Frame-Based, Part 3

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So far we've been talking about jack pine, white pine and spruce. To simplify some of the concepts in frame-based modeling, I'm going to use another example that came out of a live class. It was a hot day, and we were talking about frame-based modeling after lunch, and inevitably somebody in the audience fell asleep. That led to a really simple example of frame-based modeling. Let's call the guy who fell asleep Ted. The diagram here is the state in transition diagram for Ted. Ted is either awake or asleep. There are two transitions about that if he's awake, he can fall asleep. If he's asleep, he can wake up.

Notice that this really stresses the point that the two models, the two frames, see completely different model worlds. For example, what are the things, if Ted is awake, that cause him to fall asleep? It could be the temperature in the room. It could be what he had to drink over lunch. It could be the monotony of my voice. There are a number of things that one would need to consider in the awake frame.

On the other hand, suppose Ted were asleep? What would wake him up? Well, it could be that he wakes up naturally after he's had a nap of 10 or 15 minutes. Or it could be that there's a change in activity in the room. Or it could be that he starts snoring and his neighbor kicks him. So these are the things one would need to see in the asleep frame.

Now, let's take this ridiculous example a little further, because it actually illustrates the power of frame-based modeling. You might say if you have a simple model like this with two frames and two arrows, how interesting could the results possibly be? And the answer is, the complexity comes out of the interaction between the different components in the frames. And if you think about it, these frames contain both slow accumulation of change. For example, if Ted is asleep, there's the time that he spends being asleep and then he wakes up refreshed. That is what I would call a slow accumulation. We saw that, too, in the jack pine model. Where if there are no fires, then there's a slow accumulation of age of the jack pine, which could eventually lead to a switch.

At the same time, you have your disturbances, the rapid changes. So you could have somebody kicking Ted which wakes him up immediately. Or the two could interact, because maybe there's a slow accumulation. Because Ted doesn't begin to snore until he has been asleep for a certain amount of time, and nobody kicks him until he starts snoring.

So you can see that if you were trying to keep that time line of Ted being awake or asleep, then depending on when he snored and depending on whether or not his neighbor bothered to kick him, you could get very interesting results. And the same is true of the jack pine, white pine, red pine model, because you could get situations where for a long time there is no fire, and that leads to a switch of a slow accumulation of age of something. Or just before the trees are about to die of old age there's a fire which switches you to a different frame. Or maybe the fire occurs really early, which has a different effect. So you can get very complex behavior coming out of very simple frame models where each frame just focuses on a few key processes and disturbances. That is why frame modeling is particularly powerful. It leads to a richness.

The other point is that frame models are relatively simple models and run very quickly on a computer. So if one were to go back - remember we started off by looking at a landscape and then said we were going to concentrate on a particular patch in it? If one were now to go back to a landscape and imagine a frame model running in every single patch of the landscape, with interactions between them, such as fires spreading from one patch to another or herbivores moving from one patch to another. I think you could see you could still get results in a landscape model that didn't take a supercomputer to compute.

Finally, I'd like to make a point about the control of the model. Remember the pesky clock expert. When you were developing a model in a bottom-up approach, if somebody thought something was important, you would have to put in that component in the model and plan to use it. If you were using frame models, you have a way of segmenting the importance of particular parts of the model. So, for example, if you are in the spruce frame and you have the deer expert saying, "What about the dear?" You can say, "You know, we're in the spruce frame, remember. Deer are totally unimportant. All that matters is fire.

So, what frame modeling allows you to do, which is a really useful strategy in modeling, is to divide and conquer. By dealing with small segments, you can decide what is important in that segment and ignore what isn't essential in that segment.

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