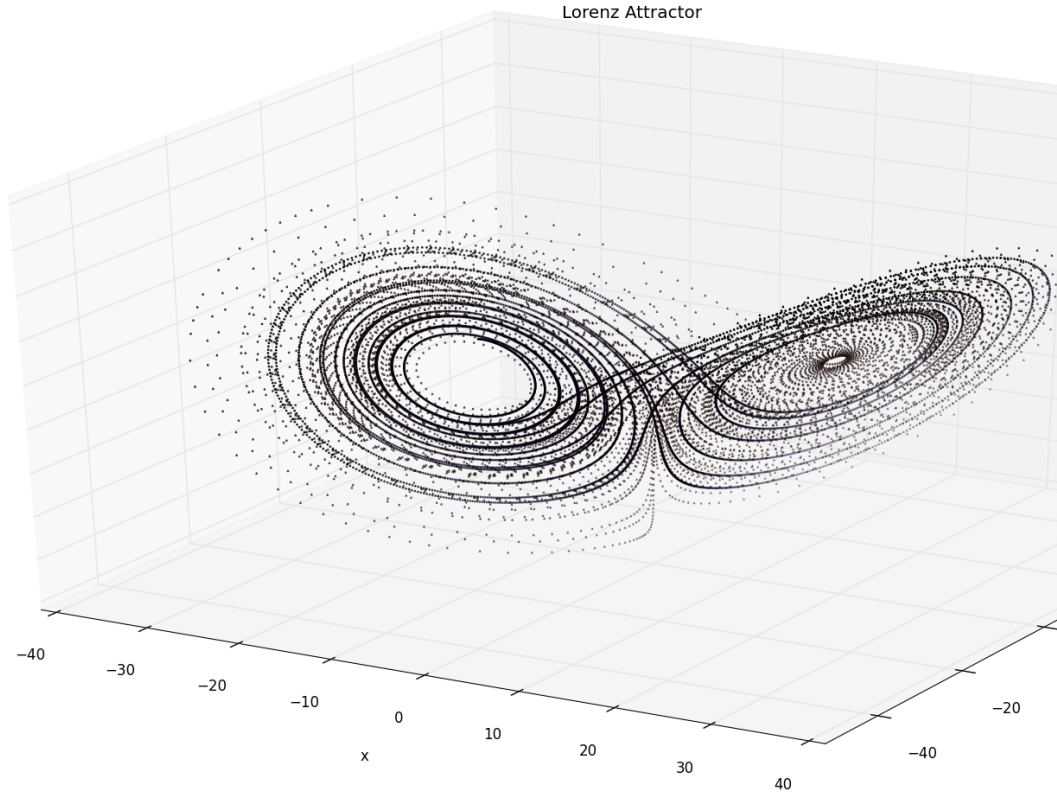
2.2   b

Figure 2: Lorenz system using [a,r,b] = [16, 45, 4]. Initial guess [x,y,z] = [-13, -12, 52], Using adaptive RK4 (red), Nonadaptive(black)

We see how our non-adaptive RK4 method looks more like a continuous line and overall covers much less dynamics of the system, because it couldn't go fast enough. Overall, both solutions are accurate, but we can see a lot more using adaptive solver.

