In this assignment, we will revisit our world of organisms for a slightly more complicated situation. In this revision, the organisms’ environments also contribute to daily changes in their energy levels. Where should the code for these contributions go? Hopefully, you know it wouldn’t go in the individual organism classes. That would create a great deal of repeated code (especially if we had many more types of organisms). It shouldn’t really be in the root organism class, either. Why? Well, we are not talking about a property of an organism, but a property of an environment, so that would not be a particularly accurate object model.

Where, then, shall we put it? If the environmental impact calculation doesn’t go in the specific or general organism classes or even the parent class, the only answer left is: in a new class. How should such a class compute the energy change caused by the environment? Well, we could have a method that computes it given the relevant parameters. But why should a caller (i.e., an organism) have to know what the relevant parameters are? The answer: it shouldn’t! Instead, we should make use of the \textit{visitor} pattern. That is, the organism should send a reference to itself to an environment object so that the environment can probe the organism for whatever information is needed, if any, in calculating the environmental impact on energy.

Our three environment types—desert, wetland, and forest—each have a different impact on an organism’s energy:

- **Forest**: An organism increases its total energy level daily by 5% (i.e., as calculated before its regular daily use)
- **Desert**: An organism increases its total energy level daily by 2%, plus half of whatever its regular daily energy use may be.
- **Wetland**: No energy impact

Our guiding biologists have future plans to expand this model, so our design must scale to the possibility of many more environments! (Fortunately, for this assignment we only need to worry about three.) Where should the environmental energy impact calculator reside? How should we determine which formula to use?

We could have one energy calculator class and use if statements to determine which formula to use. This seems problematic. If an environment were to change its impact, we’d have to hunt down the formula in a (potentially) huge function and make the change. This could also jeopardize the correctness of all the other environments’ calculations. Instead, we’re better off with a larger number of (relatively small) individual environment classes.

How do we determine which method/class to call? We don’t really want a big case statement to clutter our organism class(es). Instead, we can use a special class that returns a polymorphic reference to an appropriate environmental impact calculator object—the \textit{factory} pattern! With this, an organism object method can update its energy appropriately using just two lines of code: one (presumably in the organism’s constructor) that gets a reference to an appropriate environment calculator object, and another to call the actual energy calculation computation (the \textit{state} pattern) using information from the the organism \textit{(a la the visitor pattern)!}. This code should be the same for every organism, regardless of its type or environment.

Furthermore, we don’t really need more than one instance of each environment type, so these should use the \textit{singleton} pattern. (Because many organisms will share references to the same environment energy calculators, you will have a \textit{flyweight} pattern!).
Update and re-design the organisms and world from Assignment 2 so that they now incorporate the environmental energy impacts described above. Create a short program that generates sample updates showing amounts of environmental contributions for several organisms of each type, demonstrating the various aspects of your system.

In summary, you will need:

- Several environmental energy change calculators (each a singleton)
- A environmental calculator factory
- Organism energy updates that incorporate the environmental factors appropriately

If you wish, you may use my solution to Assignment 2 found in /home/weinman/courses/CSC207/code/life/ as your starting point.