2.3   c

r value changes the topological structure of the system. For example, from being a stable attractor at $r = 13.6$, it goes to 2 different attractors as r increases and then stays there for awhile, until r becomes large enough.
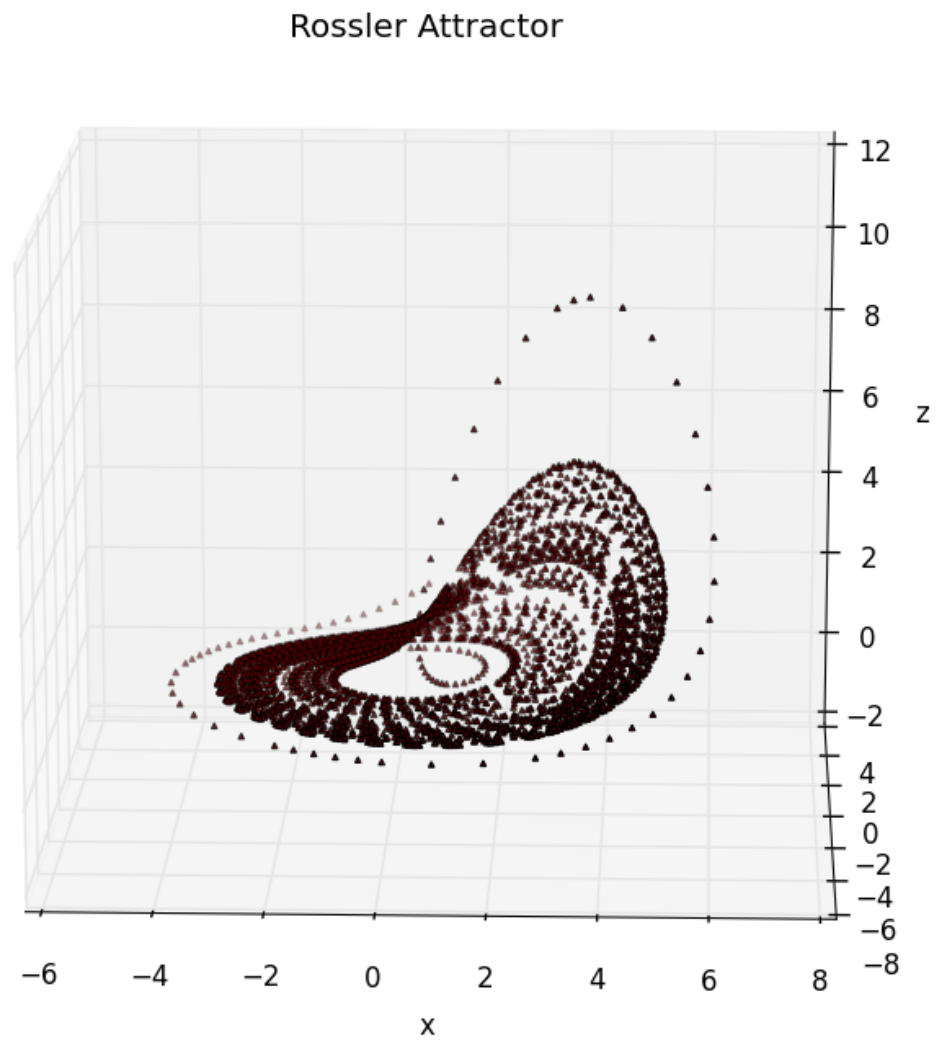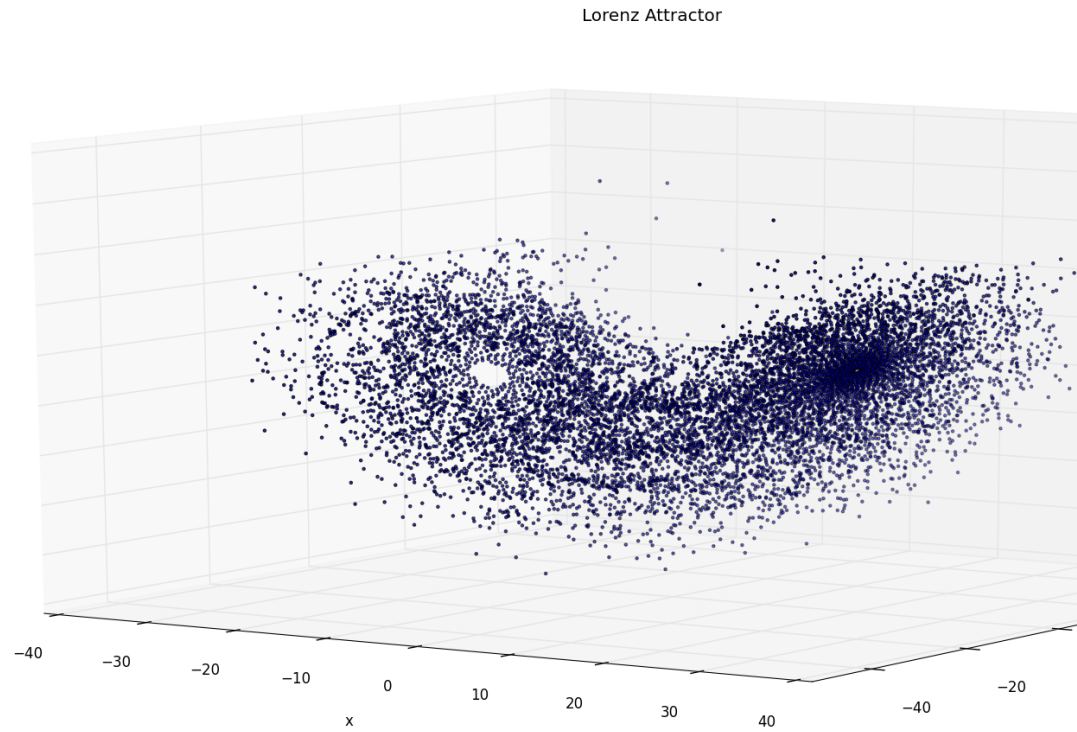
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Figure 3: Rossler system.

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Figure 4: [a,r,b] = [16, 45, 4], [x,y,z] = [-13, -12, 52], Using nonadaptive RK4, step = 0.15

We see how the system starts to look fuzzy, as the step size is no longer capable of precise enough calculations.
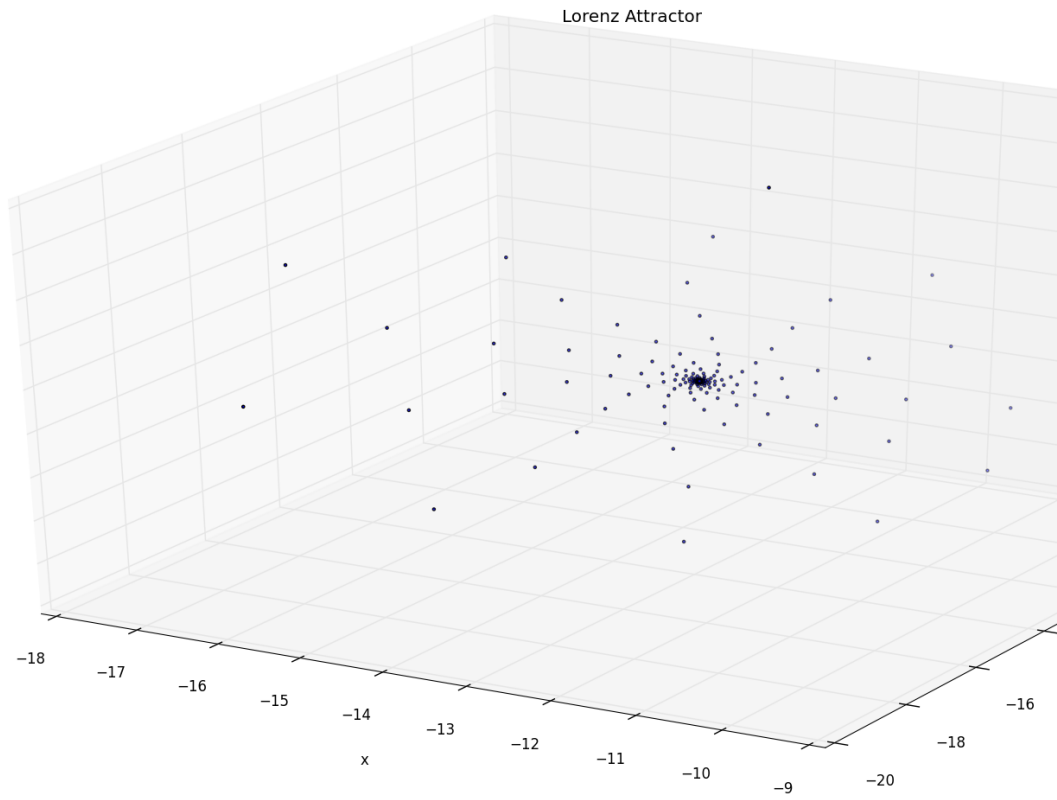
Figure 5: [a,r,b] = [16, 45, 4], [x,y,z] = [-13, -12, 52], Using nonadaptive RK4, step = 0.18

We see how our system falsely "converges" to a non existing attractor in the center. Once again, we see the danger of misinterpreting our results due to numerical error.